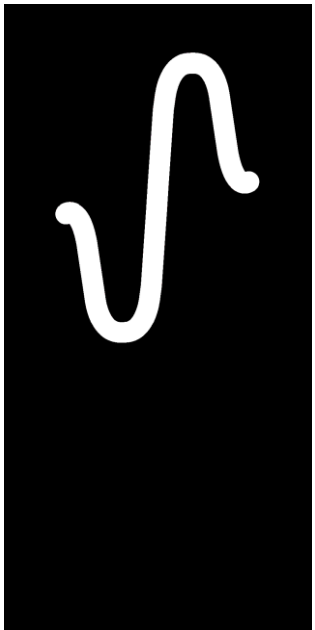
Waterhouse Gardens, Manchester

Plant Noise Assessment Report

Client:
Domis Construction Limited
Douglas House, Green Street
Wigan, WN3 4DQ

Date:
17 July 2025

Our Ref:
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Consultants in acoustics, noise and vibration

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Document Control

Revision	Date	Author	Description
0	13-06-2025	AJ	-
1	17-07-2025	AJ	Appendix B calculation sheets (amending 'night-time' to 'daytime') & addition of Section 10.0 for emergency plant.

This report has been prepared with all reasonable skill, care and diligence for the sole benefit, use and information of the aforementioned Client in accordance with the purposes and terms agreed between ourselves and the Client. The liability of Jameson Acoustics Limited in respect of the information contained within this report will not extend to any third party.

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1.0 Introduction

Jameson Acoustics Limited has been commissioned by Domis Construction Limited to provide an external plant noise assessment in relation to for the Waterhouse Gardens in Manchester. The purpose of the report is to assist in the discharge of Planning Condition 17 as below.

No	Wording
17	Notwithstanding the noise and vibration section of the ES stamped as received by the City Council, as Local Planning Authority, on the 19 January 2018, prior to the first occupation of the residential element and first use of each commercial unit with each phase, details of any externally mounted ancillary plant, equipment and servicing shall be submitted for approval. The approved scheme shall be implemented prior to the first occupation of the residential element and each commercial unit for each phase and thereafter retained and maintained in situ. *Reason - To minimise the impact of plant on the occupants of the development pursuant to policies SP1 and DM1 of the Manchester Core Strategy (2012) and saved policy DC26 of the Unitary Development Plan for the City of Manchester (1995).*

NB: Please refer to Appendix A for a description of the acoustic terminology used herein.

2.0 Plant Summary

The development comprises 6nr blocks (Blocks A-F). Blocks A to E are residential led, with some commercial and amenity spaces at lower floor levels. Block F is speculative commercial (retail) accommodation. The key items of non-emergency building services plant (that will have the potential to emit noise externally) are summarised below.

Landlord Plant

Block	Item	Location
A-E	MVHR units serving apartments	Internal: within apartments with ducted air inlet/outlet to facades over windows
A	2nr condenser units serving residential lobby and comms room	External: within street level compound, adjacent to north elevation
A	Substation	Internal: within plantroom with open louvred doors onto Dutton St
C-D	5nr condenser unit serving spa and Block C & D amenity spaces	External: podium rooftop
C-D	HRU units serving amenity spaces	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet to facades over windows (facing west)
C-D	Extract fan	Internal: ceiling mounted fan with ducted air outlet to façade over windows (facing west)
C-D	Substation	Internal: within plantroom with open louvred doors onto Dutton St
F	HRU units serving spa	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet through Block C & D podium roof
F	AHU serving pool	Internal: within basement plantroom with ducted air inlet/outlet through Block C & D podium roof

Tenant Plant

Block	Item	Location
A	Tenant plant provision	External: within street level compound, adjacent to north elevation
B	2nr tenant plant provisions	Internal: Basement 1 plantroom & Level 0 plantroom in bin store
E	Tenant plant provision	Internal: Level 0 plantroom facing Trinity Way
F	Tenant plant provision	Internal: Level 0 plantroom on the north-west corner of Block E

3.0 Plant Noise Emissions Limits

Based on the Hilson Moran ES chapter, the following plant noise limits shall be achieved by all normal (non-emergency) plant operating concurrently when measured/calculated at 1m from the nearest noise sensitive residential windows. Plant noise shall be assessed in accordance with BS 4142: 2014+A1: 2019.

Location	Maximum Plant Noise Rating Level, $L_{Ar,Tr}$	
	Daytime (07:00-23:00)	Night-time (23:00-07:00)
Existing off-site sensitive receptors	48 dB	43 dB
New dwellings in Blocks A-C	48 dB	43 dB
New dwellings in Blocks D-E	53 dB	40 dB

4.0 Apartment MVHR Units

This assessment considers the MVHR units serving apartments:

Landlord Plant

Block	Item	Location
A-E	MVHR units serving apartments	Internal: within apartments with ducted air inlet/outlet to facades over windows
A	2nr condenser units serving residential lobby and comms room	External: within street level compound, adjacent to north elevation
A	Substation	Internal: within plantroom with open louvred doors onto Dutton St
C-D	5nr condenser unit serving spa and Block C & D amenity spaces	External: podium rooftop
C-D	HRU units serving amenity spaces	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet to facades over windows (facing west)
C-D	Extract fan	Internal: ceiling mounted fan with ducted air outlet to façade over windows (facing west)
C-D	Substation	Internal: within plantroom with open louvred doors onto Dutton St
F	HRU units serving spa	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet through Block C & D podium roof
F	AHU serving pool	Internal: within basement plantroom with ducted air inlet/outlet through Block C & D podium roof

Consideration shall be given to 2nr receptors:

(1) A typical apartment window within the development in the centre of a façade with MVHR inlet/outlet grilles within a circa 10 metre radius – i.e. grilles serving 3nr apartments on the floor above, grilles serving the 2nr apartments each side on the same floor, and grilles serving 3nr apartments on the floor below. Any grilles further away can be discounted (i.e. due to increased distance, they will not influence the cumulative noise from grilles in close proximity).

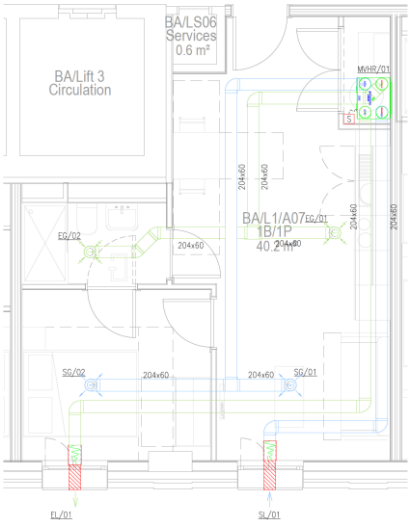
(2) Dutton Arms, directly opposite Block B – again, we shall consider a reasonable number of MVHR grilles in the general proximity to the receptor (i.e. cumulative noise from a grid of 3nr facing apartments x 3nr floor levels = 9nr inlets and 9nr outlets).

The MVHR units are internally mounted per apartment, each with a ducted air inlets and a ducted air outlets tracking through ceiling voids to grilles in the façade above windows. All atmospheric side ducts have attenuators installed.

