The peril of ignoring insect noise in the assessment of ambient noise levels

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ABSTRACT

Noise measurements undertaken during the environmental impact assessment process typically consist of overall levels only, using broad-band noise loggers without spectral capability. This temporal information does not provide enough insight into the noise sources surrounding the noise logger to accurately determine the ambient noise levels for the duration of the year. Several one-third octave noise loggers were used in combination with meteorological measurements at two different reference heights, to evaluate the spectral content of baseline noise records as well as the contribution from seasonal and episodic biological noise. Examples are presented that contrast the conclusions that can be drawn from spectral noise monitoring compared with broad-band noise logging for both the determination of rating background noise levels in the gas fields and noise criteria for a wind farm.

INTRODUCTION

The purpose of ambient noise measurements taken during the planning phase of an industrial or wind farm development is to identify the existing noise levels in the area surrounding the proposed site. These measurements are often described as the baseline noise assessment, which are fundamental to the assessment and determination of noise emissions limits for large infrastructure or industry developments.

While the broad-band logging has been the standard for many years, the lack of information to allow the determination of sources of the noises making up the ambient noise level is a serious concern, particularly if the end result is an artificially inflated noise criteria which potentially provides the developer with a false confidence which may lead to disaster. Most concerning is the unknowing inclusion of seasonal episodic noise such as insect noise into the unattended logging.

Noise complaints after the commissioning of an industrial development or wind farm often include reference to the character of the noise or low-frequency content of the noise heard at the nearby residence. To truly assess the effects of the development requires the knowledge of what the noise environment was like before the installation of the development. An additional reason for having a better understanding of the spectral information before the commissioning of the development is to ensure an accurate determination of the background noise levels and thus the resultant noise criteria.

BROADBAND NOISE LOGGING SHORTCOMINGS

Statistical information is not sufficient to determine extraneous noise. Guesses can and are often made as to what particularly noises ‘could’ be but such decisions are made based more on personal experience of the consultant and guesswork than specific information available through the data recorded by the logger.

Examples of extraneous noise are dependent upon the type of noise being measured, very often including insect noise and fauna such as bird calls or frog noise. This type of noise can be seasonal and is not present for a significant part of the year. If this type of noise is measured, there is not enough information present in the data recorded by broadband noise logging to allow for any adjustments to be made, with the data often having to be discarded. This would not be a problem in the ideal world, as the consultant could just wait until the part of the year where this noise is not present so the most accurate measurement could be taken, or alternatively conduct measurements for the entire year. The pressures of the real world however bring limited budgets as well as limited timeframes for measurements to be conducted ie. “start straight away and finish as soon as possible”.

SPECTRAL NOISE LOGGING

Advances in instrumentation has made the spectral measurements more easily available, ranging from the simple octave measurement to one third octave measurements to digital audio recordings, allowing replaying or FFT analysis to identify noise sources after the measurements are conducted.

With the additional spectral information available, determination of the noise source in question is aided significantly. Insect noise is particularly simpler to identify and remove, as constant noise of significant level in the 2.5kHz to 5kHz bands are not usually present in the majority of environmental noise measurements. This information allows the use of mathematical algorithms to extract or remove the contributions of specific frequency bands and recalculation of the aggregate overall noise levels forming the baseline noise.

CASE STUDY: AMBIENT NOISE STUDY

The 24 hour time history presented at the top of Figure 1 represents the ambient noise environment in a regional environment in central Queensland, as would typically be presented from the results of a Type 1 broad-band noise logger. In the horizontal centre of the figure is midnight, with midday at the far left and right. The L_{A90}, or background noise level, is shown as the black for the raw data and light blue for the data filtered to exclude extraneous noise in specific one-third octave bands. Wind speed is shown by the purple line at the bottom of the chart.

The noise survey was conducted in February 2011, with no possibility of monitoring during winter months. In this instance the project budget allowed for only a week of noise logging.

