THE EQUUS PARTNERSHIP

Member of the Association of Noise Consultants

CONSULTANTS IN ACOUSTICS

WHITTINGTON HOUSE

ALFRED PLACE, LONDON, WC1

Environmental Noise Assessments of Proposed Mechanical Plant

Report Reference: EPL/8735/ENA/RP/02

January 2019

Report prepared for:

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CONTENTS

APPENDICES

1 INTRODUCTION

This Environmental Noise Assessment Report has been prepared to accompany a Planning Application submitted on behalf of Platine Holdings. The Planning Application seeks approval to the proposed installation of new air cooled condenser units (in conjunction with the removal of existing condenser units and air cooled chillers) on an external flat roof area at 1st floor level of Whittington House, Alfred Place, London WC1. These building services plant are required to serve internal areas of the building at ground and 1st floor levels as part of an ongoing refurbishment of the building.

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 SITE AND SURROUNDING AREA

The subject property is located at the corner of Alfred Place and Chenies Street. This is an existing office building known as Whittington House and comprises a basement car park and plant areas, ground floor reception/showroom, with office accommodation on levels above. The flat roof area at 1st floor level contains a number of existing air cooled condensers and air cooled chillers (many of which are to be removed) and it is proposed to install new air cooled condenser units.

There is a terrace of 4 to 5 storey properties on the opposite side of Alfred Place all of which generally appear to have commercial use.

To the north, the subject premises overlook Chenies Street. Land usage on the northern side of this road appears to be mixed, including residential use. The closest residential properties are those within 9 Chenies Street.

The north eastern boundary of the subject premises is principally formed with existing buildings in educational use (RADA) and residential properties in Rossetti Close, Ridgmount Place. Further residential accommodation is to be found in Ridgmount Street slightly further east of the site.

To the south, the site adjoins 31-32 Alfred Place, a seven storey property in commercial (office) use.

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

The proposed plant layout of the 1st floor flat roof area is indicated on Vector Design drawing no. 4168 / M403 (Rev. P5) 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 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 Wednesday 12 and Thursday 13 September 2018.

It is understood the condenser plant will operate between 07.00 to 19.00 hours, with the exception of the existing UPS Room condenser units and the new Comms Room condenser units which will need to operate overnight on demand. The environmental noise surveys therefore comprised a series of three fully attended noise monitoring periods (06.00 to 08.00 hours, 18.00 to 20.00 hours and 01.00 to 04.00 hours) to cover operational times when background noise levels were likely to be lowest in the surrounding area.

4.1 Noise Measurement Locations

Noise measurements were monitored at the following measurement locations:

Position A: On the pavement outside No. 13 Alfred Place. The sound level meter was positioned approximately 3m from the building façade and 1.5m above ground level.

Position B: On the pavement outside No. 17 Alfred Place near the junction with Chenies Street. The sound level meter was positioned approximately 3m from the building façade and 1.5m above ground level.

Position C: On the pavement outside No. 9 Chenies Street (Flats 1-36 of Chenies Street Chambers). The sound level meter was positioned approximately 2m from the building façade and 1.5m above ground level.

Position D: On the pavement outside No's. 10 to 40 Ridgmount Street. The sound level meter was positioned approximately 1m from the building façade and 1.5m above ground level.

The approximate locations of the measurement positions are shown on **Figure 2** attached at **Appendix C**.

4.2 Instrumentation

The following instrumentation was used for the noise survey:

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 the 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) and with 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 10-15 minute sample period (excluding periods where the 'back erase' facility of the real time analyser was used to eliminate non-representative short term peaks).

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

4.5 Noise Survey Results

The noise survey results are presented in **Tables 1 to 4** attached at **Appendix E**.

4.6 Discussion of Results

Noise levels at all measurement locations were generally controlled by local and distant road traffic and were also influenced by plant noise emissions from neighbouring and surrounding buildings.

The highest background noise levels were measured in the vicinity of Alfred Place (Positions A and B), which appeared to be most particularly influenced by plant noise emission emanating from the direction of Store Street.

