

Figure A-2 Graph of unattended noise logging results, 15 minute intervals

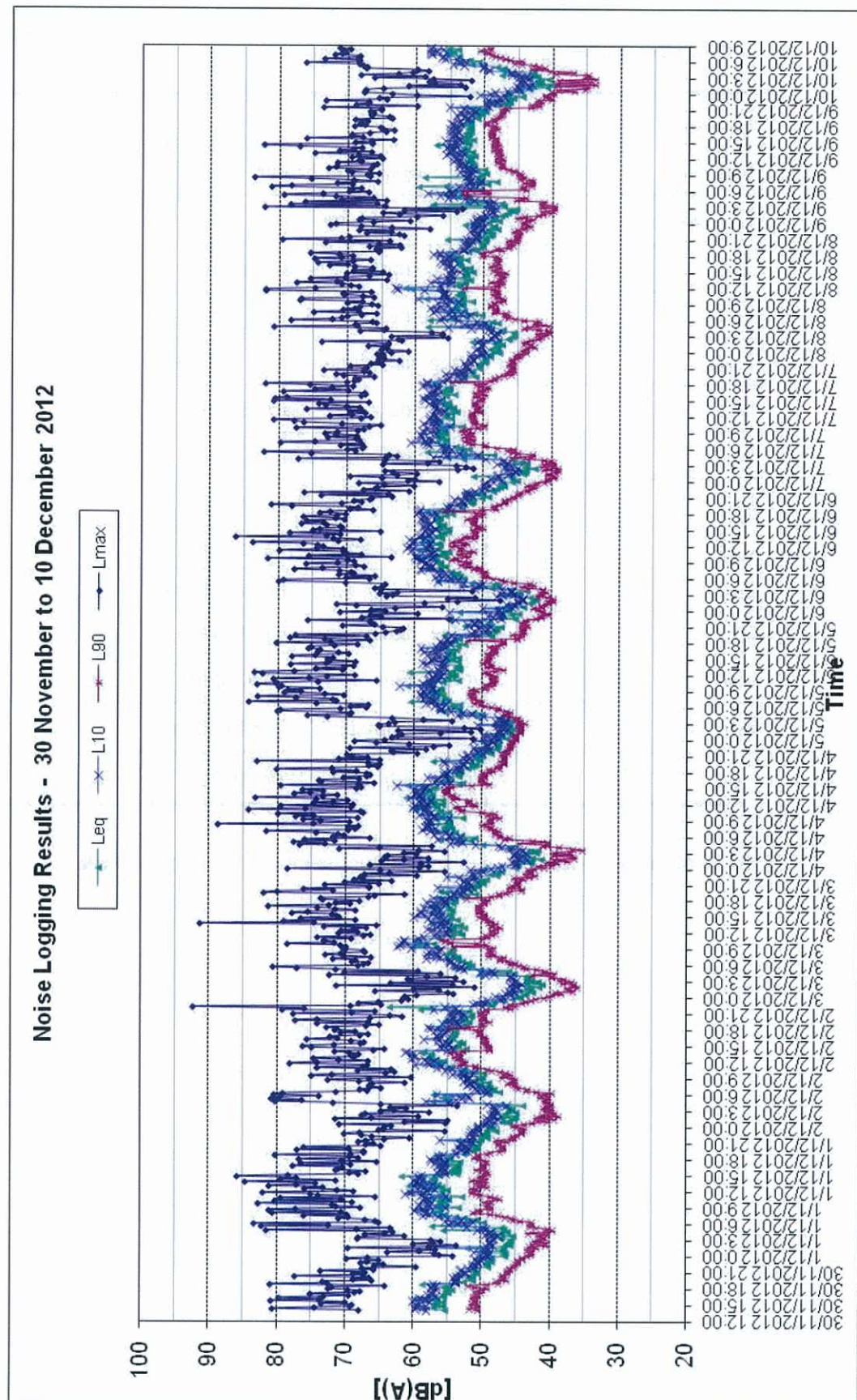


Figure A-3 Calibration Certificate for Rion NL21 Sound Level Meter

CERTIFICATE OF CALIBRATION			
CERTIFICATE No.: SLM38896			
Equipment Description: Sound Level Meter			
Manufacturer:	Rion		
Model No:	NL-21	Serial No:	01277351
Microphone Type:	UC-52	Serial No:	117644
Filter Type:		Serial No:	
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services 18 Lade Street Enoggera QLD 4051		
Ambient Pressure:	1017 hPa ± 1.5 hPa		
Temperature:	23 °C $\pm 2^\circ$ C Relative Humidity: 54 %RH $\pm 5\%$ RH		
Date of Calibration:	11/04/2012	Issue Date:	11/04/2012
Acu-Vib Test Procedure:	AVP05 (SLM) & AVP06 (Filters) if applicable		
CHECKED BY:	<i>AV</i>	AUTHORISED SIGNATORY:	<i>Jack Rielt</i>
This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025 The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.			
			
