

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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NatWest, Spinningfields

Planning Condition 3b discharge report

London, Manchester, Edinburgh, Birmingham, Belfast, Leeds

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Summary

Sandy Brown has been commissioned to provide acoustic advice in relation to the proposed development at the proposed development at NatWest Spinningfields, 182 Deansgate, Manchester, M3 3LY.

This report sets out relevant information to discharge Planning Condition 3b (133238/FO/2022) to external plant noise egress.

The wording is set out below,

b) Prior to the use, other than for validation noise testing, a verification report shall be submitted to and approved in writing by the City Council as local planning authority to validate that any plant and equipment installed in association with this application conforms to the recommended plant noise limit in the approved acoustic report. The validation assessment shall undertake post completion testing to confirm that the noise criteria have been met. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria.

The representative background sound levels measured during the survey were:

- L_{A90} 55 dB during the daytime and L_{A90} 49 dB at night to the north and west
- L_{A90} 56 dB during the daytime and L_{A90} 54 dB at night to the south and east.

Based on the requirements of the Manchester City Council and on the results of the noise survey, noise egress limits have been set. These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied, and the limits will be more stringent than those set.

Following installation of the generators, acoustic sample measurements were carried out on 1 June 2023 to determine the actual noise emission from the generator in operation.

The generators are proposed to run for planned maintenance, and simultaneously when there is a building mains failure as well as for emergencies. This could be during the day and night.

An environmental noise survey and sample plant noise measurements have been carried out on 3 October 2023 with a view to verify noise emitting levels from the installed plant items, and carry out a noise egress assessment to discharge Local Authority planning condition 3b.

Based on the measurement results with the plant switched on and switch off, it can be concluded that plant in normal operation do not increase the existing ambient noise levels at the nearest noise sensitive premises

Based on plant measurement results, an assessment of the installed plant items associated with the development has been carried out. The predicted levels with normally operating plant

in operation only, comply with the day and night noise egress limits at the nearest noise sensitive premises.

In the case of a power cut, the predicted cumulative noise levels at the nearest noise sensitive premises with the generator in operation comply with the day noise egress limits at the nearest noise sensitive premises except at Centurion House and 1 The Avenue, at which day limits are exceeded by 2 dB and 5 dB respectively. At night, the predicted cumulative noise levels exceed the night limits outside three nearby commercial premises, as follows: by 2 dB at 3 Hardman Street, by 7 dB at 1 The Avenue, and 8 dB at Centurion House.

The proposal includes occasional plant in operation during the night-time, and the worst-case scenario of normally operating plant and generator use from 06:00 hr. In the event of a power cut during the night-time, the limits could be exceeded outside 3 nearby commercial premises. The local authority should be consulted to agree a potential relaxation in the event of a power cut during the day and night to fully discharge Planning Condition 3b.

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1 Introduction

Sandy Brown has been commissioned by NatWest Group to provide acoustic advice in relation to the proposed development at the proposed development at NatWest Spinningfields, 182 Deansgate, Manchester M3 3LY.

An environmental noise survey was carried out between 10:25 on 17 December 2021 and 11:55 on 22 December 2021. The measurements method and results are set out in 21579-R01-H *Noise survey and plant noise egress assessment* dated 08 June 2023.

Based on the result of the noise survey and the requirements of Manchester City Council, cumulative noise egress limits were set out and apply to all plant in operation under normal conditions.

An environmental noise survey and sample plant noise measurements have been carried out on 3 October 2023 with a view to verify noise emitting levels from the installed plant items, and carry out a noise egress assessment to discharge Local Authority planning condition 3b (133238/FO/2022).

The noise egress assessment of the normally operated plant installed, has been carried out, the predicted noise levels with normally operating plant in operation only, comply with the day and night noise egress limits at the nearest noise sensitive premises.

In the event of a power cut during the day, the limits could be exceeded outside 2 nearby commercial premises. At night, the limits could be exceeded outside 3 nearby commercial premises.

The local authority should be consulted to agree a potential relaxation in the event of a power cut during the day and night to discharge Planning Condition 3b (133238/FO/2022).

2 Site description

2.1 The site and its surrounding

The site location in relation to its surroundings is outlined in red in Figure 1.

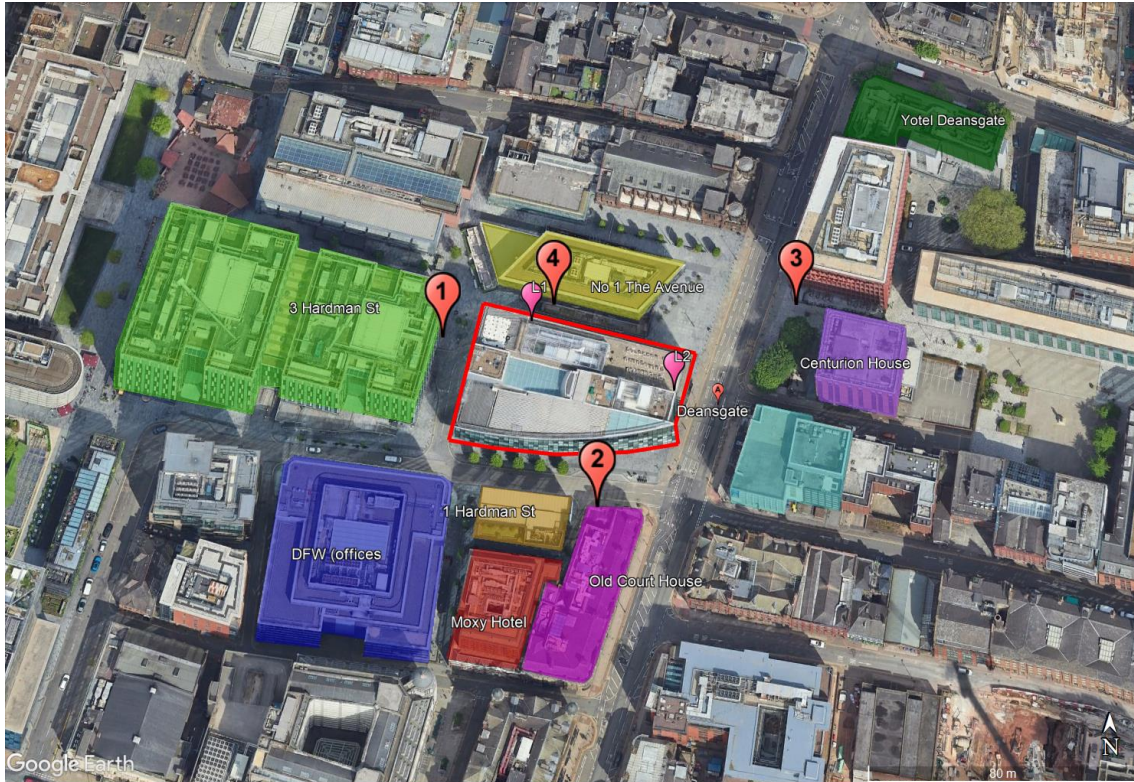


Figure 1 Aerial view of site (courtesy of Google Earth Pro)

2.2 Adjacent premises

The site is adjacent to the following premises:

- The Old Courthouse (residential, offices and commercial) highlighted in pink in Figure 1
- Yotel Deansgate (hotel), highlighted in dark green in Figure 1.
- Moxy Hotel, highlighted in red in Figure 1.
- DFW (offices) highlighted in blue in Figure 1.
- 3 Hardman Street (offices) highlighted in light green in Figure 1.
- 1 The Avenue (offices and commercial) highlighted in yellow in Figure 1.
- St John's House (offices and commercial) highlighted in cyan in Figure 1.
- Centurion House (offices) highlighted in purple in Figure 1.
- 1 Hardman Street (offices) highlighted in orange in Figure 1

3 Development proposal

The proposals include changes to the rooftop plant on the NatWest building on Deansgate, Manchester. The proposal includes the following:

- Level 8, two generators
- Level 7, two AHUs
- Level 6 north plant room, three Air Source Heat Pumps (ASHPs)
- Level 6 south plant room, one AHU, four condenser unit² and two air cooler units

The plant room on level 7 comprises an extent of level 6 north plant room such that it encroaches onto the terrace above.

4 Building services noise egress criteria

4.1 Standard guidance

BS 4142:2014+A1:2019 *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 nearby noise sensitive premises.

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.

4.2 Local authority requirements

4.2.1 *Planning Condition 3b (133238/FO/2022)*

Planning Condition 3b states the following:

'Prior to the use, other than for validation noise testing, a verification report shall be submitted to an approved in writing by the City Council as local planning authority to validate that any plant and equipment installed in association with this application conform to the recommended plant noise limit in the approved acoustic report. The validation assessment shall undertake post completion testing to confirm that the noise criteria have been met. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria together with timescales for implementation.'

5 Noise survey method

5.1 Unattended measurements

The unattended measurements were taken over 15 minute periods between 10:25 on 17 December 2021 and 12:10 on 22 December 2021. The measurement locations of the monitoring equipment were chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises.

The measurement positions used during the survey are indicated in Figure 1, denoted by 'L1' and 'L2'. A photograph showing the measurement locations are provided in Figure 2.

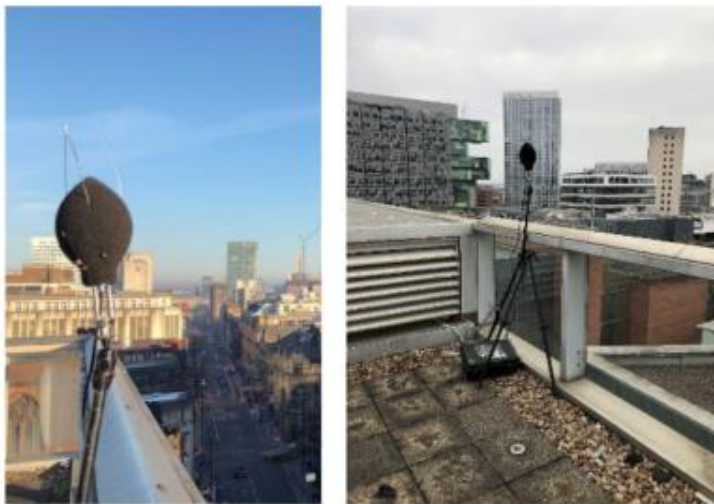


Figure 2 Photographs of measurement positions 1 (left) and 2 (right)

These locations were chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises. The existing roof top plant during the unattended measurements were not operational during the visit, consequently levels measured do not include their contributions.

5.2 Attended plant measurements

Attended sample measurements were carried out on 3 October 2023. All measurements were carried out in 1/3 octave bands.

On level 6 plant room (north), measurements of the installed Air Source Heat Pumps (ASHPs) were carried out at 1 m from the exhaust. The microphone was located on a tripod and extended out to approximately the centre of the unit. For the ASHP intake, the microphone was mounted on a tripod approximately 1.5 m above floor level and 1 m from the intake grille. These are indicated as positions 1 and 2 in Figure 3.

On level 6 plant room (south), in each case, the microphone was mounted on a tripod approximately 1.5 m above floor level, and approximately 1 m from the AHU intake/exhaust, condenser unit and air cooler unit. The measurement positions are marked as 3, 4 and 5 respectively in Figure 3.

