Mt Piper Power Station Extension Environmental Assessment

OPERATIONAL AND CONSTRUCTION NOISE IMPACT ASSESSMENT

- 18 September 2009

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1. Introduction

1.1. General Introduction

The existing Mt Piper Power Station comprises two 700 megawatt (MW) steam turbine generators, which are driven by steam from coal fired boilers. Delta Electricity is proposing to extend the existing Power Station to provide for the projected increase in base load electricity demand in New South Wales.

The following options have been proposed to extend the existing capacity by 2000 MW:

Option 1- Coal Fired Plant Extension

Option 1 would comprise of two (2) 1000 MW ultrasupercritical coal fired generators and associated infrastructure, such as boilers, turbines, condensers, fly ash collection plant, exhaust stack, transformers and overhead wires. A new coal live storage area, coal conveyors and fly ash conveyors would also be constructed.

Option 2 - Gas Fired Plant Extension

Option 2 would consist of up to six (6) CCGT totalling nominally 2000MW and associated infrastructure. The simplest CCGT configuration consists of a gas turbine (GT), a heat recovery steam generator (HRSG) and a condensing steam turbine (ST). Natural gas is fired in the gas turbine which drives a generator to produce electrical power. The hot exhaust gases from the turbine are then ducted into a HRSG to produce steam, which is then used to drive a conventional steam turbine, that is in turn coupled to an electrical generator.

The new plant (the extension) for both options would be constructed, on the western side and adjacent to the existing coal fired plant. With this configuration it would also utilise some components of the existing plant such as the high pressure fire and domestic water tanks, water pipes and rising main, the fuel oil tanks and pipeline and the Fish River water supply pipeline.

1.2. Requirements of the Director General

The NSW Director General has provided project requirements for the noise impacts associated with the Proposal. These requirements have been reproduced below and are addressed in this noise assessment.

Noise Impacts *- the Environmental Assessment must include a comprehensive operational noise impact assessment for the project, prepared in accordance with NSW Industrial Noise Policy (EPA, 2000) considering worst case operating scenarios and meteorological conditions, representative monitoring and receiver locations, and cumulative impacts from surrounding power stations (including Mount Piper and Wallerawang) and the Western Rail Coal Unloader. The assessment* *must consider the potential for low frequency noise generation and peak noise events with the potential to cause sleep disturbance. The Environmental Assessment must also consider the potential for:*

- *construction noise impacts considering potential cumulative impacts from concurrent construction works (e.g. the Western Rail Coal Unloader) consistent with the DECC's "construction noise - existing guidelines" available electronically at http://www.environment.nsw.gov.au/noise/constructnoise.htm*
- *vibration impacts during construction and operation consistent with Assessing Vibration: A Technical Guideline (DECC, 2006); and*
- *traffic generated noise during construction and operation consistent with Environmental Criteria for Road Traffic Noise (EPA, 1999).*

The Environmental Assessment must include a framework for the mitigation, management and monitoring of noise impacts, particularly with respect to sensitive receptors likely to be significantly impacted by cumulative noise impacts in the local area.

1.3. Site Location

Delta Electricity's Mt Piper Power Station is located in the Central West region of New South Wales, approximately 17 km west of Lithgow, and 5 km east of Portland. The Power Station operates in a setting of bushland and rural industry with agricultural farming, forestry and coal mining as major sources of income in the area.

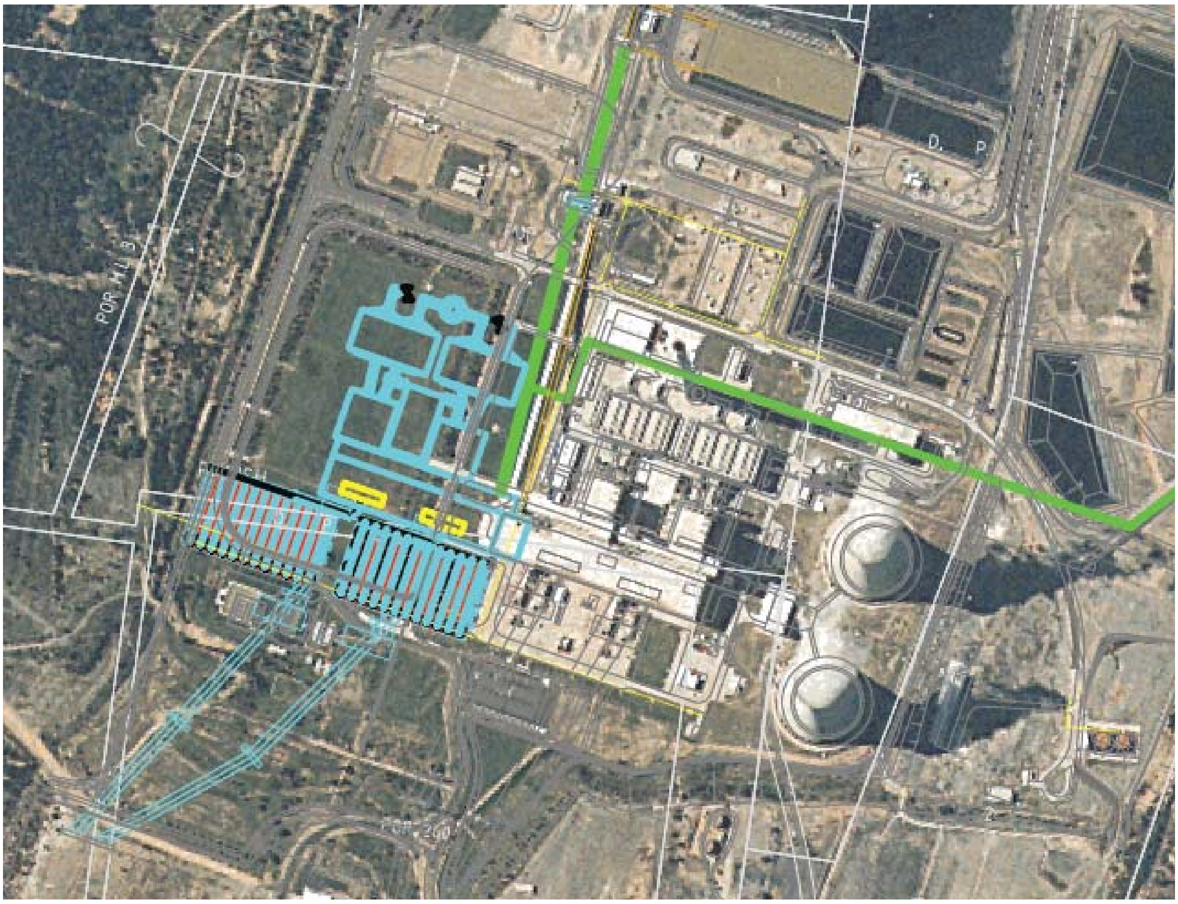
A site plan showing the Power Station site and surrounds is included as **Figure 1-1**. This also details the residential monitoring locations A to D outlined in **Section 2**.

▪ **Figure 1-1 Site Plan and Aerial View of Surrounding Land Uses**

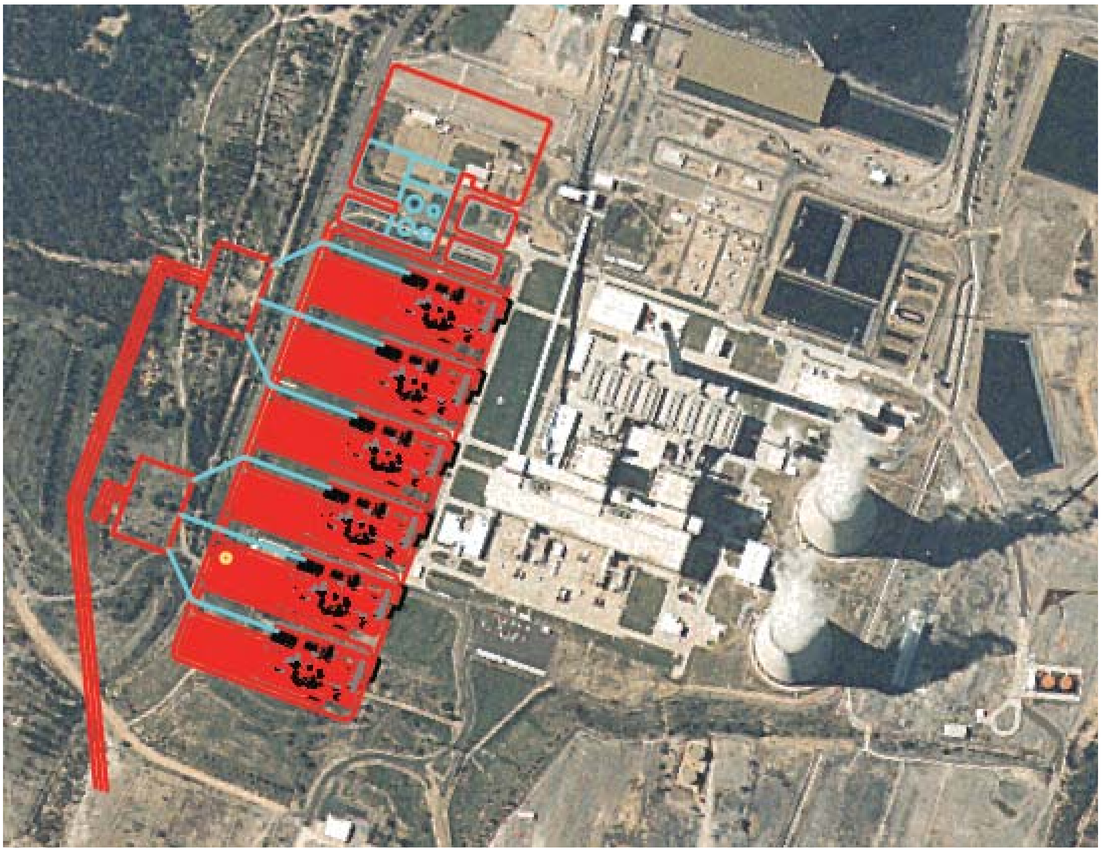
1.4. Description of Existing Mount Piper Power Station

This section provides a description of the existing operations and the proposed extension of Mt Piper Power Station. A site Layout diagram of the existing and proposed coal fired plant extension and gas fired plant extension are included in **Figure 1-2** and **Figure 1-3** respectively.

■ **Figure 1-2 Existing and Proposed Coal Fired Plant Extension Site Layout**



- **Figure 1-3 Existing and Proposed Gas Fired Plant Extension Site Layout**



1.4.1. Existing Power Station

The existing Mt Piper Power Station was commissioned in 1992 and 1993. It comprises two 660 megawatt (MW) steam turbine generators (now operating at 700 MW), known as Units 1 and 2 and driven by steam (sub-critical pressure cycle) provided from coal fired boilers.

The operation of the coal fired station begins with the coal being delivered to the Power Station via conveyor or truck, and is ground in pulverising mills before injection into the boiler furnace chamber in a stream of preheated air. Maximum coal consumption is approximately 250 tonnes per hour. The boiler furnace heats purified fresh water to high pressure steam which is collected in a pressure vessel (steam drum) at the top of the boiler, before it passes through a superheater stage on route to the steam turbines.

Boiler exhaust gases pass through a series of fabric filters to trap ash particles and prevent particle emissions from the boiler stack. The trapped ash particles are collected and disposed of in a designated ash disposal area.

The high pressure superheated steam is expanded through multiple stages of turbine blades on the drive shaft of the turbine, in turn connected to the electric generator. The exhaust steam is cooled to water for re-use in the boiler as it passes over a series of condenser tubes, through which cooling water is circulated. The cooling water is circulated through a natural draft cooling tower and cooled by evaporation of typically 2-3% of water. The generation of electricity from Mt Piper Units 1 and 2 requires significant volumes of water for cooling (about 40 ML/day) and a smaller volume for steam cycle makeup (about 0.4 ML/day). Heat is dissipated to the atmosphere as a humidified plume of warm air from the cooling towers.

The electrical generator consists of the revolving section, called the rotor (which is directly coupled to the steam turbine main shaft), and the stator (the static coil), which operates within the power station's turbine hall. Electricity is produced by the 700 MW generators before it passes through a transformer and then on to the high voltage switchyard and the electricity transmission network.

The elements of the power station including the boiler, turbine, filters and stack are all sources of noise emissions from the existing station.

1.5. Proposed Power Station Extension

The following sections outline the proposed works associated with each option for the Mt Piper Power Station capacity upgrade.

1.5.1. Coal Fired Plant Extension

The first option for the Mt Piper Extension Project would comprise the installation of two new 1000 MW generators, adjacent to and on the western side of the existing Mt Piper Power Station. New overland conveyors will be required to transport coal from a new rail siding to a new long term coal stockpile.

The coal will be pulverised and used to fire two new boilers which will operate with an ultra-supercritical pressure cycle. Ash will be collected from the boiler furnace chamber, economiser, air-heater and fabric filter baghouse. The quantity of ash produced will depend on the ash content of the coal being used and the quantity of coal being burned. Flue gas will be emitted to the atmosphere via a single stack approximately 250m in height, comprising 2 flues.

The steam generated by the boilers will be routed to the high pressure turbines where some of the heat energy will be converted to mechanical energy. The steam will then return to the boiler for reheating before it flows through the intermediate pressure turbines and then to the low pressure turbine to convert more of the heat energy into mechanical energy. Steam discharged from the low pressure turbines will pass to direct air cooled condensers (ACC), which transfer steam from the turbine directly to banks of finned tube heat exchange modules. The steam will be condensed to water before it is returned to the boiler by way of feed heaters, which use steam extracted from the turbines. Heat will be dissipated to the atmosphere via fan-forced air flow over the tube banks of the ACCs located on the south west of the site.

The electrical power output of the Power Station will be delivered, via step up transformers, to a new 500kV switchyard which is located adjacent to the existing switchyard. High voltage transmission lines will connect the extended Power Station to the new switchyard.

The proposed coal fired plant (extension) option differs from the existing plant in three major factors:

- It will use 1000 MW generators, instead of the existing 700 MW units, however the noise emissions from these units are not expected to vary significantly from the existing units;
- It will use ultrasupercritical rather than sub-critical technology for the boiler steam cycle, thereby increasing efficiency and reducing the level of greenhouse gas emissions from coal burning. Once again there is not expected to be an increase in noise levels when compared to the existing unit; and
- It will use air cooled condensers, rather than cooling towers, to eliminate the consumption of water for steam condensing. The air cooled condensers are a significant source of environmental noise emissions compared to the cooling towers.

1.5.2. Gas Fired Plant Extension

Option 2 would consist of up to six (6) Combined Cycle Gas Turbines (CCGT) totalling a nominal 2000MW and associated infrastructure. Generation of electricity from the gas turbines is from a natural gas fired gas turbine which drives a generator producing power. The hot exhaust gases from the gas turbine are ducted into the heat recovery steam generator to produce steam (replacing the conventional fossil fuel fired boiler).

The steam is expanded through the steam turbine driving a generator to produce additional power. Steam is raised at three pressures and there is normally a reheat section in the steam cycle wherein steam leaving the high pressure steam turbine is reheated and mixed with intermediate pressure steam generated in the heat recovery steam generator. Low pressure steam would be mixed with the steam leaving the intermediate pressure steam turbine section. The expanded steam is condensed and returned to the heat recovery steam generator as feedwater. The gases leaving the heat recovery steam generator are exhausted to the atmosphere.

The air, fuel, water and steam cycles can be integrated to greater or lesser extents (eg fuel pre-heating, steam generation using cooling air extracted from the compressor, steam cooling of gas turbine blades). The final design would normally depend on the equipment supplier’s approach.

Approximately two thirds of the cycle power is generated by the gas turbine and the remaining one third by the steam turbine. This ratio varies slightly, however, with plant selection and the mode of operation.

The proposed gas fired plant (extension) option differs acoustically from the existing plant in the following ways:

- One or more of the gas turbines may be running at any given time (depending on the configuration) and therefore the noise emissions will vary accordingly.
- The exhaust stacks for the gas turbines are significantly lower than the coal fired plant and therefore emissions from the exhaust mouth would tend to be shielded by the surrounding topography to a greater degree.
- The gas turbines will use banks of air cooled condensers to cool the recirculated water for the cooling system. These air cooled condensers are a a significant source of noise when compared to the existing cooling towers.

There are four main manufacturers for large heavy industrial gas turbines: Alstom, General Electric (GE), Mitsubishi Heavy Industries (MHI) and Siemens. The performance of the various plant options available in the size range under consideration here is summarised in **Table 1-1**.

- **Table 1-1 ISO Ratings for Available Plant**

GT Model	GT26	9 FB	701 F	4000F	9H	701 G	8000H
Supplier	Alstom	GE	MHI	Siemens	GE	MHI	Siemens
Nominal Capacity	424	413	416	416	520	498	530
Nominal Efficiency (HHV)	53.0%	52.7%	53.6%	53.0%	54.5%	53.9%	54.5%

Data from Gas Turbine World 2007/08 and Siemens, assuming one gas turbine/HRSG/steam turbine and at 15°C, sea level and 60% relative humidity and wet cooling.

Based on available data for a CCGT, modelling for noise emissions has been undertaken based on an Alstom GT26 plant. The noise modelling inputs for this unit have been taken from manufacturer data and field measurements. The modelling of the CCGT has been based on a design that incorporates attenuation in the turbine building such as equipment enclosures and insulation in the walls and roof. Other external noise sources from the unit such as air intake and stack opening also include a high degree of noise attenuation. Sound power data for the modelled CCGT is presented in **Table 4-2**.

2. Existing Noise Environment

2.1. Overview

Noise monitoring for the project was undertaken to enable the setting of appropriate criteria with respect to the existing environment. In general to categorise the range in the background noise levels, one week of ambient noise monitoring must be undertaken. One 24-hour monitoring period is categorised into the following three assessment periods:

- Day – 7:00 am to 6:00 pm;
- Evening – 6:00 pm to 10:00 pm; and
- Night – 10:00 pm to 7:00 am.

Background noise levels were measured at locations around Mt Piper Power Station between September and October 2005 and again on between July and August 2006. The purpose of long term noise monitoring is to provide noise level data to help characterise the influence of the existing noise sources in the vicinity of the Power Station. The additional data is aimed at determining variations in seasonal changes to the noise environment surrounding the Power Station.

The sites selected for logging were based on availability of residents combined with a diverse range of locations approximating north, south, east and west of Mt Piper Power Station. The locations of the noise loggers, with respect to the Power Station, are shown in **Figure 1-1**. Subsequent monitoring used the same locations to ensure repeatability of the initial results. The location and a description of where the loggers were situated on the properties is given in **Table 2-1** below.

- **Table 2-1 Monitoring Locations**

Location ID	Location	
A	Back Cullen Road, Portland	Fence on the western side of the property
B	Humphrey Street, Portland	Corner Strainer of paddock (Laneway)
C	Irondale Road, Pipers Flat	Along the fence line near cattle yards
D	Noon Street, Blackmans Flat	Side fence of property

2.2. Environmental Noise Measurements

The following section provides a summary of the background noise surveys and the results of the attended as well as the unattended monitoring.

2.2.1. Unattended Noise Monitoring

The unattended monitoring was undertaken with automatic noise loggers that measure environmental noise and store the results in memory. The loggers used were ARL type 316, 215 and 015 and had been NATA tested by the manufacturer within the last 12 months. The loggers were set to record a range of noise indices at 15 minute intervals. This data was used to determine the median values for the L_{Aeq}, L_{A90}, L_{A10} and L_{A1} descriptors for the day, evening and night time period.

The Rating Background Level (RBL) is the overall, single-figure, background level representing each of the day, evening or night assessment periods over the whole monitoring period. This is the level used for assessment purposes. It is defined as the median value of all the day, evening or night assessment background levels over the monitoring period. A summary of the noise data is shown in **Table** 2-2 and the daily graphs are provided in **Appendix A.** For information on the definitions of the noise descriptors refer to **Appendix B**. Importantly **Table 2-2** has modified data sets for separate occasions at Locations A & B due to errors with the logger equipment. While this data cannot be solely used to quantify the noise environment, it provides additional information to the full data sets obtained during other logging periods. These incomplete data sets have been denoted with a (‘) for each of the monitoring periods.

- **Table 2-2 Summary of Unattended Noise Survey**

Location	Date	Rating Background Level (RBL)			L_{Aeq} over the assessment period		
		Day	Evening	Night	Day	Evening	Night
A	14/9/05	32	34	31	45	43	43
A’	25/07/06	31	30	31	40	44	40
B’	14/9/05	32	31	29	49	40	39
B	25/08/06	30	28	25	50	43	40
C	14/9/05	34	44	35	49	49	46
C	25/08/06	27	25	23	43	43	38
D	14/9/05	39	36	32	51	47	50
D	25/07/06	41	34	31	55	50	52

Revised noise data - B’ = Humphrey Street, A’ = Back Cullen Road

2.2.2. Discussion of Unattended Noise Data

Location A - Back Cullen Road, Portland:

- **14/09/05** The noise levels at Location A are as per expectations for this location and in line with attended noise monitoring measurements. The main influences on the noise levels at night are natural sources such as wildlife (birds, frogs) and other sources such as road traffic.
- **25/07/06** Noise logger failure during the survey at this location meant that there was not a full set of data recorded. The noise levels during this monitoring are for a period of only three

days and are presented in the table as A'. Measured noise levels during this period are however very similar to the previous set of unattended monitoring results.

Attended measurements were made during calm cold conditions with clear skies that may enhance temperature inversion formation. The measured background levels for the attended survey were approximately 5 dB(A) higher than previously measured but still 2 dB(A) less than the median RBL for night time at this location. The 2006 monitoring identified audibility of Mount Piper Power Station during the attended survey in higher background levels than previous measured at this location.

Location B - Humphrey Street, Portland:

14/09/05 From the graphs in **Appendix A** it is apparent that the data at Location B has been effected for a large part of the monitoring period, which later proved to be a logger fault. The last 3 days show a more normal level of noise activity and are presented in the table as B' for the same location.

- **25/08/06** Unattended monitoring during this survey showed consistent results with the previous abridged monitoring data. During the attended survey the weather conditions were ideal for monitoring and Mount Piper PS was clearly audible. The previous attended monitoring returned lower background noise results coupled with inaudibility of the Power Station. Meteorological effects (possibly a noise enhancing temperature inversion) are therefore likely to be the cause of some of the increase in background noise levels and audibility of the power station during the latest attended monitoring. Although as with Location A, the potential for temperature inversions during this unattended survey has not affected the RBL for the night time.

Location C - Irondale Road, Pipers Flat:

- **14/09/05** The monitoring data a Location C indicates that day time noise levels are constantly low through the day. In conjunction with the attended monitoring it has been surmised that the increase in noise level during the evening and night periods is due to wildlife activity which at this location is heavily dominated by frog noise. Other sources of noise at this location include cattle noise and occasional road traffic. The logger at this location was in an open paddock and was not located near any trees.

- **07/08/06** There was no significant noise from wildlife during the latest attended monitoring and this is reflected in the lower noise levels recorded for the unattended monitoring. Mount Piper Power Station was not audible during the attended monitoring in a lower background than that which was recorded during the previous survey. The weather conditions during the attended monitoring were cold with clear skies and winds that varied from still to a light westerly breeze and were considered ideal for monitoring.

Location D - Noon Street, Blackmans Flat:

- **14/09/05** The noise at this location is influenced by road traffic and noise from natural sources such as birds and dogs. At the time of logger deployment a diesel pump was operational and therefore other noise sources were not audible at this location.

- **25/08/06** The unattended monitoring indicates that noise levels had not varied significantly during the latest round of measurements with only 1-2 dB(A) difference in levels. During the attended survey, noise emissions from Wallerawang were clearly audible and tended to dominate the background noise environment, however no audible noise was noted from the Mount Piper Power Station.

With the exception of Location C (Irondale Road), the 2006 unattended noise monitoring results returned a median that was similar for the majority of the day evening and night time periods to the values obtained for the 2005 monitoring. At Location C the previous monitoring was highly affected by insect noise and therefore the results obtained during the 2006 monitoring will be a better indicator of background levels for this location.

At Locations A & B the median RBL results were the same or lower for the night time during the 2006 monitoring, despite Mount Piper Power Station being audible during the attended monitoring. From this result it may be concluded that while temperature inversions may affect the local noise environment around the Power Station, the long-term median result is not likely to be significantly impacted.

2.2.3. Attended Monitoring

Attended noise monitoring was carried out at the same locations where noise loggers had been positioned. The attended monitoring around the Power Station was conducted over two survey periods one year apart. It was assumed and supported by monitoring data in **Table 2-2** that background noise levels are at the lowest during the night time and therefore any noise emissions from the Power Station may be detected.

The attended monitoring during these surveys has been used to establish the lowest ambient noise level and to observe if the Mt Piper Power Station was audible during these times at these locations. **Table 2-3** presents a summary of the monitored noise levels and the various sources that comprised the noise environment for the two separate surveys.

Table 2-3 Summary of Attended Noise Survey

Loc'n	Date & Time	Night Time Noise Levels – dB(A)				Mount Piper P.S. Audible?	Contribution to noise environment
		L_{A90}	L_{A10}	L_{Aeq}	L_{Amax}		
A	14/9/05	24	38	34	49	N	Frogs, dogs, voices, distant traffic
A	7/08/06	29	34	33	48	Y	Mt Piper P.S. audible against background levels
B	14/9/05	25	33	29	41	N	Frogs, dogs, sheep
B	7/08/06	32	37	35	52	Y	Max from occasional dog bark, some road traffic Mt Piper P.S. audible against background levels
C	14/9/05	28	32	30	42	Y	Frogs, cows, some traffic. Mount Piper occasionally audible
C	7/08/06	24	30	31	51	N	Wallerawang audible against background levels. Became barely audible at the end of the attended monitoring Mount Piper not audible during survey.
D	14/9/05	N/A	N/A	N/A	N/A	N	Generator operational during survey
D	7/08/06	33	54	49	64	N	Max level from truck passby. Wallerawang audible and dominant background source. Mount Piper not audible during survey

For the initial attended survey (2005), at Location C the measurements were taken further along Pipers Flat Road where the effect of frog noise was significantly less. At this location the Power Station was just audible when noise levels were at a minimum. The estimated continuous noise level from the Power Station was 26 dB(A) at this location.

At all other locations the Power Station was not audible during the day or night. Anecdotal evidence from residents at Locations C and D indicate that during certain meteorological conditions the Power Station may be audible.

During the second attended survey in 2006, audibility of Mount Piper Power Station was observed. Operational noise was audible against background levels at two of the four locations to the west of Mount Piper. The character of the noise was that of a low hum centred on the 160 and 630 Hz $^{1}/_{3}$ Octave Band from the direction of the power station. It has been concluded that the increase in background noise and the audibility of the power station are related to the possibility of temperature inversions on cold calm nights. The phenomenon whereby the sensitive receivers on the western side are exclusively affected is thought to be due to the influence of upper air currents or regional drainage flows, enhancing emissions in this direction.

2.2.4. Discussion of Noise Monitoring Results

In summary it is determined that the current operations of the Mt Piper Power Station may only affect noise levels at nearby receivers during certain meteorological conditions such as down wind direction and during temperature inversion conditions.

During the initial noise survey (2005) the Power Station noise impacts were inaudible at all receiver locations except for Location C and were below background noise levels, during the night time period where very low noise levels exist within the rural environment. For the second round of attended noise monitoring (2006) the Power Station was audible at only two of the attended monitoring locations.

While the background noise levels of attended measurements in 2006 were higher than those previously measured in 2005, the unattended monitoring results were similar or less than those previously recorded which indicates that the effects of meteorological conditions has little impact on the longer term RBL's for the night time period. During both surveys there were no observed tonal or impulsive noise emissions from the Power Station.

The influence of Wallerawang Power Station at some of the receiver locations is largely due to the effects of wind direction. The cumulative noise influence of the Wallerawang and Mt Piper Power Stations at sensitive receiver locations is negated by the location of the receivers in relation to the stations. When the wind is directed towards a receiver from one of the power stations, it would reduce any impacts from the other, being in a diametrically opposing direction.

3. Legislative Requirements

3.1. Overview

The Mt Piper Environment Protection Licence number 13007 does not include the provision for noise limits for current operations.

In January 2000, the Department of Environment and Climate Change (DECC) released the *NSW Industrial Noise Policy* (INP). This document provides the framework and process for deriving project specific noise limits for impact assessments and (separately) limits for consents and licences that will enable the authority to regulate premises that are scheduled under the *Protection of the Environment and Operations Act, 1997*.

The INP is designed to determine an acceptable level of impact expected at a community level, and has been used as a guideline for the noise impact assessment for the proposed Power Station extension. Where the INP criteria are met no adverse noise impacts would be reasonably expected at the closest receivers. The specific noise objectives that are presented in this report were derived in accordance with the INP.

The INP requires that the noise from a development under assessment comply with the lower of the amenity or intrusive noise criteria. The intrusive criterion is determined by the difference between the industrial noise under assessment being no more than 5 dB(A) above the Rating Background Level (RBL). The RBL is the tenth percentile of the background noise environment evaluated in the absence of industrial noise from the development in question. This is usually assessed prior to the commencement of operations.

The amenity criterion is based on the zoning of the residences likely to be affected by noise, the general land use near the receiver location and the extent of the existing industrial noise in the area. Where there is an existing influence of industrial noise, the INP implements modifying factors to the criteria to account for cumulative noise impacts in order to minimise background creep and control the long term noise environment. The amenity levels are more suited to planning of noise levels rather than the assessment of project specific impacts. The intrusive noise criteria are designed to account for shorter duration noise impacts and are often the most appropriate tool for assessing the effects of noise at a residential location.

3.2. Intrusive Noise Criteria

A noise source is considered to be non-intrusive if:

- the $L_{Aeq,\ 15\ minute}$ level does not exceed the RBL by more than 5 dB(A) for each of the day, evening and night-time periods,

- the subject noise does not contain tonal, impulsive, or other modifying factors as detailed in Chapter 4 of the INP.

From **Table 2-2** the lowest RBL noise levels for day, evening and night the intrusive noise limits have been applied to the monitoring locations as the assessment criteria. The corresponding intrusive noise criteria for the day, evening and night time periods are presented in **Table 3-1**.

The Industrial noise policy provides guidance in the application of setting the Rating Background Level in **Appendix B - Applying the background noise policy**. Part 3 of section **B1.3 Analysis procedure**, states in relation to an RBL:

"*Where this level is found to be less than 30 dB(A), the rating background level is set to 30 dB(A)*".

Although part of the noise policy, in rural areas this has the effect of setting the intrusive noise limit artificially higher than would be calculated using the background plus 5 dB(A) method. The assessment of the proposed extension has included the INP guidance for a minimum RBL of 30 dB(A) at sensitive receivers, thus making the lowest intrusive noise criterion $L_{Aeq,\ 15\ minute}$ 35 dB(A) at Locations B & C.

It is however cautioned that a blanket application of this policy is not always in the best interests of the project. In-house experiences with similar projects shows that noise emissions may comply with environmental criteria, however, noise impacts can still be the cause of ongoing tension with neighbouring residents. This report recommends the control of potential noise emissions from the extension through careful design that may provide lower intrusive noise emissions than those identified under the INP.

3.3. Amenity Noise Criterion

The amenity criteria apply to the L_{Aeq} Level determined for the period of assessment of day, evening or night. The definition of the noise amenity classification for the area surrounding the Power Station is "Rural" based on the description for this type of location in the DECC Industrial Noise Policy. The INP recommends that for a residences located in a rural area, an acceptable amenity criteria would be an $L_{Aeq\ (Period)}$ of 50, 45 and 40 dB(A) for day, evening and night periods respectively.

3.4. Cumulative Noise Impact Criteria

The INP aims to control cumulative noise impacts resulting from the combined effects of a proposed project and existing industrial noise sources by modifying the amenity criteria depending on the level of existing impact. Where there is an existing industrial noise influence, the amenity criteria are decreased in accordance with Table 2.2 of the INP.

From **Table 2-2** the measured existing L_{Aeq} noise levels for day, evening and night range from 45-51, 40-49 and 39-50 dB(A) respectively. **Table 2-3** details measurements of the quietest ambient noise levels measured in the vicinity of the Power Station at night. At the residential locations the attended monitoring identified that there were audible emissions from the Power Station at two sites during the night time period. The audibility of the Mount Piper Power Station was only recorded during the second round of monitoring in 2006. Prior to this the monitoring did not reveal any noise emissions from the power station and therefore it has been concluded that audibility is possibly a result of temperature inversion conditions and may not occur under neutral meteorological conditions.

From location C it was estimated that under neutral meteorological conditions the existing noise emission from the Power Station is approximately 27 dB(A) L_{Aeq}. Therefore from Table 2.2 of the INP no penalties are applied to the Acceptable Amenity criteria for the night time. The amenity noise criteria for rural residential receivers are presented with the other criteria in **Table 3-1**. The lower of the Amenity or Intrusive criterion has been selected as the project specific level for each location.

3.5. Low Frequency Noise Impacts

Section 4 of the INP lists modifying factor adjustments to account for certain annoying characteristics of noise emissions from industrial premises. The low frequency adjustment requires that the difference between the predicted C weighted and A weighted levels is no more than 14 dB(A), without penalty. The average difference between the C weighted and the A weighted levels calculated for the Mt Piper extension project is in the order of 20 dB when calculated at a receiver location and therefore the current assessment includes a penalty for low frequency noise. In accordance with Table 4.1 of the INP, a 5 dB(A) penalty has been added to the predicted noise levels.

- **Table 3-1 Derivation of Project Specific Noise Criterion**

	Day	Evening	Night-time
Intrusiveness Criteria	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$
Project Intrusiveness Criteria	L_{A90} + 5 dB(A)	L_{A90} + 5 dB(A)	L_{A90} + 5 dB(A)
Project Specific RBL levels			
Location A	37 dB(A)	39 dB(A)	36 dB(A)
Location B	35 dB(A)	35 dB(A)*	35 dB(A)*
Location C	35 dB(A)*	35 dB(A)*	35 dB(A)*
Location D	44 dB(A)	39 dB(A)	36 dB(A)
Amenity Criteria	$L_{Aeq\ 11hr}$	$L_{Aeq\ 4hr}$	$L_{Aeq\ 9hr}$
Acceptable Amenity Criteria	50 dB(A)	45 dB(A)	40 dB(A)
Modified Amenity Criteria	-	-	-
Project Amenity Criteria	50 dB(A)	45 dB(A)	40 dB(A)
Project Noise Criteria	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$
Location A	**37** dB(A)	**39** dB(A)	**36** dB(A)
Location B	**35** dB(A)	**35** dB(A)	**35** dB(A)
Location C	**35** dB(A)	**35** dB(A)	**35** dB(A)
Location D	**44** dB(A)	**39** dB(A)	**36** dB(A)

(*) Adjusted to meet the INP Minimum RBL Requirement

As discussed the amenity criteria are primarily designed to control long term noise through planning goals. The intrusiveness criteria are better suited to control noise impacts that may potentially cause annoyance at nearby residences. Due to the low existing background noise levels, the intrusiveness criteria for the day time and night time are the most stringent of the noise goals, and these will be used to assess the potential for noise impacts as the result of the proposed extension of Mt Piper Power Station. The day, evening and night time limits would apply to noise generated by the Power Station operations at any residential dwelling or sensitive receiver.

