Annex G

G. Noise Assessment

APPIN AREA 7 GOAF GAS DRAINAGE PROJECT

NOISE ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 08396
VERSION B

WILKINSON MURRAY

APPIN AREA 7 GOAF GAS DRAINAGE PROJECT

NOISE ASSESSMENT

REPORT NO. 08396
VERSION B

MAY 2009

PREPARED FOR

CARDNO FORBES RIGBY PTY LTD
278 KEIRA STREET
WOLLONGONG NSW 2500

Wilkinson Murray Pty Limited
ABN 41 192 548 112 • Level 1, 123 Willoughby Road, Crows Nest NSW 2065, Australia • **Asian Office: Hong Kong**
t +61 2 9437 4611 • **f** +61 2 9437 4393 • **e** acoustics@wilkinsonmurray.com.au • **w** www.wilkinsonmurray.com.au

TABLE OF CONTENTS

1 INTRODUCTION

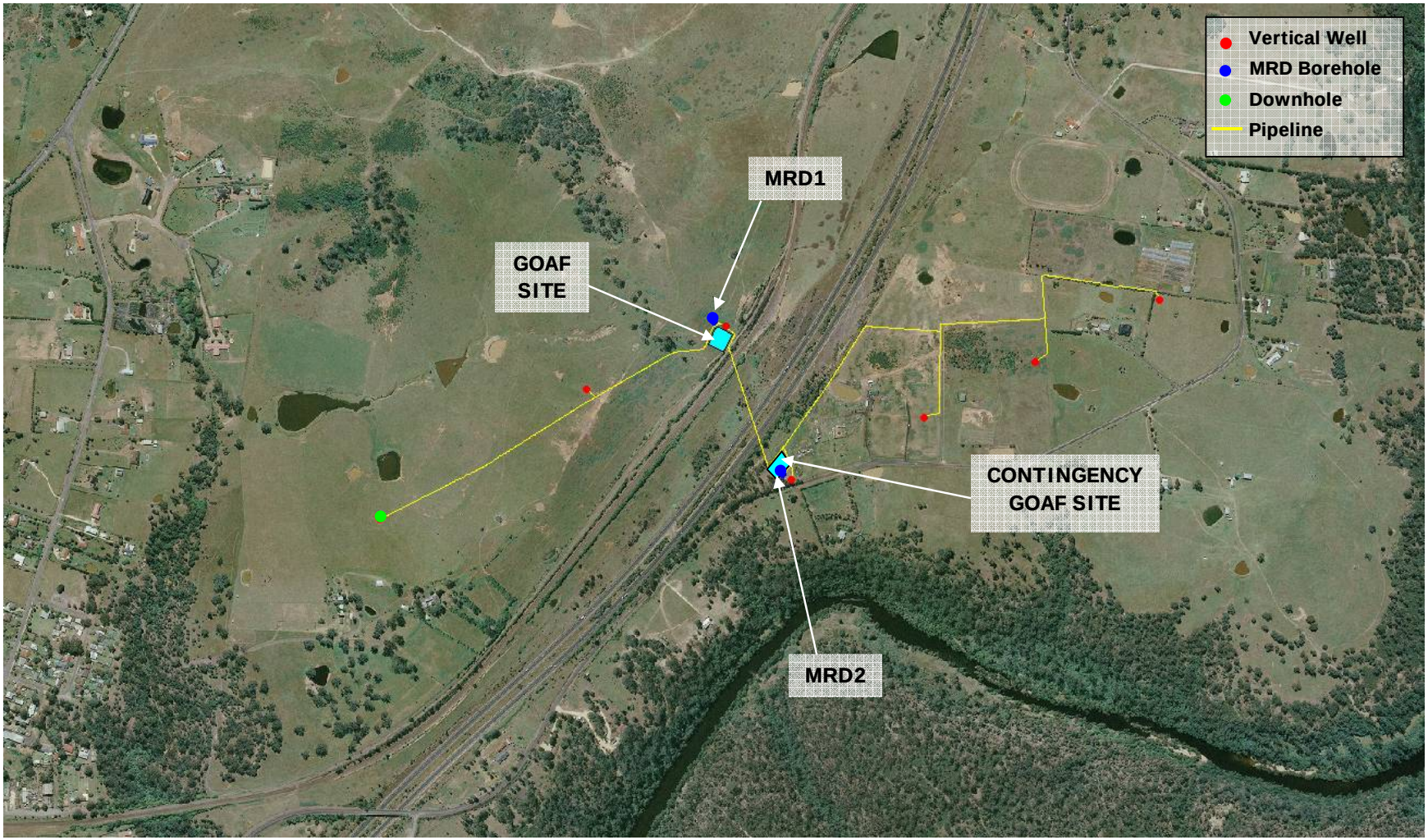
This report presents an assessment of the potential noise impact associated with the proposed Goaf Gas Drainage Project located east of Douglas Park. The proposed site locations and an aerial photograph are shown in Figure 1-1 and Figure 1-2, respectively.

Assessment has been made in general accordance with NSW Department of Environment & Climate Change (DECC) guidelines contained within either the *NSW Industrial Noise Policy (INP)* or the *Environmental Noise Control Manual (ENCM)*. This assessment considers the following issues:

- Operational Noise; and
- Construction noise;
  - Drilling boreholes; and
  - Installing pipelines including trenching works and under boring of the Hume Highway and Main Southern Rail Line

Figure 1-1 Proposed Site Locations

Figure 1-2 Aerial Photograph of Location



2 SITE DESCRIPTION & PROPOSED OPERATION

2.1 Site Layout & Operations

The proposed operation will consist of a series of boreholes drilled to a depth of ~500m through which methane gas will be drained from the goafs of Longwalls 703 and 704 via boreholes and a surface pipeline reticulation system connected to the electric or diesel powered extraction plant/s. After being extracted by the extraction plant/s, the majority of the methane gas will be piped back underground to the existing underground connection to the EDL Power Station where it will be re-used to generate electricity. A small amount of goaf gas will be vented to the atmosphere. If goaf gas cannot be continuously supplied to the underground pipe range, Illawarra Coal will investigate the use of on-site flares to abate the greenhouse gas contribution of methane emissions to the atmosphere.

For the proposed project, the preferred option is the installation of a single gas extraction plant to be implemented within Lot 2 DP576136. The proposed extraction plant will be situated in a centralised location so that it may draw gas from multiple wells for both Longwalls 703 and 704 that are connected by a surface pipeline reticulation system.

In order for the one extraction plant located on Lot 2 DP576136 to extract goaf gas from both longwalls, BHPBIC propose to under bore the Hume Highway and the Main Southern Rail Line in order to connect the extraction plant to the reticulation pipeline and wells servicing Longwall 703.

A second back up or contingency extraction plant has been proposed to be installed on the property described as Lot 7 DP250231 should under boring the Hume Highway and Main Southern Rail Line prove unreliable or unfeasible.

The proposed extraction plant locations are shown in Figure 1-1.

The preferred extraction plant site is immediately surrounded by paddocks on three sides and the railway line followed by the Hume Hwy on the remaining eastern side. The nearest residences are on the opposite side of the Hume Hwy. Other residences are several hundred meters away.

The contingency plant location is bounded by the Hume Hwy, Moreton Park Rd and an adjoining residential property to the north. The nearest receivers are located on the adjoining property to the north and also across Moreton Park Rd.

The location of surrounding residences are indicated in Figure 2-1.

The proposed project includes the construction of a Goaf Gas Drainage Plant on the property described as Lot 2 DP576136 and a back up or contingency extraction plant to potentially be constructed on the property described as Lot 7 DP250231 if required, and associated boreholes and pipelines. The drainage of goaf gas is an integral part of longwall mining activities in the Appin Colliery. The gas extraction plant/s consists of the following:

- Vacuum pump with electric motor, and inlet/outlet manifolds;
- Gas/water separator;
- Flow control recirculation;
- Discharge gas pipe work to discharge point;
- Discharge stack; and
- Associated diesel powered electricity generator or direct connection to mains electrical

power.

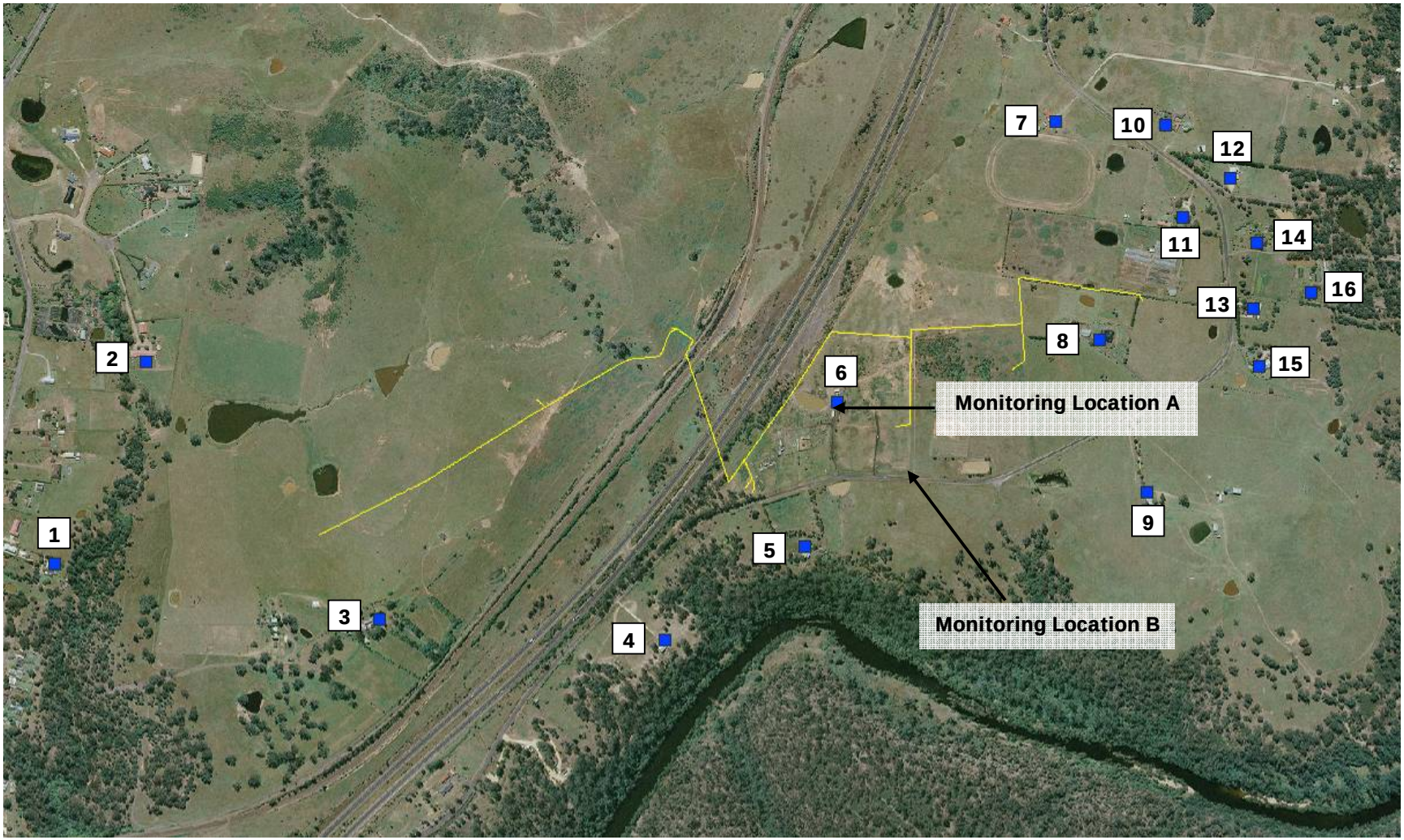
The Goaf Gas Drainage Plant/s will operate 24 hours, seven days a week.

Table 2-1 shows the identified surrounding receivers and the approximate distances to the nearest drill site (borehole) and the Goaf Plant/s. The receiver numbers correspond to the numbers in Figure 2-1.

Table 2-1 Surrounding Residential Receivers

Receiver #	Distance to Goaf Plant (m)	Distance to Nearest Drilling Site (m)	Distance to Contingency Goaf Plant (m)
1	1200	500	1500
2	1000	500	1400
3	850	215	770
4	610	360	400
5	500	205	215
6	350	125	280
7	900	410	1000
8	875	90	800
9	1000	390	830
10	1100	360	1150
11	1100	200	1050
12	1200	330	1200
13	1200	250	1100
14	1200	290	1150
15	1200	300	1100
16	1300	370	1200

Figure 2-1 Aerial Photograph showing Residence Locations



3 EXISTING NOISE LEVELS

Existing noise levels were monitored at the following locations, being representative of the existing noise levels at residences most likely to be affected by noise from the proposed project:

- Monitoring Location A Lot 1, DP 838568, near the house; and
- Monitoring Location B Lot 1, DP 838568, near Moreton Park Rd.

These monitoring locations are shown in Figure 2-1.

Unattended noise monitoring was conducted continuously from the 8th April to the 20th April 2009 at both monitoring locations.

The noise monitoring equipment used for these unattended measurements consisted of an environmental noise logger set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift occurred.

The logger determines $L_{A1,}$ $L_{A10,}$ L_{A90} and L_{Aeq} levels of the ambient noise. The $L_{A1,}$ L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Appendix A for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional passby of a heavy vehicle. This is used for the assessment of sleep disturbance.

The L_{A90} level is normally taken as the background noise level during the relevant period. The L_{Aeq} level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. The L_{Aeq} is used for the assessment of operational noise and traffic noise. The L_{A10} is used for the assessment of construction noise.

These noise levels were recorded every 15-minutes during the monitoring period. Monitored noise levels are shown in graphical form in Appendix B.

The Rating Background Levels (RBLs) are shown in Table 3-1. The RBLs for the standard periods of daytime, evening and night time are presented.

Table 3-1 Measured L_{A90} Noise Levels (RBL)

Monitoring Location (Figure 2-1)	Day[1]	Evening[1]	Night[1]
A	45	48[2]	38
B	40	44[2]	36

Note: 1) Daytime 7.00am–6.00am; Evening 6.00pm–10.00pm; and Night 10.00pm-6.00am.
2) DECC Application notes state if evening background noise levels are higher than daytime levels then criteria should be derived from daytime background levels

Observations during installation and collection of the noise loggers identified the Hume Hwy as the primary noise source in the area.

Attended measurements during placement and collection of the logger also showed that there

was no existing significant industrial noise in the area.

The LAeq, period noise Levels are shown in Table 3-2.

Table 3-2 Measured $L_{Aeq, period}$ Noise Levels

Monitoring Location (Figure 2-1)	Day[1]	Evening[1]	Night[1]
A	56	55	53
B	55	54	52

Note: 1) Daytime 7.00am–6.00am; Evening 6.00pm–10.00pm; and Night 10.00pm-6.00am.

