
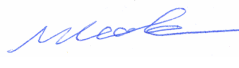








Great Ormond Street Hospital, Acoustic Survey Report

2 November 2006

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1 Introduction

1.1 INTRODUCTION

1.1.1 WSP has been appointed to undertake a survey of the prevailing noise climate surrounding Great Ormond Street Hospital for Children (GOSH), London, in relation to phase 2 of the GOSH redevelopment.

1.1.2 Accordingly, WSP has undertaken measurements of the existing background and ambient noise levels in the vicinity of the nearest noise-sensitive receptors to the site.

1.1.3 Noise measurements were taken at six positions around the site. The details of the noise survey methodology are given in Section 4 of this Report.

1.1.4 Based on the results of the ambient and background noise survey, maximum permissible noise emission limits have been set for all new plant and equipment.

1.1.5 This Report is necessarily technical in nature and a glossary of terms can be found in Appendix A.



2 Site Description

2.1.1 A site plan and area plan showing the site and the surrounding area are presented in Appendix B of this report.

2.1.2 The site is bounded to the north by Guilford Street, to the east by Lambs Conduit Street, to the south by Great Ormond Street, and to the west by Queen Square.

2.1.3 The area was found to comprise a mixture of housing, retail, health and educational facilities.

2.1.4 Of the three roads bounding the site, Guilford Street was found to be relatively busy with Great Ormond Street and Lambs Conduit Street generally less busy.

2.1.5 The main entrance to the hospital and access for ambulances is via Great Ormond St.

2.1.6 The nearest noise-sensitive receptors to the site are identified below and can be seen on the site plan in Appendix B.

- The dwellings on the South side of Great Ormond St.
- The dwellings on the East side of Lambs Conduit.
- The dwellings on to North side of Guilford St.

2.1.7 The measurement positions that relate to the above locations are described in Section 4.

3 Assessment Criteria

3.1 PLANNING POLICY GUIDANCE NOTE 24

3.1.1 Planning Policy Guidance Note (PPG) 24, *Planning and Noise*, published in September 1994, sets out the Government's policies on noise related planning issues. It gives guidance to local authorities in England on the use of their planning powers to minimise the adverse impact of noise. Specifically, it:

- outlines the considerations to be taken into account when determining planning applications for both noise-sensitive developments and for those activities which will generate noise;
- sets out Noise Exposure Categories for residential development, encourages their use and recommends appropriate levels for exposure to different sources of noise; and
- advises on the use of planning conditions to minimise the impact of noise.

3.1.2 PPG24 advises that *"Developments such as offices, hospitals and schools will contain buildings and activities which are noise-sensitive. But these developments are likely to occupy sizeable sites and to contain a proportion of buildings and activities which are less noise-sensitive. The NEC principle cannot therefore be sensibly applied to such developments and it will be more appropriate to refer to specific guidance on internal noise standards in respect of each activity."*

3.1.3 With regards to industrial noise, PPG 24 advises that *"The likelihood of complaints about noise from industrial development can be assessed, where the standard is appropriate, using the guidance in BS 4142"* and that *"In addition, general guidance on acceptable noise levels within buildings can be found in BS 8233."*

3.1.4 The requirements of BS 4142: 1997 are summarised below.

3.2 BRITISH STANDARD 4142: 1997 METHOD FOR RATING INDUSTRIAL NOISE AFFECTING MIXED RESIDENTIAL AND INDUSTRIAL AREAS

3.2.1 BS 4142 is intended to be used to assess whether noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises is likely to give rise to complaints from people residing in nearby dwellings.

3.2.2 The procedure contained in BS 4142 for assessing the likelihood of complaint is to compare the measured or predicted noise level from the source in question, the '*specific noise level*', immediately outside the dwelling with the background noise level.

3.2.3 Where the noise contains a '*distinguishable discrete continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough to attract attention*' then a correction of +5 dB is added to the specific noise level to obtain the '*rating level*'.

3.2.4 The likelihood of noise provoking complaints is assessed by subtracting the background noise level from the rating noise level. BS 4142 states:

"A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance. A difference of -10 dB is a positive indication that complaints are unlikely."

3.2.5 For the daytime, this assessment is carried out over a one hour period, and over a five minute period at night. Day and night are not defined in the standard but it states that night should cover the times when the general adult population are preparing for sleep or are actually sleeping. For the purposes of this assessment it is assumed that the day and night periods reflect those stated in PPG 24, i.e. day is 07:00 to 23:00 hours and night 23:00 to 07:00 hours.

3.3 REQUIREMENTS OF LONDON BOROUGH OF CAMDEN REPLACEMENT UNITARY DEVELOPMENT PLAN

3.3.1 The requirements of the London Borough of Camden (LBC) are set out within their Replacement Unitary Development Plan (UDP) and are summarised below.

“SD7 – Light, noise and vibration pollution

.....

B – Noise/vibration pollution

Unless appropriate attenuation measures are available and are included, the Council will not grant planning permission for:

- a). development likely to generate noise/vibration pollution; or*
- b). development sensitive to noise/vibration in locations with noise/vibration pollution.*

In assessing applications against these criteria, the Council will have regard to the levels set out in Appendix 1 to this Plan.

