INAUDIBILITY CRITERIA AND ALTERNATIVE METHODS FOR CONTROLLING MUSIC NOISE LEVELS FROM LATE NIGHT ENTERTAINMENT

J Gardner University of Derby and JG Acoustics, UK
G Hance Electric Star Live, UK
AJ Hill Electro-Acoustics Research Lab, University of Derby, UK

1 INTRODUCTION

Sound or noise from regulated entertainment and music is unique in that for some sections of a community the source sound is desirable and for others it is not. The noise emissions from music are not a by-product, such as in an industrial setting or factory, but the intention. The methods and criteria for controlling music noise levels (MNL) from entertainment at night-time (23:00+) has always been a controversial and highly debated topic. Since the early 1980s a subjective criterion of inaudibility has been commonly used in many parts of the UK. It has faced fierce criticism in many respects, such as in legal proceedings where it has been argued to not be compliant with the Licensing Act 2003. However, as no mainstream alternative has been adopted, the requirement for inaudibility continues to be used in many premises' licenses that are either for fixed or temporary sites, and for both indoor and outdoor events.

This paper considers the existing guidance and research on the use of a subjective inaudibility criteria. Other proposed objective methods for controlling entertainment noise at night-time such as from the Department of the Environment, Food and Rural Affairs (DEFRA) and the Institute of Acoustics (IOA), are tested with a real-world case study, to compare and correlate both the objective and subjective outcomes of these methods in practice. In conclusion, further comments are made for consideration of music and entertainment levels specifically during night-time hours.

2 BACKGROUND

Since the 1980s, inaudibility has been promoted and used for a variety of noise management applications including music and entertainment. A W M Sommerville (from Edinburgh District Council) in 1991 stated it was used as a criterion 'to prevent or minimise loss of amenity from certain new developments, and to deal with situations where it is considered a nuisance to have to listen to another person's music.' The defining condition of inaudibility used by Edinburgh District Council was that 'any music and vocals shall be controlled as to be inaudible within the nearest noise-sensitive premises' [1]. There is no further detail provided on how to ensure this target is possible, the repeatable methods of assessment, or ways to evidence compliance.

Advocates of inaudibility such as Craik and Stirling (1986) reported on results in a survey showing that music becomes annoying at levels just above the threshold of perception, which can vary between source type and individuals [2]. In 2000, Craik provided favourable data to demonstrate how practitioners and other subjects can in fact accurately agree when music levels are audible. They argued that subjectively assessed inaudibility criteria cannot be discredited because of listeners making significantly different conclusions in their assessments, which has often been presented in arguments against its use. The results of the survey were also used to criticise any other objective method which allows the noise level to significantly exceed the background level, since such methods do not actually indicate the threshold of audibility. Such objective methods were therefore dismissed for having a greater variation in their outcome to subjective audibility, as a criterion for rating amplified music [3]. However, the topic of inaudibility criteria in Edinburgh is in fact highly controversial. The criterion is rooted in the local authority's approach to the inability to accurately measure offending or

annoying noises that were low frequency in nature. At the time, A-weighting was (and is) still heavily relied upon as the primary measurement method. Inaudibility was adopted as a by-law and this resulted in what many felt was a large over-enforcement, with many venues forced to close.

With the use of inaudibility becoming more commonplace, in 1989 it was also argued that inaudibility was not compliant with section 58 of the Control of Pollution Act. In a particular Scots Law case cited by Latham, Environmental Health Officers (EHOs) were told they relied on the criterion too heavily and were unable to prove that their records were genuine. Among consideration of what is reasonable, Latham comments that if it is impossible to do the works to achieve the criteria it cannot be termed reasonable. 'The consequence of the criterion does not appear to assist the complainant achieve an effective solution.' The sheriff in the 1989 Morayshire District Council v. D. Littlewood case stated that the EHOs were supposed to be not so much on the side of the complainant but also on the side of the complainee and therefore had failed in their duty [4].