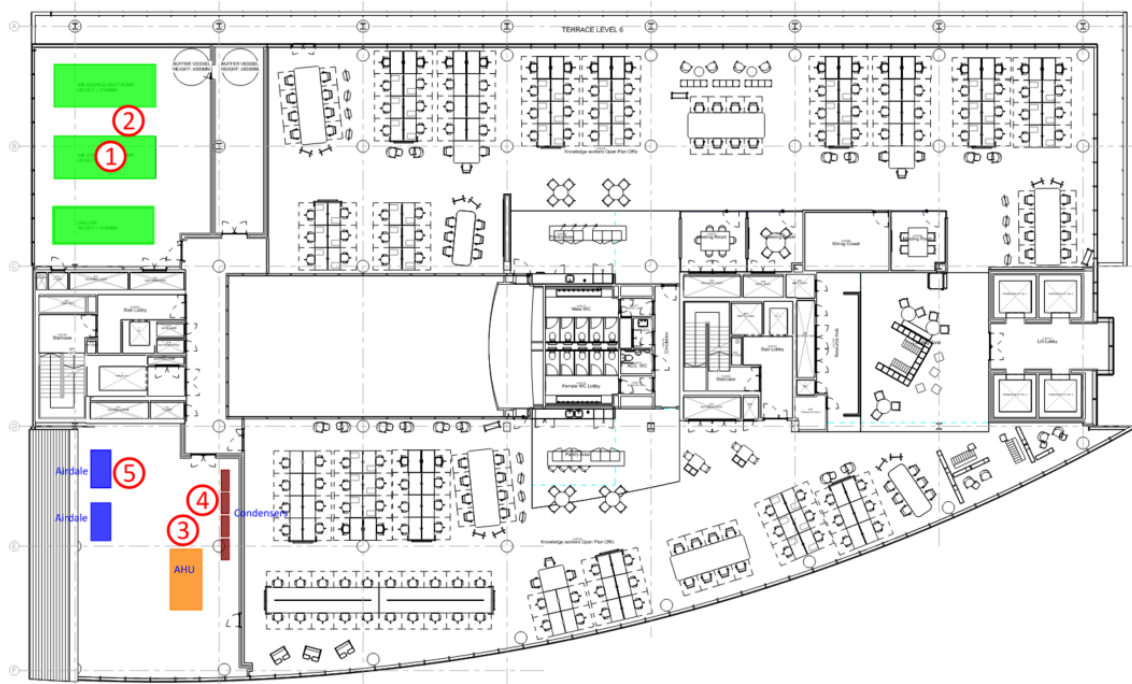


Figure 3 Measurement positions for installed plant at level 6 north and south plant rooms

On level 7, the microphone was mounted on a tripod approximately 1.5 m above floor level, and 1 m from AHU 07 01 and AHU 07 02 intake terminations, these are marked as positions 6 and 9 respectively in Figure 4.

For measurements a 1 m from AHU exhaust termination, the microphone was mounted on a tripod, extended out and approximately 1 m from each termination, these are marked as positions 7 and 10 respectively in Figure 4.

For AHU break out measurements, the microphone was mounted on a tripod approximately 1.5 m above floor level and 1 m from AHU 07 01 and AHU 07 02 noise emitting elements. These are marked as positions 8 and 11 respectively in Figure 4.

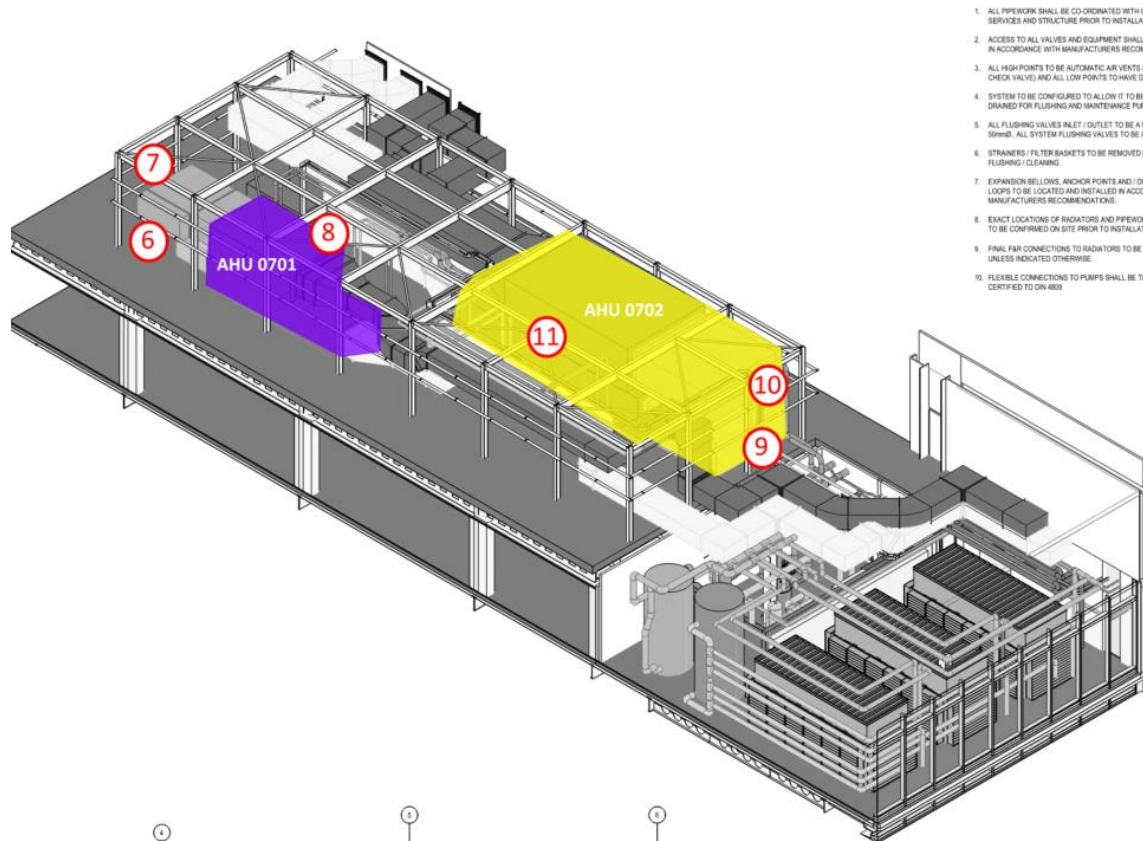


Figure 4 Measurement positions for installed plant at level 7 plant room

Background noise levels with plant switched off were carried out at the above measurement locations. At level 6 plant room (south), the installed condenser units and air cooler units are critical for the building, and were operating on demand as it was not possible to switch them off.

An MEP engineer was present during the visit to operate the items of plant and confirming plant operation for each measurement.

5.3 Attended generator measurements

Two generators are installed within the level 8 plant room. The location is highlighted in pink in Figure 5.

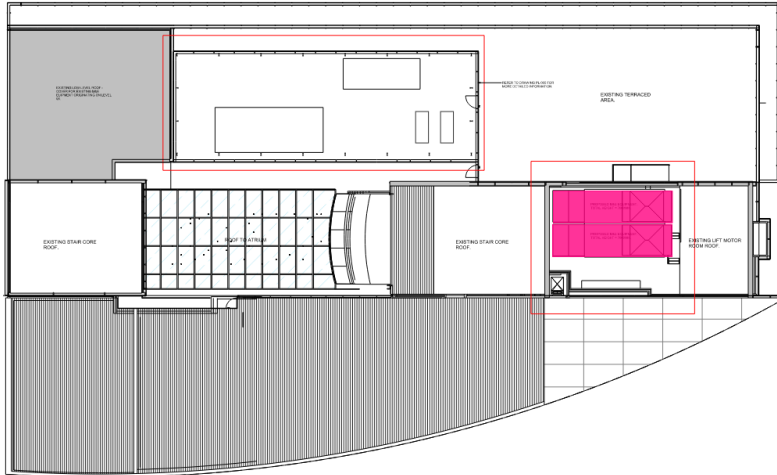


Figure 5 Proposed plant items at level 8

Attended sample measurements were carried out at 3 locations around the generators on 1 June 2023. These locations are indicated as positions 1 to 3 in Figure 6.

The attended measurements were carried out to determine the noise levels from the generator noise emitting terminations (i.e. intake and exhaust) and break out. The site conditions were considered suitable to carry out the measurements.

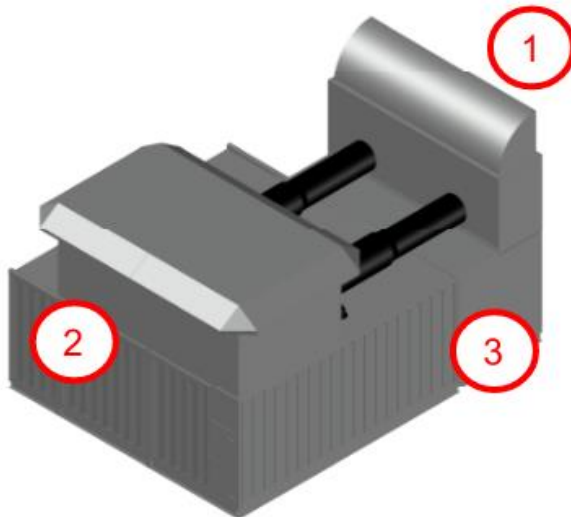


Figure 6 Attended measurement locations

At measurement positions 1 and 2, the microphone was mounted on a tripod approximately 1.5 m above the local rooftop level and at least 3 m from any other reflective surface.

For measurement position 3, the microphone was mounted on a tripod approximately 1.5 m above a scaffold tower toe board, approximately 5 m from the rooftop level and approximately 1.5 m from the existing louvre.

All measurements were carried out in third octave band and time interval of 1 minute.

Background measurements were carried out with the generators switched off at each position. Measurements with the generators in operation were carried out with the generators at 50% duty, this is understood to be N+1 configuration, and how they will operate in case of emergency.

It is understood that the generators were suitably loaded, equivalent to future building loading operation.

Photographs showing the measurement positions are provided in Figure 7.

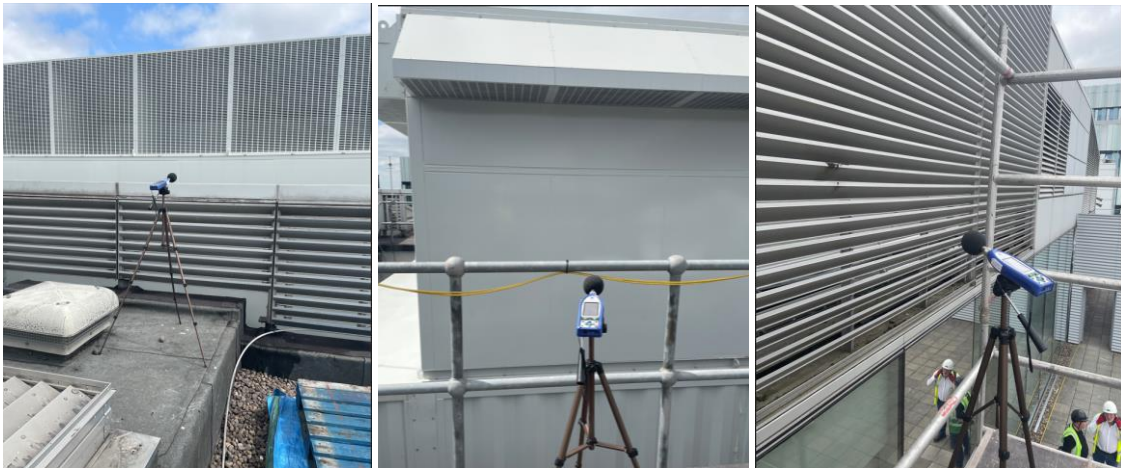


Figure 7 Photographs of generator measurement positions 1 (left), 2 (centre) and 3 (right)

5.4 Attended environmental measurements

Attended sample environmental measurements were carried out at 4 locations around the site. These are shown in Figure 1 as positions 1 to 4. These measurements were carried out on 3 October 2023, over 5 minute periods.

For all positions, the microphone was mounted on a tripod approximately 1.5 m above the ground level. For positions 1, 2 and 4, the microphone was approximately 1 m from a reflective surface and be considered facade levels. For position 3, the microphone was at least 3 m from a reflective surface and be considered free field.

Details of the equipment used and noise indices measures are provided in Appendix A.

Dominant noise sources occurring during the measurements were noted.

Photographs of the measurement locations are provided in Figure 8.

