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Project:

UCL South Wing, 2nd Floor

Title:

Plant Noise Impact Assessment

quietly moving forward

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Client	Fowler Martin
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Revision	Date	Author	Checked
0			

CONTENTS:

1 INTRODUCTION

1.01 Environmental Equipment Corporation Limited has been commissioned by Fowler Martin to undertake a noise assessment of two condenser units to serve the second-floor classrooms of the South Wing of the University College London Campus.

1.02 This noise assessment has been conducted in accordance with the policies and requirements of London Borough of Camden Council (LBCC) and is based on a noise survey carried out at the site over a typical weekday period.

1.03 This assessment includes:

- the setting of plant noise limits in accordance with the requirements of LBCC and national planning policy, standards and guidance; and
- the prediction of noise impacts at the worst affected noise sensitive receptors based on the proposed items of plant and their location.

1.04 This report is prepared solely for Fowler Martin. Environmental Equipment Corporation Limited accepts no responsibility for its use by any third party.

1.05 Whilst every effort has been made to ensure that this report is easy to understand, it is necessarily technical in nature. To assist the reader, an explanation of the terminology used in this report is contained in Appendix A.

2 SITE

2.01 The University College London has its primary campus centred around a Main Quad close to Gower Street.
It is proposed that as part of renovation works to the South Wing of the Campus, two condenser units will be installed on the south façade of an externally located plantroom adjacent to the South Quad and to the south of the South Wing.
University College London is completely surrounded by educational buildings/ museums.

2.02 The property is bound by the following:

- North – University College Main Quad, an open section of the University campus;
- East – South Cloisters a five-storey teaching area/ museum;
- South – The South Quad a smaller open section of the University campus which contains a café in its centre and one storey plantroom structure to the west; and
- West – Chadwick a five-storey Anatomy teaching area.

2.03 This application is for 2 No. *Daikin* condenser units which are to be located on the south elevation of the plantroom structure within the South Quad, as presented in Appendix B.

2.04 The closest noise sensitive receptors to the proposed plant items are the second-floor south-facing classroom windows of the South Wing.

2.05 If noise levels are designed as assessed in this report to the second-floor classroom windows as identified above, then they, will meet the design criteria by default at the closest residential windows which are over 50 m away from the proposed plant locations and significantly screened by the Anatomy Building.

All other noise sensitive receptors are at a greater distance from the proposed location of the units, or are protected by more screening by the intervening structures, and as such will be subject to lower levels of noise.

3 GUIDANCE

3.01 Local and National Planning Policy for London Borough of Camden Council (LBCC) are presented in Appendix C of this document.

3.02 A summary of the pertinent points relating to this application are presented below.

Noise from new plant affecting existing residential amenity is considered to be acceptable where:

- Daytime - its rating level is at least 10dB less than the existing background noise (in Gardens and at the facades of noise sensitive dwellings)
- Night time - its rating level is at least 10dB less than the existing background noise (at the facades of noise sensitive dwellings)
- Plant should be designed to be 15dB less than the background noise if and where it contains distinguishing tonal characteristics.

3.03 It is noted that the guidance as written relates to noise sensitive receptors defined as *Dwellings*. LBCC's guidance document also indicates that other noise sensitive receptors also need to be identified and protected accordingly using an appropriate target in-line with their policy aims. This would apply to noise sensitive facades identified hear as part of the UCL educational facilities.

4 MEASUREMENTS

4.01 Environmental noise measurements were carried out over a weekday period, between 1545 hours on Monday 4th February 2019 and concluded 0245 hours the following day, to establish the existing noise levels at the site. The survey methodology and results are set out below.

4.02 Noise measurements have been carried out at the following position, as shown in Appendix B and described as being located at a height of approximately 1.5 metres above the first-floor flat roof of the plantroom at the South Wing. The measurement was not located with 3.5 meters of any reflecting surfaces other than the mounting surface.

4.03 This position is considered to be representative of noise levels at the nearest windows to the proposed new plant items.

5 EQUIPMENT

5.01 The equipment used for the survey was as follows:-

- 01dB Metravib Black Solo Integrating Sound Level Meter conforming to Class 1 BS EN 61672, Type 1 BS EN 60804 & BS EN 60651: 1994;
- 01dB Metravib MCE 212 Condenser Microphone, PRE 21 S Pre-amp and Connecting Leads;
- 01dB Outdoor Microphone Kit and a
- Tripod.

5.02 The equipment holds current UKAS or equivalent accreditation and serial numbers as follows:

Sound Level Meter 01dB Black Solo	Serial No.	61719
	Calibration Date	27th June 2018
	Cal Certificate No.	U28879
½" MCE 212 Condenser Mic.	Serial No.	166397
	Calibration Date	27th June 2018
	Cal Certificate No.	28878
Calibrator CAL 21	Serial No.	34344442
	Calibration Date	27th June 2018
	Cal. Certificate No.	U25658

N.B. Copies of calibration certificates are available upon request.