3.3.2 It goes on to say,

1.48 The Council will only grant planning permission for development sensitive to noise/vibration in locations that experience noise/vibration pollution if appropriate attenuation measures are taken. Table B sets out noise pollution levels from road and rail at and above which attenuation measures will be required before planning permission is granted for adjoining residential sites

1.49 Planning permission will not be granted for development sensitive to noise/vibration in locations that have unacceptable levels of noise/vibration. Tables A and C set out unacceptable noise and vibration levels from road and rail at and above which planning permission will not be granted for adjoining residential sites.

.....

1.52 The Council seeks to ensure that the level of noise/vibration from all plant and machinery does not increase existing ambient noise levels, therefore planning permission will only be granted for plant or machinery if it can be operated without causing a loss to local amenity and does not exceed the thresholds set out in Table E. In determining whether a proposal may be acceptable, the Council will require planning applications to include details of all proposed plant and machinery associated with a development, including an acoustic report. This may require close co-operation between an environmental or air handling engineer and the architect to agree an acceptable design solution for the particular premises and uses for which the system is designed. Supplementary guidance contains general guidance on minimising the impacts of plant and machinery.

APPENDIX 1 – NOISE AND VIBRATION THRESHOLDS

Table A: Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1m external to a sensitive facade	Day	0700-1900	74 dB $L_{Aeq,12hr}$	72 dB $L_{Aeq,12hr}$
	Evening	1900-2300	74 dB $L_{Aeq,4hr}$	72 dB $L_{Aeq,4hr}$
	Night	2300-0700	66 dB $L_{Aeq,8hr}$	66 dB $L_{Aeq,8hr}$

Table B: Noise levels on residential sites adjoining railways and roads at and above which attenuation measures will be required

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1m external to a sensitive facade	Day	0700-1900	65dB $L_{Aeq,12hr}$	62 dB $L_{Aeq,12hr}$
	Evening	1900-2300	60 dB $L_{Aeq,4hr}$	57 dB $L_{Aeq,4hr}$
	Night	2300-0700	55 dB $L_{Aeq,1hr}$	52 dB $L_{Aeq,8hr}$
Individual noise events several times an hour	Night	2300-0700	>82 dB $L_{Amax,s;low}$	>82 dB $L_{Amax,s;low}$

Table C: Vibration levels on residential sites adjoining railways and roads at which planning permission will not be granted (BS 6742:1992)

Vibration description and location of measurement	Period	Time	Vibration levels
Vibration inside critical areas such as hospital operating theatre	Day, evening and night	0000-2400	0.1 VDV $ms^{-1.75}$
Vibration inside dwellings	Day and evening	0700-2300	0.1 to 0.4 VDV $ms^{-1.75}$
Vibration inside dwellings	Night	2300-0700	0.13 VDV $ms^{-1.75}$
Vibration inside offices	Day, evening and night	0000-2400	0.4 VDV $ms^{-1.75}$
Vibration inside workshops	Day, evening and night	0000-2400	0.8 VDV $ms^{-1.75}$
Where dwellings may be affected by ground-borne regenerate noise internally from, for example, railways or underground trains within tunnels, noise level within the rooms should not be greater than 35 dB(A) max.			

Table D: Noise levels from places of entertainment on adjoining residential sites at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Sites adjoining places of entertainment
Noise at 1m external to a sensitive facade	Day and evening	0700-2300	$L_{Aeq,5m}$ shall not increase by more than 5 dB*
	Night	2300-0700	$L_{Aeq,5m}$ shall not increase by more than 3 dB*
Noise inside any living room of any noise sensitive premises, with the windows open or closed	Night	2300-0700	$L_{Aeq,5m}$ (in the 63 Hz Octave band measured using the "fast" time constant) should show no increase in dB*
*As compared to the same measure, from the same position, and over a comparable period, with no entertainment taking place.			

Table E: Noise levels on from plant and machinery at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Noise level
Noise at 1m external to a sensitive facade	Day, evening and night	0000-2400	5 dB(A) < L_{A90}
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1m external to a sensitive facade	Day, evening and night	0000-2400	10 dB(A) < L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1m external to a sensitive facade	Day, evening and night	0000-2400	10 dB(A) < L_{A90}
Noise at 1m external to a sensitive facade where $L_{A90} > 60$ dB	Day, evening and night	0000-2400	55 dB < L_{Aeq}

3.4 NHS ESTATES – HEALTH TECHNICAL MEMORANDUM 2045, ACOUSTICS, DESIGN CONSIDERATIONS

3.4.1 Health Technical Memorandum (HTM) 2045 - 'Acoustics' is mainly applicable to new sites; but measures have sometimes been given which could also be applied retrospectively to existing buildings. It gives advice and guidance to healthcare management, design engineers, estates managers and operations managers on the legal requirements, design implications, maintenance and routine measures which should be adopted.

3.4.2 HTM 2045 is published as four separate volumes, each addressing a specialist discipline. The most relevant to this report is the 'Design Considerations' volume. This volume does not set out to give instruction to design work, but to highlight the overall requirements and considerations that should be applied to noise control.

