Acoustic Consultancy Report

90193/3/1/10
Acoustic Report

Report Prepared For

David Webb Associates
20 Red Lion Street
11 March 2019

Report Author

Robert Martin

Checked By

M Balsom MSc MIOA (D) (E)

Telephone
0118 918 6460
Facsimile
0118 918 6480

enquiries@lcpacoustics.co.uk
www.lcpacoustics.co.uk

LCP
Riverside House
3 Winnersh Fields
Gazelle Close
Winnersh
Wokingham
RG41 5QS

A division of Caice
Acoustic Air Movement Ltd.

Company Registration Number
2790667
VAT Registration Number
GB614683632

Contents

i) Executive Summary

Lee Cunningham Partnership has been commissioned to conduct an appraisal of the acoustic performances of the office refurbishment and extension at 20 Red Lion Street, London for compliance with BREEAM and Local Authority external noise planning permission requirements.

The refurbishment will include an extension towards the rear of the property, additional 6th floor and new reception area, upgrade of mechanical services internal and external, and the installation of a new ceiling raft and raised access floor to the main office, and an externally sited Lossnay ventilation unit on the roof.

This report determines the required acoustic performance and assesses the current design of all aspects of the development in order to comply with BREEAM HEA05 and POL05 of BREEAM 2014 Refurbishment and Fit-out Non-domestic buildings.

For Cat A developments only the internal ambient noise can be fully assessed. This report assesses the current design to the internal ambient noise criteria.

The recommended criteria for sound insulation and reverberation times have been provided.

This report concludes that:

The current design, inclusive of the recommendations within this report can achieve BREEAM HEA05 internal ambient noise criteria and 1 credit can be achieved.

The current design can achieve BREEAM POL05 and Local Authority external noise planning condition criteria and 1 credit is achievable.

This assessment confirms that given a typical arrangement and fit-out specification for the building type, the development is likely to meet the levels required to demonstrate compliance with the BREEAM reverberation and sound insulation criteria.

Testing will be carried out upon completion to confirm compliance and gain any relevant BREEAM credits, as well as confirming compliance with post completion and pre-occupation planning conditions.

ii) Document History

Issue	Date	Issue Details	Issued by	Checked by
1	23/08/2017	Initial Issue	RM	JN
2	11/09/2017	Minor Amendments	RM	JN
3	31/10/2017	Amendments to mechanical services running speeds.	RM	MB
4	06/11/2017	Minor Amendments	RM	JN
5	18/01/2019	Review of mechanical services Basement – Level 5	RM	-
6	15/02/2019	Minor Amendments	RM	-
7	01/03/2019	Revised Issue	RM	-
8	11/03/2019	Revised Issue	RM	-

1 Introduction

Lee Cunningham Partnership has been commissioned to conduct an appraisal of the acoustic performances of the office refurbishment at 20 Red Lion Street, London.

The refurbishment will include an extension towards the rear of the property, additional 6th floor and new reception area, upgrade of mechanical services internal and external, and the installation of a new ceiling raft and raised access floor to the main office.

This report determines the required acoustic performance and assesses the current design of all aspects of the development in order to comply with BREEAM HEA05 and POL05 of BREEAM 2014 Refurbishment and Fit-out Non-domestic buildings.

2 Internal Design Criteria

2.1 BREEAM 2014 - HEA 05

BREEAM 2014 Refurbishment and Fit-out HEA 05 criterion is aimed to ensure the building's acoustic performance including sound insulation meet the appropriate standards for its purpose. BREEAM acoustic criteria for office buildings are shown in the following table.

Table 1: BREEAM Acoustic criteria for office buildings

Credit Available	Criteria	Testing Required
First Credit	The sound insulation between acoustically sensitive rooms and other occupied areas complies with the performance criteria given in Section 7 of BS8233:2014	Yes
Second Credit	Achieve indoor ambient noise levels that comply with the design ranges given in Section 7 of BS 8233:2014.	Yes
Third Credit	Acoustic environment Achieve the requirements relating to sound absorption and reverberation times, where applicable, set out in Section 7 of BS 8233:2014.	Yes

For Cat A developments only the internal ambient noise can be fully assessed. This document assesses the current design to the internal ambient noise criteria.

The recommended criteria for sound insulation and reverberation times have been provided. Initial recommendations are contained within this report, which should be applied where practical and/or possible at this stage of development.

2.2 Sound Insulation

BS8233:2014 states that in order to achieve unintelligible speech from another office, the following minimum performances are required. It is possible that voices can be heard, but the conversation is not normally understood. Where the internal ambient noise level is low it might be necessary to design for higher insulation values.

Table 2: Wall sound insulation criteria, dB

Element	Criterion
Minimum	D_w 38
Minimum where privacy is important	D_w 48

In open plan offices it is recommended that screening between workstations should be at least 1.5m high and absorbent-faced to provide adequate general privacy.

BCO considers the sound insulation performance of floors and recommends the criteria in the table below.

Table 3: Floor sound insulation criteria, dB

Element	Criterion
Floor	D_{nTw} 48

2.3 Internal Ambient Noise Levels

BS8233: 2014 section 7 provides the following guidance for internal ambient noise levels in unoccupied spaces.

The noise levels provided generally apply to steady sources, such as those due to road traffic and mechanical services, and should be the noise level in the space during normal hours of occupation but excluding any noise produced by the occupants and their activities.

Table 4: Indoor ambient noise levels in unoccupied spaces, dB LAeq, T

Space	Criterion
Open Plan Offices	45 – 50
Staff meeting room/training room	35 – 45
Executive Office	35 – 40
Corridor, circulation space	45 – 55

2.4 Reverberation Time

BS8233: 2014 states that the optimum reverberation time for a space depends on the purpose and volume of the space and guide values for reverberation times for rooms of different volumes can be found in standard texts.

The following table is taken from the Association of Interior Specialist (AIS) ‘A guide to office acoustics’.

Table 5: Reverberation time criteria at 500Hz in unoccupied rooms for speech, seconds

Room Volume m^3	Reverberation Time
50	0.4
100	0.5
200	0.6
500	0.7
1000	0.9
2000	1.0

BCO 2014 recommends that in open plan office the ceiling should be as acoustically absorbent as possible. This is conventionally achieved with a Class A absorbent ceiling, when no such ceiling is proposed then alternative soffit finishes/treatments should control primary reflections and achieve an equivalent standard of acoustic separation/privacy between workstations. A carpet is desirable in offices areas to control noise from footfall and provide additional absorption.

3 External Noise Criteria

3.1 BREEAM 2014 - Pol 05

BREEAM Pol 05 criterion is aimed to reduce the likelihood of noise arising from fixed installations on the new development affecting nearby noise-sensitive buildings. One credit is available; the following table details the requirements to demonstrate compliance.

Table 6: BREEAM Pol 5 criteria

Credit Available	Criteria	Testing Required
One Credit	1. Where there are, or will be, no noise-sensitive areas or buildings within 800m radius of the assessed development.	
	2. Where the building does have noise-sensitive areas or buildings within 800m radius of the development a credit can be awarded for: a) Where a noise impact assessment in compliance with BS7445 has been carried out and the following noise levels measured/determined: i) Existing background noise levels at the nearest or most exposed noise-sensitive development or at a location where background conditions can be argued to be similar ii) The rating noise level resulting from the new noise source 3. The noise impact assessment must be carried out by a suitable qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body. 4. The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (07:00 to 23:00) and +3dB at night (23:00 to 07:00) compared to the background noise level. 5. Where the noise source(s) from the proposed site/building is greater than the levels described in the criterion, measures have been installed to attenuate the noise at its source to a level where it will comply	Yes

3.2 Local Authority Requirements

The primary noise condition is contained within Condition 3 of the most recent planning consent. This states:-

Condition 3 - The external noise level emitted from plant, machinery or equipment at the development with specified noise mitigation hereby approved shall be 46 dB $L_{Aeq,\ T}$ at 23m, 22 Sandland Street, with all machinery operating together at maximum capacity and an internal noise level of NR35 as designed in report ref: 83633/3/2/5 dated 13 June 2017.

Condition 12 - Prior to use of the development, details shall be submitted to and approved in writing by the local planning authority, of the external noise level emitted from plant/ machinery/ equipment and mitigation measures as appropriate. The measures shall ensure that the external noise level emitted from plant, machinery/ equipment will be lower than the lowest existing background noise level by at least 10dBA as assessed according to BS4142:2014 at the nearest and/or most affected noise sensitive premises, with all

machinery operating together at maximum capacity. Approved details shall be implemented prior to occupation of the development and thereafter be permanently retained.

Condition 13 - Prior to use of the development, details shall be submitted to and approved in writing by the Council to confirm that noise emitted by standby or emergency generators during power outages or testing does not exceed the lowest daytime $L_{Aeq\ (15min)}$ as measured or calculated according to BS4142:2014.

The planning consent requires Conditions 12 &13 to be discharged upon completion and prior occupation.

3.3 Recommended Residential Design Rating Level

On the basis of the above the recommended residential design rating level should therefore be:

Residential Design Rating Level
Lowest $L_{A90,\ 15\ mins}$ - 10 dB

3.4 Emergency Generator and Smoke Extract

It would be inappropriate to impose the standard noise condition on emergency generators, although some restrictions should be imposed to prevent excessive use or nuisance.

Where emergency generation plant is installed and requires testing, the noise emitted from this plant should not exceed the lowest daytime $L_{Aeq\ (15min)}$. This testing period is for up to one hour per month between 09.00 and 17.00 Monday to Friday only and not on public holidays.

Emergency Plant Design Rating Level
Lowest $L_{Aeq,\ 15\ mins}$ dB

4 Consultant Qualifications

This assessment has been carried out by a suitably qualified acoustician, as defined by BREEAM. Qualifications follow the consultants name on the front cover of this report.

5 Noise Monitoring

5.1 Measurements

The noise monitoring took place from the 19th April 2017 to the 20th April 2017. The predominant noise sources were existing mechanical plant and local road traffic noise. The measurement period was considered sufficient to establish the representative background sound levels corresponding to the operational period of the plant.

The weather conditions monitored during the survey are shown in the following table.

Table 7: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	2.2m/s
Wind Direction	E
Cloud Cover	60%
Max. Temperature	14°C
Min. Temperature	8°C
Precipitation	None

Further facade noise measurements were carried out on 26th July 2017. The predominant noise source was local road traffic noise. The measurement periods were considered sufficient to establish the typical noise levels impinging upon the façade.
The weather conditions monitored during the survey are shown in the following table.

Table 8: Weather Conditions at Measurement Location

Weather	Value
Average Wind Speed	1-2m/s
Wind Direction	SW
Cloud Cover	80%
Max. Temperature	22°C
Min. Temperature	16°C
Precipitation	None

5.2 Measurement Results

The measured statistical broad-band sound pressure levels are shown within Appendix B. The lowest background sound level(s) obtained being as follows:

Table 9: Lowest background sound levels, dB re $2x10^{-5}$ Pa

Measurement Position	$L_{A90,\ 15\ mins}$ Day*
MP1	51

* Day periods are defined as between 07:00 - 19.00.

5.3 Façade Survey Results

The typical noise levels impinging upon the façade during the daytime period are shown in the following table.

Table 10: Averaged measured façade noise levels, dB re $2x10^{-5}$ Pa

Description	Indices	Octave Band Centre Frequency (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
MP1 - Rear of site	L_{Aeq}	65	60	58	54	52	49	41	31	57
MP2 – Sandland Street	L_{Aeq}	72	63	58	58	56	53	48	42	61
MP3 – Red Lion Street	L_{Aeq}	71	65	60	61	59	55	51	46	63

6 Internal Ambient Noise

6.1 Mechanical Services Noise

The internal building services noise at basement level will consist of 1x Lossnay unit (LGH100RV-X) which will be located within a water tank room and 12x wall mounted Mitsubishi VRF (PFFY-P32VLMM-E) units.

