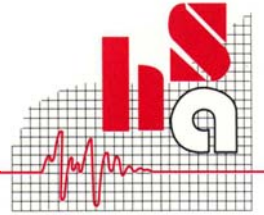


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ALCOA WORLD ALUMINA

**PINJARRA ALUMINA REFINERY
ENVIRONMENTAL NOISE MONITORING**

PREPARED BY

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CONTENTS

- 1.0 EXECUTIVE SUMMARY
- 2.0 INTRODUCTION
- 3.0 METHODOLOGY
 - 3.1 Monitoring Strategy
 - 3.2 Measurement Location
 - 3.3 Measurement Equipment
 - 3.4 Refinery Noise Source Status
- 4.0 ENVIRONMENTAL NOISE CRITERIA
 - 4.1 Environmental (Noise) Regulations Table 1
 - 4.2 Southern Residences – Napier Road Monitoring Location
 - 4.3 Noise Characteristics
- 5.0 MEASUREMENTS
 - 5.1 Statistical Parameter to Represent L_{A10} of Refinery Noise Emission
 - 5.2 Tonal Characteristics
- 6.0 ASSESSMENT OF COMPLIANCE WITH REGULATIONS
 - 6.1 Occurrence of Adverse Weather Conditions
 - 6.2 Noise Levels Under Temperature Inversion Conditions
 - 6.3 Noise Levels Under Light NNE Wind Conditions
 - 6.4 Noise Levels Under Other Climatic Conditions

APPENDICES

- A Plan showing Napier Road measurement location and residences
- B Napier Road Noise Level Graphs and Observations
 - 6th June, 2003
 - 7th June, 2003
 - 17th June, 2003
 - 18th June, 2003
 - 19th June, 2003
 - 7th July, 2003
 - 11th July, 2003
- C Statistical Analysis Summary of June Wind Data

1.0 EXECUTIVE SUMMARY

A six week noise monitoring program at the Napier Road monitoring location was targeted at climatic conditions known to result in “worst case” conditions for sound propagation from the Pinjarra Alcoa Alumina Refinery to the rural residences to the south of Napier Road. These residences have previously been identified as the most significant in terms of noise immission (noise received at a location) due to the refinery.

Over the monitoring period a total of seven nights were selected for detailed noise measurement and observation based on Pinjarra specific Bureau of Meteorology forecasts for this project.

Measured noise levels varied depending on climatic conditions, with the following typical “worst case” conditions being:

- a) Relatively calm, and suspected strong temperature inversion: 32 – 36 L_{A10} noise levels
- b) Light NNE breeze: 30 – 33 L_{A10} noise levels

The measured noise levels can be compared to the 36.4 L_{A10} noise level which has been determined by computer modelling to be equivalent to the Environmental Protection (Noise) Regulation 1997 “assigned level” of 35.0 L_{A10} at night-time for rural residences south of Napier Road. Refinery noise immission has been determined as not having any significant noise characteristic as per the Regulations.

It is noted that due to the relatively low natural background noise for rural properties near the refinery, the complying refinery noise immission is audible under certain climatic conditions. The noise control work carried out at the refinery in recent years has been effective in reducing the audibility and level of refinery noise.

It is concluded that the Pinjarra Alcoa Alumina Refinery noise immission complies with the requirements of the Environmental Protection (Noise) Regulations.

2.0 INTRODUCTION

Alcoa World Alumina Pinjarra Alumina Refinery commissioned Herring Storer Acoustics to carry out an environmental noise monitoring program to determine the status of the refinery environmental noise immission following a program of ‘tonal noise control’.

Maximum acceptable environmental noise emissions are defined by the requirements of the Environmental Protection (Noise) Regulations 1997. The Regulation criteria are expressed in terms of the ‘assigned level’, which varies with time of day, location and statistical frequency of noise at a receiver from surrounding premises. There is also an adjustment for defined noise characteristics which have the potential to increase the level of annoyance at receiver locations (+5 dB(A) for tonal characteristic for example).

Previous monitoring and studies around the Pinjarra Alumina Refinery have identified the rural residences to the south of Napier Road to be the most significant noise receivers with respect to noise emissions from the refinery operations. The night-time period between 10 pm and 7 am is the period with the lowest 'assigned level', with the statistical parameter L_{A10} (A-weighted noise level not exceeded for more than 10% of the time period) being the most significant assessment parameter in this instance.

Noise received at residential locations is a result of a) refinery noise source emissions and b) climatic conditions which affect the propagation of noise from the refinery to the residences. Noise sources at the refinery generally operate on a continuous basis, with some less significant equipment / operations which fluctuate in noise emission. The climatic conditions are a significant factor in the noise propagation over the 4,100m distance between the refinery (plant) and residences and 3,600m distance from refinery to Napier Road monitoring location. Two 'worst case' audible noise conditions occur with climatic conditions of a) 'calm' wind conditions with a strong lower atmosphere (0 – 500m) temperature inversion, and b) very light NNE breeze with a mild temperature inversion. These climatic conditions tend to occur with low ambient temperatures, and predominantly in winter months following the passing of a high pressure system.

Exclusion of normal ambient noise from measurements is required as at relatively low noise levels the influence of natural sound (wind generated tree noise, frogs, crickets), residential sounds (cows, dogs, vehicles) and traffic noise (aeroplanes, trains, vehicles on the Williams Road) can significantly affect the measured level or be the dominant noise. A combination of night measurements and observations can be used to establish whether measured noise levels are due to the refinery or other noise sources. Climatic conditions are determined by use of a calibrated weather station and observation, however apart from observations there is not currently any data available with respect to quantification of temperature inversions or low atmosphere conditions.

The noise monitoring assessment is supported by acoustic modelling of the Alcoa Pinjarra Alumina Refinery using SoundPlan 5.0. Noise monitoring is the primary indicator of environmental noise compliance as acoustic modelling is only representative of the noise immission. Regulations 7 (3) allows for determination of a noise emission by measurement of the noise at a representative reference location and calculation of noise levels at the point of reception.

3.0 METHODOLOGY

3.1 MONITORING STRATEGY

Refinery environmental noise at distant receiver locations is strongly affected by climatic conditions. Hence it is essential to monitor both climatic factors and noise levels concurrently.

The climatic conditions which result in the greatest potential for exceedance of noise Regulation criteria and potential audibility of plant noise above background are where wind direction is from the refinery to the residential location, with wind speeds of 0.5 – 3 m/s and a lower atmosphere temperature gradient or inversion layer. Based on statistical assessment of wind data for the Alcoa Wagerup refinery and recently available data from the Alcoa Pinjarra refinery weather station these conditions occur most frequently around the month of June. Hence the environmental noise monitoring was commenced in June to increase the opportunity to obtain 'worst case' environmental noise propagation conditions.

To obtain statistical third-octave acoustic data with a low noise measurement capability, a Brüel & Kjær 2260 sound level meter with the enhanced environmental logging software was utilized. Based on Bureau of Meteorology forecasts, overnight measurements were carried out at the Napier Road monitoring location over a number of evenings. Light breeze from the NNE direction (refinery to residences) occurs relatively infrequently (even in the month of June) and to obtain the required measurements a number of evenings were monitored. Over the period June to mid July overnight monitoring was carried out for a total of seven nights.

In order to obtain meaningful noise measurements for short duration climatic conditions matching the 'worst case scenario', relatively short statistical measurement duration is required. A six minute measurement period has been used as the measurement duration.

Representative third octave and narrowband spectral analysis is required to determine if the noise is 'tonal' as per the Noise Regulations, to assist in identification of any tonal noise sources and to fully describe the noise emissions.

3.2 MEASUREMENT LOCATION

The key residential areas have been identified as being farmhouses immediately south of Napier Road, typically 4,100m due south of the refinery.

The attachment (Appendix A) show the monitoring location and southern residence locations.

3.3 MEASUREMENT EQUIPMENT

The climatic data has been provided by Alcoa Pinjarra Alumina Refinery, sourced from a relatively new weather monitoring station located to the south of the residue area.

