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Consultants in Acoustics, Noise & Vibration

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75 Farringdon Road

Planning condition 5 discharge report

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Version	Date	Comments	Author	Reviewer
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Summary

Sandy Brown has been appointed by St James's Place Property Unit Trust to provide acoustic advice in relation to the CAT A office development at 75 Farringdon Road, London.

As part of this, building services equipment has been installed, which have associated planning conditions in relation to noise egress.

An environmental noise survey has been carried out to determine the existing background sound levels in the area and to set appropriate plant noise limits in line with the requirements of the London Borough of Camden.

Based on the requirements of Camden's planning condition 5 for the site and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed L_{Aeq} 49 dB during the daytime, L_{Aeq} 50 dB during the evening and L_{Aeq} 48 dB at night. These limits are cumulative, and apply with all plant operation under normal conditions. If plant items contain tonal or attention catching features, then an additional 5 dB penalty will be applied.

As assessment of the proposed building services plant associated with the development has been carried out. The calculated noise levels at the nearest noise sensitive receiver are L_{Aeq} 42 dB under normal operation and L_{Aeq} 47 dB under emergency operation.

The noise emissions are therefore expected to comply with the above limits, providing the specified mitigation is provided.

Contents

1 Introduction

Sandy Brown has been appointed by St James's Place Property Unit Trust to provide acoustic advice in relation to the CAT A office development at 75 Farringdon Road, London.

As part of this, building services equipment has been installed, which have associated planning conditions in relation to noise egress.

An environmental noise survey has previously been undertaken, the purpose of which is to establish the existing background sound levels in the vicinity of nearby noise sensitive premises and to set appropriate limits for noise egress from building services plant. An assessment of plant noise egress of the installed plant items has also been undertaken to determine whether the requirements of the relevant planning conditions have been achieved.

This report presents relevant plant noise limits, details of the assessment and the predicted noise levels at the nearest noise sensitive premises based on the operation of the new plant items.

A summary of the method and results from the environmental noise survey are provided in Appendix A.

2 Noise egress limits

2.1 Standard guidance

Guidance for noise emission from proposed new items of building services plant is given in BS 4142: 2014 '*Methods for rating and assessing industrial and commercial sound*'.

BS 4142 provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

2.2 Planning condition 5

Planning condition 5, set by the London Borough of Camden, states the following:

1. Prior to commencement of the development, details shall be submitted to and approved in writing by the Council, of the external noise level emitted from plant/ machinery/ equipment and mitigation measures as appropriate. The measures shall ensure that the external noise level emitted from plant, machinery/ equipment will be lower than the lowest existing background noise level by at least 5dBA, by 10dBA where the source is tonal, as assessed according to BS4142:1997 at the nearest and/or most affected noise sensitive premises, with all machinery operating together at maximum capacity. A post installation noise assessment shall be carried out where required to confirm compliance with the noise criteria and additional steps to mitigate noise shall be taken, as necessary. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

2. Reason: To safeguard the amenities of the premises and the area generally in accordance with the requirements of policies G1, CC1, D1,and A1 of the London Borough of Camden Local Plan 2017.

2.3 Limits

Based on the criteria set in Planning condition 5 and the measurement results, the cumulative noise level resulting from the operation of all new plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 1.

Table 1 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)
Daytime (07:00-19:00)	49
Evening (19:00-23:00)	50
Night-time (23:00-07:00)	48

The limits set out in Table 1 do include any corrections for any attention catching features. These limits will be 5 dBA more stringent if the plant contains attention-catching features.

Emergency plant should only be operational in the case of an emergency or during testing, which should take place during weekday daytime hours (09:00 – 17:00).

3 Assessment

3.1 Proposed plant items

All the main noise emitting plant items will be installed at roof level. The proposed plant items along with their locations and distances from the nearest noise sensitive receptor (73 Farringdon Road) are given in Table 2.

Table 2 Proposed building services units

Unit	Type	No. units	Distance to receptor(m)	Normal/ emergency
AHU 1	Office AHU	1	21	Normal
SQFTA61	WC extract fan	1	26	Normal
PUMY-P112	Condenser units	7	23	Normal
PURY-EP200	Condenser units	3	25	Normal
PURY-EP300	Condenser units	6	23	Normal
	Tenant plant allowance		30	Normal
	Lobby pressurisation fan	1	26	Emergency
	Lift pressurisation fan	1	28	Emergency
P110-3	Generator	1	23	Emergency

The spectral noise levels of each of these units and used as a basis for the assessment are provided in Appendix B.

3.2 Plant layout

The layout of the plant items on the roof in relation to the nearest noise sensitive receptor (73 Farringdon Road) is shown in Figure 1.