The ground floor will consist of 2x Lossnay units which will be located within a bulkhead and 17x Mitsubishi VRF units which comprise of 16x (PFFY-P50VLMM-E), 1x (PEFY-P50VMA-E).

The reception area will consist of 1x fan coil which will be located within the ceiling void above the main reception area.

Floors 1 – 3 are identical, each floor consist of 2x Lossnay units which are within a bulkhead and 18x VRF units which comprise of 17x (PFFY-P50VLMM-E) and 1x (PEFY-P50VMA-E).

The 4th and 5th floor will consist of 2x Lossnay units which are within a bulkhead and 18x VRF units which comprise of 17x (PFFY-P50VLMM-E) and 1x (PEFY-P50VMA-E).

The 6th floor will consist of 1x Lossnay unit which will be located on the roof, a AET CAM-C35 unit, 24x AET TUSEC underfloor ventilation and 19x return grills.

The combined noise from all ventilation equipment within each space has been reviewed.

6.1.1 Attenuator Insertion Losses

The Lossnay fresh air units on each floor will require room side attenuators to the supply and extract, the following attenuator insertion losses are advised and have been used in calculations.

Table 11: Advised Lossnay unit room side attenuator insertion losses, dB

Plant	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Basment Lossnay unit Supply	0	6	14	24	26	26	21	14
Basment Lossnay unit Extract	0	14	19	28	32	34	26	19
Ground floor Lossnay unit Zone 1 Supply	0	0	6	18	20	19	15	8
Ground floor Lossnay unit Zone 1 Extract	0	16	20	29	33	35	27	20
Ground floor Lossnay unit Zone 2 Supply	0	0	0	16	21	22	17	10
Ground floor Lossnay unit Zone 2 Extract	0	13	18	27	28	29	22	15
Floor 1 - 5 Lossnay unit Zone 1 Supply	0	0	5	20	24	25	20	13
Floor 1 - 5 Lossnay unit Zone 1 Extract	0	13	18	26	26	27	21	14
Floor 1 - 5 Lossnay unit Zone 2 Supply	0	0	0	6	7	6	5	0
Floor 1 - 5 Lossnay unit Zone 2 Extract	0	14	19	27	27	27	21	14
Level 6 Lossnay unit Supply	0	5	11	20	21	21	17	10
Level 6 Lossnay unit Extract	0	5	11	20	21	21	17	10

There will also be a fan coil units on floors ground – 5 and in the main reception which will also require room side attenuators. The insertion loss required for theses attenuators are shown in the table below.

Table 12: Advised FCU attenuator insertion losses, dB

Plant	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Reception Discharge PEAD-RP140JAQ (4 No)	0	8	9	11	15	13	5	7
Reception Intake PEAD-RP140JAQ	13	21	38	55	55	48	29	21
Ground – floor 5 PEFY-P50VMA-E Discharge	6	9	16	32	46	32	21	16
Ground – floor 5 PEFY-P50VMA-E Intake	2	5	14	24	41	35	24	20

6.1.2 Calculated Mechanical Services Noise Contribution

The calculated internal ambient noise level contribution from internal building services noise inclusive of advised attenuators in section 6.1.1, are shown in the following table.

Table 13: Internal ambient noise levels contribution from internal building services noise, dB $L_{Aeq,T}$

Space	Calculated Result dB
Basement	39 (Low fan speed)
Ground floor Zone 1	42 (Low fan speed)
Ground floor Zone 2	42 (Low fan speed)
Open Plan Offices 1 – 3 Zone 1	42 (Low fan speed)
Open Plan Offices 1 – 3 Zone 2	42 (Low fan speed)
Open Plan Offices 4 - 5 Zone 1	41 (Low fan speed)
Open Plan Offices 4 - 5 Zone 2	42 (Low fan speed)
6th Floor Open Plan Office	45
Reception	43

Plant noise data used calculations is provided in Appendix C.

6.2 External Noise Break-in

Double glazing is proposed to all new façade areas. The minimum advised sound reduction performance is provided in the following table.

Table 14: minimum advised glazing performances, dB R_w

Element	Rw
Double Glazing 4 mm / (6 - 16 mm) / 4 mm	29

6.2.1 Calculated External Noise Break-in Contribution

The external noise break-in levels have been calculated using the glazing sound reduction values shown in the table above, results are shown in the following table.

Table 15: Internal ambient noise levels contribution from external noise, dB $L_{Aeq,T}$

Space	Calculated Results
Ground floor Zone 1	41
Ground floor Zone 2	42
Open Plan Offices 1 – 5 Zone 1	40

Open Plan Offices 1 – 5 Zone 2	41
6th Floor Open Plan Office	43
Reception	45

6.3 Bulkheads recommendations

As the bulkheads on ground level to the 5 floor level, will be located on the ceiling in the office areas recommendations have been made for the acoustic performance of the bulkhead. The material and the sound reduction index are shown in the table below.

Table 16: Bulkhead material and SRI, dB

Material	Octave Band Centre Frequency (Hz)							Rw
	63	125	250	500	1k	2k	4k	
2 x Gyproc SoundBloc 15mm	20	24	28	33	37	33	37	35

Any access hatches installed will require a minimum Rw of 35dB.

It is recommended that the bulkhead is constructed from 2 layers of 15mm sound block and 50mm acoustic foam is installed inside the bulkhead on the entire bottom of the bulkhead between the bulkhead and the mechanical plant. The absorption coefficient for the acoustic foam is shown in the table below.

Table 17: Bulkhead specification Absorption Coefficient at Octave Band Centre Frequency (Hz), dB

Material	Absorption Coefficient at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
AG – Foam 50mm	0.24	0.47	0.75	0.84	0.17	1.02

The unit at basement level will be located within a water tank room which will require the same acoustic performance as shown in the above table.

6.3.1 Calculated Noise Break-in from bulkheads

The break-in levels from the bulkheads including the recommendations have been calculated using the sound reduction values shown in the table above, results are shown in the following table.

Table 18: Internal ambient noise levels contribution from Bulkheads, dB $L_{Aeq,T}$

Space	Calculated Results
Ground floor Zone 1	31
Ground floor Zone 2	31
Open Plan Offices 1 – 5 Zone 1	31
Open Plan Offices 1 – 5 Zone 2	31

6.4 Combined Internal Ambient Noise

The calculated level for the combination of noise from external sources and internal building services is shown in the table below.

Table 19: Internal ambient noise levels from external noise and internal building services noise, dB $L_{Aeq,T}$

Space	Criteria	Calculated Result
Basement	45 – 50	48
Ground floor Zone 1	45 – 50	49
Ground floor Zone 2	45 – 50	50
Open Plan Offices 1 – 3 Zone 1	45 – 50	49
Open Plan Offices 1 – 3 Zone 2	45 – 50	49
Open Plan Offices 4 - 5 Zone 1	45 – 50	49
Open Plan Offices 4 - 5 Zone 2	45 – 50	49
6th Floor Open Plan Office	45 – 50	48
Reception	45 - 55	47

Note: the calculated noise levels are based on achieving a reverberation time of 1.5s in the reception, 0.7s in the reception meeting room and 1.0s in offices. Higher reverberation times will result in an increased noise level.

7 Sound Insulation

7.1 Office Floor Sound Insulation

The floor for the new extension areas and the partition between the 6th floor and the plant area have been modelled in the proprietary software package, Insul, using the advised build-ups and assumptions based on the supplied drawings. The resultant SRIs are shown in the table below.

Table 20: Element sound reduction performances, dB R_w

Element	Description	Modelled Performance
Floor	38mm raised access flooring, 130mm concrete slab (353 kg/m_2).	53
Separating partition	70mm Brick, Point connections within cavity, 215mm concrete block.	63

7.2 Calculated results

The sound insulation requirements have been assessed against the criteria; calculated results are shown in the table results.

Table 21: Calculated floor sound insulation, DnTw

Element	Source Room	Receive Room	Criterion D_{nTw}	Calculated
Floor	Ground zone 1	1st floor zone 1	≥48	48
Floor	Ground zone 2	1st floor zone 1	≥48	48
Floor	1st floor	2nd floor	≥48	48
Floor	2nd floor	3rd floor	≥48	48
Floor	3rd floor	4th floor	≥48	48
Floor	4th floor	5th floor	≥48	48
Floor	5th floor	6th floor	≥48	48

7.3 Recommendations for future partitions

While not a specific BREEAM requirement at Cat A stage, the following table provides the recommended laboratory rated sound reduction performances of internal partitions. The recommended performances are based on the guidance given in BS8233: 2014.

Table 22: Minimum recommended partition SRI performance, dB

Element	Criterion
Typical situations	≥ R_w 45
Situations where privacy is important	≥ R_w 55

8 Reverberation Time

The recommended reverberation time criteria based on room volume are shown in the table below.

Table 23: Recommended reverberation time and criteria (s)

Space	Recommended Criterion
Open Plan Offices	≤ 1.0

The office reverberation time can meet the criteria in the previous table with the proposed plasterboard ceiling if the floor is fully carpeted. It is therefore recommended that floors are carpeted at fit-out stage.

It is considered best practice to provide acoustic absorption to circulation areas. Typically, an area of Class C absorption equal to the area of the floor is considered adequate.

In reception spaces a degree of reverberation is normally expected to be desirable as it adds to the impression of the space. Too much reverberation however can be problematic for speech intelligibility and it is therefore highly recommended that some absorption is included in the vicinity of the reception desk to aid speech communication.

9 External Plant Assessment

9.1 Current Design

There are 3 areas of proposed mechanical plant, the first of these areas will be located on the 6th floor, a partition will separate the plant area form the 6th floor office. The plant area on the 6th floor will consist of 13x Mitsubishi PURY-EP350YLM-A units, 1 x Mitsubishi PUHZ-ZRP140VKA2 unit, 1x Daikin RYTQ10T unit, 11x units which are to be installed by future tenants and an emergency generator. The plant area will require to be surrounded by an acoustic louvered screen. The minimum performance for the acoustic screen is shown in the table below.

Table 24: Acoustic louvre minimum required performance, dB

	Octave Band Centre Frequency (Hz)								R_w
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Acoustic Louvre enclosure	7	7	10	17	29	30	27	21	22

The second area of proposed mechanical plant will be located on the on the roof of the building above the 6th floor office. This plant area will consist of 1x lossnay LGH100RVX unit, 1 x Nuaire ATV6-R unit on the roof and 1x emergency smoke extract unit in the riser. The Nuaire ATV6-R unit will require an acoustic attenuator to be installed on the exhaust. The minimum required insertion loss for the exhaust attenuator is shown in the table below. (NB. The locations of these 3 units are all shown on the Orms Architects roof drawings as shortly to be submitted to Camden Council plans for approval.)

Table 25: Atmosphere attenuator minimum required insertion loss, dB

	Octave Band Centre Frequency (Hz)							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
ATV-6 Exhaust attenuator	3	6	12	18	14	8	5	2

The third area of external plant will be located Ground floor and will consist of 2x external units which will be selected by the future tenants. There will also be fresh air and exhaust ducts from the Lossnay units on each level which will be located on the east and north facing facades at the rear of the building along with a Nuaire ATV4 exhaust duct. Each fresh air and exhaust duct will be positioned behind a louvre. The acoustic performance of these louvres is shown in the table below.

Table 26: Acoustic louvre minimum required performance, dB

	Octave Band Centre Frequency (Hz)								R_w
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Acoustic Louvre	4	4	6	8	11	11	11	10	11

The proposed plant may run consistently between 07:00 and 19:00.