Monitoring was undertaken at a reference location considered to be representative of residential sites around Napier Road using Brüel & Kjær 2260 third octave sound level meter with the enhanced software logging package. The meter was deployed over selected evenings where weather forecasting indicated the possibility of light winds from the refinery towards the residential locations. Spot measurements were made with a SVAN 912E sound level meter / spectrum analyser and Rion NA-27 third-octave precision sound meter.

All sound meters hold NATA certified calibration certificates which were current for the duration of the measurement period and check field calibrations were carried out as required to verify calibration.

Weather forecasting services were provided by the Bureau of Meteorology Special Services Unit.

3.4 REFINERY NOISE SOURCE STATUS

Refinery noise emissions consist of general rotational machinery noise including pumps and fans and general flow induced noise from liquid, gas and steam flows from a multitude of plant areas, together with a number of more identifiable noise sources with distinctive characteristics.

Significant noise sources which have been previously identified and which have been the subject of recent noise control engineering include:

- Powerhouse – ICAL Boiler Forced Draft Fans 167 Hz pure tone attenuated significantly with provision of inlet silencers and acoustic lagging.
- Calciner Blowers – 545 & 1090 Hz pure tones. Acoustic lagging of calciner blower casings and installation of the inlet silencers for the calciner blowers have been carried out, together with the construction of an acoustic barrier wall immediately in front of the calciner blowers. This has been effective in attenuation of the previously strongly audible and tonal calciner blower noise.

PA systems have been identified as being audible at receiver locations under certain climatic conditions. Due to the short duration of such emissions, PA system noise would be assessed under the LA1 criteria and is therefore not considered a critical acoustic noise source under the regulations (the level is so low that noise characteristics are not technically evident and adjustment under the Regulations is not required). However, amplified speech is identifiable as being emitted from the refinery and it is desirable that emissions are controlled as far as practicable.

A number of smaller blowers and fans have been attenuated as part of the 'tonal noise reduction project'. These are primarily located within the Alumina Trainload facilities. Tonal noise emissions from the bauxite trainloading conveyor (485) have also been attenuated.

4.0 ENVIRONMENTAL NOISE CRITERIA

4.1 ENVIRONMENTAL (NOISE) REGULATIONS – TABLE 1

The criteria used is in accordance with the Environmental Protection (Noise) Regulations 1997. These regulations stipulate maximum allowable external noise levels determined by the calculation of an influencing factor which is then added to the base levels shown below. The influencing factor is calculated for the usage of land within the two circles, having a radii of 100m and 450m from the premises of concern.

TABLE 1 - BASELINE ASSIGNED OUTDOOR NOISE LEVEL

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Residential	0700 - 1900 hours Monday to Saturday	45	55	65
	0900 - 1900 hours Sunday and Public Holidays	40	50	65
	1900 - 2200 hours all days	40	50	55
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	35	45	55
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

The above levels are conditional on no annoying characteristics existing in the noise of concern, such as tonality, amplitude modulation or impulsiveness. If such characteristic exist and cannot be practically removed then any measured level is adjusted according to Table 2 below.

TABLE 2 - ADJUSTMENTS TO MEASURED LEVELS

Where tonality is present	Where modulation is present	Where impulsiveness is present
+5 dB(A)	+5 dB(A)	+10 dB(A)

Note: These adjustments are cumulative to a maximum of 15 dB

4.2 SOUTHERN RESIDENCES – NAPIER ROAD MONITORING LOCATION

There are a number of residences to the south of Napier Road.

For the rural residences to the south of Napier Road the influencing factor is typically zero as most of the residences are further than 450m from any industrial premises (such as the Rhone-Poulenc site). The applicable night-time 'assigned level' is therefore 35 L_{A10} .

The representative residential monitoring location is located at the junction of Napier Road and the main power-line crossing perpendicular to Napier Road. There is line of sight along the power-line easement to the calcination stacks of the Alcoa Pinjarra Alumina Refinery.

Monitoring at the representative residential monitoring location on Napier Road was necessary as the residences of concern are on large private properties, there are a number of residences to be considered in the general area, potential local noise from the properties was to be excluded and measurements were carried out overnight.

Acoustic modelling predicts a reduction of 1.4 dB(A) between the residential reference location and the nearest residences under 3 m/s 2 degrees/100m temperature lapse rate conditions. Hence the equivalent acoustic criteria at the Napier Road monitoring location is 36.4 L_{A10} .

4.3 NOISE CHARACTERISTICS

Tonal Noise is assessed in accordance with the Regulations based on the measured L_{Aeq} spectrum at the receiver location.

5.0 MEASUREMENTS

5.1 STATISTICAL PARAMETER TO REPRESENT L_{A10} OF REFINERY NOISE EMISSION

The Regulation L_{A10} 'assigned level' refers to the noise level exceeded for 10% of the measurement period at the receiver location due to the refinery noise emissions. However, at locations far from the refinery such as the Napier Road monitoring location or the Napier Road residences, the local background noise generally dominates, with the refinery noise being a 'background' noise.

Noise measurements cannot be considered to represent refinery noise emissions where the local noise does not fall below the level of the refinery noise on a regular basis. Observations have shown that reliable environmental noise measurements cannot generally be made before 10pm or after 5-6 am due to the predominance of passing traffic on the Williams Road in the evening and the activity of birds and animals at dawn. Where wind speeds are moderate or greater (typically > 3 m/s at the Alcoa Pinjarra weather station) the noise generated by moving tree leaves generally contributes to the noise level being measured.

Comparison of observation at the Napier Road monitoring location and the weather station wind speed has demonstrated that wind conditions are not always identical. There have been times when almost calm conditions have been observed at the monitoring location while 10m weather station readings of greater than 3 m/s wind speed have been recorded.

By relating audible refinery noise observations to measured levels and comparison with the measured 6 minute statistical levels it has been determined that the refinery noise immission typically falls between the 6 minute L_{Amin} and the L_{A90} statistical noise measurements under good measurement conditions. These levels appear to have a consistent relationship, with the L_{A90} being approximately 1 dB(A) higher than the L_{Amin} level. The L_{A90} level is regarded as a conservative representation of the refinery L_{A10} noise contribution at the Napier Road monitoring location. This takes into account the minor variations in refinery source noise (which is relatively constant) and the minor variations in level due to climatic fluctuations during the 6 minute measurement periods.

With the relatively short 6 minute measurement periods, any significant changes in climatic conditions are reflected by a change in both L_{Amin} and L_{A90} noise levels. Thus over a 1 or 4 hour representative measurement period the highest 1/10th of the 6 minute L_{A90} levels statistical measurements should be used to calculate the L_{A10} for that representative measurement period (eg. the lowest of the four highest 6 minute L_{A90} levels for a 4 hour period is the actual L_{A10} level for that period).

The conclusions drawn from relating the audible observations with the 6 minute statistical monitoring for the Napier Road location are similar to previously established relationships for the Alcoa Wagerup Refinery. At the Wagerup refinery the 1 hour L_{A99} statistical parameter has been determined as being representative of the refinery emissions.

The use of the 6 minute L_{A90} level as a representation of the refinery L_{A10} noise contribution at the Napier Road monitoring location appears to be conservative and relatively reliable measurement parameter.