3.6. Sleep Disturbance Criteria

The DECC Environmental Noise Control Manual (ENCM) (NSW EPA 1994) provides guidance in assessing the likelihood of sleep arousal due to industrial noise impacts. The assessment of sleep disturbance varies between studies however it is commonly acknowledged that not all people are affected to the same degree or by the same noise exposure.

Findings from studies of sleep disturbance measured by an awakening, change in sleep state or after-effects, reflect the considerable variation in people's response to noise. Suggested peak permitted noise levels vary from 45 to 68 dB(A), depending on ambient noise (Griefahn 1991), and disturbance is related to both the number and maximum level of noise events (Bullen *et al.* 1996). Appropriate internal design noise levels for various types of occupancy are detailed in the Australian Standard AS 2107-1987.

For assessment purposes, the ENCM uses the criteria based on L_{A1} noise level of the source being no more than 15 dB(A) above the L_{A90} (background) noise level, when measured outside a bedroom window. From the monitoring results in **Table 2-2** and based on the audibility of the power station at Location C the sleep disturbance noise criterion for the most affected sensitive receiver would be 38 dB(A).

Attended monitoring results indicate that the current noise environment not related to the Power Station may produce L_{Amax} events at this location that exceed the sleep disturbance criteria by more than 10 dB(A). In addition noise emission from the power station is at a steady state and therefore not likely to generate noise that could cause sleep disturbance.

3.7. Traffic Noise Impacts

The DECC *Environmental Criteria for Road Traffic Noise*, (ECRTN) (NSW DEC, 1999), details the current NSW policy on road traffic noise. This document provides guidance for all road noise impacts and more specifically the setting of noise objectives that apply to developments that have the potential to create additional traffic on an existing road network. The appropriate noise goals for the proposed Extension are defined in Table 1 of the ECRTN and are summarised for this project in **Table 3-2.**

- **Table 3-2 Road Traffic External Noise Objectives**

Type of Development	Daytime Design Objectives	Night-time Design Objectives	Where the Criteria are already exceeded
Land use developments with potential to create additional traffic on existing collector roads.	60 dB(A) $L_{Aeq(1\,hour)}$	55 dB(A) $L_{Aeq(1\,hour)}$	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using quiet vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB(A).

For the purpose of road traffic noise assessment only, the RTA and DEC define daytime as 7:00 am to 10:00 pm, whilst night-time is 10:00 pm to 7:00 am Monday to Sunday.

3.8. Construction Noise Criteria

The estimated construction period for the extension of the power station is 4-5 years. During this time there would be earthworks and building activities on the Mt Piper site as well as truck movements to and from the power station

In general the acceptability of impacts from construction noise within a community depends on the potential for the noise to interfere with day-to-day activities, the duration of the event, and the extent of its emergence above the background noise level. The DECC recommends limiting the free-field $L_{A10\ (15\ minute)}$ noise levels arising from a construction site (or works) should not exceed criteria detailed in “construction noise – existing guidelines”. These noise criteria are dependent on the existing background noise levels and the expected duration of the works. The noise goals for construction activity are detailed in **Table 3-3**.

▪ **Table 3-3 DEC Construction Criteria Guidelines**

Criterion No.	Duration Of Works	DEC L_{A10} Guidelines
1	Construction period of 4 weeks and under	The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).
2	Construction period greater than 4 weeks and not exceeding 26 weeks	The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).
3	Construction period greater than 26 weeks	The EPA does not provide noise control guidelines for construction periods greater than 26 weeks duration, however, it is generally accepted that provided L_{A10} noise levels from the construction area do not exceed a level of 5 dB(A) above background, then adverse (intrusive) noise impacts are not likely to be experienced at nearest sensitive receptor locations.

Based on the expected duration of the works the criterion at number 3 in the table of background + 5dB(A) would be nominated as the construction noise goal for the Project.

Restrictions are also placed on the hours of construction to ensure that the acoustic amenity of the closest residences is protected. Hours of operation for construction works and associated road traffic for the Power Station Extension would follow standard construction times listed below. An allowance for negotiated variations to these times with the DECC will be necessary where construction works will need to take place at times outside these hours for operational, safety and access reasons.

- Monday to Friday: 7am to 6pm;
- Saturday: 8am to 1pm; and
- No audible construction work to take place on Sundays or public holidays.

3.9. Summary of Project Noise Goals

Table 3-4 summarises the project specific noise goals outlined above at the potentially most affected residence.

- **Table 3-4 Summary of Project Specific Noise Criteria**

Description	Day	Evening	Night
Operational Criteria	$L_{Aeq\ 15\ min}$	$L_{Aeq\ 15\ min}$	$L_{Aeq\ 15\ min}$
Location A	**37** dB(A)	**39** dB(A)	**36** dB(A)
Location B	**35** dB(A)	**35** dB(A)	**35** dB(A)
Location C	**35** dB(A)	**35** dB(A)	**35** dB(A)
Location D	**44** dB(A)	**39** dB(A)	**36** dB(A)
Traffic Noise Criteria	$L_{Aeq\ 1hr}$		$L_{Aeq\ 1h\ r}$
Collector Roads	**60** dB(A)	N/A	**55** dB(A)
Sleep Disturbance Criteria	N/A	N/A	$L_{A1\ 15\ min}$
Location A			**46** dB(A)
Location B			**40** dB(A)
Location C			**38** dB(A)
Location D			**46** dB(A)
Construction Noise Criteria	$L_{A10,\ 15\ min}$		
Location A	**37** dB(A)	N/A	N/A
Location B	**35** dB(A)		
Location C	**35** dB(A)		
Location D	**44** dB(A)		

4. Noise Impact Assessment Methodology

4.1. Assessment Methodology

Noise impacts are assessed by firstly predicting the noise levels from the proposed extension as well as the other site noise sources such as the existing power station and the coal unloader at each of the representative receiver locations. The cumulative impacts from the proposed Power Station Extension for both options are then compared to the project specific noise goals identified in **Table 3-1** to confirm compliance with these goals. Assessment of the predicted noise impacts associated with Option 1 (coal fired plant) and Option 2 (gas fired plant) are discussed in **Section 5** and **Section 6** respectively.

4.2. Noise Modelling Methodology

The assessment of noise impacts at residences nearest to the Power Station is based on the prediction of noise impacts using a validated noise model. The model was validated by comparing predictions at known locations to measurements taken at the same locations during the noise survey. The measurements identified noise levels from both the natural environment and the existing Power Station operations and were based on observations during the survey. A summary of the measurement results used in the model validation is presented in **Table 4-3.**

4.2.1. SoundPLAN Model

SoundPLAN noise prediction software was used to estimate noise levels from the new plant layout for each option at the nearest residential locations. The modelling was based on sound power data determined by measurement of existing equipment, or in the case of proposed new equipment, noise data obtained from SKM's database.

The noise model used CONCAWE algorithms to predict the $L_{Aeq\ 15\ min}$ impacts at the nearby residences for both daytime and night time scenarios. The use of the CONCAWE model allows for prediction of noise impacts from adverse weather conditions, where the INP identifies these effects must be assessed.

4.2.2. Sources of Noise Emissions

Assessing the noise impacts at nearby residences is complicated by the number of noise sources and the high background levels at the Power Station. Many of the sources are caused by emissions over a large structure such as the boiler house, turbine hall, mills and exhaust stack and associated infrastructure. Where necessary for building sources, estimates of the contribution have been made based on limited site measurement.

To predict the noise impact at the nearby receivers a very good approximation of the individual contribution from each major source is required. In some instances these measurements can only be taken in the absence of other noise influences, which would involve shutting down parts of the Power Station to accurately obtain this data. Other items such as the stack outlet cannot be measured at the source and has been estimated based on other reports of similar infrastructure.

Mt Piper has several existing major sources of noise, which may be broadly described as:

- Induced Draft (ID) Fans, which pull boiler emissions through the static precipitators and pass the exhaust gasses out through the stack;
- Forced Draft (FD) and Primary Air (PA) Fans that feed the boiler;
- Steam Turbines;
- Coal Ball Mills / Feeders;
- Coal Handling Area; and
- Boilers and Associated Pumps.

The ancillary processes and equipment that are associated with the major noise sources also produce noise emissions that contribute to the general noise levels around the site. At closer locations the major sources of noise can be identified however when heard from a distance the noise from the Power Station takes on the characteristic of a general roar and specific items are not able to be distinguished.

4.2.3. Noise Sources for Proposed Coal Fired Plant Extension

Figure 1-2 showed the location of the proposed coal fired option extension the with respect to the existing Power Station facilities.

It is assumed that the new plant would essentially be a duplication of the existing noise sources. Although the new plant is proposed to be 2000MW as opposed to the 1400MW for the existing plant, the noise sources are expected to have similar noise emissions (see Section 1.5.1). It should be noted that the the proposed duplication also includes air cooled condensers (ACC) shown to the south of the proposed turbine hall extension, with red dots indicating the fan positions.

While it is possible that these condensers would have a significant effect on site noise emissions, there are options available to reduce operational fan noise, although this comes with an increase in capital cost. The (ACC) fans used in the noise model represent the noisier option identified, however this data is subject to verification from an equipment supplier.

The list of noise sources identified for the coal fired option used in the modelling process is presented in **Table 4-1**. This table is not an exhaustive list of noise sources from the Mt Piper site, although the main items of plant have been identified for validation of the noise model. Where noise sources are inside building an estimate of the sound power over the facade has been made based on internal measured levels.

- **Table 4-1 Modelled Building and Equipment Sound Power Levels for Coal Fired Plant**

Description	Source Type	SWL dB(A)
Primary Air Forced Draft Fans – Boilers	Building	104
Bag Filters	Building	103
Turbine Hall	Building	105
ID Fan – Stack Noise	Stack	112
Coal Pulveriser/Ball Mill	Building	104
Coal Loader Facility	Point	117
Air Cooled Condensers	Area	120

4.2.4. Noise Sources for Proposed Gas Fired Plant Extension

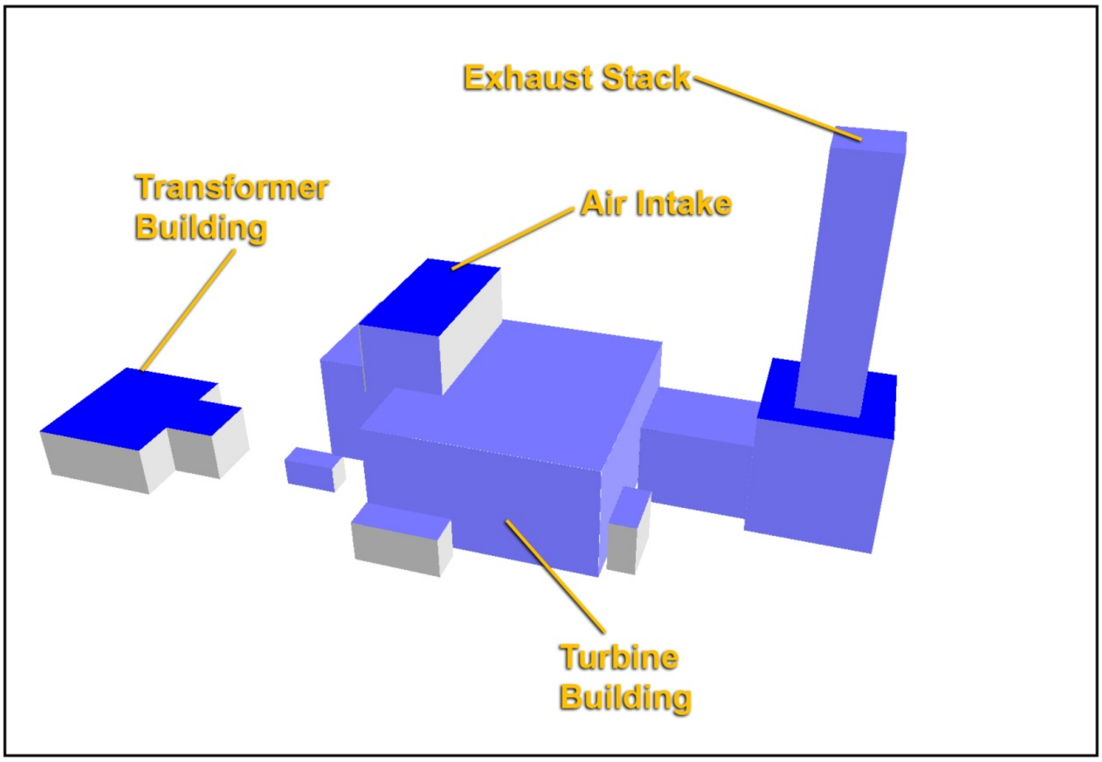
Figure 1-3 showed the location of the proposed installation of CCGT the with respect to the existing Power Station facilities. The major sources of noise from a CCGT include the exhaust stack, the air intake, the turbine building and the transformer building. Secondary noise sources include the feedwater pumps, start up ejectors and blow down valves.

The CCGT would also obtain cooling via air cooled condensers as the heat exchange mechanism for the process water. The cooling towers alone can be a significant source of noise and must be carefully designed to provide adequate attenuation of noise emissions.

All of the above mentioned components tend to exhibit noise spectra that have a significant low frequency content, which attenuates at a slower rate than the higher frequencies and can persist over long distances. These low frequencies also tend respond less to attenuation measures applied at the source of the emissions.

Figure 4-1shows a block diagram of a typical plant with the main noise sources identified. The diagram assumes that other noise sources are contained within the building envelope.

▪ **Figure 4-1 Combined Cycle Gas Turbine Noise Sources**



The list of noise sources identified for the gas fired option used in the modelling process are presented in **Table 4-2**

▪ **Table 4-2 Modelled Sound Power Levels for Gas Fired Plant**

CCGT Plant Item	Sound Power Level dB(A)	Emission Height Range (m)
Air cooled condenser	105	12
Air intake	101	14-25
Main Transformer	97	0-3
Stack Mouth	94	60
Lube Oil Cooler	94	2-4
Diffuser	93	0-7
HVAC System	93	0-3
Feed Water Pump	90	0-3
Turbine building	90	0-23

Non continuous noise sources from CCGT Plants

Noise impacts from start up and shut down procedures may be louder than the normal operations of the plant. These events would include noise from start up ejectors, blow down valves, sirens, circuit breakers and the like. Some of these are process requirements and some are safety requirements.

Due to the intermittent nature of these activities, their effects have not been included in the modelling of normal operational noise emissions at the external receivers. The infrequent nature of these sources is evidenced by their function, which may occur at start up, shut down or during abnormal operations.

These impacts have been assessed against the DECC sleep disturbance guidelines to determine the potential for impacts during these periods. The noise emissions used in the sleep disturbance noise assessment have been based on measurements made during the shutdown operation of a 175MW class OCGT plant. This is considered to be representative of the worst case for similar events in a CCGT plant expected to occur at similar or lower levels. The noise emissions are:

- At shut down, a volume of gas will be trapped in the gas supply system. This gas is normally released and this can create a reasonable noise – measured at 103 dB(A) at 20 m, but for a short period of up to about 30 seconds. If problematic, these noise emissions can be reduced by first passing the gas through a silencer.
- At start up and shut down, the gas turbine compressor bypass valves open, venting air to the HRSG. This can create a short lived noisy event. This discharge is normally piped to bypass air system eventually going to the atmosphere via the HRSG and then the exhaust silencers for a CCGT.
- During start up, noise from the start up ejector may occur.
- When a generator breaker opens or closes an instantaneous noise is emitted. In a CCGT plant, this is normally inside and therefore heavily attenuated by the building enclosure. There are also breakers in the switch yard, which cannot be readily attenuated.
- In an abnormal operational situation, the HRSG safety valves of a CCGT plant may open to relieve the pressure in the steam system. This discharge normally flows through silencers to the atmosphere.

4.2.5. Model Validation

In addition to the residential monitoring sites shown in **Figure 1-1** additional measurement locations on and around Mt Piper Power Station were taken as a reference and used in the model validation. These validation sites are shown in **Figure 4-2** and **Table 4-3** presents the results of the noise model validation based on predictions made to the reference locations.

- **Figure 4-2 Reference Measurements Locations, Mt Piper Power Station**

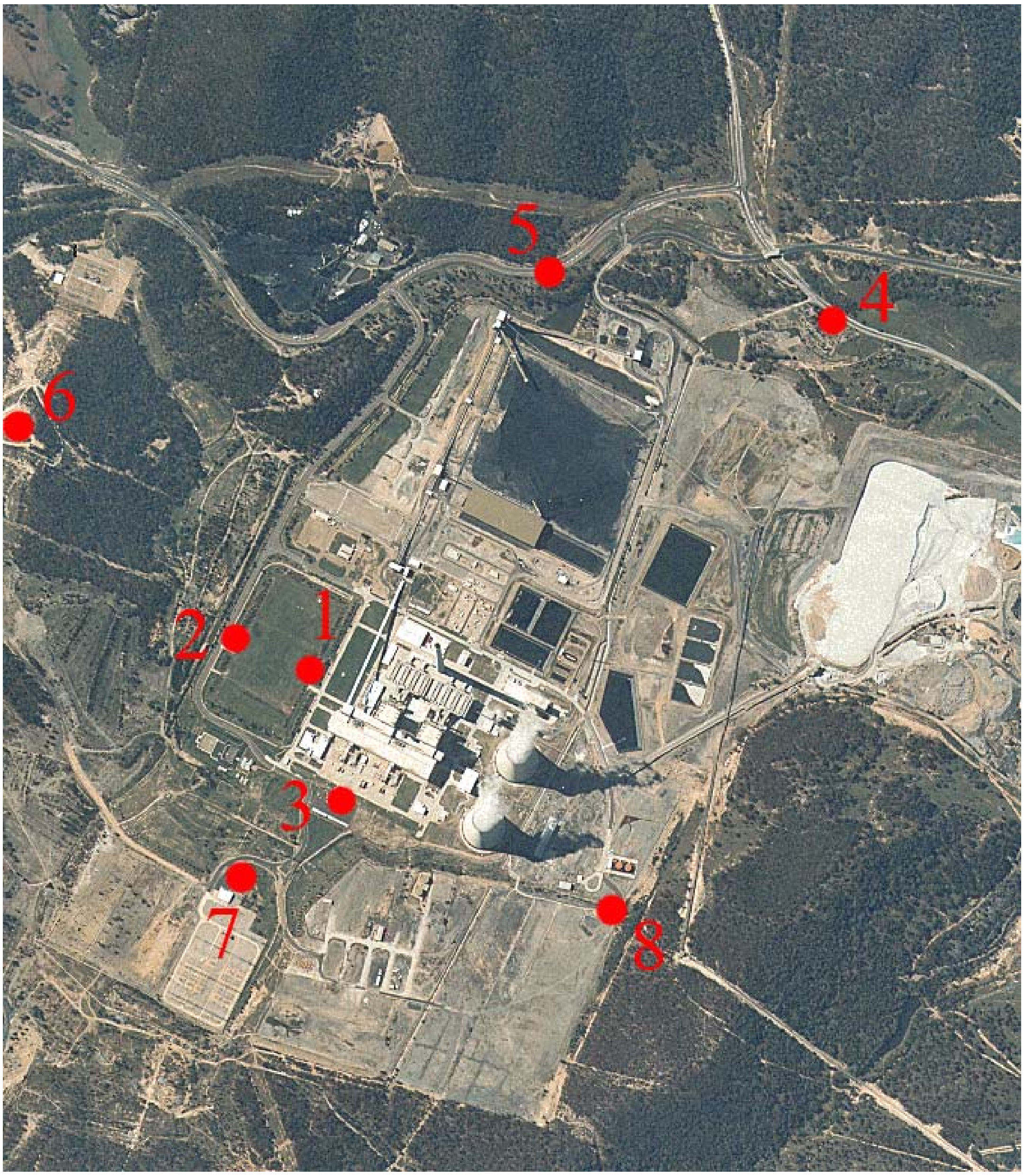


Table 4-3 Noise Model Validation Results

Location	L_{Aeq} Noise Level dB(A)l		Predicted Versus Measured Difference dB(A)
	Measured	Predicted	
Power Station 1	56	54	-2
Power Station 2	51	50	-1
Power Station 3	65	63	-2
Power Station 4	49	49	0
Power Station 5	56	57	+1
Power Station 6	45	45	0
Power Station 7	49	51	+2
Power Station 8	48	51	+3

The Power Station is a complicated network of noise sources and variability of the predicted levels with the measured levels is therefore expected at some locations. The stack exhaust can be a significant source of noise emission from the power station but it is very difficult to quantify noise levels with the existing stack height of 250 metres. The validation measurements at location 6 were taken on a nearby hilltop which overlooked the site and possibly captured stack noise emissions along with other sources on the site. The predicted noise levels from the model however, show good correlation at most locations with measured values and the model is therefore considered to be acceptable for use in the prediction of noise impacts to residential receivers.

4.2.6. Meteorological Conditions

Meteorological conditions were reviewed in accordance with INP guidelines to determine the frequency of adverse weather conditions that may enhance noise from the site at the nearest residences.

As part of the INP noise assessment procedure, the DECC recommends:

- An occurrence of winds less than 3 m/s for 30% of the assessed period is required before the effects of wind on noise propagation from an industrial site are considered significant; and
- The significance of temperature inversions on the propagation of noise emission from an industrial site must be considered where the occurrence of “F” stability class (characteristic of temperature inversion conditions) is 30% or more during the night time winter months. In accordance with the INP, night time is considered to be between 6pm and 7am, i.e. generally 1 hour before sun down and one hour after sun up.

The following sections provide a review of prevailing wind and atmospheric stability conditions in the vicinity of the Power Station to determine whether the effects of adverse meteorological conditions should be considered as part of the impact assessment process

Wind Effects

Table 4-4 presents a summary of the wind occurrence data from Mt Piper met station for 2001, analysed by direction and wind speed. The percentage occurrence of wind in any direction at speeds of less than 3.9 metres per second are estimated to occur for a maximum of only 10% of the time. It follows therefore that wind speeds of less than 3m/s would also occur for less than the DECC recommended limit of 30% occurrence before the effects of wind are considered significant. The effects of adverse wind on the propagation of noise from the site are therefore not required to be assessed for this project.

- **Table 4-4 Wind Occurrence Matrix (Yearly Data)**

Wind Speed (m/s)	Wind Direction								Totals by Speed
	N	NE	E	SE	S	SW	W	NW	
<0.5 (calm)									5.54
0.5 – 1.9	3.73	2.47	1.4	2.22	2.97	4.65	5.1	4.18	26.72
2 – 3.9	4.75	4.6	3.08	5.28	3.39	4.98	5.61	5.55	37.26
4 – 5.9	1.02	0.76	0.97	4.27	2.15	3.72	5.04	2.62	20.55
6 – 7.9	0.14	0	0.26	1.91	0.91	0.87	3.03	0.77	7.9
8 – 9.9	0	0	0.06	0.14	0.62	0.01	1	0.12	1.96
10 – 11.9	0	0	0	0	0.07	0	0	0	0.07
12 – 13.9	0	0	0	0	0	0	0	0	0
Totals by Direction	9.64	7.84	5.78	13.81	10.12	14.24	19.79	13.25	100

While winds are not considered a feature of the area, an additional assessment of wind speeds of up to 3m/ s in all directions has been undertaken in accordance with the INP default values to enable an assessment of these conditions for licensing purposes. An assessment of 3m/s winds shows that the predicted noise levels are the same as those for a temperature inversion and 2m/s winds for all locations. The assessment of adverse weather conditions will therefore be interchangeable for winds of up to 3m/s and temperature inversions of F class stability and 2m/s winds (source to receiver).

Temperature Inversions

The percentage occurrence of Pasquill – Gifford stability classes has been assessed from 2001 meteorological data from Mt Piper Power Station. A summary of the percentage occurrence of the various stability classes, during the winter night-time (6pm - 7am) met assessment period, is presented in **Table 4-5**.

■ **Table 4-5 Night-time Stability Class Occurrence (Winter Months)**

	Stability Classes						
	A	B	C	D	E	F	Total
Number	0	0	0	467	233	497	1197
Percent	0	0	0	39	19.5	41.5	**100**

The meteorological assessment indicates that temperature inversions occur for approximately 42% of the time between the hours of 6pm to 7am during the winter months and therefore an assessment of adverse conditions, i.e. temperature inversions, is required. The temperature inversion parameters recommended in the INP have been used in the modelling and are based on F class stability conditions.

The assessment of winds during the winter months between has also been undertaken to identify the appropriate modelling parameters for meteorological effects under inversion conditions. This is considered to be a more accurate representation of adverse meteorological conditions for the local area around the Power Station.

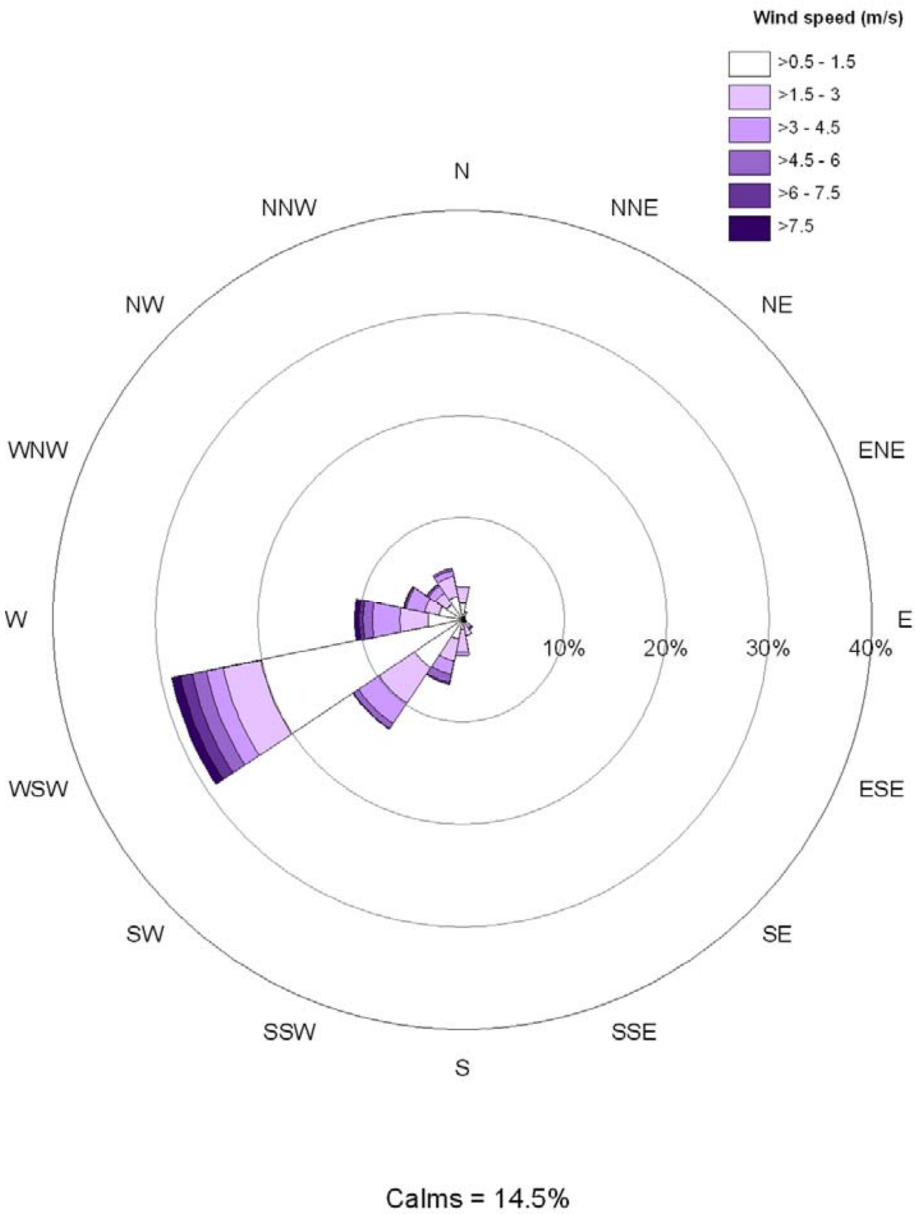
■ **Table 4-6 Night-time Wind Occurrence (Winter Months)**

Wind Speed	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0.5 to 1.5	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.8	1.2	4.8	19.6	3.3	2.3	1.7	1.8	1.3
1.5 to 3	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.3	1.0	3.0	3.0	1.9	0.8	1.2	0.9	0.5
3 to 4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	0.2	0.2	0.3	0.0	0.0	0.0
> 4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	0.2	0.1	0.2	0.0	0.0	0.1	0.0	1.0	2.3	8.4	22.8	5.4	3.3	2.8	2.8	1.8

From the results in the table it can be seen that during this time of year, the night time drainage flow is from the WSW to an ENE direction, which effectively directs noise emissions away from residential locations under inversion conditions. The majority of measured wind speeds during this time are below 1.5 m/s.

Therefore the assessment of temperature inversions should consider wind from the WSW direction at 1.5m/s in the noise modelling scenario. **Figure 4-3** presents a graphical representation of the local wind patterns during the winter months.

- **Figure 4-3 Winter Months Windrose**



5. Coal Fired Plant Noise Assessment

5.1. Predicted Noise from Power Station Operations

The noise model has been used to predict the noise impact from the operations of the existing Mt Piper Power Station combined with the proposed coal fired plant extension. The cumulative impacts to the environment have been considered in the modelling of noise sources by including the noise emissions from the existing coal fired plant as well as the predicted levels from the proposed Western Rail Coal Unloader. The noise levels used in the modelling for existing operations have been validated in the noise model for accuracy but the results of the predictive modelling for the proposed coal fired plant are based on the following assumptions:

- Sound Power levels of new equipment are estimated and should be confirmed with equipment suppliers during the design stage.
- Buildings housing the new equipment are assumed to be of the same design and construction as the existing ones and therefore have the same noise emissions.
- The Power Station operations do not vary between day and night and therefore noise emissions are at a continuous, constant level. Abnormal operations such as safety valve relief have not been included in the modelling.

Table 5-1 presents the results of the noise predictions at the nearest residences for neutral and adverse meteorological weather conditions along with criteria for night time operations, relative to the specific residential monitoring location. The assessed adverse weather conditions include an F class stability and a 1.5m/s wind from the source to the receiver. The INP default conditions include either a 3m/s wind or an F class stability with a 2m/s wind from the source to the receiver. These results have been adjusted to account for low frequency noise impacts by adding 5 dB(A) to the predicted values.

- **Table 5-1 Predicted Levels at Key Residential Locations Coal Fired Option**

Location	Predicted Noise Level Neutral Weather Conditions $L_{Aeq\ 15\ Min}$	Predicted Noise Level Assessed Adverse Weather Conditions $L_{Aeq\ 15\ Min}$	Predicted Noise Level INP Default Adverse Weather Conditions $L_{Aeq\ 15\ Min}$	Project Specific Criteria $L_{Aeq\ 15\ Min}$
	Day or Night	Night	Night	Day or Night
A	33 dB(A)	33 dB(A)	34 dB(A)	36 dB(A)
B	30 dB(A)	30 dB(A)	31 dB(A)	35 dB(A)
C	35 dB(A)	35 dB(A)	39 dB(A)	35 dB(A)
D	33 dB(A)	36 dB(A)	36 dB(A)	36 dB(A)

The results indicate that the predicted noise levels would provide compliance of the INP criteria for night time neutral weather conditions. Conversely predictions under adverse weather conditions indicate that there is potential for marginal exceedances of the project specific criteria during these times. The predicted noise levels for neutral meteorological conditions are shown as noise contours in **Figure 5-1**.

5.2. Discussion of Results

The noise predictions were made using source to point calculations at residential receivers that are representative of the greater residential communities at various locations around the Mt Piper Power Station. These results may therefore be generalised to cover other residences surrounding the Power Station site.

The major contributions to the predicted noise levels at the nearby residences are noise emission from the stacks and the air cooled condensers. As a general rule the duplication of the Power Station would be expected to add approximately 3 dB(A) to the existing noise levels at any receiver location. As it is proposed to use air cooled condensers in place of cooling towers for the extension works, it is expected that the ACC units would increase this noise level by a further 2-3 dB(A) based on the available data.

The exhaust stacks often provide a noise impact over long distances due to the low frequency components of their noise emissions that attenuate at a slower rate than the higher frequencies. Exhaust stack noise is generally tonal at the lower frequencies and it is these tones that are often audible. The air-cooled condensers operate on forced air from fans that exhibit the same tonal characteristics as the stack.

Should the coal fired option be chosen and approved for construction, it is recommended that pre and post noise monitoring be undertaken prior to the final commissioning of the project in order to quantify the impact on the nearby residential receivers under a variety of meteorological conditions.

5.3. Sleep Disturbance

For the proposed coal fired plant extension option the noise levels are expected to be constant in nature. As the predicted noise levels at the nearest residences are estimated to be nominally at the DECC INP noise criterion, it follows that, due to the steady state nature of the noise emissions from the Power Station and the infrequent stoppages, sleep disturbance impacts due to loud noise events are not likely to occur as the result of operations of the proposed extension.

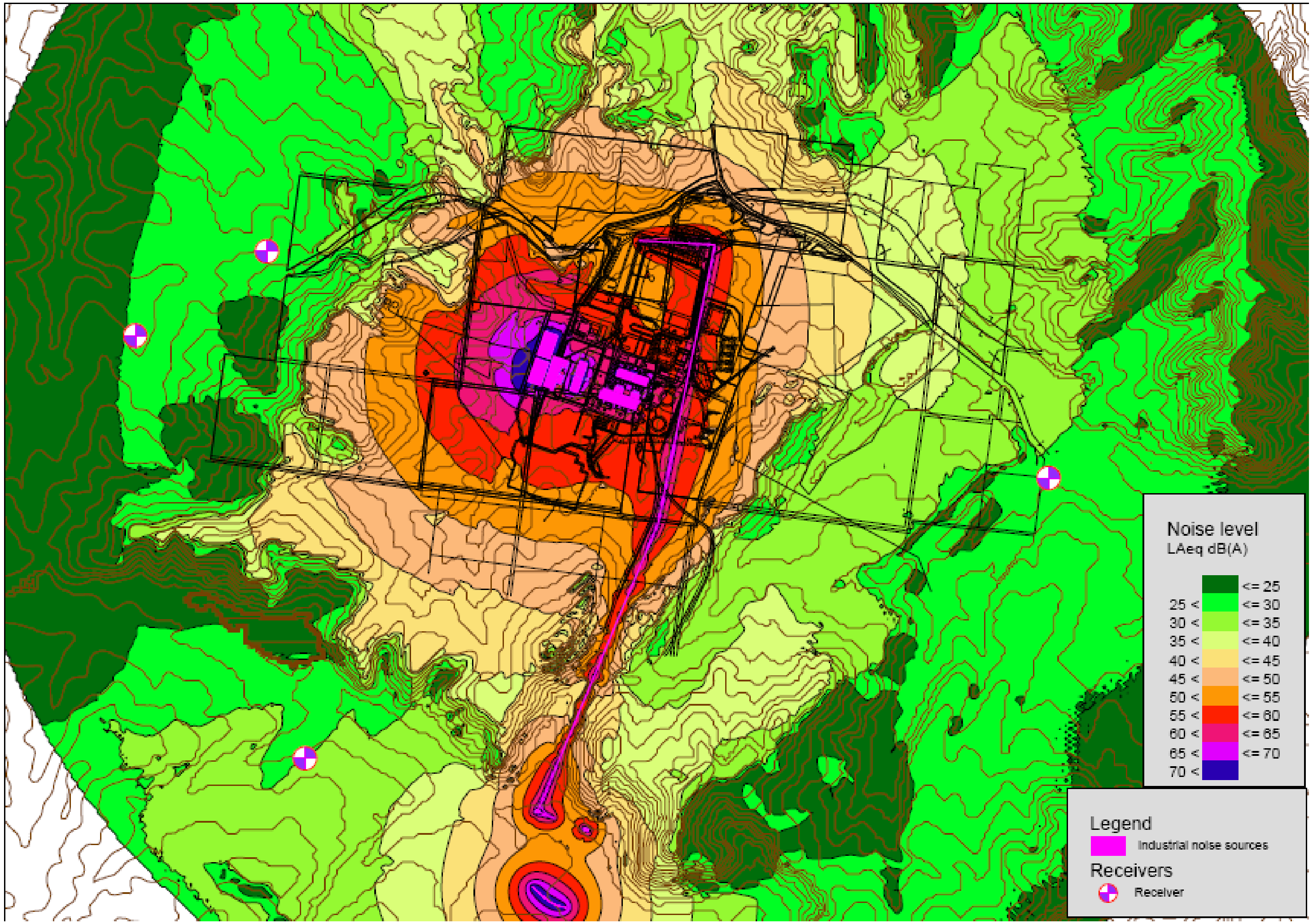
5.4. Limitations of the Modelling

While the predictions indicate that noise levels would generally be below the nominal noise criteria under neutral meteorological conditions, there is the need for caution in the application of these results. The limitations to the modelling process include the accuracy of the noise data used in the model and the accuracy of the algorithm used to predict the noise impacts.