The lowest background noise levels were measured at Position D which was exposed to less traffic flow and was effectively screened from plant noises emanating from nearby buildings.

5 ACOUSTIC DESIGN TARGETS

5.1 Local Authority Requirements

As noted above, the London Borough of Camden require that noise emissions from proposed plant to nearby dwellings 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 living room, dining room or bedroom window of nearby properties. The guidance within the Camden Local Plan indicates that plant noise emissions during the night-time period need consider bedroom windows only.

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 Operating Hours (07.00 - 19.00 hours)	**Evening / Night-Time Hours** (19.00 - 07.00 hours)
Position A	54	52
Position B	53	49
Position C	52	45
Position D	48	43

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 Environmental Acoustic Design Targets

Location of Noise Sensitive Receptors	Plant Noise Emission Level, $L_{Aeq,15mins}$ dB	
	Daytime Operating Hours (07.00 - 19.00 hours)	**Evening / Night-Time Hours** (19.00 - 07.00 hours)
Alfred Place (Southern End)	44	42
Alfred Place (Northern End)	43	39
Chenies Street	42	35
Ridgmount Street / Ridgmount Mews / Rossetti Court	38	33

The above acoustic design targets are to be achieved at a distance of 1m from the nearest living room, dining room or bedroom window of nearby dwellings with all plant operating normally. It is clear that the 'worst case' potential impact with regard to environmental noise emissions from the subject proposals would be outside the façade of the closest noise sensitive windows of Rossetti Court. This has therefore been considered in order to provide a 'robust' assessment in Planning terms. Guidance within the Camden Local Plan indicates that plant noise during the night-time period need take into account bedroom windows only.

6 PROPOSED PLANT AND NOISE MITIGATION MEASURES

The proposed condenser plant will comprise:-

- 8 no. Daikin 'REYQ' type condenser units, to be installed on 1st floor level roof area;
- 4 no. Daikin 'RZQG' type condenser units, to be installed on 1st floor level roof area;
- 3 no. Toshiba 'RAV-SM22' type condenser units, to be installed on 1st floor level roof area;
- 3 no. Daikin 'REYQ' type condenser units, to be retained on 1st floor level roof area;
- 6 no. Daikin 'RZQG' type condenser units, to be retained on 1st floor level roof area;

The proposed disposition of the condenser units on the flat roof area at 1st floor level is shown on Vector Design drawing no. 4168 / M403 (Rev. P5) [attached in **Appendix B]**.

Manufacturer's noise data for the proposed plant is summarised on **Schedule 8735/PN1** attached at **Appendix F**.

In order to provide adequate control of environmental noise emissions, it will be necessary for 2.7m high proprietary acoustic screens to be constructed adjacent to each bank of condenser units on the 1st floor level roof area, as shown on Woods Bagot architects drawings accompanying the Planning Application. The acoustic screens will generally need to be constructed as 'L' sections to control noise radiation in all critical directions. (**Please Note:** It will also be necessary to increase the height of the existing acoustic screens to the same height as the new screens).

The proposed acoustic screens 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 screens 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.noisecontrol-uk.com), 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 screens shall comply with the minimum acoustic performances tabulated below and shall be continuous - i.e. without any gaps between panels, below the screen and/or around any services penetrations etc.

Minimum Acoustic Performance of Condenser Unit Screens								
Acoustic Performance	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Minimum Sound Reduction Indices	15	18	25	30	35	40	40	40
Minimum Sound Absorption Coefficients	0.10	0.25	0.60	0.95	0.95	0.95	0.90	0.90

7 ENVIRONMENTAL PLANT NOISE ASSESSMENT

7.1 Cumulative Plant Noise Emissions to Atmosphere

The nearest living room, dining room or bedroom windows to the proposed 1st floor rooftop condenser plant are the windows and balconies in the south western elevation of Rossetti Court which are estimated to be between approximately 31m and 56m from the various rooftop condenser plant. The closest non sensitive windows of Rossetti Court (kitchens, bathrooms) are estimated to be approximately 10-11m from the closest condenser plant.