9.2 Limiting levels

As the future tenants, mechanical plant is yet to be selected. Limiting levels have been calculated to ensure that the addition of this plant will not have a negative impact on noise sensitive receivers. The limiting level for the future plant is show in the table below.

Table 27:Limiting level sound pressure data, dB re $2x10^{-5}$ Pa

Plant	Distance (m)	Octave Band Centre Frequency (Hz)								L_{PA}
		63	125	250	500	1k	2k	4k	8k	
Future Tenants Plant	1	62	57	52	49	43	35	30	25	50

9.3 Calculated Results

Calculations have been carried out, inclusive of the mitigation detailed in section 9.1, with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces and multiple source addition. The design rating levels to be adopted for this project, together with the calculated results, are set out in the table below.

Plant and attenuation data use in calculations is contained in Appendix D.

Table 28: Calculated and design noise levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level (Day) $L_{Aeq,\ 12\ hr}$	Calculated Result $L_{Aeq,T}$
22 Sandland Street	23	41	41
Red lion Street toward the north	9	41	41
Red lion Street towards the west	31	41	40

9.4 Emergency Generator and Smoke Extract

Calculations have been carried out, inclusive of the mitigation detailed in section 9.1, with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces and multiple source addition. The design rating levels to be adopted for this project, together with the calculated results, are set out in the table below.

Table 29: Calculated and design noise levels, dB re $2x10^{-5}$ Pa

Receiver Premises	Approximate Distance (m)	Design Level (Day) $L_{Aeq,\ 1\ hr}$	Calculated Result $L_{Aeq,T}$
22 Sandland Street	31	54	54
Red lion Street toward the north	9	54	54
Red lion Street towards the west	24	54	52

10 Conclusion

This report determines the required acoustic performance and assesses the current design of all aspects of the development in order to comply with BREEAM HEA05 and POL05 of BREEAM 2014 Refurbishment and Fit-out Non-domestic buildings, and comply with all planning conditions as stated in Section 3.2 of this report(Local Authority Requirements).

This report concludes that:

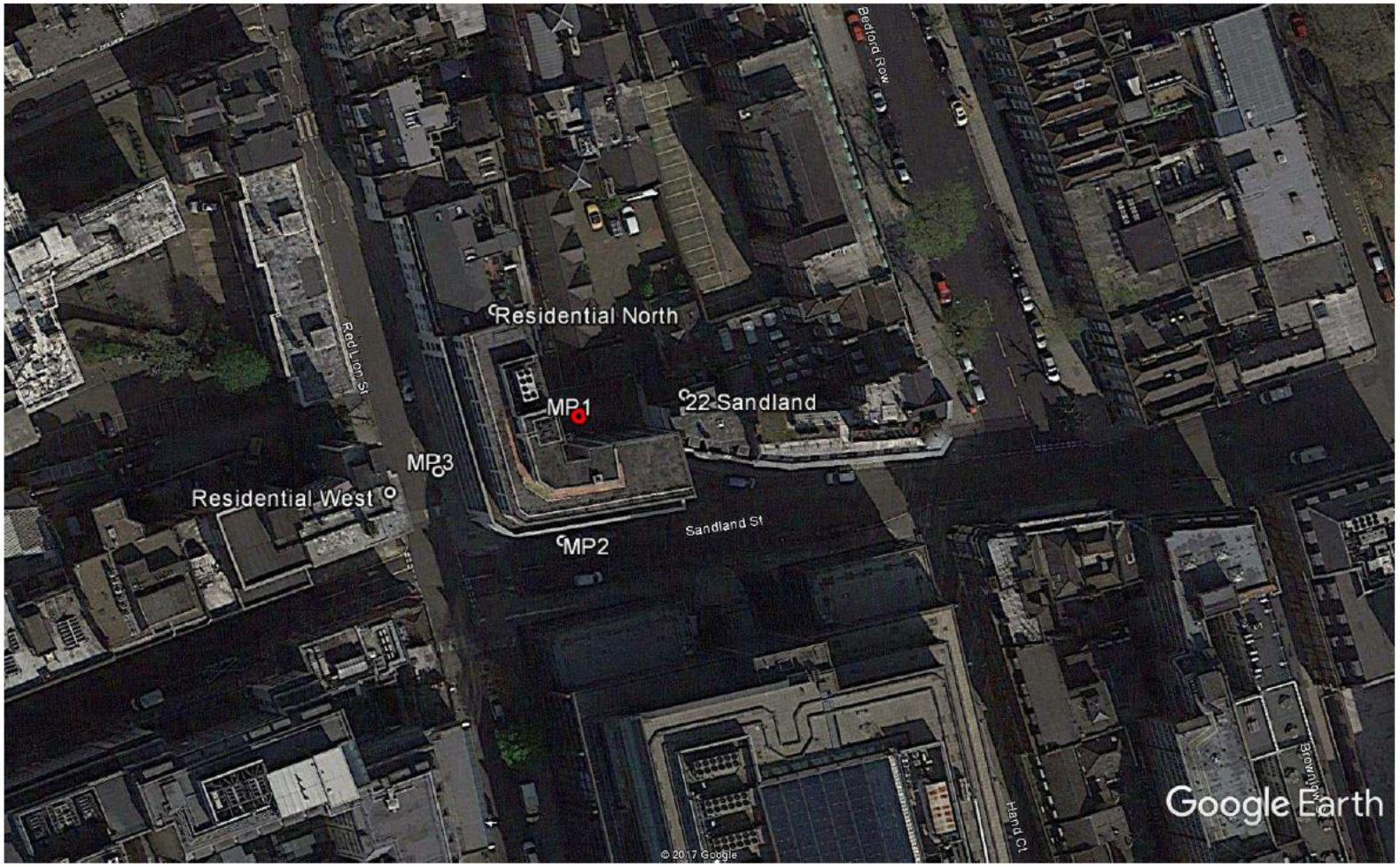
The current design, inclusive of the recommendations within this report can achieve BREEAM HEA05 internal ambient noise criteria and 1 credit can be achieved.

The current design can achieve BREEAM POL05 and Local Authority requirements upon external noise criteria and 1 credit is achievable.

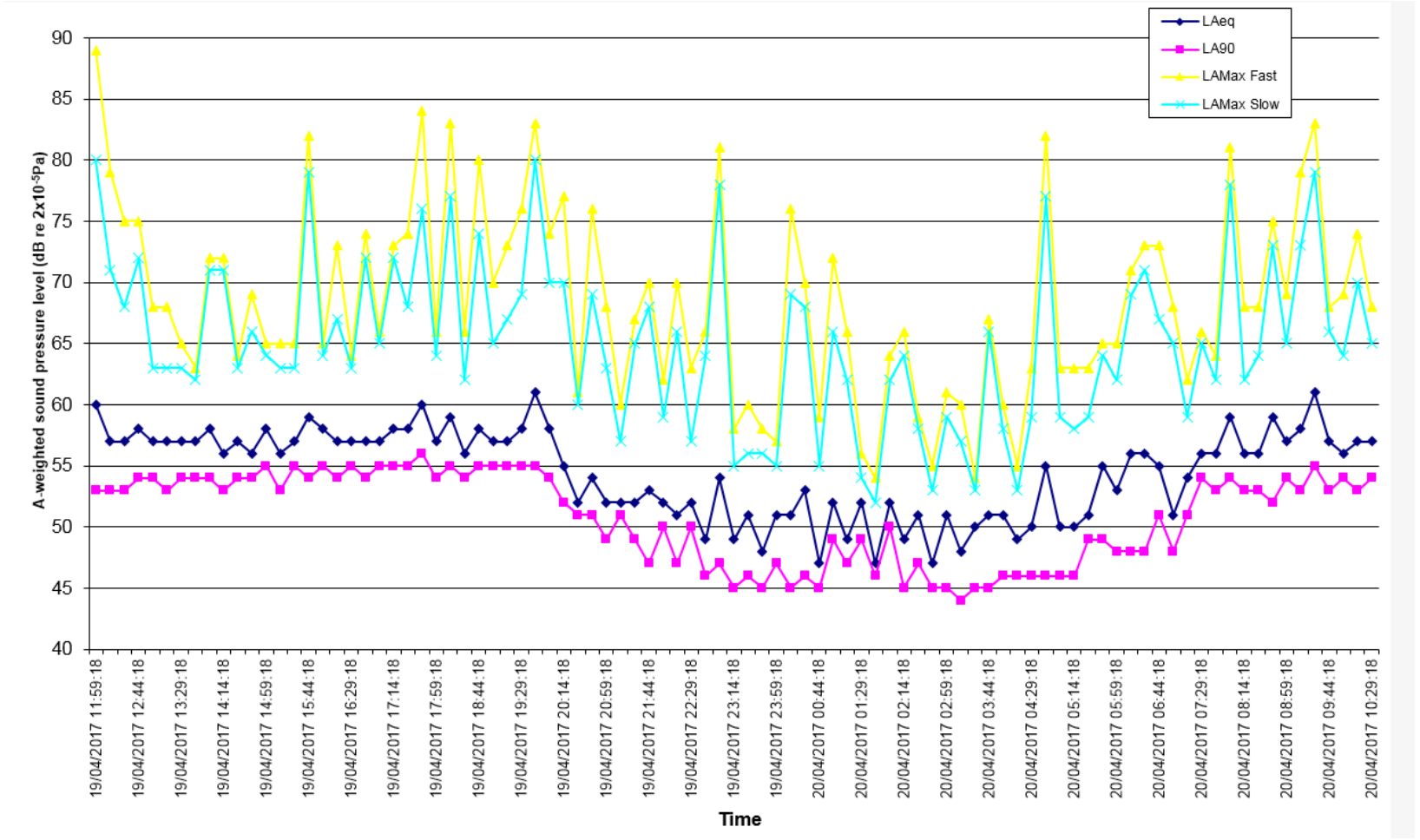
This assessment confirms that given a typical arrangement and fit-out specification for the building type, the development is likely to meet the levels required to demonstrate compliance with the BREEAM reverberation and sound insulation criteria.

Testing will be carried out upon completion to confirm compliance and gain any relevant BREEAM credits as well as to secure the Local Authority requirements and discharge of planning conditions 12 &13.

Appendix A: Site Plan



Appendix B: Measurement Data



Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11258
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 86548

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Location	Date & time	Elapsed time	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	L_{Aeq}
MP2 Sandland Street	26/07/2017 13:05:20	00:02:02	69	60	56	55	54	51	47	41	59
MP2 Sandland Street	26/07/2017 13:10:34	00:05:00	74	63	60	59	56	54	50	43	61
MP2 Sandland Street	26/07/2017 13:21:40	00:05:00	70	61	57	56	55	52	47	41	59
MP2 Sandland Street	26/07/2017 13:32:34	00:05:00	72	61	59	59	57	54	50	43	62
MP2 Sandland Street	26/07/2017 13:43:34	00:05:00	73	67	59	59	56	55	49	44	62
MP2 Sandland Street	26/07/2017 13:54:22	00:05:00	73	64	57	58	55	51	46	38	60
	Average		**72**	**63**	**58**	**58**	**56**	**53**	**48**	**42**	**61**
Location	**Date & time**	**Elapsed time**	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1000Hz**	**2000Hz**	**4000Hz**	**8000Hz**	L_{Aeq}
MP3 Red Lion Street	26/07/2017 13:16:10	00:05:00	71	66	62	63	61	57	53	50	65
MP3 Red Lion Street	26/07/2017 13:27:06	00:05:00	71	62	59	59	58	55	51	45	63
MP3 Red Lion Street	26/07/2017 13:33:09	00:00:01	69	65	60	60	58	52	47	40	62
MP3 Red Lion Street	26/07/2017 13:38:12	00:05:00	73	66	61	62	59	57	53	47	64
MP3 Red Lion Street	26/07/2017 13:48:56	00:05:00	72	64	58	60	59	55	50	43	63
MP3 Red Lion Street	26/07/2017 13:59:48	00:05:00	69	65	58	57	56	53	49	42	61
	Average		**71**	**65**	**60**	**61**	**59**	**55**	**51**	**46**	**63**

Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 27152
- Svantek pre-amplifier SV12L S/N: 25151 with GRAS microphone capsule 40AE S/N: 152102

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10893 complying with Class 1 specification of BS EN 60942:2003, calibration level 114.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Plant Data

Plant noise data used in the preceding assessment follow.

