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Report 1471/BN/R1-

29<sup>th</sup> January 2015

9-13 Grape Street

Report 1471/BN/R1-  
Issue Date 29<sup>th</sup> January 2015

Project **9-13 Grape Street**  
London

Title **Background Noise Survey**

Sub Title

Client Scotch Partners LLP  
28 St John's Square  
London  
EC1M 4DN

Case No

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Revision	Reason	Checked	Signature

Background Noise Survey



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## 1. INTRODUCTION

- 1.1 An environmental noise investigation and assessment report has been commissioned by Scotch Partners LLP for 9-13 Grape Street, London.
- 1.2 The immediate vicinity is a mix of businesses and residential properties located within the London Borough of Camden. An environmental noise report and assessment is required in accordance with planning policies and requirements of this Borough.
- 1.3 Adnitt Acoustics Services Ltd has been commissioned to undertake an investigation of planning compliance for noise emissions as follows:
  - Environmental noise survey to establish the existing background noise levels at the boundary of the nearest noise sensitive premises
  - Recommendation of noise emission limits for any proposed plant work
  - Initial indicative external building fabric assessment.
- 1.4 Final details of the proposed mechanical plant installation have not yet been confirmed. However we have been provided with a likely number, location and noise level of the proposed new plant items.
- 1.5 This report presents the results of the environmental noise survey and recommended plant noise emission levels along with an initial indicative external building fabric assessment.

## 2. NOISE PRINCIPLES AND STANDARDS USED

2.1 The noise level measurements and calculations have been made in general accordance with the procedures set out in:

- British Standard BS 7445-1: 2003 'Description and measurement of environmental noise. Guide to quantities and procedures'
- British Standard BS 7445-2: 2003 'Description and measurement of environmental noise. Acquisition of Data Relevant to Land Use'
- British Standard BS 4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas'
- Calculation of Road Traffic Noise [CRTN] - Department of Transport Welsh Office
- British Standard BS 8233:1999 'Sound insulation and noise reduction for buildings - Code of Practice'.

2.2 We have liaised with the Planning Department, through the Duty Planning Officer, and the Environmental Health Department of the Local Authority and understand that the planning policy and associated technical guidance for noise is currently being revised following the introduction of the National Planning Policy Framework (NPPF).

2.3 Therefore, until this policy and associated guidance is published we have made use of the requirements given in the old noise policy document (DP28) and British Standard BS 8233:1999 which we believe is consistent with requirements and the spirit of paragraph 123 of the NPPF.

2.4 As a result, the following assessment procedure was undertaken:

- 2.4.1 Plant noise emission levels have been calculated and have been based on the table found in DP28.
- 2.4.2 An initial external building fabric assessment has been undertaken using the methodology contained within BS 8233:1999.

### 3. THE SITE AND ITS SURROUNDINGS

- 3.1 The site address is 9-13 Grape Street and is located within the London Borough of Camden.
- 3.2 The local area is a mixture of residential and small businesses with Shaftesbury Avenue Theatre and the Cuban Embassy to the south end of the street.
- 3.3 The proposal is for the extension, alterations and change of use of the existing building [sui generis] at 9-13 Grape Street into residential [C3] above ground floor and commercial space at ground floor and basement [B1/A1].
- 3.4 This will include the installation of new plant items to the rear of the building [at the top, see attached plans].
- 3.5 Traffic noise from Shaftesbury Avenue to the North and High Holborn to the South is the main constitution of the underlying ambient noise levels.
- 3.6 Grape Street itself is a very quiet one way street with very little traffic.
- 3.7 From on-site observations there are no windows on the rear (east) façade of 9-13 Grape Street.
- 3.8 Directly opposite the rear of 9-13 Grape Street is a multi-storey Car Park.
- 3.9 Directly adjacent to the rear of 9-13 Grape Street is the Cuban Embassy and the rear of 5-7 Grape Street. The Cuban Embassy doesn't have any windows on the rear elevation, whereas 5-7 Grape Street has some windows to the rear, approximately 30m from the proposed location of the new plant items
- 3.10 See Figures 1371/F1 and 1371/F2 below.
- 3.11 The closest noise sensitive windows to the proposed new plant items are the rear of 5-7 Grape Street.



