NOISE AND VIBRATION ASSESSMENT

TECHNICAL PAPER 3

Wellington Gas-fired Peaking Power Station Project

Environmental Assessment Technical Paper 3 - Noise and Vibration Assessment

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Executive summary

This report has been prepared by Parsons Brinckerhoff (PB) on behalf of ERM Power to assess the potential noise and vibration impacts of the proposed construction and operation of the Wellington open-cycle gas-fired power station (the power station) and associated compressor station and gas supply pipeline (the project). The study has been prepared for inclusion within the Environmental Assessment being prepared by PB.

The scope of work for this study was to provide a detailed assessment of potential noise and vibration impacts associated with the construction and operation of the project.

This assessment has been undertaken in accordance with the Department of Environment and Climate Change *Industrial Noise Policy* (NSW EPA INP 1999) and associated *Industrial Noise Policy Application Notes* and with consideration to the NSW *Environmental Criteria for Road Traffic Noise Control* (EPA 1999) and Chapter 171 *Noise Control Guideline, Construction Site Noise, Environmental Noise Manual* (ENCM 1994).

The proposed power station would be located approximately 2 kilometres north north-east of the outskirts of Wellington along Gulgong Road and adjacent to TransGrid's 330/132 kilovolt Wellington substation. Residential properties in the vicinity of the proposed site have been identified within approximately 700 metres and 2.5 kilometres. A minimum separation distance of 300 metres has been maintained between residences and the proposed pipeline route. The proposed compressor station would be located near the Central West Pipeline at Alectown West, where the nearest residence is more than 600 metres away.

Existing background noise profiles were characterised for daytime, evening and night-time noise periods within the study area through unattended and operator attended noise monitoring. The measured background noise profiles were used to determine adopted noise design goals for the associated construction and operational stages of the project.

The baseline monitoring demonstrated that the existing noise environments were influenced by local and distant road traffic, residential activity and fauna. No existing industrial influence was measured at the location. Measured background noise levels for the study area were as follows:

- daytime (7 am – 6 pm) 24 – 30 dB(A) L_{A90}
- evening (6 pm – 10 pm) 23 – 27 dB(A) L_{A90}
- night-time (10 pm – 7 am) 22 – 25 dB(A) L_{A90}.

Construction noise assessment

Construction noise design goals have been established, in accordance with the ENCM, at 35 – 50 dB(A) L_{A10} at the nearest potentially affected receptors for the gas supply pipeline, compressor station and power station works.

The predictive construction modelling identified potential non-compliance with ENCM noise design goals, at nearest potential receptors, as detailed below:

- gas supply pipeline potential exceedance 2 – 6.5 dB(A) $L_{A10,\ 15\ mins}$
- power station construction potential exceedance 2 – 13 dB(A) $L_{A10,\ 15\ mins}$
- compressor station works have been predicted to be compliant at the nearest potentially affected receptors.

Road traffic noise impacts have been assessed to Environmental Criteria for Road Traffic Noise (NSW EPA ECRTN, 1999). Recommended 'base' goals for land use developments with the potential to create additional traffic on collector and arterial roads are: daytime $L_{Aeq,\ 1hr}$ levels of 60 dB(A), and night-time $L_{Aeq,\ 1hr}$ levels of 55 dB(A). Quantitative assessment for road traffic movements indicated compliance with base goals.

Operational noise assessment

Power station operational noise design goals have been determined through the application of the NSW INP guidance. The noise impact of the project at any residential receptor in the local area shall be subject to a noise design goal of 35 dB(A), applicable for the daytime, evening and night-time periods.

Predictive noise impact assessment of the open-cycle gas-fired power station operation for identified key noise generating sources was determined through the application of SoundPLAN noise propagation modelling software (Version 6.4). Propagation of noise emissions was treated through point and area source consideration with sound emission data provided by ERM Power for the preferred technical supplier — Siemens. The exhaust stacks have been determined as the dominant noise source, a 90° angle of noise propagation has been assumed for the stack tip.

Worst-case assumptions have been made for all four turbines and associated plant in cumulative operation. Noise model runs were performed accounting for neutral and noise enhancing prevailing wind and temperature inversion meteorological conditions.

Operational noise impacts have been determined for the identified nearest potentially affected receptors during neutral and noise enhancing meteorological conditions to be:

- Mount Nanima: 1.5 – 3.5 dB (A) $L_{Aeq,\ 15\ min}$
- Nanima House: 8 – 9.5 dB(A) $L_{Aeq,\ 15\ min}$
- Keston Rose Garden Café: 2 dB(A) $L_{Aeq,\ 15\ min}$
- noise levels received at the Cadonia subdivision are predicted to be compliant for all meteorological conditions modelled
- noise levels received at Wellington township are predicted be less than 25 dB(A).

A noise impact assessment was undertaken for the associated Alectown compressor station applying typical noise source emission data provided by ERM Power. The detailed design of the compressor station had not been confirmed at the time of assessment, as such, reasonable assumptions in compressor station noise source profiles were applied. Assessment of potential noise impacts for the nearest potentially affected receptors determined potential worst case operational noise impacts of 31 – 34.5 dB(A) $L_{Aeq,\ 15mins}$.

Outcomes

A range of noise management and mitigation measures designed to reduce construction and operational noise impacts, in line with the adopted noise design goals, have been recommended as part of this report.

The design of the project will include best available technology economically achievable principles, the proposed power station plant is considered a world's best design standard for Siemens.

Three noise management zones have been recommended:

- Zone 1: compliance zone — 35 dB(A) $L_{Aeq, 15 mins}$
- Zone 2: noise management zone — >35 – 40 dB(A) $L_{Aeq, 15 mins}$ for the amelioration of internal noise environments
- Zone 3: acquisition zone — >40 dB(A) $L_{Aeq, 15 mins}$ for the negotiation of property procurement.

For the operational noise impact of the power station, PB considers that negotiation for property procurement, or similar, as per Section 8 of the NSW INP, would be the most effective noise amelioration measure for Nanima House. Adopted operational noise design goals of 39 dB(A) for Mount Nanima and 37 dB(A) for Keston Rose Garden Café (where a low frequency modifying correction factor is present), and 35 dB(A) at all other times may also be applied. This assumes that further implementation controls are neither economically reasonable nor technically feasible.

1. Introduction

This report has been prepared by Parsons Brinckerhoff (PB) on behalf of ERM Power to assess the potential noise and vibration impacts of the proposed construction and operation an open-cycle gas-fired power station (the power station) and associated gas supply pipeline (the project) at Wellington. The study has been prepared as part of the Environmental Assessment for the project being prepared by PB.

1.1 Background

This assessment has been completed in accordance with the guidelines presented in the *Industrial Noise Policy* (NSW EPA INP 2000), the *Environmental Noise Control Manual* (NSW EPA ENCM 1994), the *Environmental Criteria for Road Traffic Noise* (NSW ECRTN 1999) and other relevant guidelines.

The report presents an assessment of off-site noise issues associated with the proposed construction and operational activities for the project. Predictive noise modelling has been carried out for construction works and power station operation.

1.2 Scope

The scope of work for this study was to prepare a noise and vibration impact assessment for the proposed construction and operation of the project. This required completion of the following tasks:

- assessing the existing ambient noise environment in the study area
- establishing noise design objectives and assessment goals for the study area
- providing a detailed assessment of potential noise impacts associated with the development
- providing an assessment of potential vibration impacts associated with the development
- assessing potential impacts against relevant legislation and guidelines
- providing a concise statement of potential noise and vibration impact
- developing noise and vibration impact mitigation measures.

Supporting documentation has been included in the appendices to this report. Limitations to the scope and use of this assessment are discussed in Section 12.

2. Project description

2.1 Overview

2.1.1 Power station

The proposed power station would consist of four gas-fired turbines in open-cycle formation. Each turbine would have a nominal capacity of 150 MW (depending on the manufacturer's specifications and detailed technical planning), with a total output capacity of approximately 600 MW.

The proposed power station would include other ancillary plant items such as generator-transformers, a demineralised water treatment plant, air-cooled condensers, evaporation pond, plant control system, emergency diesel generator, water tanks, exhaust stacks and silencers, and an office building and workshop.

The proposed power station would operate as a peaking plant and its annual operation would respond to market conditions. It is expected that the proposed power station would have an annual capacity factor of around 4% — this equates to between 350 hours per year (all four gas turbines operating) and 1,400 hours per year (one gas turbine operating) of operation. In practice, two or three gas turbines would likely run simultaneously and, according, the annual hours of operation would be approximately midway between 350 and 1,400 hours.

2.1.2 Gas pipeline

Gas would be supplied via a new 100-kilometre long underground pipeline between the proposed power station site and the Central West Pipeline at Alectown West, connecting to the existing Sydney to Moomba gas pipeline.

2.1.3 Compressor station

A compressor station is required to compress gas for transportation in the proposed 100 kilometre gas lateral pipeline for line packing purposes. A compressor station is proposed to be located at Alectown West at the start of the pipeline network.

2.2 Location

2.2.1 Power station

The proposed power station would be located at Wellington in Central Western NSW. The site is approximately 2 kilometres north north-east of the outskirts of Wellington along Gulgong Road and adjacent to TransGrid's 330/132 kilovolt Wellington substation (see Figures 2-1 and 2-2).

The proposed site is gently undulating grazing land with some scattered paddock trees. The gas-fired turbines are proposed to be developed at a ground height of 331 metres Australian Height Datum (AHD).

2.2.2 Gas pipeline

The pipeline would be located as shown on Figure 2-3.

2.2.3 Compressor station

The compressor station would be situated in Alectown, as shown on Figure 2-4.

2.3 Sensitive receptors

The nearest potentially affected receptors to the power station site are outlined in Table 2-1 and are shown in Figure 2-2.

Residential properties are located in the vicinity of the proposed power station — the nearest is approximately 700 metres from the site. The closest residence in the Cadonia subdivision is located approximately 1.6 kilometres to the north-east (most land parcels are approximately 2.5 kilometres away) and the outskirts of Wellington are approximately 2 kilometres south-west of the site.

Identified sensitive receptors have been considered in the assessment of potential construction noise impacts in Section 6 and potential operational noise impacts in Section 7.

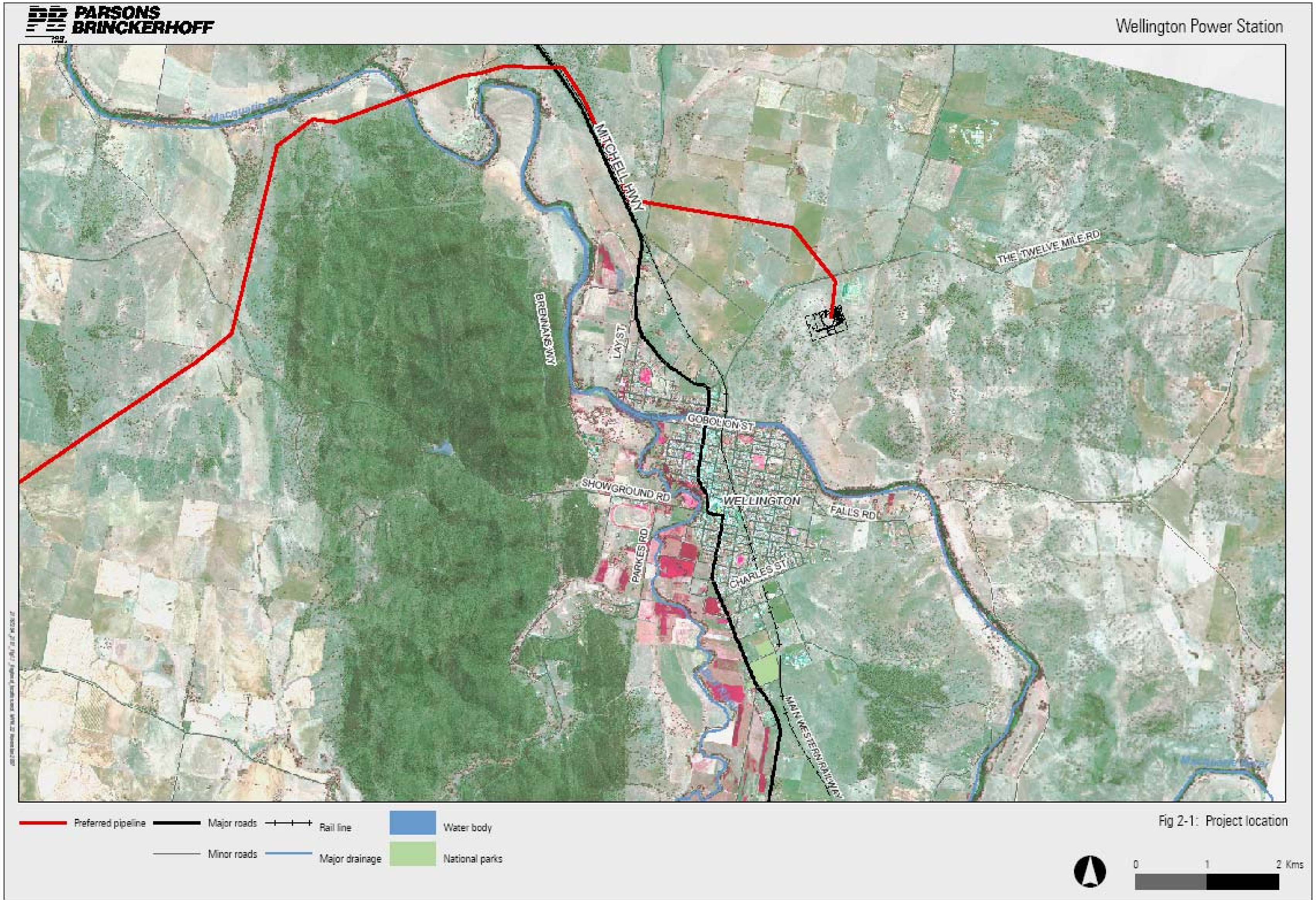


Figure 2-1 Proposed power station location

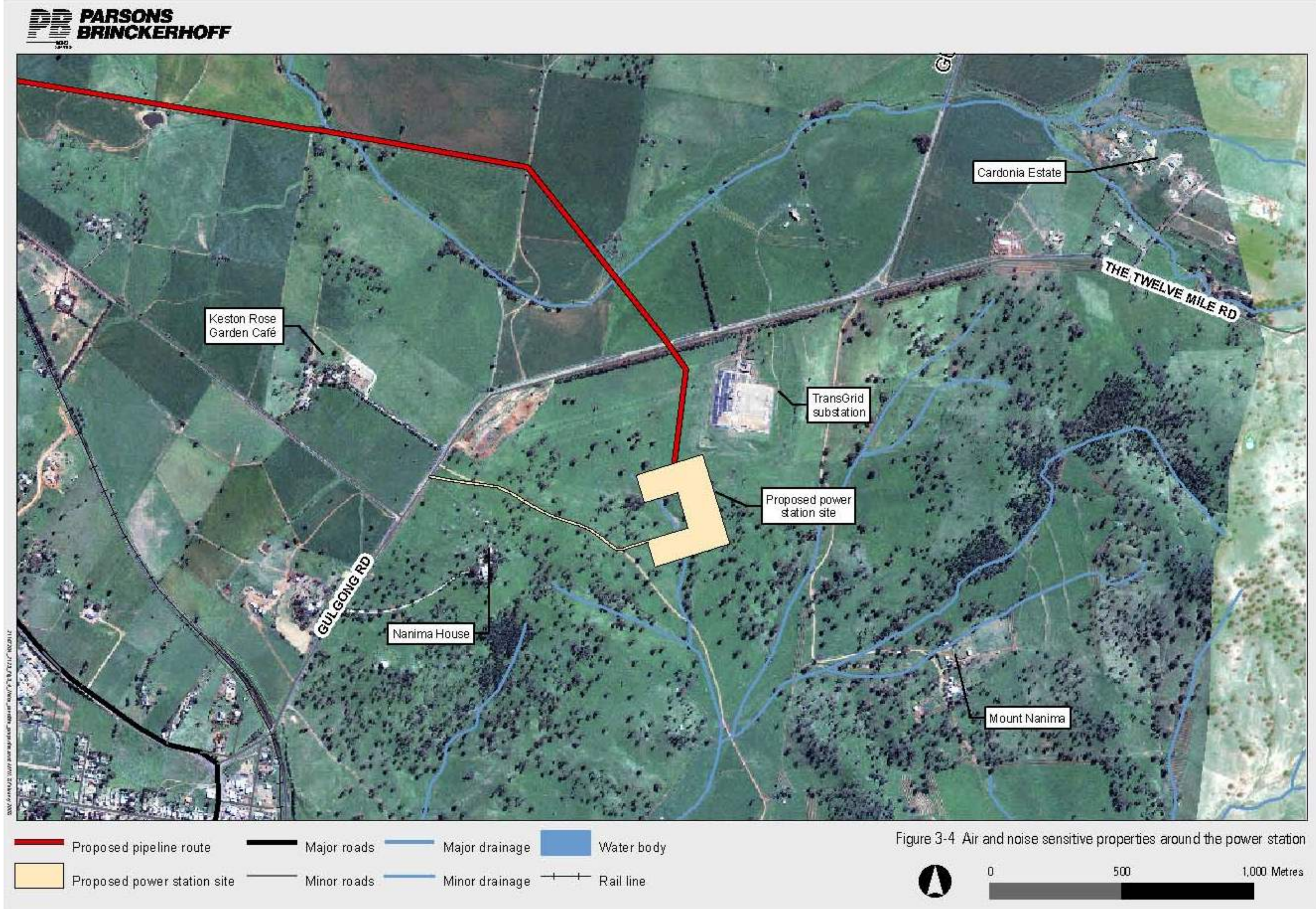


Figure 2-2 Nearest potentially affected receptors at the proposed power station

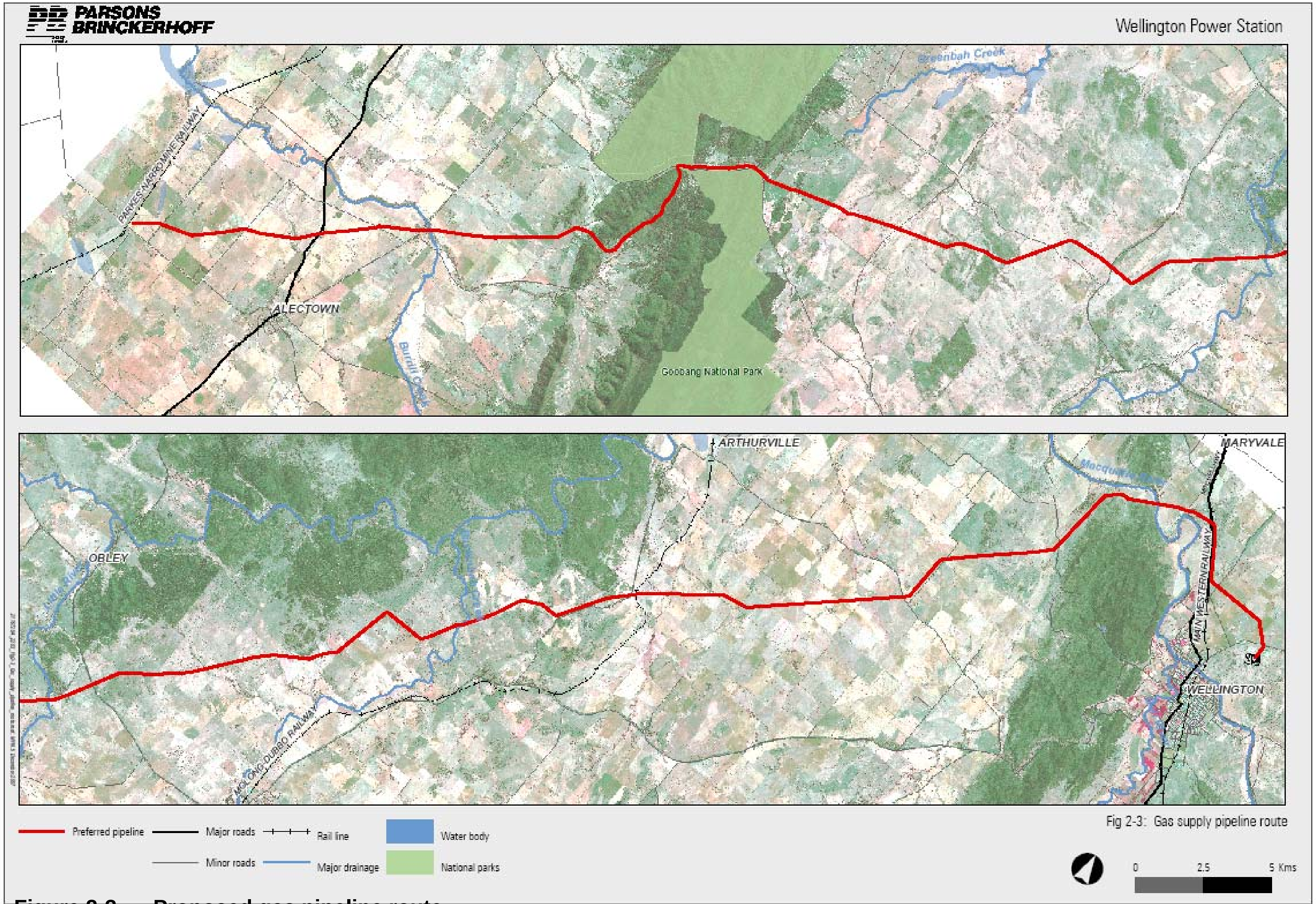


Figure 2-3 Proposed gas pipeline route

Figure 2-4 Nearest potentially affected receptors at the proposed compressor station site

3. Noise monitoring methodology

3.1 Overview

The ambient noise monitoring results have been used to characterise current background noise profiles and establish project-specific noise design objectives.