5.03 The equipment was calibrated both before and after the survey with no difference noted in the levels.

6 RESULTS

6.01 The weather during the survey was suitable for noise measurement, it being mostly dry with little wind for the duration of the survey.

6.02 Noise sources at the site were dominated by existing plant items serving the site, located on the first-floor flat roof and at higher level, these were in operation for the duration of the survey. Noise levels at the measurement location are representative of those at the closest noise sensitive classroom windows.

6.03 A list of the levels measured is included in Appendix D and represented graphically in Appendix E.

6.04 A summary of the time averaged ambient levels and lowest measured background levels over the measurement periods are shown in Table 6.1. The minimum L_{A90} is the lowest fifteen-minute measurement in the specified period.

Position	Period	Average $L_{Aeq,T}$ – dB	Minimum L_{A90} – dB
1	Day time (0700-1900 hrs)	59	56
	Evening (1900-2300 hrs)	57	56
	Night-time (2300-0700 hrs)	57	55

Table 6.1: Free-Field Measured Ambient and Lowest Background Noise Levels

7 PLANT ASSESSMENT

7.01 This application is for the installation of 2 No. *Daikin RXYSQ8TY1* condenser units to be located on the southern façade of the existing plantroom to the west of the South Quad. To differentiate the condensers are described as:

- Unit 1: located at the west of the plantroom's southern façade and underneath an existing overhang; and
- Unit 2: located on the east of the plantroom's southern façade.

7.02 Based on the standard requirements of LBCC and the lowest measured background noise level in each time period, Table 7.1 sets out the recommended noise limits that the proposed items of plant should meet.

7.03 Please note, that in accordance with the requirements of LBCC, the proposed noise limits are based on being 10 dB below the measured background noise level.

Location	Period	Measured Existing $L_{A90,T}$	Proposed Noise Limit L_{Ar}
1	Day	56 dB	46 dB
	Evening	56 dB	46 dB
	Night	55 dB	45 dB

Table 7.1: Suggested Plant Noise Emission Limits Based on Lowest Measured L_{A90}, Free-field dB

7.04 Note that the limits suggested above are rating levels and as such any design should take into account the acoustic characteristics of the plant. In this instance the proposed units display none of the characteristics whereby the acoustic correction should be applied.

7.05 Assuming the proposed items meet the noise limits set out in Table 7.1 noise will be below the NOEL with respect to the NPPF.

7.06 The proposed units have a stated manufacturers sound power level of 73 dB(A) during cooling mode. Copies of the manufacturer's plant data sheets are included in Appendix F.

7.07 These plant items will be in operation for the daytime 0700 – 1900 hrs and will only operate in cooling mode.

It is proposed that absorptive acoustic wall lining is installed on each of the façades the condensers will be fixed to.

7.08 The condenser installation will also include vibration isolation measures to prevent the transfer of vibrational energy to the connecting walls and areas.

7.09 Predicted noise levels have been calculated at the closest noise sensitive windows, the second-floor south-facing classroom windows of the South Wing.

7.10 Other noise sensitive receptors located further from the site will be subject to lower noise levels than those predicted at the above locations.

7.11 Tables 7.2 – 7.5 present the results of worst-case plant noise predictions at the worst-case locations. The calculations include the contribution of the direct sound paths and the direct reflection from the façade of the masonry façade of the building opposite.

Item	Noise Level	Notes
Daikin RXYSQ8TY1 (Unit 1)	73 dB(A)	Sound Power Level
Direct noise path		
Reflections	+ 3 dB	Additional reflections rear wall
Noise control	- 3 dB	EEC acoustic wall lining
Barrier Effect	- 9 dB	Screening from building structure
Conformal area losses over 9.5 metres	- 31 dB	Distance to closest window
Direct noise level	33 dB(A)	Noise from direct noise path
First order reflection		
Reflections	+ 3 dB	Additional reflections rear wall
Noise control	- 3 dB	EEC acoustic wall lining
Conformal area losses over 12 metres	- 33 dB	Reflected distance to closest window
Reflected noise level	40 dB	Noise from reflected noise path
Total Noise Level	41 dB(A)	At second-floor windows

Table 7.2: Second-floor south-facing classroom windows of the South Wing Plant Noise Calculation

