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15th November 2023

Ormskirk Market

Assessment/Set-Up of Fan Noise and Music
Noise at the Food and Drink Market, L39 4RT.

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1.0 SUMMARY

Weather conditions were not ideal, but it was agreed by all parties that they were good enough to proceed. The noise was dominated at all time by traffic but the wind in the trees did have some effect.

Qualitatively, the fans were barely audible and, without listening for them, we would suggest that they would be unnoticeable and have very little impact. However, there was some influence of wind in trees and, on a still evening, they would inevitably be more noticeable.

In terms of a BS 4142 assessment using previous background levels on a still evening, the results are above what the *"Initial estimate"* rates as *"low impact depending on the context"* but below what it rates as an *"adverse impact depending on the context"*. Note that if we were to use the background levels measured in the recent survey the outcome would be *"low impact depending on the context"*. These outcomes match perfectly with our qualitative assessment that the fan noise was audible but only just, but that it would inevitably have been more noticeable on a still evening.

We have recommended a further 8 dB reduction in fan noise.

Music was initially just audible but was adjusted down so that it was inaudible. The limiter was then set and locked at this level.

A R Raymond

P J Durell

2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the noise from the fans and the music at the above site. The fans had recently been fitted with silencers and need their performance checking, and the music was to have its limiter set in consultation with Environmental Health Officers.

3.0 ASSESSMENT STANDARDS

3.1 NPPF, NPSE and NPPG

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG) provide nothing in the way of quantitative criteria but instead provide general policy aims and statements and some guidance on how certain situations can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 185:-

> 185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:
>
> a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[65];
>
> b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
>
> c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

Paragraph 187 is also relevant:-

> 187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The NPPF refers to the NPSE which sets out the following aims:-

1. *avoid significant adverse impacts on health and quality of life;*

2. *mitigate and minimise adverse impacts on health and quality of life;*

   and

3. *where possible, contribute to the improvement of health and quality of life.*

It also introduces the concepts of:

- *NOEL – No Observed Effect Level. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*

- *LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.*

- *SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.*

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the effects.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided Noise Exposure Hierarchy, as follows:-

Response	***Examples of outcomes***	***Increasing effect level***	***Action***
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

It also makes the point that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation, including the level of the noise in absolute terms and how it might compare with the underlying background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise sources (most of which have their own specific guidance, such as BS 4142, BS 8233, etc.) and the potential impact on wildlife.

3.2 BS 8233

BS 8233 was updated in March 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations. Its guidance is primarily intended for new buildings, but the criteria are routinely referred to for putting general noise climates into context.

The criteria in Table 4 of BS 8233 are based on WHO guidance and give the desirable criteria for indoor ambient noise levels for dwellings as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,8hour}$	30 dB $L_{Aeq,8hour}$

Note that the standard accepts the widely used rule of thumb that, for a partly open window, the levels just outside will be 15dB higher than those just inside. This brings us to an external equivalent of the above table, as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	50 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	55 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	50 dB $L_{Aeq,8hour}$	45 dB $L_{Aeq,8hour}$

It goes on to state that, where necessary, the criteria can be relaxed by up to 5 dB and still achieve reasonable conditions. Note that the new version does not explicitly state criteria for bedroom noise in terms of dB L_{Amax}.

Garden area criteria are unchanged with 50 dB L_{Aeq} and 55 dB L_{Aeq} being considered desirable and reasonable respectively.

Note that the new version of BS 8233 more explicitly specifies the assessment periods as 16 hour and 8 hour for daytime and night time respectively.

3.3 BS 4142

BS 4142 is the most appropriate tool to assessing the mechanical equipment. It is not suitable for assessing music noise or noise from customers.

It was updated in November 2014. The standard is very complicated but, basically, it describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) sound from industrial and manufacturing processes

b) sound from fixed installations which comprise mechanical and electrical plant and equipment

c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises

d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

Characteristics and Context

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, we need to add a character correction to the specific sound level to obtain the rating level.

These features can include tonality, impulsivity and intermittency with corrections typically ranging potentially from 0 dB to 9 dB. Corrections at the higher end would represent characteristics which are highly perceptible in the context of the ambient noise as a whole. Corrections at the lower end would represent characteristics which are just perceptible in the presence of the ambient noise as a whole,

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Assessment

We obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and considering the following.

