Bickerdike
Allen
Partners
Architecture
Acoustics
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35-37 ALFRED PLACE, LONDON WC1E

PLANT NOISE ASSESSMENT

PLANNING APPLICATION REF: 2013/2802

Report to

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Introduction

Bickerdike Allen Partners (BAP) have been appointed by The City of London Corporation to carry out a plant noise assessment at 35-37 Alfred Place, London WC1E, which is part of a planning application to the London Borough of Camden.

Section 2 describes the location of the site in relation to noise sensitive premises

Section 3 sets out current local authority noise criteria

Section 4 explains the survey methodology and presents the results

Section 5 presents the predicted noise limits for proposed plant items

This report is summarised in Section 6.

1.0 THE SITE

1.1 35-37 Alfred Place

35-37 Alfred Place is a four-storey building which is due to be redeveloped to provide office space. The location of the site is shown in Figure 1 below.

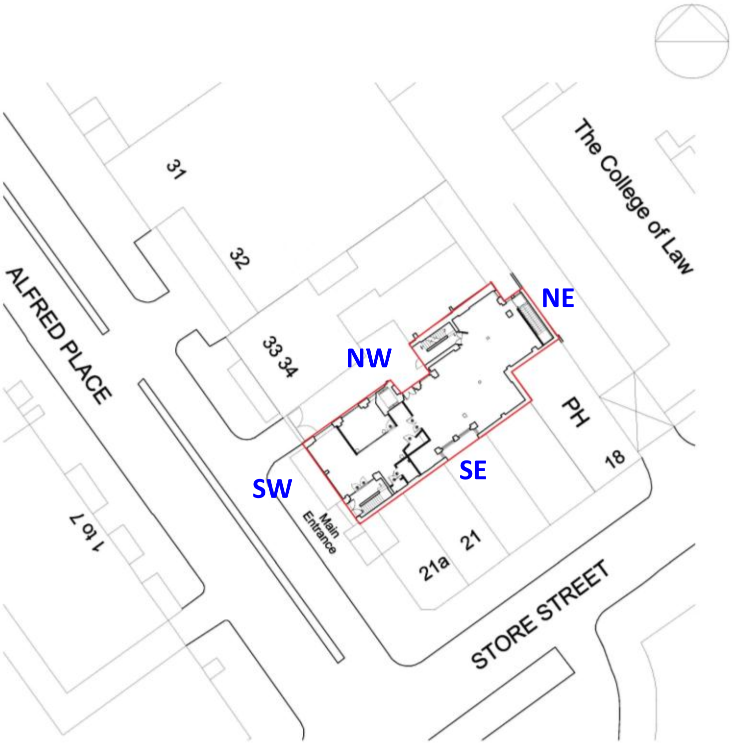


Figure 1 – Location of site, local area and geographic position of facades

The site is located east of Tottenham Court Road and bordered by Alfred Place to the South West, commercial property to the North West, The College of Law delivery yard to the North East, and commercial and residential mixed use property to the South East, on the corner of Alfred place and Store Street.

The building is made up of four storeys and a basement level, with the main access for the site located on Alfred Place. The current proposal is for the redevelopment of the property into commercial office space on all floors.

Drawings of the existing and proposed works have been provided by Gibberd.

1.2 Proposed works and details of plant

BAP have not received any specific information about the future plant which has yet to be selected.

Under current proposal, the future offices are to be served by new plant. There are to be three stand-alone VRF units and three wall-mounted condenser units installed in a courtyard on the north west façade.

Additionally, a new air handling unit (AHU) is to be installed in a lightwell on the south-east façade, see Figure 2. The external wall forming a part of the lightwell is part of a common staircase in the residential building at 21 Store Street.

The nearest noise sensitive window (NNSW) to any of these plant units is Flat 11 at 21 Store Street (see Figures 2 and 3). This location is approximately 7 m away from the supply of the AHU in the lightwell. The NNSW is well screened from the plant units to be installed in the courtyard of 35-37 Alfred Place.

BAP understand that the AHU unit will be operating during office business hours between 9:00 and 18:00 hours. However, we understand that VRF and condenser in the courtyard units may run overnight during low temperature on anti freeze programme.

