SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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Guardian Space, Midland Goods Shed and East Handyside Canopy

Environmental plant noise assessment

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Version	Date	Comments	Author	Reviewer
A	6 Aug 15	Draft issue	Steven Wheeler	Andrew Long
B	12 Aug 15	Updated to incorporate NLP and Hoare Lea comments	Steven Wheeler	Andrew Long

Summary

Sandy Brown Associates LLP (SBA) has been appointed to provide acoustic advice in relation to the Guardian Space fit-out of the Midland Goods Shed (MGS) and East Handyside Canopy (EHC), Kings Cross, London

As part of the fit-out works, it is proposed to install items of external mechanical services plant. This report provides an assessment of the expected environmental noise emissions from the new plant.

The assessment shows that the noise egress from the installation is expected to be compliant with the requirements of the local planning authority providing that the recommended attenuation measures are implemented.

Contents

1 Introduction

Sandy Brown Associates LLP (SBA) has been appointed to provide acoustic advice in relation to the Guardian Space fit-out of the Midland Goods Shed (MGS) and East Handyside Canopy (EHC), Kings Cross, London

As part of the fit-out works, it is proposed to install items of external mechanical services plant. This report provides an assessment of the expected environmental noise emissions from the new plant in line with the requirements of the London Borough of Camden (LBC).

2 Local Authority requirements (Planning condition 60)

Appropriate external noise criteria for building services plant is typically related to the level of background ambient noise and the proximity of nearby noise sensitive buildings. Environmental noise limits for new plant are typically set at a distance of 1 metre from the most affected windows of the noise sensitive premises.

The MGS/EHC development is part of the wider King's Cross Central (KCX) project and is therefore subject to meeting the requirements of planning condition 60 attached to the outline planning permission of 22 December 2006 (ref: 2004/2307/P), which states:

> *'Applications for approval of Reserved Matters shall include full particulars of the noise impact of any plant or equipment included in that application which shall meet the following standards unless otherwise agreed in writing by the local planning authority:*
>
> *a) noise levels at a point 1 metre external to sensitive facades to be at least 5 dB(A) less than the existing background measurement (L_{A90}), expressed in dB(A) when all plant/equipment are in operation;*
> *b) where it is anticipated that any plant/equipment will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) and/or if there are distinct impulses (bangs, clicks, clatters, thumps) special attention to be given to reducing the noise levels from that piece of plant/equipment at any sensitive façade to at least 10 dB(A) below the L_{A90}, expressed in dB(A).'*

3 Noise sensitive premises

Camden Council provides the definition of 'noise sensitive premises' in their Unitary Development Plan (UDP). This definition (from paragraph 1.45 of the Camden UDP) is set out below:

'Noise/vibration sensitive development includes housing, schools and hospitals as well as offices, workshops and open space.'

Therefore, any nearby residential, educational, medical, and commercial premises need to be considered in this assessment.

Noise limits at residential premises and hospitals are applicable over the full operational hours of the plant, as they are generally occupied at all times of the day and night.

Noise limits at other noise sensitive premises are typically applicable over the hours of occupation of the sensitive premises.

For the MGS and EHC, the nearest noise sensitive premises are:

- University of the Arts (UAL) building to the west - education
- Regeneration House to the south - office/gallery
- Building J (ArtHouse) to the east - residential