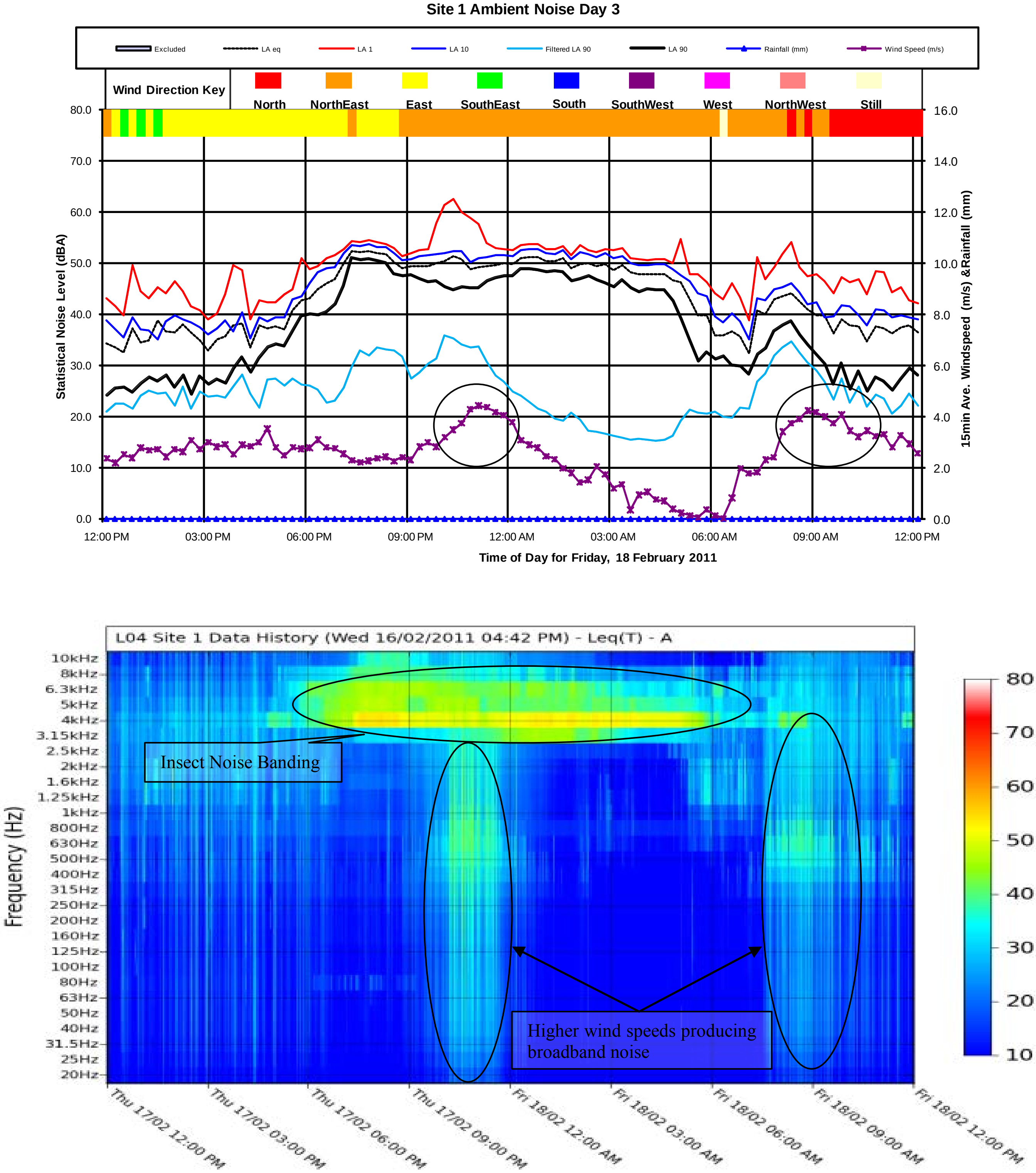

Figure 1. **Statistical Baseline Noise Record and One-third Octave Sonogram**

From the broadband record it can be seen that the noise levels during the night period are significantly higher than those during the day period and have a reasonably small spread which is difficult to qualify. There is however not enough information to identify the types of noise present and whether it is representative of the noise environment for the entire year. This would, if handled without due consideration, result in determined background noise levels and resultant noise criteria which are significantly inflated and would possibly result in noise complaints in the future.

From the one-third octave spectral record shown in the lower portion of Figure 1, insect noise is evidenced by 3.15kHz to 8kHz banding during the evening and night period. When the one-third octave record is used to remove the insect noise within the 3.15kHz to 8kHz bands, a substantial reduction in the background noise level can be seen, by comparing the black line (L_{A90} for raw data) and light blue line (L_{A90} for filtered data). By the use of the sonogram in combination with the level chart, the broadband noise just before midnight and around 9am the following day can also be explained as wind induced noise, with wind speeds over $4ms^{-1}$ at ground level are evident at the same times as this noise is recorded.

The effects on an environmental impact assessment are also substantial, with the effects on the the Assessment Background Noise Level (ABL) results illustrated in Table 1. Without the filtering out of the insect noise, an overestimation of 17dB would have resulted for the Assessment Background Noise Level during the critical night-time period.

Table 1. ABL with and without filtering

	ABL using Raw Data	ABL using Filtered Data (Filters Exclude: 3.15, 4, 5, 6.15 and 8 kHz)
Day, 7am to 6pm	24	21
Evening, 6pm to 10pm	40	22
Night, 10pm to 7am	33	16

The same data for the ambient noise study has also been assessed as if it were to be used for a wind farm assessment, using the measured wind speeds and plotting the L_{A90} noise level against wind speed. This assessment is shown in Figure 2, which includes the data as a L_{A90} noise level against wind speed for both the raw data (shown in blue) and that with the insect noise filtered out (shown in red). For each set of data a 2nd order polynomial trend line is shown.