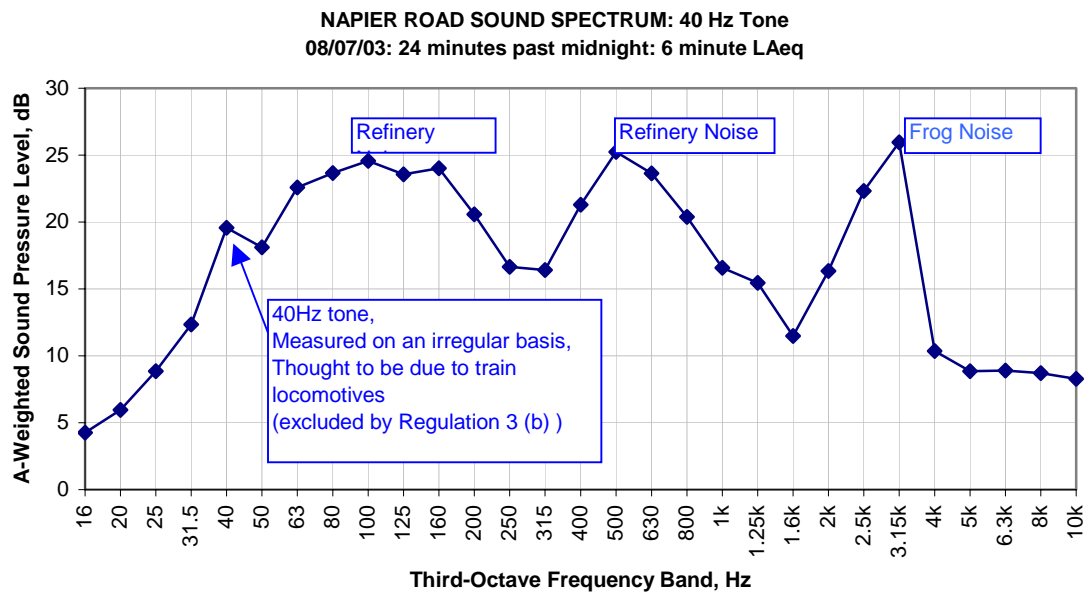
5.2 TONAL CHARACTERISTIC

The technical assessment of tonal characteristic is based on the L_{Aeq} measurement of refinery noise for a duration of at least 10% of the representative measurement period at the receiver location. For continuous operating plant such as refineries a one hour period is commonly used as the representative measurement period.

Assessment of measurements carried out over the monitoring period showed sporadic 6 minute measurements with technical 'tonality'. These irregular tones are considered to be associated with general background noise events.

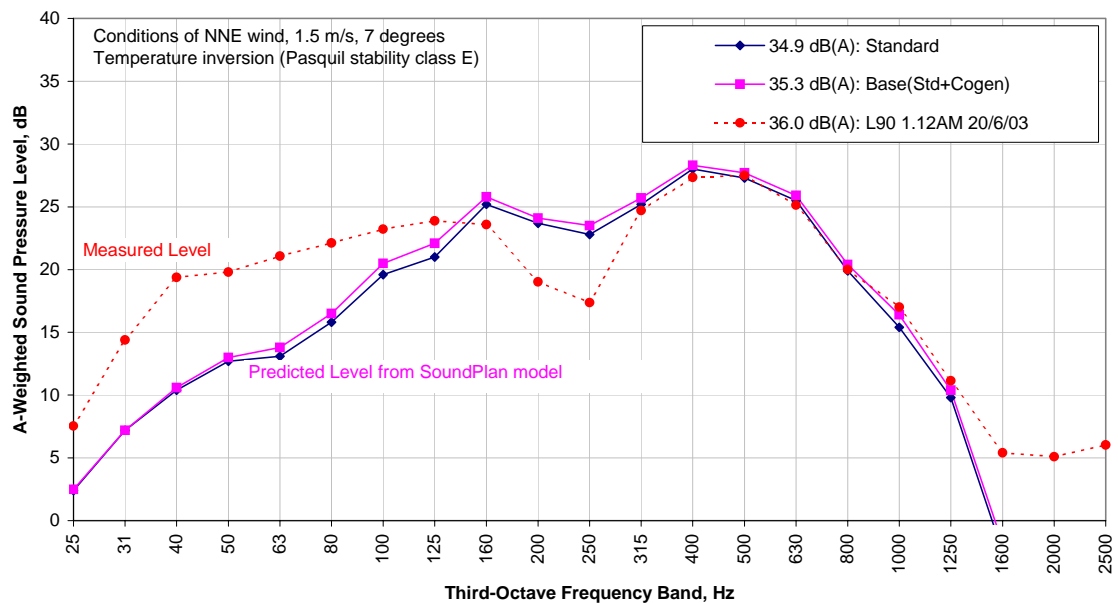
Two 1/3 octave frequency bands were identified as showing a tone occurring for a number of consecutive measurements, namely 3.15kHz and 40 Hz.

Noise centred at 3.15kHz is associated with local frog generated noise and this has been confirmed by a number of observations and audible associatively. Noise in the 40Hz 1/3 octave band was not identified with any particular noise source (and were not subjectively noted as a tone) during observation at Napier Road. Subsequent review of the refinery noise model did not identify any noise source with a dominant 40Hz noise contribution at the receiver location. A graph showing the measured 40 Hz tone, together with noise at frequencies associated with the refinery operation and local frog activity is shown on the graph titled 'Napier Road Sound Spectrum: 40 Hz tone' in Appendix C.



Modelling of an idling locomotive (based on 1/3 octave file data) showed a significant 40 Hz noise contribution at the Napier Road receiver location, although at a lower level than measured during monitoring. However, there were numerous audible observations of low level train locomotive engine noise during the monitoring evenings. At times the locomotive was heard (just audible) during changes of engine speed during presumed bauxite / alumina loading. This supports the conclusion that train locomotive engine noise is the likely source of the 40Hz tone, with occasional measurement of this tone due to the ongoing movement of trains and the variable sound propagation from refinery to Napier Road with climatic conditions. The calculated sound spectra from the SoundPlan 5.0 modelling program may not be particularly accurate at low frequency, as inferred by the noticeable underestimation of sound propagation at frequencies below 100Hz(refer graph 'Measured / Predicted Noise Spectra', below). This may be due to the limitations of the modelling program with respect to low frequency ground absorption and atmospheric temperature inversion effects.

**ALCOA PINJARRA REFINERY
 MEASURED / PREDICTED NOISE SPECTRA AT NAPIER ROAD**



Section 3 (b) of the Environmental Protection (Noise) Regulations 1997 specifically excludes noise emissions from trains or aircraft, this noise being considered in a similar manner to natural background noise such as wind and animal noise. It is noted that from a practical aspect the 40Hz tone is a result of technical assessment and was not obvious as an audible tone during measurement. The lack of audibility of the 40Hz noise is not surprising as it is at a relatively low level of 20 dB(A).

6.0 ASSESSMENT OF COMPLIANCE WITH REGULATIONS

Selective monitoring of noise at the Napier Road monitoring location was undertaken over the period 1st June to 12th July, 2003. The objective of the monitoring was to obtain representative “worst case” noise propagation conditions from the Alcoa Pinjarra Alumina Refinery to the most significant residential receivers located just south of Napier Road.

The approach was to use the Bureau of Meteorology Specialist Services Unit to provide forecasts as to when light northerly winds were likely. For the predicted suitable nights the continuous measurement of 1/3 octave noise levels and collection of 6 minute period statistical noise parameters with spot observations was carried out. Previous monitoring programs had showed that this methodology was effective in capturing the “worst case” sound propagation conditions. Typically the “worst case” climatic conditions occur as the trailing edge of a high pressure system passes over Pinjarra, and this can occur between 3 – 8 times in winter months. By carrying out measurements over a number of nights, a range of the combination of wind speed, wind direction, temperature (and potential inversions) were covered. Wind direction was considered particularly important as downwind sound propagation is generally more effective than for other directions, and for any one receiver location a range of wind directions is required to cover the major noise sources from the relatively large Pinjarra Alumina Refinery. From a residence at Napier Road the refinery subtends an angle of approximately 25 degrees (from N to NNE direction for the Napier Road monitoring location).

From measurement and observation it was found that there were two distinct climatic conditions which result in the strongest noise propagation conditions at night. These were:

- a) light northerly (NNE) breeze, 0.5 – 3 m/s
- b) virtually calm, strong temperature inversion

With a strong temperature inversion (which requires a period of virtual calm to develop) the wind direction was not particularly significant and all the noise sources on the refinery footprint make a contribution to the noise level at the receiver location. With the condition of light winds direct from noise source to receiver, the major contributing noise sources were those in the line of the wind direction, with a reduced noise contribution from other noise sources at the refinery. The temperature inversion condition generally resulted in the highest noise immission at receiver locations.

