

APPENDIX B

Review of Noise Impact Assessment for Proposed EfW Site by D R Kettlewell
(July 2009)



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REVIEW OF NOISE IMPACT ASSESSMENT
FOR PROPOSED EfW SITE

AT

TOCKWITH

ON BEHALF OF

TOCKWITH RESIDENTS ASSOCIATION

Planning Application Ref: NY/2009/0176/FUL

Date: 3rd July 2009
Consultant: D.R. Kettlewell MSc MIOA MAE I.Eng
Report No.: R09.1680/1/DRK

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1.0 INTRODUCTION:

- 1.1 It is understood that BCB Environmental Limited are proposing to construct and operate a Energy from Waste site at Marston Business Park, Tockwith.
- 1.2 According to the Environmental Statement '*The Energy from Waste plant will process non-hazardous, Municipal Waste, Commercial and Industrial Waste from the local area and businesses together with hazardous waste from the adjacent Waste Transfer Station to generate power to be exported to the National Grid. Heat will also be generated, and will be available as a resource for local businesses or district heating subject to there being sufficient demand for the system and further discussions on distribution.*'
- 1.3 The proposed plant will include the following elements:
- (i) 6 gasification chambers arranged in two rows of three
 - (ii) 2 liquid waste evaporation units
 - (iii) 1 waste oils distillation unit
 - (iv) Secondary Thermal Treatment
 - (v) 2 Steam Boilers
 - (vi) Flue gas treatment system to clean the hot gases that are produced from the process.
 - (vii) 31 metre chimneystack
 - (viii) A turbine hall in which the steam produced by the boilers is used to generate electricity and provide heat for re-use
 - (ix) Three external air cooled condensers; and
 - (x) An electrical connection so that electricity can be exported to the national Grid.
- 1.4 The Energy from Waste plant will operate on a 24 hours a day, 7 days a week basis. Waste is will brought to the plant between 8am and 5pm Monday to Friday, and between the hours of 8am and 1pm on Saturdays.
- 1.5 Noise & Vibration Consultants Limited was instructed to review the report and provide their expert opinion with respect to the methodology, criteria and conclusions relating to the development in terms of noise. This has been requested to ensure that the nearest residential or sensitive receptors are not adversely affected by the proposed development. Where appropriate we would give advice on any additional considerations that may be required to protect amenity of local residents.
- 1.6 An assessment of noise has been provided by Sharps Redmore Partnership (ref. report no. 089915 dated 30 March 2009).

Sources of Information

- 1.7 Information used in this assessment has been obtained from the following sources:

- Report by Sharps Redmore Partnership `Proposed Energy from Waste Facility – Tockwith Noise Level Predictions’: Dean E Barke dated 30 March 2009.
- Environmental Statement – section 12.0: Noise
- Site plan
- Noise Control in Industry: Sound Research Laboratories Ltd 1991
- Telephone conversation with EHO at Harrogate BC on Monday 29th June and 1st July 2009.
- Noise Design Advice – Harrogate Borough Council

2.0 ASSESSMENT METHODOLOGY & CRITERIA

2.1 With any impact assessment relating to potential industrial noise sources of this type, it is our expert opinion and practical experience obtained over 25 years within the field of industrial acoustics (including many EfW sites) that the following issues should be considered in detail to ensure that the nearest sensitive receptors are adequately protected to ensure their amenity is not adversely affected by the development:

a) The Local Authority EHO would normally be consulted prior to commencement of an assessment in respect of the extent of baseline noise measurements, location of baseline measurements, noise criteria and any other noise sources that need to be considered in the assessment.

b) A detailed study of background noise at the nearest sensitive property boundaries during daytime and night-time periods.

