THE EQUUS PARTNERSHIP

Member of the Association of Noise Consultants

CONSULTANTS IN ACOUSTICS

7BR SEVEN BEDFORD ROW
6-7 BEDFORD ROW, LONDON WC1R (ALSO 6-7 JOCKEY'S FIELDS)

Environmental Noise Assessments of Proposed Condenser Plant

Report Reference: EPL/8730/ENA/RP/01A

January 2019

Report prepared for:

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APPENDICES

1 INTRODUCTION

This Environmental Noise Assessment Report has been prepared to accompany a Planning Application submitted on behalf of 7BR SEVEN BEDFORD ROW for replacement condenser plant to be installed at 6-7 Bedford Row and 6-7 Jockey's Fields barristers' chambers buildings, in conjunction with the removal of existing condenser plant from both buildings.

The Planning Application seeks approval to the proposed installation of replacement air cooled condenser units within: (i) a purpose designed acoustic screened enclosure at the base of the lower ground floor courtyard adjoining the Bedford Row building, and, (ii) an existing condenser plant location on the roof of the Jockey's Fields building. The proposed new condenser units are required to serve internal areas of the subject premises in connection with proposed refurbishment.

This Environmental Noise Assessment Report:

- presents the results of environmental noise surveys undertaken in the vicinity of the site to establish existing ambient and background noise levels;
- discusses environmental acoustic design targets for the proposed condenser plant in the context of national and local planning policy and other relevant industry standard guidance;
- assesses noise emissions from the proposed condenser plant and, where necessary, the engineering controls that will be implemented to control noise emissions to mitigate any adverse noise impacts, in accordance with relevant national and local planning policy.

2 THE SUBJECT PREMISES AND SURROUNDING AREA

The listed buildings at 6-7 Bedford Row are located within a row of similar terraced properties having commercial use. The more modern premises at 6-7 Jockey's Fields are linked via courtyards and lightwells to the Bedford Row premises.

Bedford Row is positioned to the north of High Holborn between Red Lion Square and Gray's Inn and runs north to south between Theobalds Road and Sandland Street.

Jockey's Fields runs parallel to Bedford Row and Gray's Inn Gardens which also contains numerous barristers' chambers buildings. There are residential flats in some of the Gray's Inn Gardens buildings.

There are a number of existing condenser units within the demise of the subject premises which (subject to Planning Permission) will be replaced by the new condenser units, and also various other visible condenser and air handling plant items external to neighbouring buildings.

The location of the site and its general environs are shown on **Figure 1** attached at **Appendix A**.

The proposed condenser plant arrangements are shown on Mansfield Monk drawing no. 172332/DT22 (Rev. C) and MEP Pro Building Services drawing no. 2018-3-M1 (Rev. 3.1). Both of these drawings are attached in **Appendix B**.

3 PLANNING POLICY GUIDANCE

3.1 National Planning Policy

Current governmental guidance relating to the determination of planning applications is given in the recently updated National Planning Policy Framework (NPPF: July 2018). The NPPF policy guidelines include, inter alia, references to conserving and enhancing the natural environment; for example by ensuring developments are not adversely affected by unacceptable levels of soil, air, water or noise pollution etc., by means of suitable mitigation measures.

With specific regard to noise, the NPPF has previously directed the reader to the advice contained in DEFRA's Noise Policy Statement for England (NPSE). This Policy Statement introduces the concept of a "Significant Observed Adverse Effect Level" (SOAEL), "Lowest Observed Adverse Effect Level" (LOAEL) and "No Observed Adverse Effect Level" (NOAEL). However, whilst the intent of the NPSE in relation to the NPPF is clear, the Noise Policy Statement for England does not, at this time, provide any quantitative threshold values for each identified level of "effect". Indeed, the NPSE carefully highlights that:

> *"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

The Government has previously issued *"National Planning Practice Guidance"* to assist in understanding the perception of noise effects, outcomes and actions that should be taken to align decision making with the NPPF. The table below sets out this guidance:

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	**No specific measures required**
No Observed Adverse Effect Level (NOAEL)			
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	**No specific measures required**
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows for some of the time because of the noise. Potential for non-awakening sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	**Mitigate and reduce to a minimum**
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. having to keep windows closed most of the time, avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	**Avoid**
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	**Prevent**

In light of the above, it can be seen that whilst the NPPF and associated planning practice guidance sets out stringent imperatives to ensure the satisfactory development of land in relation to possible noise impacts, the NPPF does not generally provide any detailed

technical guidance defining what may be considered to constitute a *"significant" or "other"* adverse impact. In the absence of such technical guidance, reference needs to be made to sustainable development standards contained within relevant *'industry standard'* guidance documents and/or local Planning policy guidance, as set out in Section 3.2 of this report.

