AIRCRAFT NOISE IN AUSTRALIA: MEASUREMENT, ASSESSMENT AND CONTROL

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This talk will cover ...

- A historical perspective on aircraft noise issues in Australia.

- Where does “health” fit in to discussions of aircraft noise impact?

- The importance of using the correct noise metric.

- The urgent need for research to investigate key questions in this area.
HISTORICAL PERSPECTIVE:
The beginning ....

• 1959 - first commercial jet aircraft service in Australia (Sydney – San Francisco, flying a B707-138).

• Sydney Airport was then, and still is, the most significant single source of noise disturbance in Australia.

• Through the 1960’s and early 1970’s, aircraft noise moves from a symbol of advanced technology to a symbol of environmental degradation. Increasing public calls for controls.
The 70’s: Options for controlling aircraft noise impact?

• Quieter aircraft – not much chance for control in Australia.

• Control flight tracks and/or airport operating modes

  At this stage only the worst-affected areas were considered, and flight tracks here are essentially fixed. The only operating mode adjustments considered were curfews – informal curfews introduced at Sydney and Adelaide

• Control where people live and/or the houses that they live in

  Here there seemed to be significant opportunities for reducing noise impacts
AS 2021 and the NAL Survey


• 1977 – Expanded to cover land use planning guidelines. Basically adopts the US NEF land use planning system.

Recommendation for a survey to validate under Australian conditions.

• 1982 – NAL survey. Survey of 3,500 residents around 5 airports. Focus on areas within 20 NEF, but includes some with lower exposure. Specifically a study of “noise reaction” (roughly, “annoyance”).
AS 2021 and the NAL Survey

- Results:
  - Individual noise exposure explains only about 12% of the variation in individual noise reaction. The rest is due to variation between people in how they react to the same noise.
  - Nevertheless, grouped reaction measures such as “proportion of people seriously affected by noise” are reasonably predictable based on noise exposure.
  - Numerous possible noise exposure metrics were tested for correlation with reaction. These include:
    - “equal energy” metrics like NEF, Leq, Ldn, etc;
    - “number above” metrics like N70;
    - “maximum level” metrics like “Mean maximum level of the loudest 5 aircraft in a day”.

Equal energy units clearly gave a better prediction of reaction than any other type.
AS 2021 and the NAL Survey

- Results:
  - The NEF unit was modified slightly on the basis of survey results to become ANEF.
  - Reaction (in terms of percentage of people “seriously affected” by aircraft noise) increases steadily from very low noise exposure. Overall, at 20 ANEF, about 12% of people will be “seriously affected” and 45% will be “moderately affected”.

Aircraft Noise Dose / Response
(from Miedma & Vos, 1998)

Approx. 20 ANEF
AS 2021 and the NAL Survey

• 1985 – The NAL report results in significant changes to AS 2021. NEF replaced by ANEF, and guidance becomes:
  - Less than 20 ANEF “Acceptable”
  - 20–25 ANEF “Conditionally Acceptable”
  - Greater than 25 ANEF “Unacceptable”

• AS 2021 recommendations have been adopted by all relevant land use planning authorities and form the basis for planning around all airports in Australia. They are about equal to the most stringent criteria anywhere in the world.
ANEF Chart for Sydney Airport
The 90’s

• Exposure patterns begin to change – lower maximum levels, more operations

• The Third Runway at Sydney Airport
  - EIS used ANEF as a measure of reaction to newly-introduced noise.
  - EIS and other documents used ANEF as a way to explain noise exposure to potentially-affected residents. The change in the most-affected areas was about 3 dB which was taken to be not very significant.
  - On opening there was very strong public response, including a sense that residents were lied to.
The 00’s

• 2002 – “Expanding Ways to Describe and Assess Aircraft Noise”
  - Arose directly from consultation with Sydney residents following opening of the Third Runway
  - Sets out a range of alternative metrics including N70, flyover numbers and respite time, for describing aircraft noise, and particularly changes to aircraft noise
  - Explicitly states that these metrics should not be used for land use planning

• These metrics allow for detailed analysis of changes to airport operating modes, and this becomes increasingly important as a noise mitigation option.

• The metrics proved to be very effective for communication, and appear to help in making choices between alternative operational procedures in areas outside the “land use planning zone”.

Wilkinson Murray
Flight Path Chart

**Average Daily Movements**

- **A**: 122
  - Percentage of all jet movements: 28%
  - Daily range: 12 - 227
  - Days with no movements: 0%

- **B**: 39
  - Percentage of all jet movements: 2%
  - Daily range: 0 - 123
  - Days with no movements: 28%

- **C**: 83
  - Percentage of all jet movements: 19%
  - Daily range: 0 - 227
  - Days with no movements: 23%

- **D**: 18
  - Percentage of all jet movements: 4%
  - Daily range: 0 - 61
  - Days with no movements: 37%

- **E**: 14
  - Percentage of all jet movements: 3%
  - Daily range: 0 - 125
  - Days with no movements: 50%

- **F**: 21
  - Percentage of all jet movements: 5%
  - Daily range: 0 - 71
  - Days with no movements: 37%

- **G**: 31
  - Percentage of all jet movements: 7%
  - Daily range: 0 - 74
  - Days with no movements: 13%

- **H**: 105
  - Percentage of all jet movements: 24%
  - Daily range: 0 - 242
  - Days with no movements: 4%

- **I**: 90
  - Percentage of all jet movements: 21%
  - Daily range: 0 - 136
  - Days with no movements: 2%

*Track A is tracks B & C combined*
Respite Chart
On an average annual day in 1998 the number of noise events louder than 70 dB(A) within the coloured areas was:

- Light grey: 10 to 20 events
- Light purple: 100 to 200 events
- Light orange: 20 to 50 events
- Dark purple: more than 200 events
- Dark red: 50 to 100 events
- Dark blue: 10 to 50 events
- Dark grey: 100 to 200 events
- Light blue: more than 200 events
The 00’s

• Increasing concentration on impacts in areas outside 20 ANEF as newly-privatised airports look to make changes to their infrastructure – e.g. runway expansion at Gold Coast; third runway at Brisbane.