Measurements would normally include the monitoring of LAeq, LA90 and LMax indices for each monitoring time period and possibly frequency analysis.

c) Predict the noise levels from the site using appropriate calculation methodologies (e.g. ISO9613-2 for fixed plant and BS5228: Part 1: 2009 for mobile plant).

d) Following the prediction calculations it would then be appropriate to assess the results against appropriate and relevant noise criteria. In this particular case, the noise source relates to fixed and mobile plant noise sources. For fixed noise sources, the appropriate noise criteria would relate to BS4142: 1997. For daytime activities (i.e. after 0700 hours and before 2300 hours), as a minimum, in order to ensure that complaints are unlikely, the noise from site should not exceed the background noise level +5dB(A). Where sites utilise fixed and mobile plant, it is not uncommon for Local Authorities to request a daytime design criteria equivalent to the background noise level for the fixed plant to allow for the cumulative effect of noise from both types of noise sources. Additionally, night-time noise would normally attract a lower criteria relative to background noise (e.g. not to exceed background noise levels or 5dB(A) lower than background). See paragraph 2.6 below for information from Harrogate BC.

e) Where the site operates HGVs in and out of the site, it would also be normal procedure to assess the effect of road traffic movements on the local road network and on site relative to the nearest residential receptors. The method of calculation and assessment is provided within Calculation of Road Traffic Noise (CRTN). An increase of 3dB(A) or more in terms of road traffic noise is defined as significant in accordance with recent Government advice. Where traffic volumes are relatively low then the methodology found within BS5228: 2009 would be more suitable.

- f) An assessment of 'event' noise sources, such as reverse alarms and safety valve tests which produce peak noise would also normally form part of the scope of work to be considered in terms of their impact on levels at nearest receptor boundaries and façade positions. This is a particularly relevant to the period after 2300 hours and before 0700 hours.
 - g) Consideration of low frequency noise is also a common request by Local Authorities for these types of plant particularly when dealing with respect to large slow speed fans on air-cooled condensers, turbine exhaust systems and boilers. Whilst there is no specific statutory legislation on low frequency noise, there are Defra reports published on various aspects of low frequency noise criteria and the assessment of low frequency noise complaints (Ref.: NANR45 Feb 2005 University of Salford).
- 2.2 The above noise sources are then compared with typical background and residual noise levels to assess the impact at the nearest receptors, which should include the cumulative effect of these noise sources operating together in any particular period.
- 2.3 This site operates 24 hours, 7 days per week. For daytime periods (i.e. between 0700 and 2300 hours) we are mainly concerned with noise levels within garden areas and design criteria within living rooms of the dwellings. This will therefore generally relate to ground floor monitoring positions. For the night-time scenario (i.e. 2300 to 0700) we are mainly interested in achieving sleep disturbance criteria within bedroom areas of sensitive dwellings, which assumes that bedroom windows are left open. For this assessment consideration of LAeq and LMax levels outside the bedroom window would be appropriate. Bedroom positions will normally relate to first floor positions. For guidance on a good to reasonable design range for internal levels within rooms refer to BS8233: 1999.

Consultation with Harrogate BC

- 2.4 We understand from conversation with the Environmental Health Department at Harrogate BC that they are a consultee in the process of the application. They are not aware of any contact made by the appointed noise consultant for the project with their department to discuss noise criteria or any local issues of concern in respect of noise.
- 2.5 Once the site is in operation this will require a PPC permit and the effective environmental control will be the responsibility of the Environment Agency.
- 2.6 In terms of an appropriate noise criteria the EHO would refer to BS4142: 1997 as being the relevant British Standard. Information provided by the EHO makes reference to 'Noise Design Advice', which sets out the required noise criteria that the Local Authority would refer to. The section dealing with industrial noise is as follows:

"3.0 New Residential Development near to existing Industrial or Commercial Use where industrial noise is the dominant source.

3.1 This advice aims to protect the occupiers of your new noise sensitive premises from noise from existing industrial or commercial premises.

Developers should carry out an assessment in accordance with BS4142 to determine the rating level at the new development. **This rating level can be determined including proposed attenuation measures.** It is recommended that during normal daytime hours, 0700 to 2300 hours, the BS4142 rating level, measured over 1 hour, should be 5dB below the background level (L_{A90}). During the night-time period, 2300 to 0700 hours, the BS4142 rating level, measured over 5 minutes, should be 5dB below the background level (L_{A90}).