Table 30: Internal plant sound data, dB

Plant	Data Type	Octave Band Centre Frequency (Hz)								L_A
		63	125	250	500	1k	2k	4k	8k	
LGH100RVX-E Surrounding	Lp at 1.5m	53	44	37	35	31	25	17	10	37
PFFY-P32VLMM-E*	Lw	39	41	38	39	30	27	18	13	38
PEFY-P80VMH-E*	Lw	51	53	50	51	43	39	29	27	50
PFFY-P50VLMM-E*	Lw	40	41	44	42	37	30	23	18	43
PEFY-P50VMA-E2*	Lw	72	68	60	65	55	35	51	50	64
CAM-C35*	Lw	85	75	67	61	57	54	52	50	66
AET TUSEC	Lw	43	44	51	49	42	36	28	24	48

* The sound power spectrum for this unit has been estimated based upon the manufacturer's data.

Table 31: External plant sound data, dB

Plant	Data Type	Octave Band Centre Frequency (Hz)								L_A
		63	125	250	500	1k	2k	4k	8k	
LGH100RVX-E Supply	Lw	72	72	67	69	66	66	63	52	72
LGH100RVX-E Surrounding	Lp at 1.5m	53	44	37	35	31	25	17	10	37
PURY-EP350YLM-A	Lp at 1m	74	69	65	62	56	48	43	38	62
AVT 4 Outlet duct	Lw	84	79	74	76	71	68	63	56	77
AVT 6-R Open Outlet	Lw	77	80	77	76	72	69	63	54	78
Future wall mounted condenser ground	Lp at 1m	62	57	52	49	43	35	30	25	50
Future condensers roof	Lp at 1m	62	57	52	49	43	35	30	25	50
RYYQ10T	Lp at 1m	62	65	57	58	51	48	41	35	58
PUHZ-ZRP140VKA2	1.00	62	55	53	50	47	42	38	30	52

Table 32: Emergency Plant data, dB

Plant	Data Type	Octave Band Centre Frequency (Hz)								L_A
		63	125	250	500	1k	2k	4k	8k	
Powerhouse Series PHG220Do Generator*	Lp at 7m	66	67	67	67	65	63	60	55	70
Smoke Extract break out	Lw	80	76	67	69	67	62	65	58	72
Smoke Extract outlet	Lw	89	95	92	94	91	88	82	80	96

* The sound pressure spectrum for this unit has been estimated based upon the manufacturer's single figure broadband value.

Appendix D: Calculations

22 Sandland Street:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	PURY-EP350YLM-A	1.00	74	69	65	62	56	48	43	38	62	70
2	AVT 4 Outlet duct		84	79	74	76	71	68	63	56	77	77
3	AVT 6-R Open Outlet		77	80	77	76	72	69	63	54	78	78
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2		72	72	67	69	66	66	63	52	72	72
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2		72	72	67	69	66	66	63	52	72	72
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1		72	72	67	69	66	66	63	52	72	72
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1		72	72	67	69	66	66	63	52	72	72
8	LGH100RVX-E Exhaust air Levels Ground Zone 2		72	72	67	69	66	66	63	52	72	72
9	LGH100RVX-E Fresh air Levels Ground Zone 2		72	72	67	69	66	66	63	52	72	72
10	LGH100RVX-E Exhaust air Levels Ground Zone 1		72	72	67	69	66	66	63	52	72	72
11	LGH100RVX-E Fresh air Levels Ground Zone 1		72	72	67	69	66	66	63	52	72	72
12	LGH100RVX-E Exhaust air Levels Basement		72	72	67	69	66	66	63	52	72	72
13	LGH100RVX-E Fresh air Levels Ground Basement		72	72	67	69	66	66	63	52	72	72
14	LG100RVX-E Exhaust 6th Floor		72	72	67	69	66	66	63	52	72	72
15	LG100RVX-E Fresh air 6th Floor		72	72	67	69	66	66	63	52	72	72
16	PUHZ-ZRP140VKA2	1.00	62	55	53	50	47	42	38	30	52	60
17	Future wall mounted condenser ground	1.00	62	57	52	49	43	35	30	25	50	58
18	Future condensers roof	1.00	62	57	52	49	43	35	30	25	50	58
19	Future condensers roof	1.00	62	57	52	49	43	35	30	25	50	58
21	RYYQ10T	1.00	62	65	57	58	51	48	41	35	58	66

Ref.	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	dB	Façade correction	dB
1	31.0	-38	33	13	11	None	0	0	0	0	0	0	0	0	0	Yes	3
2	18.0	-33	44	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
3	26.0	-36	41	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
4	23.0	-35	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
5	23.0	-35	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
6	23.0	-35	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
7	23.0	-35	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
8	18.0	-33	39	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
9	12.5	-30	42	1	0	45(-3dB)	-3	-3	-3	-3	-3	-3	-3	-3	0	Yes	3
10	18.0	-33	39	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
11	12.5	-30	42	1	0	45(-3dB)	-3	-3	-3	-3	-3	-3	-3	-3	0	Yes	3
12	18.0	-33	39	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
13	12.5	-30	42	1	0	None	0	0	0	0	0	0	0	0	0	Yes	3
14	28.0	-37	35	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
15	28.0	-37	35	1	0	45(-3dB)	-3	-3	-3	-3	-3	-3	-3	-3	0	Yes	3
16	23.0	-35	25	1	0	None	0	0	0	0	0	0	0	0	3	Yes	3
17	12.5	-30	28	1	0	None	0	0	0	0	0	0	0	0	3	Yes	3
18	31.0	-38	20	6	8	None	0	0	0	0	0	0	0	0	0	Yes	3
19	31.0	-38	20	5	7	None	0	0	0	0	0	0	0	0	0	Yes	3
21	31.0	-38	28	1	0	None	0	0	0	0	0	0	0	0	0	Yes	3

Ref.	Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k	Additional Attenuation 63	125	250	500	1k	2k	4k	8k
1									7	7	10	17	29	30	27	21
2	-11	-8	-4	-2	-1	-1	-1	-1	4	4	6	8	11	11	11	10
3	-5	-2	0	0	0	0	0	0	3	6	12	18	14	8	5	2
4	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
5	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
6	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
7	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
8	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
9	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
10	-14	-9	-5	-3	-2	-3	-3	-3	4	4	6	8	11	11	11	10
11	-14	-9	-5	-5	-5	-7	-7	-7	4	4	6	8	11	11	11	10
12	-15	-11	-7	-8	-10	-13	-13	-13	4	4	6	8	11	11	11	10
13	-15	-11	-7	-7	-8	-10	-10	-10	4	4	6	8	11	11	11	10
14	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
15	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
16																
17																
18									7	7	10	17	29	30	27	21
19									7	7	10	17	29	30	27	21
21									7	7	10	17	29	30	27	21

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	57	52	48	45	39	32	27	21	46
2	AVT 4 Outlet duct	47	42	37	39	34	31	26	19	40
3	AVT 6-R Open Outlet	37	40	37	36	32	29	23	14	38
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	40	40	35	37	34	34	31	20	41
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	40	40	35	37	34	34	31	20	41
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	40	40	35	37	34	34	31	20	41
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	40	40	35	37	34	34	31	20	41
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	35	35	30	32	29	29	26	15	36
9	LGH100RVX-E Fresh air Levels Ground Zone 2	42	42	37	39	36	36	33	22	42
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	35	35	30	32	29	29	26	15	36
11	LGH100RVX-E Fresh air Levels Ground Zone 1	42	42	37	39	36	36	33	22	42
12	LGH100RVX-E Exhaust air Levels Basement	35	35	30	32	29	29	26	15	36
13	LGH100RVX-E Fresh air Levels Ground Basement	45	45	40	42	39	39	36	25	45
14	LG100RVX-E Exhaust 6th Floor	32	32	27	29	26	26	23	12	32
15	LG100RVX-E Fresh air 6th Floor	35	35	30	32	29	29	26	15	35
16	PUHZ-ZRP140VKA2	40	33	31	28	25	20	16	8	30
17	Future wall mounted condenser ground	46	41	36	33	27	19	14	9	34
18	Future condensers roof	42	37	32	29	23	15	10	5	31
19	Future condensers roof	42	37	32	29	23	15	10	5	30
21	RYYQ10T	35	38	30	31	24	21	14	8	31
	Total	**59**	**55**	**51**	**50**	**46**	**45**	**42**	**32**	**53**

Ref.	Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1	1.0				31.0	-0.98	0	0	0	0	0	0	0	0
2	1.0				18.0	-0.97	0	0	0	0	0	0	0	0
3	1.0				26.0	-0.98	0	0	0	0	0	0	0	0
4	1.0				23.0	-0.98	0	0	0	0	0	0	0	0
5	1.0				23.0	-0.98	0	0	0	0	0	0	0	0
6	1.0				23.0	-0.98	0	0	0	0	0	0	0	0
7	1.0				23.0	-0.98	0	0	0	0	0	0	0	0
8	1.0				18.0	-0.97	0	0	0	0	0	0	0	0
9	1.0				12.5	-0.96	0	0	0	0	0	0	0	0
10	1.0				18.0	-0.97	0	0	0	0	0	0	0	0
11	1.0				12.5	-0.96	0	0	0	0	0	0	0	0
12	1.0				18.0	-0.97	0	0	0	0	0	0	0	0
13	1.0				12.5	-0.96	0	0	0	0	0	0	0	0
14	1.0				28.0	-0.98	0	0	0	0	0	0	0	0
15	1.0				28.0	-0.98	0	0	0	0	0	0	0	0
16	1.0				23.0	-0.98	0	0	0	0	0	0	0	0
17	1.0				12.5	-0.96	0	0	0	0	0	0	0	0
18	1.0				31.0	-0.98	0	0	0	0	0	0	0	0
19	1.0				31.0	-0.98	0	0	0	0	0	0	0	0
21	1.0				31.0	-0.98	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
32	61	50	42	36	32	29	27	25	41

