

Inadequate standards currently applied by local authorities to determine statutory nuisance from LF and infrasound

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ABSTRACT

Knowledge of the latest results in Low Frequency Noise (LFN) and infrasound research are not being transmitted, either to government whose job it is to legislate on standards of noise and vibration, or to local authority officers whose job it is to look into complaints and enforce standards. The dismissal of complaints is frequently based on inappropriate techniques such as the application of A-weighting, a lack of understanding of vibration transmission including building resonance, and a lack of basic understanding about the perception of low frequencies by complainants, for instance the lowering of the lower audibility threshold arising from exposure.

This paper asks those involved in research to ensure that their relevant findings are more widely disseminated, along with advice to legislators and local authorities on measurement, information on LF and infrasound resonance in buildings, recommendations for appropriate standards to be used in assessing LF and infrasound as a Statutory Nuisance, and information about the effects of long-term exposure. There is a need for more research *in situ* into specific effects.

1. SUMMARY

This paper examines some of the barriers experienced by those who complain to their local authorities about low frequency noise (LFN).

The extent of the problem will be examined by presenting data from a survey of UK Environmental Health Officers (EHOs) on their use of weighting with low frequencies, and by quoting from my own experience.

The root causes of the problem will be identified, and solutions suggested.

2. INTRODUCTION

My own background is not as an expert in any of the fields associated with LFN. I was a lecturer in mathematics for 35 years, and then a transpersonal psychotherapist in private practice for the next 15 years. My link with LFN is as a person who has had the experience of hearing an infrasound tonal hum inside my flat, caused by the structure resonating to vibrations from an external source. In other words I have firsthand experience of what it is like to be on the receiving end, and I am now a Committee Member of the UK Noise Association.

3. BACKGROUND

By contacting the Low Frequency Noise Sufferers Association (LFNSA), I discovered that there are hundreds of people in the UK who suffer LFN and are unable to get anything done about it, and this is probably only the tip of an iceberg.

Personal descriptions suggest that they fall mainly into two overlapping groups. The first consists of those who experience a hum inside their homes, due to resonance in the building itself caused by vibrations from some external source. This sort of LFN cannot usually be heard outside the building, only from inside it. (Gavreau 1968.)



The other group consists of those whose lower audibility threshold appears to be lower than that of the investigating Environmental Health Officer (EHO), because in a particular environment they are plagued by sounds which the officer cannot hear. (Frost 1987, for threshold variability.)

I was informed by the LFNSA that there are three standard reasons given to their members as to why their complaints had been dismissed by local EHOs, and these are:

- 1) Readings are A-weighted, making them fall below the standard threshold for Statutory Nuisance.
- 2) The EHO cannot hear it, so the complainant must have tinnitus and that is what he/she is hearing.
- 3) Even if the complaint were taken to court, it would be dismissed by the magistrate because the mere fact that the complainant is bothered by this noise means that he/she must have abnormal hearing, and the law applies only to people with normal hearing.

In my own problem of an indoor resonant hum consisting of tonals at 12 and 16 Hz, the local EHO gave me all three reasons in spite of their being to some extent mutually exclusive. However the third of these reasons is outside the scope of this paper, so only the first two will be discussed.

There are hundreds of people suffering from LFN, whose complaints have been dismissed for one or more of these reasons. The system which was set up to protect them is not working. Why is this?

Before examining this question I wish to make it clear that this paper is not a criticism of EHOs, but rather of the system which expects them to deal with LFN/infrasound/resonance problems which are the province of experts, and to do this without the necessary training and with inappropriate guidelines.

4. SURVEY OF WEIGHTING FOR LFN

First let us turn to reason number one on the above list of three, namely A-weighting. I understand that it is currently a matter of debate as to whether A, C or some other weighting should be used for LFN (Persson Way 1995 pp24–25, Andresen and Moller 1984 pp7–8), but there is general agreement that the very lowest of frequencies including infrasound should definitely not be A-weighted, and ideally should be left as linear readings (Sargent 1994).

In order to find out how widespread is the practice of using A-weighting with complaints of LFN, in January 2002 I sent a questionnaire to all Chief EHOs in the UK. Of 469 forms sent, I received 162 back, a response rate of 34.5%.

The first question was simply to state the name of the Council.

Question 2 asked: 'In the 3 years from 1st Jan 1999 to 31st Dec 2001, how many complaints of low frequency noise did you receive?'

Of the 162 authorities who returned their questionnaires:

- 59 (36.4%) received no complaints at all,
- 84 (51.9%) received at least 1 complaint,
- 19 (11.7%) did not answer.

The top three scorers received 57/50/30 complaints respectively. These figures indicate a wide variation in the incidence of LFN complaints across the UK.

Fortunately I had asked them to add written comments if they were unable to answer any question, and 38 (nearly a quarter) stated that the information was not available and/or they were having to estimate their answers. One volunteered information on the reason for this, namely that their system of classification in which they record complaints is according to type of noise such as industrial, domestic, aircraft, etc. They do not classify LFN complaints separately. This system is the one which is recommended by government. That was why they did not find it easy to retrieve the requested data.