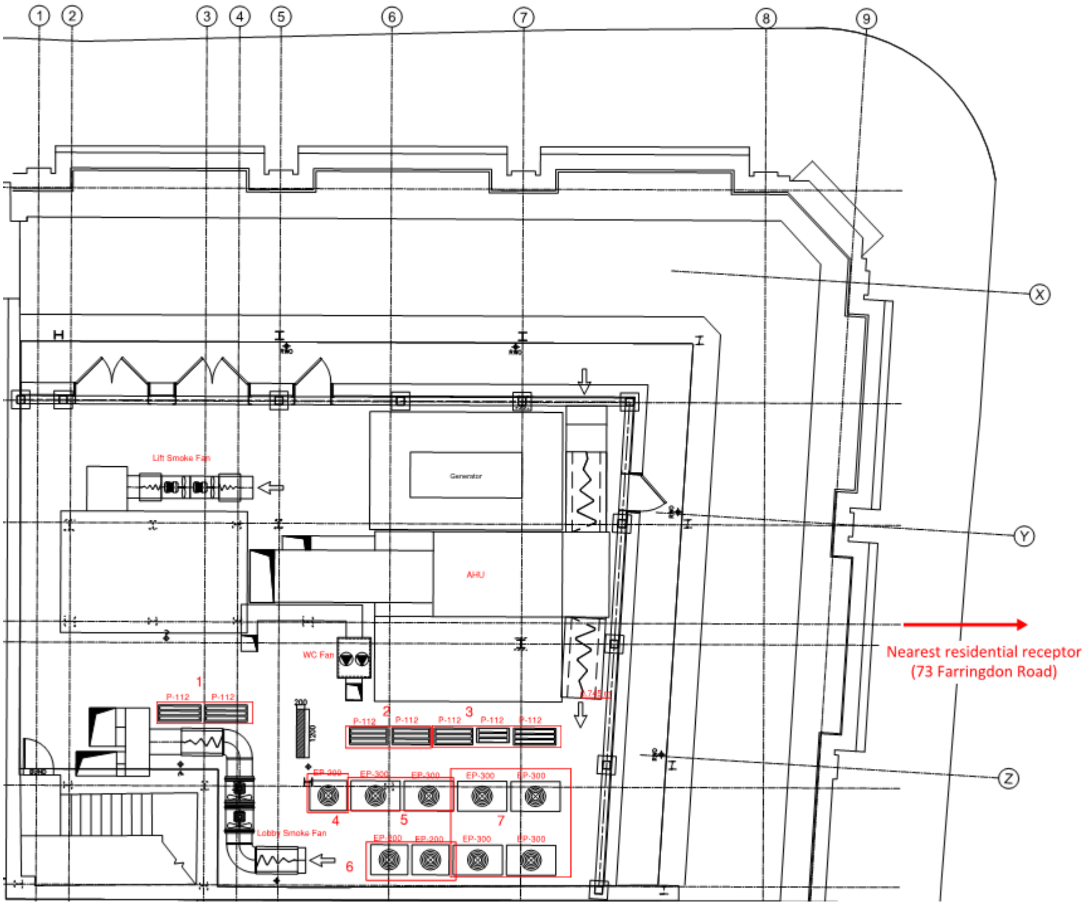

Figure 1 Layout of plant items on roof of 75 Farringdon Road

3.3 Attenuation measures

A plant screen will surround the roof top plant area, which will be the height of the tallest item of plant (assumed to be the AHU at 2.2 m). This will be a standard weather louvre or architectural screen and does not provide any notable insertion loss.

The standby generator will be housed in an acoustic enclosure that is proposed to limit noise breakout to L_{Aeq} 66 dB at 15 m.

In order to control duct-borne noise, in-duct attenuators will be fitted to all air handling plant (AHU/WC fan/pressurisation fans) and will achieve the minimum insertion losses shown in Table 3.

Table 3 Minimum insertion losses for atmospheric side in-duct attenuators

	Octave-band centre frequency (Hz)								Length (mm)
	63	125	250	500	1k	2k	4k	8k	
All air handling plant	5	10	14	19	24	29	13	8	1200

These attenuation measures are based on the sound levels used as a basis for the assessment (shown in Appendix B). Should these levels change, then the attenuation measures will also change accordingly.

3.4 Noise egress assessment

3.4.1 Normal operation plant

Predicted noise levels at the nearest noise sensitive receptor for each item of the proposed rooftop plant, together with their cumulative level are given in Table 4.

The predicted noise levels are inclusive of all proposed attenuation measures including silencer selections. The cumulative noise level of all proposed rooftop plant is compliant with the planning condition 5.