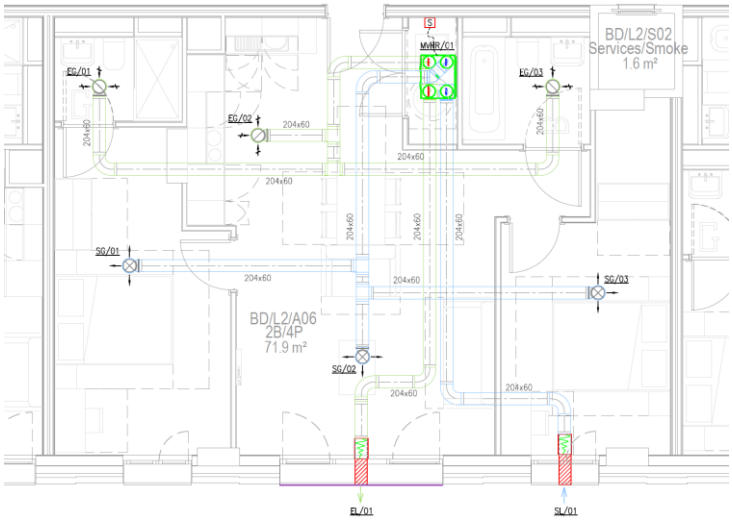
The MVHR units serving all apartments are supplied by Nuaire, model MRXBOX-ECO2 or ECO3. For a worst-case assessment we shall consider that all assessed apartments have the ECO3 (the noisier of the two) and will all run on summer boost mode. The in-duct sound power levels for the air inlet/outlet of the ECO3 operating at summer boost duty are presented below.

Nuaire ECO3	In-Duct Sound Power Level (dB) at OBCF (Hz)						
	63	125	250	500	1k	2k	4k
Inlet – summer boost	61	65	65	52	48	40	30
Outlet – summer boost	72	75	68	66	60	58	48

See below a typical apartment ventilation layout showing how the ductwork runs from the unit (installed within a utility cupboard) through the ceiling void to the façade grille via an in-duct attenuator.



Typical 1-bed vent layout



Typical 2-bed vent layout

Each duct is provided with a 'Verplas' attenuator onto the atmospheric ductwork. This attenuator provides the following insertion losses.

Element	Insertion Loss (dB) at OBCF (Hz)						
	63	125	250	500	1k	2k	4k
Verplas attenuator	0	0	11	12	13	37	23

With losses applied for length of ductwork, bends, the attenuator and end reflection at the grille, the calculation noise level at 1 metre external to each grille is calculated to be:

- **Inlet** – 32 dBA at 1m
- **Outlet** – 42 dBA at 1m

The cumulative calculation of the resultant noise rating level at each receptor is summarised below, with a comparison drawn against the lowest/relevant night-time plant noise limit.

RECEPTOR 1 - WINDOWS OF APTS IN DEVELOPMENT

Description	Apt to L/R		Apt to Above/Below		Apt to diagonal corners	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Source Sound Level (dB)	**32**	**42**	**32**	**42**	**32**	**42**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*2*	*2*	*2*	*2*	*4*	*4*
Correction for Nr of Units (dB)	3	3	3	3	6	6
Distance (m)	*5*	*5*	*3*	*3*	*6*	*6*
Distance Loss (dB)	-14	-14	-10	-10	-16	-16
Directionality ?	*90° H*	*90° H*	*90° V*	*90° V*	*90° V, 45° H*	*90° V, 45° H*
Directionality Correction (dB)	-3	-3	-3	-3	-4	-4
Reflections - Q factor (reference=2)	*2*	*2*	*2*	*2*	*2*	*2*
Directionality/Reflection Correction (dB)	0	0	0	0	0	0
Screening?	*None*	*None*	*None*	*None*	*None*	*None*
Screening Loss (dB)	0	0	0	0	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	18	28	22	32	18	28
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	18	28	22	32	18	28
*10^*	*63*	*631*	*158*	*1585*	*63*	*631*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**35**					
Plant Noise Limit (lowest night-time), $L_{Ar,Tr}$ (dB)	40					
Compliance/Exceedance?	-5					

RECEPTOR 2 - DUTTON ARMS		
Description	**3 x 3 grid of Apts**	
	Inlet	**Outlet**
Source Sound Level (dB)	**32**	**42**
Index	*SPL,1m*	*SPL,1m*
Nr of Units	*9*	*9*
Correction for Nr of Units (dB)	10	10
Mean Distance (m)	*15*	*15*
Distance Loss (dB)	-24	-24
Directionality ?	*on axis*	*on axis*
Directionality Correction (dB)	0	0
Reflections - Q factor (reference=2)	*2*	*2*
Directionality/Reflection Correction (dB)	0	0
Screening?	*None*	*None*
Screening Loss (dB)	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	18	28
Acoustic Feature Correction, re. BS 4142 (dB)	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	18	28
*10^*	*63*	*631*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**28**	
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	43	
Compliance/Exceedance?	**-15**	

The assessment finds that, for both receptors considered, cumulative noise levels from the MVHR inlet/outlet grilles (with units operating at summer boost duty) would achieve the respective night-time plant noise limits.

5.0 Block A Condensers

This assessment considers the 2nr landlord condenser units serving Block A.

Landlord Plant

Block	Item	Location
A-E	MVHR units serving apartments	Internal: within apartments with ducted air inlet/outlet to facades over windows
A	2nr condenser units serving residential lobby and comms room	External: within street level compound, adjacent to north elevation
A	Substation	Internal: within plantroom with open louvred doors onto Dutton St
C-D	5nr condenser unit serving spa and Block C & D amenity spaces	External: podium rooftop
C-D	HRU units serving amenity spaces	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet to facades over windows (facing west)
C-D	Extract fan	Internal: ceiling mounted fan with ducted air outlet to façade over windows (facing west)
C-D	Substation	Internal: within plantroom with open louvred doors onto Dutton St
F	HRU units serving spa	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet through Block C & D podium roof
F	AHU serving pool	Internal: within basement plantroom with ducted air inlet/outlet through Block C & D podium roof

The two condensers are positioned as shown below.



The nearest noise sensitive receptors are windows serving the development in Block A. These windows are set back from the condensers on the north elevation. At lower floors, the condensers will be fully screened by the northern podium up to and including Level 3. At Level 4, the outer condenser will be visible but the condenser nearest the building will still be screened. This nearest condenser would not be visible until you reach Level 8 and above.

We have undertaken calculations of noise levels from the operation of both condensers to windows below Level 3 (full screening), Level 4 (partial screening) and Level 8 (no screening).

The calculations are based on the manufacturer's noise level data of the units operating at 100% duty.

Unit	Index	Sound Level (dB) at OBCF (Hz)							(dB) L_A
		63	125	250	500	1k	2k	4k	
ACC/BA/00/01 Mitsubishi PUZ-ZM100YKA2	SPL @ 1m (cooling)	52	51	49	46	44	40	34	**49**
ACC/BA/00/02 Mitsubishi PUZ-ZM35VKA2	SPL @ 1m (heating)	Not available							**46**

It is anticipated that the spectral curve for the smaller condenser unit would be similar to that of its larger (same model type) counterpart. Based on the spectral curve of the larger unit, no acoustic feature correction for tonality is deemed necessary. The units are new and can be expected to operate with smooth ramp up/down characteristics, meaning no correction for impulsivity or intermittency shall be necessary.