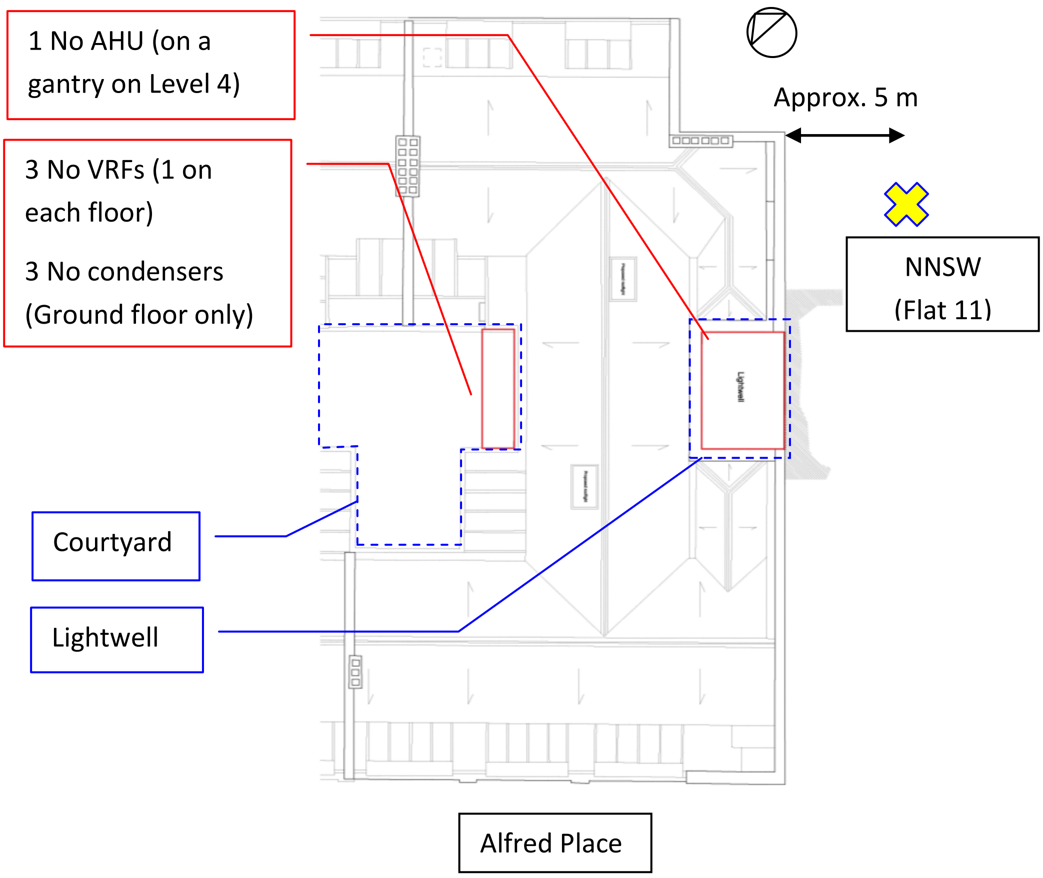


Figure 2 – Location of plant items

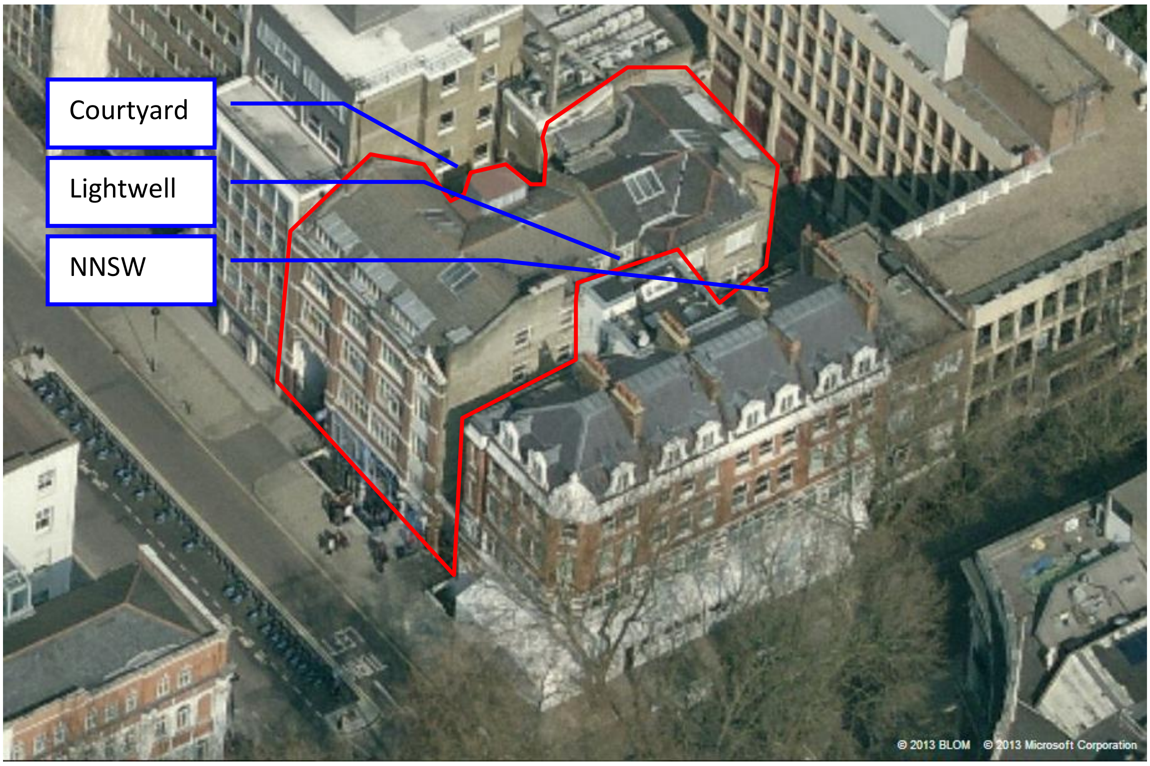


Figure 3 –Location of site and local area

2.0 CRITERIA

2.1 Local Authority

2.1.1 Planning Condition

BAP understand that the local authority, the London Borough of Camden (LBC), have provided specific planning conditions that relate to plant and mechanical noise (dated: 16 May 2013). London Borough of Camden require the acoustic report to validate the planning application as follows:

1. Please provide an acoustic report prepared by qualified noise consultants relating to the proposed condenser units. The acoustic report should contain the following information:- (i) background noise levels before installation of plant (ii) manufacturers' details and noise output from proposed plant (iii) whether proposed plant would comply with Camden's noise standards in relation to nearest noise sensitive facades (5-10db below background levels) e.g. residential properties including a spreadsheet calculation of noise prediction that demonstrates theoretically that Camden's planning noise conditions will be met (iv) any means of attenuation or isolation necessary to ensure that the proposed plant complies with noise standards (e.g. acoustic screens). The acoustic report should address the cumulative noise levels of all the proposed and existing units.

2.1.2 Plant and machinery noise levels

In order to comply with the Local Authority standards noise from plant machinery should be controlled in accordance with the following guidance has been taken from LBC *Noise Strategy: Appendix 2 – UDP Planning Guidance*, June 2006.

Disturbance from plant and machinery

1.51 Plant and machinery, including ventilation and air handling equipment and any ancillary plant, ducting and equipment can have undesirable impacts on nearby properties. This can relate to their appearance and location as well as the odour and fumes and noise/vibration pollution that can be created.

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.*

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 a sensitive façade where LA90 >60dB	Day, evening and night	0000-2400	55dB LAeq

Table 1 - London Borough of Camden plant noise limits (Table E)

The London Borough of Camden plant noise guidance states that noise from all plant and building services equipment should be 5 dB below the lowest measured background noise level ($L_{A90,\ 15min}$) as measured one metre from the nearest affected window of the nearest affected residential property. Allowing for possible tonal or impulsive characteristics of plant, the noise level should be controlled to a level of 10 dB below the lowest measured background level.

3.0 BACKGROUND NOISE SURVEY

Mechanical plant is to be installed and replaced on both the west and east façades. In order to accurately determine existing noise levels and therefore the noise limits that will be placed on plant units in relation to the redevelopment, attended and unattended noise measurements were taken at a number of locations around the site.

3.1 Unattended long-term survey

In order to determine external ambient noise levels around the site, unattended noise surveys were carried out between the 14th and 16th May, 2013. The monitor locations are shown in Figure 4.