6.1 OCCURRENCE OF ADVERSE WEATHER CONDITIONS

The graph ‘Proportion of night time for high noise propagation conditions: Napier road residences’ (below) shows that June 2003 was a ‘worst case’ month for propagation of refinery noise to southern residences near Napier Road.

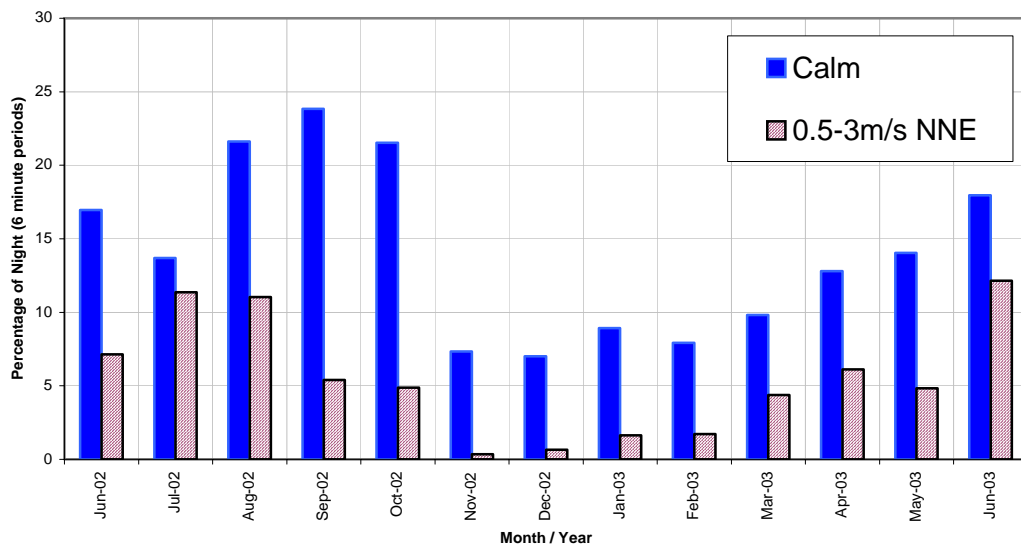
The summary graph shows that light northerly breezes occur most often in winter, typically for two months over the period June – August. The graph is considered an over-estimation of the condition of light wind direct from refinery to residential locations as it includes wind directions from NE through to North. Previous observation of noise immission at the Napier Road monitoring location has led to the conclusion that at the distance of 3.6 km only wind direct from source to receiver results in significantly increased noise propagation. This had been most noticeable prior to the noise control of the calciner blowers and powerhouse ICAL boiler forced draught fans.

The summary graph also shows the proportion of time that relatively calm conditions occur. Relatively calm conditions (over an extended period of time) are one of the necessary conditions for a strong temperature inversion to occur. However, suitable temperature and low level atmospheric conditions are also required. Unfortunately there is no available measurable data to verify the presence or conditions for strong temperature inversions or to compare sound propagation against. A significant temperature inversion does not occur under all calm night conditions and therefore the graph indicates the typical upper limit of occurrence of temperature inversion conditions. There are thought to be two types of temperature inversions, the condition of a gradual lower atmosphere temperature gradient and the condition of a sudden change in air temperature (layer inversion). Observation tends to suggest that a layer inversion often occurs at Pinjarra, with an upper level wind evident by the sudden direction change of the calciner plume. The close proximity of the scarp may be associated with the occurrence of these lower atmosphere conditions.

Observation during noise monitoring has shown that under some circumstances there are moderate to strong upper level winds (as observed from calciner plume behaviour) with relative calm at ground level (and at the 10m weather station). It was not possible to quantify these atmospheric conditions at the time. It is sufficient to say that the monitoring period of June/July 03 had a significant proportion of both light northerly and calm conditions, and that this monitoring period is considered to be during a 'worst case' month for noise propagation from the refinery to southern residences.

A more detailed breakdown of wind speeds and direction for the month of June 2003 is in Appendix C.

PROPORTION OF NIGHT TIME FOR HIGH NOISE PROPAGATION CONDITIONS
 ALCOA PINJARRA REFINERY - NAPIER ROAD RESIDENCES



6.2 NOISE LEVELS UNDER TEMPERATURE INVERSION CONDITIONS

The presence of a temperature inversion condition could not be measured, and has been inferred from observation of calciner plume behaviour, temperature and wind measurement and observations, and from audibility of sounds known to be generated at a distance and from a particular direction.

The monitoring carried out over the night of the 11th July (11th – 12th July) and 19th June (19th – 20th June) are considered to represent refinery noise propagation under temperature inversion conditions.

The night of 19th/20th June had relatively calm wind conditions with low temperature (5 °C) and fluctuating wind direction (E to W at weather station and E/NE at Napier Road). Refinery noise levels from 11pm to 3 am ranged from 32 – 36 L_{A10} over this period. After 3 am the wind speed increased, temperature increased to 10 °C plus and wind generated tree noise became a significant noise source for the Napier Road monitoring location. There was an observed vertical drift of the calciner plume to a level of approximately 100m where there was a noticeable change in plume direction towards the south west (indicative of a moderate north easterly wind at that level).

The evening of 11th July from 10.30pm to midnight appeared to be another example of temperature inversion conditions, with possible break-up of the inversion conditions after that time. Noise levels were affected by local background noise from frog activity (following recent rainfall), with noise levels decreasing from 36 L_{A10} to 32 L_{A10} over this ninety minute period. Observation of calciner plume showed a vertical rise with drift to the west at about 400m elevation, with gradually increasing upper level wind speed towards midnight.

It is concluded that under conditions of strong temperature inversion the refinery immission at the Napier Road monitoring location is within the range of 32 – 36 L_{A10}. The occurrence of noise levels around 36.5 were for limited and non-continuous 6 minute measurements and the 1 hour L_{A10} level would be somewhat less than these levels. The measurements show that under particular infrequent climatic conditions the noise immission is close to the 'assigned level' of 35.0 L_{A10} at the nearest residences (after adjustment by - 1.4 dB to measured levels to allow for increased distance of residences from the refinery).

It is concluded that under conditions of strong temperature inversion the refinery immission complies with the requirements of the Environmental Protection (Noise) Regulations 1997.

6.3 NOISE LEVELS UNDER LIGHT NNE WIND CONDITIONS

There were a number of evenings where noise measurements were carried out under the condition of light breeze from the NNE.

Measurements carried out during the night of 16th/17th June were at weather station wind speeds up to 5 m/s and there was significant tree generated wind noise observed at the Napier Road monitoring location. The L_{A90} ranged between 32 – 36 dB(A). The contribution of significant tree generated noise masks the refinery noise immission and elevates the overall noise level. Similarly on the 7th/8th July the effect of increasing windspeed can be observed between the hours of 11.30pm to 4 pm, with having an influence on overall level from 0030hrs onward. The L_{A90} noise level ranged from 32 to 45, with noise levels above 33 dB(A) having a significant wind generated tree noise component.

Early morning of the 18th June light winds from the NNE were measured from 4am onwards, with L_{A90} noise levels of the order of 33 dB(A) (representing the refinery L_{A10} immission level). After 5.15am the influence of bird noise, vehicle noise (Williams Road) and other local noise dominated the noise measurements. For the evening of 11th/12th July the breakup of an inferred temperature inversion after midnight resulted in steady conditions with 3 m/s breeze from the NNE until dawn. The refinery immission ranged between 30 – 33 L_{A10} over this period.

It is concluded that refinery immission at the Napier Road monitoring location for conditions of light NNE breeze (up to 3 m/s) without a strong temperature inversion effect is of the order of 30 – 33 L_{A10} . At windspeeds above this, wind generated tree noise dominates the noise level. We note that there are trees near the Napier Road monitoring location, and trees were observed surrounding most of the rural residences near Napier Road.

It is concluded that under conditions of NNE winds of the order of 3 m/s wind speed the refinery immission complies with the requirements of the Environmental Protection (Noise) Regulations 1997. Typically at higher wind speeds the receiver noise level is dominated by wind induced tree noise and at lower wind speeds the refinery noise immission decreases. For very low wind speeds a temperature inversion may occur (refer previous section of this report), and at wind speeds above 2 m/s any temperature inversion tends to disperse.