Item	Noise Level	Notes
Daikin RXYSQ8TY1 (Unit 2)	73 dB(A)	Sound Power Level
Direct noise path		
Reflections	+ 3 dB	Additional reflections rear wall
Noise control	- 3 dB	EEC acoustic wall lining
Barrier Effect	- 6 dB	Screening from edge of plantroom
Conformal area losses over 8 metres	- 30 dB	Distance to closest window
Direct noise level	37 dB(A)	Noise from direct noise path
First order reflection		
Reflections	+ 3 dB	Additional reflections rear wall
Noise control	- 3 dB	EEC acoustic wall lining
Conformal area losses over 12 metres	- 33 dB	Reflected distance to closest window
Reflected noise level	40 dB	Noise from reflected noise path
Total Noise Level	42 dB(A)	At second-floor windows

Table 7.3: Second-floor south-facing classroom windows of the South Wing Plant Noise Calculation

Item	Noise Level	Notes
Daikin RXYSQ8TY1 (Unit 1)	43 dB(A)	Sound Power Level
Daikin RXYSQ8TY1 (Unit 2)	44 dB(A)	Noise from reflected noise path
Total Noise Level	**45 dB(A)**	**At second-floor windows**

Table 7.4: Second-floor south-facing classroom windows of the South Wing Total Plant Noise Calculation

Property	Period	Proposed Noise Limit L_{Ar}	Predicted $L_{Aeq,T}$	Exceedance of noise limit
Second-floor South Wing Classrooms	Daytime	46 dB	45 dB	- 1 dB
	Evening	46 dB	-	N/A
	Night-time	45 dB	-	N/A

Table 7.5: Assessment of Predicted Noise Levels Based on Proposed Noise Limit, Free-field dB(A)

7.12 It can be seen from the above tables that the noise limits are not exceeded at any period of proposed operation.

7.13 Assuming that the proposed plant and noise control equipment and measures outlined in Section 7.07 is included in the installation, predicted noise levels will meet the requirements of the Local Authority during all periods of operation and at the closest noise sensitive receptors.

7.14 With respect to the NPPF, achieving the noise limits would be classified as being below the NOEL and meeting the limits of the LOAEL as defined by LBCC.

7.15 The proposed scheme of vibration isolation will also mitigate the transfer of vibration to the supporting and connecting structures and ensure that the airborne sound mitigation design is not compromised.

7.16 The proposals are therefore expected to meet the 'Green' criterion in line with LBCC Local Plan whereby noise emissions are considered to be acceptable.

8 CONCLUSIONS

8.01 Fowler Martin has appointed Environmental Equipment Corporation Limited to undertake a noise assessment for two *Daikin* condenser units to serve the second-floor classrooms of the South Wing of the University College London Campus.

8.02 The assessment has been carried out in accordance with national planning guidance and the requirements of the LBCC, and is based on an environmental noise survey conducted at the site over a mid-week period.

8.03 A noise assessment has been undertaken to evaluate the potential noise impact of the proposed condensers at the closest existing noise sensitive receptors.

8.04 Plant noise limits have been set based on the methodology contained in BS4142, the results of a background noise survey and the requirements of LBCC, to control the noise from the proposed plant items. In accordance with the LBCC, the noise limit has been set 10 dB below the lowest measured background noise level.

8.05 Predictions have shown that the noise criterion is met at all assessment locations during all periods of the condenser's proposed operation, assuming, noise control measures described in section 7.07 are included in the installation.

8.06 Assessing the site in accordance with the principles of the National Planning Policy Framework has shown that predicted noise levels would be below the level at which no effects are observed to occur, the NOEL and will be below the LOAEL as defined in LBC's Local Plan, Appendix 3.

8.07 On the basis of this assessment it is considered that noise does not pose a material constraint to the operation of the condenser units.

APPENDIX A

GLOSSARY OF TECHNICAL TERMS

TECHNICAL TERMS AND UNITS

Decibel (dB) - This is the unit used to measure sound. The human ear has an approximately logarithmic response to sound over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). We therefore use a logarithmic scale to describe sound pressure levels, intensities and power levels. The logarithms used are to base 10; hence, an increase of 10 dB in sound pressure level corresponds to a doubling in perceived loudness of the sound.

Sound Power Level (SWL) - This is a function of the noise source alone and is independent of its surroundings. It is a measure of the amount of sound power output measured in decibels.

Sound Pressure Level (SPL) - This is a function of the source and its surroundings and is a measure of the sound pressure at a point in space. For example, a sound pressure level measured at 1 metre from a sound source of certain sound power in reverberant room will not be the same as the sound pressure level a 1 metre from the sound source measured in open space.

Octave and One-Third Octave Bands - The human ear is sensitive to sound over a range of approximately 20 Hz to 20 KHz and is generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum is divided into frequency bands and the sound pressure level is measured in each band. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For finer analysis, each octave band may be split into one-third octave bands.

