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THE MOSQUITO EFFECT: COMMUNITY REACTION TO NOISE FROM A GENERAL AVIATION AIRPORT

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ABSTRACT

This study was undertaken to determine the reaction of residents to aircraft noise from a general aviation airport. The results of the study were compared with the expected responses calculated using the Australian Noise Exposure Forecast (ANEF) system. The response of residents was determined by conducting a social survey in the areas within the computed ANEF contours. The results of the survey indicated that reaction to light aircraft noise was approximately 7 ANEF units higher than expected. Validation of the ANEF contours showed that actual noise levels from aircraft over-flights were 3 ANEF units higher than the computed ANEF levels. When taking into consideration the actual noise, it was concluded that the reaction to aircraft noise from this airport was 4 ANEF units higher than would be expected for major airports. This would suggest that a 4 ANEF adjustment should be considered when planning for residential land use around general aviation airports.

1 - INTRODUCTION

Decisions regarding acceptable uses of land close to Australian airports are generally based on the Australian Noise Exposure Forecast (ANEF). This is a system of assessing the level of annoyance caused by aircraft noise for a future airport scenario. This system of noise exposure was based upon a similar measure (NEF) developed in the United States of America in the late 1960's. Adaptation for its use in Australia followed a research project undertaken in 1982 by the National Acoustics Laboratory (NAL) of the response to aircraft noise of residents living around five major airports in Australia. This paper also refers to the Australian Noise Exposure Index (ANEI). This is essentially the same as the ANEF, except the values used are actual aircraft movements from a previous year rather than a future airport scenario.

There have been a number of criticisms of the ANEF system. For example, it has been argued that the maximum noise levels from individual events and the number of occurrences more accurately correlate with the human response to aircraft noise than the equal energy theory adopted in the ANEF system.

For this particular study the most relevant argument is that the ANEF system was developed from human reaction to aircraft noise around major airports and not from reaction around general aviation airports. The ANEF system is based on the equal energy principle, which states that the acoustic energy of one large commercial jet would be equal to the acoustic energy of a significant number of small general aviation aircraft. The ANEF system, therefore, suggests that the likely response to both airport scenarios is the same.

This study challenges these assumptions by determining the response of residents, located around a general aviation airport, to aircraft noise and comparing the results with the expected response calculated using the ANEF system.

2 - BACKGROUND

Jandakot Airport is a general aviation airport located approximately 18 kilometres south of Perth, Western Australia. It is the main base in Western Australia for light aircraft maintenance, private flying, flying training and aerial work activities. The airport has three main runways and caters for approximately 1100 daily aircraft movements.

Since the construction of the airport in 1963, there has been considerable residential development in the surrounding areas. This has subsequently led to an increase in the number of people exposed to aircraft noise, which in turn has led to an increase in noise complaints and the formation of a number of action groups against aircraft noise in the area.
A brief outline of the study is provided below together with a summary of the tasks that were undertaken:

- social survey of the residents around the airport and a comparison between the dose response to aircraft noise of residents around Jandakot Airport and that of residents interviewed in the 1982 NAL survey;
- on-site noise measurements and analysis and comparison between measured aircraft noise levels around Jandakot Airport and predicted noise levels using the computer modelling program Integrated Noise Model (INM); and
- evaluation of ANEF system in the Jandakot general aviation airport context.

3 - THE SOCIAL SURVEY

A social survey was undertaken over a period of approximately three weeks, canvassing residents within and outside the Jandakot Airport 25 ANEI contour. The purpose of the survey was to assess whether the relationship between ANEF levels and community reaction at this airport follows the same pattern determined for larger airports as stated in the NAL report. An additional purpose of the study was to determine whether there are specific factors operating at Jandakot, which result in higher or lower levels of reaction than would be expected. It was anticipated that this information would be useful to: 1) determine the appropriateness of using ANEF levels for decisions regarding planning of residential areas; or 2) determine an adjustment that can be applied to the ANEF levels to better represent the community reaction around general aviation airports.
The sample size consisted of approximately 330 residents, and the area extended to approximately the 10 ANEI contour.
Standard questions were used to determine whether the respondent could be described as "seriously affected", "moderately affected", or "highly annoyed" by aircraft noise. The study made a comparison between the proportion of people seriously affected and the ANEI level to which they were exposed. The questions used were the same as those used for the 1982 NAL study, although some of the original questions that were considered irrelevant to this study were omitted. The results of the analysis were compared with previous data from the NAL study.
The survey was performed before any on-site noise measurements were taken to avoid any possible biasing effects as a result of local residents observing noise levels being measured in the area.