4 OPERATIONAL NOISE CRITERIA

4.1 Operational Noise Criteria

This section of the report discusses noise criteria for the assessment of operational noise. The main noise sources within the Goaf Plant/s are a diesel generator and a pump. There is potential for the preferred extraction plant, located on the property described as Lot 2 DP576136, to be mains powered. If this is the case then the diesel generator would not be required and noise emissions from this extraction plant would be greatly reduced. If the contingency extraction plant is required to be implemented it will be powered by a diesel generator.

This assessment has been based on a "worst case scenario" to provide a conservative assessment of the predicted noise impacts from the proposed project, and thus has assumed that both extraction plants (if required) are powered by diesel generators.

These operational noise sources have been assessed in terms of the requirements of the *Industrial Noise Policy (INP)* to consider amenity and intrusiveness.

The *INP* sets out two forms of noise criterion. In assessing noise levels at residences, the criteria should be assessed at the most-affected point on or within the residential property boundary or, if this is more than 30m from the residence, at the most-affected point within 30m of the residence. The two criteria are described below. Both noise criteria need to be considered, but in most cases, only the one will become the limiting criterion and form the Project Specific Noise Levels (PSNL) for the project.

4.1.1 Intrusiveness Criterion

The intrusiveness criterion specifies that the $L_{Aeq\ 15\ minute}$ noise level from the proposed source should not exceed the RBL by more than 5dBA. The RBL is defined as the overall single-figure background level representing each measurement period (day, evening and night) over the whole monitoring period.

The *INP* requires where noise sources contain certain characteristics, such as tonality, impulsiveness, intermittency or dominant low frequency content a modifying factor should be applied because this type of noise typically causes greater annoyance to the community.

This criterion should be assessed under specific meteorological conditions, which are detailed in the *INP.* Definition of appropriate meteorological conditions is discussed in detail in section 5.3.

4.1.2 Amenity Criterion

The second type of criterion is an amenity criterion, and is intended to ensure that the total L_{Aeq} noise level from all industrial sources does not exceed specified levels. For rural residences, the relevant recommended "Acceptable" Noise Levels (ANL) are:

- Daytime (7.00am-6.00pm) 50dBA L_{Aeq}
- Evening (6.00pm-10.00pm) 45dBA L_{Aeq}
- Night Time (10.00pm-7.00am) 40dBA L_{Aeq}

To set the amenity criteria for any project the INP has a sliding scale based on the existing industrial noise. As there is no significant source of industrial noise in this area the ANL becomes the amenity criteria.

In areas where traffic flows exist and where the $L_{Aeq, (period), traffic}$ noise level is more than 10 dB above the ANL presented above, the ANL is replaced by $L_{Aeq, (period), traffic}$ minus 10 dB. This becomes the new ANL for the receiver area.

The amenity and intrusive noise criteria for potentially affected receivers are presented in Table 4-1. Where practicable, noise levels should be controlled to below these limits.

Table 4-1 Noise Level Criteria

Receiver #	Intrusive Noise Criteria (dBA) $L_{Aeq, 15minutes}$			Amenity Criteria $L_{Aeq,period}$		
	Day	Evening	Night	Day	Evening	Night
1	45	45	41	55	50	42
2	45	45	41	55	50	42
3	50	50	43	55	50	43
4	50	50	43	55	50	43
5	45	45	41	55	50	42
6	50	50	43	55	50	43
7	45	45	41	55	50	42
8	45	45	41	55	50	42
9	45	45	41	55	50	42
10	45	45	41	55	50	42
11	45	45	41	55	50	42
12	45	45	41	55	50	42
13	45	45	41	55	50	42
14	45	45	41	55	50	42
15	45	45	41	55	50	42
16	45	45	41	55	50	42

Note: 1) Daytime 7.00am–6.00am; Early Morning 6.00am–7.00am; Evening 6.00pm–10.00pm; and Night 10.00pm-6.00am.
2) Locations are shown in Figure 1-2.

4.2 Sleep Disturbance

For the night time period it is also necessary to consider the potential impact of sleep arousal from activities at the loading dock. The DECC recommends that the $L_{A1,1min}$ or L_{Amax} noise level should not exceed the background L_{A90} level by more than 15dBA.

As the operation of the plant/s is constant, with no significant variation in noise level, there is no potential for sleep disturbance. As such this is not discussed further.

4.3 Project Specific Noise Level

The limiting noise criteria for the project are the intrusive noise criteria which therefore become the PSNL as presented in Table 4-2.

Table 4-2 Project Specific Noise Level

Receiver #	Project Specific Noise Level (dBA) $L_{Aeq, 15minutes}$		
	Day	Evening	Night
1	45	45	41
2	45	45	41
3	50	50	43
4	50	50	43
5	45	45	41
6	50	50	43
7	45	45	41
8	45	45	41
9	45	45	41
10	45	45	41
11	45	45	41
12	45	45	41
13	45	45	41
14	45	45	41
15	45	45	41
16	45	45	41

5 PREDICTED NOISE LEVELS

5.1 Goaf Plant Source Noise Levels

In order to establish the source noise levels of the proposed Goaf Gas plant/s, noise measurements of a similar, existing goaf gas extraction plant at West Cliff Mine Area 5 were conducted on 8 April 2009 as part of the fieldwork for this project.

Noise measurements were conducted with a Bruel and Kjaer Type 2260 Sound Level Meter (SLM). The SLM holds current NATA calibration and has been internally laboratory calibrated within the past three months in accordance with Wilkinson Murray Quality Assurance procedures. Additionally the calibration was checked in the field before and after the measurements and no significant drift was observed. Spectra were measured in standard third-octave bandwidths.

From these measurements the diesel generator was identified as the dominant noise source. There was also some notable noise emission from the vacuum pump. These sources were shielded in some directions by associated equipment, thus the noise level varied with direction.

As the orientation of the proposed Goaf Plant/s is unknown at this stage the highest measured noise level has been applied to all directions. The assumed sound power level is shown in Table 5-1.

Table 5-1 Sound Power Level (dB) – Goaf Gas Plant

Octave Band Centre Frequency (Hz)								dBA
31.5	63	125	250	500	1k	2k	4k	
105	117	98	94	92	87	80	79	95

The measured noise level also showed a tonal characteristic in the 80Hz third-octave. This tone has been assessed in accordance with the INP and was judged to not be tonal as the level in third octave containing the tone does not exceed the adjacent bands by 15dB or more.

5.2 Noise Level Prediction

Noise levels experienced by a receiver at relatively large distances from a source can vary considerably under different meteorological conditions, particularly at night. Prevailing wind and air temperature gradients will change over the course of the night time period, and hence noise levels at receivers will change, even when the source noise level is constant.

The *INP* generally directs the use of a single set of adverse meteorological data to use in the assessment of noise impacts; however Wilkinson Murray has adopted a more rigorous approach in past assessments where noise levels at residences are calculated under a varied set of existing meteorological conditions. Measured statistical occurrences of these conditions over a period of one year are then applied to the results, and a 10^{th} percentile exceedance level calculated, which is then compared with relevant criteria. This approach is generally more conservative than one using a single set of meteorological data as it accounts for the directional distribution of prevailing winds for each residence surrounding the site.

This alternative assessment procedure involves significantly greater computational complexity

than the use of a single set of meteorological conditions, but provides a much more direct and comprehensible description of noise impacts at a receiver. This approach of using the 10th percentile calculated noise level as a measure of noise impacts on residences has been considered acceptable by the DECC for previous similar assessments.

5.3 Measured Meteorological Data

Meteorological data for Appin Bureau of Meteorology Weather Station for the period May 2007 to May 2008 was available for this assessment. The data includes wind speed, wind direction, temperature, relative humidity, and sigma theta data from which Pasquill stability class and subsequently temperature inversion strengths are calculated.

The full methodology of calculation of temperature inversion strengths for the proposal can be found in Appendix E of the INP.

Operational noise levels at residences are calculated using the Environmental Noise Model (ENM) prediction model. This model has been endorsed by the DECC for environmental noise assessment. The ENM model takes account of noise attenuation due to geometric spreading, atmospheric absorption, shielding and the effect of acoustically soft ground. It can also be used to predict noise levels under various meteorological conditions, defined by a combination of temperature gradient, wind speed and wind direction.

Noise levels were calculated using the ENM model for each of the scenarios under a total of 97 meteorological conditions. A statistical data set representing the proportional occurrence of these conditions at Appin over a year was then applied to the calculated noise levels. The noise level exceeded for 10% during each of the day, evening and night time periods was then calculated.

It should be noted that the calculations described above rely on predictions produced by the ENM model. This model is based on simple assumed vertical profiles of temperature and wind speed, and does not accurately model more complex situations. In particular, there are times when a combination of non-linear vertical temperature and wind speed profiles can result in "focussing" of noise in a small area. In these events, increases in noise level of 10-20dBA can occur over periods of minutes to hours. The frequency of these events, and the level of noise enhancement occurring, cannot be accurately predicted using ENM or any other known model. However, the validation of the model used has shown good correlation between measured and predicted noise levels as a 10th percentile exceedance level.

5.3.1 Preferred Goaf Plant Predicted Level

The predicted 10th percentile receiver noise levels are presented in Table 5-2. Levels exceeding the relevant criteria are highlighted.

The model predicts minor exceedances of 1-2dB at receivers 5 and 6. This is addressed by constructing an earth mound adjacent to the Goaf Plant on the side facing the railway line. The mound would need to extend above the height of the generator/vacuum pump by at least 1m and be located as close as possible to the source. A 5m earth mound, located 10m from the generator was modelled. The results of the revised modelling are presented in Table 5-3. Noise contours of the preferred Goaf Plant are shown in Figure 5-1.

With the inclusion of the earth mound described above the 10th percentile noise level is predicted to be within criteria at all surrounding receivers.

5.3.2 Contingency Goaf Plant Predicted Level

The predicted 10th percentile receiver noise levels are presented in Table 5-4. Levels exceeding the relevant criteria are highlighted.

The model predicts exceedances of up to 10dB at receiver 5 and lesser exceedances at receivers 4 and 6. This is addressed by constructing a noise barrier adjacent to the Goaf Plant on all sides except that facing the Hume Hwy. The barrier would need to extend above the height of the generator/vacuum pump by at least 2m and be located as close as possible to the source. Subject to site specific geometric restrictions the barrier could consist of an earth mound, a purpose build masonry (or similar) noise wall, or a combination of the two.

A 5.5m barrier, located 10m from the generator was modelled. The results of the revised modelling are presented in Table 5-5. Noise contours of the preferred Goaf Plant are shown in Figure 5-2.

With the inclusion of the noise barrier described above the 10th percentile noise level is predicted to be within criteria at all surrounding receivers.

Table 5-2 Summary of Predicted Receiver Levels without the Earth Mound

#	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	15	16	17	15	13	17	15	13	17	14	15	16	45	45	41
2	17	18	19	17	16	19	17	16	19	16	17	18	45	45	41
3	27	28	28	27	26	28	27	26	28	26	27	28	50	50	43
4	39	40	39	39	36	39	39	36	39	36	39	39	50	50	43
5	42	42	**42**	42	40	41	42	40	41	41	42	**42**	45	45	41
6	44	45	**45**	44	43	**44**	44	43	**44**	44	45	**45**	50	50	43
7	30	33	34	29	27	32	29	27	32	31	34	33	45	45	41
8	29	31	31	29	26	30	29	26	30	30	32	31	45	45	41
9	34	35	35	34	30	35	34	30	34	34	35	35	45	45	41
10	25	26	27	23	20	26	24	20	26	26	27	27	45	45	41
11	26	28	28	25	22	27	26	22	27	27	29	28	45	45	41
12	25	27	27	24	21	26	25	21	26	27	27	27	45	45	41
13	24	25	25	24	22	25	24	22	24	25	25	25	45	45	41
14	27	28	28	26	25	27	27	25	27	27	28	28	45	45	41
15	26	27	27	26	24	27	26	24	27	27	28	27	45	45	41
16	23	25	25	23	20	24	23	20	24	24	25	25	45	45	41

Table 5-3 Summary of Predicted Receiver Levels with the Earth Mound

#	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	15	16	17	15	13	17	15	13	17	14	15	16	45	45	41
2	17	18	19	17	16	19	17	16	19	16	17	18	45	45	41
3	27	28	28	27	26	28	27	26	28	26	27	28	50	50	43
4	39	40	39	39	36	39	39	36	39	36	39	39	50	50	43
5	30	31	30	30	29	30	30	29	30	29	31	31	45	45	41
6	34	34	34	34	33	34	34	33	34	34	35	34	50	50	43
7	30	33	34	29	27	32	29	27	32	31	34	33	45	45	41
8	29	31	31	29	27	30	29	27	30	30	31	31	45	45	41
9	26	28	28	26	24	27	26	24	26	26	28	28	45	45	41
10	25	27	28	24	21	27	24	21	27	27	28	27	45	45	41
11	26	27	28	25	22	27	26	22	27	27	28	28	45	45	41
12	25	27	27	24	21	26	25	21	26	27	27	27	45	45	41
13	25	26	26	25	24	25	25	24	25	25	26	26	45	45	41
14	26	27	28	26	25	27	26	25	27	27	28	28	45	45	41
15	25	26	26	25	23	26	25	23	26	26	27	26	45	45	41
16	24	25	25	24	23	25	24	23	25	25	26	25	45	45	41

Table 5-4 Summary of Predicted Receiver Levels without the Barrier

#	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	17	19	21	18	15	21	17	15	22	15	18	19	45	45	41
2	16	18	19	16	14	19	16	14	19	15	17	18	45	45	41
3	33	35	36	33	31	36	33	31	37	32	32	34	50	50	43
4	43	44	**44**	43	43	**44**	43	43	**44**	43	43	**44**	50	50	43
5	**51**	**51**	**51**	**51**	**50**	**51**	**51**	**50**	**50**	**50**	**51**	**51**	45	45	41
6	48	48	**48**	48	47	**48**	48	47	**48**	48	48	**48**	50	50	43
7	23	24	25	22	20	24	22	20	24	24	25	25	45	45	41
8	38	39	39	38	31	39	38	31	39	39	39	39	45	45	41
9	35	38	39	35	31	38	35	31	36	37	39	39	45	45	41
10	25	27	28	24	20	27	24	20	26	26	27	27	45	45	41
11	26	28	28	25	21	28	25	21	27	27	28	28	45	45	41
12	24	27	27	23	20	26	24	20	26	26	27	27	45	45	41
13	27	28	28	26	25	28	27	25	28	28	28	28	45	45	41
14	26	27	28	25	23	27	25	23	27	27	28	27	45	45	41
15	28	29	29	28	26	29	28	26	29	29	29	29	45	45	41
16	26	27	28	26	24	27	26	24	27	27	28	28	45	45	41