3.4.3 It must be noted that this document is no longer in print, with a new draft version being developed. However, given it is the latest published relevant NHS document available, it is considered appropriate to consider the guidance provided within it.

3.4.4 Section 3.0 of HTM 2045 deals with the specification of relevant acoustic design criteria:

“Intrusive Noise

3.13 Intrusive noise is a blanket term used to describe the sum of noise reaching an area from all sources other than mechanical services installation. Examples of intrusive noise would be:

- a) Traffic on nearby roads;
- b) Aircraft flying overhead
- c) Plant on neighbouring buildings.

3.14 Intrusive noise criteria should be specified in terms of NR value for each area under consideration. Appropriate values are given in Table 4.

Table 4 Intrusive Noise Criteria

Location	Recommended NR level for mechanical services noise
Lecture theatre	35
Operating theatre, single bed ward	35
Private office, meeting and consultation room	35
Multi-bed ward, waiting room	40
General office	40
Staff room, recreation room, cafeteria	45
Corridor, laboratory	50
Washroom, toilet, kitchen	50

3.15 The NR values given above are in terms of equivalent continuous sound pressure level (L_{eq}) for “worst-case” situations, that is, the periods during which intrusive noise is likely to be at its highest value.”

3.4.5 It goes on to say,

“Airborne sound insulation – external facades

3.22 Under certain circumstances, it may be deemed necessary to specify the actual performance requirement for a façade. Even when criteria are in terms of intrusive noise limits, the façade performance requirement will have to be identified at some point during the design process. The procedure for calculating façade requirements is laid out below:

- a) Noise data for external sources should be obtained from surveys, predictive calculations, or a combination of both;
- b) The appropriate intrusive noise criterion (or criteria) should be used in conjunction with the external noise data to calculate the façade performance requirement in terms of weighted apparent sound reduction index as defined in BS 5281 Part 3.”



4 Noise Survey

4.1 SURVEY METHODOLOGY

4.1.1 WSP conducted a series of noise measurement surveys to establish the prevailing ambient noise and background noise levels at key locations around the site. The surveys comprised 24 hour unattended noise surveys at three positions and attended short term measurements at an additional three locations.

4.1.2 The unattended noise surveys were undertaken at the following positions and times:

- **Position 1** – 1m from the southern façade of level 1 of the hospital facing Great Ormond Street. This survey was undertaken between 13:00 7th of November and 14:00 8th of November 2005. This position was adjacent the main hospital entrance on top of the first floor balcony.
- **Position 2** – in line with the façade on the roof of The Lamb public house located on the eastern side of Lambs Conduit Street. This survey was undertaken between 14:00 4th of November and 01:00 6th of November 2005. The meter on this survey stopped recording prematurely, however this has not affected the survey significantly.
- **Position 3** – 1m from the northern façade of level 1 of the hospital facing Guilford Street. This survey was undertaken between 13:00 7th of November and 14:00 8th of November 2005.

4.1.3 The attended noise surveys were undertaken at the following positions and times:

- **Position 4** – 1m from the southern façade of the hospital facing Great Ormond Street. This position was exposed to similar noise levels as to position 1 described above.
- **Position 5** – 1m from the eastern façade of the hospital facing Lambs Conduit Street. This position was exposed to similar noise levels as to position 2 described above.
- **Position 6** – 1m from the northern façade of the hospital facing Guilford Street. This position was exposed to similar noise levels as to position 3 described above.

4.1.4 All attended measurements were undertaken at 1m from the façade of the GOSH and at 1.5m above the ground.

4.1.5 Each of the attended measurements lasted for a period of between 20 and 30 minutes during the day and night, which apart from some low level construction noise audible at positions 4 and 6 during the day, no atypical noise sources were observed.

4.1.6 It should be noted however, that the construction noise was infrequent and at such a low level as not to be dominant and unlikely to significantly affect the reported background noise levels. It is possible the construction noise levels had a small effect on the ambient levels.

4.1.7 The weather during all surveys was conducive to the measurement of noise, it being fine and dry with only a little wind.

4.1.8 Table 1 presents the noise monitoring equipment used to conduct the noise surveys.



Table 1 - Inventory of Acoustic Measurement Equipment

Item	Make & Model	Serial No.
Sound Level Meter	01dB-Stell Solo Master	10330
Pre-amplifier	01dB-Stell PRE 21 S	10423
Microphone	Microtech Gefell GmbH MCE212 Condenser	37991
Sound Level Meter	01dB-Stell Solo Master	10712
Pre-amplifier	01dB-Stell PRE 21 S	11349
Microphone	Microtech Gefell GmbH MCE212 Condenser	39755
Sound Level Meter	01dB-Stell Solo Master	10706
Pre-amplifier	01dB-Stell PRE 21 S	11464
Microphone	Microtech Gefell GmbH MCE212 Condenser	39648
Calibrator	01dB-Stell Cal 21	51031216

4.1.9 The meters were calibrated before and after the surveys. No drift in calibration levels occurred.

4.1.10 The L_{Aeq} , L_{A90} , L_{A10} and $L_{Amax,fast}$ noise indices were measured (see Appendix A for a glossary of terminology).

