

**ROYAL BERKSHIRE HOSPITAL, READING:
ICU PHASE 2
NOISE ASSESSMENT RE PROPOSED AIR HANDLING UNIT**

**On behalf of:
Gray Baynes + Shew**

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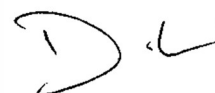
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1.0 INTRODUCTION

- 1.1 Hepworth Acoustics Ltd was commissioned by Gray Baynes + Shew to carry out a noise impact assessment in connection with a planning application for the installation of a new roof-top air handling unit, associated with development at the ICU facility at Royal Berkshire Hospital, Redlands Road, Reading.
- 1.2 Proposals are for the partial removal of an existing rooftop plant room, and the existing plant located therein, and introduction of a single new Air-Handling Unit (AHU). The new equipment will operate throughout 24-hours.
- 1.3 The nearest residences to the proposed plant are the 2- and 3-storey properties directly to the opposite side of Redlands Road, near to the junction with Morgan Road. The proposed plant is at least 45m from these residences, at a higher elevation even than the top floor dormer windows of the houses.
- 1.4 The site location is identified in Figure 1.
- 1.5 The primary scope of this report is to consider noise from the proposed new plant at residential locations, for planning purposes. Nonetheless, some initial guidance is included with regards to control of noise to internal Hospital areas.
- 1.6 The various noise units and indices referred to in this assessment are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.

2.0 ENVIRONMENTAL NOISE SURVEY

- 2.1 A baseline noise survey was undertaken at the site to determine prevailing ambient/background noise levels at the nearest residences to the proposed plant over a 2-hour period of the early night-time, commencing at 2330hrs on Thursday 22 June 2023.
- 2.2 Noise measurements were undertaken in 15-minute samples at a single location, in plan view, representative of the nearest residences, as identified in Figure 1. However, noise measurements were undertaken simultaneously in this location with two separate measurement systems, with microphones mounted at 1.5m and ~5m above local ground. This was to determine representative noise levels at upper and lower floor levels of the nearest residences, given that much of the prevailing noise is due to existing hospital plant, located at various height levels.
- 2.3 The noise measurements were undertaken at lower level using and a Norsonic 118 Class 1 integrating sound level meter (serial no. 31617) and at higher level using a Norsonic 140 Class 1 integrating sound level meter (serial no. 1406529). Calibration checks were carried out to all equipment using a Brüel & Kjær Type 4231 acoustical calibrator (serial no. 2389221) before and after the survey, and no variation in calibration level was observed.
- 2.4 The measurement microphones were fitted with windshields and mounted in free-field conditions.
- 2.5 The measured noise levels are set out in Table 1.

Table 1 : Measured Noise Levels

Time	Noise Level (dB)			
	$L_{Aeq,15min}$		$L_{A90,15min}$	
	At 1.5m height	At ~5m height	At 1.5m height	At ~5m height
2330 – 2345 hrs	52	52	45	46
2345 – 0000 hrs	51	51	45	46
0000 – 0015 hrs	52	51	45	46
0015 – 0030 hrs	52	52	45	46
0030 – 0045 hrs	50	50	45	45
0045 – 0100 hrs	49	49	45	46
0100 – 0115 hrs	49	49	45	45
0115 – 0130 hrs	49	49	45	45

- 2.6 The measured background noise levels (L_{A90}) were generally due to existing hospital building services plant noise emissions. Residual noise (L_{Aeq}) was also attributable to vehicular activity on Redlands Road.
- 2.7 It can be seen that the noise levels at both measurement heights were virtually the same, albeit indicating a background / existing plant noise level at ~5m height that is about 1dB higher than the level at 1.5m height.
- 2.8 The weather during the survey was dry and calm, with windspeeds typically below 3m/s.

3.0 NOISE IMPACT ASSESSMENT

Environmental Noise Assessment

- 3.1 British Standard 4142: 2014 +A1:2019 'Methods for rating and assessing industrial and commercial sound' provides methods for rating and assessing sound of an industrial nature from industrial or commercial premises.
- 3.2 This requires the sound from a specific source (in L_{Aeq}) to be compared with the existing background sound level (L_{A90}) outside residential locations. The standard also puts weight on the importance of the context in which the sound will occur.
- 3.3 The 'rating' level is based on the 'specific' L_{Aeq} sound level attributable to the operation with an 'acoustic feature' penalty added for any sound sources which give rise to tonal, impulsive, intermittent, or other characteristics readily distinctive against the residual acoustic environment.
- 3.4 BS 4142 stipulates that impacts should be assessed over a reference time interval of 1-hour during the daytime (0700-2300hrs) and 15-minutes during the night-time (2300-0700hrs).
- 3.5 An initial estimate of the impact of the operation is determined by subtracting the background level from the 'rating' level. BS 4142 states that:
- A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context
 - A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context
 - 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.
- 3.6 Regarding background sound levels, BS 4142 requires that *"values are reliable and suitably represent the particular circumstances and periods of interest... the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods"*. It is also stated that *"diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes"*.

- 3.7 We note from previous similar assessments undertaken locally, that Reading Borough Council typically seek for the rating sound level of new plant to be 10dB below the pre-existing background sound level, $L_{A90,T}$ at a point 1 metre externally to nearby residences.
- 3.8 The foregoing demonstrates that this is a particularly onerous stipulation, following the provisions of BS 4142. Nonetheless, for the purposes of this assessment, based on this, and the findings of the baseline noise survey described here, the following noise rating limit is determined:
- 35dB $L_{A,r}$ at 1m from residences at Redlands Road
- 3.9 We have been provided by the project M+E engineers with the noise emissions data for the proposed Daikin unit, as set out in Table 2.