Noise measurements were carried out using Acoustic Research Laboratories statistical environmental noise loggers, type EL-316 (long-term unattended noise monitoring) a RION NA27 Precision Sound Level Meter (operator attended noise monitoring). The instrument sets comply with AS 1259. The noise logger has a noise floor of approximately 20 dB (A).

Instrument sets were calibrated by a NATA accredited laboratory within two years of the measurement period. Copies of the instrument set calibration certificates have been included in Appendix D.

Microphones were positioned 1.2 metres above ground level and were fitted with windsocks. Each instrument was calibrated before and after the measurement period to ensure the reliability and accuracy of the results. No significant variances were observed.

The instruments were set on A-weighted fast response, and logged noise levels over fifteen minute statistical intervals. Observations of sources influencing the ambient noise environment were made during logger placement and the attended noise monitoring intervals.

3.1.1 Unattended

Unattended noise monitors were established at identified key residential locations. Continuous 15-minute statistical measurements were obtained for a number of descriptors.

Locations were selected to be representative of the existing noise environment, to avoid influence from extraneous noise, and to be secure and accessible.

Background noise levels measured with the environmental noise loggers are influenced by all local noise sources. Background noise profiles should be viewed in conjunction with attended noise measurements and comments.

Unattended noise monitoring was undertaken from Friday 11 May to Sunday 20 May 2007.

3.1.2 Attended

The instrument was set on A-weighted, fast response and logged noise levels over 15-minute statistical intervals. Observations were recorded during the measurement interval for attended noise monitoring.

Attended noise monitoring was carried out during the daytime period on Friday 11 May 2007.

3.2 Noise monitoring locations

3.2.1 Ambient noise monitoring

Noise monitoring sites were chosen at four residential properties within the surrounding environment of the proposed Wellington power station site. Daytime attended and long-term unattended noise monitoring was carried out.

Ground level meteorological conditions were also measured continuously over the monitoring period. Where the wind speed was greater than 5 metres per second (m/s) and/or during periods of precipitation, noise measurements were excluded from the analysis.

The noise monitoring was undertaken at the following residential locations (noise monitoring locations as detailed in Figure 2-2).

Location 1 — Mount Nanima

The property is located approximately 1,300 metres to the south-east of the power station site. Mount Nanima is situated at approximately 338 metres AHD, the intervening topography between the property and the proposed power station site is characterised by regions of raised ground peaking at an approximate ground height of 350 metres AHD.

At this location noise logger 16-302-485 was established.

Location 2 — Cadonia subdivision

The closest house in the Cadonia subdivision is approximately 1,600 metres north-east of the proposed power station site (most land parcels are approximately 2,500 metres away). The subdivision is located at approximately 380 metres AHD, which is 50 metres above the proposed power station footprint. The area consists of a community of residences all potentially affected by the project.

At this location noise logger 16-203-502 was established at a distance approximately 2,500 metres from the proposed power station site.

Location 3 — Keston Rose Garden Cafe

The Keston Rose Garden Cafe consists of a separate residential property and commercial tea house premises located approximately 1,500 metres north-west of the power station site. The Keston Rose Garden Cafe is located at approximate ground height of 348 metres AHD.

The eastern façade of the property has direct line of sight to the proposed power station site.

At this location noise logger 16-306-008 was established.

Location 4 — Nanima House

Nanima House is a single residential property located approximately 700 metres south west of the power station site. The property has an approximate ground height of 368 metres AHD.

The north-eastern façade of the property has direct line of sight to the proposed power station site.

Noise logger 16-004-010 was established at this location.

4. Existing noise environment

4.1 Unattended

For the survey period 11 May 2007 to 20 May 2007, the results of the ambient noise monitoring program are presented in Table 4-1. Daily noise logger graphs are included in Appendix B.

The noise environs followed typical diurnal trends where the background noise level was reduced during the night-time period. At all four monitoring locations the evening period demonstrated an increase in noise level from the daytime averages.

Existing ambient noise environs for all periods of the day, evening and night-time are considered low.

Table 4-1 Unattended noise monitoring results

Date	Day[1] (7 am – 6 pm)		Evening[1] (6 pm – 10 pm)		Night[1] (10 pm – 7 am)	
	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}
1. Mount Nanima						
ABL[2] Range	38.5 – 50.5	23 – 31.5	28 - 34	22 - 26	24.5 – 54.5	22 - 26.5
RBL[3] (median of ABLs)	41	23.5	30.5	22.5	32	22
2. Cadonia subdivision						
ABL[2] Range	45 – 54.5	23.5 - 31.5	39.5 - 55.5	22.5 - 28.5	33 – 63	21.5 - 29
RBL[3] (median of ABLs)	47.5	24.5	42	23.5	36	22
3. Keston Rose Garden Café						
ABL[2] Range	30 - 41.5	27.5 – 31.5	26 – 38.5	25 – 32.5	23 -53	23.5-27.5
RBL[3] (median of ABLs)	34	30	28.5	25.5	29.5	24.5
4. Nanima House						
ABL[2] Range	40 – 44	27.5 – 355	32 – 38.5	24 - 32	30 - 61.5	22.5 - 27
RBL[3] (median of ABLs)	43	29.5	35.5	26.5	36.5	25

Notes:

1 Values expressed as dB(A); dB(A) = decibels, A-weighted; LAeq = equivalent continuous (energy average) A-weighted sound pressure level; L_{A90} = A-weighted sound pressure level exceeded for 90% of the time (background); All values rounded to nearest 0.5 dB(A)

2 ABL = assessment background level

3 RBL = rating background level

The background noise environment at Mount Nanima is characterised by a noise level range of 1.5 dB(A) L_{A90} between the daytime, evening and night-time periods. The existing noise environment has minimal influencing noise sources. As a working farm the local environment is subject to short-term noise influences from machinery and vehicles, which are reflected in the L_{Aeq} period noise levels. The night-time period noise levels are influenced by early morning farm activity.

The Cadonia subdivision noise environment is characterised by daytime, evening and night-time periods that are subject to short-term noise influence from residential activity, local vehicle movements and fauna. Background noise levels fluctuate by 2.5 dB(A) L_{A90} during the diurnal period. Such variation in noise level is considered minimal and infers that the period noise environments are relatively consistent.

The noise environment at the Keston Rose Garden Cafe is influenced by distant road traffic noise, which influences the LAeq and LA90 descriptors. The background noise environment of this location is characterised by variation in noise levels consistent with diurnal trends, as the distant road traffic noise is relatively constant throughout the daytime. A range of 5.5 dB(A) L_{A90} was observed between the daytime, evening and night-time periods.

The Nanima House noise environment is influenced by distant road traffic noise, which is a constant noise source. As a working farm the noise environment is also subject to short-term noise influences from machinery and vehicles. The L_{A90} descriptor demonstrates that the noise environment fluctuates by 4.5 dB(A) during the daytime, evening and night-time periods. This infers that the noise environment is relatively constant.

On the 18 May 2007, at approximately 3 am, an unknown short-term noise event resulted in atypically elevated noise levels in the Wellington area, as detailed by a distinct peak in the noise logger graphs (see Appendix B). This event resulted in an elevated night-time period assessment baseline level for 18 May 2007, but did not adversely influence the period rating background level.

4.2 Attended

Attended daytime and night-time noise monitoring results are presented in Table 4-2. Meteorological conditions during the attended noise monitoring program were observed to be satisfactory for noise monitoring purposes.

Table 4-2 Attended noise monitoring (day)

Location	Time/ date	L_{A1}	L_{A10}	L_{Aeq}	L_{A90}	Comments
1. Mount Nanima	8.12 am 11/05/07	47	36	38	26	fauna sheep and birds 29-32 fauna peak noise 62 branch movement 29 steady state 26-27.
2. Cadonia subdivision	9.05 am 11/05/07	44	36	35	34	local residential activity 29-30 sprinkler system 27 car pass-by 36-38 distant traffic pass-by 28-30 steady state 25-26.
3. Keston Rose Garden Cafe	10.17 am 11/05/07	49	48	42	34	distant traffic 29-33 aircraft pass by 36-48 steady state 34-35.

Location	Time/ date	L_{A1}	L_{A10}	L_{Aeq}	L_{A90}	Comments
4. Nanima House	11.05 am 11/05/07	51	46	43	35	trees rustling 46-48 fauna peak 56 distant road traffic 39-40 steady state 35-36.

Notes: Values expressed as dB(A) and rounded to nearest 0.5 dB(A); L_{Aeq} = equivalent noise level (average); L_{A90} = noise level 90% of time (background); L_{A10} = noise level 10% of the time

The attended monitoring demonstrated that the existing noise environments were influenced by local and distant road traffic, residential activity and fauna. Steady state measurements were made in the presence of minimal extraneous noise sources.

No existing industrial noise influence was measured at any of the measurement locations.

5. Adopted noise design objectives

5.1 Overview

The *Protection of the Environment Operations Act 1997* (POEO Act) regulates noise generation and prohibits the generation of "offensive noise" as defined under the POEO Act.

In addition to the regulatory requirements under the POEO Act, the NSW Department of Environment and Climate Change (DECC) provides guidelines regarding acoustic goals and noise controls.

5.2 Construction noise

Noise goals for construction sites are established in accordance with Chapter 171 of the ENCM (NSW EPA 1994). The acoustic design objectives for construction are presented in Table 5-1. The recommended goals are planning goals only.

The construction noise goals established in this report are planning levels only. Factors such as social impacts (annoyance) and other environmental effects of the project will be considered with regard to the approval process.

The potential noise impacts from construction works will be assessed with respect to additional factors such as the social benefits of the activity, economic constraints, and the nature and duration of a proposed construction program.

DECC recognises that individuals accept higher perceived noise impacts for emission sources with a limited duration and an identified end date.

Table 5-1 Acoustic design objectives for construction activities

Construction period	Acoustic design objective
<4 weeks	Received $L_{A10} \leq L_{A90}$+ 20 dB(A)
4 to 26 weeks	Received $L_{A10} \leq L_{A90}$ + 10 dB(A)
>26 weeks	Received $L_{A10} \leq L_{A90}$ + 5 dB(A)

Note: L_{A90} = A-weighted sound pressure level exceeded for 90% of the time (background).

Construction of the power station, including earthworks/ground clearance and installation and construction of infrastructure is expected to take approximately 18 – 20 months.

Construction of the compressor station is expected to take 3 month. Construction of the pipeline is expected to take 12 – 14 months. Pipeline construction would proceed progressively along the route with approximately 70% of the construction personnel concentrated in a 5 – 7 kilometre section of the pipeline at any time. As such, the duration of construction in the vicinity of any given noise receptor is expected to be short term.

Acoustic objectives have been determined based on an adopted daytime background noise level of 30 dB(A) L_{A90}, determined from the unattended noise monitoring undertaken at the nearest potentially affected receptors (see Section 4).

The following noise design objectives have been established at nearest potentially affected receptors:

- power station construction works:
  - **35** dB(A) L_{A10} determined from L_{A90} of 30 dB(A) + 5 dB(A)
- gas supply pipeline construction works:
  - **50** dB(A) L_{A10} determined from L_{A90} of 30 dB(A) + 20 dB(A)
- compressor station construction works:
  - **50** dB(A) L_{A10} determined from L_{A90} of 30 dB(A) + 20 dB(A).

5.3 Operational noise

5.3.1 General noise criteria

Noise emissions from the operation of the power station and compressor station would require adherence to the INP (NSW EPA 2000).

The policy sets out two goals that are used to assess potential off-site noise impacts. The first criterion aims at controlling intrusive short-term noise impacts for residences (intrusive criterion). The second criterion aims at maintaining the long-term amenity of particular land uses (amenity criterion). The more conservative of the two limits are established as project-specific operational noise goals.

The relevant intrusive criterion can be summarised as follows:

- $L_{Aeq\ (15\ min)} \leq$ rating background level + 5 dB(A).

The rating background level is the overall background noise level representing the daytime, evening and night-time periods over the whole background noise monitoring period.

Section 3.1.2 (page 24) of the INP states 'where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A)' Noise monitoring results demonstrate that during the daytime, evening and night-time periods the rating background level is below this figure. Therefore, all background levels have been assumed as 30 dB(A).

The amenity criterion is determined based on guidelines presented in the INP (EPA 2000). The acceptable amenity limits for a rural area are listed in Table 5-2.

Table 5-2 NSW INP amenity goals – rural environment

Type of receiver	Period of day/day of week	Acceptable noise level (L_{Aeq})
Residential — daytime	7 am – 6 pm, Monday to Saturday 8 am – 6 pm, Sundays and Public Holidays	50 dB(A)
Residential — evening	6 pm – 10 pm	45 dB(A)
Residential — night-time	Remaining periods	40 dB(A)
Commercial premises	When in use	65 dB(A)
Industrial premises	When in use	70 dB(A)

Source: Table 2.1 NSW INP (EPA 2000)

Note: L_{Aeq} = Equivalent noise level (average)

Amenity criterion is established with reference made to the L_{Aeq} noise levels for an area and the existing industrial noise influence. The amenity criterion is then corrected with reference to Table 2-2 of the INP (EPA 2000).

The NSW INP (NSW INP, Table 4-1) provides modifying factor corrections to the criteria where noise source characteristics such as tonality or low frequency are determined.

5.3.2 Adopted operational noise goals

The rating background levels have been determined from the unattended noise monitoring, as there is no existing industrial influence, the intrusive design goals would apply.

The noise impact of the project at any residential receptor in the local area shall, therefore, be subject to an assessment goal of **35 dB(A)**. This shall apply for the daytime, evening and night-time periods. The criterion is considered to be indicative of the worst-case scenario during night-time operation, when the background noise environment is most sensitive.

This is determined by the addition of 5 dB(A) to the lower limiting adopted background noise level of 30 dB(A). This noise design goal assumes that there would be no annoying characteristics to site-related noise emissions.

In proximity to the proposed compressor station and the nearest residential receptor is the Parkes to Narromine Railway Line. It has been considered that train pass-by frequencies are such that the railway line will not have an influence upon daytime, evening or night-time period background noise levels. The worst case night-time INP adopted operational noise design goal of 35 dB(A) $L_{Aeq,\ 15\ mins}$ has been applied for the purpose of assessment.

5.4 Road traffic noise

Road traffic noise impact may be associated with the construction and operation phases of the project. Road traffic noise goals have been considered as part of the construction and operation noise impact assessment. The ECRTN (NSW EPA, 1999) recommends 'base' and 'allowance' goals.

The recommended 'base' goals for land use developments with the potential to create additional traffic on collector and arterial roads are base goals of daytime $L_{Aeq,\ 1hr}$ levels of **60 dB(A)**, and night-time $L_{Aeq,\ 1hr}$ levels of **55 dB(A)**.

The 'allowance' goals are generally established where the 'base' goals are already exceeded. In such circumstances, traffic arising from a development should not lead to an increase in existing noise levels of more than 2 dB. Adopting the allowance criteria is not deemed appropriate for this project based on the short duration of the increased road vehicle movements.

5.5 Sleep disturbance goals

The emission of peak noise levels for an instant or very short time period may cause sleep disturbance to residents. In accordance with the ENCM (NSW EPA 1994), the L_{A1} level of any specific noise source should not exceed the background noise level (L_{A90}) by more than 15 dB(A) when measured outside the bedroom window of the nearest potentially affected receiver.

Adopting a background noise level of 30 dB(A), a sleep disturbance criterion of **45 dB(A)** L_{A1} shall be applied to the nearest potentially affected receptors.

Sleep disturbance is subjective and not all individuals are affected by noise to the same degree, the noise goals for sleep disturbance are designed to protect potentially affected residents from sleep arousal.

5.6 Vibration

Two main issues can be present in relation to vibration levels from construction and operational activities: disturbance to residents from intermittent vibration resulting from activities such as heavy vehicle passage; and potential architectural/structural damage to off-site buildings.

Human comfort and structural damage limits vary across the frequency spectrum, although they are generally a constant level across the frequency range generated by most construction activities. Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

5.6.1 Annoyance/human comfort

The NSW Department of Environment and Conservation (now DECC) *Environmental Noise Management Assessing Vibration*: a technical guideline (2006) provides recommendations for vibration goals from continuous, impulsive and intermittent sources. Construction works associated with the proposal have potential vibration sources including the daytime movement of heavy vehicles, and operation of compactors and bulldozers. This type of vibration is assessed on the basis of vibration dose levels. Acceptable vibration levels are outlined in Table 5-3.

Table 5-3 Acceptable vibration dose levels for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[!]	
	Preferred value	Maximum value
Residences	0.20	0.40

Source: BS 6472-1992

Note: Daytime is the period between 7 am and 10 pm

5.6.2 Structural damage

Although not specified by DECC, German Standard DIN 4150: Part 3-1986 provides guidance on vibration velocity for evaluating potential structural damage. Limits range from 5 millimetres per second (mm/s) (< 10 hertz (Hz)), 5-15 mm/s (10-50 Hz) and 15-20 mm/s (50-100 Hz) at the foundation for a residential dwelling. At the uppermost storey floor plane, a vibration limit of 15 mm/s is applicable for a residential dwelling.

6. Construction noise impact assessment

The proposed Wellington power station project requires the construction and development of new infrastructure. Transient works would be associated with the gas supply pipeline. The construction of the power station would also include a number of discrete noise generating activities. Delivery of materials and plant would also be required. Each anticipated component of the construction phase has been assessed.

Where deemed necessary, PB has assumed standard construction techniques and plant in the modelled scenarios. The construction works are not limited to referenced plant and equipment.

6.1 Construction period

The 100 kilometres of trenching and pipe installation for the proposed gas pipeline is expected to take approximately 12 – 14 months to complete.

Construction of the proposed power station is expected to take approximately 18 – 20 months, including ground clearance and excavation works and the installation of the power station infrastructure.

The proposed compressor station is expected to require 3 months to construct.

Construction activities would be undertaken 6 days per week and would comply with all relevant guidance regarding working hours and noise emissions. Should the project require construction activities to be undertaken outside of standard construction hours, approval would be sought.

6.2 Construction activity

The construction activities associated with construction of the power station, gas pipeline and compressor station are detailed below. It has been assumed that pipeline construction works would be uniform in nature, unless otherwise identified for the crossing of existing infrastructure and where site specific topographical requirements dictate.

6.2.1 Power station construction

Construction of the power station is expected to involve ground clearance, construction of foundations and the installation and erection of power station components.

It is anticipated that all excavated material would be stored and used on-site, no capacity for the external removal of material has been included as part of the construction noise impact assessment.

Through previous experience of power station construction, the following plant, additional to Table 6-1, has been included in the noise impact assessment:

- 1,000 tonne crane
- 100 tonne crane
- concrete vibrator.

The construction period is expected to be approximately 52 weeks in duration; all works are proposed to be undertaken during daytime hours Monday to Friday (7 am – 6 pm) and Saturdays (8 am – 2 pm). No construction works would be undertaken at any time on Sundays or public holidays, or on Saturdays after 2 pm.

6.2.2 Gas pipeline construction

The construction works associated with the installation of the gas supply pipeline are detailed in Table 6-1, based on information provided by ERM Power. Pipeline construction would proceed progressively along the route with approximately 70% of the construction personnel concentrated in a 5 – 7 kilometre section of the pipeline at any time.

Table 6-1 Gas pipeline construction activity

Construction activity	Required plant/equipment
Ground clearance and soil separation	Grader, dozer, backhoe, two tip trucks.
Pipe haul and string	Ten semi-trailers truck per day, mobile crane.
Excavation	Dozer with ripper, excavator, trenching machine, two tip trucks, backhoe, front end loader.
Welding and x-ray joint wrapping	Two 4WDs with trailers, tray truck generator.
Pipe lay	Directional drilling rig and two side booms.
Backfill and topsoil spreading	Grader, dozer, backhoe, two tip trucks.
Seeding and restoration	Tractor and seeder.
Site vehicle operations	6 x 4WDs.
Miscellaneous	Fire fighting equipment on trailers, fuel truck, maintenance truck, site utilities, generators and compressors.

The construction works are unlikely to be limited to the application of the above plant and equipment.

The pipeline has been designed to minimise potential impacts to the local environment, and would be situated no closer than 300 metres from nearest potentially affected receptors. For the purpose of the construction noise impact assessment a noise impact catchment area of 300 – 500 metres from the pipeline construction locations has been established. Predictive calculations of potential noise impacts have been undertaken for this catchment area.

6.2.3 Compressor station construction

Construction of the compressor station is expected to be approximately 3 months duration. Construction works would apply standard techniques and use plant as per the gas supply pipeline, plus crane requirements.

The nearest potentially affected receptors have been identified at 1 – 1.5 kilometres to the north and east of the site, as detailed in Figure 2-4.

6.2.4 Road traffic noise

A road traffic assessment has been undertaken as part of the environmental assessment for the project. The construction works associated with the power station have been identified as the primary potential road traffic influence to the localised noise environments.

A summary of potential road traffic requirements for the power station construction is provided in Table 6-2.

Table 6-2 Road traffic vehicles for power station construction

Vehicle type	Number of vehicles
Light vehicles	75 per day.
Concrete/gravel trucks (approximately 5 cubic metres)	800 over the construction period (9 per day for 3 months).
Semi-trailers (26 tonne)	104 over the construction period (for transport of plant).
B-Double (40 tonne)	8 over the construction period.
Licensed loads (2 x 5 trailer and low-loader)	8 over the construction period.

Note: Volumes indicate one-way traffic.

Road traffic requirements for the gas supply pipeline works are expected to include typical daily movements of up to 10 semi-trailers, 10 tip trucks and, as required, light vehicles operating between work sites.

Vehicle requirements associated with the construction of the compressor station have been assumed to be 10 light vehicles and 2 trucks per day, equating to 20 light vehicle movements and 4 truck movements (allowing for arrival and departure from the site).

6.3 Construction noise source data

The source sound power levels (L_{Aeq}) for the required plant and equipment for pipeline and power station construction works are detailed in Table 6-3. The noise impact potential of four-wheel drive vehicles and tractors has not been considered as a significant noise sources.