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will

have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Where the initial estimate of the impact needs to be modified due to the context, pertinent factors need to be taken into consideration, including the following.

1) The absolute level of sound.

   For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

   Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

   Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound.

   We need to consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

3.4 Music Noise

Full discussions of various approaches to assessing music noise are very cumbersome and practices vary. They tend to vary for how many events take place and how often, and some reference the impact inside a habitable room and some reference the facades, or even gardens. In all cases we would suggest that *context* is key.

This section summarises our own recommendations.

For up to 12 events per year, we would suggest the criteria from the Code of Practice on Environmental Noise Control at Concerts. Above this, we suggest that a combination of the annex to the IOA Good Practice Guide and the local authority criteria cited in Noise from Pubs and Clubs, modified for practicalities as discussed.

Inaudibility of music noise is sometimes suggested for regular event and where they run into the night. There may be contexts where this is an appropriate aim, but not for most. It is also impossible to guarantee inaudibility as perceptions obviously differ – does it mean inaudibility while doing normal things, or inaudibility while holding the breath, pressing an ear to the wall, and concentrating hard? Either way, as a guide, music noise which is just audible outside would normally be more or less inaudible inside. Scenario 4 below can be expected to provide such conditions, albeit ultimately subjective.

So, our recommended music noise criteria at the nearest residential properties are as follows:-

1. For up to 3 events per year between 07:00 and 23:00 hours:

   Music noise levels should not exceed 65 dB $L_{Aeq,15min}$ at 1m from the façade of any noise sensitive room.

2. For between 4 and 12 events per year between 07:00 and 23:00 hours:

   Music noise levels measured in terms of $L_{Aeq,15min}$ at 1m from the façade of any noise sensitive room should not exceed the background noise levels (ie. without music playing) measured in terms of L_{A90} by more than 15 dB.

3. For between 12 and 30 events per year between 07:00 and 23:00 hours:

   Music noise levels measured in terms of $L_{Aeq,15min}$ at 1m from the façade of any noise sensitive room should not exceed the background noise levels (ie. without music playing) measured in terms of L_{A90} by more than 5 dB.

   In addition music noise levels measured in the same way as above in the 63 Hz and 125Hz octave bands should not exceed the background noise levels also as measured above by more than 5 dB in respective octave bands.

4. For more than 30 events per year, and/or for times extending beyond 23:00 and 07:00 hours regardless of how many events a year:

   Music noise levels measured in terms of $L_{Aeq,15min}$ at 1m from the façade of any noise sensitive room should not exceed the background noise levels (ie. without music playing) measured in terms of L_{A90}.

In addition music noise levels measured in the same way as above in the 63 Hz and 125Hz octave bands should not exceed the background noise levels also as measured above in respective octave bands.

All of these criteria should be adjusted to any assessment/enforcement position that is closer to (or indeed further away from) the facades of noise sensitive rooms, for instance the site boundary.

The above set of suggested criteria should be considered in the light of the context, for instance a vibrant part of the city centre versus a quiet suburb.

If it is known that the operators intend to run a given number of times a year and up to a given time then the appropriate set of criteria can be suggested. Note, however, that it will not usually be acceptable for the limits to "slide" as the number of events increases. In other words it will not normally be acceptable to work to the 3 events per year limits for the first three events, and then to the 4 to 12 events per years limits, for the next 9 events and so on. If it is intended to hold more than 30 events per year, then that is the limit that should be worked to.

3.5 Perceived Change

The background/ambient noise is predominantly people and traffic. The noise from people on the terrace and from people leaving will also be predominantly people and traffic. For that reason perceived change criteria will be appropriate, along with the general criteria of BS 8233 above.

Quoting from the Guidelines for Noise Impact Assessment (draft 10/04/02) by the Institute of Environmental Management and Assessment and the Institute of Acoustics, the following table shows the effects of changes in noise:-

Change in Level (no other changes of character)	Subjective Effect	Likely Impact
0 dB	No change	None
Up to 3 dB	Imperceptible	Slight
3 to 5 dB	Perceptible	Moderate
5 to 10 dB	Up to a doubling	Substantial
10dB or more	At least doubling	Severe

Note, however, that "Subjective Effects" assume that the nature of the noise is unchanged. Also, many acousticians feel that the wording under the "Likely Impact" column can be unhelpful.