However, it is recognised that a flexible approach may be required in certain circumstances where the need is justified. The following minimum standards may be accepted notwithstanding the rating level:-

- NR 25 in bedrooms (2300 to 0700)
- NR 30 in all habitable rooms (0700 to 2300)
- If there is a distinguishable tone the NR curves should be reduced to NR 20 and NR 25 respectively
- Noise Rating curves should be measured as a 15 minute linear L_{eq} at the octave band centre frequencies 31.5 Hz to 8 kHz.
- For outdoor areas a BS4142 rating of up to +5 dB higher than the background level (L_{A90}) may be accepted.
- In addition the levels specified in Appendix 1 should not be exceeded.
- All indoor levels shall be taken with windows open or with alternatively provided acoustic ventilation over and above "background" ventilation.

3.2 Justification for advice

PPG24 recommends that wherever practicable noise sensitive developments should be separated from major sources of noise. PPG24 also refers to the use of BS4142: 1997 (where appropriate) to consider noise from industrial and commercial developments. This standard assesses the likelihood of complaints in relation to noise.

Noise Rating (NR) curves are another way of setting acceptable levels in noise sensitive premises where industrial/commercial noise may be an issue. From experience of statutory nuisance investigation work, the setting of broad band A weighted noise level limits on their own are not appropriate for industrial noise."

- 2.7 The advice recognises that BS4142 is relevant and suggests a design level that is 5dB(A) below background noise. At night-time this would suggest that a level of 25dB(A) is required. However, it also recognises that a flexible approach is required in some circumstances and makes reference to the minimum standards within rooms based on an NR level. The NR levels are frequency dependent and are as follows:

Minimum level in bedrooms: NR25, the noise from the site will therefore have to achieve the following levels in bedrooms (with windows open) in each of the octave band frequencies:

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
dB	55	44	35	29	25	22	20	18

If there is a tonal characteristic the levels are as follows (NR20) at night:

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
dB	51	39	31	24	20	17	14	13

- 2.8 Appendix 1 of the document detail, which is additional to the above criteria, is as follows:

Appendix 1

Room/Area	L_{Aeq} (16 hr) 700-23.00	L_{Aeq} (8 hr) 23.00-07.00	L_{A1}(15 min) 23.00-07.00	L_{Amax} 23.00-07.00
Living Rooms/Studies	35dB	xxxxx	xxxxx	xxxxx
Gardens	55dB	xxxxx	xxxx	xxxxx
Bedrooms	xxxxx	30dB	45dB	55dB

Table of Noise Levels that should not be exceeded

Notes

1. Where windows are to remain closed to ensure good internal noise levels and an alternative means of ventilation is provided, ventilation that complies with the performance specification given in Part 6 of Schedule 1 of the Noise Insulation Regulations 1975 will be accepted. Alternatively four air changes per hour will be accepted.
2. We will accept that a open window will provide a sound reduction of 12dB(A) unless the developer has a good reason why a higher reduction is acceptable.
3. When calculating/predicting attenuation of noise levels we will accept single figure Sound Reduction Indexes provided they are suitable for that particular source, for example Pilkington's R_{tra} for Road traffic. However if the Sound Reduction Index is not specifically for the sound source under consideration then a frequency analysis of the noise, and attenuation in that octave band and recalculation of a single "A" weighted level will be required.
4. It will be acceptable to use the shortened method for calculating the daytime NEC for road traffic noise.
5. It will be acceptable to use 1 hours monitoring at night to determine NEC provided the method can be justified (for example if the busiest predicted hour is measured).
6. If your development doesn't fit into any of the five scenarios, then please contact the Environmental Protection team.

3.0 COMMENTS ON ES SECTION ON NOISE

3.1 Section 12.0 of the ES provides information on the assessment methodology and information gathered for the study, which cover the following points:

3.2 Assessment methodology: The process of assessment includes identification of nearest receptors, data on existing baseline noise levels at the nearest receptors, identification of significant noise sources, determination of sound insulation for the EfW buildings, calculations for the operation of the site, an assessment of the effects of the site operating and noise control measures. The general methodology is what we would expect to see for an appropriate assessment of noise.