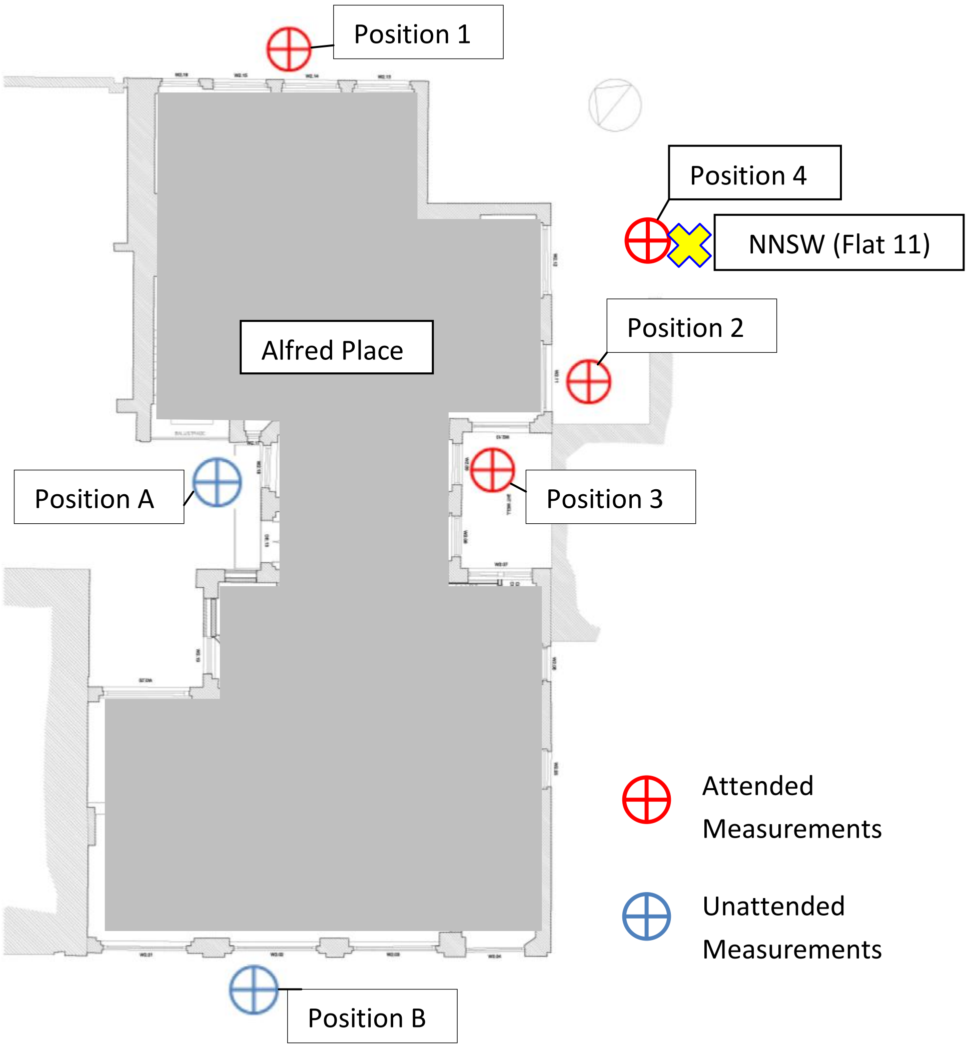


Figure 4 –Attended and unattended survey location

The instrumentation used for the long term, unattended surveys consisted of a Norsonic 140 Type 1 meter for Position A and a Norsonic 118 Type 1 meter for Position B, each with appropriate weather protection equipment. The meters were checked for calibration before and after the survey using a Norsonic 1251 calibrator. No significant drift was observed.

3.2 Attended measurements

Attended measurements were carried out between 10:00 and 13:00 on 14th May 2013. The locations of the measurements are shown in Figure 4.

Noise measurements were made using two Brüel and Kjær 2260 Type 1 sound level meters, calibrated with a Brüel and Kjær 4231 calibrator. The microphone was mounted on a tripod and was positioned at various levels across the facades. The meter was calibrated before and after each set of measurements with no significant drift observed.

3.3 Results

3.3.1 Unattended long-term survey

The results of façade noise measurements at Position A and B are summarised in Table 2 below.

Position	Date	Period	Min $L_{A90\ 15\ min}$ dB(A)
A	15th May	Daytime 1445-2300	50
A	15th May	Night time 2300-0700	50
A	16th May	Daytime 0700-1500	49
B	14th May	Daytime 1000-1300	57

Table 2 – Long term noise survey results for Position A and B, $L_{A90\ 15\ min}$ dB(A)

The minimum daytime background noise level measured for Position B over the 3 hour daytime period was 57 dB $L_{A90\ 15\ min}$, which occurred at a number of occasions throughout the survey. The dominate background source of noise was from local and distant road traffic on and around Alfred Place.

The minimum daytime (9:00 to 18:00 hours) background noise level measured for Position A was 49 dB $L_{A90\ 15\ min}$. This was measured at 11:15 on the morning of the 16th May.

The measurements are graphically presented in Appendix 2.

3.3.2 Attended measurements

All attended measurements were taken between 10:00 and 13:00 on 14th May. A summary of the attended façade measurement results can be seen below in Table 3.

Position	Location	$L_{A90\ 5\ min}$ dB(A)	Typical Background
1	1st floor north east façade	55	Nearby condenser unit on, distant road traffic
1	1st floor north east façade	52	Distant road traffic (Condenser off)
2	1st floor south east façade	55	Nearby condenser unit
3	Light-well south east façade	43	Distant road traffic (faint)
4	4th floor south east façade (Flat 11)	53	Condenser unit on lower floor of nearby building, distant road traffic
4	4th floor south east façade (Flat 11)	52	Distant road traffic (Condenser off)

Table 3 – Attended measurement results, Min $L_{A90\ 5\ min}$ dB(A) (Daytime)

3.3.3 Assessment levels

Noise emissions from building services systems will need to be controlled to comply with local authority planning requirements, based on the environmental noise survey data.

During the survey it was observed that the acoustic environment around 35-37 Alfred Place is controlled by local and distant road traffic and, in the case of the NNSW, existing plant from the adjacent building.

Positon 3 (lightwell) was screened from all above sources.

The attended measurements shown in Table 3 indicate that when the condenser was off, the background noise level was measured at around 52 dB L_{A90}. Noise measurements shown in Appendix 2 indicate that at the same time, background noise level at Position A was measured at around 51 dB L_{A90}. This shows that Position A can provide indicative information about the noise environment at the NNSW location (Position 4) throughout the day, as both receptors are predominantly affected by distant road traffic, rather than plant noise.

During a day, the lowest measured background noise level at Position A was 49 dB L_{A90}. When traffic diminishes it is expected that this background noise level will be similar to that at the NNSW position.

In order to comply with the local criteria, the assessment level for non-tonal and non-impulsive noise is 5 dB lower than the lowest measured background noise level, i.e. 44 dB L_{A90}.

4.0 PLANT NOISE ASSESSMENT

In this section, a noise assessment including AHU, VRFs and condensers is reported.

