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Bowmer & Kirkland Ltd | St Michaels, Manchester

63068-MAI-ZZ-RP-Y-0300

Plant Noise Acoustics Report

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VERSION CONTROL

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Introduction



1.0 INTRODUCTION

A new build detached 10 storey office building with ground floor retail units and rooftop bar/restaurant unit is proposed for Phase 1 of the St Michael's mixed-use development in Manchester city centre. The 1st to 9th floor levels are speculative open plan office spaces to be finished to Cat A fit-out standards (excluding suspended ceilings). In addition, the existing former Police station is to be refurbished to form additional office space. The following subjects have been reviewed in this report:

- Atmospheric plant noise emissions.

This report summarises the acoustic requirements and reviews the current design proposals for the development.

Atmospheric Plant Noise Emissions

A photograph of a modern building featuring a large, lush vertical garden wall. The wall is covered in dense green foliage, including various leafy plants and ferns. Below the garden, there is a curved glass facade that reflects the surrounding environment. The building is situated in an urban setting, with a street lamp visible on the right side. The overall scene is bright and vibrant, with a mix of green and grey tones.

2.0 ATMOSPHERIC PLANT NOISE EMISSIONS

2.1 Requirements

The requirements of BREEAM 2018 section Pol 05 state that plant noise levels must be at least 5dB lower than the background noise throughout the day and night at the nearest noise sensitive development.

With regards to atmospheric plant noise emissions from proposed plant items Manchester City Council (MCC) have imposed the following condition.

"34. Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a noise level of 5dB below the existing background (LA90) in each octave band at the nearest noise sensitive location.

The scheme should be submitted to and approved in writing by the City Council as local planning authority prior to the first occupation of each part of the development, in order to secure a reduction in the level of noise emanating from the site."

As such, the requirements of the Local Authority are in line with that required by BREEAM 2018 Pol 05.

Based on the results of the environmental noise survey and the above requirements the following atmospheric plant noise emission limits are permissible at the nearest noise sensitive receptors.

Nearest Noise Sensitive Receptor	Period	Atmospheric Plant Noise Emission Limits L_{eq} (dB)* at Octave Band Centre Frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Radisson Edwardian Hotel	Daytime	53	53	50	47	45	40	33	27	50
	Night-time	53	53	49	46	44	38	31	25	49
Old Nag's Head	Daytime	55	51	49	47	46	40	31	19	50
	Night-time	52	49	48	45	43	37	29	17	48

*Character correction to be applied for tonal or impulsive characteristics in line with BS 4142:2014.

In addition, cumulative atmospheric plant noise emissions from proposed emergency plant items (standby generator, smoke extract fans) shall achieve a noise level of up to 5dB above the existing background (L_{A90}) at the nearest noise sensitive location. This is on the basis that maintenance testing of the proposed emergency plant items is limited to weekday daytime hours only.

The above limits are subject to final approval by Manchester City Council. Plant noise emissions should be assessed in terms of BS 4142: 2014.

In addition to the BREEAM 2018 and MCC requirements, a project requirement is proposed for atmospheric plant noise emissions to the Level 10 roof terrace of L_{Aeq} 50dB.

2.2 BS 4142:2014

BS 4142: 2014 “Methods for rating and assessing industrial and commercial sound”, describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- sound from industrial and manufacturing processes
- sound from fixed installations which comprise mechanical and electrical plant and equipment
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems. It should be noted that the determination of noise amounting to a nuisance is beyond the scope of BS 4142.

The likely impact is indicated by subtracting the existing background sound level from the rating level of the industrial and/or commercial sound. The standard states that:

-
- a) *Typically, the greater this difference, the greater the magnitude of the impact.*
 - b) *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
 - c) *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.*

d) 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.

Note 2 Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

The industrial and/or commercial sound is expressed as the specific sound level and given as a L_{Aeq,T_r} sound level. Should the specific sound level exhibit any acoustic features (i.e. tonality, irregularity or impulsiveness) a character correction is applied. The rating level is the specific sound level with character correction applied (if applicable) and is given as a L_{Ar,T_r} sound level.

The existing background sound level is given as a $L_{A90,T}$ sound level.

The reference time interval, T_r , is 1 hour during the daytime period (07:00 to 23:00 hours) and 15 minutes during the night-time period (23:00 to 07:00 hours).

2.3 Plant Noise Data

Atmospheric building services noise levels have been assessed based on the manufacturers noise data detailed in the Plant Schedule detailed in Appendix A enclosed at the rear of the report.