Accredited Lab. No. 9262 Acoustic and Vibration Measurements		HEAD OFFICE Unit 14, 22 Hudson Ave. Castle Hill NSW 2154 Tel: (02) 96808133 Fax: (02) 96808233 Mobile: 0413 609606 web site: www.acu-vib.com.au	

Figure A-4 Calibration Certificate for B&K Calibrator

NATA
NATIONAL METROLOGY
ACCREDITATION

Brüel & Kjær Australia

Head Office: Suite 2, 6-10 Talavera Road, North Ryde NSW 2113
 Phone: +61 2 9889 8888 Fax: +61 2 9889 8866
 Email: auinfo@bksv.com www.bksv.com.au

Accredited Laboratory Number 1301

CALIBRATION CERTIFICATE

No.:6883-0712

Owner: Norman Disney & Young-QLD
 120 Edward Street
 Brisbane QLD 4000

CALIBRATION OF:

Manufacturer:	Brüel & Kjær		
Equipment Description:	Sound Calibrator	IEC Class:	1
Model Type:	4231	Serial Number:	2656359

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application software Type 7794 using calibration procedure 4231 Complete

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	22.7 °C
	Air pressure:	101.8 kPa
	Relative Humidity:	44.4 %RH

RESULTS:

☐ Initial Calibration
☒ Recalibration without repair/adjustment

☐ Calibration before repair/adjustment
☐ Calibration after repair/adjustment

SPECIFICATIONS:

The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.
 This Laboratory is accredited for compliance with ISO/IEC 17025
 This document is issued in accordance with NATA's accreditation requirements
 The reported expanded uncertainty is bidirectional and is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration

Date of Calibration: 23/07/2012

Certificate issued: 23/07/2012

Approved Signatory: Jan Rasmussen

Reproduction of the complete certificate is allowed. Part of the certificate may only be reproduced after written permission.

Page 1 of 2

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A2 Attended Monitoring

Attended monitoring was conducted on the 30 November 2012. Equipment used for the noise monitoring was as follows:

Table A-5 Attended Noise Monitoring Equipment

Instrument	Serial Number	Lab Calibration Due	Field Calibration
Bruel and Kjaer 2270 Type 1 Sound Level Meter	2644676	20/07/2014	94 dB(A) before 94 dB(A) after
Bruel and Kjaer Calibrator Type 4231	2656359	23/07/2013	N/A

The noise monitoring location is shown in Figures A5

Figure A-5 Logger Location, L2



Noise results are presented below.

Table A-6 Attended Noise Monitoring Results

Location	Time Period	L_{Amax} , dB(A)	L_{A10} , dB(A)	L_{A10} , dB(A)	L_{Aeq} , dB(A)	L_{A90} , dB(A)	L_{Amin} , dB(A)	Noise Activities
L2	Friday 30/11/12 2.00pm to 2.15pm	70	66	61	58	51	48	Road Traffic on Markwell Street

Figure A-6 Calibration Certificate for B&K2270 Sound Level Meter

NATA
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ACCREDITATION

Brüel & Kjær Australia

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Accredited Laboratory Number 1301

CALIBRATION CERTIFICATE

Certificate No: 6882-0712 Page 1 of 26

CUSTOMER: Norman Disney & Young-QLD
 120 Edward Street
 Brisbane QLD 4000

Manufacturer:	Brüel & Kjær		
Sound Level Meter:	2270	Serial Number:	2644676
Microphone:	4189	Serial Number:	2650622

CALIBRATION CONDITIONS:

Preconditioning:	12 hours at 23 °C		
Environment conditions	Air temperature:	22.3 °C	± 3 °C
	Air pressure:	101.8 kPa	± 3.0 kPa
	Relative Humidity:	30.8 %RH	± 25 %RH

SPECIFICATIONS: The Sound Level Meter has been calibrated in accordance with the requirements as specified in AS 1259.1 and AS 1259.2.