6.4 NOISE LEVELS UNDER OTHER CLIMATIC CONDITIONS

Climatic conditions other than described above (temperature inversion or light NNE breeze) occur for the majority of the time. These conditions typically are either:

- a) Windy conditions where wind induced tree noise dominates the background noise and where winds tend to 'blow' noise away from residences when not from the NNE.

- b) Light cross-wind conditions (eg. 18/6/03 2300hrs, 30 L_{A10}) where noise levels in the vicinity of Napier Road are of the order of 30-31 L_{A10} .
- c) Light southerly winds (eg. 7/6/03 2200 – 0030hrs, 28 – 24 L_{A10}) where noise levels can be relatively low and of the order of 24 – 28 dB(A).

Refinery immission is generally less than 31 L_{A10} and often not audible under windy or light southerly wind conditions.

It is concluded that the refinery immission complies with the requirements of the Environmental Protection (Noise) Regulations 1997.

For: **HERRING STORER ACOUSTICS**

Paul Drew

17 September 2003

APPENDIX A

PLAN SHOWING NAPIER ROAD
MEASUREMENT LOCATION AND RESIDENCES



Piniarra Alumina Refinery

Napier Rd monitoring location

Rural Residences

APPENDIX B

NAPIER ROAD NOISE LEVEL GRAPHS AND OBSERVATIONS

6th June, 2003

7th June, 2003

17th June, 2003

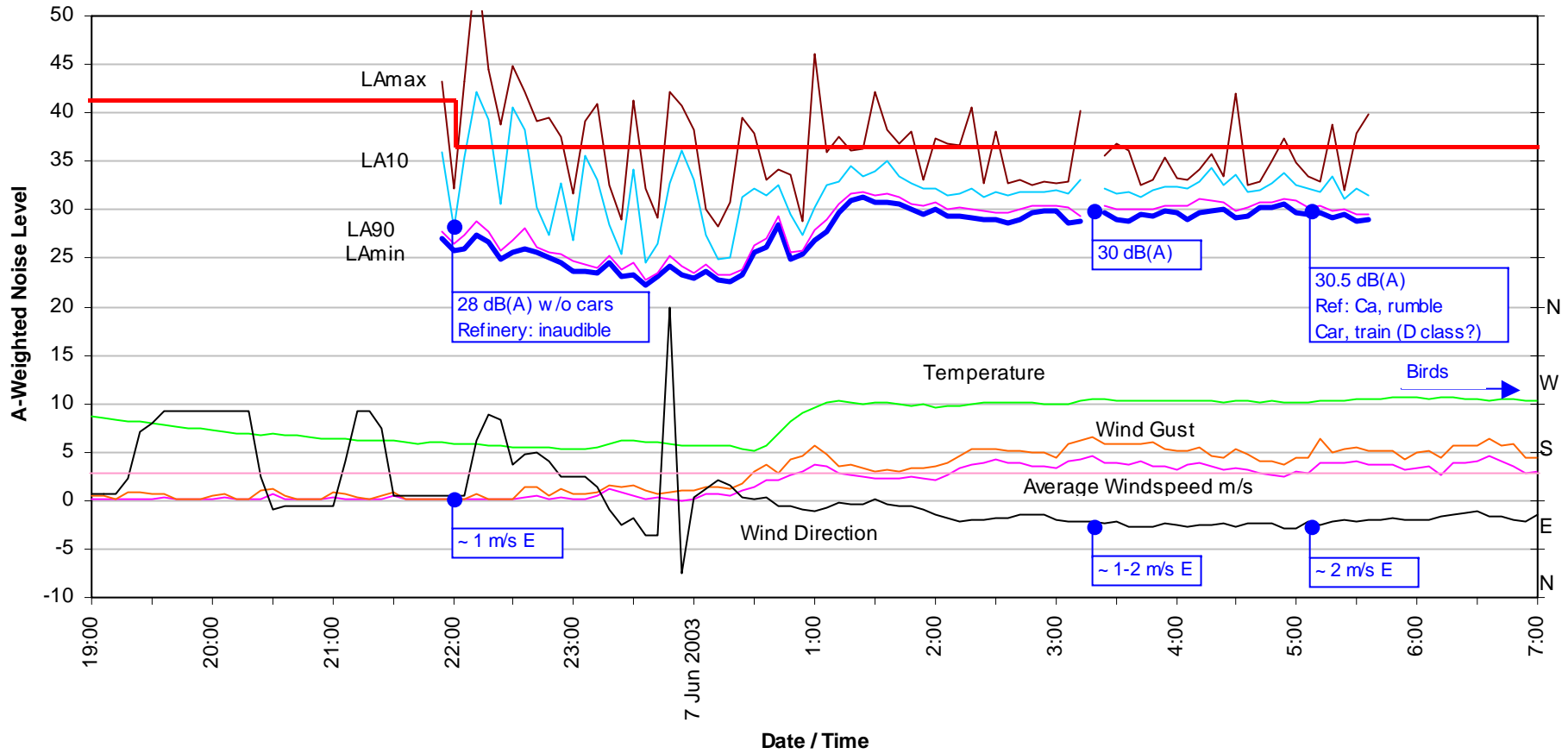
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19th June, 2003

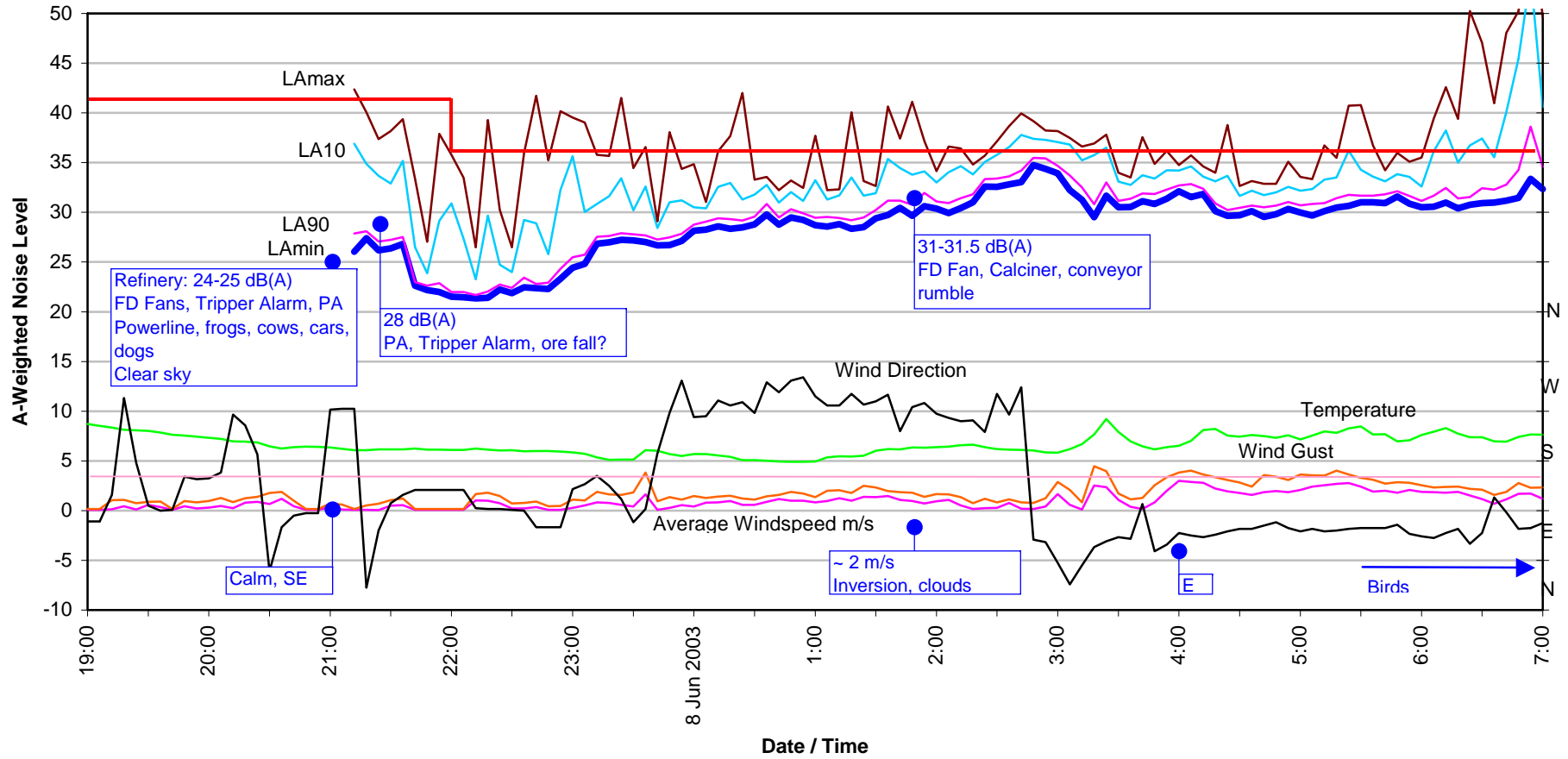
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11th July, 2003