3.2 Local Planning Policy

The London Borough of Camden's adopted *"Camden Local Plan"* includes, inter alia, recommended noise thresholds that are designed to reduce noise impact from industrial and commercial noise sources and thereby seek to protect the amenity of existing neighbours from proposed mechanical plant installations. The Council's plant noise emission criteria relevant to the *"Lowest Observed Adverse Effect Level" (LOAEL)* are contained within Table C in Appendix 3 (Noise Thresholds) of the Camden Local Plan and are summarised below:

Table C: Noise Levels Applicable to Proposed Industrial and Commercial Developments (Including Plant and Machinery)

Existing Noise Sensitive Receptor (Design Period)	Assessment Location	LOAEL (Green)
Dwellings ** (Day)	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	'Rating level' 10dB* below background
Dwellings ** (Night)	Outside bedroom window (façade)	'Rating level' 10dB* below background and no events exceeding 57 dB L_{Amax}

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

** Levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

4 ENVIRONMENTAL NOISE SURVEYS

Environmental noise surveys have been undertaken to determine typical prevailing background noise levels in the vicinity of the subject premises. These surveys were conducted on Monday 17 September 2018.

The Client advised that the condenser plant will operate between 07.00 to 19.00 hours. The environmental noise surveys were therefore carried out during the most critical afternoon/evening period to cover times when background noise levels were likely to be lowest in the surrounding area.

4.1 Noise Measurement Locations

Noise readings were taken at the following locations:

Position A: Sample noise readings were taken during the early afternoon period on the 1st floor level roof terrace of 6-7 Jockey's Fields at approximately 2m from the building façade and 1.5m above roof level. This position was considered reasonably representative of the ambient / background noise levels prevailing outside the neighbouring (rear) office windows of No. 5 Bedford Row and No. 5 Jockey's Fields. However, in practice, the ambient / background noise levels outside the neighbouring office windows are likely to be higher than measured due to the extent of mechanical plant on the neighbouring roof.

Position B: Sample noise readings were taken during the early afternoon period on the 2nd floor level roof terrace of 6-7 Jockey's Fields at approximately 3m from the building façade and 1.5m above roof level. This position was considered reasonably representative of the ambient / background noise levels prevailing outside the neighbouring (rear) office windows of No. 8 Bedford Row and No. 8 Jockey's Fields.

Position C: A series of half hourly noise readings were taken during the afternoon /early evening at pavement level outside No. 6 Raymond Buildings (Gray's Inn). This building is principally barristers' chambers but also contains residential flats at 3rd floor level. These flats appear to be the closest to the subject premises. The sound level meter was positioned approximately 2m from the building façade and 1.5m above pavement level. This position was considered reasonably representative of the ambient / background noise levels prevailing outside the residential windows.

4.2 Instrumentation

The following instrumentation was used for the noise surveys:

Brüel and Kjær Precision Real Time Analyser	Type 2260B
Brüel and Kjær ½" Condenser Microphone	Type 4189
Brüel and Kjær Sound Level Calibrator	Type 4230
Brüel and Kjær ½" Windshield	Type UA 0237

The real time analyser was calibrated prior to each survey and the calibration was checked again upon completion. No drift was found to have occurred.

4.3 Weather Conditions

Weather conditions during the environmental noise surveys were generally warm, entirely dry (no precipitation) with a clear sky and a variable light breeze.

4.4 Noise Survey Procedure

Noise measurements of the L_{A90}, L_{Aeq} and $L_{Amax,fast}$ sound levels were measured over a 10 minute sample period at each position (excluding periods where the 'back erase' facility of the real time analyser was used to eliminate non-representative short term peaks such as aircraft flyovers).

Please refer to **Appendix C** for an explanation of the acoustic terminology used above.

4.5 Noise Survey Results

The noise survey results are presented in **Tables 1 to 3** attached at **Appendix D**.

