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Greville Street Camden

Acoustic Report

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Date 23 February 2016

The Authors

Richard Lyons BEng PhD CEng MIOA MCIBSE (Partner) started his career as a Building Services Design Engineer gaining over 8 years' experience and a Bachelor of Engineering degree in Building Services Engineering from the University of Liverpool in 1989. Having developed a special interested in acoustics, Richard obtained his Diploma in Acoustics and Noise Control from the IOA in 1990, before going on to complete a PhD in 1993 on research into open screen noise transmission and alternative methods of sound insulation measurement. Richard works in all areas of the practice and has over 25 years of experience in research, teaching and consultancy in acoustics. He joined WBM in 2005 and became a Partner in 2009. He is a Chartered Engineer and Member of the Institute of Acoustics.

Paul Cockcroft BEng PhD CEng MIMMM FIOA (Senior Partner) has been practising in mining engineering and acoustics since 1983. He joined WBM in 1989, became a Partner in 1997 and Senior Partner in 2004. Paul has worked for many of the major mineral extraction and waste disposal companies in the UK and Mineral Planning Authorities on a wide range of surface mineral workings, aggregate related plant sites, waste disposal and recycling projects, including advising safeguarded wharf operators to protect vital industrial operations. He also specialises in the measurement and prediction of environmental, industrial and transportation noise and acoustic aspects of site development, road schemes, rail-linked sites, traincare depots and commercial and residential developments. Paul has prepared and presented evidence at planning appeals and for court cases, including Judicial Review applications, Breach of Condition Notices, nuisance cases and is known for his rigorous approach.

WBM

WBM (the trading name of The Walker Beak Mason Partnership) is an established independent acoustic consultancy specialising in architectural & building acoustics, environmental noise, planning issues and expert work. WBM is a member of the Association of Noise Consultants and is also an associate assessor member of the Institute of Environmental Management & Assessment. The Consultants are Members or Fellows of the Institute of Acoustics.

ACOUSTIC CONSULTANTS

Contents

1 Introduction

WBM was instructed by Workspace Group PLC in October 2014 to provide professional acoustic consultancy services to assist with planning requirements in connection with a proposal for the redevelopment of 12-14 Greville Street, Camden, London, EC1N.

The services provided by WBM for this project included baseline noise surveys and assessment of data, determination of façade design noise levels for noise ingress, acoustic assessment of the building façade fenestration and setting of noise limits for external M&E plant. The details of the baseline surveys and above assessments have been provided to our client via 3 separate Technical Notes, dated 30 November 2014, 19 December 2014 and 14 January 2015, and these have been combined together in this report for submission to the Local Planning Authority.

To aid comprehension, a glossary of acoustic terms is presented in Appendix A.

2 Assessment Methodology

The various relevant noise guidance documents used in this assessment are detailed below.

2.1 British Standard 8233

British Standard (BS) 8233: 2014 *"Guidance on sound insulation and noise reduction for buildings"* gives recommendations for the control of noise in and around buildings, and suggests indoor ambient noise levels for dwellings from noise sources without a specific character ("anonymous noise").

In BS 8233: 2014, Table 2 on page 22 is titled "*Indoor ambient noise levels in spaces when they are unoccupied and privacy is also important*". The "*Design range* $L_{Aeq,\,T}$" for "*Open plan office*" is presented as "*45-50 dB*".

The text under Table 2 of BS 8233 states "*Noise levels generally apply to steady sources, such as those due to road traffic, mechanical services or continuously running plant, and should be the noise level in the space during normal hours of occupation but excluding any noise produced by the occupants and their activities …*"

In BS 8233: 2014, Table 6 on page 28 is titled "*Typical noise levels in non-domestic buildings*".

The "*Design range*" for "*Staff/meeting room, training room*" is presented as "*35-45 dB $L_{Aeq,T}$*". The "*Design range*" for "*Executive office*" is presented as "*35-40 dB $L_{Aeq,T}$*"

2.2 Local Authority

The London Borough of Camden Noise Strategy document dated September 2002 has been referenced for noise levels in offices and for noise from noisy plant or equipment. In addition, Policy DP26. "*Managing the impact of development on occupiers and neighbours"* and Policy DP28. *"Noise and Vibration"* have also been referenced. The relevant paragraphs are reviewed below.

Internal Noise 'Standards' for Offices

The London Borough of Camden Noise Strategy document dated September 2002 includes a table at the bottom of page 52 in Appendix 2 – UDP Planning Guidance under the heading *"Standards related to specific land uses"*.

The text before the table states *"Developers should aim to achieve the predicted noise levels indicated below in respect of the following activities"*. The noise level for *"General offices (internal)"* is given as *"45dB(A)LAeq,1h"*.

Noise From New Developments Involving Noisy Plant/Equipment

There are two paragraphs from "*London Borough of Camden Noise Strategy September 2002*" relating to 'ventilation ducts and air handling equipment'. These are paragraph 16.33 and 16.34 as follows:

"16.33 The following standard applies to all air-cooling, heating, ventilation, extraction and conditioning systems and to any ancillary plant, ducting and equipment which would have an impact on the external environment. The Council seeks to ensure that noise level output from all such systems does not increase existing ambient noise levels, in order to protect existing levels and prevent "creep" (a rise in background noise levels). 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.

16.34 The Council considers that for new developments involving noisy plant / equipment or other uses, design measures should be taken to ensure that noise levels predicted at a point 1 metre external to sensitive facades are at least 5dB(A) less than the existing background measurement (LA90) when the equipment is in operation. Where it is anticipated that 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), special attention should be given to reducing the noise levels from plant and equipment at any sensitive facade to at least 10dB(A) below the LA90 level."