The IOA continually consulted on this matter and in 2003 (the same year the Licensing Act was introduced), the 'Good Practice Guide to Control the Noise from Pubs and Clubs' was published. It described inaudibility as 'not recognisable as emanating from the source in question and does not alter the perception of the ambient noise environment that would prevail in the absence of the source in question' and as 'sound which cannot be heard or is imperceptible to the human ear' [5]. Eventually long-standing pressures from the leisure industry, acoustics academics, and the wider public, resulted in a relaxation of the policy as a byelaw in 2016 [6]. Despite this additional guidance and definition, the criterion has faced further criticism in UK courtrooms. It was argued in 2011 to not be compatible with the Licensing Act 2003 and to be 'so vague as to be unenforceable' and 'without some degree of specificity as to what is meant by inaudibility' [7]. Yet temporary outdoor licenses and fixed premises licenses continue to use inaudibility criteria, without change or a further degree of specificity. This leaves the credibility of a local authority license and the holders of such licenses vulnerable to challenge. Residents are also still likely to struggle when using audibility as a means of evidencing genuine disturbance, leading to the question if such licenses serve the community fairly? Post 2011, there has been little to no further published works found on the topic and no other methods or targets have been formally proposed. The appetite for resolving the issues appear to be at an all-time low.

Audibility is also not always indicative of annoyance. Many environmental noise factors are generally accepted when they are not extreme, such as some levels of community noise from transport and industry. The context of the listening environment is important, as road noise would not likely be offensive when heard while walking down a main road, but may be offensive when heard from inside an office or bedroom. A listener's expectations change from one environment or circumstance to another. Therefore, finding a clear, and standardised definition of inaudibility as an indication of disturbance is very difficult. Methods of considering audibility are adopted in the TRAPT tranquility rating and prediction tool, which is used to assist planners and designers in the creation of 'tranquil spaces' [8]. This kind of approach can be demonstrated with wind farm sites. It was found that the human response to wind farms is determined by both the visual factors as well as noise exposures. The 'degree of annoyance cannot solely be determined by a predicted noise level, but the overall impact on tranquility through the integration of aural and visual factors as an overall descriptor' [9]. As such, it leads to the question as to whether this could be applied to music? Music for some may be tranquil, for others disturbing. The bright lighting or lasers emitting from an outdoor concert in tandem with the perceived noise disturbance, may heighten perception and therefore annoyance for some. Audibility, or rather the noticeability of a sound intrusion is therefore linked to the level of enjoyment or annoyance of all factors emanating from the source. This is very difficult, or perhaps impossible to quantify.

3 AN ALTERNATIVE METHOD

A variety of different methods with a more objective led assessment have been proposed, none of which have become either mainstream or have been formally adopted. DEFRA commissioned various studies which are of relevance. Post 2003 Licensing Act, DEFRA commissioned two studies into noise from pubs and clubs. The output of the program outlined in NANR92 was to be 'an optimised UK assessment method and a deeper understanding of the factors affecting perception of noise from pubs and clubs' [10]. The audibility debate was discussed but the report did not provide an alternative criterion. Part II of this was presented in DEFRA NANR163 in 2006, and despite the earlier recommendation for laboratory testing, indicated that the best performers under such conditions were not compatible with real world conditions. Despite this, the DEFRA report recommended criteria in order of correlation to subjective response:

1. 'An absolute LAeq,5 min with an additional subjective requirement for clearly audible to an ontologically normal listener 'e.g., the songs/tracks would be recognisable to a listener familiar with the music and any words intelligible'.
2. LA90 – LA90 (no music). Would require measurement without music which is not practical on the night in question. The Pop Code however allows for assessment to be performed on a proxy evening; at the same time an event was due to take place.
3. LAeq – LA99.95 or existing Noise Act methodology (LAeq – LA99.8). These metrics include some consideration of the underlying noise level at the same time as any offending noise level is measured, without requiring a separate 'no music' measurement to be made' [11].

Guidance from the IOA working group on pubs and clubs was also published within the DEFRA report NANR92. The included annex suggests measurement parameters of L10 Entertainment Noise Level not exceeding L90 Representative Background Level and advises this would achieve virtually inaudible inside noise sensitive property. The obvious criticism to the above is that it requires the assessment of the LA90 levels without the music taking place. This is not going to be practical on the night of an event without stopping the music for a suitably long period time. It could also present crowd safety issues as audiences are known to become frustrated under such circumstances. It is common to have statistical analysis functions on modern sound level meters, yet it is uncommon to be able to assess 1/3 octave bands for statistical levels in handheld operation. It is therefore not workable for many to give real time feedback to a venue or engineer without some degree of desktop analysis after the event. A simpler method was also proposed for equipment without statistical analysis features and likewise favoured a somewhat subjective 'ear eye estimate' assessment method. The guidance however was withdrawn by the IOA as it was accepted by the group that the criteria produced inconclusive results. Yet numerous commercial reports were found that do use the criteria as evidence for showing compliance. Some of the guidance was also closely mirrored by the British Beer and Pub Association, so while not published by the IOA, remains very much in use.