Barrier SRI	63	125	250	500	1k	2k	4k	8k
Manual								
CS300	5	6	8	12	19	19	18	17

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	-3	2	7	9	7	3	0	-4	5
2	AVT 4 Outlet duct	-13	-7	-4	3	2	2	0	-6	-1
3	AVT 6-R Open Outlet	-24	-10	-5	0	0	0	-3	-11	-3
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	-21	-10	-7	1	2	5	5	-5	-1
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	-21	-10	-7	1	2	5	5	-5	-1
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	-21	-10	-7	1	2	5	5	-5	-1
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	-21	-10	-7	1	2	5	5	-5	-1
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	-25	-14	-11	-4	-3	0	0	-10	-5
9	LGH100RVX-E Fresh air Levels Ground Zone 2	-19	-8	-5	3	4	7	6	-3	1
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	-25	-14	-11	-4	-3	0	0	-10	-5
11	LGH100RVX-E Fresh air Levels Ground Zone 1	-19	-8	-5	3	4	7	6	-3	1
12	LGH100RVX-E Exhaust air Levels Basement	-25	-14	-11	-4	-3	0	0	-10	-5
13	LGH100RVX-E Fresh air Levels Ground Basement	-16	-5	-2	6	7	10	9	0	4
14	LG100RVX-E Exhaust 6th Floor	-29	-18	-15	-7	-6	-3	-4	-13	-9
15	LG100RVX-E Fresh air 6th Floor	-26	-15	-12	-4	-3	0	-1	-10	-6
16	PUHZ-ZRP140VKA2	-21	-17	-10	-8	-7	-9	-10	-17	-11
17	Future wall mounted condenser ground	-15	-9	-6	-3	-5	-10	-13	-16	-7
18	Future condensers roof	-18	-12	-9	-7	-9	-14	-16	-20	-10
19	Future condensers roof	-19	-13	-10	-7	-9	-14	-17	-20	-11
21	RYYQ10T	-26	-12	-12	-5	-8	-8	-13	-17	-10
	Total	-2	6	9	14	14	16	15	7	12

Barrier Deration	63	125	250	500	1k	2k	4k	8k
PURY-EP350YLM-A	1	1	1	0	0	0	0	0
AVT 4 Outlet duct	1	1	1	0	0	0	0	0
AVT 6-R Open Outlet	1	1	1	0	0	0	0	0
LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	1	1	1	0	0	0	0	0
LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	1	1	1	0	0	0	0	0
LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	1	1	1	0	0	0	0	0
LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	1	1	1	0	0	0	0	0
LGH100RVX-E Exhaust air Levels Ground Zone 2	1	1	1	0	0	0	0	0
LGH100RVX-E Fresh air Levels Ground Zone 2	1	1	1	0	0	0	0	0
LGH100RVX-E Exhaust air Levels Ground Zone 1	1	1	1	0	0	0	0	0
LGH100RVX-E Fresh air Levels Ground Zone 1	1	1	1	0	0	0	0	0
LGH100RVX-E Exhaust air Levels Basement	1	1	1	0	0	0	0	0
LGH100RVX-E Fresh air Levels Ground Basement	1	1	1	0	0	0	0	0
LG100RVX-E Exhaust 6th Floor	1	1	1	0	0	0	0	0
LG100RVX-E Fresh air 6th Floor	1	1	1	0	0	0	0	0
PUHZ-ZRP140VKA2	1	1	1	0	0	0	0	0
Future wall mounted condenser ground	1	1	1	0	0	0	0	0
Future condensers roof	1	1	1	0	0	0	0	0
Future condensers roof	1	1	1	0	0	0	0	0
RYYQ10T	1	1	1	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	51	46	39	28	10	2	0	0	35
2	AVT 4 Outlet duct	33	32	29	30	22	19	14	8	30
3	AVT 6-R Open Outlet	30	33	26	18	18	21	18	12	27
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	23	28	25	25	19	17	14	4	26
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	23	28	25	25	19	17	14	4	26
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	23	28	25	25	19	17	14	4	26
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	23	28	25	25	19	17	14	4	26
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	18	23	20	20	14	12	9	-1	21
9	LGH100RVX-E Fresh air Levels Ground Zone 2	25	30	27	29	25	25	22	12	31
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	18	23	20	21	16	15	12	2	23
11	LGH100RVX-E Fresh air Levels Ground Zone 1	24	29	26	26	20	18	15	5	27
12	LGH100RVX-E Exhaust air Levels Basement	17	22	19	17	8	5	2	-8	17
13	LGH100RVX-E Fresh air Levels Ground Basement	26	31	28	27	19	17	14	4	27
14	LG100RVX-E Exhaust 6th Floor	15	20	17	19	15	15	12	2	21
15	LG100RVX-E Fresh air 6th Floor	18	23	20	22	18	18	15	5	24
16	PUHZ-ZRP140VKA2	41	34	32	28	25	20	16	8	31
17	Future wall mounted condenser ground	47	42	37	33	27	19	14	9	34
18	Future condensers roof	36	31	23	12	-6	-15	-17	-16	19
19	Future condensers roof	36	31	23	12	-6	-15	-17	-16	18
21	RYYQ10T	29	32	21	14	-5	-9	-13	-13	18
	Total	**53**	**49**	**43**	**39**	**33**	**31**	**27**	**19**	**41**

Net barrier loss	63	125	250	500	1k	2k	4k	8k
PURY-EP350YLM-A	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
AVT 4 Outlet duct	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
AVT 6-R Open Outlet	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Exhaust air Levels Ground Zone 2	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Fresh air Levels Ground Zone 2	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Exhaust air Levels Ground Zone 1	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Fresh air Levels Ground Zone 1	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Exhaust air Levels Basement	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LGH100RVX-E Fresh air Levels Ground Basement	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LG100RVX-E Exhaust 6th Floor	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
LG100RVX-E Fresh air 6th Floor	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
PUHZ-ZRP140VKA2	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
Future wall mounted condenser ground	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
Future condensers roof	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
Future condensers roof	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
RYYQ10T	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**

Red lion Street toward the north:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	dB	Façade correction	dB	Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k	Additional Attenuation 63	125	250	500	1k	2k	4k	8k
1	PURY-EP350YLM-A	1.00	74	69	65	62	56	48	43	38	62	70	9.0	-27	43	13	11	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3								7	7	10	17	29	30	27	21
2	AVT 4 Outlet duct		84	79	74	76	71	68	63	56	77	77	25.0	-36	41	1	0	None	0	0	0	0	0	0	0	0	0	Yes	3	-11	-8	-4	-2	-1	-1	-1	-1	4	4	6	8	11	11	11	10
3	AVT 6-R Open Outlet		77	80	77	76	72	69	63	54	78	78	27.0	-37	41	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-5	-2	0	0	0	0	0	0	3	6	12	18	14	8	5	2
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2		72	72	67	69	66	66	63	52	72	72	24.0	-36	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2		72	72	67	69	66	66	63	52	72	72	24.0	-36	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1		72	72	67	69	66	66	63	52	72	72	24.0	-36	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1		72	72	67	69	66	66	63	52	72	72	24.0	-36	37	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
8	LGH100RVX-E Exhaust air Levels Ground Zone 2		72	72	67	69	66	66	63	52	72	72	32.0	-38	34	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
9	LGH100RVX-E Fresh air Levels Ground Zone 2		72	72	67	69	66	66	63	52	72	72	26.0	-36	36	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
10	LGH100RVX-E Exhaust air Levels Ground Zone 1		72	72	67	69	66	66	63	52	72	72	32.0	-38	34	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-14	-9	-5	-3	-2	-3	-3	-3	4	4	6	8	11	11	11	10
11	LGH100RVX-E Fresh air Levels Ground Zone 1		72	72	67	69	66	66	63	52	72	72	26.0	-36	36	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-5	-5	-7	-7	-7	4	4	6	8	11	11	11	10
12	LGH100RVX-E Exhaust air Levels Basement		72	72	67	69	66	66	63	52	72	72	32.0	-38	34	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-15	-11	-7	-8	-10	-13	-13	-13	4	4	6	8	11	11	11	10
13	LGH100RVX-E Fresh air Levels Ground Basement		72	72	67	69	66	66	63	52	72	72	26.0	-36	36	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-15	-11	-7	-7	-8	-10	-10	-10	4	4	6	8	11	11	11	10
14	LG100RVX-E Exhaust 6th Floor		72	72	67	69	66	66	63	52	72	72	27.0	-37	36	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
15	LG100RVX-E Fresh air 6th Floor		72	72	67	69	66	66	63	52	72	72	27.0	-37	36	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
16	PUHZ-ZRP140VKA2	1.00	62	55	53	50	47	42	38	30	52	60	10.0	-28	32	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	3	Yes	3																
17	Future wall mounted condenser ground	1.00	62	57	52	49	43	35	30	25	50	58	24.0	-36	22	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	3	Yes	3																
18	Future condensers roof	1.00	62	57	52	49	43	35	30	25	50	58	9.0	-27	31	6	8	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3								7	7	10	17	29	30	27	21
19	Future condensers roof	1.00	62	57	52	49	43	35	30	25	50	58	9.0	-27	31	5	7	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3								7	7	10	17	29	30	27	21
20	RYYQ10T	1.00	62	65	57	58	51	48	41	35	58	66	9.0	-27	39	1	0	90(-6dB)	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3								7	7	10	17	29	30	27	21

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	62	57	53	50	44	37	32	26	51
2	AVT 4 Outlet duct	51	46	41	43	38	35	30	23	43
3	AVT 6-R Open Outlet	37	40	37	36	32	29	23	14	37
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	40	40	35	37	34	34	31	20	40
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	40	40	35	37	34	34	31	20	40
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	40	40	35	37	34	34	31	20	40
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	40	40	35	37	34	34	31	20	40
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	27	27	22	24	21	21	18	7	28
9	LGH100RVX-E Fresh air Levels Ground Zone 2	32	32	27	29	26	26	23	12	32
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	27	27	22	24	21	21	18	7	28
11	LGH100RVX-E Fresh air Levels Ground Zone 1	32	32	27	29	26	26	23	12	32
12	LGH100RVX-E Exhaust air Levels Basement	27	27	22	24	21	21	18	7	28
13	LGH100RVX-E Fresh air Levels Ground Basement	32	32	27	29	26	26	23	12	32
14	LG100RVX-E Exhaust 6th Floor	29	29	24	26	23	23	20	9	29
15	LG100RVX-E Fresh air 6th Floor	32	32	27	29	26	26	23	12	32
16	PUHZ-ZRP140VKA2	39	32	30	27	24	19	15	7	29
17	Future wall mounted condenser ground	31	26	21	18	12	4	-1	-6	19
18	Future condensers roof	47	42	37	34	28	20	15	10	35
19	Future condensers roof	46	41	36	33	27	19	14	9	34
20	RYYQ10T	39	42	34	36	28	25	18	12	36
	Total	**63**	**58**	**54**	**52**	**47**	**43**	**39**	**31**	**53**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
19.7	18.0			9.0	-30.67	0	0	0	0	0	0	0	0
18.7	18.0			25.0	-24.50	0	0	0	0	0	0	0	0
1.0	18.0			27.0	-1.54	0	0	0	0	0	0	0	0
15.0	18.0			24.0	-20.81	0	0	0	0	0	0	0	0
15.0	18.0			24.0	-20.81	0	0	0	0	0	0	0	0
15.0	18.0			24.0	-20.81	0	0	0	0	0	0	0	0
15.0	18.0			24.0	-20.81	0	0	0	0	0	0	0	0
3.0	18.0			32.0	-4.37	0	0	0	0	0	0	0	0
3.0	18.0			26.0	-4.61	0	0	0	0	0	0	0	0
3.0	18.0			32.0	-4.37	0	0	0	0	0	0	0	0
3.0	18.0			26.0	-4.61	0	0	0	0	0	0	0	0
1.0	18.0			32.0	-1.48	0	0	0	0	0	0	0	0
1.0	18.0			26.0	-1.56	0	0	0	0	0	0	0	0
19.0	18.0			27.0	-24.43	0	0	0	0	0	0	0	0
19.0	18.0			27.0	-24.43	0	0	0	0	0	0	0	0
6.0	18.0			10.0	-10.97	0	0	0	0	0	0	0	0
6.0	18.0			24.0	-9.17	0	0	0	0	0	0	0	0
19.7	18.0			9.0	-30.67	0	0	0	0	0	0	0	0
19.7	18.0			9.0	-30.67	0	0	0	0	0	0	0	0
19.7	18.0			9.0	-30.67	0	0	0	0	0	0	0	0