Calculations have been undertaken to assess environmental noise emissions from the proposed 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 daytime noise levels outside the nearest noise sensitive windows of Rossetti Court are summarised below:

Condenser Unit Ref.	Predicted Noise Level, dB L_{Aeq}
Daikin REYQ12T (Gnd. Flr. Office AC 2.1)	19
Daikin REYQ16T (Gnd. Flr. Office AC 2.2)	23
Daikin REYQ20T (North Office AC)	24
2 no. Daikin RZQG100L9V1 (Gnd. Comms Rm.)	12
2 no. Toshiba RAV-SM22 (Gnd. North AHU)	18
Daikin REYQ12T (Gnd. Flr. Office AC 1.1)	21
Daikin REYQ14T (Gnd. Flr. Office AC 1.2)	20
4 no. Daikin RZQG100L9V1 (Existing UPS Rm. Units)	16
Daikin REYQ18T	24
Daikin REYQ8T	19
Daikin REYQ12T (Level 1 South Office AC)	22
2 no. Daikin RZQG100L9V1 (Level 1 Comms Rm.)	14
Toshiba RAV-SM22 (Gnd. South AHU)	18
2 no. Daikin RZQG100L9V1 (Existing Units)	16
Daikin REYQ10T (Existing Unit)	21
2 no. Daikin REYQ16T (Existing Units)	31
TOTAL CONDENSER PLANT SOUND LEVEL	**35**

The cumulative plant noise emission level outside the nearest bedroom windows of Rossetti Court during the night-time period - i.e with all the condenser units inoperative except the existing UPS Room condenser units and the new Comms Room condenser units - has been calculated to approximately 19 dB L_{Aeq}.

The cumulative plant noise emission levels outside the closest non sensitive windows of Rossetti Court (kitchens, bathrooms) have been calculated to be 43 dB L_{Aeq} during the daytime period and 25 dB L_{Aeq} during the night-time period.

The above calculations demonstrate that cumulative noise emissions due to operation of the proposed condenser plant (incorporating the specified noise mitigation measures) should accord with industry good practice and satisfy the Council's noise threshold 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 subject premises at Whittington House, Alfred Place, London WC1. 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 (i.e. proprietary acoustic screens).

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 the existing condenser units and 3 no. large air cooled chillers 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.