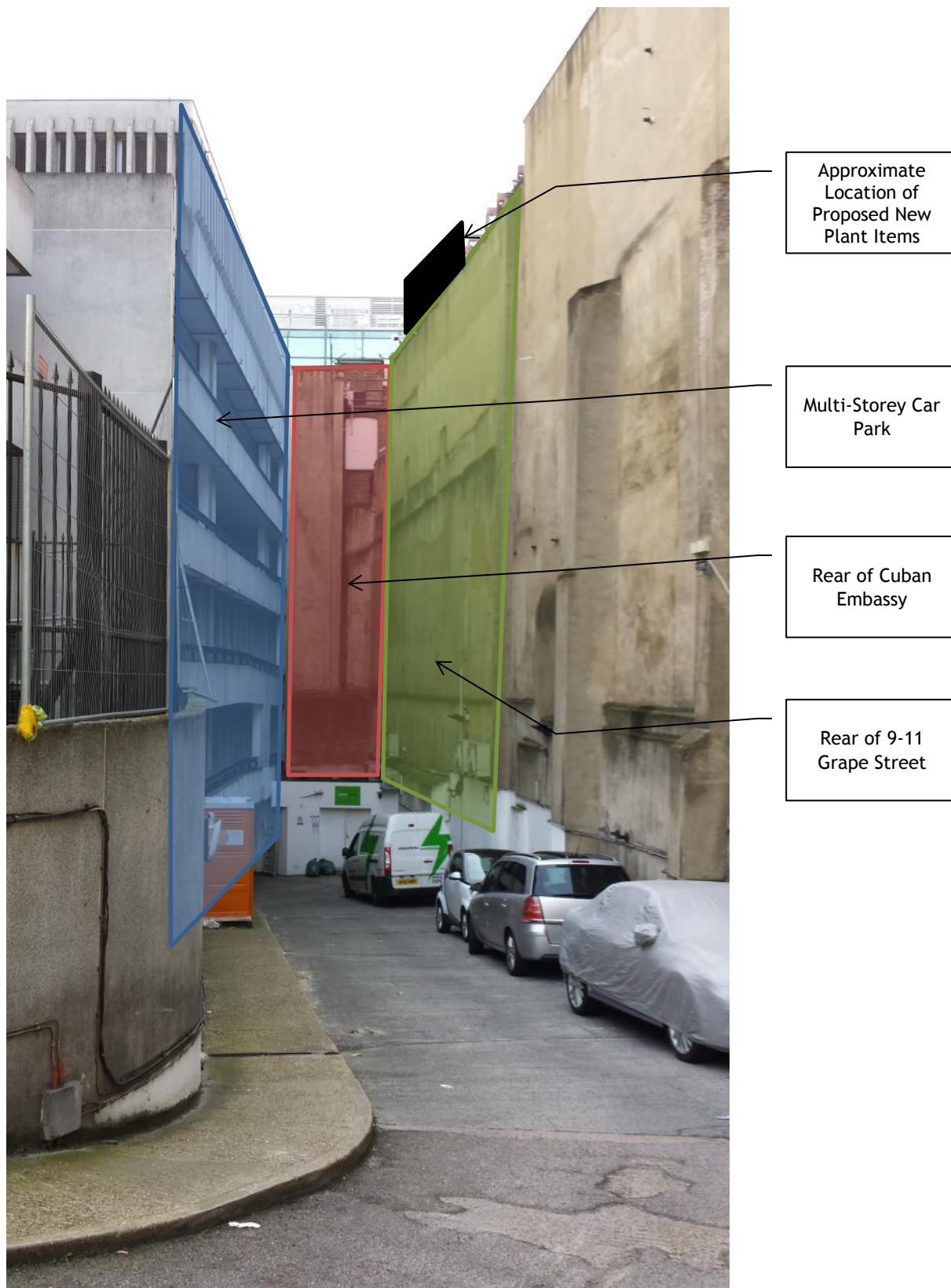


Figure 1437/F1 - Photograph showing the rear of 9-13 Grape Street



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Figure 1437/F2 - Photograph showing the rear of 5-7 Grape Street