"A" Weighting - A number of frequency weightings have been developed to imitate the ear's varying sensitivity to sound of different frequencies. The most commonly used weighting is the "A" weighting. The "A" weighted SPL can be measured directly or derived from octave or one-third octave band SPLs. The result is a single figure index which gives some idea of the subjective loudness of the sound, but which contains no information as to its frequency content.

Noise Rating (NR) Curves - The "A" weighted sound pressure level cannot be used to define a spectrum or to compare sounds of different frequencies. NR curves convey frequency information in a single-figure index. This is done by defining the maximum permissible sound pressure level at each frequency for each curve. To measure the noise rating of a given environment, the SPL is measured in octave or one-third octave bands and the noise rating is then the highest NR curve touched by the measured levels.

Intermittency and Time-Weighting - The degree of annoyance caused by a noise also depends on its duration and intermittency of a noise. Intermittent, impulsive or repetitive noises tend to be more annoying than continuous noises. Various time-weightings have been derived to measure sounds of differing intermittences and these can be measured directly on modern equipment. The most common time-weightings in use are as follows:-

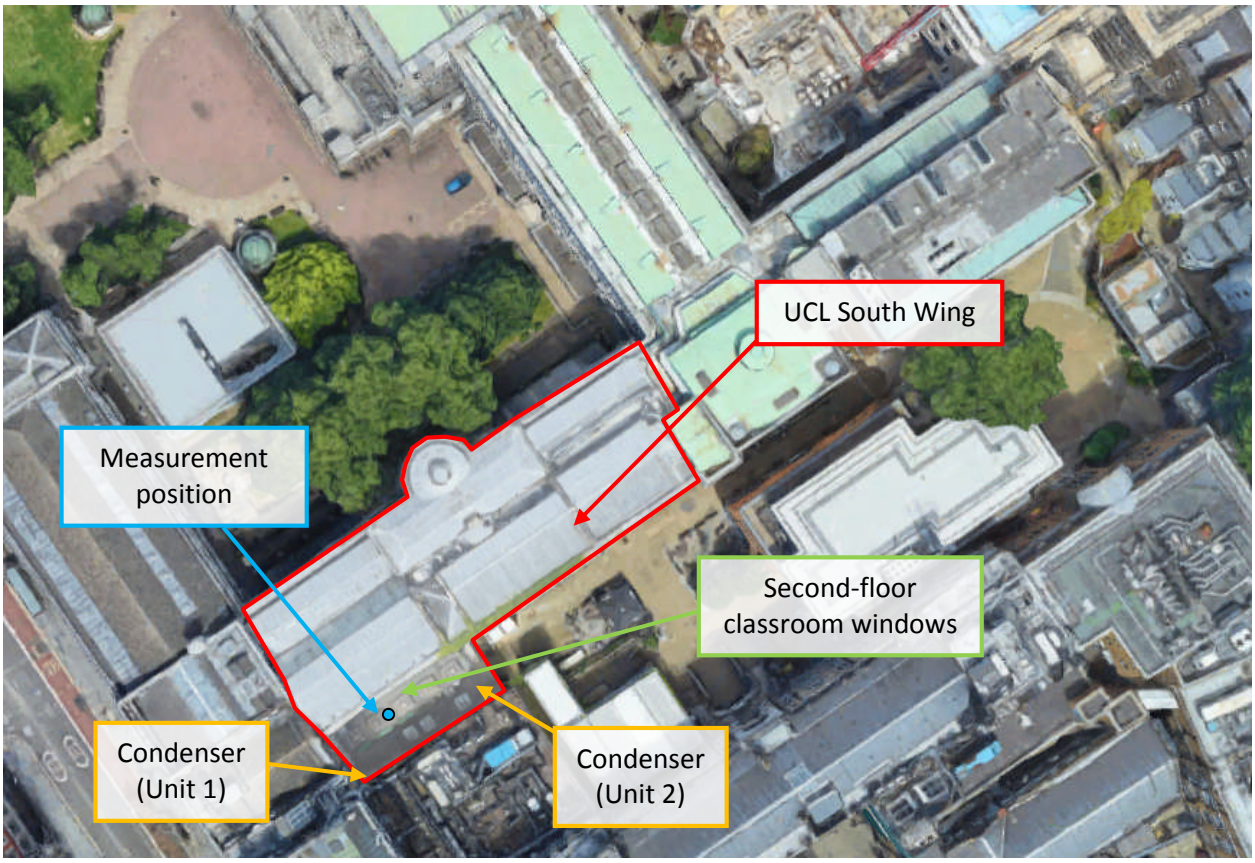
L_{90} This is the sound pressure level exceeded for 90% of the measurement period. It is widely used to measure background noise levels.