This could explain the number of respondents who either did not answer the question or said they were giving an estimate.

Question 5: 'Did you have access to a frequency analyser?'

108 (66.7%) answered yes,
16 (9.9%) answered no,
38 (23.5%) did not answer.

If we concentrate on those 84 authorities who reported having had at least one LFN complaint during the 3-year period:

70 (83.3%) answered yes,
9 (10.7%) answered no,
5 (6.0%) did not answer.

This means that a number of authorities, including some who received LFN complaints, did not have the equipment recommended in their own official guidelines (Sargent 1994).

The numbers may in fact be even worse than these figures indicate, because in order to keep things simple I did not ask whether the frequency analyser to which they had access was narrow band or 1/3 octave. 14 respondents wrote at the side that what they had was only 1/3 octave. It is likely that far more only had 1/3 octave but did not feel it necessary to volunteer this information.

Question 9: 'In future if you had access to a frequency analyser, would you use it for complaints of low frequency noise?'

103 (63.6%) answered yes,
2 answered no,
57 (35.2%) did not answer.

I do not know what to read into the fact that 35% felt unable to answer this straightforward question. Also, although only two actually answered 'no', it is very worrying that anyone at all should give this answer.

Question 10: 'What weighting, if any, would you employ? (Please tick)' Table I shows the result of adding up all the ticks.

	A	C	Linear	Other
0–25Hz	32	13	75	0
26–50Hz	35	13	79	0
51–100Hz	39	12	79	0
101–150Hz	40	13	80	0

A worrying feature of this table is the fact that as many as 32 authorities indicated that they would A-weight frequencies in the range 0–25 Hz.

Table II shows the same data re-arranged according to respondents.

8 authorities ticked	A only	for all 4 frequency ranges
4 authorities ticked	C only	for all 4 frequency ranges
50 authorities ticked	L only	for all 4 frequency ranges
17 authorities ticked	A & L only	for all 4 frequency ranges
2 authorities ticked	A & C only	for all 4 frequency ranges
0 authorities ticked	C & L only	for all 4 frequency ranges
4 authorities ticked	A & C & L only	for all 4 frequency ranges

17 authorities ticked their boxes in such a way as to indicate that they would treat the lowest frequency ranges differently from the higher ones
60 (37%) did not answer

Among the written comments, 4 authorities said 'yes' they would use a frequency analyser in future, but could not answer question 10 because they were unsure how to use weighting.

These data demonstrate a lack of consistency across the UK.

At this point I would like to inject a note of caution with regard to the interpretation of the A and L combination, by quoting my own experience of infrasound tonal hum at 12/16Hz. In accordance with their official guidelines our EHO took linear readings with a frequency analyser. So far, so good. After all, she had a Diploma in Acoustics.

However she then deducted A-weighting (which is huge at those frequencies) to determine her final decibel readings which would be used to represent our noise. Why did she do that? If she wanted to end up with A-weighted readings, why not take A-weighted readings in the first place? Why go through the bother of taking linear readings and then doing some arithmetic?

A possible explanation for this might be found in the guidelines drawn up by Sargent (1994) which state that linear readings must be taken when dealing with LFN, but do not say what one then does with those readings. Unfortunately official guidelines give the threshold for Statutory Nuisance in terms of dBA. This means that the EHO has to convert linear readings into dBA in order to assess the noise. As a result the whole point of taking linear readings is negated.

So we must not assume that the A&L respondents in this survey used their A-weighted values only for comparison purposes. It is possible that at least some, if not all, will have used the A-weighted reading as their final working value.

In fact one respondent spelled it out in a written comment which stated that all laws on noise nuisance and all guidance to EHOs, are in terms of A-weighting, and that is why he uses only A for all frequencies including infrasound, although he disagrees with this practice.

5. CONCLUSIONS FROM THE SURVEY

One is led to conclude from the inconsistencies in the handling of LFN across the UK, that there are two factors responsible. One is that the training received by many EHOs is totally inadequate for such areas as LFN, infrasound and building resonance. This is not surprising when one considers how many different subjects they are expected to study: hygiene, infestations, noise, law, etc. It must be impossible to study any one of these areas in depth.

The other cause is inadequate regulations and guidelines given to EHOs for assessing Statutory Nuisance at these frequencies. It appears that scientific advice given to government has not been adequately translated into workable regulations and guidelines for assessing noise nuisance.

6. THE LOWER AUDIBILITY THRESHOLD

The second on the list of three reasons for the dismissal of complaints about LFN, was: 'The EHO cannot hear it, so the complainant must have tinnitus and that is what he/she is hearing.'

This reason is given frequently in spite of the fact that low frequency tinnitus is rare, if it exists at all. Revealed here is a lack of understanding of the significance of lower audibility thresholds, especially when dealing with very low frequencies and infrasound. It is treating lower audibility thresholds as if they were absolutes, when in fact they are averages over the population.