4.2 SURVEY RESULTS

4.2.1 Table 2 below presents a summary of the ambient noise levels measured during the unattended noise surveys.

4.2.2 Full tabulated and graphical results of the noise measurement data are presented in Appendix C.

Table 2 – Unattended Noise Survey Results

Position	Period	Time	T	Measured Noise Level, dB $L_{Aeq,T}$
1	Day	0700-1900	12h	64.7
	Evening	1900-2300	4h	60.2
	Night	2300-0700	8h	56.4
2	Day	0700-1900	12h	64.9
	Evening	1900-2300	4h	64.9
	Night	2300-0700	8h	55.0
3	Day	0700-1900	12h	70.7
	Evening	1900-2300	4h	65.0
	Night	2300-0700	8h	65.3



4.2.3 In accordance with BS4142, the assessment for all new plant and equipment will be for a time period of 1 hour during the day (07:00-23:00) and 5 minutes during the night (23:00-07:00).

4.2.4 To enable the rating noise level for new plant and equipment to be determined Table 3 below outlines the lowest measured background noise levels during the day and night.

Table 3 – Summary of Unattended Lowest Measured Background Noise Levels

Position	Period	Time	T	Lowest Measured Background Noise Level, dB $L_{A90,T}$
1	Day	0700-2300	1h	47.1
	Night	2300-0700	5mins	44.3
2	Day	0700-2300	1h	48.8
	Night	2300-0700	5mins	46.7
3	Day	0700-2300	1h	50.1
	Night	2300-0700	5mins	41.2

4.2.5 Table 4 presents a summary of the measured noise levels during the short term attended measurements.

Table 4 – Summary of Attended Noise Measurements

Position	Period	Start	Finish	Measured Noise Level, dB			
				L_{Aeq}	L_{AFmax}	L_{A90}	L_{A10}
4	Day	10:07	10:52	68.4	88.9	58.4	71.1
	Night	01:38	01:58	50.3	72.7	44.5	46.3
5	Day	11:35	12:00	67.1	85.9	56.9	70.1
	Night	02:01	02:21	52	73.8	45.1	53.4
6	Day	10:56	11:31	69.7	86.1	57.5	73.6
	Night	02:01	02:21	62	90	47.6	57.5

4.2.6 As previously stated, no atypical noise sources were noted during the attended surveys.

4.2.7 Comparison of the recorded noise levels in Tables 2, 3 and 4 show good correlation between the unattended and attended noise surveys.

4.2.8 As such, the more comprehensive unattended noise survey is presumed to be a good representation of the typical noise climate around the site.

4.2.9 Based on the this the unattended noise survey data has been used to assess the suitability of the site for a hospital development, any required acoustic treatments to mitigate excessive internal noise levels, and to determine suitable noise emission limits for all new plant and equipment.

5 Assessment

5.1 FAÇADE NOISE EXPOSURE

5.1.1 The measured noise levels shown in Table 2 are all below the levels indicated in Table A of Appendix 1 of the LBC UDP for which planning permission should not be granted. They are, however, in some cases above the levels shown in Table B of the same Appendix. For these levels the LBC UDP states that attenuation measures will be required.

5.2 BUILDING SERVICES PLANT NOISE EMISSION CRITERIA

5.2.1 Table 5 below outlines the maximum permissible total noise emission from all plant and equipment based on the lowest measured background levels.

Table 5 – Maximum Permissible Plant Noise Emission Limits at 1m from the Façade of Noise Sensitive Premises

Position	Period	T	Lowest Measured Background Noise Level, dB $L_{A90,T}$	Total Noise Emission Limit from all Plant and Equipment, dB $L_{Aeq,T}$
Great Ormond Street	Day	1h	47	42
	Night	5mins	44	39
Lambs Conduit Street	Day	1h	49	44
	Night	5mins	47	42
Guilford Street	Day	1h	50	45
	Night	5mins	41	36

Note ¹ Where it is anticipated that the equipment will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses in the noise (bangs, clicks, clatters, thumps), the total noise level from all plant and equipment should be at least 5 dB below those levels shown in the final column.



7 Conclusion

7.1.1 WSP has been appointed to undertake a noise survey and assessment in relation to the design for Phase 2 of the redevelopment of Great Ormond Street Hospital for Children (GOSH).

7.1.2 The assessment has been based upon the results of an environmental noise survey that has been undertaken in order to establish the prevailing noise conditions at the site. The measured noise levels have been compared against the noise criteria within the London Borough of Camden Replacement Unitary Development Plan to determine the suitability of the site for the proposed development and possible need for noise mitigation measures.

7.1.3 Based on the survey results it is concluded that subject to the incorporation of suitable noise mitigation measures, as outlined in Section 6, the existing noise climate is suitable for hospital developments.

7.1.4 The noise impact from the proposed hospital onto existing noise sensitive sites should be also acceptable subject to compliance with the noise emission limits outlined in Table 5.