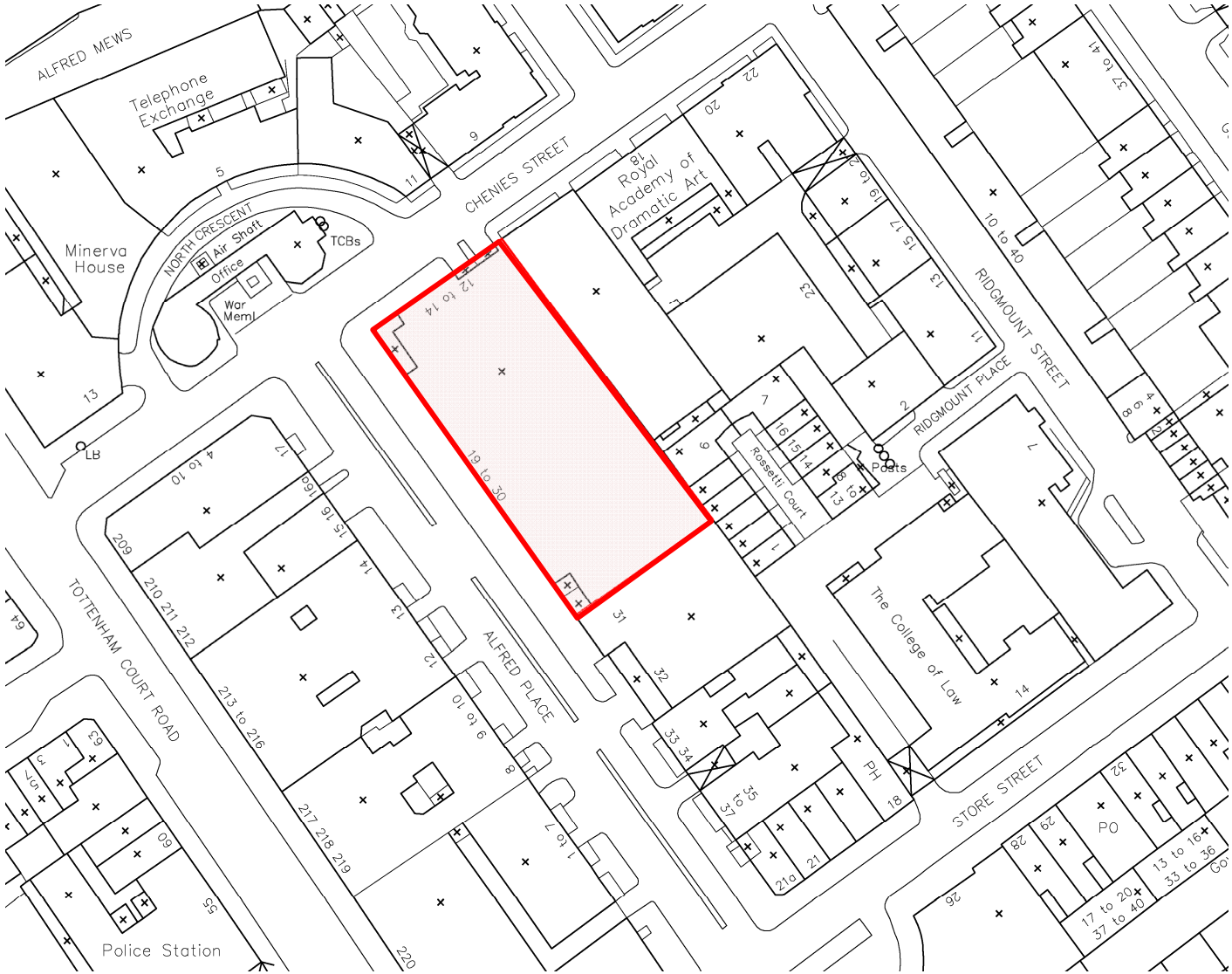
Report Prepared by:

Steven G. Gardner MIOA MSEE.....

Report Checked by:

Christopher Hookway AMIOA.....

APPENDIX A



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WHITTINGTON HOUSE
ALFRED PLACE, LONDON WC1

Site Location Plan

Date: January 2019

Scale: NTS

Drawing Ref: Figure 1

APPENDIX B

4 5 6 7 8 9 10 11 12 13

LOW LEVEL ENTRY POINT TO BE DETAILED

FRESH AIR INTAKE PLENUM FROM BELOW

VENT

ELECTRICAL 450mm CABLE BASKET

450mm CABLE BASKET

APPROX 1400x1400 EXHAUST AIR DUCT FB

REMOVE SECTION OF EXISTING ROOFLIGHT AND INSTALL NEW PENTHOUSE LOUVRE ENCLOSURE APPROX 1500x1500x750H NOTE BLANKED ONE SIDE