Our calculations of resultant noise rating levels to each receptor are summarised below. Our calculations consider a Q-factor of 8 for canyon effect reflections off Block A and the opposing building.

LEVEL 3 & BELOW

Description	Condensers	
	/01	/02
Source Sound Level (dB)	**49**	**46**
Index	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*1*
Correction for Nr of Units (dB)	0	0
Mean Distance (m)	*11*	*12*
Distance Loss (dB)	-21	-22
Directionality ?	*on axis*	*on axis*
Directionality Correction (dB)	0	0
Reflections - Q factor (reference=2)	*8*	*8*
Directionality/Reflection Correction (dB)	6	6
Screening?	*Full*	*Partial*
Screening Loss (dB)	-9	-5
Specific Noise Level at NSR, L_{Aeq} (dB)	25	25
Acoustic Feature Correction, re. BS 4142 (dB)	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	25	25
*10^*	*316*	*316*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**28**	
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	43	
Compliance/Exceedance?	**-15**	

LEVEL 4-7

Description	Condensers	
	/01	/02
Source Sound Level (dB)	**49**	**46**
Index	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*1*
Correction for Nr of Units (dB)	0	0
Mean Distance (m)	*14*	*14*
Distance Loss (dB)	-23	-23
Directionality ?	*on axis*	*on axis*
Directionality Correction (dB)	0	0
Reflections - Q factor (reference=2)	*8*	*8*
Directionality/Reflection Correction (dB)	6	6
Screening?	*Partial*	*None*
Screening Loss (dB)	-5	0
Specific Noise Level at NSR, L_{Aeq} (dB)	27	29
Acoustic Feature Correction, re. BS 4142 (dB)	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	27	29
*10^*	*501*	*794*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**31**	
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	43	
Compliance/Exceedance?	**-12**	

LEVEL 8+

Description	Condensers	
	/01	/02
Source Sound Level (dB)	**49**	**46**
Index	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*1*
Correction for Nr of Units (dB)	0	0
Mean Distance (m)	*25*	*25*
Distance Loss (dB)	-28	-28
Directionality ?	*on axis*	*on axis*
Directionality Correction (dB)	0	0
Reflections - Q factor (reference=2)	*8*	*8*
Directionality/Reflection Correction (dB)	6	6
Screening?	*None*	*None*
Screening Loss (dB)	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	27	24
Acoustic Feature Correction, re. BS 4142 (dB)	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	27	24
*10^*	*501*	*251*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**29**	
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	43	
Compliance/Exceedance?	**-14**	

The results demonstrate compliance with the night-time plant noise limit with a significant margin of safety (over 10 dB). When considered cumulatively with MVHR noise (Section 4.0), the contribution of the condenser noise would have a negligible effect on the overall noise level to apartment windows, and the plant noise limits would still be achieved.

6.0 Block A Substation

This assessment considers the internal substation in Block A.

Landlord Plant

Block	Item	Location
A-E	MVHR units serving apartments	Internal: within apartments with ducted air inlet/outlet to facades over windows
A	2nr condenser units serving residential lobby and comms room	External: within street level compound, adjacent to north elevation
A	Substation	Internal: within plantroom with open louvred doors onto Dutton St
C-D	5nr condenser unit serving spa and Block C & D amenity spaces	External: podium rooftop
C-D	HRU units serving amenity spaces	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet to facades over windows (facing west)
C-D	Extract fan	Internal: ceiling mounted fan with ducted air outlet to façade over windows (facing west)
C-D	Substation	Internal: within plantroom with open louvred doors onto Dutton St
F	HRU units serving spa	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet through Block C & D podium roof
F	AHU serving pool	Internal: within basement plantroom with ducted air inlet/outlet through Block C & D podium roof

We understand the internal substation plantroom shall house an 800 kVA transformer. Manufacturers noise data for the specified transformers is not available as the equipment is being procured and installed by a third party. In lieu, the following noise level data shall be adopted. These levels are for typical transformer rated at 800 kVA. The data is supplied by Schneider, who are the leading UK supplier of substation transformers. The data sheet is enclosed in Appendix B.

Item	Linear Sound Power Level (dB) at Octave Band Centre Frequency (Hz)							L_W (dBA)
	63	125	250	500	1k	2k	4k	
800kVA Schneider Transformer	51	59	46	42	49	51	37	**55**

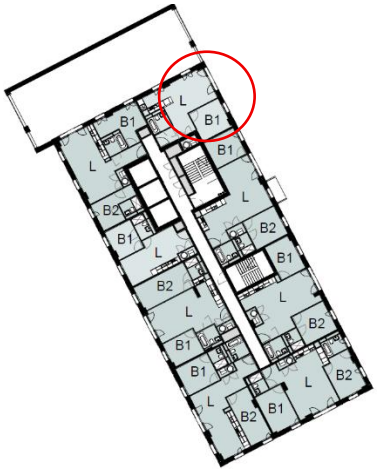
The substation will be housed internally within the building, within a cavity masonry external wall construction. However, natural ventilation louvres for air flow will be provided. Based on the project drawings, the louvres will be provided via the doors which are sized at approx. 2.0 m x 2.2 m. The total free-area of ventilation has been calculated as 2.0 m^2 (approx. 50% of the total door area).

In terms of tonality, the spectral data suggests the unit may exhibit tonal noise characteristics at 125 Hz. Provided the resultant noise rating level falls below the background noise level, this tonality would only be 'just perceptible' meaning a +2 dB correction shall be applied in accordance with BS 4142.

The substation is located to the north-east corner of Block A, as shown below. The nearest noise sensitive receptor will be Level 1 apartment windows on the north east corner of Block A



Level 0 (showing substation location)



Level 1 (showing apartments)

The following tables present our BS 4142 plant noise calculations to the Level 1 apartment closest to the substation. The calculations consider the substations operating at night (2300-0700).

Receptor: Level 1 nearest apartment

Description	Night-time, 2300-0700
	Substation
Sound Power Level, L_{Aw} (dB)	55
Resultant Lp in substation room (dB)	57
Resultant Lp at 1m – breakout through front elevation (dB)	50
No of Units	*1*
No of units correction (dB)	0
Distance (m)	*5*
Distance Loss (dB)	-14
Reflections – Q factor (ref. 2)	*3*
Reflection Correction (dB)	+3
Directionality?	*90deg off axis*
Directionality Correction (dB)	-7
Specific Noise Level at Window, L_{Aeq} (dB)	32
Acoustic Feature Correction, re. BS 4142 (dB)	+2
Noise Rating Level at Window, $L_{Ar,Tr}$ (dB)	**34**
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	*43*
Compliance/exceedance	**-9**

The results demonstrate compliance with the night-time plant noise limit with a significant margin of safety (9 dB). When considered cumulatively with MVHR noise (Section 4.0), the contribution of the substation noise would have a negligible effect on the overall noise level to apartment windows, and the plant noise limits would still be achieved.