3.3 Baseline data: The assessment shows that a significant survey of background noise has been undertaken in 2007 with supportive additional monitoring in 2009. The assessment recognises that the background noise levels fall to very low levels at night-time and states the daytime and evening periods as being as low as 30dB LA90 and 28dB LA90 for night-time levels. The extent of the survey in our expert opinion is suitable and typically more than would be expected to be provided.

3.4 Noise Criteria: The assessment refers to BS4142: 1997 as being the appropriate standard for assessing industrial type noise and the likely determination of complaints. The Sharps Redmore assessment also refers to WHO guidelines on community noise levels for general levels and sleep disturbance criteria and BS8233: 1999 as a reference for good design criteria for indoor levels within bedrooms. These are the general standards that we would expect to be referred to in this application. There are two considerations, one is to look at what is acceptable in terms of an allowance above or below background noise (i.e. BS4142: 1997 methodology) and the second consideration of absolute noise limits to ensure people are not disturbed during sleep.

BS4142: 1997 Method for rating industrial noise affecting mixed residential and industrial areas'

3.5 In terms of BS4142: 1997, the standard is based on the measurement of background noise using L_{A90} noise measurements compared to source noise levels measured in L_{Aeq} measurements. The differential between the two measurements determines the likelihood of complaints. If a differential of +5dB(A) is resultant, then the standard says that the noise is 'of marginal significance', if the differential is +10dB(A) then it could indicate that 'complaints are likely'. Where the noise is deemed to have a characteristic that would attract attention (e.g. impact noise, tonal noise, impulsive noise) then a correction of +5dB(A) is added to the noise source level in the calculation. For night-time noise levels it is not uncommon for Local Authorities to request that the noise from site should not exceed the background noise level or in some instances 5dB(A) below the background noise level. Based on a background of 28dB(A) in theory this would relate to a criteria of 23-28dB(A) Leq. However, BS4142 itself acknowledges that it is not suitable for assessing noise in situations where the background and

rating noise levels are both very low (i.e. low being a level of 30dB LA90 and site noise 35dB(A) Leq). In this situation it would seem reasonable to then also consider absolute noise level criteria.

Absolute Noise Level Criteria – Night-time

- 3.6 When considering an absolute noise level for establishing criteria, we have considered existing planning guidance and health criteria. External noise levels of 40dB_{LAeq, 1 hour} equate to internal noise levels of about 25-30dB_{LAeq, 1 hour} with windows open for ventilation, which, based on guidance in BS8233 "Sound Insulation and Noise Reduction for Buildings – Code of Practice", is a good internal standard in a bedroom. PPG24 identifies 45dB_{LAeq} as the level below which noise need not be considered as a determining factor in granting planning permission for a residential site. The World Health Organisation indicates that an internal noise level of 30dB_{LAeq} would be acceptable for sleep. MPS2 guidance also refers to a level of 42dB(A) L_{Aeq,1hour} (free field) as being the limit for night-time activities.
- 3.7 The World Health Organisation research on disturbance of sleep suggests that "*For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night (Vallet & Vernet 1991)*"
- 3.8 In overall conclusion in relation to noise criteria I would expect that if the site can operate at night-time at a level between 35dB(A) and 40dB(A) Leq_{1hour} then this would be within the range deemed to be reasonable and acceptable in consideration of BS4142, BS8233 and WHO guidance on noise. For weekdays and Saturday morning periods a criteria of 40-45dB(A) Leq_{1hr} would seem reasonable and appropriate.