As a baseline for health, the WHO recommends absolute levels of 30dB LAeq over 8 hours at night inside bedrooms and 45dB outside bedrooms with an open window at night [12]. To achieve this 45dBA limit outside bedrooms, an outdoor concert with LAeq of 95dBA would need to be very far away from any noise sensitive premises. Typically outdoor concerts must end for compliance before 23:00 due to inaudibility criteria. For an indoor concert, a high level of sound insulation and rigid implementation of best practicable means would be required to operate post 23:00 in a built-up urban area with close receptors. When using absolute levels as the target criteria, it has also become more common in urban areas to license music as both a C and A-weighted criteria. It is now typical to see a +15dB max limit for A/C-weighted levels. Greater than this is likely to be excessive in low frequency disturbance and cause complaint during daytime for outdoor concerts at these measured levels. How this can be applied to an inaudibility criterion of no absolute target criteria for night-time is an unknown and cannot be deduced, yet this could be factored into a standardized assessment procedure, alongside other low frequency parameters that may help such as the DEFRA NANR45 reference curve [13].

4 CASE STUDY

An assessment was performed of a music venue to the license condition of inaudible at the nearest sensitive premises. Some of the data such as location and artist has been anonymised for commercial sensitivity reasons. It was not possible or practical to conduct a LA90 measurement without the music during concert hours, without stopping the event. Levels were measured at the request of the local authority and venue between 19:00-23:00 some years prior as part of the planning process and were accepted by all parties as a reasonable working benchmark. This weeklong data has been averaged to reduced uncertainty and a representative level was shown to be LA90 (No Music) = 52dB. The consultant was able to return to the venue several months later (09/12/22) after the concert and briefly measure levels with no music playing at 00:00. At that time, it was indicated that over a steady 15 minutes the residual LAeq was 46dB and background LA90 was much lower at 43dB. Therefore, there is great uncertainty over background levels and appropriate measurement times, periods, and positions. Both levels have been considered in the results below, however the 43dB measurement being performed later in the year could only be considered retrospectively and not during the concert in question. It was noted that none of the equipment in the consultant's possession (class 1 NTI, Svantek and others) had the ability to calculate decimal placed statistical levels (LA99.99) in real time without desktop analysis. Calculation post event defeats the point of attended measurement and control. Therefore, a rounded LA99 must be used instead, with some fair tolerance considered for the decimals.

Table 1 – Results from case study indoor night club/ concert 1/10/2022 outside the nearest NSR.

*Time	Duration	LAeq	LCeq	L10	L99	LA90 (Music)	Subjective/ Audibility Assessment
01:10:32	00:05:00	50	78	53	41	44	Expressed concerns about controlling bass/ hi pass filter applied by engineer at 60Hz.
01:15:32	00:05:00	53	79	54	42	45	Audible/ Dominant. Advised overall Leq 5min -3dBA drop on sound system.
01:20:32	00:05:00	50	78	52	42	45	Reduced levels. Slightly audible outside.
01:25:32	00:05:00	51	80	54	41	44	Slightly audible.
01:30:32	00:05:00	53	81	55	42	45	Excessive wind at position. Remains slightly audible.
01:35:32	00:05:00	55	84	58	41	44	Slightly audible outside.
01:40:32	00:05:00	55	84	57	43	46	Slightly audible outside.
01:45:32	00:05:00	55	84	58	42	45	MNL reducing further for close.

*Limited to between 01:00 and 02:00 due to wet weather.

Number of complaints logged: 0.

The case study confirms that using LAeq alone does not correlate to the consultant's subjective response when using inaudibility criteria as a target. When the music is considered near the threshold of what is audible and it is not the dominant sound being measured, it is also unlikely to be the deciding factor to determining overall LAeq levels. In this scenario LAeq levels were shown to fluctuate quite widely despite audibility appearing acceptable. Changes in the environment and weather (which were

noted to be having an impact at this time) could be reasoned for this, particularly noting the MNL was once described as ‘dominant’ at LAeq 50dB and then only ‘slightly audible’ at a higher measured overall level of 55dB. However, despite unfavourable findings for achieving internal inaudibility using LAeq, it is felt reasonable that the overall LAeq should be logged alongside the usual subjective assessment for audibility, as recommended by the DEFRA studies. With the absence of a complaint, this is likely to be reasonable data to demonstrate at least nothing excessive had occurred in noise levels during the concert and the obligation to control levels was being acted upon.