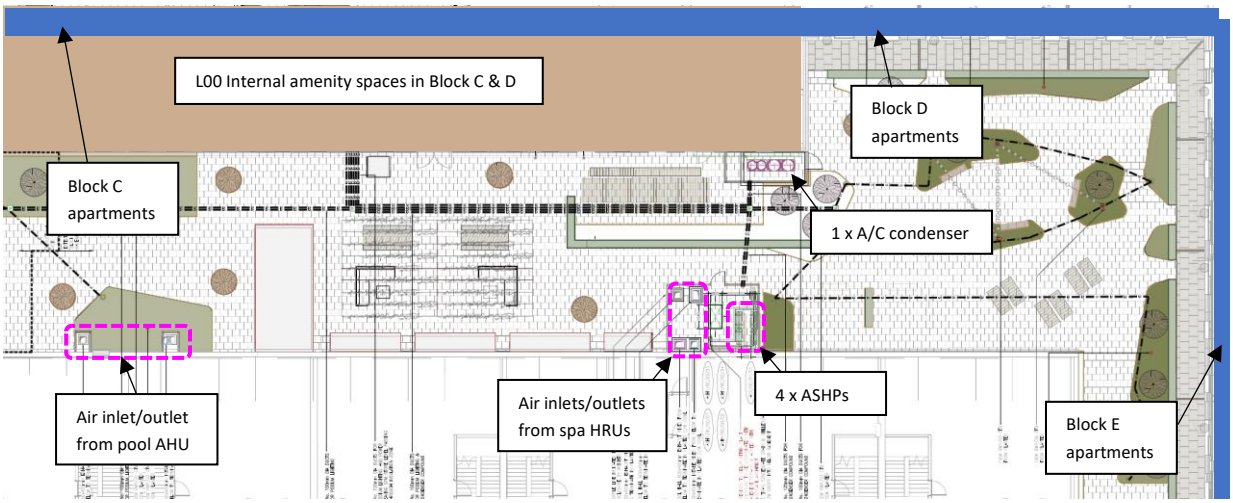
7.0 Block C-D & F Condensers & Air Handling Plant

This assessment considers all condensers and air handling plant which serves the spa/amenity spaces in Block C, D and F.

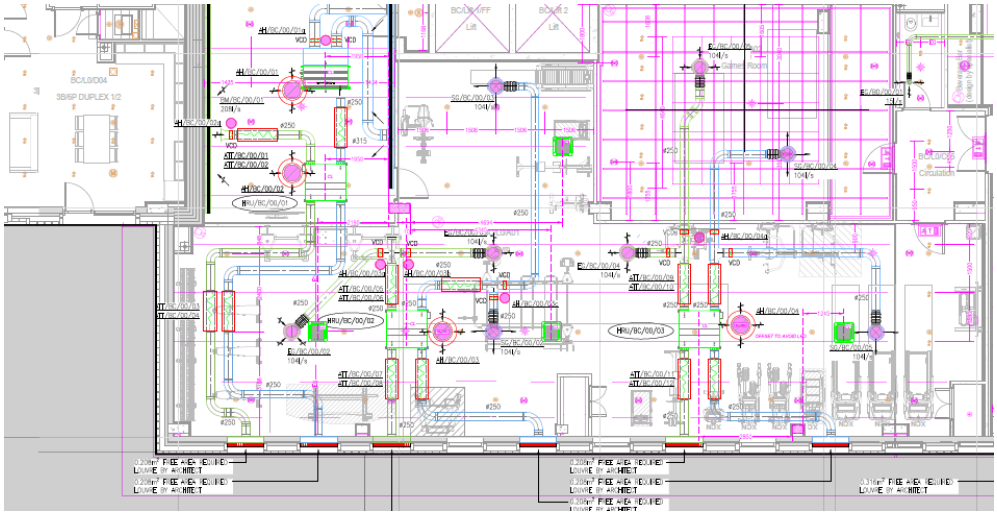
Landlord Plant

Block	Item	Location
A-E	MVHR units serving apartments	Internal: within apartments with ducted air inlet/outlet to facades over windows
A	2nr condenser units serving residential lobby and comms room	External: within street level compound, adjacent to north elevation
A	Substation	Internal: within plantroom with open louvred doors onto Dutton St
C-D	5nr condenser unit serving spa and Block C & D amenity spaces	External: podium rooftop
C-D	HRU units serving amenity spaces	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet to facades over windows (facing west)
C-D	Extract fan	Internal: ceiling mounted fan with ducted air outlet to façade over windows (facing west)
C-D	Substation	Internal: within plantroom with open louvred doors onto Dutton St
F	HRU units serving spa	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet through Block C & D podium roof
F	AHU serving pool	Internal: within basement plantroom with ducted air inlet/outlet through Block C & D podium roof

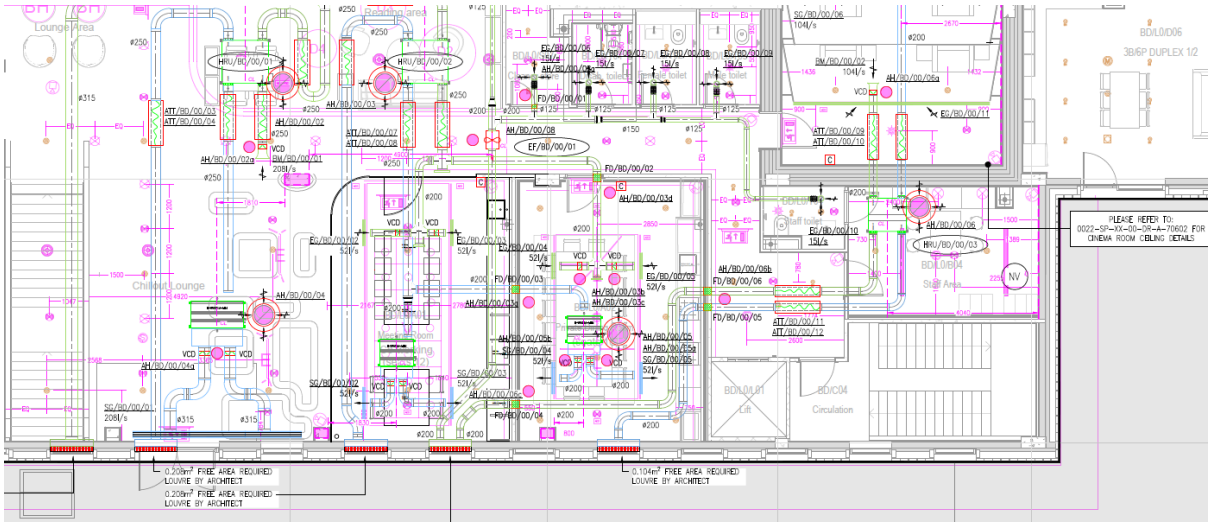
The 5nr condenser units (1nr for A/C, 4nr ASHPs) are located on the podium roof of Block C & D. Air handling equipment serving the spa/pool is located in the basement with atmospheric ducts terminating on the podium roof, as shown below.



The HRUs and extract fan serving the amenity spaces are located internally with inlet/outlet (as applicable) terminating through the west facing elevation of are positioned as shown below (see red boxes on the façade line, these are high level louvres above windows serving each HRU/extract fan).