Table 6-3 Construction plant noise source sound power levels

Construction activity	Required plant/equipment
Front-end loader	111[1]
Dozer	110[1]
Excavator	114[1]
Grader	109[1]
Tip truck	102[1]
Concrete vibrator	112[1]

Construction activity	Required plant/equipment
Crane 1,000 tonne	108[2]
Crane 100 tonne	100[2]
Generator	92[2]
Compressor	93[2]

Note: All noise levels to nearest dB(A)

1 RTA Noise Management Manual (RTA 2001)

2 Australian Standard AS 2436 – 1981

For the purpose of this assessment, construction noise sources have been assumed to be constant rather than intermittent.

6.4 Construction noise assessment

Construction noise impact assessment has been undertaken for the worst case 15-minute period assuming all required plant in operation with representative percentage on-times.

Given the nature of the local environment and distances between noise source and receiver, it has been determined that predictive noise impact assessment can be undertaken through the application of the following noise propagation relationship:

- SPL received = SWL source – 20 log (source to receiver distance) – 8.

Where SPL received is the received sound pressure level, SWL source is the source sound power level and 8 dB is a constant, applied for the loss of acoustic energy resultant from hemi-spherical radiation of noise from a point source.

This approach is considered conservative, as there is potential for a greater than 8 dB(A) reduction in received noise level resulting from the influence of intervening topography and ground conditions.

The following assumptions have been made in determining the potential noise impacts from the construction activities:

- point source hemispherical propagation of noise
- intervening topography between noise source and receiver assumed to be uniform
- minimum separation distance between construction sites and nearest potentially affected receptors
- nearest receptors to the compressor station have been identified at Manre Road and a property to the north, Property A, as detailed in Figure 2-4.

The worst-case modelling is indicative of noise levels received during the most intensive period of construction works.

The predicted construction noise impacts are detailed in Table 6-4. Comparison with construction impact design goals has been undertaken.

Table 6-4 Gas pipeline, power station and compressor station construction noise impacts

Construction	Distance from works (metres)	Construction L_{A10} noise impact dB(A)		
		Predicted	Criterion	Compliance
Power station	Mount Nanima	42.5	35	No (+ 7.5)
	Cadonia subdivision	37	35	No (+ 2)
	Keston Rose Garden Cafe	41.5	35	No (+ 6.5)
	Nanima House	48	35	No (+ 13)
Gas supply pipeline	300	56.5	50	No (+ 6.5)
	350	55.5	50	No (+ 5.5)
	400	54	50	No (+ 4)
	500	52	50	No (+ 2)
Compressor station	Mountain View, Alectown	47.5	50	Yes
	Property A	42	50	Yes

Note: noise levels to nearest 0.5 dB(A)

Power station

The predicted noise impacts for the construction of the power station have been assessed for the nearest residential properties to the proposal site, as indicated on Figure 2-2.

The predictive noise modelling for construction noise impacts has not considered potential reductions in received noise level resulting from intervening elevated ground and topographical features.

The construction noise impact assessment predicted a potential non-compliance with the adopted construction noise goal of 35 dB(A) L_{A10} of 2 – 13 dB(A) L_{A10} at the nearest potentially affected receptors.

Assessment of the required key activities determines that the ground clearance and excavation works are the dominant influence to received predicted noise impacts. The ground clearance and excavation works are predicted to have a received noise impact range of 39.5 – 50.5 dB(A) L_{A10}. Following the completion of these works, the installation of the power station would occur. The predicted received noise impact of the installation works is 30.5 – 41.5 dB(A) L_{A10}.

The predicted received noise impacts detailed in Table 6-4 are not expected to occur throughout the full works program. Once ground clearance and excavation works have been completed, a reduction in received noise impact is expected in line with predicted installation noise impacts.

Gas supply pipeline

The nature of the pipeline construction excavation works are such that noise impacts at individual properties are expected to occur for approximately 1 to 2 weeks.

It is understood that works are proposed to be undertaken at approximate minimum separation distances of 300 metres to the nearest potentially affected receptors. Worst-case noise impacts for pipeline construction works at this distance are predicted to be in exceedance of the ENCM noise goal of 50 dB(A) L_{A10} by up to 7 dB(A).

The pipeline installation is likely to require periodic use of excavation equipment, identified as the dominant source of construction noise. The influence of these events are predicted to result in increased short-term received noise levels of up to 5 dB(A) L_{A10}, which is reflective of the intensity of the potential noise impact.

Compressor Station

The predicted noise impacts at the nearest potentially affected receptors for the compressor station construction works are compliant with the adopted noise goal of 50 dB(A) L_{A10}. Separation distances between the proposed compressor station site and nearest receptors are sufficient to attenuate construction plant noise.

Outcome

Exceedance of the noise design goals has been predicted for the nearest potentially affected receptors to the pipeline and power station construction locations. The construction noise design goals are goals rather than limits. Where exceedances occur, best management practice should be implemented. Section 10 details a range of noise mitigation and management measures to reduce received noise levels associated with the pipeline, power station and compressor station construction activities.

6.5 Road traffic noise impact assessment

Road vehicle requirements for the power station, gas supply pipeline and compressor station construction works are detailed in Section 6.2.4.

Due to the low number of traffic movements compared with existing vehicle numbers on the local traffic network, road traffic noise has been assessed based on qualitative factors informed by road traffic studies.

In order to determine potential road traffic noise impacts, Calculation of Road Traffic Noise (CORTN, HMSO 1988) guidance has been applied. CORTN provides the following method for determining basic hourly road traffic noise levels, for planning purposes:

- basic noise level hourly $L_{A10} = 42.2 + 10\log q$ (where q = hourly flow rate).

A correction factor addition is provided for the inclusion of heavy vehicles, such as trucks, in to the calculation procedure, this is determined by the following formula:

- correction = $33\log (V + 40 + 500/V) + 10\log (1 + 5p/V) – 68.8$ (where V = velocity in km/h and p = percentage of heavy vehicles).

Power station construction

Hourly L_{A10} levels from light vehicle and truck movements have been determined based upon an assumed speed of 75 kilometres per hour and a total vehicle flow of 14 light vehicle movements and 24 truck movements.

The basic noise level has been predicted to be 61 dB(A) $L_{A10,\ 1\ hour}$. At a distance of 20 metres between a given façade and the middle of the near side road carriageway, applying a CORTN distance correction, the basic noise level would be approximately 59 dB(A) $L_{A10,\ 1\ hour}$. This corresponds to an approximate received level of 56 dB(A) $L_{Aeq,\ 1\ hour}$.

Hourly noise levels from vehicle movements are predicted to be less than the ECRTN noise goal of 60 dB(A) $L_{Aeq,\ 1hr}$, despite the ECRTN goals applying to long-term operational noise rather than short-term construction noise.

Vehicle movements associated with the project are not considered significant when compared to existing traffic flows on the nearby highways (Mitchell, MR233 and Newell). Truck movements would be via existing major transport routes.

Given the separation distances between the noise receptors and the local roads, combined with the low number of vehicle movements, received noise levels are expected to comply with the 'base' criterion.

Truck manoeuvring at construction sites and the loading and unloading of spoil and equipment were considered as part of the construction noise impact assessment.

Gas supply pipeline construction

Road traffic volumes associated with the construction of the gas supply pipeline would comprise 10 semi-trailers, 10 tip trucks, and as required, light vehicles — corresponding to approximately 1 – 2 truck movements per hour and infrequent light vehicle movements.

Given the frequency of vehicle movements and minimum separation distances between the work site and the nearest potentially affected receptors, road traffic noise impact from the pipeline works have been determined to achieve ECRTN base goals of 60 dB(A) $L_{Aeq,\ 1\ hour}$.

Compressor station construction

Road traffic movements required for the construction of the compressor station are predicted to be less than 1 truck per hour and approximately 2 light vehicle movements per hour.

It has been determined that road traffic movements of this frequency would not influence existing hourly noise environments and are expected to achieve ECRTN base noise goals.

6.6 Construction vibration assessment

The main source of construction vibration would be the excavation works required for power station and gas supply pipeline construction. Received vibration levels are influenced by the specific construction equipment used, geological conditions and generated vibration frequency spectrum. Where pipeline excavation works are undertaken at a distance of 300 metres or greater from the nearest potentially affected receptors it is considered that source vibration levels would not result in received vibration levels in exceedance of the annoyance and structural limits defined in Section 5.

It considered that separation distances between the power station site and nearest potentially affected receptors are sufficient to limit the potential for any perceived vibration impacts.

6.7 Summary of construction noise impact

The predictive analysis of potential worst-case noise impacts for the gas supply pipeline and the power station construction works have determined the following range of noise impacts at the nearest potentially affected receptors.

Predicted pipeline construction impacts were assumed based on a minimum separation distance of 300 metres between receptors and construction activities.

Power station

- Mount Nanima potential non-compliance up to 7.5 dB(A) $L_{A10,\ 15\ min}$

- Cadonia subdivision potential non-compliance up to 2 dB(A) $L_{A10,\ 15\ min}$
- Keston Rose Garden Cafe potential non-compliance up to 6.5 dB(A) $L_{A10,\ 15\ min}$
- Nanima House potential non-compliance up to 13 dB(A) $L_{A10,\ 15\ min.}$

Gas supply pipeline

- Range of potential non-compliance 2 – 6.5 dB(A) $L_{A10,\ 15\ min}$.

Compressor station

- Compliance predicted to be achieved at nearest receptors.

Road traffic

Predicted road traffic noise impacts associated with the construction works indicate that the hourly light vehicle and truck movements for the gas supply pipeline, power station and compressor station construction works would not result in exceedance of the ECRTN base noise goals of 60 dB(A) $L_{Aeq,\ 1\ hour}$ at the nearest potentially affected receptors.

7. Operational noise impact assessment (power station)

7.1 Operational noise model

An operational noise propagation model was established for the assessment of potential noise impacts from the operation of the power station at the nearest potentially affected receptors. Noise modelling was undertaken through the use of SoundPLAN noise propagation modelling software (Version 6.4). The modelling was based on the following:

- digital land topography 2 metre contours for the immediate study area and 10 metre contours for a 20 square kilometre calculation area
- ground coverage has been assumed to be non-reflective
- the power station located as shown in Figure 2-2 (note that while ancillary infrastructure on the site may change following design development, the gas turbines and associated stacks, which are the dominant noise source, will not)
- residual level ground height set at 331 metres AHD for source heights
- exhaust stack height at 35 metres (375 metres AHD)
- receptors have been established relative to the topography with receiver heights 1.2 metres above the ground
- point and area source calculations have been assumed for plant
- 1/1 octave sound power levels for the power station plant as detailed in Section 7.3
- worst case assumptions of all four turbines and associated plant in cumulative operation
- hours of operation for the power station have been assumed as 24 hours a day, 7 days a week
- model runs were performed accounting for neutral and noise enhancing meteorological conditions
- CONCAWE industrial standard model parameters were applied.

7.2 Noise source data

Operational 1/1 octave noise source data for the plant at the power station have been based on the Siemens plant (provided by ERM Power) as used for the recent Uranquinty Gas-Fired Power Station project; the Wellington Power Station is assumed to be of identical design. Adopted noise source emission data is included in Table 7-1.

Table 7-1 Key operational noise source sound power levels (per turbine)

Source	Sound power level dB(A)
Exhaust stack with absorption silencer.	98
Exhaust stack area source.	98
Fin fan coolers — low noise design.	96

Source	Sound power level dB(A)
Diffuser with acoustic enclosure.	94
Transformers — low noise design.	93
Inlet air filter house with absorptive silencer area source.	90
Gas turbine building area source.	85
Gas turbine ventilation.	85
Unidentified sources.	90

The propagation of noise from sources has been considered as both point and area sources. Noise propagating from the exhaust stack tip was subject to directivity consideration. Directivity is a measure of the radiation pattern from a source, indicating how much of the total energy is radiating in a particular direction.

A 90 degree angle of propagation was assumed for the exhaust stack tip with a resultant sound power level of 96 dB(A).

7.3 Operational noise impacts

Predicted received noise impacts at the nearest potentially affected receptors to the power station site for the worst case scenario (four turbines cumulative operation) are detailed in Table 7-2. Received noise impacts were predicted for neutral and noise enhancing meteorological conditions: wind speeds greater than 3 m/s or temperature inversion conditions.

In Section 4 of the INP, where a noise source has particular characteristics such as low frequency, tonality, impulsive or intermittent noise it is suggested that it can cause greater disturbance.

Noise emissions from the site are expected to contain a low frequency component. Based on this, a correction of **+5 dB(A)** has been added to all predictions.

Table 7-2 Operational noise impacts

Location	Received noise level (dB(A), $L_{Aeq, 15min}$)		
	Neutral conditions	Adverse conditions	35 dB(A) compliance
1. Mount Nanima	36	38.5	No
2. Cadonia subdivision	26.5	29.5	Yes
3. Keston Rose Garden Cafe	34.5	37	No (adverse conditions)
4. Nanima House	43	44.5	No

Note: Noise levels shown to the nearest 0.5 dB(A)

7.3.1 Mount Nanima

For neutral metrological conditions operational noise levels received at Mount Nanima are predicted to exceed the 35 dB(A) noise design criterion by 1 dB(A). Where meteorological conditions provide noise enhancing conditions the extent of the exceedance is predicted to be 3.5 dB(A).

7.3.2 Cadonia subdivision

Operational noise levels received at the Cadonia subdivision are predicted to be compliant with the noise design criterion during neutral and noise enhancing meteorological conditions.

7.3.3 Keston Rose Garden Cafe

The predicted received noise impact of 34.5 dB(A) at the Keston Rose Garden Cafe during neutral meteorological conditions is compliant with the 35 dB(A) noise design criterion. Noise enhancing meteorological conditions are predicted to result in an increase in received noise impact to 37 dB(A), which is a 2 dB(A) exceedance of the criterion.

7.3.4 Nanima House

Nanima House is predicted to receive the greatest operational noise levels of all receivers. Under neutral meteorological conditions, received operational noise levels are predicted to be 43 dB(A), an exceedance of the noise design criterion of 8 dB(A). For noise enhancing meteorological conditions, noise levels of 44.5 dB(A) are predicted, which is an exceedance of 9.5 dB(A).

The noise impact isopleth for the power station and surrounding environment (neutral conditions with +5 dB low frequency modifying correction factor) is detailed in Figure 7-1.

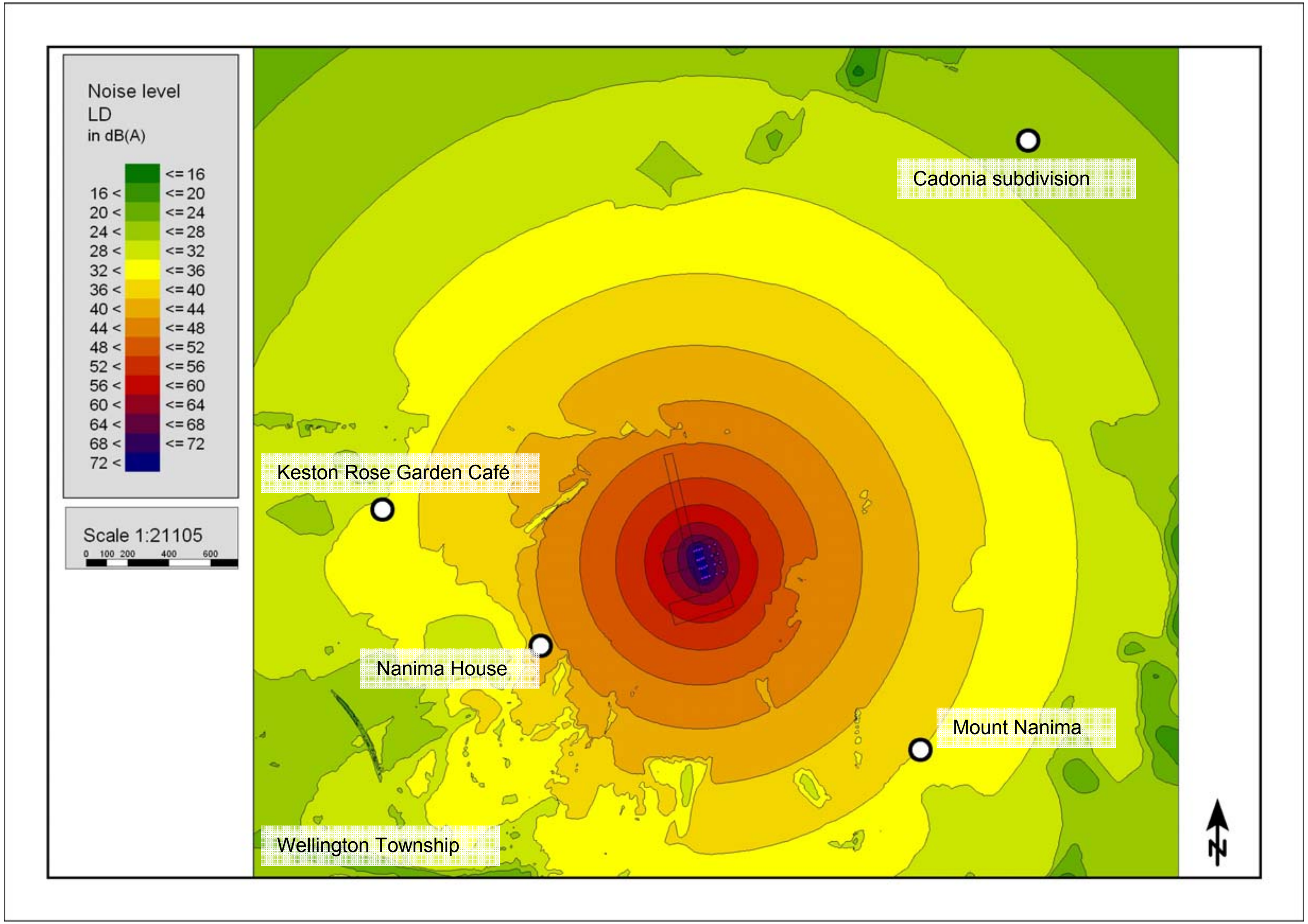


Figure 7-1 Noise impact isopleth (neutral conditions with +5 dB low frequency modifying correction factor) for power station and surrounding environment

7.4 Operational road traffic noise assessment

Road traffic volumes associated with the operation of the power station are estimated to comprise approximately six light vehicles and, as required, trucks for deliveries. During the peak morning and evening hourly periods this would equate to less than 10 light vehicle movements per hour and infrequent truck movements.

Given the frequency of vehicle movements and the minimum separation distances between the power station site and the nearest potentially affected receptors, road traffic noise impact from power station operations is expected to achieve ECRTN base goals of 60 dB(A) $L_{Aeq,\ 1\ hour}$.

7.5 Sleep disturbance assessment

Where power station and associated infrastructure plant would become operational during the night, the change in ambient noise level could be sufficient to disrupt sleep and wake occupants.

A sleep disturbance noise goal of 45 dB(A) L_{A1} was determined for the nearest potentially affected properties based on night-time baseline noise levels, in accordance with DECC's sleep disturbance criteria.

A literature review of sleep disturbance issues presented within the NSW Environment Protection Authority's (1999) ECRTN indicates that, in some circumstances, higher noise levels can be present without significant sleep disturbance. Guidance provided within the ECRTN indicates that short-term external noise levels of between 60 and 65 dB(A) are not expected to cause awakening reactions. However, this value does not address issues relating to getting back to sleep or changes in sleep state.

The level of sleep disturbance impact would be dependent on the level of L_{A1} noise emissions from the plant. Referencing available L_{Aeq} data, it is considered reasonable to assume that there is potential for short-term L_{A1} impacts above the recommended noise design goal. However, exceedance of the noise goal is not a definitive indicator to the disturbance of sleep, as this is a subjective issue.

The only location likely to experience an exceedance of the 45 dB(A) L_{A1} sleep arousal criterion is Nanima House, and only under adverse meteorological conditions. At all other locations there would be a small risk of non-compliance only.

7.6 Vibration impacts

The operation of the power station is not expected to result in sources of vibration of sufficient magnitude for received propagated vibration levels at the nearest potentially affected receptors to be in exceedance of annoyance or structural limits.

Vibration is not expected to occur external to the immediate locality of operational plant, as such, no further vibration assessment has been considered.

7.7 Summary of operational noise impact

The noise impact assessment of the proposed power station operation has identified potential exceedances of the worst case adopted NSW INP noise design goal of 35 dB(A), dependent upon noise enhancing meteorological conditions.

- Predicted noise design goal exceedances are summarised below:
- Mount Nanima predicted exceedance: 1.5 – 3.5 dB(A)
- Keston Rose Garden Cafe predicted exceedance: 2 dB(A) (under adverse meteorological conditions only)
- Nanima House predicted exceedance: 8 – 9.5 dB(A).

Noise levels received at the Cadonia subdivision are predicted to be compliant under neutral and adverse meteorological conditions.

Potential received noise levels for the Wellington township are predicted to be less than 25 dB(A) L_{Aeq}.

8. Operational impact assessment (compressor station)

The project requires the operation of a compressor station at Alectown. Residential receptors have been identified in the locality of the proposed compressor station, at Manre Road, Alectown and an identified receptor to the north of the proposed site as detailed in Figure 2-4.

Detailed design of the compressor station had not been finalised at the time of this assessment, where considered necessary, assumed compressor station noise source profiles have been applied and are identified in the report.

An operational noise propagation model was established for the assessment of potential noise impacts from the compressor station operation at the nearest potentially affected receptors. The modelling was based on the following:

- uniform ground height attributed to sources and receptors
- 1/1 octave sound power levels for the compressor station plant as detailed in Section 8.1
- a worst-case scenario is assumed, where all compressor station plant is in parallel operation
- operational conditions have been determined as 24 hours, on an ‘as required’ basis
- neutral meteorological conditions were modelled only (at this stage)
- only point source noise propagation was considered, no area sources were considered
- noise propagation has been considered inclusive of distance and intervening ground conditions between noise source and receivers.