Table 4 Predicted sound pressure levels at the nearest noise sensitive receptor – normal operation

Unit name	Predicted noise level L_{Aeq} (dB)
Office AHU	37
WC extract fan	23
Condenser units	38
Tenant plant allowance	36
Cumulative noise level at nearest receptor	42

3.4.2 Life-safety plant

Predicted noise levels at the nearest noise sensitive receptor during life-safety plant operation are given in Table 4. The predicted noise levels are inclusive of all proposed attenuation measures including silencer selections and the generator enclosure.

Table 5 Predicted sound pressure levels at the nearest noise sensitive receptor – emergency operation

Unit name	Predicted noise level L_{Aeq} (dB)
Normal operation (including tenant allowance)	42
Standby generator	34
Lobby pressurisation fan	43
Lift pressurisation fan	41
Cumulative noise level at nearest receptor	47

During emergency operation with both pressurisation fans running and the generator, the noise level at the nearest receptors is calculated to be L_{Aeq} 47 dB. This is within the plant noise limits for normal operation and is therefore acceptable.

3.4.3 Plant noise assessment on the terrace

Based on the proposed plant selections and tenant plant allowance noise levels at the terrace due to plant are expected to be ≤ L_{Aeq} 55 dB under normal operation and around L_{Aeq} 66 dB under emergency operation.

4 Conclusion

Based on planning condition 5 and the results of the environmental noise survey, the relevant plant noise limits at the worst affected noise sensitive premises are L_{Aeq} 49 dB during the daytime, L_{Aeq} 50 dB during the evening and L_{Aeq} 48 dB at night.

As assessment of the proposed building services plant associated with the development has been carried out and noise emissions are expected to comply with the above limit at all times, providing the specified mitigation is provided.

Appendix A – Summary of site measurements

Method

Both attended and unattended surveys have been undertaken at the site. The method for each of these is detailed below.

Measurement locations

The measurement locations are shown in Figure A1, where 'L' indicates the unattended measurement position and '1', '2' and '3' indicate the attended measurement positions at ground level

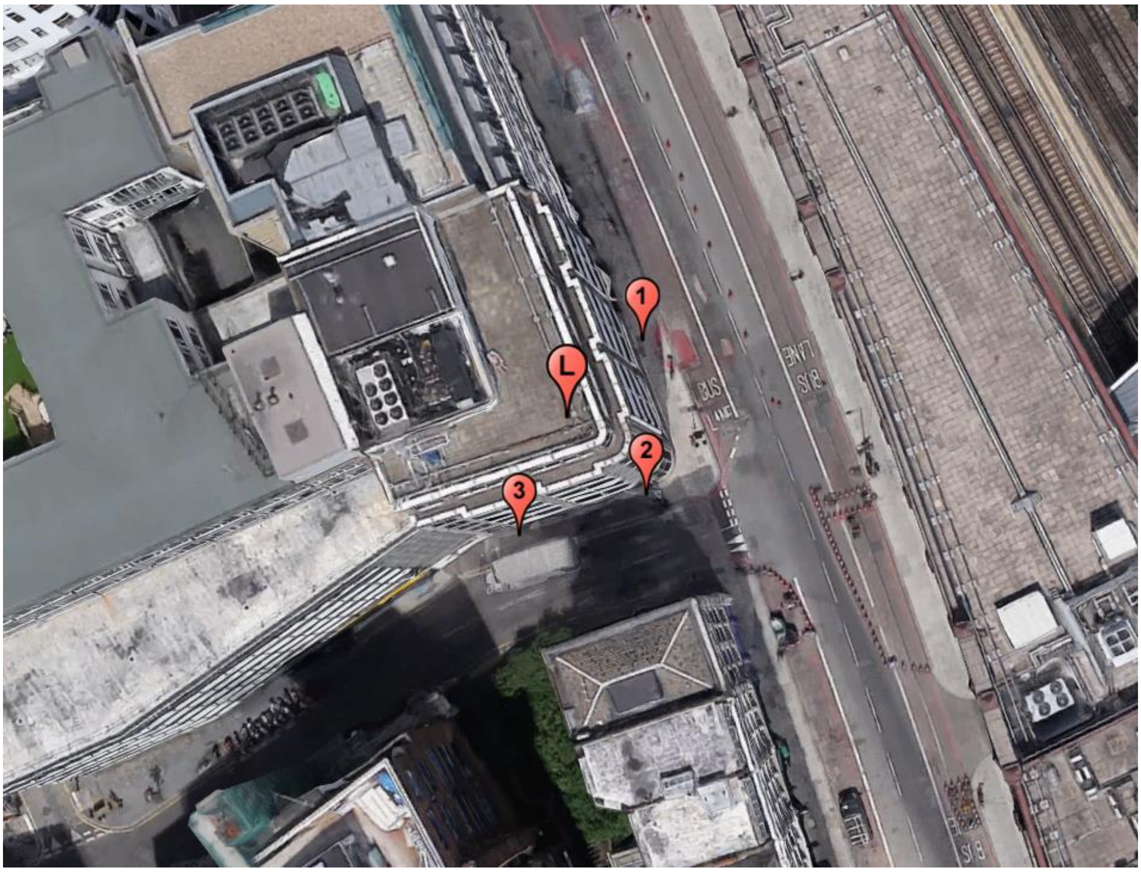

Figure A1 Mark-up of measurement positions (courtesy of Google Earth Pro)