## 4. MEASUREMENT METHODOLOGY

### *Attended Survey*

- 4.1 Daytime and night time attended surveys were conducted on both Grape Street to the front of the property and West Central Street to the rear of the property.
- 4.2 The daytime survey was conducted in line with the shortened measurement procedure outlined in the 'Calculation of Road Traffic Noise' [CRTN] on 9<sup>th</sup> December 2013.
- 4.3 The night time survey was conducted between 23h00-00h00, 02h00-05h00 and 06h00-07h00 8<sup>th</sup>-9<sup>th</sup> December 2013.
- 4.4 In all cases the microphone was approximately 1.3m from the local ground level. For the measurements on Grape Street and the microphone was 1m away from the building façade and for the measurements on West Central Street the microphone was 3m from any reflecting surfaces.
- 4.5 The road directly behind 9-13 Grape Street was inaccessible during the night time survey. Therefore the alternate location on West Central Street was used which was deemed to be representative of the background noise climate at the nearest noise sensitive window.
- 4.6 A verification measurement was undertaken on the 3<sup>rd</sup> floor of the multi-storey car park to ascertain a height correction for the noise levels measured at West Central Street.
- 4.7 The measurement locations are indicated on the attached site plan 1471/SP1.

### *Equipment and Weather Conditions*

- 4.8 The equipment used is detailed in Table 1 below. The sound level meters were fitted with windshields and calibrated before and after the measurements. Calibration certificates are attached to the end of this report.

Equipment			Calibration	
Description	Manufacturer & Type Number	Serial Number	Last Date	Certificate Number
Integrating sound level meter	Cirrus CR:171A	G061849	Sept 2012	199943
Acoustic Calibrator	Cirrus CR:515	60704	Sept 2013	210804

**Table 1471/T1 - Equipment Details**

- 4.9 The weather was dry for the duration of the measurement with little or no wind due to the sheltered location of the measurements.

## 5. NOISE SURVEY RESULTS

### Attended Survey

5.1 Tabulated data is available on request.

5.2 The results from the attended daytime survey are presented in table 1471/T2 below.

Date start time	Measurement Position (see map and notes)	L <sub>Aeq</sub> dB	L <sub>AF(max)</sub> dB	L <sub>AF,10</sub> dB	L <sub>AF,90</sub> dB
09/12/2013 10:29	1	63.68	79.64	65.7	59.7
09/12/2013 10:46	2	60.24	77.62	62.5	54.8
09/12/2013 11:02	1	67.37	91.12	67.1	57.6
09/12/2013 11:19	2	58.96	79.25	59.8	53.8
09/12/2013 11:59	1	64.08	77.97	67.1	59
09/12/2013 12:18	2	57.27	73.37	59.1	53.2

**Table 1471/T2 - Daytime Attended Survey Measurement Results**

\*All measurements uncorrected

5.3 The results from the attended night time survey are presented in table 1471/T3 below.

Date start time	Measurement Position (see map and notes)	L <sub>Aeq</sub> dB	L <sub>AF(max)</sub> dB	L <sub>AF,10</sub> dB	L <sub>AF,90</sub> dB
08/12/2013 23:00	1	62.27	79.87	63.9	54.3
08/12/2013 23:18	2	55.31	73.41	57.2	49.5
08/12/2013 23:37	3	51.94	65.54	54.2	48.4
09/12/2013 01:58	1	58.57	76.67	60.9	50.3
09/12/2013 02:14	2	51.12	60.65	54.2	46
09/12/2013 03:00	1	57.07	73.13	60.1	50.1
09/12/2013 03:16	2	54.79	73.22	57.7	45.4
09/12/2013 03:59	1	58.28	77.08	61.7	50.8
09/12/2013 04:15	2	51.73	62.88	55	45.8
09/12/2013 06:45	1	62.58	86.17	64.9	56.1