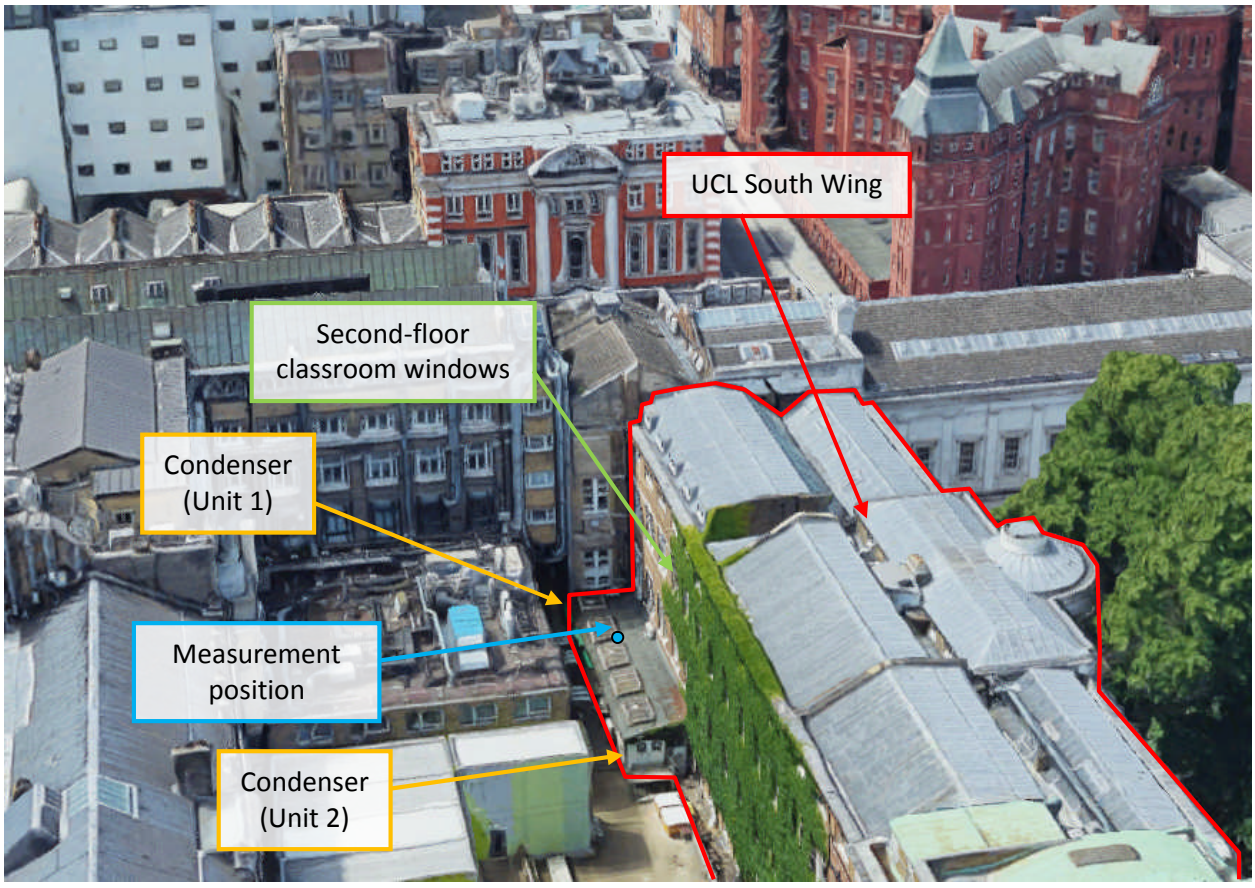
L_{10} This is the sound pressure level exceeded for 10% of the measurement period. It is widely used to measure traffic noise. For a given measurement period, the L_{10} level is by definition greater than or equal to the L_{90} level.

L_{eq} The equivalent continuous noise level is often used to measure intermittent noise. It is defined as the notional steady noise level that would contain the same acoustic energy as the varying noise. Because the averaging process used is logarithmic, the L_{eq} level tends to be dominated by the higher noise levels measured.

APPENDIX B

SITE PLAN
&
MEASUREMENT LOCATION





APPENDIX C

PLANNING POLICY AND GUIDANCE

PLANNING POLICY AND GUIDANCE

Planning Policy Camden Borough Council

London Borough of Camden's planning policy is set out in a range of documents that constitute its 'development plan'. This includes its **Local Plan** and proposed supplementary planning guidance (SPG's) documents. The Local Plan was adopted on 3 July 2017 and has replaced the 'Core Strategy' and 'Camden Development Policy' documents; as the basis for planning decisions and future development in the borough. The SPG's are in the process of being updated at time of writing (Sept 2017).

