RF | ENVIRONMENTAL

NOISE | VIBRATION | AIR QUALITY

DR G BRAVERMAN

FLAT 17, THE POLYGON
89 AVENUE ROAD
SWISS COTTAGE
LONDON

NOISE IMPACT ASSESSMENT

TECHNICAL REPORT: RFE-0216-18-02

DATE: AUGUST 2018

PROJECT TITLE: FLAT 17 THE POLYGON, 89 AVENUE ROAD, SWISS COTTAGE LONDON

REPORT REF: RFE-0216-18-02

DATE: AUGUST 2018

	Name	Position	Signature	Date
Prepared By	Richard Fenton	Director		9th August 2018
For and on behalf of RF Environmental Ltd				

DOCUMENT HISTORY		
Status	**Description**	**Date**
01	Draft report for client comment	03/08/2018
02	Final report issued	09/08/2018

RF | ENVIRONMENTAL
Director: RICHARD FENTON
BSc (Hons) MSc MCIEH MIOA

27 Greenleaf Gardens
Polegate
East Sussex BN26 6PE

T 01323 488396
M 07872 929883
E info@rfenvironmental.co.uk

Registered in England & Wales
Registered No. 10086337
Registered Office: 4a Gildredge Rd
Eastbourne BN21 4RL

FLAT 17 THE POLYGON, 89 AVENUE ROAD, LONDON
NOISE IMPACT ASSESSMENT

CONTENTS **PAGE**

1.0 INTRODUCTION

1.1 RF Environmental Ltd (RFE) was commissioned by Dr Braverman in July 2018 to provide an acoustic report to accompany a planning application for the installation of 2no. air handling units at Flat 17, The Polygon, 89 Avenue Road, within the London Borough of Camden.

1.2 The aim of this report is to assess the noise impact of the proposed mechanical plant at the nearest noise sensitive receptor, in accordance with appropriate standards and criteria. The requirement for any noise mitigation measures will be assessed.

1.3 The existing site and proposed development are described in the following section of this report, whilst the legislation and criteria used for the assessment are included within Section 3 of this report. The noise survey is presented in Section 4, whilst the noise impact assessment is addressed in Section 5. Finally, the conclusions of this study are summarised in Section 6. A description of useful acoustic terms can be found in Appendix C.

1.4 The report has been produced by Richard Fenton (MIOA, MCIEH). Richard is experienced in the production of noise impact assessments following the methodology provided in BS 4142. Richard has produced a significant number of noise assessments in consultancy roles and reviewed them in local authority roles. He has also provided training workshops on the implementation of BS4142:2014 to Local Authority Environmental Health Teams.

2.0 SITE DESCRIPTION AND PROPOSED PLANT

Site Description

2.1 The site is a split level residential apartment located on the top floor of The Polygon, 89 Avenue Road, Swiss Cottage, within the administrative boundary of the London Borough of Camden.

2.2 The Polygon is an eight-storey block of apartments at the northern end of Avenue Road. Swiss Cottage tube station is situated to the north and Regents Park is located at the southern end of Avenue Road.

2.3 A plan of the site and immediate area is presented in Figure A1 of Appendix A.

2.4 The ambient noise climate in the immediate vicinity of the site is dominated by road traffic noise from the local and distant road network. It was also observed that existing external condensing units have been installed at other apartments at the development site.

Proposed Plant

2.5 The air handling plant consist of 2no. Panasonic U-6LE2E5 condensing units.

2.6 The units are to be installed against a wall of the external balcony area. A plan of the proposed installation area is presented in Figure A2 of Appendix A.

2.7 The units will operate to provide heating and cooling to the premises, as required, on a 24/7 basis.

2.8 The closest noise sensitive receptor to the unit is the residential apartment directly beneath the development site. The closest window to this receptor is highlighted in Figure A3 of Appendix A.

3.0 ASSESSMENT CRITERIA

Noise Policy Statement for England (NPSE)

3.1 The Noise Policy Statement for England (March 2010)[1] sets out the long term vision of Government noise policy.

3.2 The vision of the NPSE is to 'Promote good health and a good quality of life through the effective management and control of noise within the context of Government policy on sustainable development.' This vision is supported by three key aims:

- avoid significant adverse impacts on health and quality of life;
- mitigate and reduce to a minimum, other adverse impacts on health and quality of life; and
- where possible, contribute to the improvement of health and quality of life.

3.3 The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace (occupational noise).

3.4 The NPSE had adopted the following concepts, to help consider whether noise is likely to have 'significant adverse' or 'adverse' effects on health and quality of life:

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 noise.

LOAEL – Lowest Observed Adverse Effect Level
This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level
This is the level above which significant adverse effects on health and quality of life occur.

3.5 However the NPSE goes on to state 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.*'

National Planning Policy Framework

3.6 The Department for Communities and Local Government introduced the National Planning Policy Framework (NPPF) in April 2012 [2]. This framework replaced most national planning policy, circulars and guidance, including Planning Policy Guidance 24: Planning and Noise.

3.7 The NPPF defines the Government's planning policy for England and sets out the framework, within which local authorities must prepare their local and neighbourhood plans, reflecting the needs and priorities of their communities. Paragraph 123 of the NPPF requires Local Authorities to develop local policies and make decisions which aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Planning Practice Guidance - Noise

3.8 Planning Practice Guidance (PPG) on noise[3] was issued in March 2014. This web-based guidance advises local planning authorities to take into account the acoustic environment, and in doing so consider the following:

- whether or not a significant adverse effect is occurring or likely to occur;
- whether or not an adverse effect is occurring or likely to occur; and
- whether or not a good standard of amenity can be achieved.