8.1 Compressor station noise sources

Operational 1/1 octave sound power level data for the primary noise sources at the compressor station has been provided by ERM Power, as detailed in Table 8-1.

Table 8-1 Wellington compressor station source noise data

Noise source	Sound power level dB(A)	Number of sources
Compressor station housing	85	1
Driver exhaust (silenced)	96	1
Radiator fans	96	1
Process piping	100	1
Control valve	99	1

Note: Noise levels shown to the nearest dB(A)

The compressor station housing noise source emission data has been recommended based upon previous compressor station noise impact assessment experience. The compressor station housing emission data and operational plant sound power levels will need to be confirmed at the detailed design stage.

8.2 Compressor station noise impacts

Predicted received noise impacts at the nearest potentially affected receptors to the proposed compressor station site for the worst-case scenario night-time operations are detailed in Table 8-2. The worst case night-time NSW INP adopted operational noise design goal of 35 dB(A) $L_{Aeq,\ 15mins}$ has been applied for the purpose of this assessment.

It is assumed that there are no annoying characteristics associated with noise source emissions; no modifying correction factors have been included.

Table 8-2 Operational noise impacts

Location	Received noise level (dB(A), $L_{Aeq,\ 15min}$)	
	Noise impact	**35 dB(A) compliance**
Mountain View, Alectown	34.5	Yes
Property A	31	Yes

Note: Noise levels shown to the nearest 0.5 dB(A)

8.3 Statement of compressor station compliance

Predicted operational noise levels associated with the compressor station demonstrate compliance with the NSW INP adopted noise design goal of 35 dB(A) $L_{Aeq,\ 15\ mins}$ for the identified nearest potentially affected receptors.

Further assessment of noise source emissions is recommended to determine potential annoyance characteristics, source configuration, operating conditions and anticipated noise emission levels.

8.4 Operational road traffic noise assessment

Road traffic volumes associated with the operation of the compressor station have been determined to be infrequent, as the compressor station is likely to be remotely operated. It is considered that the frequency of vehicle movements and minimum separation distances between the access roads and compressor site and the nearest potentially affected receptors, are such that road traffic noise impact from the compressor station operation would be expected to achieve ECRTN base goals of 60 dB(A) $L_{Aeq,\ 1\ hour}$.

9. Meteorological data

The NSW INP has been referenced in relation to assessing meteorological conditions with regard to potential noise impacts. It should be noted that the data sets referenced, based on location of referenced sites and length and extent of conditions compiled, provide an indication of noise enhancing conditions only.

9.1 Gradient wind flows

The INP states:

> 'Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source-to-receiver wind speeds (at a 10m height) of 3m/s or below occur for 30 percent of the time or more in any assessment period (day, evening, night) in any season.'

An analysis of regional wind enhancing noise conditions was undertaken as part of this assessment. This included an assessment of all hours of recorded wind flow patterns. The detailed assessment of noise enhancing meteorological conditions was based on wind speed data obtained from the Bureau of Meteorology (BOM) Dubbo (I.D. 065070) station for 2004-2005. The data were separated into the four seasons and then into the daytime, evening and night-time assessment periods. Further to this, the data were separated into flow vectors relevant to each of the nearest potentially affected receivers considered.

A review of the above data indicates no gradient or drainage wind flow regime present for more than 30% of the time (upon consideration of both directional and prevailing vector wind patterns) throughout the year during the night-time period.

Winds were not a feature for the area based on the 2004-2005 Dubbo data set. Detailed assessment of meteorological wind conditions is provided in Appendix B.

9.2 Temperature inversions

In order to determine the presence of temperature gradients, an analysis of cloud cover and wind speed was carried out with reference to the Pasquill scheme (Appendix E of the INP). The winter evening and night-time (6 pm to 7 am) period was specifically assessed.

Three-hourly cloud cover data was assessed for Wellington (2004-2005). Standard deviation wind profile data was not available from the BOM nor was net radiation data.

Temperature inversions are a feature when they occur for at least 30% (approximately 2 nights per week) of the total evening and night-time in winter, with inversions considered to be present during F-class (moderate inversion) or G-class (strong inversion) stability conditions. Wind speeds of less than 2 m/s are generally associated with G-class (strong inversion) irrespective of cloud cover, with wind speeds of 2 - 3 m/s associated with F-class (moderate inversion) conditions when cloud cover is less than or equal to 3/8 octaves.

The assessment procedure requires cloud coverage data at night for the winter period. The meteorological data available from the BOM Wellington site (I.D. 065034/65) for this period was reviewed with the three-hourly cloud cover data for 2004-2005 indicating that less than 3/8 octaves cloud cover was present for approximately 50% of the time, with average cloud cover data generally between 3/8 and 4/8 octaves during the night-time winter period. This indicates a reasonable potential of occurrence for the moderate F-class stability categories (wind speeds up to 3 m/s).

Considering wind speed conditions during the night-time winter period only, an occurrence of less than 16% was present in 2004 - 2005 (Dubbo) based on wind speed conditions of 3 m/s and less (F-class (moderate inversion) stability conditions). When a wind speed of 2 m/s and less (G-class (strong inversion) stability conditions) is considered, an occurrence of less than 49% in 2004 and 32% in 2005 (Dubbo) was present.

Analysis of the synthetically compiled meteorological file (CSIRO TAPM program) indicated that inversion conditions may be present for up to 29% of the time, with wind speeds of 3 m/s and less (G-class (strong inversion) stability conditions). When wind speeds of 2 m/s and less (F-class (moderate inversion) stability conditions) are considered, the frequency of less than 8% was present.

The data, and screening analysis approach adopted, indicates that temperature gradients F- and G- class stability categories (occurring separately or in combination) may potentially be a feature of the area.

10. Recommended noise management and mitigation measures

This section details recommended measures for consideration in mitigating or reducing received noise impacts to achieve compliance with the intent and guiding principles of the NSW INP.

All measures have been made considering the principles of ‘best management practice’ and ‘best available technology economically achievable’, and should be subject to costing and feasibility works by ERM Power.

10.1 Management of construction noise

Construction noise levels are predicted to exceed the adopted ENCM goals. The noise impact potential reported for the proposed construction works is consistent with short-term construction activities undertaken in proximity to existing residential receptors.

Reductions in received noise levels would occur where the noise emission characteristics are intermittent in nature.

It is expected that a range of economically reasonable and technically feasible noise mitigation measures would be considered by the construction contractor to manage the noise impact of the construction works.

A series of pre-construction and construction phase measures and management practices designed to mitigate and reduce noise impacts are detailed in Section 10.1.1.

The construction noise impact assessment for the proposed pipeline installation has identified a potential exceedance of construction noise goals at that nearest affected properties of up to 5 dB(A) for pipeline construction works and up to 9 dB(A) for power station construction. As detailed in Section 8, this is a worst-case prediction assuming all plant operating simultaneously. Events of this nature are only likely to occur during short duration, specific construction activities, such as excavation and ground clearance.

In order to provide noise mitigation to reduce received noise levels by up to 9 dB(A) and achieve ENCM compliance, noise mitigation measures and construction works management would be required. Such measures may include restricting plant operation to short-term use, changing pipeline construction techniques and considering enclosures around works sites.

Compliance with the adopted noise design goals is the primary objective for noise management. Where it is identified that the required noise goals would not be met, all reasonable and feasible measures would be undertaken to reduce the noise emissions.

It is recommended that construction plant and equipment noise source data is confirmed as part of detailed construction noise management planning for the project.

10.1.1 Construction noise impact management

During the planning and scheduling of construction works the predicted noise impacts should be considered in establishing work site locations, construction techniques and on-site practises. The following principles and proactive noise management measures will be implemented prior to the commencement of construction works:

- Construction noise management measures will be formulated as part of the development of the project construction environmental management plan (CEMP) to provide a framework for addressing noise impacts associated with construction works. Noise control options including site mitigation and the investigation of low noise plant will be detailed in the CEMP and direction provided for the delivery of best practice noise management on site.
- Construction works will adopt best management practice and best available technology economically achievable practices as encouraged by the DECC and as addressed in current acoustic guidelines. Best management practice includes some of the factors discussed within this report, but also includes encouraging a general staff attitude to reducing noise emissions. Contractors would be made aware of the problems associated with noise. Best available technology economically achievable practices involve incorporating the most advanced and affordable technology to minimise noise emissions. All plant will be selected after considering noise emissions.
- The pipeline excavation construction sites will be enclosed by temporary screening; the screening will comprise solid facades enclosing the work site.
- Due to the elevation of nearest receptors to the proposed power station site, screening and fencing is likely to have a negligible impact upon received construction noise levels.
- Information would be provided to potentially affected local residents prior to commencement of noisy activities. Construction methods, duration and timing of events would be outlined. Often with short-term construction works, the provision of information to potentially affected residents reduces the propensity for enquiry and complaint.
- Temporary and permanent construction sites will display appropriate signage, including project information and relevant contact details for public information and enquiry.
- The measures detailed below incorporate the principles of best management practice and best available technology economically achievable, and are designed to be implemented to manage and mitigate construction noise impacts.
- Standard construction noise mitigation techniques would be required to be applied, as a minimum, to include the following measures:
  - Residential class mufflers and, where applicable, engine shrouds (acoustic lining) would be used. All equipment would be maintained in good order, including mufflers, enclosures and bearings to ensure unnecessary noise emissions are eliminated.
  - Construction works will be restricted to between 7 am and 6 pm Monday to Friday, and between 8 am and 2 pm Saturdays, with no works on Sundays or public holidays.

- Construction activities will be undertaken in accordance with AS 2436-1981 Guide to Noise Control *on Construction, Maintenance and Demolition Sites*. All equipment used on site would be required to demonstrate compliance with the noise levels recommended within AS 2436-1981.
- Appropriate use of all plant and equipment, with reasonable work practices applied, including no extended periods of ‘revving’, idling or ‘warming up’ in proximity to existing residential receivers. Any excessively loud activities will be scheduled during periods of the day when general ambient noise levels are greatest. This will reduce the potential for cumulative noise impacts (relating to worst-case elevated operations) and extended periods of off-site annoyance.
- Engines will not be started and on-site activities (including entry or departure from the site) will not be undertaken outside of the specified construction hours.
- Minimising reversing alarm noise emissions from mobile plant and transport truck operations will be considered, provided occupational health and safety requirements are satisfied. Where practicable, site entry and exit points will be managed to limit the need for reversing.
- Regular maintenance will be undertaken on all plant and machinery used throughout the constructions works.

It is recommended ERM Power undertake a costing and feasibility study of the proposed mitigation and management techniques with respect to noise goal compliance and project delivery.

10.2 Operational noise management

The management of the operational noise impacts from the power station can be undertaken by considering the following zones of impact:

- Zone 1: NSW INP compliance — 35 dB(A) $L_{Aeq,\ 15\ mins}$
- Zone 2: a noise management zone of 35 – 40 dB(A) L_{Aeq} for the amelioration of internal noise environments
- Zone 3: an acquisition zone of >40 dB(A) L_{Aeq} for the negotiation of property procurement.

In order to achieve compliance with the NSW INP adopted operational noise design goals, the following reductions in received noise level, dependent upon meteorological conditions, would be required:

- Mount Nanima: 1.5 – 4 dB(A) $L_{Aeq,\ 15\ min}$ (Zone 2)
- Keston Rose Garden Café: 2 dB(A) $L_{Aeq,\ 15\ min}$, adverse meteorological conditions only (Zone 2)
- Nanima House: 8 – 10 dB(A) $L_{Aeq,\ 15\ min}$ (Zone 3).

Compliance with the INP noise goals through the application of on-site noise mitigation measures alone is not feasible, due to technology constraints. However, Table 10-1 provides an overview of potential noise management and mitigation measures designed to demonstrate that all ‘reasonable and feasible’ measures have been applied in order to achieve reductions in source noise emissions and received noise levels.

The recommendations have been made considering the principles of best management practice and best available technology economically achievable as detailed in Section 7 of the NSW INP.

Consideration of the potential costs for developing and implementing mitigation has been provided in the rationale for determining prospective feasibility of the measures discussed.

Table 10-1 Power station operational noise management and mitigation – hierarchy of options

Technique		Performance potential	Limitations	Feasibility	Viable
1. Procurement of property.	NSW INP — non-compliant properties purchased by the proponent.	Residential properties identified to not meet the INP goals of 35 dB(A), or more particularly the NSW INP recommended night-time amenity level of 40 dB(A), could be purchased by the proponent, thus removing the receptor to the noise impact. Purchase of Nanima House would result in the only exceedance of 35 dB(A) noise criterion by 1.5 – 4 dB(A) at Mount Nanima and up to 2 dB(A) at Keston Rose Garden Café.	Associated cost is subject to ongoing negotiations.	Nanima House is the only property identified to receive predicted noise impacts greater than 5 dB(A) above the adopted noise design goal.	Yes
2. Amelioration at residential property.	Section 8 of the INP provides a process for negotiating with potentially affected receivers for acoustic treatment of properties.	Acoustic treatment would be required at Mount Nanima and Nanima House to meet the noise criterion during neutral conditions and additionally at Keston Rose Garden Cafe where noise enhancing conditions are prevalent. Treatment could include installation of glazing, building wall and roof insulation, passive ventilation/air conditioning systems to limit transmission of external airborne noise to the internal environment.	Typically, a cost of $25,000 - $30,000 + GST will be allowed for each property where acoustic treatment options are considered.	The approach would need to be undertaken in a manner that is consistent with the intent of the Department of Planning and DECC (applied through any conditions of approval).	Yes
3. Limiting operations.	Amend turbine operating configuration to reduce potential noise emissions from the dominant stack sources.	The noise assessment has assumed that four diffuser exhaust stacks will be in operation simultaneously. Where three stacks are in operation, received noise levels would be predicted to be reduced by 1.5 dB(A). Where 2 stacks are in operation a 3 dB(A) decrease in received noise level would be expected. This could result in compliance with noise criteria at Mount Nanima and at Keston Rose Garden Café.	Amending turbine operational configuration may limit the potential to generate power at full capacity, which would significantly impact the business case for the development. Where full capacity is not achieved a penalty rate dependent upon the prevailing electricity market rate would be incurred.	Whilst delivering required reductions in received noise level the associated performance limitations and financial burden mean that this technique is considered unfeasible. It is understood that the project would be unlikely to proceed with this significant level of risk.	No

Technique		Performance potential	Limitations	Feasibility	Viable
4. Enclosure of key noise sources.	Restrict the transmission of airborne noise from operational plant with enclosures.	Plant building housing will consider internal and external acoustical insulation. The building walls and roof are recommended to be subject to detailed noise assessment to determine sound reduction performance requirements	Exhaust stacks are the dominant noise source, mitigation of additional noise source impacts would have marginal benefit to received noise levels of less than 0.5 dB(A).	The potential reduction in received noise levels would not be sufficient to achieve NSW INP compliance. The associated cost of implementation would not be reflected in resultant noise impact reduction.	No
5. Complete stack enclosure.	Extension of the stack wall enclosure to surround the entire stack.	The stack is proposed to incorporate an acoustic enclosure on the lower section to reduce wall breakout noise. The enclosure would be extended to the entire stack wall structure.	Enclosure of the stack would involve considerable capital outlay to complete the works for all four stacks. Stack constructability and operational access would be limited.	The stack exhaust exit noise would still dominate in the far field; essentially negating any noise reduction potential at receptors. Associated cost is considered prohibitive when balanced against the minor improvement in source noise emissions	No
6. Improvement to stack silencer.	Further stack silencer options may be considered, such as a low frequency stack silencer or multiple stack silencers.	Lower sound level emissions from the exhaust stack can be achieved through progressively longer silencer baffles or multiple silencers. Further noise reduction than the existing configuration may be achieved.	Incorporating designs to achieve greater than 10 dB(A) reduction in noise levels would be expected to impose significant cost for installation, testing, research and development works.	Increased back pressure in exhaust system corresponds to a decrease in performance of gas turbine efficiency. Increase fuel usage from poor turbine performance.	No
7. Increased stack silencer baffles.	Provision of additional thickness to current baffle design for the stack silencer.	Increased mitigation of exhaust stack breakout would be expected with thicker baffles. Potential noise reductions would be determined following further assessment of baffle specifications and source noise characteristics.	Progressively thicker silencer baffles would result in additional pressure drops or exhaust duct cross-sectional diameter increases. Thick baffles can result in self-noise where exiting flows result in aerodynamic noise from abrupt changes in flow dynamics.	Any achievable further acoustic mitigation performance is off-set by potential reductions in turbine efficiency and self-noise generation. The associated cost is considered prohibitive in comparison to potentially achievable reductions in received noise level.	No
8. Noise barrier at receptor.	Construction of a barrier or wall in proximity to noise generating sources.	A barrier would be required to be of sufficient dimension to provide attenuation through noise path difference. Typical barrier performance would be expected to achieve 10 dB(A) reductions.	Low frequency noise would not be efficiently attenuated. Exhaust stacks would remain the dominant noise source for received noise levels.	Consideration of a residential barrier is limited by potential reduction to received noise level, and barrier extent. The associated cost is considered reasonable. Prior agreement with resident required.	No

Technique		Performance potential	Limitations	Feasibility	Viable
9. Noise barrier at source.	Construction of a barrier or wall in proximity to receptor facades.	The barrier would be required to be of sufficient dimension to provide attenuation through noise path difference. Typical barrier performance would be expected to achieve potentially up to 5 dB(A) reductions.	Barrier dimensions would need to account for the elevated stack exhaust source. Visual amenity and shadowing may occur. Low frequency noise impact would be minimal.	The acoustic performance is limited by the influence of the dominant exhaust noise sources. Associated cost is considered significant.	No

10.2.1 Comment on acoustic design of power station

The proposed acoustic design of the project has been undertaken in accordance with the requirements specified within Chapter 7 of the NSW INP. The current acoustic design of the plant relies on best technology economically achievable principles.

Siemens have advised that the acoustic design provides the following:

- the facility offers incremental improvements that materially improve noise emissions when compared with the reference plant and similar contemporary facilities constructed both in Australia and overseas
- a gas turbine building and associated enclosures that are either at, or better than, industry available options
- the proposed two stage parallel baffle silencer configuration is equivalent to, or better than, noise attenuation provided by multiple back-end silencers.

Based on PB's experience, the proposed Siemens design compares favourably with the designs of other gas turbine turn-key suppliers such as Alstom and GE.

10.2.2 Management of noise issues

Management solutions will also be adopted to ensure adverse off-site noise impacts and loss of acoustic amenity do not occur over the short, medium or long term.

A number of options will be included in the design of the facility reflecting the level of noise management anticipated during the operation of the proposal.

These are as follows:

Complaint verification

In the event that noise complaints are received, ERM Power shall, within one week of receiving the complaint, undertake night-time operational noise monitoring at the affected residence for a representative period of time to confirm the occurrence of operational noise levels greater than L_{Aeq} (15min) 35 dB(A), once modification factors described in Section 4 of the NSW INP have been taken into account.

Should an exceedance exist ERM Power will employ a suitably qualified independent acoustic consultant to prepare a noise mitigation design report with the objective of providing a satisfactory level of internal noise amenity.

The one exception to this condition is where such complaints arise from or in circumstances that can only be attributed to emergency events and the like beyond the control of the operators.

Residential amelioration

On receipt of a written complaint within the noise management zone, ERM Power will seek to offer items to ameliorate internal noise levels to industry standard acceptable levels. Options include, but are not necessarily limited to:

- upgrade of external facades (walls and roof)
- treatment of openings (windows and doors)

- upgrade of insulation
- passive/active ventilation options (mechanical ventilation)
- at receiver barrier considerations.

Confirmation, design and assessment of adequacy will be required prior to implementation. Consideration will be made to applicable and accepted industry standards and guidelines. Any required measure would be assessed on an ‘as-needs’ basis for relevant affected residents.

Such a condition will provide a ‘safety net’ to the potentially affected landowners if the project operational noise management practices are not sufficient to proactively deal with a legitimate complaint.

It is recommended that post-commissioning noise monitoring be undertaken to verify the presence of the low frequency modifying correction factor.

10.3 Noise mitigation strategy

ERM Power’s strategy for the management of power station operational noise impacts for the nearest potentially affected receptors would include:

1. Negotiation with landowner under Section 8 of NSW INP for property procurement, or similar, of Nanima House.
2. An adopted operational noise design goal of 39 dB(A) for Mount Nanima (where a low frequency modifying correction factor is applicable — 35 dB(A) at all other times).
3. An adopted operational noise design goal of 37 dB(A) for Keston Rose Garden Café (where a low frequency modifying correction factor is applicable, 35 dB(A) at all other times).

The above strategy would be deemed reasonable where considered with the application of noise amelioration measures as presented for Zone 2: noise management zone.

The proposed maximum allowable noise contributions would be in close agreement with the INP developed goals for both Mount Nanima and Keston Rose Garden Café.

10.4 Potential sleep disturbance

In order to minimise potential disturbance to sleep, it is recommended that total power station source emission noise levels not exceed 110 dB(A) L_{A1}. It is expected that this will achieve the sleep disturbance noise design goal of 45 dB(A) L_{A1}, determined from the established background noise levels at the nearest potentially affected receptors.

10.5 Compressor station noise management

It is recommended that during the detailed design of the compressor station facility source emission data and acoustic performance of operational plant be confirmed with the supplier.

Following the detail design of the compressor station, operational plant should be installed to achieve compliance with the NSW INP noise design goal of 35 dB(A) $L_{Aeq,\ 15\ mins}$ at the nearest potentially affected receptors.

11. Conclusion

This report documents an assessment of environmental noise and vibration issues for the proposed construction and operation of the proposed Wellington power station.