Block C (left hand side of L00 amenity floor)



Block D (right hand side of L00 amenity floor)

The nearest noise sensitive receptors to the above equipment will apartments facing onto the podium roof within the development. We shall consider apartments in Blocks B, C, D and E, as shown below (plant locations highlighted pink).



Plant showing approximate podium roof plant (pink) and apartments in Blocks B, C, D & E

The calculations are based on the manufacturer's noise level data of the units operating at their relative design (max. normal operation) duty.

Unit	Index	Sound Level (dB) at OBCF (Hz)							(dB) L_A
		63	125	250	500	1k	2k	4k	
A/C Condenser *Mitsubishi PURY-P950YSNW-A2*	SPL @ 1m (100%)	79	70	70	67	61	58	53	**68**
	SPL @ 1m (night)	70	62	58	52	50	47	43	**56**
4 x ASHP *Mitsubishi PUZ-HWM140YHA*	SPL @ 1m	57	57	53	50	47	43	40	**53**
AHU Pool *Heatstar P34369D*	FAI Intake, SWL	69	70	67	68	65	67	65	-
	Exhaust, SWL	72	73	72	73	70	72	69	-
HRU Spa/Amenities Mitsubishi LGH-100RVX	Inlet, SWL	54	51	48	43	38	31	25	-
	Outlet, SWL	61	59	57	52	50	45	38	-
Extract Fan *Nuaire MEVDC* **end corrections added*	Outlet, SWL	60	55	54	48	41	31	28	-

All air handling equipment will have atmospheric side attenuators, and the following insertion loss values have been provided by the installers.

Atmospheric side attenuator – insertion losses

Unit	Length	Insertion Loss (dB) at OBCF (Hz)							(dBA)
		63	125	250	500	1k	2k	4k	
HRUs *(Caice PG01U/1K/L/)*	1215mm	1	2	6	16	24	10	10	-
Extract Fan *(Caice PG01U/1K/L/)*	1215mm	1	2	6	16	24	10	10	-
AHU Pool *(Caice rectangular)*	1200mm	5	11	19	29	36	37	29	-

Based on the above information, the following sound pressure levels at 1m from grilles are calculated for each air handling plant (accounting for in-duct attenuators).

- All HRU inlet (x2) : 23 dBA at 1m (per grille)
- All HRU outlet (x2) : 32 dBA at 1m (per grille)
- Pool AHU inlet : 32 dBA at 1m
- Pool AHU outlet : 38 dBA at 1m
- Extract fan outlet : 29 dBA at 1m

Based on the spectral curves above, no acoustic feature correction for tonality is deemed necessary. The units are new and can be expected to operate with smooth ramp up/down characteristics, meaning no correction for impulsivity or intermittency shall be necessary.

We have undertaken calculations to the nearest apartment windows of Blocks B, C, D and E based on all units operating at full duty (daytime). For night-time, we have considered all units running full duty with the exception of the A/C condenser, which would run on night-mode between 23:00-07:00hr. The services engineers have confirmed this has been programmed into the unit.

Our calculations of resultant noise rating levels to each receptor are provided in Appendix B. A summary of the results is presented below.

Block	Period	Noise Rating Level, $L_{Ar,Tr}$ (dB)	Plant Noise Limit, $L_{Ar,Tr}$ (dB)	Compliance?
B	Day (0700-2300)	38	48	✓
	Night (2300-0700)	28	43	✓
C	Day (0700-2300)	37	48	✓
	Night (2300-0700)	28	43	✓
D	Day (0700-2300)	49	53	✓
	Night (2300-0700)	39	40	✓
E	Day (0700-2300)	47	53	✓
	Night (2300-0700)	36	40	✓

The results demonstrate compliance with the night-time plant noise limit with a significant margin of safety in most cases. For Block D (closest to the A/C condenser) margin is only 1 dB at night-time. When considered cumulatively with MVHR noise (Section 4.0) – which is at worst, 35 dB $L_{Ar,Tr}$ – the combined noise level to Block D apartments would be (35 + 39) = 40 dB $L_{Ar,Tr}$, which is equal to the plant noise limit for Block D apartments.

This demonstrates compliance with the plant noise limits.

8.0 Block C-D Substation

This assessment considers the internal substation in Block C-D.

Landlord Plant

Block	Item	Location
A-E	MVHR units serving apartments	Internal: within apartments with ducted air inlet/outlet to facades over windows
A	2nr condenser units serving residential lobby and comms room	External: within street level compound, adjacent to north elevation
A	Substation	Internal: within plantroom with open louvred doors onto Dutton St
C-D	5nr condenser unit serving spa and Block C & D amenity spaces	External: podium rooftop
C-D	HRU units serving amenity spaces	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet to facades over windows (facing west)
C-D	Extract fan	Internal: ceiling mounted fan with ducted air outlet to façade over windows (facing west)
C-D	Substation	Internal: within plantroom with open louvred doors onto Dutton St
F	HRU units serving spa	Internal: ceiling mounted HRU units per space with ducted air inlet/outlet through Block C & D podium roof
F	AHU serving pool	Internal: within basement plantroom with ducted air inlet/outlet through Block C & D podium roof

We understand the internal substation plantroom shall house 2 x 800 kVA transformers. Manufacturers noise data for the specified transformers is not available as the equipment is being procured and installed by a third party. In lieu, the following noise level data shall be adopted. These levels are for typical transformer rated at 800 kVA. The data is supplied by Schneider, who are the leading UK supplier of substation transformers. The data sheet is enclosed in Appendix B.

Item	Linear Sound Power Level (dB) at Octave Band Centre Frequency (Hz)							L_W (dBA)
	63	125	250	500	1k	2k	4k	
800kVA Schneider Transformer	51	59	46	42	49	51	37	**55**

The substation transformers will be housed internally within the building, within a cavity masonry external wall construction. However, natural ventilation louvres for air flow will be provided. Based on the project drawings, the louvres will be provided via the doors which are sized at approx. 2.0 m x 2.2 m (x 2nr). The total free-area of ventilation has been calculated as 4.0 m^2 (approx. 50% of the total door area).

In terms of tonality, the spectral data suggests the unit may exhibit tonal noise characteristics at 125 Hz. Provided the resultant noise rating level falls below the background noise level, this tonality would only be 'just perceptible' meaning a +2 dB correction shall be applied in accordance with BS 4142.

The substation is located on the east elevation of Block C (ground level), as shown below. The nearest noise sensitive receptor will be Level 1 apartment windows directly above.



Level 0 (showing substation location)



Level 1 (showing apartments)

The following tables present our BS 4142 plant noise calculations to the Level 1 apartment closest to the substation. The calculations consider the substations operating at night (2300-0700).