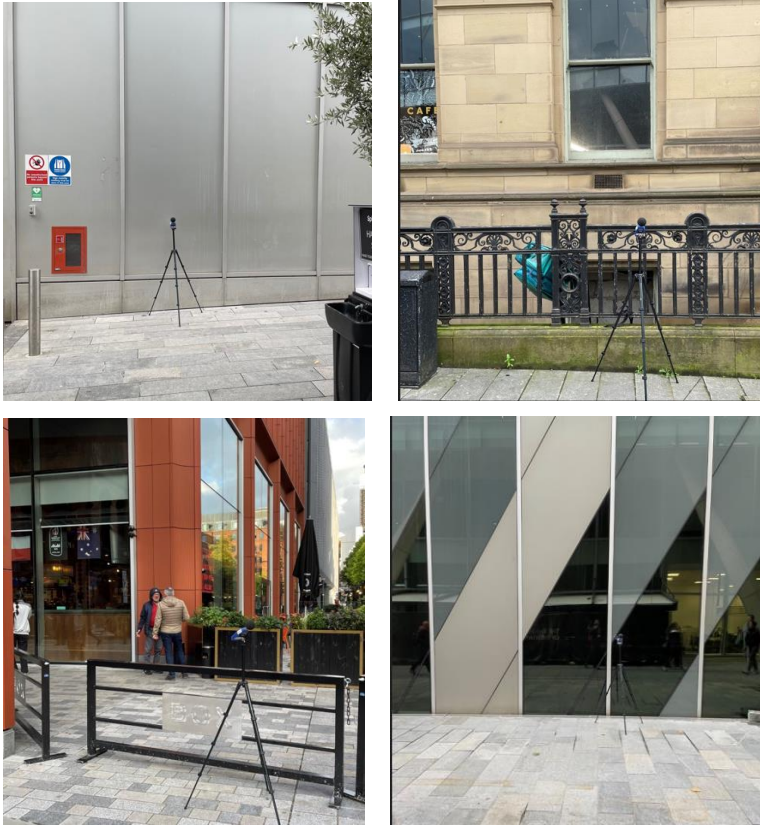


Figure 8 Photos of measurement locations (top left- Pos 1, top right- Pos 2, bottom left- Pos 3, bottom right- Pos 4)

At these locations, measurements were carried out with plant from the proposed development in operation and switched off. Further details are provided in Section 6.2.4.

5.5 Weather conditions

Weather conditions during the attended measurements on 3 October 2023 are described in Appendix A.

6 Noise survey results

6.1 Unattended noise measurements

Detail measurement results are included in 21579-R01-H *Noise survey and plant noise egress assessment* dated 8 June 2023. A summary of the measurement results are provided below for reference.

A graph showing the results of the unattended measurements is provided in Appendix B and C.

Day and night-time ambient noise levels measured during the unattended survey are presented in Table 1 and Table 2.

Table 1 Ambient noise levels measured during the unattended survey at position 1

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Friday 17 December 2021	-	62
Saturday 18 December 2021	64	65
Sunday 19 December 2021	65	58
Monday 20 December 2021	62	57
Average	64	61

Table 2 Ambient noise levels measured during the unattended survey at position 2

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Tuesday 21 December 2021	64 ^[1]	55
Wednesday 22 December 2021	71 ^[1]	-
Average	-	55

^[1] Measurement not made over full period due to monitoring start and end time (the measurement on 21 December 21 was over 12 hours, and on 22 December 21 over 5 hours); not included in the average.

In line with BS 4142:2014+A1:2019, representative background sound levels have been determined using statistical analysis of the continuous measurements.

Based on day and night statistical analysis of the measured values, the representative free-field background sound levels measured during the survey were:

- Position L1: L_{A90} 55 dB during the daytime and L_{A90} 49 dB at night
- Position L2: L_{A90} 56 dB during the daytime and L_{A90} 54 dB at night.

6.2 Noise measurements

6.2.1 Observations

The dominant noise sources were plant in operation, with less significant contributions from other environmental sources.

6.2.2 Noise measurement results (plant noise)

Noise levels and sources recorded during the attended sample measurements are summarised in Table 3. The measurement positions relate to Figure 3 and Figure 4.

Table 3 Noise levels and sources from attended plant measurements

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,1min}$	$L_{AFmax,1min}$	$L_{A90,1min}$	
1	15:38	63	65	62	Dominated by ASHP exhaust fans at 50% duty
2	15:45	71	78	70	Dominated by ASHP intake ramping up and in operation at higher duty
3	15:54	60	63	58	Dominated by AHU 06 01 intake with contributions from exhaust termination
	15:58	63	70	59	Dominated by AHU 06 01 exhaust termination
4	18:20	48	50	47	Dominated by Daikin RXY SQ6T8VB9 in operation
5	18:22	63	68	52	Dominated by Airdale air cooler unit in operation, including fan rump up
6	16:13	60	64	58	Dominated by AHU 07 01 intake with contributions from exhaust termination
7	16:16	59	63	58	Dominated by AHU 07 01 exhaust termination with contributions from intake termination
8	16:19	59	67	58	Dominated by AHU 07 01 case radiation
9	16:22	70	75	67	Dominated by AHU 07 02 intake with contributions from exhaust termination
10	16:24	69	73	68	Dominated by AHU 07 02 exhaust termination with

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,1min}$	$L_{AFmax,1min}$	$L_{A90,1min}$	
					contributions from intake termination
11	16:27	62	65	61	Dominated by AHU 07 02 case radiation

6.2.3 Noise measurement results (background)

Background measurements were carried out to account for environmental sources at the measurement locations, the plant items were switched off at Level 6 plant room (north) and Level 7 plant room.

The installed condensers and air cooler units on level 6 plant room (south) are critical for the building, and were operating on demand as it was not possible to switched them off. Measurements were carried out such that environmental background noise levels were the dominant source.

Noise levels and sources recorded during the attended sample measurements are summarised in Table 4.

Table 4 Background measurement results

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,1min}$	$L_{AFmax,1min}$	$L_{A90,1min}$	
1	18:38	57	61	56	Dominated by plant in operation from No 1 the Avenue with contributions from distant road traffic
2	18:43	52	58	51	Dominated by plant in operation from No 1 the Avenue with contributions from distant road traffic
3	18:25	50	52	49	Dominated by distant road traffic with contributions from distant intermittent angle grinder, with less contributions from condenser in operation
7	18:49	51	58	50	Dominated by distant plant in operation from No 1 the Avenue

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,1min}$	$L_{AFmax,1min}$	$L_{A90,1min}$	
8	18:51	50	54	49	and road traffic on Deansgate Dominated by distant road traffic
9	18:55	52	55	51	Dominated by distant plant in operation from No 1 the Avenue and road traffic on Deansgate
11	18:56	49	52	49	Dominated by distant road traffic

6.2.4 Generator measurements

Noise levels and key sources recorded during the attended measurements are summarised in Table 5. The measurement positions relate to Figure 6.

Table 5 Noise level and key noise sources from attended measurements

Position	Start time	Sound pressure levels (dB)			Description and noise sources
		$L_{Aeq,1min}$	$L_{AFmax,1min}$	$L_{A90,1min}$	
1	12:37	55	63	54	Background measurement with generator switched off, dominated by road traffic and road works on Deansgate (including piling and hammering), distant plant in operation, occasional car horn and reverse beeping
	12:38	55	58	54	
	12:39	56	71	54	
	12:40	56	64	54	
	12:41	58	77	53	
	14:21	71	72	70	Dominated by generator exhaust atmosphere termination
	14:22	71	78	71	
	14:23	71	72	71	
	14:24	71	73	71	
	14:25	71	72	71	

Position	Start time	Sound pressure levels (dB)			Description and noise sources
		$L_{Aeq,1min}$	$L_{AFmax,1min}$	$L_{A90,1min}$	
2	12:46	50	56	50	Background measurement with generator switched off, dominated by road traffic and road works on Deansgate (including piling and hammering)
	12:47	53	66	50	
	12:48	53	59	51	
	12:49	54	60	51	
	12:50	53	60	50	
2	14:27	79	81	79	Dominated by generator intake atmosphere termination
	14:28	79	80	78	
	14:29	79	80	79	
	14:30	79	81	79	
	14:31	79	82	79	
3	13:02	60	66	55	Background measurement with generator switched off, dominated by road works on Deansgate (including piling and hammering), with less contributions from road traffic on Deansgate and reverse beeping
	13:03	57	64	54	
	13:04	57	65	53	
	13:05	58	69	54	
	13:06	61	67	54	
	14:41	74	75	73	Dominated by generator break out with contributions from intake atmosphere termination
	14:42	74	76	73	
	14:43	73	75	73	
	14:44	74	75	73	
	14:45	74	75	73	

The average octave band sound pressure levels measured from the intake and exhaust terminations are summarised in Table 10. The one-third octave band measurement results are presented in Appendix E.

6.2.5 Environmental measurement results at noise sensitive receivers

Measured noise level results and key sources recorded during the attended environmental noise measurements with plant in operation and switched off are summarised in Table 6 and Table 7 respectively.

Measurements with plant in operation do not include generator in operation.

The measurement positions relate to Figure 1.

For reference, measurement positions are summarised below

- Position 1 – 3 Hardman St
- Position 2- The Old Court House
- Position 3- Centurion House
- Position 4 - No 1 The Avenue

Table 6 Noise levels and key noise sources from attended measurements (with plant in operation)

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
1	16:36	69	73	67	Dominated by cars passing by, pedestrians talking, plant extract (not from NatWest), distant circular saw cutting. Less contributions from van reverse beeping, car slamming door, with contributions of road traffic on Hardman St
	17:09	64	90	54	Dominated by distant road traffic on Hardman St, pedestrian talking, with contributions from delivery truck, bottle glass droppings and distant plant from No 1 The Avenue
	17:35	57	74	54	Dominated by car passing by with contributions from No1 The Avenue plant in operation and pedestrians talking, less contributions from car slamming door and car horn
2	16:46	63	89	59	Dominated by cars passing by with contributions from road traffic on Deansgate, distant plant from Sidney Street
	17:16	63	72	61	
	17:42	63	79	60	As above, with contributions from delivery truck, metal trolley and car slamming door

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
3	16:55	62	77	60	Dominated by metal trolleys dragging and road traffic on Deansgate, with less contributions from pedestrians talking
	17:23	63	80	60	Dominated by rod traffic on Deansgate with contributions from distant angle grinder, less contributions from pedestrians talking
	17:48	63	78	61	dominated by distant circular saw cutting/ angle grinder, with contributions from road traffic on Deansgate
4	17:02	60	79	57	Dominated by plant from No 1 The Avenue, with contributions from distant angle grinder, road traffic on Deansgate and pedestrian talking
	17:29	57	64	56	As above with distant siren on Deansgate
	17:54	59	73	56	As above with distant car horn on Deansgate

Subjectively, plant in operation from the proposed development was not audible at the measurement positions.

As discussed in Section 6.2.3, plant items were operating on demand on Level 6 plant room (south) during the measurements with plant switched off.

Table 7 Noise levels and key noise sources from attended measurements

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
1	19:14	61	73	53	Dominated by extract fan from NatWest building from ground floor retail units, distant road traffic from Hardman St and contributions from distant angle grinder
	19:45	55	72	52	Dominated by plant from No 1 The Avenue, with contributions from road traffic on Hardman St and distant angle grinder
	20:13	53	65	51	Dominated by road traffic on Hardman St, pedestrians talking, car slamming door, with contributions from distant metal fencing clashing and angle grinder
	20:42	68	72	67	Dominated by extract fan from NatWest building from ground floor retail units, with distant contributions from distant angle grinder
2	19:22	66	95	57	Dominated by road traffic on Hardman St with contributions from Plant and pedestrian talking. Less contributions from car slamming doors and car horn
	19:52	60	73	55	
	20:19	59	70	56	Dominated by cars passing by with contributions from plant, less contributions from pedestrians talking
3	19:29	63	78	59	Dominated by road traffic on Deansgate with contributions from pedestrians talking

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
	20:01	62	75	58	Dominated by road traffic on Deansgate, with contributions from distant plant and pedestrians talking. Less contributions from car slamming door and reverse beeping
	20:26	63	76	57	Dominated by road traffic on Deansgate with contribution from amplified sound egress from retail unit, contributions from angle grinder, pedestrians talking and metal droppings
4	19:36	61	78	55	Dominated by plant from No 1 The Avenue, with contributions from distant angle grinder, road traffic on Deansgate and pedestrian talking. Less contributions from amplified music
	20:07	57	72	55	Dominated by plant from No 1 The Avenue, with contributions from pedestrian talking
	20:32	62	76	58	Dominated by plant from No 1 The Avenue, with contributions from angle grinder, less contributions from distant amplified music and pedestrian talking

Based on the measurement results with the plant switched on and switch off, it can be concluded that plant in normal operation do not increase the exiting ambient noise levels at the nearest noise sensitive premises.