11.1 Construction noise impact

Predicted worst-case cumulative pipeline construction noise impacts have been determined to be in exceedance of ENCM noise design goals by 2– 9 dB(A) $L_{A10,\ 15\ min}$ at the nearest potentially affected receptors. The worst construction noise exceedances relate to pipeline construction; however, due to the transient nature of pipeline construction, construction impacts would be short-term (generally less than 2 weeks) in duration.

Worst-case cumulative power station construction noise impacts have been predicted to result in potential noise exceedance of 2 – 13 $L_{A10,\ 15\ min}$ at the nearest potentially affected receptors. Ground clearance and excavation works have been identified as the greatest influence to received noise impacts. These works are not expected to be undertaken throughout the construction program.

A range of construction noise management techniques to reduce received construction noise impacts to achieve ENCM noise goal compliance have been recommended in Section 9. It is recommended that construction works and construction plant sound power levels are confirmed prior to the commencement of works.

11.2 Operational noise impact

Source emission scenarios with impact potential (and loss of residential amenity/noise intrusion) were compared with site-specific noise design goals derived in accordance with EPA guidelines.

The operational noise impacts of the power station have been predicted for the night-time period (10 pm – 7 am) under neutral and noise enhancing meteorological conditions for the nearest potentially affected receptors. The night-time period has been considered indicative of the worst-case operational scenario where background noise levels are most sensitive.

Operational noise impacts have been assessed against the NSW INP night-time noise design goal of 35 $L_{Aeq,\ 15\ min}$. The potential noise exceedances for neutral and noise enhancing meteorological conditions are as follows.

- Mount Nanima: 1.5 – 3.5 dB (A) $L_{Aeq,\ 15\ min}$
- Nanima House: 8 – 9.5 dB(A) $L_{Aeq,\ 15\ min}$
- Keston Rose Garden Café: 2 dB(A) $L_{Aeq,\ 15\ min}$
- Noise levels received at the Cadonia subdivision are predicted to be compliant under all conditions.

All predicted noise impacts include a modifying correction factor of 5 dB(A) for the consideration of potentially disturbing low frequency characteristics of the source noise.

Where the power station is proposed to operate during the night-time period, potential for sleep disturbance may also occur.

A range of noise management and mitigation measures designed to reduce received noise levels have been recommended in Section 10. The turbine stacks have been identified as the dominant operational noise source. The stack height in relation to intervening topography between source and receiver is such that negotiation for property procurement, or similar, as per Section 8 of the NSW INP considered the most effective noise amelioration measure.

Although it is understood that implementing all feasible and reasonable measures is not the sole consideration that the Department of Planning and DECC use in their decision making processes in this matter. There are other provisions contained in the NSW INP that will be met by ERM Power. Key elements of this report are provided below:

- The proposed maximum allowable noise contributions with the low frequency correction represent best practice for commercially achievable performance levels.
- Where the recommended maximum allowable noise contributions of 35 dB(A) may not be practically achievable at two sensitive receivers, alternate noise contribution objectives have been provided for consideration.
- Direct negotiation and agreement will be sought with owners of Nanima House.
- The proposed noise limits (where a, low frequency component is present) are lower than the NSW INP recommended amenity limit for a night-time rural environment (40 dB(A)) for all locations except Nanima House.
- A reduction of between 3 and 6 dB(A) in received noise levels is expected when only one or two units are operating.
- With consideration to the expected operational profile of the facility (specifically the low likelihood of operation during the night-time period), the potential for sleep disturbance is reduced.
- Post commissioning noise monitoring will be undertaken to confirm the presence of low frequency modifying correction factor.

12. Limitations

Scope of services and reliance of data

This noise impact study ('the study') has been prepared in accordance with the scope of work/services set out in the contract, or as otherwise agreed, between PB and the Client. In preparing this noise impact study, PB has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the noise impact study ('the data'). Except as otherwise stated in the noise impact study, PB has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this noise impact study ('conclusions') are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. PB will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to PB.

Study for benefit of client

This noise impact study has been prepared for the exclusive benefit of the Client and no other party. PB assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with in this noise impact study, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in this noise impact study (including without limitation matters arising from any negligent act or omission of PB or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in this noise impact study). Other parties should not rely upon the noise impact study or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

Other limitations

To the best of PB's knowledge, the project presented and the facts and matters described in this noise impact study reasonably represent the Client's intentions at the time of printing of the noise impact study. However, the passage of time, the manifestation of latent conditions or the impact of future events (including a change in applicable law) may have resulted in a variation of the project and of its possible noise impact.

PB will not be liable to update or revise the noise impact study to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the noise impact study.

13. References

AS 2436-1981, *Guide to Noise Control on Construction, Maintenance and Demolition Sites*

DIN 4150-3 1999, *Structural Vibration Part 3 Effects of Vibration on Structures*

NSW DEC 2006, *Environmental Noise Management Assessing Vibration: a technical guideline*

NSW EPA 1994, *Environmental Noise Control Manual*

NSW EPA 2000, *Industrial Noise Policy*

Protection of the Environment Operations Act 1997

BS 5228 *Noise and Vibration Control on Construction and Open Sites* (BS 1997).

Appendix A

Meteorological data analysis

Noise enhancing wind conditions

The NSW Industrial Noise Policy has been referenced in relation to assessing meteorological conditions in potential noise impacts. The Policy states:

> Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source-to-receiver wind speeds (at a 10m height) of 3m/s or below occur for 30 percent of the time or more in any assessment period (day, evening, night) in any season.

An analysis of regional wind enhancing noise conditions was undertaken as part of this assessment. This included an assessment of all hours of recorded wind flow patterns. The detailed assessment of noise enhancing meteorological conditions was based on wind speed data obtained for the Dubbo (I.D. 065070) station for the years 2004 - 2005. The data were separated into the four seasons and then into the daytime, evening and night-time assessment periods for each source to receiver wind flow vector.

The data has been tabulated for wind speeds of between 0.1 – 3 m/s as detailed below.

2004 wind speed analysis

Percentage occurrence of 0.1 – 3 m/s wind frequencies

(values expressed as % percentages)

Location	Period	Summer	Autumn	Winter	Spring
Mount Nanima NW (292.5° - 337.5°)	**Daytime**	1.3	1.9	3.7	1.4
	Evening	3.8	1.9	4.1	2.5
	Night-time	1.2	1	4.9	1
Cadonia subdivision SW (202.5° - 247.5°)	**Daytime**	0.7	1.4	3.6	1.2
	Evening	2.5	5.2	5.8	4.9
	Night-time	1.7	2.6	3.8	2.4
Keston Rose Garden Cafe E (67.5° - 112.5°)	**Daytime**	2.2	2.6	3.4	3.7
	Evening	2.5	2.5	4.9	4.9
	Night-time	3.5	8.9	7.1	5.1
Nanima House NE (22.5° - 67.5°)	**Daytime**	2	2.1	2.4	1.6
	Evening	0.5	2.5	4.9	2.2
	Night-time	3.4	2.8	4.5	3

Note: daytime defined as 7 am – 6 pm
evening defined as 6 pm – 10 pm
night time defined as 10 pm – 7 am

2005 wind speed analysis

Percentage occurrence of 0.1 – 3 m/s wind frequencies (values expressed as %)

Location	Period	Summer	Autumn	Winter	Spring
Mount Nanima NW (292.5° - 337.5°)	**Daytime**	0.6	1	2	2
	Evening	0.6	3	2.2	3.6
	Night-time	0.5	1.1	3.3	1
Cadonia subdivision SW (202.5° - 247.5°)	**Daytime**	0.1	1.3	1.1	0.6
	Evening	4.4	9	4.7	1.9
	Night-time	0.9	2.3	3.8	1.2
Keston Rose Garden Cafe E (67.5° - 112.5°)	**Daytime**	2.4	4.1	4.1	3.8
	Evening	0.8	5.5	3.3	2.5
	Night-time	4.5	4.6	2.4	5.5
Nanima House NE (22.5° - 67.5°)	**Daytime**	1.4	2.2	2	2.3
	Evening	0.8	1.6	2.2	4.1
	Night-time	3.2	1.5	3.3	3.4

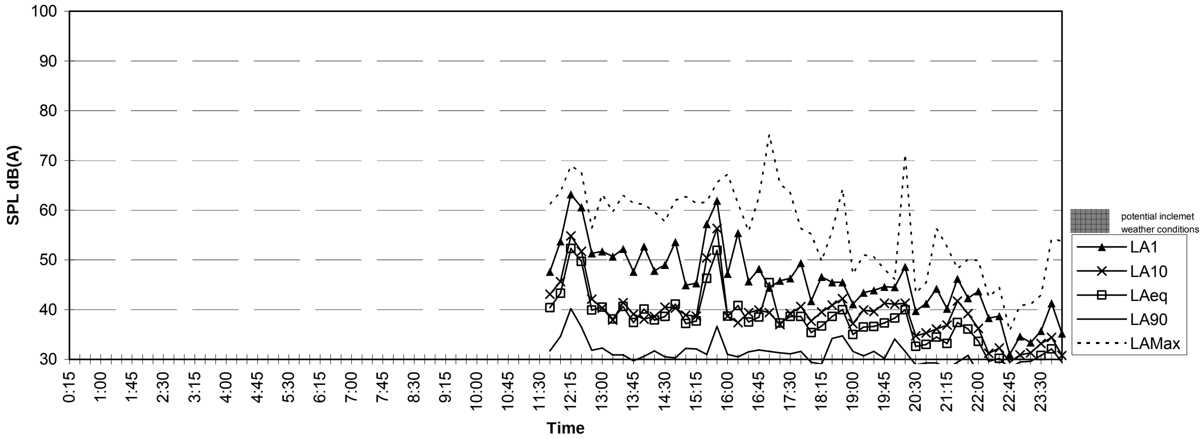
Note: daytime defined as 7 am – 6 pm
evening defined as 6 pm – 10 pm
night time defined as 10 pm – 7 am

Review of the above data indicates that there was a gradient or drainage wind flow regime present for more than 30% of the time (upon consideration of both directional and vector some wind patterns) during the daytime hours for the winter period.

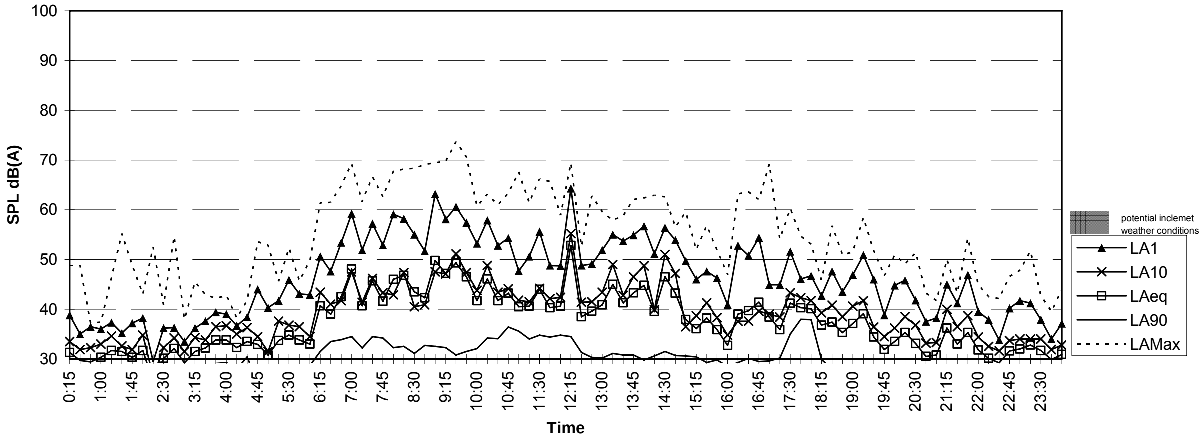
Appendix B

Noise logger graphs

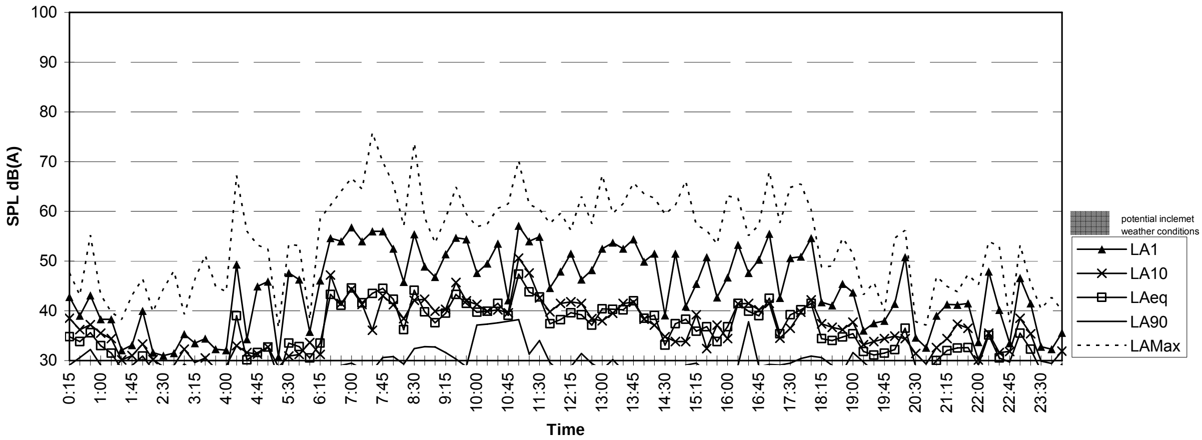
Location - Nanima House
Measured Noise Levels - Friday 11th May, 2007



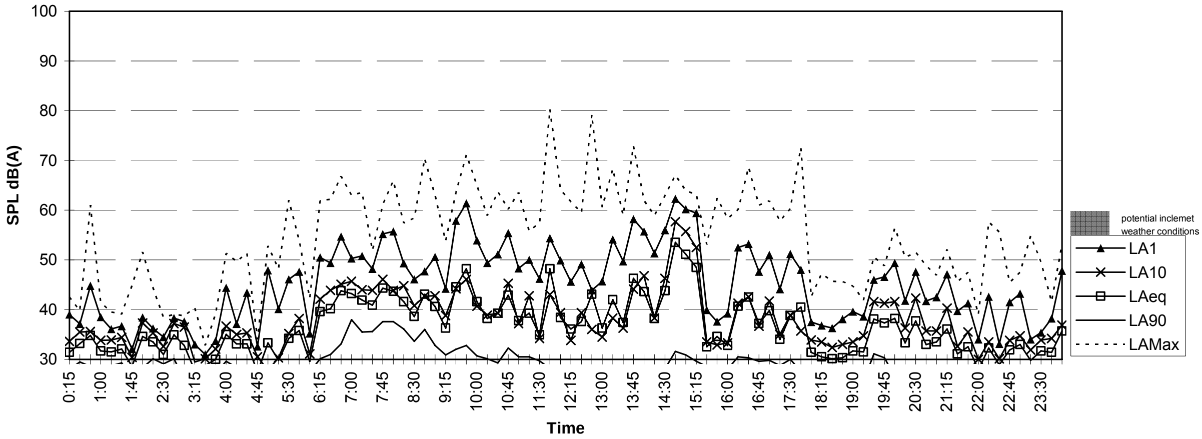
Location - Nanima House
Measured Noise Levels - Saturday 12th May, 2007



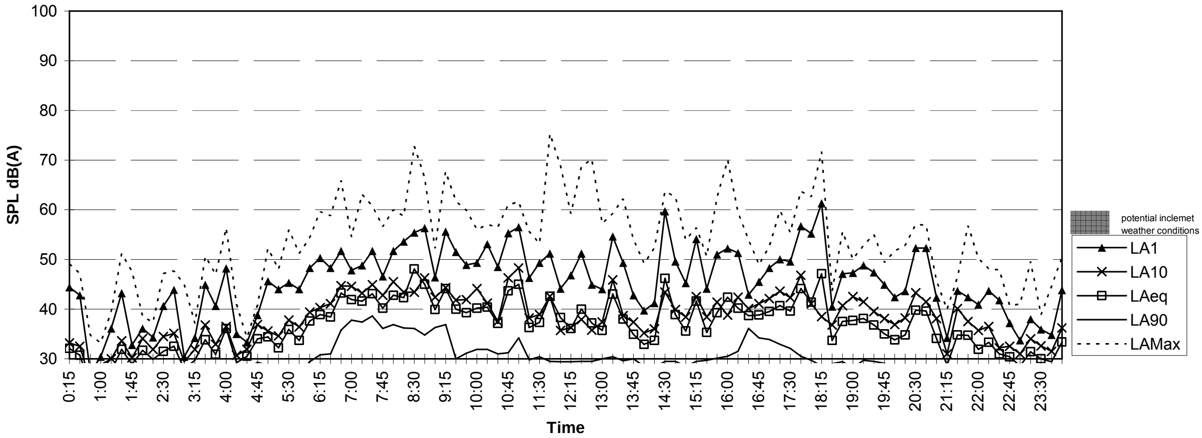
Location - Nanima House
Measured Noise Levels - Sunday 13th May, 2007



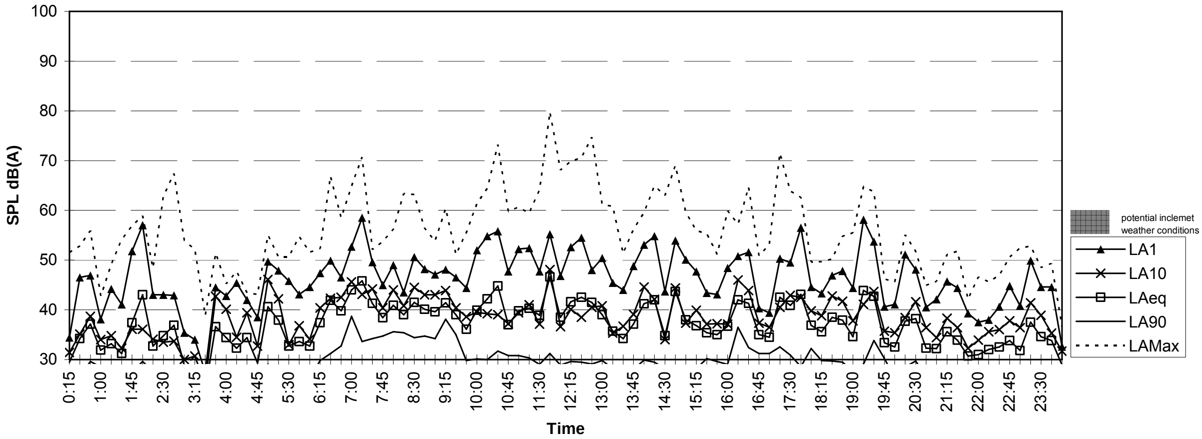
Location - Nanima House
Measured Noise Levels - Monday 14th May, 2007



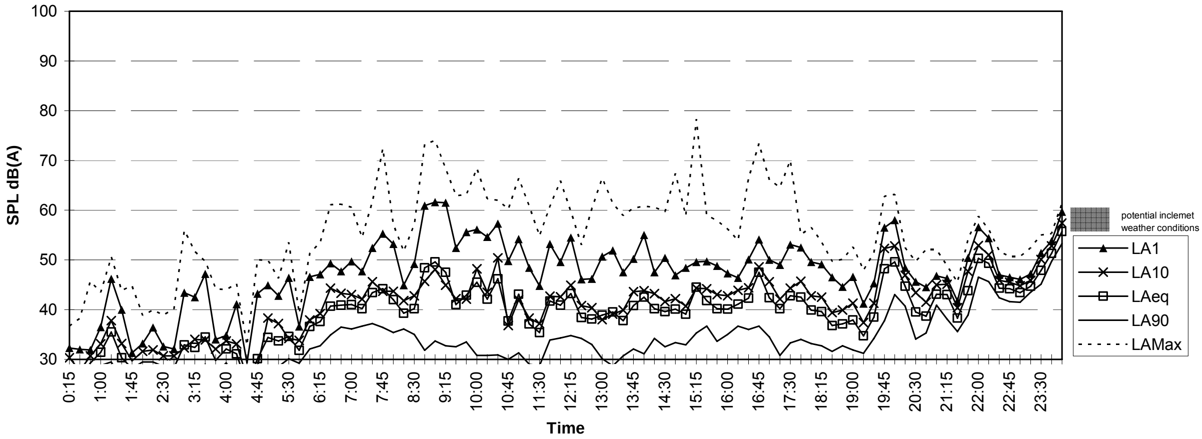
Location - Nanima House
Measured Noise Levels - Tuesday 15th, 2007



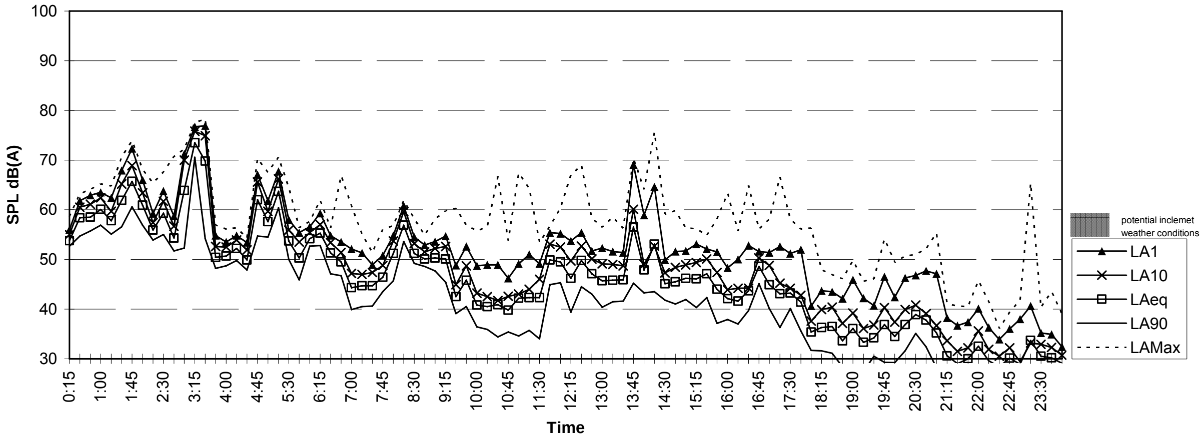
Location - Nanima House
Measured Noise Levels - Wednesday 16th May, 2007