BAP have not been provided with manufacturer's data for proposed plant units. Plant noise power limits required for the unit to meet the local criteria have therefore been set using the conservative method of calculations shown in Tables 4 to 7.

The calculation procedure has involved applying correction factors to account for distance attenuation and a façade correction at the receiver position.

Duct attenuation loss has been ignored therefore the limits set for supply and discharge apply to the outlet and inlet at the unit.

4.1 AHU in the lightwell

The nearest noise sensitive window (NNSW) is located at Flat 11 on the fourth floor of the residential building on the corner of Alfred Place and Store Street. The window is directly adjacent to 35-37 Alfred Place at a distance of approximately 5 m away from the roof. Figure 5 shows the location of noise outputs from the AHU which have been used in the calculations.

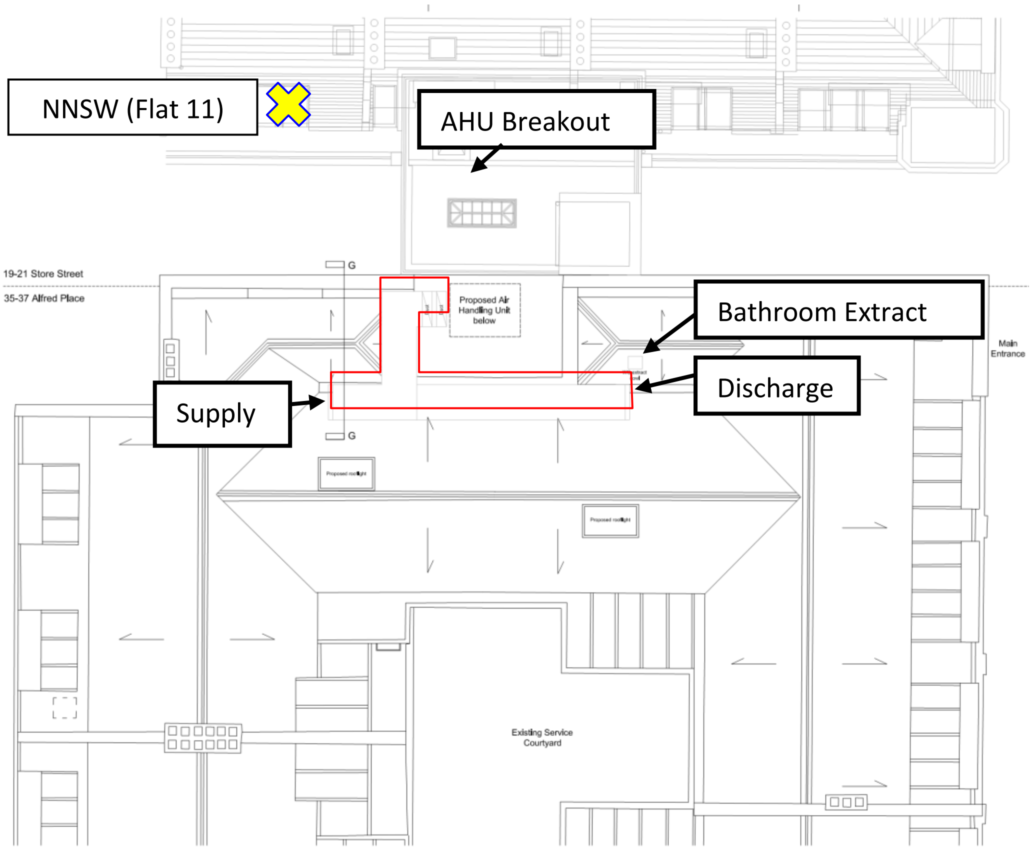


Figure 5 - Proposed location of AHU ductwork (Based on drwg: (PA) 017)

From BAP's experience, bathroom extract fans are generally very quiet. The bathroom extract unit depicted above also benefits from screening provided by roof. Therefore noise generated by the bathroom extract is considered as insignificant.

Breakout	Octave Band Centre Frequency, Hz							A
	63	125	250	500	1000	2000	4000	
$L_{A90\ 15\ min}$ at NNSW	40	36	37	36	34	28	17	38
+Barrier attenuation	9	11	14	17	20	22	25	
+Distance (9.6m)	20	20	20	20	20	20	20	
+Directivity	11	11	11	11	11	11	11	
-Reflections	6	6	6	6	6	6	6	
Plant SWL Limit	74	72	76	78	79	75	67	82

Table 4 - Calculations for AHU breakout sound power limit

Supply	Octave Band Centre Frequency, Hz							A
	63	125	250	500	1000	2000	4000	
$L_{A90\ 15\ min}$ at NNSW	40	36	37	36	34	28	17	38
+Barrier attenuation	8	10	12	15	18	21	24	
+Distance (7.6 m)	18	18	18	18	18	18	18	
+Directivity	11	11	11	11	11	11	11	
-Reflections	3	3	3	3	3	3	3	
Plant SWL Limit	74	72	75	77	78	75	67	82