Secondly, it was noted that background levels without music cannot be expected to be measured on the night in question. In this case, measurements on earlier or later dates did not help demonstrate compliance using the LA90 (no music). The alternative that was suggested in the DEFRA report relied on using the Noise Act Method of LAeq - LA99.98% (or LA99). This again presents the same problems as above as the LAeq was shown to fluctuate without any negative perceived audibility changes in the music levels. The DEFRA report recommended 5-minute measurements [14]. The LAeq time could be increased from 5 minutes to 15 minutes to reduce this fluctuation and uncertainty, but in doing so it was felt this limits the time responsiveness of the consultant to respond and act quickly to control the source.

In the case study, DEFRA NANR45 methods were considered outdoors, which is not within its intended scope. Such methods were found to be very workable in that the LA10 and LA90 with music is very easy to read in real time on a handheld meter and is generally available (as previously noted with BS4142) to most consultants and EHOs [15]. For this reason, and with the additional layer of subjective assessment for audibility it was felt that this could be a suitable method. Further consideration would be required for what an acceptable difference in L10 and L90 would be, and for the added factor of impulsive bass content. The case study shows that a difference of around 7-14dB between these values outside the NSR was present when subjective ‘slightly audible’ targets were deemed acceptable. Further work would be required to test this to see how a low frequency reference curve (such as DEFRA NANR45 or C-weighted level) and the LA10 and LA90 levels outside correlate when inside impacted residential properties.

The case study supports the view of the DEFRA report that the measurement of absolute levels (such as LAeq) is reasonable at below dominant audibility levels with the additional layer of subjective assessment. However, an LAeq is not to be considered against an absolute target level or as a descriptor of audibility without this degree of subjective assessment. WHO guidelines indicate what is excessive and it can be shown that with the addition of the music, the overall level does not exceed or contribute to already exceeding WHO thresholds. Despite this method being somewhat workable, additional objective considerations to low frequency levels are still required.

With MNL from indoor venues and at increasing distance, most the audible and tonal elements are from low frequency emissions. This leads to question whether it would be possible to develop a 10-165Hz low frequency reference curve for use outside noise sensitive premises for music. This would be like the internal NANR45 curve and be used in tandem with a L10 - L90 acceptable level. Somatosensory perception plays an important role in the body’s perception of very low frequency (or infra-sub) noise. ‘Audibility’ implies only auditory perception is the basis for disturbance whereas other factors do exist. The NANR45 curve illustrates levels at 10Hz, below that of normal human auditory perception but possible on the surface of the skin, etc. More testing under repeatable conditions and the sharing of data from concerts and venues would be required to experiment with L10-L90 (with music) differences and what is acceptable for slightly audible targets outside.

Further research should be undertaken into the appropriate assessment and use of background levels against music. Proxy positions away from the source noise could be considered (such as made available with BS4142), assessment on an alternative evening, or dropping the use of background noise levels entirely, as they were also heavily criticised for not indicating the threshold of audibility (such as in the study performed by Craik et al 2000). Largely this author agrees with this point of view, and it is supported by the often-conflicting results of noise impacts using an LA90 in the case study.

5 CONCLUSIONS

A hired consultant working in regulated entertainment has the task of controlling and advising levels, limiting complaint, and ultimately being able to evidence and argue compliance to protect a venue or events license. If a subjectively determined audibility criteria continues to be used exclusively in such licenses, it is reasonable to expect that venues will continue to be threatened in legal proceedings as they cannot accurately evidence compliance to the conditions. Ultimately, if an objective method can be used to meet a similar target and demonstrate the results of inaudibility assessment, it would be highly desirable. The methods explored in this study do not definitively achieve this. Continued use of subjective inaudibility criteria is problematic as it has been argued to not be compliant to the Licensing Act 2003 and it is very difficult to continue to justify its use. This study successfully explores what other objective methods could aid this; however, it is limited in arguing that such objectively derived levels are useful in predicting or matching subjective audibility assessment or effectively controlling music noise. The case study supports the view that such methods are very limited in correlating with subjective response. However, it is not possible to quantify what is not known - i.e., the number of times subjective inaudibility criteria has been used successfully, in proportion to those times it has been controversial. Therefore, on balance, inaudibility criteria may be the best available option while the issue remains open for further development. Some of the methods outlined above could be implemented as part of a best practice assessment or as an objective yardstick, while working to the unchanged inaudibility criteria. It is not known how effective this would be until such methods are again robustly tested in future court proceedings.