3.9 The PPG includes examples of how to recognise when noise could be a concern and provides example outcomes to which the Observed Effect Levels can apply. The PPG noise exposure hierarchy is presented in Table 3.1, based on the likely average response, along with example outcomes.

3.10 While it is acknowledged that planning and nuisance regimes are separate entities, the hierarchy table does provide useful information regarding how the concept of SOAELs and LOAELs, introduced through the NPSE, could be applied and does allow for subjective observations to be considered in the context of potential effect levels. The presence of an "Effect Level" does not infer whether a nuisance is or is not present.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
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	

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; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported 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	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. 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

TABLE 3.1: PPG NOISE EXPOSURE HIERARCHY
(Source –Planning Practice Guidance)

3.11 The PPG guidance states that "if external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended." Furthermore the guidance goes on to so say "Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced with increasing noise exposure and could be such that significant adverse effects occur."

<u>British Standard 4142</u>

3.12 Guidance on the rating and assessing of sound of an industrial and/or commercial nature is contained in British Standard (BS) 4142: 2014 'Methods for rating and assessing industrial and commercial sound' [4].

3.13 The standard states that:

"This standard is applicable to the determination of the following levels at outdoor locations:

a) rating levels for sources of sound of an industrial and/or commercial nature; and

b) ambient, background and residual sound levels

for the purposes of:

1) investigating complaints;
2) assessing sound from proposed, new, modified or additional source(s) of sound of an industrial nature and/or commercial nature; and
3) assessing sound at proposed new dwellings or premises used for residential purposes."

3.14 The determination of noise amounting to a nuisance is beyond the scope of this British Standard.

3.15 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.

3.16 Typically, the greater the difference between rating level and background noise level, the greater the magnitude of the impact:

- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5 dB is likely to be an indication of an adverse impact, depending on context; and
- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific 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.

3.17 Certain acoustic features can increase the significance of the impact of a specific sound source. These features include tonality and impulsivity, as well as additional characteristics and intermittency of the sound.

3.18 Where appropriate, a rating penalty for sound based on a subjective assessment of its characteristics should be established. In other circumstances an objective appraisal of tonal and/or impulsive characteristics may be appropriate.

Local Authority Criteria

3.19 Following pre-application advice, the planning officer at London Borough of Camden provided the following response in relation to the condensing units:

'My only query prior to registering the application is about the two condenser units shown on the proposed plan. Any new or replacement plant requires an associated noise assessment to be submitted that demonstrates the plant would be compliant with the Council's noise limits. I've attached the Camden Local Plan 2017, to which the noise limits are attached as appendix 3. This would be a validation requirement'.

Camden Local Plan

3.20 The noise and vibration policy presented in the Camden Local Plan [5] sets out the requirements and thresholds for assessing noise from fixed plant installations.

3.21 For industrial and commercial noise sources, Appendix 3 of the local plan provides the following information:

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).

3.22 In addition, the plan also states:

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.

4.0 ENVIRONMENTAL NOISE SURVEY

Introduction

4.1 Unattended measurements were undertaken to establish the background and ambient sound levels in the immediate vicinity on the nearest noise sensitive receptor.

Continuous Baseline Noise Survey

4.2 Unattended continuous monitoring of existing noise levels was undertaken at the monitoring location shown as LT1 on Figure A1 of Appendix A. The equipment used during the survey is presented in Table 4.1 below.

Manufacturer	Model No.	Description	Serial No.	Calibration Due Date
Larson Davis	LxT	Sound Level Meter	0004968	April 2020
Larson Davis	LxTPRM1L	Microphone Preamplifier	042703	April 2020
Larson Davis	337B02	½" Electret microphone	161390	April 2020
Larson Davis	CAL200	Calibrator	12981	April 2019

TABLE 4.1: SOUND MONITORING EQUIPMENT

4.3 The sound level meter was powered by a dry cell battery and stored inside a weatherproof security box.

4.4 Measurements were obtained using the 'F' time weighting and A-weighting frequency network. The equipment was calibrated before and after the survey to generate a calibration level of 114.0 dB at 1 kHz, with the noted drift falling within acceptable tolerances.

4.5 15-minute measurements of $L_{Amax,F}$, L_{Aeq}, and L_{A90} noise levels were obtained at this monitoring location between 09:13 hrs Friday 27th July 2018 and 09:02 hrs Tuesday 1st August 2018, with the microphone position set at a height of approximately 1.5 m above local ground level. A photograph of the monitoring equipment can be seen in Figure A4 of Appendix A. The dominant noise sources observed during site visits are discussed in section 2. Local and distant traffic movements were the dominant source of ambient noise.

Weather Conditions

4.6 Weather conditions during the site visits are presented below in Table 4.2.

Site Visit	Date and Time	Noted Weather
Setup	27/07/18 09:00am	No rain, sunny, 1/8 cloud cover, 23 °, windspeed <1m/s
Collection	01/08/18 09:00am	No rain, sunny, 2/8 cloud cover, 20 °, windspeed <1 m/s

TABLE 4.2: WEATHER CONDITIONS DURING SITE VISITS

4.7 A history of the weather conditions during the continuous survey period has been obtained from a weather station in Primrose Hill, London (www.wunderground ILONDON 593).

4.8 Analysis of the data shows periods of weather with some rainfall recorded during the measurement periods. However, the rainfall does not appear to have influenced the noise levels and therefore have not been removed from the data set.

4.9 The weather conditions obtained for the survey period are summarised in Figure A5 of Appendix A.

Continuous Noise Survey Results

4.10 The full results of the unattended noise measurement survey are presented graphically in Figure A6 of Appendix A and in tabular form in Table B1 of Appendix B. They are summarised in Table 4.3 below.