Unattended noise survey method

Unattended noise monitoring was undertaken at the site over 5 days to determine the existing background sound levels in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 15 minute periods between 15:53 on 11 August 2016 and 16:08 on 15 August 2016. The equipment was installed by Ben Southgate and Rob Conetta and collected by Ben Southgate.

The measurement position used during the survey is indicated in Figure A1, denoted by the letter 'L'. A photograph showing the measurement location is provided in Figure A2. This location was chosen to be reasonably representative of the noise levels experienced by the nearest noise sensitive premises, and also of night maximum noise levels experienced at the site.

Figure A2 Photograph of unattended measurement position

Attended measurements

Attended sample measurements were performed by Ben Southgate at three locations around the perimeter of the building. These are indicated in Figure A1 as positions ‘1’ to ‘3’. The attended measurements were carried out on 6 November 2017 over 15 minute periods, to determine the existing facade noise levels from road traffic, pedestrians and other significant noise sources in the area.

Photographs of the measurement positions are indicated in Figure A3. In each case the microphone was mounted on a tripod approximately 1.5 m above the ground level and 1 m away from the facade of the building.

Figure A3 Photographs showing attended measurement positions 1 (top left), 2 (top right) and 3 (bottom left)

Equipment

The unattended noise measurements were performed using a Svantek 957 sound level meter. A Rion NL-52 sound level meter was used to undertake the attended measurements.

The calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	SVAN957/12327	Svantek	2 Nov 17	1511575
Microphone	ACO7052H/43273	Svantek	2 Nov 17	1511575
Pre-amp	SV12L/13569	Svantek	2 Nov 17	1511575
Calibrator	SV30A/7451	Svantek	30 Oct 17	1510572
Sound level meter	NL-52/00242702	Rion	9 Jun 19	TCRT17/1341
Microphone	UC-59/06185	Rion	9 Jun 19	TCRT17/1341
Pre-amp	NH-25/32730	Rion	9 Jun 19	TCRT17/1341
Calibrator	CAL200/4499	Larson Davis	9 Jun 19	TCRT17/1339

Calibration of the meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and the respective measurement chains were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant calibration deviation occurred.

Weather conditions

During the unattended noise measurements between 11 August 2016 and 15 August 2016, weather reports for the area indicated that temperatures varied between 15 °C at night and 28 °C during the day, and the wind speed was less than 5 m/s.

During the attended measurements carried out on 6 November 2017, the weather was generally clear and dry and no rain occurred. Wind speeds were generally less than 1 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Measurement results

Observations

The dominant noise sources observed at the site during the unattended survey consisted of road traffic noise, railway noise and plant noise from roof-top building services plant with less significant noise sources including construction noise.

During the attended measurements, the dominant noise source was road traffic along Farringdon Road as well as pedestrians. Less significant sources noted during these measurements included some construction works, railway noise and road traffic along other nearby roads including St. Cross Street.

Unattended measurement results

The results of the unattended noise measurements are summarised in the following tables. A graph showing the results of the unattended measurements is shown in Figure A4.

The day and night time ambient noise levels measured during the unattended survey are presented in Table A2. These measurements were considered to be free-field.

Table A2 Ambient noise levels measured during the survey

Date	Daytime (07:00 – 19:00) $L_{Aeq,12h}$ (dB)	Evening (19:00 – 23:00) $L_{Aeq,4h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Thursday 11 August 2016	-	60	59
Friday 12 August 2016	63	62	59
Saturday 13 August 2016	60	58	58
Sunday 14 August 2016	59	59	59
Average	61	60	59

The minimum background sound levels measured during the unattended survey are given in Table A3.

Table A3 Minimum background sound levels measured during the survey

Date	Daytime (07:00 – 19:00) $L_{A90,15min}$ (dB)	Evening (19:00 – 23:00) $L_{A90,15min}$ (dB)	Night (23:00 – 07:00) $L_{A90,15min}$ (dB)
Thursday 11 August 2016	59 *	56	54
Friday 12 August 2016	58	56	54
Saturday 13 August 2016	54	55	54
Sunday 14 August 2016	54	55	53
Monday 15 August 2016	57 *	-	-

* Measurement not made over full period due to monitoring start and end time

The lowest background sound levels measured during the survey were $L_{A90,15min}$ 54 dB during the daytime, $L_{A90,15min}$ 55 dB during the evening and $L_{A90,15min}$ 53 dB at night.