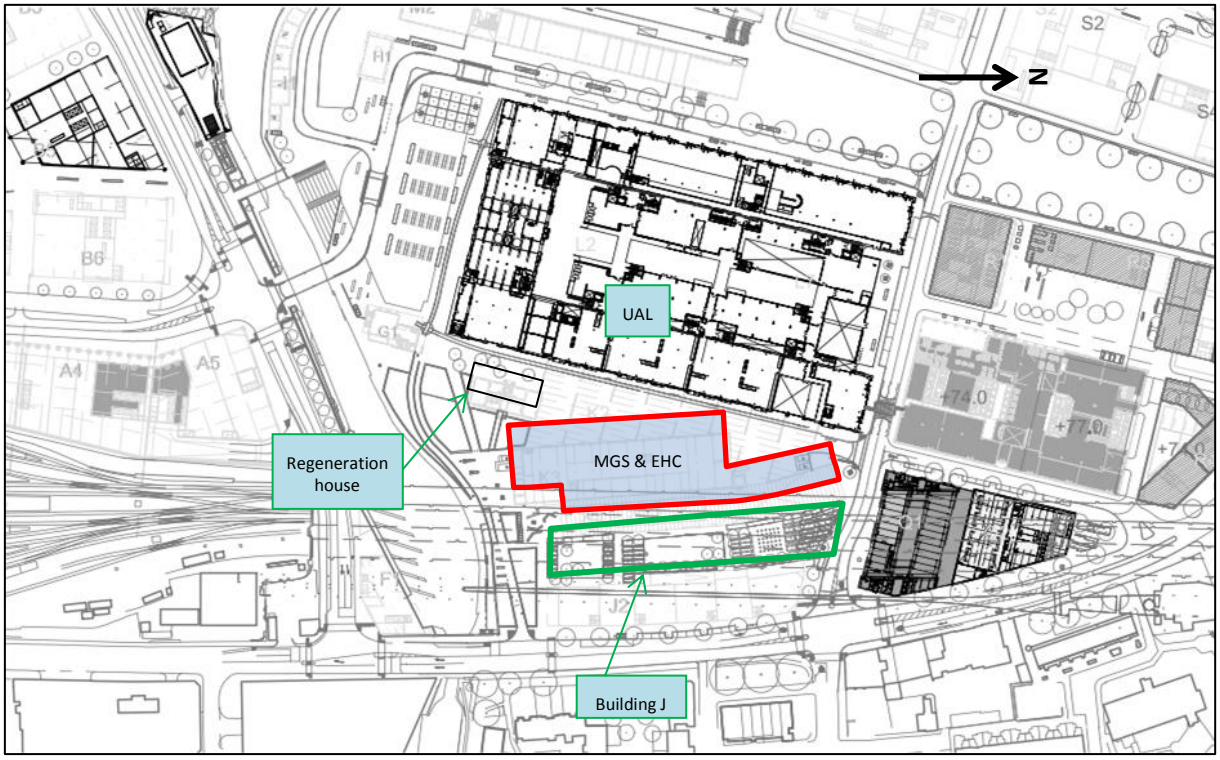


Figure 1 Plan showing the site (in red) and nearby receptors

3.1 Noise sensitive facades

The plant noise limits set out in this report apply at 1 m from the affected facades of the respective buildings, as set out below and indicated in Figure 2:

- University of the Arts building: East facing roof terrace
- Regeneration House: North facade
- Building J: West facade

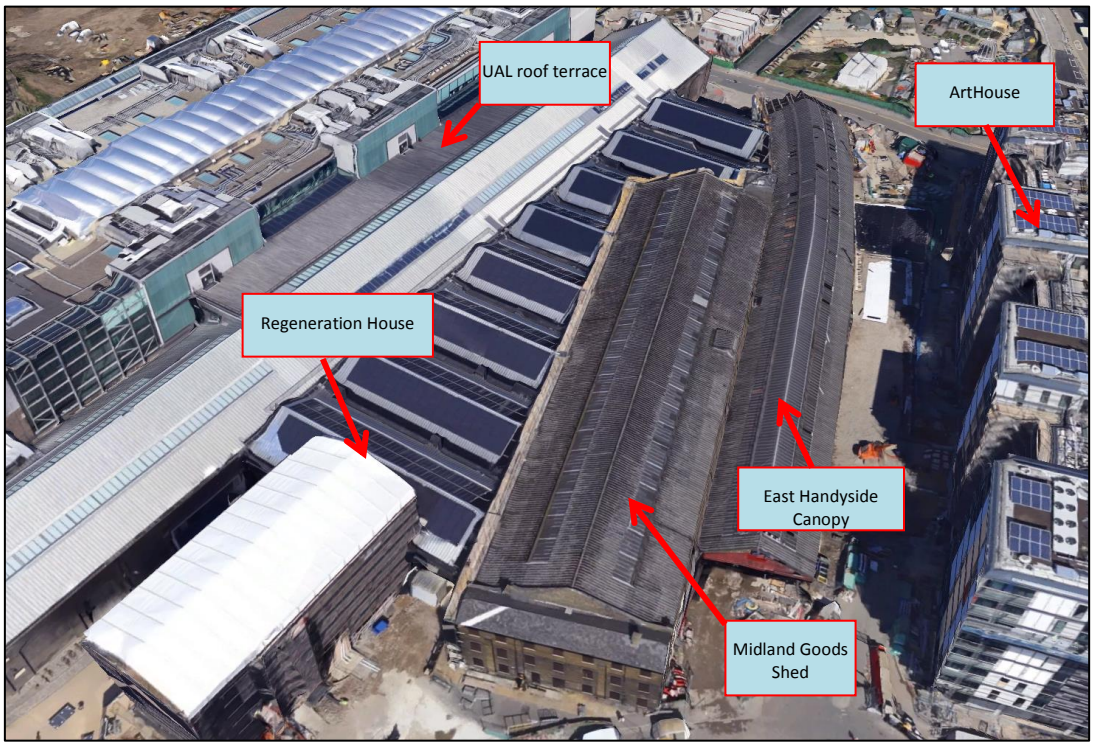


Figure 2 Three-dimensional view of the site indicating the nearest noise sensitive facades (source: Google Earth Pro)

4 Noise survey

The external noise emission limits to follow in subsequent sections are based upon the results detailed within the English Cogger baseline noise survey report (ref. 00489/R03a, dated April 2008). The Midland Goods Shed lies between the measurement positions at Granary east (to the west) and the Training Centre (to the east).