Table 5 - Calculations for AHU supply sound power limit

Extract	Octave Band Centre Frequency, Hz							A
	63	125	250	500	1000	2000	4000	
$L_{A90\ 15\ min}$ at NNSW	40	36	37	36	34	28	17	38
+Barrier attenuation	7	8	10	12	15	17	20	
+Distance (16.7m)	24	24	24	24	24	24	24	
+Directivity	11	11	11	11	11	11	11	
-Reflections	3	3	3	3	3	3	3	
Plant SWL Limit	79	76	79	80	81	77	69	84

Table 6 - Calculations for AHU discharge sound power limit

The above calculations show that the dominant source of noise at the NNSW will be from the AHU itself and its supply vent located on the roof of the site opposite the window at Flat 11.

The limits for the AHU breakout, supply and extract are given in the above tables. Any future plant item and associated ductwork in the position shown in Figure 5 will need to adhere to these limits in order to meet current plant noise criteria set by The London Borough of Camden or revised calculations undertaken to account for the spectral content of the specified plant.

4.2 VRF units in the courtyard

Four VRF units are to be installed within the courtyard to the north-east of the building at 35-37 Alfred Place, with one unit per floor, see Figure 6.

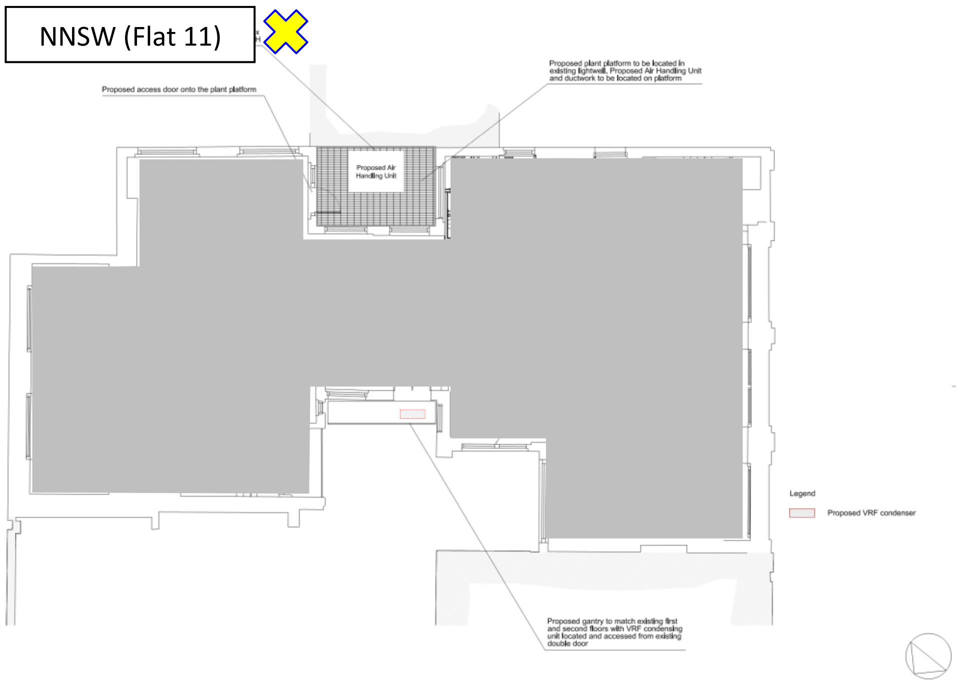


Figure 6 - Proposed location of VRF units (Based on drwg: (PA)016)

VRF at 4th floor	Octave Band Centre Frequency, Hz							A
	63	125	250	500	1000	2000	4000	
$L_{A90\ 15\ min}$ at NNSW	37	33	34	33	31	25	14	35
+Barrier attenuation	13	16	19	22	25	25	25	
+Distance (9.6m)	23	23	23	23	23	23	23	
+Directivity	11	11	11	11	11	11	11	
-Reflections	6	6	6	6	6	6	6	
Plant SWL Limits								
4th floor (above)	78	77	81	83	84	78	67	87
3rd floor	82	81	85	86	84	78	67	88
2nd floor	85	84	88	87	85	79	68	89
1st floor	87	86	89	88	86	80	69	90

Table 7 – Example of calculations for VRF sound power limit (4th floor unit) and power limits for units at other floors

The calculations above indicate that the sound power level generated by any VRF unit should not exceed 87 dB(A) in order to meet the noise target at the NNSW.

4.3 Condenser units

It is expected that wall-mounted condensers on the ground floor will produce much less noise that VRF units combined. All three units will not contribute to the total plant noise if their individual sound power levels are 81 dB(A). In BAP's experience this would constitute an upper range for a plant item of this type and therefore these units are excluded from detailed assessment.

4.4 Night time operation

It is understood that VRF and condenser units located in the courtyard may run 24 hours a day in order to prevent freezing of liquids. We understand, however, that this operation does not require full power and is therefore not considered to produce significant amount of noise. For this reason, night time noise levels have not been assessed.