Moving away from this current status quo of inaudibility criteria must be sensibly considered, as a small, ill-considered change could again cause damage to the night-time economy. Significantly more time and data are required to develop fair and unbiased arguments from all relevant stakeholders who set the noise targets. Due to the commercial sensitivity of such data, it is difficult to evaluate in large quantity what could work in practice. Greater transparency and sharing of data would be very useful and allow new ideas to be better evaluated and presented.

New technology and research may also present itself in the debate (such as with the development of AI), to provide greater understanding of the perception, audibility, and emotional response to music noise disturbance. In this author's experience, people who are most disturbed by unwanted music noise can become very emotionally distressed. A sound level reading on a screen is not always adequate to pacify someone in such a situation, nor can it delegitimise how they are feeling. Such situations can certainly fall outside of the scope of acoustics, but nonetheless they are incredibly relevant when considering what is reasonable and fair to take place. This very human factor should inform and measure the success of any new guidance put forward.

6 REFERENCES

1. Somerville, A, W, M. (1991) Inaudibility an Established Criterion, Proceedings of the Institute of Acoustics, 13(8). pp. 225-231.
2. Craik, R, J, M., Sterling, J, R. (1986) Amplified Music as a Noise Nuisance, Proceedings of the Institute of Acoustics, 8(4), pp. 13-18.
3. Craik, R, J, M. (2000) Inaudibility as a Criterion For Assessing Amplified Music, IOA Acoustics Bulletin 25(4), pp. 9-10.
4. Latham, H, G. (1989) The Control of Pollution Act, Section 58 – Use of Inaudibility Criterion and the Common Law Principle of Reasonableness, Proceedings of the Institute of Acoustics, 11(2), pp. 23-28.
5. Institute of Acoustics (2003) Good Practice Guide on the Control of Noise from Pubs and Clubs. Milton Keynes: Institute of Acoustics.
6. AES Technical Committee. (2020) Technical Document AESTD1007.1.20-05 Understanding and managing sound exposure and noise pollution at outdoor events.

Available at: https://www.aes.org/technical/documents/AESTD1007_1_20_05.pdf (Accessed: 10 Feb 2022).

7. The Queen on the Application of Developing Retail Limited v East Hampshire Magistrates Court (2011) High Court of Justice, case 618. BAILII. Available at: https://www.bailii.org/ew/cases/EWHC/Admin/2011/618.html (Accessed: 12th March 2022).
8. Watts, G., Marafa, L. (2017) Validation of the Tranquility Rating Prediction Tool (TRAPT): comparative studies in UK and Hong Kong, Noise Mapp, 4(1) pp. 67-74.
9. Watts, G, R., Pheasant, R, J. (2015) Identifying Tranquil Environments and Quantifying Impacts, Applied Acoustics, 89 pp. 122-127.
10. Department for Environment, Food and Rural Affairs, (2005) Noise from Pubs and Clubs – Phase 1 DEFRA contract no. NANR 92. London: DEFRA.
11. Department for Environment, Food and Rural Affairs (2006), Noise from Pubs and Clubs – Phase 2 DEFRA contract on. NANR 163. London: DEFRA.
12. World Health Organization (1999) Guidelines for Community Noise. Geneva: WHO.
13. Department for Environment, Food and Rural Affairs. (2011) Proposed criteria for the assessment of low frequency noise disturbance DEFRA contract no. NANR 45, 2011
14. Department for Environment, Food and Rural Affairs (2006), Noise from Pubs and Clubs – Phase 2 DEFRA contract on. NANR 163. London: DEFRA.
15. Moorhouse, A, T. Waddington, DC. Adams, M D. (2011) Procedure for the assessment of low frequency noise disturbance. NANR45: Procedure. Manchester: University of Salford for DEFRA.