4.6 Discussion of Results

The noise levels at Positions A and B (roof terraces of subject premises) were generally controlled by local plant noise emissions from surrounding buildings together with local and distant road traffic movements.

The noise levels at Position C (outside Raymond Buildings in Gray's Inn) were generally controlled by local and distant road traffic movements, and to a lesser extent, were also influenced by plant noise emissions from neighbouring buildings.

5 ACOUSTIC DESIGN TARGETS

5.1 Local Authority Requirements

London Borough of Camden require that noise emissions from proposed plant to adjoining noise sensitive properties will need to be controlled to a level 10dB(A) below the minimum measured background noise level during the proposed operational hours of the plant, as measured at 1m from the nearest window of adjoining properties.

5.2 Typical Minimum Background Noise Levels

The minimum L_{90} background noise levels measured during the environmental noise surveys during normal daytime operating hours (07.00 to 19.00) and during the night-time period at each location are summarised in **Table 1** below:

Table 1: Minimum Measured Background Noise Levels

Measurement Location	Minimum Measured Background Noise Level, L_{A90} dB Daytime Hours (07.00 - 19.00 hours)
Position A	50
Position B	50
Position C	49

5.3 Environmental Acoustic Design Targets

Based on the above minimum measured background noise levels, the Local Authority's requirements will require that mechanical services installations are designed in accordance with the following acoustic design targets:

Table 2: Proposed Plant Noise Emission Targets

Location of Noise Sensitive Receptors	Plant Noise Emission Level, $L_{Aeq,15mins}$ dB Daytime Hours (07.00 - 19.00 hours)
Rear façades of No. 5 Bedford Row and No. 5 Jockey's Fields (offices)	40
Rear façades of No. 8 Bedford Row and No. 8 Jockey's Fields (offices)	40
Front façade of Raymond Buildings in Gray's Inn (residential flats)	39

The above acoustic design targets are to be achieved at a distance of 1m from the nearest noise sensitive window of any neighbouring property with all condenser plant operating under normal design duty conditions.

6 PROPOSED PLANT AND NOISE MITIGATION MEASURES

6.1 Proposed Condenser Plant

The proposed condenser plant will comprise:-

- 3 no. Mitsubishi PURY-P450YNW-A condenser units to be installed within a purpose designed acoustic screened enclosure at the base of the lower ground floor courtyard (**N.B.** existing condenser units to be removed);
- 8 no. Mitsubishi PUMY-P200YKM condenser units (includes 1 no. future unit) to be installed on the roof of the Jockey's Fields building (**N.B.** existing condenser units to be removed);

The proposed arrangements of the above condenser plant are shown on Mansfield Monk drawing no. 172332/DT22 (Rev. C) and MEP Pro Building Services drawing no. 2018-3-M1 (Rev. 3.1) [both attached in **Appendix B**].

Manufacturer's noise data for the proposed condenser units is summarised on **Schedule 8730/PN1** attached at **Appendix E**.

6.2 Noise Mitigation Requirements

6.2.1 Lower Ground Floor Units (Mitsubishi PURY-P450YNW-A)

In order to provide adequate control of environmental noise emissions, it will be necessary for a proprietary acoustic screened enclosure to be installed around the 3 no. Mitsubishi PURY P450YNW-A condenser units within the lower ground floor courtyard, and also for discharge attenuators to be fitted directly onto each of the condenser units. The height of the acoustic screened enclosure shall be the same as the installed height of the top of the discharge attenuators.

The proposed acoustic screened enclosure shall be manufactured from proprietary double skinned panels comprising a solid steel outer skin on one side and (minimum) 23% free area perforated steel panel to the other side, filled with acoustic insulation, and orientated such that the acoustically absorptive side of the screens are facing towards the condenser plant to absorb reflected noise. The outer face of the panels shall be finished in accordance with the architect's requirements.

The double skinned panels shall be filled with an acoustically absorptive infill with a minimum density of at least 45kg/m³. The acoustic medium shall be inert, rot and vermin proof, non-hygroscopic and non-combustible. The acoustic medium shall be suitably faced with an acoustically transparent finish to prevent fibre migration. The acoustic medium shall not contain fibres that have a diameter of 3 microns or less and a length of 200 microns or less.