The baseline noise level measurements at these locations, as detailed within the English Cogger LLP report, are summarised in Table 1 and Table 2.

Table 1 Granary east weekday background noise levels

Lowest measured background noise levels – weekday (dB, $L_{A90,15mins}$)		
Day (07:00 – 19:00)	Evening (19:00 – 23:00)	Night (23:00 – 07:00)
53	52	46

Table 2 Training centre background noise levels

Day	Lowest measured background noise levels (dB, $L_{A90.15mins}$)		
	Day (07:00 – 19:00)	Evening (19:00 – 23:00)	Night (23:00 – 07:00)
Weekday	57	52	45
Saturday	53	53	51
Sunday	49	51	41

5 Plant noise limits

5.1 Overall noise limits

The nearest noise sensitive buildings to the south and west are all commercial/educational developments, and it is deemed reasonable to set limits upon baseline noise levels during times when the buildings will be occupied, ie during the weekday daytimes (ie 07:00 – 19:00). The nearest measurement location to these buildings was the Granary east measurement location.

The nearest noise sensitive building to the east is Building J, which is a residential building and will therefore be occupied during both day and night, during the week and at weekend. The nearest measurement position to Building J was at the Training Centre.

The overall noise limit for building services plant associated with the Midland Goods Shed are set out in Table 1 and Table 2.

Noise limits are deemed to be not applicable during periods where the premises will not be occupied. As building J contains residential accommodation, it is likely to be occupied continuously.

Table 3 Overall weekday plant noise limits at nearby receptors

Location	Weekday noise limit at 1 m from facade (dBA)		
	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
Regeneration House	45	-	-
UAL	45	-	-
Building J	49	44	37

Table 4 Overall weekend plant noise limits at nearby receptors

Location	Weekend noise limit at 1 m from facade (dBA)		
	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
Building J	41	43	33

If the character of the plant noise is tonal, intermittent, impulsive etc, then the noise limits should be reduced by 5 dB.

Emergency plant noise limits are 5 dB higher than those set out in the tables above.

5.2 Guardian Space specific noise limits

Specific noise limits for base-building and tenant plant systems were set as part of the base-building design with respect to the requirements of Condition 60. The weekday and weekend tenant noise limits are given in Table 5 and Table 6 respectively. The noise limits incorporate a 6 dB allowance below the overall noise limits to accommodate the base-building and other tenant plant.

Table 5 Base building and tenant weekday plant noise limits at nearby receptors

Location	Weekday noise limit at 1 m from facade (dBA)		
	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
Regeneration House, UAL, Plots R & Q	39	-	-
Building J (ArtHouse)	43	38	31

Table 6 Base building and tenant weekend plant noise limits at nearby receptors

Location	Weekend noise limit at 1 m from facade (dBA)		
	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
Building J (ArtHouse)	35	37	27

If the character of the plant noise is tonal, intermittent, impulsive etc, then the noise limits should be reduced by 5 dB.

6 Environmental noise assessment

6.1 Plant installation

Items of mechanical services plant are proposed to be installed as part of the Guardian Space fit-out in order to increase the cooling, heating and air handling capacity above the base-building provision.

The plant installation can be summarised as follows:

- 6 No. condensers (1 unit in standby) serving the comms room and located on the roof garden mezzanine
- 3 No. air source heat pumps located in the rooftop chiller compound
- 1 No. kitchen extract fan mounted internally and discharging above the EHC roof
- 1 No. pantry extract fan mounted internally and discharging above the MGS roof
- 5 No. supply/extract air handling units (AHUs) mounted internally and connected to four new louvres (EL-01-01, EL-01-02, EL-01-03 and EL-01-04)

All plant is expected to operate during the daytime (07:00-19:00) and evening (19:00-23:00) periods only. This is with the exception of the room condenser units, which could potentially operate on a 24/7 basis. The Heat pumps will typically only operate during peak winter conditions, ie when it is coldest and the base-building chillers will not be operating.