Policy DP26. Managing the Impact of Development on Occupiers and Neighbours

Section 26.5 refers to noise and vibration and states: *"Noise/vibration pollution has a major effect on amenity and health and can be a particularly significant issue in Camden given the borough's dense urban nature. More detail on how to prevent disturbance from noise and vibration, including the requirement for mitigation measures can be found in policy DP28".*

Section 26.9 discusses attenuation measures for Construction Management Plans (CMP). The CMP Pro forma for this project has been drafted by Hother Associates for this project.

Policy DP28. Noise and Vibration

DO28 states: *"The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:*

a) *development likely to generate noise pollution; or*
b) *development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.*

Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.

The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds.

The Council will seek to minimise the impact on local amenity from the demolition and construction phases of development. Where these phases are likely to cause harm, conditions and planning obligations may be used to minimise the impact."

Camden's Noise and Vibration Thresholds are stated in Tables A to E of DP28. The relevant table is Table E and the limits stated in this table are as per the limits stated above from paragraph 16.34 of "*London Borough of Camden Noise Strategy September 2002*" relating to 'ventilation ducts and air handling equipment'.

3 Site Description

No 14 Greville Street is an existing commercial office building located approximately 200m west of Farringdon Station. The building is positioned on the south side of Greville Street between Hatton Garden and Kirby Street.

The building is proposed to be re-developed and the façade retained to provide a new office building constructed on the site of 12 to 14 Greville Street. It is understood that there are mainly commercial buildings to each side of the site, although numbers 11, 17 and 35 Greville Street and 24 Hatton Garden are nearby properties which may have partial residential premises and 30 Greville Street is understood to be an apartment block above retail units.

A site plan is shown in Appendix B, together with photographs of the area and details of the survey measurement locations.

4 Measurement Methodology

4.1 Measurement Description

A baseline noise survey at was undertaken at 12-14 Greville Street between Tuesday 28 October 2014 and Tuesday 04 November 2014.

Two positions were selected on the roof of the building, one towards the front and the other towards the rear of the building, for unattended noise measurements over the seven day period. Two other positions were selected at ground floor level for sample noise measurements.

The locations are listed in Table 1 below and the noise measurement locations for the installations and samples are shown in Appendix B.

Table 1: Baseline Noise Survey Locations

Ref	Baseline Noise Survey Location (free field or façade measurement)
A	Meter installed with microphone on roof towards front of building (free field)
B	Meter installed with microphone on roof towards rear of building (free field)
1	Ground level, 1 m to façade of building on pavement by No. 14 Greville Street (façade)
2	Ground level, opposite Bleeding Heart Bistro, Bleeding Heart Yard (façade)

The data logging sound level meters installed on the roof of the building were connected to the microphones by extension cables. For both of these positions, measurements were made at five minute intervals over seven days including a weekend.

Attended 5-minute sample measurements were also taken at ground level during the two daytime visits for installation and collection of the meters, in order to sample the facade noise level at the front of the property and at a location to the side of the building. Observations were made of the noise sources in the area, which were generally traffic related and local activity and movement.

The instrumentation, calibration and survey details for the installations are given in Appendix C. The instrumentation, calibration and survey details for the attended sample measurements are given in Appendix D. The weather details for the duration of the installations are tabulated in Appendix E.

4.2 Results

The detailed results of the unattended surveys are presented in graphical form in Appendix F. The results of the attended surveys are presented in in Appendix G.

The baseline noise data obtained from the installed sound level meters have been analysed in order to present average noise levels for daytime and night-time. The daytime values are for the period between 07:00 - 23:00 and are in terms of the $L_{Aeq\ 16\ hour,\ free\ field}$ and are shown in Table 2.

The night-time values are for the period between 23:00 - 07:00 and are in terms of the $L_{Aeq\ 8\ hour,\ free\ field}$ and are shown in Table 3.

Table 2: Daytime Average Noise Levels

Day	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Mon**
Date	29/10/14	30/10/14	31/10/14	01/11/14	02/11/14	03/11/14
Position	**Daytime Average Noise Levels dB $L_{Aeq\ 16\ hour,\ free\ field}$**					
A Roof (front)	57	57	57	55	52	59
B Roof (rear)	55	55	56	53	53	56

Note that all of the noise survey data and associated analysis is available in spread sheet form for review if required. Values for the Tuesdays are not presented as they were not full 16 hour periods.

Table 3: Night time Average Noise Levels

Day	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Mon**
Date	29/10/14	30/10/14	31/10/14	01/11/14	02/11/14	03/11/14
Position	**Night time Average Noise Levels dB $L_{Aeq\ 8\ hour,\ free\ field}$**					
A Roof (front)	51	51	52	52	51	51
B Roof (rear)	49	49	50	50	50	49

The lowest background noise levels during the night time period, for the locations on the roof towards the front and towards the rear, were about 45 dB $L_{A90,\ 5\ minutes,\ free\ field}$.

The noise climate was controlled by road traffic on Hatton Garden and vehicles on Greville Street, together with pedestrian activity.

5 Acoustic Assessment of Façade Glazing

Part of WBM's remit is to provide details on the façade design noise levels for the proposed building based upon the baseline noise surveys. On 12 December 2014, XCO2 Energy Ltd specifically requested confirmation regarding the ventilation strategy. In particular XCO2 Energy Ltd needed to know if they could use natural ventilation (via openable windows) or would there be a requirement to have mechanical ventilation (not openable windows).

WBM provided an initial response in an email dated 12 December 2014 stating "*I have looked at the measured noise levels for daytime periods and the 'standards' required for internal noise levels for offices. The conclusion is that partially open windows will not provide sufficient attenuation to allow the internal noise levels to be demonstrated*."