The acoustic screened enclosure shall include all necessary framing and support posts to allow for potential wind loading and stresses etc. The acoustic screen walls shall be formed from (minimum) 50mm thick acoustic panels manufactured by Allaway Acoustics (www.allawayacoustics.co.uk), Ambient Acoustics (www.ambientacoustics.co.uk), Environmental Equipment Corporation (EEC) (www.eec.co.uk) or equal and approved supplier, and comprise a sound absorptive perforated facing towards the plant and a solid sheet external facing with mineral wool infill.

The acoustic screened enclosure shall comply with the minimum acoustic performances tabulated below and shall be continuous - i.e. without any gaps between panels and/or around any services penetrations etc. - with the exception of a 50mm airgap at the base of the screen:

Minimum Acoustic Performance of Condenser Unit Acoustic Screened Enclosure								
Acoustic Performance	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Minimum Sound Reduction Indices	15	18	25	32	36	40	40	40
Minimum Sound Absorption Coefficients	0.10	0.25	0.60	0.95	0.95	0.95	0.90	0.90

The 3 no. Mitsubishi PURY P450YNW-A condenser units shall each be fitted with a 900mm high specialist discharge attenuator selected to achieve the following acoustic performance:

Minimum Acoustic Performance of Condenser Unit Specialist Discharge Attenuator								
Acoustic Performance	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Minimum Insertion Losses	4	7	14	24	29	27	24	18

The specialist discharge attenuators shall be designed and manufactured by Ambient Acoustics (www.ambientacoustics.co.uk).

6.2.2 Rooftop Condenser Units (Mitsubishi PUMY-P200YKM)

The 8 no. Mitsubishi PUMY-P200YKM condenser units will be strategically positioned such that they are behind an existing louvre bank (the existing condenser units shall be removed). These louvres shall be backed with 18mm (painted) weather proofed plywood sheets to provide additional acoustic screening. The joints in the plywood shall abut closely and be sealed with mastic. Alternatively, plywood joints may be 'fish plated' together with full height overlapping sheets of 18mm ply (or steel angle). Additional wind bracing shall be included if deemed necessary by the structural engineer.

The existing (pitched) roof of the Jockey's Fields building will provide useful acoustic screening towards the 3rd floor level residential flats in Raymond Buildings (Gray's Inn). As such, these condenser units should not require any further noise mitigation.

7 ENVIRONMENTAL PLANT NOISE ASSESSMENT

7.1 Cumulative Plant Noise Emissions to Atmosphere

Calculations have been undertaken to assess environmental noise emissions from the proposed condenser plant in general accordance with the procedures of ISO 9613-3: 1996, with appropriate allowances made for plant directivity and propagation attenuation etc. The calculated cumulative noise levels incident upon the nearest noise-sensitive windows are summarised below.

The nearest noise sensitive windows to the proposed condenser units within neighbouring buildings are office windows in the rear elevations of commercial premises in Bedford Row and Jockey's Fields, and also the front elevation of the 3rd floor residential flats in Raymond Buildings (Gray's Inn). The approximate distances to these windows from the nearest condenser plant items, together with the calculated cumulative plant noise emission levels at 1m outside the windows, are presented below:

i. **No. 5 Bedford Row** - closest window approximately 12m from Mitsubishi PURY P450YNW-A condenser units (lower ground floor courtyard acoustic screened enclosure) and screened from plant location. The calculated 'worst case' cumulative plant noise emission level at 1m outside this office window is 40 dB L_{Aeq} allowing for the proposed noise mitigation measures.

ii. **No. 8 Bedford Row** - closest window approximately 16m from Mitsubishi PUMY-P200YKM condenser units (existing roof of Jockey's Fields building) and screened by existing louvre bank backed with plywood sheets as described in Section 6.2.2 above. The calculated 'worst case' cumulative plant noise emission level at 1m outside this office window is 38 dB L_{Aeq} allowing for the proposed noise mitigation measures.

iii. **No. 6 Raymond Buildings (Gray's Inn)** - closest window approximately 38m from Mitsubishi PUMY-P200YKM condenser units (existing roof of Jockey's Fields building) and screened by existing roof profile. The calculated 'worst case' cumulative plant noise emission level at 1m outside this window is 38 dB L_{Aeq} allowing for the proposed noise mitigation measures.

It may be seen that the calculated plant noise emission levels accord with the noise emission targets given in Section 5.3 of this report. This demonstrates that cumulative noise emissions due to operation of the proposed condenser plant (incorporating the specified noise mitigation measures) should be expected to satisfy the Council's standard policy requirements.