Table 5-5 Summary of Predicted Receiver Levels with the 5.5m Barrier

#	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	17	19	21	18	15	21	17	15	22	15	18	19	45	45	41
2	16	18	19	16	14	19	16	14	19	15	17	18	45	45	41
3	30	31	32	30	29	32	30	29	32	29	30	31	50	50	43
4	33	34	34	33	32	34	33	32	34	32	33	33	50	50	43
5	41	41	41	41	41	41	41	41	41	41	41	41	45	45	41
6	41	41	42	41	40	41	41	40	41	41	41	41	50	50	43
7	21	22	23	21	19	22	21	19	22	22	23	22	45	45	41
8	32	33	34	31	29	33	32	29	33	33	34	33	45	45	41
9	29	30	30	29	27	30	29	27	30	30	31	30	45	45	41
10	23	24	25	23	20	24	23	20	24	24	25	25	45	45	41
11	23	25	25	23	21	25	23	21	24	24	25	25	45	45	41
12	23	24	24	22	20	24	22	20	24	23	25	24	45	45	41
13	25	26	26	25	23	26	25	23	26	26	27	26	45	45	41
14	25	26	26	24	22	26	24	22	25	26	26	26	45	45	41
15	26	27	27	26	24	26	26	24	26	26	27	27	45	45	41
16	25	26	26	24	22	25	24	22	25	25	26	26	45	45	41

Figure 5-1 Noise Contours of the Preferred Goaf Plant with the Earth Mound

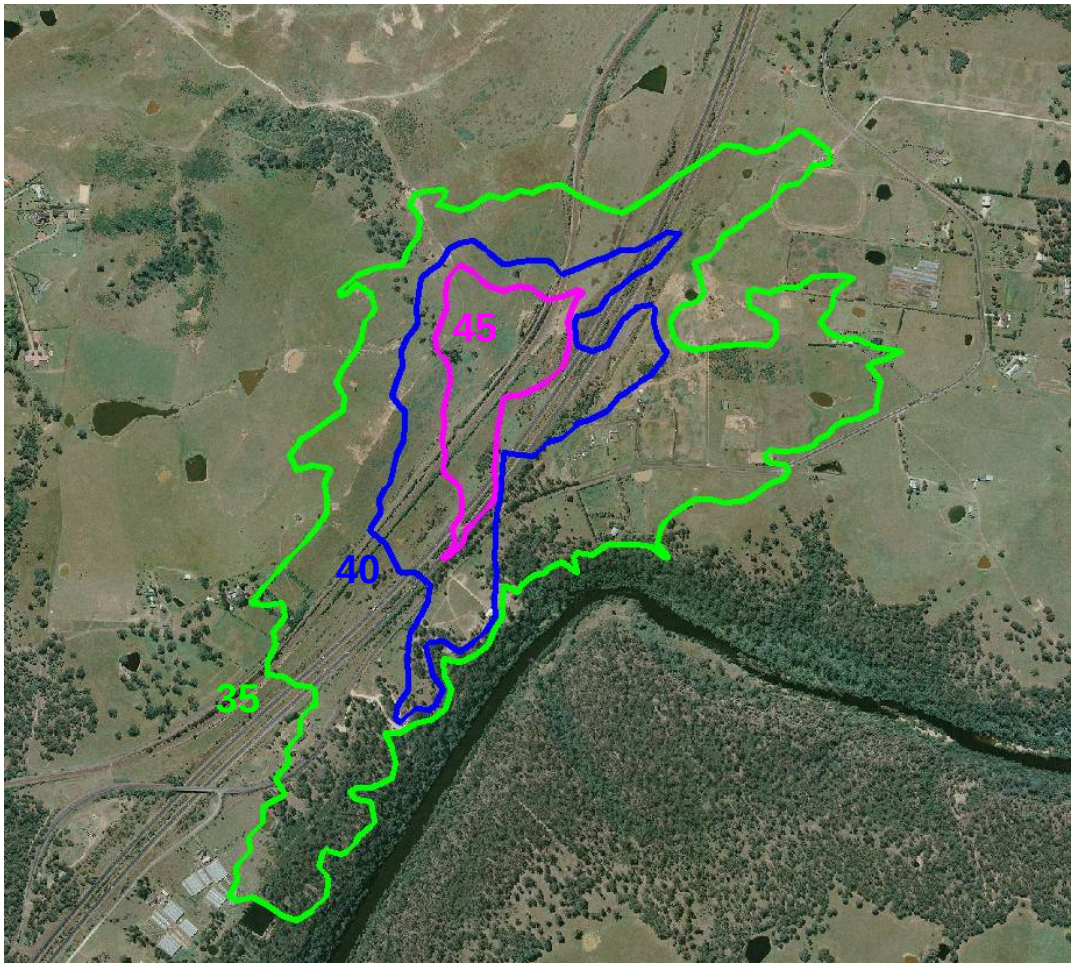
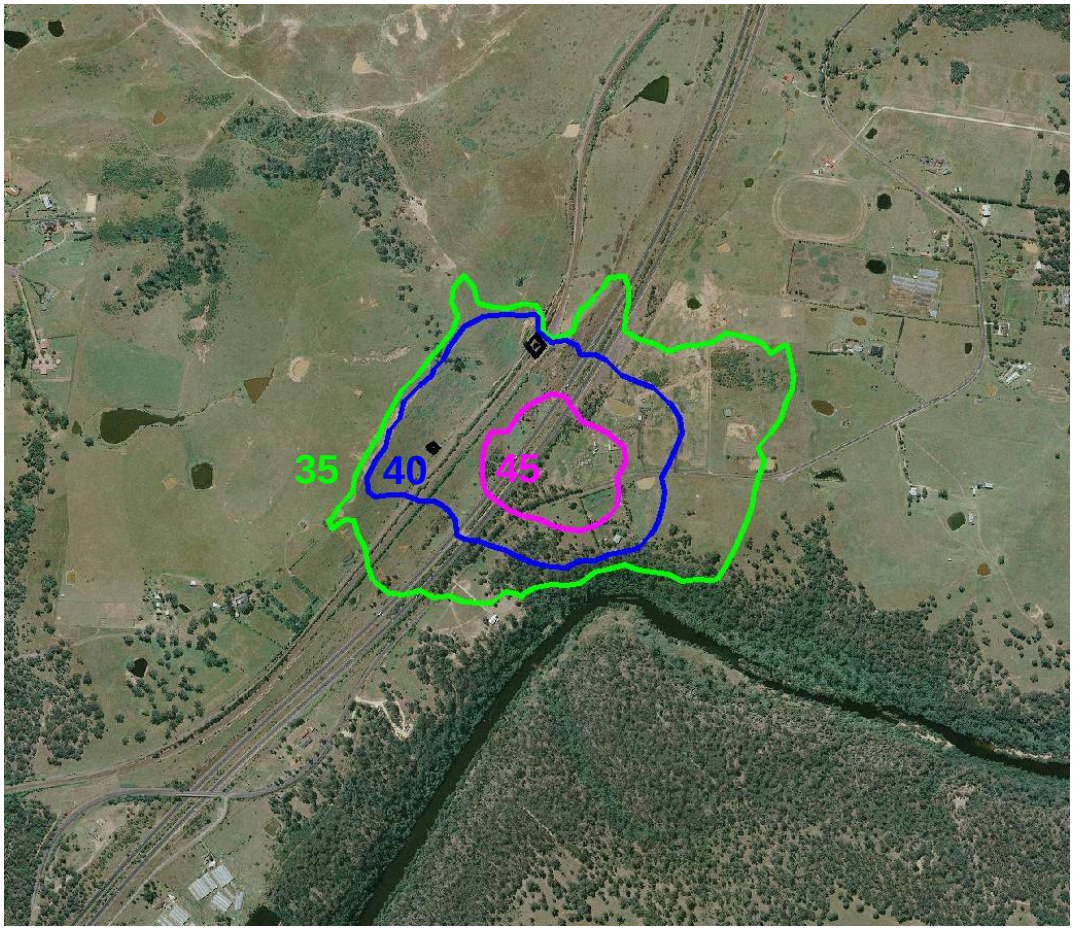


Figure 5-2 Noise Contours of the Contingency Goaf Plant with the Noise Barrier



6 CONSTRUCTION NOISE ASSESSMENT

This section of the report assesses the potential impact of noise during the construction and drilling phase of works.

Construction involves the installation of pipelines connecting the wells/boreholes to the Goaf Plant/s, under boring of the Hume Highway and Main Southern Rail Line and construction of the goaf plant and drilling compounds. This will require some shallow excavation and trenching works and is likely to involve the use of an excavator and one or two trucks.

A total of six vertical wells and one vertical downhole will be drilled. Additionally two MRD boreholes will be drilled. The vertical wells and vertical downhole will be drilled during daylight hours, Monday to Saturday. It is expected that each vertical well will take approximately two weeks to drill with a total duration of approximately 14 weeks. Due to the nature of directional drilling the MRD boreholes will be drilled 24 hours, seven days a week. Drilling the MRD boreholes is expected to take six weeks for each borehole. The total construction timeframe is anticipated to be within 26 weeks.

6.1 Construction Noise Goals

Noise and groundborne vibration will be generated during construction and installation of the plant/s and associated pipelines.

6.1.1 Construction Noise Criteria

The requirements outlined in Chapter 171 of DECC's *Environmental Noise Control Manual (ENCM)* are typically applied and this approach is detailed below.

Level Restrictions

(i) Construction period of 4 weeks and under.
The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A) at residential receivers.

(ii) Construction period greater than 4 weeks and not exceeding 26 weeks.
The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A) at residential receivers.

Time Restrictions

Monday to Friday	*7am–6pm*
Saturday	*7am–1pm (if inaudible at residential premises)*
	8am–1pm (if audible at residential premises)

No construction work to take place on Sundays or Public Holidays

Silencing

All possible steps should be taken to silence construction site equipment. It is particularly important that silenced equipment should be used on road or rail works where 24 hour operation is necessary.

There is no suggested criterion for projects that require out of hours construction. However, the following criterion is typically used:

> *The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 5 dB(A) at residential receivers.*

Construction, including drilling each of the wells and boreholes, is anticipated to occur for up to 26 weeks. The derived construction noise criteria (assuming between 4-26 weeks of construction) for this project are given in Table 4-3.

Table 4-3 Construction Noise Criteria

Receiver #	Criteria (dBA)		
	Day	Evening	Night
1	50	50	41
2	50	50	41
3	55	55	43
4	55	55	43
5	50	50	41
6	55	55	43
7	50	50	41
8	50	50	41
9	50	50	41
10	50	50	41
11	50	50	41
12	50	50	41
13	50	50	41
14	50	50	41
15	50	50	41
16	50	50	41

Note: 1) Daytime 7.00am–6.00am; Early Morning 6.00am–7.00am; Evening 6.00pm–10.00pm; and Night 10.00pm-6.00am.
2) Locations are shown in Figure 1-2.

6.2 Predicted Construction Noise Levels

The following construction plant items and associated maximum sound pressure levels at 7m are summarised as follows:

- Excavator 84dBA
- Truck 83dBA

Based on attenuation due to distance the following range of L_{Aeq} noise levels are predicted at the nearest residences from the various activities on different parts of the site.

Table 6-1 Predicted Construction Noise Level – $L_{Aeq,15min}$

Receiver #	Closest Distance (m)	Predicted Level (dBA)	Criteria (dBA)
1	500	49	50
2	500	49	50
3	210	**56**	55
4	340	52	55
5	205	**59**	50
6	90	**64**	55
7	330	**53**	50
8	80	**65**	50
9	380	**51**	50
10	360	**52**	50
11	180	**58**	50
12	330	**53**	50
13	250	**55**	50
14	290	**54**	50
15	300	**53**	50
16	370	**52**	50

The noise level from the installation of pipelines is predicted to exceed the noise goals at most receivers when construction is at its nearest location. The maximum predicted level is 65dBA which is at a similar level to traffic $L_{Aeq,15min}$ from the Hume Hwy. Given that the construction is mobile and will only be adjacent to any one receiver for a short duration, it is not considered reasonable to implement temporary barriers. Therefore mitigation is limited to utilizing quiet and well maintained plant and also informing the potentially affected receivers of the work, which should include an indication of expected durations.

6.3 Predicted Drilling Noise Levels – Vertical Well

Based on the measured data provided to us by Cardno Forbes Rigby, the sound power level of a drill rig was calculated. Because the orientation of the rig at each location is unknown at this stage the highest sound power level has been assumed in all directions.

Receiver noise levels were calculated using the ENM computer noise model. As the drilling of the vertical wells and downhole will be done during the day, meteorological effects such as temperature inversions are considered unlikely. Therefore only a still, isothermal condition was modelled.

The predicted receiver noise levels are presented in Table 6-2.

Table 6-2 Calculated Vertical Well Drilling L_{Aeq} Noise Levels

Receiver #	Vertical Well Number							Criteria
	1	2	3	4	5	6	7	(dBA)
1	**52**	47	26	24	23	22	20	50
2	**54**	49	26	23	24	22	19	50
3	**59**	49	35	46	44	42	33	55
4	32	40	52	**58**	48	48	33	55
5	30	40	**54**	**65**	**57**	**54**	37	50
6	29	39	**57**	**61**	**67**	52	39	55
7	22	27	38	28	32	36	56	50
8	26	34	39	45	**56**	**63**	**63**	50
9	25	32	46	47	**54**	**58**	47	50
10	22	27	40	26	32	37	**57**	50
11	22	29	41	28	34	41	**63**	50
12	20	28	40	25	31	37	**56**	50
13	22	30	34	30	36	40	**58**	50
14	21	27	38	27	32	39	**58**	50
15	23	30	33	33	39	43	**55**	50
16	21	29	35	29	34	39	**56**	50

At most surrounding residences the drilling is predicted to exceed the relevant construction noise goals. Given the short duration of works at each site, typically two weeks, the implementation of temporary noise barriers is not considered feasible.

It is recommended that the following noise control measures be considered:

- Drilling should be limited to the DECC's recommended standard hours of 7.00am-6.00pm Monday to Friday and 8.00am-1.00pm Saturday, with no audible work on Sunday or Public Holidays;
- Use of the quietest available plant, which is regularly maintained and fitted with appropriate mufflers;
- The plant should, if possible, be oriented so that the loudest side is not facing the nearest receivers; and
- Impacted neighbours should be contacted and informed of likely duration of work.

6.4 Predicted Drilling Noise Levels – MRD Borehole (directional)

Receiver noise levels for the drilling of the two MRD boreholes have been calculated using the ENM computer noise model. As the drilling is required to operate 24 hours, metrological effects are considered to have a potentially significant impact. The 10th percentile level (i.e. the level exceeded 10% of the time) was calculated for each time period. Works are anticipated to commence in August 2009, therefore met data for the winter months was used. The calculated MRD Borehole Drilling Noise Levels are shown in Table 6-3.