Whilst it is not possible to assess plant irregularity or impulsiveness based on manufacturer's sound data, BS 4142: 2014 provides an objective method for assessing the audibility of tones in sound. The one-third octave method states that if the level of a one third octave band exceeds the level of both adjacent one third octave bands by the following amounts, then a tonal component may be identified as present:

- 15dB in the low-frequency one-third-octave bands (25Hz to 125Hz)
- 8dB in the mid-frequency one-third-octave bands (160Hz to 400Hz)
- 5dB in the high-frequency one-third-octave bands (500Hz to 10kHz).

However, one third octave band sound data is rarely available from manufacturers as is the case in this instance.

By applying the same principal to the octave band sound data in the enclosed Plant Schedule, a review indicates that these items are unlikely to exhibit a tonal component. As such, no character correction has been applied to the specific sound level for these items.

Should one third octave band sound data become available a revised assessment should be undertaken.

2.4 Operating Hours

It is understood that the proposed plant items have the potential to operate simultaneously at up to 100% duty over a 24-hour period.

It is understood that the emergency standby generator will only operate upon loss of mains power to the building and during maintenance testing which will be limited to weekday daytime hours only.

It is understood that the smoke extract fans will only operate during an emergency and during maintenance testing which will be limited to weekday daytime hours only.

2.5 Plant Locations

The locations of the proposed plant items have been taken from the following drawings.

Author	Drawing No.	Revision	Date
AB Engineering	63068-ABE-ZZ-12-DR-M-5700	C07	19.07.24
Hoare Lea	63068-HOA-ZZ-B1-DR-M-57-00	-	26.05.22

This indicates that the 7No. AHUs, 22No. VRF condenser units, 19No. DX condenser units 2No. smoke extract fans and 1No. emergency standby generator are located at roof level with 1No. AHU, 1No. smoke intake fan, 1No. smoke extract fan, 1No. car park exhaust fan, 1No. waste room intake fan and 1No. waste room exhaust fan situated internally at basement level with intake and exhaust ducts terminating at street level.

2.6 Nearest Noise Sensitive Receptors

The nearest existing noise sensitive receptors to the locations of the proposed plant items are the Radisson Edwardian Hotel situated approximately 60m to the south of the Level 11 rooftop plant area. The nearest future noise sensitive receptors to the locations of the proposed plant items are the Phase 2 hotel

bedrooms/apartments situated approximately 25m to the west of the Level 11 rooftop plant area. The Level 10 roof terrace is situated adjacent to the north, south and west of the Level 11 rooftop plant area.

2.7 Attenuation Measures

Calculations indicate that in order to achieve the proposed atmospheric plant noise emission limits at the various receptors, AHUs, extract fans and supply fans should be fitted with the FAI and Exhaust silencers specified in the Silencer Schedule detailed in Appendix B enclosed at the rear of the report.

It is understood that the 3m high architectural louvred perimeter screen to the Level 11 rooftop plant area is to be blanked off to the rear with aluminium panels (min. 2mm thick), with the exception of where the AHU duct terminations connect directly to the rear.

Calculations indicate that this should provide sufficient screening between the VRF and DX condenser units (all below the top of the 3m high screen) to the Radisson Edwardian Hotel and Level 10 roof terrace.

However, it will provide no attenuation to the future Phase 2 hotel/apartments which will overlook the Level 11 rooftop plant area. Calculated sound levels at the facade of the future Phase 2 hotel/apartments are in the region of 50-57dBA (depending on the floor level) which is up to 8dBA in excess of the target level at the Radisson Edwardian Hotel. This therefore means that the specification of the facade of the future Phase 2 hotel/apartments needs to take account of the Phase 1 Level 11 rooftop plant sound.

It should be noted that if any future tenant plant is situated close to the perimeter screen, and therefore requires additional ventilation, the tenant would be responsible for the replacement of the aluminium blanking panel with an appropriate acoustic louvre (potentially 300-600mm deep).

Appendices



APPENDIX A: PLANT SCHEDULE

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
AHU 01	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	70	80	75	73	69	66	64	63
			-	-	Supply	L _w	74	87	78	81	78	74	71	66
			-	-	Extract	L _w	73	78	74	72	68	65	62	61
			-	-	Exhaust	L _w	76	84	78	80	77	72	69	65
			-	-	Casing	L _w	63	76	60	61	58	52	39	30
AHU 02	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	69	79	73	70	67	64	62	61
			-	-	Supply	L _w	74	86	77	80	76	73	69	65
			-	-	Extract	L _w	71	77	74	71	68	64	62	61
			-	-	Exhaust	L _w	75	83	78	80	77	72	69	64
			-	-	Casing	L _w	63	75	59	60	56	51	37	29