**Table 1471/T3 - Night time Attended Survey Measurement Results**

\*All measurements uncorrected

5.4 From the above data, the lowest measured LA90 at the rear of Grape Street was 45.4dBA.

5.5 Applying the 1dB correction found from the measurement on the 3<sup>rd</sup> floor of the multi-storey car park; the lowest LA90 at the nearest noise sensitive façade is 44.4 dBA.

5.6 The following daytime L<sub>Aeq</sub> has been calculated using the shortened measurement methodology contained within the Calculation of Road Traffic Noise [CRTN] from the attended measurement data and will be used for the external building fabric assessment.

5.7 The night time L<sub>Aeq</sub> was determined by the highest night time measured L<sub>Aeq</sub> at position 1 between 06:45 and 7:00.

Measurement Position (see map and notes)	Time of Day	$L_{Aeq}$ , dB	Octave Band Centre Frequency, $L_{eq}$ in dB						
			125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Grape Street Façade	07h00-23h00	63.6	62.9	60.3	58	60.1	58	48.6	39.4
	23h00-07h00	62.6	64.2	63.1	59.6	58.3	54.8	46.4	37.6

Table 1471/T4 -  $L_{eq}$  Values Used in Assessment

- 5.8 The typical  $L_{AFMax}$  for Grape Street was determined by vehicle movements on Grape Street.
- 5.9 The typical  $L_{AFMax}$  spectra which will be used during the external building fabric assessment are reproduced in Table 1471/T5 below:

Measurement Position (see map and notes)	Time of Day	$L_{AF,Max}$ , dB	Octave Band Centre Frequency, $L_{FMax}$ in dB						
			125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Grape Street Façade	07h00-23h00	77.6	73.0	68.2	68.7	71.4	70.5	67.0	57.2
	23h00-07h00	77.6	73.0	68.2	68.7	71.4	70.5	67.0	57.2

Table 1471/T5 - Typical  $L_{AFMax}$  Values Used in Assessment

- 5.10 In all cases there was no difference between the typical  $L_{FMax}$  spectra measured at night and during the day due to the early morning and late evening periods being similar to the daytime periods.
- 5.11  $L_{AFMax}$  values measured between 23:00-00:00 and 06:00-07:00 were adversely effected by sirens and these have not been included in the  $L_{AFMax}$  analysis.

## 6. LOCAL AUTHORITY NOISE EMISSION LIMITS

6.1 The following extract is taken from Camden's Development Policy 28:

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

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive façade	Day, evening and night	0000-2400	5dB(A) <LA90
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	Day, evening and night	0000-2400	10dB(A) <LA90
Noise at 1 metre external to sensitive façade where LA90>60dB	Day, evening and night	0000-2400	55dB <sub>LAeq</sub>

6.2 Therefore following plant noise emission limits apply and are set out below. These limits apply at 1m from the nearest sensitive façade.

6.3 Due to measurements being undertaken on a Sunday/Monday night it is expected that the plant noise emission limits presented here represent a worst case scenario.

Time Period	Plant Noise Emission Limits L <sub>Aeq,T</sub> dB
Weekday	
0000-2400 - Rear Facade	39
0000-2400 - Grape Street Facade	42

**Table 1471/T6 - Noise Emission Limits for Continuous Broadband Noise**

\*Based on noise levels corrected to free field conditions where applicable

Time Period	Plant Noise Emission Limits L <sub>Aeq,T</sub> dB
Weekday	
0000-2400 - Rear Facade	34
0000-2400 - Grape Street Facade	37

**Table 1471/T7 - Noise Emission Limits for Tonal, Impulsive or Intermittent Noise**

\*Based on noise levels corrected to free field conditions where applicable

6.4 The final plant item selection has yet to be made, but we have been provided by Scotch Partners with a likely plant item which has a noise level of 49dB<sub>A</sub> at 1m. There are 10 identical plan items with this noise level.