Criteria	63	125	250	500	1k	2k	4k	8k	dB(A)
NR	61	50	42	36	32	29	27	25	41

Barrier SRI		63	125	250	500	1k	2k	4k	8k
	Manual								
	Unknown	100	100	100	100	100	100	100	100

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	1	7	11	14	12	8	5	1	10
2	AVT 4 Outlet duct	-10	-4	-1	7	6	6	3	-2	2
3	AVT 6-R Open Outlet	-24	-10	-5	0	0	0	-4	-11	-4
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	-21	-10	-7	1	2	5	4	-5	-1
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	-21	-10	-7	1	2	5	4	-5	-1
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	-21	-10	-7	1	2	5	4	-5	-1
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	-21	-10	-7	1	2	5	4	-5	-1
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	-33	-22	-19	-12	-11	-8	-8	-18	-13
9	LGH100RVX-E Fresh air Levels Ground Zone 2	-29	-18	-15	-7	-6	-3	-3	-13	-9
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	-33	-22	-19	-12	-11	-8	-8	-18	-13
11	LGH100RVX-E Fresh air Levels Ground Zone 1	-29	-18	-15	-7	-6	-3	-3	-13	-9
12	LGH100RVX-E Exhaust air Levels Basement	-33	-22	-19	-12	-11	-8	-8	-18	-13
13	LGH100RVX-E Fresh air Levels Ground Basement	-29	-18	-15	-7	-6	-3	-3	-13	-9
14	LG100RVX-E Exhaust 6th Floor	-32	-21	-18	-10	-9	-6	-7	-16	-12
15	LG100RVX-E Fresh air 6th Floor	-29	-18	-15	-7	-6	-3	-4	-13	-9
16	PUHZ-ZRP140VKA2	-22	-18	-12	-9	-9	-10	-12	-18	-12
17	Future wall mounted condenser ground	-30	-24	-21	-18	-20	-25	-28	-31	-22
18	Future condensers roof	-14	-8	-5	-2	-4	-9	-12	-15	-6
19	Future condensers roof	-14	-8	-5	-3	-5	-10	-12	-16	-7
20	RYYQ10T	-21	-7	-7	-1	-4	-4	-8	-13	-5
	Total	2	8	12	16	15	14	13	6	12

Barrier Deration		63	125	250	500	1k	2k	4k	8k
	PURY-EP350YLM-A	0	0	0	0	0	0	0	0
	AVT 4 Outlet duct	0	0	0	0	0	0	0	0
	AVT 6-R Open Outlet	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust air Levels Ground Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels Ground Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust air Levels Ground Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels Ground Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust air Levels Basement	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels Ground Basement	0	0	0	0	0	0	0	0
	LG100RVX-E Exhaust 6th Floor	0	0	0	0	0	0	0	0
	LG100RVX-E Fresh air 6th Floor	0	0	0	0	0	0	0	0
	PUHZ-ZRP140VKA2	0	0	0	0	0	0	0	0
	Future wall mounted condenser ground	0	0	0	0	0	0	0	0
	Future condensers roof	0	0	0	0	0	0	0	0
	Future condensers roof	0	0	0	0	0	0	0	0
	RYYQ10T	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	55	50	43	33	15	7	5	5	38
2	AVT 4 Outlet duct	36	34	31	33	25	22	17	11	33
3	AVT 6-R Open Outlet	29	32	25	18	18	21	18	12	26
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	22	27	24	25	19	17	14	4	26
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	22	27	24	25	19	17	14	4	26
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	22	27	24	25	19	17	14	4	26
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	22	27	24	25	19	17	14	4	26
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	9	14	11	12	6	4	1	-9	13
9	LGH100RVX-E Fresh air Levels Ground Zone 2	14	19	16	19	15	15	12	2	22
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	9	14	11	13	8	7	4	-6	15
11	LGH100RVX-E Fresh air Levels Ground Zone 1	14	19	16	17	10	8	5	-5	17
12	LGH100RVX-E Exhaust air Levels Basement	8	13	10	9	0	-3	-6	-16	9
13	LGH100RVX-E Fresh air Levels Ground Basement	13	17	14	14	7	5	2	-8	15
14	LG100RVX-E Exhaust 6th Floor	11	16	13	16	12	12	9	-1	18
15	LG100RVX-E Fresh air 6th Floor	14	19	16	19	15	15	12	2	21
16	PUHZ-ZRP140VKA2	39	32	30	27	24	19	15	7	29
17	Future wall mounted condenser ground	31	26	21	18	12	4	-1	-6	19
18	Future condensers roof	40	35	27	17	-1	-10	-12	-11	23
19	Future condensers roof	39	34	26	16	-2	-11	-13	-12	22
20	RYYQ10T	32	35	24	18	-1	-5	-9	-9	22
	Total	**55**	**51**	**44**	**38**	**30**	**28**	**25**	**17**	**41**

Net barrier loss		63	125	250	500	1k	2k	4k	8k
	PURY-EP350YLM-A	0	0	0	0	0	0	0	0
	AVT 4 Outlet duct	0	0	0	0	0	0	0	0
	AVT 6-R Open Outlet	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust air Levels Ground Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels Ground Zone 2	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust air Levels Ground Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels Ground Zone 1	0	0	0	0	0	0	0	0
	LGH100RVX-E Exhaust air Levels Basement	0	0	0	0	0	0	0	0
	LGH100RVX-E Fresh air Levels Ground Basement	0	0	0	0	0	0	0	0
	LG100RVX-E Exhaust 6th Floor	0	0	0	0	0	0	0	0
	LG100RVX-E Fresh air 6th Floor	0	0	0	0	0	0	0	0
	PUHZ-ZRP140VKA2	0	0	0	0	0	0	0	0
	Future wall mounted condenser ground	0	0	0	0	0	0	0	0
	Future condensers roof	0	0	0	0	0	0	0	0
	Future condensers roof	0	0	0	0	0	0	0	0
	RYYQ10T	0	0	0	0	0	0	0	0

Red lion Street towards the west:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality
1	PURY-EP350YLM-A	1.00	74	69	65	62	56	48	43	38	62	70	24.0	-36	35	13	11	None
2	AVT 4 Outlet duct		84	79	74	76	71	68	63	56	77	77	32.0	-38	39	1	0	180(-9dB)
3	AVT 6-R Open Outlet		77	80	77	76	72	69	63	54	78	78	22.0	-35	43	1	0	90(-6dB)
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2		72	72	67	69	66	66	63	52	72	72	28.0	-37	35	5	7	90(-6dB)
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2		72	72	67	69	66	66	63	52	72	72	28.0	-37	35	5	7	90(-6dB)
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1		72	72	67	69	66	66	63	52	72	72	28.0	-37	35	5	7	90(-6dB)
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1		72	72	67	69	66	66	63	52	72	72	28.0	-37	35	5	7	90(-6dB)
8	LGH100RVX-E Exhaust air Levels Ground Zone 2		72	72	67	69	66	66	63	52	72	72	39.0	-40	32	1	0	90(-6dB)
9	LGH100RVX-E Fresh air Levels Ground Zone 2		72	72	67	69	66	66	63	52	72	72	32.0	-38	34	1	0	90(-6dB)
10	LGH100RVX-E Exhaust air Levels Ground Zone 1		72	72	67	69	66	66	63	52	72	72	39.0	-40	32	1	0	90(-6dB)
11	LGH100RVX-E Fresh air Levels Ground Zone 1		72	72	67	69	66	66	63	52	72	72	32.0	-38	34	1	0	90(-6dB)
12	LGH100RVX-E Exhaust air Levels Basement		72	72	67	69	66	66	63	52	72	72	39.0	-40	32	1	0	90(-6dB)
13	LGH100RVX-E Fresh air Levels Ground Basement		72	72	67	69	66	66	63	52	72	72	32.0	-38	34	1	0	90(-6dB)
14	LG100RVX-E Exhaust 6th Floor		72	72	67	69	66	66	63	52	72	72	22.0	-35	37	1	0	90(-6dB)
15	LG100RVX-E Fresh air 6th Floor		72	72	67	69	66	66	63	52	72	72	22.0	-35	37	1	0	180(-9dB)
16	PUHZ-ZRP140VKA2	1.00	62	55	53	50	47	42	38	30	52	60	23.0	-35	25	1	0	180(-9dB)
17	Future wall mounted condenser ground	1.00	62	57	52	49	43	35	30	25	50	58	12.5	-30	28	1	0	180(-9dB)
18	Future condensers roof	1.00	62	57	52	49	43	35	30	25	50	58	24.0	-36	22	6	8	None
19	Future condensers roof	1.00	62	57	52	49	43	35	30	25	50	58	24.0	-36	22	5	7	None
20	RYYQ10T	1.00	62	65	57	58	51	48	41	35	58	66	24.0	-36	31	1	0	None

Ref.	63	125	250	500	1k	2k	4k	8k	dB	Façade correction	dB
1	0	0	0	0	0	0	0	0	0	Yes	3
2	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3
3	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
4	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
5	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
6	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
7	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
8	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
9	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
10	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
11	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
12	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
13	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
14	-6	-6	-6	-6	-6	-6	-6	-6	0	Yes	3
15	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3
16	-9	-9	-9	-9	-9	-9	-9	-9	3	Yes	3
17	-9	-9	-9	-9	-9	-9	-9	-9	3	Yes	3
18	0	0	0	0	0	0	0	0	0	Yes	3
19	0	0	0	0	0	0	0	0	0	Yes	3
20	0	0	0	0	0	0	0	0	0	Yes	3

Ref.	Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k	Additional Attenuation 63	125	250	500	1k	2k	4k	8k
1									7	7	10	17	29	30	27	21
2	-11	-8	-4	-2	-1	-1	-1	-1	4	4	6	8	11	11	11	10
3	-5	-2	0	0	0	0	0	0	3	6	12	18	14	8	5	2
4	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
5	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
6	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
7	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
8	-14	-9	-5	-4	-4	-6	-6	-6	4	4	6	8	11	11	11	10
9	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
10	-14	-9	-5	-3	-2	-3	-3	-3	4	4	6	8	11	11	11	10
11	-14	-9	-5	-5	-5	-7	-7	-7	4	4	6	8	11	11	11	10
12	-15	-11	-7	-8	-10	-13	-13	-13	4	4	6	8	11	11	11	10
13	-15	-11	-7	-7	-8	-10	-10	-10	4	4	6	8	11	11	11	10
14	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
15	-14	-9	-5	-2	0	0	0	0	4	4	6	8	11	11	11	10
16																
17																
18									7	7	10	17	29	30	27	21
19									7	7	10	17	29	30	27	21
20									7	7	10	17	29	30	27	21

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	60	55	51	48	42	35	30	24	49
2	AVT 4 Outlet duct	40	35	30	32	27	24	19	12	33
3	AVT 6-R Open Outlet	39	42	39	38	34	31	25	16	40
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	39	39	34	36	33	33	30	19	39
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	39	39	34	36	33	33	30	19	39
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	39	39	34	36	33	33	30	19	39
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	39	39	34	36	33	33	30	19	39
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	29	29	24	26	23	23	20	9	29
9	LGH100RVX-E Fresh air Levels Ground Zone 2	31	31	26	28	25	25	22	11	31
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	29	29	24	26	23	23	20	9	29
11	LGH100RVX-E Fresh air Levels Ground Zone 1	31	31	26	28	25	25	22	11	31
12	LGH100RVX-E Exhaust air Levels Basement	29	29	24	26	23	23	20	9	29
13	LGH100RVX-E Fresh air Levels Ground Basement	31	31	26	28	25	25	22	11	31
14	LG100RVX-E Exhaust 6th Floor	34	34	29	31	28	28	25	14	34
15	LG100RVX-E Fresh air 6th Floor	31	31	26	28	25	25	22	11	31
16	PUHZ-ZRP140VKA2	32	25	23	20	17	12	8	0	22
17	Future wall mounted condenser ground	37	32	27	24	18	10	5	0	25
18	Future condensers roof	45	40	35	32	26	18	13	8	33
19	Future condensers roof	44	39	34	31	25	17	12	7	32
20	RYYQ10T	37	40	32	33	26	23	16	10	34
Total		**64**	**59**	**55**	**53**	**48**	**45**	**41**	**32**	**55**