7.2 Structure-Borne Noise and Vibration

Structure-borne noise and/or vibration transmissions due to condenser plant operation does not form part of this assessment report. However, it is recommended that the contractor ensures all plant and associated pipework are installed on proprietary vibration isolation equipment (incorporating 'noise stop' pads where appropriate) designed and selected to achieve at least 95% isolation efficiency in accordance with good installation practice.

8 CONCLUSIONS

Environmental noise surveys have been undertaken in order to establish the prevailing ambient and background noise levels in the vicinity of the 7BR SEVEN BEDFORD ROW premises at 6-7 Bedford Row and 6-7 Jockey's Fields, London WC1R. Based on the measured levels, environmental noise emission design targets have been determined in accordance with the London Borough of Camden's policy requirements.

Cumulative environmental noise emissions due to operation of the proposed condenser plant have been assessed based on manufacturer's noise data and allowing for the proposed noise mitigation measures specified herein - i.e. proprietary acoustic screened enclosure, discharge attenuators and plywood backing to existing rooftop louvred screen.

It is concluded that noise emissions from the proposed condenser units should be adequately controlled in accordance with the Council's noise threshold policy requirements. The proposed plant installation does not, therefore, raise any significant or other adverse noise impact concerns. It should be noted that a number of existing condenser units will be removed as part of the refurbishment of the subject premises.

It is concluded, therefore, that the proposed plant installation should comply fully with relevant national and local planning policy, in particular the noise threshold policy of the Camden Local Plan.

All the plant noise data referred to within this report are to be considered as 'limiting' (i.e. not to be exceeded) design criteria. Any changes to the stated plant noise levels, proposed plant selections, operating conditions, unit locations and/or arrangements etc., shall be referred back to The EQUUS Partnership for further review and advice.

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Report Checked by:

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APPENDIX A

THE EQUUS PARTNERSHIP
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7BR SEVEN BEDFORD ROW
6-7 BEDFORD ROW, LONDON WC1R
(ALSO 6-7 JOCKEY'S FIELDS)

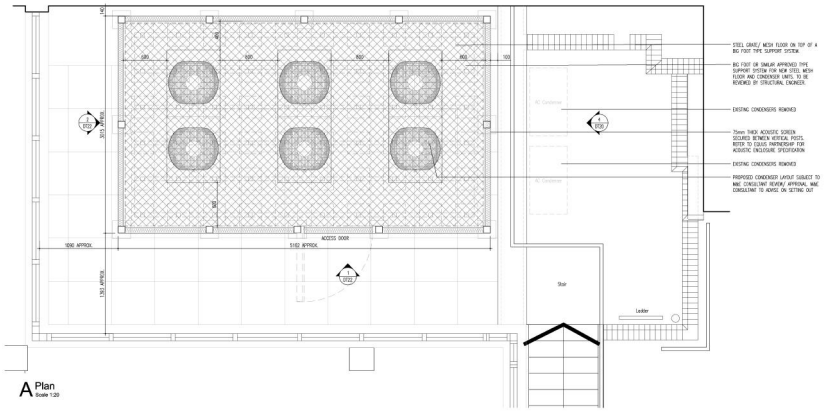
Site Location Plan

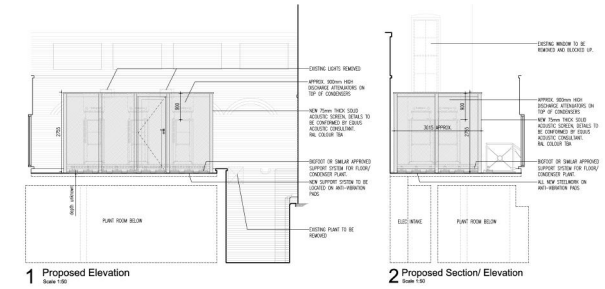
Date: January 2019

Scale: NTS

Drawing Ref: Figure 1

APPENDIX B





C	LC	Issued for Tender. Drawing revised following confirmation of acoustic/ plant data.	11.10.18
B	LC	Drawing revised following confirmation of acoustic/ plant data. Issued for information and comment.	09.10.18
A	LC	Drawing revised following coordination meeting with acoustic consultant.	01.10.18
-	LC	Preliminary issue.	24.09.18
Rev.	Drawn	Description	Date