7 Plant noise limits

7.1 Basis limits

If noise from existing plant is not accounted for, based on the above criteria and the measurement results, the cumulative noise level from the operation of all new plant should not exceed the limits set out in Table 8.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels. These have been corrected relative to the measured free-field background noise levels by the addition of 3 dB. In this case these limits would apply at the locations shown in Table 8.

Table 8 Plant noise limits at 1 m from the nearest noise sensitive premises

Location	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)	
	Day (07:00-23:00)	Night (23:00-07:00)
The Old Courthouse, Yotel, Moxy Hotel	53	47
Centurion House, St John's House	53	47 ^[1]
1 The Avenue, 3 Hardman Street, DFW, 1 Hardman Street	54	52 ^[1]

^[1] These noise sensitive premises are not for residential purposes, however it is understood that Manchester City Council requires night criteria for these buildings '*as the purpose of the condition is also to prevent a general increase of noise in the area and prevent noise creep*'

^[2] The limits set out in Table 8 do not include any attention catching features. Penalty corrections for attention catching features may be significant and will need to be considered. This is discussed in Appendix D.

8 Plant noise egress assessment

8.1 Plant items and locations

The development comprises the installation of the following items of plant:

Level 6 plant room (north):

- 3 x Air source heat pumps (AHSP) with AA203S (highlighted in green in Figure 3).

Level 6 plant room (south):

- 1 x AHU with supply and extract atmosphere connections (highlighted in orange in Figure 3)
- 4 x Daikin RXY SQ6T8VB9 condenser units (highlighted in brown in Figure 3)
- 2 x Airdale air cooler units (highlighted in blue in Figure 3).

Level 7 plant room:

- 1 x AHU 07 01 with supply and extract atmosphere connections (highlighted in purple in Figure 4)
- 1 x AHU 07 02 with supply and extract atmosphere connections (highlighted in yellow in Figure 4).

Level 8:

- 2 x MTU Generators highlighted in pink in Figure 5), these units are proposed to operate simultaneously when there is a building main failure and during planned maintenance.

8.2 Plant noise levels

The measured plant noise levels for each item of plant installed in operation are summarised in Table 9. These measurement results have been derived from the measured one-third octave band measurement results and are not background corrected.

Table 9 Plant measurement results

Plant item	Sound pressure levels, L_{eq} at 1 m (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
<i>ASHP exhaust</i>	72	68	63	60	57	55	49	44
<i>ASHP intake</i>	72	70	69	72	62	58	54	49
<i>AHU06 01</i>								
<i>Intake</i>	70	75	61	52	47	42	38	36
Exhaust	67	75	65	58	55	52	46	40
Daikin RXY SQ6T8VB9	53	54	52	44	41	36	33	32
Airdale cooler unit	64	71	70	59	56	51	45	38
<i>AHU07 01</i>								
<i>Intake</i>	69	75	60	50	48	44	39	36
Exhaust	68	74	60	51	49	44	41	41
Case radiation	69	72	61	51	50	46	41	36

Plant item	Sound pressure levels, L_{eq} at 1 m (dB)							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
<i>AHU07 02</i>								
<i>Intake</i>	73	84	65	56	55	49	44	40
Exhaust	75	83	69	61	56	51	52	54
Case radiation	66	75	61	54	52	48	41	36

The octave band measurement results in Table 10 have been derived from the one-third octave band measurement results, and presented in Appendix E. In each case the data relates to 2 units in operation (50% duty in N+1 configuration). The levels include attenuation measures included by the generator manufacturer.

Table 10 Generator measurement results (N+1 configuration)

Measurement location	Average sound pressure levels L_{eq} (dB) at 1.5 m from atmosphere terminations and break out							
	Octave-band centre frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
1 exhaust	75	77	72	68	62	63	59	55
2 Intake	83	81	78	75	69	73	70	67
3 Break out	72	80	73	71	68	65	59	53

The generators are proposed to run for planned maintenance, and simultaneously when there is a building mains failure, this could be during the day and night-time.

8.3 Noise egress assessment

The predicted noise rating levels at the nearest noise sensitive premises take into account the following:

- plant item measurement results that have been corrected for the measured background noise level
- attenuation due to distance, screening and directionality
- AHUs, ASHP, and Condenser units in continuous operation during the daytime
- AHUs, ASHP, and Condenser units proposed to be in operation from 06:00 hrs to provide heating/ cooling prior building use

- two generators being in continuous operation during power shortage in N+1 configuration
- the location of the plant and directivity due to reflection from nearby surfaces
- 3 dB correction for facade reflection at the nearest noise sensitive premises.

8.3.1 Predicted noise levels

The predicted noise levels for operating plant, including the generators, at the nearest noise sensitive premises are summarised in Table 11.

The predicted noise levels do not include corrections for acoustic catching features.

Table 11 Predicted noise egress from rooftop plant at the nearest noise sensitive premises

Location	Predicted sound pressure level at 1 m from noise sensitive premises from normally operating plant only, L_{Aeq} (dB)	Predicted sound pressure level at 1 m from noise sensitive premises from normally operating plant with generator, L_{Aeq} (dB)
The Old Court House	31	45
Yotel Deansgate (Hotel)	35	47
Moxy Hotel	31	45
DFW	46	51
3 Hardman Street	51	54
1 Hardman Street	30	38
1 The Avenue	52	59
Centurion House	38	55

The predicted levels, with normally operating plant in operation only, comply with the day and night noise egress limits at the nearest noise sensitive premises without additional mitigation measures.

In the case of a power cut, the predicted cumulative noise levels at the nearest noise sensitive premises with the generator in operation comply with the day noise egress limits at the nearest noise sensitive premises except at Centurion House and 1 The Avenue, at which day limits are exceeded by 2 dB and 5 dB respectively.

At night, the predicted cumulative noise levels exceed the night limits outside three nearby commercial premises, as follows: by 2 dB at 3 Hardman Street, by 7 dB at 1 The Avenue, and 8 dB at Centurion House.

The proposal includes occasional plant in operation during the night-time, and the use of normally operating plant and potentially generator from 06:00 hr. Based on this as a worst case scenario, the generator and normally operating plant will potentially be in operation 1 hr during the night-time.

In the unlikely event of a power cut during the night-time, the limits are exceeded outside three commercial premises. The Local Authority should be consulted and agree a potential relaxation in the event of a power cut during the day and night to fully discharge Planning Condition 3b.

9 Conclusion

A noise survey has been carried out to determine the representative background sound levels in the vicinity of the site and surrounding noise sensitive premises.

The representative background sound levels measured during the survey were $L_{A90,15min}$ 55 dB during the daytime and $L_{A90,15min}$ 49 dB at night at position 1 and L_{A90} 56 dB during the daytime and L_{A90} 54 dB at night at position 2.

Based on the requirements of the Local Authority, the relevant plant noise limits are:

- The Old Courthouse, Yotel and Moxy Hotel: L_{Aeq} 53 dB during the day and L_{Aeq} 47 dB during the night
- St John's House and Centurion House: L_{Aeq} 53 dB during the day
- 1 The Avenue, 3 Hardman Street, DFW and 1 Hardman Street: L_{Aeq} 54 dB during the day

These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent than those set out above. If plant items contain tonal or attention catching features, a penalty based on the type and impact of those features will be applied.

Environmental noise measurement results at the nearest noise sensitive

Based on the measurement results with the plant switched on and switch off, it can be concluded that plant in normal operation do not increase the existing ambient noise levels at the nearest noise sensitive premises.

An assessment of the proposed plant items associated with the development has been carried out. The predicted levels with normally operating plant in operation only, comply with the day and night-time noise egress limits at the nearest noise sensitive premises.

In the case of a power cut, the predicted cumulative noise levels at the nearest noise sensitive premises with the generator in operation comply with the day noise egress limits at the nearest noise sensitive premises except at Centurion House and 1 The Avenue, at which day limits are exceeded by 2 dB and 5 dB respectively.

At night, the predicted cumulative noise levels exceed the night limits outside three nearby commercial premises, as follows: by 2 dB at 3 Hardman Street, by 7 dB at 1 The Avenue, and 8 dB at Centurion House.

The proposal includes occasional plant in operation during the night-time, and the worst case scenario of normally operating plant and generator use from 06:00 hr. In the event of a power cut during the night, the limits could be exceeded at 3 premises. The Local Authority should be consulted to agree a potential relaxation in the event of a power cut during the day and night to fully discharge Planning Condition 3b.

Appendix A

Survey details

Equipment

The unattended and attended noise measurements were taken using a Rion NL-52 sound level meters.

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
<i>Unattended measurements December 2021</i>				
Sound level meter	NL-52/01143564	Rion	15 Dec 22	TCRT20/1738
Microphone	UC-59/10153	Rion	15 Dec 22	TCRT20/1738
Pre-amp	NH-25/43581	Rion	15 Dec 22	TCRT20/1738
Calibrator	NC-74/34257023	Rion	14 Dec 22	TCRT20/1736
<i>Attended measurements June 2023</i>				
Sound level meter	NL-52/00932326	Rion	21 Mar 25	TCRT23/1250
Microphone	UC-59/05549	Rion	21 Mar 25	TCRT23/1250
Pre-amp	NH-25/32354	Rion	21 Mar 25	TCRT23/1250
Calibrator	NC-74/34125432	Rion	21 Mar 25	TCRT23/1248
<i>Attended measurements October 2023</i>				
Sound level meter	NL-52/01010788	Rion	20 Sep 25	TCRT23/1666
Microphone	UC-59/20416	Rion	20 Sep 25	TCRT23/1666
Pre-amp	NH-25/11436	Rion	20 Sep 25	TCRT23/1666
Calibrator	SV30A/10559	Svantek	20 Sep 25	TCRT23/1665

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

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg, L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS 7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures*.

Weather conditions

During the unattended noise measurements in December 2021, weather reports for the area indicated that temperatures varied between -1°C at night and 9°C during the day, and the wind speed was less than 3 m/s.

During the attended generator sample measurements on 1 June 2023, the weather was clear and dry and no rain occurred, during the measurements, the measured wind speeds were between 0 m/s and 2.5 m/s.

