REPORT TITLE:

10 Ferncroft Avenue, London, NW3 7PH: Environmental noise assessment.

CLIENT DETAILS:

XUL Architecture.

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PREPARED BY:

Joan-Carles Blanco BSc (Hons), MIOA

CHECKED/AUTHORISED BY:

Martin Jones BSc (Hons), MIOA

Pace Consult Ltd, 652 The Crescent, Colchester Business Park, Colchester CO4 9YQ
t: 0845 241 0142 | **f:** 0845 241 2212 | **e:** info@paceconsult.co.uk | www.paceconsult.co.uk

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Document Status and Revision Schedule

Issue/Revision	Description/Comments	Date	Prepared by	Approved by
-	Checked & Authorised	20/07/20	JCB	MJ
A	Additional A/C units	22/07/20	JCB	MJ
B	A/C unit relocated	20/11/20	JCB	MJ
C	Minor changes	25/11/20	JCB	MJ

1. Summary

A noise assessment was commissioned by XUL Architecture, in support of the planning application for a proposed A/C unit located at 10 Ferncroft Avenue, London, NW3 7PH.

The assessment has considered the most relevant guidelines and standards, including BS 4142:2014+A1:2019: *Methods for rating and assessing industrial and commercial sound* and Local Authority Criteria.

The assessment of the impact has shown that the calculated specific sound sources are 10 dB below the typical measured background levels and therefore, compliance with the acoustic criteria recommended by the relevant acoustic guidelines has been achieved.

2 Introduction

This report provides the noise impact calculation and assessment for the A/C unit which are proposed at 10 Ferncroft Avenue, London, NW3 7PH.

The figure below includes the location of the proposed A/C unit and the nearest noise sensitive receptors (R1, and R2).

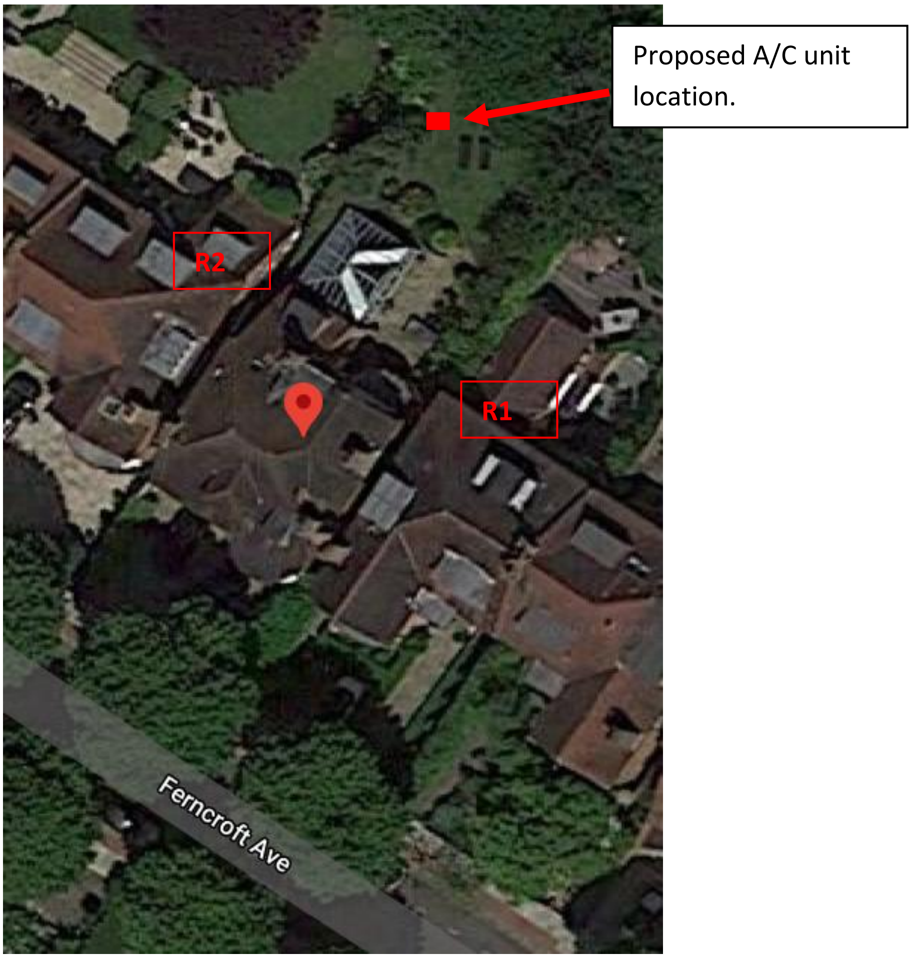

Figure 1. A/C unit location and nearest residentials properties.