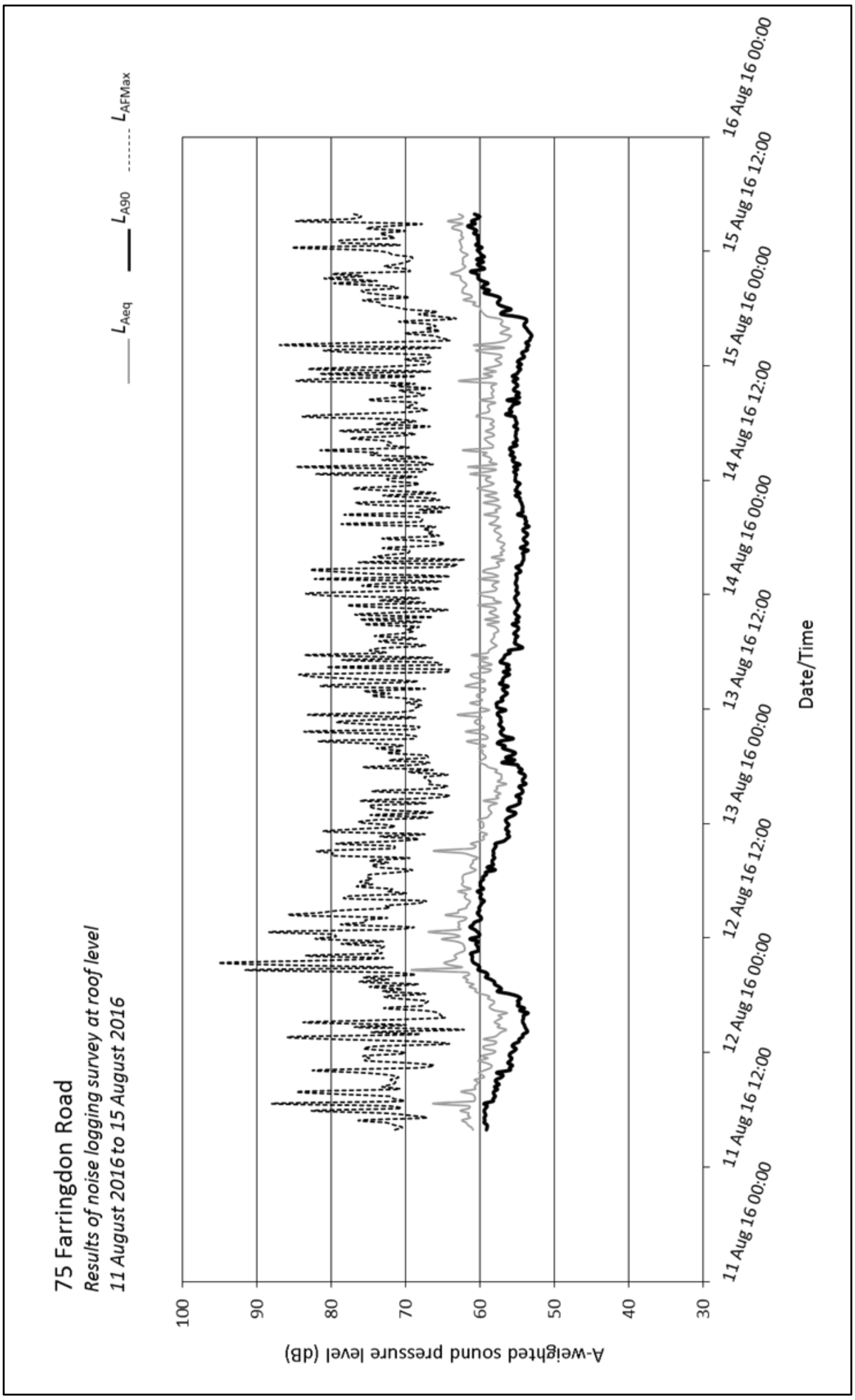

Figure A4 Results of unattended noise measurements

Attended measurement results

The sound pressure levels recorded during the attended measurements are summarised in Table A4. All the attended measurements were performed over 15 minute periods and are considered to be facade noise levels.