5.1 Façade Noise levels

Section 4 above, sets out the external noise levels measured at the site. In order to determine façade design levels for external noise ingress, the noise levels measured on the roof towards the front of the building (Position A) have been compared with those measured on the pavement by the façade of No. 14 Greville Street (Position 1, Appendix F).

Comparison of measurements made at the same time allows a relationship between the noise climates at these two locations to be determined, assuming that the noise levels are dominated by road traffic at both locations. The 'correction' which has been derived can then be applied to the unattended measurements over seven days thereby providing much more relevant data than that obtained from the few samples measured on the pavement by the façade.

A 'correction' of 7 dB $L_{Aeq,\ T}$ has been derived, to be added to the daytime noise levels measured on the roof towards the front of the building (Position A), to indicate the daytime noise levels at 1 m to the front façade of No. 14 Greville Street. The daytime period has been selected as being relevant to the normal hours of use of the proposed offices at 12-14 Greville Street.

The baseline noise data obtained from the installed sound level meter on the roof towards the front of the building (Position A) is shown in Table 2 as average noise levels for 16 hours during the daytime between 07:00 - 23:00. Table 4, below, shows the addition of 7 dB $L_{Aeq,\ T}$ to each of the average noise levels, to represent the corresponding noise levels at 1 m to the front facade.

Table 4: Proposed Noise Levels at 1m from Façade

Day [1]	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	**Mon**
Date	29/10/14	30/10/14	31/10/14	01/11/14	02/11/14	03/11/14
Position	**Daytime Average Noise Levels dB $L_{Aeq\ 16\ hour,\ free\ field}$**					
A Roof (front)	57	57	57	55	52	56 [2]
+ 7 dB $L_{Aeq,\ T}$ (façade)	64	64	64	62	59	63

Notes

[1] Values for the Tuesdays are not presented as they were not full 16 hour periods.

(2) Three of the five minute measurements on the roof towards the front of the building during the daytime on Monday 03 November 2014 were higher than 70 dB $L_{Aeq, 5\ minutes, free\ field}$ and are assumed not to be attributable to road traffic. The values higher than 70 dB $L_{Aeq, 5\ minutes, free\ field}$ are not included to determine the average noise level presented for this daytime period.

The weekday daytime noise levels are 63 or 64 dB $L_{Aeq, 16\ hour, façade}$ and the weekend daytime noise levels are 62 and 59 dB $L_{Aeq, 16\ hour, façade}$ at 1 m to the front façade at ground level.

Individual hourly values have also been obtained by the logarithmic averaging of the five-minute measurements on the roof towards the front of the building. Table 5 below shows the individual hourly values, with the addition of 7 dB $L_{Aeq, T}$ to each of the hourly noise levels, to represent the corresponding noise levels at 1 m to the front façade at ground level.

Table 5: Daytime Hourly Noise Levels dB $L_{Aeq, 1\ hour, façade}$ at ground level

Day (Date)	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue
Start Time (hh:mm)	28/10/14	29/10/14	30/10/14	31/10/14	01/11/14	02/11/14	03/11/14	04/11/14
08:00	-	66	68	66	61	60	64	63
09:00	-	64	65	64	64	60	63	64
10:00	-	**68**	63	64	61	61	66	64
11:00	-	65	63	64	61	60	65	-
12:00	66	65	63	64	62	60	64	-
13:00	64	63	63	65	63	59	63	-
14:00	64	64	64	65	62	59	64	-
15:00	64	65	63	66	62	59	63	-
16:00	65	64	64	64	61	59	63	-
17:00	62	64	66	63	60	59	62	-
18:00	62	62	64	63	68	59	60	-
19:00	60	61	62	61	61	59	61	-
20:00	59	60	61	62	60	59	61	-
21:00	59	60	61	62	59	**58**	60	-
22:00	60	60	61	61	61	59	60	-

Note that the lowest value is 58 dB $L_{Aeq, 1\ hour, facade}$ on Sunday evening and the highest value is 68 dB $L_{Aeq, 1\ hour, façade}$ on Wednesday morning at 1 m to the front façade at ground level, as indicated in bold.

5.2 Assessment of Expected Internal Noise Levels

It is commonly accepted that a partially open window provides a reduction of about 13 dB(A) from external façade noise levels to internal noise levels.

The highest weekday daytime noise levels is 64 dB $L_{Aeq,\ 16\ hour,\ façade}$ at 1 m to the front façade at ground level, which would equate to 51 dB $L_{Aeq,\ 16\ hour}$ as an internal noise level with a partially open window.

The highest hourly value of 68 dB $L_{Aeq,\ 1\ hour,\ façade}$ on Wednesday morning at 1 m to the front façade at ground level would equate to 55 dB $L_{Aeq,\ 1\ hour}$ as an internal noise level with a partially open window.

It would be expected that a closed window, set in a standard brick or blockwork wall, would provide a reduction of about 28 to 33 dB(A) from external façade noise levels to internal noise levels. The reduction of 28 dB(A) would apply to a single glazed window and the reduction of 33 dB(A) would apply to a double glazed window.

The highest weekday daytime noise levels of 64 dB $L_{Aeq,\ 16\ hour,\ façade}$ at 1 m to the front façade at ground level, would therefore equate to 36 dB $L_{Aeq,\ 16\ hour}$ as an internal noise level with a closed single glazed window and 31 dB $L_{Aeq,\ 16\ hour}$ as an internal noise level with a closed double glazed window.

