



TO **Colm Donaghy**
OF Bruntwood
colm.donaghy@bruntwood.co.uk

CC As per email distribution list

FROM **Joseph Hardy**
NO. OF PAGES 12 (with 35 pages of appended documents)

DATE 23 October 2022
FILE REF P3002412(COR)U005

SUBJECT **BASE LCA FIT-OUT**
Review of external plant noise egress

1. Introduction

We are writing to present our review of external plant noise egress in relation to the proposed tenant fit-out of the London College of Accounting (the 'LCA fit-out'), within the existing Base development ('BASE').

The proposed LCA fit-out includes the addition of external noise generating plant items. The purpose of this correspondence is to demonstrate that the LCA Fit-out includes sufficient external plant noise attenuation measures to enable compliance with Local Planning Authority (LPA) noise limits at identified noise sensitive receptors (NSRs).

All advice provided in this correspondence is from an acoustic perspective only.

A glossary of acoustic terms is appended to this correspondence.

2. Background information

2.1 LPA external plant noise limits

In order to comply with LPA noise limits at identified nearest noise sensitive receptors, we understand that the LCA fit-out external plant noise emissions must enable compliance with BASE Planning Condition 18a, which is as follows:

Planning condition 18a

"Prior to occupation of the development a scheme for the acoustic insulation of any externally mounted ancillary equipment to ensure that it achieves a rating level (LAeq) of 5dB below the existing background (LA90) in each octave band at the nearest noise sensitive location shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the equipment.."

BASE is complete and operational. The current external plant noise emission levels (prior to the LCA fit-out) and LPA criteria at identified NSRs have been reported in Stroma Report PRO-062587-AC-3v1 (the 'Stroma Report' –

appended to this correspondence); the Stroma Report was prepared in support of the discharge of BASE Planning Condition 18b. Figures 1, 2 and 3 of this correspondence present relevant extracts from the Stroma Report.

Figure 1: Figure 1 from the Stroma Report, presenting the identified noise sensitive receptors surrounding BASE



Figure 2: Table 1 from the Stroma Report, presenting the LPA external plant noise limits relating to the cumulative operation of all landlord and tenant BASE plant

Table 1: Maximum plant noise limits

NSR	Assessment period	Representative background noise level (dB $L_{A90,7}$)	Rating noise limit (dB $L_{A1,7r}$)
Residential properties on Greenheys Lane	Daytime (07:00-23:00)	48	≤ 43
	Night Time (23:00-07:00)	38	≤ 33
Darul Aman Mosque	Daytime (07:00-23:00)	42	≤ 37
Rutherford House	Daytime (07:00-23:00)	43	≤ 38
Greenheys Technology building	Daytime (07:00-23:00)	45	≤ 40

Figure 3: Table 3 from the Stroma Report, presenting the assessed current external plant noise rating level at BASE (prior to the LCA fit-out)

Table 3: Summary of BS 4142 Assessments

NSR	Assessment period	Assessed BS 4142 Rating Level $L_{A,T,r}$ (dB)	Representative background noise level (dB $L_{A90,T}$)	Difference
Residential properties on Greenheys Lane	Daytime (07:00-23:00)	≤ 35	48	-13
	Night Time (23:00-07:00)		38	-3
Darul Aman Mosque	Daytime (07:00-23:00)	≤ 36	42	-6
Rutherford House	Daytime (07:00-23:00)	≤ 29	43	-14
Greenheys Technology building	Daytime (07:00-23:00)	≤ 32	45	-13

On the basis of the above stated assessed external plant noise levels resulting from the current operation of BASE, additional BASE plant operation to service the LCA Fit-out would need to be limited to the following noise levels, in order to enable compliance with the LPA noise limits applying to the cumulative operation of all landlord and tenant plant forming part of BASE.

Table 1: Proposed external plant noise rating limits for additional BASE plant operation to service the LCA Fit-out (in order to enable compliance with the LPA noise limits applying to the cumulative operation of all landlord and tenant plant forming part of BASE – presented in Figure 2)

NSR	Assessment period	Rating noise limit, $L_{A,T,r}$ (dB)
Residential properties on Greenheys Lane	Daytime (07:00 to 23:00 hours)	42
	Night time (23:00 to 07:00 hours)	23
Darul Aman Mosque	Daytime (07:00 to 23:00 hours)	38
Rutherford House	Daytime (07:00 to 23:00 hours)	37
Greenheys Technology building	Daytime (07:00 to 23:00 hours)	35

2.2 LCA fit-out internal activity noise break-out

We understand the LCA Fit-out comprises of the introduction of general higher education teaching and learning spaces within existing Cat A commercial office space within BASE.

The type of activities that take place in general higher education teaching and learning spaces are not expected to differ significantly in activity noise level from activities that would take place in commercial office space; for this reason, no further assessment of LCA Fit-out internal activity noise break-out is considered necessary, on the basis that BASE has been granted planning permission for commercial office use with no planning conditions associated with commercial office use internal activity noise break-out.

3. LCA Fit-out external plant noise egress assessment

We have undertaken external plant noise egress calculations, using CadnaA noise modelling software, to predict BASE plant noise emissions resulting from additional plant operation required to service the LCA Fit-out.

CadnaA is an internationally recognised software package for calculation and assessment of environmental noise resulting from industrial and traffic sources. From input of calibrated noise sources, topographical data and building locations, a 3D model of an area can be produced. The propagation of noise from user defined sources can then be evaluated, taking into account height data and building locations. Noise levels at specific locations (such as a particular building façade) can then be calculated. The standard outdoor noise propagation model used in the CadnaA program is in accordance with ISO 9613 Parts 1 & 2: 1996 'Attenuation of sound during propagation outdoors'.

3.1 Plant equipment selection and operational assumptions

We understand that the following additional BASE plant operation would be required to service the LCA fit-out:

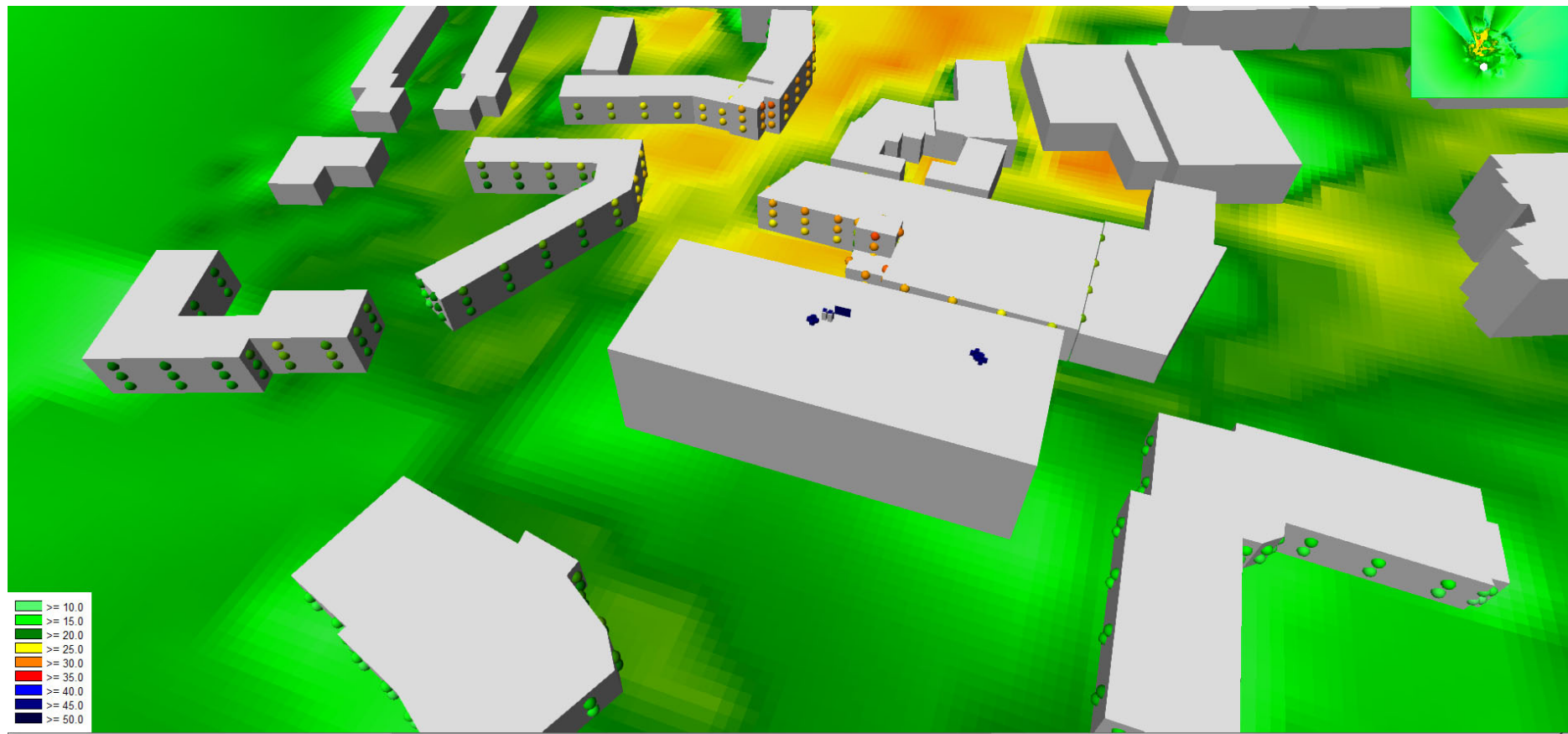
- Addition of 2 no. outdoor VRF units. We understand that both these units can operate in 'low noise mode' (as stated on the appended equipment data sheets) between 23:00 and 07:00 hours.
- Increase in operational duty of AHU 1. We understand this increase in operational duty will not be required between 23:00 and 07:00 hours.
- The introduction of a new extract fan.

All the above plant items are proposed to be located on the roof of BASE. A roof plan indicating the location of these plant items is appended to this correspondence.

Data sheets for the referenced plant equipment and associated duct attenuators (for the ventilation plant) are appended to this correspondence.

A 3D screenshot from the CadnaA model is presented in Figure 4.

Figure 4: Screenshot from CadnaA environmental noise model (blue crosses and blue areas identify modelled plant – not all modelled plant are shown in the image)



4. External plant noise egress assessment results

The predicted plant noise rating levels at the identified noise sensitive receptors are presented in Figure 5, Figure 6 and Table 2 below.