PROCEDURE: The measurements have been performed with the assistance of:
 Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 using procedure B&K proc 2270-4189

RESULTS: The reported expanded uncertainty is bidirectional and is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effects of environmental conditions and any short time contribution from the device under calibration.

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Date of Calibration: 20/07/2012

Certificate Issued: 23/07/2012

Approved signatory: _____
 Jan Rasmussen

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B-2 Soundplan Modelling

Noise calculations were carried out using SoundPLAN software version 7.1. In SoundPLAN a three-dimensional model of terrain, roads and surrounding buildings was created. SoundPLAN uses receiver based ray tracing algorithms and includes 3D topographical effects. Modelling parameters are listed below.



Table B-1: Modelling Data

Parameter	Value
Receivers height	1.5 m above finished floor level
Set back distance for single point receivers	1m from building facade
Grid spacing for SPLAN noise mapping	5 m
Facade Reflection	Yes
RLs of noise source and receivers pad levels:	As per terrain contours in drawing, filename: S6761.dwg and BCC's PD Online website
SNP Building RL's	Plant Deck RL 41.4

Figure B-3: Mechanical Plant Noise Sources at point of discharge on building, dB

Number of items	Source	Details	Octave band centre frequency (Hz)								Overall dB(A)
			63	125	250	500	1k	2k	4k	8k	
4	Cooling Towers	Aqua Cool MSS225ALS 4	99	95	92	89	90	87	86	85	95
6	Car Park Fans	25,000l/s duct mounted	78	65	56	38	36	35	38	44	55
10	Lab Exhaust	730l/s, rooftop mounted	74	71	66	59	59	55	55	50	65
1	Kitchen Exhaust	1,950l/s, rooftop mounted	89	90	85	75	73	71	69	69	81
2	Cooling Tower at 75%	Aqua Cool MSS225ALS 4	90	86	83	80	85	83	84	84	91
6	Car Park Fan at 50%	25,000l/s duct mounted	68	55	46	28	26	25	28	34	45
4	Lab Exhaust at 100%	730l/s, rooftop mounted	74	71	66	59	59	55	55	50	65



Figure B-4: Mechanical Plant (major items) Component noise levels . NSR (north)

Noise Sensitive Receiver	Tim Period	Plant Item	Component Noise Level, dB(A)
8 Hurworth St – Level 7	Day and Evening (7am to 10pm)	Cooling Tower 1	29
		Cooling tower 2	29
		Cooling Tower 3	29
		Cooling Tower 4	29
		Lab Exhaust 1	2
		Car Park Exhaust 1	0
		Kitchen exhaust	12
		Car Park Exhaust 2	0
		Car Park Exhaust 3	0
		Car Park Supply 3	0
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 2	2
		Lab Exhaust 3	2
		Lab Exhaust 4	2
		Lab Exhaust 5	1
		Lab Exhaust 6	1
		Lab Exhaust 7	1
		Lab Exhaust 8	1
		Lab Exhaust 9	14
		Lab Exhaust 10	14
	Night (10pm to 7am)	Cooling Tower 3	22
		Cooling Tower 4	22
		Car Park Exhaust 1	0
		Car Park Exhaust 2	0
		Car Park Exhaust 3	0
		Car Park Supply 3	0
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 5	1
		Lab Exhaust 6	1
		Lab Exhaust 9	14
		Lab Exhaust 10	14



Figure B-5: Mechanical Plant (major items) Component noise levels NSR (west)

Noise Sensitive Receiver	Tim Period	Plant Item	Component Noise Level, dB(A)
24 Jeays St – 12th floor	Day and Evening (7am to 10pm)	Cooling Tower 1	46
		Cooling tower 2	43
		Cooling Tower 3	44
		Cooling Tower 4	44
		Lab Exhaust 1	19
		Car Park Exhaust 1	3
		Kitchen exhaust	29
		Car Park Exhaust 2	15
		Car Park Exhaust 3	14
		Car Park Supply 3	0
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 2	19
		Lab Exhaust 3	19
		Lab Exhaust 4	20
		Lab Exhaust 5	20
		Lab Exhaust 6	20
		Lab Exhaust 7	20
		Lab Exhaust 8	21
		Lab Exhaust 9	15
		Lab Exhaust 10	16
	Night (10pm to 7am)	Cooling Tower 3	39
		Cooling Tower 4	38
		Car Park Exhaust 1	0
		Car Park Exhaust 2	5
		Car Park Exhaust 3	4
		Car Park Supply 3	0
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 5	20
		Lab Exhaust 6	20
		Lab Exhaust 9	15
		Lab Exhaust 10	16