Receptor: Level 1 nearest apartment

Description	Night-time, 2300-0700
	Substation
Sound Power Level, L_{Aw} (dB)	55
No of Units	*2*
No of units correction (dB)	+3
Resultant Lp in substation room (dB)	60
Resultant Lp at 1m – breakout through front elevation (dB)	53
Distance (m)	*4*
Distance Loss (dB)	-14
Reflections – Q factor (ref. 2)	*3*
Reflection Correction (dB)	+3
Directionality?	*90deg off axis*
Directionality Correction (dB)	-7
Specific Noise Level at Window, L_{Aeq} (dB)	37
Acoustic Feature Correction, re. BS 4142 (dB)	+2
Noise Rating Level at Window, $L_{Ar,Tr}$ (dB)	**39**
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	*43*
Compliance/exceedance	**-4**

The results demonstrate compliance with the night-time plant noise limit with a reasonable margin of safety (4 dB). When considered cumulatively with MVHR noise (Section 4.0) – which is at worst, 35 dB $L_{Ar,Tr}$ – the combined noise level to Block C apartments would be (35 + 39) = 40 dB $L_{Ar,Tr}$, which is 3 dB below the night-time noise limit for Block C apartments.

This demonstrates compliance with the plant noise limits.

9.0 Tenant Plant

It is not possible to assess noise from tenants' plant, as this information is not known. For all commercial units, tenants shall be responsible for assessing plant noise emissions from their own external plant equipment associated with their fit-out. With consideration for the location of tenant plant compounds, the above assessment demonstrates there is sufficient 'head room' to accommodate additional equipment, provided it is appropriately designed/specified/attenuated.

This is secured by means of an appropriate clause in the commercial lease agreements. Clause 13 in particular covers this, but we have provided the wording direct from the AfL document for two acoustic-related clauses below.

Clause 8.2: *The tenant is not to:*

(k) - play any live or recorded music through any medium or to use any machinery in the Property which is audible outside the Property or which causes material vibration either within or outside the Property between the hours of 11.00 pm and 8.00 am;

Clause 13: *The Tenant covenants with the Landlord and the Building Management Company on the terms of this clause 13:*

(13.1)- The Tenant is to comply with all statutes, other legislation and any notice, order, proposal, requisition, direction or other communication from any public authority in respect of the Property, its use and occupation or the carrying out of any works to the Property including the Planning Acts and indemnify the Landlord and the Building Management Company against any breach of this obligation.

10.0 Emergency Plant

Emergency plant on the scheme includes a standby generator (in a ground floor plantroom of Block A) and smoke extract fans on the roof of Blocks A to E.

No emergency plant noise criterion was set in the ES Noise & Vibration Chapter on which planning permission was granted, and there is no specific requirement set out in MCC's planning noise guidance. In lieu, emergency plant was designed to satisfy the following, which has been set and agreed with MCC on other previous large scale schemes (including Viadux).

For life-safety emergency equipment, e.g. smoke extract fans, the noise output during an emergency would be inconsequently provided they do not compromise the audibility of fire alarms in all private/public outdoor spaces. However, maintenance testing of emergency equipment should be schedule for weekday daytime (office) hours only and limited to only brief periods of operation. During these brief periods, a noise limit of 65 dB L_{Aeq} at the nearest on- or off-site residential window would be considered reasonable, which would represent a level not more than +10 dB above the representative daytime ambient noise level across the majority of the site (ca. 12 dB above the representative daytime background noise level).

The generator in Block A is a packaged P165-5 FG Wilson engine with a manufacturer's rated maximum sound pressure level of 75 dBA at 1m at full load (semi-anechoic). Based on measurements of this same specification unit installed inside a plantroom at a similar past project, the following reverberant sound pressure level shall be used in our calculations:

Standby Generator

Source	Sound Pressure Level (dB) at Octave Band Centre Frequency (Hz)							L_p (dBA)
	63	125	250	500	1k	2k	4k	
Plantroom, reverberant (measured)	86	87	84	78	75	70	64	**82**

The external frontage of the generator plantroom contains natural-air louvred panels and double doors for ventilation. The louvres occupy an area of circa 4 m (W) x 2.5 m (H).

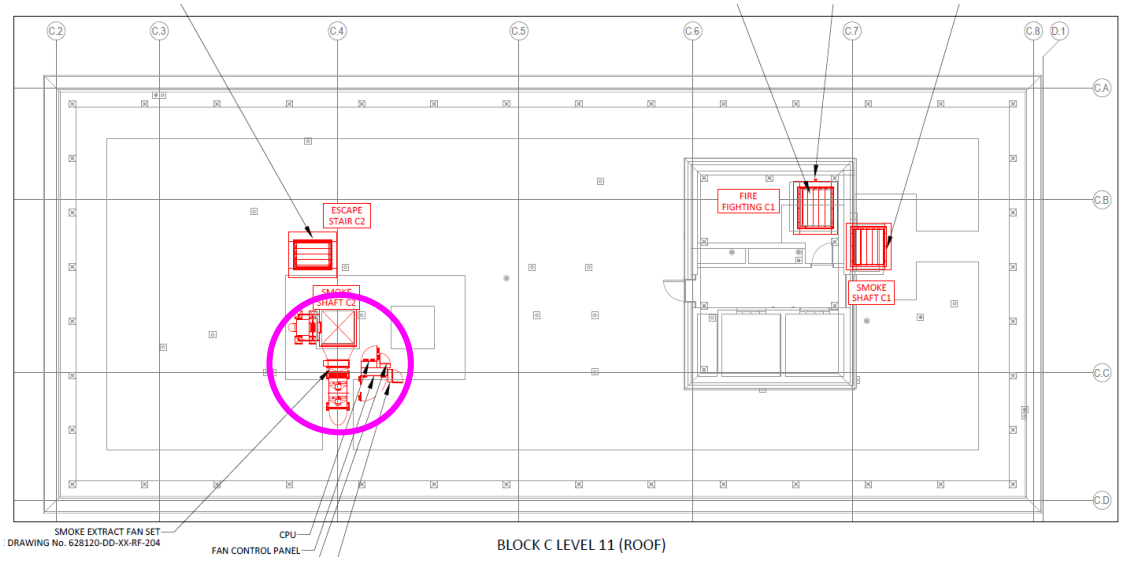
The exhaust flue discharges out of this same elevation. The exhaust system has a residential attenuator associated with the acoustic package which ensures a noise level of not higher than 75 dBA at 1m from the flue outlet.

Based on the above noise data, the following table summarises our calculation of emergency noise breakout to the nearest receptor, which will be residential windows directly above the plantroom (circa 4 metres, 90 degrees off-axis).

Description	Generator	
	Plantroom breakout	Exhaust flue
Lp in plantroom (dB)	82	N/A
Composite SRI of front elevation	-3	N/A
Resultant Lp at 1m external of grille/louvre (dB)	79	75
Distance (m)	*4*	4
Distance Loss (dB)	-12	-12
Reflections – Q factor (ref. 2)	*4*	*4*
Reflection Correction (dB)	6	6
Directionality?	*90deg off*	*90deg off*
Directionality Correction (dB)	-13	-10
Specific Noise Level at Window, L_{Aeq} (dB)	60	59
*10^*	*990558*	*786828*
Cumulative Noise Level at Window, L_{Aeq} (dB)	**62**	
Emergency Plant Noise Limit, LAeq (dB)	*65*	
Compliance/exceedance	-3	

This demonstrates the generator installation complies with the emergency plant noise limit.

For rooftop smoke extract fans, there is a single mechanical smoke extract fan on each block roof (A to E). This fan is supported by natural extract AOVs. A typical example rooftop layout is provided below (this shows Block C).