Table 2 : AHU Noise Emissions Data

Component	Sound Power Level dB / Octave Band Centre Frequency Hz							
	63	125	250	500	1k	2k	4k	8k
Supply Fan Intake	69	80	76	73	69	66	62	61
Extract Fan Exhaust	78	85	79	80	77	74	71	66
Supply Casing	66	76	64	64	61	57	54	35
Extract Casing	69	76	63	62	59	54	51	32

- 3.10 Furthermore, we have been provided with the insertion losses for the proposed atmosphere-side attenuators, which are proposed to both the intake and exhaust ducts, as set out in Table 3.

Table 3 : Atmosphere-Side Attenuator Insertion Loss Data

Component	Sound Power Level dB / Octave Band Centre Frequency Hz							
	63	125	250	500	1k	2k	4k	8k
Atmosphere-Side Attenuator Insertion Loss	12	20	34	45	40	31	23	20

- 3.11 Based on the data set out in Tables 2 and 3, the total noise emissions have been calculated at the nearest residences, accounting for surface directivity, distance attenuation, end reflection losses (for the ducted elements only) plus a +3dB façade correction at the residences. Source directivity has been taken as 'on-axis' to ensure a highly cautious assessment.
- 3.12 The calculated resultant noise levels are set out in Table 4.

Table 4 : Predicted Noise Levels at Residences

Component	Noise Level dB								
	Octave Band Centre Frequency Hz								A Weighted
	63	125	250	500	1k	2k	4k	8k	
Supply Fan Intake	17	23	7	-7	-6	0	4	6	11
Extract Fan Exhaust	26	28	10	0	2	8	13	11	18
Supply Casing	31	41	29	29	26	22	19	0	32
Extract Casing	34	41	28	27	24	19	16	-3	30
Total >>>>									34

- 3.13 For the type of plant proposed, it is not anticipated that the noise emissions will display any characteristics that would warrant acoustic feature corrections to be applied to derive the 'rating' level, in line with BS 4142.
- 3.14 Therefore it can be seen from Table 4 that the predicted rating noise level is 34dB $L_{A,r}$, which is 1dB lower than the limit defined in paragraph 3.8.
- 3.15 It is understood that a solid barrier will also be erected around the plant, which will reduce noise levels even further.
- 3.16 Therefore, it is shown that the proposed installation will not give rise to any harm to amenity by way of noise at the nearest residences.

Comments on Noise Impact on Hospital

- 3.17 Further to above, albeit not a planning issue, it is recommended that consideration is given to controlling noise emissions from the proposed new plant within other hospital accommodation, both within the new development and other nearby buildings.
- 3.18 The Department of Health document Health Technical Memorandum 08-01 (HTM 08) stipulates certain internal noise levels not to be exceeded from sources of external noise. These are in absolute terms, rather than in terms relative to existing noise levels.

- 3.19 HTM 08 sets out suitable internal noise design criteria in rooms in healthcare buildings in terms of dB $L_{Aeq,T}$ noise levels, for the consideration of general intrusive external noise. However, these criteria do not include hospital plant noise, which instead should be assessment using a separate set of HTM 08 criteria based on the noise rating (NR) system. This applies to airborne, structure-borne and ductborne noise transfer into areas of the building in/on which the plant is to be installed.
- 3.20 The criteria applicable to internal areas are set out in Table 5.

Table 5 : HTM 08 Criteria for Internal Noise from Mechanical and Electrical Services

Space	M+E Noise Limit
Ward areas, Sleeping areas, Large meeting rooms (>35m ²)	NR30
Recovery rooms, Small office-type spaces, Small meeting rooms (≤35m ²)	NR35
Open clinical areas, Circulation spaces, Public areas, Personal hygiene (ensuite), Small food-preparation areas, Operating theatres, Laboratories, Utility rooms	NR40
Personal hygiene (general access)	NR45
Large food-preparation areas, Laminar-flow theatres	NR50

- 3.21 The implications of the above guidelines upon the proposed new plant will be dependent upon a number of factors. This will include factors relating to the noise emissions from the plant itself, such as the relative location and orientation of the plant with respect to the various nearby hospital areas. However, it may also be necessary to consider existing M+E noise levels inside individual space, so as to avoid adding to this such that the cumulative level exceeds the applicable criterion, and also the sound insulation of the building envelope of the space, and/or the reliance of the use of the space on openable windows for ventilation of the space.
- 3.22 Determination of noise impact on hospital areas, and consequent specific implications, is beyond the scope of this assessment.

4.0 SUMMARY AND CONCLUSION

- 4.1 The potential noise impact associated with the installation of a new roof-top air handling unit associated with development at the ICU facility at Royal Berkshire Hospital, Redlands Road, Reading.
- 4.2 A survey of prevailing background noise has been undertaken close to the nearest residences to the proposed installation.
- 4.3 It has been determined that the proposed plant noise will be at a level lower than one 10dB below the prevailing background noise level at the nearest residences.
- 4.4 Therefore, it is shown that the proposed installation will not give rise to any harm to amenity by way of noise at the nearest residences.
- 4.5 Additional noise and vibration control measures may be needed to ensure adequate control of noise impact inside Hospital areas. Outline guidance has been provided in that regard.

Figure 1 – Site Plan



Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3dB(A) higher than each of the individual noise levels e.g. 60dB(A) plus 60dB(A) = 63dB(A). In terms of perceived 'loudness', a 3dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

L_{pA} This is the A-weighted sound pressure level.

L_{Aeq} This is the A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.

L_{A90} This is the A-weighted noise level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.

L_{Ar} This is the rating sound level as defined in BS 4142: 2014 +A1:2019