Predicted Noise Levels

- 3.9 In terms of mobile plant and HGV movements, the receipt of waste only occurs between the hours of 0800-1700 during the weekdays and 0800 to 1300 hours on Saturday. It is assumed that any reversing activities where reverse alarms are used would only occur within the building, although this is not clear. The problem with external reversing is the audibility of reverse 'beeper' alarms as opposed to white noise or 'broadband' noise alarms, which are less audible at distance. Paragraph 12.29 refers to forklift movement outside building and states "*Subject to an appropriate review of site safety, the use of tonal reversing alarm sounders on a forklift may be mitigated*". The use of "broadband" noise alarms is common place in all industries and I see no reason why the tonal alarms could not be replaced without compromise of safety (refer to Brigade Electronics web site reversinsafety.co.uk BBS TEK alarms)
- 3.10 Predicted noise levels, assuming that these are accurate and robust, would represent a reasonable level that would meet general guidance and standards of noise to protect process of sleep and residential amenity.

- 3.11 In relation to the 'Design Noise Advice' provided by Harrogate BC , the levels predicted at the nearest receptor at night-time are 30dB(A) Leq. The level within the bedroom with open window would therefore be approximately 18dB(A), which is relatively low and likely to achieve the criteria although this is not confirmed in the assessment.

4.0 COMMENT ON SHARPS REDMORE PARTNERSHIP REPORT

Report 089915 dated 30 March 2009

4.1 We have examined the report provided by Sharps Redmore Partnership dated March 2009 and would make the following observations:

a) The reverberant noise level assumed is provided and we therefore assume that this is part of some form of contractual guarantee (i.e. specification passed onto the main contractor for the site development).

b) It is also noted that the type of wall cladding system and roof construction is specified as follows:

Wall: Kingspan AWP/60-70 + insulation + perforated liner

Roof: Rw 30/80 + insulation + perforated liner

Roof lights at 10% of area

c) Paragraph 4.10 mentions that any louvres or apertures for ventilation would be acoustically treated so as not to degrade the required sound insulation of the building. This would normally involve the fitting of acoustic louvres or attenuators behind the weather louvres/apertures although no detail is provided.

d) No detail of the overhead sectional doors is provided although the sound power level radiating from the doors is provided in Table 4.10.

e) Table 4.12 details the sound power level from the ID fan, condenser fans and HGVs. The ID fan is to be fitted with an attenuator 3 metres long with 33% free area, which will be effective. The condenser fans have variable speed depending on the ambient temperature. The calculations assume that at night-time the slower speed will be relevant. Is there any guarantee that the fans will not run at a higher speed during the Summer nights? Condenser fans generate more low frequency noise due to the operating speed, table 4.12 indicates that they have assumed a flat spectrum which would tend to give a much lower assumption of noise at low frequency.

f) Paragraph 5.1 indicates that 6dB per doubling of distance occurs from a point/small source, which is true however we assume that this has not been applied to the building itself as it would act more like a 'plane' source where the noise attenuates as follows:

X = Building height/PI

Y = Building length/PI (PI =3.142)

At distance of X from building = no change in noise level

At distance of X to Y from building = 3dB per doubling of distance

[i.e. $10 * \log (\text{distance } Y) - 10 * \log (\text{distance } X)$]

At distance Y to receptor position (R) = 6dB doubling of distance

[i.e. $20 * \log (\text{distance } R) - 20 * \log (\text{distance } Y)$]

- g) Paragraphs 5.2 and 5.3 details the methodology used for the prediction calculations, which allows for a `downwind' condition, frequency analysis, air absorption and ground conditions, which is reasonable.
- h) Paragraphs 5.4 and 5.5 give the assumed distances to the nearest receptors along Rupert Drive and heights above ground assumed.
- i) Table 5.6 gives the predicted noise levels from the facility during daytime and night-time periods. We have undertaken provisional calculations of the development based on the assumptions provided in the report in terms of radiated sound power levels and distances/heights for the building and receptor positions. Our calculations generally concur with the levels predicted by Sharps Redmore.

5.0 CONCLUSIONS

Background Noise Levels:

- 5.1 The background noise levels undertaken and referred to in the ES section on noise would appear to be reasonable and sufficiently extensive to establish typical noise level data at the nearest receptors to the site. The levels measured indicate a very low noise climate during night-time periods.