Mansfield Monk

Client	Chambers 7BR		
Project	7 Bedford Row, London WC1R 4BS		
Drawing	Proposed A/C Plant Enclosure Plan & Elevations		
Drawing Status	PRELIMINARY		
Scale	1:20/50@A1	Cad file	-2332 DT22
Drawn by	LC	Project no.	172332
Checked by	JM	Drawing no.	DT22
Date	SEPT 2018	Revision	C

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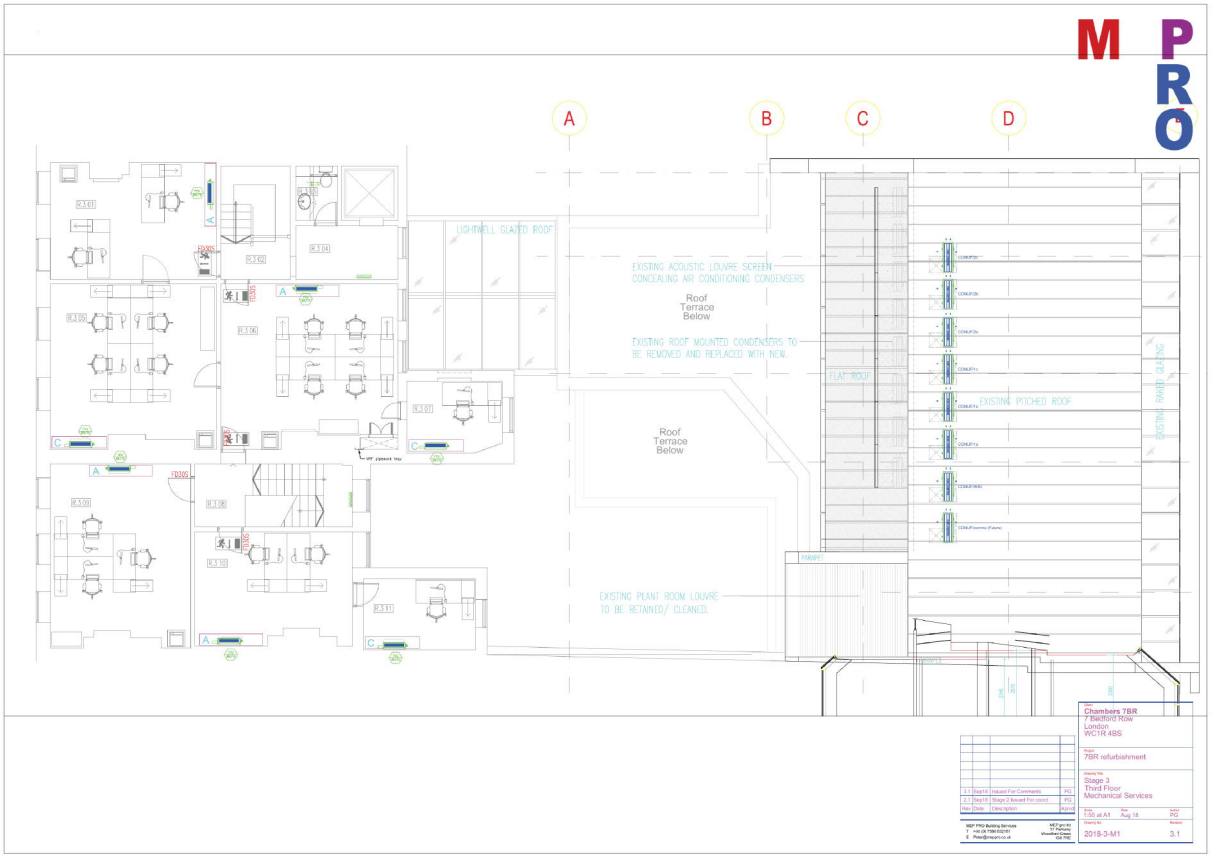
A
B
C
D
LIGHTWELL GLAZED ROOF
EXISTING ACOUSTIC LOUVRE SCREEN CONCEALING AIR CONDITIONING CONDENSERS
Roof Terrace Below
EXISTING ROOF MOUNTED CONDENSERS TO BE REMOVED AND REPLACED WITH NEW.
FLAT ROOF
EXISTING PITCHED ROOF
EXISTING RAKED GLAZING
Roof Terrace Below
PARAPET
EXISTING PLANT ROOM LOUVRE TO BE RETAINED/ CLEANED.
R.3.01
R.3.02
R.3.04
R.3.05
R.3.06
R.3.07
R.3.08
R.3.09
R.3.10
R.3.11
FD30S
Chambers 7BR
7 Bedford Row
London
WC1R 4BS
7BR refurbishment
Stage 3
Third Floor
Mechanical Services
1:50 at A1
Aug 18
PG
2018-3-M1
3.1