Table 6-3 Calculated MRD Borehole Drilling L_{Aeq} Noise Levels

Receiver	Predicted Level (dBA)						Criteria (dBA)		
	MRD1			MRD2					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	26	27	28	24	27	29	50	50	41
2	26	27	28	24	26	27	50	50	41
3	34	35	36	47	48	**51**	55	55	43
4	**51**	53	**53**	**57**	**58**	**59**	55	55	43
5	**54**	**56**	**55**	**63**	**64**	**64**	50	50	41
6	**58**	**59**	**59**	**62**	**63**	**62**	55	55	43
7	45	46	**46**	33	35	34	50	50	41
8	**47**	**51**	**50**	**52**	**53**	**52**	50	50	41
9	**47**	49	**49**	**51**	**53**	**52**	50	50	41
10	**47**	48	**48**	35	37	37	50	50	41
11	**48**	49	**49**	36	38	38	50	50	41
12	**49**	**50**	**50**	33	36	35	50	50	41
13	39	41	40	35	36	35	50	50	41
14	41	42	**42**	32	33	33	50	50	41
15	37	40	39	37	38	38	50	50	41
16	42	44	**43**	34	36	35	50	50	41

The receiver noise levels resulting from drilling the MRD boreholes are predicted to exceed the relevant construction noise goals at some residences. In general noise levels from MRD1 project further than those from MRD2 due to the relative heights and surrounding topography of the two drill sites.

As the work is required to be conducted 24 hours a day, and the duration is expected to be six weeks at each MRD drill site, the implementation of temporary noise barriers is required.

Figure 6-1 shows the indicative locations of the required barriers. Each barrier should be located as close as possible to the drill rig and extend above the height of the rig engine/pumps by at least 1m. An example of a suitable construction of these barriers is locating shipping containers or other suitable noise attenuation barriers in the required positions, though the required height may require some minor earthworks to mount each barrier. The calculated MRD Borehole Drilling Noise Levels with barriers in place are shown in Table 6-4.

Note that MRD1 and MRD2 will be located adjacent to both of the proposed preferred and contingency extraction plant locations which require barriers to be situated as per Figure 6-1. It may be practical to utilize these barriers to mitigate the drilling noise, however additional height may be required due to the relative topography.

Figure 6-1 Indicative Location of MRD Borehole Drilling Barriers

Table 6-4 Calculated MRD Borehole Drilling L_{Aeq} Noise Levels

Receiver	Predicted Level (dBA)						Criteria (dBA)		
	MRD1			MRD2					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	26	27	28	24	27	29	50	50	41
2	26	27	28	24	26	27	50	50	41
3	32	33	34	44	45	**47**	55	55	43
4	34	36	36	46	47	**48**	55	55	43
5	37	38	38	**53**	**54**	**54**	50	50	41
6	41	42	42	**57**	**58**	**57**	55	55	43
7	36	37	36	33	35	35	50	50	41
8	35	36	36	**49**	**50**	**50**	50	50	41
9	33	35	35	45	48	**47**	50	50	41
10	35	36	35	34	36	35	50	50	41
11	35	36	36	33	35	35	50	50	41
12	34	35	35	32	34	34	50	50	41
13	31	32	32	36	37	36	50	50	41
14	34	35	35	32	33	33	50	50	41
15	31	32	31	39	40	39	50	50	41
16	31	32	31	35	36	36	50	50	41

With the implementation of temporary barriers around the drill sites the criteria is predicted to be satisfied at most receivers, however moderate exceedances remain at the closest residences to MRD2.

Given that night time works are necessary to successfully drill the MRD boreholes it is recommended that the potentially affected receivers be contacted and an agreement negotiated. BHPBIC have consulted with and obtained written agreements from all landowners on whos' land the proposed works including night time drilling of the MRD boreholes is occurring. It should be noted that the predicted levels are generally similar to traffic noise levels in the area and thus the subjective annoyance of surrounding residents may be reduced.

Additional mitigation could be achieved by orienting the drill rig so that the quietest side faces the receivers. Placing water tanks or other drill rig infrastructure on the Hume Hwy side will also reduce the impact to the nearest receivers. Measured data indicates that these measures are likely to reduce the emission level by up to 9dB.

7 CONCLUSION

Operational and construction noise impacts associated with the proposed Goaf Gas Drainage Plant/s near Douglas Park have been assessed in accordance with criteria recommended by the NSW Department of Environment & Climate Change (DECC-EPA).

7.1 Operational Noise

The following noise mitigation measures are recommended:

- Construction of noise barriers at each of the proposed extraction plant locations as per Figure 6-1, if the contingency extraction plant is required. If the contingency extraction plant is not required, a single noise barrier constructed on Lot 2 DP576136 should be installed as per Figure 6-1. The barrier/s should be located as close as possible to the generator/vacuum pump and extend above the height of the generator/vacuum pump by at least 1m at the preferred site and 2m at the contingency plant site. An earth mound constructed out of the excavated material from the construction of the extraction plant compound or the use of shipping containers would be suitable for this application.
- Should the preferred extraction plant, located on the property described as Lot 2 DP576136, be powered by mains power and thus not require a diesel generator, the noise emissions from this extraction plant will be greatly reduced. Should this be the case it is expected that noise mitigation barriers at this location will not be required for the operation of this extraction plant.

With the implementation of the above noise mitigation the operational noise emissions from the Goaf Plant/s are predicted to satisfy criteria at all receivers.

7.2 Construction of Pipelines, Drilling Vertical Wells and Under Boring of the Hume Highway and Main Southern Rail Line

Noise levels from construction are predicted to exceed relevant goal levels when works are nearest the residences. Due to the mobile nature of the works and the short duration the implementation of temporary noise barriers is considered unreasonable.

It is recommended that the following noise control measures be considered:

- Drilling should be limited to the DECC's recommended standard hours of 7.00am-6.00pm Monday to Friday and 8.00am-1.00pm Saturday, with no audible work on Sunday or Public Holidays;
- Use of the quietest available plant, which is regularly maintained and fitted with appropriate mufflers;
- Impacted neighbours should be contacted and informed of likely duration of work.

7.3 Drilling MRD Boreholes

Drilling the two MRD boreholes requires 24 hour, seven days a week operation. Noise levels during this drilling are predicted to exceed relevant criteria at some receivers, even with the implementation of reasonable barriers surrounding the drill rig. It is therefore recommended that the following mitigation measures be applied:

- Use of the quietest available plant, which is regularly maintained and fitted with appropriate mufflers;
- Orient the drill rig and equipment so that the quietest side (identified as being up to 9dB quieter than the loudest side) is faced toward the nearest receivers;
- Place temporary barriers around the drill rig on three sides. The barriers must extend above the height of the drill rig engine and any pumps by at least 1m and be located as close as possible to these noise sources;
- Impacted neighbours should be contacted and informed of likely duration of work, noise mitigation works to be installed, and provided contact details of the Illawarra Coal Operations Manager- Exploration to provide feedback on any noise impacts.

Note
All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Quality Assurance
We are committed to and have implemented AS/NZS ISO 9001:2000 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC
This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	Draft	1 May 2009	Adam Bioletti	John Wassermann
B	Final	22 May 2009	Adam Bioletti	

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

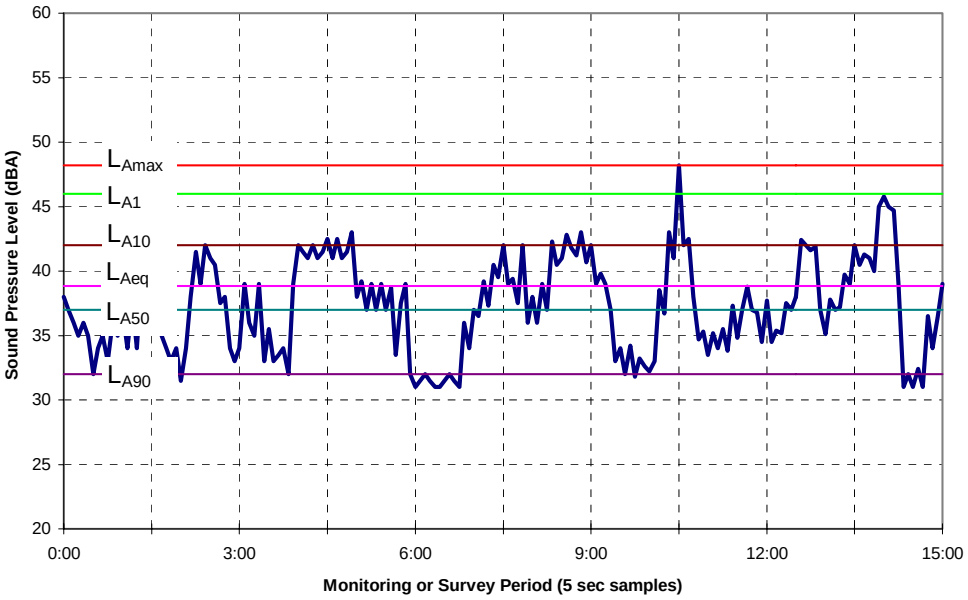
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.