The highest hourly value of 68 dB $L_{Aeq,\ 1\ hour,\ façade}$ on Wednesday morning at 1 m to the front façade at ground level would equate to 40 dB $L_{Aeq,\ 1\ hour}$ as an internal noise level with a closed single glazed window and 35 dB $L_{Aeq,\ 16\ hour}$ as an internal noise level with a closed double glazed window.

Section 2.1 indicates the guidance stated within BS 8233: 2014 for various office spaces which states "*Design range*" values for offices from 35 to 50 dB $L_{Aeq,\ T}$ internally.

Section 2.2 indicates the specific guidance contained within the London Borough of Camden Noise Strategy document, indicating the noise level for "*General offices (internal)*" as "*45dB(A)LAeq,1h*".

Therefore it is clear that:

1. Partially open windows would not provide sufficient attenuation to allow the internal noise levels to be demonstrated.

2. The highest hourly value of 40 dB $L_{Aeq,\ 1\ hour,}$ as an internal noise level with a closed single glazed window, is 5 dB(A) below the internal noise limit of "*45dB(A)LAeq,1h*" stated in the London Borough of Camden Noise Strategy document and within the range indicated in BS 8233:2014.

3. The highest hourly value of 35 dB $L_{Aeq,\ 16\ hour}$, as an internal noise level with a closed double glazed window, is 10 dB(A) below the internal noise limit of "*45dB(A)LAeq,1h*" stated in the London Borough of Camden Noise Strategy document and at the lower end of the range indicated in BS 8233:2014.

4. Therefore the conclusion is that closed single or double glazed windows would provide sufficient attenuation to allow the internal noise levels to be demonstrated.

Once the details internal layouts are determined and relevant internal noise level requirements of each space decided, the façade noise levels presented in Section 5.1 above can be used by the design team to select the appropriate glazing requirements.

6 Plant Noise Limits

Part of WBM's remit is to consider and propose appropriate M&E plant noise break-out limits for submission with the planning application. In order to do this WBM has reviewed the *"London Borough of Camden Noise Strategy September 2002"*. The relevant paragraphs 16.33 and 16.34 are set out in Section 2.5, together with Camden Policy DP28, which also references noise limits that are the same limits as those stated in the noise strategy. The first part of Paragraph 16.34 starts:

"The Council considers that for new developments involving noisy plant/equipment or other uses, design measures should be taken to ensure that noise levels predicted at a point 1 metre external to sensitive facades are at least 5dB(A) less than the existing background measurement (LA90) when the equipment is in operation."

An important piece of information for consideration of appropriate noise limits for the roof top plant and any terminals to atmosphere is the times at which the equipment will be operating. At this stage the hours of use of the proposed building and therefore the design operating hours for the plant are unknown and therefore a worst case of night-time operation is assumed, subject to confirmation later.

6.1 Nearest Noise Sensitive Dwellings and Limits

In response to requests for information regarding the location of the nearest noise sensitive facades, WBM have been provided with the daylight & Sunlight Report prepared by Waldrams Ltd, reference 1411, dated 5 February 2016. Waldrams report has identified the users of the surrounding properties to 14 Greville Street to determine which are residential and which are commercial, or both.

According to the report the following properties are understood to be at least partially of residential use (Approximate distance from 14 Greville Street indicated):

24 Hatton Garden (Approx. 0-5m – distance unclear)
11 Greville Street (Adjacent)
17 Greville Street (Approx.12m)
35 Greville Street (Approx.10m)

These properties can be seen in the layout plan in Appendix B. and are considered sensitive for the purpose of paragraph 16.34.

In addition, it was noticed during the surveys that there are serviced studios and apartments at Atelier EC1, 30 Greville Street, which is at the corner of Kirby Street and Greville Street, approximately 20m to the east.

The details of WBM baseline noise surveys and results are indicated in Section 4 and appendices B to F. It can be seen from the results of the meters installed on the roof of the existing offices at Greville Street that the lowest measured background noise levels were around 45 dB $L_{A90,\ 5\ minutes,\ free\ field}$. The measurement locations were set back from the edge of the roof and would have been shielded to some extent from traffic at ground level.

It is not possible to state with certainty what the measured background noise levels would have been at any other location but these levels, in particular Position B, should be representative of the rear of the sensitive receptors of 11 & 17 Greville Street and 24 Hatton Garden. Position A would be more representative of the sensitive receptors at 30 and 35 Greville Street.

At this stage a working limit for plant noise is suggested of 40 dB $L_{Aeq,\ 5\ minutes}$ at a point 1 metre external to the nearest noise sensitive façades. However, this limit should be reviewed and could potentially be increased once the actual operating hours are understood.

In addition, if there are found to be other residential properties, other than those identified in the Waldrams report and listed above, these noise sensitive receptors should also have the same plant noise limit assigned to them.

Summary baseline noise survey data and detailed octave band data, in the range 16 Hz to 16 kHz, was provided by WBM to Workspace Group Ltd in December 2014 for forwarding on to the M&E consultants for use in the M&E plant design as necessary.

7 Summary and Conclusions

WBM was instructed by Workspace Group PLC in October 2014 to provide professional acoustic consultancy services to assist with planning requirements in connection with a proposal for the redevelopment of 12-14 Greville Street, London, EC1N.

WBM undertook baseline noise surveys at 12-14 Greville Street between Tuesday 28 October 2014 and Tuesday 04 November 2014. Analysis of the survey data has been undertaken to determine the façade design noise levels and from this an assessment of noise ingress and the glazing acoustic performance has been provided. Based on the information available at this stage, WBM has also proposed noise limits for the external M&E plant.

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Appendix A - Glossary of Acoustic Terms

General Noise and Acoustics

The following section describes some of the parameters that are used to quantify noise.