As discussed in **Section 4.2.2**, when setting up the model, the gathering of accurate data in a high noise environment has its limitations. The data gathered for the noise model is based on measurement of the actual equipment but may be contaminated during the measurements by other nearby noise sources. The limitations of the accuracy of predictions are controlled as best as possible by validating the noise model against the site measured data. However it may be seen from the validation of the model that there is the potential for variation of around ± 2dB(A) between predictions and measurements.

It is recommended that at the time of detailed design of the extended power station, contractors responsible for equipment specification and procurement should revisit the current modelling assessment. A full inventory of plant and equipment and associated noise emission data should be provided such that the noise model could be refined to ensure the noise criteria determined for this assessment, is complied with at all times and under all meteorological conditions.

- **Figure 5-1 Predicted Operational Noise Contours – Coal Fired Powered Station (Neutral Conditions)**



6. Gas Fired Plant Noise Assessment

6.1. Predicted Noise from Power Station Operations

The cumulative noise impacts from the existing coal fired plant, the rail coal unloader and the proposed CCGT extension have been considered in the CCGT noise modelling scenario. This scenario included all 6 CCGTs under steady continuous operational load.

As for the Coal fired option, Table 6-1 presents the results of the noise predictions at the representative noise sensitive receiver locations. The predictions are for neutral and adverse meteorological conditions these results and the associated criteria are for night time operations. The assessed adverse weather conditions include an F class stability and a 1.5m/s wind from the source to the receiver. The INP default conditions include <u>either</u> a 3m/s wind or an F class stability with a 2m/s wind from the source to the receiver. These results have been adjusted to account for low frequency noise impacts by adding 5 dB(A) to the predicted values..

▪ **Table 6-1 Predicted Levels at Key Residential Locations CCGT Option**

Location	Predicted Noise Level Neutral Weather Conditions $L_{Aeq\ 15\ Min}$	Predicted Noise Level Assessed Adverse Weather Conditions $L_{Aeq\ 15\ Min}$	Predicted Noise Level INP Default Adverse Weather Conditions $L_{Aeq\ 15\ Min}$	Project Specific Criteria $L_{Aeq\ 15\ Min}$
	Day or Night	Night	Night	Day or Night
A	31 dB(A)	31 dB(A)	33 dB(A)	36 dB(A)
B	27 dB(A)	27 dB(A)	29 dB(A)	35 dB(A)
C	35 dB(A)	36 dB(A)	40 dB(A)	35 dB(A)
D	32 dB(A)	36 dB(A)	36 dB(A)	36 dB(A)

The results for the CCGT indicate that the predicted noise levels would comply with the INP night time criteria at all locations under neutral and assessed adverse meteorological conditions, although the influence of the coal unloader for residences to the south of the power station make this compliance marginal.

Predictions of noise impacts due to default adverse weather conditions indicate the potential for a marginal exceedance at residential locations in Blackman's Flat and a substantial exceedance of the project specific criteria for residences in Pipers Flat, to the south of the power station.. The predicted noise levels for neutral meteorological conditions are shown as noise contours in **Figure 6-1**. These contours do not carry the 5 dB(A) penalty for low frequency impacts.

6.1.1. Discussion of Results

For the operation of the CCGT component of the power station, depending on the ultimate configuration, there is the potential to run 1 or all of the 6 CCGTs. The modelling has assumed that all 6 CCGT would be operational simultaneously and therefore this may be considered a worst case scenario.

The representative receiver locations indicate that noise guidelines will be met at the majority of locations. However, under adverse weather conditions when the coal unloader and the power station are fully operational, the addition of a low frequency noise penalty indicates an exceedance of the noise goals by up to 5 dB(A) is possible for receivers to the south of the power station at Pipers Flat. This is primarily because of the addition of a low frequency penalty being applied to the combined influence of the power station and the coal unloader. Under normal circumstances, the coal unloader operations would not draw the low frequency penalty in its own right.

6.1.2. Sleep Disturbance

The nature of the gas fired Power Station means that stop/start noise influences can occur much more frequently that a coal fired power station. Due to the potential for noise impacts that are louder than normal operations to occur, an assessment of sleep impacts from start up and shut down noise sources has been undertaken for the CCGT. Based on estimated noise levels of 103 dB(A) at 20 metres, an assessment of the potential for sleep disturbance impacts has been made. These results are shown in Table 6-2.

- **Table 6-2 Predicted Sleep Disturbance Levels at Key Residential Locations**

Location	Predicted Noise Level INP Default Adverse Weather Conditions L_{A1}	Project Specific Criteria L_{A1}
	Night	Day or Night
A	33 dB(A)	46 dB(A)
B	26 dB(A)	40 dB(A)
C	29 dB(A)	38 dB(A)
D	34 dB(A)	46 dB(A)

The noise level for peak events from the CCGT are expected to be significantly lower than the sleep disturbance criteria at all sensitive receiver locations.

6.1.3. Limitations of the Modelling

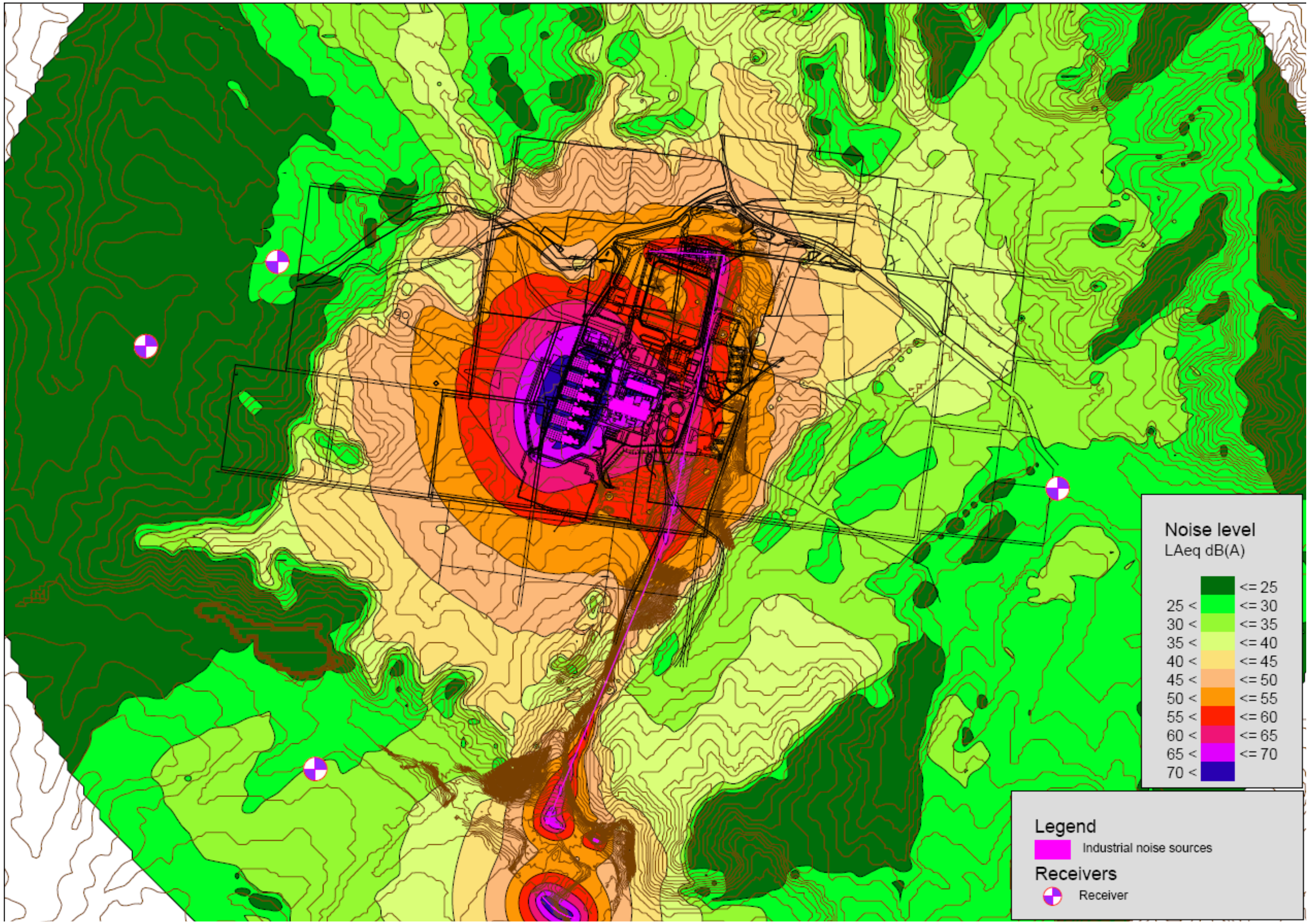
The modelling for the CCGT is based on available data for a single turbine type. The number of gas turbines that are potentially available from different manufacturers will have individual noise emission characteristics and may not be the same as the unit model for this assessment.

The CCGT used in the modelling is based on measurements of existing units, which incorporates attenuation in the design of the plant. Where the model type or level of attenuation varies from that modelled a corresponding change in the predicted noise levels would occur.

6.2. Vibration Impacts from the Existing and Proposed Power Station

The nearest residential receiver is several kilometres from the existing and proposed expansion site. At these distances vibration impacts from the power station cannot be felt. Furthermore a new source of vibration emissions such as the proposed extension would not combine to provide a cumulative vibration impact at sensitive receiver locations.

■ Figure 6-1 Predicted Operational Noise Contours – Gas Fired Powered Station (Neutral Conditions)



7. Construction Noise Impacts

7.1. Construction Noise Impact Assessment

The construction programme and methodology for the proposed extension has not been completed at this stage therefore a full assessment of noise impacts is not possible. As a general discussion it should be noted that while the noise emission from construction activities in the immediate vicinity of the Power Station will be high, it would not provide a noise impact at sensitive receivers over and above the operational noise from the existing Power Station.

7.1.1. Description of Works

During construction activities, the resulting noise levels at a sensitive receiver will vary according to distance from the works, the type of equipment in operation and any available topographical shielding. General site works will involve daytime construction activities as well as transport to site of construction materials. Potentially any night works would provide the greatest risk of noise impacts during construction.

To assess the potential for noise impacts due to normal construction activities during daytime hours, estimates of the noise emissions from general works at the Power Station have been modelled using the SoundPLAN noise prediction software with the CONCAWE assessment method. Predictions of the $L_{A10,\ 15minute}$ construction noise levels from these scenarios are based on noise levels in **Table** 7-1 and typical construction activities that may take place during any given period.

The list of equipment in **Table** 7-1 is based on generic types, which provides an estimated sound pressure level at seven metres used in this assessment. Equipment that is to be used on this Project is to have a sound pressure level equivalent or less than that detailed in the table in order to remain consistent with this assessment. To account for equipment that has a directional noise component, the sound pressure level at seven metres will be the average of sound pressure readings taken on all sides of the equipment when operational.

- **Table 7-1 Equipment Sound Power Level, L_{A10} dB(A)**

Item #	Description	Sound Power Level L_{A10} dB(A)	Approximate Sound Pressure Level @ 7m
1	Asphalt Pavers	100	75
2	Compressor	103	78
3	Excavator	108	83
4	Grader	108	83
5	Mobile Crane	108	83
6	Vibratory Roller	110	85
7	Water Cart	111	86
8	Back Hoe	111	86
9	Cement/ Concrete Agitator	112	87
10	Tip Truck	112	87
11	Compactor	113	88
12	Bulldozer	113	88
13	Front End Loader,	114	89
14	Concrete pump	115	90
15	Pile Driver	120	95

7.1.2. Predicted Construction Noise Levels

The predictions listed in **Table 7-2** are considered representative of anticipated noise levels based on a projected “typical” construction scenario, with all equipment operating simultaneously. The predicted noise levels are not necessarily the worst case impacts but should be used as a guide to the level of impact expected.

Table 7-2 Predicted $L_{A10,\ 15\ minute}$ Noise Levels from Construction Activities at Key Receivers

Location	Noise Levels General Construction activities	
	Nominal Distance (m)	L_{A10} dB(A)
A	1700	<20
B	2800	<20
C	1800	21
D	2800	<20

The noise from general works has been assessed and in all cases the estimated construction noise levels would be below background for daytime noise emissions. Specific noisy activities such as impulsive or explosive noise emissions or night time works may require a more detailed review at the design stage however, the predicted levels indicate that construction noise would remain within the criterion of 32 dB(A) at the nearest receiver. No additional noise mitigation measures are recommended at this time other than the implementation of appropriate management strategies during construction.

The effects of cumulative construction noise impacts have been considered for the project along with vibration impacts. From **Table 7-2** it can be seen that the construction noise from the proposal would not be audible at the nearest receiver locations. On this basis, noise impacts from any other construction activities (including the Western Rail Coal Unloader) occurring at the same time, where audible at a receiver location, would be that sole source of construction noise and therefore there would be no additional noise impacts from the proposal.

The inaudibility of the construction activities is due to the significant amount of topographical shielding available combined with the large separation distances to residential receivers. In this respect, vibration impacts would also be imperceptible due to the very large separation distances.

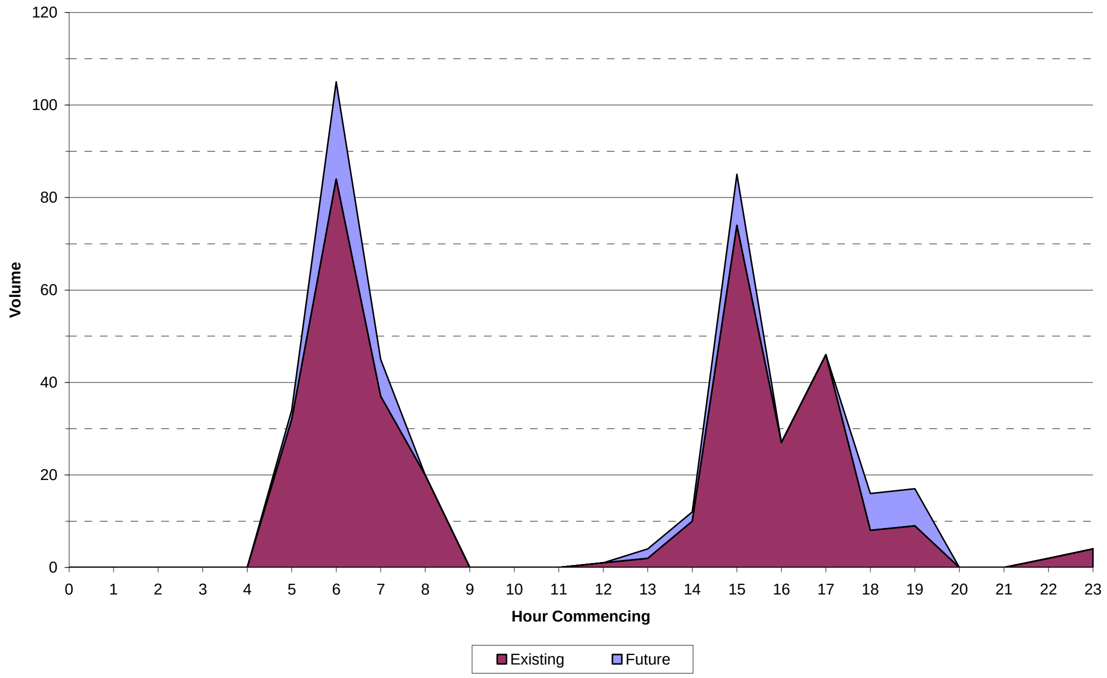
7.2. Traffic Noise Generation

The traffic noise assessment has been undertaken with respect to information provided in Chapter 14 of the EA. The traffic report notes that the Power Station currently operates 24 hours per day, with day and night shifts. The access for staff to the Power Station is from Boulder Road.

The majority of the Power Station's coal is supplied via overland conveyors or by trucks using the private haul road between the Power Station and Angus Place mine. Coal is also delivered by public road on the Castlereagh Highway both to the north and south of the Power Station. For the proposed new power station these road based deliveries would not increase. The additional coal requirements (if the coal fired option is adopted) would be supplied by conveyor from the western rail coal unloader.

The proposed new Power Station would require a corresponding increase in staff numbers, adding to both the day and night shift operations personnel. This increase would comprise an additional 50 staff associated with the operation of the new facility for both shift and day workers. Across an average day, there would be an additional 62 staff movements (31 each way). A car occupancy of 1 has been assumed, given the relative isolation of the site and the hours of work for most employees and therefore, this would be a worst-case scenario. **Figure 7-1** shows total staff movements (arrivals and departures) with and without the expanded facility.

▪ **Figure 7-1 Total Staff Movements for existing and new Facility**



When averaged for the day and night time periods, the traffic movements for operational impacts would be so small as to not noticeably affect the existing L_{Aeq} 15 hour and L_{Aeq} 9 hr noise levels.

Based on the increase in road traffic for the construction period, changes to the general noise environment have been estimated for both peak and normal construction activities. Deliveries of equipment and materials to the site would occur throughout the duration of the construction works. At its peak 1,200 vehicles over a two month period could be expected. This would result in approximately 40 return trips per day per month and these would be spread throughout each day.

These increases as well as the potential change in noise levels from road traffic due to staff increases on the Castlereagh Highway have been estimated based on the available traffic data showing 3-4,000 vehicles per day north of Boulder Rd The predicted noise increases are presented in **Table 7-3**.

Table 7-3 Predicted Road Traffic Noise Impacts – Proposed Extension

	Predicted Noise Impacts dB(A)		
	Operations	Construction	Construction Peak
Change in general traffic noise	<1	1	2

The predicted impacts are not considered to be significant and are within noise guidelines for limiting traffic noise increases on road networks in NSW.

8. Framework for Mitigation, Management and Monitoring of Impacts

8.1. Noise Mitigation Measures

Specific mitigation measures for the Mt Piper Power Station site have not identified at this time. The assessment of noise impacts from the combined operations of the power station indicates that noise levels will be within the criteria for neutral and assessed adverse meteorological conditions and therefore no additional noise reduction is necessary based on the assumed design.

For default adverse meteorological conditions as prescribed by the DECC INP, exceedances may be expected at locations where the influence of the coal unloader is further penalised for low frequency noise emissions in combination with the existing and proposed power station extension. The potential for noise reductions are currently un-quantified. However, further noise reductions are expected to be able to be identified once the type and make of the proposed power station extension has been resolved.

While mitigation measures of noise emissions related to the power station extension are not able to be determined until a final design has been confirmed, similarly management measures for potential impacts cannot be identified at this stage. It is expected that care taken to minimise noise emissions during the design stage (pending project approval), will be the most effective management strategy for the proponent.

8.2. Framework

8.2.1. Background Noise Monitoring

Noise monitoring is to be undertaken prior to and after the project approval but prior to operations in order to determine long term trends in the local noise environment**.** In general two kinds of noise measurements will be required to ensure adequate reporting of background and project related noise emissions.

- Periodic short-term attended measurements using a hand held sound level meter; and
- Longer term unattended monitoring using automatic noise loggers.

Attended measurements using Type 1 handheld sound level meters are primarily for spot checks, which are used to assess the instantaneous levels of the noise environment. These measurements are to be used to check equipment operational noise levels and project-specific noise levels at representative locations as required. All instrumentation utilised must comply with the requirements of AS 1259.2 *Sound Level Meters* and carry current NATA or manufacturer calibration certificates, with certification at intervals not exceeding two years.

Unattended noise monitoring using noise-logging instrumentation is used for long term monitoring of project related noise emissions. These monitors sample continuously over each 24-hour period. The instrumentation must be set up to record the relevant environmental noise parameters in 15-minute time intervals over a minimum period of 7 days.

The minimum noise parameters recorded should include L_{Amax}, L_{A10}, L_{A90} and L_{Aeq} for each 15-minute time period. Events identified as extraneous, including insect noise, lawn mowers and wall-mounted air-conditioners and the like are to be excluded from the computation of the noise parameters. All data that is considered to be affected by adverse weather conditions, including rain and wind, are also to be excluded from the computation of the noise parameters.

8.2.2. Noise Monitoring Program

Monitoring must be undertaken to ensure that both existing background noise levels and operational equipment noise levels are captured prior to commencement of any works and after construction has been completed (pending successful approval). Noise levels should be measured at representative receiver locations identified in this report or where new receiver locations are developed that may have an exposure to the operations of the Mt Piper site.

A program to assess the existing noise levels at receiver locations around the Mt Piper site should aim to capture noise data under various meteorological conditions. This data can be used to establish a noise profile for receiver locations during seasonal variations of the noise environment. Noise monitoring and measurements should be performed according to relevant standards and policies including but not limited to:

- The Department of Environment and Climate Change *Environmental Noise Control Manual*;
- The Department of Environment and Climate Change *Industrial Noise Policy*; and
- Australian Standard *AS1055.*

If the measured levels show substantial influence from low frequency noise resulting from the power station alone (as described in Chapter 4 of the NSW Industrial Noise Policy above), 5dB(A) must be added to the measured noise level before comparing the the level to the project noise objectives.

8.2.3. Modelling during Design

To determine the requirement for and extent of mitigation measures it will be necessary to model the potential noise impacts from the equipment likely to be used in the operation of the power station. The modelling will allow testing of design options to meet noise criteria set as part of the licence developed for the operation of the new plant. It is only with the results of these data that detailed mitigation measures will be developed.

8.2.4. Monitoring during Operation

Following commencement of operation of the plant it will be necessary to implement a verification process to test the predictions of the modelling and to determine whether the criteria set for plant operation are being met.

9. Conclusions and Recommendations

An acoustic assessment has been undertaken of the potential for noise emissions from the proposed Mt Piper Power Station extension to impact on nearby residences. Noise levels for two (2) options for the proposed extension were assessed including:

- *Option 1* - Two (2) 1000 MW coal fired generators and associated infrastructure; and
- *Option 2* - Six (6) Combined Cycle Gas Turbines (CCGT) totalling 2000MW and associated infrastructure.

Under neutral weather conditions compliance with the project specific noise goals is indicated at all prediction locations for both options. An assessment of meteorological conditions has determined that under the DECC guidelines, temperature inversions for this area occur frequently enough during the winter months to be included in an assessment of adverse weather conditions. Predictions of noise levels under the locally assessed temperature inversion conditions indicate that the proposed power station extension, when assessed in conjunction with other noise sources from the site, indicates a marginal compliance.

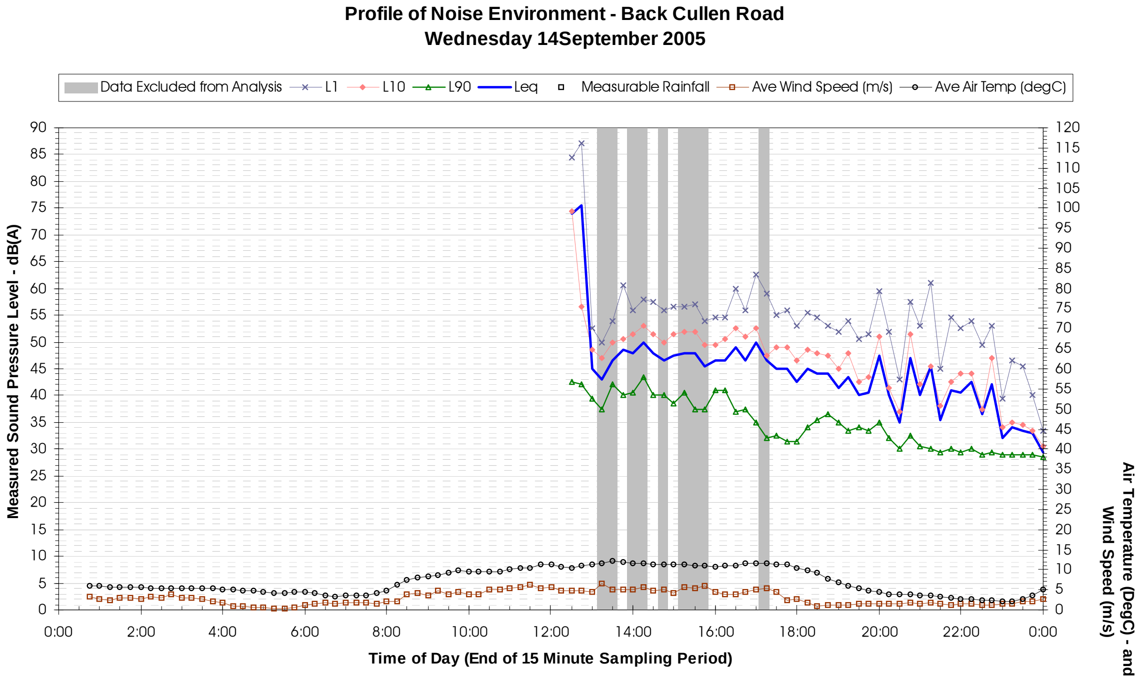
The local effects of temperature inversions are seen to increase measured noise levels from the Power Station at the nearby residences under specific meteorological conditions and this was evident during attended monitoring (2006). The results of the attended monitoring indicated that while the power station was audible during some parts of the evening, the long term noise monitoring RBL's were not adversely affected and were lower than the 2005 monitoring at some locations.

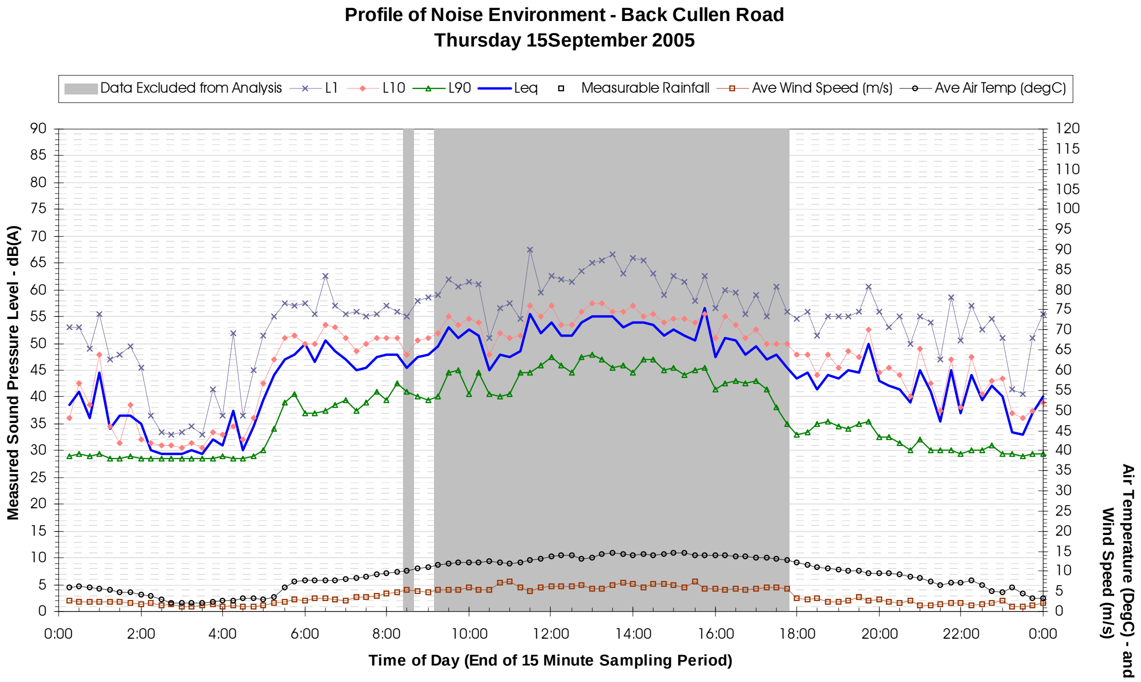
Where background noise levels are low the INP recommends that a minimum RBL of 30 dB(A) is applied and that the L_{Aeq} intrusiveness criteria is then set as a minimum of 35 dB(A). Based on this requirement and the predicted results under neutral conditions, it is expected that specific noise mitigation measures would not be required for the proposed Mount Piper Power Station Extension Project. While compliance with INP criterion is indicated in the assessment, it is recommended that lower levels should be adopted for the project where possible to limit impacts on the local community, and the potential for adverse comment from sensitive receivers.

The compliance of the noise goals under adverse weather conditions are based on estimated equipment sound power levels for the proposed extension. Reductions of equipment noise emission levels should be sought during the design stage by the specification of equipment with low noise characteristics. Where noise reductions are possible the revised levels should be incorporated into the noise model to refine the predictions at the nearby residences. Areas of particular benefit from noise reduction would be the in the design of the stack using passive or active attenuation measures and the design and type of duty fans and air cooled condensers.