• Assessments for these projects become MUCH more detailed, and use of the new metrics becomes the norm.

• This provides a wealth of valuable information for interested parties (provided the information is correct)

• It also provides the possibility of another form of impact mitigation – allowing potential residents to understand their future noise environment and select according to their noise sensitivity.
The 01’s

- Several very significant airport development projects are looming – at Perth, Melbourne, and the fabled Western Sydney Airport.

- The impact of these projects will be assessed using a suite of noise metrics and associated tools that is:
  - VERY complex;
  - fundamentally derived from one experience at one airport;
  - directed toward minimisation of noise reaction only;
  - not used anywhere else in the world; and
  - supported by zero hard scientific evidence.

- Perhaps it’s time to do some more research ...
But what does all this have to do with health?

None of the assessment procedures or decision-making processes described above makes any explicit reference to impacts on health (unless you regard noise reaction *per se* as a health impact).

Since at least the '90s there have been growing indications that environmental noise, and aircraft noise in particular, is associated with impacts that are very clearly health-related (e.g. rate of myocardial infarctions; hypertension).

Results from recent studies are very compelling. Detectable impacts seem to begin at exposure levels of around 20-25 ANEF (approx. 55-60 dB $L_{dn}/L_{den}$). However, whether these equal energy metrics are the appropriate ones to use is still unknown.

Similar comments apply to other impacts such as learning deficits in children.
Sleep disturbance

Whether, for example, an increase in the number of behavioral awakenings per night should count as a health impact *per se* is moot.

However, [I understand that] sleep disturbance is known to be a precursor to other effects that are definitely clinically significant.

There is a consistent string of studies from about the early 90’s indicating clearly that equal-energy metrics are NOT a good way to characterise sleep disturbance.

Unfortunately the studies are not nearly as clear as to what WOULD be an appropriate metric. For this reason, guidance such as that in the WHO publication “Night Noise Guidelines for Europe” is still expressed in equal-energy terms.

In Australia, sleep disturbance due to aircraft noise is typically assessed in terms of a night-time N60. However this is also based on assumptions and guesses.
Why does the metric matter?

In existing situations, all noise metrics are always highly inter-correlated. It is therefore tempting to believe that the choice of metric is not important – we just need to reduce noise exposure, no matter how it is measured.

If mitigation were just a matter of reducing the noise level from all overflights, that would be correct.

However, in practice in Australia (and many other countries), aircraft noise mitigation is mostly about designing flight paths, operating procedures and airport operating modes to achieve lower values of some overall “cost function” that depends on the noise metric.

Using the wrong cost function could easily lead to “mitigation” that makes the problem worse.
We need research on two fronts:

1. Noise Reaction

Questions:

How should we describe noise reaction in areas outside, say, 20 ANEF? Is this related to reaction to a CHANGE in noise exposure?

What metrics should we use to drive noise mitigation in these cases? Are they related to the metrics currently in use in Australia?

Methodology:

The research may not look like a traditional survey. Probably a combination of laboratory and home-based experimental designs, “focus groups”, and small-scale directed surveys.

One useful reference point for research methodology would be “soundscape” research.
We need research on two fronts:
2. Clinically Significant Health Impacts

Questions:
Can we confirm the existence of already-detected effects, and of a dose/response relationship?
What noise metric(s) should we use to drive mitigation measures?

Methodology:
I believe this will require some clever and directed epidemiological research, including strong input from acousticians.
A Final Word: Information

In my experience it is hard to over-state the importance of providing clear, accurate information on aircraft operations to potentially-affected people. This:

• gives residents some sense of why the number and type of overflights varies in the way it does, and so mitigates uncertainty and suspicion;

• mitigates the surprise factor when exposure patterns change; and

• allows potential residents to choose not to move into areas where they would experience significant noise reaction.

Good information and transparent consultation are worth at least 10 dB in noise reduction.

My experience is specifically related to noise reaction, but I would not be surprised if transparency and openness were also found to mitigate actual health impacts.
To Summarise:

For land use planning around airports, Australia has what I regard as a successful, well-grounded system, accepted by most stakeholders and applied consistently throughout Australia.

For assessment of aircraft noise impacts, and in particular of changing impacts, the noise metric used for land use planning is not appropriate. Here we have developed a unique system that seems to work well for conveying information to the public, but is completely without scientific backing.

The realisation that in some areas there are impacts apart from noise reaction introduces a new and urgent requirement to find appropriate ways to reduce those impacts.

Without further solid, high-quality research into both noise reaction and specific health effects, noise mitigation will at best be hit-and-miss.
Thank you