EXISTING PERIMETER LOUVRE UTILISED FOR FRESH AIR INTAKE TO PLANTROOM AREA BELOW

BOILER PLANTROOM VENTILATION DUCT FB

NEW WATER HEATER FLUE FB

EXISTING WATER HEATER FLUE FB

NEW BOILER FLUE FB

NOTE:
SKY LIGHT MAY REQUIRE ACOUSTIC TREATMENT SUBJECT TO SOUND LEVEL CHECKS POST PLANT COMMISSION

SKYLIGHT

NOTE 1

APPROX 700x450 EXHAUST AIR DUCT FB

APPROX 900x450 FRESH AIR DUCT FB

AC PIPEWORK DROPS TO BASEMENT VIA OPENING IN LOUVRE

REFRIGERATION PIPEWORK, POWER & CONTROLS WIRING FB MOUNTED ON CABLE BASKET AT ROOF LEVEL

LEVEL 1 NORTH OFFICE AC UNIT
DAIKIN REYQ20T
1240Lx765Wx1685H – 337Kg

GROUND FLOOR OFFICE AC 2.1
DAIKIN–REYQ12T
930L x 765W x1685H – 218KG

GROUND FLOOR OFFICE AC 2.2
DAIKIN–REYQ18T
1240L x 765W x1685H – 305KG

DAIKIN REYQ18T
1240Lx765Wx1685H – 337Kg

DAIKIN REYQ8T
930Lx765Dx1685H – 210Kg

LEVEL 1 SOUTH OFFICE AC UNIT
DAIKIN REYQ12T
930Lx765Dx1685H – 218Kg

GROUND FLOOR SOUTH AHU CONDENSING UNIT
TOSHIBA RAV–SM22 44 AT8–E
900Lx320Dx1540H – 134Kg

GROUND FLOOR OFFICE AC 1.1
DAIKIN REYQ12T
930Lx765Wx1685h – 218Kg

GROUND FLOOR OFFICE AC 1.2
DAIKIN REYQ14T
1240Lx765Wx1685H – 304Kg

DB/1/B/1AC/9L1/SP/32A
DB/1/B/1AC/9L2/SP/32A
DB/1/B/1AC/9L3/SP/32A
DB/1/B/1AC/8L2/SP/32A
DB/1/B/1AC/8L3/SP/32A

LEVEL 1 COMMS ROOM AC UNITS
2No DAIKIN R2QA 100LW1
940Lx320Dx1430H

EXISTING CONDENSING UNITS RETAINED

DB/1/B/1AC /9L2/SP/32A
DB/1/B/1AC /13L2/SP/32A
DB/1/B/1AC /13L3/SP/40A
DB/1/B/1AC /9L1/SP/32A

AC UNITS FED FROM DB/1/B/1AC

AC UNITS FED FROM DIST. BOARD DB/1/B/1AC

GROUND FLOOR COMMS ROOM AC UNITS, 2No DAIKIN R2QG100LW1
940L x 320D x 1430H – 102KG

GROUND FLOOR NORTH AHU CONDENSING UNITS 2No TOSHIBA RAV–SM22 44 AT8–E
900Lx320Dx1540H – 134Kg

AC PIPEWORK, POWER & CONTROLS WIRING FB THROUGH EXISTING OPENING MOUNTED ON CABLE BASKET AT ROOF LEVEL

EXISTING CONDENSING UNITS RETAINED

AC PIPEWORK CONTAINMENT

NOTE:
SKY LIGHT MAY REQUIRE ACOUSTIC TREATMENT SUBJECT TO SOUND LEVEL CHECKS POST PLANT COMMISSION

SKYLIGHT

Riser

STAIR 2
ST02

LOBBY
R1.04

Riser

Riser

DIMENSIONS
Figured dimensions are to be taken in preference to scaled dimensions. All dimensions are to be verified on site prior to work commencing.

DISCREPANCIES
Any discrepancy is to be referred to the consultant before proceeding.

RELATED DOCUMENTS
This drawing shall be read in conjunction with the written specification where appropriate.

P5	UPDATED TO SUIT SITE CONDITIONS & COMMENTS RECEIVED	LA	DT	05.09.18
P4	LEVEL 1 PLANT DETAILS UPDATED	TQ	DT	27.07.18
P3	GENERAL UPDATES TO INCLUDE SERVICES ASSOCIATED WITH "RAMP" PLANTROOM & BASEMENT PLANT AREAS	TQ	DT	06.07.18
P2	LEVEL 1 AC CONDENSING UNITS & GROUND FLOOR AHU CONDENSING UNITS ADDED	JH	DT	22.06.18
P1	ISSUED FOR COMMENT	TQ	DT	20.06.18