4.0 GUIDE TO MODELLING AND ASSESSMENT

The assessments were primarily based on measurements at the neighbouring properties with straight forward processing, and qualitative assessments by ourselves and Officers.

In the case of the fans, they were measured while running at normal speed at the most affected residential properties and then shut down and measured again. The difference between the two sets of measurements was then processed in accordance with BS 4142 to drive the noise from the fans alone (in the absence of general noise such as traffic). This is then compared with the background noise level taken on this and previous occasions. Note that, due to the non-ideal weather conditions, the processing also is carried out using difference noise indices (L_{eq}, L_{50}, L_{90}, etc) to add further clarity and confidence.

The case of the music noise, measurements were made but the assessment was primarily qualitative, in consultation with Officers. The limiter was adjusted until the music was generally inaudible[1]. One of the Officers was with us at the residential property, and one was inside the venue observing the adjustment of the sound system and limiter.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The survey was carried out on the evening of Tuesday 17th October 2023 by Andrew Raymond of ADC Acoustics. We were observed and assisted by Environmental Health Officers Carol Pollitt and Jim Martin. The running and adjusting of the sound system was done by the installation engineer.

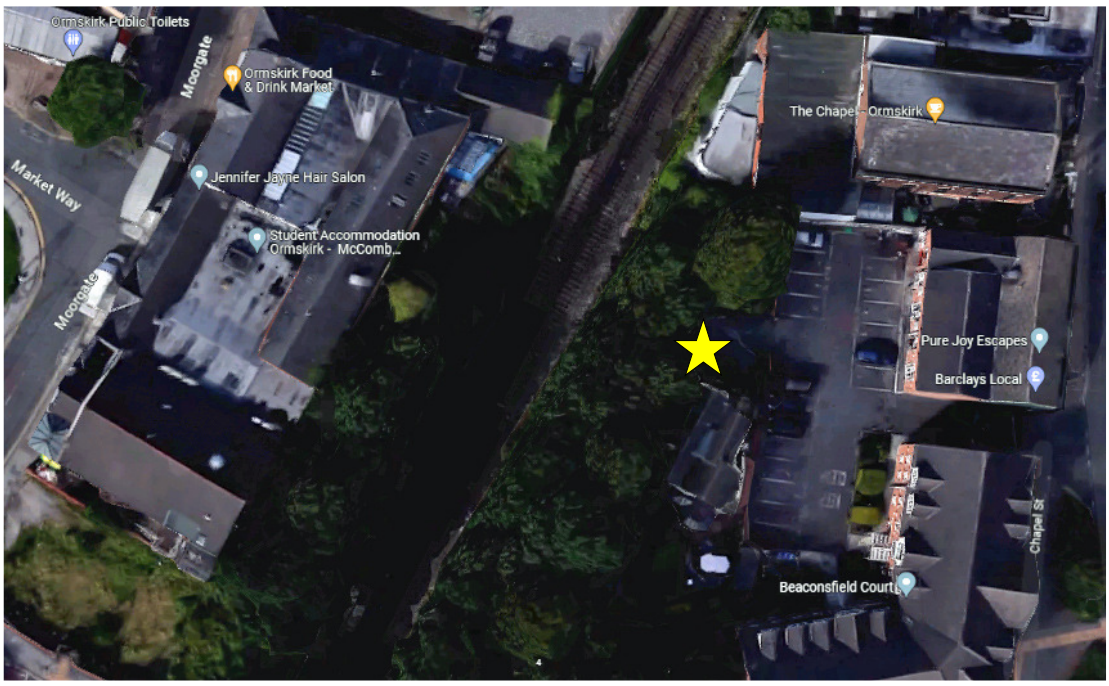
5.2 Instrumentation

Instrumentation used was a Rion NL-52. This is a Class I sound level meter which holds a current calibration certificate and which was field-calibrated as necessary with no drift noted. The meter was set up to measure continuous 5 minute samples in terms of dB L_{eq}, dB L_{max}, dB L_{50} and dB L_{90} in overall A-weighted terms, and in octave bands across the frequency range. See Definition of Acoustic Terms in Appendix 1.