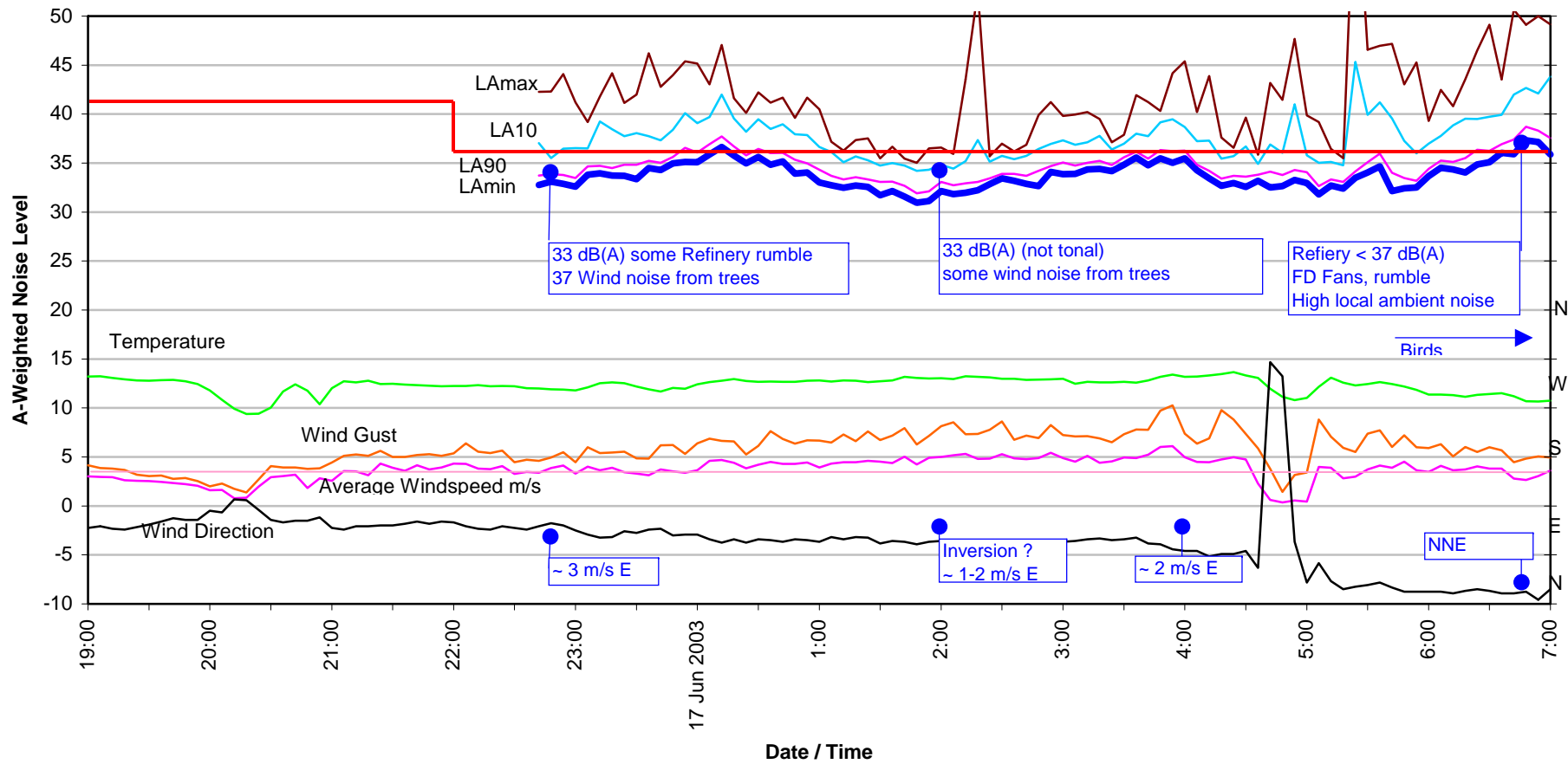
ALCOA PINJARRA NOISE MONITORING
 Napier Road: 6th June 2003



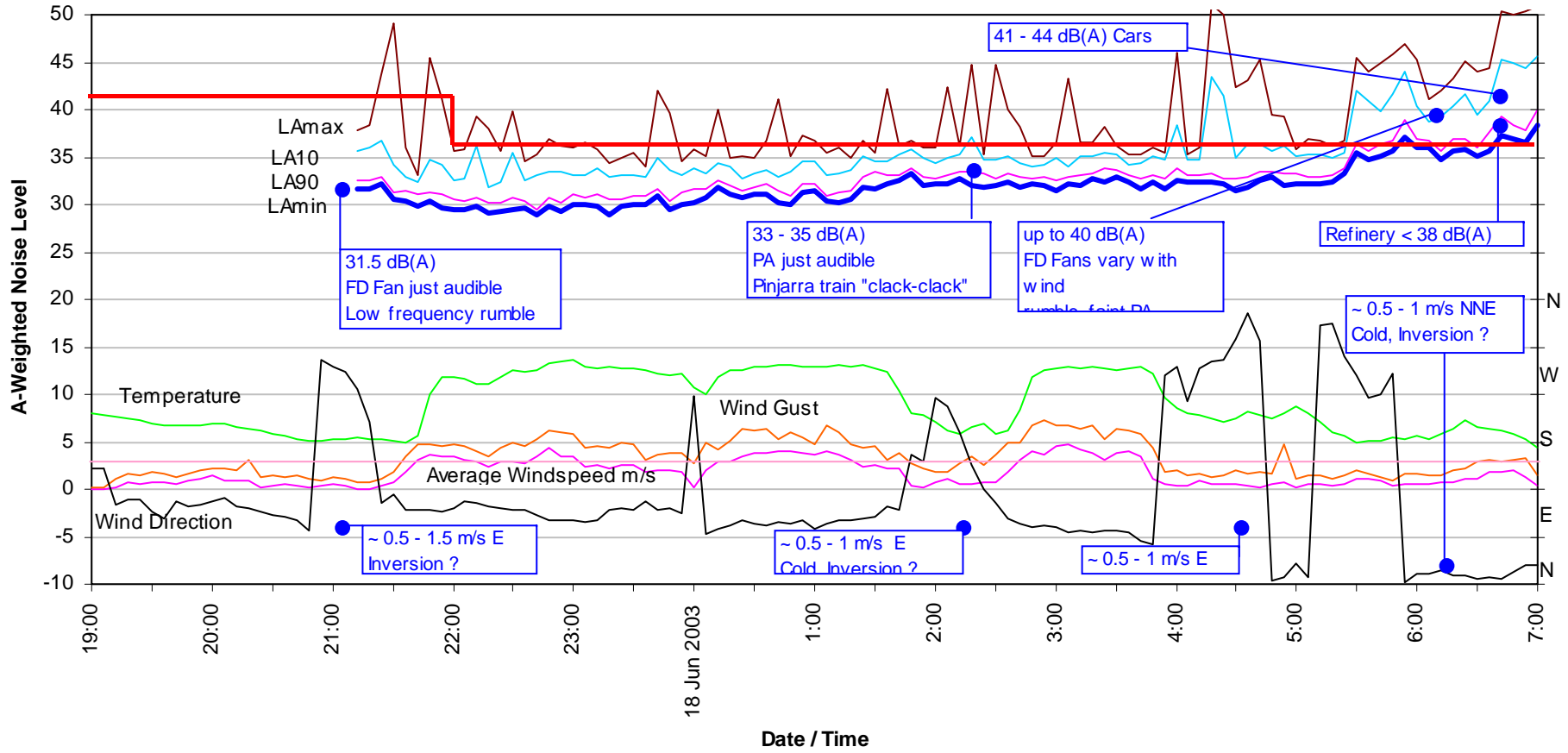
ALCOA PINJARRA NOISE MONITORING
 Napier Road: 7th June 2003