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
AHU 03	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	72	83	79	75	69	67	63	62
			-	-	Supply	L _w	76	88	81	83	80	77	74	69
			-	-	Extract	L _w	73	79	73	71	68	64	62	59
			-	-	Exhaust	L _w	78	85	77	79	76	71	68	62
			-	-	Casing	L _w	65	77	63	63	60	55	42	33
AHU 04	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	72	80	75	74	70	66	64	64
			-	-	Supply	L _w	76	87	79	81	79	74	71	67
			-	-	Extract	L _w	70	80	76	73	67	64	61	57
			-	-	Exhaust	L _w	74	85	79	80	77	74	71	66
			-	-	Casing	L _w	65	76	61	61	59	52	39	31

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
AHU 05	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	71	79	72	70	67	63	61	59
			-	-	Supply	L _w	75	84	76	78	76	71	68	62
			-	-	Extract	L _w	72	76	70	65	63	59	55	54
			-	-	Exhaust	L _w	75	83	74	76	72	68	65	59
			-	-	Casing	L _w	64	73	58	58	56	49	36	26
Landlord AHU	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	74	80	76	74	70	66	64	64
			-	-	Supply	L _w	78	86	80	82	79	75	71	68
			-	-	Extract	L _w	71	81	77	73	67	65	61	58
			-	-	Exhaust	L _w	74	86	80	81	78	75	72	67
			-	-	Casing	L _w	67	75	62	62	59	53	39	32

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
Southmill AHU	Supply & Extract AHU	Level 11 Rooftop Plant Area	-	-	FAI	L _w	67	81	76	72	66	64	59	57
			-	-	Supply	L _w	72	87	78	80	77	74	71	65
			-	-	Extract	L _w	67	78	73	70	64	62	58	55
			-	-	Exhaust	L _w	71	82	77	78	75	72	69	63
			-	-	Casing	L _w	61	76	60	60	57	52	39	29
Basement AHU	Supply & Extract AHU	Basement	-	-	FAI	L _w	65	77	73	68	65	62	58	56
			-	-	Supply	L _w	70	84	79	78	76	72	67	63
			-	-	Extract	L _w	66	72	69	69	65	62	59	56
			-	-	Exhaust	L _w	69	79	74	78	75	71	66	62
			-	-	Casing	L _w	59	73	61	58	56	50	35	27

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
-	Smoke Extract Fan 1	Level 11 Rooftop Plant Area	-	-	Extract	L _w	89	84	92	92	92	90	86	84
			-	-	Exhaust	L _w	89	84	92	92	92	90	86	84
			-	-	Casing	L _w	81	68	72	72	72	69	71	65
-	Smoke Extract Fan 2	Level 11 Rooftop Plant Area	-	-	Extract	L _w	89	84	92	92	92	90	86	84
			-	-	Exhaust	L _w	89	84	92	92	92	90	86	84
			-	-	Casing	L _w	81	68	72	72	72	69	71	65
-	Standby Generator	Level 11 Rooftop Plant	-	-	Casing	L _p at 1m	85dBA							
-	1No. VRF Condenser Unit Daikin REYA12A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	85	82	82	78	73	72	66
-	2No. VRF Condenser Unit Daikin REYA16A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	86	84	86	79	76	76	69
-	1No. VRF Condenser Unit Daikin REYA18A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	85	83	84	77	75	76	69
-	3No. VRF Condenser Unit Daikin REYA20A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	90	88	89	83	78	79	71
-	2No. VRF Condenser Unit Daikin REYA22A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	86	85	84	79	75	73	67

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
-	1No. VRF Condenser Unit Daikin REYA24A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	87	86	87	80	77	76	70
-	5No. VRF Condenser Unit Daikin REYA26A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	88	85	86	80	76	75	69
-	7No. VRF Condenser Unit Daikin REYA28A	Level 11 Rooftop Plant	-	-	Casing	L _w	-	89	86	87	82	78	77	71
-	1No. DX Condenser Unit Daikin RZA200D	Level 11 Rooftop Plant	-	-	Casing	L _w	76	75	73	72	67	65	60	56
-	1No. DX Condenser Unit Daikin RXYSA4AY1	Level 11 Rooftop Plant	-	-	Casing	L _w	74	71	68	69	59	55	47	44
-	1No. DX Condenser Unit Daikin RXYSA6AY1	Level 11 Rooftop Plant	-	-	Casing	L _w	75	74	71	70	63	57	51	47
-	2No. DX Condenser Unit Daikin RZAG125NY1	Level 11 Rooftop Plant	-	-	Casing	L _w	72	71	69	70	61	56	50	48
-	2No. DX Condenser Unit Daikin ERQ140AV1	Level 11 Rooftop Plant	-	-	Casing	L _w	-	84	79	76	73	67	66	61
-	10No. DX Condenser Unit Daikin ERQ200AW1	Level 11 Rooftop Plant	-	-	Casing	L _w	-	84	79	76	73	67	66	61
-	2No. DX Condenser Unit Daikin ERQ250AW1	Level 11 Rooftop Plant	-	-	Casing	L _w	-	84	79	77	73	66	59	53