5.3 Measurement Positions

The main measurement position was chosen in consultation with Officers and was considered to be representative of the closest residential property and where the fans were most audible. The approximate position is as shown by the yellow star on the following plan.

[1] Note that we use the phrase “generally inaudible” simply because it is a qualitative assessment and to state categorically that there was no music audible is difficult to justify. However, all parties agreed that, once adjusted, it was inaudible during the course of the survey period.



The microphone was approximately 1.3 m above the ground and approximately 2m away from the corner of the house. It was screened for the road by a 1.8m high wall.

5.4 Survey Conditions

We have no reason to believe that the conditions set up by the operators were anything other than representative of normal operations.

Weather conditions were not ideal, but it was agreed by all parties that they were good enough to proceed. They were as follows :-

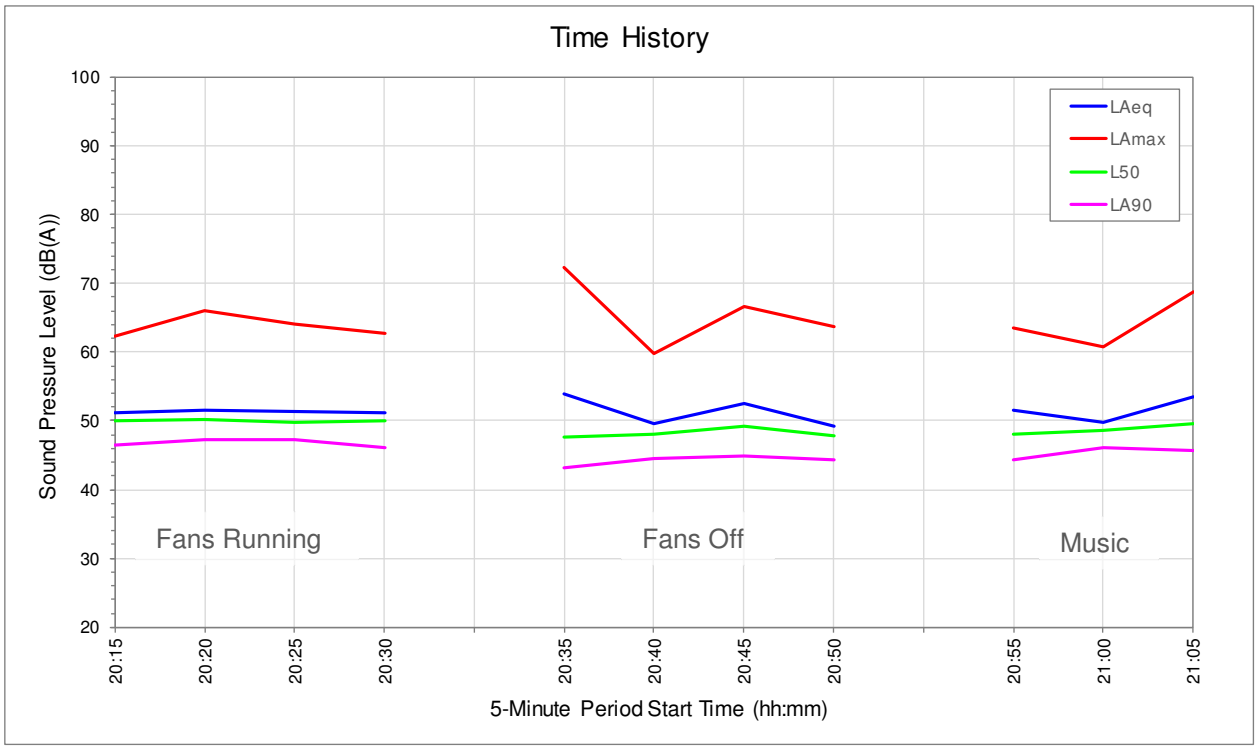
Rain	:	none, dry roads
Cloud	:	100%
Temperature	:	10 to 11 Celsius
Wind	:	generally below 5 m/s at the measurement position, although higher wind speeds created some noise in the trees at higher levels. The direction varied.