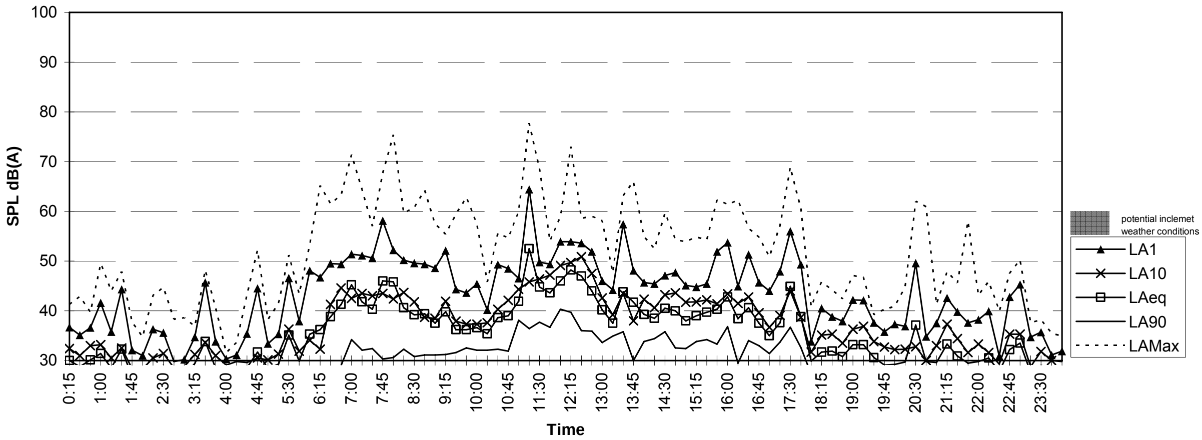
Location - Nanima House
Measured Noise Levels - Thursday 17th May, 2007



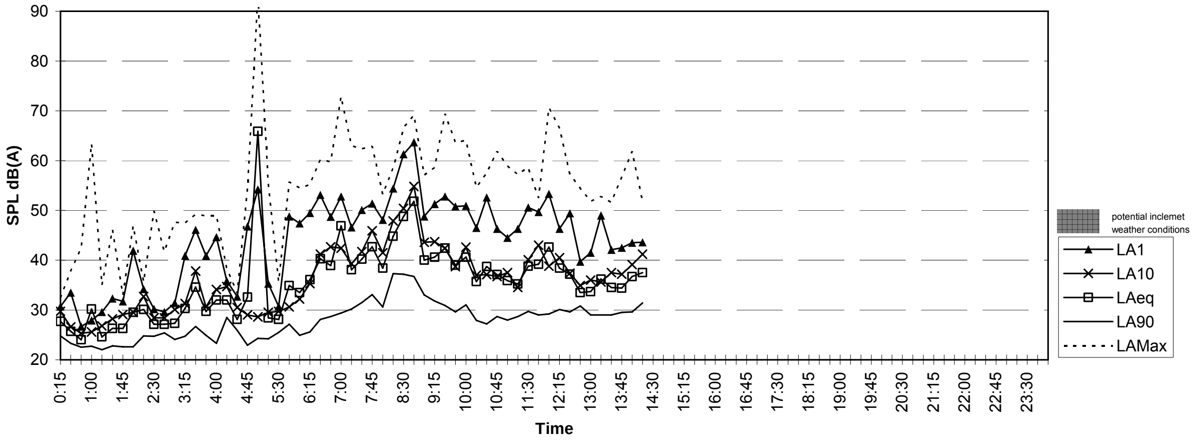
Location - Nanima House
Measured Noise Levels - Friday 18th May, 2007



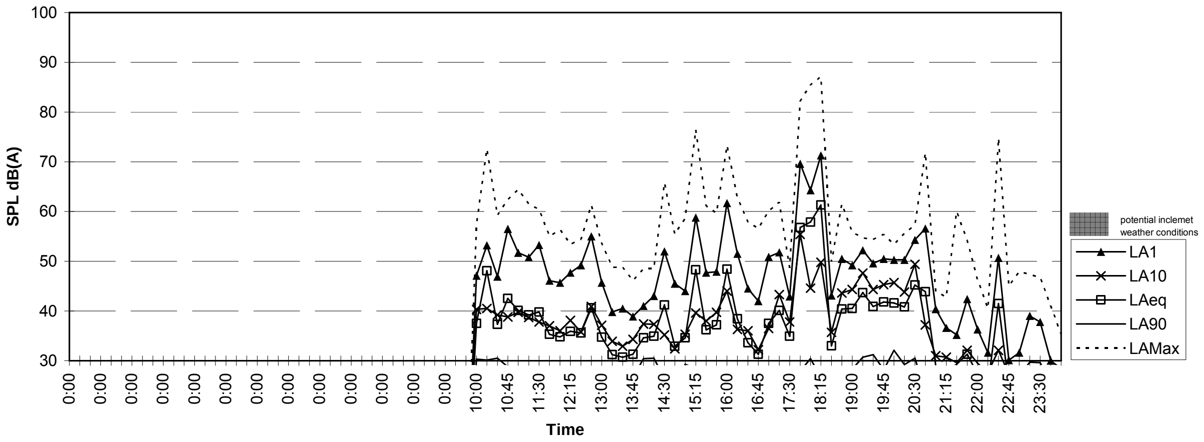
Location - Nanima House
Measured Noise Levels - Saturday 19th May, 2007



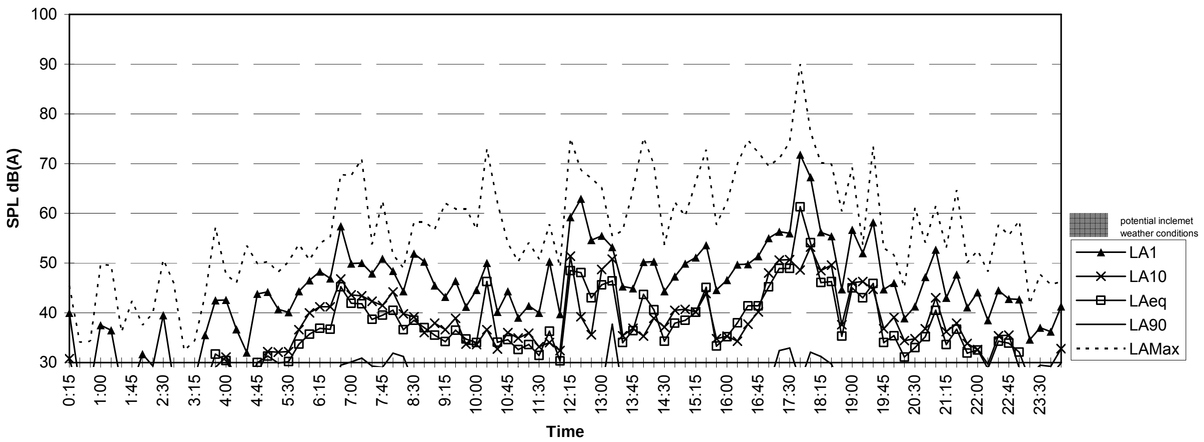
Location - Nanima House
Measured Noise Levels - Sunday 20th May, 2007



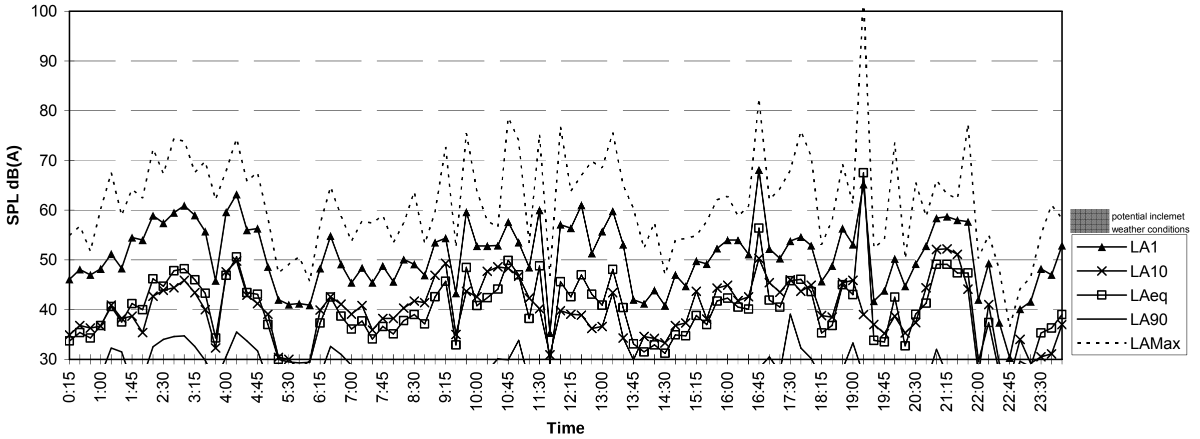
Location - Cardonia Sub Division
Measured Noise Levels - Friday 11th May, 2007



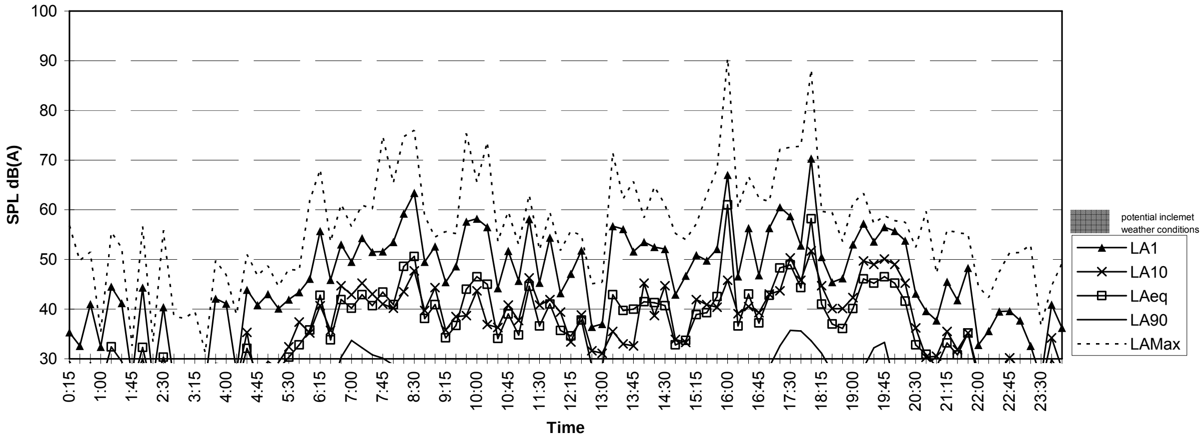
Location - Cardonia Sub Division
Measured Noise Levels - Saturday 12th May, 2007



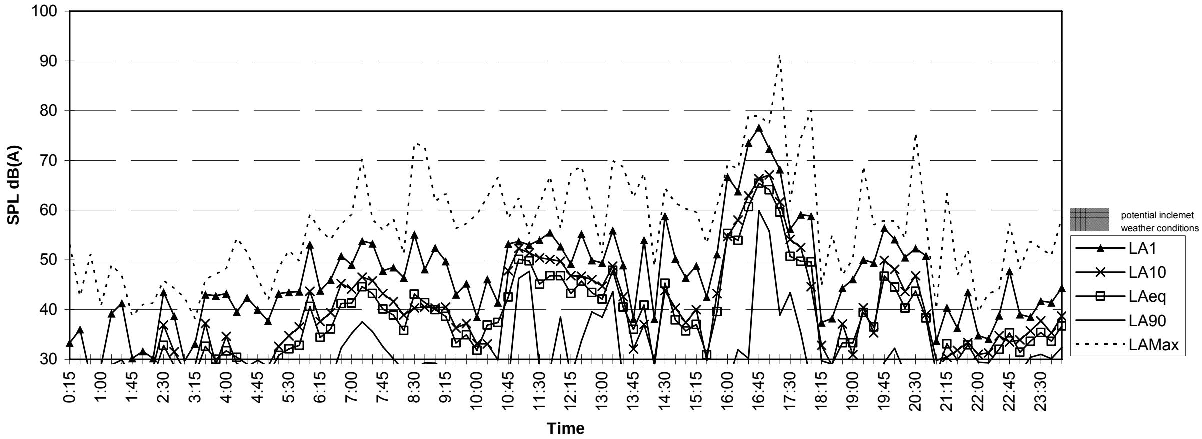
Location - Cardonia Sub Division
Measured Noise Levels - Sunday 13th May, 2007



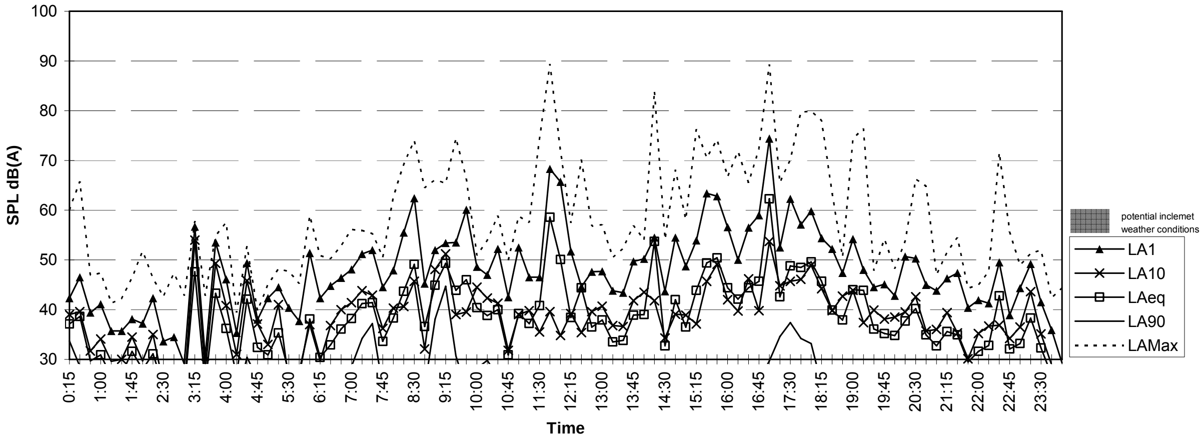
Location - Cardonia Sub Division
Measured Noise Levels - Monday 14th May, 2007



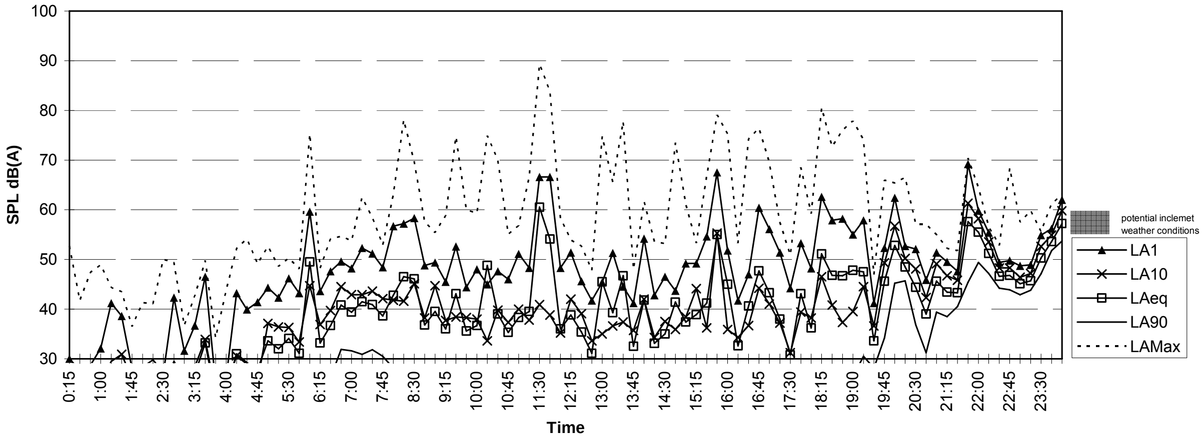
Location - Cardonia Sub Division
Measured Noise Levels - Tuesday 15th May, 2007



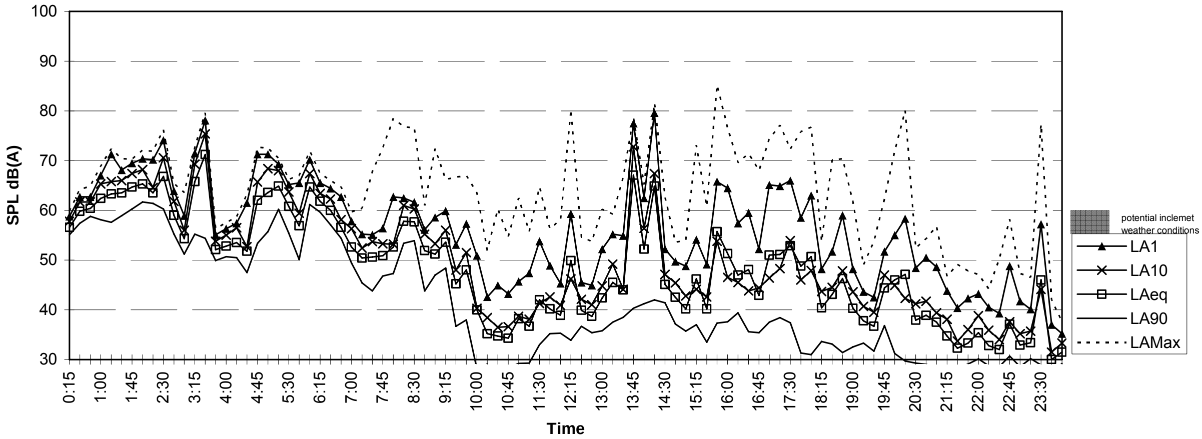
Location - Cardonia Sub Division
Measured Noise Levels - Wednesday 16th May, 2007



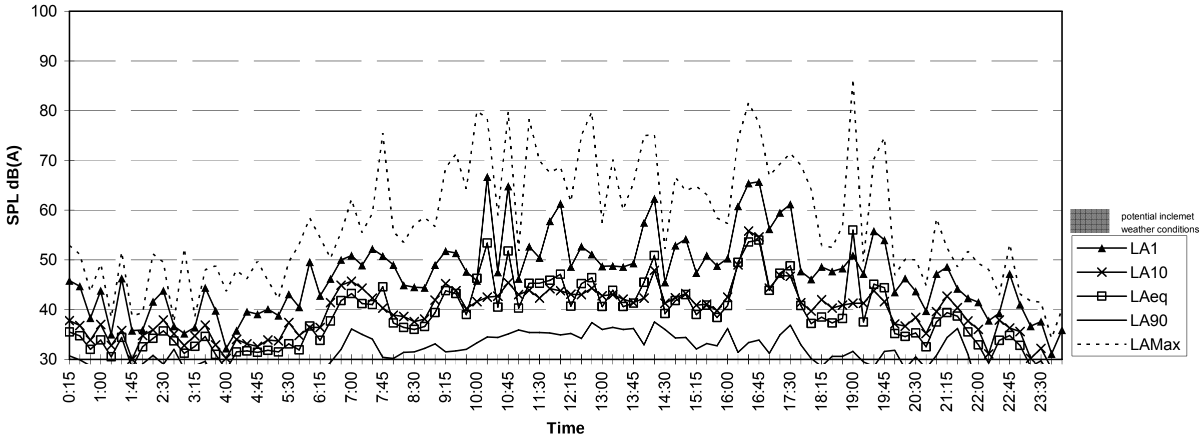
Location - Cardonia Sub Division
Measured Noise Levels - Thursday 17th May, 2007



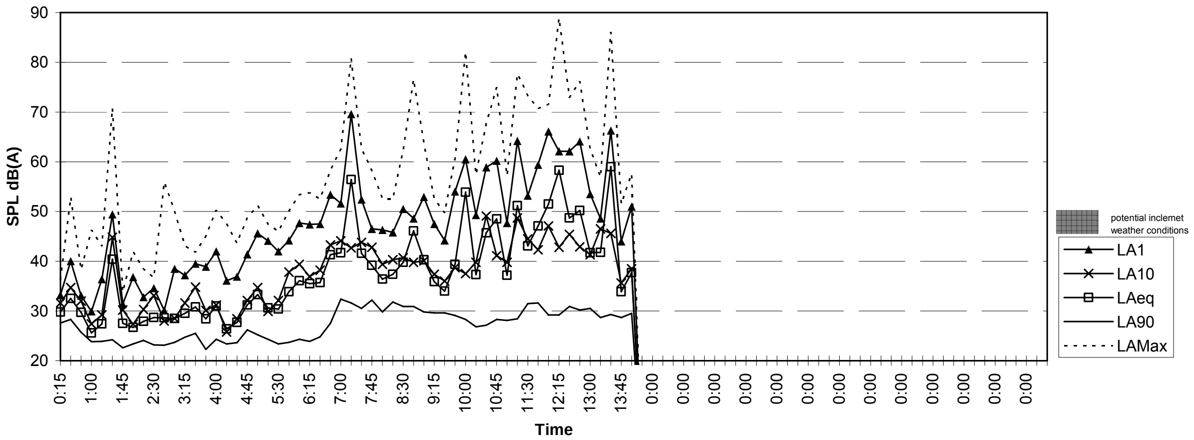
Location - Cardonia Sub Division
Measured Noise Levels - Friday 18th May, 2007