R1 (no 12 Ferncroft road) and R2 (no 8 Ferncroft road).

3 Environmental Methodology

3.1 Perception

Noise is defined as unwanted sound. Human ears are able to respond to sound over the frequency range of about 20 Hz to 20 kHz and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, and is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates to the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear. To help understand the range of noise levels which may be encountered, an indication of the level of some common sounds on the dB(A) scale is given in the table below.

Table 1. Common Sounds on the dB(A) Scale

dB(A)	Description
140	Threshold of pain
120	Jet take off at 50 metres
100	Maximum noise levels on an underground platform
80	Kerbside of a busy urban street
60	Busy general office
40	Residential area at night
20	Background in a TV and recording studio
0	Threshold of hearing

Furthermore, the perception of noise may be determined by a number of other factors, both acoustic and non-acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time.

In addition, the time of day and other acoustic features such as tonality may be important, as may the disposition of the affected individual receptor. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that corresponds to the response of the human ear is the A-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or LAeq, LA90, etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) of a steady source is generally regarded as the minimum difference needed to perceive a change.

3.2 Legislation and Policy

3.2.1 BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound.*

This standard sets out a methodology for the assessment of whether noise from factories, industrial premises or fixed installations and sources of an industrial/commercial nature.

The procedure contained in BS4142 for assessing the impact is to compare the measured or predicted noise level from the source in question, the 'specific noise level', at the assessment position with the correct background noise level for the worst-case time of operation.

Where the noise contains a 'distinguishable, discreet, continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks or clatters), or if the noise is irregular enough to attract attention' then a range of correction factors can be added to the specific noise level as appropriate to obtain the 'rating level'.

As this is a prescriptive report prior to plant installation, overall rating noise levels will be specified for the new installation. Compliance with the rating value will be necessary to provide evidence that significant adverse impact has been avoided as required by the NPSE.

To assess the impact, the measured background noise level is subtracted from the rating noise level. BS4142 states:

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 assessment and arriving at decisions, therefore, it is essential to place the sound in context.

Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (See Clause 8) from the rating level (see Clause 9) and consider the following.

a) Typically the greater the difference, the greater the magnitude of the impact.

b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around 5dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a 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 impact, depending on the context.

Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that *would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as;

i) Façade sound insulation treatment

ii) Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and Acoustic screening.

3.2.2 Local Authority criteria.

Regarding industrial and commercial noise sources, the Camden Local Plan states the following:

A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).

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}

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4 Noise Survey

4.1 Baseline Noise Level Survey Details

Noise measurements were undertaken in free-field conditions between Wednesday 15th and Thursday 16th July 2020 at the rear garden of 10 Ferncroft Avenue, London, NW3 7PH. The sound level meters were positioned 1.5 m above ground level (tripod mounted) and 3 metres from any reflective surface. The figure below includes the measurement locations.