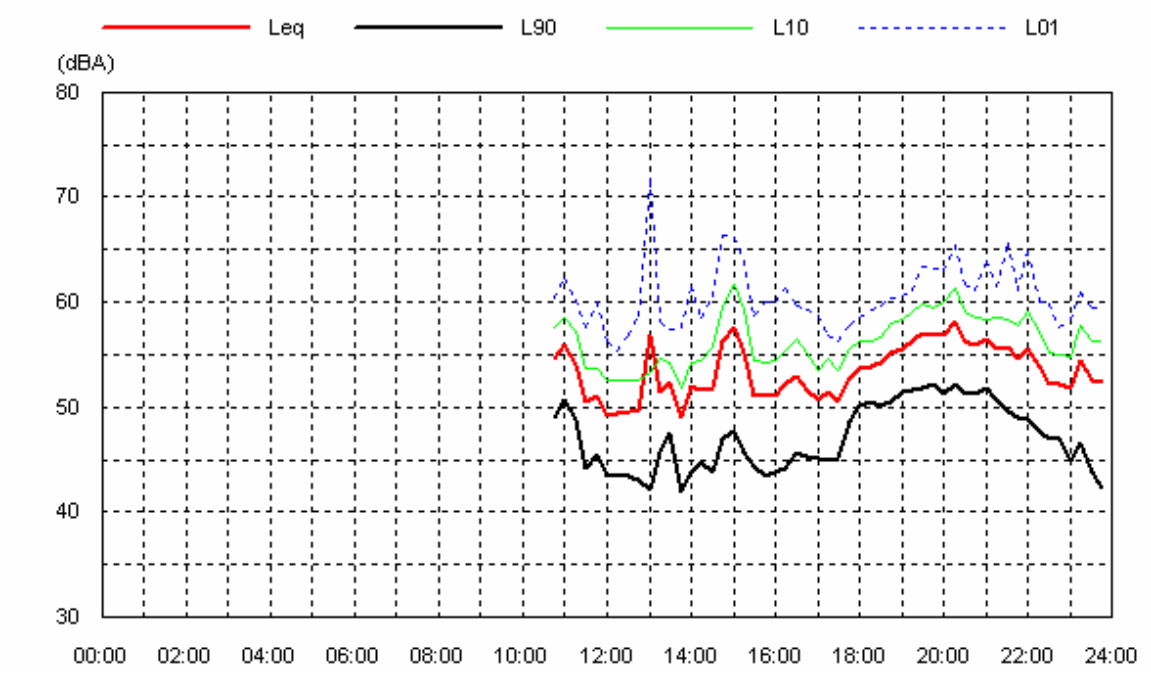

60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

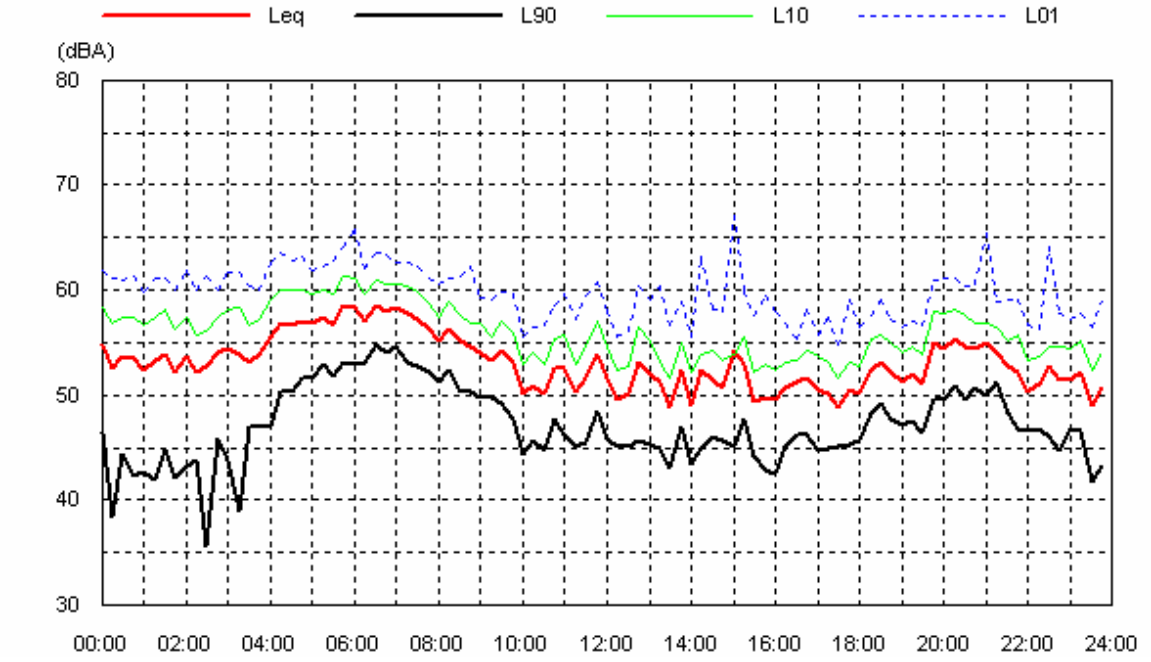
NOISE MEASUREMENT RESULTS

Location: 1. Lot 1, Near the house

Wed 08 Apr 09

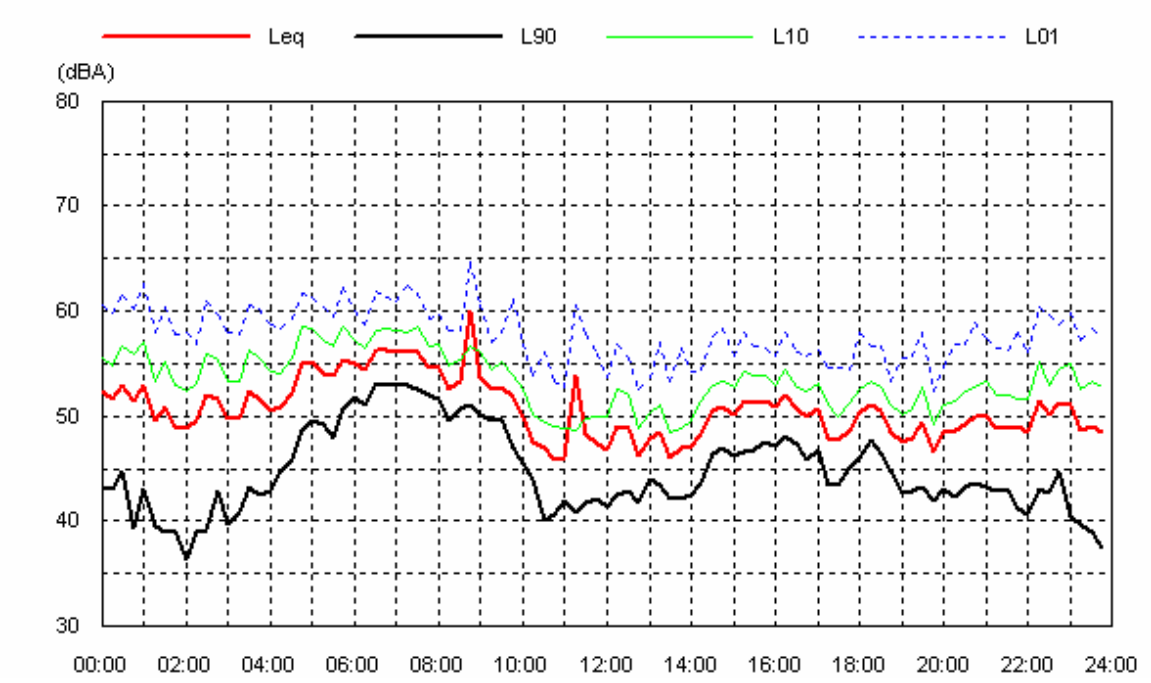


Thu 09 Apr 09

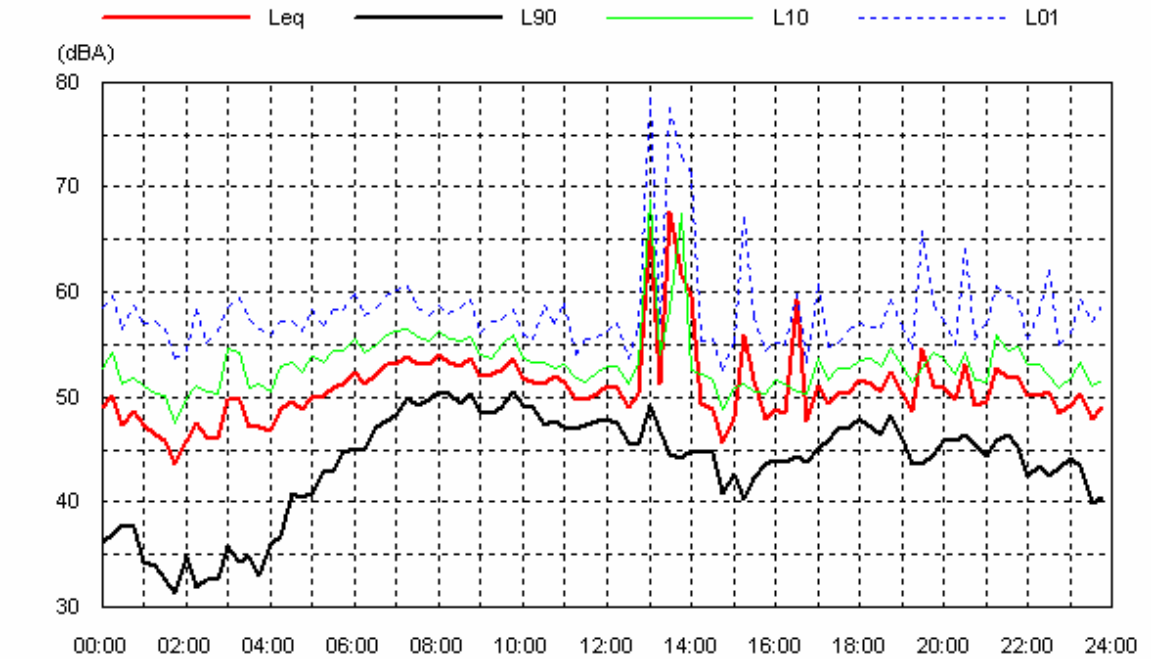


Location: 1. Lot 1, Near the house

Fri 10 Apr 09

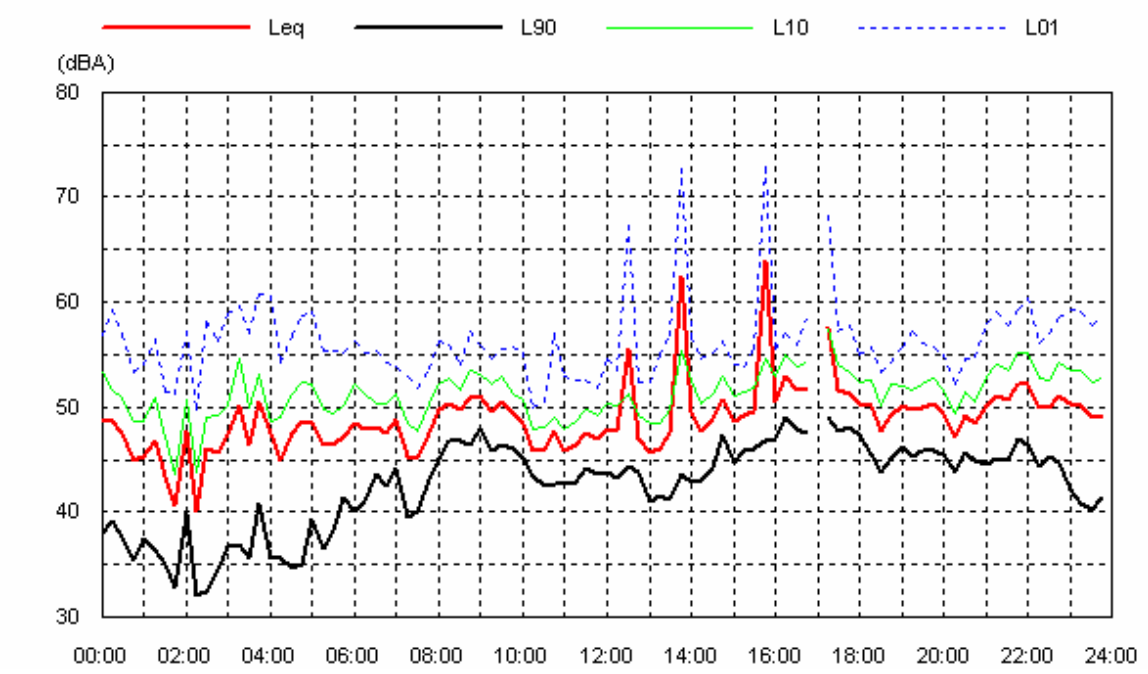


Sat 11 Apr 09

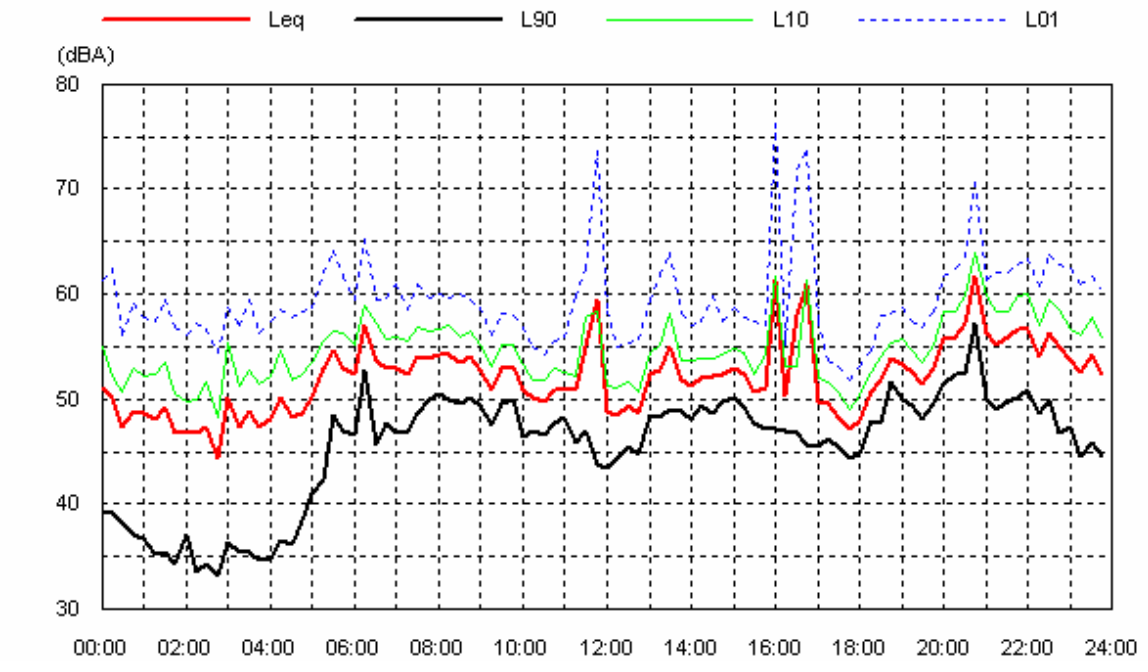


Location: 1. Lot 1, Near the house

Sun 12 Apr 09