7.1.5 The limitations to this report are presented in Appendix D.

Appendix A Glossary of Acoustic Terminology

NOISE

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Typical sound levels found in the environment

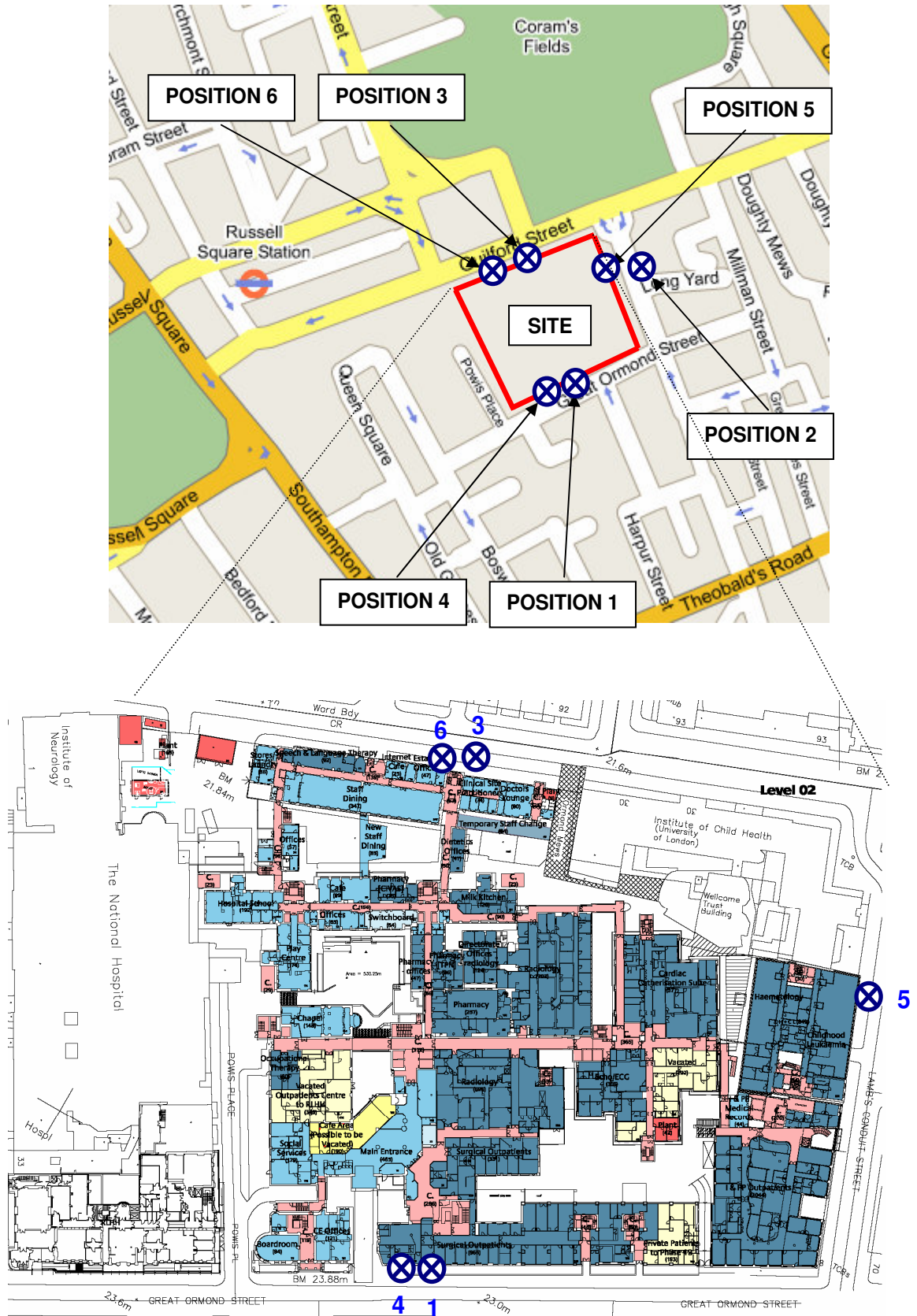
Sound Level	Location
0 dB(A)	Threshold of hearing
20 to 30 dB(A)	Quiet bedroom at night
30 to 40 dB(A)	Living room during the day
40 to 50 dB(A)	Typical office
50 to 60 dB(A)	Inside a car
60 to 70 dB(A)	Typical high street
70 to 90 dB(A)	Inside factory
100 to 110 dB(A)	Burglar alarm at 1m away
110 to 130 dB(A)	Jet aircraft on take off
140 dB(A)	Threshold of pain

Acoustic Terminology

dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2×10^{-5} Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response (L_{AFmax}).
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Ambient Noise Level	The all encompassing noise level measured in $L_{Aeq,T}$. The Ambient Noise Level incorporates background sounds as well as the industrial source noise under consideration.
Residual Noise Level	The Ambient Noise Level in the absence of the industrial source noise under consideration, measured in $L_{Aeq,T}$.
Specific Noise Level	The noise level measured in $L_{Aeq,T}$ attributed to the industrial noise source under consideration alone.
Background Noise Level	The noise level in the absence of the industrial source noise under consideration, measured in L_{A90} .