Appendix A Ambient Noise Monitoring Data

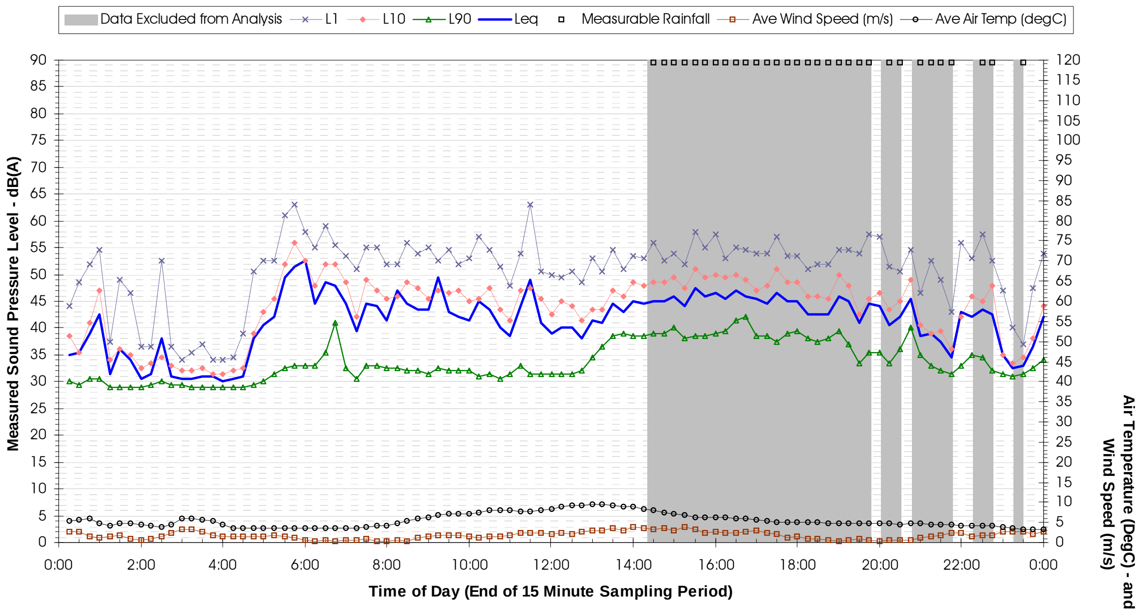
A.1 Location A



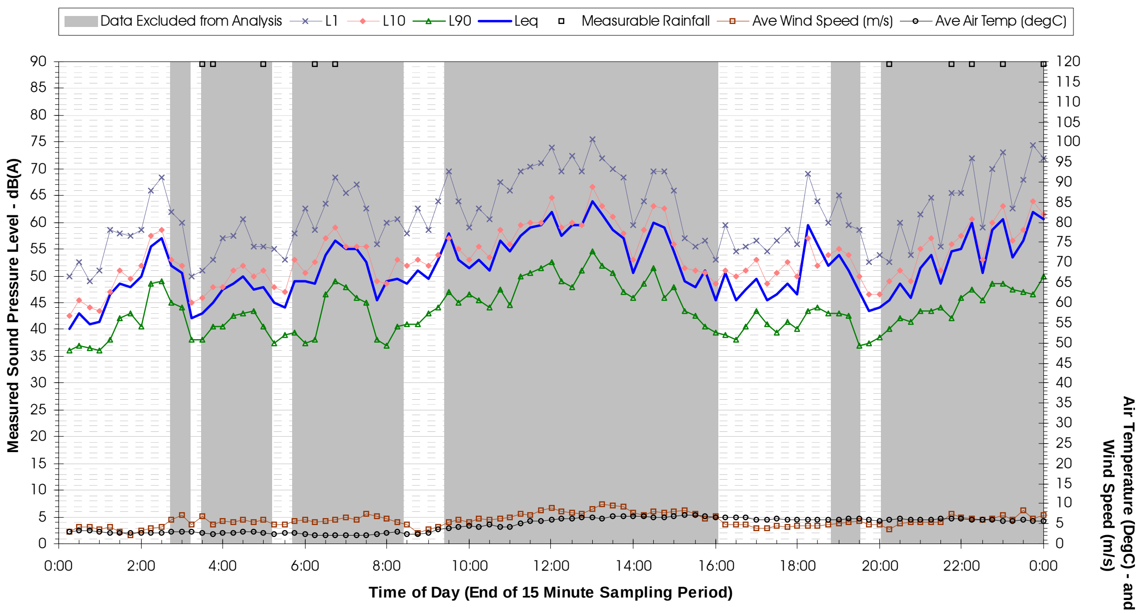


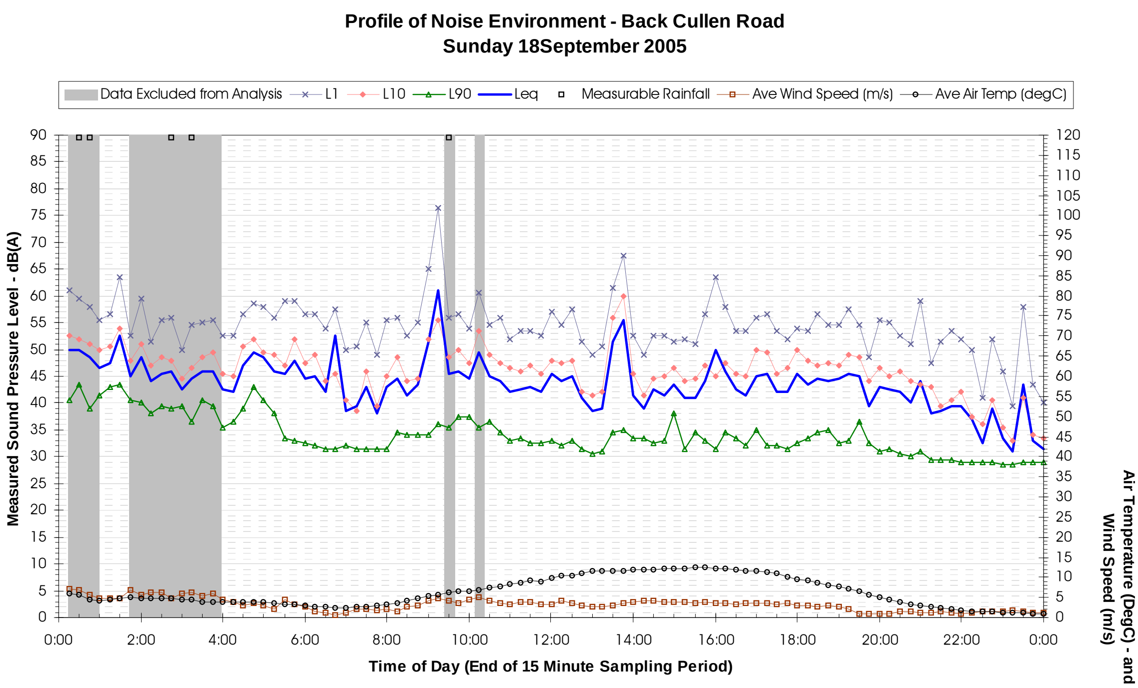
SKM

Profile of Noise Environment - Back Cullen Road
Friday 16September 2005



Profile of Noise Environment - Back Cullen Road
Saturday 17September 2005

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L10
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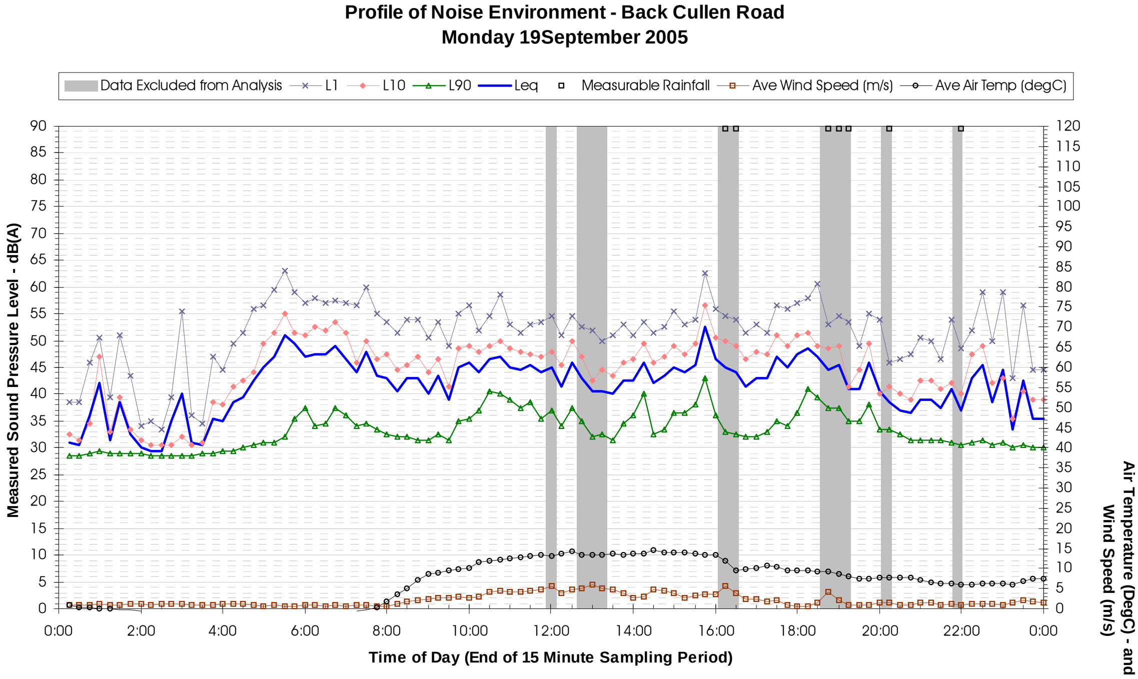
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)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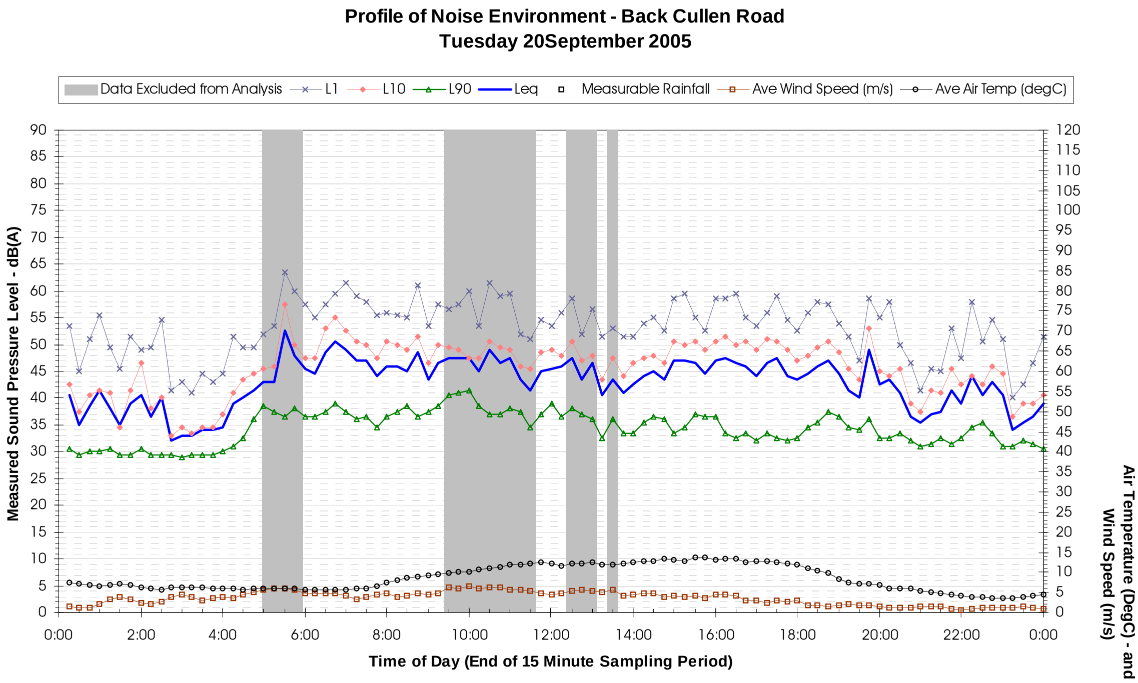
Time of Day (End of 15 Minute Sampling Period)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Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)
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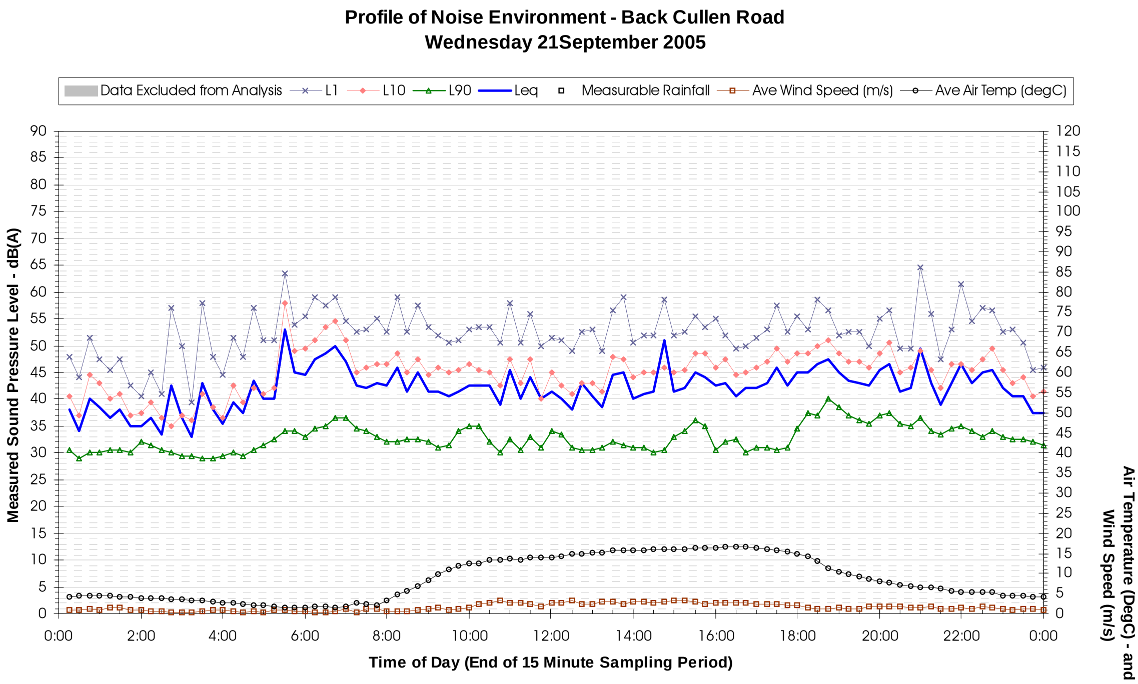
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Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)
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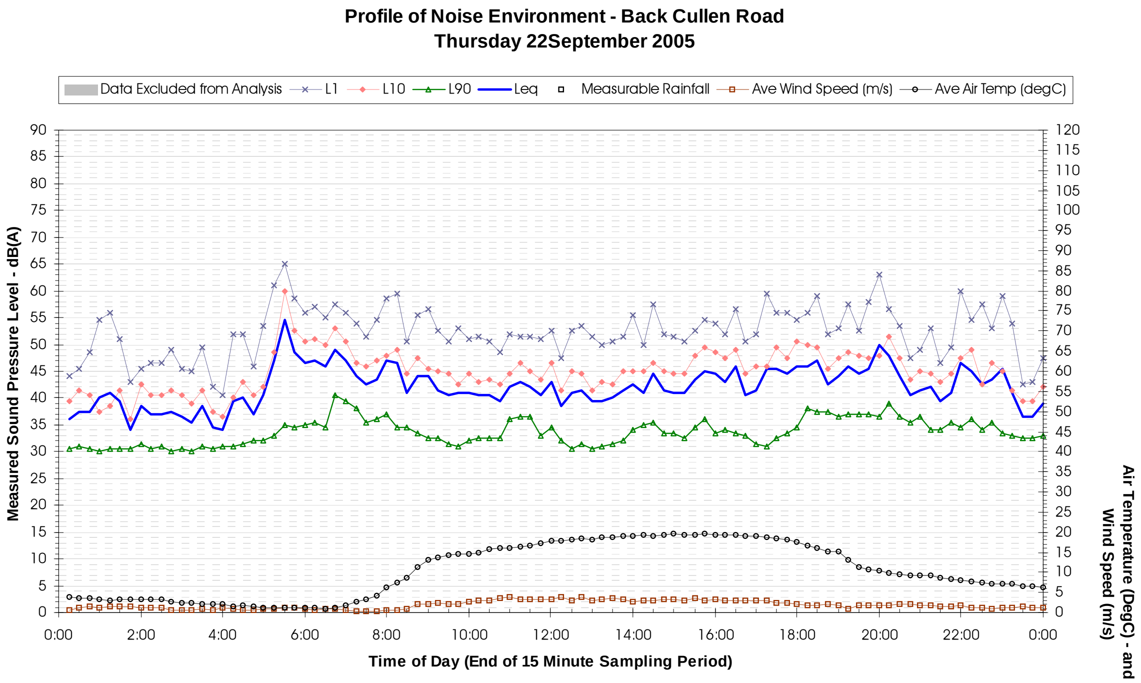
SKM



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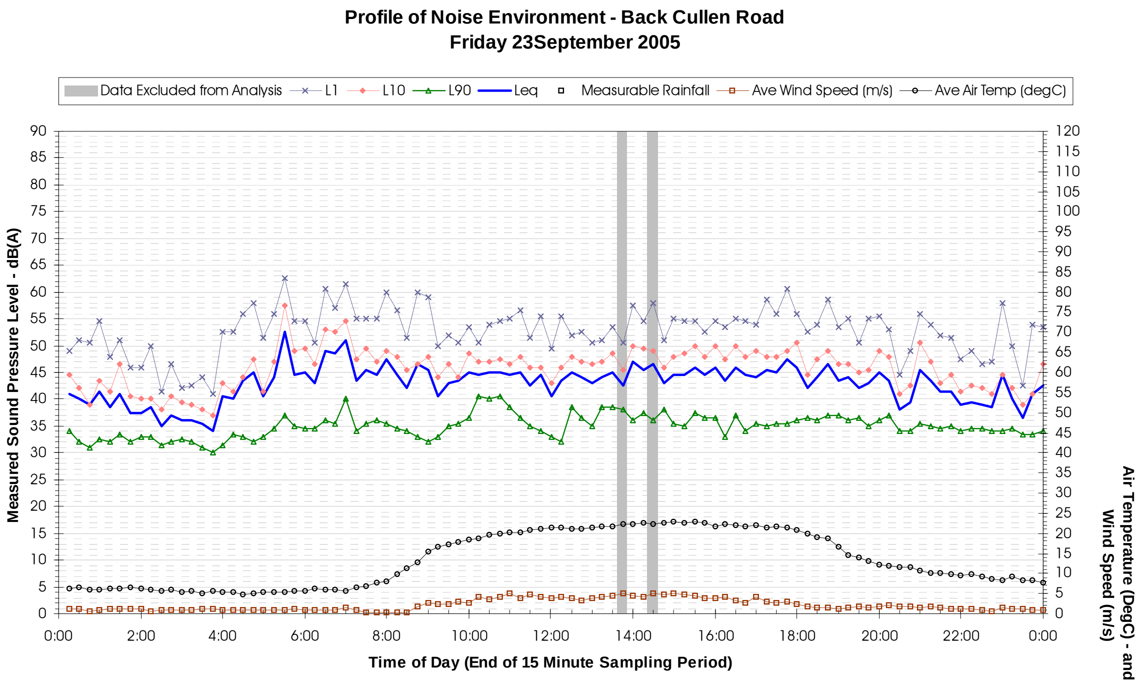
Time of Day (End of 15 Minute Sampling Period)



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Time of Day (End of 15 Minute Sampling Period)

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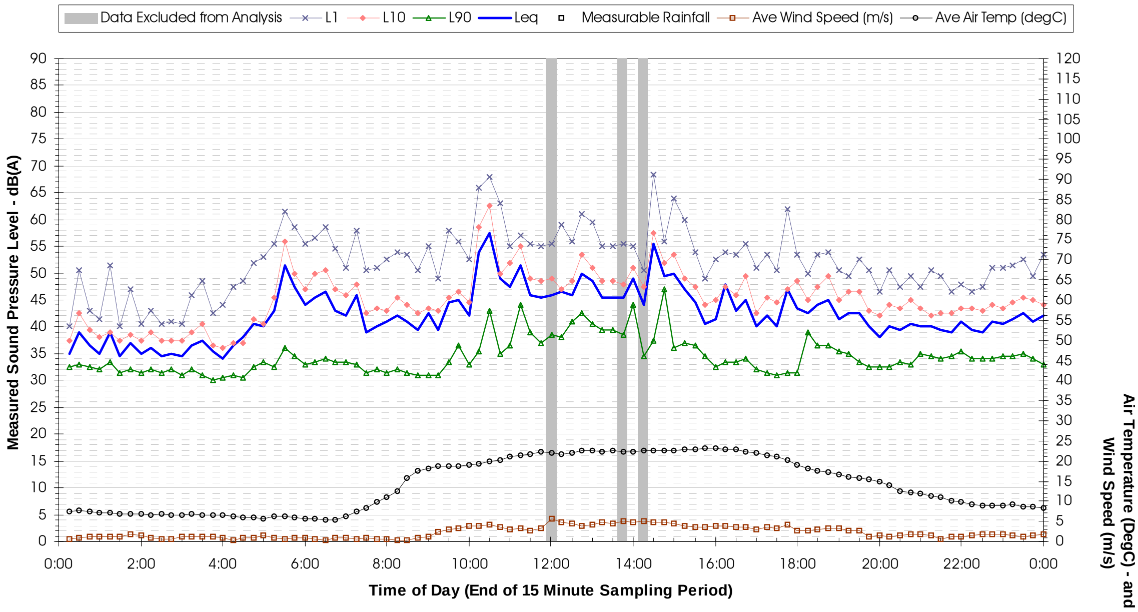

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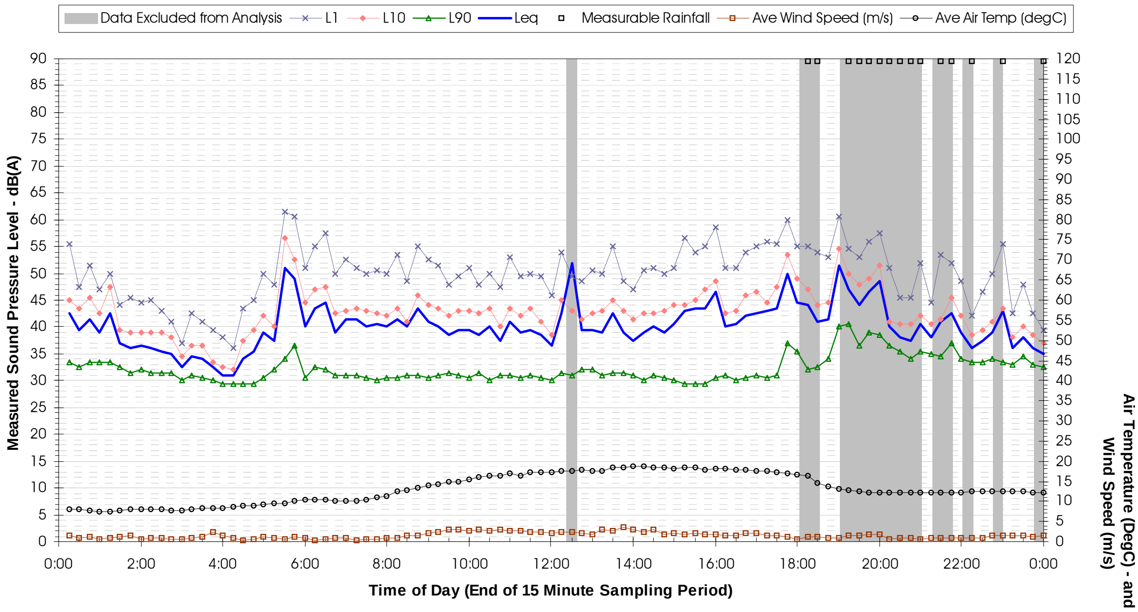

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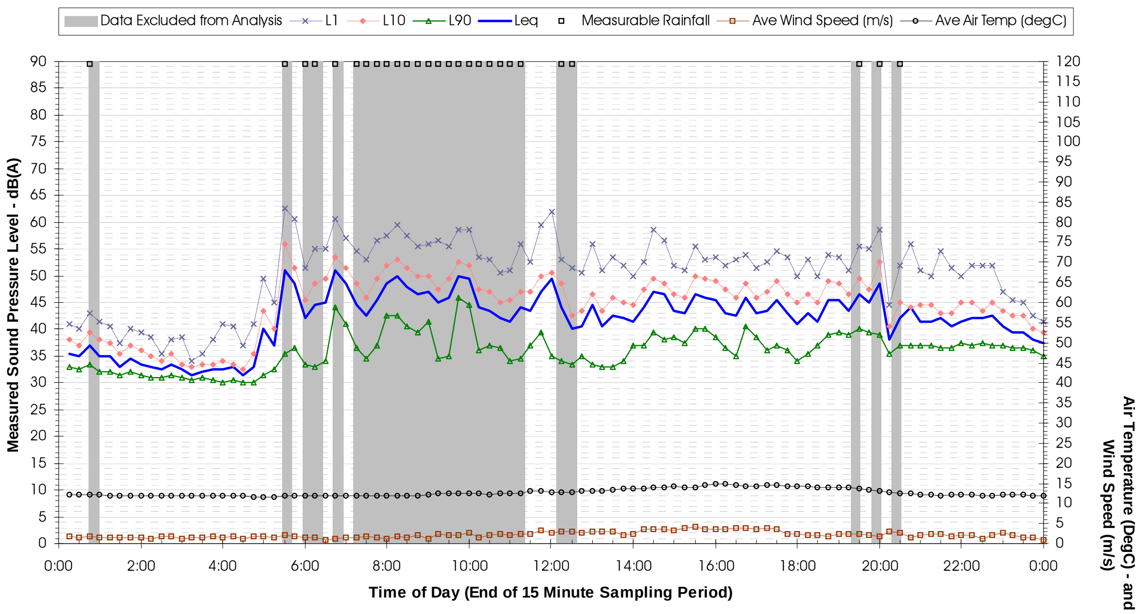

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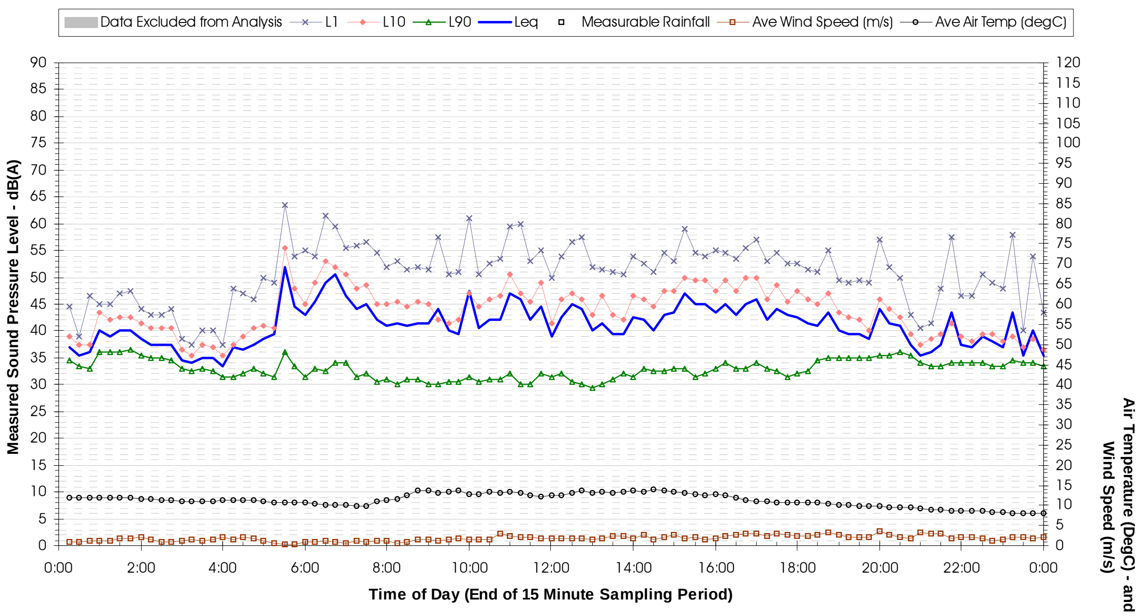

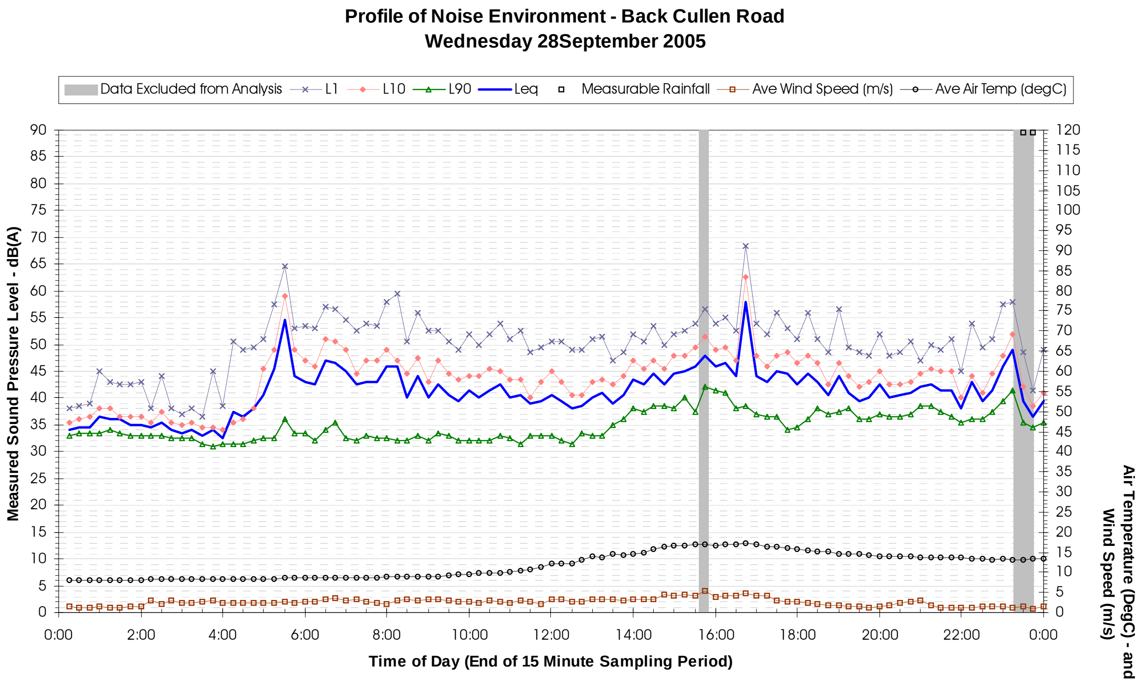
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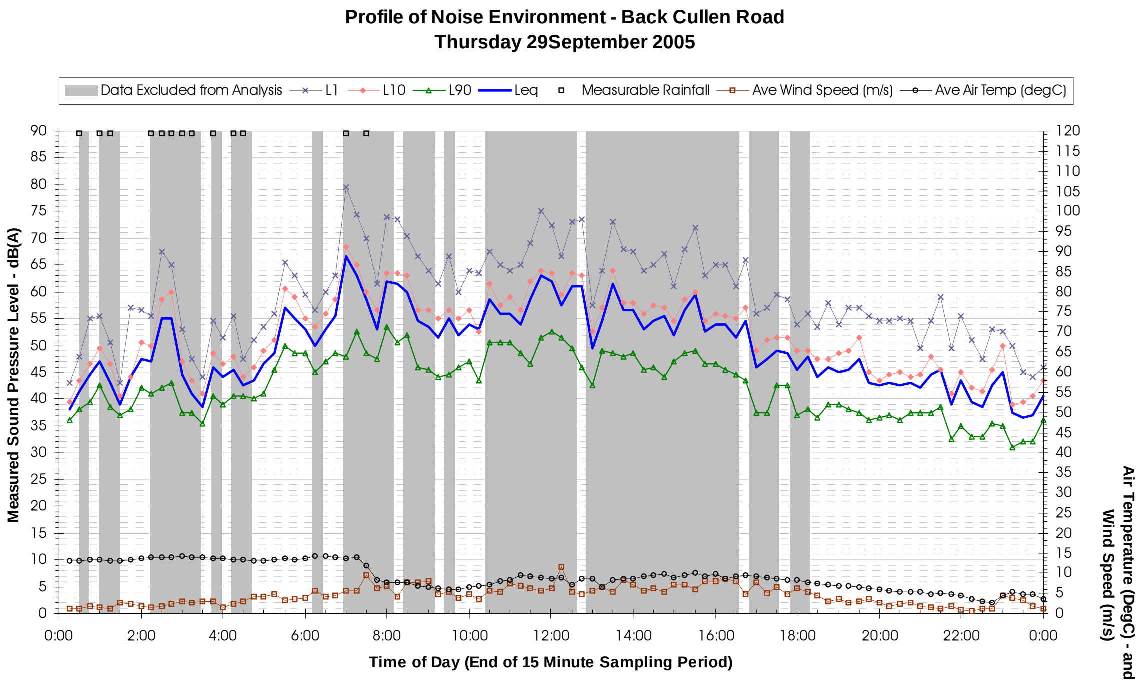
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Profile of Noise Environment - Back Cullen Road
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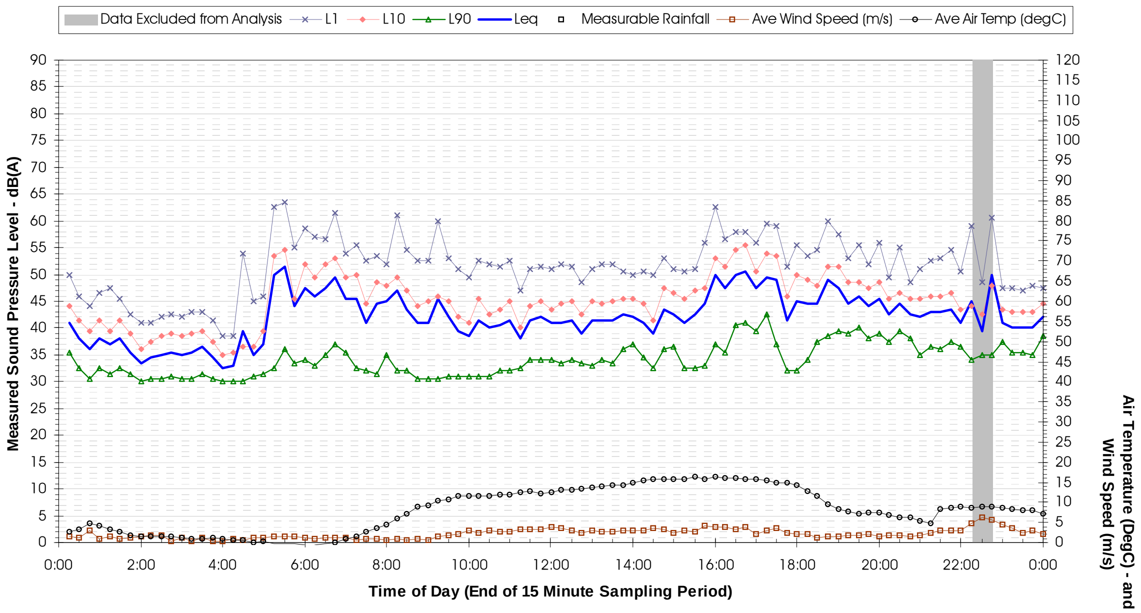

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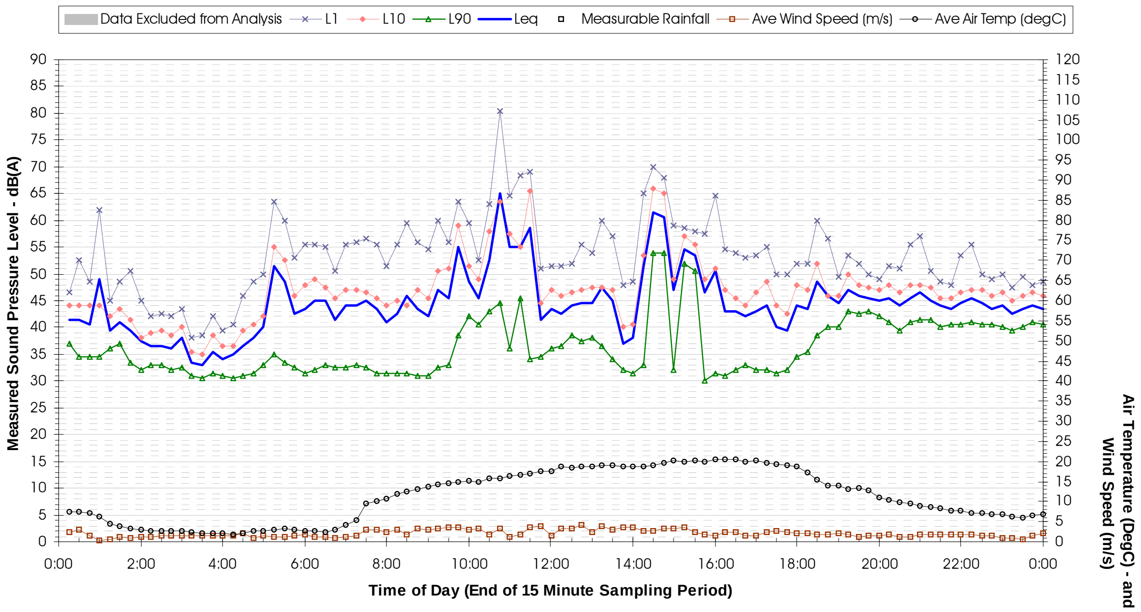