Architect
WOODS BAGOT

Client
Lowe & Oliver
Electrical & Mechanical Contractors

Project
Whittington House
Ground Floor
G Research

Drawing Title
Proposed Combined Services At Roof Level

Project Ref.	Scale	Drawing No.
4168	1:50 @ A0	M403

Drawn	Designed	Date	Rev.
TQ	DT	June 2018	P5

vectordesign
BUILDING SERVICES CONSULTANTS
Church Farm Barns, Copson Lane, Stadhampton, Oxon. OX44 7TZ
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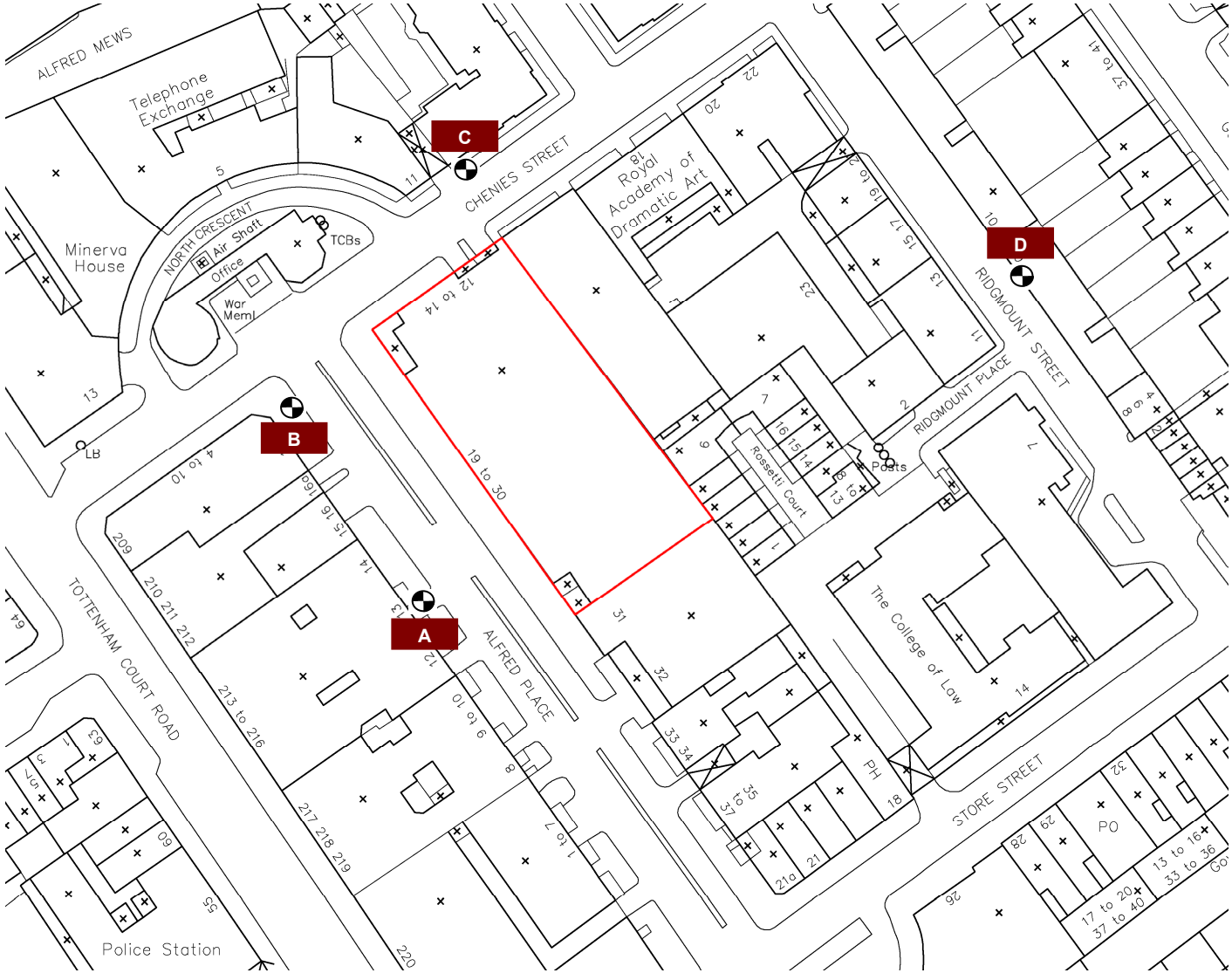
Vector File Ref: xxxxx