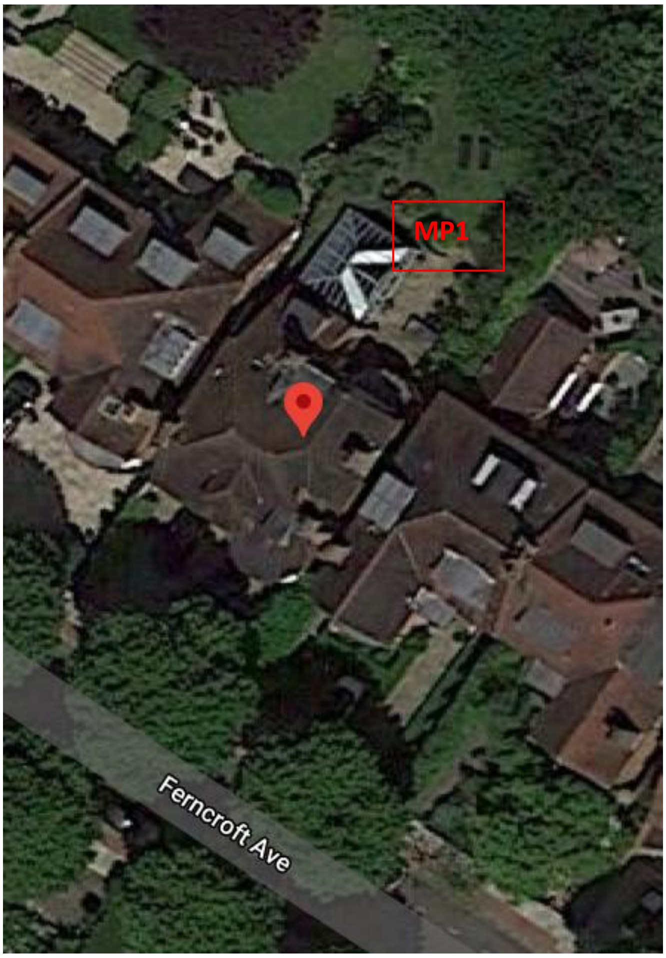

Figure 2. Measurement location (MP1).

Noise measurements were made with a calibrated precision grade sound level meter which achieves the requirements of BS EN 61672:2003. The survey was carried out in accordance with the principles of BS 7445:1997 Parts 1-3, 'Description and Measurement of Environmental Noise' and British Standard BS 4142:2014+A1:2019: *Methods for rating and assessing industrial and commercial sound.*

The noise assessment locations were representative of the background noise levels at the nearest noise sensitive receptors which have the potential to be affected by the noise emission from the proposed A/C unit.

The "typical" background levels as defined by BS4142:2014 is included in the table below.

Table 2: Typical measured L_{A90}, dB levels during survey		
MP1		
Time	L_{A90}	L_{Aeq}
07:00 / 23:00	39	45
23:00 / 07:00	32	41

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The measurement results of the entire noise survey are included below.

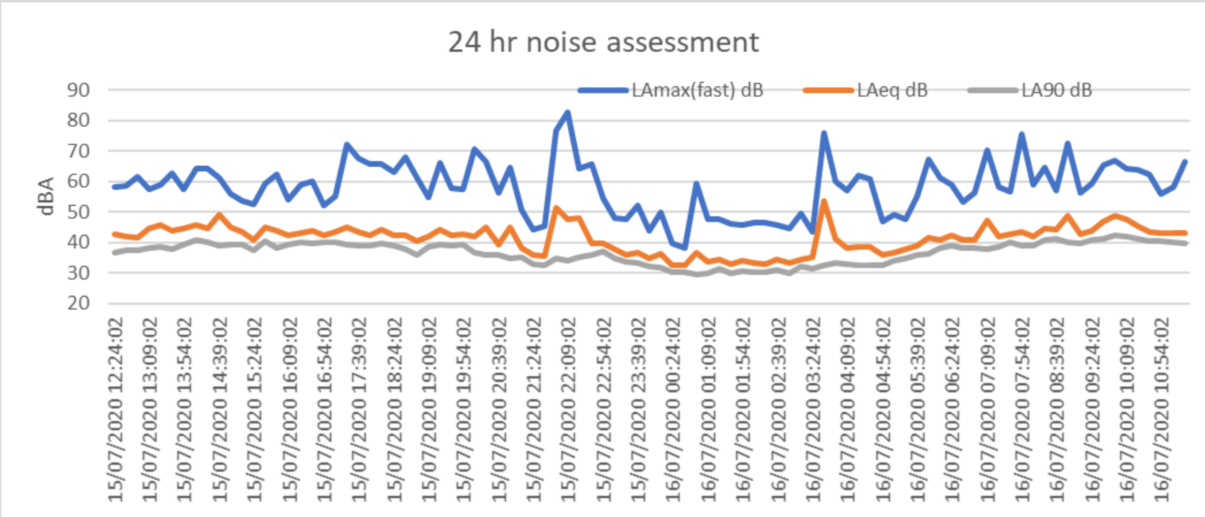

Figure 3. Noise measurements at location MP1.