A drawing indicating the locations of plant items/connections is provided in Appendix A**.** Specific details and noise data for the proposed plant equipment are given below:

6.1.1 Condenser units

Make / model: Mitsubishi Electric / PUHZ-ZRP140YKA

Sound power level (cooling): 70 dBA

6.1.2 *Air source heat pumps*

Make / model: Daikin Electric / PUHZ-ZRP140YKA

Sound power level: 86 dBA

6.1.3 *Kitchen extract fan*

Make / model: Nuaire / SQFTA43-3

Discharge sound power level: 89 dBA

6.1.4 *Pantry extract fan*

Discharge sound power level: 69 dBA

6.1.5 *Air handling units*

Make / model: Swegon / Gold RX

Extract side atmospheric discharge sound power level: 78 dBA

Supply side atmospheric inlet sound power level: 68 dBA

6.2 Attenuation

Based on the manufacturers' noise data provided for the plant items, attenuation measures will be required in order to reduce noise emission and be compliant with the planning noise limits. Details of the proposed attenuation measures are discussed below:

6.2.1 *Condenser units*

Noise emission from each unit will need to be attenuated by at least 11 dB with an acoustic enclosure.

6.2.2 *Air source heat pumps*

Noise emission from each unit will need to be attenuated by at least 20 dB overall with an acoustic enclosure. Indicative insertion losses for the enclosure are given below:

Table 7 Required acoustic enclosure performance

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-12	-13	-20	-29	-36	-37	-39	-39

6.2.3 Kitchen extract fan

An attenuator is required on the discharge connection, minimum insertion losses and maximum regenerated (self) noise figures are given in Table 8. The performances would typically be achievable with a 1250 mm long Melinex lined attenuator.

Table 8 Required attenuator performance for kitchen extract fan

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-3	-8	-25	-39	-50	-49	-30	-25
Maximum regenerated sound power(dB)	49	45	54	56	61	57	41	36

6.2.4 Pantry extract fan

An attenuator is required on the discharge connection, minimum insertion losses and maximum regenerated (self) noise figures are given in Table 9. The performances would typically be achievable with a 900 mm long Melinex lined attenuator.

Table 9 Required attenuator performance for kitchen extract fan

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-7	-7	-11	-10	-7	-6	-6	-7
Maximum regenerated sound power(dB)	67	63	56	57	57	53	49	42

6.2.5 AHUs connected to discharge louvre EL-01-01

The extract side AHUs that are connected to this louvre (AHU01/01, AHU01/02 and AHU01/03) will require individual attenuators on each discharge connection. The required performance data is provided in Table 10, which is typically achievable with a 900 mm long splitter type attenuator.

In addition to the attenuators, a minimum length of 7 m of acoustically lined ductwork (50 mm thick Class A foam) is required in the main ductwork branch between the atmospheric louvre connection and before the point at which the secondary ductwork connects.

Table 10 Required attenuator performance for AHUs connected to discharge louvre EL-01-01

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-3	-7	-18	-29	-42	-33	-22	-18
Maximum regenerated sound power(dB)	27	26	31	37	39	37	22	19

6.2.6 AHUs connected to inlet louvre EL-01-02

An attenuator will be required in the main ductwork branch between the atmospheric louvre connection and before the point at which the secondary ductwork connects. The required performance data is provided in Table 11, which is typically achievable with a 600 mm long splitter type attenuator.

Table 11 Required attenuator performance for inlet connection to louvre EL-01-02

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-3	-5	-11	-19	-24	-18	-13	-12
Maximum regenerated sound power(dB)	36	44	42	45	45	42	38	21

6.2.7 AHUs connected to inlet louvre EL-01-03

An attenuator will be required in the main ductwork branch between the atmospheric louvre connection and before the point at which the secondary ductwork connects. The required performance data is provided in Table 12, which is typically achievable with a 600 mm long splitter type attenuator.

Table 12 Required attenuator performance for inlet connection to louvre EL-01-03

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-3	-5	-11	-19	-24	-18	-13	-12
Maximum regenerated sound power(dB)	36	44	42	45	45	42	38	21

6.2.8 AHUs connected to discharge louvre EL-01-04

An attenuator will be required in the main ductwork branch between the atmospheric louvre connection and before the point at which the secondary ductwork connects. The required performance data is provided in Table 13, which is typically achievable with a 600 mm long splitter type attenuator.