APPENDIX C



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-- Noise Monitoring Location

WHITTINGTON HOUSE
ALFRED PLACE, LONDON WC1

Site Plan Showing Approximate Locations of Noise Monitoring Positions

Date: January 2019

Scale: NTS

Drawing Ref: Figure 2

APPENDIX D

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 sourd 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 E

TABLE 1:
Results of Attended Noise Measurements – Position A (No. 13 Alfred Place)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
06.00 – 07.00	53	58	72
07.00 – 08.00	54	59	73
18.00 – 19.00	54	60	76
19.00 – 20.00	55	61	77
01.00 – 02.00	52	56	72
02.00 – 03.00	52	54	69
03.00 – 04.00	52	54	67

TABLE 2:
Results of Attended Noise Measurements – Position B (Corner Alfred Place / Chenies Street)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
06.00 – 07.00	52	56	72
07.00 – 08.00	53	58	72
18.00 – 19.00	53	62	76
19.00 – 20.00	53	60	76
01.00 – 02.00	51	54	70
02.00 – 03.00	51	54	60
03.00 – 04.00	49	54	65

TABLE 3:
Results of Attended Noise Measurements – Position C (No. 9 Chenies Street)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
06.00 – 07.00	52	67	79
07.00 – 08.00	52	67	77
18.00 – 19.00	53	67	80
19.00 – 20.00	51	67	84
01.00 – 02.00	48	65	76
02.00 – 03.00	46	65	77
03.00 – 04.00	45	57	75

TABLE 4:
Results of Attended Noise Measurements – Position D (No's 10 to 40 Ridgmount Street)

Time	Measured Sound Level, dB		
	$L_{A90,10mins}$	$L_{Aeq,10mins}$	$L_{Amax,fast}$
06.00 – 07.00	47	56	77
07.00 – 08.00	48	57	75
18.00 – 19.00	48	64	82
19.00 – 20.00	49	62	86
01.00 – 02.00	44	64	82
02.00 – 03.00	43	59	77
03.00 – 04.00	43	64	85

APPENDIX F

SCHEDULE: 8735/PN1

SHEET NO. 1 OF 1

DATE: October 2018

WHITTINGTON HOUSE - CONDENSER UNIT NOISE DATA

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Manufacturer	Model Type	Location	m3/s	Pa.	Lw / Lp	Octave Band Centre Frequency, Hz							
						63	125	250	500	1k	2k	4k	8k
Daikin	REYQ8T	1st Floor Level Roof	--	--	(M) Lp @ 1m	60	58	58	57	56	46	48	38
Daikin	REYQ10T	1st Floor Level Roof	--	--	(M) Lp @ 1m	62	65	57	58	51	48	41	35
Daikin	REYQ12T	1st Floor Level Roof	--	--	(M) Lp @ 1m	59	65	60	61	58	50	44	37
Daikin	REYQ14T	1st Floor Level Roof	--	--	(M) Lp @ 1m	65	68	64	59	54	50	48	39
Daikin	REYQ16T	1st Floor Level Roof	--	--	(M) Lp @ 1m	70	68	67	62	57	53	48	42
Daikin	REYQ18T	1st Floor Level Roof	--	--	(M) Lp @ 1m	66	65	67	63	59	55	50	44
Daikin	REYQ20T	1st Floor Level Roof	--	--	(M) Lp @ 1m	65	65	67	65	60	57	52	46
Daikin	RZQG100L9V1 (Cooling Mode)	1st Floor Level Roof	--	--	(M) Lp @ 1m	50	57	50	50	43	41	35	28
Daikin	RZQG100L9V1 (Heating Mode)	1st Floor Level Roof	--	--	(M) Lp @ 1m	58	57	53	48	46	45	40	28
Toshiba	RAV-SM22 (Cooling Mode)	1st Floor Level Roof	`	--	(M) Lp @ 1m	58	61	56	54	51	47	41	32
Toshiba	RAV-SM22 (Heating Mode)	1st Floor Level Roof	--	--	(M) Lp @ 10m	61	59	58	53	53	48	42	35

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