The tables below include the statistical analysis in order to evaluate the "typical" background as per BS4142:2014 recommendations.

<u>Day time</u>

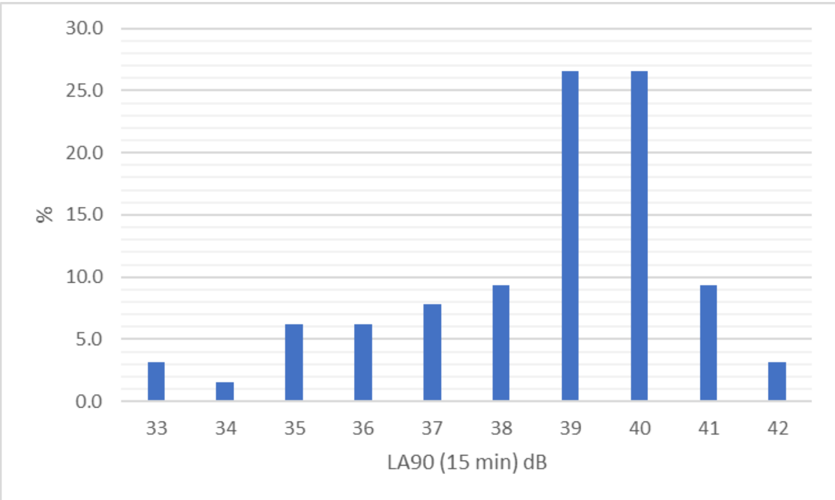

Figure 4. Statistical analysis day time.

The figure below includes the statistical analysis during the night time period.

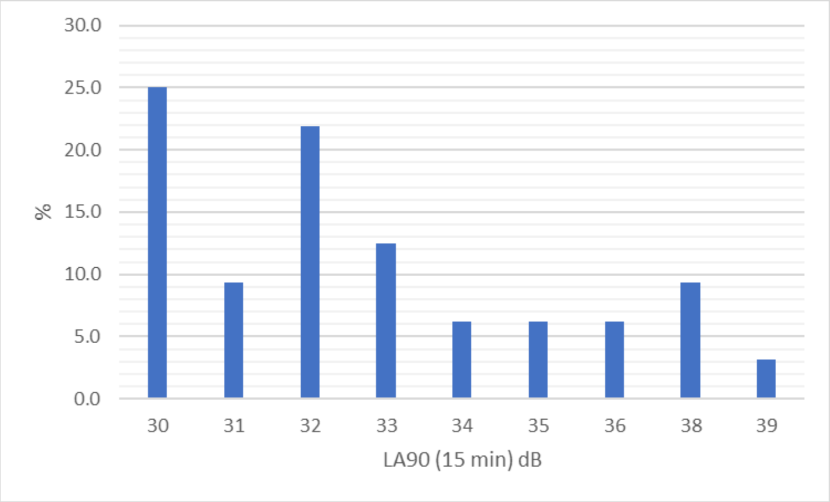

Figure 5. Statistical analysis night time

4.2 Equipment

- Svantek precision grade sound level meters. Serial numbers 34937.
- Nor-1251 Calibrator. Serial number 31327.
- Environmental wind shield.

The sound level meters were calibrated before and after the survey. No significant drift was noted between the two reference checks. Full calibration certificates are available upon requests.

4.3 Weather

In order to evaluate the weather conditions three weather check measurements were undertaken on site (beginning, during and at the end of the measurement period). During the visits, the sky was clear.

Table 3: Weather conditions				
	ºC	Wind speed m/s	Relative Humidity %	Wind direction
1st visit (12:25) Wednesday	17.1	0.8	58	SE
2nd visit (21:00) Wednesday	18.2	1.1	57	SE
3rd visit (11:30) Thursday	15.3	0.9	59	NW

The weather conditions were measured using a Pocket weather tracker KESTREL 4500. As the weather condition did not show significant variations it was concluded that three weather checks were sufficient.