The following noise data for the fans has been provided by the supplier, 'Vent Engineering' during maintenance test operation (50% duty). NB Each fan is slightly different, but the below represents the noisiest unit.

Item	Sound Power Level (dB) Octave Band Centre Frequency (Hz)						
	63	125	250	500	1k	2k	4k
Inlet (in-duct)	78	71	72	72	73	80	79
Outlet (in-duct)	76	71	72	71	73	79	78
Breakout (casing radiated)	76	66	65	66	65	61	53

The worst-case receptor location will be upper floor apartment windows within the development that overlook an adjacent block's roof space. Each block is a sufficient distance apart that there would be no cumulative effect at any one receptor from all units operating simultaneously. The relative distance between Block B and C (with upper floor Block B windows overlooking the Block C roof) represents the worst-case scenario whereby, for Block B level 12-14 apartments, the Block C fan will be in full view. The closest distance is measured at 16 metres. *NB: Top floor apartments in Block C itself (or any block subject to noise from their own block's fan) benefit from significant screening loss provided by the roof parapet, so these are not the worst-case receptors.*

Based on the above noise data, the equivalent noise level at 1m from the external fan casing and exhaust outlet are calculated to be:

- Casing: 65 dBA at 1m (hemi-spherical)
- Air exhaust: 81 dBA at 1m

The following table summarises our assessment of resultant noise levels at the nearest, most exposed apartment windows (considering Block B Level 12 windows and Block C's rooftop smoke fan).

Description	Smoke Extract	
	Casing	Exhaust
Source Sound Level (dB)	**65**	**81**
Index	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*1*
Correction for Nr of Units (dB)	0	0
Mean Distance (m)	*16*	*16*
Distance Loss (dB)	-24	-24
Directionality ?	*n/a*	*see note*
Directionality Correction (dB)	0	0
Reflections - Q factor (reference=2)	*2*	*2*
Directionality/Reflection Correction (dB)	0	0
Screening?	*None*	*None*
Screening Loss (dB)	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	41	57
*10^*	*12353*	*491768*
Cumul. Noise Level at Receptor, L_{Aeq} (dB)	**57**	
Emergency Plant Noise Limit, LAeq (dB)	65	
Compliance/Exceedance?	**-8**	
Note: assumed on-axis for worst-case assessment		

This demonstrates the smoke fans shall comply with the emergency plant noise limit.

11.0 Conclusions

Jameson Acoustics Limited has been commissioned by Domis Construction Limited to provide an external plant noise assessment in relation to for the Waterhouse Gardens in Manchester. The purpose of the report is to assist in the discharge of Planning Condition 17.

The assessment finds that landlord plant noise emission levels are expected to comply with Manchester City Council's plant noise emission requirements.

The assessment deems there is sufficient 'head room' to accommodate additional tenants' plant without breeching the plant noise limits. For all commercial units, tenants shall be responsible for assessing plant noise emissions from their own external plant equipment associated with their fit-out.

Appendix A – Acoustic Terminology

dB Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form.

dB(A) The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The $_A$ subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted (e.g. $L_{Aeq,T}$ in dB). Noise levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is only just perceptible.

$L_{Aeq,T}$ $L_{Aeq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time measurement period, *T*.

$L_{10,T}$ L_{10} is the noise level exceeded for 10% of the measurement period *T* (i.e. the quietest 10% of the measurement) and has, for many years, been used in the assessment of road traffic noise.

$L_{90,T}$ L_{90} is the noise level exceeded for 90% of the measurement period *T* (i.e. the quietest 10% of the measurement) and is often used to describe the 'background' noise level.

L_{max} L_{max} is the maximum sound pressure level recorded over the measurement period, *T*. L_{max} is often used in assessing scheduled environmental noise 'events' (such as train passbys), particularly at night where such events may cause sleep disturbance.

R_w The weighted sound reduction index, R_w, is a single figure description of sound reduction as defined in BS EN ISO 717-1. It is single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The R_w is calculated from sound insulation measurements taken in an acoustic laboratory. Sound insulation ratings derived from site measurements are invariably lower than the laboratory figures and are referred to as the apparent weighted sound reduction index, R'_w.

$D_{n,e,w}$ The weighted element-normalised level difference, $D_{n,e,w}$, is a single figure description of the sound insulation performance of small building elements, such as a trickle ventilator.

C_{tr} C_{tr} is correction term applied against the sound insulation single-number values (e.g. R_w) to provide a weighting against low frequency performance. The reference values used within the C_{tr} calculation are based on urban traffic noise.

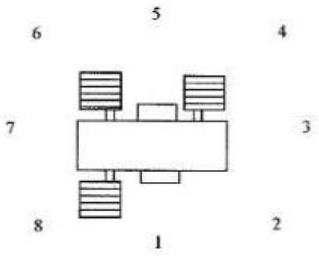
Appendix B – Supporting Documents

Sound Level Measurement

Transformer Rating 800kVA	Serial No 100204736
Transformer Type GM	Location IN THE TEST AREA
Drawing Number LK50295A0	
EDF Spec ES 4-6001	Date of Test 25/05/07
HV Voltage 11000	Tested in Accordance with BS EN 60076-10:2001 / IEC 60076-10:2001
LV Voltage 433	
Tap position 3	
Witness	Customer EDF Energy
Measurement in dB(A)	
	With Breather Cap

Microphone Position	Ambient Before	Measured Level	Ambient After	Octave filter Frequency Hz	Measured value at point 1 (**trf energised)**
1	40.7	42.2	41.9	31.5	57.5
2	40.9	42.2	41.6	62.5	50.5
3	41.8	44.2	41.1	125	59.3
4	41.9	44.7	42.3	250	45.6
5	40.2	44.3	41.0	500	42.4
6	41.9	42.9	41.9	1000	48.6
7	41.6	44.0	41.0	2000	51.4
8	40.6	44.9	40.5	4000	37.2
				8000	31.7
				16000	30.4
Average	41	44	41	A	55.3
Difference		3			
Correction		3			
Corrected	Lpa	41			
height	1.6m	Contour Lm	7.3m	S=1.25hLm = 14.6 m²	
				Lwa = Lpa+10logS	
				= 41 + 12 = 53	
Sound pressure	41 dB(A)	Sound power Level	53 dB(A)	Guaranteed value 55dB(A)	
Tested by [redacted]					

See Drawing LK50295A0 For Plan View



1000kVA Substation Noise Data

Section 7.0 Podium Plant Noise Assessment Calculations

Daytime

Block B

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**68**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*75*	*70*	*35*	*35*	*35*	*35*	*60*	*60*	*60*
Distance Loss (dB)	-38	-37	-31	-31	-31	-31	-36	-36	-36
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*
Directionality Correction (dB)	5	0	-2	-2	-2	-2	-2	-2	-2
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Screening Loss (dB)	0	0	0	0	0	0	0	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	38	22	-1	5	-2	7	-7	2	-6
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	38	22	-1	5	-2	7	-7	2	-6
*10^*	*6310*	*158*	*1*	*3*	*1*	*5*	*0*	*2*	*0*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**38**								
Plant Noise Limit (daytime), $L_{Ar,Tr}$ (dB)	48								
Compliance/Exceedance?	**-10**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Block C