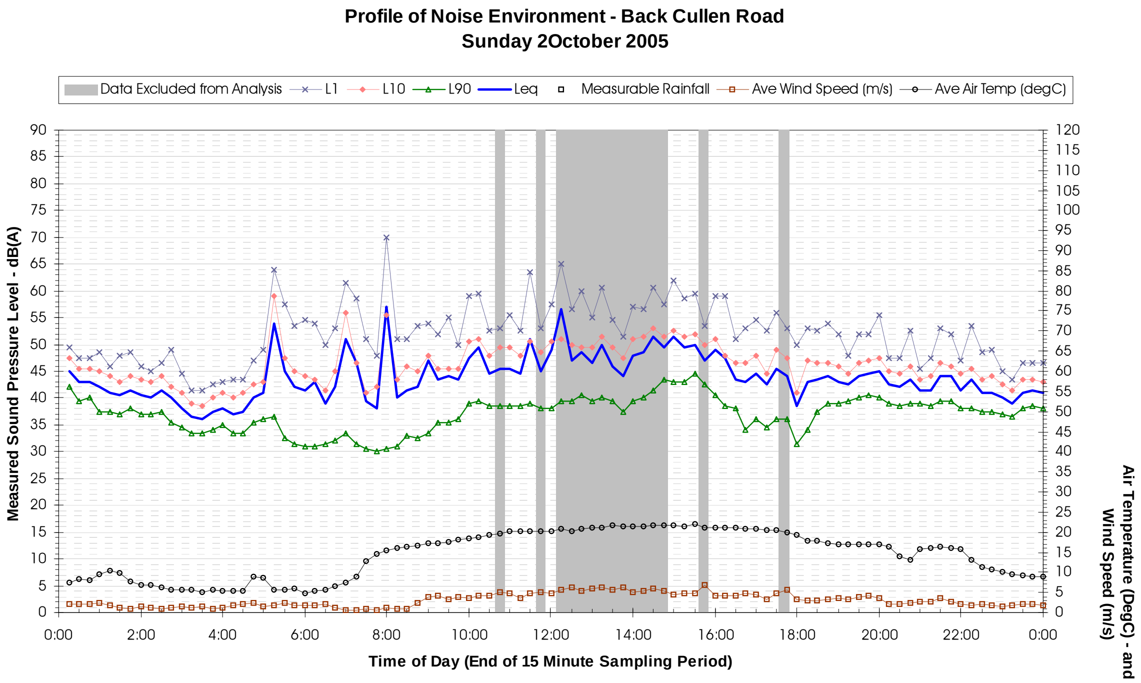
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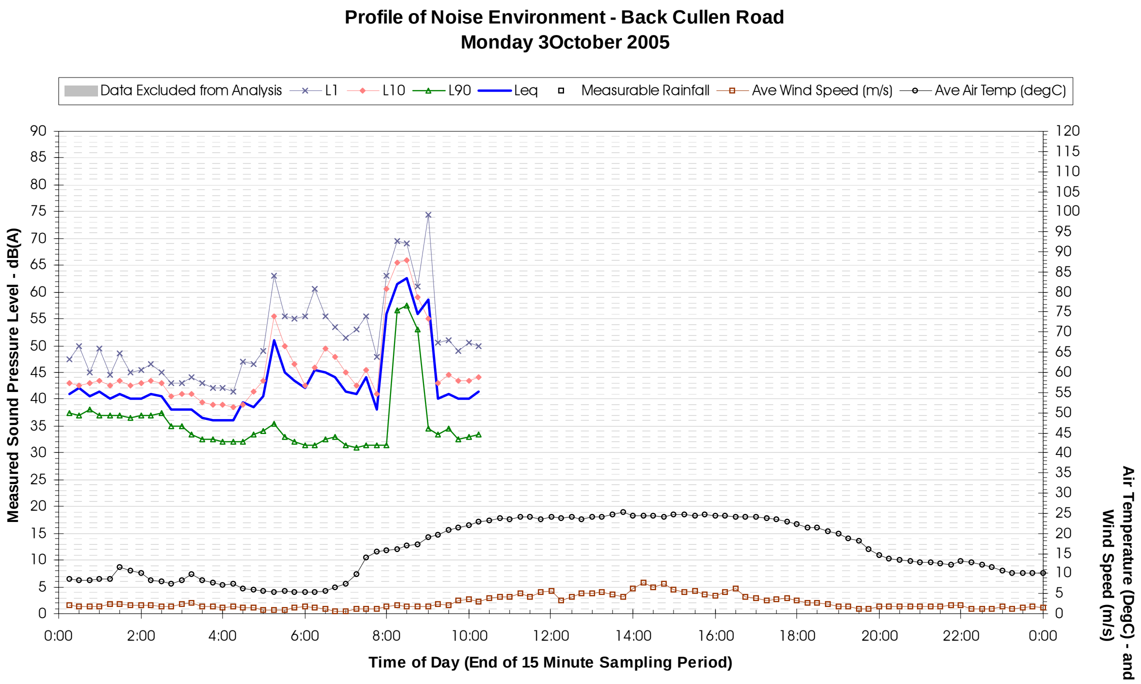
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)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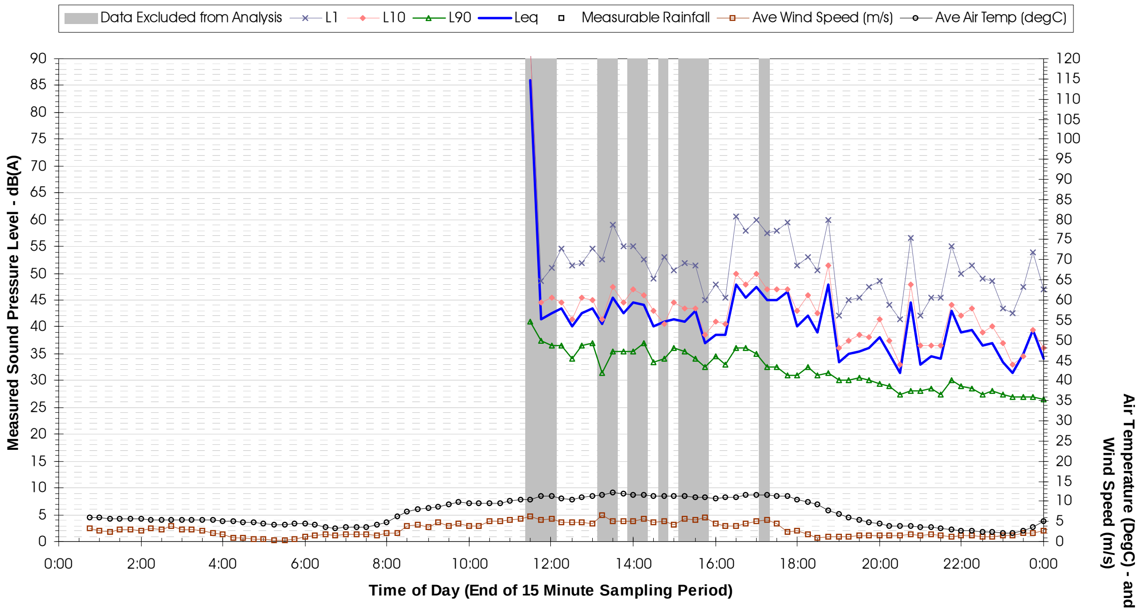
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

A.2 Location B

Profile of Noise Environment - Humphrey Street, Portland
Wednesday 14 September 2005



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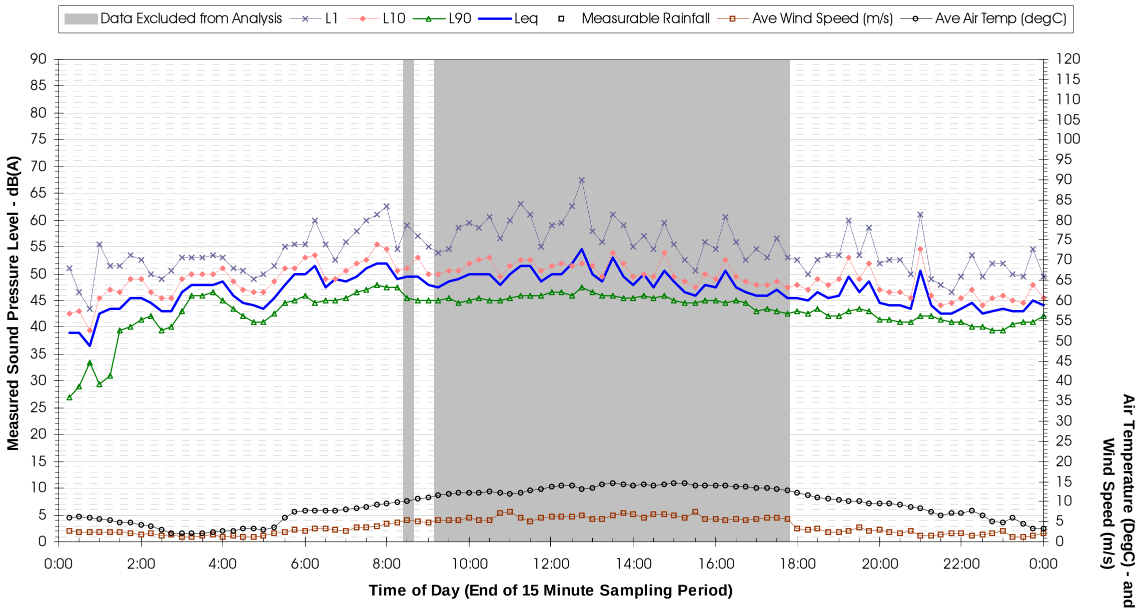

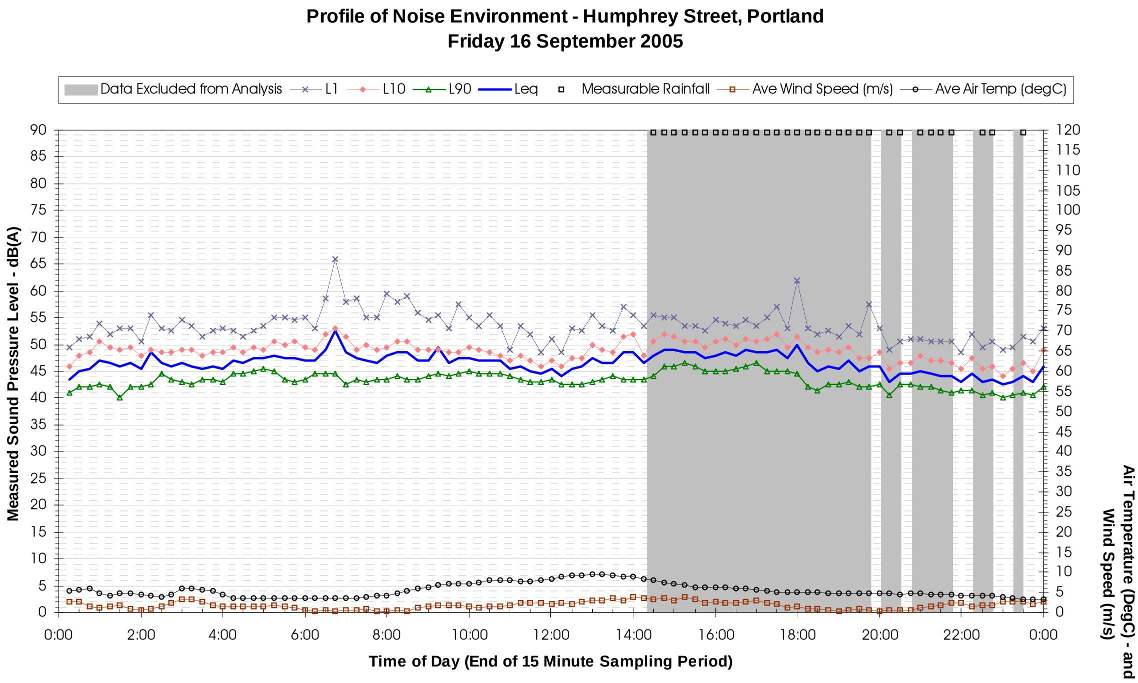
Profile of Noise Environment - Humphrey Street, Portland
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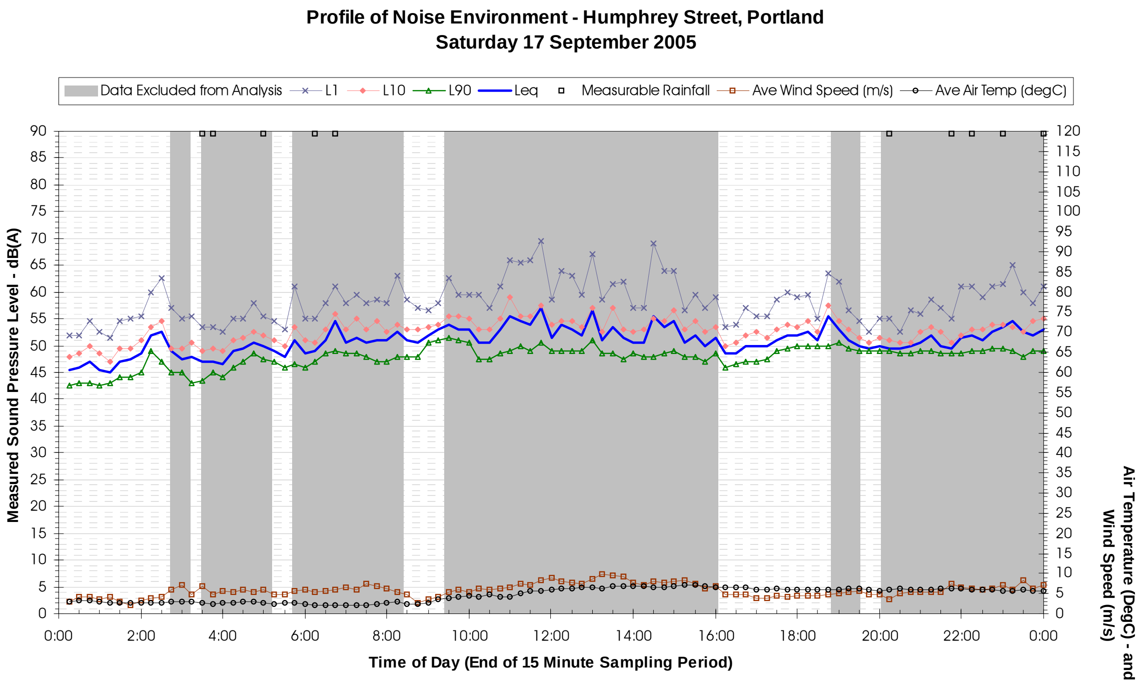
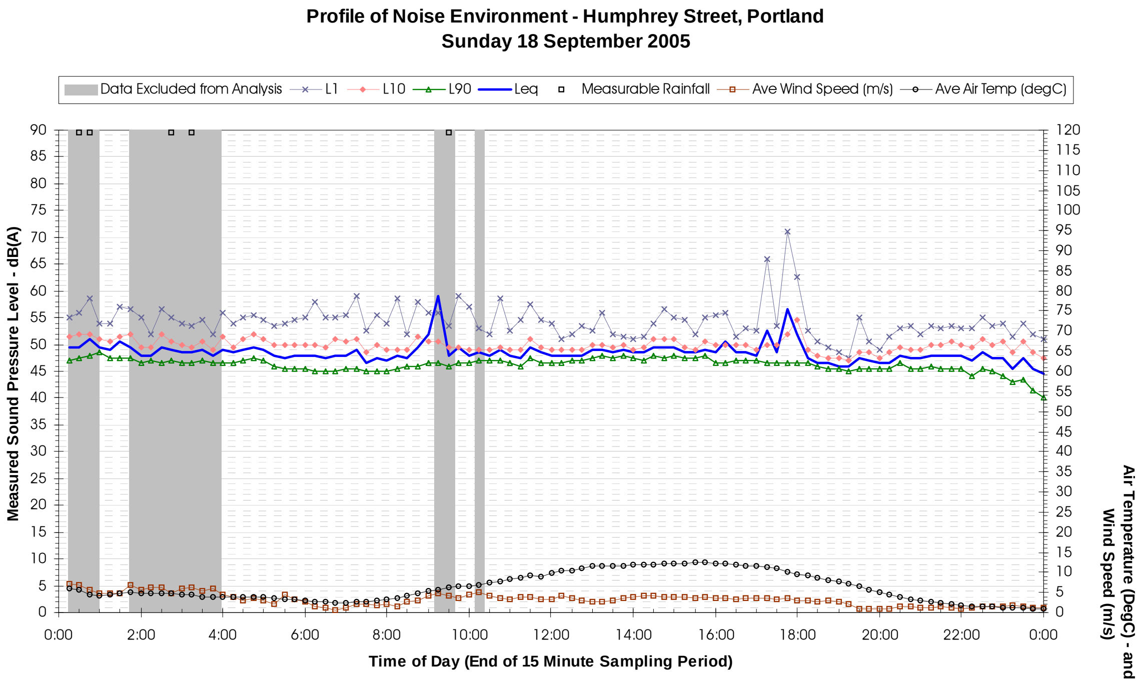
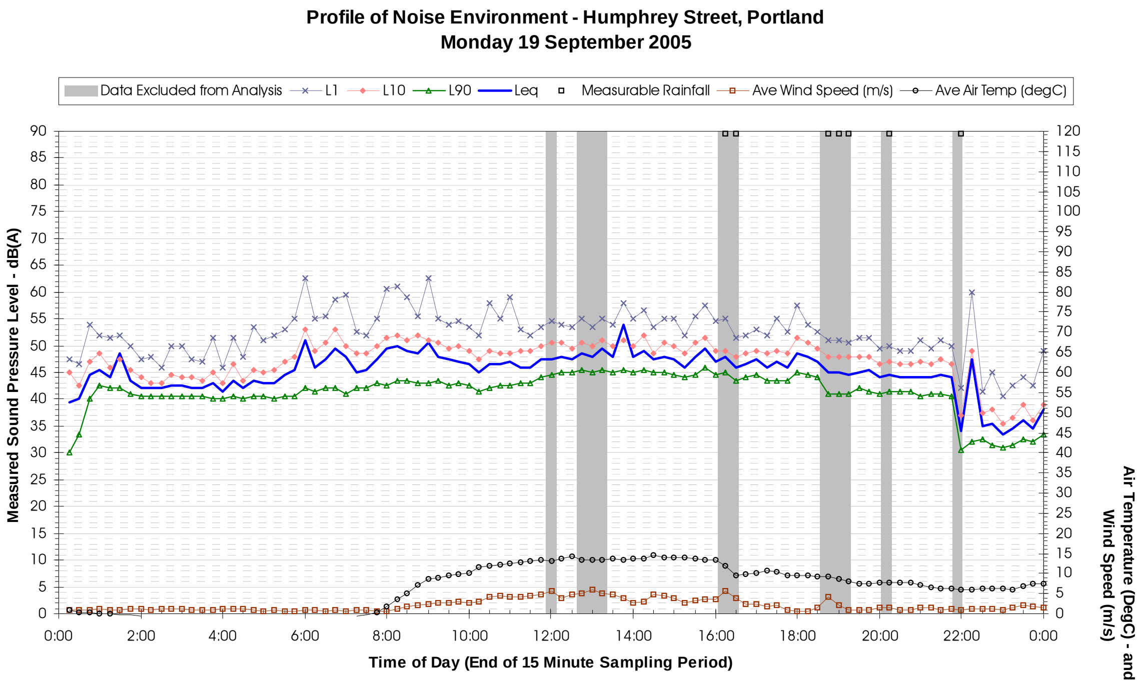
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Profile of Noise Environment - Humphrey Street, Portland
Saturday 17 September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

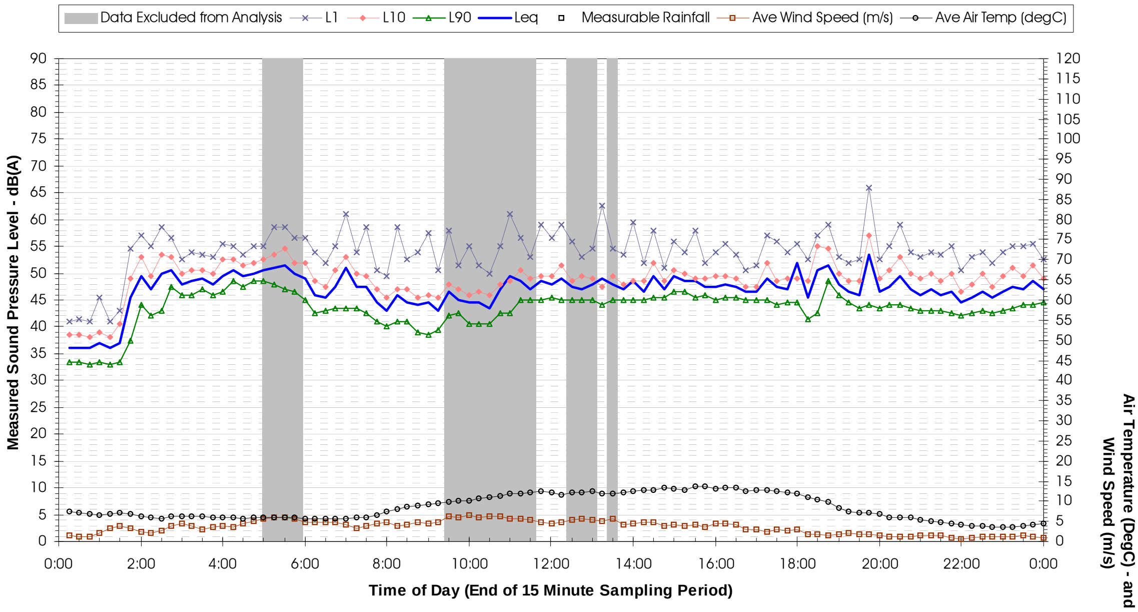


Profile of Noise Environment - Humphrey Street, Portland
Sunday 18 September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

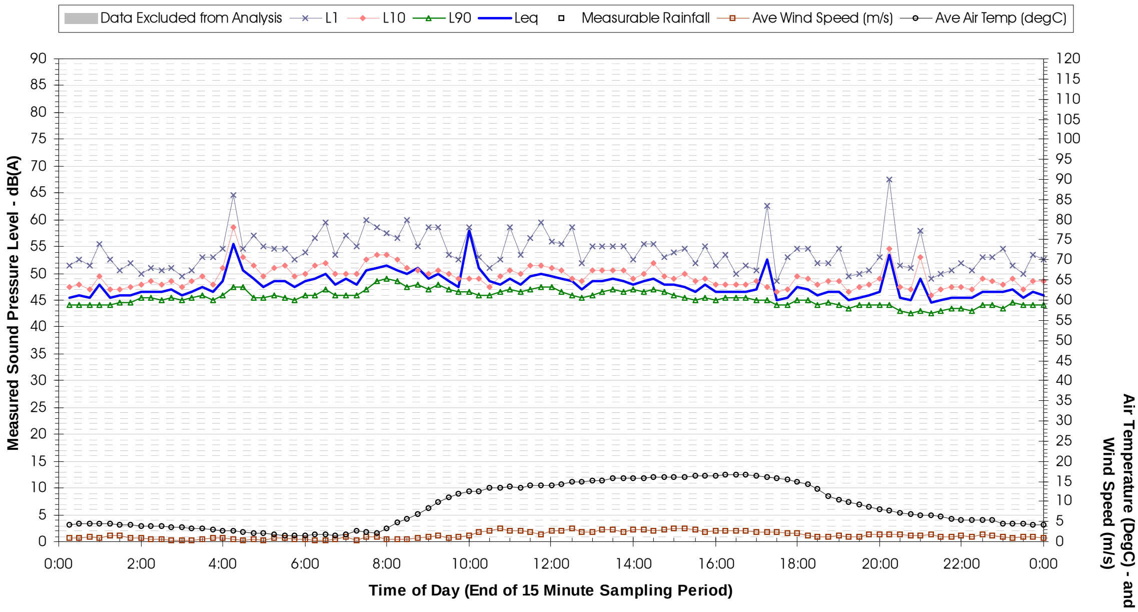


Profile of Noise Environment - Humphrey Street, Portland
Monday 19 September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

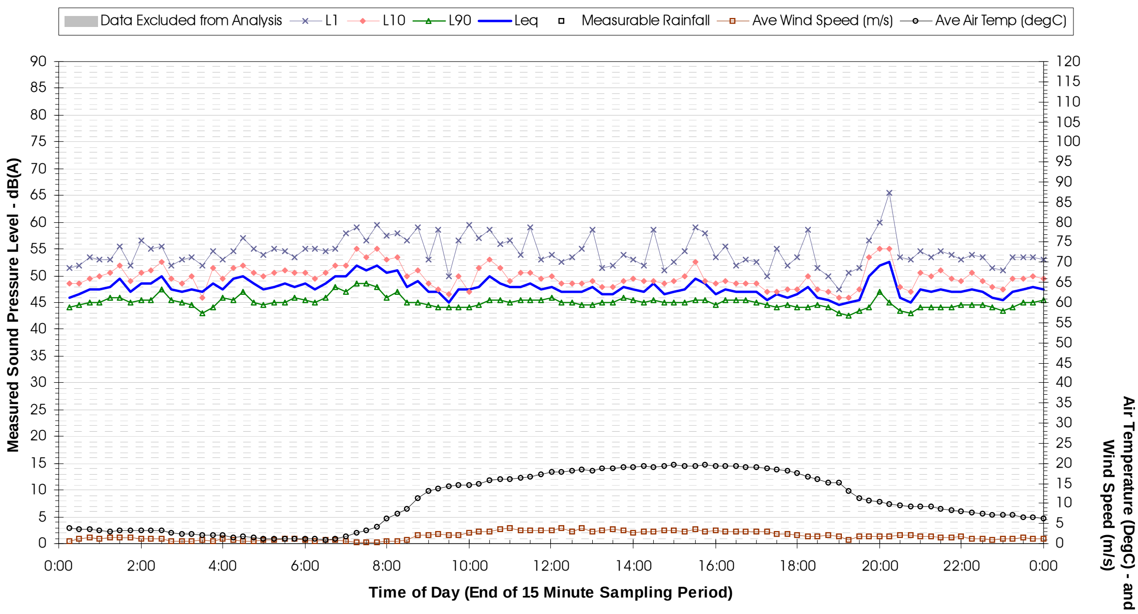
Profile of Noise Environment - Humphrey Street, Portland
Tuesday 20 September 2005



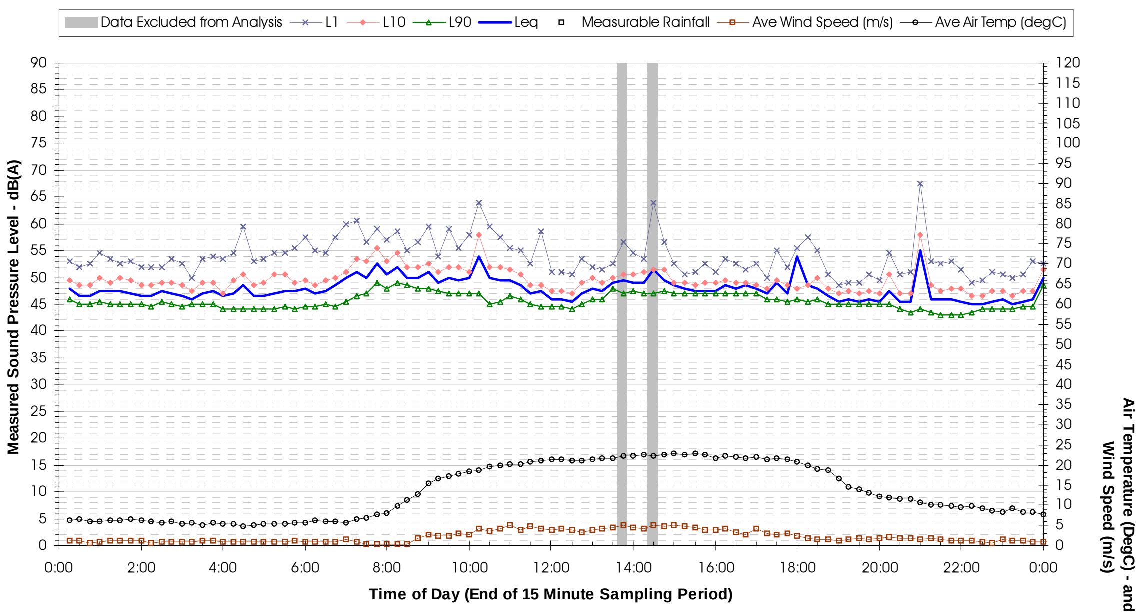
Profile of Noise Environment - Humphrey Street, Portland
Wednesday 21 September 2005

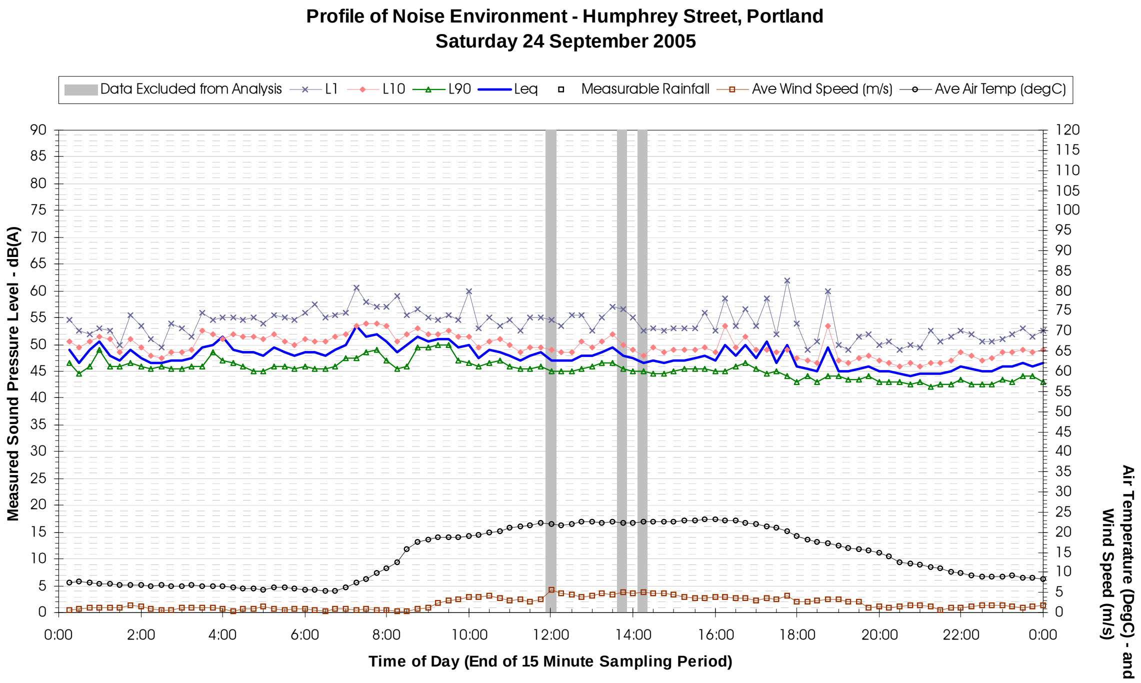


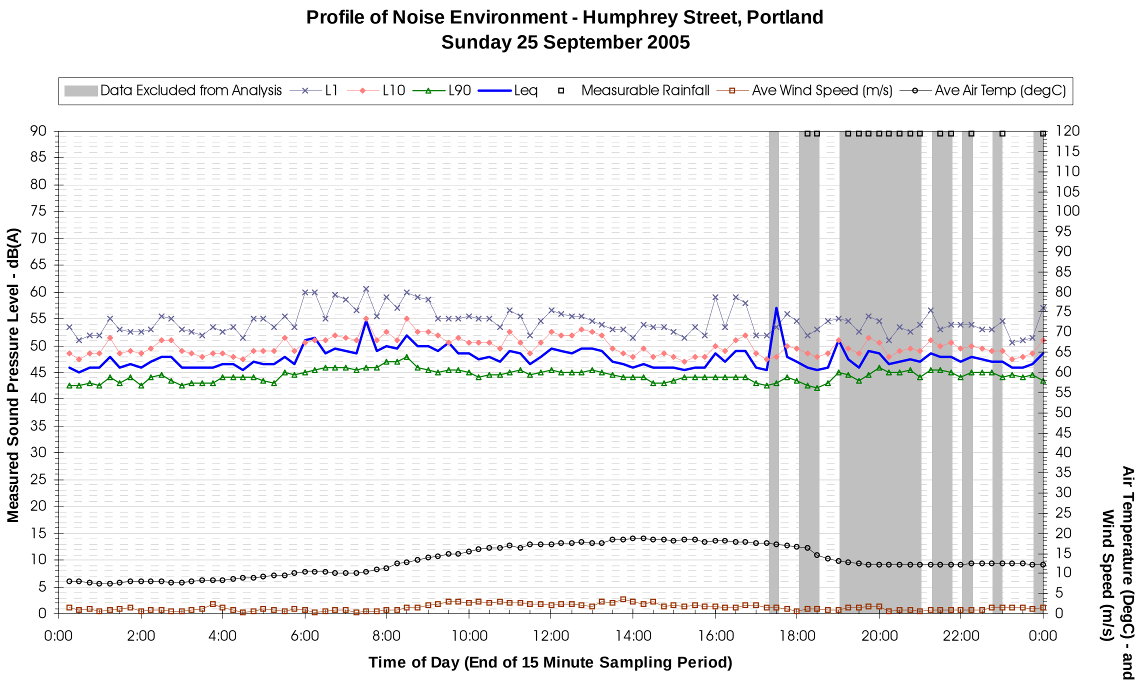
Profile of Noise Environment - Humphrey Street, Portland
Thursday 22 September 2005



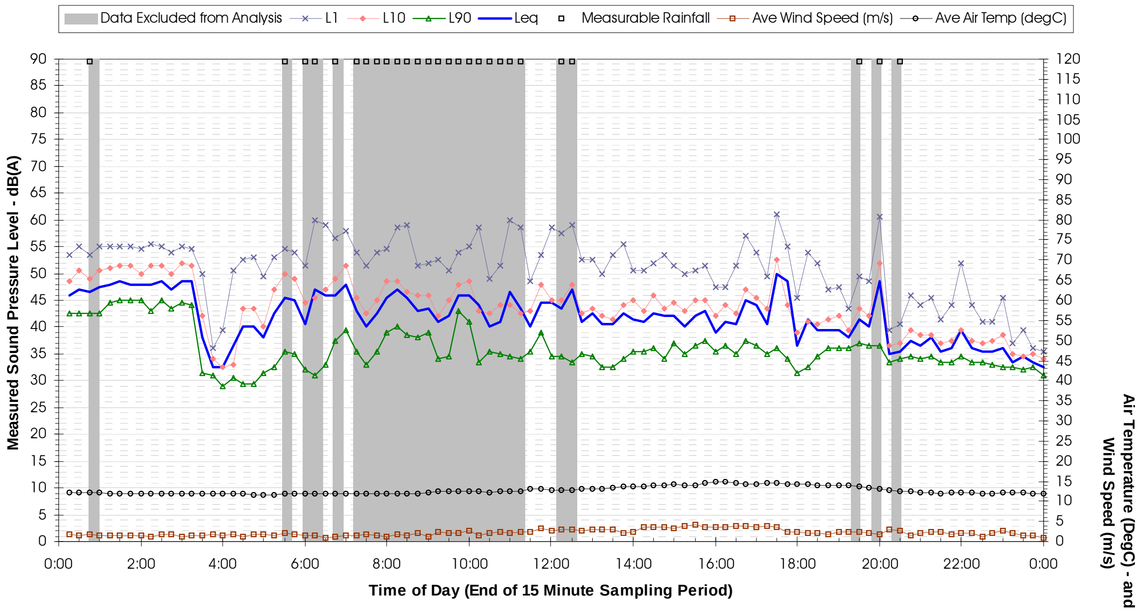
Profile of Noise Environment - Humphrey Street, Portland
Friday 23 September 2005



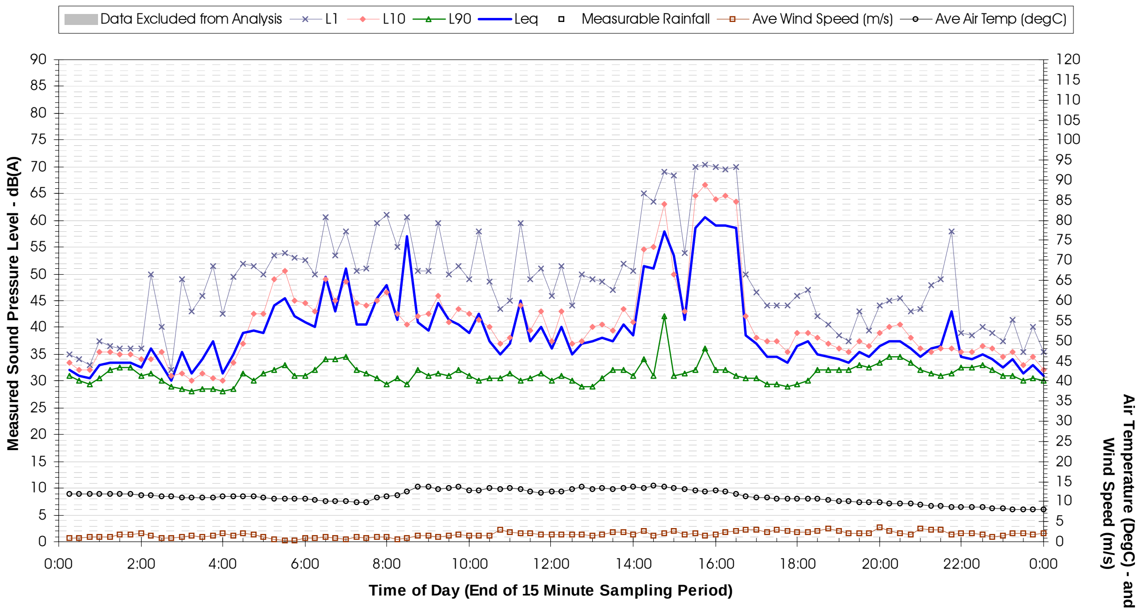

Profile of Noise Environment - Humphrey Street, Portland
Saturday 24 September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