Policy A4 – *Noise and Vibration* outlines the following aims:

> *The Council will seek to ensure that noise and vibration is controlled and managed.*
>
> *Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:*
>
> *a. development likely to generate unacceptable noise and vibration impacts; or*
> *b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*
>
> *We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development.*

Appendix 3 of the Local Plan outlines noise thresholds for both noise generating and noise sensitive developments and identifies three basic design criteria upon which the acceptability of any proposal is likely to be assessed:

- Green – where noise is considered to be at an acceptable level.
- Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.
- Red – where noise is observed to have a significant adverse effect.

In the context of National Planning Policy Framework and Noise Policy Statement for England, Camden Council consider the above criteria to fall into three associated categories in terms of their noise 'effects':

- LOAEL Green
- LOAEL to SOAEL Amber
- SOAEL Red

Table C of Appendix 3 defines the target noise levels for mechanical services plant and machinery:

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 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

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

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

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 Leq,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.

National Planning Policy Framework and the Noise Policy Statement for England

The Ministry of Housing Communities and Local Government published the National Planning Policy Framework (NPPF) on July 2018 and upon its publication, presented the government's overarching planning policy on noise.

The NPPF contains three aims, which are set out at paragraph 180 in Section 15 of the document, titled *Conserving and enhancing the natural environment*:

> *"Planning policies and decisions also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> *a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life [See explanatory note to the Noise Policy Statement for England];*
>
> *b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
>
> *c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

The Department for Environment Food and Rural Affairs published the Noise Policy Statement for England (NPSE) in March 2010. The explanatory note of NPSE defines the following terms used in the NPPF:

> *"NOEL – No Observed Effect Level*
>
> *This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
>
> *LOAEL – Lowest Observed Adverse Effect Level*
>
> *This is the level above which adverse effects on health and quality of life can be detected.*
>
> *2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.*
>
> *SOAEL – Significant Observed Adverse Effect Level*
>
> *This is the level above which significant adverse effects on health and quality of life occur."*

The NPSE does not define any of the above effect levels numerically.

The NPSE presents the Noise Policy Aims as:

> *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy and sustainable development:*
>
> *avoid significant adverse impacts on health and quality of life;*
>
> *mitigate and minimise adverse impacts on health and quality of life; and*
>
> *where possible, contribute to the improvement of health and quality of life."*

It can be seen that the first two bullet points are similar to Section 11 of the NPPF, with a third aim that seeks to improve health and quality of life. The NPSE later expands on the Noise Policy Aims, stating:

> *2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).*
>
> *2.24 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.*
>
> *2.25 This aim* (the third aim)*, seeks where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."*

It is clear that noise described in the NPSE as SOAEL that would lead to significant adverse effects should be avoided, although there is no definition as to what constitutes a significant adverse effect. Similarly, noise should be mitigated where it is high enough to lead to adverse effects, termed the LOAEL, but not so high that it leads to significant adverse effects.

British Standard 4142

To assess the acceptability of the resultant noise levels we have consulted the relevant standards. BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' has been used to assess the likelihood any adverse impacts based on the resultant noise level from the new plant item, including any corrections for the character of the noise against the existing background noise level.

BS4142 gives guidance on assessing the likelihood of adverse impacts by calculating a 'rating level' of the new noise source and comparing its magnitude at noise sensitive locations to the existing or underlying background noise level. The background noise level is subtracted from the 'rating level' to assess the likelihood of complaints:

- The greater the difference the greater the likelihood of complaints.
- A difference of around +10dB or more is an indication of a significant adverse impact, depending on the context.
- A difference of +5dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background noise level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low sound impact, depending on the context.

This assessment is carried out over a one hour period for the daytime and a fifteen minute period for the night-time. For the purposes of the standard it states that daytime and night-time are typically 07:00 to 23:00 hours and 23:00 to 07:00 hours respectively.

The 'rating level' of the noise source is obtained taking the following factors into consideration:

- The new plant noise (the specific noise) is measured or predicted in terms of L_{Aeq}.
- An additional correction shall be included if the noise contains a distinguishable, discrete continuous note, if the noise contains distinct impulses or if the noise is irregular enough to attract attention. The value for any tonal noise can be an addition of up to 6dB and for impulsive noise of up to 9dB.

BS 4142 goes onto state that:

'The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.'

BS4142 has been referenced in setting noise limits for any fixed plant proposed as part of the proposed development.