6.5 The location of these units is shown on the attached plans.

6.6 Taking a worst case scenario where all have line of sight to the nearest noise sensitive façade, the predicted noise level for all of the plant items at the nearest noise sensitive façade approximately 30m away is in the order of 38dB<sub>A</sub> L<sub>Aeq,T</sub> which is in compliance with the noise emission limit outlined above.

- 6.7 The above prediction ignores the directivity correction due to the location of the windows which are facing in the same direction as the louvre. This directivity correction could potentially reduce the noise levels by up to 15dB at those windows.
- 6.8 The nearest noise sensitive façade which has direct line of sight to the propose plan location is approximately 40m away. At this distance the predicted noise level from all of the plant items is in the order of 36dBA L<sub>Aeq,T</sub> which is in compliance with the noise emission limit outlined above.
- 6.9 From the predicted levels no acoustic louvre should be required where indicated on the attached plans.
- 6.10 A calculation has also been undertaken to 1m in front of the window on the top floor of the proposed development at 9-13 Grape Street facing towards Grape Street.
- 6.11 Taking into account distance and directivity the predicted noise level from all plant items is in the order of 40dBA L<sub>Aeq,T</sub> which is in compliance with the noise emission limit outlined above.
- 6.12 All the plant items should be installed on suitable vibration isolation mounts to minimise the structure born vibration. Specialist advice should be sought.
- 6.13 It is recommended that a verification calculation is made, using octave band data if available, once the final plant items have been chosen to confirm compliance with the above.

## 7. INDICATIVE EXTERNAL BUILDING FABRIC ASSESSMENT

7.1 British Standard BS 8233:1999 presents the following guidance for indoor ambient noise levels in spaces when they are unoccupied. These guidance levels are reproduced in Table 1471/T8 below.

Criterion	Typical Situations	Design Range $L_{Aeq,T}$ (dB)	
		Good	Reasonable
Reasonable speech or telephone communications	Kitchen	50	55
Reasonable resting/sleeping conditions	Living Room	30	40
	Bedroom	30	35

\*Note: For a reasonable standard in bedrooms at night, individual noise events (measured with F time-weighting) should not normally exceed 45dB  $L_{Amax}$ .

Table 1471/T8 - Internal Ambient Noise Levels (from BS 8233:1999 Table 5)

7.2 An assessment of the proposed building fabric constructions has been undertaken using the methodology detailed in section 6 of BS 8233:1999.

7.3 We would recommend that regardless of any planning condition the 'Reasonable' levels in table 1471/T8 be designed to as good practice. Therefore the 'Reasonable' levels have been used in the following external building fabric assessment.

7.4 However options to meet the 'Good Standard' have also been provided.

7.5 The following assumptions have been made for the assessment:

7.5.1 There will be a requirement to retain, or replace with visually similar units, the windows due to the age and location of the building.

7.5.2 The existing windows will be refurbished or replaced and upgraded to improve the seal with the frame.

7.5.3 Generic room sizes have been used.

7.5.4 Each flat will be mechanically ventilated using a whole house heat recovery system.

Location	Period	Type of Room	Predicted Internal Noise Level	External Wall Type	Window Type	Ventilator Type
Grape Street Façade	0700 -2300	Living Room	<40 $L_{Aeq,T}$	EW1	W4	V1
	2300 -0700	Bedroom	<35 $L_{Aeq,T}$ <45 $L_{Amax}$	EW1	W2	V1
Grape Street Façade	0700 -2300	Living Room	<35 $L_{Aeq,T}$	EW1	W3	V1
	2300 -0700	Bedroom	<30 $L_{Aeq,T}$ <45 $L_{Amax}$	EW1	W1	V1

