PO Box 1030, Warrington, Cheshire WA4 9FJ
t. 01925 723333 www.adcacoustics.co.uk

ARR/C/3707.02

13th November 2024

Wynne Construction

Assessment of noise impact of the kitchen extract fan at Ysgol Yr Hafod, LL14 2SW.

Prepared for:-

Wynne Construction
Charles House
Kinmel Park
Bowdelwydden
LL18 5TY

Prepared by:

Andrew Raymond

ADC Acoustics is a trading name of Acoustic Design & Control Limited
Registered Office: 367 Chester Road, Little Sutton, Ellesmere Port, CH66 3RQ
Registered in England and Wales 05117653

CONTENTS

1.0 SUMMARY

2.0 INTRODUCTION

3.0 ASSESSMENT STANDARDS

3.1 Planning Conditions
3.2 BS 4142

4.0 GUIDE TO MODELLING

5.0 SURVEY DETAILS

5.1 Site Times and Personnel
5.2 Instrumentation
5.3 Measurement Positions
5.4 Survey Conditions

6.0 RESULTS AND DISCUSSIONS

6.1 Basic Results
6.2 Assessment
6.3 Discussion of Uncertainty

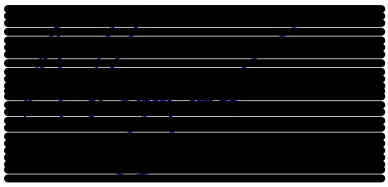
7.0 CONCLUSIONS/RECOMMENDATIONS

Appendix 1: Definition of Acoustic Terms
Appendix 2: Measurement and Calculation Details

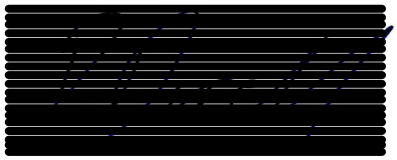
1.0 SUMMARY

The general noise was dominated by traffic on the nearby roads. Seagulls also had a significant influence. It appeared to be normal and representative in terms of general sources of noise. It was half term, however, and there was essentially no activity at the school and the local traffic may have been a little less than during term time. If anything, this would tend to make the assessment more robust.

With the fan running, even at full speed, it was completely inaudible and unmeasurable at the boundary position closest to the nearest residential property. A BS 4142 assessment based on measurements close to the fan supports the qualitative assessment that the impact is negligible, and essentially zero.



A R Raymond



P J Durell

2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of the new extract fan.

This report begins by summarising assessment standards and, where appropriate, discusses alternative interpretations.

After a brief statement of survey details we discuss basic results and the resulting assessment. The impact is discussed along with any recommendations for mitigation.

3.0 ASSESSMENT STANDARDS

3.1 Planning Conditions

Planning Condition 2 applies to this assessment.

> 2. The rating level of any noise generated by reason of this development shall not exceed the pre-existing background level at any time. The noise levels shall be determined at nearby noise sensitive premises, and measurements and assessment shall be made in accordance with BS4142:2014 Methods for Rating and Assessing Industrial and Commercial Sound (or any Guidance revoking or re-enacting that Guidance with or without modification).

The condition is reasonable and clear, and refers to BS 4142, the main standard for assessing sources of this type. It refers to the *"initial estimate"* stage only and not the full assessment which includes the context.

3.2 BS 4142

BS 4142 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 0dB 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.

4.0 GUIDE TO MODELLING

As the equipment was already installed and running, we could rely on measurements rather than calculation. However, it is discussed later that the fan was completely inaudible at the site boundary close to the nearest residential property and so measurements were made at 1 m from the discharge in the direction of the houses. We have done a very simple calculation based on distance correction from 1 m to 20 m (the distance to the nearest houses is actually a little more than that) and assuming a direct line of sight from the discharge to the residential.

Distance correction = $20 \times \log(d_M/d_R)$

Where d_M is the distance from the discharge to the measurement position and d_R the distance from the discharge to the residential position.