APPENDIX D

SURVEY RESULTS
(TABULAR)

EC 16630 - UCL South Wing

Fowler Martin

Tabulated Noise data

Time	L_{Aeq}	L_{AMax}	L_{A90}
15:45	*60*	*74*	*58*
16:00	*59*	*70*	*57*
16:15	*59*	*67*	*57*
16:30	*58*	*69*	*57*
16:45	*59*	*69*	*57*
17:00	*59*	*75*	*56*
17:15	*58*	*65*	*56*
17:30	*58*	*71*	*56*
17:45	*58*	*66*	*56*
18:00	*58*	*76*	*56*
18:15	*58*	*67*	*56*
18:30	*58*	*64*	*56*
18:45	*60*	*79*	*57*
19:00	*58*	*71*	*56*
19:15	*57*	*64*	*56*
19:30	*58*	*71*	*56*
19:45	*59*	*71*	*56*
20:00	*57*	*64*	*56*
20:15	*57*	*65*	*56*
20:30	*57*	*62*	*56*
20:45	*57*	*62*	*56*
21:00	*57*	*62*	*56*
21:15	*57*	*62*	*56*
21:30	*57*	*63*	*56*
21:45	*57*	*62*	*56*
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22:15	*57*	*62*	*56*
22:30	*57*	*64*	*56*
22:45	*57*	*62*	*56*
23:00	*57*	*62*	*56*
23:15	*57*	*71*	*56*
23:30	*57*	*66*	*55*
23:45	*57*	*62*	*56*
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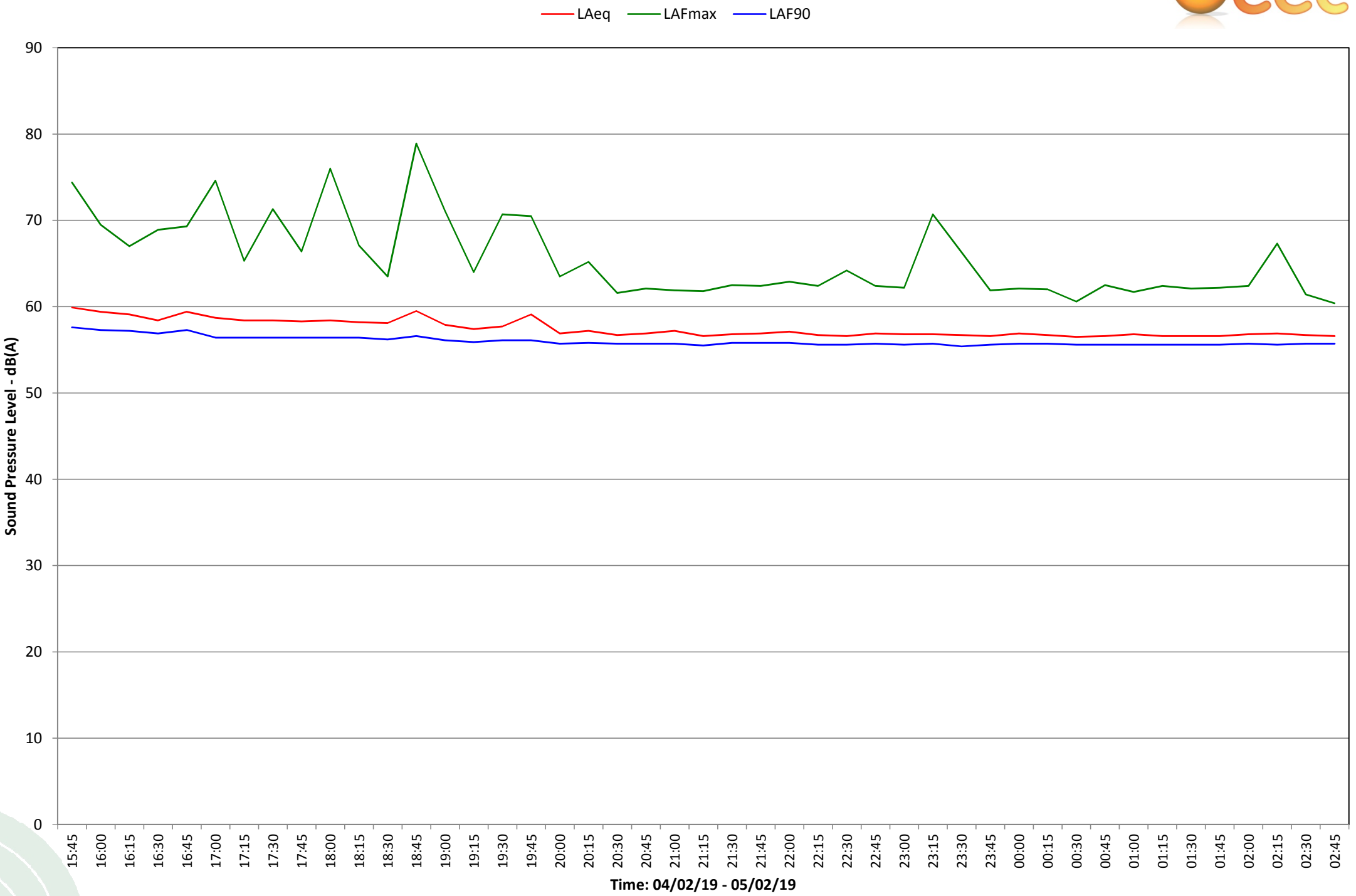
01:30	*57*	*62*	*56*
01:45	*57*	*62*	*56*
02:00	*57*	*62*	*56*
02:15	*57*	*67*	*56*
02:30	*57*	*61*	*56*
02:45	*57*	*60*	*56*