It is quite possible to have a very low frequency which is inaudible to the EHO but is very disturbing to the complainant. This makes it worrying that six authorities added a comment to their survey forms to the effect that, if an officer cannot hear an alleged noise then it cannot possibly be a nuisance and therefore there is no point in taking readings at all.

By contrast just one authority expressed concern for LF sufferers who are able to hear low frequencies that others cannot hear.

Again, a lack of training is responsible for this lack of understanding of the

variability in thresholds at the lower frequencies (Frost 1987), and for failure to take into account the current degree of uncertainty as to how the human brain interprets LF and infrasound.

7. SOLUTIONS

It seems to me that the only effective way of preventing these situations in future, is for the scientists to become proactive. Each professional institute could set up a Committee which would monitor how their discipline is being interpreted and applied in the real world. If it finds any discrepancies the Committee would take appropriate action to rectify matters.

I would also like to add that scientists do not help matters by using language which means one thing to another scientist but something different to a layman, and therefore misleads the latter. I refer here specifically to the term 'infrasound' which is a misnomer, and also to the statement: '20 Hz is the lowest audible frequency.' To a layman this means that no-one can possibly hear a frequency lower than 20 Hz, no matter how powerful it is. It would cause less misunderstanding if this statement were dropped in favour of: '20 Hz is the lowest audibly distinguishable frequency.'

8. COMPLAINANTS AS A SOURCE OF DATA

So far this paper has concentrated on distortion of the science of LFN in the course of its communication from the experts to the general public. Let us now examine a communication failure in the opposite direction, namely the apparent absence of any feedback of data from those who suffer from LFN, back to the scientists in order to inform and guide further research.

Effects which are experienced by at least some of those who have suffered prolonged exposure to their noise, include the following:

- 1) A LF or infrasound tonal may be faint, but it can still be very disturbing and stressful. At the lowest frequencies the brain does not habituate as it does at higher frequencies.
- 2) Sensitisation. After prolonged exposure one's lower audibility threshold can become even lower, permanently.
- 3) Delay in adjustment. After having been away from the noise environment for a while, on one's return the noise appears to be less or even absent. But after a short delay it returns to its usual strength. Obviously the noise is not really timing itself to one's comings and goings. It is the brain's perception that is creating this effect.

I suspect these are survival mechanisms in the brain, designed to make one aware of some danger and take evasive action. Unfortunately in our society evasive action is not always possible.

The importance of these three effects is that they demonstrate that the threshold above which annoyance or nuisance is experienced from very low frequencies is not dependent just on decibels, but also on length of previous exposure time in both the long and short terms.

At the moment the criteria used for assessing nuisance from LF and infrasound in terms of decibels, have been based mostly on research carried out in laboratories on subjects with normal hearing, who have not suffered previous exposure to the frequencies being tested, either in the long-term or immediately before the experiment took place (e.g. Poulsen 2002). Moreover they have simply walked into the laboratory fresh from outside with no period of exposure prior to the test in order to enable them to 'tune in' (Benton 1997 p 22).

Consequently they are not representative of the vast majority of people who complain to their local EHO about LFN. Complainants have already been exposed to the noise for at least a few days before the officer arrives to investigate, and in many cases for several weeks or even months. It is unlikely that the officer has had long-term exposure to that particular noise, and therefore may not even be able to hear the LFN which is stressful to the complainant.

This reminds one uncomfortably of the six authorities who wrote on their survey forms that if the officer cannot hear the noise then it is not a nuisance.

For practical and ethical reasons laboratory subjects cannot be made to undergo preconditioning which involves long-term exposure to LFN. The only way to get realistic standards to recommend to government for defining annoyance or nuisance, is to do research with long-term sufferers, and if possible in their own noise environment in order to eliminate both the short-term delay mechanism and the probable failure to replicate in the laboratory the exact noise to which they have been subjected.

A paper by Persson Waye and Rylander in the *Journal of Sound and Vibration* 2001, is one of those beginning to address this problem, as does Persson Waye's earlier thesis of 1995, published by the University of Gothenburg, Sweden. But we are nowhere near having realistic standards which take these problems into account and which government can recommend to EHOs for assessing annoyance or nuisance.

There are other interesting effects concerning the brain's perception of infrasound resulting from long-term exposure, which I personally have experienced, but they are not relevant to the title of this paper. However I am sure I am not alone in saying that I would be happy to be used as a subject in somebody's research, as that would mean that what I have had to put up with will have served a useful purpose.

9. CONCLUSIONS

- 1) The results of research in LFN and infrasound are not being communicated adequately to EHOs.
- 2) The government's guidelines on levels for annoyance and nuisance are inadequate because they take into account neither individual differences nor the actual experiences of those who have been exposed to LFN for some time.

Suggested solutions are:

- 1) Committees be set up by the relevant professional institutes, to monitor how their disciplines are interpreted and applied in practice.
- 2) There needs to be a completely new approach to the way in which standards for annoyance and nuisance from LFN and infrasound are determined, by taking into account the ways in which exposure to LFN and infrasound actually affects people in both long and short terms.
- 3) More research is needed on how LFN and infrasound affect the brain in both long and short terms.

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