Distance Correction = $2- \times \log(1/20) = - 26$ dB

5.0 SURVEY DETAILS

5.1 Site times and Personnel

The survey on the proposed site was carried out by Mark Pickering of ADC Acoustics on 29th October 2024 from shortly after 11:00 to shortly before 13:00. We were joined by Paul Rowe of M A Cooper Projects, the project M&E engineers who operated the fan for us and advised on running conditions.

The period was chosen to represent a quieter (non-rush hour) time of day leading up to lunch time when the fan is most likely to be in use.

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} 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 as shown by the yellow star on the following plan.



The position was chosen to represent the closest houses in terms of background levels.

The microphone was 1.3 m above ground and well away from other reflecting surfaces.

As the fan was completely inaudible at this position, we also made some brief measurements on the roof at 1m from the fan discharge. The approximate location is as shown by the orange circle on the above image.

5.4 Survey Conditions

The general noise climate appeared to be normal and representative in terms of general sources of noise. It was half term, however, and there was essentially no activity at the school and the local traffic may have been a little less than during term time.

Weather conditions were as follows:-

Rain	:	none, dry roads
Cloud	:	20%
Temperature	:	13 Celsius
Wind	:	negligible

6.0 RESULTS AND DISCUSSIONS

6.1 Basic Results

The general noise was dominated by traffic on the nearby roads. Seagulls also had a significant influence.

With the fan set running, it was completely inaudible at the boundary nearest to the residential property on Noddfa Court. We are advised that the fan speed is variable and responds automatically to the kitchen environment, and would typically run at around 50% speed. We asked the M&E engineer to set it to run at full speed. It was still inaudible. With the fan turned off, there was no perceptible difference. Measurements were made at position 1 on the boundary.

Overall Levels	*Index*	***dB(A)***
Fan Running	Leq	**39**
	Lmax	**54**
	L90	**34**
Fan Off	Leq	**42**
	Lmax	**70**
	L90	**35**

At face value, the levels with the fan running are lower than the levels with it off. This simply shows that all we were measuring was the general background and residual noise climate.

6.2 Assessment

Essentially, the assessment is simply that the fan noise was inaudible and unmeasurable, and that the impact is effectively zero. However, for completeness, we have carried out a BS 4142-type assessment as best we can. The process is described in section 4.0 above.

Fan Running	*Index*	***dB(A)***
Measured at 1m	Leq	**53**
Distance Correction	-	**-26**
Level at Houses	Leq	**27**

We can see that the calculated level is significantly below all background levels, in fact it is significantly below the lowest single 5 minute measurement of 33 dB L_{A90}.

To illustrate what should be a very robust case, the following BS 4142 assessment assumes the fan running at full speed and is set against the single lowest 5 minute background measurement:-

Specific Sound Level	27 dB L_{Aeq}
Feature Corrections	
tonality	0 dB
impulsivity	0 dB
intermittency	0 dB
other	0 dB
Rating Level	27 dB L_{Ar}
Background Sound Level	33 dB L_{A90}
Rating Level Excess re. Background	-6 dB

This is well below what a BS 4142 *"Initial estimate"* rates as *"low impact depending on the context".*

The context of course is an established school site. The impact is clearly negligible.

6.3 Discussion of Uncertainty

BS 4142 requires us to

"Consider the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty".

The measurements of Background/Residual Sound were taken at times regarded as representing what are likely to be the worst case (quietest) time of the day. We have no reason to believe that the conditions were anything other than representative of normal conditions, other than it was half term and, if anything, the background levels were likely to be lower than usual. BS 4142 does not state what would be a representative background noise but there is certainly no suggestion that it should be lowest and practices vary widely. However, in order to

allow for the possibility of variation in levels, we have used the single 5 minute measurement.

Varying meteorological conditions are unlikely to have a significant impact on results as the distances involved are small.

7.0 CONCLUSIONS/RECOMMENDATIONS

With the fan running, even at full speed, it was completely inaudible and unmeasurable at the boundary position closest to the nearest residential property. A BS 4142 assessment based on measurements close to the fan supports the qualitative assessment that the impact is negligible, and essentially zero.

There are no further recommendations, other than to issue this report to planners and we would encourage officers to contact us directly with any queries.

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 20□Pa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20□Pa). 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 give 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 levels are discussed below.