Appendix B Site Location and Noise Survey Positions

SITE LOCATION AND NOISE MEASUREMENT POSITIONS



Appendix C Noise Survey Data

TABLE C1 - ATTENDED NOISE SURVEY DATA

Position	Start	End	Desc.	Leq	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	Fast Max (A)
4	08/11 01:38	08/11 01:58	L _{Aeq}	50.3	57.2	51.5	51.4	48.3	46.5	41.3	32.3	53.1
			L _{Amax}	72.7	77.5	71.4	75.3	67.4	71	64.9	53.7	74.9
			L _{A90}	44.5	52.9	47.8	45.6	43.5	38.4	32.5	25.2	45.1
			L _{A10}	46.3	55.8	49.9	48.6	46.2	41.2	36.1	31.5	47.5
4	08/11 10:07	08/11 10:52	L _{Aeq}	68.4	76.9	69.7	66.1	64.4	64.1	61.9	56.5	70.6
			L _{Amax}	88.9	92.7	89.2	84.9	82.4	83.5	84.5	79.6	91.2
			L _{A90}	58.4	66.2	59	56.6	55.4	54.3	49	41.5	59.5
			L _{A10}	71.1	80.2	72.3	68.7	67.4	67	64	58.6	73.1
5	08/11 02:01	08/11 02:21	L _{Aeq}	52	59.6	55.1	50.5	48.9	47.7	44.8	38.5	53.5
			L _{Amax}	73.8	77.2	74.7	70.9	69.3	70.2	67.2	60.1	75.1
			L _{A90}	45.1	54.6	51.4	44.8	42	39.3	36.6	30.8	45.6
			L _{A10}	53.4	60.8	55.5	51.7	50.5	49.3	45.8	39.9	54.6
5	08/11 11:35	08/11 12:00	L _{Aeq}	67.1	77.7	69.4	64.9	63.4	62.3	60.4	55.8	68.8
			L _{Amax}	85.9	96.5	84.8	83.1	81	79.8	81.4	76.6	86.9
			L _{A90}	56.9	66.6	60.5	55.5	53.1	51.4	49.4	42.7	57.9
			L _{A10}	70.1	80	72.4	68.2	66.3	66	62.7	57.2	71.8
6	08/11 02:01	08/11 02:21	L _{Aeq}	62	65.1	58	55.7	55.5	59.5	55.7	46.9	67.4
			L _{Amax}	90	88.2	77.2	73.3	81.2	88.1	83.8	72	96.2
			L _{A90}	47.6	54.9	51.8	49.9	46.4	40.9	37.2	35	48.1
			L _{A10}	57.5	63.7	59.5	56.1	53.9	52.5	50.6	45.3	58.7
6	08/11 10:56	08/11 11:31	L _{Aeq}	69.7	79	75.3	68.8	65.7	64.8	62.9	57.8	71.3
			L _{Amax}	86.1	95.4	93.7	90	85.2	79.7	79.3	75.1	87.5
			L _{A90}	57.5	66.9	61.3	56.9	54.5	52.8	49.3	42.5	58.5
			L _{A10}	73.6	83	77.8	71.8	69.1	68.8	66.9	62.3	74.8

**TABLE C2 - UNATTENDED SURVEY DATA – POSITION 1, GREAT ORMOND ST**

Start Time	L _{Aeq}	L _{Amax,fast}	L _{A90}	L _{A10}
07/11/2005 13:00	60.3	80.1	53.4	63.3
07/11/2005 14:00	61.8	83.7	54.3	64
07/11/2005 15:00	60.2	81.8	52.5	63.3
07/11/2005 16:00	60.7	77.2	52.4	63.8
07/11/2005 17:00	61.1	86.6	50	63.8
07/11/2005 18:00	59.9	78.1	50.6	63.4
07/11/2005 19:00	59.3	86.6	49.1	61.7
07/11/2005 20:00	58.3	79.3	49.8	61.1
07/11/2005 21:00	63.3	96.4	48.3	62.8
07/11/2005 22:00	57.2	80.5	47.1	59.5
07/11/2005 23:00	54.4	73.6	46.3	55.5
08/11/2005 00:00	52.9	72.9	45.6	53.3
08/11/2005 01:00	49.4	75.7	44.9	47.4
08/11/2005 02:00	50.9	79.2	44.9	49.9
08/11/2005 03:00	52.2	73.6	44.9	51.1
08/11/2005 04:00	52.2	73.4	45	49.4
08/11/2005 05:00	62.5	85.2	46	68.4
08/11/2005 06:00	58.6	79.1	48	61.1
08/11/2005 07:00	59.5	83.5	48.8	62.6
08/11/2005 08:00	61.6	88.2	52.7	64.8
08/11/2005 09:00	61.5	84.6	54.1	64.5
08/11/2005 10:00	63	84	54.8	65.1
08/11/2005 11:00	73.5	88.9	54.9	80.3
08/11/2005 12:00	63	85.7	55.7	65.3
08/11/2005 13:00	61.6	85.6	55.3	64.3