Table 1471/T9 - Summary of the Recommended Practicable Façade Element Types



Façade Element ID	Single Figure Rating	Sound Reduction Values (dB)				
		125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
EW1	R <sub>w</sub> 52 dB	41	45	45	54	58
W1	R <sub>w</sub> 47 dB	39	45	50	53	51
W2	R <sub>w</sub> 41 dB	25	28	38	45	44
W3	R <sub>w</sub> 38 dB	23	24	34	44	43
W4	R <sub>w</sub> 35 dB	23	22	27	38	40
V1	D <sub>new</sub> 55 dB	46	46	49	55	66

**Table 1471/T10 - Minimum Sound Reduction Values**

- 7.6 The specified sound reduction values shall be met by the façade element as a whole, including all framing and openable elements, such as doors, windows and vents.
- 7.7 Table 1471/T11, below, provides typical constructions of the various elements that could provide the acoustic performance above in suitable framing. However, it is the acoustic performance that is specified and any construction is indicative only; and will be subject to provision of suitable independently verified acoustic performance test data, including all opening windows, doors, and ventilation elements.

Façade Element ID	Typical Constructions
EW1	Traditional cavity masonry construction
W1	Secondary glazing in window reveal; 200mm air gap and 8mm pane; eg Selectaglaze S20 VS in a heavy duty frame with 8mm pane or similar and equal; existing primary glazing made good with acoustic/weather seals
W2	New or refurbished double glazing with acoustic seals and typically 6mm Pane/ 16mm Air/ 10.8 Acoustically Laminated Pane
W3	New or refurbished double glazing with acoustic seals and typically 6mm Pane/ 16mm Air/ 6.8 Acoustically Laminated Pane
W4	New or refurbished double glazing with acoustic seals and typically 6mm Pane/ 16mm Air/ 4mm Pane
V1	Whole house; mechanical ventilation heat recovery system

**Table 1471/T11 - Typical Constructions**

- 7.8 The internal noise level values presented in Table 1471/T9 should be met if the façade elements used in the construction have sound reductions that meet or exceed the values presented in Table 1471/T10 for all relevant locations during the night time [23h00-07h00] and daytime [07h00-23h00] periods.
- 7.9 This assessment is indicative only and further clarification should be sought once the internal layout is finalised.

## **8. CONCLUSION**

- 8.1 Adnitt Acoustics has undertaken an investigation of the existing ambient noise climate of 9-13 Grape Street, London.
- 8.2 Results from the daytime and night time attended noise surveys are presented.
- 8.3 Minimum background noise levels at the nearest noise sensitive receiver have been determined.
- 8.4 Limiting noise emission criteria have been proposed for any potential plant items in compliance with the requirements of Camden Council.
- 8.5 An initial indicative external building fabric assessment has been undertaken and the results are presented.