Figure B-6: Mechanical Plant (major items) Component noise levels NSR (south)

Noise Sensitive Receiver	Tim Period	Plant Item	Component Noise Level, dB(A)
8 Best St – 12 th storey	Day and Evening (7am to 10pm)	Cooling Tower 1	39
		Cooling tower 2	36
		Cooling Tower 3	40
		Cooling Tower 4	37
		Lab Exhaust 1	22
		Car Park Exhaust 1	0
		Kitchen exhaust	31
		Car Park Exhaust 2	3
		Car Park Exhaust 3	4
		Car Park Supply 3	1
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 2	22
		Lab Exhaust 3	22
		Lab Exhaust 4	22
		Lab Exhaust 5	22
		Lab Exhaust 6	22
		Lab Exhaust 7	21
		Lab Exhaust 8	21
		Lab Exhaust 9	6
		Lab Exhaust 10	6
	Night (10pm to 7am)	Cooling Tower 3	34
		Cooling Tower 4	29
		Car Park Exhaust 1	0
		Car Park Exhaust 2	0
		Car Park Exhaust 3	0
		Car Park Supply 3	0
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 5	22
		Lab Exhaust 6	22
		Lab Exhaust 9	6
		Lab Exhaust 10	6



Figure B-7: Mechanical Plant (major items) Component noise levels NSR (east)

Noise Sensitive Receiver	Tim Period	Plant Item	Component Noise Level, dB(A)
26/28 Rosetta St – Upper Level	Day and Evening (7am to 10pm)	Cooling Tower 1	35
		Cooling tower 2	35
		Cooling Tower 3	32
		Cooling Tower 4	25
		Lab Exhaust 1	5
		Car Park Exhaust 1	0
		Kitchen exhaust	14
		Car Park Exhaust 2	0
		Car Park Exhaust 3	0
		Car Park Supply 3	1
		Car Park Supply 2	2
		Car Park Supply 1	0
		Lab Exhaust 2	5
		Lab Exhaust 3	4
		Lab Exhaust 4	3
		Lab Exhaust 5	3
		Lab Exhaust 6	3
		Lab Exhaust 7	3
		Lab Exhaust 8	2
		Lab Exhaust 9	1
		Lab Exhaust 10	0
	Night (10pm to 7am)	Cooling Tower 3	26
		Cooling Tower 4	19
		Car Park Exhaust 1	0
		Car Park Exhaust 2	0
		Car Park Exhaust 3	0
		Car Park Supply 3	0
		Car Park Supply 2	0
		Car Park Supply 1	0
		Lab Exhaust 5	3
		Lab Exhaust 6	3
		Lab Exhaust 9	1
		Lab Exhaust 10	0



Detailed SoundPLAN outputs for the most affected noise sensitive receiver are listed below.