Plant Ref.	Description	Location	Duty		Data (Inlet/Outlet/Casing)	L _w / L _p at dist. (m)	Sound Level (dB) at Octave Band Centre Frequency (Hz)							
			m ³ /s	Pa			63	125	250	500	1k	2k	4k	8k
-	Smoke Intake Fan (Duty/Standby)	Basement	-	-	FAI	L _w	81	81	85	86	82	79	73	68
			-	-	Supply	L _w	82	82	86	86	82	80	74	69
			-	-	Casing	L _w	72	61	60	61	57	53	55	45
-	Smoke Extract Fan (Duty/Standby)	Basement	-	-	Extract	L _w	79	84	82	85	83	81	76	73
			-	-	Exhaust	L _w	80	87	83	85	83	81	77	74
			-	-	Casing	L _w	70	69	61	62	58	53	55	50
-	Car Park Exhaust Fan (Duty/Standby)	Basement	-	-	Extract	L _w	100	100	99	100	98	93	88	83
			-	-	Exhaust	L _w	101	101	100	101	99	94	90	85
			-	-	Casing	L _w	91	78	72	74	72	65	69	62
-	Waste Room Intake Fan & Exhaust Fan	Basement	-	-	FAI/Extract	L _w	49	57	65	60	57	58	53	48
			-	-	Supply/Exhaust	L _w	50	58	62	57	56	56	51	49
			-	-	Casing	L _w	46	49	45	44	42	40	33	28

APPENDIX B: SILENCER SCHEDULE

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
AHU 01	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	1800	<3.5	<55	10	19	29	45	48	47	42	28
		Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
AHU 02	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	900	<4.5	<55	5	9	15	29	34	30	22	14
		Supply	-	1800	<3.5	<55	10	19	29	45	48	47	42	28
		Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
AHU 03	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1500	<4.5	<55	8	15	23	40	46	41	33	20
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
AHU 04	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1500	<4.5	<55	8	15	23	40	46	41	33	20
AHU 05	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	900	<4.5	<55	5	9	15	29	34	30	22	14
		Supply	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Extract	-	900	<3.5	<55	5	10	16	32	38	35	26	16
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
Landlord AHU	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1500	<4.5	<55	8	15	23	40	46	41	33	20

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
Southmill AHU	Supply & Extract AHU Level 11 Rooftop Plant Area	FAI	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
		Supply	-	2100	<3.5	<55	11	20	33	47	49	47	45	31
		Extract	-	1200	<3.5	<55	7	14	21	38	43	41	33	20
		Exhaust	-	1200	<4.5	<55	7	12	19	35	40	36	28	17
Basement AHU	Supply & Extract AHU Basement	FAI	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Supply	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<6.0	<55	5	7	13	23	25	20	15	10
-	Smoke Extract Fan 1 Level 11 Rooftop Plant Area	Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
-	Smoke Extract Fan 2 Level 11 Rooftop Plant Area	Extract	-	1500	<3.5	<55	9	17	25	43	47	46	39	24
		Exhaust	-	1500	<3.5	<55	9	17	25	43	47	46	39	24

Plant Ref.	Description	Inlet/Outlet	Vol. (m ³ /s)	Typical Length (mm)	Face Velocity (m/s)	Pressure Drop (Pa)	Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
							63	125	250	500	1k	2k	4k	8k
-	Smoke Intake Fan (Duty/Standby) Basement	FAI	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Supply	-	900	<3.5	<55	5	10	16	32	38	35	26	16
-	Smoke Extract Fan (Duty/Standby) Basement	Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<3.5	<55	5	10	16	32	38	35	26	16
-	Car Park Exhaust Fan (Duty/Standby) Basement	Extract	-	3000	<3.5	<55	13	25	42	49	52	50	49	41
		Exhaust	-	3000	<3.5	<55	13	25	42	49	52	50	49	41
-	Waste Room Intake Fan Basement	Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<6.0	<55	5	7	13	23	25	20	15	10
-	Waste Room Exhaust Fan Basement	Extract	-	900	<6.0	<55	5	7	13	23	25	20	15	10
		Exhaust	-	900	<6.0	<55	5	7	13	23	25	20	15	10