Barrier Path Difference Loss:

Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
19.7	18.0	0.0		24.0	-25.64	0	0	0	0	0	0	0	0
18.7	18.0	0.0		32.0	-23.41	0	0	0	0	0	0	0	0
1.0	18.0	18.0	16.0	6.0	1.54	-12	-14	-17	-20	-23	-24	-24	-24
15.0	18.0	18.0	2.0	26.0	1.45	-11	-14	-17	-19	-22	-24	-24	-24
15.0	18.0	18.0	2.0	26.0	1.45	-11	-14	-17	-19	-22	-24	-24	-24
15.0	18.0	18.0	4.0	24.0	0.84	-10	-12	-14	-17	-20	-23	-24	-24
15.0	18.0	18.0	4.0	24.0	0.84	-10	-12	-14	-17	-20	-23	-24	-24
3.0	18.0	18.0	0.1	38.9	12.12	-20	-23	-24	-24	-24	-24	-24	-24
3.0	18.0	18.0	8.0	24.0	5.66	-17	-19	-22	-24	-24	-24	-24	-24
3.0	18.0	18.0		39.0	12.21	-20	-23	-24	-24	-24	-24	-24	-24
3.0	18.0	18.0		32.0	11.66	-20	-22	-24	-24	-24	-24	-24	-24
1.0	18.0	18.0	8.0	31.0	7.24	-18	-20	-23	-24	-24	-24	-24	-24
1.0	18.0	18.0		32.0	12.76	-20	-23	-24	-24	-24	-24	-24	-24
19.0	18.0	18.0		22.0	-0.98	0	0	0	0	0	0	0	0
19.0	18.0	18.0		22.0	-0.98	0	0	0	0	0	0	0	0
6.0	18.0	18.0	0.1	22.9	8.96	-18	-21	-24	-24	-24	-24	-24	-24
6.0	18.0	18.0	0.1	12.4	7.07	-17	-20	-23	-24	-24	-24	-24	-24
19.7	18.0	18.0		24.0	-1.64	0	0	0	0	0	0	0	0
19.7	18.0	18.0		24.0	-1.64	0	0	0	0	0	0	0	0
19.7	18.0	18.0		24.0	-1.64	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
32	61	50	42	36	32	29	27	25	41

Barrier SRI	63	125	250	500	1k	2k	4k	8k
Manual								
Unknown	100	100	100	100	100	100	100	100

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	-1	5	9	12	10	6	3	-1	8
2	AVT 4 Outlet duct	-21	-15	-12	-4	-5	-5	-8	-13	-8
3	AVT 6-R Open Outlet	-22	-8	-3	2	2	2	-2	-9	-1
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	-22	-11	-8	0	1	4	3	-6	-2
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	-22	-11	-8	0	1	4	3	-6	-2
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	-22	-11	-8	0	1	4	3	-6	-2
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	-22	-11	-8	0	1	4	3	-6	-2
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	-32	-21	-18	-10	-9	-6	-7	-16	-12
9	LGH100RVX-E Fresh air Levels Ground Zone 2	-30	-19	-16	-8	-7	-4	-5	-14	-10
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	-32	-21	-18	-10	-9	-6	-7	-16	-12
11	LGH100RVX-E Fresh air Levels Ground Zone 1	-30	-19	-16	-8	-7	-4	-5	-14	-10
12	LGH100RVX-E Exhaust air Levels Basement	-32	-21	-18	-10	-9	-6	-7	-16	-12
13	LGH100RVX-E Fresh air Levels Ground Basement	-30	-19	-16	-8	-7	-4	-5	-14	-10
14	LG100RVX-E Exhaust 6th Floor	-27	-16	-13	-5	-4	-1	-2	-11	-7
15	LG100RVX-E Fresh air 6th Floor	-30	-19	-16	-8	-7	-4	-5	-14	-10
16	PUHZ-ZRP140VKA2	-29	-25	-19	-16	-15	-17	-19	-25	-19
17	Future wall mounted condenser ground	-24	-18	-15	-12	-14	-19	-22	-25	-16
18	Future condensers roof	-16	-10	-7	-4	-6	-11	-14	-17	-8
19	Future condensers roof	-16	-10	-7	-5	-7	-12	-14	-18	-9
20	RYYQ10T	-23	-9	-9	-3	-6	-6	-10	-15	-7
Total		3	9	13	17	16	16	15	7	13

Barrier Deration								
PURY-EP350YLM-A	0	0	0	0	0	0	0	0
AVT 4 Outlet duct	0	0	0	0	0	0	0	0
AVT 6-R Open Outlet	0	0	0	0	0	0	0	0
LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	0	0	0	0	0	0	0	0
LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	0	0	0	0	0	0	0	0
LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	0	0	0	0	0	0	0	0
LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	0	0	0	0	0	0	0	0
LGH100RVX-E Exhaust air Levels Ground Zone 2	0	0	0	0	0	0	0	0
LGH100RVX-E Fresh air Levels Ground Zone 2	0	0	0	0	0	0	0	0
LGH100RVX-E Exhaust air Levels Ground Zone 1	0	0	0	0	0	0	0	0
LGH100RVX-E Fresh air Levels Ground Zone 1	0	0	0	0	0	0	0	0
LGH100RVX-E Exhaust air Levels Basement	0	0	0	0	0	0	0	0
LGH100RVX-E Fresh air Levels Ground Basement	0	0	0	0	0	0	0	0
LG100RVX-E Exhaust 6th Floor	0	0	0	0	0	0	0	0
LG100RVX-E Fresh air 6th Floor	0	0	0	0	0	0	0	0
PUHZ-ZRP140VKA2	0	0	0	0	0	0	0	0
Future wall mounted condenser ground	0	0	0	0	0	0	0	0
Future condensers roof	0	0	0	0	0	0	0	0
Future condensers roof	0	0	0	0	0	0	0	0
RYYQ10T	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	PURY-EP350YLM-A	53	48	41	31	13	5	3	3	36
2	AVT 4 Outlet duct	25	23	20	22	15	12	7	1	22
3	AVT 6-R Open Outlet	20	20	10	0	-3	-1	-4	-10	8
4	LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	10	12	6	5	-4	-8	-11	-21	5
5	LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	10	12	6	5	-4	-8	-11	-21	5
6	LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	11	14	9	7	-2	-7	-11	-21	7
7	LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	11	14	9	7	-2	-7	-11	-21	7
8	LGH100RVX-E Exhaust air Levels Ground Zone 2	-8	-6	-11	-10	-16	-18	-21	-31	-9
9	LGH100RVX-E Fresh air Levels Ground Zone 2	-4	-1	-7	-6	-10	-10	-13	-23	-3
10	LGH100RVX-E Exhaust air Levels Ground Zone 1	-9	-6	-11	-9	-14	-15	-18	-28	-7
11	LGH100RVX-E Fresh air Levels Ground Zone 1	-7	-5	-10	-9	-15	-17	-20	-30	-8
12	LGH100RVX-E Exhaust air Levels Basement	-8	-6	-12	-14	-22	-25	-28	-38	-13
13	LGH100RVX-E Fresh air Levels Ground Basement	-8	-7	-11	-11	-18	-20	-23	-33	-11
14	LG100RVX-E Exhaust 6th Floor	16	21	18	21	17	17	14	4	24
15	LG100RVX-E Fresh air 6th Floor	13	18	15	18	14	14	11	1	21
16	PUHZ-ZRP140VKA2	13	3	-1	-4	-7	-12	-16	-24	-2
17	Future wall mounted condenser ground	20	12	4	0	-6	-14	-19	-24	2
18	Future condensers roof	38	33	25	15	-3	-12	-14	-13	21
19	Future condensers roof	37	32	24	14	-4	-13	-15	-14	20
20	RYYQ10T	30	33	22	16	-3	-7	-11	-11	20
Total		**56**	**51**	**44**	**35**	**24**	**23**	**20**	**12**	**40**

Net barrier loss								
PURY-EP350YLM-A	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
AVT 4 Outlet duct	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
AVT 6-R Open Outlet	**-12**	**-14**	**-17**	**-20**	**-23**	**-24**	**-24**	**-24**
LGH100RVX-E Exhaust Levels 1 - 5 Zone 2	**-11**	**-14**	**-17**	**-19**	**-22**	**-24**	**-24**	**-24**
LGH100RVX-E Fresh air Levels 1 - 5 Zone 2	**-11**	**-14**	**-17**	**-19**	**-22**	**-24**	**-24**	**-24**
LGH100RVX-E Exhaust Levels 1 - 5 Zone 1	**-10**	**-12**	**-14**	**-17**	**-20**	**-23**	**-24**	**-24**
LGH100RVX-E Fresh air Levels 1 - 5 Zone 1	**-10**	**-12**	**-14**	**-17**	**-20**	**-23**	**-24**	**-24**
LGH100RVX-E Exhaust air Levels Ground Zone 2	**-20**	**-23**	**-24**	**-24**	**-24**	**-24**	**-24**	**-24**
LGH100RVX-E Fresh air Levels Ground Zone 2	**-17**	**-19**	**-22**	**-24**	**-24**	**-24**	**-24**	**-24**
LGH100RVX-E Exhaust air Levels Ground Zone 1	**-20**	**-23**	**-24**	**-24**	**-24**	**-24**	**-24**	**-24**
LGH100RVX-E Fresh air Levels Ground Zone 1	**-20**	**-22**	**-24**	**-24**	**-24**	**-24**	**-24**	**-24**
LGH100RVX-E Exhaust air Levels Basement	**-18**	**-20**	**-23**	**-24**	**-24**	**-24**	**-24**	**-24**
LGH100RVX-E Fresh air Levels Ground Basement	**-20**	**-23**	**-24**	**-24**	**-24**	**-24**	**-24**	**-24**
LG100RVX-E Exhaust 6th Floor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
LG100RVX-E Fresh air 6th Floor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
PUHZ-ZRP140VKA2	**-18**	**-21**	**-24**	**-24**	**-24**	**-24**	**-24**	**-24**
Future wall mounted condenser ground	**-17**	**-20**	**-23**	**-24**	**-24**	**-24**	**-24**	**-24**
Future condensers roof	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Future condensers roof	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
RYYQ10T	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Emergency Plant

22 Sandland Street:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	Powerhouse Series PHG220Do Generator	7.00	66	67	67	67	65	63	60	55	70	95
2	Smoke Extract break out		80	76	67	69	67	62	65	58	72	72
3	Smoke Extract outlet		89	95	92	94	91	88	82	80	96	96

Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	dB	Façade correction	dB	Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k	Additional Attenuation 63	125	250	500	1k	2k	4k	8k
31.0	-38	57	1	0	None	0	0	0	0	0	0	0	0	0	Yes	3									7	7	10	17	29	30	27	21
31.0	-38	35	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3																
31.0	-38	58	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-4	-1	0	0	0	0	0	0								

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	56	57	57	57	55	53	50	45	60
2	Smoke Extract break out	36	32	23	25	23	18	21	14	28
3	Smoke Extract outlet	45	51	48	50	47	44	38	36	52
	Total	**56**	**58**	**57**	**57**	**55**	**53**	**50**	**45**	**60**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				31.0	-0.98	0	0	0	0	0	0	0	0
1.0				31.0	-0.98	0	0	0	0	0	0	0	0
1.0				31.0	-0.98	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
46	72	62	55	50	46	43	41	39	54