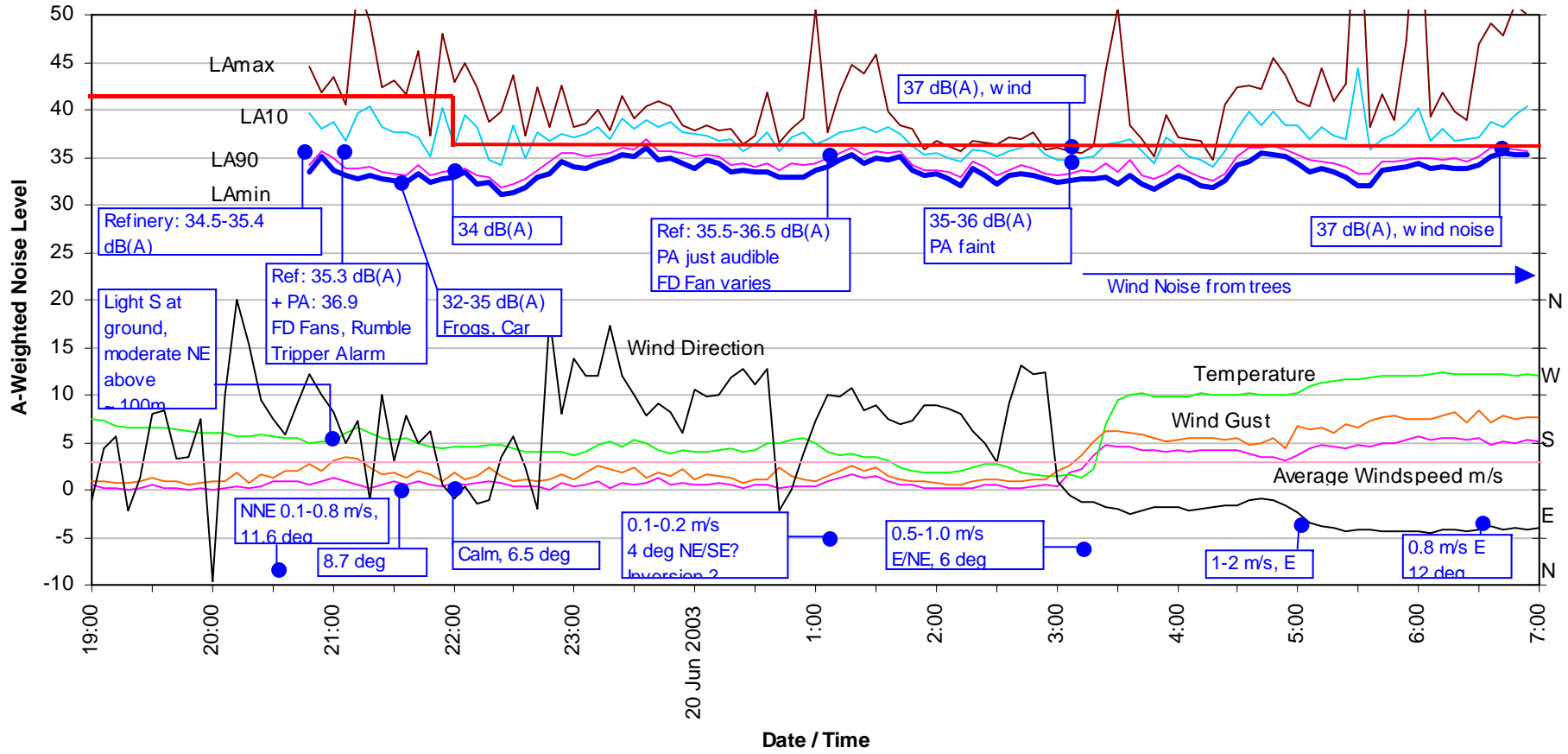
ALCOA PINJARRA NOISE MONITORING
 Napier Road: 17th June 2003



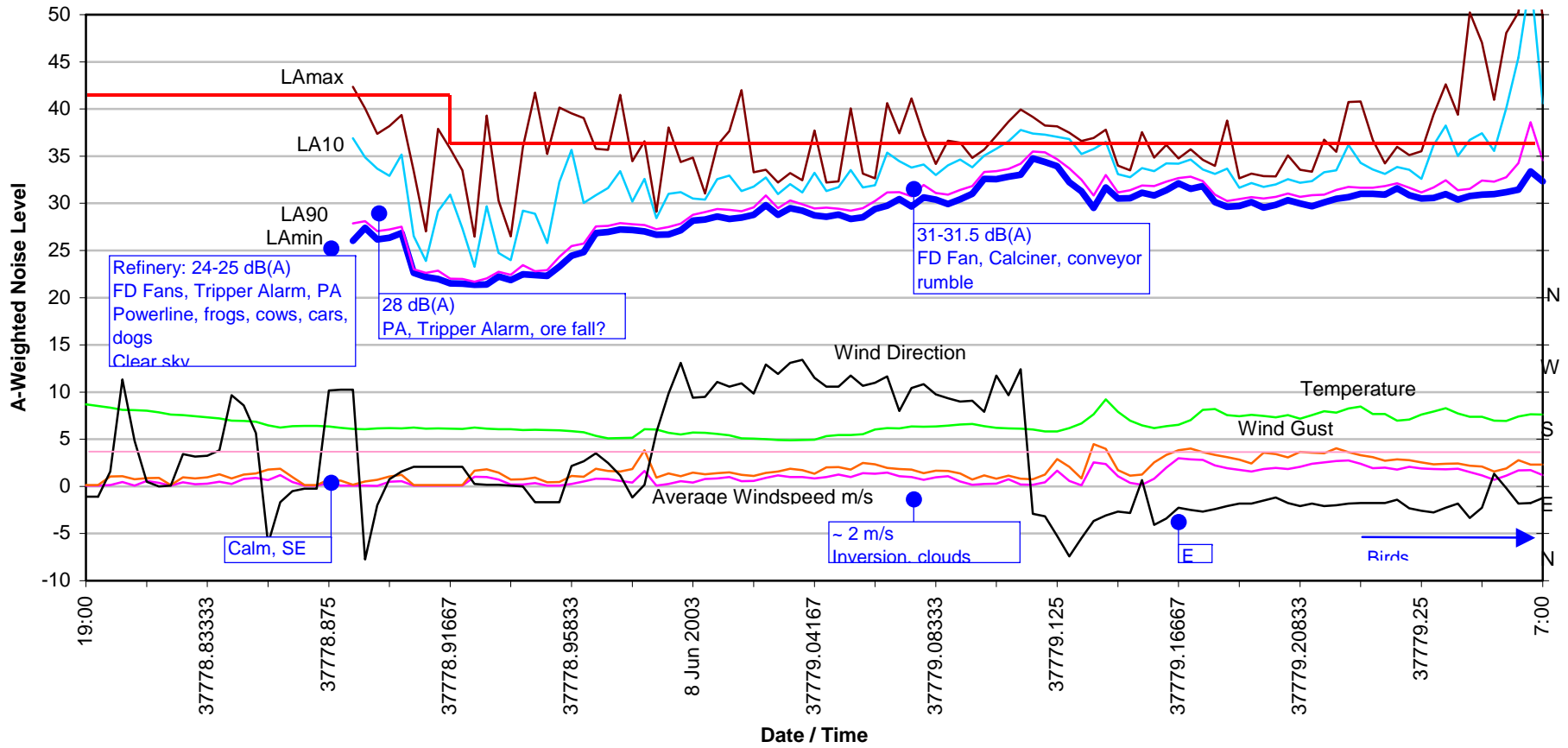
ALCOA PINJARRA NOISE MONITORING
 Napier Road: 18th June 2003