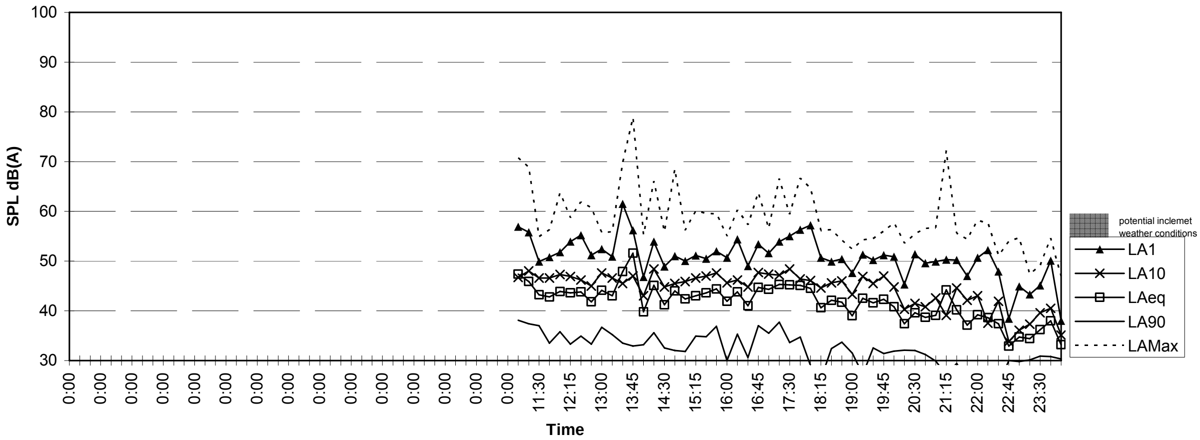
Location - Cardonia Sub Division
Measured Noise Levels - Saturday 19th May, 2007



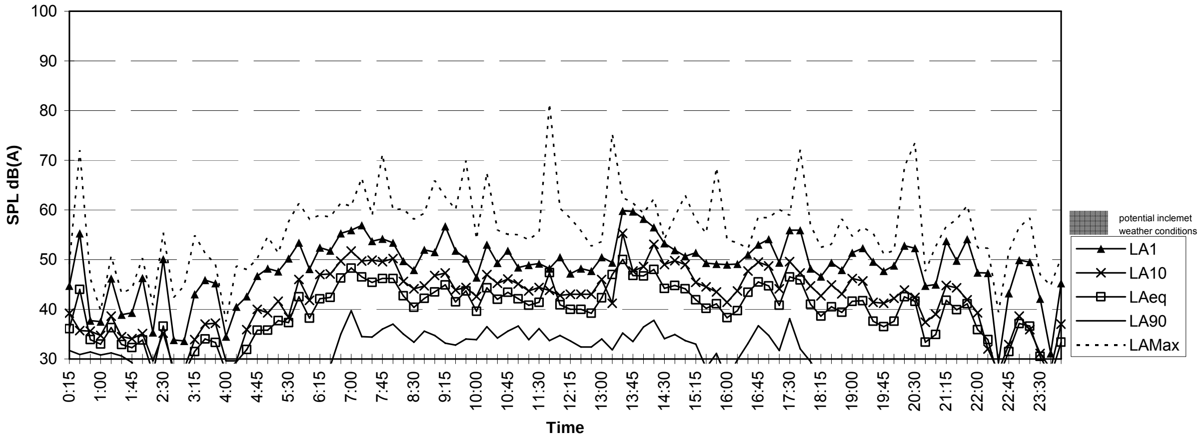
Location - Cardonia Sub Division
Measured Noise Levels - Sunday 20th May, 2007



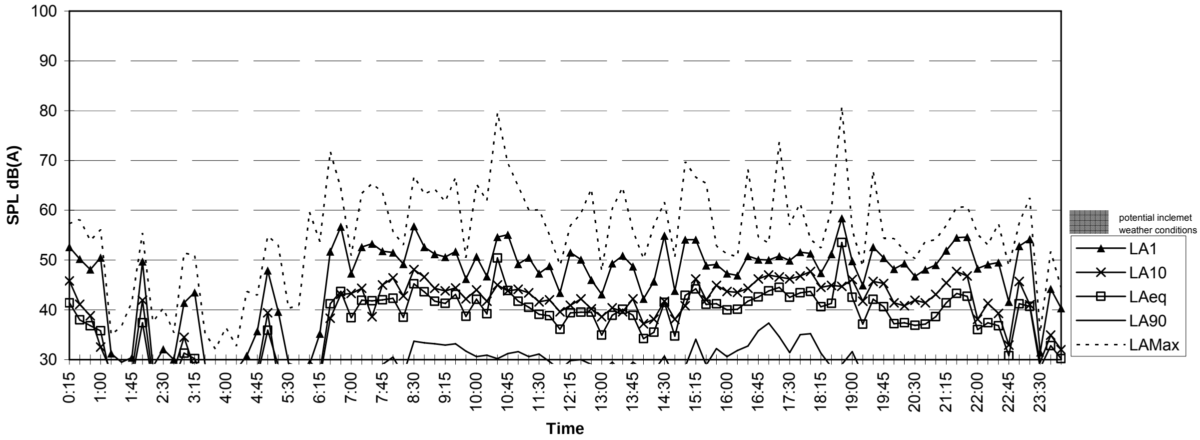
Location - Keston Rose Garden Cafe
Measured Noise Levels - Friday 11th May, 2007



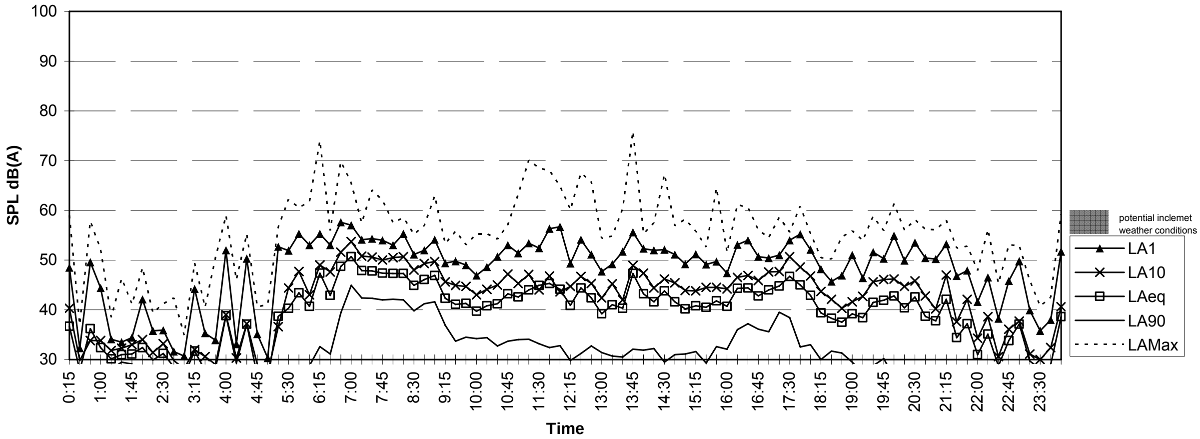
Location - Keston Rose Garden Cafe
Measured Noise Levels - Saturday 12th May, 2007



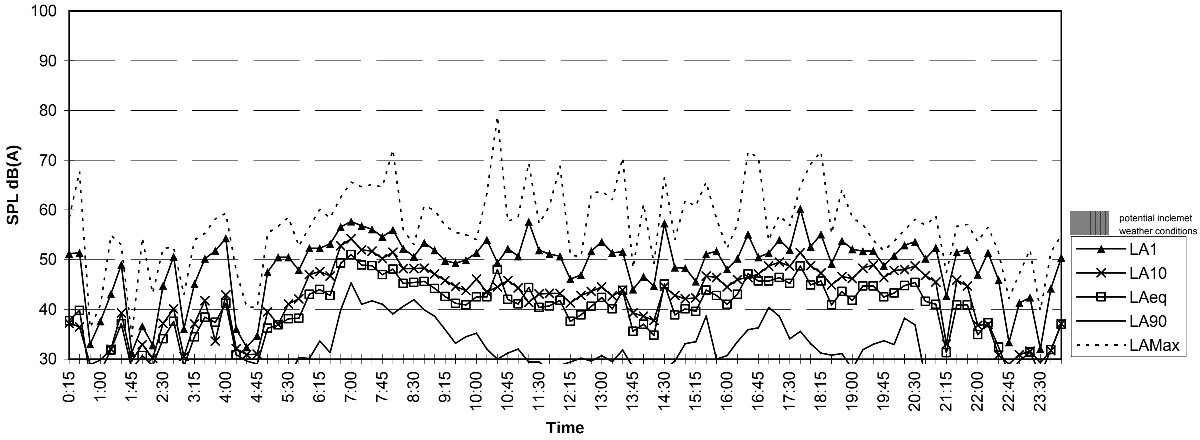
Location - Keston Rose Garden Cafe
Measured Noise Levels - Sunday 13th May, 2007



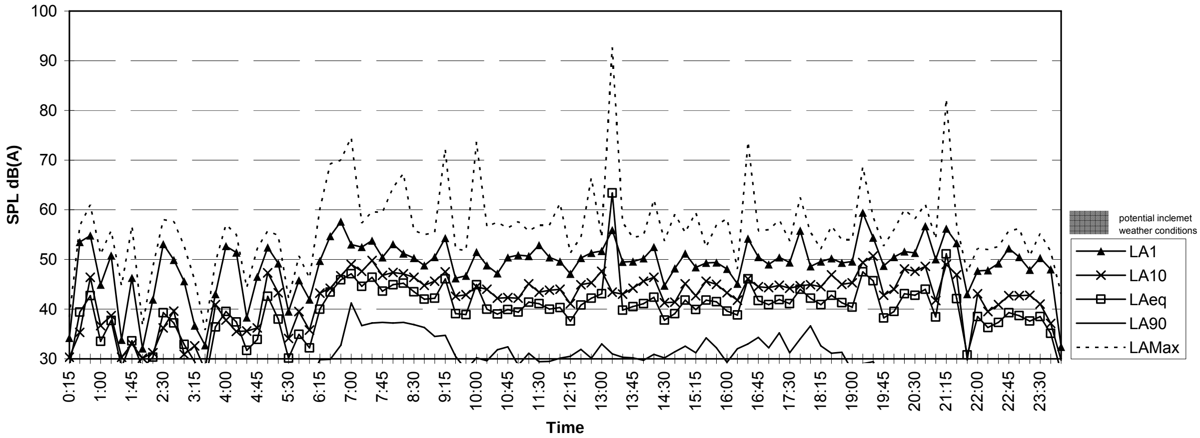
Location - Keston Rose Garden Cafe
Measured Noise Levels - Monday 14th May, 2007



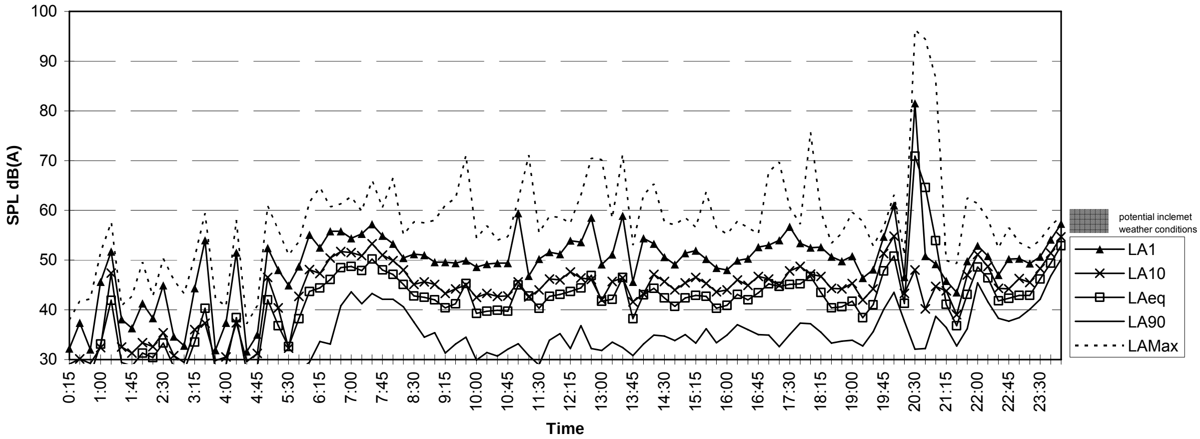
Location - Keston Rose Garden Cafe
Measured Noise Levels - Tuesday 15th May, 2007



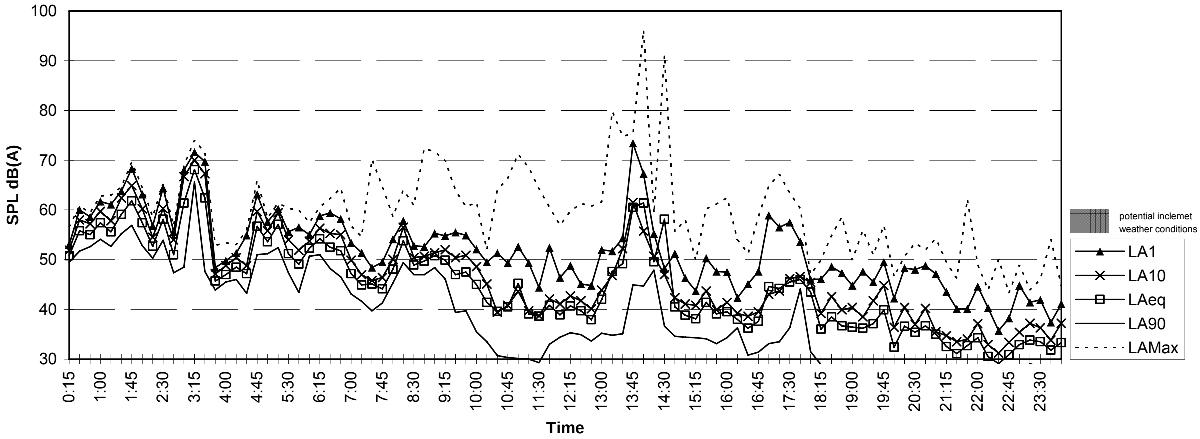
Location - Keston Rose Garden Cafe
Measured Noise Levels - Wednesday 16th May, 2007



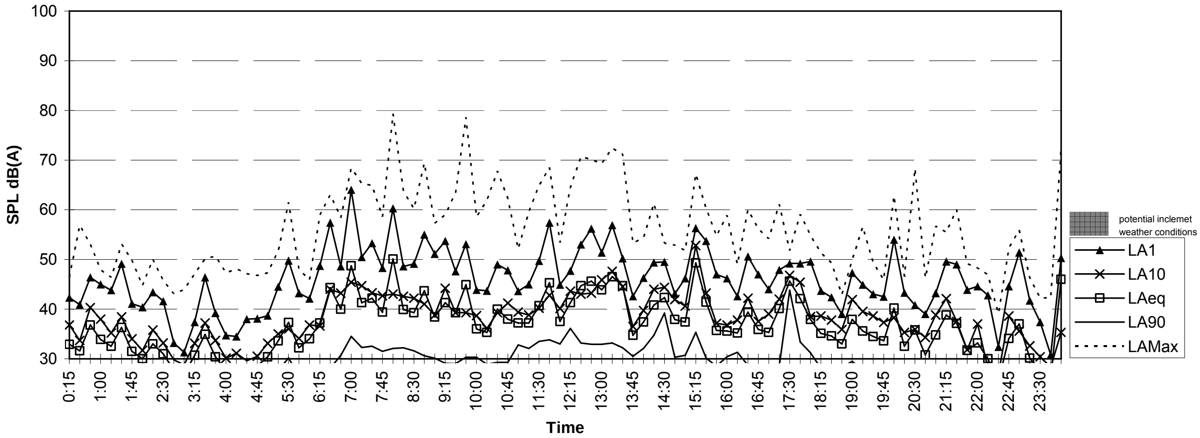
Location - Keston Rose Garden Cafe
Measured Noise Levels - Thursday 17th May, 2007



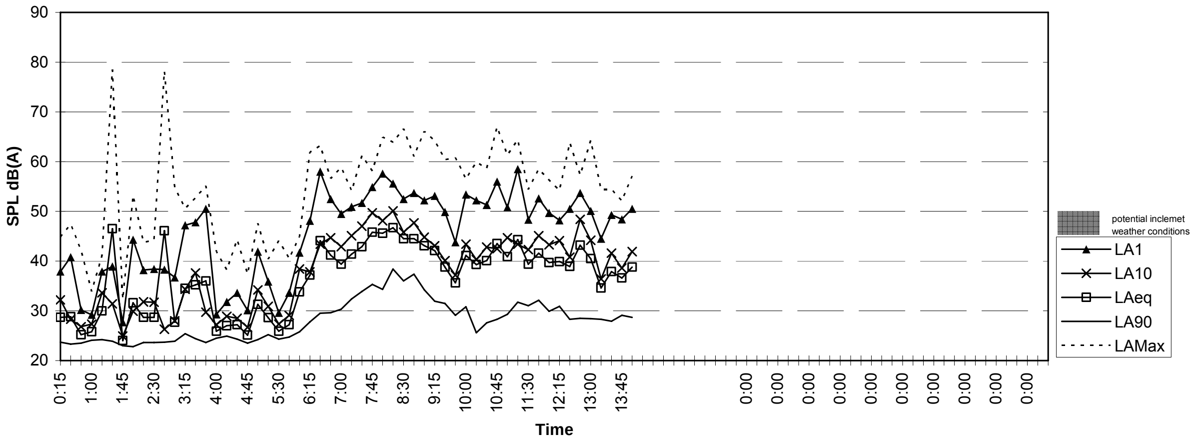
Location - Keston Rose Garden Cafe
Measured Noise Levels - Friday 18th, 2007



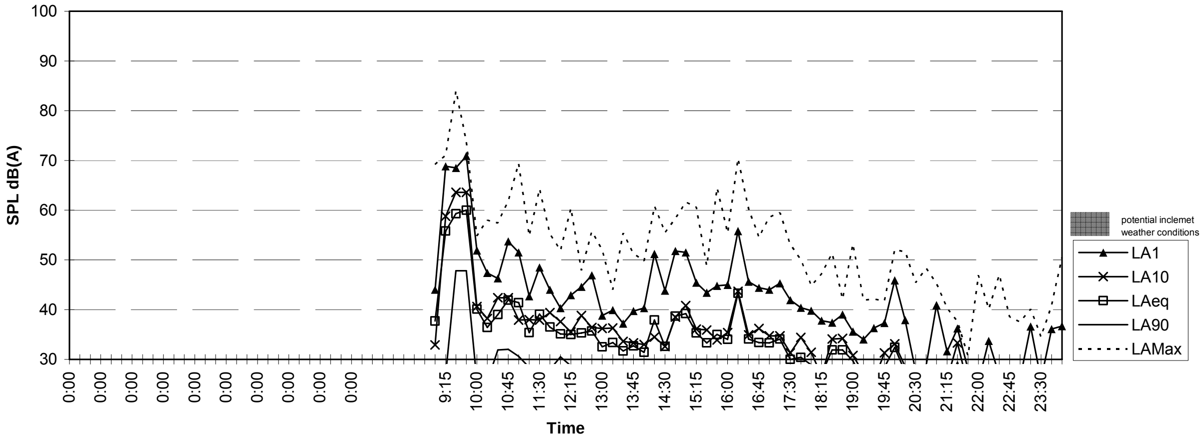
Location - Keston Rose Garden Cafe
Measured Noise Levels - Saturday 19th May, 2007



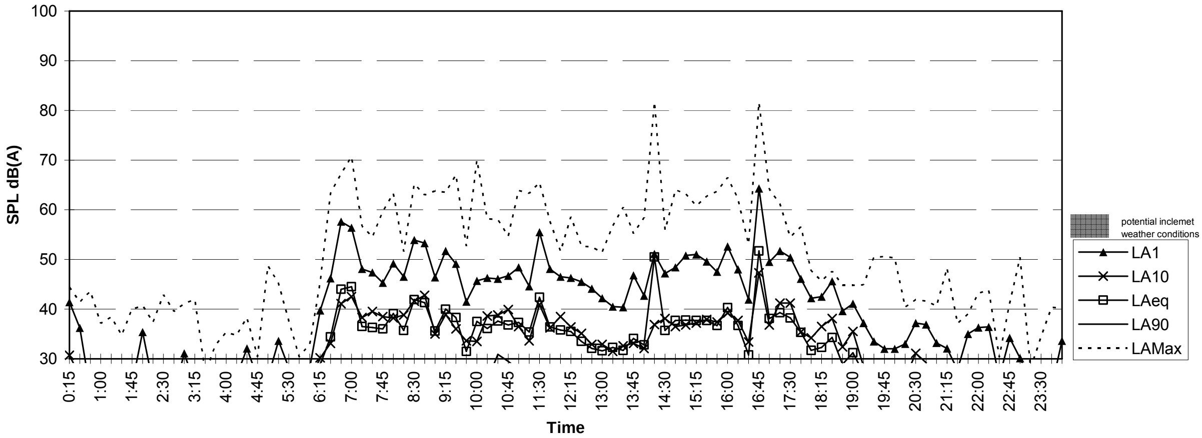
Location - Keston Rose Garden Cafe
Measured Noise Levels - Sunday 20th, 2007



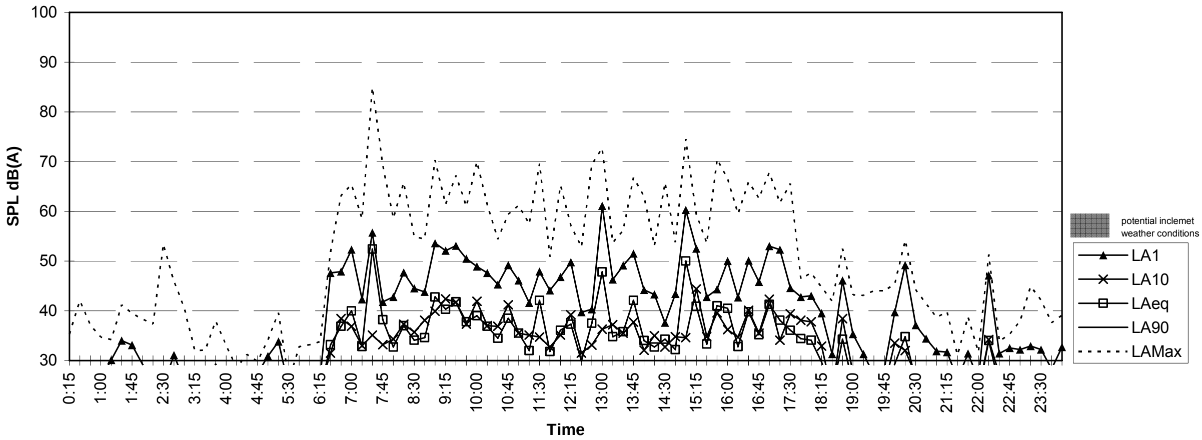
Location - Mt Nanima
Measured Noise Levels - Friday 11th May, 2007