Date	Measured Noise Levels, dB					
	Daytime (07:00 - 23:00)			Night-time (23:00 - 07:00)		
	$L_{Amax,F}$	$L_{Aeq,16hr}$	$L_{A90,16hr}$	$L_{Amax,F}$	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Fri 27/07/18	76(63-95)*	60*	52*	68(62-80)	54	46
Sat 28/07/18	76(66-88)	58	53	71(63-85)	55	47
Sun 29/07/18	76(66-85)	60	54	66(62-74)	54	44
Mon 30/07/18	76(63-99)	60	53	67(61-83)	55	45
Tue 31/07/18	78(72-91)*	61*	52*			
Average	***76(76-78)***	***60***	***53***	***68(66-71)***	***55***	***46***

TABLE 4.3: SUMMARY OF UNATTENDED NOISE MEASUREMENTS, LT1

*Note: * denotes incomplete period.*

4.11 The results of the unattended sound measurement show that ambient day time $L_{Aeq,16hr}$ sound levels ranged from 58 to 61 dB with an arithmetic mean of 60 dB $L_{Aeq,16hr}$.

4.12 The night time $L_{Aeq,\ 8hr}$ sound levels ranged from 54 to 55dB, with an arithmetic mean of 55dB $L_{Aeq,\ 8hr}$.

5.0 ASSESSMENT OF NOISE LEVELS

BS4142

5.1 The method for predicting the significance of sound of an industrial and/or commercial nature in accordance with the principles of BS 4142:2014 is based on a comparison of the rating level, defined as the specific sound level plus any adjustment for the characteristic features of the sound, with the background sound level, $L_{A90,T}$.

5.2 The standard is applicable for assessing sound at proposed new dwellings or premises used for residential purposes.

Background Sound Levels

5.3 The $L_{A90,T}$ background sound level is the sound level exceeded for 90 % of the time in the absence of any sound from the specific source of interest.

5.4 'Typical' background sound levels observed over the period of interest, as described in BS4142:2014, are usually established for the purposes of a noise assessment of this kind, with BS4142 stating that a *'representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value'.*

5.5 Due to ongoing works at the site during the weekday periods, the daytime background sound level has been derived from data measured during the weekend period only.

5.6 Free-field background sound levels of 56 to 48dB $L_{A90,15min}$ have been recorded during the weekend daytime period between the hours of 07:00 and 23:00 at LT1. The daytime background sound level adopted for the purposes of this assessment is 54 dB $L_{A90,15min}$ as this is considered a representative value and was most commonly recorded at 27% of the time, as presented in Figure A7 of Appendix A.

5.7 Free field background sound levels of 40 to 54 dB $L_{A90,15min}$ have been recorded during the night time between the hours of 23:00 and 07:00 during the monitoring period at LT1. The night time background sound level adopted for the purposes of this assessment is 46 dB $L_{A90,15min}$ as this is considered a representative value and was most commonly recorded at 13% of the time, as presented in Figure A7 of Appendix A.

Plant Specific Sound Level

5.8 Details of the proposed units, the associated sound power levels and operational periods are presented in Table 5.1. The sound test data for the unit is presented in Figure A8

Make	Model	Quantity	Operating Period	Sound Power Level (dB,L_w)
Panasonic	U-6LE2E5	2	24/7	64

TABLE 5.1: AIR CONDITIONING UNIT SPECIFICATIONS

Closest Noise Sensitive Receptors

5.9 The closest sensitive receptor to the development is identified in Figure A3 of Appendix A, as R1. This is below the balcony area of Apartment 17 at a distance approximately 5 metres from the units. No line of site will exist between the units and the receptor window and screening from the balcony balustrade will increase the level of noise attenuation. For the purposes of the assessment, a screening correction of -10dB has been applied, however, in reality the level of attenuation afforded is likely to be higher than this.

Rating Level Assessment

5.10 Where appropriate, a rating penalty for sound based on a subjective assessment of its characteristics should be established and added to the specific sound level, however the units are not considered to be tonal or impulsive in nature. It is not likely to be discernible against the existing ambient noise at the nearest residential receptors therefore no rating penalty has been applied to the specific sound level.

5.11 The assessment for the daytime and night time periods are set out in Table 5.2

Results	Day Time (07:00 - 23:00)	Night Time (23:00 - 07:00	Commentary
Specific sound level of plant (dB)	59	59	Specific sound Level at 1m from the a/c units
Distance attenuation from assessment point to closest noise sensitive receptor (5m)	-14	-14	Distance from unit to closest window will be a minimum of 5m.
Screening effect (dB)	-10	-10	Assumes no line of site due to proximity of a/c unit above receptor location.
Likely acoustic feature correction	0	0	The source is not anticipated to be impulsive or tonal, rather broadband in nature and it is not expected to be discernible against the existing ambient noise.
Rating level at receptor	35	35	Specific sound level at sensitive receptor adjusted for distance to outlet and screening effects.
Background sound level (dB $L_{A90,15min}$)	54	46	Measured at position LT1
Excess of rating over background sound (dB)	-19	-11	Assessment indicates low impact as described in BS4142:2014, depending on context
Compliance with local authority criteria?	Yes	Yes	Complies with Local Authority criteria of 10dB below the existing $L_{A90\ 15min.}$

TABLE 5.2: ASSESSMENT OF DAYTIME AND NIGHT TIME RATING LEVEL AT NEAREST NOISE SENSITIVE RECEPTOR

5.12 The assessment presented in Table 5.2 indicates that the rating noise level during the daytime and night time periods will be below the existing background noise levels at the closest residential receptor. According to BS4142:2014, this is an indication of low impact.

The predicted levels also fall below the preferred LBC criteria of 10dB below background noise levels and therefore no further mitigation options are considered necessary.

Uncertainty

5.13 Uncertainty in the measurements and calculations needs to be taken into account when assessing the validity of these conclusions.