6.0 RESULTS AND DISCUSSIONS

The area was very busy with noise from traffic by far the dominant source, even at positions heavily sheltered from the road, such as the side passage of the house. There was also some influence of wind in the trees. The fan noise was audible but only just. It is likely to be a little more audible on a still night.

6.1 Basic Results

Basic results are shown graphically over time as follows:-



For a BS 4142 assessment, we would normally use the L_{Aeq} index for the fans running and the fans off to derive the level of the fans alone. However, we can see that the overall L_{Aeq} levels generally increased after the fans were switched off. This simply shows us that the measured levels were dominated by other sources such as traffic.

The following table summarises the basic results, at the measurement position, as well as levels within the venue around internal edges.

Fans	*Index*	***dB(A)***
Overall Fans Running	Leq	**51**
	Lmax	**64**
	L50	**50**
	L90	**47**
Overall Fans Off	Leq	**52**
	Lmax	**68**
	L50	**49**
	L90	**45**

Music	*Index*	***dB(A)***
Overall Music Playing	Leq	**52**
	Lmax	**66**
	L50	**49**
	L90	**45**
Music within Venue	Leq	**83**
	Lmax	**92**
	L50	**82**
	L90	**76**

6.2 Noise from Fans

The processing required by BS 4142 is not recommended where the noise from the fans is close to the residual noise, and is mathematically impossible when it is below. The standard recommends that a closer measurement position is adopted so that reasonable measurements can be made, and then appropriately adjusted for distance. However, this was not possible due to the railway line. We have therefore carried out some alternative processing to assist in deriving and noise level for the fans running on their own, ie. in the absence of general noise.

The fan noise is steady (ie. does not vary) and so we can look at the lowest measurement of the L_{Aeq} index and assume that these were the least affected by other more transient sources of noise such as traffic. If we do the same with the Fans off measurements, we can use those results as if they were normal measurements. So, by ignoring the 5 minute measurements beginning at 20:20 and 20:25 for the fans running, and the 5 minute measurements beginning at 20:35 and 20:45 for the fans off, we have:-

Overall Fans Running : 51dB L_{Aeq}
Overall Fans Off : 50dB L_{Aeq}
Fans Running Alone : 44dB L_{Aeq}

A second method would be to use the L_{A50} index. This is a different form of average (mathematically the median) which is far less affected by transient events than the L_{Aeq} index is. We could go further and use the L_{A90} index, which is almost completely uninfluenced by transient events. There is no strict mathematical basic for processing these indices, but they provide a useful guide.

Overall Fans Running	:	50dB L_{A50}
Overall Fans Off	:	49dB L_{A50}
Fans Running Alone	:	44dB L_{A50}
Overall Fans Running	:	47dB L_{A90}
Overall Fans Off	:	45dB L_{A90}
Fans Running Alone	:	42dB L_{A90}

All in all, we would suggest that 44 dB L_{Aeq} provides a reasonable representation of the noise from the fans running normally, in the absence of any residual noise.

6.3 Assessment of Fan Noise

Qualitatively, the fans were barely audible and, without listening for them, we would suggest that they would be unnoticeable and have very little impact. However, there was some influence of wind in trees and, on a still evening, they would inevitably be more noticeable.

A basic BS 4142 assessment is as follows (note that the background sound level is taken from our survey in September 2022 – the lowest 15 minute period up to 23:00:-

Specific Sound Level:	44 dB L_{Aeq}
Feature Corrections[2]	
tonality:	0 dB
impulsivity:	0 dB
intermittency:	0 dB
other:	0 dB
Rating Level:	44 dB L_{Ar}
Background Sound Level:	41 dB L_{A90}
Rating Level Excess re. Background	+3 dB

This is above what a BS 4142 *"Initial estimate"* rates as *"low impact depending on the context"* but below what it rates as an *"adverse impact depending on the context"*. Note that if we were to use the background levels measured in the recent survey (45 dB L_{A90}), the outcome would be *"low impact depending on the context"*. These outcomes match perfectly with our qualitative assessment that the fan noise was audible but only just, but that it would inevitably have been more noticeable on a still evening.

