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171 GRAYS INN ROAD

LONDON

WC1X 8UE

ENVIRONMENTAL SOUND SURVEY

& PLANT NOISE EMISSIONS ASSESSMENT

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1.0 Introduction

1.1 Applied Acoustic Design Ltd have been instructed by Maddox Planning to undertake an environmental sound survey and plant noise emissions assessment. The assessment is to support a planning application regarding the installation of new items of external mechanical building services plant to serve 171 Grays Inn Road, London, WC1X 8UE.

1.2 An environmental sound survey has been undertaken during a representative period regarding the proposed plant operation to establish typical prevailing levels of ambient and background sound in the vicinity of the wort affected noise sensitive receiver.

1.3 A plant noise emissions assessment has been undertaken to determine if the proposed mechanical building services plant achieves the noise requirements of Camden Council.

2.0 Site Description

2.1 The proposed mechanical building services plant is to be installed in the courtyard behind the development address, 171 Grays Inn Road. A total of five new condenser units are proposed to be installed at ground level.

2.2 The worst affected noise sensitive receiver has been identified as the residential windows of Jubilee House on Grays Inn Road; approximately 8 to 10m metres away from the proposed plant location.

3.0 Site Sound Survey

3.1 Instrumentation: NTI XL2 Class 1 sound level meter (Serial No. AZA-13312-EO). The instrument was powered by an external battery and stored in a weatherproof case. The instrument was checked for calibration before and after use with a Larson Davis type CAL 250 calibrator whereupon no calibration drift was recorded. The instrument was used in accordance with manufacturer's instructions.

3.2 Location: The sound level meter was located at ground level near the northwest facade of Jubilee House. The microphone was located on a tripod giving a measurement position approximately 2.5m above local ground level and 2m from the existing building fabric. Refer to Appendix 1 for the site plan and sound monitoring location.

3.3 Periods: Sound level monitoring was continuous from approximately 15:00 hours on Monday 18th July 2022 to approximately 15:00 hours on Wednesday 20th July 2022. The sound level meter was configured to monitor sound levels continuously in fifteen-minute intervals.

3.4 Weather: The prevailing weather conditions over the survey period were dry and mild. Wind speed, although not recorded, was considered to be less than 5 m/s throughout the survey periods, based upon published weather data and observed conditions at the time of the deployment and collection of the surveying equipment.

3.5 Site sound characteristics: The ambient sound level was characterised by road traffic sound from Grays Inn Road, and plant noise from a kitchen extract duct serving Jubilee House. It is considered that no unusual events occurred during the survey period, and the data is a true representation of the ambient and background sound levels in the area.

3.6 Surveyor: Jay Butler (AMIOA)

3.7 Results: The results of the survey are summarised in the tables below. These are considered to be façade sound levels.

Table 1: Summary of Ambient Sound Measurement Results

Description	Ambient Sound Levels
Daytime (07:00 to 23:00)	55 dB L_{A90} (15 minutes)
Night time (23:00 to 07:00)	49 dB L_{A90} (15 minutes)

Table 2: Summary of Background Sound Measurement Results

Description	Typical Measured Background Sound Level
Daytime (07:00 to 23:00)	45 dB L_{A90} (15 minutes)
Night time (23:00 to 07:00)	44 dB L_{A90} (15 minutes)

3.8 Refer to Appendix 4 for a glossary of terms.

4.0 Plant Noise Criteria

4.1 Local authority criteria

4.1.2 The below tables are extracts from the *Camden Local Plan 2017*, which set out Camden Council's mechanical building services plant noise emission requirements. Table B is used to determine the site sound level e.g. LOAEL (Green), LOAEL to SOAEL (Amber) or SOAEL (Red) area. Table C sets out the required mechanical building services plant noise rating level for industrial and commercial developments.