5.14 Uncertainty in the measurement for meteorological effects is reduced by monitoring over a 4-day period.

5.15 Rounding has been used in the derivation of the background sound level and calculations, to avoid an impression of precision to decimal places. Rounding has been to integer values with 0.5 being rounded up on completion of the statistical analysis.

6.0 CONCLUSIONS

6.1 A noise impact assessment at Apartment 17 The Polygon, 89 Avenue Road, London has been undertaken and is presented in this report.

6.2 The assessment considered the potential noise impact on the nearest noise sensitive receptor, from 2no. air handling units, installed in the external area at the development site.

6.3 Continuous noise monitoring was undertaken to establish the existing background sound levels in the vicinity of the proposed development.

6.4 Following the criteria and methodology set out in British Standard BS4142:2014, an assessment of the rating noise level for the air handling unit was undertaken.

6.5 The results indicate that the rating noise level from the units will be below the adopted background sound level, $L_{A90,\ 15min}$ during the daytime and night time periods, which according to BS4142:2014 provides an indication of low impact. In addition, the preferred rating noise criteria of 10dB below background noise levels, set by LBC, will also be achieved.

6.6 No further mitigation measures are considered necessary and there should be no reasons on noise grounds why the application should be refused planning permission.

7.0 REFERENCES

1. Department for Environment, Food and Rural Affairs (DEFRA). Noise *Policy Statement for England (NPSE),* 2010.

2. Department of Communities and Local Government. *National Planning Policy Framework*, 2012.

3. Department for Communities and Local Government: *Planning Practice Guidance* – Noise. Revision date March, 2014.

4. British Standard BS 4142:2014: *Methods for Rating and Assessing Industrial and Commercial Sound*.

5. Camden Local Plan*. Adopted Version. June 2017*.

APPENDIX A: FIGURES

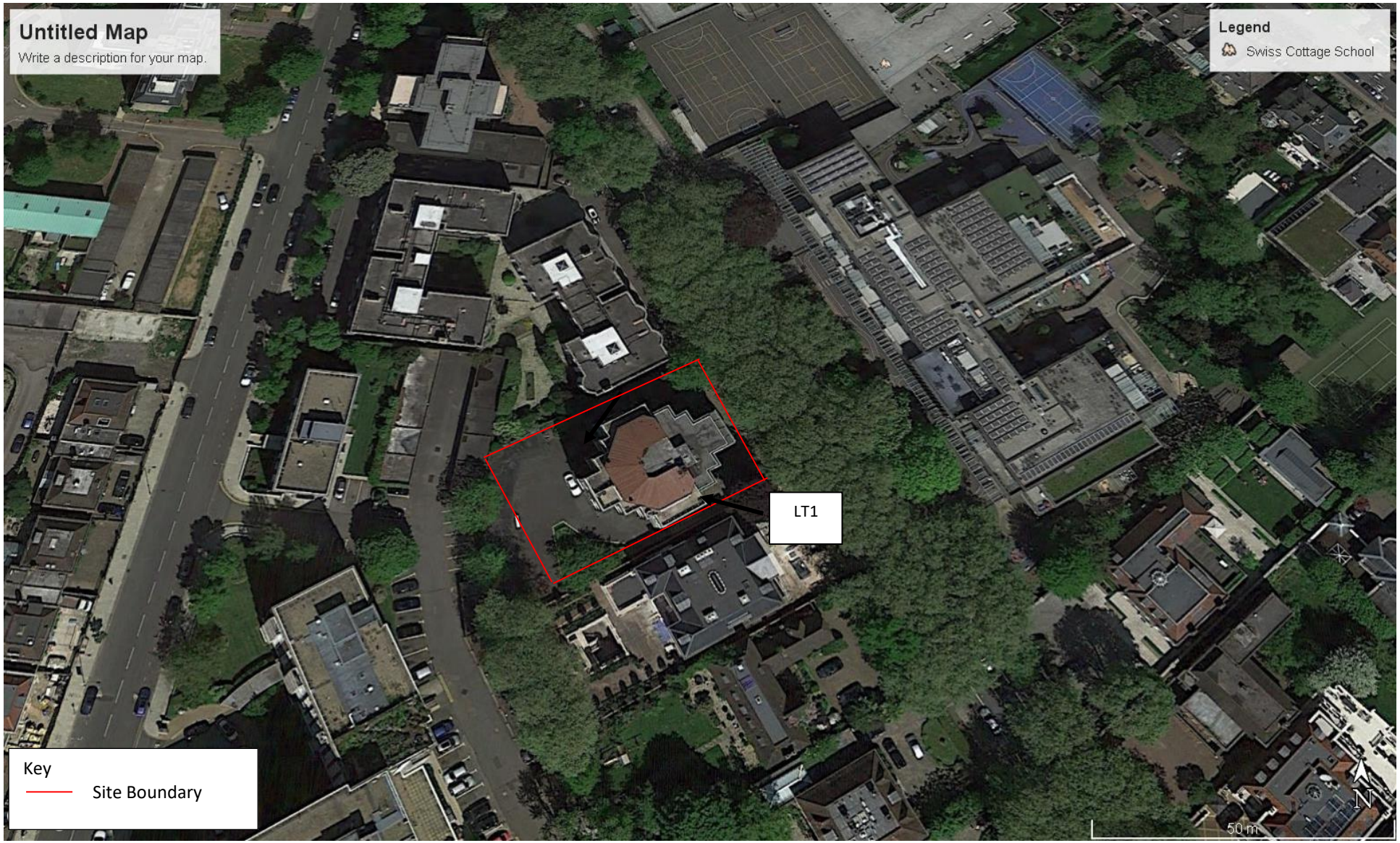


FIGURE A1: LOCATION OF PROPOSED DEVELOPMENT SITE (source Google 2018)

