Acoustic Consultancy Report

79581/3/3/4

External Plant Assessment

Report Prepared For

Walmsley Associates
Hatfield One Healthcare
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Report Author

[redacted]

Sam Shapley BSc (Hons)

Checked By

[redacted]

J Niemann BSc (Hons) MIOA (D)

Telephone
0118 918 6460
Facsimile
0118 918 6480

enquiries@lcpacoustics.co.uk
www.lcpacoustics.co.uk

LCP
Riverside House
3 Winnersh Fields
Gazelle Close
Winnersh
Wokingham
RG41 5QS

A division of CAICE
Acoustic Air Movement Ltd.

Company Registration Number
2790667
VAT Registration Number
GB614683632

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i) Executive Summary

Acoustic commissioning test has been performed at ONE Hatfield Hospital.

External testing of plant was carried out in accordance with the procedure outlined in BS4142:2014.

The BS4142 assessment undertaken concludes that there is indication of low impact.

Further analysis of measurements show that the plant has no influence on the background noise levels and it can therefore be concluded that the plant is at least 10dB below background noise level and achieves Condition 7 of Decision Notice S6/2015/1061/MA.

This report also concludes that the design criteria and BREEAM POL 05 requirements have been achieved and 1 BREEAM credit can be awarded.

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	29/09/2017	Initial Issue	SS	MB
2	03/10/2017	Revised wording	SS	-
3	09/10/2017	Revised wording	SS	-
4	09/11/2017	Site Revisit following full plant balancing and commissioning	SS	JN

1 Introduction

The development at ONE Hatfield Hospital has reached Practical Completion.

Acoustic commissioning testing has been carried out to confirm the following noise aspect of the design has been achieved:

Commissioned Aspect
External Airborne noise levels from mechanical plant.

This report details all measurement results and data obtained during the testing period, and sets out all findings following comparison of the obtained data with the project design criteria.

2 Testing Programme

The testing was carried out from 23:00 8th November 2017 to 00:15 9th November 2017.

The plant was tested operating in two conditions, daytime and night-time.

Testing was carried out by Sam Shapley of LCP.

Neil Mercer from The James Mercer Group was in attendance to operate the plant.

All plant had been balanced and commissioned prior to testing.

All external noise measurements have been made in accordance with the method outlined in BS4142:2014.

2.1 Calibration

The measurement equipment (as detailed at the end of Appendix B) was calibrated prior to and after obtaining measurements.

The recorded calibration gain adjustment levels were as follows:

Table 1: Calibration gain adjustment levels (114dB at 1 kHz), dB re $2x10^{-5}$ Pa

Location	Before	After
MP1	1.32	1.28

2.2 Site Description

The site layout, together with the measurement positions, is shown in the drawing contained within Appendix A.

The nearest receiver with direct line of sight to the plant area is 33m to the north east of the site. This is shown in the site plan in Appendix A.

2.3 Local Noise Climate

The predominant local noise source was road traffic noise on the A1(M).

2.4 Weather

The weather conditions monitored during the survey are shown in the following table.

Table 2: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	2 m/s
Wind Direction	West
Cloud Cover	50%
Temperature	2°C
Precipitation	None

3 Residential Design Criteria

The design criteria have been obtained from condition 7 in Decision Notice - S6/2015/1061/MA and are summarised below.

"Prior to the commencement of the development details relating to noise from plant and equipment to be installed at the premises with evidence in the form of an acoustic report showing that noise emissions from plant and equipment will be 10dB (L_{Aeq}) below the background noise level (L_{A90}) at the nearest residential property (using the methodology outlined within BS4142:2014) must be submitted to and approved in writing by the Local Planning Authority. The development must not be carried out other than in accordance with the approved scheme."

3.1 BS4142:2014

BS4142:2014 states that 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.

Table 3: BS4142 assessment based upon rating level

Difference between background noise and rating levels	Assessment
+ 10 dB	Indication of a significant adverse impact
+ 5 dB	Indication of an adverse impact
0 dB	Indication of low impact

Certain acoustic features can increase the significance of impact. The specific sound level should be corrected if a tone, impulse or other acoustic feature is expected to be present.