**Graham Shaw BSc(Hons) MSc AMIOA AMInstP**

**for ADNITT ACOUSTICS**

## APPENDIX A: GLOSSARY OF ACOUSTIC TERMS

<b>Ambient Noise</b>	The noise climate heard over a period of time due to all normal sources, in the absence of extraneous or atypical sounds. Used to describe noise in the absence of the introduced sound, generally.	
<b>Ambient Noise Level</b>	Describes the average noise level of the ambient noise over a stated period of time, e.g. hourly noise	
	Parameter: A-weighted Continuous Equivalent Sound Pressure Level determined over the time period T. Expressed in decibels / A-weighted decibels	$L_{eq,T}$ or $L_{Aeq,T}$  dB(A) or dB
<b>Decibel scale dB</b>	A linear numbering scale used to define a logarithmic amplitude scale, thereby compressing a wide range of amplitude values to a small set of numbers	
<b>dB(A)</b>	An electronic filter in a sound level meter, which approximates under defined conditions the frequency response of the human ear.	
$L_{Aeq,T}$	The equivalent continuous sound level. The steady dB(A) level which would produce the same A-weighted sound energy over a stated period of time as the measured sound pressure level.	
$L_{Amax}$	The maximum dB(A) level measured during a survey period.	
$L_{A10}$	The dB(A) level exceeded for 10% of the survey period, often used as a quantifier of traffic noise level.	
$L_{A90}$	The dB(A) level exceeded for 90% of the survey period. Used in BS 4142:1997 as being representative of the background noise level.	
<b>Acoustic screening</b>	Physical barrier to sound formed by fence, wall, building or other structure, which has the effect of reducing the sound transmitted.	
<b>Individual Event Noise</b>	The noise of a distinctive event with the varying noise climate, usually a transient activity, such as a vehicle pass-by, aircraft flyover or similar, rather than an isolated impulsive noise.	
<b>Individual Event Noise Level</b>	Describes the highest noise level during the event as measured under particular conditions of time-weighting	
	Parameter: A-weighted Maximum Sound Pressure Level with FAST or SLOW time weighting  Expressed in decibels / A-weighted decibels	$L_{Amax,FAST}$ or $L_{Amax,F}$ $L_{Amax,SLOW}$ or $L_{Amax,S}$  dB(A) or dB
<b>Sound Reduction Index <math>R_w</math></b>	Single number rating used to describe the sound insulation of building elements as defined in BS EN ISO 717 1997.	
<b>Weighted element-normalized level difference <math>D_{n,e,w}</math></b>	Single number rating used to describe the sound insulation of building elements as defined in BS EN ISO 717 1997.	

## APPENDIX B: CALIBRATION CERTIFICATES

### Certificate of Calibration



#### Equipment Details

Instrument Manufacturer Cirrus Environmental  
 Instrument Type CR:171A  
 Description Sound Level Meter  
 Serial Number G061850

#### Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

#### Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 6009
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5964

Calibrated by



Calibration Date

07 September 2012

Calibration Certificate Number

199945

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH  
 Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742  
 Email: sales@cirrusresearch.co.uk

# Certificate of Calibration



## Equipment Details

Instrument Manufacturer Cirrus Research plc  
 Instrument Type CR:515  
 Description Acoustic Calibrator  
 Serial Number 60704

## Calibration Procedure

The acoustic calibrator detailed above has been calibrated to the published data as described in the operating manual. The procedures and techniques used to follow the recommendations of the IEC standard Electroacoustics – Sound Calibrators IEC 60942:2003, IEC 60942:1997, BS EN 60942:1998 and BS EN 60942:2003 where applicable.. The calibrator's main output is 94.00 dB (1 Pa) and this was set within the 0.01 dB resolution of the test system, i.e. one hundredth of a decibel. Numbers in { parenthesis } refer to the paragraph in IEC 60942.

## Calibration Traceability

The calibrator above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 6009
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5964

## Calibration Climate Conditions

The climatic test conditions were all maintained within the permitted limits of IEC 60942:1997.

Temperature	{B.3.2}	Permitted band	15°C to 25°C
Humidity	{B.3.2}	Permitted band	30% to 90% RH
Static Pressure	{B.3.2}	Permitted band	85 kPa to 105 kPa
Ambient Noise Level	{B.3.3.6}	Max permitted level	64 dB(Z)

## Measurement Results

The figures below are the Calibration Laboratory test limits for this model calibrator and have a smaller tolerance than those permitted in IEC 60942.

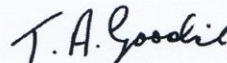
94 dB Output	94.00 dB	Permitted band	93.95 to 94.05dB
104 dB Output	dB	Permitted band	103.80 to 104.30dB
Frequency	1000 Hz	Permitted band	990 to 1010Hz

## Uncertainty

With an uncertainty coefficient of k=2, i.e. a 95% confidence level, the uncertainty of each measure is

94 dB Output	± 0.13 dB	104 dB Output	± 0.14 dB
Frequency	± 0.1 Hz	Level Stability	± 0.04 dB