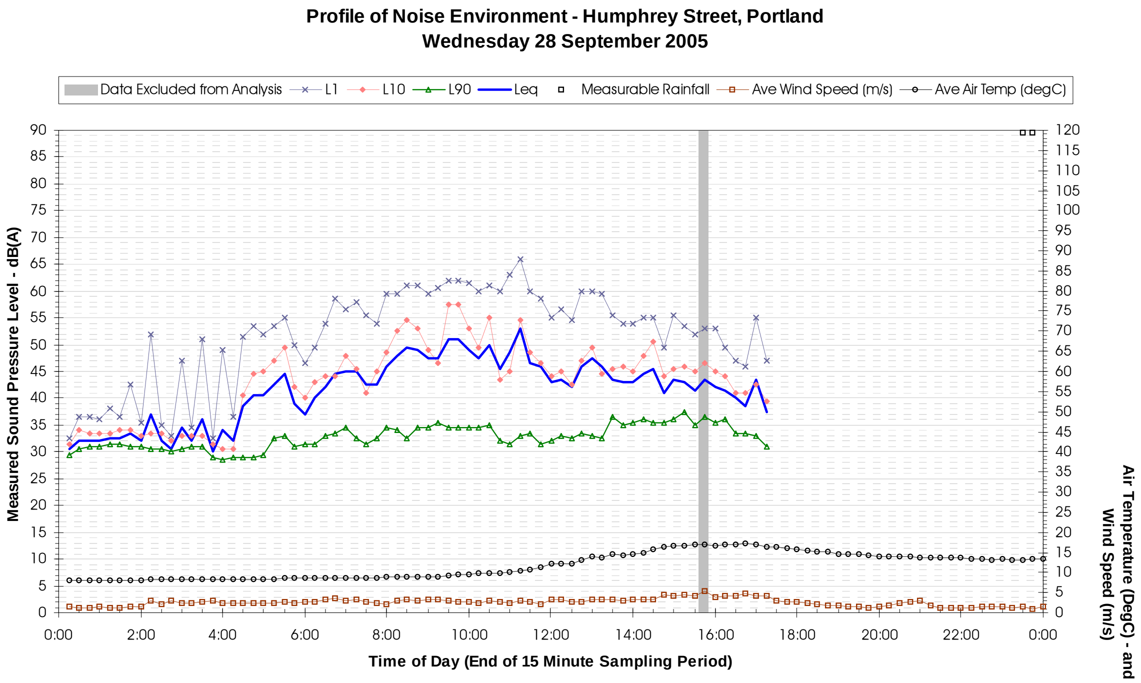

Profile of Noise Environment - Humphrey Street, Portland
Sunday 25 September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

Profile of Noise Environment - Humphrey Street, Portland
Monday 26 September 2005

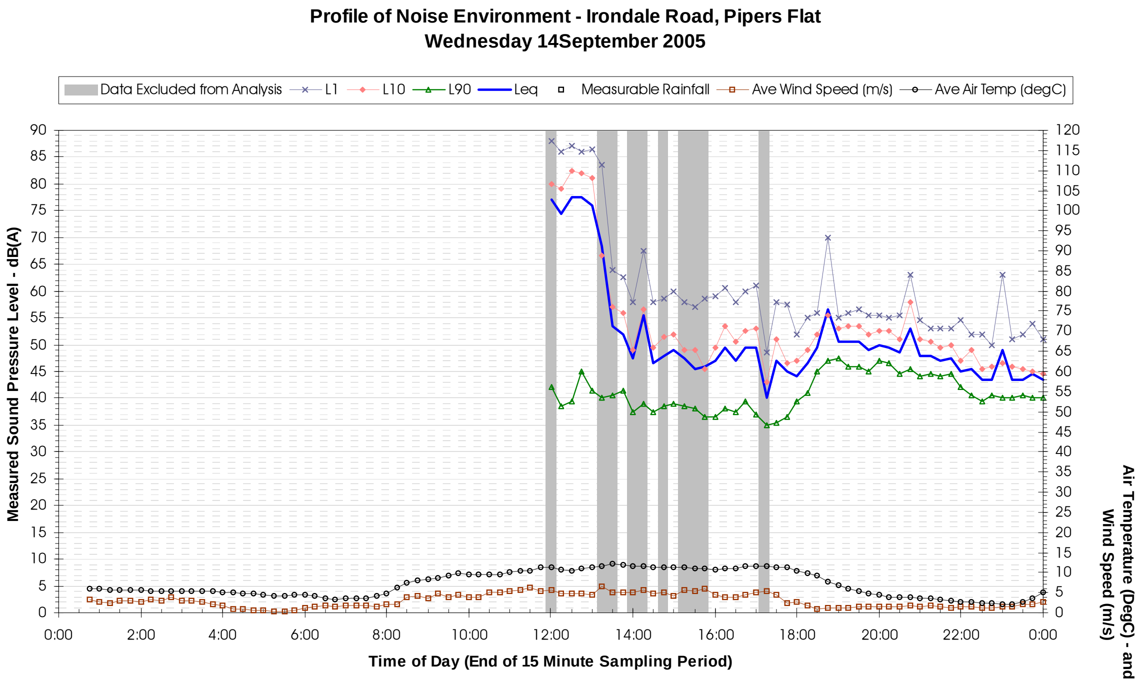


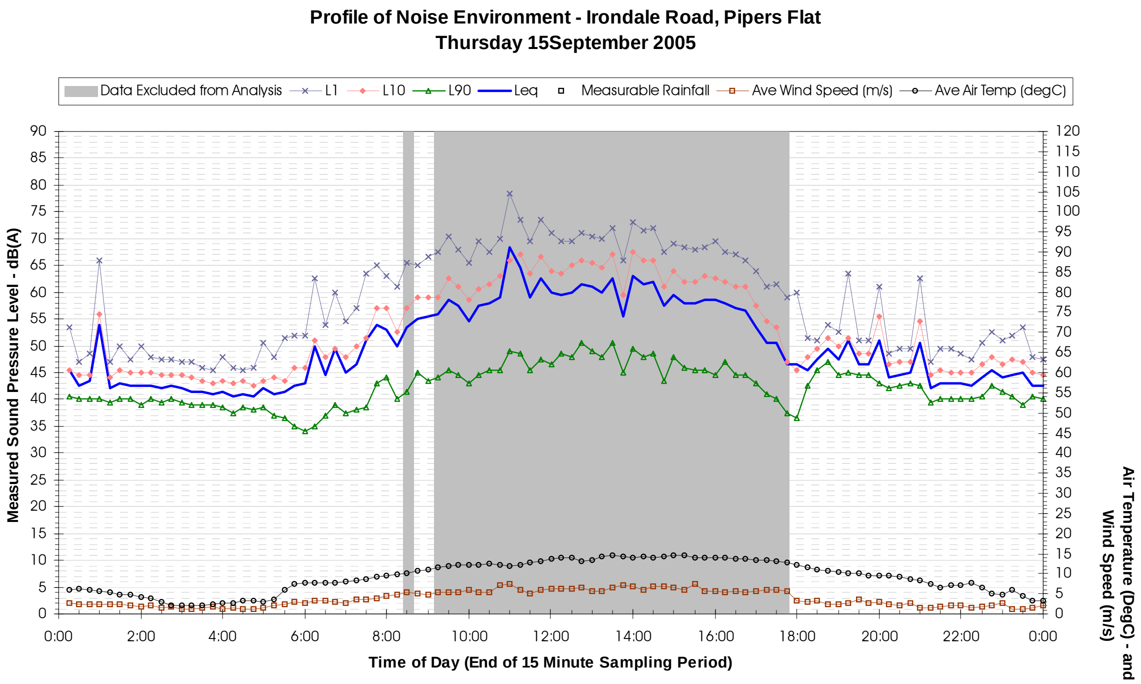
Profile of Noise Environment - Humphrey Street, Portland
Tuesday 27 September 2005



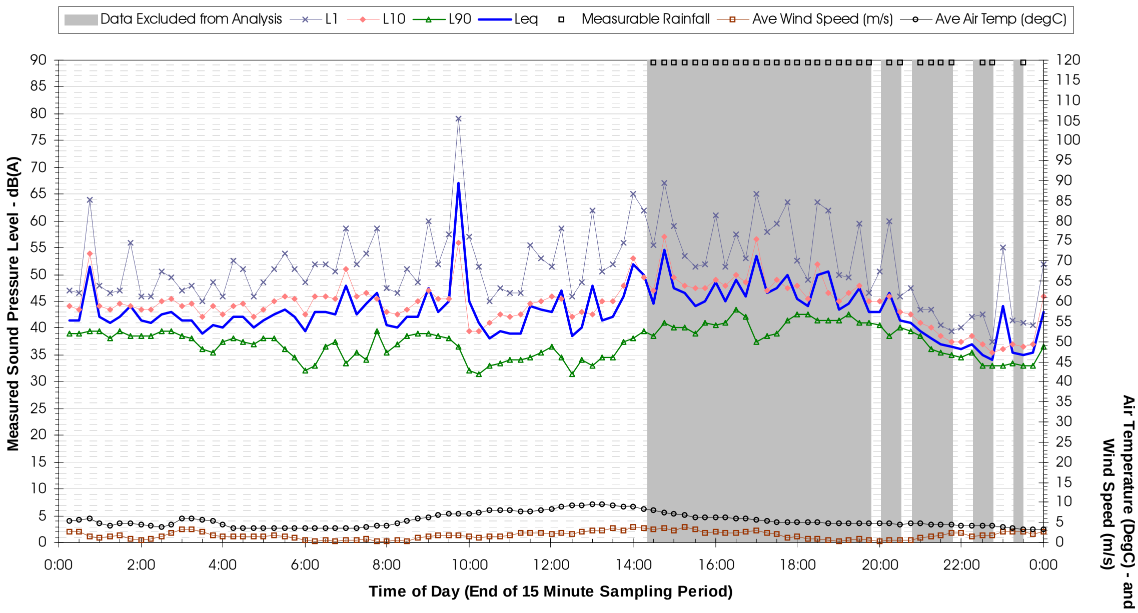

Profile of Noise Environment - Humphrey Street, Portland
Wednesday 28 September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

A.3 Location C

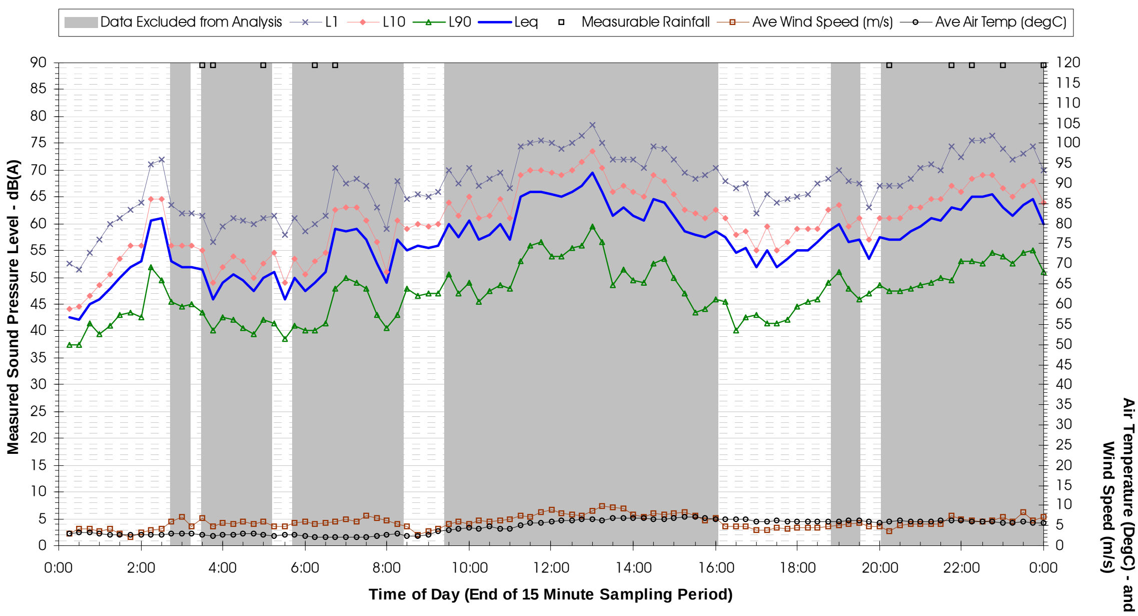




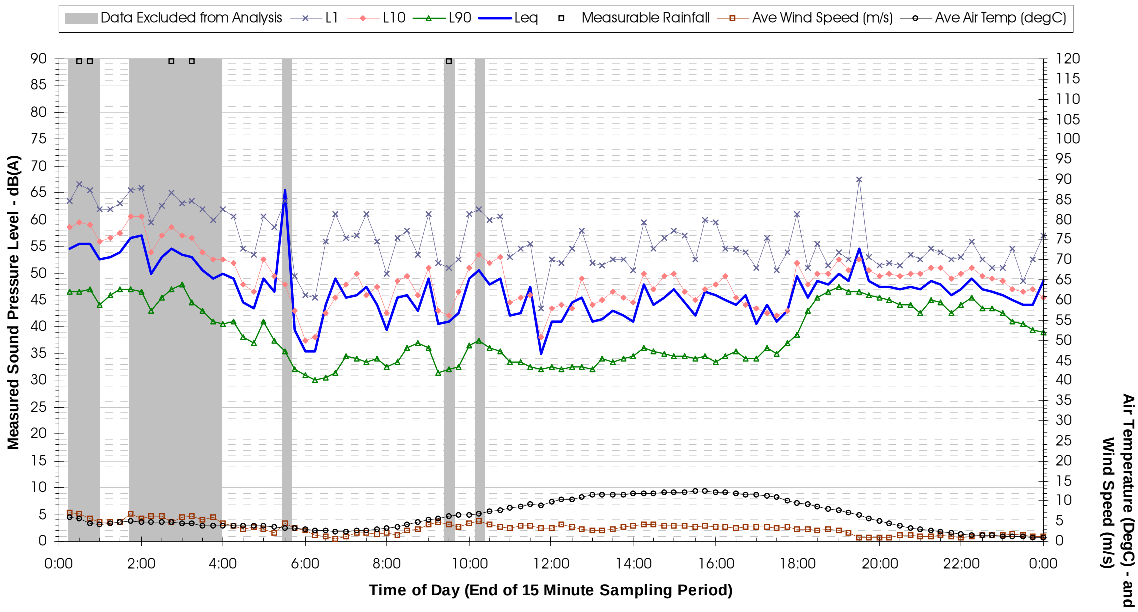
Profile of Noise Environment - Irondale Road, Pipers Flat
Friday 16September 2005



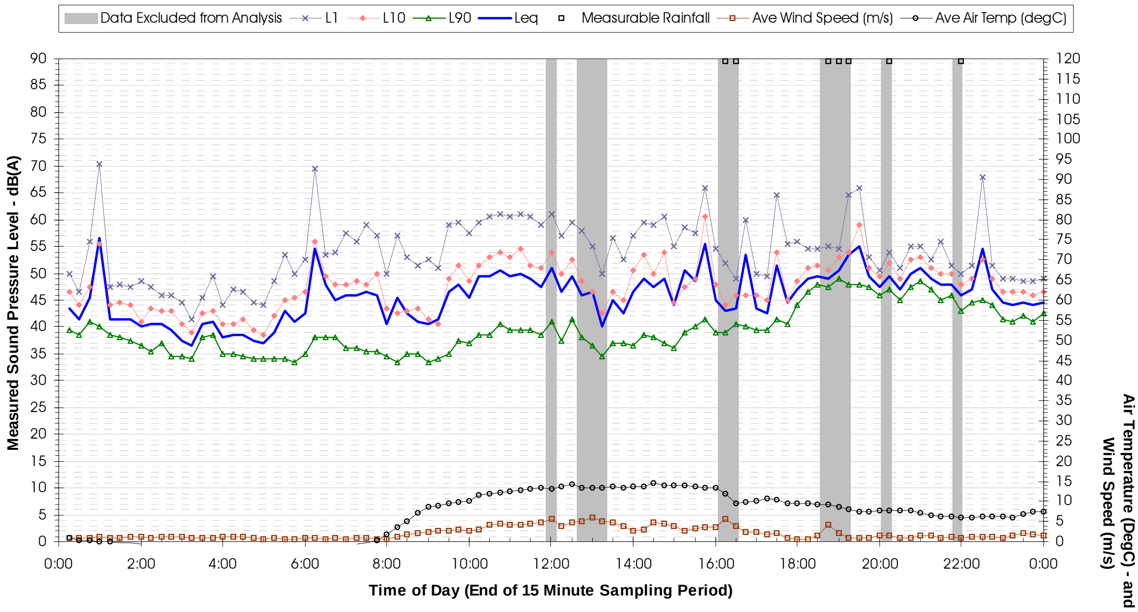
Profile of Noise Environment - Irondale Road, Pipers Flat
Saturday 17September 2005



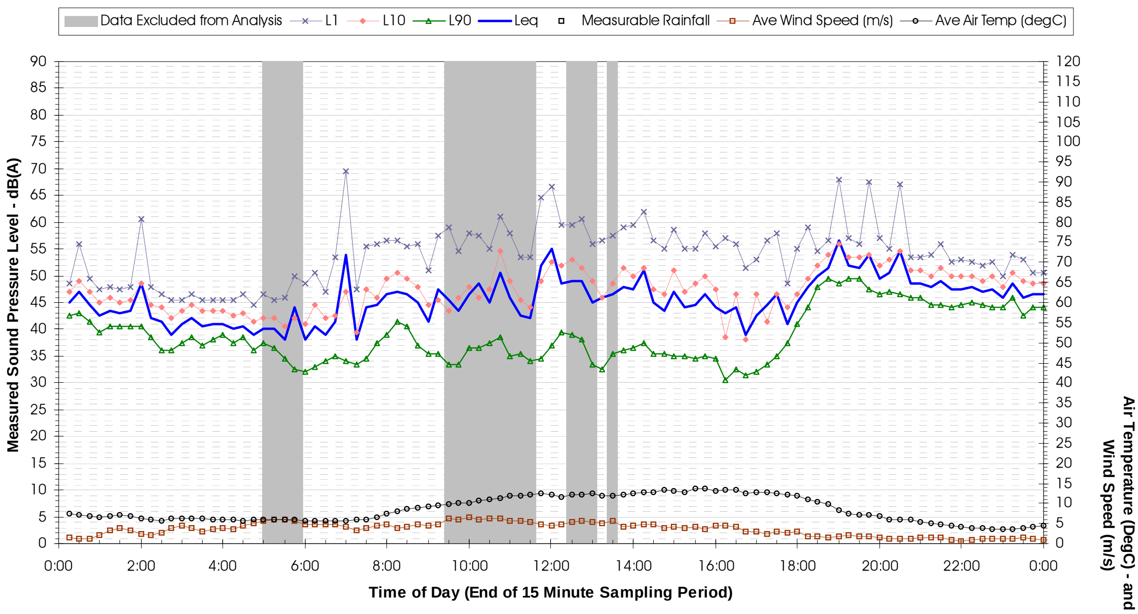
Profile of Noise Environment - Irondale Road, Pipers Flat
Sunday 18September 2005



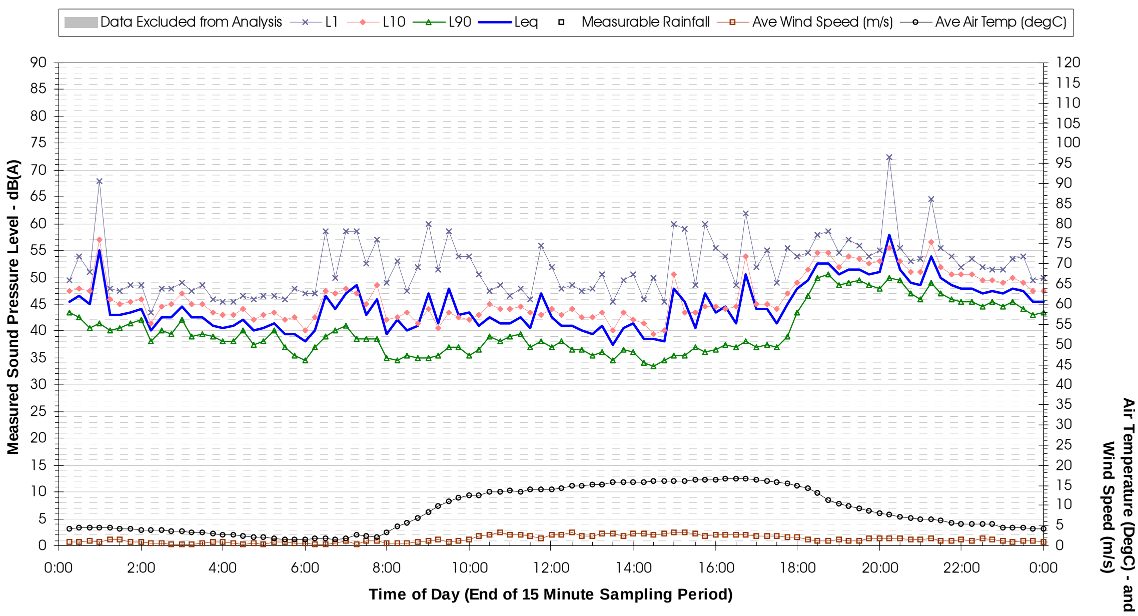
Profile of Noise Environment - Irondale Road, Pipers Flat
Monday 19September 2005

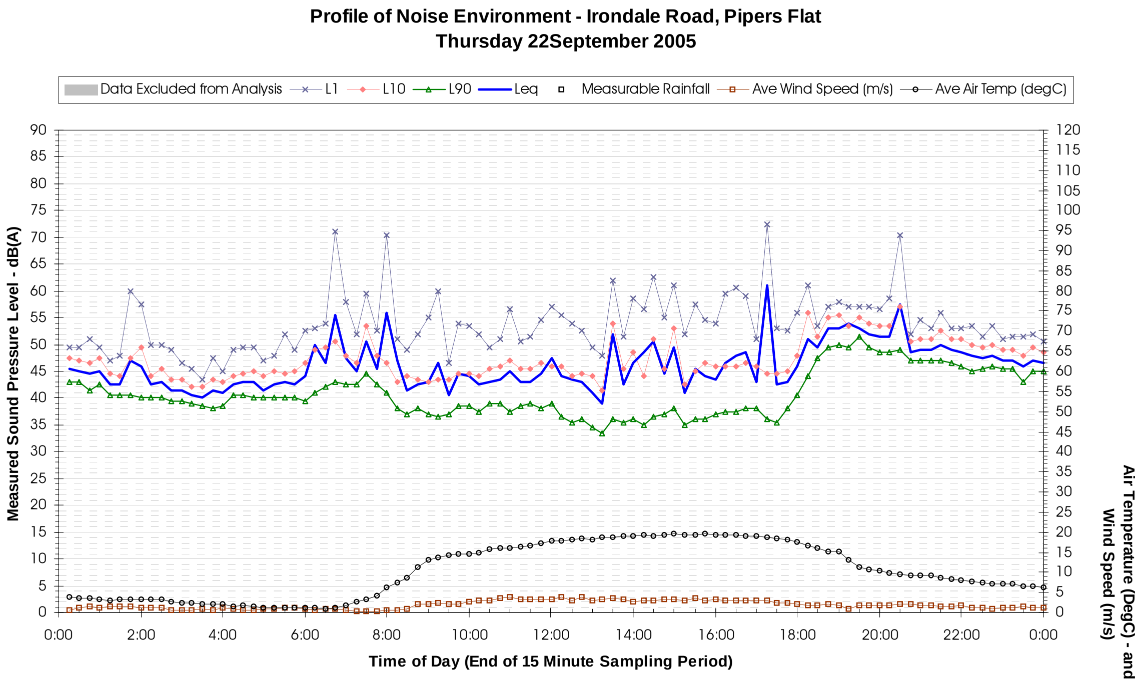


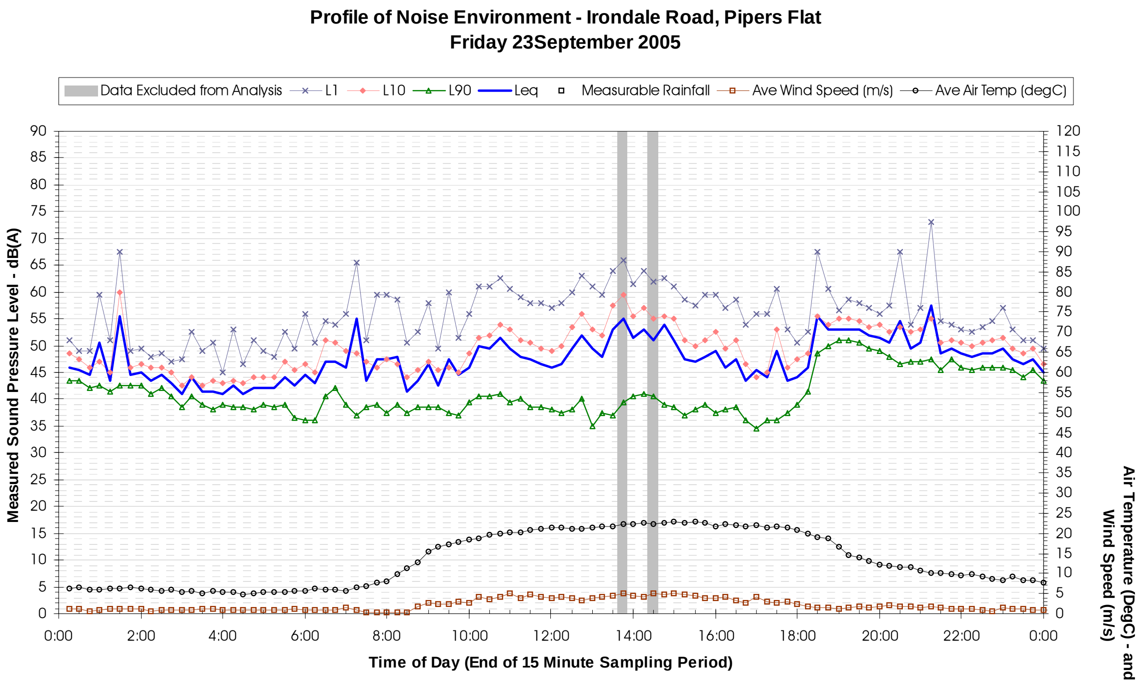
Profile of Noise Environment - Irondale Road, Pipers Flat
Tuesday 20September 2005



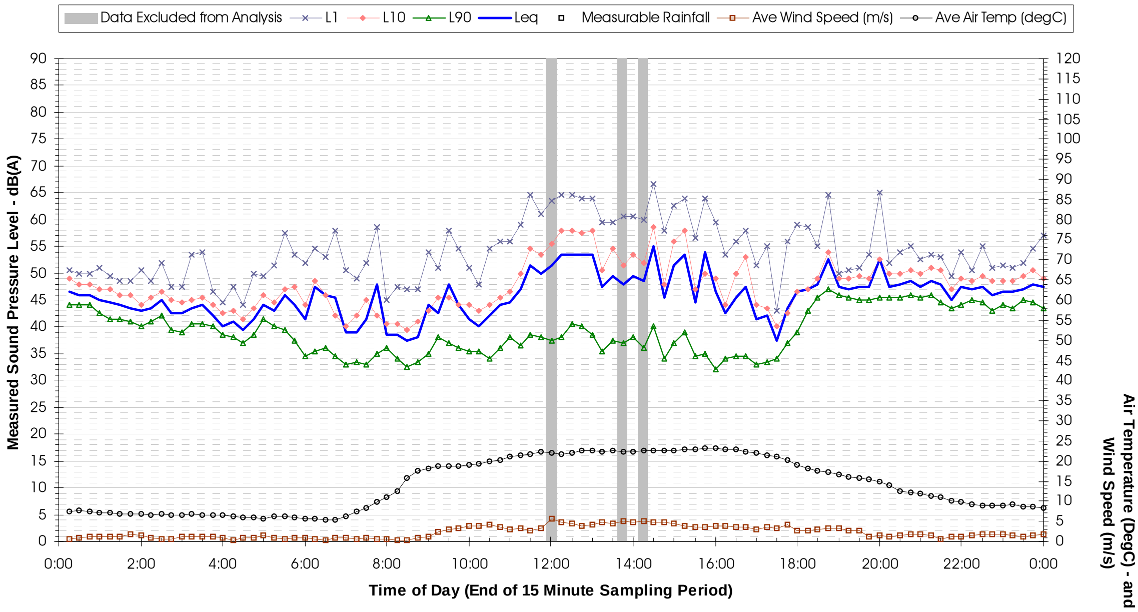
Profile of Noise Environment - Irondale Road, Pipers Flat
Wednesday 21September 2005



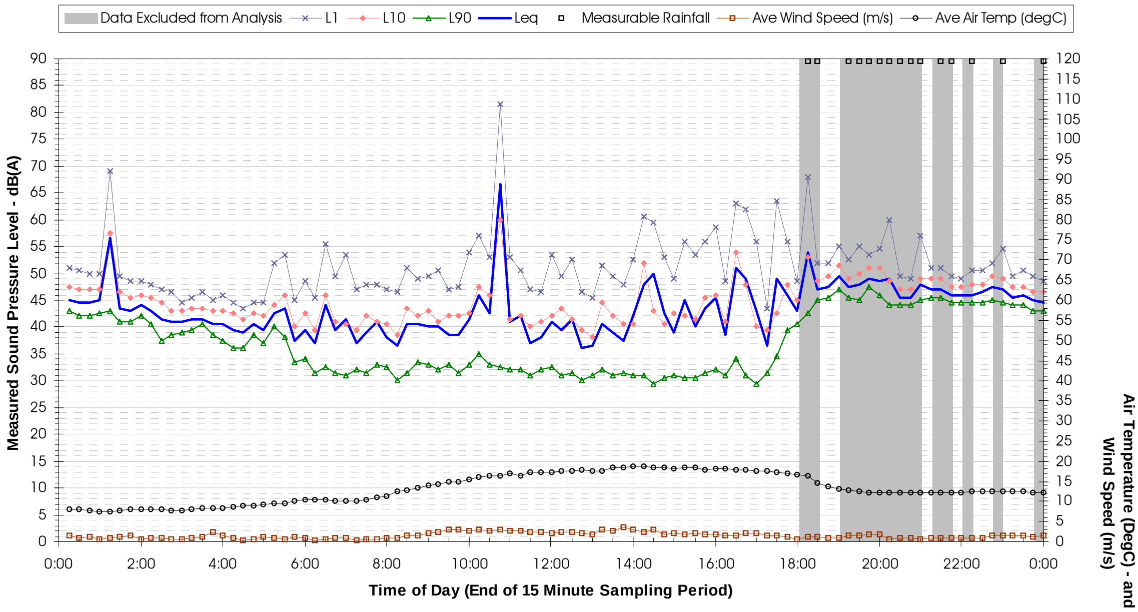

Profile of Noise Environment - Irondale Road, Pipers Flat
Thursday 22September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

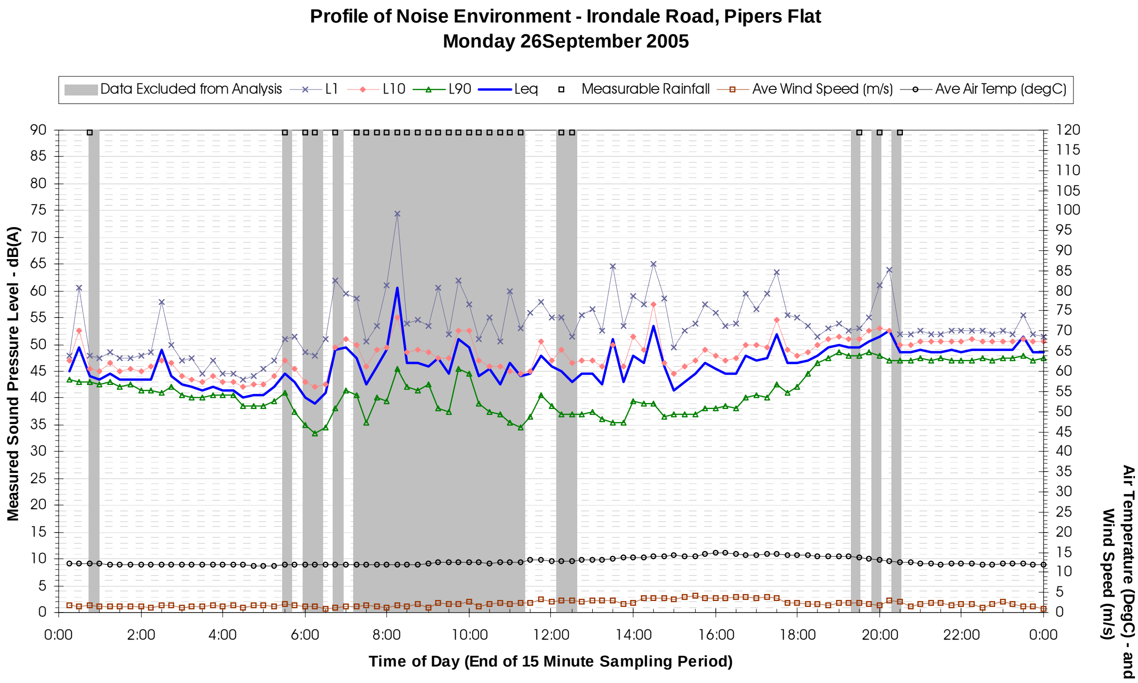

Profile of Noise Environment - Irondale Road, Pipers Flat
Friday 23September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