Table B: Noise levels applicable to noise sensitive residential development proposed in areas of existing noise

Dominant Noise Source	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Anonymous noise such as general environmental noise, road traffic and rail traffic ~	Noise at 1 metre from noise sensitive façade/free field	Day	<50dB$L_{Aeq,16hr}$*	50dB to 72dB$L_{Aeq,6hr}$*	>72dB$L_{Aeq,16hr}$*
		Night	<45dB$L_{Aeq,8hr}$ 3 <40 dB$L_{Aeq,8hr}$**	45dB to 62dB$L_{Aeq,8hr}$* >40dBL_{night}**	>62dB$L_{Aeq,8hrs}$*
	Inside a bedroom	Day	<35dB$L_{Aeq,16hr}$	35dB to 45dB$L_{Aeq,16hr}$	>45dB$L_{Aeq,16hr}$
		Night	<30dB$L_{Aeq,8hr}$ 42dB$L_{Amax,fast}$	30dB to 40dB$L_{Aeq,16hr}$ 40dB to 73dB$L_{Amax,fast}$	>40dB$L_{Aeq,8hr}$ >73dB$L_{Amax,fast}$
	Outdoor living space (free field)	Day	<50dB$L_{Aeq,16hr}$	50dB to 55dB$L_{Aeq,6hr}$	>55dB$L_{Aeq,16hr}$
Non-anonymous noise	See guidance note on non-anonymous noise				

*LAeq, T values specified for outside a bedroom window are façade levels
**Lnight values specified for outside a bedroom window are free field levels

Table C: Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

**10dB should be increased to 15 dB if the noise contains audible tonal elements (day and night)*

4.1.3 Camden Council also set out the following condition wording regarding external plant noise emission:

'There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted L_{eq}, 5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area'

4.1.4 The table below provides an assessment of the site sound categorisation and sets out the corresponding mechanical building services plant 'rating level' noise criteria.

4.1.5 The measured survey data indicates that the site falls under the LOAEL to SOAEL (Amber) category. Therefore, the assessment requirements detailed in Section 4.1.2 for 'quiet background areas' are not considered a requirement. Mechanical building services plant should be designed to achieve a noise level between 9 dB below and 5 dB above the typical background sound level at the site, when calculated to 1m away from the worst affected residential receiver.

Table 3: Camden Local Plan: Site sound categorisation and plant noise criteria

Assessment location	Assessment period	L_{Aeq}	Site sound categorisation	Plant limiting criteria
1m from noise sensitive facade	Daytime 07:00 to 23:00	55 dB	LOAEL to SOAEL (Amber)	Between 9 dB below and 5 dB above typical background
	Night time 23:00 to 07:00	49 dB	LOAEL to SOAEL (Amber)	

5.0 Mechanical Building Services Plant Limits

5.1 Considering the site sound categorisation detailed above, Camden Council's policy with regard to plant noise emissions requires new plant to achieve a rating level that is 9 dB below to 5 dB above the typical measured background sound level for the given hours of plant operation.

5.2 It is understood that the proposed condenser plant will typically operate during the daytime from 07:00 to 19:00. However, the plant has been noted to have potential to operate over 24hours, during the day and night.

5.3 Analysis of the spectral sound data associated with the proposed plant suggests that the condensers do not have tonal acoustic features. Therefore a 5dB correction for tonality has not been applied to the limiting plant criteria.

5.4 To form a worst case assessment, the proposed plant has been assessed with regard to the night time background noise levels. The typical background night time sound level measured during the survey was 44 $L_{A90\ (15\ minutes)}$. Therefore the plant should be designed to see that noise emissions do not exceed a rating level of 35 dB $L_{Ar,Tr}$ when assessed to a location 1m from the worst affected window of the nearest noise sensitive receiver. In accordance with BS 4142, achieving this criterion is considered to be an indication of negligible impact.

6.0 Plant Noise Assessment

6.1 The worst affected noise sensitive receiver has been identified as the residential windows of Jubilee House on Grays Inn Road; south of the proposed plant location (shown in Appendix 1).

6.2 The proposed mechanical building services plant comprises the following units. Four units are to be house in an acoustic enclosure, with one split condenser unit to be located outside of the enclosure.

- Units housed in an acoustic enclosure
  - 3no PURY-P200NW-A1 condenser
  - 1no PURY-P250YNW-A1 condenser
- Units outside acoustic enclosure
  - 1no PUZ-ZM71VHA split-unit condenser

6.3 The manufacturers published sound data for the proposed mechanical building services plant are shown in the table below.