Decibels dB

Noise levels are measured in decibels. The decibel is the logarithmic ratio of the sound pressure to a reference pressure ($2x10^{-5}$ Pascals). The decibel scale gives a reasonable approximation to the human perception of relative loudness. In terms of human hearing, audible sounds range from the threshold of hearing (0 dB) to the threshold of pain (140 dB).

A-weighted Decibels dB(A)

The 'A'-weighting filter emulates human hearing response for low levels of sound. The filter network is incorporated electronically into sound level meters. Sound pressure levels measured using an 'A'-weighting filter have units of dB(A) which is a single figure value to represent the overall noise level for the entire frequency range.

A change of 3 dB(A) is the smallest change in noise level that is perceptible under normal listening conditions. A change of 10 dB(A) corresponds to a doubling or halving of loudness of the sound. The background noise level in a quiet bedroom may be around 20 –30 dB(A); normal speech conversation around 60 dB(A) at 1 m; noise from a very busy road around 70-80 dB(A) at 10m; the level near a pneumatic drill around 100 dB(A).

Façade Noise Level

Façade noise measurements are those undertaken near to reflective surfaces such as walls, usually at a distance of 1m from the surface. Façade noise levels at 1m from a reflective surface are normally around 3 dB greater than those obtained under freefield conditions.

Freefield Noise Level

Freefield noise measurements are those undertaken away from any reflective surfaces other than the ground

Frequency Hz

The frequency of a noise is the number of pressure variations per second, and relates to the "pitch" of the sound. Hertz (Hz) is the unit of frequency and is the same as cycles per second. Normal, healthy human hearing can detect sounds from around 20 Hz to 20 kHz.

Octave and Third-Octave Bands

Two frequencies are said to be an octave apart if the frequency of one is twice the frequency of the other. The octave bandwidth increases as the centre frequency increases. Each bandwidth is 70% of the band centre frequency.

Two frequencies are said to be a third-octave apart if the frequency of one is 1.26 times the other. The third octave bandwidth is 23% of the band centre frequency.

There are recognised octave band and third octave band centre frequencies. The octave or third-octave band sound pressure level is determined from the energy of the sound which falls within the boundaries of that particular octave of third octave band.

Equivalent Continuous Sound Pressure Level $L_{Aeq,T}$

The 'A'-weighted equivalent continuous sound pressure level $L_{Aeq,T}$, is a notional steady level which has the same acoustic energy as the actual fluctuating noise over the same time period T. The $L_{Aeq,T}$ unit is dominated by higher noise levels, for example, the $L_{Aeq,T}$ average of two equal time periods at, for example, 70 dB(A) and 50 dB(A) is not 60 dB(A) but 67 dB(A).

The $L_{Aeq,}$ is the chosen unit of BS 7445-1:2003 "Description and Measurement of Environmental noise".

Maximum Sound Pressure Level L_{Amax}

The L_{Amax} value describes the overall maximum 'A'-weighted sound pressure level over the measurement interval. Maximum levels are measured with either a fast or slow time weighted, denoted as $L_{Amax,f}$ or $L_{Amax,s}$ respectively.

Sound Exposure Level L_{AE} or SEL

The sound exposure level is a notional level which contains the same acoustic energy in 1 second as a varying 'A'-weighted noise level over a given period of time. It is normally used to quantify short duration noise events such as aircraft flyover or train passes.

Statistical Parameters L_N

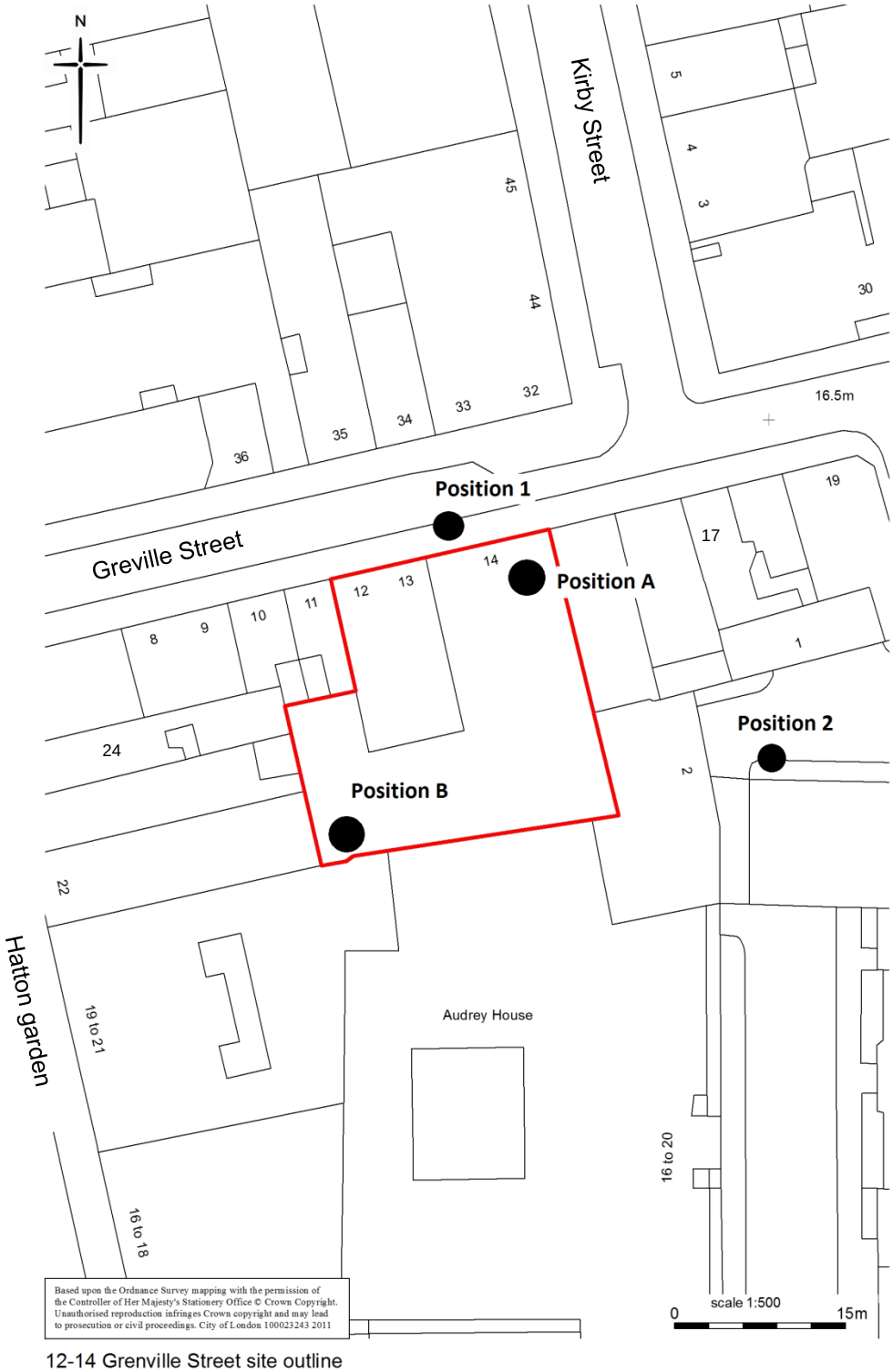
In order to cover the time variability aspects, noise can be analysed into various statistical parameters, i.e. the sound level which is exceeded for N% of the time. The most commonly used are the $L_{A01,T}$, $L_{A10,T}$ and the $L_{A90,T}$.