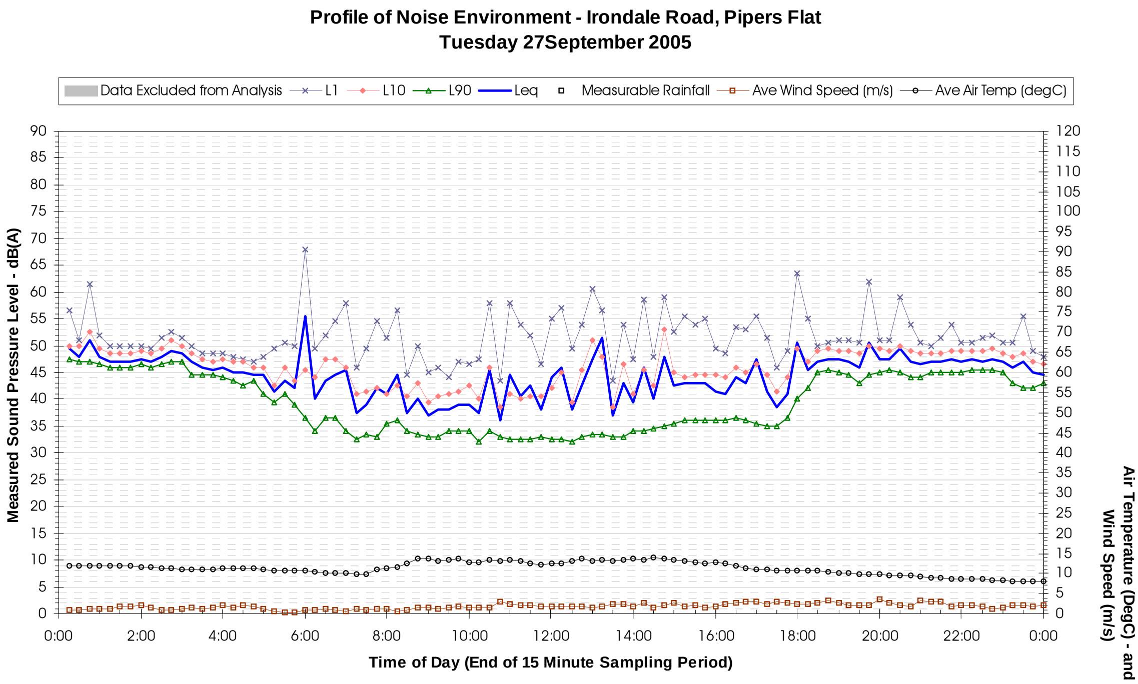
Profile of Noise Environment - Irondale Road, Pipers Flat
Saturday 24September 2005



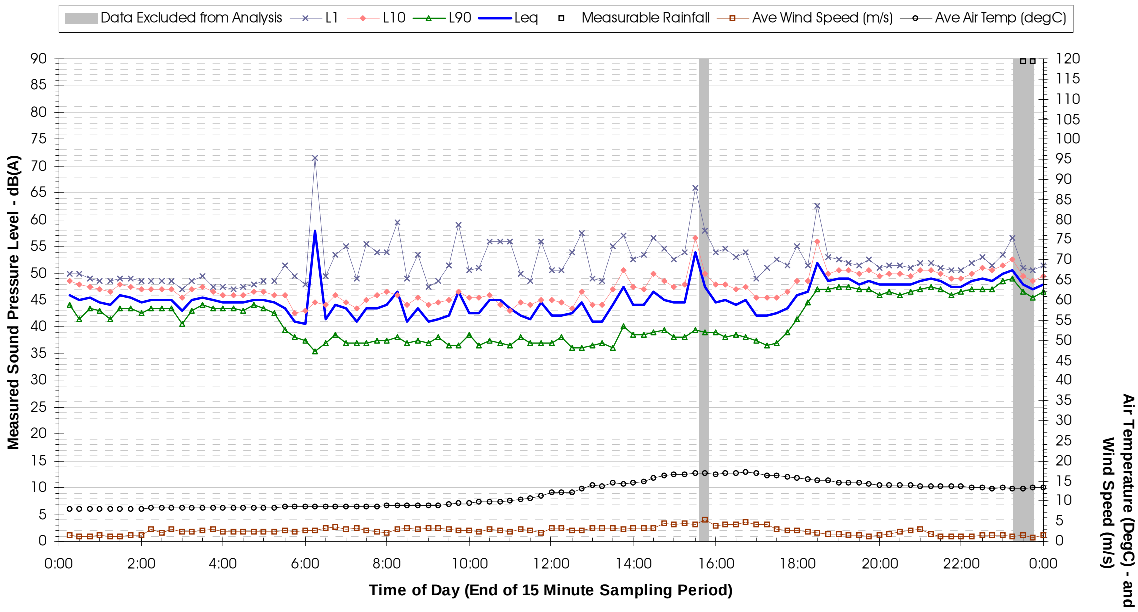
Profile of Noise Environment - Irondale Road, Pipers Flat
Sunday 25September 2005



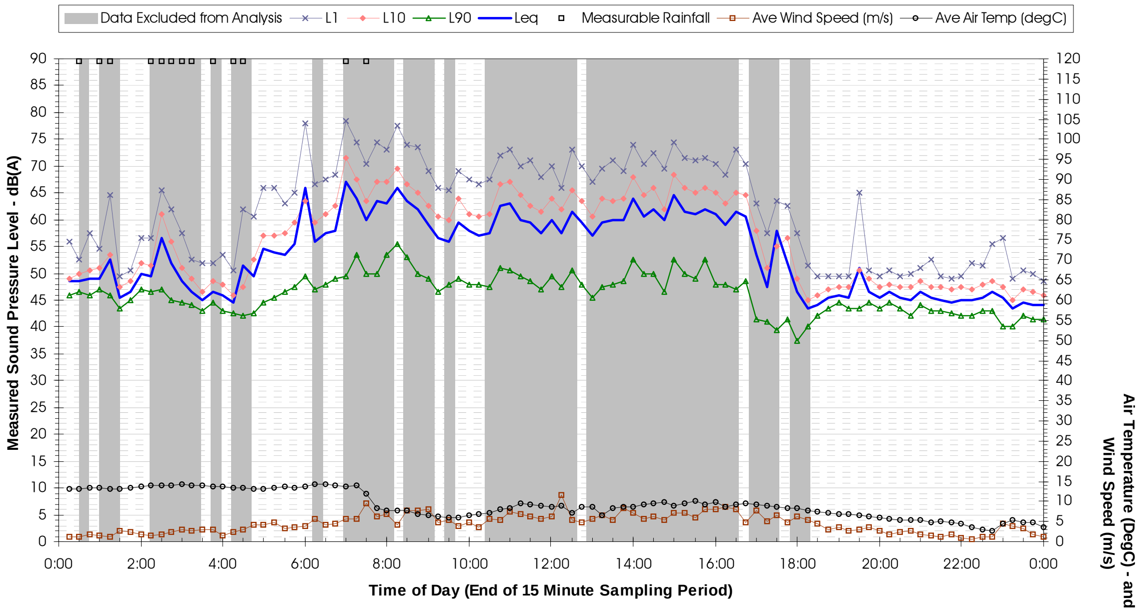

Profile of Noise Environment - Irondale Road, Pipers Flat
Monday 26September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)


Profile of Noise Environment - Irondale Road, Pipers Flat
Tuesday 27September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

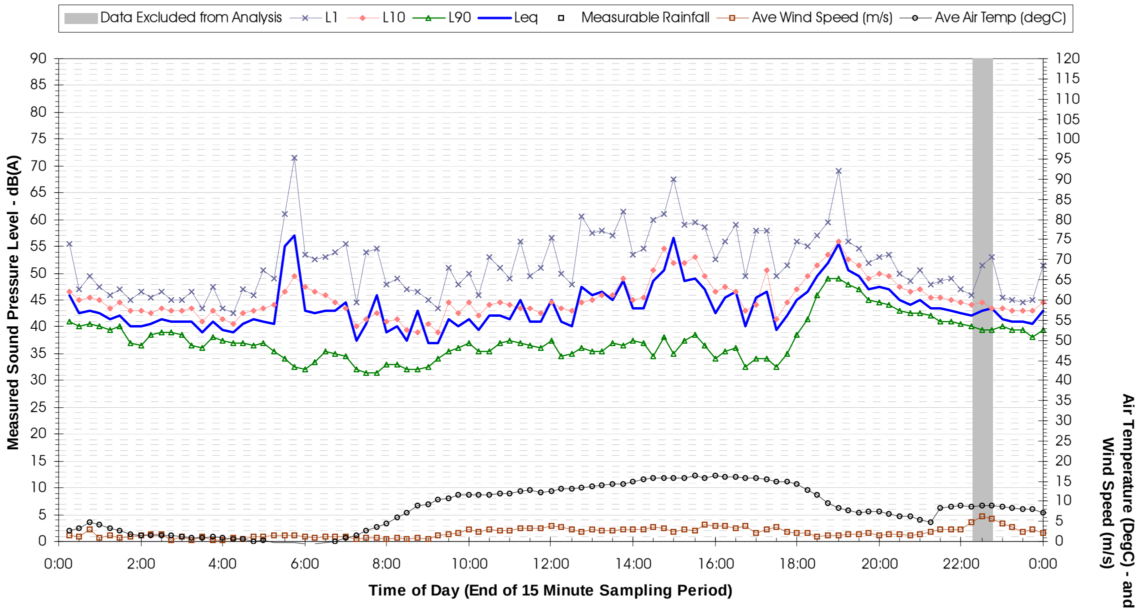
Profile of Noise Environment - Irondale Road, Pipers Flat
Wednesday 28September 2005



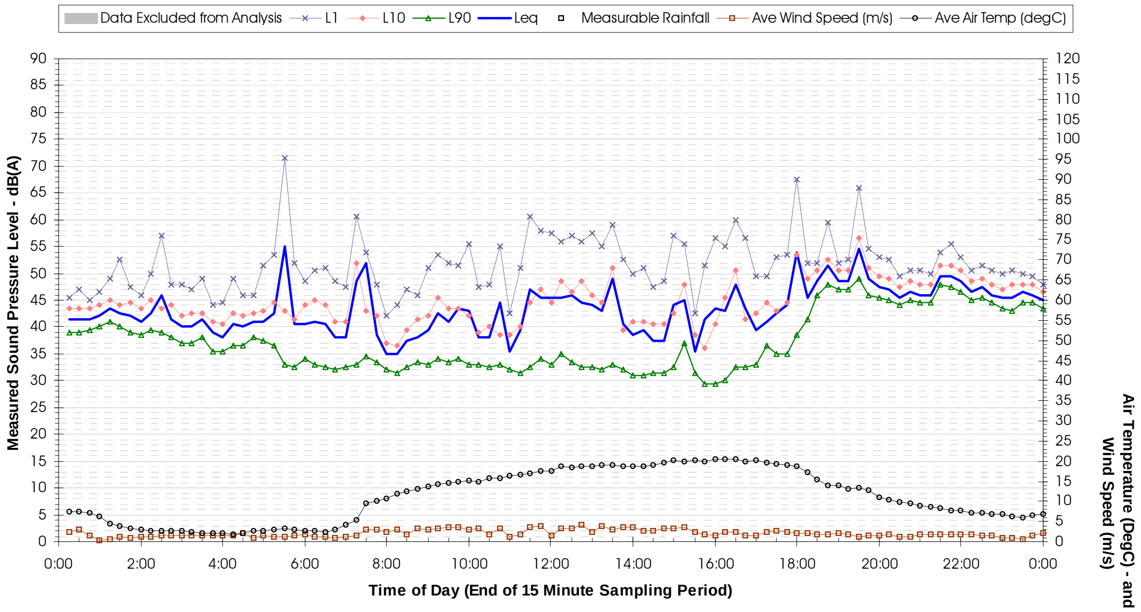
Profile of Noise Environment - Irondale Road, Pipers Flat
Thursday 29September 2005



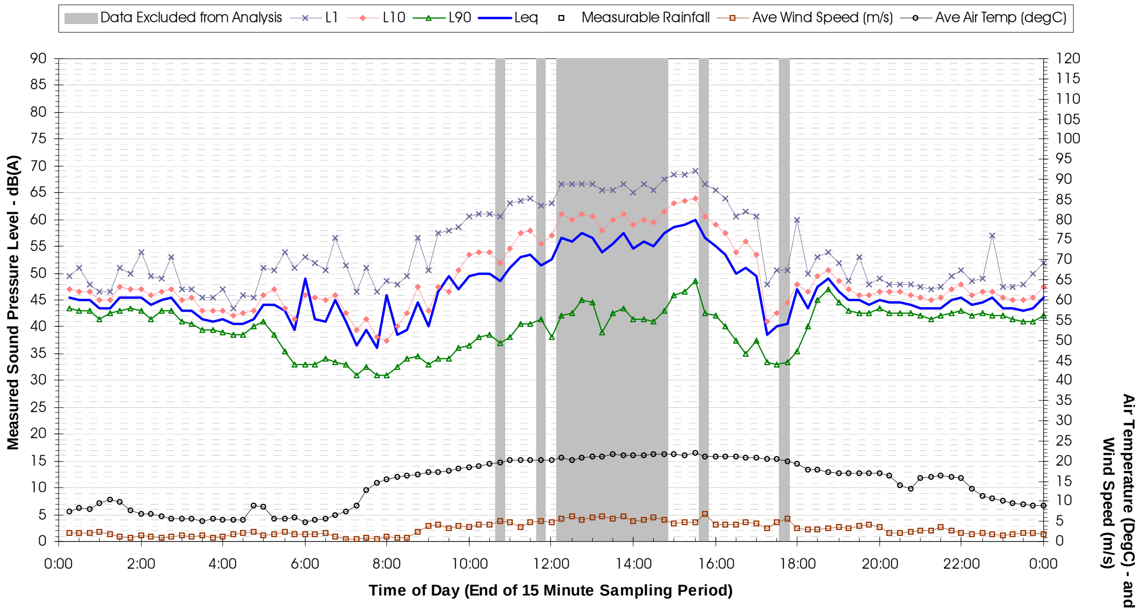
Profile of Noise Environment - Irondale Road, Pipers Flat
Friday 30September 2005



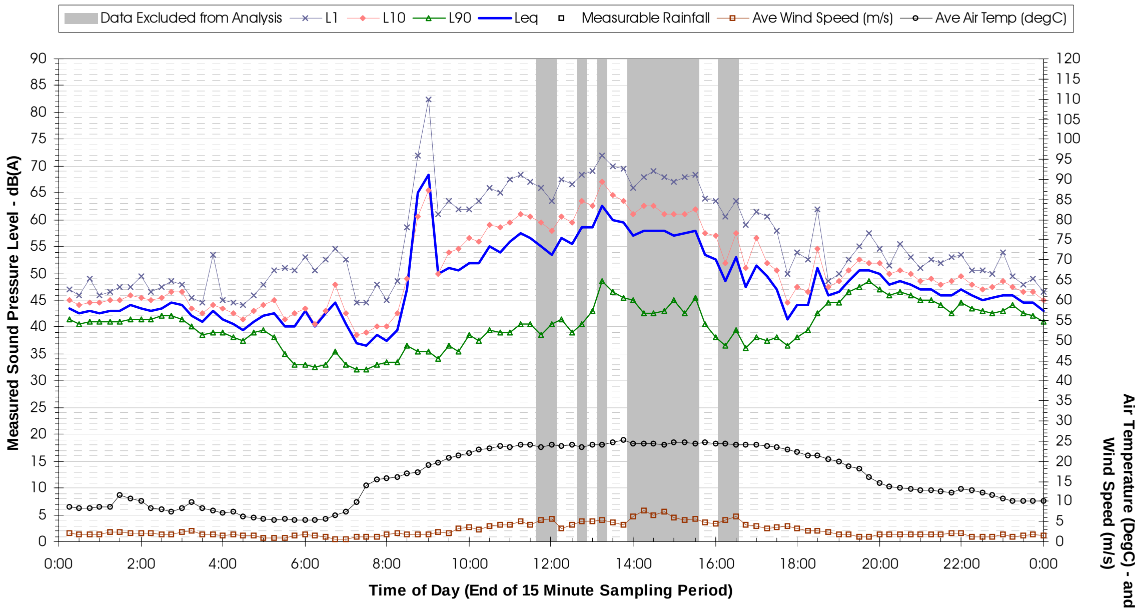
Profile of Noise Environment - Irondale Road, Pipers Flat
Saturday 1October 2005



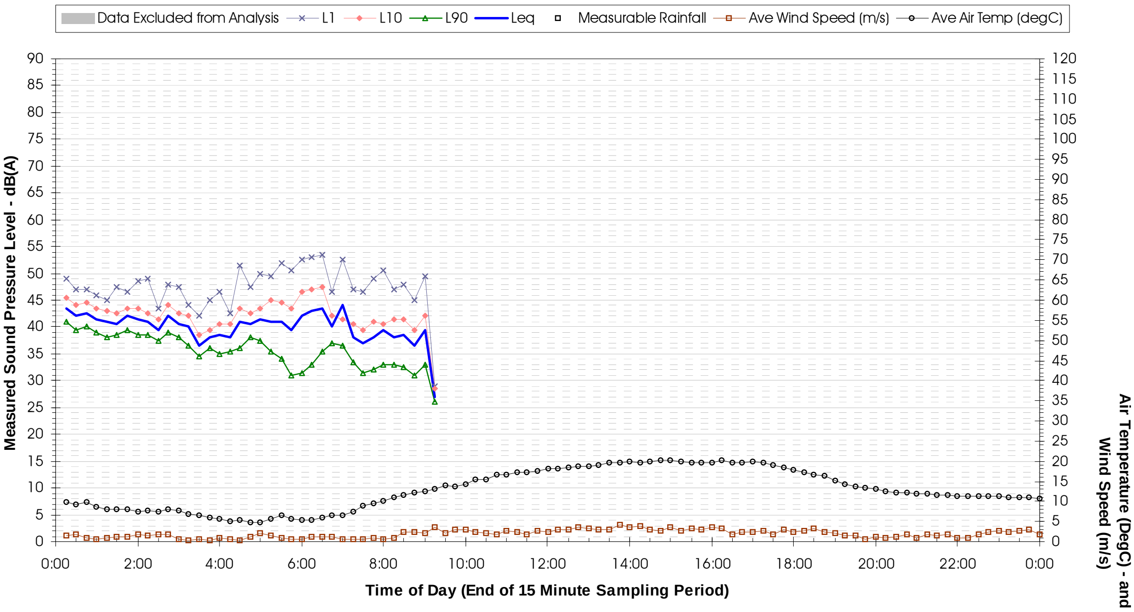
Profile of Noise Environment - Irondale Road, Pipers Flat
Sunday 2October 2005



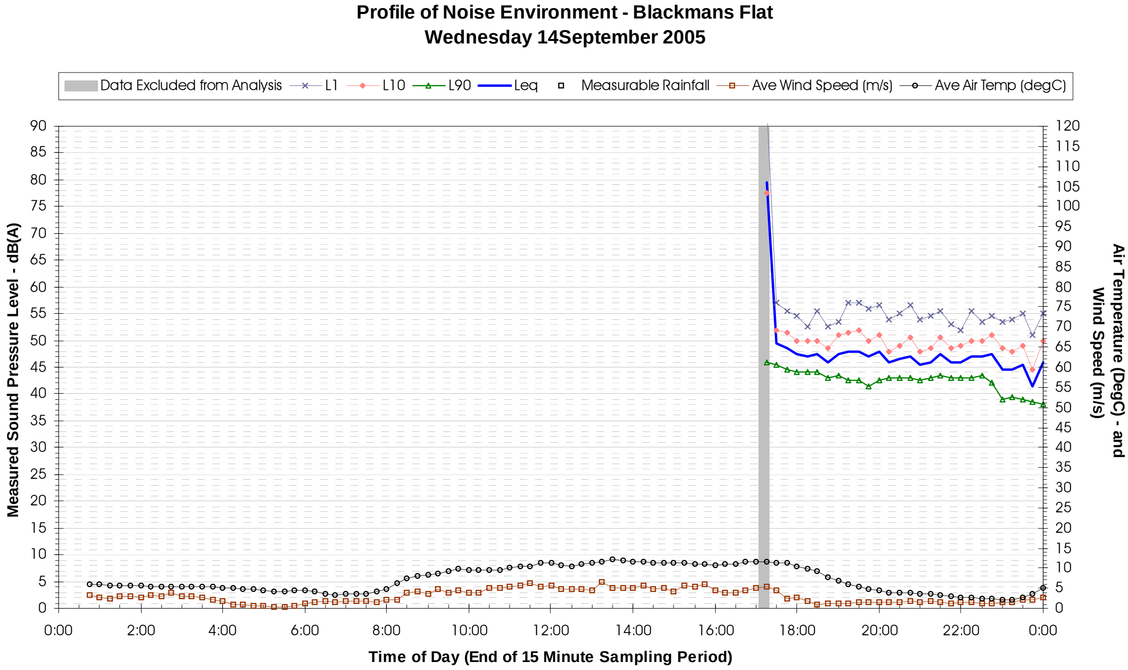
Profile of Noise Environment - Irondale Road, Pipers Flat
Monday 3October 2005

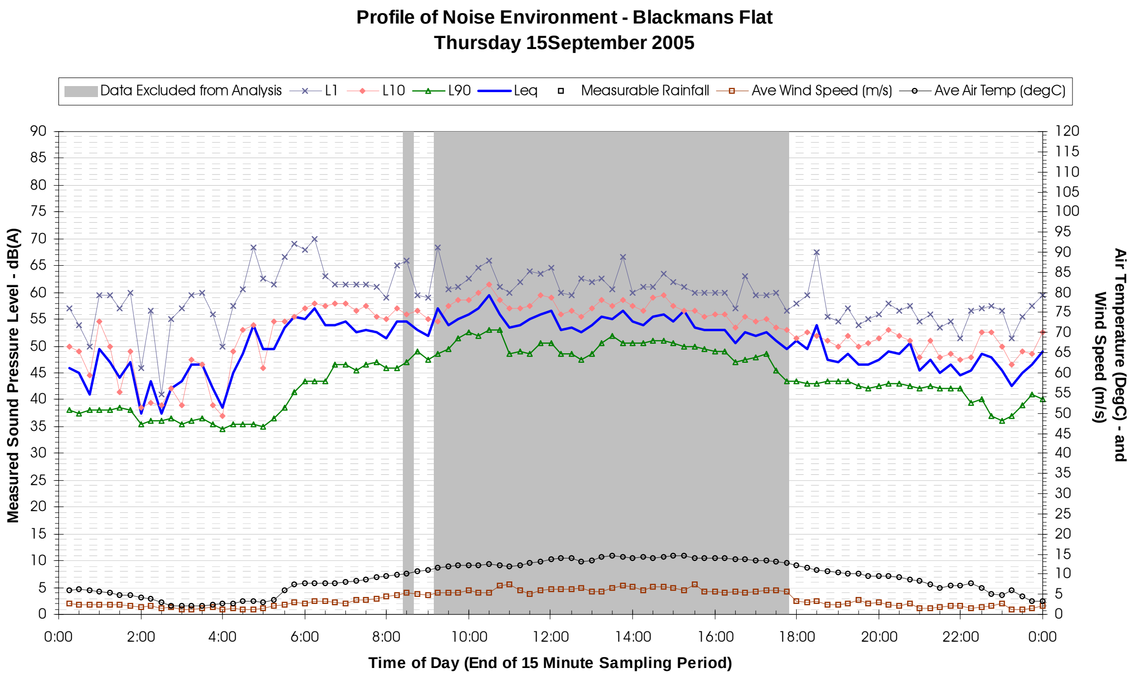


Profile of Noise Environment - Irondale Road, Pipers Flat
Tuesday 4October 2005

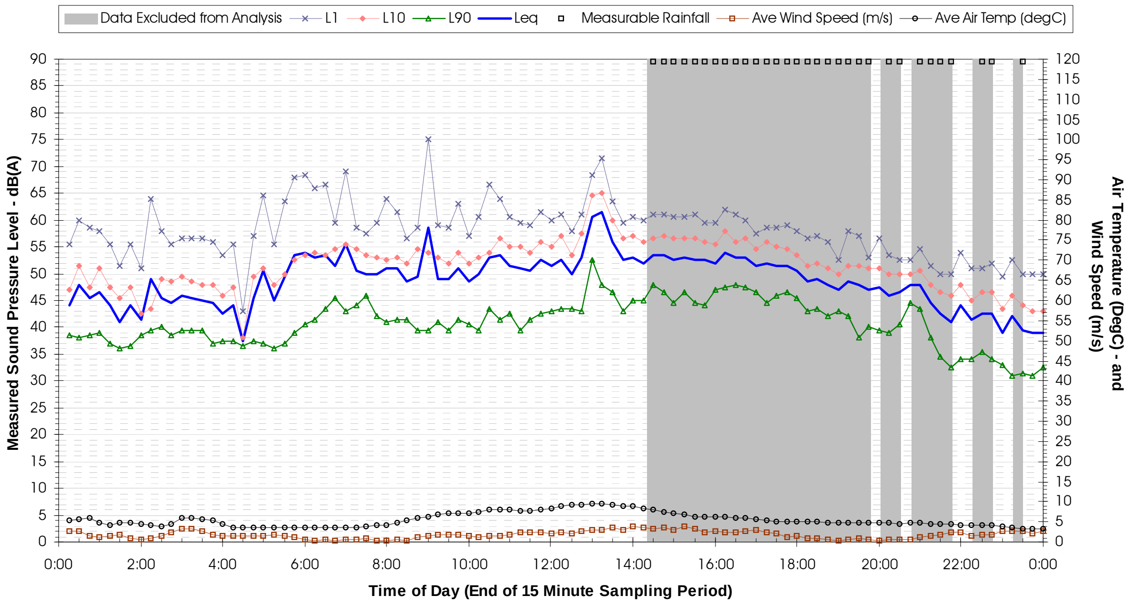


A.4 Location D

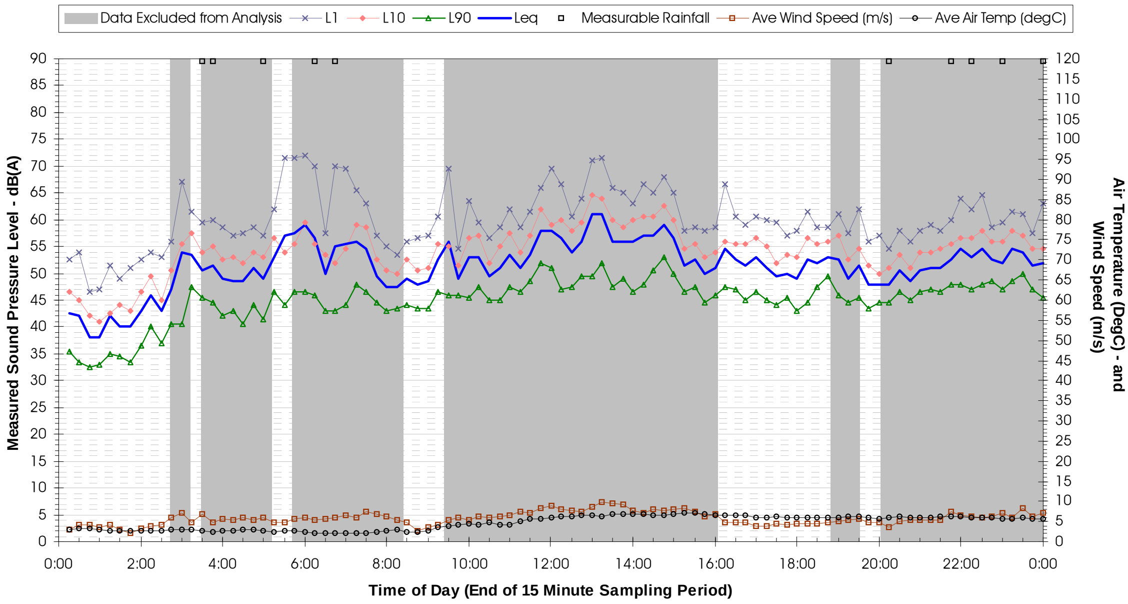


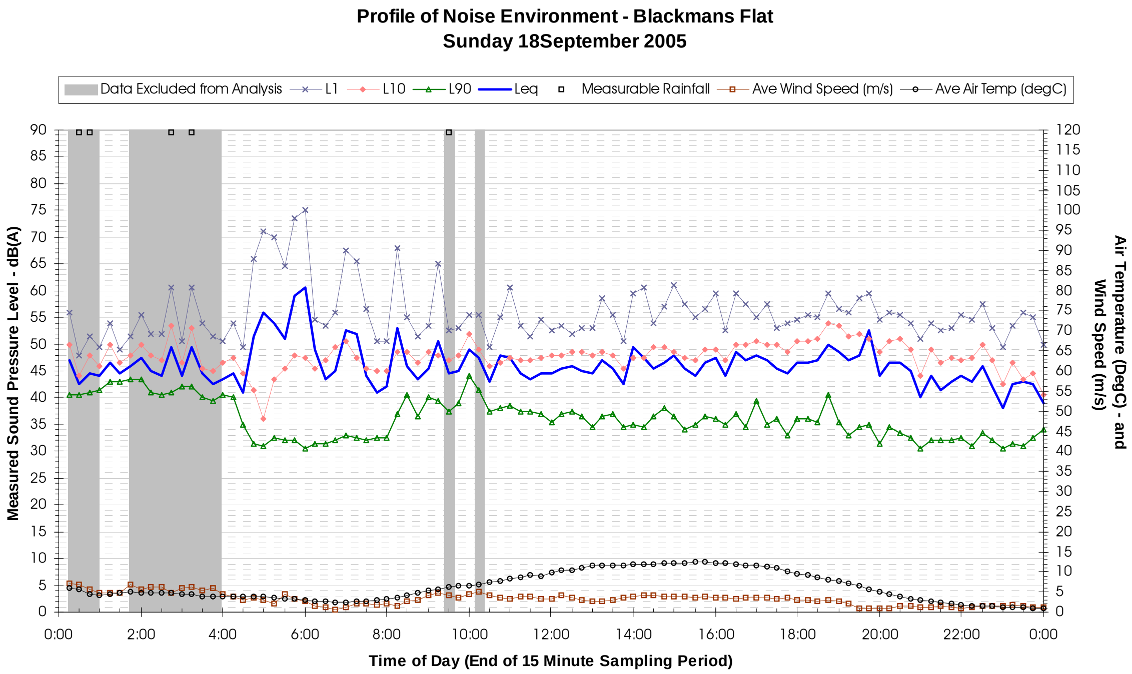


Profile of Noise Environment - Blackmans Flat
Friday 16September 2005

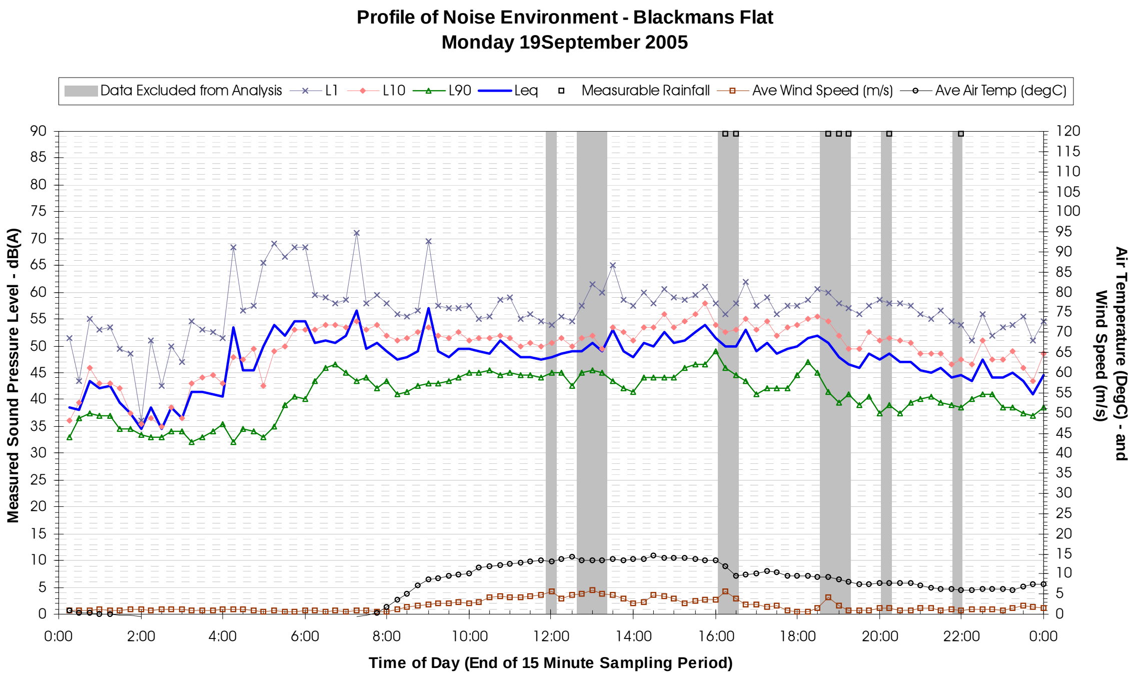


Profile of Noise Environment - Blackmans Flat
Saturday 17September 2005



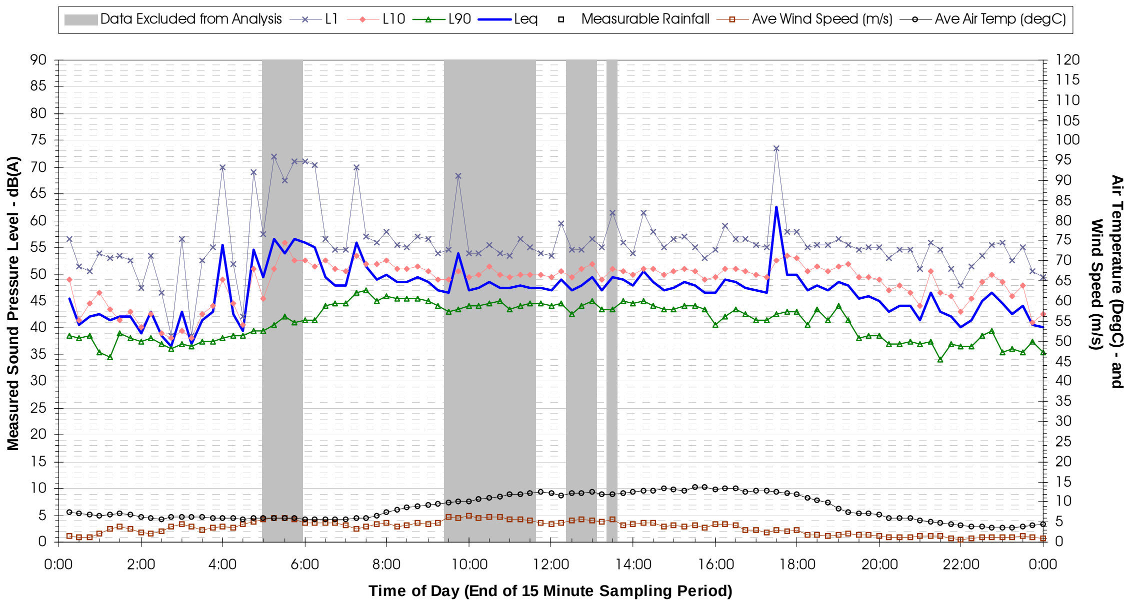


Profile of Noise Environment - Blackmans Flat
Sunday 18September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