Table 4: Plant Data – Sound Pressure Level Octave Band Data

Plant Item	octave band centre frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
	Sound Pressure Level, dB re 2 x 10^{-5} Pa								
PURY-P200YNW-A1	77	61	61	58	51	47	44	42	59
PURY-P250YNW-A1	78	63	62	59	52	49	49	43	61
PUZ-ZM71VHA	53	52	53	44	43	39	34	27	49

6.4 Plant noise calculations have been undertaken to determine noise levels due to the operation of the proposed mechanical services plant when calculated to a location 1m from the worst affected window of the nearest identified noise sensitive receiver. The calculations use manufacturers' sound data with corrections for distance losses and façade reflections. A summary is set out in the table below.

Table 5: Plant Noise Emissions Assessment

Description	**A-weighted Calculation Summary, dB**
Units housed in an acoustic enclosure	
PURY-P200NW-A1 condenser, L_p at 1m	59
PURY-P250YNW-A1 condenser, L_p at 1m	61
Correction for 3no units (PURY-P250YNW-A1)	5
Enclosure L_p at 1m	**67**
Acoustic Enclosure Loss *	-22
Distance Attenuation 8m	-18
Façade Reflection	3
L_p at the Receiver	**30**
Unit outside acoustic enclosure	
PUZ-ZM71VHA split-unit condenser, L_p at 1m	49
Distance Attenuation 10m	-20
Façade Reflection	3
L_p at the Receiver	**32**
Total L_p at the Receiver, $L_{Ar,Tr}$	**34**
Typical Background Noise Level during night time, L_{A90}	**44**
Difference	**-10**

* A-weighted reduction based on actual effect of attenuation

6.5 The predicted noise emission level as a result of the proposed mechanical building services plant is 34 dB $L_{Ar,Tr}$, when 4no condensers (detailed in Section 6.2) are housed in an acoustic enclosure. The proposed mechanical services plant therefore achieves the night time local authority plant noise emissions requirement of 35 dB $L_{Ar,Tr.}$

6.6 The minimum insertion loss requirements for the acoustic enclosure are detailed in the table below. The acoustic enclosure must provide a minimum 22 dB A-weighted noise attenuation.

Table 6: Minimum acoustic enclosure loss required (per octave band)

Plant Item	**octave band centre frequency (Hz)**							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
	Insertion loss, dB							
Acoustic enclosure loss required	14	16	23	30	34	33	33	28