During the attended sample measurements on 3 October 2023, the weather was generally clear with occasional light rain during the measurements, however, this did not affect the measurements results. The measured wind speeds were between 0 m/s and 2 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

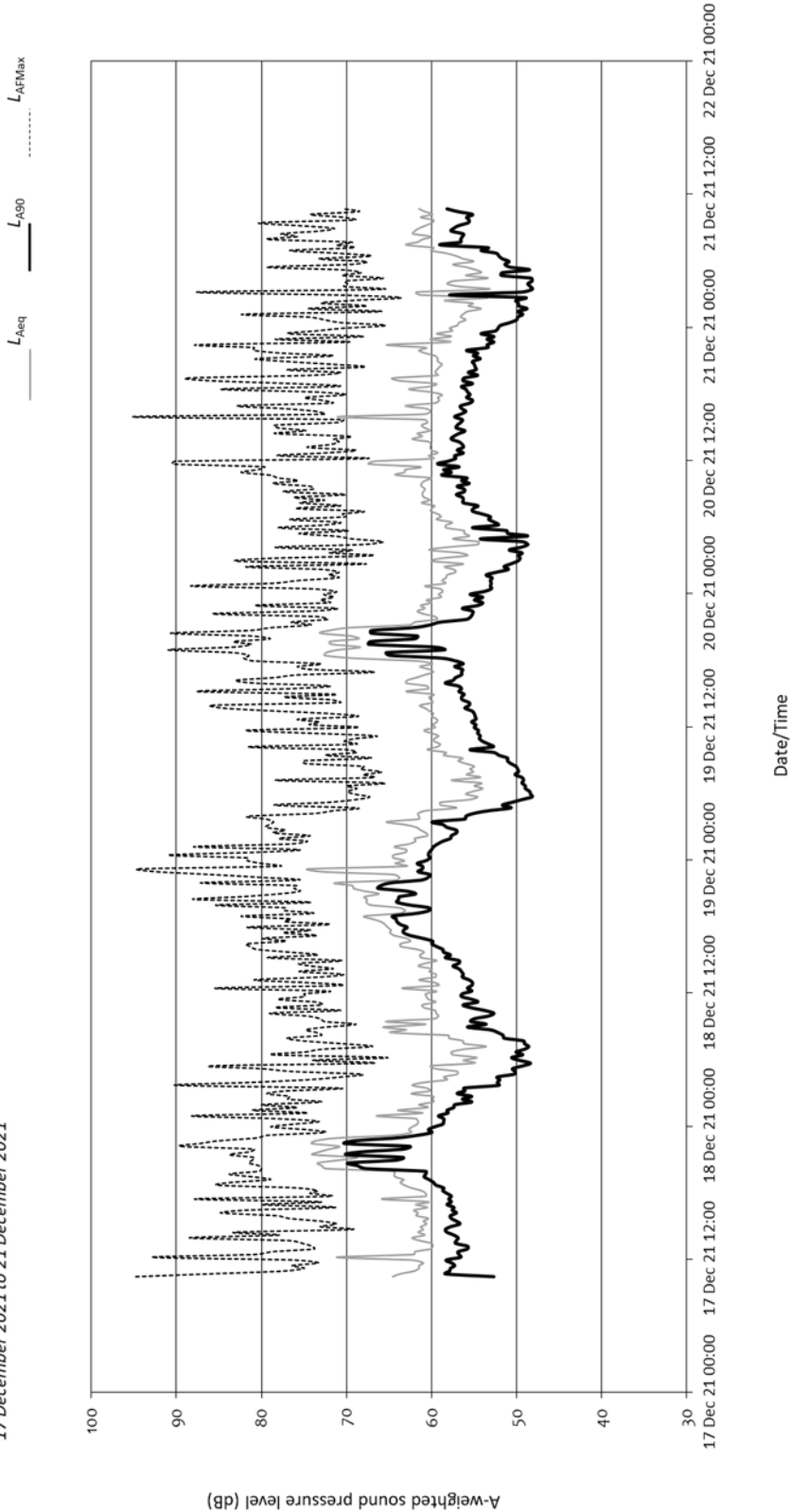
Appendix B

Results of unattended measurements at position L1

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

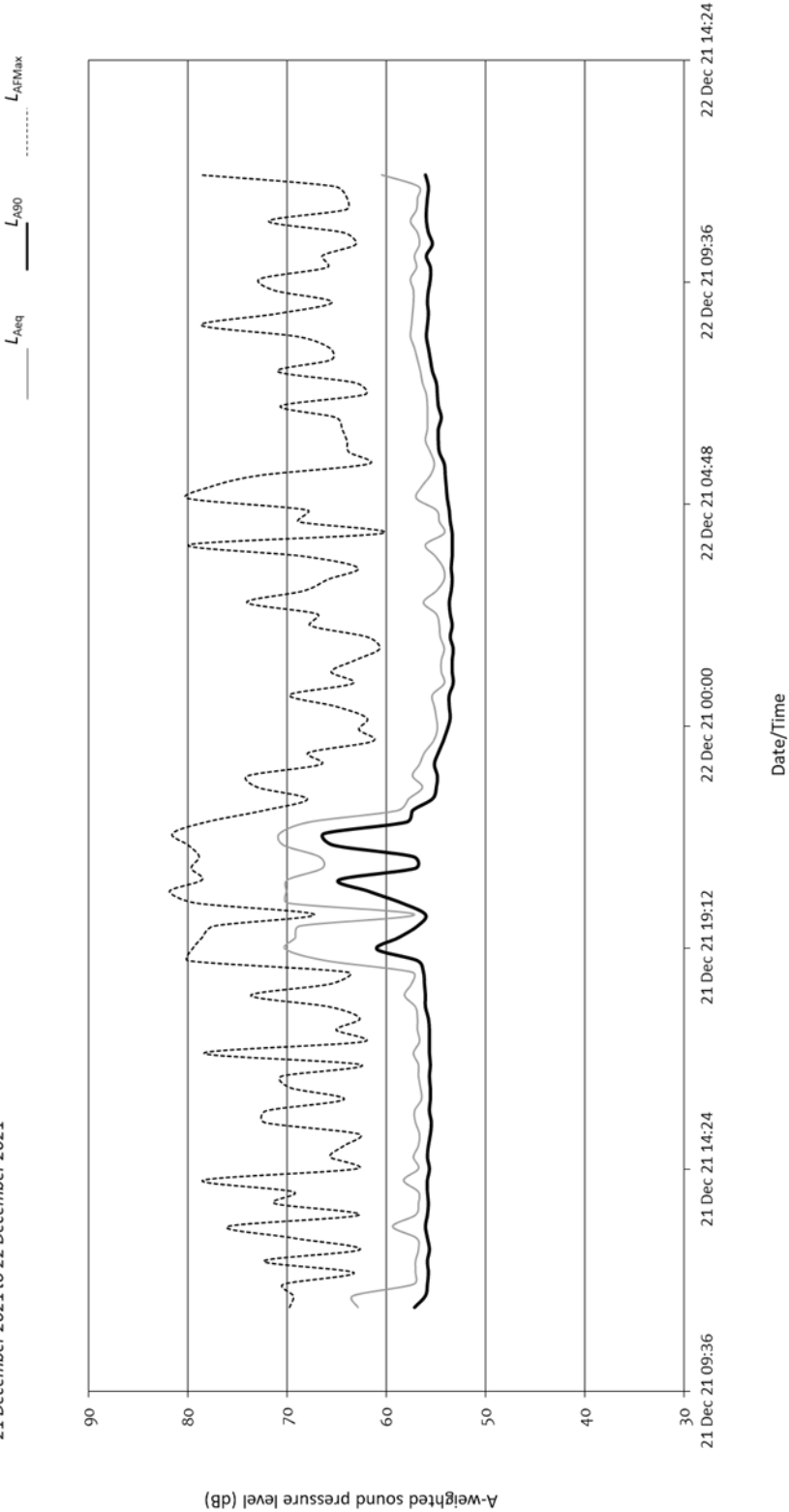
NatWest, Spinningfields
Results of noise logging survey at position 1
17 December 2021 to 21 December 2021



Appendix C

Results of unattended measurements at position L2

NatWest, Spinningfields
Results of noise logging survey at position 2
21 December 2021 to 22 December 2021



Appendix D

BS 4142 corrections for attention catching features

The following applies where plant noise is assessed in accordance with BS 4142:2014+A1:2019.

If the proposed plant noise contains attention catching features (such as tonal elements, whines, whistles, bangs etc), penalty corrections should be applied based on the type and impact of the features.

If appropriate, a subjective assessment of the plant features can be adopted. Where the plant noise contains tonal elements, the following corrections can be made depending on how perceptible the tone is at the noise receptor:

- 0 dB where the tone is not perceptible
- 2 dB where the tone is just perceptible
- 4 dB where the tone is clearly perceptible
- 6 dB where the tone is highly perceptible.

Where the plant noise is impulsive, the following corrections can be made depending on how perceptible the impulsivity is at the noise receptor:

- 0 dB where the impulse is not perceptible
- 3 dB where the impulse is just perceptible
- 6 dB where the impulse is clearly perceptible
- 9 dB where the impulse is highly perceptible.

For noise which is equally both impulsive and tonal, then both features can be accounted for by linearly summing the corrections for both characteristics.

If the plant has other distinctive characteristics, such as intermittency, then a 3 dB correction can be made.

If a subjective assessment of tonality is not appropriate, an objective assessment can be made by analysis of time-averaged, third-octave band sound pressure levels. A noise source is deemed to be tonal if the level in a third-octave band exceeds the level in adjacent third-octave bands by the level differences given below:

- 15 dB in the low frequency third-octave bands (25 Hz to 125 Hz)
- 8 dB in the mid frequency third-octave bands (160 Hz to 400 Hz)
- 5 dB in the high frequency third-octave bands (500 Hz to 10000 Hz).

If an objective assessment identifies the plant noise to be tonal then a 6 dB correction must be made.

Appendix E

Generator average measurement results (1/3 octave band)

Average sound pressure levels L_{A5} (dB) at 1.5 m from atmosphere terminations and break-out																								
Measurement position		Octave-band centre frequency (Hz)																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	8k	10k
1	70	68	72	73	73	72	73	69	64	67	63	65	62	59	55	56	61	57	57	54	56	52	50	52
2	72	76	82	79	75	72	72	70	73	74	72	69	70	67	62	64	71	65	65	65	66	64	62	64
3	67	67	68	71	78	72	72	70	65	68	67	66	65	65	62	60	64	57	58	56	55	50	48	50

Appendix F

Environmental noise egress predictions

Comments	Octave band centre frequency (Hz)								Rating 1	Rating 2
	63	125	250	500	1k	2k	4k	8k		
21579										
Natwest, Spinningfields										
JMG										
13/10/2023										
Manchester City Council										
Noise egress assessment										
To 3 Hardman Street										
Level 6 plant room (north)										
ASHP top/exhaust (full operation- 1 unit)										
Lp at 1m	72	68	63	60	57	55	49	44	L _A =	63
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
3 units 10*log(3)	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (exhaust- worst ca	77	71	67	63	59	59	54	49		
Distance (m)	20									
Lp= Lp@1m-20*log(r2/r1)	51	45	41	37	33	33	28	23	L _A =	40
ASHP side/intake (full operation- 1 unit)										
Lp at 1m	72	70	69	72	62	58	54	48		
apply correction for typical load	70	68	67	70	60	56	52	46		
Lp at 1m background correction	59	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
3 units 10*log(3)	5	5	5	5	5	5	5	5		
4.5 m width directivity correction SRL	-1	-1	-8	-8	-8	-8	-8	-8	only 1/2 correction taken	
Lp predicted 3 unit (intake- worst case	73	72	64	68	57	53	49	44		
Distance (m)	20									
Lp= Lp@1m-20*log(r2/r1)	47	46	38	41	31	27	23	18	L _A =	40
Level 6 plant room (south)										
AHU 06 01										
Intake at 1m	70	75	61	52	47	42	38	36	L _A =	61
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Distance (m)	20									
Lp= Lp@1m-20*log(r2/r1)	44	49	33	25	18	13	10	10	L _A =	34
Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Distance (m)	20									
Lp= Lp@1m-20*log(r2/r1)	41	49	39	32	29	26	19	14	L _A =	37
Daikin RXY SQ6T8VB9										
Lp at 1m	53	54	52	44	41	36	33	32		
4 units 10*log(4)	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Distance (m)	22									
Lp= Lp@1m-20*log(r2/r1)	32	33	31	23	20	15	12	12	L _A =	27

Air cooler unit									
Lp at 1m	64	71	70	59	56	51	45	38	
Lp at 1m background correction	56	54	55	45	42	38	33	26	
Specific Lp at 1m	63	71	69	59	55	51	45	38	
2 units 10*log(2)	3	3	3	3	3	3	3	3	
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41	
Distance (m)	17								
Lp= Lp@1m-20*log(r2/r1)	41	50	48	37	34	29	23	16	L _A = 42