5 Noise from the proposed power plant

To undertake the outdoor sound level calculations Part 2 of ISO 9613 Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation was used. This ISO standard is incorporated in the SoundPLAN v 8.1 software. This software was used to generate outdoor sound levels from the proposed power plant to the nearest noise sensitive receptors and to produce noise contour maps.

The figure below shows the location of the proposed A/C unit.

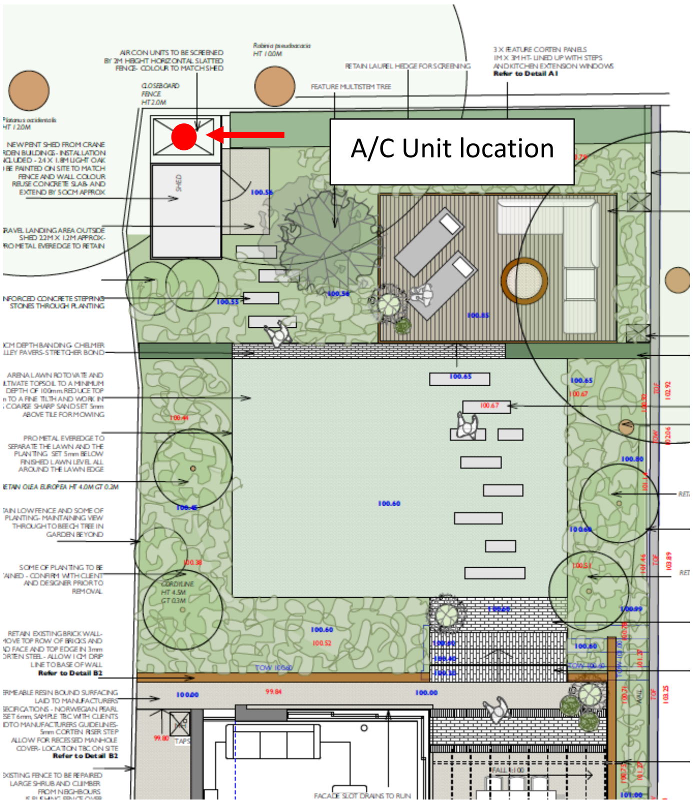

Figure 6. A/C proposed location.

5.1 Calculation assumptions

5.1.1 Plant items noise emission.

The noise data used for the calculations is extracted from the technical data (PUMY-P200YKM).

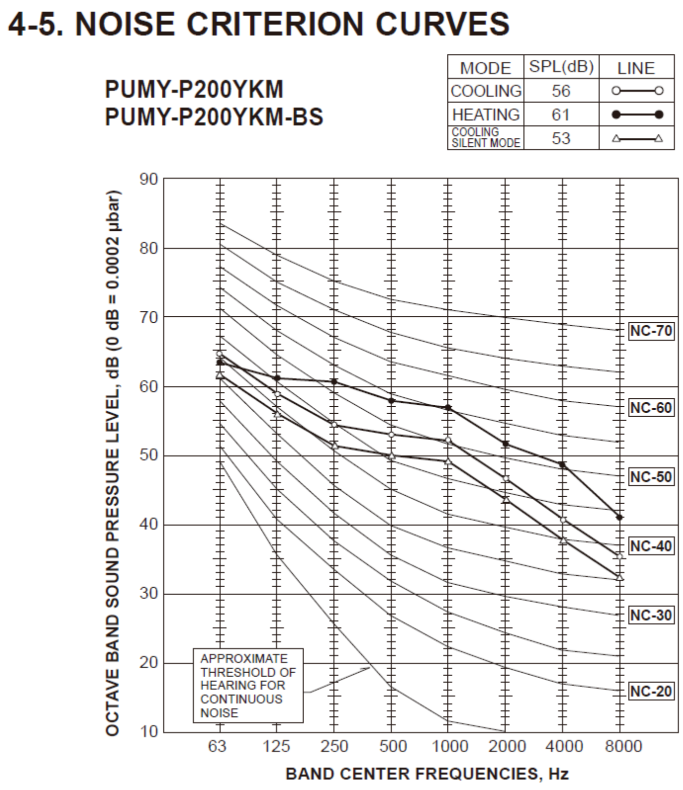

Figure 7. A/C noise data.