Assessment Methodology

- 5.2 We have no criticism of the methodology used to assess the noise source or the calculation method adopted in principle (however see notes below in 5.7).
- 5.3 In terms of liaison with the Local Authority, according to the EHO at Harrogate BC they are not aware of any consultation that has occurred between the developers noise consultant in relation to this site. They would have then been able to give their view on appropriate noise criteria or any concerns that they may have with the development.

Noise Criteria

- 5.4 The noise criteria referred to and assessed against detailed in the ES section on noise is relevant and appropriate for this type of development. The EHO at Harrogate BC confirms that BS4142: 1997 would be the appropriate criteria to apply to this site. The EHO referred to a document entitled 'Noise Design Advice', which advises that NR20-25 would be the required design level within bedrooms and NR30 in all other rooms during the daytime. There is no consideration of this design requirement in the application documents.
- 5.5 The logic in terms of the relatively low levels predicted from site at the nearest receptor is valid providing the predictions and assumptions made are correct.

Predicted Noise Levels

- 5.6 The predicted noise levels, based on the assumptions made in relation to noise levels inside/outside and construction of the buildings would appear to be as expected based on our experience.

Conclusions

- 5.7 In general, the information and methodology (apart from consideration of NR levels within bedrooms and habitable rooms) would appear to be reasonable and expected based on the assumptions given. The main areas of concern would therefore relate more to guarantees and additional clarification/information on specific points, as detailed below:

- a) No consideration of the Harrogate BC 'Noise Design Advice' is provided in the assessment, which also requires an assessment of frequency limits for bedrooms and all other habitable rooms.
- b) The assessment assumes that the Cooler Condenser Fans operate at their lowest speed during night-time and late evening periods. What guarantees are they providing to ensure that the fans do not increase speed in the Summer months when ambient temperatures can reach high levels.
- c) There is very limited information on the noise level from the Condenser Fans. The main concern would relate to the frequency content particularly at low speeds, which can generate relatively high levels of low frequency noise. The consultants have assumed a flat frequency response (due to lack of data), which will tend to hide low frequency noise. Further information should be requested on this aspect, as low frequency noise is hidden by the method by which we measure noise (i.e. 'A' weighted noise levels penalise low frequency content). Reference to be made to NANR45 Feb 2005 University of Salford. Low frequency noise can travel great distance due to the amount of energy content within the sound waves which can cause disturbance to residents within buildings at night-time even though the overall noise level [in terms of dB(A)] is low. The other areas where low frequency noise may be of concern would relate to the steam boilers noise and exhaust systems (e.g. turbines).
- d) The assessment assumes an overall reverberant noise level within the building. Is there any guarantees or specification to achieve this being imposed on the contractor?
- e) The report details the assumed construction for the building, is there any guarantees that this will actually happen to ensure that the building radiated sound power level is achieved?
- f) Noise 'break-out' via weather louvres or openings in the building structure and roof mounted ventilation cowls etc. is an important point. The report indicates that these would be attenuated to meet the building construction performance. No detail of how this is to be achieved is detailed.
- g) It is not clear how Sharps Redmore have calculated the distance attenuation from the building although they do refer to 6dB per doubling of distance for a point/small source. For noise radiation from the building this would not be appropriate unless the calculation makes allowance for the surface area of the building. It really depends on how the noise is calculated so a point perhaps for clarification.
- h) The use of broadband white noise reverse alarms should be imposed for any mobile plant being used on site rather than 'beeper' tonal type.
- i) The question should be asked about whether safety valve tests are likely to be carried out on site and if so, how often and when would they occur. These types of sites often require tests to be carried out on safety valves

for steam, which is a noisy event but is not normally a regular occurrence.

- j) Confirmation of the fitting of an attenuator to the ID fan/s outlet duct/s to the stack should be sought.