$L_{A01,T}$ is the 'A'-weighted level exceeded for 1% of the time interval T and is often used to gives an indication of the upper maximum level of a fluctuating noise signal.

$L_{A10,T}$ is the 'A'-weighted level exceeded for 10% of the time interval T and is often used to describe road traffic noise. It gives an indication of the upper level of a fluctuating noise signal. For high volumes of continuous traffic, the $L_{A10,T}$ unit is typically 2–3 dB(A) above the $L_{Aeq,T}$ value over the same period.

$L_{A90,T}$ is the 'A'-weighted level exceeded for 90% of the time interval T, and is often used to describe the underlying background noise level.

Appendix B - Noise Measurement Locations – Installations & Samples



12-14 Grenville Street site outline

Appendix B (continued)

Position A (and view to north)

Position B (and view to west)

Appendix B (continued)

View from Kirby Street east of 14 Greville Street

View from west of 14 Greville Street towards Kirby Street

Appendix C - Installed Survey, Instrumentation and Calibration Details

Date and Location of Surveys

Tuesday 28 October 2014 to Tuesday 04 November 2014.

12-14 Greville Street, front and rear of roof

Meters Installed by	**Meters Collected by**
Mr Matthew Sweet	Dr Robert Storey

Survey Details

Continuous measurements of 5 minute duration were taken at both of the chosen positions over the specified periods. In each case the microphone was fitted with a windshield and weather protection used throughout the measurements. The microphones were positioned as free field for the measurements. Measurement locations and descriptions are set out below.

Ref	Measurement Location	Measurement Dates
A	Roof (front)	28 October 2014 to 04 November 2014
B	Roof (rear)	28 October 2014 to 04 November 2014

Instrumentation used

Position	Instrumentation	Serial Number
A Roof (front)	RION NL-52 Sound Level Meter	420716
B Roof (rear)	RION NL-52 Sound Level Meter	420715

Position	Microphone	Serial Number
A Roof (front)	RION UC-59 Microphone	3513
B Roof (rear)	RION UC-59 Microphone	3512

Weather Protection

Weather protection was used on the microphones for both the meters installed, namely a WS-15 windshield.

Appendix C (continued)

Calibration

The sensitivity of each meter was verified on site immediately before and after each survey. Measured levels were as follows.

Position	Calibrator	Serial Number	Start Calibration	End Calibration
A Roof (front)	RION NC-74	34425557	94.0 dB(A)	94.3 dB(A)
B Roof (rear)	RION NC-74	34425556	94.0 dB(A)	94.2 dB(A)

The meters and the associated calibrators used are tested monthly against a Bruel and Kjaer Pistonphone, type 4220 (serial number 375806) and a Norsonic Calibrator, type 1253 (serial number 22906) with UKAS approved laboratory certificate of calibration.

Appendix D - Attended Survey, Instrumentation and Calibration Details

Times and Date of Surveys

12:22 to 12:27 Tuesday 28 October 2014

11:30 to 12:10 Tuesday 04 November 2014

Two positions at ground level, Greville Street & Bleeding Heart Yard:

Ref	Measurement Location
1	Ground level, 1 m to façade of building on pavement by No. 14 Greville Street (façade)
2	Ground level, opposite Bleeding Heart Bistro, Bleeding Heart Yard (façade)

Personnel Present

Mr Matthew Sweet & Dr Robert Storey

Instrumentation	**Serial Number**
Tuesday 28 October 2014: Norsonic 140 Sound Level Meter	1403138
Tuesday 04 November 2014: Norsonic 140 Sound Level Meter	1404819

Calibration

The sensitivity of each meter was verified on site immediately before and after each survey, by means of a Norsonic 1251 Calibrator. Measured levels were as follows.