Figure 5: Predicted daytime (07:00 to 23:00 hours) plant noise rating levels ($L_{A,T,r}$, dB) resulting from additional BASE plant operation to service the LCA Fit-out (1.5 metre noise contour grid height; plant noise rating levels stated on the buildings are highest predicted at any building floor level)

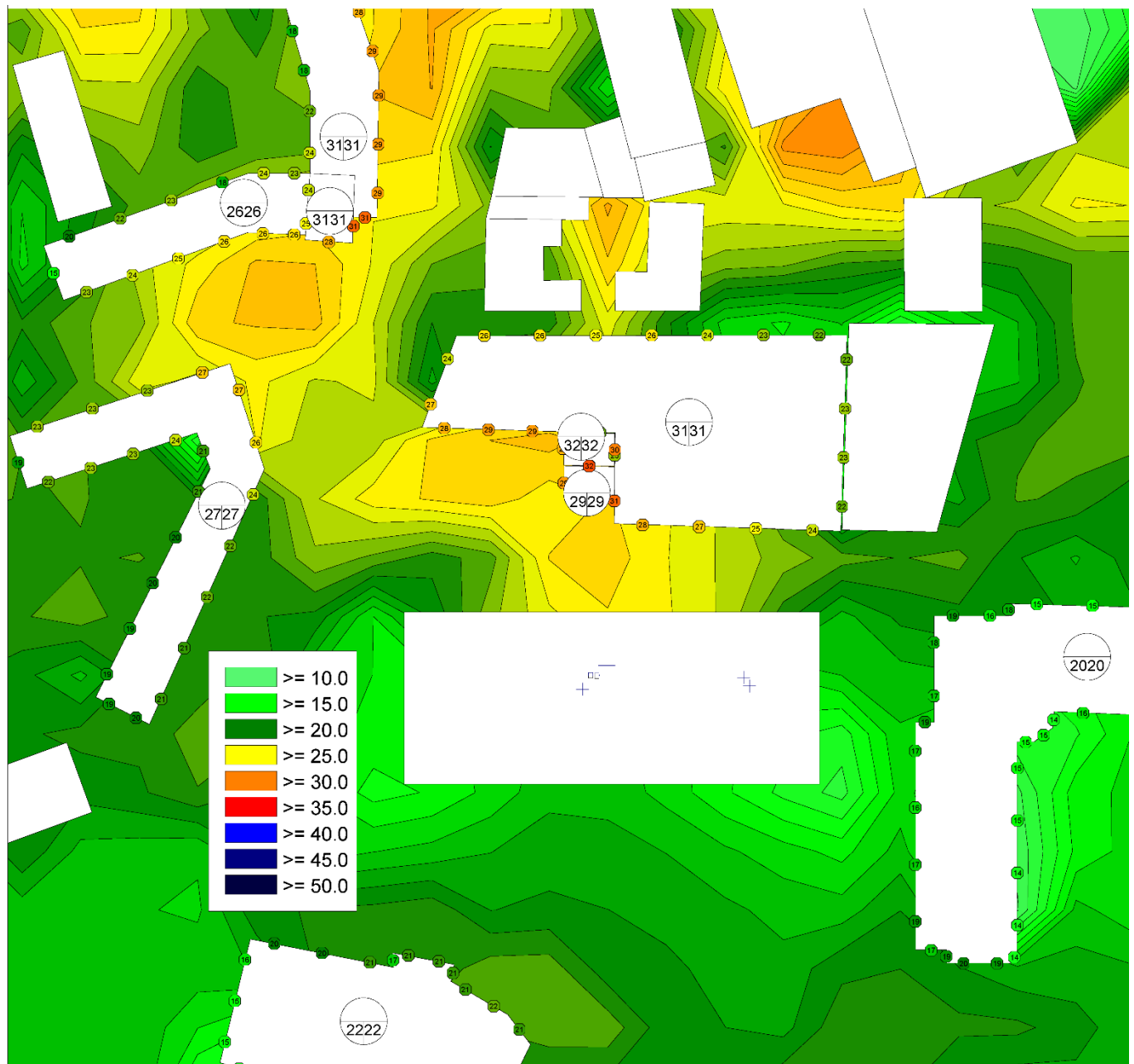


Figure 6: Predicted night time (23:00 to 07:00 hours) plant noise rating levels ($L_{A,T,r}$, dB) resulting from additional BASE plant operation to service the LCA Fit-out (1.5 metre noise contour grid height; plant noise rating levels stated on the buildings are highest predicted at any building floor level)

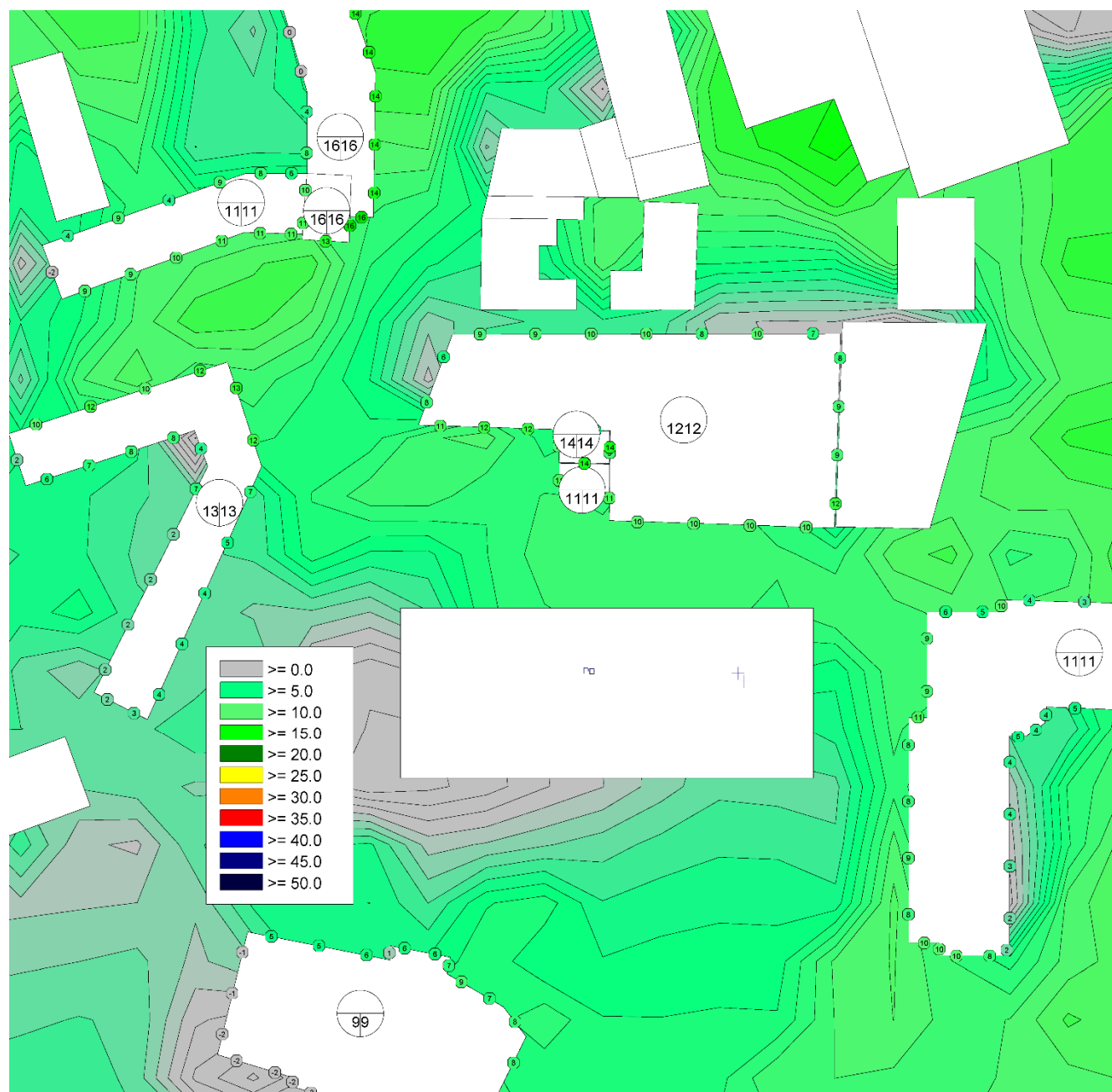


Table 2: Predicted external plant noise rating limits resulting from additional BASE plant operation to service the LCA Fit-out

NSR	Assessment period	Rating noise limit, $L_{A,r,Tr}$ (dB) (refer to Table 1)	Predicted rating noise level, $L_{A,r,Tr}$ (dB)
Residential properties on Greenheys Lane	Daytime (07:00 to 23:00 hours)	42	31
	Night time (23:00 to 07:00 hours)	23	16
Darul Aman Mosque	Daytime (07:00 to 23:00 hours)	38	22
Rutherford House	Daytime (07:00 to 23:00 hours)	37	20
Greenheys Technology building	Daytime (07:00 to 23:00 hours)	35	32

It can be seen from Figure 5, Figure 6 and Table 2 that all predicted plant noise rating levels are below the assessment limits presented in Table 1 of this correspondence.

Our assessment therefore indicates that the LCA Fit-out proposals include sufficient external plant noise attenuation measures to be capable of enabling compliance with the LPA noise limits at the identified NSRs.

5. Summary

- The purpose of this correspondence is to demonstrate that the LCA fit-out includes sufficient external plant noise attenuation measures to enable compliance with LPA noise limits at identified NSRs.
- Assessment noise limits have been proposed related to the additional BASE plant operation required to service the LCA Fit-out, in order to enable compliance with the LPA noise limits applying to the cumulative operation of all landlord and tenant plant forming part of BASE.
- We have undertaken external plant noise egress modelling, using CadnaA noise modelling software, to predict noise resulting from additional BASE plant operation required to service the LCA Fit-out. CadnaA is an internationally recognised software package for calculation and assessment of environmental noise resulting from industrial and traffic sources.
- Our assessment indicates that the LCA Fit-out proposals include sufficient external plant noise attenuation measures to be capable of enabling compliance with the LPA noise limits at the identified NSRs.

FILE REF
DATE

P3002412(COR)U005
23 October 2022

Please do not hesitate to contact us should you have any queries.

Yours sincerely
for BDP Acoustics

A handwritten signature in black ink, appearing to read 'J Hardy', with a horizontal line underneath.

Joseph Hardy
Acoustic Associate
joseph.hardy@bdp.com

Glossary of acoustic terms

A-Weighting

Normal hearing covers the frequency range from approximately 20Hz to 20kHz but sensitivity is greatest between about 500Hz and 8kHz. The “A-Weighting” is an electronic filters network incorporated in sound level meters which approximately corresponds to the frequency response of the ear. The unit of measurement of A-weighted sound level is dBA or dB(A).

Decibel, dB

This is the unit to measure sound. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). We therefore use a logarithmic scale to describe sound pressure level, intensities and sound power levels. Subjectively, an increase of 10 dB corresponds to a doubling in the perceived loudness of sound.

Statistical Level L_{90} or L_{A90}

Sound pressure level that is exceeded for 90% of the measurement time. Consequently it is indicative of the general background noise level in the absence of any higher level short duration events that occur during the period.