REFERENCES

1. BS4142: 1997 Method for rating industrial noise affecting mixed residential and industrial areas.
2. BS8233: 1999 Sound Insulation and noise reduction for buildings – Code of Practice
3. Guidelines for Community Noise – World Health Organisation: April 1999
4. BS 7445: 2003, Description and measurement of environmental noise.
5. BS 5228: 2009 Code of practice on noise and vibration control on construction and open sites
6. Calculation of Road Traffic Noise: Department of Transport 1988
7. ISO 9613-2: 1996 Acoustics – Attenuation of Sound During Propagation Outdoors.
8. Defra Research: NANR45 Feb 2005 University of Salford
Proposed criteria for assessment of low frequency noise disturbance
Procedure for the assessment of low frequency noise complaints
A review of published research on low frequency noise and its effects
9. Noise Design Advice – Harrogate Borough Council

APPENDIX 1

BASIC ACOUSTIC TERMINOLOGY

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

Sound Pressure Level is a measurement of the size of these pressure fluctuations. It is expressed in decibels (dB) on a logarithmic scale. Each 3 dB increase in sound pressure level represents a doubling of the sound energy. An increase of around 10dB is said to subjectively double the sound level. The threshold of hearing is approximately 0 dB.

The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz), that is, cycles per second. The human ear is sensitive to sounds from about 20 Hz to 20,000 Hz. Although sound can be of one discrete frequency - a 'pure tone' - most noises are made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same 'subjective' way. This is the basis of the A-weighted sound level dB(A), normally used to assess the effect of noise on people. The dB(A) weighting emphasises or reduces the importance of certain frequencies within the audible range.

Noise Measurement

The measurement of sound pressure level is only really meaningful where the level of noise is constant. In the typical industrial environment noise levels can vary widely and sometimes short duration high levels of noise are interspersed with periods of relative quiet. The most widely used means of 'averaging' the noise over a period of time is the Equivalent Continuous Sound Level. Normally written as L_{Aeq} this value takes into account both the level of noise and the length of time over which it occurs. There are many meters available which are capable of measuring L_{Aeq} by electronic integration over the measurement period.

The L_{Aeq} or A-weighted equivalent continuous noise level is a measure of the total noise energy over a stated time period and includes all the varying noise levels and re-expresses as an 'average', allowing for the length of time for which each noise level was presented.

The L_{An} parameters are defined as the noise levels which are exceeded for n% of the monitoring period, thus, for example, the L_{A90} parameter is the noise level exceeded for 90% of the 15 minute period, i.e. 13.5 minutes. The L_{A50} parameter is the noise level exceeded for 50% of the hourly period, i.e. 30 minutes, etc. The L_{max} parameter is the maximum RMS A-weighted noise level occurring during the measurement period.

The definition in layman's terms is given below for terminology used in the measurement and results obtained during the survey work.

A-weighting: Normal hearing covers the frequency (pitch) range from about 20Hz to 20,000 Hz but sensitivity of the ear is greatest between about 500Hz and 5000Hz. The "A-weighting" is an electrical circuit built into noise meters to mimic this characteristic of the human ear.

Ambient noise: The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Attenuation: Noise reduction

Background noise: The general quiet periods of ambient noise when the noise source under investigation is not there.

Decibel (dB): The unit of measurement for sound based on a logarithmic scale. 0dB is the threshold of normal hearing; 140dB is the threshold of pain. A change of 1dB is only detectable under controlled laboratory conditions.

dB(A) [decibel A weighted]: Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) serves to distinguish sounds of different frequency (or pitch) in a similar way to how the human ear responds. Measurements in dB(A) broadly agrees with an individual's assessment of loudness. A change of 3dB(A) is the minimum perceptible under normal everyday conditions, and a change of 10dB(A) corresponds roughly to doubling or halving the loudness of sound.

dB(C): [decibel C weighted]: Frequency weighting which does not alter low frequency octave band levels by very much compared to 'A' weighting. Similar to linear reading (i.e. linear does not alter frequency spectra at all)

Frequency (Hz): The number of sound waves to pass a point in one second.