7.0 Conclusion

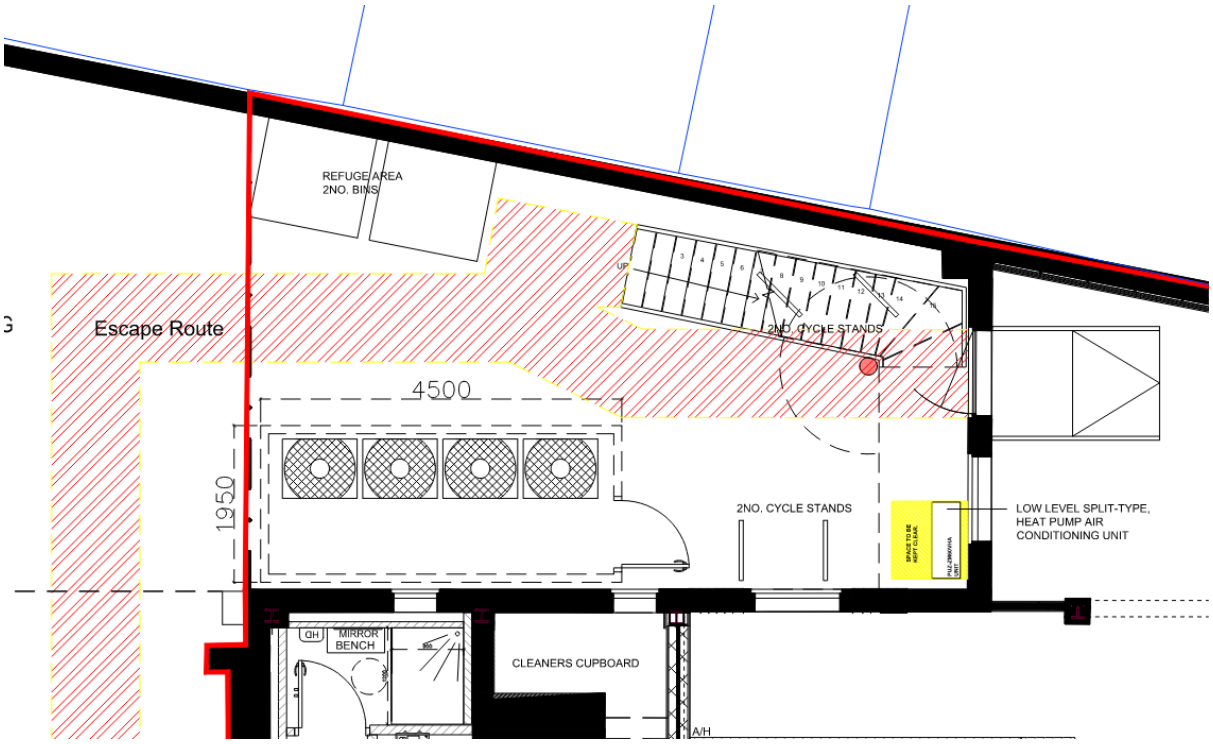
7.1 An environmental sound monitoring survey and plant noise emissions assessment has been undertaken to determine if the proposed items of mechanical building services plant achieve the noise requirements of Camden Council.

7.2 The worst affected noise sensitive receiver has been identified as the residential dwellings at Jubilee House.

7.3 The proposed items of mechanical building services plant achieve the local authority requirements regarding noise emissions providing the mitigation measures detailed in Section 6.6 are installed. e.g. 9 dB below the typical measured background sound level for the given hours of plant operation, when assessed to a location 1m from the worst affected window of the nearest noise sensitive receiver.

Appendix 1: Site Plan & Measurement Location

Appendix 2: Proposed Plant Location



Appendix 3: Proposed Plant Data

PURY-P200YNW-A data sheet:

Model				PURY-P200YNW-A (-BS)
Power source				3-phase 4-wire 380-400-415 V 50/60 Hz
Cooling capacity (Nominal)		*1	kW	22.4
			kcal/h	20,000
			BTU/h	76,400
	Power input		kW	4.43
	Current input		A	7.4-7.1-6.8
	EER		kW/kW	5.05
Temp. range of cooling	Indoor		W.B.	15.0~24.0°C (59~75°F)
	Outdoor		D.B.	-5.0~52.0°C (23~126°F)
Heating capacity (Max)		*2	kW	25.0
			kcal/h	21,500
			BTU/h	85,300
	Power input		kW	4.71
	Current input		A	7.9-7.5-7.2
	COP		kW/kW	5.30
(Nominal)		*3	kW	22.4
			kcal/h	20,000
			BTU/h	76,400
	Power input		kW	4.14
	Current input		A	6.9-6.6-6.3
	COP		kW/kW	5.41
Temp. range of heating	Indoor		D.B.	15.0~27.0°C (59~81°F)
	Outdoor		W.B.	-20.0~15.5°C (-4~60°F)
Indoor unit connectable	Total capacity			50~150%
	Model/Quantity			P15~P250/1~20
Sound pressure level (measured in anechoic room) *4			dB <A>	59.0/59.0
Sound power level (measured in anechoic room) *4			dB <A>	76.0/78.0
Refrigerant piping diameter	High pressure		mm (in.)	15.88 (5/8) Brazed
	Low pressure		mm (in.)	19.05 (3/4) Brazed

PURY-P250YNW-A data sheet:

Model				PURY-P250YNW-A (-BS)
Power source				3-phase 4-wire 380-400-415 V 50/60 Hz
Cooling capacity (Nominal)		*1	kW	28.0
			kcal/h	25,000
			BTU/h	95,500
	Power input		kW	5.97
	Current input		A	10.0-9.5-9.2
	EER		kW/kW	4.69
Temp. range of cooling	Indoor		W.B.	15.0~24.0°C (59~75°F)
	Outdoor		D.B.	-5.0~52.0°C (23~126°F)
Heating capacity (Max)		*2	kW	31.5
			kcal/h	27,100
			BTU/h	107,500
	Power input		kW	6.06
	Current input		A	10.2-9.7-9.3
	COP		kW/kW	5.19
(Nominal)		*3	kW	28.0
			kcal/h	25,000
			BTU/h	95,500
	Power input		kW	5.27
	Current input		A	8.8-8.4-8.1
	COP		kW/kW	5.31
Temp. range of heating	Indoor		D.B.	15.0~27.0°C (59~81°F)
	Outdoor		W.B.	-20.0~15.5°C (-4~60°F)
Indoor unit connectable	Total capacity			50~150%
	Model/Quantity			P15~P250/1~25
Sound pressure level (measured in anechoic room) *4			dB <A>	60.5/61.0
Sound power level (measured in anechoic room) *4			dB <A>	78.5/80.0
Refrigerant piping diameter	High pressure		mm (in.)	19.05 (3/4) Brazed
	Low pressure		mm (in.)	22.2 (7/8) Brazed

PUZ-ZM71VHA data sheet:

Service Ref.				PUZ-ZM60VHA		PUZ-ZM71VHA	
Mode				Cooling	Heating	Cooling	Heating
OUTDOOR UNIT	Power supply (phase, cycle, voltage)			Single, 50Hz, 230V			
		Max. current	A	19			
	External finish			Munsell 3Y 7.8/1.1			
	Refrigerant control			Linear Expansion Valve			
	Compressor			Hermetic			
		Model		SVB172FFUM1			
		Motor output	kW	1.1		1.2	
		Starter type		Inverter			
		Protection devices		HP switch Comp.shell thermo			
	Crankcase heater		W	—			
	Heat exchanger			Plate fin coil			
	Fan	Fan(drive) × No.		Propeller fan × 1			
		Fan motor output	kW	0.06			
		Airflow	m³/min (CFM)	55 (1,940)			
	Defrost method			Reverse cycle			
	Sound pressure level	Cooling	dB	47			
		Heating	dB	49			
	Dimensions	W	mm (inch)	950 (37-3/8)			
		D	mm (inch)	330+30 (13+1-3/16)			
		H	mm (inch)	943 (37-1/8)			
	Weight		kg (lb)	70 (154)			
	Refrigerant			R32			
		Charge	kg (lb)	2.8 (6.2)			
		Oil (Model)	L	0.70 (FW68S)		0.70 (FW68S)	
REFRIGERANT PIPING	Pipe size O.D.	Liquid	mm (inch)	9.52 (3/8)			
		Gas	mm (inch)	15.88 (5/8)			
	Connection method	Indoor side		Flared			
		Outdoor side		Flared			
	Between the indoor & outdoor unit	Height difference		Maximum 30 m			
		Piping length		Maximum 55 m			