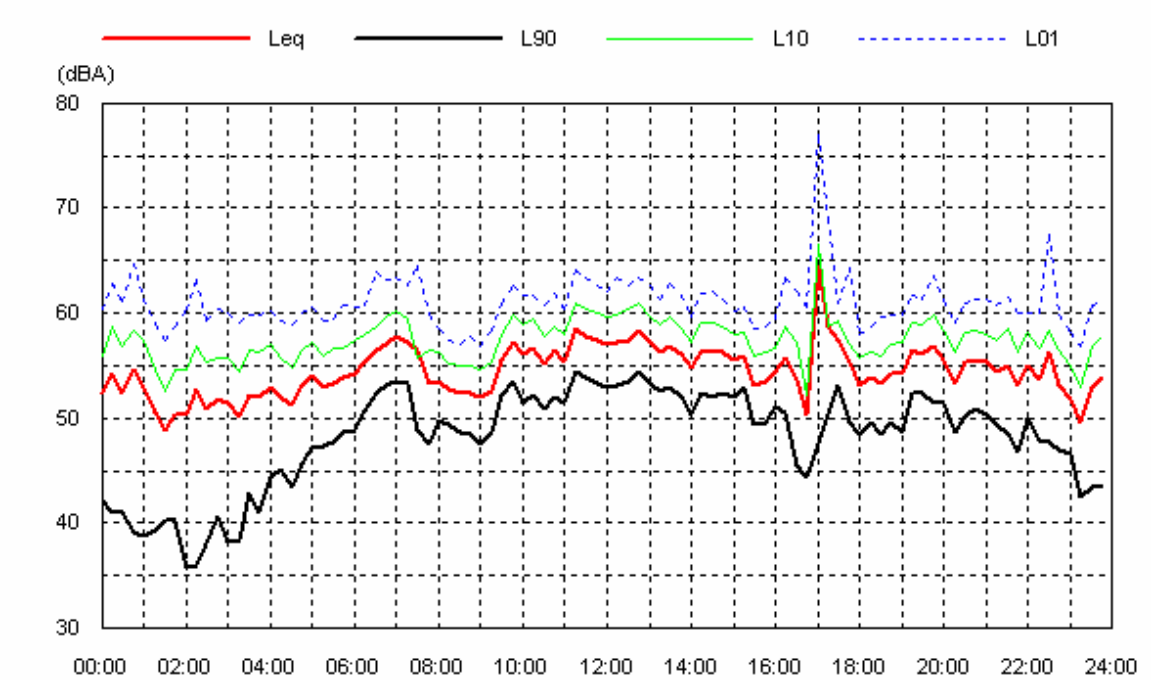


Mon 13 Apr 09

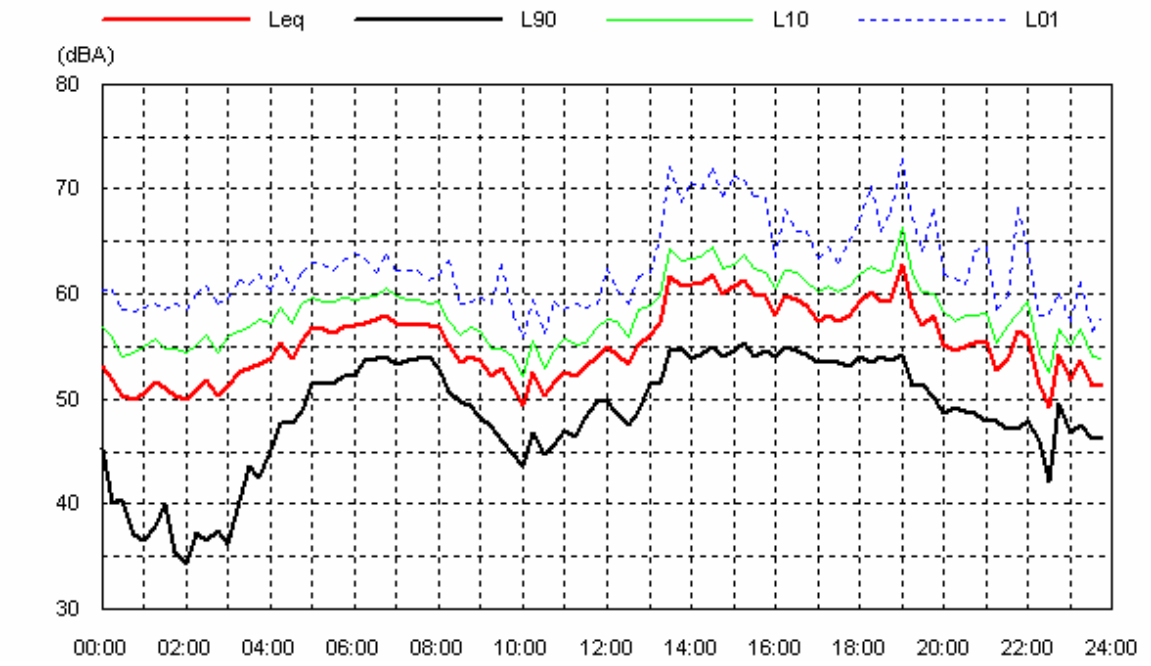


Location: 1. Lot 1, Near the house

Tue 14 Apr 09

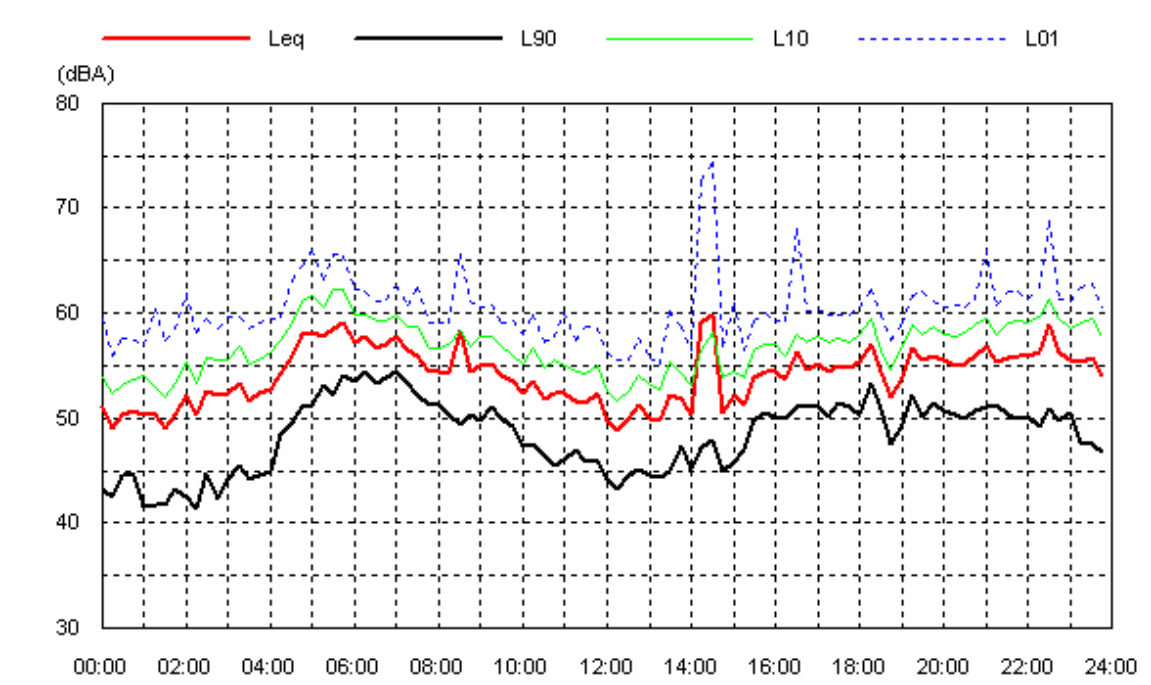


Wed 15 Apr 09

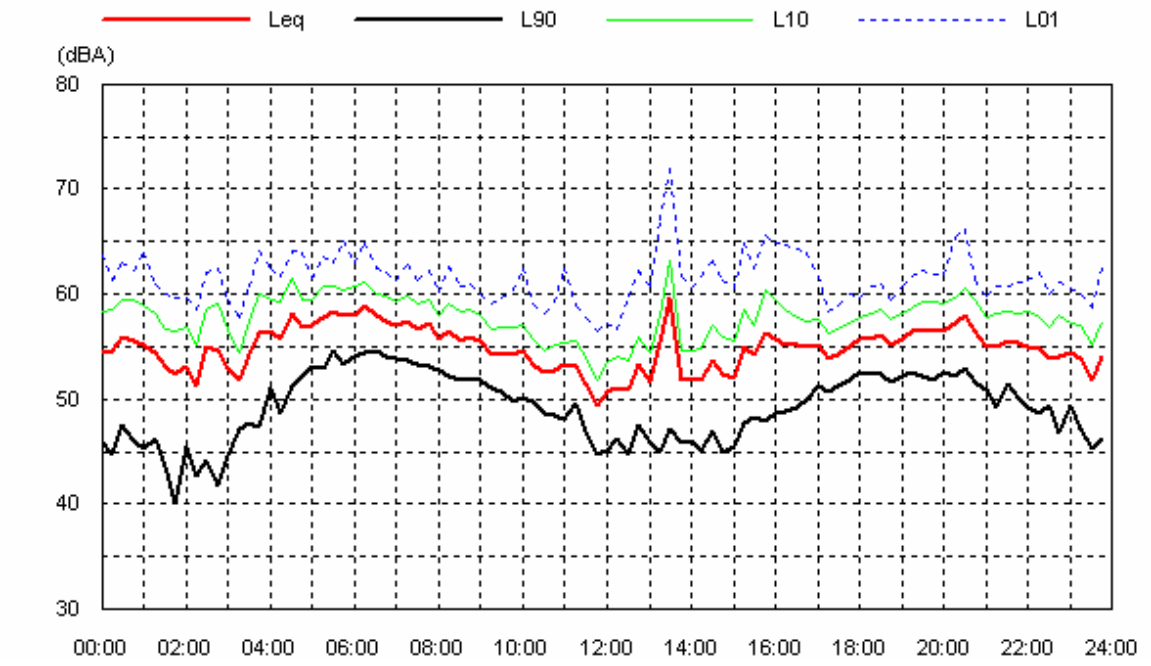


Location: 1. Lot 1, Near the house

Thu 16 Apr 09

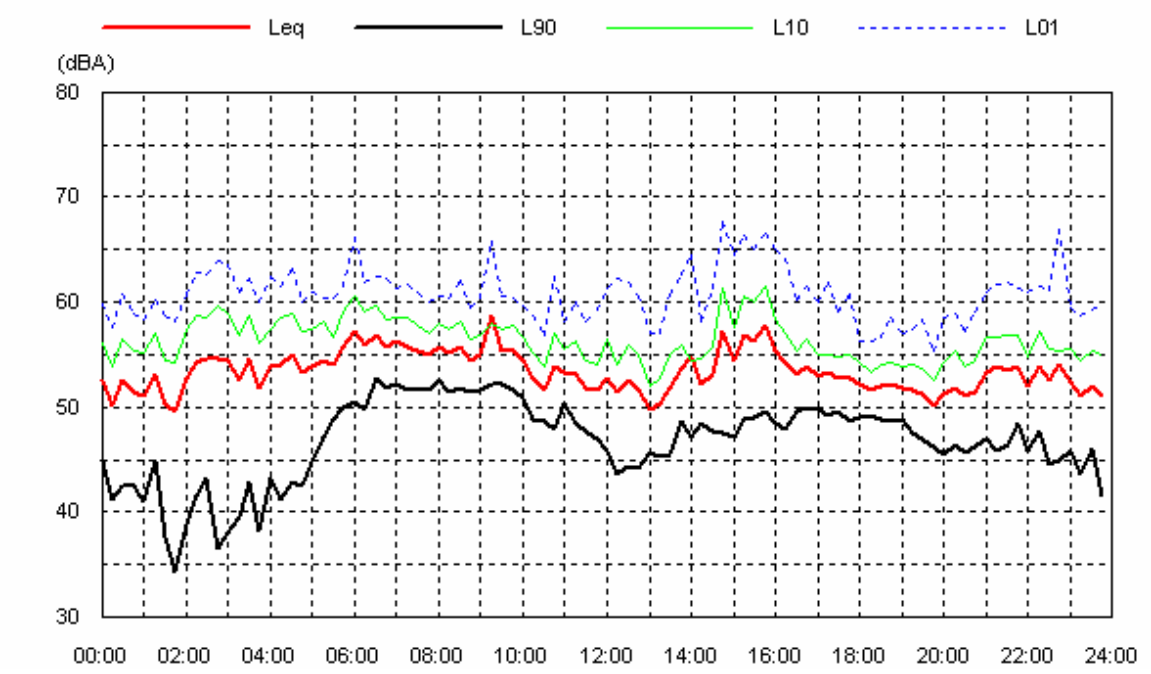


Fri 17 Apr 09

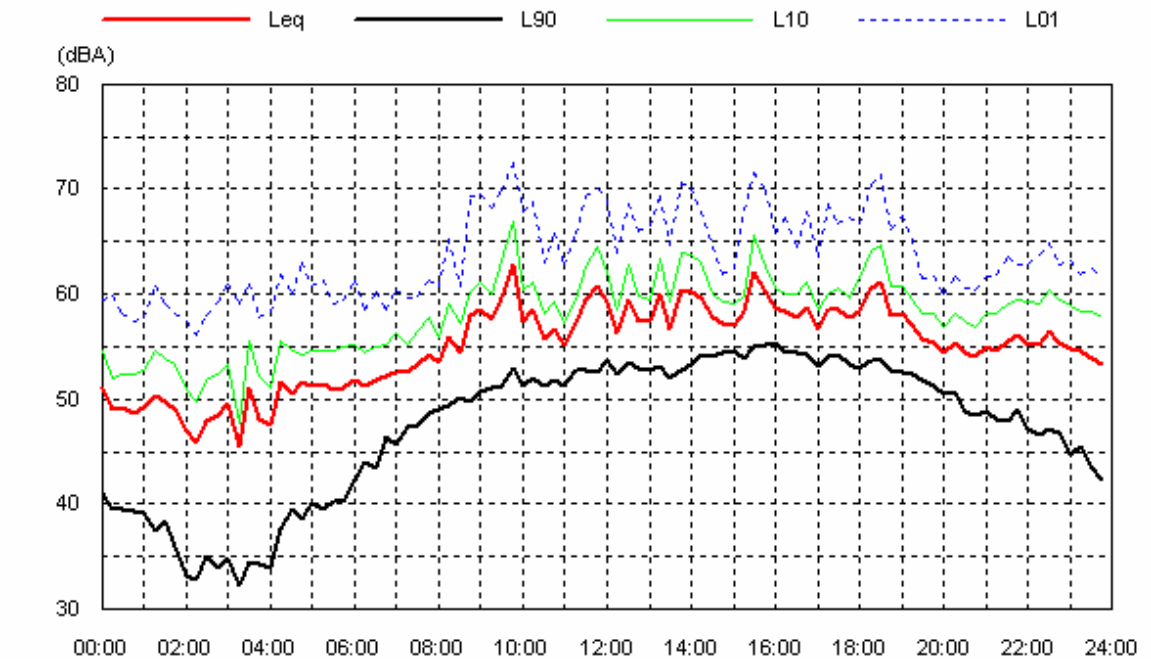


Location: 1. Lot 1, Near the house

Sat 18 Apr 09

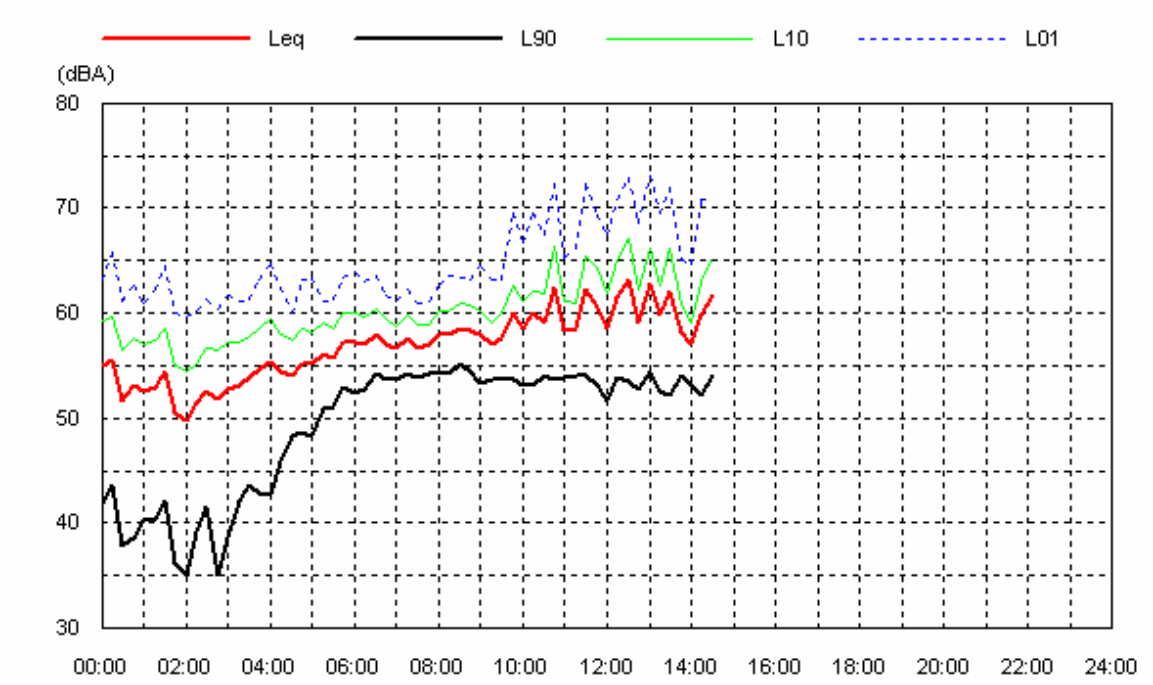


Sun 19 Apr 09