The context of course is a town centre location overlooking a railway line and other commercial uses nearby, which would tend to lessen the impact. However, the recent history may have sensitised residents and

[2] The units are extremely unlikely to be tonal or impulsive. They will be intermittent to a degree at source but, at the receiver position, the intermittency is extremely unlikely to be *"readily distinctive against the residual acoustic environment"*, as BS 4142 describes it. Also the equipment tends to ramp up and down rather than abruptly cut in and out, and of course all the units will do so at different times, each masking the effect of the others. In any case, the noise is likely to be barely audible at the receiver positions and so no character corrections apply.

so, on balance we would suggest that the context has little overall effect on the assessment.

It is important to note that the main purpose of the assessment is planning. If this was an investigation of an alleged nuisance, then we would conclude that no nuisance existed. However, as it is a planning issue, the could be considered to be a little higher. We would suggest that noise should be reduced by at least 3 dB plus a reasonable design safety margin such 5 dB, ie. 8 dB in total.

The silencers already fitted are not what was specified in our report of 10th May 2023. The suppliers should provide an additional silencer which will reduce the levels at assessment position noise by a further 8 dB. The additional silencer specification is as follows:-

Silencer Reqirements	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Exisitng Levels	**44**	54	42	42	41	38	34	35	34
Silencer Spec	**-**			7	11	11	8	9	6
Predicted Levels	**36**	54	42	35	30	27	26	26	28

As an illustration, a 2 to 3 diameter long straight-through type silencer should meet these requirements, but suppliers should confirm. There will need to be a separation between the additional silencers and the existing ones to gain the full performance. They could of course provide a replacement silencer as originally specified - one which would provide an overall reduction of 20 dB. It was also discussed in the past that the discharge could be directed over the roof away from the houses. This should provide a significant further reduction.

Note that it is not possible at this stage to judge if any significant noise is due to breakout from the fan bodies while the noise in the back yard area is dominated by the discharges. We suspect it is not an issue but we cannot know for sure until the additional silencers are fitted.

6.4 Music Noise

Measured results are shown in 6.1 above, but this part of the assessment was entirely straight forward and primarily qualitative.

The operators were asked to set their music running at their normal, preferred level. In discussion with Officers, this was judged to be marginally too high and the operator was asked to take the levels down until the music was inaudible at the assessment location. This was left running while one of the officers returned to the venue to witness the settings and discuss how it would be “locked-off”.

We should acknowledge two variables. The first is that the evening was far from ideal in terms of weather. There was wind in the trees a lot of the time and this may have had an effect of masking the music noise, although there were plenty of lulls in both wind and traffic. Traffic was generally the dominant noise by some margin. However, we should also acknowledge that the venue was empty. Customers provide significant absorption and room-edge levels are likely to be lower when the venue

is full. The volume control is likely to be lower when the venue is empty and only turned up towards the limit level when it is full.

Either way, there is no reason why the setting cannot be reviewed from time to time.

We have no further recommendations.

7.0 CONCLUSIONS/RECOMMENDATIONS

In terms of a BS 4142 assessment using previous background levels on a still evening, the results are above what the *"Initial estimate"* rates as *"low impact depending on the context"* but below what it rates as an *"adverse impact depending on the context"*. Note that if we were to use the background levels measured in the recent survey the outcome would be *"low impact depending on the context"*. These outcomes match perfectly with our qualitative assessment that the fan noise was audible but only just, but that it would inevitably have been more noticeable on a still evening.

We have recommended a further 8 dB reduction in fan noise. This should be feasible with a 2 to 3 diameter long straight through silencer. We also recommend that suppliers consider directing the discharge away from the houses.

Music was initially just audible but was adjusted down so that it was inaudible. The limiter was then set and locked at this level. We have no further recommendations regarding music noise.

Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but is really should be stated. The threshold of human hearing is a sound pressure of 20μPa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20μPa). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to given an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted level are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

Equivalent Continuous Sound Level, L_{eq}

This is a kind of mean noise level.

The unit is dB L_{eq}. For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq}. The Noise at Work Regulations use $L_{eq(s)}$ which refers to a sample level.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max}. For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax}.

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceed for a percentage of the time. L_n is the index representing the level exceeded for n% of the measurement period.

The unit is dB L_n. For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{An}.

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceed for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band form low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq}, L_{max}, L_n, etc. as defined above.