Table A4 Sound pressure levels from attended measurements

Position	Start time	Sound pressure levels (dB)		
		$L_{Aeq,15min}$	$L_{AFmax,15min}$	$L_{A90,15min}$
1	14:00	70	89	59
2	14:17	68	88	56
3	14:34	66	93	55
1	14:50	71	93	57
2	15:08	69	90	56
3	15:25	64	82	53
1	15:42	73	89	60
2	15:58	74[1]	99	62[1]
3	16:14	67	87	56

[1] These measurements were higher than the other levels measured at position 2 due to a helicopter that was hovering over the site for a large portion of the measurement period.

In general the L_{Aeq} and L_{A90} levels were set by road traffic noise from Farringdon Road, with the L_{AFmax} levels being set by large trucks, car horns and sirens.

Appendix B – Plant noise data

The plant noise data used as a basis for the assessment is shown in Table B1.

Table B1 Sound level data used as a basis for the plant noise assessments (dB)

Noise source	L_w / L_p[1]	Octave-band centre frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
AHU supply fan outlet	L_w	76	77	88	84	82	79	76	74	87
AHU supply fan inlet	L_w	71	73	80	77	73	71	69	68	80
AHU extract fan outlet	L_w	69	74	77	76	75	70	68	66	79
AHU extract fan inlet	L_w	66	71	74	71	65	64	63	62	73
AHU breakout[2]	L_w	69	69	74	66	59	51	43	36	68
WC extract fan outlet	L_w	83	83	77	75	67	68	68	54	77
WC extract fan inlet	L_w	82	89	80	70	63	66	66	57	77
WC extract fan breakout	L_w	71	77	69	61	49	51	44	32	65
Stair pressurisation inlet	L_w	96	100	110	108	106	101	97	95	110
Stair pressurisation outlet	L_w	95	100	110	108	106	101	97	95	110
Lobby pressurisation inlet	L_w	96	100	110	108	106	101	97	95	110
Lobby pressurisation outlet	L_w	95	100	110	108	106	101	97	95	110
Condenser (PUMY-P112)	L_p	64	52	51	49	46	41	35	32	51
Condenser (PURY-EP200)	L_p	75	65	62	58	51	45	39	33	59
Condenser (PURY-EP300)	L_p	74	69	65	62	56	48	41	37	63
Generator[3]	L_p[4]	58	65	62	62	62	59	53	46	66
Tenant plant[5]	L_p	75	65	62	58	51	45	39	33	59
FCU outlet (PEFY-P50VMA)	L_w	70	50	48	45	41	34	26	20	48
FCU inlet (PEFY-P50VMA)	L_w	62	54	53	48	43	38	34	30	50

1. L_w indicates that the levels shown are sound power levels re. 10^{-12} W.
   L_p indicates that the levels shown are sound pressure levels measured at 1 m re. 2×10^{-5} Pa
2. The AHU breakout sound power levels were not supplied, but were calculated based on the sound power levels of the fans and the expected reduction through the casing
3. As no spectral data was provided for the generator, these levels are based on the spectrum of another enclosed generator, weighted to the manufacturer's quoted dBA level with the casing
4. These levels are the sound pressure levels at 15 m, re. 2×10^{-5} Pa
5. Based on the spectrum of the PURY-EP300 unit

Appendix C – Calculation stages

Comments	Octave band centre frequency (Hz)								Rating 1	
	63	125	250	500	1k	2k	4k	8k		

16327 - 75 Farringdon Road

Plant noise egress calcs
BS - 9/11/2017

Criteria

Daytime	L_A=	49
Evening	L_A=	50
Night	L_A=	48
Emergency	L_A=	63

Nearest noise sensitive reciever is 73 Farringdon Road

Calculated levels

Normal operation	L_A=	**42**
Emergency operation	L_A=	**47**

Equation

Using: **Lp2 = Lw - 20log(r2) + 10log(Q) - 11 + FC - Abar**
and: **Lp2 = Lp1 - 20log(r2/r1) + FC - Abar**
Where:
Lp2 is the sound pressure level at the receiver
Lp1 is the sound pressure level at the specified distance r1
Lw is the sound power level of the source
r2 is the distance from the source to the receiver
r1 is the distance from the source to the measurement position for Lp1
Q is the directivity of the source
FC is the facade correction, assumed to be 3 dB
Abar is the attenuation provided by barriers and other screening

Assumptions

Barrier height is 2.2 m (same as AHU height)
Calcs based on no barrier (ie louvre) and screening from building