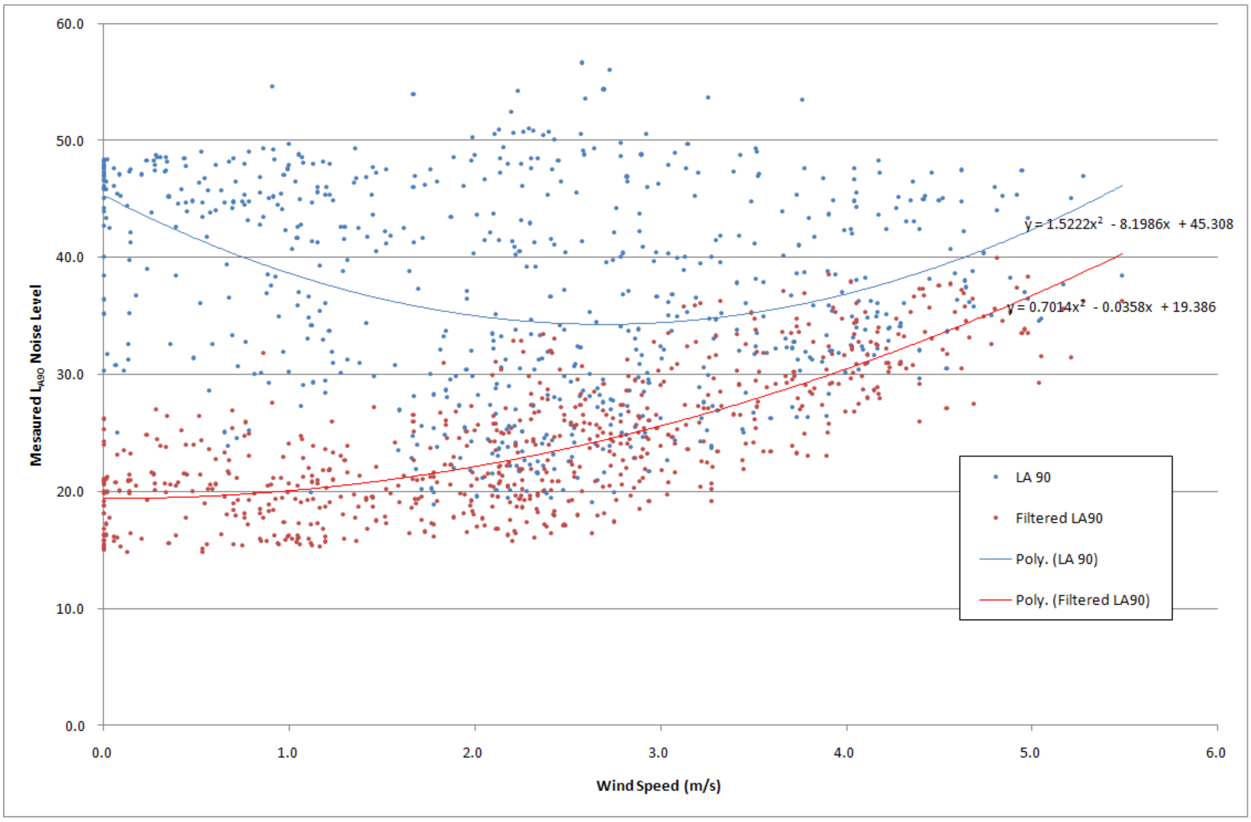

Figure 2. Site 1 Measured Noise Level Vs Wind Speed (m/s)

From the data shown in Figure 2, it can be seen that the insect noise shown in the raw data set significantly obscures the relationship which is intended to be studied, as the insect noise is not significantly dependant on the wind speed. When the one-third octave record is used to remove the insect noise within the 3.15kHz to 8kHz bands, a more understandable and reasonable trend line emerges, which is significantly different to that produced by the raw data. If the raw data was used, the noise criteria resulting from the assessment would be significantly inflated and would be unlikely to be remotely reasonable for periods of the year where little or no insect noise is evident.

CONCLUSIONS

Assessments of background noise levels utilising broadband noise loggers can result in a significant overprediction of the ambient noise levels due to the inclusion of seasonal biological noise such as insects, resulting in an inflation of the noise criteria.

Spectral noise logging allows for the identification and removal of extraneous contributions with a greater degree of confidence, using mathematical algorithms to extract or remove the contributions of specific frequency bands and recalculation of the aggregate overall noise levels forming the baseline noise (such as ABL or RBL). Using this method the relationship between wind speed and ambient noise level can be confirmed without the influence of seasonal biological noise, which would otherwise significantly distort the assessed relationship between wind speed and ambient noise level.

The use of spectral noise measurements is also anticipated to help with noise complaints as the before and after spectral content will be known, allowing for a more rigorous assessment of both low frequency noise and any identified tonality.