Figure B-8: Example calcs for most affected noise sensitive receiver 24 Jeays St

Mean propagation Leq - Future - mech plant															
Source	SrcType	Lw dB(A)	Lw' dB(A)	KI dB	KT dB	Ko dB	time dB(A)	s m	Li dB(A)	R'w dB	Ls dB(A)	Adiv dB	Agf dB	Abar dB	Aatm dB
CPEF2	Point	55.1	55.1	0	0	0	0	33.32	0	0	14.9	-41.4	1.4	0	-0.1
CPEF3	Point	55.1	55.1	0	0	0	0	38.05	0	0	13.7	-42.6	1.4	0	-0.2
CPSF1	Point	55.1	55.1	0	0	0	0	104.67	0	0	-14.2	-51.4	1.2	-19	-0.1
CPSF2	Point	55.1	55.1	0	0	0	0	83.13	0	0	-9.7	-49.4	1.2	-16.4	-0.1
CPSF3	Point	55.1	55.1	0	0	0	0	79.17	0	0	-9.2	-49	1.2	-16.4	-0.1
CT1	Point	94.9	94.9	0	0	0	0	60.01	0	0	45.7	-46.6	0	-1.7	-1.1
CT2	Point	94.9	94.9	0	0	0	0	56.05	0	0	43.3	-46	0	-5.4	-0.5
CT3	Point	94.9	94.9	0	0	0	0	54.06	0	0	43.8	-45.6	0	-4.9	-0.6
CT4	Point	94.9	94.9	0	0	0	0	49.61	0	0	43.6	-44.9	0	-6	-0.5
Car Park Exhaust	Point	55.1	55.1	0	0	0	0	72.63	0	0	3	-48.2	1.2	-5	0
Lab Ex 1	Point	64.8	64.8	0	0	0	0	54.21	0	0	18.7	-45.7	0.1	0	-0.4
Lab Ex 2	Point	64.8	64.8	0	0	0	0	52.87	0	0	18.9	-45.5	0.1	0	-0.4
Lab Ex 4	Point	64.8	64.8	0	0	0	0	49.87	0	0	19.5	-44.9	0.1	0	-0.4
Lab Ex 5	Point	64.8	64.8	0	0	0	0	47.68	0	0	19.9	-44.6	0.1	0	-0.4
Lab Ex 6	Point	64.8	64.8	0	0	0	0	46.46	0	0	20.1	-44.3	0.1	0	-0.4
Lab Ex 7	Point	64.8	64.8	0	0	0	0	45.11	0	0	20.4	-44.1	0.1	0	-0.4
Lab Ex 8	Point	64.8	64.8	0	0	0	0	43.68	0	0	20.7	-43.8	0.1	0	-0.4
Lab Ex 9	Point	64.8	64.8	0	0	0	0	77.94	0	0	15.4	-48.8	0.1	0	-0.6
Lab Ex 10	Point	64.8	64.8	0	0	0	0	76.58	0	0	15.6	-48.7	0.1	0	-0.6
Lab ex 3	Point	64.8	64.8	0	0	0	0	51.22	0	0	19.2	-45.2	0.1	0	-0.4
kitchen exhaust	Point	74.3	74.3	0	0	0	0	48.51	0	0	29.3	-44.7	0.1	0	-0.4

Legend	
Source	Source name
SrcType	Type of source (point, line, area)
Lw	Sound power per unit
Lw'	Sound power per m ²
KI	Correction for impulsiveness
KT	Correction for tonality
Ko	Correction for non spherical emission
time slice	Name of time slice
s	Distance source - receiver
Li	Level inside
R'w	Rated transmission loss
Ls	Unassessed sound pressure at receiver
Adiv	Mean attenuation due to geometrical spreading
Agf	Mean attenuation due to ground effect
Abar	Mean attenuation due to screening
Aatm	Mean attenuation due to air absorption
ADI	Mean directivity correction
dLrefl	Level increase due to reflections
dLw	Correction due to source operation time
Cmet	Meteorological correction
Lr	Assessed level of time slice



APPENDIX C – ACOUSTIC CRITERIA

C-1 Queensland Government

In Queensland, the acoustic environment is protected under the Environmental Protection Act 1994. The object of the Act is to protect Queensland's environment while allowing for development that improves the total quality of life using "ecologically sustainable development".

In respect of the acoustic environment, the object of the Act is achieved by the Environmental Protection (Noise) Policy 2008 (EPP (Noise)). This policy identifies environmental values to be protected, states acoustic quality objectives, and provides a framework for making consistent, equitable and informed decisions about the acoustic environment.

The acoustic environmental values to be enhanced or protected are as follows:-

- Qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems,
- The qualities of the acoustic environment that are conducive to human health and the wellbeing of an individual, including the individual's opportunity to have sleep, study or learn, be involved in recreation, including relaxation and conversation, and
- The qualities of the acoustic environment that are conducive to protecting the amenity of the community.

Noise emissions should be reduced to minimise the risk of complaint, and noise criteria should be developed with risk minimisation as the principle concern, irrespective of alternative noise criteria.

To reduce the likelihood of noise complaints, the Environmental Protection Agency (EPA) will issue an Environmental Noise License to Environmentally Relevant Activities (ERA's). The license makes use of noise criteria from a previous Queensland noise policy, as follows in Table C-1.