Calculations - normal operation

Air handling unit

	63	125	250	500	1k	2k	4k	8k		
Supply fan										
AHU supply fan inlet Lw	71	73	80	77	73	71	69	68	L_A=	80
+ 6 dB correction (AHU mounting)	6	6	6	6	6	6	6	6		
IAC 3L face vely -10 m/s	-5	-10	-14	-19	-24	-29	-13	-8		
- 20log(r2); [r2 = 21 m]	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4	-26.4		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.038 m]	-5.2	-5.5	-5.9	-6.7	-8.1	-10.1	-12.6	-15.5		
Lp2	40.6	32.1	34.7	25.9	15.5	6.5	18.0	19.1	L_A=	29
Extract fan										
AHU extract fan outlet Lw	69	74	77	76	75	70	68	66	L_A=	79
+ 6 dB correction (AHU mounting)	6	6	6	6	6	6	6	6		
IAC 3L face vely +10 m/s	-5	-10	-14	-19	-24	-29	-13	-8		
- 20log(r2); [r2 = 20 m]	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0	-26.0		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.228 m]	-6.4	-7.5	-9.2	-11.5	-14.3	-17.2	-20.2	-23.2		
Lp2	39.0	31.5	28.8	20.5	11.7	-1.2	9.8	9.8	L_A=	24

Breakout										
Breakout Lw - with case	69	69	74	66	59	51	43	36	L_A=	68
+ 6 dB correction (AHU mounting)	6	6	6	6	6	6	6	6		
- 20log(r2); [r2 = 22 m]	-26.8	-26.8	-26.8	-26.8	-26.8	-26.8	-26.8	-26.8		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.047 m]	-5.3	-5.6	-6.1	-7.1	-8.6	-10.8	-13.5	-16.4		
Lp2	43.0	37.3	42.4	32.7	24.4	13.9	3.3	-6.6	L_A=	36
Total										
Lp2	45.9	39.3	43.2	33.7	25.1	14.7	18.7	19.6	L_A=	37
WC fan										
Extract fan										
WC fan induct outlet Lw	83	83	77	75	67	68	68	54	L_A=	77
IAC 3L face vely +10 m/s	-5	-10	-14	-19	-24	-29	-13	-8		
- 20log(r2); [r2 = 26 m]	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.545 m]	-7.8	-9.7	-12.2	-15.0	-18.0	-21.0	-24.0	-24.0		
Lp2	44.7	30.0	17.5	7.7	-8.3	-15.3	-2.3	-11.3	L_A=	20
Breakout										
WC fan breakout Lw	71	77	69	61	49	51	44	32	L_A=	65
- 20log(r2); [r2 = 25 m]	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.693 m]	-8.4	-10.5	-13.1	-16.1	-19.0	-22.1	-24.0	-24.0		
Lp2	38.1	33.6	23.0	12.0	-2.9	-4.0	-12.9	-24.9	L_A=	20
Total										
Lp2	45.6	35.2	24.1	13.4	-1.8	-3.7	-1.9	-11.1	L_A=	23
VRF condenser units										
Group 1										
VRF condenser PUMY-P112 Lp@1 m	64	52	51	49	46	41	35	32	L_A=	51
+ 10log(N); [N = 2]	3	3	3	3	3	3	3	3		
- 20log(r2/r1); [r2 = 29 m, r1 = 1 m]	-29.2	-29.2	-29.2	-29.2	-29.2	-29.2	-29.2	-29.2		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.852 m]	-9.0	-11.2	-14.0	-16.9	-19.9	-23.0	-24.0	-24.0		
Lp2	40.8	17.6	13.8	8.9	2.9	-5.2	-12.2	-15.2	L_A=	16
Group 2										
VRF condenser PUMY-P112 Lp@1 m	64	52	51	49	46	41	35	32	L_A=	51
+ 10log(N); [N = 2]	3	3	3	3	3	3	3	3		
- 20log(r2/r1); [r2 = 25 m, r1 = 1 m]	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.46 m]	-7.5	-9.2	-11.5	-14.3	-17.3	-20.3	-23.3	-24.0		
Lp2	42.1	20.9	17.6	12.8	6.8	-1.2	-10.2	-13.9	L_A=	18
Group 3										
VRF condenser PUMY-P112 Lp@1 m	64	52	51	49	46	41	35	32	L_A=	51
+ 10log(N); [N = 3]	5	5	5	5	5	5	5	5		
- 20log(r2/r1); [r2 = 23 m, r1 = 1 m]	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.229 m]	-6.4	-7.5	-9.2	-11.5	-14.3	-17.3	-20.3	-23.3		
Lp2	44.5	25.0	22.3	18.0	12.2	4.2	-4.8	-10.8	L_A=	22