Rating Level, $L_{Ar,Tr}$

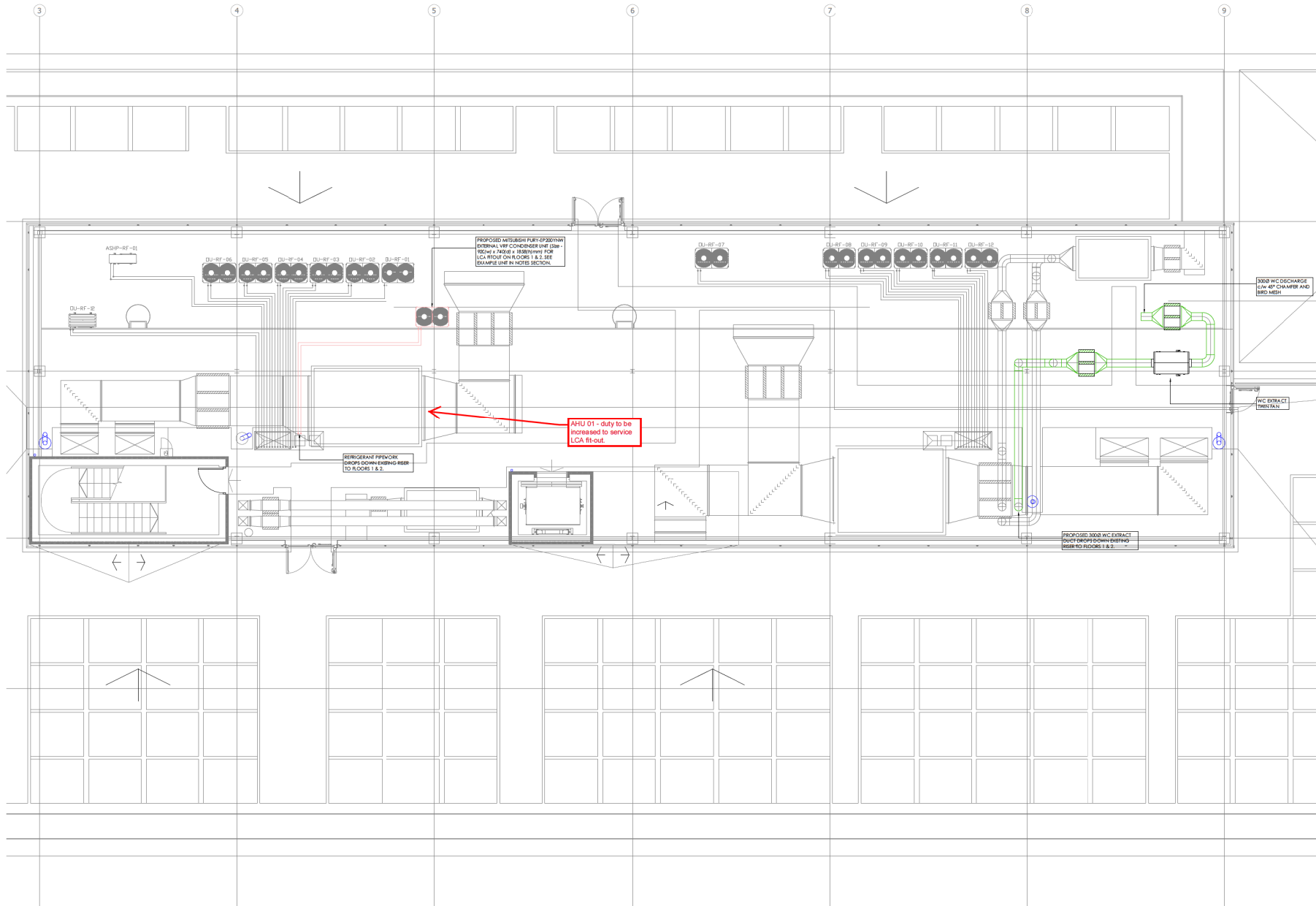
The specific sound level plus any adjustment for the characteristic features of the sound, as described in BS 4142:2014.

FILE REF
DATE

P3002412(COR)U005
23 October 2022

Referenced plant noise data and drawings

Last saved by: PCHAMBERS\2022\04\30 - Last Printed: 2022/04/30
Drawing: C:\Users\p chambers\Documents\Projects\THE BASE - LCA\3813-HEC-ZF-RF-DR-M-0000.DWG



- ### VENTILATION NOTES
1. ALL GENERAL SUPPLY AND EXTRACT DUCTWORK SHALL BE MANUFACTURED AND INSTALLED IN ACCORDANCE WITH THE HVAC SPECIFICATION ON A LOW PRESSURE CLASS A.
 2. ALL DUCTING WITHIN UNHEATED SPACES MUST BE INSULATED IN ACCORDANCE WITH PART F OF BUILDING REGULATIONS.
 3. FLEXIBLE DUCTING HAS BEEN ALLOWED FOR THE FINAL UNIT CORRECTION NO MORE THAN 300mm PER USE SHOULD BE USED AS PER BPEC GUIDANCE.
 4. A MINIMUM OF 300mm IS REQUIRED BETWEEN EACH SPOT OFF THE UNIT AND ANY DUCTWORK FITTING. FLEXIBLE DUCTING SHOULD BE PULLED TAUGHT WITH SMOOTH BENDS ONLY.
 5. BRACKETS INSTALLED IN EVERY 1200MM HORIZONTAL AND 1500MM VERTICAL BRACKETS IN ACCORDANCE WITH BS EN 12236:2002.
 6. ACCESS DOORS FITTED IN ACCORDANCE WITH TR/F3 FOR LEVEL 2.
 7. DUCTWORK PRESSURE TESTING: 5% OF PRIMARY SUPPLY AND EXTRACT DUCTWORK CLASS A PRESSURE CLASSIFICATION IN ACCORDANCE WITH DW14.8 SECONDARY DUCTWORK PRESSURE TESTING FROM FCU IS NOT REQUIRED.
 8. VCSU UP AND INCLUDING 2500mm ABE TO BE SINGLE LEAF DAMPERS. ALL SIZES ABOVE ARE OF MULTI-LEAF ORB TYPE.
 9. SUPPLY AIR TO THE BACK OF THE FCU'S TERMINATE WITHIN 300MM OF THE FCU INTAKE.
 10. ALL CHAS TO BE FITTED WITHIN WALL (CONTRACTOR TO DETERMINE BEST POSITION ON SITE)

VENTILATION LEGEND

SG	— SUPPLY GRILLE	OTG	— DOOR TRANSFER GRILLE
RA	— RETURN AIR	SEA	— GENERAL EXTRACT
GSA	— GENERAL SUPPLY	EDH	— EXHAUST AIR
FA	— FRESH AIR	FCU	— FAN COIL UNIT
VCD	— VOLUME DAMPER	ATT	— ATTIC ACCESS
AD	— ACCESS DAMPER	PFL	— FINISH FLOOR LEVEL
CTA	— CROSS TALK ATT	CL	— CONTINUOUS
IL	— INLET LEVEL	SD	— SET DOWN
SU	— SET UP	TR	— TO RELIEF
FA	— FROM ABOVE	RTA	— RISE TO ABOVE
FB	— FROM BELOW	RL	— RISE TO BELOW
FA	— FROM ABOVE	HL	— HIGH LEVEL
LL	— LOW LEVEL	VS	— VCSU SHUT OFF
VS	— VCSU SHUT OFF	VS	— LOCAL FAN SWITCH

- ### AIR CONDITIONING NOTES
1. ALL REFRIGERANT PIPEWORK SHALL BE REFRIGERANT GRADE COPPER TO BS 2835 PART TWO, CLEANED AND DE-OXYGENATED.
 2. ALL REFRIGERANT PIPEWORK SHALL BE INSULATED WITH CLASS 2 URAMULEX WITH U.V. PROTECTIVE COVERING WHERE EXTERNAL TO THE BUILDING.
 3. INTER UNIT WIRING SHALL RUN ADJACENT TO LIQUID AND SUCTION LINES.
 4. TRIMS OF PLANT SHALL BE IDENTIFIED AND TAGGED WITH TRIM POLYTE LABELS.

- ### HVAC LEGEND
- DENOTES RELOCATED MEP EQUIPMENT
 - DENOTES NEW MEP EQUIPMENT
 - DENOTES EXISTING MEP EQUIPMENT REMAINING (BLACKED OUT)
 - DENOTES PROPOSED SUPPLY VENTILATION FITOUT (GREEN OUTLINE)
 - DENOTES PROPOSED EXTRACT VENTILATION FITOUT (BLUE OUTLINE)



P01	PC	30/09/22	Stage 4a - Preliminary Issue for Comment			
REV	CHW	DATE	DESCRIPTION			
Architectural X-Ref Drawings: E2004_20_100_L						
FF&E X-Ref Drawings:						
Drawing Status: STAGE 4a PRELIMINARY						
 						
 www.hurstwood-eng.co.uk						
<table><tr><td>■ Bolton Office Atkins Barn Road Bolton BL7 9JZ T: 01204 794141 E: bolton@hurstwood-eng.co.uk</td><td>■ Liverpool Office 25 Goodwood Road Liverpool L15 3BE T: 0151 708 3861 E: liverpool@hurstwood-eng.co.uk</td><td>■ London Office 2nd Floor, 100 Broad Street London WC1A 9BS T: 020 7557 7111 E: london@hurstwood-eng.co.uk</td></tr></table>				■ Bolton Office Atkins Barn Road Bolton BL7 9JZ T: 01204 794141 E: bolton@hurstwood-eng.co.uk	■ Liverpool Office 25 Goodwood Road Liverpool L15 3BE T: 0151 708 3861 E: liverpool@hurstwood-eng.co.uk	■ London Office 2nd Floor, 100 Broad Street London WC1A 9BS T: 020 7557 7111 E: london@hurstwood-eng.co.uk
■ Bolton Office Atkins Barn Road Bolton BL7 9JZ T: 01204 794141 E: bolton@hurstwood-eng.co.uk	■ Liverpool Office 25 Goodwood Road Liverpool L15 3BE T: 0151 708 3861 E: liverpool@hurstwood-eng.co.uk	■ London Office 2nd Floor, 100 Broad Street London WC1A 9BS T: 020 7557 7111 E: london@hurstwood-eng.co.uk				
Drawn: L. BIRFA		Checked: F. CHAMBERS	Approved: M. JORDAN			
Date: OCT 2020		Scale: 1:25	A1			
Client: LCA MANCHESTER						
Project: THE BASE - LCA FITOUT						
Drawing Title: HEATING, AIR CONDITIONING & VENTILATION LAYOUT ROOF LEVEL						
Drawing No: C3813-HEC-ZF-RF-DR-M-5000			Rev: P01			

Project

MSP Base Manchester

AHU

bruntwood*AHU-RF-01 - Copy

Size

850 7.90/7.90 m³/s

Sound data (sound power EN13053)

Frequency band	63	125	250	500	1k	2k	4k	8k		Total	
Supply air:										/	
To surroundings	82	82	66	58	51	50	46	41	dB	67	dB(A)
Outdoor air	79	77	70	65	57	51	41	40	dB	67	dB(A)
Supply air	87	91	87	87	83	81	77	77	dB	89	dB(A)
Extract air:											
To surroundings	82	82	67	58	55	53	52	46	dB	68	dB(A)
Extract air	79	79	72	66	64	59	52	51	dB	70	dB(A)
Exhaust air	86	90	87	87	83	80	77	76	dB	89	dB(A)
Total:											
To surroundings	85	85	70	61	56	55	53	47	dB	71	dB(A)

REVERSIBLE HEAT-PUMP THERMOCOOLER HP

Output	Power variant	2V	
	Stepless control		
	No. compressors	2	st
	Refrigerant R410a circuit 1	14.0	kg
		29.23	CO ₂ e (tonnes)
	Refrigerant R410a circuit 2	9.0	kg
		18.79	CO ₂ e (tonnes)
	Min flow	1.98	m³/s
	Max. operating current (400V 3-phase)	66.4	A
	Electrical connection 3 x 400V+N, 50 Hz		

ROTARY HEAT EXCH.