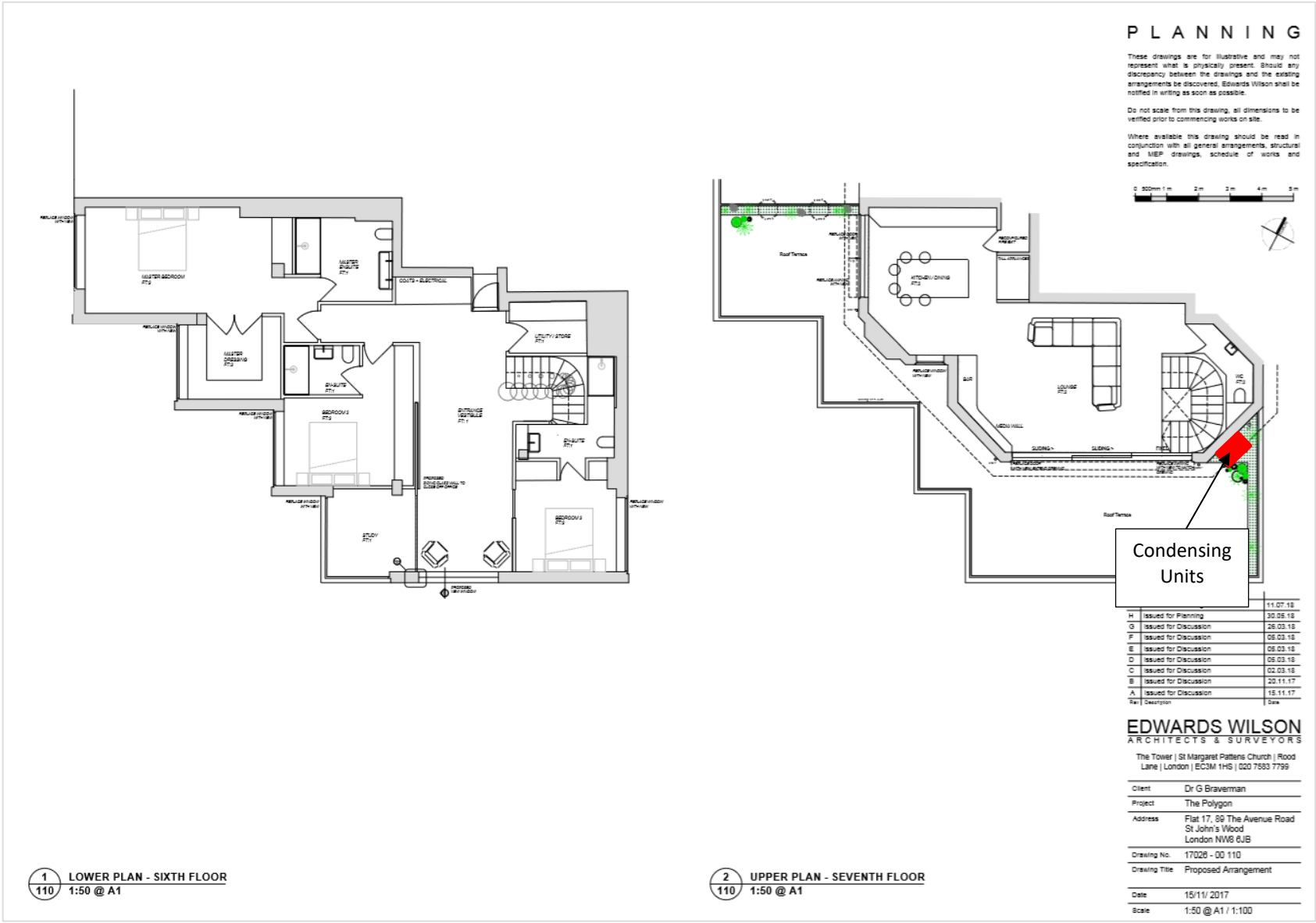


FIGURE A2: PLAN IDENTIFYING POSITION OF PROPOSED A/C UNITS

FIGURE A3: PHOTOGRAPH IDENTIFYING CLOSEST NOISE SENSITIVE RECEPTOR

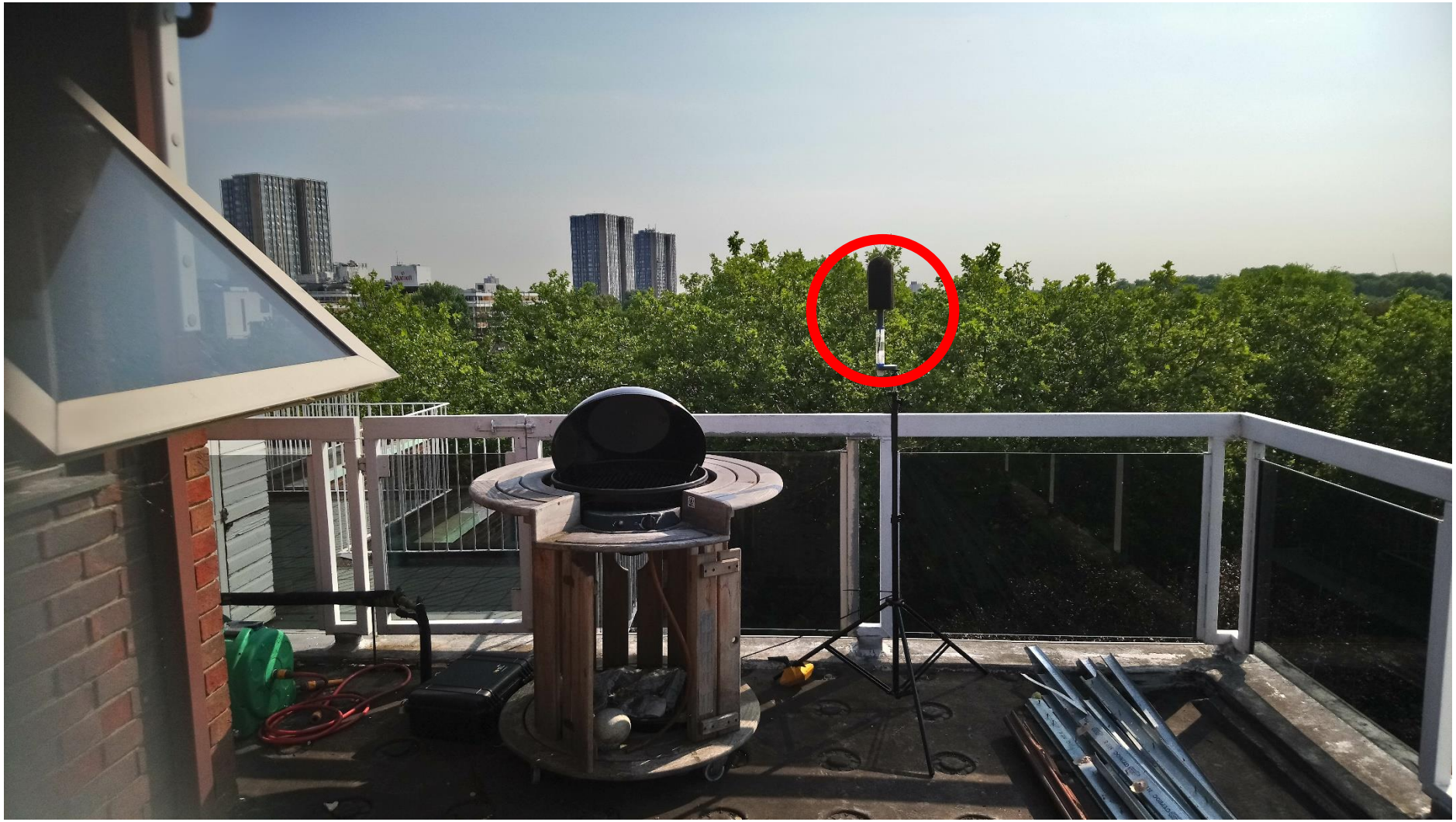


FIGURE A4: PHOTOGRAPH IDENTIFYING NOISE MONITORING LOCATION