Table 13 Required attenuator performance discharge connection to louvre EL-01-04

	Octave-band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Minimum insertion loss (dB)	-3	-5	-11	-19	-24	-18	-13	-12
Maximum regenerated sound power(dB)	36	44	42	45	45	42	38	21

6.2.9 Louvre generated noise

Noise generated by airflow over louvre blades should be limited to a sound pressure level of 30 dBA at 1 m from EL-01-01, and 45 dBA at 1 m from EL-01-02, EL-01-03 and EL-01-04.

6.3 Noise egress

The noise egress from the plant installation has been assessed to the noise sensitive locations that were identified in Section 3.1. A summary is set out in the following sections. A full listing of the calculations is given in Appendix B.

6.3.1 Noise egress to Building J (ArtHouse)

The predicted worst-case weekday and weekend noise levels from tenant plant at the ArtHouse residential facade are summarised below in Table 14 and Table 15 respectively. The LBC requirements are satisfied for all time periods.

Table 14 Predicted weekday tenant plant noise egress

	Weekday noise level (dBA)					
Location	Daytime (07:00-19:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	Predicted	Limit	Predicted	Limit	Predicted	Limit
ArtHouse	35	43	35	38	27	31

Table 15 Predicted weekend tenant plant noise egress

Location	Weekday noise level (dBA)					
	Daytime (07:00-19:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	Predicted	Limit	Predicted	Limit	Predicted	Limit
ArtHouse	35	35	35	37	27	27

6.3.2 Noise egress to UAL

The predicted worst-case weekday noise levels from tenant plant at the UAL building facade are summarised in Table 16. Due to the operational hours of UAL, evening and weekend noise limits do not apply. The LBC requirements are satisfied for all time periods.

Table 16 Predicted weekday tenant plant noise egress

Location	Weekday noise level (dBA)					
	Daytime (07:00-19:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	Predicted	Limit	Predicted	Limit	Predicted	Limit
UAL	36	39	36	N/A	24	N/A

6.3.3 Noise egress to Regeneration House

The predicted worst-case weekday noise levels from tenant plant at the UAL building facade are summarised below in Table 17. Due to the operational hours of the building, evening and weekend noise limits do not apply. The LBC requirements are satisfied for all time periods.

Table 17 Predicted weekday tenant plant noise egress

Location	Weekday noise level (dBA)					
	Daytime (07:00-19:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	Predicted	Limit	Predicted	Limit	Predicted	Limit
Regen. House	33	39	33	N/A	18	N/A

6.3.4 Noise egress to Guardian Space roof garden

The proposed condenser units are located at mezzanine level within the accessible roof garden and therefore will have an impact on the noise climate within the space. The air source heat pumps are also in close proximity to the roof garden. These are located in the base-building chiller dormer, which is surrounded by an acoustic louvre.

The noise levels within the roof garden as a result of the heat pump and condenser operation have been predicted to be around 40 dBA. This is considered to be comparable or lower than the general ambient noise level expected in the roof garden. On this basis plant noise in the roof the space is not expected to be an issue.