Barrier SRI		63	125	250	500	1k	2k	4k	8k
	Manual								
	Unknown	100	100	100	100	100	100	100	100

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	-16	-5	2	7	9	9	9	5	6
2	Smoke Extract break out	-36	-30	-32	-25	-23	-26	-20	-26	-26
3	Smoke Extract outlet	-27	-11	-7	0	1	0	-3	-4	-2
	Total	-16	-4	2	8	9	10	9	6	6

Barrier Deration			63	125	250	500	1k	2k	4k	8k
		Powerhouse Series PHG220Do Generator	0	0	0	0	0	0	0	0
		Smoke Extract break out	0	0	0	0	0	0	0	0
		Smoke Extract outlet	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	49	50	47	40	26	23	23	24	41
2	Smoke Extract break out	36	32	23	25	23	18	21	14	28
3	Smoke Extract outlet	41	50	48	50	47	44	38	36	52
	Total	**49**	**53**	**50**	**50**	**47**	**44**	**38**	**36**	**52**

Net barrier loss			63	125	250	500	1k	2k	4k	8k
		Powerhouse Series PHG220Do Generator	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Smoke Extract break out	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Smoke Extract outlet	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Red lion Street toward the north:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)
1	Powerhouse Series PHG220Do Generator	7.00	66	67	67	67	65	63	60	55	70	95
2	Smoke Extract break out		80	76	67	69	67	62	65	58	72	72
3	Smoke Extract outlet		89	95	92	94	91	88	82	80	96	96

Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	dB	Façade correction	dB	Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k	Additional Attenuation 63	125	250	500	1k	2k	4k	8k
9.0	-27	68	1	0	None	0	0	0	0	0	0	0	0	0	Yes	3									7	7	10	17	29	30	27	21
27.0	-37	36	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3																
27.0	-37	59	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-4	-1	0	0	0	0	0	0								

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	66	67	67	67	65	63	60	55	71
2	Smoke Extract break out	37	33	24	26	24	19	22	15	29
3	Smoke Extract outlet	46	52	49	51	48	45	39	37	53
	Total	**65**	**66**	**66**	**66**	**64**	**62**	**59**	**54**	**70**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				9.0	-0.94	0	0	0	0	0	0	0	0
1.0				27.0	-0.98	0	0	0	0	0	0	0	0
1.0				27.0	-0.98	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
46	72	62	55	50	46	43	41	39	54

Barrier SRI		63	125	250	500	1k	2k	4k	8k
	Manual								
	Unknown	100	100	100	100	100	100	100	100

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	-6	5	13	18	19	20	19	16	17
2	Smoke Extract break out	-35	-29	-31	-24	-22	-24	-19	-25	-25
3	Smoke Extract outlet	-26	-10	-6	1	2	2	-2	-3	-1
	Total	-6	4	12	17	18	19	18	15	16

Barrier Deration			63	125	250	500	1k	2k	4k	8k
		Powerhouse Series PHG220Do Generator	0	0	0	0	0	0	0	0
		Smoke Extract break out	0	0	0	0	0	0	0	0
		Smoke Extract outlet	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	59	60	57	50	36	33	33	34	52
2	Smoke Extract break out	37	33	24	26	24	19	22	15	29
3	Smoke Extract outlet	42	51	49	51	48	45	39	37	53
	Total	**58**	**60**	**57**	**53**	**47**	**44**	**39**	**38**	**54**

Net barrier loss			63	125	250	500	1k	2k	4k	8k
		Powerhouse Series PHG220Do Generator	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Smoke Extract break out	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		Smoke Extract outlet	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Red lion Street towards the west:

Ref.	plant	Ref.dist.	Sound Level (Lp/Lw) 63	125	250	500	1k	2k	4k	8k	dB(A)	Lw dB(A)	Reciever Distance (m)	dB(A)	Lp	No. off	dB	Angular Directionality	63	125	250	500	1k	2k	4k	8k	dB	Façade correction	dB	Duct Losses (input negative values) 63	125	250	500	1k	2k	4k	8k	Additional Attenuation 63	125	250	500	1k	2k	4k	8k
1	Powerhouse Series PHG220Do Generator	7.00	66	67	67	67	65	63	60	55	70	95	24.0	-36	60	1	0	None	0	0	0	0	0	0	0	0	0	Yes	3								7	7	10	17	29	30	27	21
2	Smoke Extract break out		80	76	67	69	67	62	65	58	72	72	24.0	-36	37	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3															
3	Smoke Extract outlet		89	95	92	94	91	88	82	80	96	96	24.0	-36	60	1	0	180(-9dB)	-9	-9	-9	-9	-9	-9	-9	-9	0	Yes	3	-4	-1	0	0	0	0	0	0								

Ref.	plant	Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	58	59	59	59	57	55	52	47	62
2	Smoke Extract break out	38	34	25	27	25	20	23	16	30
3	Smoke Extract outlet	47	53	50	52	49	46	40	38	54
	Total	**58**	**60**	**59**	**60**	**57**	**55**	**52**	**47**	**63**

Barrier Path Difference Loss: Source height	Receiver height	Barrier height	Source to barrier distance	Barrier to receiver distance	Calculated path difference	63	125	250	500	1000	2000	4000	8000
1.0				24.0	-0.98	0	0	0	0	0	0	0	0
1.0				24.0	-0.98	0	0	0	0	0	0	0	0
1.0				24.0	-0.98	0	0	0	0	0	0	0	0

Criteria NR	63	125	250	500	1k	2k	4k	8k	dB(A)
46	72	62	55	50	46	43	41	39	54

Barrier SRI		63	125	250	500	1k	2k	4k	8k
	Manual								
	Unknown	100	100	100	100	100	100	100	100

Ref.	Plant	Excess 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	-14	-3	4	9	11	12	11	7	8
2	Smoke Extract break out	-34	-28	-30	-23	-21	-23	-18	-23	-24
3	Smoke Extract outlet	-25	-9	-5	2	3	3	-1	-1	0
	Total	-14	-2	5	10	11	12	11	8	9

Barrier Deration		63	125	250	500	1k	2k	4k	8k
	Powerhouse Series PHG220Do Generator	0	0	0	0	0	0	0	0
	Smoke Extract break out	0	0	0	0	0	0	0	0
	Smoke Extract outlet	0	0	0	0	0	0	0	0

Ref.	Plant	Mitigated Receiver Lp 63	125	250	500	1k	2k	4k	8k	dB(A)
1	Powerhouse Series PHG220Do Generator	51	52	49	42	28	25	25	26	44
2	Smoke Extract break out	38	34	25	27	25	20	23	16	30
3	Smoke Extract outlet	43	52	50	52	49	46	40	38	54
	Total	**52**	**55**	**52**	**52**	**49**	**46**	**40**	**38**	**54**

Net barrier loss		63	125	250	500	1k	2k	4k	8k
	Powerhouse Series PHG220Do Generator	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Smoke Extract break out	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Smoke Extract outlet	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Appendix E: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

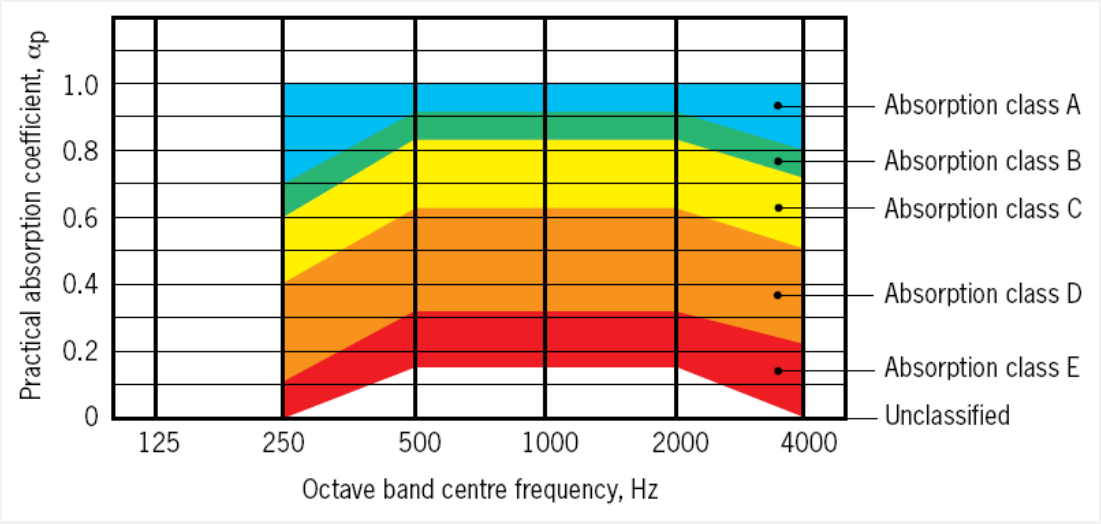
'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

The chart shown below has been extracted from BB93, and demonstrates the characteristics of each class according to BS EN ISO 11654:1997.



Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

Airborne Noise

Noise transmitted through air.

Ambient Noise
The total noise level including all ‘normally experienced’ noise sources.
dB or Decibel
Literally meaning ‘a tenth of a bel’, the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

30 dB + 30 dB ≠ 60 dB	30 dB + 30 dB = 33 dB

$D_{nTw}+C_{tr}$
The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D	Is simply L1 – L2.
D_{nT}	Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.
D_{nTw}	Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.
C_{tr}	Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)
Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.
Impact Noise
Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors. Measured in L'_{nTw}.
Insertion Loss, dB
The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The ‘A’ weighted noise level exceeded for 90% of the time period T, described or measured. The ‘90’ can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The ‘A’ weighted ‘equivalent’ noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The ‘A’ weighted maximum measured noise level. Can be measured with a ‘slow’ (1 sec) or ‘fast’ (0.125 sec) time weighting.

L_{Amin}

The ‘A’ weighted minimum measured noise level.

L'_{nTw}

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

L	Is the spatially averaged impact sound pressure level measured in a receive room.
L'_{nT}	Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.
L'_{nTw}	Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf}, RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to $2x10^{-5}$ Pa.

Speech Intelligibility, Speech Transmission Index (STI)

Speech intelligibility is the measure of how well a speaker's voice can be heard within a given space. Speech intelligibility within a room depends on a number of factors, including reverberation time and background noise.

The Speech Transmission Index or STI has emerged as the favoured method of describing speech intelligibility.

Subjective Effect of Changes in Sound Pressure Level

A basic example to illustrate the assessment of difference in noise levels follows.

A background noise survey is undertaken that yields a lowest background noise level of L_{A90} 30 dB.

As the existing background noise level is low, a rating level for new plant noise of $L_{Aeq,\,T}$ 30 dB is set.

After calculation, the plant noise is predicted to achieve $L_{Aeq,T}$ 30 dB at the nearest residential property.

After the addition of the plant predicted noise level (or Rating Level), the new overall ambient noise level will be 33 dB. The background noise level measured originally will therefore be increased by 3 dB. In terms of the subjective impression of an increase of this order, the change in levels will be 'just perceptible'.

The table below details the subjective effects of variations in sound pressures (adapted from Bies and Hansen).

Difference between background noise and rating levels	Increase in ambient noise level in 'real terms'	Change in apparent loudness
+ 10 dB	+ 10 dB	Twice as loud
+ 5 dB	+ 6 dB	Clearly noticeable
0 dB	+ 3 dB	Just perceptible
-10 dB	0 dB	No change

W

Watts, the SI unit to describe power, after engineer James Watt.