Calibrated by



Calibration Date

18 September 2013

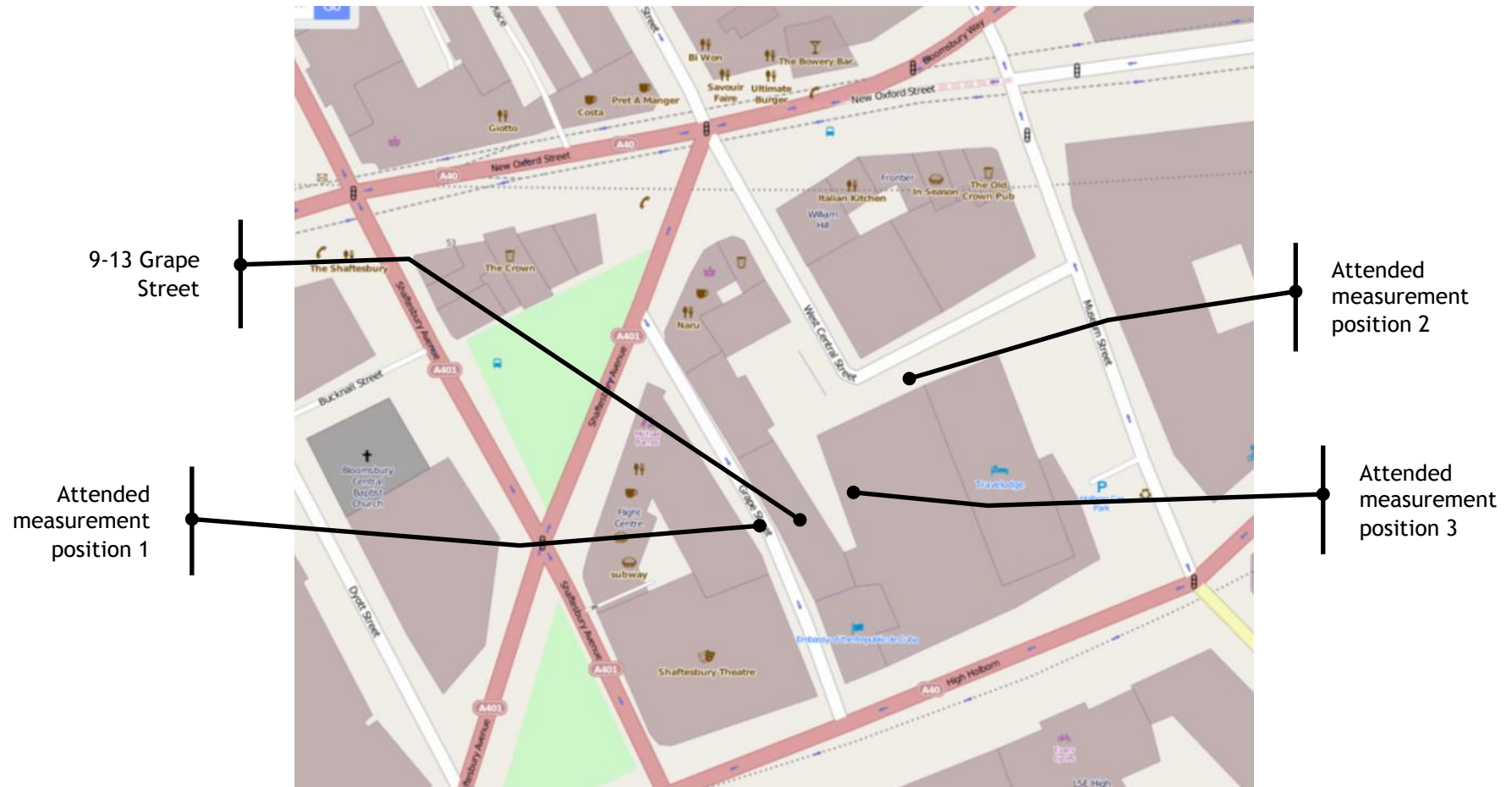
Calibration Certificate Number

210804

This Calibration Certificate is valid for 24 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH  
 Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742  
 Email: sales@cirrusresearch.co.uk

1471/SP1: Site Plan Showing Measurement Locations



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