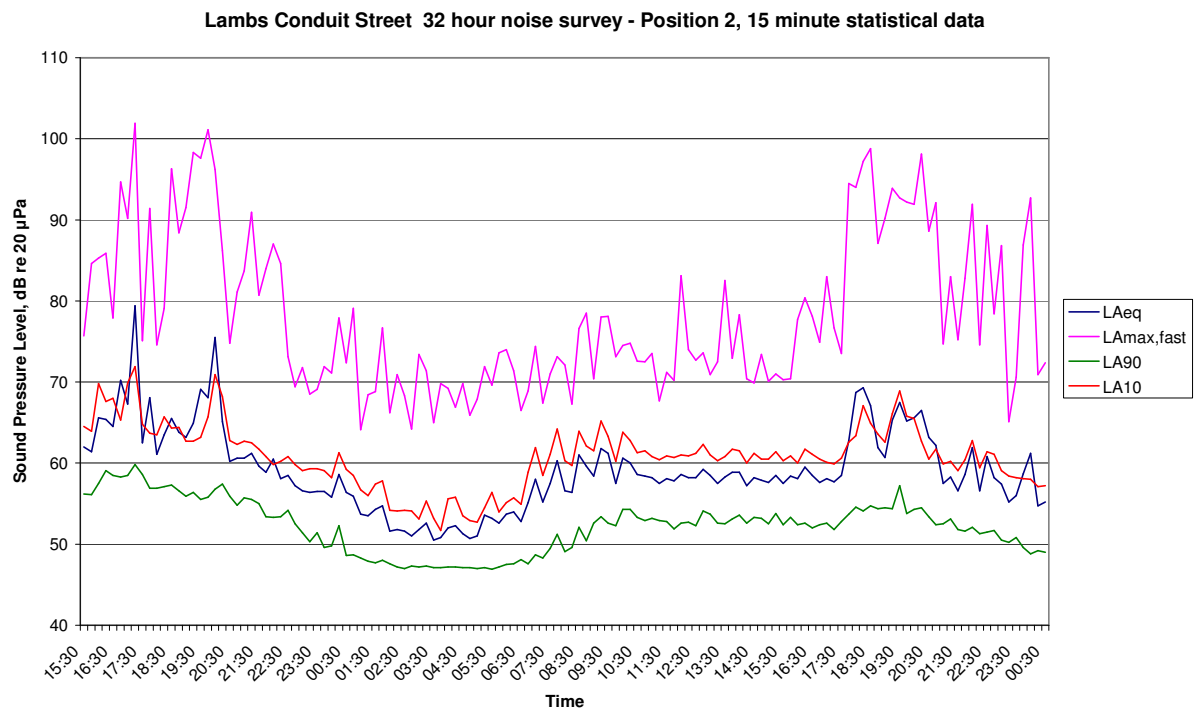
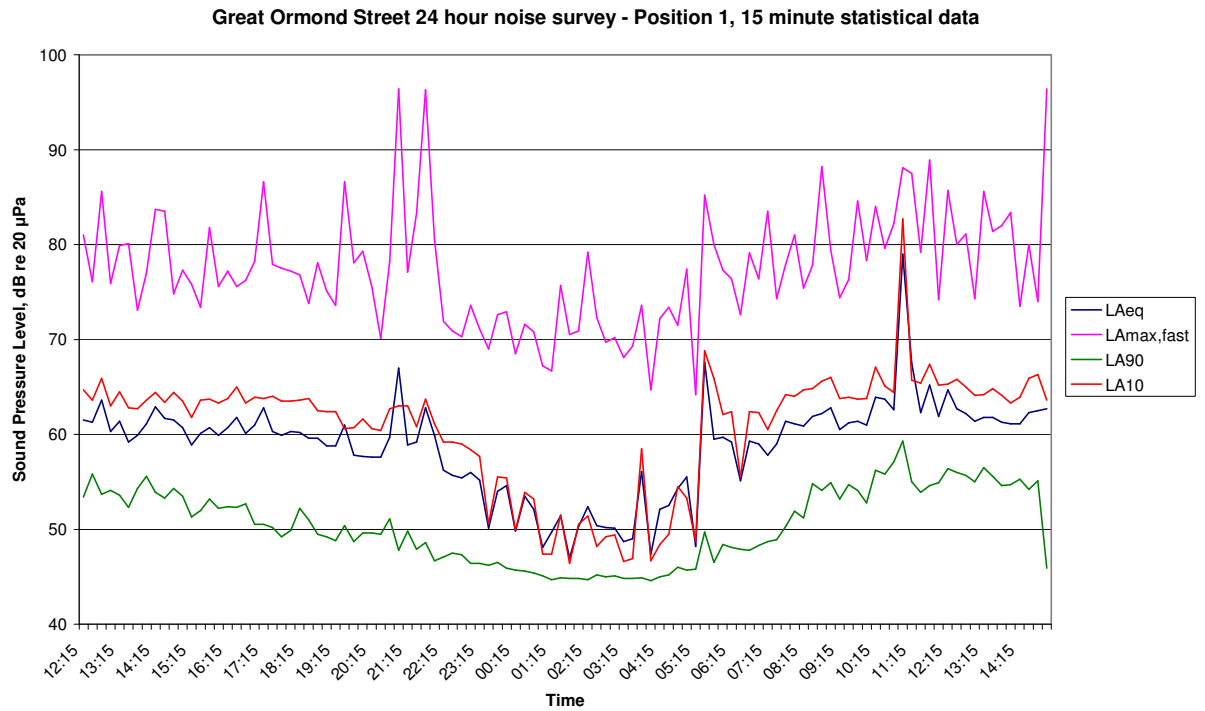
TABLE C3 - UNATTENDED SURVEY DATA – POSITION 2, LAMBS CONDUIT ST

