



# Low Frequency Noise (LFN) Annoyance

Low Frequency Noise (LFN) can be an environmental noise problem. Not everyone can hear it, as our range of hearing differs, and in many cases no source can be identified. For those who are affected, LFN is often most noticeable when they are in their homes. The sound reported by people affected is often more noticeable at night when not masked by everyday sounds. It is frequently perceived as a throb or low rumbling or referred to as a 'hum'. As well as causing irritation and annoyance, LFN can disturb sleep and make people uncomfortable in their homes. LFN can travel long distances, so sources of low frequency noise are often challenging to identify. It can be generated by pumps, large fans, compressors, diesel engines and other rotary machinery, and electrical power transmission systems. The largest proportion of LFN sufferers are over fifty, indicating that the number of people with low frequency noise problems will increase with our ageing population.

## LFN and hearing

We define the average hearing threshold of young adults as the "standard threshold of human hearing." However, there is a spread of hearing sensitivity in people. It is estimated that about 2.5% of the population has a hearing threshold which is sensitive to low frequency sounds that are 12 dB below the average threshold<sup>1</sup>, meaning that they hear sounds, like low frequency noise, that most others cannot. In addition, reactions to a noise vary depending, for example, on the listener's attitude to the noise source, how long they have been hearing it, and how loud it is.

### The frequency ranges of sound

Infrasound	below 20Hz
Audible	20 to 20,000Hz
Ultrasound	above 20,000Hz
Low frequency	10Hz to 200Hz

The frequency, or pitch, of sound is the number of times a sound wave repeats and is measured in Herz (Hz). The range of human hearing, or audible range, is conventionally assumed to be from 20 Hz to 20,000 Hz (see box). LFN extends down into the infrasound region and is taken to be from 10Hz to 200Hz<sup>2</sup>, so not everyone is able to hear it. The boundaries between infrasound, low frequencies and higher frequencies are not well defined and best described as "fuzzy."

## Low Frequency Noise and the law

Complaints of low-frequency noise are investigated by a local authority under the Environmental Protection Act 1990 (EPA). Enforcement action is only possible if the local authority is satisfied that a statutory nuisance exists, and a source is identified. Other regulatory bodies may be involved (such as the Environment Agency or the Scottish Environment Protection Agency). Current nuisance determination is based on what the average person finds unacceptable and does not consider individual sensitivities or personal circumstances. *Heath v Brighton Corporation* (1908) is an early case which highlights the effects of low-frequency noise and the legal difficulties in protecting highly sensitive or unique complainants from nuisance.

Following investigations, a decision of 'not a nuisance' is sometimes reached. When a potential source of the noise can be found and evidence provided, complainants have the option under Section 82 of the EPA of taking their complaint to a Magistrates' court. It may be that the source is linked with a leased or licensed site which may have nuisance clauses they can be held

<sup>1</sup> HG Leventhall, "Low-frequency noise and annoyance", *Noise & Health Journal*, 2004, vol 6, issue 23, Pages 59-72

<sup>2</sup> As an example, middle C on the piano is at about 256 Hz, and electrical mains hum occurs at 100 Hz (the second harmonic of the power line frequency)



accountable to, where the evidence exists. It may also be the case that planning restrictions related to noise are associated with the site. Where the source is within an industrial site with an Environmental Permit, it may be possible to direct a complaint to the Environment Agency.

### **How do we assess low frequency noise?**

Given that some low frequency noise is close to our threshold of hearing, and can vary in different rooms, it can be challenging to investigate. A suitably qualified acoustician<sup>3</sup> should use a calibrated Class 1 Sound Level Meter with 1/3 octave measurement ability, which can detect low frequency sound, when investigating. Conventional methods of assessing noise annoyance are based on measurements of overall levels, but for LFN, frequency analysis is needed, sometimes very narrow band analysis. Determining where the noise originates can require expert detective work by professionals, and there is no guarantee that they will be successful.

A 'Procedure for the assessment of low-frequency noise disturbance' was developed by Salford University for Defra<sup>4</sup>. This describes a method for identifying whether the complaints of low frequency noise disturbance have an environmental source. The method gives a criterion curve which helps an acoustician to identify problem frequencies. Acoustic consultants from the private sector may be employed to undertake an investigation, but the cost for this can be substantial<sup>5</sup>.

### **If no nuisance is found, what can be done?**

Investigations into LFN are often lengthy and outcomes often unclear. In many cases those affected by the noise turn to their local councillors, their Member of Parliament, or the local press as a last resort. There are often cases where all technical and legal avenues have failed to resolve a problem or where no environmental sound can be identified to account for the complainant's experience. When this situation arises, the consequence is that some complainants may need to learn to live with the issue they are experiencing and develop coping strategies.

A network of support centres for LFN sufferers throughout the UK was supported by Defra on a trial basis<sup>6</sup>. The results of this trial found that some of the sufferers benefited from the intervention with others showing little change. An earlier example of helping the complainant to desensitise from the noise, using Cognitive Behavioural Therapy, had useful results<sup>7</sup>. Referral to appropriate psychotherapeutic treatment, such as talking therapies which are currently available in England through the NHS, can offer a degree of support in coping with the noise to those afflicted by LFN, where the noise source cannot be identified or is not found to be a nuisance.

Successful interventions for LFN problems, by either technical or therapeutic means<sup>8</sup>, will lead to improved health and reduce demands on local services.

**To find out more:** email: [briefings@ioa.org.uk](mailto:briefings@ioa.org.uk) - <http://www.ioa.org.uk>.

With thanks to Teli Chinelis (Cahill Design Consultants) and Geoff Leventhall (Active Noise) for preparing this note.

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<sup>3</sup>A member of the Institute of Acoustics is required by their Code of Conduct to operate within their expertise.

<sup>4</sup>Procedure for the assessment of low-frequency noise disturbance, Moorhouse, AT, Waddington, DC and Adams, MD, Revision 1 December 2011, Contract no NANR45

<sup>5</sup> The cost of private consultants can run into thousands, of pounds

<sup>6</sup>A Moorhouse et al: Trials of a protocol to support LFN sufferers in the UK, (2015), Euro noise 2015

<sup>7</sup>Leventhall et al Development of a course in Computerised Cognitive Behavioural Therapy aimed at relieving the problems of those suffering from noise exposure, in particular, exposure to low-frequency noise (Defra Report NANR 237) June 2009.

<sup>8</sup> See [NHS talking therapies for anxiety and depression - NHS \(www.nhs.uk\)](http://www.nhs.uk)