Table C-1: Environmental Noise Limits for an Environmentally Relevant Activity

Noise Limits at a Noise Sensitive Place Measured as the Adjusted Maximum Sound Pressure Level $L_{Amax,adj}$	Period
Background noise level plus 5 dB(A)	7am - 6pm
Background noise level plus 5 dB(A)	6pm - 10pm
Background noise level plus 3 dB(A)	10pm - 7am
Noise Limits at a Commercial Place Measured as the Adjusted Maximum Sound Pressure Level $L_{Amax,adj}$	Period
Background noise level plus 10 dB(A)	7am - 6pm
Background noise level plus 10 dB(A)	6pm - 10pm
Background noise level plus 8 dB(A)	10pm - 7am

The noise limits in Table C-1, although not contained as part of the EPP (Noise), are still regularly used by the EPA and local councils when specifying noise criteria or assessing noise complaints. They are widely accepted as being appropriate noise limits for non-time-varying noises, such as mechanical plant, and for minimising the risk of noise complaint.



To determine appropriate noise criteria requires the use of the following:

- EPA License Noise Criteria, i.e. Background +3/+5dB(A) for a noise sensitive place,
- Environmental Protection Act 1994, and,
- Any other criteria considered appropriate for minimising the risk of noise complaint.

C-2 Sleep Disturbance Criteria

Sleep awakening criteria may be used to assess the impact of noise sources operational during the night period (10pm – 7am) that are neither steady nor quasi-steady.

There are no formal sleep disturbance criteria in the Department of Environment's Environmental Protection (Noise) Policy (the EPP), however, the issue of sleep disturbance is addressed in the "Users Guide to Queensland's Environmental Protection (Noise) Policy". In this document it is stated that with a background noise level of L_{A90} 30 dB(A) to 35 dB(A), a maximum noise level for fluctuating noise of 45 dB(A) to 50 dB(A) is recommended to reduce the likelihood of sleep disturbance.

Research adopted by the World Health Organisation (WHO), concludes that for short duration variable noise sources the onset of sleep disturbance commences at internal L_{Amax} noise levels of between 45 dB(A) and 50 dB(A).

C-3 Australian Standard AS/NZS2107

AS/NZS 2107 methodology applies to emissions and immissions (intrusion) of steady-state or quasi-steady state sound such as noise from air conditioning systems and continuous road traffic.

The methodology is applicable to road traffic noise during the day, evening and night where traffic volumes on the subject road exceed 15,000 vehicles per day.

AS/NZS 2107:2000 lists recommended internal noise levels for various building and room types, including residential bedrooms and other areas. For residential apartments, commercial areas, retail and hotel accommodation near major roads, the recommended design levels are listed in Table C-2.

Table C-2: Recommended Internal Noise Levels from AS/NZS 2107:2000

Type of Occupancy / Activity	Recommended Design Sound Level, L_{Aeq} dB(A)		Recommended reverberation time RT_{60} (s)
	Satisfactory	Maximum	
Administration and Private Offices	35	40	0.6 to 0.8
General Offices	40	45	0.4 to 0.6
Kitchens, sterilizing and service areas	50	55	0.6 to 0.8
Parking Stations (carpark areas)	55	65	-
Laboratories	45	50	0.4 to 0.7
Toilets	45	55	-



C-4 Brisbane City Council

BCC's Noise Impact Assessment Planning Scheme Policy (NIAPSP) is contained within in Volume 2 of their Brisbane City Plan 2000 document.

The objectives of NIAPSP are to provide acoustic amenity for existing and future residents, provide industry with a level of certainty with respect to urban encroachment, and to facilitate development with a standard assessment process and criteria.

The policy utilises three assessment methodologies as follows:-

- Comparison of like noise parameters for before and after development situations;
- Application of indoor noise levels specified in AS / NZS 2107;
- Assessment of sleep awakening noise levels.

The policy also contains criteria for the assessment of vibration impacts.

It is noted that irrespective of criteria developed by Council, the requirement of the EPA's EPP(Noise) must be complied with, that is, noise emission levels should be reduced to minimise the possibility of complaint.

To assist with the use of the policy, Council have released several draft NIAPSP Guidelines:-

- Noise Methodologies Guideline (dated October 2000)
- Noise Impact Assessment Report Guideline (dated January 2001)
- Guideline: Certification of Noise Compliance (dated October 2000)
- Noise Guideline: Structure Planning and Subdivision (dated October 2000)
- Guideline: Multi-unit Residential Design (Medium Density) (dated October 2000)