Date	**Meter Serial No.**	**Calibrator Serial No.**	**Start Calibration**	**End Calibration**
28 October 2014	1403138	31991	113.9 dB(A)	113.8 dB(A)
04 November 2014	1404819	33321	113.9 dB(A)	113.6 dB(A)

The meters and the calibrators used are tested monthly against a Bruel and Kjaer Pistonphone, type 4220 (serial number 375806) and a Norsonic Calibrator, type 1253 (serial number 22906) with UKAS approved laboratory certificate of calibration.

Appendix E - Weather Details

Day and Date	General Weather Conditions
Tuesday 28 October 2014	Dry, clear, ~20^{o}C
Wednesday 29 October 2014	Mostly cloudy, some rain at times, 13-16^{o}C
Thursday 30 October 2014	Dry, mostly cloudy, some clear spells, 14-19^{o}C
Friday 31 October 2014	Dry, clear, 15-23^{o}C
Saturday 01 November 2014	Dry, partly cloudy, 14-18^{o}C
Sunday 02 November 2014	Mostly dry, mainly cloudy, 12-16^{o}C
Monday 03 November 2014	Mainly dry, some showers, 8-12^{o}C
Tuesday 04 November 2014	Dry, sunny, little cloud, ~11^{o}C

Day and Date	Wind Direction and Speed
Tuesday 28 October 2014	S ~4 m/s
Wednesday 29 October 2014	Variable 2-5 m/s
Thursday 30 October 2014	Variable 0-5 m/s
Friday 31 October 2014	Variable 0-6 m/s
Saturday 01 November 2014	~SW 2-7 m/s
Sunday 02 November 2014	~SW 3-7 m/s
Monday 03 November 2014	Variable 2-6 m/s
Tuesday 04 November 2014	Fairly still

Sources of Weather Details:

Observations made by WBM personnel on 28 October 2014 & 04 November 2014

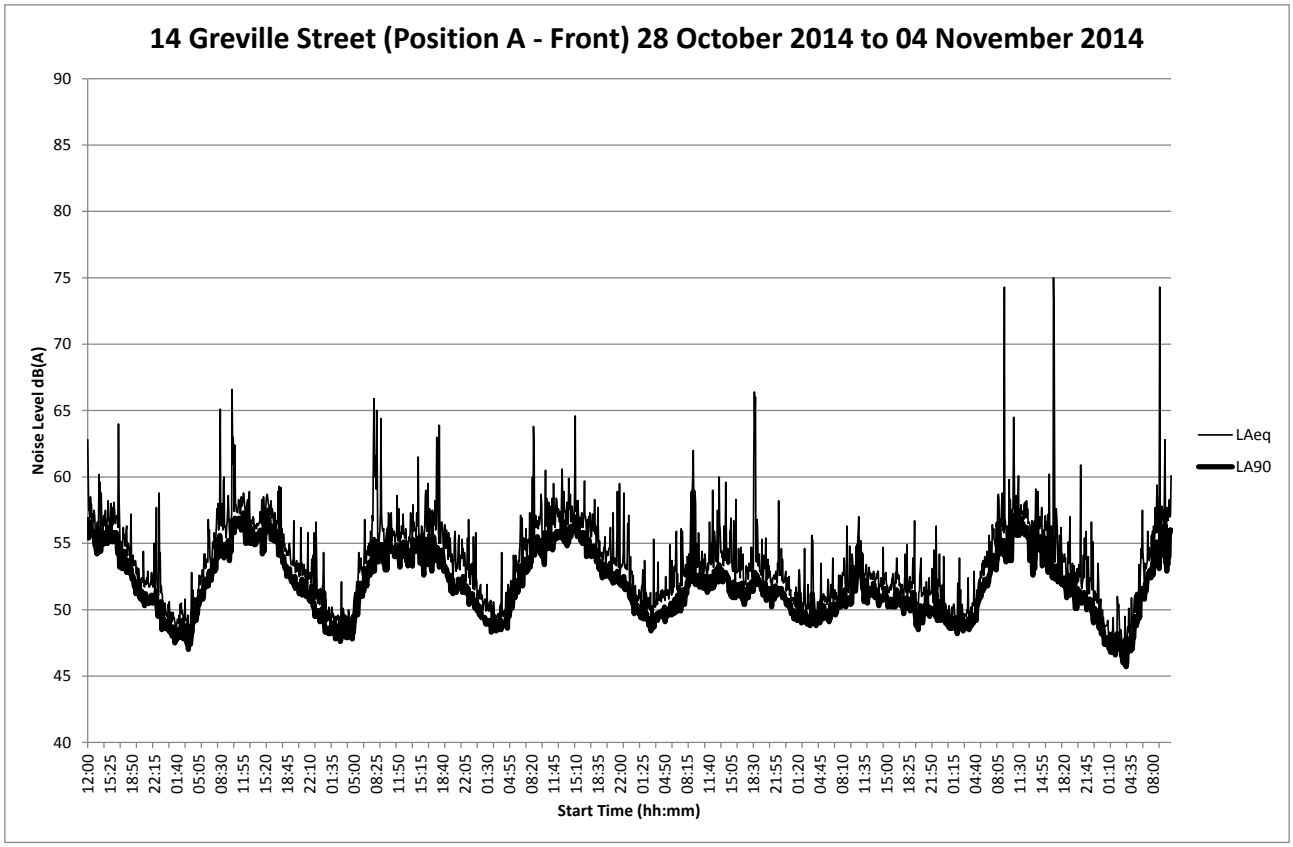
Weather Underground website for London City for general weather conditions

Appendix F - Installed Noise Survey Results

Position A – Meter installed with microphone on roof towards front of building

Tuesday 28 October 2014 to Tuesday 04 November 2014

Note: All presented values are free field levels.