4.5 Mitigation measures

If any of the selected plant is likely to produce sound power noise levels higher than the limits above, a set of mitigation measures will be required. These may include enclosures, in-line attenuators, acoustic screens or a combination of these. The amount of required attenuation will depend on the level by which the design limit has been exceeded. A suitably qualified acoustician consultant should be consulted to specify the mitigation measures.

5.0 SUMMARY

Bickerdike Allen Partners have carried out a plant noise assessment at 35-37 Alfred Place, London, with regards to the installation of new plant items.

BAP have commented of the relevant criteria relating to plant noise and have advised on noise limits for new plant in order to meet current criteria set by The London Borough of Camden.

Jonathan Baldwin	**Tom Galikowski**	**John Miller**
for Bickerdike Allen Partners		**Partner**

APPENDIX 1

GLOSSARY OF ACOUSTIC TERMINOLOGY

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10-5 pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, Lw is expressed in decibels, referenced to 10-12 watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

Statistical Term	Description
LAeq, T	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level (LAeq, T). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.
LAE	Where the overall noise level over a given period is made up of individual noise events, the LAeq, T can be predicted by measuring the noise of the individual noise events using the sound exposure level, LAE (or SEL or LAX). It is defined as the level that, if maintained constant for a period of one second, would deliver the same A-weighted sound energy as the actual noise event.
LA01	The level exceeded for 1% of the time is sometimes used to represent typical noise maxima.
LA10	The level exceeded for 10% of the time is often used to describe road traffic noise.
LA90	The level exceeded for 90% of the time is normally used to describe background noise.

: Commonly Used Environmental Noise Descriptors

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law. In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB.

Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

Screening and Diffraction

If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation, however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.