Level 7 plant room

AHU 07 01

Intake Lp at 1m	69	75	60	50	48	44	39	36	
Lp at 1m background correction	61	58	57	56	53	52	50	48	
Specific Lp at 1m	69	75	56	50	48	44	39	36	
Distance (m)	52								
Lp= Lp@1m-20*log(r2/r1)	34	41	22	16	14	10	5	2	L _A = 26

Exhaust Lp at 1m	68	74	60	51	49	44	41	41	
Lp at 1m background correction	61	58	57	56	53	52	50	48	
Specific Lp at 1m	67	74	58	51	49	44	41	41	
Distance (m)	52								
Lp= Lp@1m-20*log(r2/r1)	33	40	23	17	15	10	7	7	L _A = 25

Break out at 1m	69	72	61	51	50	46	41	36	
Lp at 1m background correction	61	58	57	56	53	52	50	48	
Specific Lp at 1m	68	72	58	51	50	46	41	36	
Distance (m)	42								
Lp= Lp@1m-20*log(r2/r1)	35	39	26	19	18	14	9	4	L _A = 26

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40	
Lp at 1m background correction	59	57	57	58	58	57	53	52	
Specific Lp at 1m	73	84	65	56	55	49	44	40	
Distance (m)	36								
Lp= Lp@1m-20*log(r2/r1)	42	53	34	25	24	18	13	9	L _A = 37

Exhaust Lp at 1m	75	83	69	61	56	51	52	54	
Lp at 1m background correction	59	57	57	58	58	57	53	52	
Specific Lp at 1m	75	83	69	58	56	51	52	54	
Distance (m)	36								
Lp= Lp@1m-20*log(r2/r1)	44	51	38	27	25	20	21	23	L _A = 37

Break out at 1m	66	75	61	54	52	48	41	36	
Lp at 1m background correction	61	58	56	54	52	51	49	48	
Specific Lp at 1m	64	75	60	43	52	48	41	36	
Distance (m)	40								
Lp= Lp@1m-20*log(r2/r1)	34	43	29	22	20	15	9	4	L _A = 29

Level 8 plant room

Generator

Exhaust measured at 1.5m (2 units)	75	77	72	68	62	63	59	55	
Att. Min IL	0	0	0	0	0	0	0	0	
r1	2	m							
r2	61	m							
L2	43	45	40	36	30	31	27	23	L _A = 39

Intake at 1.5m (2 units)	83	81	78	75	69	73	70	67				
Att. Min IL	0	0	0	0	0	0	0	0				
r1	2	m										
r2	71	m										
L2	49	47	44	41	35	39	36	33	L _A =	45		
Break out at 1.5m (2 units)	72	80	73	71	68	65	59	53				
Attenuation	0	0	0	0	0	0	0	0				
r1	2	m										
r2	67	m										
L2	39	47	40	38	35	32	26	20	L _A =	41		
Lp contributions (generator)	51	51	47	44	39	41	37	34	L _A =	47		
Lp without generators	54	58	50	44	39	36	31	27	L _A =	48	Limits	
3 dB for facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	57	61	53	47	42	39	34	30	L _A =	51	54	52
Lp with generators	56	59	52	47	42	42	38	35			Limits	
3 dB for facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	59	62	55	50	45	45	41	38	L _A =	54	54	52

To DFWLevel 6 plant room (north)*ASHP top/exhaust (full operation- 1 unit)*

Lp at 1m	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
apply correction for typical load	70	64	60	56	52	53	47	42		
3 units $10 \cdot \log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (exhaust- worst ca	75	69	65	61	57	57	52	47		
Screening (PD 0.064)	5	6	7	8	10	12	15	18		
Lp predicted 3 unit (exhaust- worst ca	69	63	59	53	48	45	37	29		
Distance (m)	50									
Lp= Lp@1m-20*log(r2/r1)	35	29	25	19	14	11	3	-5	L _A =	22

ASHP side/intaket (full operation- 1 unit)

Lp at 1m	69	70	69	72	62	58	54	48		
Lp at 1m background correction	59	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
3 units $10 \cdot \log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (intake- worst case	73	72	64	68	57	53	49	44		
Screening (PD 0.071)	6	6	7	8	10	12	15	18		
Lp predicted 3 unit (intake- worst case	68	66	58	60	47	41	34	25		
Distance (m)	50									
Lp= Lp@1m-20*log(r2/r1)	34	32	24	26	13	7	0	-9	L _A =	24

Level 6 plant room (south)*AHU 06 01*

Intake at 1m	70	75	61	52	47	42	38	36		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Distance (m)	25									
Lp= Lp@1m-20*log(r2/r1)	42	47	31	23	16	12	8	8	L _A =	32

Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Distance (m)	25									
Lp= Lp@1m-20*log(r2/r1)	39	47	37	30	27	24	17	12	L _A =	35

Daikin RXY SQ6T8VB9

Lp at 1m	53	54	52	44	41	36	33	32		
4 units $10 \cdot \log(4)$	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Distance (m)	27									
Lp= Lp@1m-20*log(r2/r1)	30	31	29	21	18	13	10	10	L _A =	25

Air cooler unit

Lp at 1m	64	71	70	59	56	51	45	38		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	63	71	69	59	55	51	45	38		
2 units $10 \cdot \log(2)$	3	3	3	3	3	3	3	3		
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41		
Distance (m)	25									
Lp= Lp@1m-20*log(r2/r1)	38	46	44	34	30	26	20	13	L _A =	39

Level 7 plant room*AHU 07 01*

Intake Lp at 1m	69	75	60	50	48	44	39	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	69	75	56	50	48	44	39	36		
Screening (PD 0.367)	7	9	11	13	16	19	22	24		
Distance (m)	60									
Lp= Lp@1m-20*log(r2/r1)	26	31	10	1	-4	-11	-19	-24	L _A =	15

Exhaust Lp at 1m	68	74	60	51	49	44	41	41		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	67	74	58	51	49	44	41	41		
Screening (PD 0.367)	7	9	11	13	16	19	22	24		
Distance (m)	60									
Lp= Lp@1m-20*log(r2/r1)	24	30	11	2	-3	-11	-17	-19	L _A =	15

Break out at 1m	69	72	61	51	50	46	41	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	68	72	58	51	50	46	41	36		
Screening (PD 0.367)	7	9	11	13	16	19	22	24		
Distance (m)	60									
Lp= Lp@1m-20*log(r2/r1)	25	27	12	2	-2	-9	-17	-24	L _A =	13

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	73	84	65	56	55	49	44	40		
Distance (m)	50									
Lp= Lp@1m-20*log(r2/r1)	39	50	31	22	21	15	10	6	L _A =	35

Exhaust Lp at 1m	75	83	69	61	56	51	52	54		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	75	83	69	58	56	51	52	54		
Distance (m)	50									
Lp= Lp@1m-20*log(r2/r1)	41	49	35	24	22	17	18	20	L _A =	34

Break out at 1m	66	75	61	54	52	48	41	36		
Lp at 1m background correction	61	58	56	54	52	51	49	48		
Specific Lp at 1m	64	75	60	43	52	48	41	36		
Distance (m)	52									
Lp= Lp@1m-20*log(r2/r1)	30	41	26	8	18	14	7	2	L _A =	26

Level 8 plant room*Generators*

Exhaust measured at 1.5m (2 units)	75	77	72	68	62	63	59	55		
Screening	0	0	0	0	0	0	0	0		
r1	2	m								
r2	58	m								
L2	43	45	40	36	30	31	27	23	L _A =	39

Intake at 1.5m (2 units)	83	81	78	75	69	73	70	67		
Screening	0	0	0	0	0	0	0	0		
r1	2	m								
r2	69	m								
L2	50	48	45	42	36	40	37	34	L _A =	46

Break out at 1.5m (2 units)	72	80	73	71	68	65	59	53				
Screening	5	5	6	6	7	8	10	13				
r1	2											
r2	64											
L2	34	42	35	32	28	24	16	7	L _A =	34		
Lp contributions (generator)	51	50	46	43	37	40	37	34	L _A =	47		
Lp without generators	48	55	46	37	33	29	24	22	L _A =	43	Limits	
3dB facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	51	58	49	40	36	32	27	25	L _A =	46	54	52
Lp with generators	52	56	49	44	39	41	37	34	L _A =	48	Limits	
3dB facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	55	59	52	47	42	44	40	37	L _A =	51	54	52

To Yotel (Hotel)Level 6 plant room (north)

ASHP top/exhaust (full operation- 1 unit)

Lp at 1m	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
3 units $10 \cdot \log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (exhaust- worst ca	75	69	65	61	57	57	52	47		
Screening	0	0	0	0	0	0	0	0		
Lp predicted 3 unit (exhaust- worst ca	75	69	65	61	57	57	52	47		
Distance (m)	130									
Lp= Lp@1m-20*log(r2/r1)	32	27	23	19	15	15	10	5	L _A =	22

ASHP side/intake (full operation- 1 unit)

Lp at 1m	69	70	69	72	62	58	54	48		
Lp at 1m background correction	59	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
3 units $10 \cdot \log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (intake- worst case	73	72	64	68	57	53	49	44		
Screening	0	0	0	0	0	0	0	0		
Lp predicted 3 unit (intake- worst case	73	72	64	68	57	53	49	44		
Distance (m)	130									
Lp= Lp@1m-20*log(r2/r1)	31	29	22	25	14	11	7	1	L _A =	24

Level 6 plant room (south)AHU 06 01

Intake at 1m	70	75	61	52	47	42	38	36		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Screening (PD 0.612)	8	10	13	16	19	22	24	24		
Distance (m)	151									
Lp= Lp@1m-20*log(r2/r1)	18	22	3	-8	-18	-26	-32	-32	L _A =	6

Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Screening (PD 0.612)	8	10	13	16	19	22	24	24		
Distance (m)	151									
Lp= Lp@1m-20*log(r2/r1)	15	21	9	-1	-7	-13	-22	-28	L _A =	7

Daikin RXY SQ6T8VB9

Lp at 1m	53	54	52	44	41	36	33	32		
4 units $10 \cdot \log(4)$	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Screening (PD 0.612)	8	10	13	16	19	22	24	24		
Distance (m)	148									
Lp= Lp@1m-20*log(r2/r1)	7	6	1	-9	-15	-23	-29	-29	L _A =	-4

Air cooler unit

Lp at 1m	64	71	70	59	56	51	45	38		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	63	71	69	59	55	51	45	38		
2 units $10 \cdot \log(2)$	3	3	3	3	3	3	3	3		
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41		
Screening (PD 0.892)	9	11	14	17	20	23	24	24		
Distance (m)	148									
Lp= Lp@1m-20*log(r2/r1)	13	20	15	1	-5	-13	-20	-27	L _A =	9

Level 7 plant room*AHU 07 01*

Intake Lp at 1m	69	75	60	50	48	44	39	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	69	75	56	50	48	44	39	36		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	114									
Lp= Lp@1m-20*log(r2/r1)	28	34	15	9	7	3	-2	-5	L _A =	19

Exhaust Lp at 1m	68	74	60	51	49	44	41	41		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	67	74	58	51	49	44	41	41		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	114									
Lp= Lp@1m-20*log(r2/r1)	26	33	16	10	8	3	0	0	L _A =	19

Break out at 1m	69	72	61	51	50	46	41	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	68	72	58	51	50	46	41	36		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	114									
Lp= Lp@1m-20*log(r2/r1)	27	30	17	10	9	5	0	-5	L _A =	17

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	73	84	65	56	55	49	44	40		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	124									
Lp= Lp@1m-20*log(r2/r1)	31	42	23	14	13	7	2	-2	L _A =	27

Exhaust Lp at 1m	75	83	69	61	56	51	52	54		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	75	83	69	58	56	51	52	54		
Distance (m)	124									
Lp= Lp@1m-20*log(r2/r1)	33	41	27	16	14	9	10	12	L _A =	26