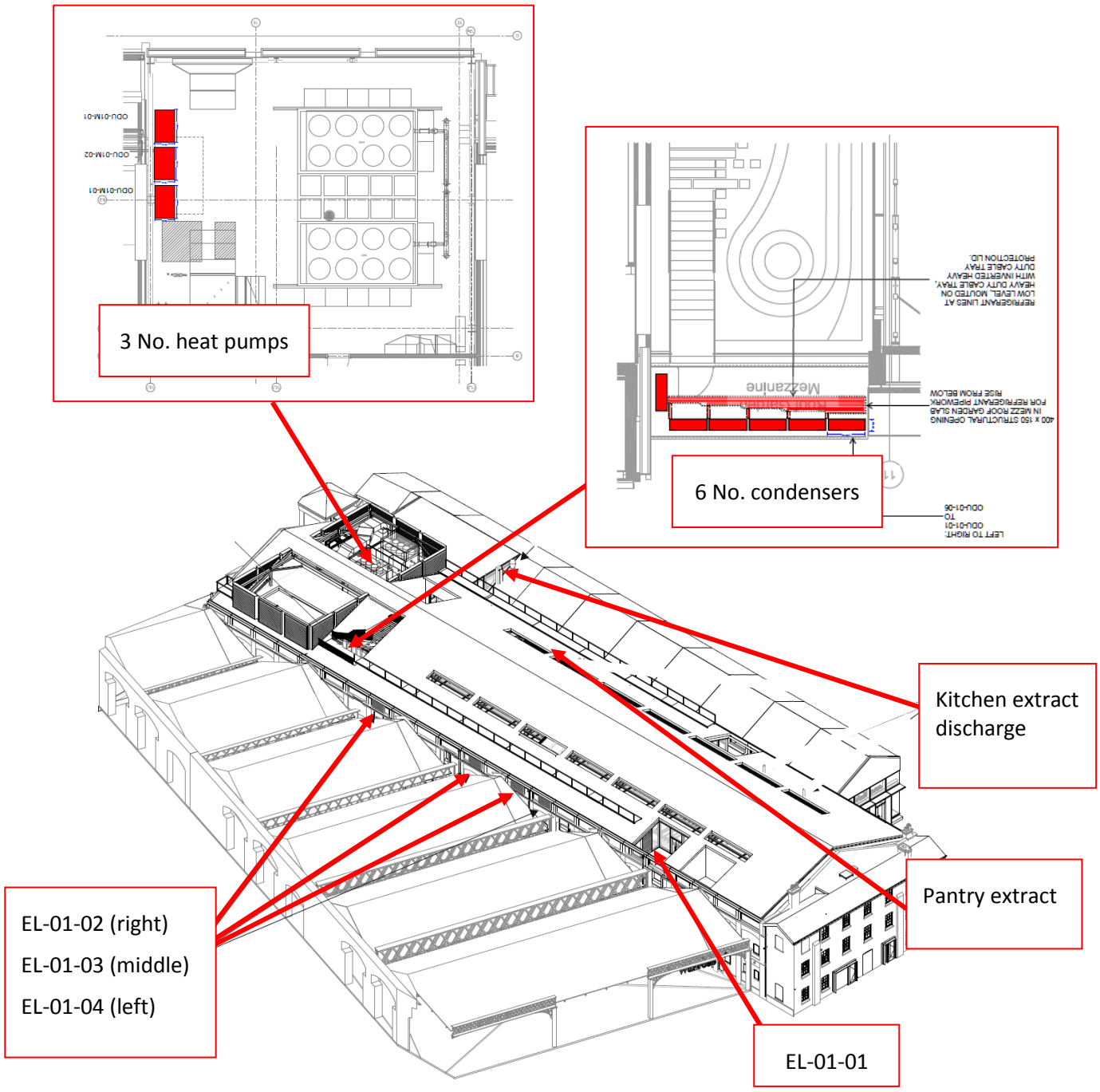
7 Conclusion

An assessment has been carried out of environmental noise egress from new items of building services plant associated with the Guardian Space fit-out.

The assessment has shown that the noise egress from the installation is expected to be compliant with the requirements of the local planning authority providing that the recommended attenuation measures are implemented.

Appendix A

Plant locations


3 No. heat pumps
6 No. condensers
Kitchen extract discharge
Pantry extract
EL-01-02 (right)
EL-01-03 (middle)
EL-01-04 (left)
EL-01-01

Appendix B

Noise calculations

Definition of symbols & abbreviations

L_p	Sound Pressure Level
L_w	Sound Power Level
I.L.	Insertion Loss
R.N.	Regenerated (self) noise

Plant noise calculations to Building J (ArtHouse)

Table 18 Plant noise calculations to Building J (ArtHouse)

	Octave-band centre frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
6 No condensers:									
PUHZ-ZRP140YKA-R1 L_w									70
3 units running									7
Acoustic enclosure I.L.									-11
L_w to L_p at receiver (52 m)									-39
L_p at receiver									27
3 No Heat pumps:									
Daikin RYYQ16T L_w		87	86	85	81	74	70	66	86
3 units running		5	5	5	5	5	5	5	
Acoustic enclosure I.L.		-13	-20	-29	-36	-37	-39	-39	
L_w to L_p at receiver (46 m)		-38	-38	-38	-38	-38	-38	-38	
L_p at receiver		41	33	23	12	4	0	0	28
Kitchen extract fan:									
Nuaire SQFTA43-3 outlet L_w	89	90	79	77	82	83	79	73	89
Attenuator I.L.	-3	-8	-25	-39	-50	-49	-30	-25	
L_w after attenuator	86	91	54	38	32	34	49	48	75
Attenuator R.N. limit	49	45	54	56	61	57	41	36	
L_w including R.N.	86	91	57	56	61	57	50	48	75
Duct losses	-11	-6	-3	-1	-0	-0	0	0	
L_w to L_p at 1 m	65	76	48	50	57	54	47	45	63
Distance correction (31 m)	-31	-31	-31	-31	-31	-31	-31	-31	
L_p at receiver	35	45	17	19	26	23	16	15	32