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

NR and NC Levels

NR curves and NC curves are a series of curves representing noise levels across the frequency range. A given noise climate has an NR level or NC level if it equals a point on the curve at any frequency. They are particularly, although by no means exclusively, used as a means of specifying noise limits in an indoor environment, for instance from mechanical services or traffic noise break-in from the outside. They are typically expressed as NR or NC followed by a number, e.g. NR40, NC55, etc.

Equivalent Continuous Sound Level, L_{eq}

This can be simplistically described as a way of expressing the average 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}.

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 from 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.

Sound Insulation

Sound insulation is best expressed across the frequency range in octave bands or third octave bands. Often, however, in known environments such as domestic sound insulation and speech privacy, it is simpler to express the sound insulation as a single figure. A higher value means better sound insulation.

The most common ways are dB D_{nTw}, dB R_w and dB$_{(mean\ 100\text{-}3150Hz)}$. The first two are ways of expressing average sound insulation, weighted to account for speech frequencies. The third is simply an un-weighted mean value.

The Building Regulations Approved Document E (ADE) routinely refer to D_{nTw} +C_{Tr}. The C_{Tr} term is a negative number which is used to modify the D_{nTw} value for the insulation properties at lower frequencies.

ADE also uses the L_{nTw} index for impact sound transmission. It is a measure of the level of noise in the room below a room in which a standard tapping machine is being used. It represents the impact sound transfer such as footfall noise, scraping chairs, washing machines, etc. A lower value means better insulation.

Reverberation Time

The most common measure of Reverberation Time is, effectively the time taken for sound from a steady source to decay by 60 dB after it has been abruptly cut off. In practice it is often difficult to measure a 60 dB decay and so decays of 30 dB, 20 dB, or even 10 dB are often used and adjusted pro rata, although the exact measure is not quite the same.

Reverberation Time is generally expressed as RT in seconds. We may, if we are being precise, add subscripts 60, 30, etc to show whether the basis of the measure is 60 dB decay, 30 dB decay, etc. E.g. the RT_{60} = 0.52s, the RT_{30} = 0.49s, etc.

RT can be expressed in octave bands or 1/3 octave bands across the frequency range, or at central frequencies such as 500 Hz or 1kHz.

Appendix 2

Measurements in full

Fan Running	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Measured at 1m	Leq	**53**	68	63	55	50	45	41	39	28
Distance Correction	-	**-26**	-26	-26	-26	-26	-26	-26	-26	-26
Level at Houses	Leq	**27**	41	37	29	24	19	15	13	2

Fan Off	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
12:00	Leq	**39**	50	43	38	35	34	30	23	21
	Lmax	**53**	60	55	55	48	46	45	40	41
	L90	**34**	43	38	31	30	31	25	17	13
12:05	Leq	**40**	51	44	39	36	35	31	23	20
	Lmax	**57**	67	58	57	52	52	50	43	39
	L90	**33**	43	37	31	29	30	24	16	12
12:10	Leq	**38**	49	41	37	35	34	31	23	21
	Lmax	**51**	58	48	49	45	44	46	39	36
	L90	**34**	43	37	31	30	31	25	17	13

Fan Running	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
12:20	Leq	**39**	50	45	40	35	34	31	23	21
	Lmax	**61**	63	69	67	54	49	45	41	50
	L90	**34**	43	38	31	30	31	25	17	13
12:25	Leq	**45**	56	51	46	41	39	37	28	21
	Lmax	**74**	86	81	77	71	69	64	54	47
	L90	**35**	45	38	32	30	32	27	18	13
12:30	Leq	**40**	50	42	37	36	35	34	27	22
	Lmax	**53**	59	48	49	45	45	49	40	37
	L90	**35**	45	38	32	32	32	26	18	14

Overall Levels	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Fan Running	Leq	**39**	50	43	38	35	34	31	23	20
	Lmax	**54**	63	55	55	49	49	48	41	39
	L90	**34**	43	37	31	30	31	25	17	13
Fan Off	Leq	**42**	53	47	43	38	37	35	26	21
	Lmax	**70**	81	77	72	66	64	59	50	47
	L90	**35**	44	38	32	31	32	26	18	13