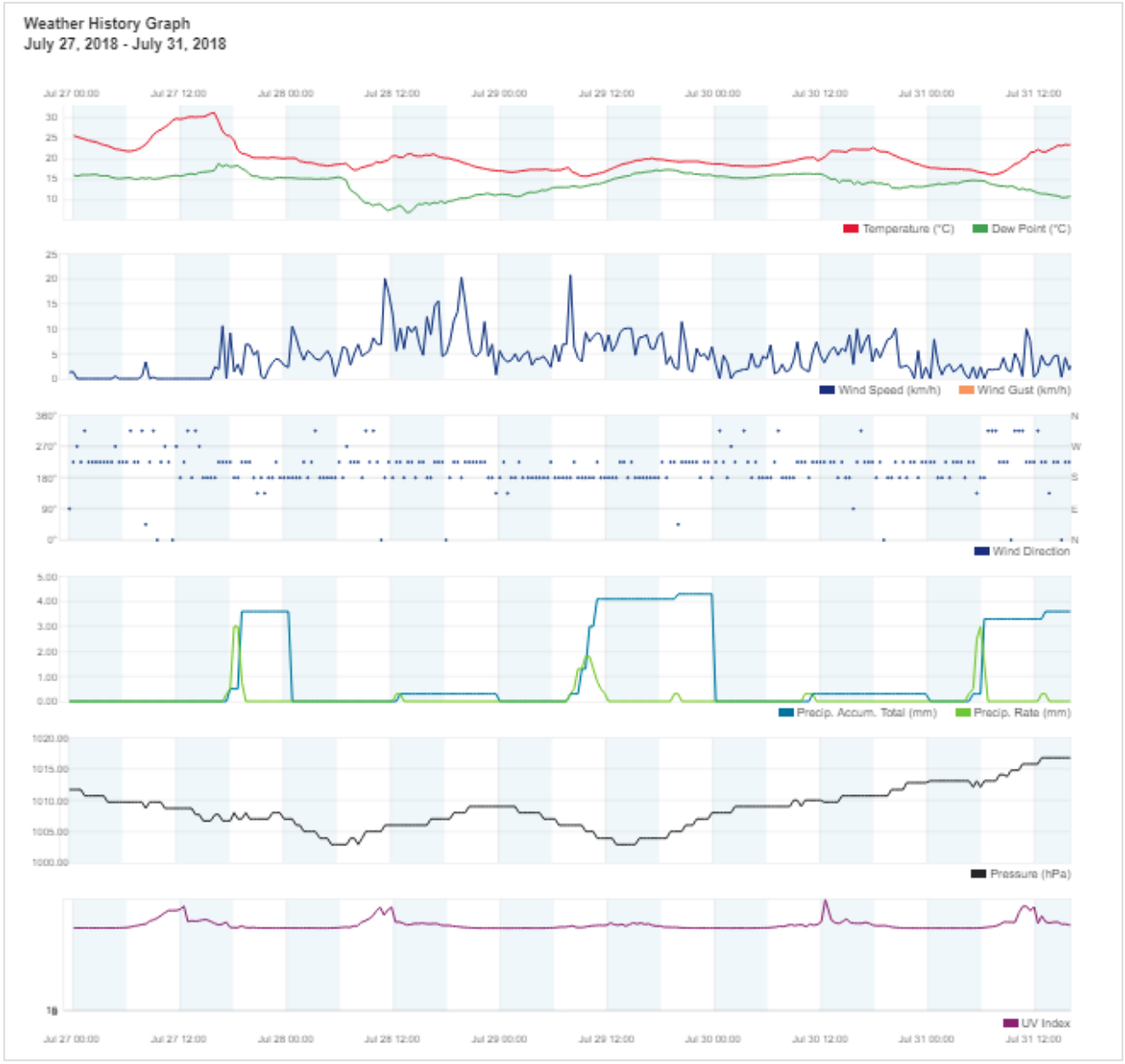


FIGURE A5: WEATHER DATA DURING MONITORING PERIOD

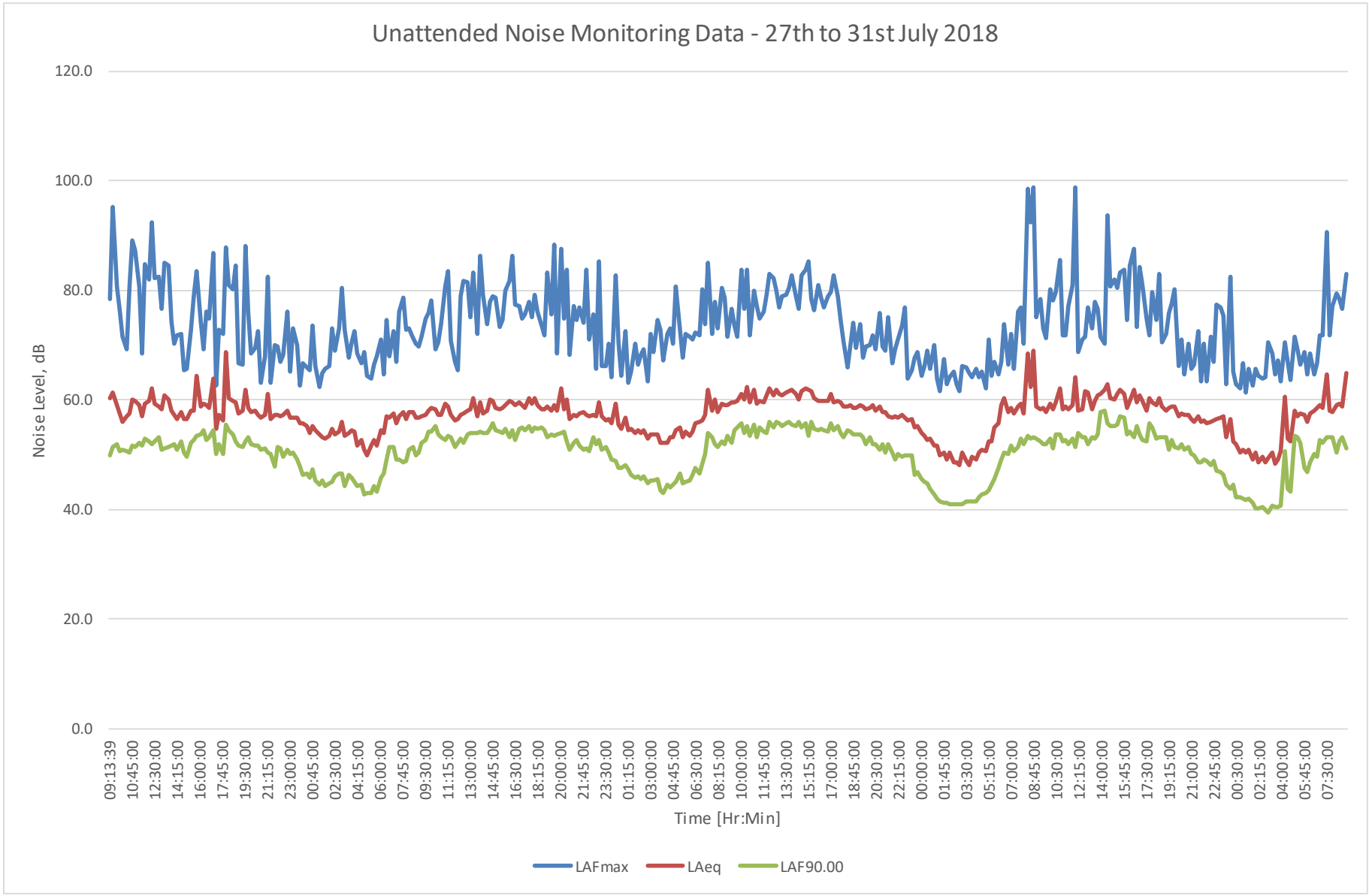


FIGURE A6: CONTINUOUS SOUND MONITORING RESULTS AT LT1, FRIDAY 27TH JULY TO TUESDAY 31ST JULY 2018

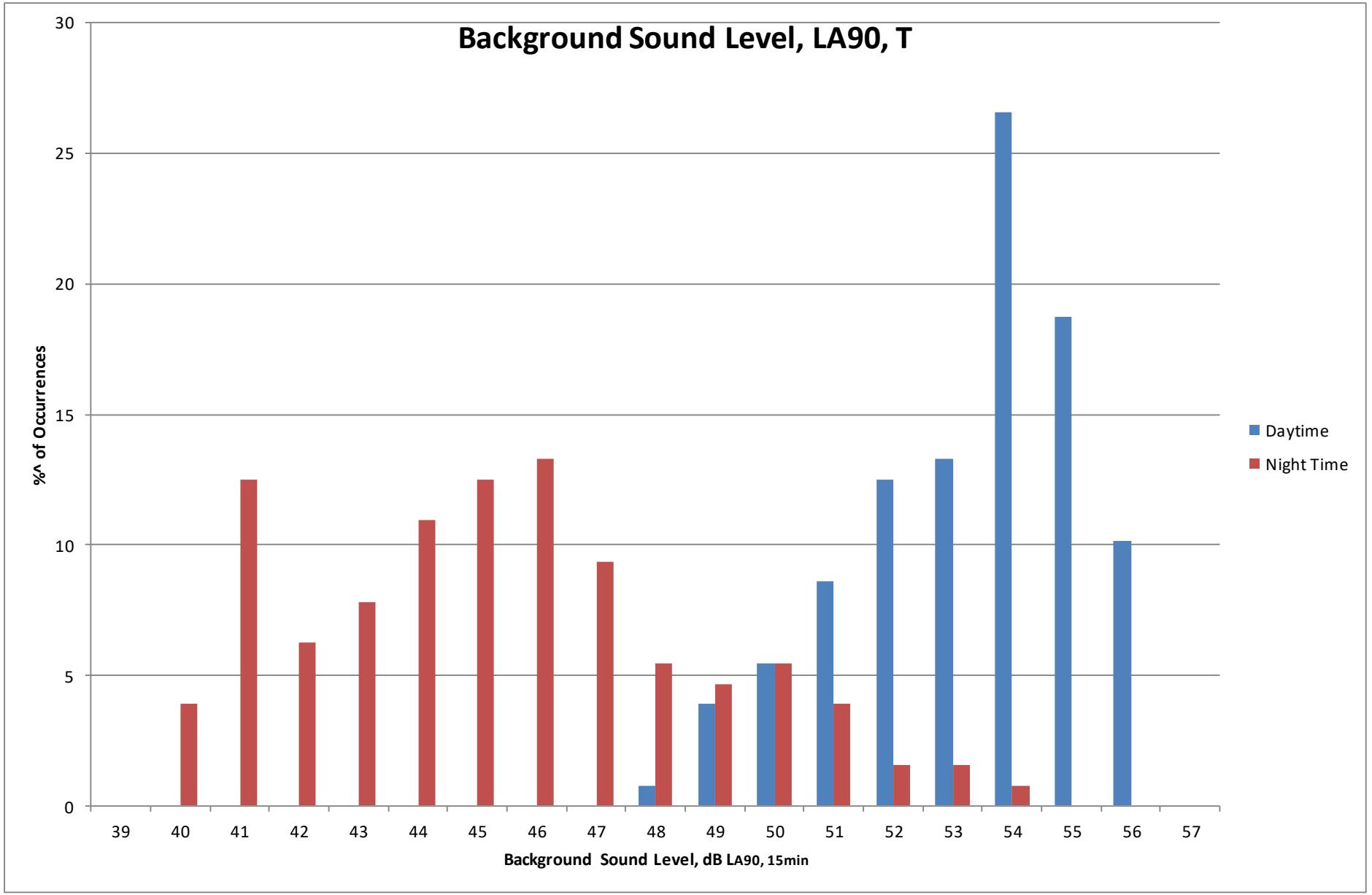