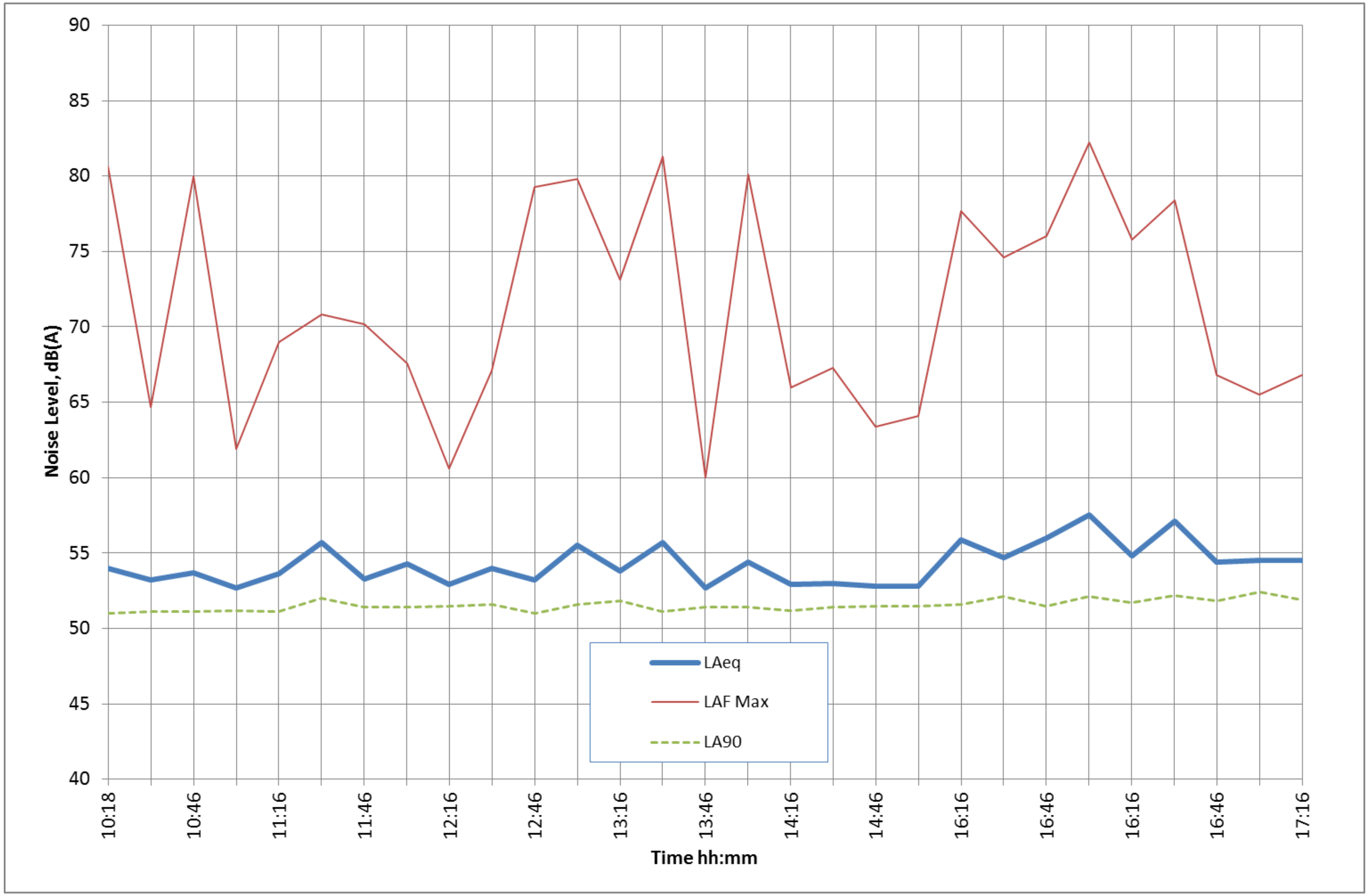
Meteorological Effects

Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradients are variable and difficult to predict.

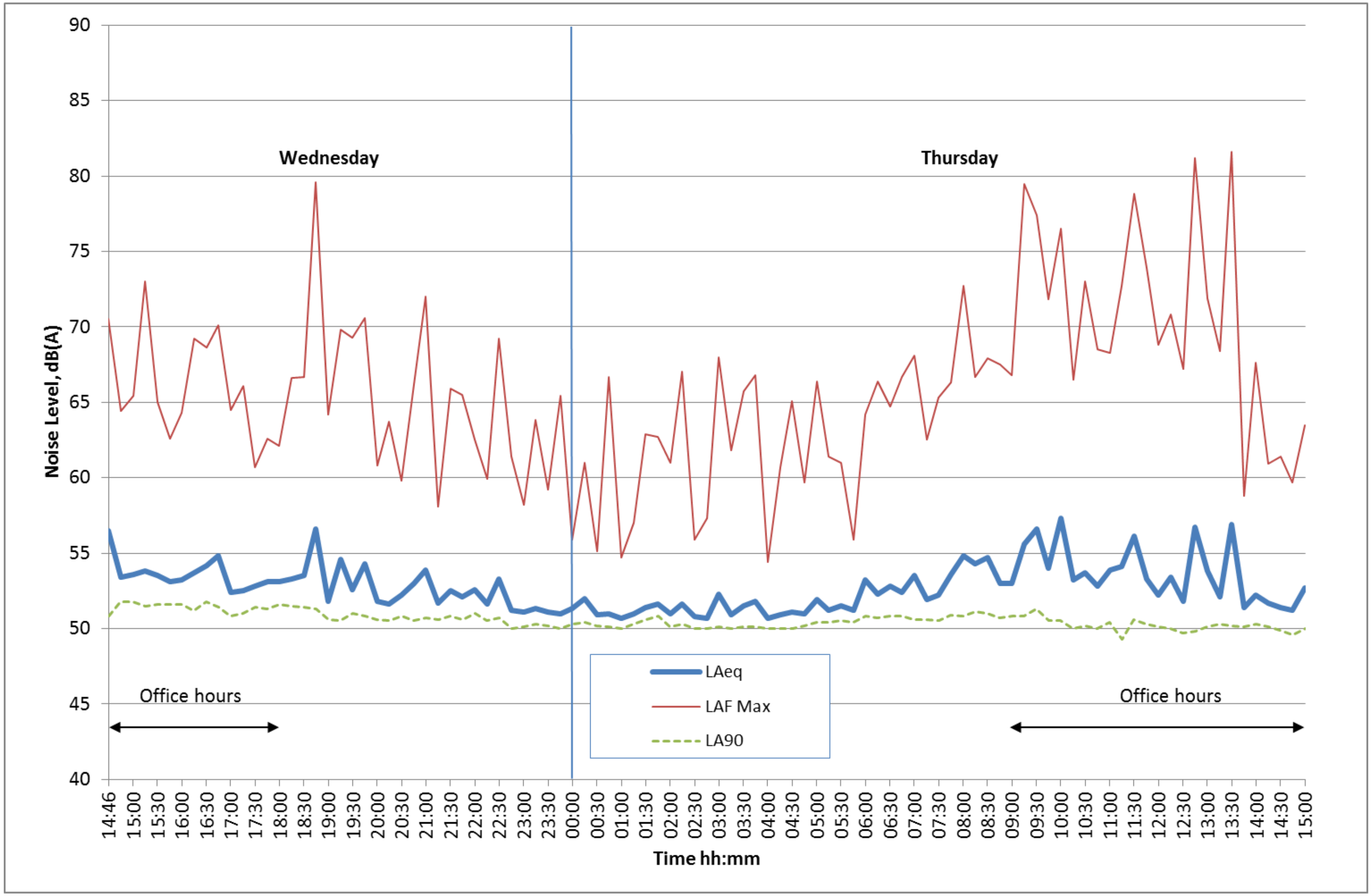
APPENDIX 2

DETAILS OF UNATTENDED MEASUREMENTS

Position A – 14th May 2013



Position B – 14th May 2013



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Position A – 15th to 16th May 2013