Rotor variant	NE
Rotor diameter	D2

Assume noise data for increased duty of AHU01.

SUMMER CASE

Input	Design outdoor temperature	25.5	°C
	RH outdoor air	40	%
	Supply air temperature	18.0	°C
	Return air temperature	24.0	°C
	Change of humidity in room	0	g/kg
Output	Supply air temp after cooling coil	17.3	°C
	Supply air temp after fan	18.0	°C
	Cooling power	79.2	kW
	Usage rate compressor 63%		
	Available internal cooling load	56.9	kW
	Cooling factor (EER)	5.3	
	Power input	14.9	kW
	Evaporation water	0	l/h

Item	System Reference	Code	Suffix	DWG	L1	L2/ID	W	H/Dia	Vol	PD	Wt	No.		Performance, dB							
37	ATT-MZ-12 MVHR-MZ-03 EXT	SL	GJ	A02G	900		350	200	0.14	30	20	1	IL	2	5	11	24	46	42	36	22
38	ATT-MZ-13 MVHR-MZ-04 DISCH	SL	GJ	A02G	900		500	200	0.24	30	25	1	IL	2	5	11	24	46	42	36	22
39	ATT-MZ-14 MVHR-MZ-04 FAI	SL	GJ	A02G	900		500	200	0.24	30	25	1	IL	2	5	11	24	46	42	36	22
40	ATT-MZ-15 MVHR-MZ-04 SUP	SL	GJ	A02G	1200		500	200	0.24	30	31	1	IL	3	7	14	30	55	53	46	28
41	ATT-MZ-16 MVHR-MZ-04 EXT	SL	GJ	A02G	1200		500	200	0.24	30	31	1	IL	3	7	14	30	55	53	46	28
42	ATT-MZ-17 ASSUMED SUPPLIED BY PLANT MANUFACTURER																				
43	ATT-MZ-18 REFERENCE NOT USED																				
44	ATT-MZ-19 REFERENCE NOT USED																				
45	ATT-MZ-20 REFERENCE NOT USED																				
46	ATT-MZ-21 REFERENCE NOT USED																				
47	ATT-MZ-22 REFERENCE NOT USED																				
48	ATT-MZ-23 ASSUMED SUPPLIED BY PLANT MANUFACTURER																				
49	ATT-MZ-24 ASSUMED SUPPLIED BY PLANT MANUFACTURER																				
50	OMITTED																				
51	OMITTED																				
52	ATT-MZ-27 OFFICE EXTRACT	SL	GJN	A05G	900		800	400	0.612	10	35	1	IL	6	11	18	26	35	30	25	16
53	ATT-MZ-28 OFFICE EXTRACT	SP	GN	A05G	900		500	500	0.468	10	31	1	IL	4	9	16	28	48	42	36	22
54																					
55	ATT-01-01 TO ATT-01-12 OMITTED																				
56	ATT-02-01 TO ATT-02-12 OMITTED																				
57	ATT-03-01 TO ATT-03-12 OMITTED																				
58	ATT-04-01 TO ATT-04-12 OMITTED																				
59																					
60	ATT-RF-01 AHU-RF-01 SUP	SP	G	A02G	1200		1550	700	6.374	50	139	1	IL	8	14	20	27	36	23	19	12
61	ATT-RF-02 AHU-RF-01 EXT	SP	G	A02G	1200		1550	700	6.374	50	139	1	IL	8	14	20	27	36	23	19	12
62	ATT-RF-03 AHU-RF-01 FAI	SP	G	A02G	900		1900	700	6.374	50	138	1	IL	7	11	17	22	30	21	17	11
63	ATT-RF-04 AHU-RF-01 DISCH	SP	G	A02G	900		1900	700	6.374	50	138	1	IL	7	11	17	22	30	21	17	11
64	ATT-RF-05 AHU-RF-02 SUP	SP	G	A02G	1200		1800	700	7.37	50	170	1	IL	8	13	20	25	33	21	17	11
65	ATT-RF-06 AHU-RF-02 EXT	SP	G	A02G	1200		1800	700	7.37	50	170	1	IL	8	13	20	25	33	21	17	11
66	ATT-RF-07 AHU-RF-02 FAI	SP	G	A02G	900		1900	700	7.37	50	138	1	IL	6	10	16	20	27	17	13	9
67	ATT-RF-08 AHU-RF-02 DISCH	SP	G	A02G	900		1900	700	7.37	50	138	1	IL	6	10	16	20	27	17	13	9
68	ATT-RF-09 AHU-RF-03 SUP	SL	GJ	A02G	1200		350	350	0.63	50	32	1	IL	6	12	20	33	44	37	32	19
69	ATT-RF-10 AHU-RF-03 EXT	SL	GJ	A02G	1200		350	350	0.63	50	32	1	IL	6	12	20	33	44	37	32	19
70	ATT-RF-11 AHU-RF-03 FAI	SL	GJ	A02G	900		350	350	0.63	50	25	1	IL	5	9	16	26	37	30	26	16
71	ATT-RF-12 AHU-RF-03 DISCH	SL	GJ	A02G	900		350	350	0.63	50	25	1	IL	5	9	16	26	37	30	26	16
72	ATT-RF-13 AHU-RF-04 SUP	SL	GE	A18G	1200	355	505	410	0.324	20	48	1	IL	8	14	21	29	33	27	22	13
73	ATT-RF-14 AHU-RF-04 EXT	SL	GE	A18G	1200	355	505	410	0.432	20	48	1	IL	8	14	21	29	33	27	22	13

Review with
revised
AHU-01 flow
rates

Hydraulic data										
Required air flow		0.62 m³/s								
Required static pressure		598 Pa								
Working air flow		0.62 m³/s								
Working static pressure		598 Pa								
Air density		1.204 kg/m³								
Power		716.6 W								
Fan control - RPM		2105 rpm								
Current		3.09 A								
SFP		1.149 kW/m³/s								
Control voltage		10.0 V								
Supply voltage		230 V								
Sound power level		63	125	250	500	1k	2k	4k	8k	Total
Inlet	dB(A)	56	68	78	71	64	68	68	63	80
Outlet	dB(A)	56	67	75	69	71	73	72	65	80
Surrounding	dB(A)	40	56	66	62	56	58	57	55	69
Sound pressure level at 3m (20m² Sabine)	dB(A)	-	-	-	-	-	-	-	-	62
Sound pressure level at 3m free field	dB(A)	-	-	-	-	-	-	-	-	48

Accessories

CXE/AVC Modbus (37256)	EC-Basic-CO2 and temperature (24808)
EC-Basic-H humidity (24807)	EC-Basic-T temperature (24805)
EC-Basic-U universal 0-10V (24806)	EC-Selector (9908)
EC-Vent control board (3115)	EC-Vent Room Unit (3018)
MTP 10, 10K, Speed control (32731)	MTV-1/010 Controller 0..10V+ (30650)
Potentiometer MTP 20, 0-10V (310220)	Pressure controller PCA 1000D2 (76739)
Step switch S-5EC, 0-10V (76738)	CO2RT-R-D Transmitter (6993)
HR1 Room Humidistat (215150)	Presence detector/IR24-P (6995)
RT 0-30 Room Thermostat (5151)	ACO8AC/EC ACO Panel IP40 (93042)

Extract fan noise data assumed.

Documents

INSTALLATION OPERATION AND MAINTENANCE INSTRUCTION_KV_DUO_KVK_DUO_KVK_EN_001.PDF
KV DUO 400 EC - ACO EC.PDF

Item	System Reference	Code	Suffix	DWG	L1	L2/ID	W	H/Dia	Vol	PD	Wt	No.		Performance, dB							
					mm	mm	mm	mm	m ³ /s	Pa	kg	Off.		63	125	250	500	1k	2k	4k	8k
1	EXTRACT FAN RETURN	SL	GE	A18G	900	250	400	305	--	--	30	1	IL	6	11	18	26	35	30	25	16
2	EXTRACT FAN EXHAUST	SL	GE	A18G	900	250	400	305	--	--	30	1	IL	6	11	18	26	35	30	25	16

NOTES

LABEL WITH ITEM NO. & SYSTEM REF.

IL = INSERTION LOSS (dB)

E - RECTANGULAR ATTENUATOR SUPPLIED C/W CIRCULAR SPIGOT END CONNECTIONS. SPIGOT SIZE IN L2/D COLUMN ABOVE.

G - SELF FINISH PRE-GALVANISED STEEL CONSTRUCTION.

ATTENUATORS DELIVERED WITH POLYTHENE BLOCKED ENDS

R2 Series VRF

High Efficiency (22.4-45kW)

Simultaneous Heating and Cooling with Heat Recovery Outdoor Unit

CITY MULTI

Delivering outstanding Seasonal Energy Efficiency, the High Efficiency City Multi R2 Heat Recovery system provides simultaneous heating and cooling, with the added benefit of heat recovery.

As the only 2-pipe Heat Recovery system on the market, the modular City Multi R2 range offers huge benefits in terms of ease of installation and maintenance, as well as complete design flexibility.

Ideal for a wide range of applications such as hotels, offices and leisure premises.

Key Features & Benefits:

- High efficiency system delivers outstanding seasonal energy performance
- Heat recovery achieves energy savings of up to 30% over Heat Pump systems
- Provides simultaneous heating and cooling with a high level of thermal comfort
- Unique 2-pipe system for ease of installation and maintenance
- Adjustable noise level options to suit application
- Connectable to a broad choice of indoor unit types and capacities