Start Time	L _{Aeq}	L _{Amax,fast}	L _{A90}	L _{A10}
04/11/2005 16:00	67.1	94.7	58.3	67.8
04/11/2005 17:00	74	101.9	58.1	67
04/11/2005 18:00	63.7	96.3	56.9	64.4
04/11/2005 19:00	66.9	101.1	55.9	63.2
04/11/2005 20:00	70.1	96.2	56	66.2
04/11/2005 21:00	60.2	90.9	54.6	62.2
04/11/2005 22:00	58.7	87	53.3	60.3
04/11/2005 23:00	56.5	71.9	50.5	59.2
05/11/2005 00:00	56.9	79.1	49.1	59.9
05/11/2005 01:00	54.1	76.7	47.9	57
05/11/2005 02:00	51.5	70.9	47.2	54.2
05/11/2005 03:00	51.5	73.4	47.2	53.4
05/11/2005 04:00	51.7	69.8	47.2	54.4
05/11/2005 05:00	52.7	73.6	47	54.7
05/11/2005 06:00	54	74	47.6	56.3
05/11/2005 07:00	58.1	74.4	48.8	61.9
05/11/2005 08:00	58.9	78.5	49.9	61.8
05/11/2005 09:00	60.1	78.1	52.6	63
05/11/2005 10:00	59.5	74.8	53.7	62.4
05/11/2005 11:00	57.9	73.5	52.7	60.7
05/11/2005 12:00	58.6	83.1	52.9	61.4
05/11/2005 13:00	58.3	82.5	53	60.9
05/11/2005 14:00	58.1	78.3	53.2	60.7
05/11/2005 15:00	58	71	53.1	60.8
05/11/2005 16:00	58.5	80.4	52.3	60.7
05/11/2005 17:00	59.9	94.5	52.6	60.9
05/11/2005 18:00	67.5	98.8	54.4	64.5
05/11/2005 19:00	65.3	93.9	54.5	66.7
05/11/2005 20:00	64.7	98.1	53.5	62.9
05/11/2005 21:00	57.8	83	52.1	59.9
05/11/2005 22:00	59.9	91.9	51.6	61.2
05/11/2005 23:00	57	86.9	50.3	58.5
06/11/2005 00:00	57.6	92.7	49	57.3



TABLE C4 - UNATTENDED SURVEY DATA – POSITION 3, GUILFORD ST

Start Time	L _{Aeq}	L _{Amax,fast}	L _{A90}	L _{A10}
00/01/1900 13:00	68.9	86.9	60.7	71.9
00/01/1900 14:00	69.5	85.6	61.2	72.5
00/01/1900 15:00	68.8	87.9	60.7	71.6
00/01/1900 16:00	68.8	86.5	59.3	71.8
00/01/1900 17:00	71.5	99	59	72
00/01/1900 18:00	68.9	95.5	57.4	71.3
00/01/1900 19:00	66.7	83.6	55.8	70.2
00/01/1900 20:00	65.3	85.3	52	69
00/01/1900 21:00	63.9	85.2	51	67.7
00/01/1900 22:00	63.4	82.6	50.1	67.2
00/01/1900 23:00	62.2	81	46.7	66.6
01/01/1900 00:00	63.3	87.6	44.8	64.8
01/01/1900 01:00	58.3	77.4	43.4	60.9
01/01/1900 02:00	57.1	84.5	42.9	59.1
01/01/1900 03:00	56.1	78.1	43.3	58
01/01/1900 04:00	57.7	78.4	42.9	60.4
01/01/1900 05:00	60.2	85	44.4	63.5
01/01/1900 06:00	73	85.5	49.3	78.3
01/01/1900 07:00	75.6	109.8	58.4	72.5
01/01/1900 08:00	70.4	86.4	62.5	73.2
01/01/1900 09:00	70.4	97	62.7	72.9
01/01/1900 10:00	70.4	91.5	62.7	72.9
01/01/1900 11:00	71.9	99	61.6	72.6
01/01/1900 12:00	69.7	88.9	61.5	72.6
01/01/1900 13:00	69.2	87.2	60.5	72.1
01/01/1900 14:00	69.7	88.4	61.4	72.4





Guildford Street 24 hour noise survey - Position 3, 15 minute statistical data





Appendix D Limitations to this Report

NOTES ON LIMITATIONS

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of WSP Environmental Limited. WSP Environmental Limited accepts no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/or WSP Environmental Limited and agree to indemnify WSP Environmental Limited for any and all loss or damage resulting therefrom. WSP Environmental Limited accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

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