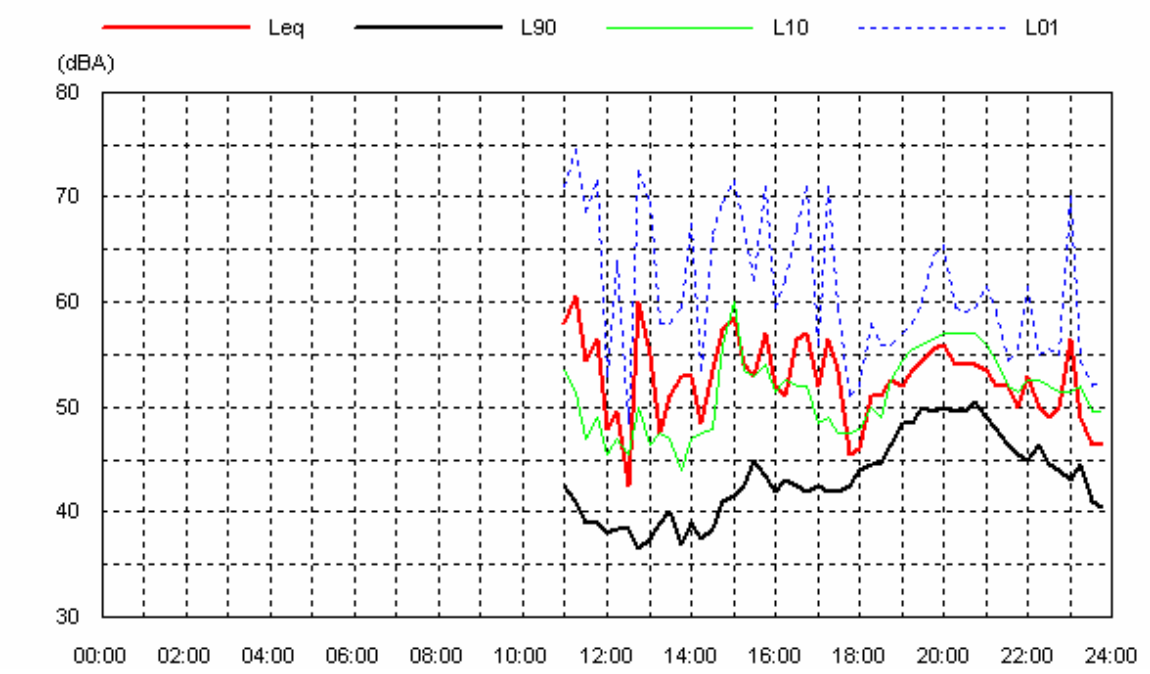
Location: 1. Lot 1, Near the house

Mon 20 Apr 09

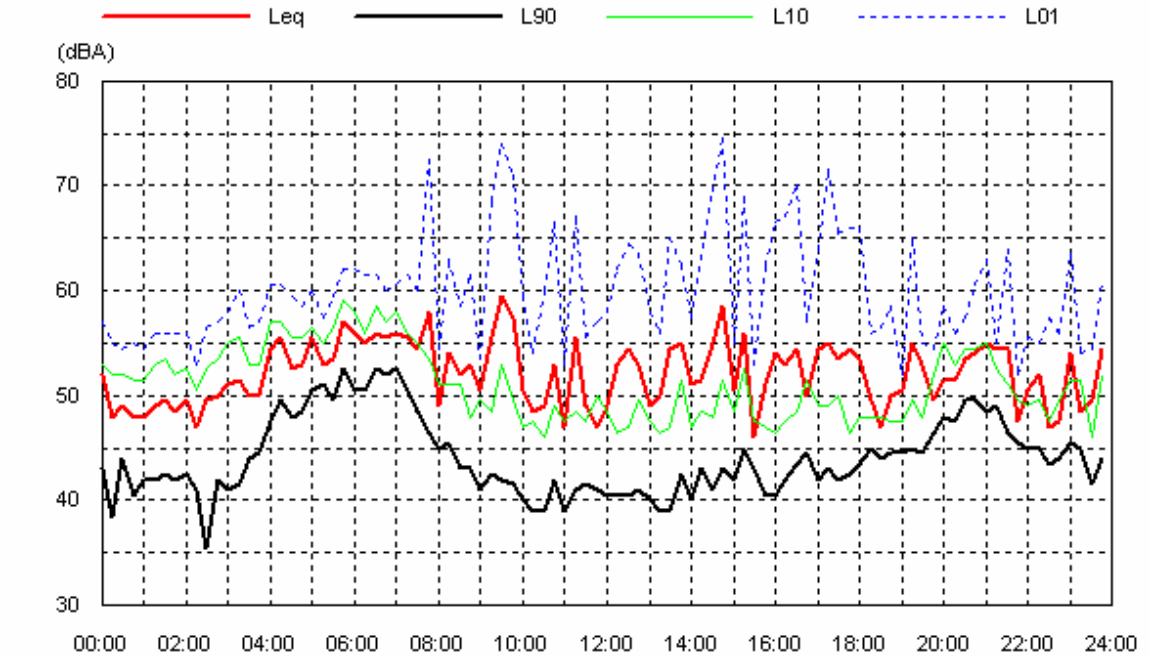


Location: 2. Lot 1, Near Moreton Park Rd

Wed 08 Apr 09

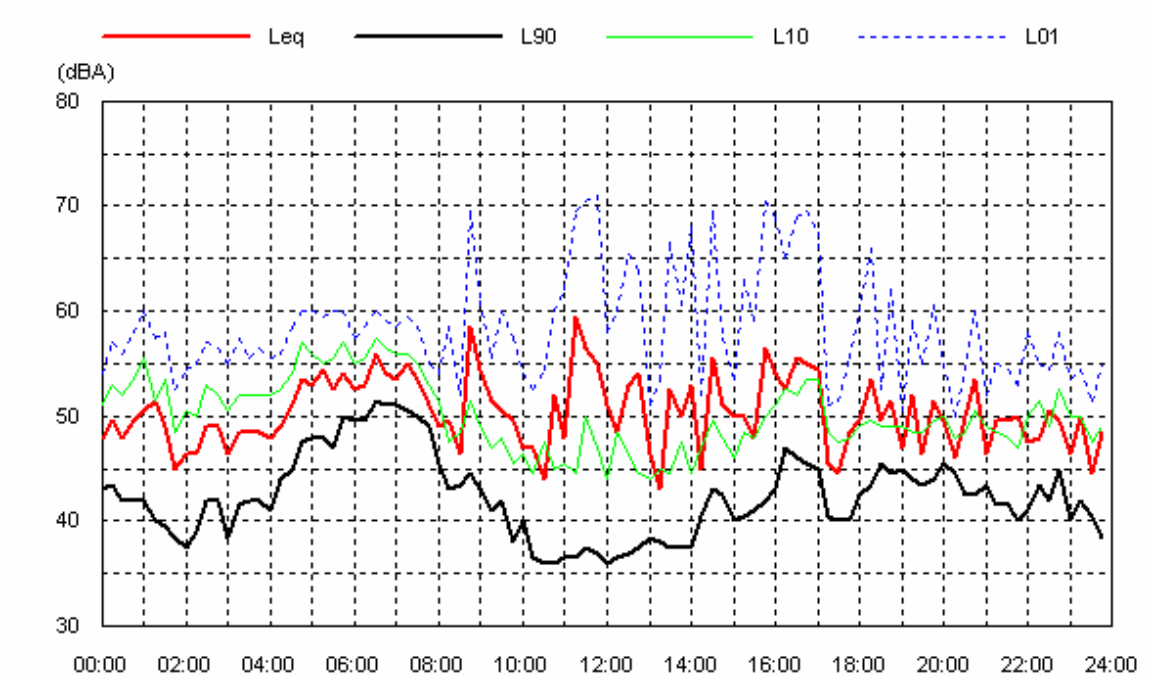


Thu 09 Apr 09

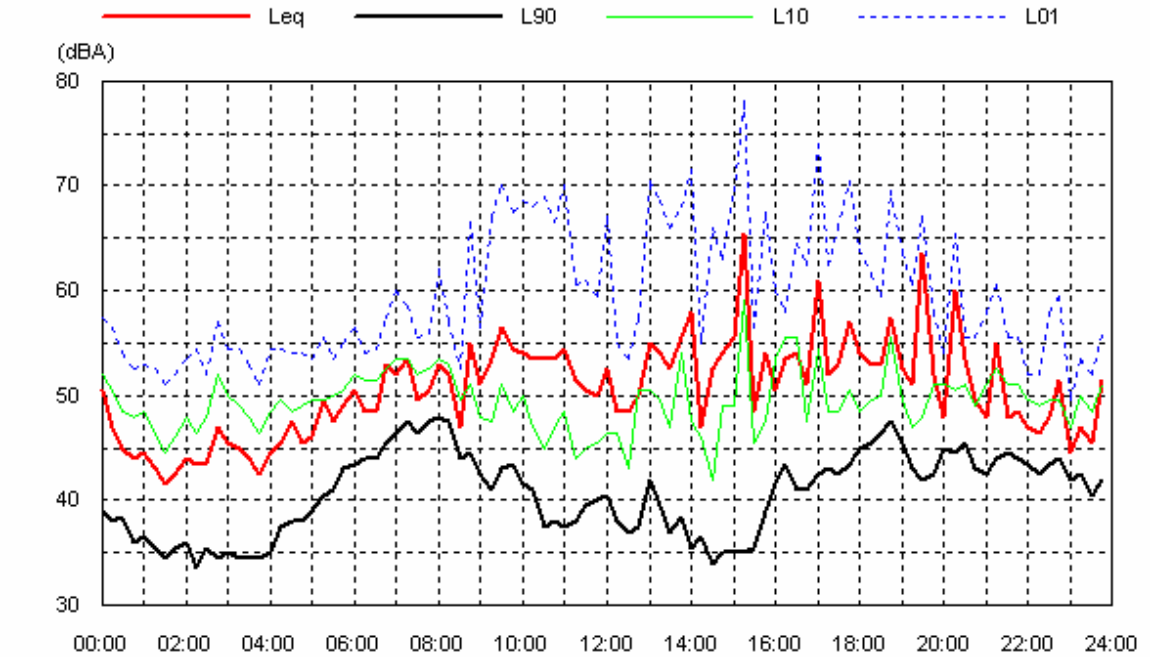


Location: 2. Lot 1, Near Moreton Park Rd

Fri 10 Apr 09

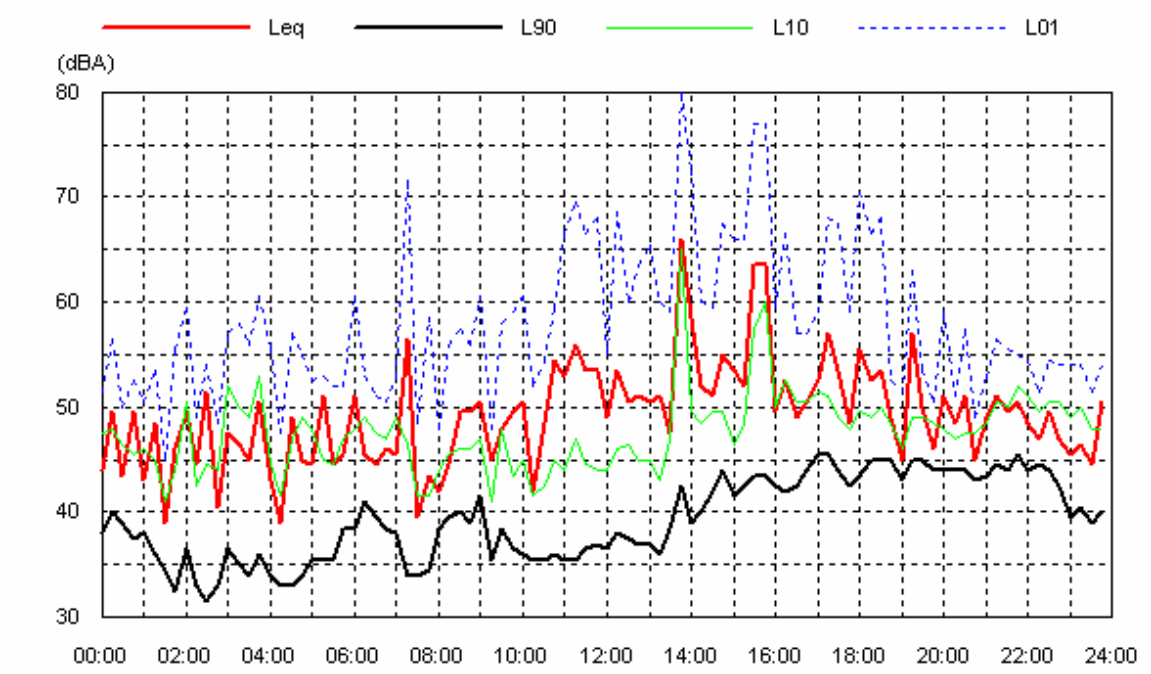


Sat 11 Apr 09

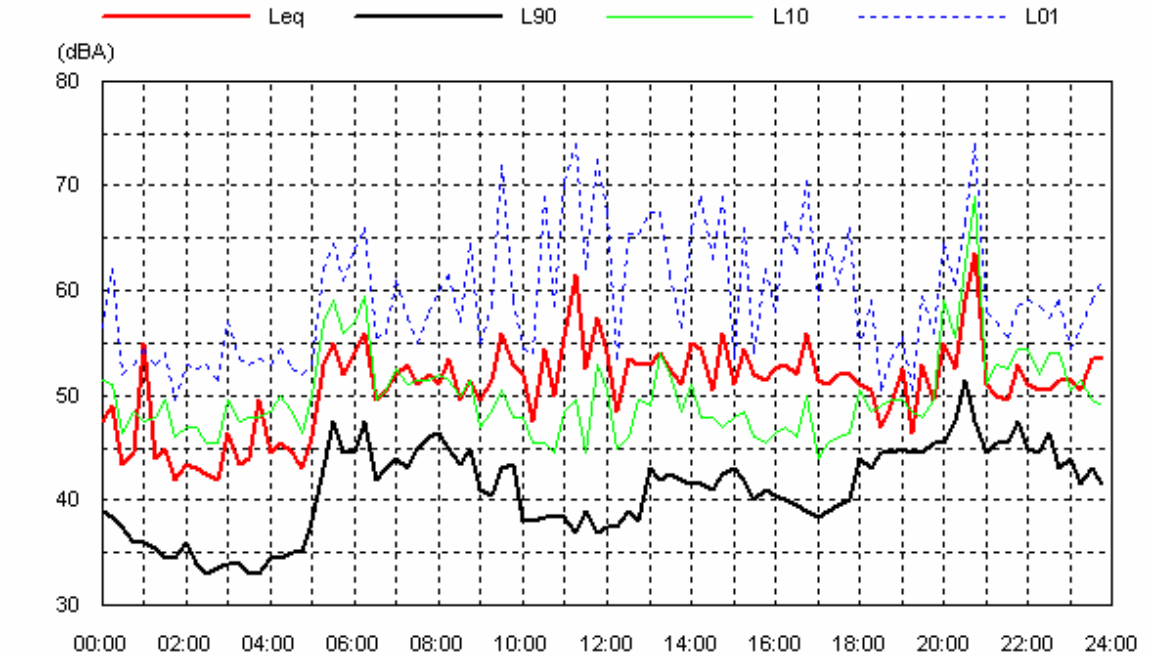


Location: 2. Lot 1, Near Moreton Park Rd

Sun 12 Apr 09

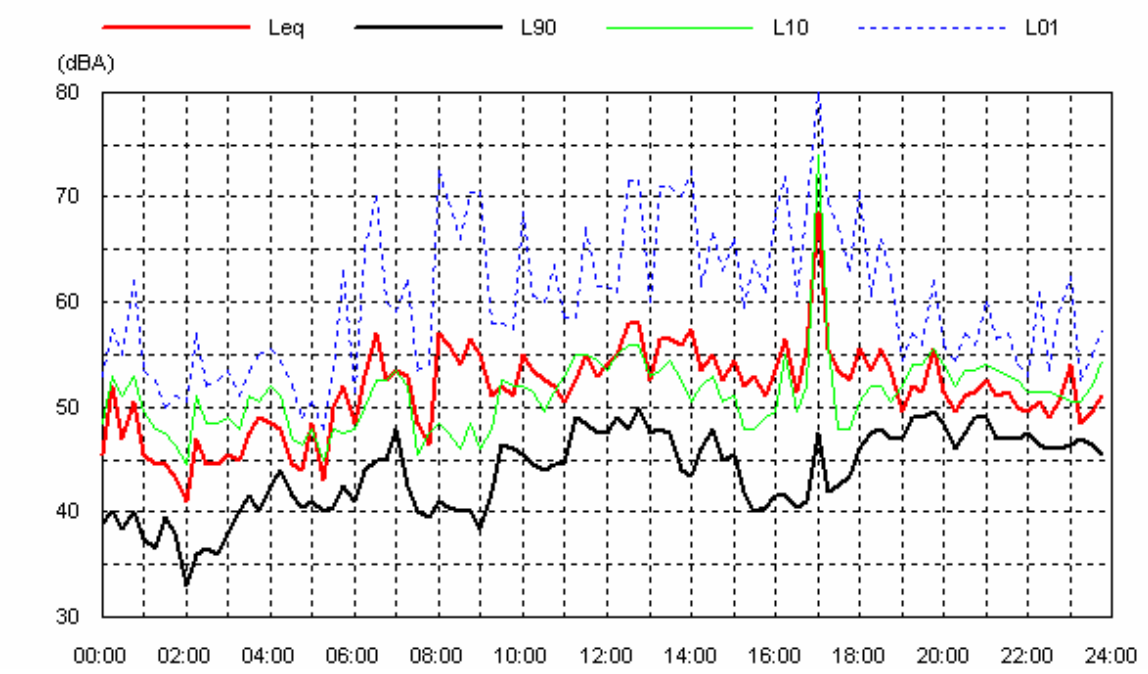