Table 18 Continued

	Octave-band centre frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Pantry extract fan:									
Outlet L_w	74	70	67	67	64	59	55	49	69
Attenuator I.L	-7	-7	-11	-10	-7	-6	-6	-7	
Duct losses	-12	-7	-3	-1	0	0	0	0	
L_w to L_p at 1 m	44	46	45	50	52	49	46	39	55
Distance correction (41 m)	-32	-32	-32	-32	-32	-32	-32	-32	
L_p at receiver	11	13	12	18	19	17	14	7	23
Total L_p at receiver:							Day		35
							Evening		35
							Night		27

Plant noise calculations to UAL

Table 19 Plant noise calculations to UAL

	Octave-band centre frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
6 No condensers:									
PUHZ-ZRP140YKA-R1 L_w									70
3 units running									7
Acoustic enclosure I.L.									-11
Screening									-5
L_w to L_p at receiver (40 m)									-37
L_p at receiver									24
3 No Heat pumps:									
Daikin RYYQ16T L_w		87	86	85	81	74	70	66	86
3 units running		5	5	5	5	5	5	5	
Acoustic enclosure I.L.		-13	-20	-29	-36	-37	-39	-39	
L_w to L_p at receiver (50 m)		-39	-39	-39	-39	-39	-39	-39	
L_p at receiver		35	27	17	6	0	0	0	22
Kitchen extract fan:									
Nuaire SQFTA43-3 outlet L_w	89	90	79	77	82	83	79	73	89
Attenuator I.L.	-3	-8	-25	-39	-50	-49	-30	-25	
L_w after attenuator	86	91	54	38	32	34	49	48	75

Table 19 continued

	Octave-band centre frequency (Hz)								
	63	125	63	125	63	125	63	125	63
Attenuator R.N. limit L_w	49	45	54	56	61	57	41	36	
L_w including R.N.	86	91	57	56	61	57	50	48	75
Duct losses	-11	-6	-3	-1	-0	-0	0	0	
L_w to L_p at 1 m	-10	-4	1	5	7	8	8	8	63
Distance correction (62 m)	-36	-36	-36	-36	-36	-36	-36	-36	31
L_p at receiver	8	10	9	14	16	13	10	3	20
Pantry extract fan:									
Outlet L_w	74	70	67	67	64	59	55	49	69
Attenuator I.L	-7	-7	-11	-10	-7	-6	-6	-7	
Duct losses	-12	-7	-3	-1	0	0	0	0	
L_w to L_p at 1 m	44	46	45	50	52	49	46	39	55
Distance correction (61 m)	-36	-36	-36	-36	-36	-36	-36	-36	
L_p at receiver	15	17	20	24	23	19	16	10	31
Air discharge louvre EL-01-01:									
AHU/01/01 discharge L_w	82	77	75	71	72	72	67	64	78
AHU/01/02 discharge L_w	82	77	75	71	72	72	67	64	78
AHU/01/03 discharge L_w	82	77	75	71	72	72	67	64	78
Attenuator I.L.	-3	-7	-18	-29	-42	-33	-22	-18	
Attenuator R.N. limit L_w	27	26	31	37	39	37	22	19	
AHU/01/01 L_w including R.N.	79	70	57	43	40	41	45	46	58
AHU/01/02 L_w including R.N.	79	70	57	43	40	41	45	46	58
AHU/01/03 L_w including R.N.	79	70	57	43	40	41	45	46	58
Combined L_w	84	75	62	50	50	49	50	51	63
7 m lined ductwork I.L.	-8	-11	-27	-73	-70	-60	-50	-43	
Duct losses	-6	-3	-1	0	0	0	0	0	
L_w to L_p at 1 m	2	4	5	6	6	7	7	7	
L_p In roof garden	63	56	30	0	0	0	0	5	51
Distance correction (60 m)	-36	-36	-36	-36	-36	-36	-36	-36	
L_p at receiver	36	30	3	0	0	0	0	0	16
Air inlet louvre EL-01-02:									
AHU/01/01 inlet L_w	76	74	71	62	56	58	58	59	68
AHU/01/02 inlet L_w	76	74	71	62	56	58	58	59	68
AHU/01/03 inlet L_w	76	74	71	62	56	58	58	59	68
Combined L_w	81	79	76	67	61	63	63	64	72
Attenuator I.L.	-3	-5	-11	-19	-24	-18	-13	-12	
Attenuator R.N. limit L_w	36	44	42	45	45	42	38	21	