Table 4: Corrections for acoustic features, subjective method

Acoustic Feature	Correction, dB		
	Just Perceptible	Clearly Perceptible	Highly Perceptible
Tonality	2	4	6
Impulsivity	3	6	9
Other Characteristics	3		
Intermittency	3		

Typically the acoustic feature correction would not be expected to exceed 10dB.

Where the level of uncertainty could affect the conclusion, take reasonably practicable steps to reduce the level of uncertainty.

3.2 BREEAM 2014 - Pol 05 Criteria

BREEAM Pol 05 criterion is aimed to reduce the likelihood of noise arising from fixed installations on the new development affecting nearby noise-sensitive buildings.

Table 5: BREEAM Pol 5 criteria

Credit Available	Criteria	Testing Required
One Credit	Where there are, or will be, no noise-sensitive areas or buildings within 800m radius of the assessed development.	
	Where the building does have noise-sensitive areas or buildings within 800m radius of the development a credit can be awarded for: a) Where a noise impact assessment in compliance with BS7445 has been carried out and the following noise levels measured/determined: i) Existing background noise levels at the nearest or most exposed noise-sensitive development or at a location where background conditions can be argued to be similar ii) The rating noise level resulting from the new noise source b) The noise impact assessment must be carried out by a suitable qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body. c) The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00) compared to the background noise level. d) Where the noise source(s) from the proposed site/building is greater than the levels described in the criterion, measures have been installed to attenuate the noise at its source to a level where it will comply	Yes

4 Current Design

The plant is located on the roof of the hospital, a 2.5m high acoustic screen surrounds the plant area. The plant includes seven AHUs.

The four AHUs supplying the Theatre & Recovery rooms will operate at a setback speed (70%) during night time hours (18:00 - 08:00). The AHU serving the Ambulatory Care and Consulting rooms will operate during day time hours (08:00 - 18:00). The two AHUs serving the Wards and Spinal Recovery rooms will operate over a 24-hour period.

Measurements were made with the plant operating in both daytime and night-time conditions.

5 Results

A BS4142 assessment has been carried out using the levels measured from the acoustic commissioning. The measured sound pressure levels are shown within Appendix B.

Measurements were taken 4m away from the nearest residential property.

The measurement position was 27m from the nearest plant. 1m from the nearest residential receiver's window was 33m from the nearest plant.

Subjectively, the plant was noted as inaudible at the nearest residential property.

Calculations can be found in Appendix C.

5.1 Daytime

Table 6: BS4142 assessment, dB re $2x10^{-5}$ Pa

Results	Result dB(A)	Comments
Measured Ambient sound level L_{Aeq} (Plant on)	51	Plant is undetectable at the boundary of site and at the measurement position
Residual sound level L_{Aeq} (Plant off)	52	
Background sound level L_{A90} (Plant off)	48	Road traffic noise was the only noise source detected.
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level L_{Aeq}	≤ 41	
Distance Correction of 6m	≤ 41 – 2 = ≤ 39	Calculations can be found in Appendix C
Acoustic feature correction	0	No tonality, impulsivity or intermittency characteristics were detected.
Rating level	≤ 39	
Excess of rating over background sound level criteria	≤ -9	
Assessment	Indication of low impact	

5.2 Night-time

Results	Result dB(A)	Comments
Measured Ambient sound level L_{Aeq} (Plant on)	51	Plant is undetectable at the boundary of site and at the measurement position
Residual sound level L_{Aeq} (Plant off)	52	Road traffic noise was the only noise source detected.
Background sound level L_{A90} (Plant off)	48	Calculations can be found in Appendix C
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level L_{Aeq}	≤ 41	
Distance Correction of 6 meters	41 – 2 = ≤ 39	Calculations can be found in Appendix C
Acoustic feature correction	0	No tonality, impulsivity or intermittency characteristics were detected.
Rating level	≤ 39	Plant is undetectable at the boundary of site and at the measurement position
Excess of rating over background sound level criteria	≤ -9	
Assessment	Indication of low impact	

6 Comments and Conclusion

Acoustic commissioning test has been performed at ONE Hatfield Hospital.