Group 4										
VRF condenser PURY-EP200 Lp@1 m	75	65	62	58	51	45	39	33	L_A=	59
+ 10log(N); [N = 1]	0	0	0	0	0	0	0	0		
- 20log(r2/r1); [r2 = 26 m, r1 = 1 m]	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.583 m]	-8.0	-9.9	-12.4	-15.3	-18.3	-21.3	-24.0	-24.0		
Lp2	49.7	29.8	23.8	16.9	7.4	-1.6	-10.8	-16.8	L_A=	25
Group 5										
VRF condenser PURY-EP300 Lp@1 m	74	69	65	62	56	48	41	37	L_A=	63
+ 10log(N); [N = 2]	3	3	3	3	3	3	3	3		
- 20log(r2/r1); [r2 = 25 m, r1 = 1 m]	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.444 m]	-7.4	-9.1	-11.4	-14.2	-17.1	-20.1	-23.1	-24.0		
Lp2	51.6	37.5	31.7	25.4	16.5	6.0	-4.0	-8.9	L_A=	30
Group 6										
VRF condenser PURY-EP200 Lp@1 m	75	65	62	58	51	45	39	33	L_A=	59
+ 10log(N); [N = 2]	3	3	3	3	3	3	3	3		
- 20log(r2/r1); [r2 = 25 m, r1 = 1 m]	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0	-28.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.39 m]	-7.2	-8.7	-10.9	-13.6	-16.6	-19.6	-22.6	-24.0		
Lp2	53.1	34.4	28.7	22.0	12.5	3.5	-6.0	-13.4	L_A=	29
Group 7										
VRF condenser PURY-EP300 Lp@1 m	74	69	65	62	56	48	41	37	L_A=	63
+ 10log(N); [N = 4]	6	6	6	6	6	6	6	6		
- 20log(r2/r1); [r2 = 23 m, r1 = 1 m]	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2	-27.2		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.16 m]	-6.0	-6.8	-8.2	-10.2	-12.8	-15.7	-18.7	-21.7		
Lp2	55.3	43.5	38.6	33.1	24.5	14.1	4.1	-2.9	L_A=	36
Total										
Lp2	59.2	45.1	40.0	34.3	25.7	15.6	5.8	-0.7	L_A=	38
Tenant plant allowance (total with 2 units per office floor)										
Typical condenser spectrum at 1m	75.0	65.0	61.5	57.5	51.0	45.0	38.5	32.5	L_A=	59
+ 10log(N); [N = 18]	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6		
- 20log(r2/r1); [r2 = 30 m, r1 = 1 m]	-29.5	-29.5	-29.5	-29.5	-29.5	-29.5	-29.5	-29.5		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 1.127 m]	-9.8	-12.3	-15.2	-18.2	-21.2	-24.0	-24.0	-24.0		
Lp2	61.0	38.7	32.3	25.3	15.8	7.0	0.5	-5.5	L_A=	36
Total - normal operation										
Lp2	63.4	47.1	45.2	37.3	28.7	18.5	19.0	19.6	L_A=	42
Nightime criteria									L_A=	48
Calculations - emergency operation										
Normal plant										
Lp2	63.4	47.1	45.2	37.3	28.7	18.5	19.0	19.6	L_A=	42
Lobby pressurisation										
Stair pressurisation fan inlet Lw	96	100	110	108	106	101	97	95	L_A=	110
IAC 3L face vely -10 m/s	-5	-10	-14	-19	-24	-29	-13	-8		
- 20log(r2); [r2 = 26 m]	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3	-28.3		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.757 m]	-8.7	-10.8	-13.5	-16.4	-19.4	-22.4	-24.0	-24.0		
Lp2	57.7	45.9	49.2	39.3	29.3	16.3	26.7	29.7	L_A=	43

Lift pressurisation										
Lift pressurisation fan inlet Lw	96	100	110	108	106	101	97	95	L_A=	110
IAC 3L face vely -10 m/s	-5	-10	-14	-19	-24	-29	-13	-8		
- 20log(r2); [r2 = 28 m]	-28.9	-28.9	-28.9	-28.9	-28.9	-28.9	-28.9	-28.9		
+ 10log(Q); [Q = 2]	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
-11	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.941 m]	-9.3	-11.6	-14.4	-17.4	-20.4	-23.4	-24.0	-24.0		
Lp2	47.8	44.5	47.7	37.7	27.7	14.7	26.1	29.1	L_A=	41
Generator										
Generator - typical spectrum weightec	58	65	62	62	62	59	53	46	L_A=	66
IAC 3L face vely -10 m/s	-5	-10	-14	-19	-24	-29	-13	-8		
- 20log(r2/r1); [r2 = 23 m, r1 = 15 m]	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7		
+ FC	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		
- Abar; [PD = 0.303 m]	-6.7	-8.1	-10.1	-12.6	-15.5	-18.5	-21.5	-24.0		
Lp2	45.7	45.9	37.7	29.5	22.0	10.6	18.3	13.5	L_A=	34
Total - emergency operation										
Lp2	64.6	52.0	52.6	43.2	33.7	21.9	30.1	32.7	L_A=	47
Emergency criteria									L_A=	63