The calculation assumes the unit operating at heating mode (sound pressure level 61 dBA at 1 m).

5.2 Uncertainty in the calculations

The following steps were taken to reduce the level of uncertainty within the sound measurements and calculations:

- The sound level meter was immediately calibrated before and after the survey, the difference between the initial calibration value, and the final calibration check of completion of measurements did not exceed ± 0.5 dB.

- The sound emission calculation has been undertaken using sound propagation software.

It is considered that the uncertainty in the results is extremely low due to the following:

- Favourable weather conditions during the background measurements

- The sound emission calculation using appropriate software was verified by Pace Consult Ltd.

5.3 Calculation methodology

The noise impact from the units at nearest residential has been assessed using the methodology described in ISO 9613-2. The ISO 9613 calculates the sound propagation for outdoor noise sources for downwind situations, the equation below is used to evaluate the equivalent continuous downwind sound pressure level, as follows:

$$L_{fT}(\mathrm{DW}) = L_W + D_c - A$$

Where: L_w: is the octave-band sound power level.

Dc: is the directivity correction.

A: Attenuation that occurs during propagation.

4.3.1 Calculation of the attenuation terms

<u>Geometrical divergence</u>

Attenuation values are calculated as follow:

$$A_{\mathrm{div}} = \left[20\,\lg\left(d/d_0\right) + 11\right] \quad \mathrm{dB}$$

Where: d: distance from the source to receiver, in meters

d_o: is the reference distance (1m).

Atmospheric absorption

The attenuation due to atmospheric absorption is given by the following equation:

$$A_{atm} = \alpha d / 1\,000$$

Where α is the atmospheric attenuation coefficient, in decibels per kilometer, for each octave band at the mid-band frequency.

Ground Effect

The calculation assumes soft ground G=1.

4.3.2 Barrier attenuation

The calculation of the barrier attenuation is calculated as follows:

$D_z = 10 \log_{10} (3+(C_2/\lambda)\ C_3 z K_{met}$

For the single diffraction with a regular ground reflection, the formula above can be rewritten in terms of the Fresnel number.

$A_b = 10 \log_{10} (3+10\ NK_{met})$

The figure below includes the parameters used within the calculation.

Run parameters

Reflection order	3	
Maximal reflection distance to receiver		200 m
Maximal reflection distance to source		50 m
Search radius	5000 m	
Weighting:	dB(A)	
Tolerance:	0.100 dB	
Create ground effect areas from road surfaces:		No

Standards:
- Industry: ISO 9613-2: 1996
- Air absorption: ISO 9613
- regular ground effect (chapter 7.3.1), for sources without a spectrum automatically alternative ground effect
- Limitation of screening loss:
  - single/multiple 20.0 dB /25.0 dB
- Calculation with side screening: Yes
- Use Eqn (Abar=Dz-Max(Agr,0)) instead of Eqn (12) (Abar=Dz-Agr) for insertion loss
- Evaluate extra path length in vertical plane defined by source and receiver
- Environment:
  - Air pressure 1013.3 mbar
  - rel. Humidity 70.0 %
  - Temperature 10.0 °C
  - Meteo. Corr. C0(7-23h)[dB]=0.0; C0(23-7h)[dB]=0.0;
  - Ignore Cmet for Lmax-Industry-Calculation: No
- Parameter for screening: C2=20.0
- Dissection parameters:
  - Distance to diameter factor 8
  - Minimal Distance [m] 1 m
  - Max. Difference GND+Diffraction 1.0 dB
  - Max. No. of Iterations 4
- Attenuation
  - Foliage: ISO 9613-2
  - Built up area: ISO 9613-2
  - Industrial site: ISO 9613-2

6 Calculation Summary

The A/C unit is proposed to be located within a 2 m height horizontal slated fence, the calculated noise levels based on this proposal is above the noise criteria recommended by the Camden Local Plan, and therefore the following noise mitigation measures are recommended:

- The A/C unit should be included within an **acoustic enclosure** with a minimum sound reduction of R_w 20 dB.