Assumed VRF unit

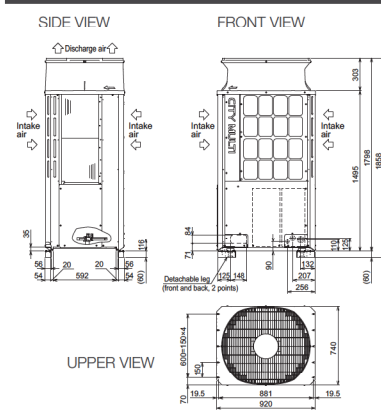


OUTDOOR UNITS

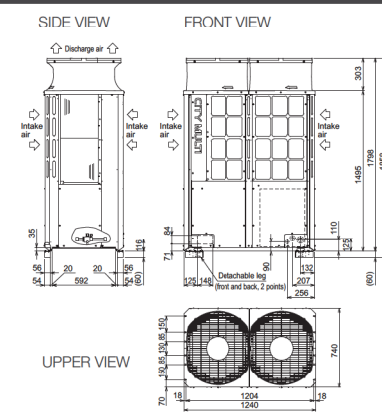
		PURY-EP200YNW-A2	PURY-EP250YNW-A2	PURY-EP300YNW-A2	PURY-EP350YNW-A2	PURY-EP400YNW-A2	PURY-EP400YSNW-A2
CAPACITY (kW)	Heating (nominal)	25.0	31.5	37.5	45.0	50.0	50.0
	Cooling (nominal)	22.4	28.0	33.5	40.0	45.0	44.8
	High Performance Heating (UK)	25.0	31.5	35.6	42.8	45.0	50.0
	COP Priority Heating (UK)	22.8	28.7	34.1	41.0	43.0	45.5
	Cooling (UK)	20.0	25.1	30.0	35.8	40.3	40.1
POWER INPUT (kW)	Heating (nominal)	6.72	9.51	10.90	13.39	16.33	13.85
	Cooling (nominal)	6.38	9.75	11.20	14.23	18.75	13.17
	High Performance Heating (UK)	8.47	11.98	14.50	17.81	18.45	17.73
	COP Priority Heating (UK)	6.72	9.51	10.90	13.39	16.33	13.85
	Cooling (UK)	3.70	5.66	6.50	8.25	12.00	7.64
COP / EER (nominal)		3.72 / 3.51	3.31 / 2.87	3.44 / 2.99	3.36 / 2.81	3.06 / 2.40	3.61 / 3.40
SCOP / SEER		-	-	-	-	-	-
MAX NO. OF CONNECTABLE INDOOR UNITS		20	25	30	35	40	40
MAX CONNECTABLE CAPACITY		50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity	50~150% OU Capacity
AIRFLOW (m³/min)	High	170	185	240	250	315	170 / 170
	Gas	19.05 (3/4")	22.2 (7/8")	22.2 (7/8")	28.58 (1-1/8")	28.58 (1-1/8")	28.58 (1-1/8")
PIPE SIZE mm (in)	Liquid	15.88 (5/8")	19.05 (3/4")	19.05 (3/4")	19.05 (3/4")	22.2 (7/8")	22.2 (7/8")
	Heating / Cooling	59.0 / 59.0	61.0 / 60.5	67.0 / 61.0	64.0 / 62.5	69.0 / 65.0	62.0 / 62.0
SOUND PRESSURE LEVEL (dBA) @ 1m	Heating / Cooling	76.0 / 76.0	60.0 / 78.0	66.0 / 80.0	83.0 / 81.0	88.0 / 83.0	79.0 / 79.0
SOUND POWER LEVEL (dBA) @ 100% CAPACITY	Heating / Cooling	- / 71.0	76.0 / 73.5	78.5 / 74.5	81.0 / 76.0	81.0 / 77.0	- / 74.0
SOUND POWER LEVEL (dBA) @ 90% CAPACITY	Heating / Cooling	- / 66.5	74.5 / 69.5	74.5 / 70.5	77.0 / 73.0	75.0 / 73.0	- / 69.5
WEIGHT (kg)		219	228	230	275	276	219 + 219
DIMENSIONS (mm)	Width	920	920	920	1240	1240	920 + 920
	Depth	740	740	740	740	740	740
	Height	1858	1858	1858	1858	1858	1858
(1798mm without legs)							
ELECTRICAL SUPPLY ¹		380-415V, 50Hz	380-415V, 50Hz	380-415V, 50Hz	380-415V, 50Hz	380-415V, 50Hz	380-415V, 50Hz
PHASE ¹		Three	Three	Three	Three	Three	Three
STARTING CURRENT (A) ¹		8	8	8	8	8	8
NOMINAL SYSTEM RUNNING CURRENT (A) ¹	Heating / Cooling [MAX]	10.7 / 10.2 [16.1]	15.2 / 15.6 [20.3]	17.4 / 17.9 [22.3]	21.4 / 22.8 [24.8]	26.1 / 30.0 [33.3]	22.2 / 21.1 [16.1 + 16.1]
GUARANTEED OPERATING RANGE (°C)	Heating / Cooling	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52	-20~15.5 / -5~52
FUSE RATING (MCB sizes BS EN 60947-2) - (A) ¹		1 x 20	1 x 25	1 x 25	1 x 25	1 x 40	1 x 20 / 1 x 20
MAINS CABLE No. Cores ¹		4 + earth	4 + earth	4 + earth	4 + earth	4 + earth	4 + earth / 4 + earth
CHARGE REFRIGERANT (kg) / CO ₂ EQUIVALENT (T) R410A (GWP 2088)		5.2 / 10.9	5.2 / 10.9	5.2 / 10.9	8 / 16.7	8 / 16.7	10.4 / 21.7
MAX ADDITIONAL REFRIGERANT (KG) / CO ₂ EQUIVALENT (T) R410A (GWP 2088)		28.3 / 59.1	34.3 / 71.6	34.3 / 71.6	39 / 81.4	39 / 81.4	48.6 / 101.5

Notes: ErP Lot 6 calculation method to EN14825. *1 A separate power supply is required for each module. Where more than one figure is quoted there are multiple modules.

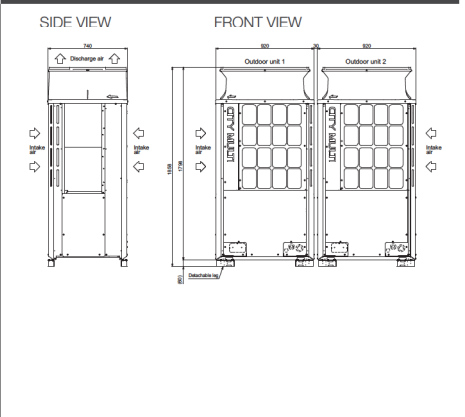
PURY-EP200/250/300YNW-A2 DIMENSIONS



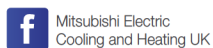
PURY-EP350/400YNW-A2 DIMENSIONS



PURY-EP400YSNW-A2 DIMENSIONS



Telephone: 01707 282880
email: air.conditioning@meeuk.mee.com
les.mitsubishielectric.co.uk



UNITED KINGDOM Mitsubishi Electric Europe Living Environment Systems Division, Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England. Telephone: 01707 282880 Fax: 01707 278881
IRELAND Mitsubishi Electric Europe, Westgate Business Park, Ballymount, Dublin 24, Ireland. Telephone: (01) 419 8800 Fax: (01) 419 8890 International code: (003531)

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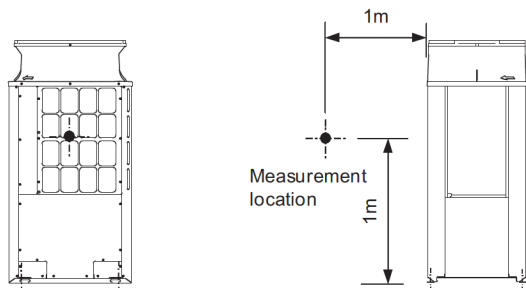
Note: Refer to 'Installation Manual' and 'Instruction Book' for further 'Technical Information'. The fuse rating is for guidance only and please refer to the relevant databook for detailed specification. It is the responsibility of a qualified electrician/electrical engineer to select the correct cable size and fuse rating based on current regulation and site specific conditions. Mitsubishi Electric's air conditioning equipment and heat pump systems contain a fluorinated greenhouse gas, R410A (GWP:2088), R32 (GWP:675), R407C (GWP:1774), R134a (GWP:1430), R513A (GWP:631), R454B (GWP:466), R1234ze (GWP:7) or R1234yf (GWP:4). *These GWP values are based on Regulation (EU) No 517/2014 from IPCC 4th edition. In case of Regulation (EU) No.626/2011 from IPCC 3rd edition, these are as follows: R410A (GWP:1975), R32 (GWP:550), R407C (GWP:1650) or R134a (GWP:1300).

Effective as of August 2022

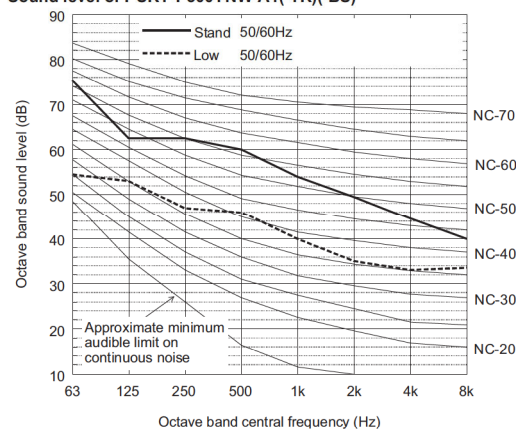


5-1. Sound levels in cooling mode

Measurement condition
PURY-P200, 250, 300YNW-A1(-TR)(-BS)



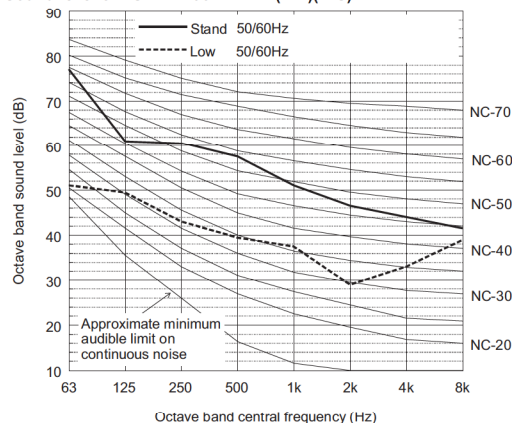
Sound level of PURY-P300YNW-A1(-TR)(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	75.5	62.5	62.5	60.0	54.0	49.5	44.5	40.0	61.0
Low noise mode	50/60Hz	54.5	53.0	47.0	46.0	40.0	35.0	33.0	33.5	47.0

When Low noise mode is set, the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

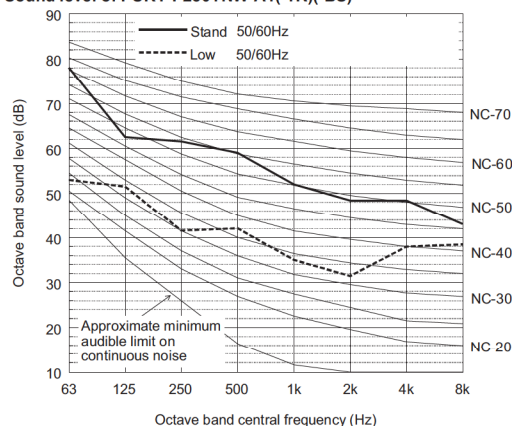
Sound level of PURY-P200YNW-A1(-TR)(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard Cooling	50/60Hz	77.0	61.0	60.5	57.5	51.0	46.5	44.0	41.5	59.0
Low noise mode	50/60Hz	51.0	49.5	43.0	39.5	37.5	29.0	33.0	39.0	44.0

When Low noise mode is set, the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Sound level of PURY-P250YNW-A1(-TR)(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard Cooling	50/60Hz	78.0	62.5	61.5	59.0	52.0	48.5	48.5	43.0	60.5
Low noise mode	50/60Hz	53.0	51.5	41.5	42.0	35.0	31.5	38.0	38.5	45.0

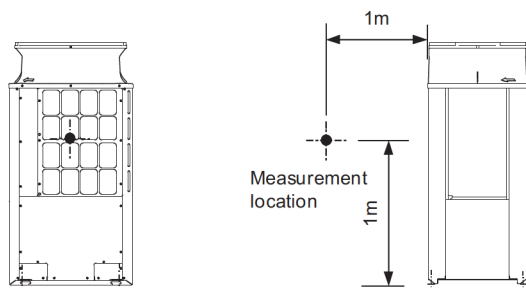
When Low noise mode is set, the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Assumed VRF noise data

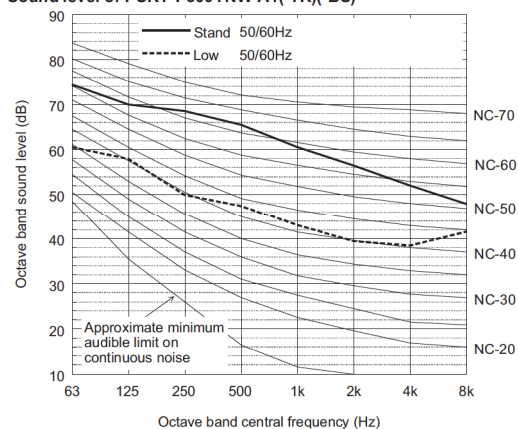
Depending on the operation conditions, the unit generates noise caused by valve actuation, refrigerant flow, and pressure changes when operating normally. Please consider to avoid location where quietness is required. For BC controller, it is recommended to be installed in places such as ceilings of corridor, rest rooms and plant rooms. The sound pressure level measured by the conventional method in JIS for reference purpose.