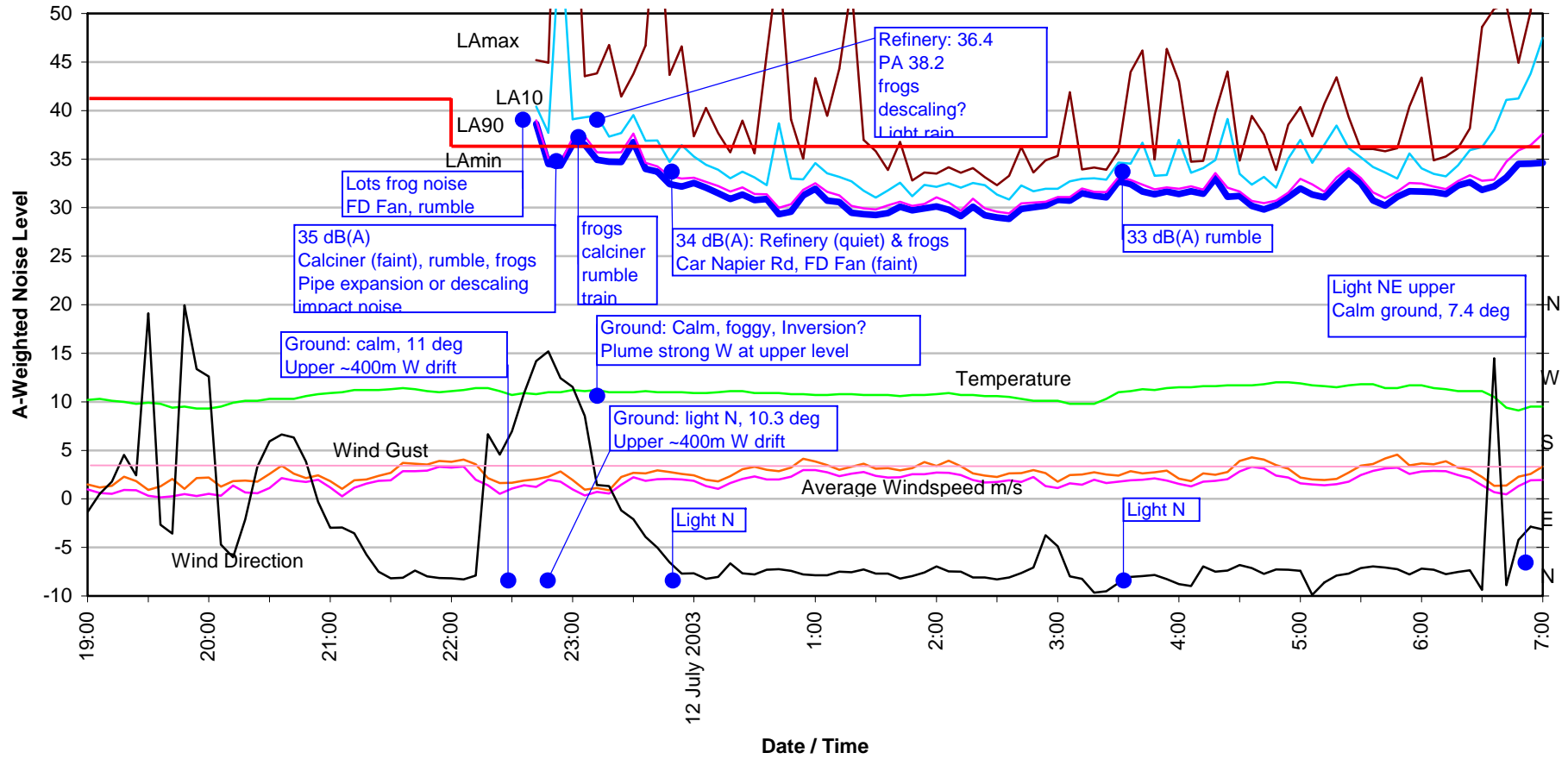
ALCOA PINJARRA NOISE MONITORING
 Napier Road: 19th June 2003



ALCOA PINJARRA NOISE MONITORING
Napier Road: 7th June 2003



ALCOA PINJARRA NOISE MONITORING
 Napier Road: 11th July 2003



APPENDIX C

STATISTICAL ANALYSIS SUMMARY OF JUNE WIND DATA

Two Parameter Data Analysis : % Occurrence of Night wind conditions

Alcoa Pinjarra : June 2003 - Wind Direction / Average Windspeed

No. Samples = 2700

Direction Range		Speed Range (m/s)						All	0.5-3	
		0 0.5	0.5 2	2 3	3 4	4 5	5 100			
0	15	0.22%	1.44%	1.26%	0.93%	0.81%	1.22%	5.89%	2.70%	
15	30	0.37%	1.81%	4.44%	4.22%	1.56%	1.56%	13.96%	6.26%	12.15%
30	45	0.33%	1.85%	1.33%	1.15%	0.81%	3.04%	8.52%	3.19%	}
45	60	0.56%	1.00%	0.22%	0.19%	0.19%	0.74%	2.89%	1.22%	
60	75	0.37%	1.41%	0.33%	0.74%	1.15%	1.81%	5.81%	1.74%	
75	90	0.44%	1.81%	0.41%	1.11%	1.52%	3.41%	8.70%	2.22%	}
90	105	2.48%	3.70%	1.30%	1.56%	0.89%	1.11%	11.04%	5.00%	
105	120	1.37%	2.26%	0.74%	0.56%	0.15%	0.15%	5.22%	3.00%	
120	135	1.11%	1.70%	0.11%	0.00%	0.00%	0.00%	2.93%	1.81%	
135	150	0.96%	1.96%	0.07%	0.00%	0.00%	0.00%	3.00%	2.04%	
150	165	0.70%	1.74%	0.22%	0.00%	0.00%	0.00%	2.67%	1.96%	
165	180	1.00%	1.78%	0.00%	0.00%	0.00%	0.00%	2.78%	1.78%	
180	195	0.41%	0.89%	0.00%	0.04%	0.00%	0.00%	1.33%	0.89%	
195	210	0.52%	1.19%	0.07%	0.00%	0.00%	0.00%	1.78%	1.26%	3.15%
210	225	1.15%	0.93%	0.07%	0.00%	0.00%	0.00%	2.15%	1.00%	}
225	240	1.56%	1.07%	0.11%	0.04%	0.00%	0.00%	2.78%	1.19%	
240	255	0.52%	1.22%	0.07%	0.04%	0.00%	0.00%	1.85%	1.30%	
255	270	1.37%	1.33%	0.22%	0.19%	0.07%	0.04%	3.22%	1.56%	}
270	285	0.74%	1.15%	0.19%	0.37%	0.22%	0.11%	2.78%	1.33%	
285	300	0.56%	1.15%	0.19%	0.19%	0.44%	0.70%	3.22%	1.33%	
300	315	0.41%	0.74%	0.15%	0.15%	0.22%	1.22%	2.89%	0.89%	
315	330	0.44%	0.52%	0.07%	0.15%	0.19%	0.11%	1.48%	0.59%	
330	345	0.22%	0.48%	0.22%	0.11%	0.11%	0.07%	1.22%	0.70%	
345	360	0.15%	0.63%	0.26%	0.33%	0.19%	0.33%	1.89%	0.89%	
		17.96%	33.78%	12.07%	12.04%	8.52%	15.63%	100.00%	100.00%	45.85%

Note: Direction degrees clockwise from North as zero (zero is wind from north)

Ranges: Includes minimum and up to maximum (but not including maximum specified)

Night: 2200hrs - 700 hrs