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**68**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*50*	*50*	*20*	*20*	*12*	*12*	*35*	*35*	*35*
Distance Loss (dB)	-34	-34	-26	-26	-22	-22	-31	-31	-31
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*
Directionality Correction (dB)	5	0	-2	-2	-4	-4	-4	-4	-4
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*Partial*	*None*	*None*	*None*	*Full*	*Full*	*Full*	*Full*	*Full*
Screening Loss (dB)	-5	0	0	0	-10	-10	-10	-10	-10
Specific Noise Level at NSR, L_{Aeq} (dB)	37	25	4	10	-5	4	-14	-5	-13
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	37	25	4	10	-5	4	-14	-5	-13
*10^*	*5012*	*316*	*3*	*10*	*0*	*3*	*0*	*0*	*0*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**37**								
Plant Noise Limit (daytime), $L_{Ar,Tr}$ (dB)	48								
Compliance/Exceedance?	**-11**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Block D

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**68**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*12*	*18*	*45*	*45*	*35*	*35*	*12*	*12*	*12*
Distance Loss (dB)	-22	-25	-33	-33	-31	-31	-22	-22	-22
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*
Directionality Correction (dB)	5	0	-2	-2	-4	-4	-4	-4	-4
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*Partial*	*None*	*None*	*None*	*Full*	*Full*	*Full*	*Full*	*Full*
Screening Loss (dB)	-5	0	0	0	-10	-10	-10	-10	-10
Specific Noise Level at NSR, L_{Aeq} (dB)	49	34	-3	3	-14	-5	-5	4	-4
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	49	34	-3	3	-14	-5	-5	4	-4
*10^*	*79433*	*2512*	*1*	*2*	*0*	*0*	*0*	*3*	*0*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**49**								
Plant Noise Limit (daytime), $L_{Ar,Tr}$ (dB)	53								
Compliance/Exceedance?	**-4**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Block E

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**68**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*28*	*30*	*65*	*65*	*70*	*70*	*45*	*45*	*45*
Distance Loss (dB)	-29	-30	-36	-36	-37	-37	-33	-33	-33
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*
Directionality Correction (dB)	5	0	-2	-2	-2	-2	-2	-2	-2
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Screening Loss (dB)	0	0	0	0	0	0	0	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	47	29	-6	0	-8	1	-4	5	-3
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	47	29	-6	0	-8	1	-4	5	-3
*10^*	*50119*	*794*	*0*	*1*	*0*	*1*	*0*	*3*	*1*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**47**								
Plant Noise Limit (daytime), $L_{Ar,Tr}$ (dB)	53								
Compliance/Exceedance?	**-6**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Night-time

Block B

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**56**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*75*	*70*	*35*	*35*	*35*	*35*	*60*	*60*	*60*
Distance Loss (dB)	-38	-37	-31	-31	-31	-31	-36	-36	-36
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*
Directionality Correction (dB)	5	0	-2	-2	-2	-2	-2	-2	-2
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Screening Loss (dB)	0	0	0	0	0	0	0	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	26	22	-1	5	-2	7	-7	2	-6
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	26	22	-1	5	-2	7	-7	2	-6
*10^*	*398*	*158*	*1*	*3*	*1*	*5*	*0*	*2*	*0*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**28**								
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	43								
Compliance/Exceedance?	**-15**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Block C

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**56**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*50*	*50*	*20*	*20*	*12*	*12*	*35*	*35*	*35*
Distance Loss (dB)	-34	-34	-26	-26	-22	-22	-31	-31	-31
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*
Directionality Correction (dB)	5	0	-2	-2	-4	-4	-4	-4	-4
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*Partial*	*None*	*None*	*None*	*Full*	*Full*	*Full*	*Full*	*Full*
Screening Loss (dB)	-5	0	0	0	-10	-10	-10	-10	-10
Specific Noise Level at NSR, L_{Aeq} (dB)	25	25	4	10	-5	4	-14	-5	-13
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	25	25	4	10	-5	4	-14	-5	-13
*10^*	*316*	*316*	*3*	*10*	*0*	*3*	*0*	*0*	*0*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**28**								
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	43								
Compliance/Exceedance?	**-15**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Block D

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**56**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*12*	*18*	*45*	*45*	*35*	*35*	*12*	*12*	*12*
Distance Loss (dB)	-22	-25	-33	-33	-31	-31	-22	-22	-22
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*	*>90deg off*
Directionality Correction (dB)	5	0	-2	-2	-4	-4	-4	-4	-4
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*Partial*	*None*	*None*	*None*	*Full*	*Full*	*Full*	*Full*	*Full*
Screening Loss (dB)	-5	0	0	0	-10	-10	-10	-10	-10
Specific Noise Level at NSR, L_{Aeq} (dB)	37	34	-3	3	-14	-5	-5	4	-4
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	37	34	-3	3	-14	-5	-5	4	-4
*10^*	*5012*	*2512*	*1*	*2*	*0*	*0*	*0*	*3*	*0*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**39**								
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	40								
Compliance/Exceedance?	**-1**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.

Block E

Description	A/C Con	ASHPs	Pool AHU		HRUs Block C		HRUs Block D		Ext. Fan
			Inlet	Outlet	Inlet	Outlet	Inlet	Outlet	
Source Sound Level (dB)	**56**	**53**	**32**	**38**	**23**	**32**	**23**	**32**	**29**
Index	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*	*SPL,1m*
Nr of Units	*1*	*4*	*1*	*1*	*3*	*3*	*3*	*3*	*1*
Correction for Nr of Units (dB)	0	6	0	0	5	5	5	5	0
Mean Distance (m)	*28*	*30*	*65*	*65*	*70*	*70*	*45*	*45*	*45*
Distance Loss (dB)	-29	-30	-36	-36	-37	-37	-33	-33	-33
Directionality ?	**see note*	*n/a*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*	*45deg off*
Directionality Correction (dB)	5	0	-2	-2	-2	-2	-2	-2	-2
Reflections - Q factor (reference=2)	*4*	*2*	*2*	*2*	*4*	*4*	*4*	*4*	*4*
Directionality/Reflection Correction (dB)	3	0	0	0	3	3	3	3	3
Screening?	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*	*None*
Screening Loss (dB)	0	0	0	0	0	0	0	0	0
Specific Noise Level at NSR, L_{Aeq} (dB)	35	29	-6	0	-8	1	-4	5	-3
Acoustic Feature Correction, re. BS 4142 (dB)	0	0	0	0	0	0	0	0	0
Noise Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	35	29	-6	0	-8	1	-4	5	-3
*10^*	*3162*	*794*	*0*	*1*	*0*	*1*	*0*	*3*	*1*
Cumul. Rating Level at Receptor, $L_{Ar,Tr}$ (dB)	**36**								
Plant Noise Limit (night-time), $L_{Ar,Tr}$ (dB)	40								
Compliance/Exceedance?	**-4**								

*SPL measured at side of unit. Unit is top discharge. Apartments look down onto unit, therefore +5dB correction applied for increased noise from top discharge fans.