The table below includes the calculated noise levels. based on the above sound mitigation recommendations.

Table 4: Calculated sound pressure level dBA	
R1	20
R2	21

The figure below shows the SoundPlan v 8.1 sound contour map of the assessment area.

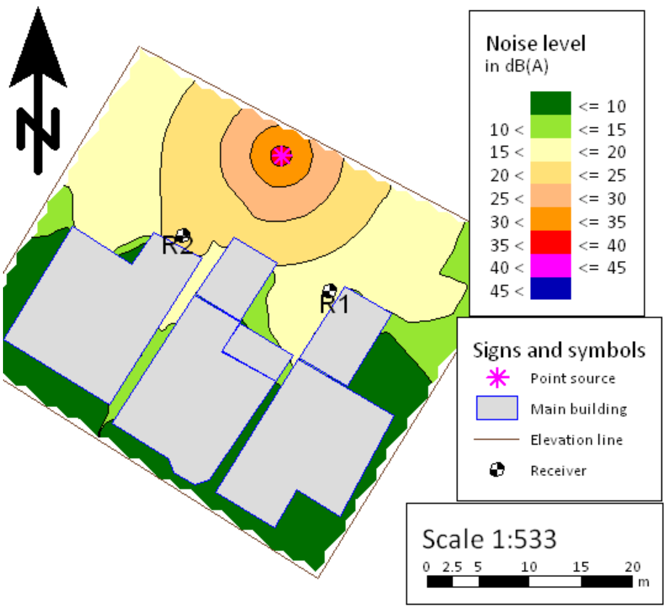

Figure 8. Noise map of the study area.

The table below shows the assessment method recommended by BS4142:2014 *Method for rating and assessing industrial and commercial sound.* As the calculated levels are well below the lowest measured background, it is considered that tonality correction is not required.

Table 5: BS4142:2014 Assessment			
Receiver	Calculated Sound Pressure Level	Background sound levels L_{A90} dB	Excess of rating over background level
R1	20	32	-12
R2	21		-11

The table above includes the typical background during night-time as recommended by BS4142:2014.

As can be seen from the table above the rating level is more than 10 dB below the lowest measured background sound level, which meets the noise criteria recommended by the Camden Local Plan. Also, based on the BS4142:2014 assessment, the specific sound levels have a low impact at the nearest noise sensitive receptors.

The table below includes the full noise prediction calculations at receiver 1 and 2.

Table 6: Noise propagation calculation.

Source	Source type	Lw dB(A)	Ko dB	S m	Adiv dB	Agr dB	Abar dB	Aatm dB	dLrefl dB	Ls dB(A)	dLw dB	ZR dB	Lr dB(A)
R1													
A/C 1	Point	42.2	0	14.01	-33.9	3	0	-0.1	2.3	13.5	0	6.4	20
R2													
A/C 1	Point	42.2	0	12.35	-32.8	3	0	-0.1	2	14.4	0	6.4	21

The figure below shows the acoustic parameters used within the noise emission calculation.

Legend

Source		Source name
Source type		Type of source (point, line, area)
Lw	dB(A)	Sound power level per unit
Ko	dB	Correction for propagation in limited spacial angle
S	m	Distance source - receiver
Adiv	dB	Mean attenuation due to geometrical spreading
Agr	dB	Mean attenuation due to ground effect
Abar	dB	Mean attenuation due to screening
Aatm	dB	Mean attenuation due to air absorption
dLrefl	dB	Level increase due to reflections
Ls	dB(A)	Unassessed sound pressure level at receiver Ls=Lw+Ko+ADI+Adiv+Agr+Abar+Aatm+Afol_site_house+Awind+dLrefl
dLw	dB	Correction due to source operation time
ZR	dB	Correction for rest periods
Lr	dB(A)	Assessed level of time slice

Figure 9. Acoustics parameters.

7 Conclusion

A noise assessment was commissioned by XUL Architecture, in support of the planning application at 10 Ferncroft Avenue, London, NW3 7PH.

The assessment of the impact has shown that the calculated specific sound sources are 10 dB below the typical measured background levels and therefore, compliance with the acoustic criteria recommended by the relevant acoustic guidelines has been achieved.