Break out at 1m	69	72	61	51	50	46	41	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	68	72	58	51	50	46	41	36		
Distance (m)	120									
Lp= Lp@1m-20*log(r2/r1)	26	30	17	9	8	4	-1	-6	L _A =	17

Level 8 plant room*Generators*

Level 8

Exhaust measured at 1.5m (2 units)	75	77	72	68	62	63	59	55	L _A =	71
r1	2	m								
r2	115	m								
L2	37	39	34	30	24	25	21	17	L _A =	33

Intake at 1.5m (2 units)	83	81	78	75	69	73	70	67		
r1	2									
r2	110	m								
L2	46	44	41	38	32	36	33	30		
Lp	46	45	42	38	32	36	33	30	L _A =	42

Break out at 1.5m (2 units)	72	80	73	71	68	65	59	53				
r1	2											
r2	110 m											
L2	35	43	36	34	31	28	22	16	L _A =	36		
Lp contributions (generator)	47	48	43	40	35	37	34	30	L _A =	44		
Lp without genarators	39	46	31	27	21	18	15	14	L _A =	32	Limits	
3 dB facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	42	49	34	30	24	21	18	17	L _A =	35	53	47
Lp with generators	48	50	43	40	35	37	34	30	L _A =	44	Limits	
3 dB facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	51	53	46	43	38	40	37	33	L _A =	47	53	47

To Centurion HouseLevel 6 plant room (north)

ASHP top/exhaust (full operation- 1 unit)

Lp at 1m	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
3 units $10*\log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (exhaust- worst ca	77	71	67	63	59	59	54	49		
Screening	0	0	0	0	0	0	0	0		
Lp predicted 3 unit (exhaust- worst ca	77	71	67	63	59	59	54	49		
Distance (m)	100									
Lp= Lp@1m-20*log(r2/r1)	37	31	27	23	19	19	14	9	L _A =	27

ASHP side/intake (full operation- 1 unit)

Lp at 1m	72	70	69	72	62	58	54	48		
Lp at 1m background correction	59	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
3 units $10*\log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (intake- worst case	73	72	64	68	57	53	49	44		
Screening (PD 0.00)	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (intake- worst case	68	67	59	63	52	48	44	39		
Distance (m)	100									
Lp= Lp@1m-20*log(r2/r1)	28	27	19	23	12	8	4	-1	L _A =	21

Level 6 plant room (south)

AHU 06 01

Intake at 1m	70	75	61	52	47	42	38	36		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Screening (PD 0.518)	8	10	12	15	18	21	24	24		
Distance (m)	105									
Lp= Lp@1m-20*log(r2/r1)	21	25	7	-4	-14	-22	-29	-29	L _A =	10

Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Screening (PD 0.518)	8	10	12	15	18	21	24	24		
Distance (m)	105									
Lp= Lp@1m-20*log(r2/r1)	18	25	12	3	-3	-10	-19	-25	L _A =	11

Daikin RXY SQ6T8VB9

Lp at 1m	53	54	52	44	41	36	33	32		
4 units $10*\log(4)$	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Screening (PD 1.220)	10	13	16	18	22	24	24	24		
Distance (m)	105									
Lp= Lp@1m-20*log(r2/r1)	8	7	2	-9	-15	-23	-26	-26	L _A =	-4

Air cooler unit

Lp at 1m	64	71	70	59	56	51	45	38		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	63	71	69	59	55	51	45	38		
2 units $10*\log(2)$	3	3	3	3	3	3	3	3		
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41		
Screening (PD 0.736)	9	11	13	16	19	22	24	24		
Distance (m)	109									
Lp= Lp@1m-20*log(r2/r1)	16	23	18	5	-2	-9	-17	-24	L _A =	12

Level 7 plant room*AHU 07 01*

Intake Lp at 1m	69	75	60	50	48	44	39	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	69	75	56	50	48	44	39	36		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	68									
Lp= Lp@1m-20*log(r2/r1)	32	38	20	13	11	7	2	-1	L _A =	23

Exhaust Lp at 1m	68	74	60	51	49	44	41	41		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	67	74	58	51	49	44	41	41		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	68									
Lp= Lp@1m-20*log(r2/r1)	30	38	21	14	12	7	4	4	L _A =	23

Break out at 1m										
Lp at 1m background correction	69	72	61	51	50	46	41	36		
Specific Lp at 1m	61	58	57	56	53	52	50	48		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	72									
Lp= Lp@1m-20*log(r2/r1)	23	21	19	19	16	15	13	11	L _A =	22

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	73	84	65	56	55	49	44	40		
Screening worst case	0	0	0	0	0	0	0	0		
Distance (m)	88									
Lp= Lp@1m-20*log(r2/r1)	34	45	26	17	16	10	5	1	L _A =	30

Exhaust Lp at 1m	75	83	69	61	56	51	52	54		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	75	83	69	58	56	51	52	54		
Distance (m)	88									
Lp= Lp@1m-20*log(r2/r1)	36	44	30	19	17	12	13	15	L _A =	29

Break out at 1m	66	75	61	54	52	48	41	36		
Lp at 1m background correction	61	58	56	54	52	51	49	48		
Specific Lp at 1m	64	75	60	43	52	48	41	36		
Distance (m)	80									
Lp= Lp@1m-20*log(r2/r1)	26	37	22	5	14	10	3	-2	L _A =	23

Level 8 plant room*Generators*

Exhaust measured at 1.5m (2 units)	75	77	72	68	62	63	59	55		
Screening	0	0	0	0	0	0	0	0		
r1	2	m								
r2	63	m								
L2	43	45	40	36	30	31	27	23	L _A =	38

Intake at 1.5m (2 units)	83	81	78	75	69	73	70	67				
Screening	0	0	0	0	0	0	0	0				
r1	2	m										
r2	54	m										
L2	52	50	47	44	38	42	39	36	L _A =	48		
Break out at 1.5m (2 units)	72	80	73	71	68	65	59	53				
Screening	0	0	0	0	0	0	0	0				
r1	2											
r2	56											
L2	41	49	42	40	37	34	28	22				
Contribution from generator	53	53	49	46	41	43	39	36	L _A =	49		
Lp without genarators	42	49	34	28	25	22	19	18	L _A =	35	Limits	
3 dB facade	3	3	3	3	3	3	3	3			Day	Night
Lp facade	45	52	37	31	28	25	22	21	L _A =	38	53	47
Lp with generators	56	56	51	48	43	46	42	39	L _A =	52	Limits	
3 dB façade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	59	59	54	51	46	49	45	42	L _A =	55	53	47

1 The Avenue

Level 6 plant room (north)

ASHP top/exhaust (full operation- 1 unit)

Lp at 1m	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
Screening	0	0	0	0	0	0	0	0		
Lp predicted 1 unit (exhaust- worst ca	72	66	62	58	54	55	49	44		
Distance (m)	13									
Lp= Lp@1m-20*log(r2/r1)	50	44	40	36	32	32	27	22	L _A =	39

Two units screened by one ASHP

ASHP top/exhaust (full operation- 1 unit)	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
add 3 dB second unit	75	69	65	61	57	58	52	47		
Screening (PD 0.905)	9	11	14	17	20	23	24	24		
Lp predicted	66	58	51	44	37	34	28	23		
Distance (m)	16									
Lp= Lp@1m-20*log(r2/r1)	42	34	27	20	13	10	4	-1	L _A =	24

ASHP side/intake (full operation- 1 unit)

Lp at 1m	72	70	69	72	62	58	54	48		
Lp at 1m background correction	70	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
Screening	0	0	0	0	0	0	0	0		
Lp predicted 1 unit (intake- worst case)	69	68	67	70	59	56	52	46		
Distance (m)	13									
Lp= Lp@1m-20*log(r2/r1)	47	46	45	48	37	34	29	24	L _A =	46

Two units screened by one ASHP

Lp at 1m	72	70	69	72	62	58	54	48		
Lp at 1m background correction	70	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
add 3 dB second unit	72	71	70	73	62	59	55	49		
Screening (fully screened) take 1/2	6	8	9	11	12	12	12	12		
Lp predicted	66	63	61	62	50	47	43	37		
Distance (m)	16									
Lp= Lp@1m-20*log(r2/r1)	42	39	37	38	26	23	18	13	L _A =	37

Level 6 plant room (south)

AHU 06 01

Intake at 1m	13	16	18	22	24	24	24	24		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	39									
Lp= Lp@1m-20*log(r2/r1)	25	28	9	-2	-11	-16	-20	-20	L _A =	12

Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	39									
Lp= Lp@1m-20*log(r2/r1)	22	28	15	5	-1	-4	-10	-16	L _A =	13

Daikin RXY SQ6T8VB9

Lp at 1m	53	54	52	44	41	36	33	32		
4 units 10*log(4)	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	36									
Lp= Lp@1m-20*log(r2/r1)	15	13	8	-3	-8	-13	-17	-17	L _A =	3

Air cooler unit

Lp at 1m	64	71	70	59	56	51	45	38		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	63	71	69	59	55	51	45	38		
2 units 10*log(2)	3	3	3	3	3	3	3	3		
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	35									
Lp= Lp@1m-20*log(r2/r1)	22	28	23	9	3	-1	-7	-14	L _A =	17

Level 7 plant room*AHU 07 01*

Intake Lp at 1m	69	75	60	50	48	44	39	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	69	75	56	50	48	44	39	36		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	13									
Lp= Lp@1m-20*log(r2/r1)	46	53	34	28	26	22	17	14	L _A =	38

Exhaust Lp at 1m	68	74	60	51	49	44	41	41		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	67	74	58	51	49	44	41	41		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	13									
Lp= Lp@1m-20*log(r2/r1)	45	52	35	29	27	22	19	19	L _A =	37

Break out at 1m	69	72	61	51	50	46	41	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	68	72	58	51	50	46	41	36		
Screening	0	0	0	0	0	0	0	0		
Distance (m)	13									
Lp= Lp@1m-20*log(r2/r1)	45	49	36	29	28	24	19	14	L _A =	36

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	73	84	65	56	55	49	44	40		
Screening (PD 0.048)	5	6	6	7	9	11	14	16		
Distance (m)	17									
Lp= Lp@1m-20*log(r2/r1)	43	54	34	24	22	14	6	-1	L _A =	38

Exhaust Lp at 1m	75	83	69	61	56	51	52	54			
Lp at 1m background correction	59	57	57	58	58	57	53	52			
Specific Lp at 1m	75	83	69	58	56	51	52	54			
Screening (PD 0.048)	5	6	6	7	9	11	14	16			
Distance (m)	17										
Lp= Lp@1m-20*log(r2/r1)	45	52	38	26	23	16	14	13	L _A =	38	
Break out at 1m	66	75	61	54	52	48	41	36			
Lp at 1m background correction	61	58	56	54	52	51	49	48			
Specific Lp at 1m	64	75	60	43	52	48	41	36			
Screening (PD 0.048)	5	6	6	7	9	11	14	16			
Distance (m)	17										
Lp= Lp@1m-20*log(r2/r1)	34	45	29	11	19	13	3	-5	L _A =	30	
<u>Level 8 plant room</u>											
<i>Generators</i>											
Exhaust measured at 1.5m (2 units)	75	77	72	68	62	63	59	55			
screening	0	0	0	0	0	0	0	0			
r1	2	m									
r2	26	m									
L2	50	52	47	43	37	38	34	30	L _A =	46	
Intake at 1.5m (2 units)	83	81	78	75	69	73	70	67			
screening	0	0	0	0	0	0	0	0			
r1	2	m									
r2	26	m									
L2	58	56	53	50	44	48	45	42	L _A =	54	
Break out at 1.5m (2 units)	72	80	73	71	68	65	59	53			
screening	5	5	5	5	5	5	7	8			
r1	2	m									
r2	26	m									
L2	42	50	43	41	38	35	27	20	L _A =	44	
Lp generator contributions	59	58	55	51	46	49	46	43	L _A =	55	
Lp without genarators	55	60	48	49	39	37	32	28	L _A =	49	Limits
3 dB facade correction	3	3	3	3	3	3	3	3			Day Night
Lp facade	58	63	51	52	42	40	35	31	L _A =	52	54 52
Lp with genarators	60	62	55	53	47	49	46	43	L _A =	56	Limits
3 dB facade correction	3	3	3	3	3	3	3	3			Day Night
Lp facade	63	65	58	56	50	52	49	46	L _A =	59	54 52