APPENDIX C

GLOSSARY OF ACOUSTIC TERMINOLOGY

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General

A vibrating surface or turbulent fluid flow will cause pressure fluctuations in the surrounding air. These pressure fluctuations are perceived by the human ear as "sound".

Measurement Units

The human ear can detect sound pressures as low as about 20 μPa, and can tolerate (for short periods) sound pressures as high as 200 Pa, an amplitude range of 10 million times. To take account of this huge amplitude range, sound pressure levels (often written in "acoustic shorthand" as SPL or Lp) are quantified using a logarithmic scale, the decibel (dB) scale. This is based on a reference pressure of 20μPa, thus a sound pressure of 20μPa would equate to 0dB and a pressure of 200Pa would equate to 140dB.

Frequency (Pitch) Characteristics

The sound received at any particular location is not solely influenced by the sound pressure level, the frequency characteristics (pitch) of the noise is also an important factor. Noise audible to a human (with "normal" hearing), typically covers the frequency range 20 Hertz to 20,000 Hertz. Hertz (Hz) are defined as the number of times the sound pressure fluctuates in one second. "Low" pitched sounds fluctuate less times per second than "high" pitched sounds. Whilst humans are capable of detecting a wide range of frequencies, the ear is not equally sensitive to all frequencies – the ear is most sensitive at frequencies towards the middle of the audible range and less sensitive to the lower and higher frequencies.

To take account of this frequency response, sound pressure fluctuations are normally quantified by applying a frequency-weighting network or filter which simulates the frequency response of the ear. In essence, this means that more significance is given to the frequencies at which the ear is most sensitive and less significance to those at which the ear is less sensitive. Noise measurements relating to human reaction are generally made using an "A-weighting" network. These measurements are reported as A-weighted decibels or dB(A). The A-weighted sound pressure level is written in "acoustic shorthand" as L_A.

Variation of Sound with Time

It will be appreciated that the sound pressure level of most noise sources will fluctuate with time. In order to take account of the way in which the human ear perceives noise, it is normal for the sound pressure level to be quantified using a time weighting network, to mimic the speed of response of the human ear. The standardised setting for most types of noise is a "Fast" time weighting.

The manner in which sound fluctuates with time can also influence the subjective manner in which noise is perceived. Noise can be continuous (showing no significant variation with time as in the case of a fan), intermittent (i.e. the noise is transient in it's nature, such as a train pass-by) or impulsive (i.e. there is a sudden build up of noise - this can range from "clanking" types sounds as might be experienced next to railway goods yard or a high energy discharge such as an explosion)

Measurement of Sound

Sound pressure levels are measured using equipment comprising a pressure-sensitive microphone, associated amplifier, frequency weighting network, time weighted network and output indicator. In its simplest form this is a small hand-held instrument called a sound level meter. More sophisticated instrumentation (a sound level analyser) is also available which allows the real-time output of the frequency characteristics of the sound to be quantified.

Comparison of Sound Levels

To put the significance of noise measurement into context, the following Table presents the A-weighted sound pressure level of some typical sources:

Sound Pressure Level, dB(A)	Typical Noise Source . Activity
160	Saturn Rocket Taking Off
140	Military Jet Taking Off at 30m
100	Nightclub
90	Heavy goods vehicle driving past at 7m
80	Busy urban road
70	Domestic vacuum cleaner at 3m
60	Busy office environment
55	Normal speech at 1m
40	Whispered conversation at 2m
30	Bedroom at night (BS 8233: 1999)
20	Remote country location
0	Threshold of hearing – a very eery silence

Addition of Sound Levels

It is important to note that the use of a logarithmic scale to describe noise does not allow normal arithmetic addition. This means that two noise sources each generating a level of, say, 60dB(A) will not generate a combined sound level of 120dB(A). The values must be added logarithmically, which would actually yield a combined sound level of 63dB(A) in this example.