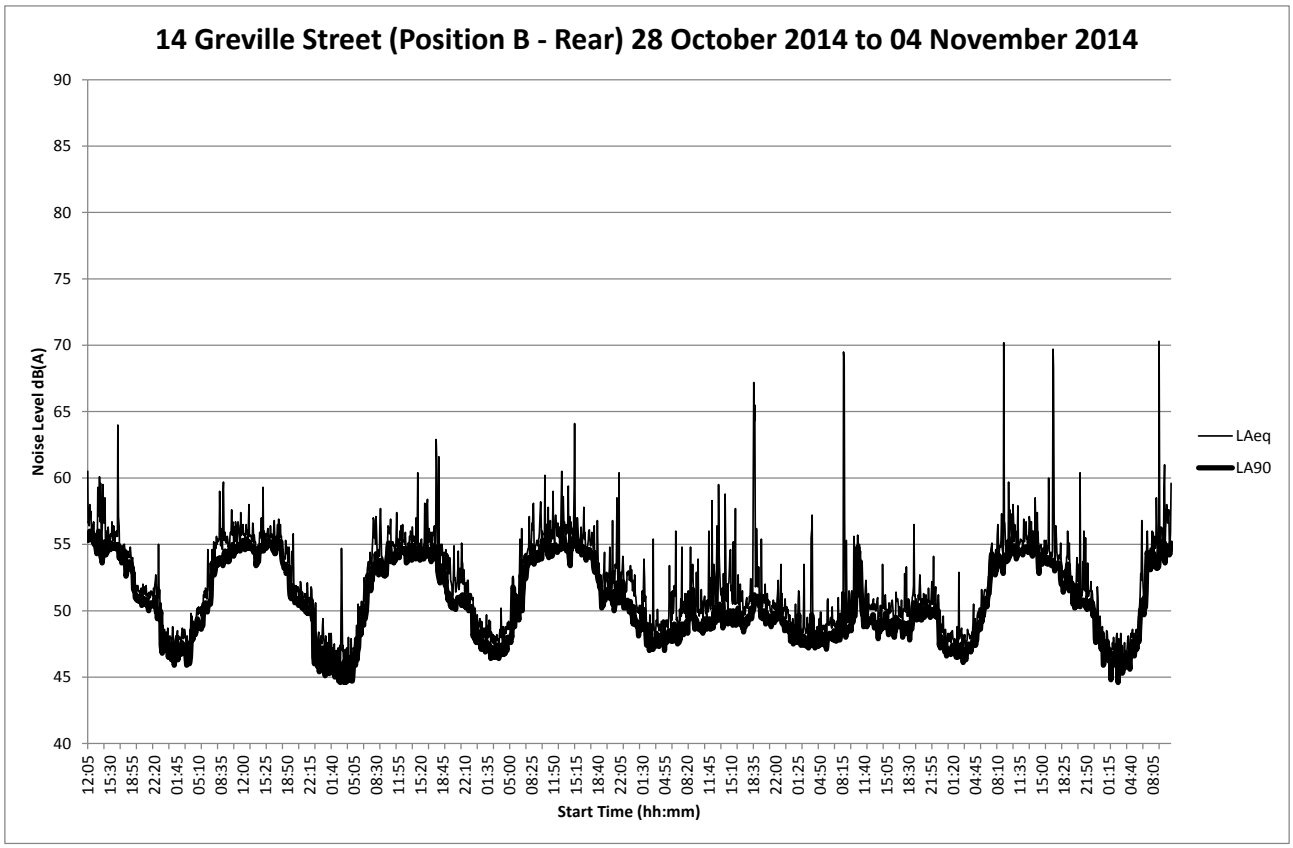
Appendix F (continued)

Installed Noise Survey Results

Position B – Meter installed with microphone on roof towards rear of building

Tuesday 28 October 2014 to Tuesday 04 November 2014

Note: All presented values are free field levels.



Appendix G - Attended Noise Survey Results

Tuesday 28 October 2014

Note: all values in dB and T=5 minutes

Position 1	$L_{A10,T}$	$L_{A90,T}$	$L_{Aeq,T}$	$L_{Amax,\ F}$
Greville Street (façade)	68	59	65	79
Measurement Time:	12:22 –12:27			

Ground level, 1 m to façade of building on pavement by No. 14 Greville Street (façade)

Comments: Road traffic on Hatton Garden and vehicles on Greville Street, pedestrians

Appendix G (continued)

Attended Noise Survey Results

Tuesday 04 November 2014

Note: all values in dB and T=5 minutes

Position 1	$L_{A10,T}$	$L_{A90,T}$	$L_{Aeq,T}$	$L_{Amax,\ F}$
Greville Street	66	56	63	82
Measurement Time:	11:38 –11:48			

Ground level, 1 m to façade of building on pavement by No. 14 Greville Street (façade)

Comments: Road traffic on Hatton Garden and vehicles on Greville Street, pedestrians, activity

Position 2	$L_{A10,T}$	$L_{A90,T}$	$L_{Aeq,T}$	$L_{Amax,\ F}$
Bleeding Heart Yard	63	52	61	82
Measurement Time:	11:50 –12:00			

Ground level, opposite Bleeding Heart Bistro, Bleeding Heart Yard (façade)

Comments: Road traffic on Greville Street, activity & movement within Yard

Position 1	$L_{A10,T}$	$L_{A90,T}$	$L_{Aeq,T}$	$L_{Amax,\ F}$
Greville Street	68	58	65	88
Measurement Time:	12:02 –12:12			

Ground level, 1 m to façade of building on pavement by No. 14 Greville Street (façade)

Comments: Road traffic on Hatton Garden and vehicles on Greville Street, pedestrians, activity