The Old Courthouse/ Moxy hotel (worst case)

Level 6 plant room (north)

ASHP top/exhaust (full operation- 1 unit)

Lp at 1m	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
3 units $10*\log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (exhaust- worst ca	77	71	67	63	59	59	54	49		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Lp predicted 3 unit (exhaust- worst ca	64	56	49	42	35	35	30	25		
Distance (m)	65									
Lp= Lp@1m-20*log(r2/r1)	28	19	12	5	-1	-1	-6	-11	L _A =	10

ASHP side/intake (full operation- 1 unit)

Lp at 1m	72	70	69	72	62	58	54	48		
Lp at 1m background correction	59	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
3 units $10*\log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (intake- worst case	73	72	64	68	57	53	49	44		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Lp predicted 3 unit (intake- worst case	60	56	46	46	33	29	25	20		
Distance (m)	65									
Lp= Lp@1m-20*log(r2/r1)	24	20	10	10	-4	-7	-11	-17	L _A =	10

Level 6 plant room (south)

AHU 06 01

Intake at 1m	70	75	61	52	47	42	38	36		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12		
Distance (m)	44									
Lp= Lp@1m-20*log(r2/r1)	31	35	17	8	0	-5	-9	-9	L _A =	19

Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12		
Distance (m)	44									
Lp= Lp@1m-20*log(r2/r1)	28	35	23	14	10	7	0	-5	L _A =	21

Daikin RXY SQ6T8VB9

Lp at 1m	53	54	52	44	41	36	33	32		
4 units $10*\log(4)$	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12		
Distance (m)	45									
Lp= Lp@1m-20*log(r2/r1)	19	19	15	7	2	-3	-6	-7	L _A =	11

Air cooler unit

Lp at 1m	64	71	70	59	56	51	45	38		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	63	71	69	59	55	51	45	38		
2 units $10*\log(2)$	3	3	3	3	3	3	3	3		
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41		
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12		
Distance (m)	48									
Lp= Lp@1m-20*log(r2/r1)	26	33	30	17	13	8	2	-5	L _A =	24

Level 7 plant room*AHU 07 01*

Intake Lp at 1m	69	75	60	50	48	44	39	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	69	75	56	50	48	44	39	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	49									
Lp= Lp@1m-20*log(r2/r1)	22	26	4	-5	-10	-14	-19	-22	L _A =	10

Exhaust Lp at 1m	68	74	60	51	49	44	41	41		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	67	74	58	51	49	44	41	41		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	49									
Lp= Lp@1m-20*log(r2/r1)	20	25	5	-4	-9	-14	-17	-17	L _A =	9

Break out at 1m	69	72	61	51	50	46	41	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	68	72	58	51	50	46	41	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	52									
Lp= Lp@1m-20*log(r2/r1)	21	22	6	-5	-8	-12	-17	-22	L _A =	7

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	73	84	65	56	55	49	44	40		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	52									
Lp= Lp@1m-20*log(r2/r1)	26	34	12	0	-3	-9	-14	-18	L _A =	18

Exhaust Lp at 1m	75	83	69	61	56	51	52	54		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	75	83	69	58	56	51	52	54		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	52									
Lp= Lp@1m-20*log(r2/r1)	28	33	16	2	-2	-7	-6	-4	L _A =	17

Break out at 1m	66	75	61	54	52	48	41	36		
Lp at 1m background correction	61	58	56	54	52	51	49	48		
Specific Lp at 1m	64	75	60	43	52	48	41	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	49									
Lp= Lp@1m-20*log(r2/r1)	18	26	8	-13	-6	-10	-17	-22	L _A =	10

Level 8 plant room*Generators*

Exhaust measured at 1.5m (2 units)	75	77	72	68	62	63	59	55		
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12		
r1	2	m								
r2	38	m								
L2	41	41	35	29	22	23	19	15	L _A =	32

Intake at 1.5m (2 units)	83	81	78	75	69	73	70	67				
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12				
r1	2	m										
r2	38	m										
L2	49	45	41	36	29	33	30	27				
Lp (2 x generator)	49	47	42	37	30	33	30	27	L _A =	41		
Break out at 1.5m (2 units)	72	80	73	71	68	65	59	53				
Screening- fully (take 1/2)	6	8	9	11	12	12	12	12				
r1	2	m										
r2	38	m										
Lp (2 x generator)	38	44	36	32	28	25	19	13	L _A =	35		
Lp generator contributions	50	50	43	39	32	34	31	28	L _A =	42		
Lp without genarators	37	41	31	20	15	11	6	2	L _A =	28	Limits	
3dB facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	40	44	34	23	18	14	9	5	L _A =	31	53	47
Lp with generators	50	50	44	39	32	34	31	28	L _A =	42	Limits	
3dB facade correction	3	3	3	3	3	3	3	3			Day	Night
Lp facade	53	53	47	42	35	37	34	31	L _A =	45	53	47

1 Hardman Street

Level 6 plant room (north)

ASHP top/exhaust (full operation- 1 unit)

Lp at 1m	72	68	63	60	57	55	49	44		
Lp at 1m background correction	60	63	56	55	53	45	37	31		
Specific Lp at 1m	72	66	62	58	54	55	49	44		
3 units $10 \cdot \log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (exhaust- worst ca	77	71	67	63	59	59	54	49		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Lp predicted 3 unit (exhaust- worst ca	64	56	49	42	35	35	30	25		
Distance (m)	48									
$L_p = L_{p@1m} - 20 \cdot \log(r_2/r_1)$	30	22	15	8	1	2	-4	-9	$L_A =$	13

ASHP side/intake (full operation- 1 unit)

Lp at 1m	72	70	69	72	62	58	54	48		
apply correction for typical load	70	68	67	70	60	56	52	46		
Lp at 1m background correction	59	58	52	49	47	41	35	30		
Specific Lp at 1m	69	68	67	70	59	56	52	46		
3 units $10 \cdot \log(3)$	5	5	5	5	5	5	5	5		
Lp predicted 3 unit (intake- worst case	74	73	72	75	64	61	56	51		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Lp predicted 3 unit (intake- worst case	61	57	53	54	40	37	32	27		
Distance (m)	48									
$L_p = L_{p@1m} - 20 \cdot \log(r_2/r_1)$	28	24	20	20	6	3	-1	-6	$L_A =$	19

Level 6 plant room (south)

AHU 06 01

Intake at 1m	70	75	61	52	47	42	38	36		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	70	75	59	51	44	39	36	36		
Screening (PD 1.718)	11	14	17	20	23	24	24	24		
Distance (m)	25									
$L_p = L_{p@1m} - 20 \cdot \log(r_2/r_1)$	30	33	14	3	-7	-12	-16	-16	$L_A =$	18

Exhaust at 1m	67	75	65	58	55	52	46	40		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	67	75	65	58	55	52	45	40		
Screening (PD 1.718)	11	14	17	20	23	24	24	24		
Distance (m)	25									
$L_p = L_{p@1m} - 20 \cdot \log(r_2/r_1)$	27	33	20	10	4	0	-7	-12	$L_A =$	19

Daikin RXY SQ6T8VB9

Lp at 1m	53	54	52	44	41	36	33	32		
4 units $10 \cdot \log(4)$	6	6	6	6	6	6	6	6		
Lp predicted 4 units (worst case)	59	60	58	50	47	42	39	38		
Screening (PD 2.468)	13	16	19	22	24	24	24	24		
Distance (m)	27									
$L_p = L_{p@1m} - 20 \cdot \log(r_2/r_1)$	17	16	10	0	-6	-11	-14	-14	$L_A =$	5

Air cooler unit

Lp at 1m	64	71	70	59	56	51	45	38		
Lp at 1m background correction	56	54	55	45	42	38	33	26		
Specific Lp at 1m	63	71	69	59	55	51	45	38		
2 units 10*log(2)	3	3	3	3	3	3	3	3		
Lp predicted 2 units (worst case)	66	74	72	62	58	54	48	41		
Screening (PD 1.953)	12	15	18	21	24	24	24	24		
Distance (m)	28									
Lp= Lp@1m-20*log(r2/r1)	25	31	26	12	6	1	-5	-12	L _A =	20

Level 7 plant room*AHU 07 01*

Intake Lp at 1m	69	75	60	50	48	44	39	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	69	75	56	50	48	44	39	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	47									
Lp= Lp@1m-20*log(r2/r1)	23	26	4	-5	-9	-13	-18	-21	L _A =	10

Exhaust Lp at 1m	68	74	60	51	49	44	41	41		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	67	74	58	51	49	44	41	41		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	47									
Lp= Lp@1m-20*log(r2/r1)	21	25	6	-4	-8	-13	-16	-16	L _A =	10

Break out at 1m	69	72	61	51	50	46	41	36		
Lp at 1m background correction	61	58	57	56	53	52	50	48		
Specific Lp at 1m	68	72	58	51	50	46	41	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	47									
Lp= Lp@1m-20*log(r2/r1)	22	23	6	-4	-7	-11	-16	-21	L _A =	8

AHU 07 02

Intake Lp at 1m	73	84	65	56	55	49	44	40		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	73	84	65	56	55	49	44	40		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	45									
Lp= Lp@1m-20*log(r2/r1)	27	35	13	1	-2	-8	-13	-17	L _A =	20

Exhaust Lp at 1m	75	83	69	61	56	51	52	54		
Lp at 1m background correction	59	57	57	58	58	57	53	52		
Specific Lp at 1m	75	83	69	58	56	51	52	54		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	45									
Lp= Lp@1m-20*log(r2/r1)	29	34	17	4	-1	-6	-5	-3	L _A =	19

Break out at 1m	66	75	61	54	52	48	41	36		
Lp at 1m background correction	61	58	56	54	52	51	49	48		
Specific Lp at 1m	64	75	60	43	52	48	41	36		
Screening (fully screened)	13	16	18	22	24	24	24	24		
Distance (m)	45									
Lp= Lp@1m-20*log(r2/r1)	18	27	8	-12	-5	-9	-16	-21	L _A =	11

Level 8 plant room*Generators*

Air outlet at 1m (2 units)

Exhaust measured at 1.5m (2 units)

Screening (PD 0.242)

r1

r2

L2

75	77	72	68	62	63	59	55		
6	8	9	12	15	17	20	24		
2	m								
61	m								
36	37	30	24	15	13	6	-1	L _A =	27

Intake at 1.5m (2 units)

Screening (PD 0.242)

r1

r2

L2

Lp (2 x generator)

83	81	78	75	69	73	70	67		
6	8	9	12	15	17	20	24		
2	m								
73	m								
43	40	35	30	21	22	16	10		
44	42	36	31	22	22	16	10	L _A =	33

Break out at 1.5m (2 units)

Screening- fully (take 1/2)

r1

r2

Lp (2 x generator)

Lp generator contributions

72	80	73	71	68	65	59	53		
12	15	18	21	24	24	24	24		
2	m								
65	m								
27	32	22	17	11	8	2	-4	L _A =	21
45	43	37	32	23	23	17	11	L _A =	34

Lp without generators

3dB facade correction

Lp facade

37	41	29	21	12	8	3	0	L _A =	27	Limits		
3	3	3	3	3	3	3	3				Day	Night
40	44	32	24	15	11	6	3	L _A =	30		54	52

Lp with generators

3dB facade correction

Lp facade

45	45	38	32	23	23	17	11	L _A =	35	Limits		
3	3	3	3	3	3	3	3				Day	Night
48	48	41	35	26	26	20	14	L _A =	38		54	52