4 - NOISE MEASUREMENTS AND ANALYSIS

Manned noise measurements were conducted over a period of approximately three weeks, covering locations under each of the major circuit and inbound/outbound flight tracks and in the same areas covered by the social survey. The purpose of the noise measurements was to validate the predicted ANEI contours, which were used to determine the expected community response to aircraft noise.
The time and registration number of each overflight was recorded to determine, as far as possible, the track, altitude and flight profile of the aircraft together with the meteorological conditions at the time of measurement. This information was used to provide validation of the actual location of the flight tracks and calculation of the ANEI contours. For each overflight, analysis of the tape recordings determined the effective perceived noise level (EPNL), the maximum A-weighted noise level (L_{Amax}) and the sound exposure level (SEL).
Comparison of each individual measured aircraft noise level with the level predicted for that aircraft type on a standard flight track was made using the computer modelling program INM.

5 - RESULTS

The results of the measurement analysis indicated that, while noise levels from individual overflights varied about the predicted noise level with a standard deviation of 4.3 EPNdB, the noise level predicted using the INM program gives a prediction of the mean level which is slightly low, by an average of 1 EPNdB, with little difference between sites or aircraft types.
However, in calculating the ANEI value at a location, the important quantity is not strictly the (arithmetic) mean noise level, but the energy-mean level (an average level that is weighted toward the higher measured values). For the measured overflights, the energy-mean level at any site was on average 2.8

EPNdB higher than the predicted noise levels rather than 1 EPNdB for the arithmetic mean. This means that the true ANEI value will be approximately 3 ANEF units higher than the value computed by the INM model.

Analysis of results from the social survey was conducted in a way that paralleled, as closely as possible, the analysis conducted in the 1982 NAL survey. In particular, noise reaction was assessed through the use of a constructed scale, referred to as GR (general reaction), taking values from 0 to 10 depending on responses to a series of questions throughout the interview.

From Figure 1 it can be seen that the mean GR scores from the Jandakot study are somewhat higher than would be predicted from the average 1982 NAL results. Detailed analysis indicates that, under the assumption that there is a constant difference between GR scores at Jandakot and the mean GR scores in the NAL study, the difference would be approximately 0.95 points on the GR scale. This is equivalent to approximately 4 ANEF units in noise exposure. Ninety-five per cent confidence limits on this value range from 2.5 to 5.5 ANEF units.

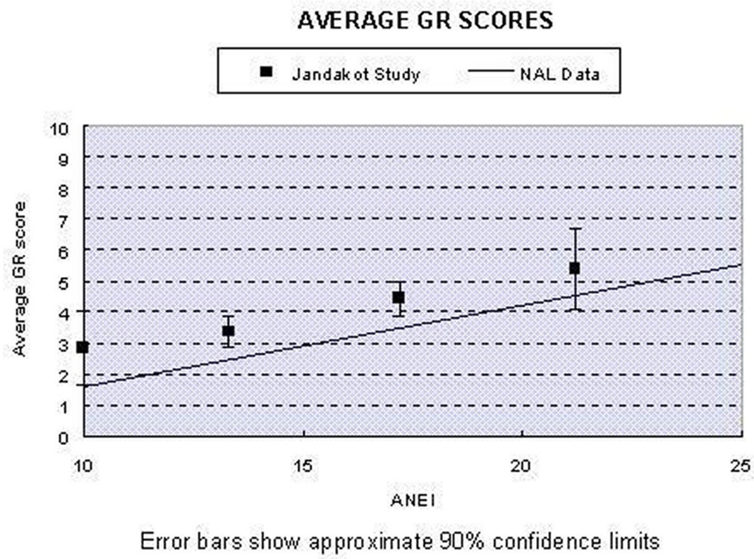

Figure 1: Analysis of GR scores.

It may be noted that without the addition of the 3 unit correction to calculated ANEI values, the difference between the dose/response data for Jandakot and the NAL study would have been close to 7 ANEF units, rather than 4 units based on the corrected ANEI values.

However, the difference of 4 ANEF units which has been found at Jandakot, while statistically significant, is not outside the bounds of variation between airports which would have been expected from results at major airports from the 1982 NAL study.

6 - CONCLUSION

The results of the social survey indicate that reaction of residents surrounding Jandakot Airport to aircraft noise is somewhat higher than would be predicted from the average response found in the NAL study. Taking into consideration the corrections ascertained from on-site measurements to the calculated INM noise levels, the reaction difference is equivalent to approximately 4 ANEF units in noise exposure. As the ANEF system is based on reactions of residences surrounding major airports, the results of this study would, therefore, suggest that a 4 ANEF adjustment should be considered when planning for residential land use around general aviation airports.

While this study has obvious importance for Australian airports, it may be applicable to land-use planning round general aviation airports in other countries.

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