Mon 13 Apr 09

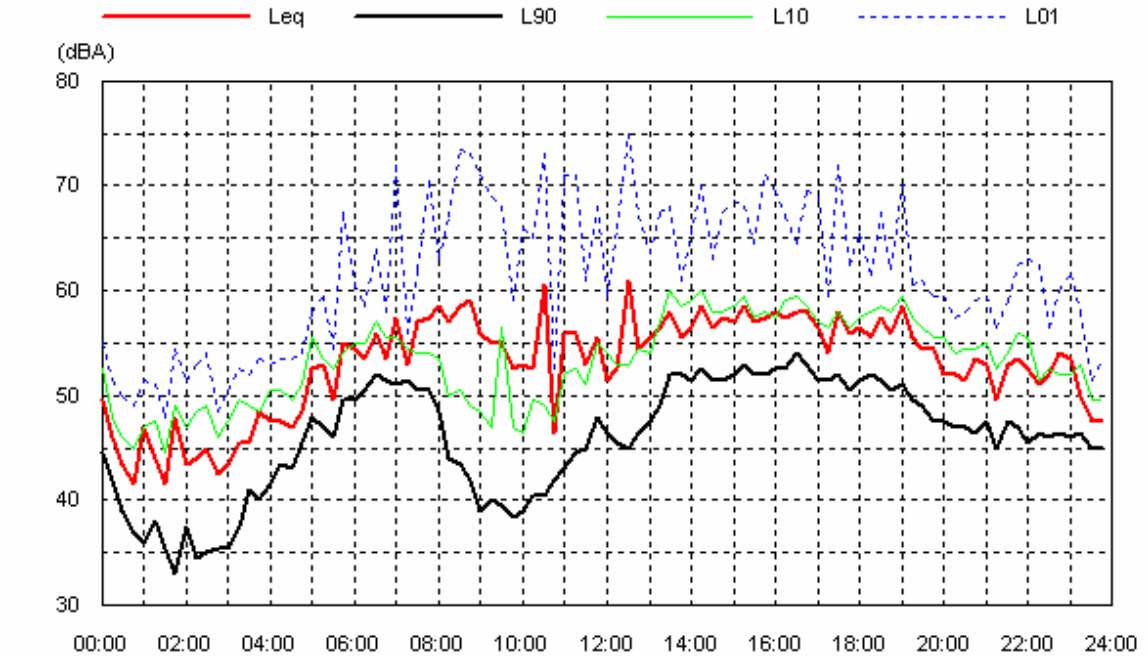


Location: 2. Lot 1, Near Moreton Park Rd

Tue 14 Apr 09

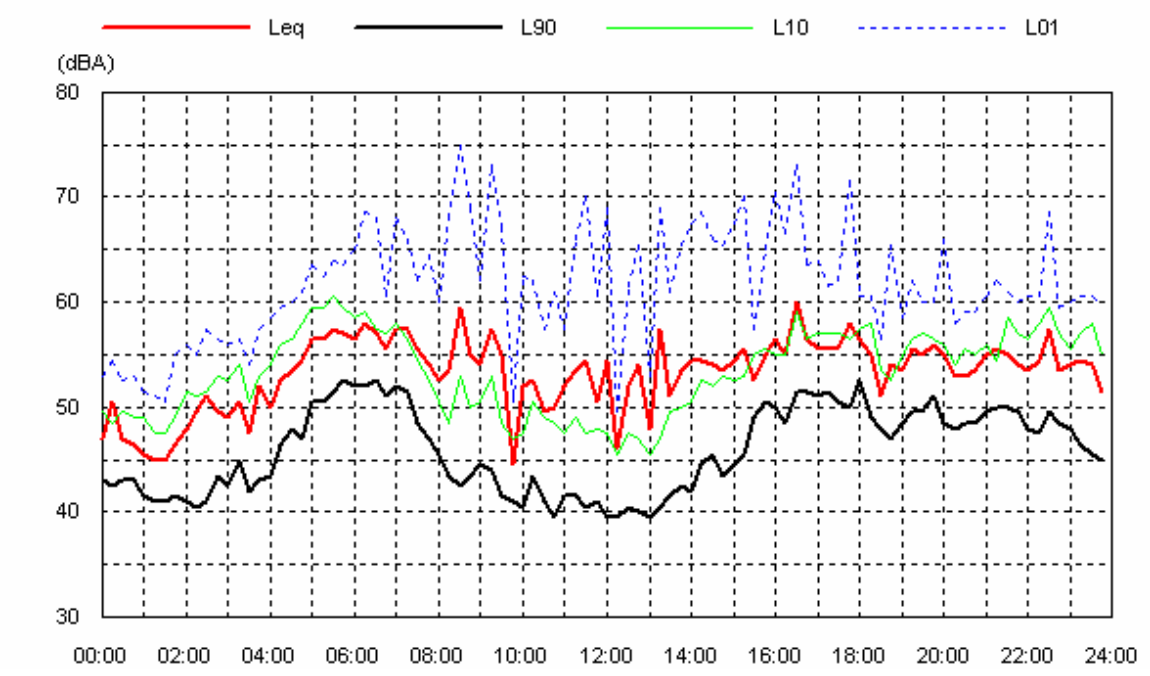


Wed 15 Apr 09

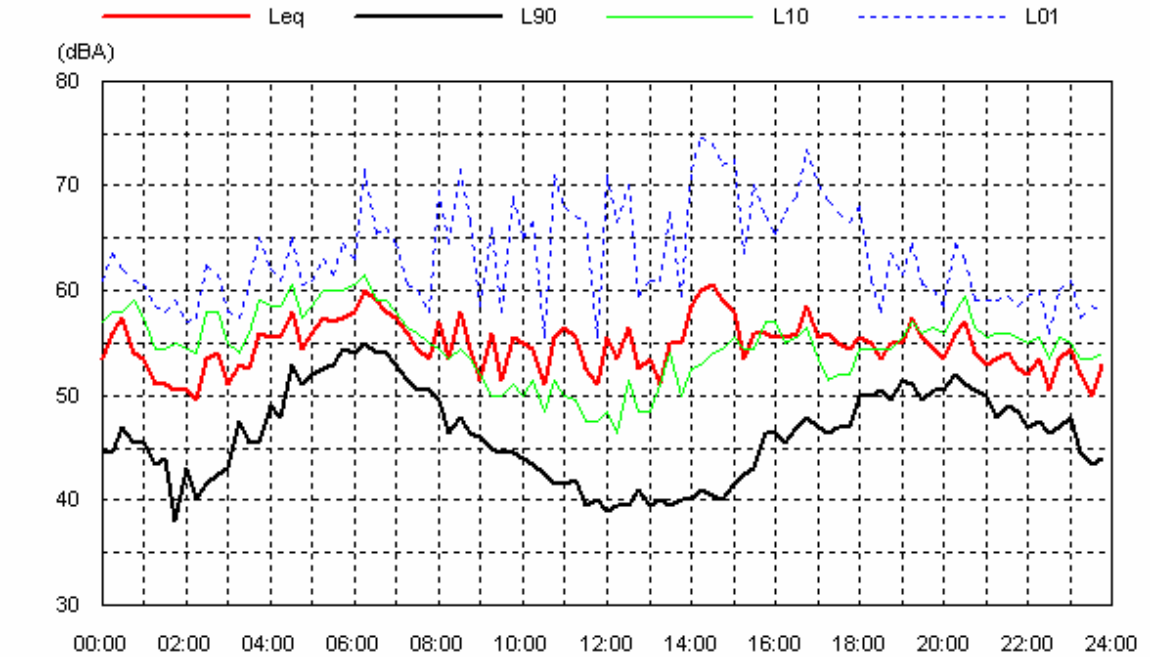


Location: 2. Lot 1, Near Moreton Park Rd

Thu 16 Apr 09

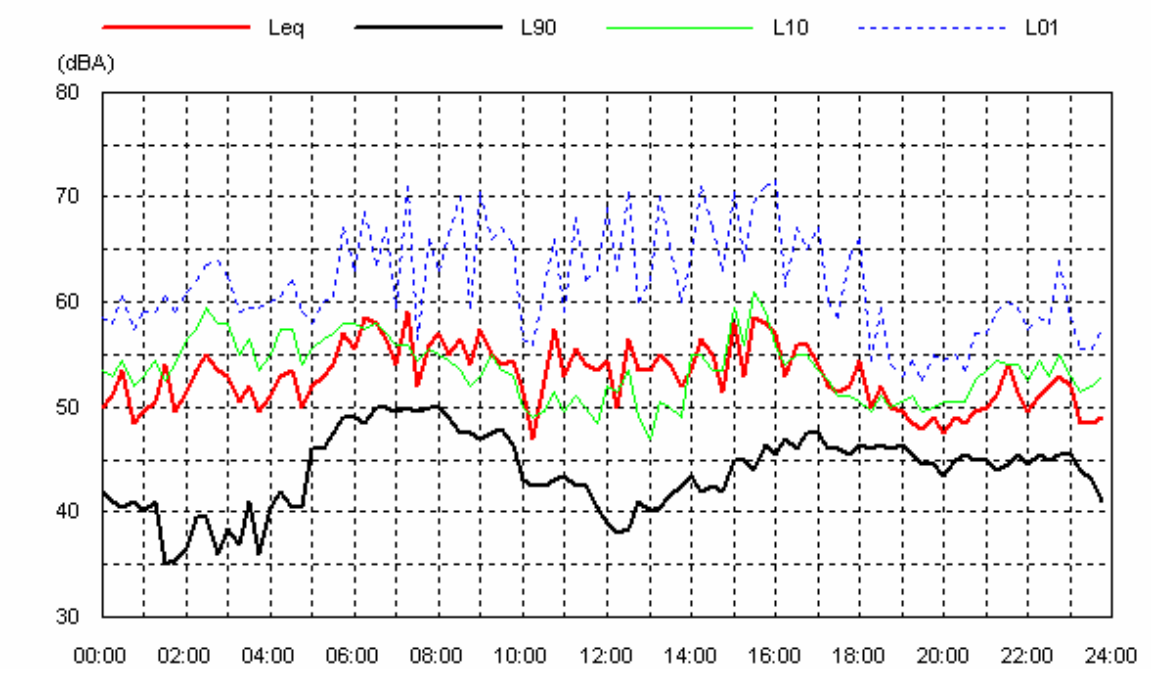


Fri 17 Apr 09

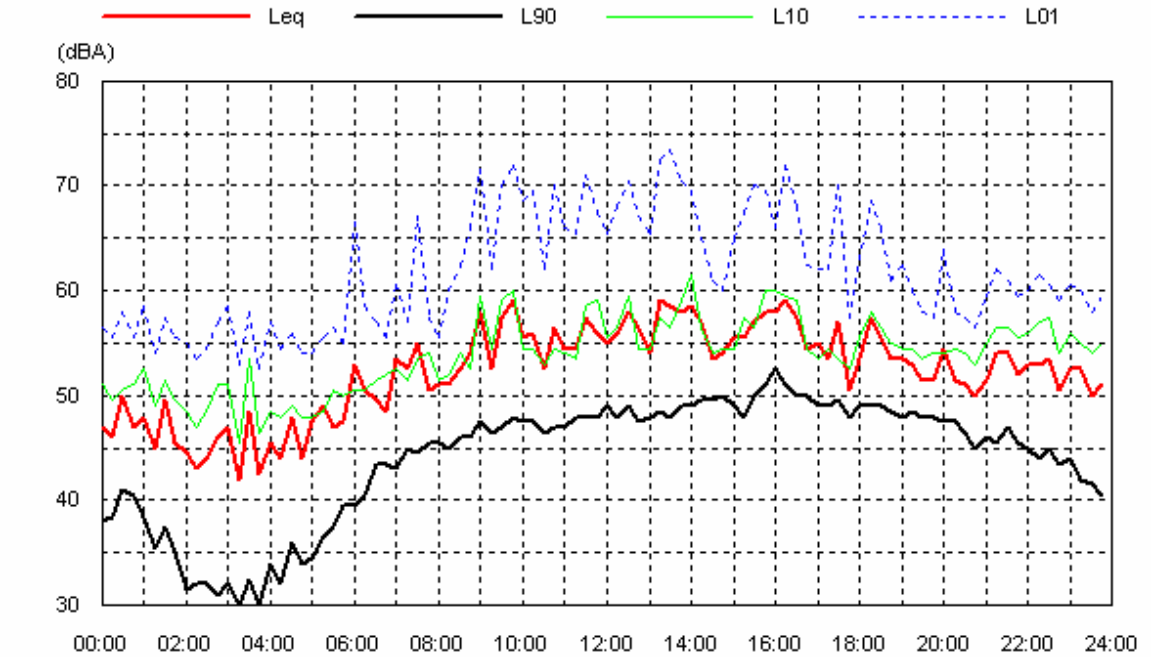


Location: 2. Lot 1, Near Moreton Park Rd

Sat 18 Apr 09



Sun 19 Apr 09



Location: 2. Lot 1, Near Moreton Park Rd

Mon 20 Apr 09