5-2. Sound levels in heating mode

Measurement condition
 PURY-P200, 250, 300YNW-A1(-TR)(-BS)



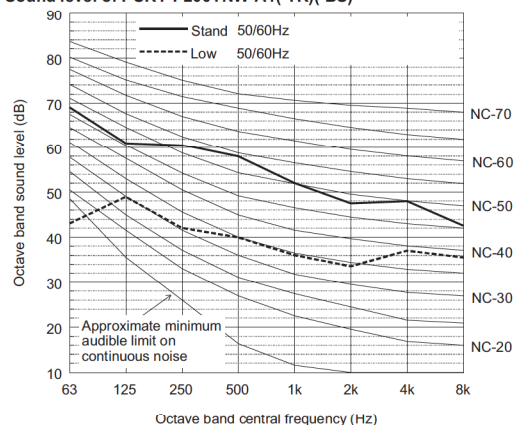
Sound level of PURY-P300YNW-A1(-TR)(-BS)



		63	125	250	500	1k	2k	4k	8k	
Standard Heating	50/60Hz	74.5	70.0	68.5	65.5	60.5	56.5	52.0	48.0	dB(A)
Low noise mode	50/60Hz	60.5	58.0	50.0	47.5	43.0	39.5	38.5	41.5	50.5

When Low noise mode is set, the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

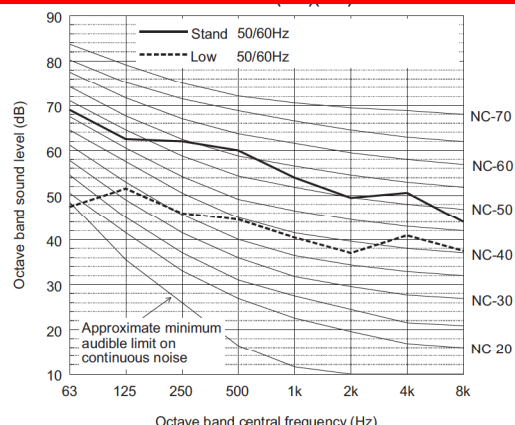
Sound level of PURY-P200YNW-A1(-TR)(-BS)



		63	125	250	500	1k	2k	4k	8k	
Standard Heating	50/60Hz	69.0	61.0	60.5	58.0	52.0	47.5	48.0	42.5	59.0
Low noise mode	50/60Hz	43.0	49.0	42.0	40.0	36.0	33.5	37.0	35.5	44.0

When Low noise mode is set, the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Sound level of PURY-P250YNW-A1(-TR)(-BS)



		63	125	250	500	1k	2k	4k	8k	
Standard Heating	50/60Hz	69.0	62.5	62.0	60.0	54.0	49.5	50.5	44.0	61.0
Low noise mode	50/60Hz	47.5	51.5	46.0	44.5	40.5	37.0	41.0	37.5	48.0

When Low noise mode is set, the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Assumed VRF noise data

• Depending on the operation conditions, the unit generates noise caused by valve actuation, refrigerant flow, and pressure changes when operating normally. Please consider to avoid location where quietness is required. For BC controller, it is recommended to be installed in places such as ceilings of corridor, rest rooms and plant rooms. The sound pressure level measured by the conventional method in JIS for reference purpose.

FILE REF
DATE

P3002412(COR)U005
23 October 2022

Referenced Stroma Report



Building Services Noise Commissioning Measurements

Base Building

Manchester

M15 6LR

Stroma Built Environment Ltd.

SBE Ref: PRO-062587 – AC – 3v1

I. Revision History

Revision	Date	Description		
3v1	04/08/2022	First Issue		
		Compiled By	Authorised By	
		Ben Reed MIOA Senior Acoustic Consultant	Tom Chaffer MIOA Principal Acoustic Consultant	
3v2	13/10/2022	Update to include MCC discussions		
		Compiled By	Authorised By	
		Ben Reed MIOA Senior Acoustic Consultant	Tom Chaffer MIOA Principal Acoustic Consultant	

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II. Executive Summary

Stroma Built Environment (SBE) has been appointed to undertake a building services plant noise impact assessment for the Base Building at Manchester Science Park.

A desktop assessment of noise impact due to operation of building services plant associated with the building has previously been undertaken and summarised in report '*PRO-062587 AC 1v1 External Plant Noise Assessment Base Building Manchester*'. This report has been issued to Manchester City Council planning team in support of discharge of Planning Condition 18.

The report calculates noise rating levels at identified NSR based on manufacturers noise data for all sources of building services plant in line with the methodology set out in BS 4142. The report sets out calculations to demonstrate that the noise rating level for building services plant is at least 5 dB below the site representative sound level during both daytime and night time periods. The report concludes that building services plant meets a BS 4142 assessment of 'low noise impact' and meets the requirements of the first part of Planning Condition 18 set out by Manchester City Council.

To validate the above report, further site measurements of installed and commissioned building services noise have been undertaken.

Based on previous site visits, it was anticipated that noise measurements would likely be affected by road traffic and potentially other noise sources, as measurements to inform the assessment were undertaken in the evening period between 8pm and 10pm.

Building services plant noise associated with the Base Buildings was not audible at any measurement position nor immediately outside the building during the assessment.

A BS 4142 assessment has been undertaken based on site noise measurements. The assessment indicates that operational noise from plant is at least 5 dB below the background sound level during the daytime at all NSRs. The assessment indicates that operational noise from plant is at least 3 dB below the background sound level at the residential properties on Greenheys Lane during the night. This is primarily expected to be due to the effect of other noise sources such as vehicle movements. In addition, the background sound levels which the assessment is based on uses the lowest background sound levels measured between 03:00 and 03:15, which are expected to be much lower than those during the plant night-time operating hours of 06:00-07:00 therefore the difference between plant noise levels and background sound levels during this period are expected to be greater in practice. It is considered that the practical difficulties in isolating plant noise on site amongst other environmental noise sources has limited the assessment as opposed to plant noise levels being above the prescribed limits. As such it should be considered that the requirements of Condition 18 are also met for the night-time.

From the results of the assessment in combination with the subjective assessment of plant inaudibility it is concluded that building services plant associated with the Base Building meets a the requirements of Planning Condition 18.

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1. Introduction

- 1.1 Stroma Built Environment (SBE) has been appointed by Caddick Construction to provide acoustic consultancy services for the Base Building at Manchester Science Park.
- 1.2 The scheme involved the construction of a single building, comprising primarily office space, with ground floor 'Maker Space' and ancillary workshop.
- 1.3 The purpose of this assessment is to assess the noise impact of new sources of building services plant equipment associated with the development upon the existing noise climate at the nearest noise sensitive receptors (NSR).
- 1.4 A desktop assessment of noise impact due to operation of building services plant associated with the building has previously been undertaken and summarised in report '*PRO-062587 AC 1v1 External Plant Noise Assessment Base Building Manchester*'. The report calculates noise rating levels at identified NSRs based on manufacturers noise data for all sources of building services plant in line with the methodology set out in BS 4142. The report sets out calculations to demonstrate that the noise rating level for building services plant is at least 5 dB below the site representative sound level during both daytime and night time periods. The report concludes that building services plant meets a BS 4142 assessment of 'low noise impact' and meets the requirements of the first part of Planning Condition 18 set out by Manchester City Council.
- 1.5 The second part of Condition 18 requires that verification measurements be undertaken of installed and commissioned building services plant on site along with a subjective assessment on noise impact by a suitably qualified acoustic consultant. Condition 18 is set out in full in Section 3 of this report.
- 1.6 This document has been prepared for the sole use, benefit and information of Caddick Construction for the purposes set out in the document or instructions commissioning the works. The liability of SBE in respect of the information contained herein will not extend to any third party.
- 1.7 This report is limited to addressing the specific acoustic issues contained herein and is based on information and drawings provided by the Client.
- 1.8 Whilst every effort has been made to ensure that this report is easy to understand, it is technical in nature. A glossary of terminology is included in Appendix III.

2. Site Baseline Conditions

2.1 The development is located within Manchester Science Park, Greenheys, Manchester. Greenheys Lane borders the site to the west with residential properties beyond that. Commercial buildings generally bound the site to the north and east with Darul Aman Mosque located to the south.

2.2 The closest noise sensitive receptors (NSRs) to the proposed building have been identified per the below list and are highlighted in Figure 1:

- Residential properties on Greenheys Lane to the west;
- Darul Aman Mosque to the south;
- Rutherford House office building to the east; and
- Greenheys Technology building to the north



Figure 1: Site location and noise sensitive receptors

2.3 A baseline noise survey has been undertaken in and around the site previously by BDP in April 2019. Data obtained from the measurements and subsequent calculations were used to establish relevant background noise criteria for noise assessment from building services plant in accordance with the requirements of Condition 18.

2.4 Full details of the measurements conducted by BDP are presented in the BASE, Manchester Environmental Noise Assessment Report (ref. P3000608/(REP)U002) dated August 2019 and are reproduced in Appendix II .

3. Noise Assessment Guidance and Criteria

Planning Requirements

- 3.1 Planning approval was granted for the development by Manchester City Council in January 2020, subject to conditions. Condition 18 is repeated below.

“18) Prior to occupation of the development a scheme for the acoustic insulation of any externally mounted ancillary equipment to ensure that it achieves a rating level (L_{Aeq}) of 5dB below the existing background (L_{A90}) in each octave band at the nearest noise sensitive location shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the equipment.

Upon completion of the development a verification report will be required to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report. The report shall also undertake post completion testing to confirm that the noise criteria has 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 approved scheme shall be implemented prior to occupancy and shall remain operational thereafter.

Reason - To safeguard the amenities of the occupiers of nearby residential accommodation, pursuant to policies SP1 and DM1 of the Core Strategy.”

- 3.2 Based on measured background noise survey data, total emission levels for plant noise, including acoustic feature corrections where applicable, should not exceed the maximum rating level values provided in Table 1.