Table 19 continued

	Octave-band centre frequency (Hz)								
	63	125	63	125	63	125	63	125	63
L_w including R.N.	78	74	65	49	45	47	50	52	62
Duct losses	-6	-3	-1	0	0	0	0	0	
L_w to L_p at 1 m	-4	-4	-3	-3	-2	-2	-2	-2	
Distance correction (35 m)	-31	-31	-31	-31	-31	-31	-31	-31	
L_p at receiver	37	36	30	15	12	14	17	19	27
Air inlet louvre EL-01-03:									
AHU/01/04 inlet L_w	76	74	71	62	56	58	58	59	68
AHU/01/05 inlet L_w	76	74	71	62	56	58	58	59	68
Combined L_w	79	77	74	65	59	61	61	62	71
Attenuator I.L.	-3	-5	-11	-19	-24	-18	-13	-12	
Attenuator R.N. limit L_w	36	44	42	45	45	42	38	21	
L_w including R.N.	76	72	63	48	45	46	48	50	60
Duct losses	-6	-3	-1	0	0	0	0	0	
L_w to L_p at 1 m	-4	-4	-3	-3	-2	-2	-2	-2	
Distance correction (35 m)	-31	-31	-31	-31	-31	-31	-31	-31	
L_p at receiver	35	35	28	14	12	13	16	17	25
Air discharge EL-01-04									
AHU/01/04 discharge L_w	82	77	75	71	72	72	67	64	78
AHU/01/05 discharge L_w	82	77	75	71	72	72	67	64	78
Combined L_w	85	80	78	74	75	75	70	67	81
Attenuator I.L.	-3	-5	-11	-19	-24	-18	-13	-12	
Attenuator R.N. limit L_w	36	44	42	45	45	42	38	21	
L_w including R.N.	82	75	67	55	52	57	57	55	
Duct losses	-6	-3	-1	0	0	0	0	0	
L_w to L_p at 1 m	-4.0	-4.0	-3.0	-3.0	-2.0	-2.0	-2.0	-2.0	
Distance correction (35 m)	-31	-31	-31	-31	-31	-31	-31	-31	
L_p at receiver	41	38	32	21	19	24	24	22	31
Total L_p at receiver:							Day		36
							Evening		36
							Night		24

Plant noise calculations to Regeneration House

Table 20 Plant noise calculations to Regeneration House

	Octave-band centre frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
6 No condensers:									
PUHZ-ZRP140YKA-R1 L_w									70
3 units running									7
Acoustic enclosure I.L.									-11
Screening									-5
L_w to L_p at receiver (80 m)									-43
L_p at receiver									18
3 No Heat pumps:									
Daikin RYYQ16T L_w		87	86	85	81	74	70	66	86
3 units running		5	5	5	5	5	5	5	
Acoustic enclosure I.L.		-13	-20	-29	-36	-37	-39	-39	
L_w to L_p at receiver (85 m)		-44	-44	-44	-44	-44	-44	-44	
L_p at receiver		30	22	12	1	0	0	0	22
Kitchen extract fan:									
L_p at 1 m from discharge louvre	44	46	45	50	52	49	46	39	55
Distance correction (80 m)	-35	-35	-35	-35	-35	-35	-35	-35	
L_p at receiver	9	11	10	15	17	14	11	4	21
Pantry extract fan:									
L_p at 1 m from discharge louvre	51	53	56	60	59	55	52	46	63
Distance correction (55 m)	-35	-35	-35	-35	-35	-35	-35	-35	
L_p at receiver	16	18	21	25	24	20	17	11	28
Air discharge louvre EL-01-01:									
L_p in roof garden	44	46	45	50	52	49	46	39	55
Distance correction (55 m)	-35	-35	-35	-35	-35	-35	-35	-35	
L_p at receiver	9	11	10	15	17	14	11	4	21
Air inlet louvre EL-01-02:									
L_p at 1 m from inlet louvre	68	67	61	46	43	45	48	50	57
Distance correction (50 m)	-34	-34	-34	-34	-34	-34	-34	-34	
L_p at receiver	34	33	27	12	9	11	14	16	23

Table 20 continued

	Octave-band centre frequency (Hz)

	63	125	63	125	63	125	63	125	63
Air inlet louvre EL-01-03:									
L_p at 1 m from inlet louvre	66	66	59	45	43	44	46	48	56
Distance correction (50 m)	-34	-34	-34	-34	-34	-34	-34	-34	
L_p at receiver	32	32	25	11	9	10	12	14	22
Air inlet discharge EL-01-04:									
L_p at 1 m from discharge louvre	72	69	63	52	50	55	55	53	62
Distance correction (65 m)	-36	-36	-36	-36	-36	-36	-36	-36	
L_p at receiver	36	32	27	16	14	19	19	17	26

Total L_p at receiver:	Day	33
	Evening	33
	Night	18