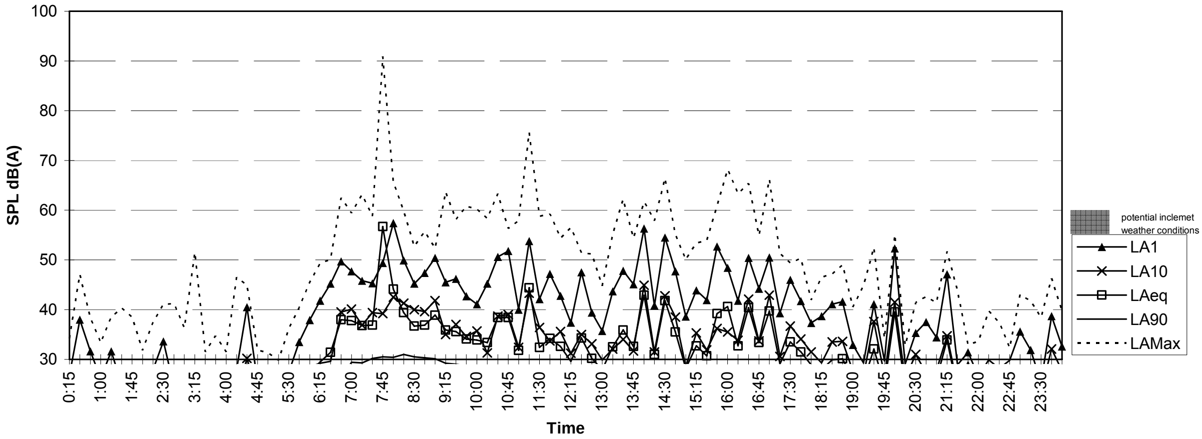
Location - Mt Nanima
Measured Noise Levels - Saturday 12th May, 2007



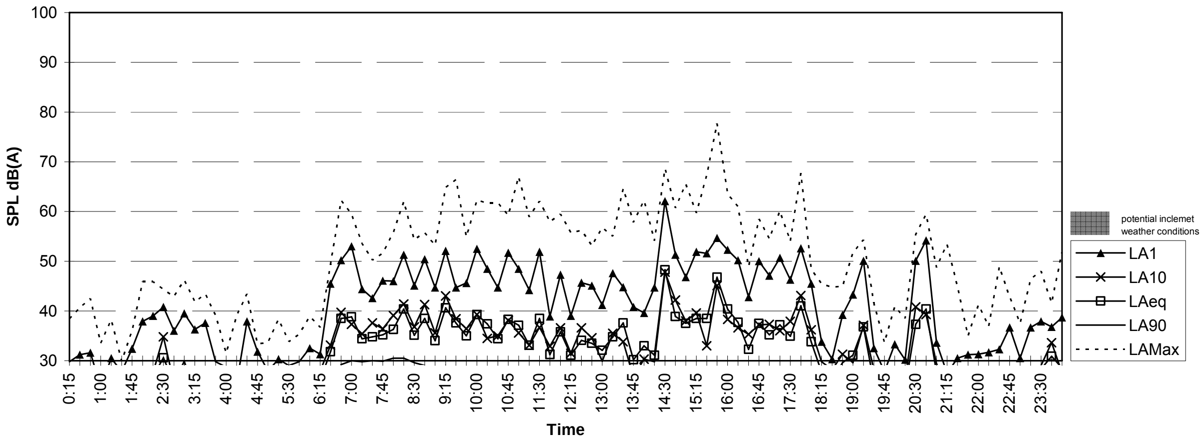
Location - Mt Nanima
Measured Noise Levels - Sunday 13th May, 2007



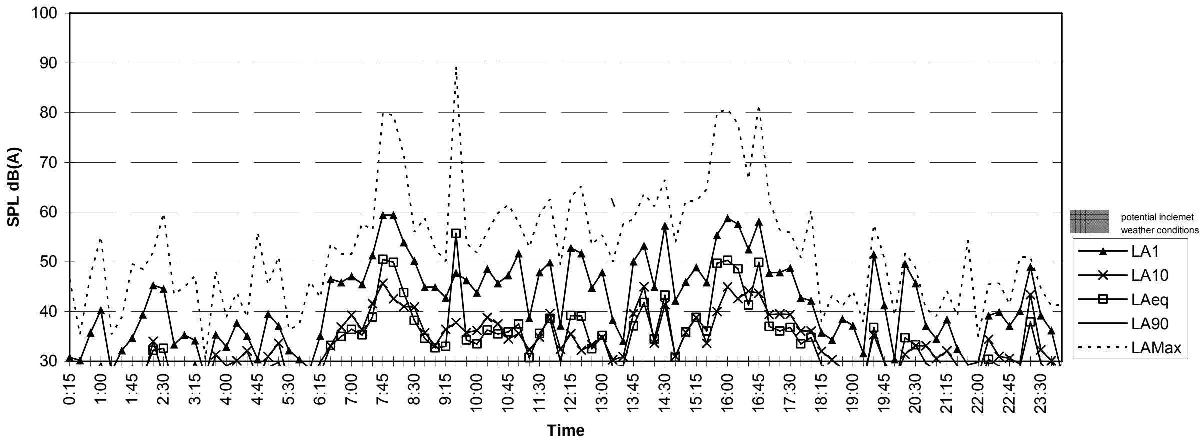
Location - Mt Nanima
Measured Noise Levels - Monday 14th May, 2007



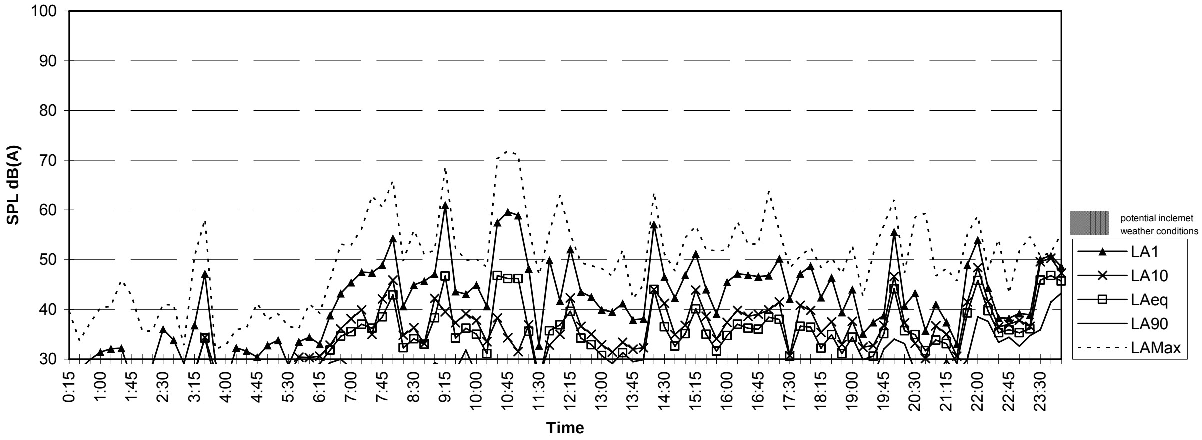
Location - Mt Nanima
Measured Noise Levels - Tuesday 15th May, 2007



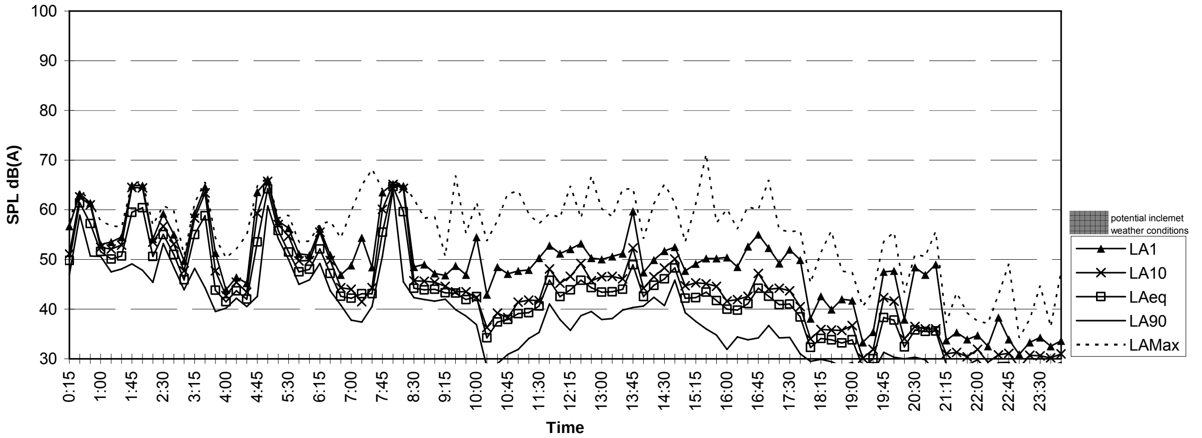
Location - Mt Nanima
Measured Noise Levels - Wednesday 16th May, 2007



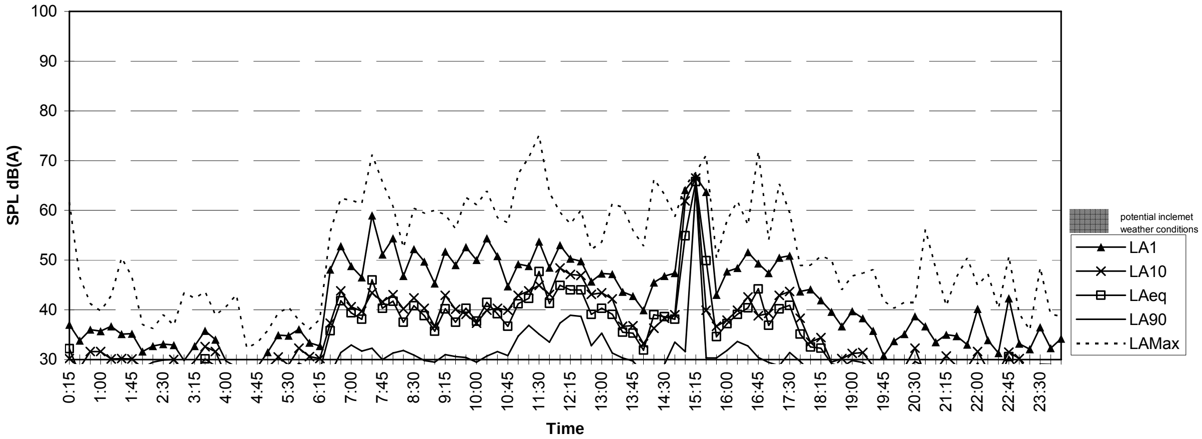
Location - Mt Nanima
Measured Noise Levels - Thursday 17th May, 2007

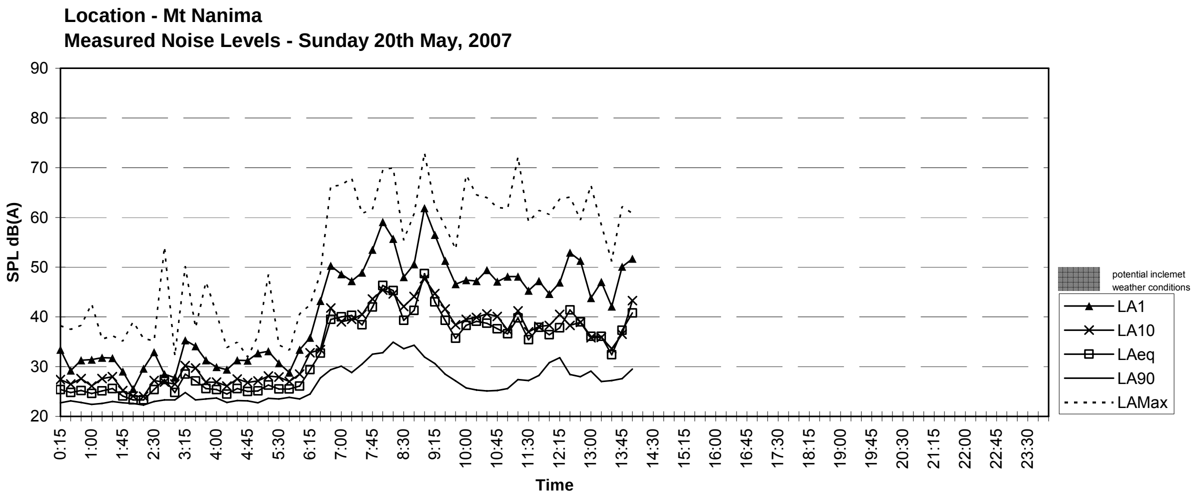


Location - Mt Nanima
Measured Noise Levels - Friday 18th May, 2007



Location - Mt Nanima
Measured Noise Levels - Saturday 19th May, 2007




Location - Mt Nanima
Measured Noise Levels - Sunday 20th May, 2007
SPL dB(A)
Time
potential inclemet weather conditions
LA1
LA10
LAeq
LA90
LAMax

Appendix C

Calibration certification

Sound Level Meter Test Report

Report Number : 07065.doc

Date of Test : 19/02/2007

Report Issue Date : 22/02/2007

Equipment Tested: **ARL Noise Logger**

Model Number: EL-316

Serial Number: 16-302-485

Client Name : Acoustic Research Laboratories Pty Ltd

Level 7, Buidling 2, 423 Pennant Hills Road

Pennant Hills NSW 2120

Contact Name : Katie Fairjones

Tested by : Michael Wastell

Approved Signatory :

Ken Williams

Date : **22nd February 2007.**

NATA
WORLD RECOGNISED ACCREDITATION

Acoustic Research Laboratories Pty Ltd is NATA Accredited Laboratory Number. 14172.

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance with ISO/IEC 17025

This document shall not be reproduced except in full.

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

Sound Level Meter Test Certificate

Report Number : 06135.doc

Date of Test : 03/04/2006

Report Issue Date : 05/04/2006

Equipment Tested: **Environmental Noise Logger**

Model Number: EL-316

Serial Number: 16-203-502

Client Name : Acoustic Research Laboratories Pty Ltd

Contact Name : Katie Fairjones

Tested by : Will Ford

Approved Signatory :

Ken Williams

Date : **5th April 2006.**

NATA Accredited Laboratory Number: 14172

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025:1999 and are traceable to Australian national standards of measurement. This document shall not be reproduced except in full.

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

Sound Level Meter Test Report

Report Number : 06248.doc

Date of Test : 30/06/2006

FILE COPY

Report Issue Date : 04/07/2006

Equipment Tested: ARL Noise Logger

Model Number: EL-316

Serial Number: 16-306-008

Client Name : Parsons Brinckerhoff

Level 27, Ernst & Young Centre
680 George Street

Sydney NSW 2000

Contact Name : Shane Harris

Tested by : Will Ford

Approved Signatory :

Ken Williams

Date : 4th July 2006.

NATA Accredited Laboratory
Number 14172

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025:1999 and are traceable to Australian national standards of measurement. This document shall not be reproduced except in full.

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

F[illegible]PY

Sound Level Meter Test Certificate

Report Number : 04264

Date of Test : 16/11/2004

Report Issue Date : 6/12/2004

Equipment Tested: **Environmental Noise Logger**

Model Number: EL-316

FILE COPY

Serial Number: 16-004-010

Client Name : Acoustic Research Laboratories

Contact Name : Katie Fairjonesq

Tested by : Will Ford

Approved Signatory :

Ken Williams

Date : **6/12/2004**

NATA Accredited Laboratory
Number: 14172

The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025:1999 and are traceable to Australian national standards of measurement. This document shall not be reproduced except in full.

Appendix D

SoundPLAN sample output file

Name Mount Nanima Floor 1. Floor LrD,lim 59 dB(A) LrN,lim 49 dB(A) LrD 35.9 dB(A) LrN 35.9 dB(A)

Source	SrcType	Lw dB(A)	Lw' dB(A)	l or S m,m²	KI dB	KT dB	Ko dB	s m	Adiv dB	Agr dB	Amisc dB	Abar dB	Aatm dB	DI dB	Re dB(A)	Ls dB(A)	LrD dB(A)	LrN dB(A)
Unidentified 4	Point	90	90		0	5	0	1299.4	73.3	3.4		0	6	0		12.4	12.4	12.4
Unidentified 3	Point	90	90		0	5	0	1338	73.5	3.4		0	6.1	0		11.9	11.9	11.9
Unidentified 2	Point	90	90		0	5	0	1375.7	73.8	3.5		0	6.2	0		11.5	11.5	11.5
Unidentified 1	Point	90	90		0	5	0	1415.2	74	3.6		0	6.4	0		11.1	11.1	11.1
Transformer 4	Point	92.2	92.2		0	5	0	1285.2	73.2	5.6		1	3.1	0		14.4	14.4	14.4
Transformer 3	Point	92.2	92.2		0	5	0	1324.3	73.4	5.7		1	3.2	0		13.9	13.9	13.9
Transformer 2	Point	92.2	92.2		0	5	0	1361.7	73.7	5.8		1	3.3	0		13.5	13.5	13.5
Transformer 1	Point	92.2	92.2		0	5	0	1402.3	73.9	5.9		1	3.4	0		13.1	13.1	13.1
Stack Area 4	Area	98.3	78.1	103	0	5	0	1338.6	73.5	1.3		0	1.5	0		27	27	27
Stack Area 3	Area	98.3	78.3	100.2	0	5	0	1379.9	73.8	1.4		0	1.5	0		26.6	26.6	26.6
Stack Area 2	Area	98.3	78	107	0	5	0	1416.3	74	1.5		0	1.6	0		26.2	26.2	26.2
Stack Area 1	Area	98.3	77.4	121.8	0	5	0	1455.7	74.3	1.8		0	1.6	0		25.6	25.6	25.6
Stack 4	Point	95.9	95.9		0	5	0	1339.1	73.5	0.3		0	0.7	0		26.4	26.4	26.4
Stack 3	Point	95.9	95.9		0	5	0	1379.5	73.8	0.5		0	0.7	0		26	26	26
Stack 2	Point	95.9	95.9		0	5	0	1414.6	74	0.6		0	0.7	0		25.6	25.6	25.6
Stack 1	Point	95.9	95.9		0	5	0	1453.9	74.2	0.8		0	0.7	0		25.2	25.2	25.2
Inlet Air Filterhouse 4	Area	90	67.2	192.5	0	5	0	1310.7	73.3	1.6		1	4.7	0		14.4	14.4	14.4
Inlet Air Filterhouse 3	Area	90	67.2	192.1	0	5	0	1349.8	73.6	1.7		1	4.8	0		13.9	13.9	13.9
Inlet Air Filterhouse 2	Area	90	67.2	189.5	0	5	0	1386.6	73.8	1.8		1	4.9	0		13.5	13.5	13.5
Inlet Air Filterhouse 1	Area	90	68.1	154	0	5	0	1425.9	74.1	2		1	5	0		13	13	13
Gast Turbine Ventilati	Point	85	85		0	5	0	1321.4	73.4	5		2.9	1.6	0		7.1	7.1	7.1
Gast Turbine Ventilati	Point	85	85		0	5	0	1360	73.7	5.2		2.9	1.6	0		6.7	6.7	6.7
Gast Turbine Ventilati	Point	85	85		0	5	0	1397.3	73.9	5.3		2.9	1.7	0		6.2	6.2	6.2
Gast Turbine Ventilati	Point	85	85		0	5	0	1434.7	74.1	5.4		2.9	1.7	0		5.8	5.8	5.8
Gas Turbine Building	Area	84.9	64.9	99.9	0	5	0	1322.1	73.4	3		4	0.4	0		9	9	9
Gas Turbine Building	Area	84.9	65.2	92.5	0	5	0	1359.3	73.7	3.2		4.1	0.4	0		8.6	8.6	8.6
Gas Turbine Building	Area	84.9	64.3	113.2	0	5	0	1397.4	73.9	3.3		4.1	0.4	0		8.2	8.2	8.2
Gas Turbine Building	Area	84.9	64.7	104.2	0	5	0	1435.4	74.1	3.5		4.1	0.4	0		7.8	7.8	7.8
Fin Fan 4	Point	96	96		0	5	0	1327.8	73.5	4.7		0.2	4.1	0		18.6	18.6	18.6
Fin Fan 3	Point	96	96		0	5	0	1366.1	73.7	4.8		0.2	4.2	0		18.1	18.1	18.1
Fin Fan 2	Point	96	96		0	5	0	1403.2	73.9	4.8		0.2	4.3	0		17.7	17.7	17.7
Fin Fan 1	Point	96	96		0	5	0	1441.9	74.2	4.9		0.2	4.4	0		17.3	17.3	17.3
Diffusor 4	Point	94	94		0	5	0	1333.2	73.5	3.9		0.2	5.5	0		16	16	16
Diffusor 3	Point	94	94		0	5	0	1373.2	73.7	4		0.2	5.6	0		15.6	15.6	15.6
Diffusor 2	Point	94	94		0	5	0	1408.3	74	4		0.2	5.7	0		15.2	15.2	15.2
Diffusor 1	Point	94	94		0	5	0	1448.4	74.2	4.1		0.2	5.8	0		14.7	14.7	14.7