Table 1: Maximum plant noise limits

NSR	Assessment period	Representative background noise level (dB $L_{A90,T}$)	Rating noise limit (dB $L_{Ar,Tt}$)
Residential properties on Greenheys Lane	Daytime (07:00-23:00)	48	≤ 43
	Night Time (23:00-07:00)	38	≤ 33
Darul Aman Mosque	Daytime (07:00-23:00)	42	≤ 37
Rutherford House	Daytime (07:00-23:00)	43	≤ 38
Greenheys Technology building	Daytime (07:00-23:00)	45	≤ 40

BS 4142:2014 + A1:2019: 'Methods for rating and assessing industrial and commercial sound'

- 3.3 BS 4142 describes a method for assessing the likelihood of complaints from noise sources that are of an industrial nature (e.g. fans, pumps, chillers, air handling units etc.). The assessment methodology is based upon determining a 'rating level' for the equipment being assessed, which is the level of noise from the item or items of plant being assessed (measured as L_{Aeq}).
- 3.4 The rating level is then compared with the underlying background noise level (measured as L_{A90}) in the absence of noise from the item or items of plant being assessed.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
 - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
 - The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
- 3.5 BS 4142 states that a penalty should be added for any plant which gives rise to noise features that may increase disturbance such as tonal, impulsive or intermittent characteristics. With respect to the acoustic feature correction, BS 4142 states:
- "Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."*
- 3.6 A rating penalty for a sound may be based on a subjective assessment of its characteristics or using objective methods to determine tonality.

Consultation with Manchester City Council (MCC)

- 3.7 Consultation discussions were carried out between SBE and Lisa Jones, Environmental Protection Officer at MCC regarding the proposed methodology to discharge Condition 18.
- 3.8 During these discussions MCC agreed generally with SBEs approach and understood the limitations of carrying out these type of verification measurements due to the affects from other noise sources outside of the site. It was agreed that it would be unfeasible to completely remove all other noise sources (e.g. road traffic noise, local businesses) and the proposed methodology to monitor where environmental noise

was likely to be reduced during the evening time would be suitable. It was agreed that the discussion of context in the assessment would be key in combination with subjective commentary on the consultants analysis of audibility whilst on site (see paragraphs 4.11, 4.12 and 4.14).

4. Noise Impact Assessment

- 4.1 A desktop assessment of noise impact due to operation of building services plant associated with the building has previously been undertaken and summarised in report '*PRO-062587 AC 1v1 External Plant Noise Assessment Base Building Manchester*'. This report has been issued to Manchester City Council planning team in support of discharge of Planning Condition 18.
- 4.2 The report calculates noise rating levels at identified NSR based on manufacturers noise data for all sources of building services plant in line with the methodology set out in BS 4142. The report sets out calculations to demonstrate that the noise rating level for building services plant is at least 5 dB below the site representative sound level during both daytime and night time periods. The report concludes that building services plant meets the requirements of the first part of Condition 18 set out by Manchester City Council.
- 4.3 The second part of Condition 18 requires that verification measurements are undertaken to ensure that the above noise levels at receptors are met. Based on SBE's previous experience of similar projects and the practical difficulty in obtaining these measurements a subjective assessment of plant noise by an acoustic consultant to supplement on site measurements is considered suitable to aid assessment which has been acceptable to Manchester City Council on previous projects.
- 4.4 It is understood that building services plant does not operate during the majority of the night time period, however building management systems are automated to turn heating and ventilation systems on at 06:00 hours, which then turn off again at 19:00 hours.
- 4.5 SBE attended site on 28th July 2022 in order to undertake an assessment of plant noise. Based on previous site visits, it was anticipated that noise measurements would likely be affected by road traffic and potentially other noise sources, as measurements to inform the assessment were undertaken in the evening period between 8pm and 10pm to minimise these effects as far as practicable.
- 4.6 Measurements were undertaken at each of the four identified receptors around the site identified in Figure 1. Approximate measurement positions are shown in Figure 2.



Figure 2: Plant noise measurement positions

- 4.7 Noise levels were measured using UKAS calibrated NTi XL2 precision integrating sound level meter. Calibration checks were carried out both before and after the measurements with no significant variance observed. Calibration certificates are available on request. Weather conditions during the survey were dry with wind speeds of less than 5 ms^{-1} . The sound level meter was mounted on a tripod at an approximate height of 1.5 metres and fitted with a proprietary outdoor microphone kit.
- 4.8 Comparative site measurements with plant on and off are summarised in Table 2.

Table 2: Summary of commissioning measurements

Measurement Location	Plant Operation	Start Time	Measurement Duration	Measured Sound Pressure Level	
				dB $L_{Aeq,T}$	dB L_{A90}
ST1	Off	20:03	00:05:00	54	44
	On	21:17		54	42
ST2	Off	20:09		44	41
	On	21:23		41	39
ST3	Off	20:20		50	47
	On	21:35		48	46
ST4	Off	20:31		66	45
	On	21:10		63	45

- 4.9 The noise climate at the time of measurements was controlled primarily by local and distant traffic noise, music and noise from patrons at The Old Abbey Taphouse, birdsong and noise from vehicle at the Darul Aman Mosque car park.
- 4.10 BS4142:2014 states that where the difference between the ambient sound level and residual sound level is ≤ 3 dB, which is the case here, then the specific sound level should be determined by calculation.
- 4.11 Given the steady state nature of the plant and comparatively transient nature of road traffic noise, it is considered suitable to base the assessment with reference to the background sound level. Building services plant noise associated with the building was not audible at any measurement position during the assessment. This subjective assessment of inaudibility implies that the specific noise level of plant is at least 10 dB below the existing background noise level. As such the assessment has been based on noise levels which are 10 dB below the background noise levels for each location.
- 4.12 BS 4142 presents a method to assess the 'specific' noise due to a noise source from comparison of measurements with and without the sound source in operation. An assessment based on the BS 4142 methodology is outlined in Table 3. It is not possible to calculate a rating level in accordance with BS 4142 as the residual noise levels (with plant off) are higher than the ambient noise levels (with plant on). This is an indication that the specific plant noise level does not increase the ambient noise level, and hence it is concluded that the specific plant noise level is at least 10 dB below the measured ambient noise level. The rating level has been calculated by comparison of the background $L_{A90,T}$ measurements with both plant operational and not in operation. Due to the noise climate around the site being heavily influenced by traffic noise, it is considered that the L_{A90} parameter provides a better assessment of steady state underlying plant noise. An example BS 4142 assessment calculation is provided in Appendix I.

Table 3: Summary of BS 4142 Assessments

NSR	Assessment period	Assessed BS 4142 Rating Level $L_{A,r,T,r}$ (dB)	Representative background noise level (dB $L_{A90,T}$)	Difference
Residential properties on Greenheys Lane	Daytime (07:00-23:00)	≤ 35	48	-13
	Night Time (23:00-07:00)		38	-3
Darul Aman Mosque	Daytime (07:00-23:00)	≤ 36	42	-6
Rutherford House	Daytime (07:00-23:00)	≤ 29	43	-14
Greenheys Technology building	Daytime (07:00-23:00)	≤ 32	45	-13

- 4.13 The results of the BS 4142 assessment indicate that the plant noise rating level at the closest NSR is at least 5 dB below the representative pre-construction background noise levels for daytime periods at all receptors. This is a low noise impact in line with BS 4142 assessment.
- 4.14 The night-time assessment shows that the plant noise rating level calculated to be at least 3 dB below the representative background noise level at the residential properties on Greenheys Lane. Based on the subjective assessment of inaudibility and the likelihood of the measurements being driven primarily by other noise sources off site including road traffic, it is considered that the outcome of the assessment for the night-time period is being driven by other noise sources other than plant noise from the building. Additionally, the background sound level used for the night-time noise assessment is based on the lowest measured $L_{A90,T}$ between 03:00 and 03:15 which is expected to be lower than the background sound levels when the plant will actually operate during the final hour of the night-time period (06:00-07:00). It is considered that the practical difficulties in isolating plant noise on site amongst other environmental noise sources has limited the assessment as opposed to plant noise levels being above the prescribed limits. As such it should be considered that the requirements of Condition 18 are also met for the night-time.

5. Conclusions

- 5.1 A plant noise impact assessment has been undertaken for external building services plant associated with the Base Building at Manchester Science Park. The assessment is based on site measurements undertaken on 28th July 2022.
- 5.2 A desktop assessment of noise impact due to the operation of building services plant associated with both schools has previously been undertaken and summarised in report “*PRO-062587 AC 1v1 External Plant Noise Assessment Base Building Manchester*”. This report has been issued to Manchester City Council planning team in support of discharge of planning condition 18.
- 5.3 The report calculates noise rating levels at identified NSR based on manufacturers noise data for all sources of building services plant in line with the methodology set out in BS 4142. The report sets out calculations to demonstrate that the noise rating level for building services plant is at least 5 dB below the site representative sound level during both daytime and night time periods. The report concludes that building services plant meets the requirements of the first part of Condition 18 set out by Manchester City Council.
- 5.4 Based on previous site visits, it was anticipated that noise measurements would likely be affected by road traffic and potentially other noise sources, as measurements to inform the assessment were undertaken in the evening period between 8pm and 10pm.
- 5.5 Building services plant noise associated with the Base Buildings was not audible at any measurement position nor immediately outside the building during the assessment.
- 5.6 A BS 4142 assessment has been undertaken based on site noise measurements. The assessment indicates that operational noise from plant is at least 5 dB below the background sound level during the daytime at all NSRs. The assessment indicates that operational noise from plant is at least 3 dB below the background sound level at the residential properties on Greenheys Lane during the night. This is primarily expected to be due to the effect of other noise sources such as vehicle movements. In addition, the background sound levels which the assessment is based on uses the lowest background sound levels measured between 03:00 and 03:15, which are expected to be much lower than those during the plant night-time operating hours of 06:00-07:00 therefore the difference between plant noise levels and background sound levels during this period are expected to be greater in practice. It is considered that the practical difficulties in isolating plant noise on site amongst other environmental noise sources has limited the assessment as opposed to plant noise levels being above the prescribed limits. As such it should be considered that the requirements of Condition 18 are also met for the night-time.

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- 5.7 From the results of the assessment in combination with the subjective assessment of plant inaudibility it is concluded that building services plant associated with the Base Building meets the requirements of Planning Condition 18.