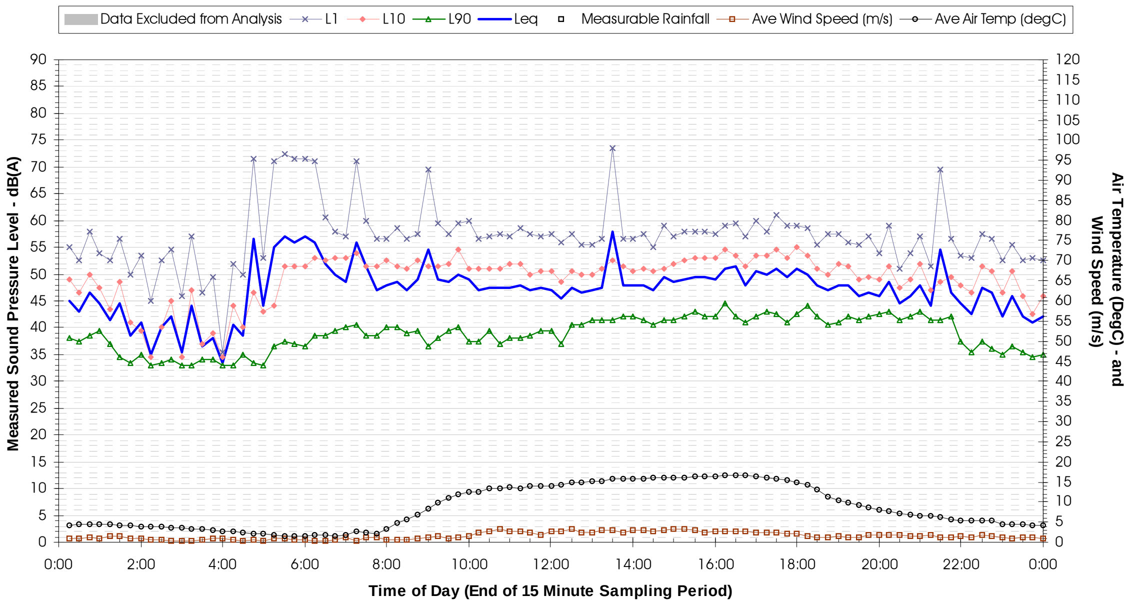


Profile of Noise Environment - Blackmans Flat
Monday 19September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

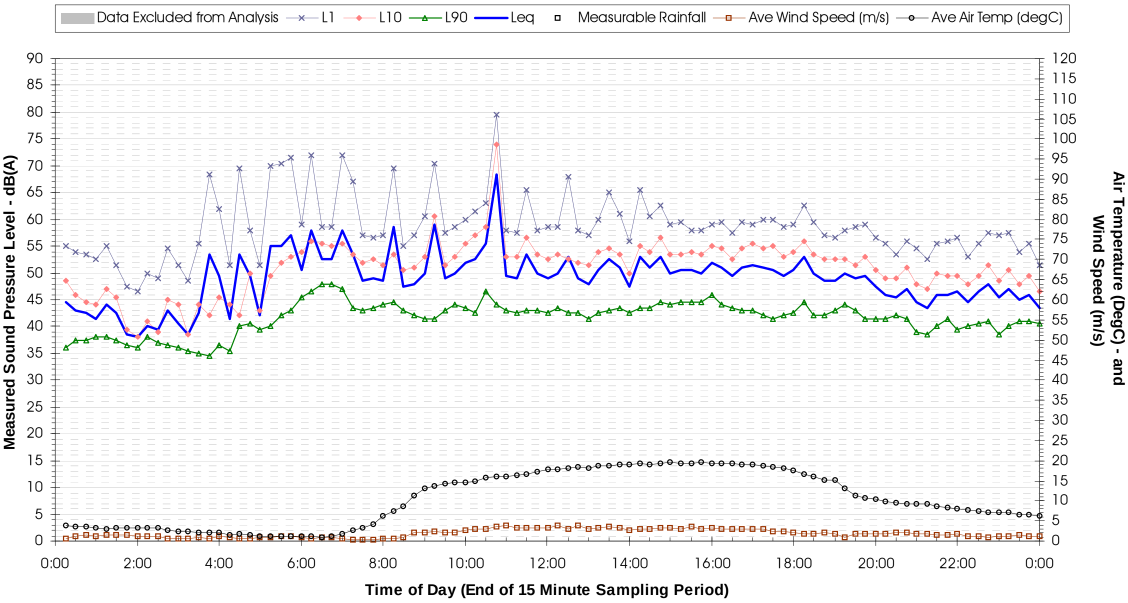
Profile of Noise Environment - Blackmans Flat
Tuesday 20September 2005



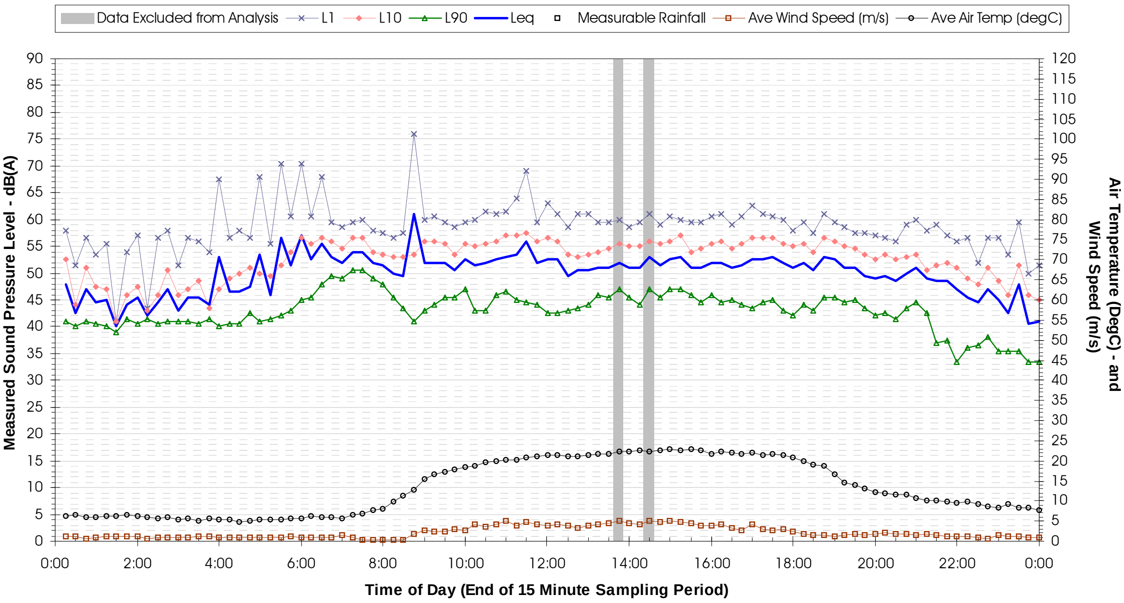
Profile of Noise Environment - Blackmans Flat
Wednesday 21September 2005

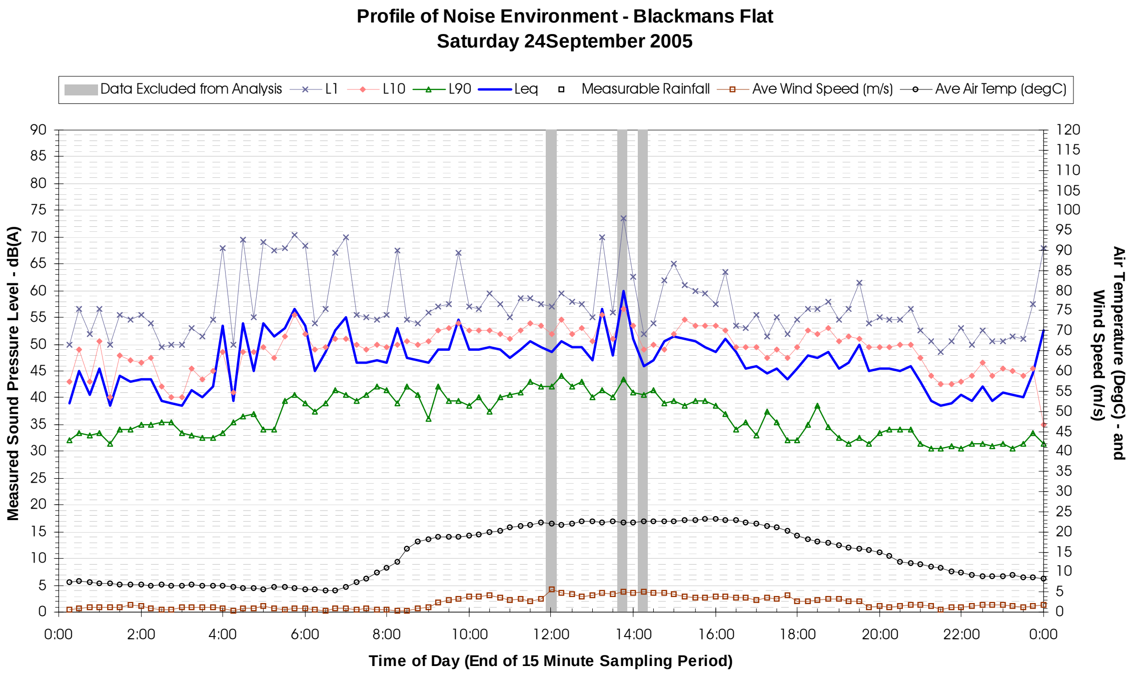


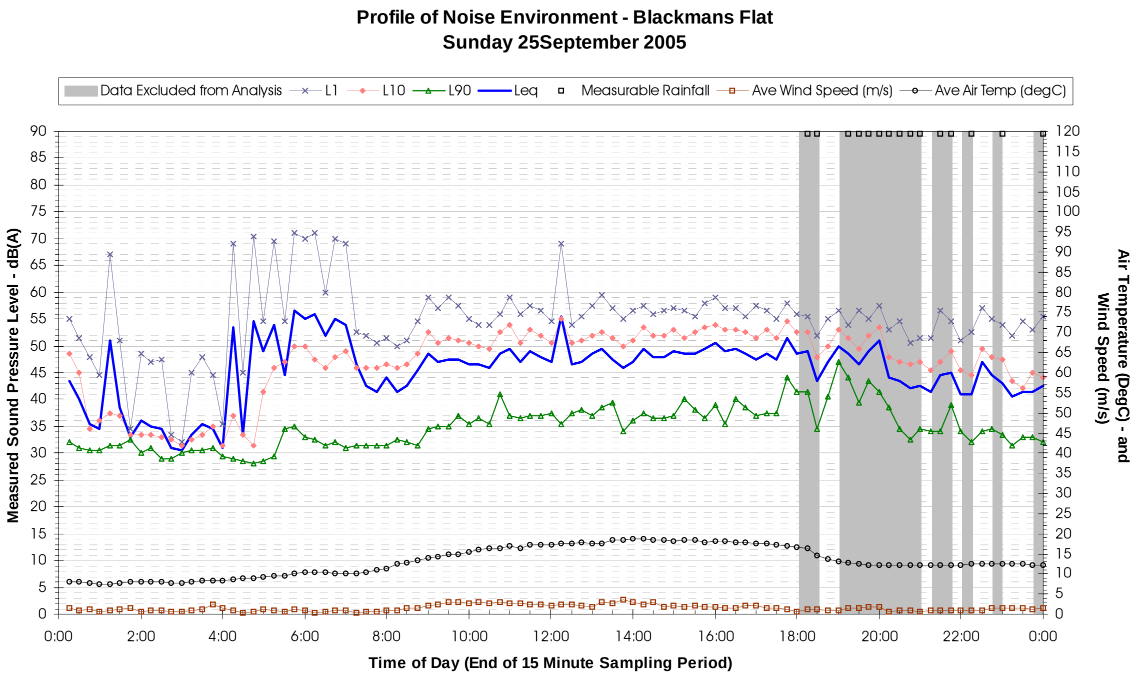
Profile of Noise Environment - Blackmans Flat
Thursday 22September 2005



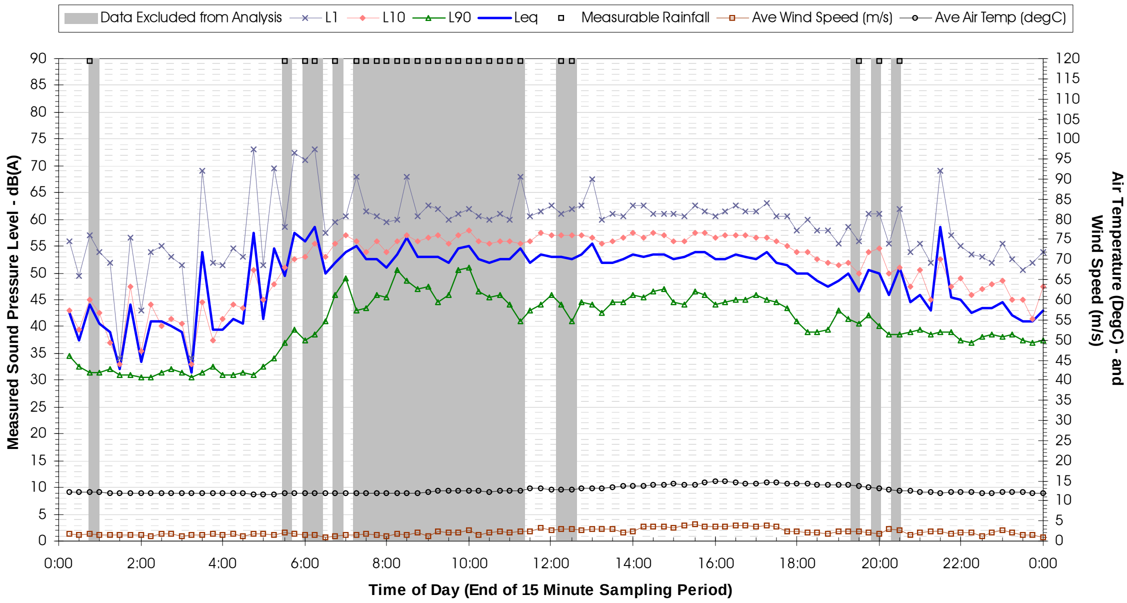
Profile of Noise Environment - Blackmans Flat
Friday 23September 2005



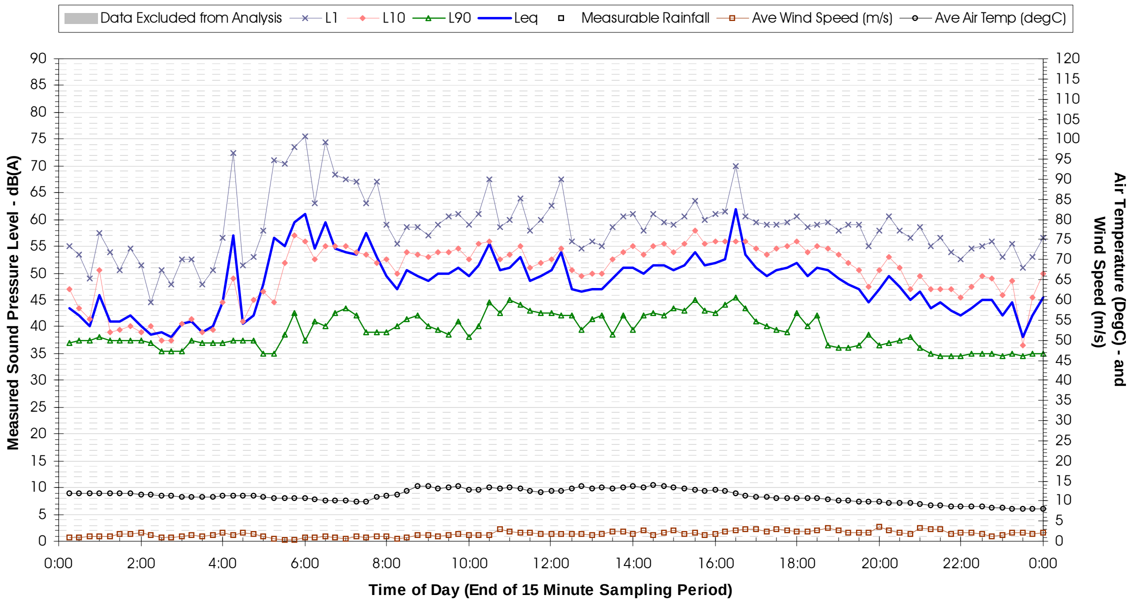

Profile of Noise Environment - Blackmans Flat
Saturday 24September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

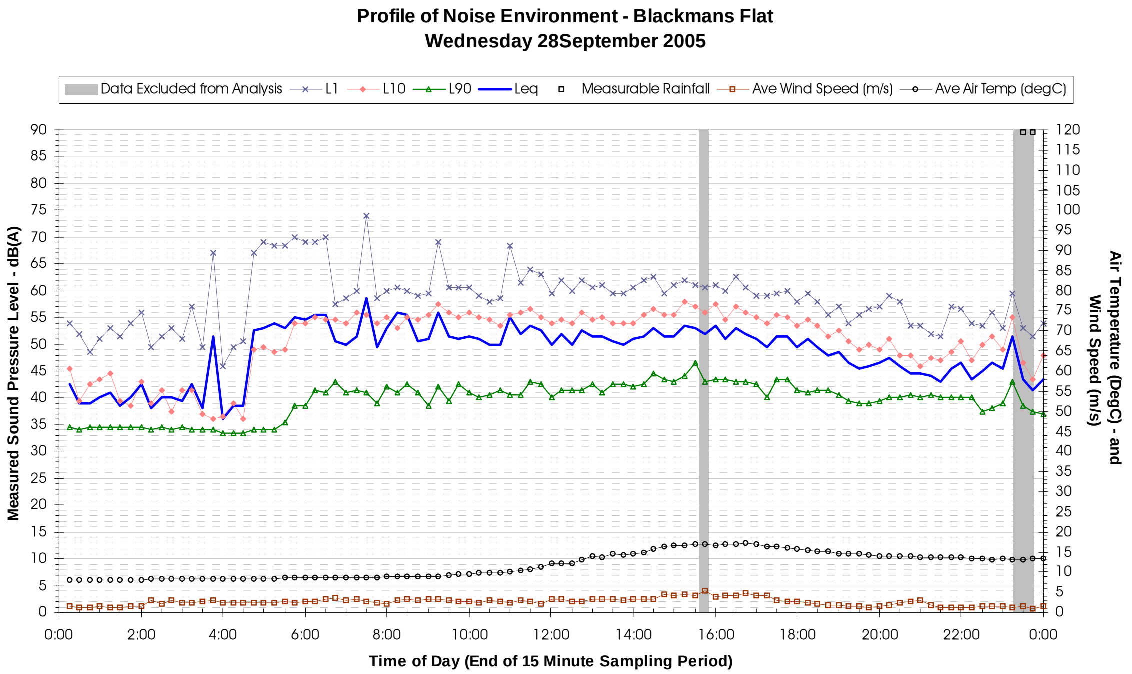

Profile of Noise Environment - Blackmans Flat
Sunday 25September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

Profile of Noise Environment - Blackmans Flat
Monday 26September 2005

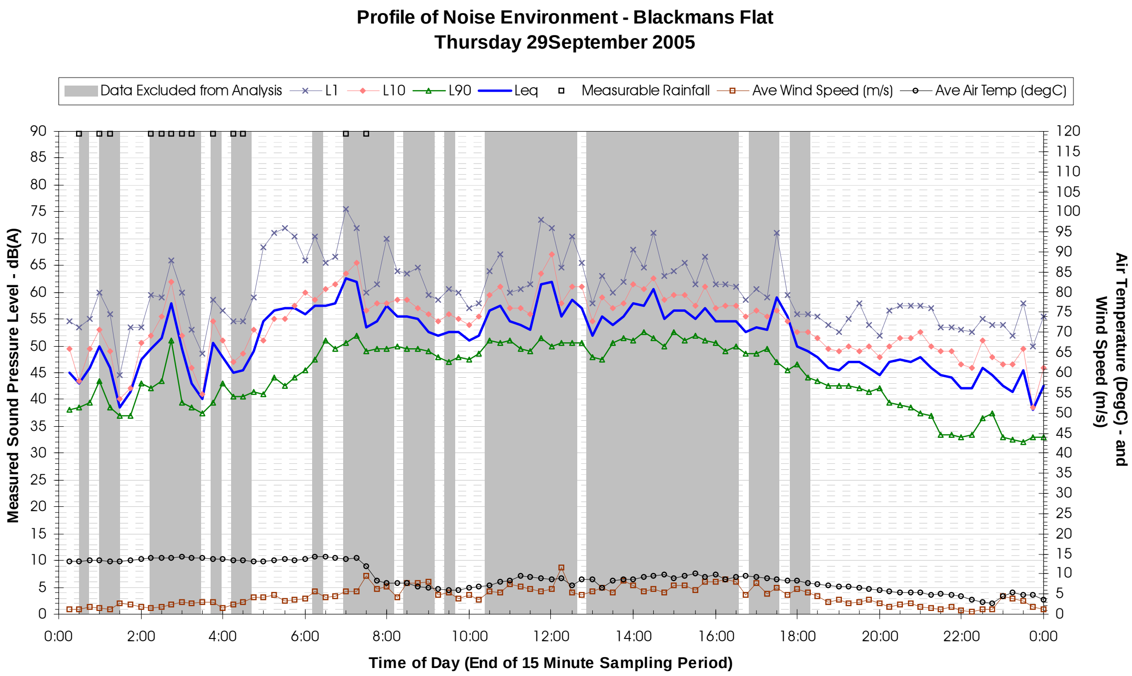


Profile of Noise Environment - Blackmans Flat
Tuesday 27September 2005



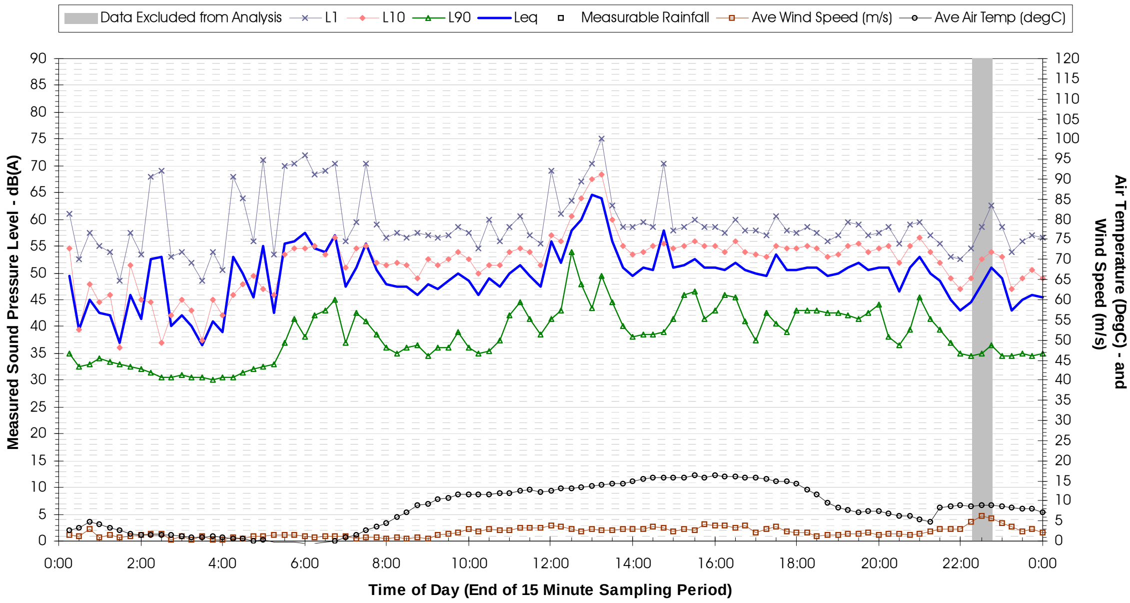


Profile of Noise Environment - Blackmans Flat
Wednesday 28September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

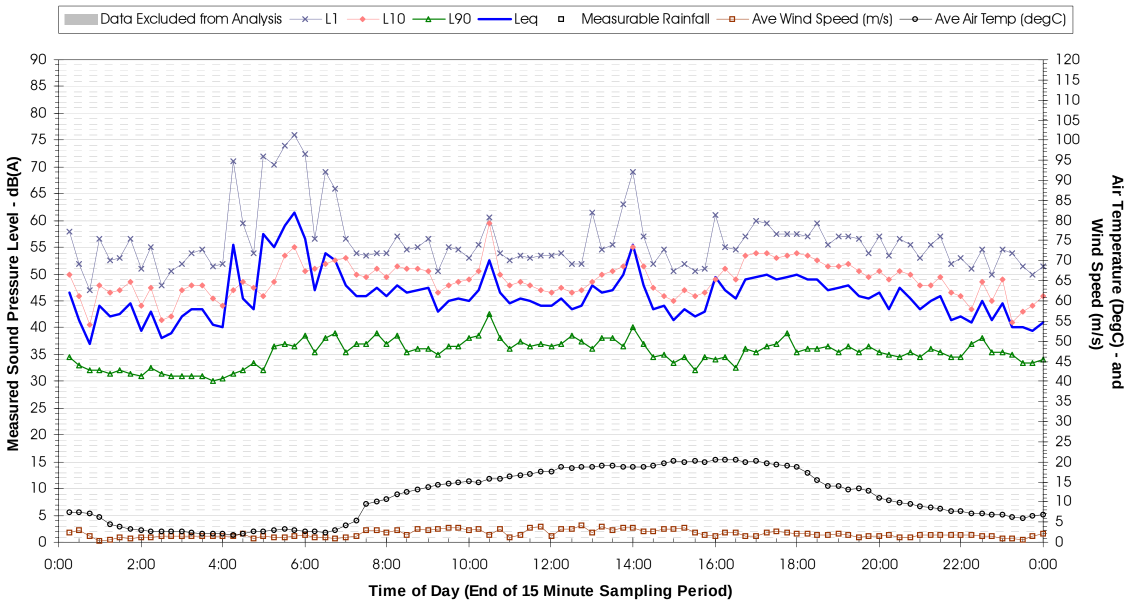


Profile of Noise Environment - Blackmans Flat
Thursday 29September 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

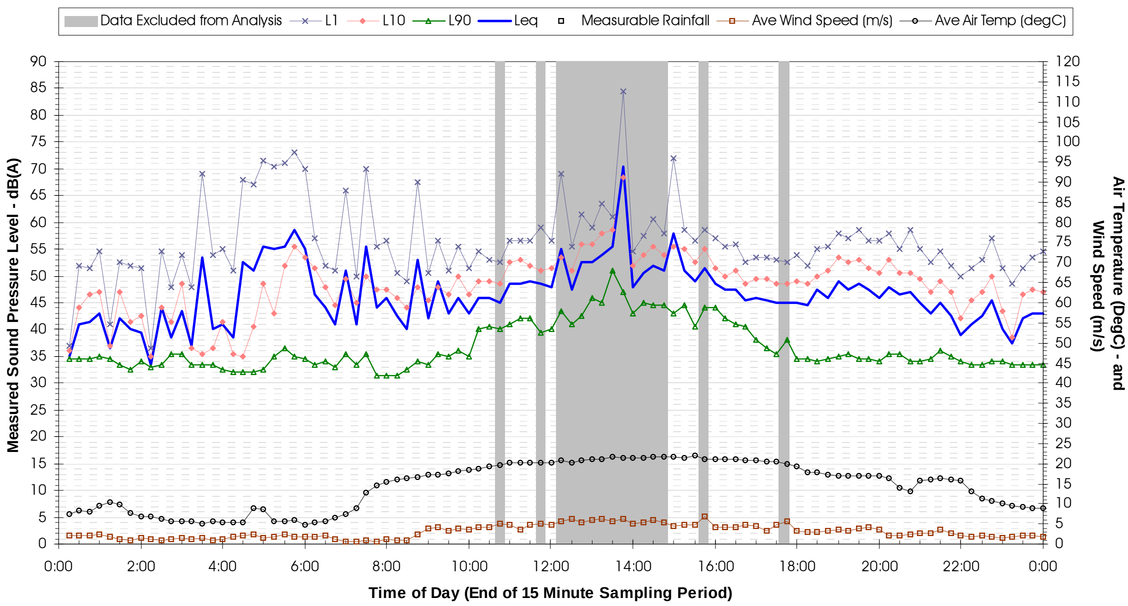
Profile of Noise Environment - Blackmans Flat
Friday 30September 2005



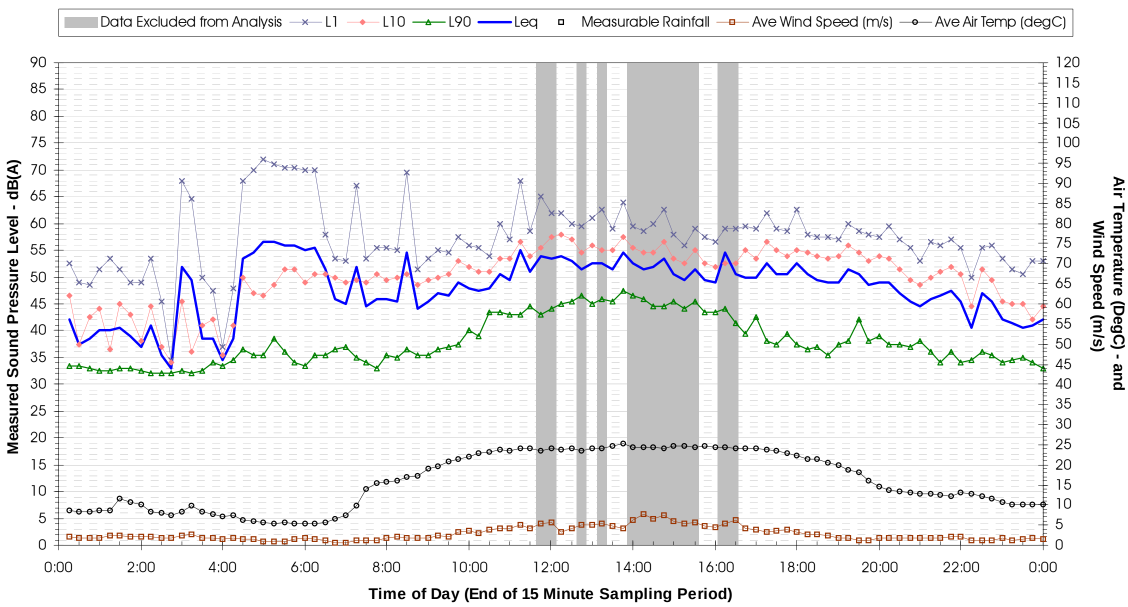
Profile of Noise Environment - Blackmans Flat
Saturday 1October 2005

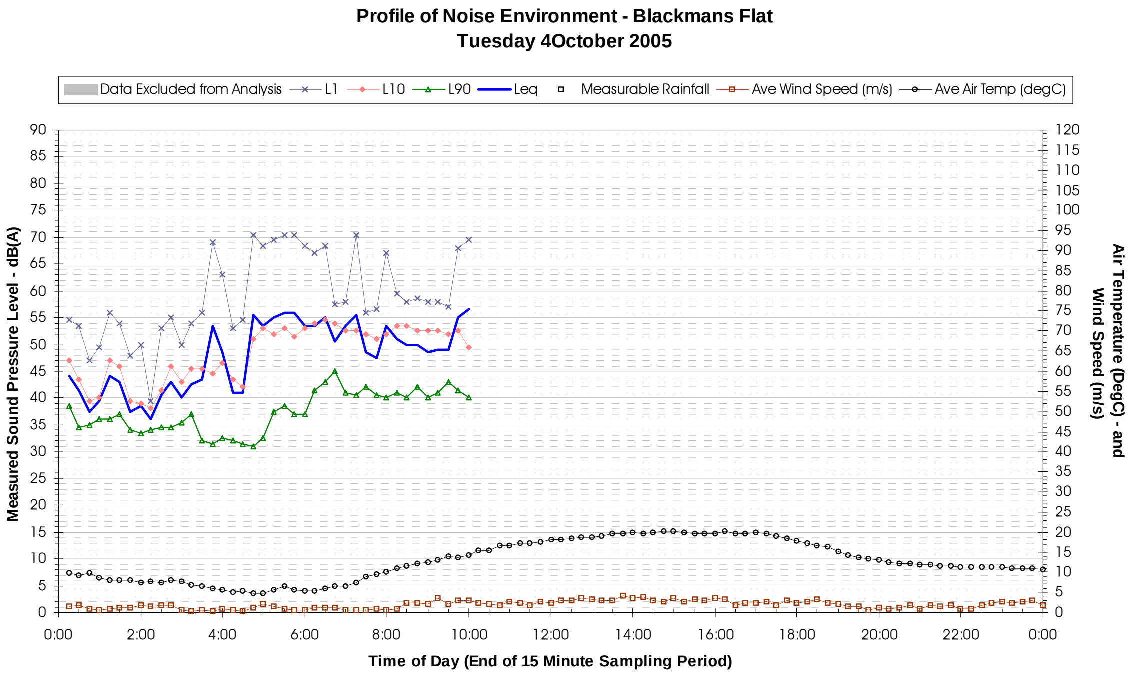


Profile of Noise Environment - Blackmans Flat
Sunday 2October 2005



Profile of Noise Environment - Blackmans Flat
Monday 3October 2005





Profile of Noise Environment - Blackmans Flat
Tuesday 4October 2005
Data Excluded from Analysis
L1
L10
L90
Leq
Measurable Rainfall
Ave Wind Speed (m/s)
Ave Air Temp (degC)
Measured Sound Pressure Level - dB(A)
Air Temperature (DegC) - and Wind Speed (m/s)
Time of Day (End of 15 Minute Sampling Period)

Appendix B Glossary of Acoustic Terms

Term	Definition
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Annoyance	Any sound that is perceived as irritating or a nuisance.
Rating Background Level (RBL)	The single-figure background level used in the EPA's *Industrial Noise Policy*. The ABL is the median of the daily 10th percentile level of the background noise levels for each day, evening and night time period. That is, three assessment background levels are determined for each 24-h period. The procedure is defined in Appendix B of the EPA's *Industrial Noise Policy*.
Attenuation	In acoustics, the diluting or holding back of the energy of sound waves as they pass through a material. Materials are rated for their ability to prevent sounds from travelling through them.
A–weighting	An adjustment made to sound level measurement, by means of an electronic filter, to approximate the response of the human ear.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is de-scribed using the L_{A90} descriptor.
Barrier	Any natural or artificial physical barrier to the propagation of noise.
Buffer	An area of land between an assessment site and a noise-sensitive land use, used as open space or for some other noise-tolerant land use.
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Construction activities	Activities that are related to the establishment phase of a development and that would occur on a site for only a limited period of time.
Day	The period from 0700 to 1800.
Evening	The period from 1800 to 2200.
Night	The period from 2200 to 0700.
dB(A)	(A weighted decibel) A single number measurement of the sound pressure based on the decibel but weighted to approximate the response of the human ear with respect to frequencies.
Intrusive noise	Refers to noise that intrudes above the background level by more than 5 dB (A)..The intrusiveness criterion is set out in Section 2.1 of the EPA's *Industrial Noise Policy*.
L_{A90}	The A-weighted sound pressure level that is exceeded for 90 % of the time over which a given sound is measured. This is considered to represent the background noise. During a 15 minute survey, it would represent the quietest 90 seconds.
L_{Aeq}	The equivalent continuous noise level—the level of noise equivalent to the energy-average of noise levels occurring over a measurement period
$L_{A,Max}$	Maximum noise level measured at a given location over a specified time interval.
L_{A1}	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{A10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured. The L 10 level measured over a 1-hour period.