External testing of plant was carried out in accordance with the procedure outlined in BS4142:2014.

Subjectively, the plant was noted as being inaudible at the nearest residential receiver.

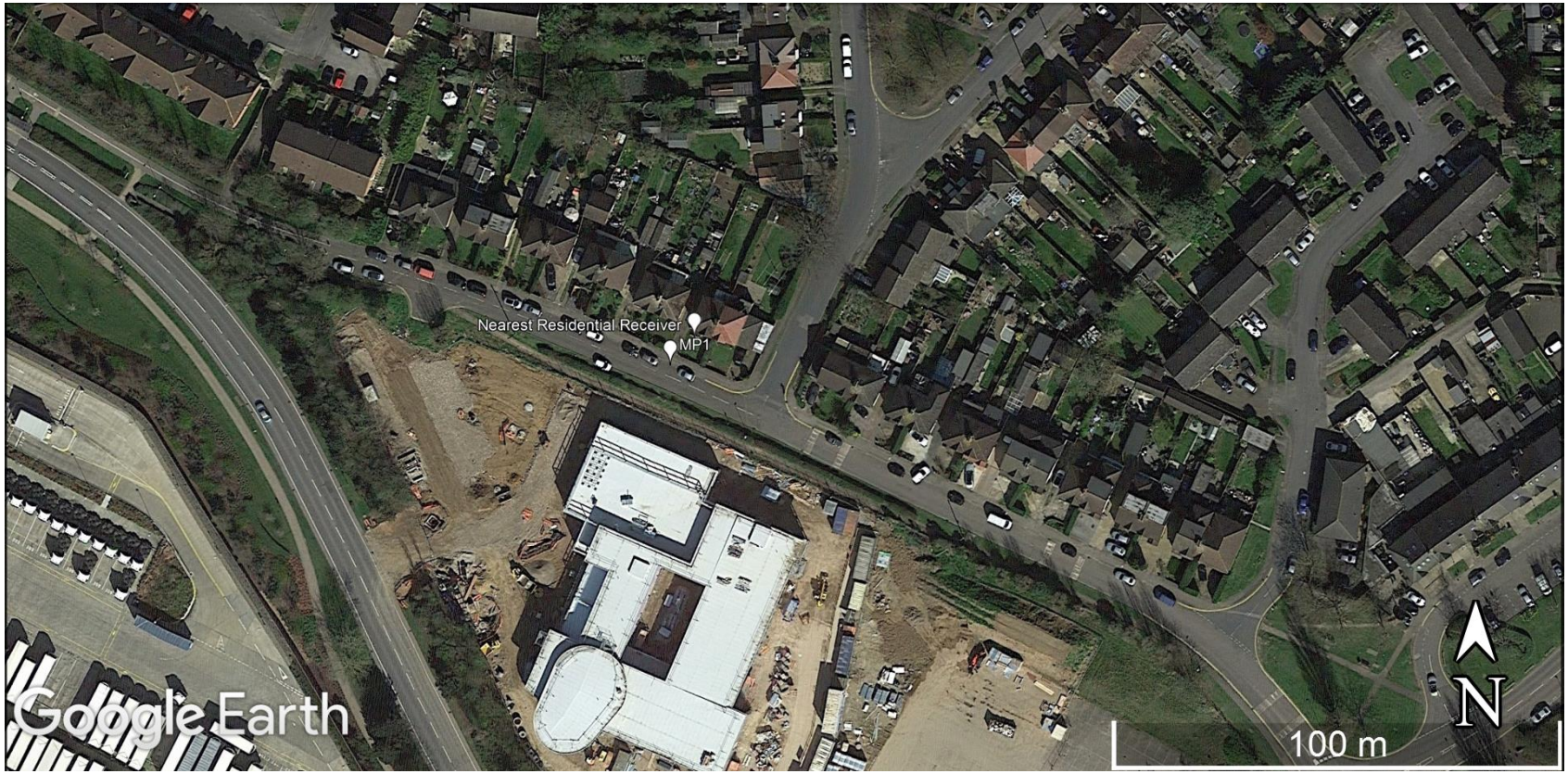
The BS4142 assessment undertaken concludes that there is indication of low impact.