Appendix 4: Glossary of Terms

Term	Description	Explanation
	Noise	Unwanted sound. In the explanation given below the words 'sound' and 'noise' can often be used interchangeably, depending on context.
dB	The decibel scale	The decibel (or dB) scale is the scale on which sound pressure levels are commonly measured. It is a logarithmic scale and is used for convenience to compress the audible range of sound pressures into a manageable range, from 0 dB to 140 dB. The zero of the scale, 0 dB, corresponds to the threshold of hearing, 0.00002 Pa, and the upper limit, 140 dB, corresponds to 20 Pa, the threshold of pain.
	Sound pressure	Sound is a disturbance or fluctuation in air pressure, and sound pressure, measured in pascals (Pa), is used as a measure of the magnitude of the sound. The human ear can detect sound pressures in the range from 0.00002 Pa to 20 Pa. This is an enormously wide range and so for convenience sound pressures are commonly measured on a decibel (dB) scale.
Lp	Sound pressure level	Instantaneous value of Sound Pressure Level (Lp).
	Sound power	The sound energy radiated per unit time by a sound source, measured in watts (W)
L_W	Sound power level	Sound power measured on a decibel scale: $L_W = 10\log(W/W_0)$, where W_0 is the reference value of sound power, 10^{-12} W.
f	Frequency	The frequency of a musical note is what gives it its pitch. It is the number of cycles of the fluctuating sound pressure which occur each second, and is measured in cycles per second, or Hertz (Hz). The human ear can detect frequencies in the range 20 to 20 000 Hz. Most sounds and noises are a mixture of all frequencies, called broad-band noise.
	Octave bands Octave band spectra	In order investigate the frequency content of broad band sounds, called its frequency spectrum, measurements of sound pressure are carried out over a range of frequency bands. The most common method is to split the audio frequency range into 8 or 9 octave bands. An octave is a frequency range from one particular frequency to double that frequency.
	Free-field	A free field sound level measurement is one which is unaffected by the presence of any sound reflecting surfaces. In an outdoor situation this is usually taken to mean with no sound reflecting surfaces within 3 m. of the source.
	Facade correction Factor	The difference between the façade level and the free field level (in the absence of the façade) is called the façade correction factor.
A	A-weighting	One of the three frequency weightings (A, C and Z) used in sound level meters, and defined in BS EN ISO 61672-1; a very widely used method of producing a single figure measure of a broad band sound which takes into account, in an approximate way at least, the frequency response of the human hearing system. The idea is that sound levels measured in this way should give an indication of the loudness of the sound.
L_A (dBA)	A- weighted sound pressure level	The value of the sound pressure level, in decibels, measured using an A-weighting electronic circuit built into the sound level meter. The vast majority of sound measurements are carried out in this way.
$L_{Aeq,T}$	Equivalent continuous sound level	It represents a measure of the 'average' sound level over the measurement period. It corresponds to the steady level of sound which, over the same period of time, T, would contain the same amount of (A-weighted) sound energy as the time varying sound. Also known as the Average sound level. This is the most common method of measuring time varying sound, and within certain limits gives the best correlation with human response to sound, for example with annoyance.

$L_{AN,T}$	Statistical percentile sound levels	$L_{AN,T}$ is the sound level, usually A-weighted, which is exceeded for N% of the measurement period, T. The most commonly used values are $L_{A10,T}$ used for the measurement and assessment of traffic sound, and $L_{A90,T}$, commonly used as a measure of background sound. $L_{A1,T}$ and $L_{A99,T}$ are also occasionally used to give an indication of the highest and lowest sound levels occurring during the measurement time interval.
	Background sound	Ambient sound which remains at a given site when occasional and transient bursts of higher level ambient sound levels have subsided to typically low levels; it is the sound normally present for most of the time at a given site. It is usually described by the L_{A90} value.
$L_{A90,T}$	Background sound level	Defined in BS 4142 as the value of the A-weighted residual sound at the assessment position that is exceeded for 90 % of a given time interval, T, (i.e. $L_{A90,T)}$ measured using time weighting, F, and quoted to the nearest whole number of decibels. (Also see under residual sound). Background sound itself often varies with time and so the $L_{A90,T}$ is almost universally used as the best measure of the 'more or less always present' sound level which underlies short term variations from other sources of sound.
	Specific Sound Source	The sound source under consideration when assessing the likelihood of adverse impact using BS4142:2014.
	Specific Sound Level	The value of $L_{Aeq,T}$ at the assessment position produced by the specific sound source, ref. BS4142:2014.
$L_{ar,Tr}$	Rating Level	The specific sound level, corrected to account for any characteristic features of the sound, by adding a rating penalty for any tonal, impulsive or irregular qualities, ref. BS4142:2014.
T_r	Reference time interval	Specified interval over which the specific sound level is determined, ref. BS4142:2014.
	Residual Sound	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound, ref. BS4142:2014.
$L_r = L_{Aeq,T}$	Residual Sound Level	Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T, ref. BS4142:2014.