L_{Aeq} : This is a noise index used to describe the "average" level of a noise that varies with time (T). It allows for the different sensitivities of the human ear to different frequencies (pitch), and averages fluctuating noise levels in a manner, which correlates well with human perceptions of loudness.

$L_{A10,T}$: This noise index gives an indication of the upper limit or peak levels of the fluctuating noise. It is the "A weighted" noise level exceeded for 10 per cent of the specified measurement period (T). e.g. If the measurement period was over 10 hours and the L_{A10} reading was say 60dB, then this means that for 1 hour out of 10 the level went above 60dB.

$L_{A90,T}$: This noise index gives an indication of the lower limit or levels of the fluctuating noise. It is the "A weighted" noise level exceeded for 90 per cent of the specified measurement period (T). e.g. If the measurement period was over 10 hours and the L_{A90} reading was say 50dB, then this means that for 9 hours out of 10 the level went above 50dB.

L_{Amax} : This is the highest 'A' weighted noise level recorded during a noise measurement period.

Residual noise: The ambient noise remaining at a given position in a given situation when the noise source under investigation is not there.

Specific noise: The noise source under investigation for assessing the likelihood of complaints

APPENDIX 2

CONSULTANT'S EXPERIENCE & QUALIFICATIONS

**Principal Consultant: Dean Robert Kettlewell - MSc MIOA MAE I.Eng
(Director & Principal Acoustic Consultant)**

Précis

As Director and Principal Acoustic Consultant with Noise & Vibration Consultants Ltd, Dean has over 25 years background experience in a wide range of issues relating to environmental, industrial and commercial noise and vibration assessment. He currently manages corporate and unit specific contracts for:

- Environmental Noise Impact Assessments
- Industrial Noise Assessment and Control
- Planning Issues for Residential and Commercial Development
- Noise at Work Regulations Assessments
- Building Acoustics and Sound Insulation Tests
- Expert Witness representation for Deafness and `Vibration White Finger' Claims
- Integrated Pollution Prevention and Control (IPPC) Applications
- Wind Farm Noise Impact Assessments
- Entertainment Noise Assessment and Control
- Architectural Acoustics
- Specialist knowledge in the Design of Noise Control Systems
- Ground borne vibration measurement and assessment
- Assessment of Environmental & Industrial Noise Nuisance
- Project Management of Noise Control Systems
- Hand-arm Vibration Assessments

Relevant Work Experience

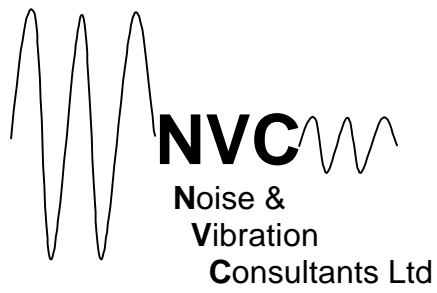
Director & Principal Consultant - Noise & Vibration Consultants Ltd	2001- to date
Senior Acoustic Consultant - Vibrock Limited	1998 - 2001
Associate & Principal Acoustic Consultant - John Savidge & Associates	1994 - 1998
Technical Manager – LBJ Limited (Noise Control Division)	1990 - 1994
Technical Engineer/ Technical Manager (1988) - Vibac (Noise Control) Ltd	1982 - 1990

Qualifications and Education

M.Sc. Applied Acoustics (Derby University – Distinction)
HNC Electrical & Electronic Engineering
IOA Diploma in Acoustics & Noise Control
IOA Certificate in Law and Administration
Certificate of Competence in Workplace Noise Assessment
Certificate of Competence in Ground Vibration Monitoring
Post Graduate Certificate in Applied Acoustics

Registered as an expert witness with the Law Society Directory of Expert Witnesses in relation to noise and vibration.

Affiliations:
Member of Institute of Acoustics (MIOA)
Member of Academy of Experts (MAE)
Member of Association of Noise Consultants (ANC)
Incorporated Engineer (I.Eng)



APPENDIX C

Review of Air Quality and Human Health Impacts by Gair Consulting Ltd
(July 2009)