Whilst the calculated rating level, calculated in accordance with BS4142, achieved -9dB below the measured background noise level. It should be noted that the L_{A90} noise level measured during all plant on and off noise measurements was consistent and stable. It can therefore be concluded that the plant is of no influence on the L_{A90} background noise level and therefore must be at least 10dB below it. For this reason, Condition 7 of Decision Notice S6/2015/1061/MA has been achieved.

This cannot be shown by the ambient noise level alone as the operational plant is inaudible and the residual sound level has been dominated by the transient noise events along Manor Road and the A1.

This report concludes that the design criteria and BREEAM POL 05 requirements has been achieved and 1 BREEAM credit can be awarded.

Appendix A: Site Plan



Approximate measurement position (Latitude & Longitude) 51°46'17.59" N 0°14'10.33" W

Appendix B: Measurement Data

L_{Aeq}

No	Date & time	Elapsed time	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	L_{Aeq}	Plant State
1	08/11/2017 23:00:06	00:15:00	65	56	50	49	51	47	42	36	54	Night-time Mode
2	08/11/2017 23:15:06	00:15:00	62	53	48	47	48	42	34	26	51	Night-time Mode
3	08/11/2017 23:31:26	00:15:00	64	56	53	50	50	46	40	32	52	Off
4	08/11/2017 23:52:26	00:15:00	63	51	47	46	47	39	31	25	50	Day-time Mode
5	09/11/2017 00:07:26	00:15:00	64	54	48	47	49	43	33	26	51	Day-time Mode

L_{A90}

No	Date & time	Elapsed time	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	L_{A90}	Plant State
1	08/11/2017 23:00:06	00:15:00	57	48	44	44	46	37	22	14	48	Night-time Mode
2	08/11/2017 23:15:06	00:15:00	55	48	44	43	45	36	22	13	48	Night-time Mode
3	08/11/2017 23:31:26	00:15:00	56	48	46	44	45	37	22	14	48	Off
4	08/11/2017 23:52:26	00:15:00	58	48	44	44	45	36	22	14	47	Day-time Mode
5	09/11/2017 00:07:26	00:15:00	57	47	42	43	44	36	22	14	47	Day-time Mode

L_{Amax}

No	Date & time	Elapsed time	$L_{AMax\ Fast}$	$L_{AMax\ Slow}$	Plant State
1	08/11/2017 23:00:06	00:15:00	82	73	Night-time Mode
2	08/11/2017 23:15:06	00:15:00	67	65	Night-time Mode
3	08/11/2017 23:31:26	00:15:00	75	71	Off
4	08/11/2017 23:52:26	00:15:00	64	58	Day-time Mode
5	09/11/2017 00:07:26	00:15:00	67	65	Day-time Mode

Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11207
- Svantek pre-amplifier SV12L S/N: 49860 with GRAS microphone capsule 40AE S/N: 215511

Calibration checks were made prior to and after completion of measurements using a Bruel & Kjaer 4231 calibrator, S/N: 10890 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Calculations

Distance correction Daytime

L1 to L2 point source				
L1	**r1**	**r2**	**L2**	**Loss**
41	27	33	39	2

Distance correction Night-time

L1 to L2 point source				
L1	**r1**	**r2**	**L2**	**Loss**
38	27	33	36	2

Appendix D: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

Airborne Noise

Noise transmitted through air.

dB or Decibel

Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB ≠ 60 dB	30 dB + 30 dB = 33 dB

$D_{nTw}+C_{tr}$

The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D	Is simply L1 – L2.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.
C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

Impact Noise

Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors.

Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The 'A' weighted maximum measured noise level. Can be measured with a 'slow' (1 sec) or 'fast' (0.125 sec) time weighting.

L_{Amin}

The 'A' weighted minimum measured noise level.

L'_{nTw}

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

L	Is the spatially averaged impact sound pressure level measured in a receive room.
L'_{nT}	Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.
L'_{nTw}	Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result .

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to $2x10^{-5}$ Pa.

W

Watts, the SI unit to describe power, after engineer James Watt.