Appendix I. BS 4142 Assessments

ST4 (Residential properties on Greenheys Lane) Day Time

Measured ambient sound level	$L_{Aeq,T} = 63$ dB	Plant on
Residual sound level	$L_{Aeq,T} = 66$ dB	Plant off
Representative Background sound level	$L_{A90,T} = 48$ dB	Pre construction background level
Specific sound level at measurement position	$L_{Aeq,T} = 35$ dB	Calculated from background sound level (-10 dB)
BS 4142 Rating level	$L_{Ar,Tr} = 35$ dB	No corrections are applied for tonality, impulsivity or other sound characteristics
Excess of rating over background sound level	-13 dB	Indication that specific noise source does not have an adverse impact

ST4 (Residential properties on Greenheys Lane) Night Time

Measured ambient sound level	$L_{Aeq,T} = 63$ dB	Plant on
Residual sound level	$L_{Aeq,T} = 66$ dB	Plant off
Representative Background sound level	$L_{A90,T} = 38$ dB	Pre construction background level
Specific sound level at measurement position	$L_{Aeq,T} = 35$ dB	Calculated from background sound level (-10 dB)
BS 4142 Rating level	$L_{Ar,Tr} = 35$ dB	No corrections are applied for tonality, impulsivity or other sound characteristics
Excess of rating over background sound level	-3 dB	Indication that specific noise source does not have an adverse impact

ST3 (Darul Aman Mosque) Day Time

Measured ambient sound level	$L_{Aeq,T} = 48$ dB	Plant on
Residual sound level	$L_{Aeq,T} = 50$ dB	Plant off
Representative Background sound level	$L_{A90,T} = 42$ dB	Pre construction background level
Specific sound level at measurement position	$L_{Aeq,T} = 36$ dB	Calculated from background sound level (-10 dB)
BS 4142 Rating level	$L_{Ar,Tr} = 36$ dB	No corrections are applied for tonality, impulsivity or other sound characteristics
Excess of rating over background sound level	-6 dB	Indication that specific noise source does not have an adverse impact

ST2 (Rutherford House) Day Time

Measured ambient sound level	$L_{Aeq,T} = 41$ dB	Plant on
Residual sound level	$L_{Aeq,T} = 44$ dB	Plant off
Representative Background sound level	$L_{A90,T} = 43$ dB	Pre construction background level
Specific sound level at measurement position	$L_{Aeq,T} = 29$ dB	Calculated from background sound level (-10 dB)
BS 4142 Rating level	$L_{Ar,Tr} = 29$ dB	No corrections are applied for tonality, impulsivity or other sound characteristics
Excess of rating over background sound level	-14 dB	Indication that specific noise source does not have an adverse impact

ST1 (Greenheys Technology Building) Day Time

Measured ambient sound level	$L_{Aeq,T} = 54$ dB	Plant on
Residual sound level	$L_{Aeq,T} = 54$ dB	Plant off
Representative Background sound level	$L_{A90,T} = 45$ dB	Pre construction background level
Specific sound level at measurement position	$L_{Aeq,T} = 32$ dB	Calculated from background sound level (-10 dB)
BS 4142 Rating level	$L_{Ar,Tr} = 32$ dB	No corrections are applied for tonality, impulsivity or other sound characteristics
Excess of rating over background sound level	-13 dB	Indication that specific noise source does not have an adverse impact

Appendix II. BDP Noise Survey

4.3 Survey Methodology

A series of manned short-term measurements were undertaken by BDP Acoustics at a number of locations on and in the vicinity of the proposed Project site during 'worst-case' daytime, evening and night-time periods.

The approximate measurement positions are presented in Figure 1. Measurement positions were selected in order to:

- Measure worst-case, i.e. noisiest, daytime (0900 – 1120 hours) noise levels at the locations of the proposed building façades in order to establish the noise levels that will impact upon the façades of the proposed building (Positions 1 – 6);
- Provide data representative of the worst-case, i.e. quietest, daytime (1120 – 1300 hours), evening (2200 – 2300 hours) and night-time (0300 – 0400 hours) noise levels at the nearest or most exposed noise sensitive receptors for the purposes of informing environmental plant noise limits to maintain residential amenity (Positions 3 – 5 and 7 – 9).

Weather conditions during the daytime survey were dry with low wind speeds (<2m/s), temperatures varying around 10°C and cloud cover of approximately 10%. Weather conditions during the evening survey were dry with no wind, temperatures of 12°C and 100% cloud cover. Weather conditions during the night-time survey were dry with no wind, temperatures of 8°C and no cloud cover.

The instrumentation used for measurements consisted of 2no. Rion NA-28 sound level meters and 1no. Bruel & Kjaer 2260 sound level meter, which were all calibrated before and after the surveys, with no significant drift in sensitivity observed.

At each position octave band and A-weighted fast response levels were recorded for a comprehensive suite of noise level metrics.

All readings were taken at a height of 1.5m above local ground level in free-field conditions, with the exception of façade measurements taken at Position 1.

Measurements were carried out by Gavin Stevenson MIOA, Dan Forbes AMIOA and Martha Sadler SMIOA.

4.4 Results

A summary of the measured results are presented in Table 2 below.

Table 2: Summary of noise measurement results

Measurement Position	Start Time (dd/mm/yyyy hh:mm)	$L_{Aeq,5mins}$ Range (dB)	$L_{AFmax,5mins}$ Range (dB)	$L_{A90,5mins}$ Range (dB)
1	29/04/2019 09:08	58	64 - 75	56
1	29/04/2019 10:07	52 - 53	62 - 70	43 - 45
2	29/04/2019 09:28	65 - 67	76 - 84	49 - 57
2	29/04/2019 10:31	63 - 64	74 - 77	49 - 50
3	29/04/2019 09:48	52 - 54	65 - 72	45 - 46
3	29/04/2019 10:55	51 - 53	61 - 63	45 - 48
3	29/04/2019 12:00	53 - 54	66 - 72	46 - 47
4	29/04/2019 09:03	48 - 50	56 - 75	46 - 47
4	29/04/2019 10:06	46 - 47	60 - 61	42 - 43
4	29/04/2019 11:21	47 - 49	61 - 65	43 - 44
5	29/04/2019 09:21	46 - 49	52 - 60	44 - 45
5	29/04/2019 10:24	48 - 51	60 - 66	45 - 46
5	29/04/2019 11:38	46 - 47	57 - 67	43 - 44
6	29/04/2019 09:38	46 - 47	54 - 63	42
6	29/04/2019 10:41	48 - 50	60 - 65	41 - 45
7	29/04/2019 11:45	64 - 65	76 - 78	48 - 50
7	30/04/2019 22:03	60 - 63	73 - 77	44 - 46
7	02/05/2019 03:00	47 - 50	66 - 70	38 - 39
8	29/04/2019 12:22	48 - 51	61 - 71	44 - 45
9	30/04/2019 22:27	45 - 46	55 - 61	38 - 39
9	02/05/2019 03:24	40	46 - 53	38

Figure 1: Approximate survey measurement positions



Figure 2: Noise monitoring positions (1 to 9 from top left to bottom right)



Appendix III. Acoustic Glossary

Sound pressure level and the decibel, dB

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. The decibel is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

Frequency and hertz, Hz

Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kilohertz (kHz), where 1 kHz = 1000 Hz. The human range of hearing is commonly accepted to be 20 Hz to 20,000 Hz. Additionally, an octave can be used to describe the interval between a frequency in Hz and either half or double that frequency.

Frequency weighting

Different weighting networks can be applied to a given sound level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The most commonly used weighting network is the 'A' weighting, and the letter 'A' will be included within a descriptor to indicate that the value has been 'A' weighted, e.g. $L_{Aeq,T}$ or L_{A90} . An 'A' weighted noise level may also be written as dB(A). Other weightings less commonly used are 'C' and 'D' weighting.

Noise indices

When a noise level varies with time, the measured 'A' weighted dB level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple 'A' weighted dB value. In order to describe noise where the level is continuously varying, a number of other indices, including statistical parameters, are used. The various indices used are described as below:

$L_{Aeq,T}$	The 'A' weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period, T
L_{Amax}	The maximum 'A' weighted noise level that was recorded during the monitoring period.
L_{A10}	The 'A' weighted noise level that was recorded for at least 10% of the monitoring period.
L_{A90}	The 'A' weighted noise level that was recorded for at least 90% of the monitoring period, usually taken as the underlying 'background' noise level.

Sound level difference, D

The sound level difference between two internal spaces, or between internal and external spaces. The 'D' value is used to denote the differences at each third octave or octave band, with a single figure 'weighted' value to describe an overall performance. Note that the 'D' value will always describe an in-situ or on-site acoustic performance. All values are described using the decibel.

D_w	Single figure weighted sound level difference, simply the measured source noise level minus receiver noise level, not adjusted to reference conditions
$D_{nT,w}$	Weighted normalised sound level difference – a single, weighted sound insulation value, normalised to a reference reverberation time using the measured reverberation time in the receive room
$D_{nT,w} + C_{tr}$	As above, with a spectral adaptation term applied to account for the effects of low frequency noise, and based on urban traffic noise
$D_{nf,w}$	Overall flanking normalised level difference - A parameter that defines the flanking transmission of sound from room to room where a dividing partition or floor construction abuts a flanking building element common to both rooms, such as the building façade or ceiling

Sound reduction index, R

This describes the sound transmitted through a material or building element, such as a wall, door or window. It is measured in a laboratory with suppressed flanking transmission. The 'R' value is used to denote the differences at each third octave or octave band, with a single figure 'weighted' value to describe an overall performance. All values are described using the decibel.

R_w	Weighted single figure sound reduction index
$R_w + C_{tr}$	As above, with a spectral adaptation term applied to account for the effects of low frequency noise, and based on urban traffic noise
R'_w	The 'apparent sound reduction index', a field measurement to obtain the sound reduction index of a material or element, with all effects of site installation accepted.

Noise rating, NR

The noise rating or NR system is commonly used in the design of noise emitted by internal building services systems. The system is frequency dependent, and was empirically derived to prevent disturbance to occupants in habitable or working areas from building services noise that exhibits 'tonal' elements, e.g. rumbles, whines, whistles etc. There is no direct relationship between the average 'A' weighted noise level in dB and the NR. However, as a guide, and assuming the absence of strong low frequency content in a given noise, the NR could generally be said to be 6 dB less than the average 'A' weighted dB value.

Appendix IV. SBE Acoustic Credentials

SBE have specialised in providing the UK Construction Industry with a range of acoustics services since 2006. Specialising in Building Acoustics, all SBE acousticians are members of the Institute of Acoustics.

SBE has been accredited for on-site acoustic testing by United Kingdom Accreditation Service (UKAS) since 2006 (Testing Laboratory Number 2587).

SBE meet the relevant acoustic requirements typically required in the UK, including for sound insulation testing as defined in Approved Document E for the purposes of testing for Part E to the Building Regulations 2010.

This report has been prepared by Ben Reed, Senior Acoustic Consultant who meets the BREEAM requirements for a suitably qualified acoustician (SQA) as follows:

1. Holds an BEng (Hons) Acoustics degree.
2. Has been an Acoustic Consultant since August 2014 and therefore has more than three year's relevant experience (within the last five years). This experience includes a practical understanding of factors affecting acoustics in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures.
3. Holds Corporate Membership of the Institute of Acoustics - MIOA membership.

This report has been read and reviewed and has been found to:

1. Represent sound industry practice.
2. Be appropriate given the building being assessed and scope of works proposed.
3. Avoid invalid, biased and exaggerated recommendations

Appendix V. Report Conditions

This document has been prepared for the sole use, benefit and information of the Client. The liability of Stroma Built Environment Ltd. in respect of the information contained herein will not extend to any third party unless prior agreement is obtained in writing from Stroma Built Environment Ltd.

This report is limited to addressing the specific acoustic issues contained herein. Advice has been provided for acoustic reasons only and it is recommended that appropriate expert advice be sought on all the ramifications, e.g. safety, fire, structural, CDM etc., associated with any proposals contained herein.

The in-situ performance of acoustic measures is influenced to a large extent by the quality of workmanship and compliance with the specifications on-site during construction, as such, Stroma Built Environment Ltd. accepts no liability for issues with acoustic performance arising from such factors.

Acoustic survey and testing work carried out for the project is representative of the prevailing conditions at the time of the work. Conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

In particular, it should be noted that where calculations are carried out that are based on assumptions regarding certain aspects where information has not been supplied, these are provided for indicative purposes only and should be treated as such.