Time	L_{Aeq}	L_{AMax}	L_{A90}

APPENDIX E

SURVEY RESULTS
(GRAPHICAL)

Noise Level Time History at UCL South Wing



APPENDIX F

PUBLISHED PLANT NOISE DATA

VRV IV S-series heat pump

Space saving solution without compromising on efficiency

- Space saving trunk design for flexible installation
- Covers all thermal needs of a building via a single point of contact: accurate temperature control, ventilation, air handling units and Biddle air cutains
- Wide range of indoor units: either connect VRV or stylish indoor units such as Daikin Emura, Nexura ...
- Incorporates VRV IV standards & technologies: Variable Refrigerant Temperature and full inverter compressors
- Possibility to limit peak power consumption between 30 and 80%, for example during periods with high power demand
- Contains all standard VRV features

RXYSQ4-6TV1_TY1

Outdoor unit				RXYSQ-TV1/RXYSQ-TY1	4TV1	5TV1	6TV1	4TY1	5TY1	6TY1	8TY1	10TY1	12TY1
Capacity range				HP	4	5	6	4	5	6	8	10	12
Cooling capacity	Nom.	35°CDB		kW	12.1	14.0	15.5	12.1	14.0	15.5		-	
		Eurovent		kW	-						22.4	28.0	33.5
Heating capacity	Nom.	6°CWB		kW	12.1	14.0	15.5	12.1	14.0	15.5	22.4	28.0	33.5
	Max.	6°CWB		kW	14.2	16.0	18.0	14.2	16.0	18.0	25.0	31.5	37.5
Power input - 50Hz	Cooling	Nom.	35°CDB	kW	3.03	3.73	4.56	3.03	3.73	4.56		-	
			Eurovent	kW	-						6.12	8.24	10.2
	Heating	Nom.	6°CWB	kW	2.68	3.27	3.97	2.68	3.27	3.97	5.20	6.60	8.19
		Max.	6°CWB	kW	3.43	4.09	5.25	3.43	4.09	5.25	6.22	8.33	10.2
EER at nom. capacity	Eurovent			kW/kW	-						3.66	3.40	3.30
COP at nom. capacity	6°CWB			kW/kW	4.52	4.28	3.90	4.52	4.28	3.90	4.31	4.24	4.09
COP at max. capacity	6°CWB			kW/kW	4.14	3.91	3.43	4.14	3.91	3.43	4.02	3.78	3.66
ESEER - Automatic					7.89	7.49	6.73	7.89	7.49	6.73	6.72	6.41	6.18
Maximum number of connectable indoor units					64 (1)								
Indoor index connection	Min.				50	62.5	70	50	62.5	70	100	125	150
	Nom.				-								
	Max.				130	162.5	182	130	162.5	182	260	325	390
Dimensions	Unit	HeightxWidthxDepth		mm	1,345x900x320						1,430x940x320	1,615x940x460	
Weight	Unit			kg	104						144	175	180
Fan	Air flow rate	Cooling	Nom.	m³/min	106						140	182	
Sound power level	Cooling	Nom.		dBA	68	69	70	68	69	70	73	74	76
Sound pressure level	Cooling	Nom.		dBA	50	51		50	51		55		57
Operation range	Cooling	Min.~Max.		°CDB	-5~46							-5~52	
	Heating	Min.~Max.		°CWB	-20~15.5								
Refrigerant	Type				R-410A								
	GWP				2,087.5								
	Charge			TCO_2eq	7.5						9.4	14.6	16.7
				kg	3.6						5.5	7	8
Piping connections	Liquid	OD		mm	9.52								12.7
	Gas	OD		mm	15.9		19.1	15.9		19.1		22.2	25.4
	Total piping length	System	Actual	m	300			-					
Power supply	Phase/Frequency/Voltage			Hz/V	1N~/50/220-240			3N~/50/380-415					
Current - 50Hz	Maximum fuse amps (MFA)			A	32			16			25		32

(1) Actual number of units depends on the indoor unit type (VRV DX indoor, RA DX indoor, etc.) and the connection ratio restriction for the system (being; 50% ≤ CR ≤130%).