Subjective Perception of Sound Levels Changes

With regard to the human perception of sound level changes, the human ear:

- Cannot generally perceive a sound level difference of less than 3dB(A)
- Will perceive a sound level difference of 4-5dB(A) as "noticeable"
- Will perceive a sound level difference of 10dB(A) as a doubling (or halving) of loudness.

GLOSSARY OF ACOUSTIC TERMINOLOGY

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Acoustic Terminology

As stated previously, most sources of noise will fluctuate with time. In order to characterize such noise, it is therefore normal to represent the noise climate using a variety of noise parameters and statistical indices. The most commonly adopted noise parameters are described below:

$L_{Aeq,T}$ This is the equivalent continuous A-weighted sound level measured over a specified time period "T". This is the notional continuous sound level which, over the time T, contains the same amount of energy as the actual fluctuating sound being measured. This parameter is widely accepted as being the most appropriate noise descriptor for most environmental noise and the effects of noise on humans.

$L_{Amax,fast}$ This is maximum A-weighted sound pressure measured with a fast frequency response recorded during the stated measurement period. It is typically used to characterise the highest sound level caused during a noise event.

$L_{A90,T}$ This is the A-weighted sound pressure level exceeded for 90% of the specified time period "T". It is normally used to describe the underlying background noise level of an environment since it inherently excludes the effects of transient noise sources.

Noise Rating (NR) Level

When describing noise from building services installations, it is common to express noise levels in terms of a Noise Rating (NR) Level. The NR level is determined by plotting the measured frequency spectrum of a noise against a series of reference curves, which roughly approximate to equal loudness values. This method permits higher sound levels at low frequencies corresponding to the sensitivity of the human ear. The NR level is defined as the value of the highest curve "touched" by the plotted frequency spectrum. For typical sources of building services noise, the overall A-weighted sound level is numerically around 5-6dB higher than the NR level of the noise.

α_w The "**Weighted Absorption Coefficient**" (α_w) is a single figure measure of the overall sound absorption capabilities of a building element determined in accordance with BS EN ISO 11654: 1997.

APPENDIX D

TABLE 1:
Results of Sample Noise Readings - Position A (1st Floor Roof Terrace of 6-7 Jockey's Fields)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
15.00 - 15.10	50	51	54
15.15 - 15.25	50	51	56

TABLE 2:
Results of Sample Noise Readings - Position B (2nd Floor Roof Terrace of 6-7 Jockey's Fields)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
15.30 - 15.40	50	51	55
15.45 - 15.55	50	51	58

TABLE 3:
Results of Noise Survey - Position C (2nd Floor Roof Terrace of 6-7 Jockey's Fields)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
14.00 - 14.10	50	53	65
14.30 - 14.40	50	54	69
16.00 - 16.10	49	55	71
16.30 - 16.40	50	54	70
17.00 - 17.10	50	54	70
17.30 - 17.40	50	54	68
18.00 - 18.10	49	53	67
18.30 - 18.40	49	52	67

APPENDIX E

SCHEDULE: 8730/PN1

SHEET NO. 1 OF 1

DATE: January 2019

7BR SEVEN BEDFORD ROW - CONDENSER UNIT NOISE DATA

THE EQUUS PARTNERSHIP
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CONSULTANTS IN ACOUSTICS

Manufacturer	Model Type	Location	m3/s	Pa.	Lw / Lp	Octave Band Centre Frequency, Hz							
						63	125	250	500	1k	2k	4k	8k
Mitsubishi	PURY-P450YNW-A	Lwr. Gnd Floor Courtyard (3 no. units in enclosure)	--	--	(M) Lp @ 1m	84	71	71	69	63	61	56	51
Mitsubishi	PUMY-P200YKM (Cooling Mode)	Jockey's Fields Roof (8 no. units behind louvres)	-	--	(M) Lp @ 1m	65	59	54	53	52	47	41	35
Mitsubishi	PURY-P200YKM (Heating Mode)	Jockey's Fields Roof (8 no. units behind louvres)	--	--	(M) Lp @ 10m	63	61	61	58	57	52	49	41

Lw = Sound Power Level (dB. re. 1 pico Watt).
Lp = Sound Pressure Level (dB. re. 20 micro Pascals).
(M) = Manufacturers Noise Data (E) = Empirical Noise Data