FIGURE A7: DERIVATION OF BACKGROUND SOUND LEVELS

1. Outdoor Unit

1-5. Noise Criterion Curves

Cooling

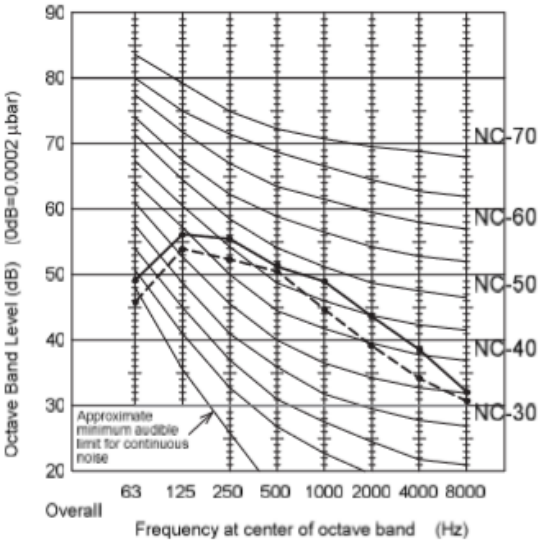
MODEL	U-6LE2E5
SOUND LEVEL dB(A)	54.0 (Quiet mode 51.0)
CONDITION	1 m in front at height of 1.5 m

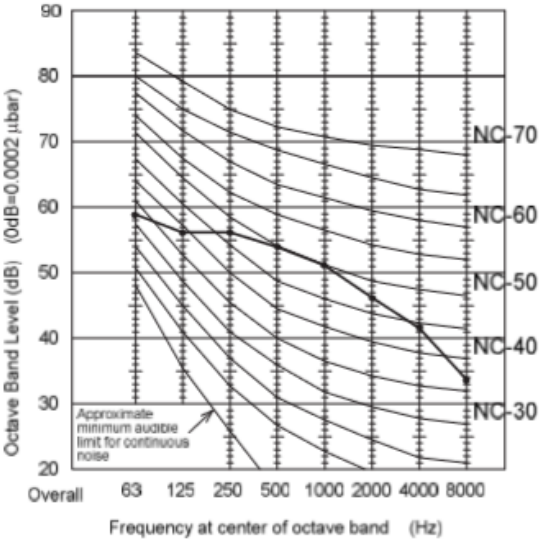
Standard mode
Quiet mode

Heating

MODEL	U-6LE2E5
SOUND LEVEL dB(A)	56.0
CONDITION	1 m in front at height of 1.5 m

Standard mode





4

FIGURE A8: SOUND TEST DATA FOR EXTERNAL CONDENSING UNITS

APPENDIX B: TABLES

Date	Time	Measured Noise Levels, dB			
		$L_{Amax, F}$	$L_{A10, 15min}$	$L_{Aeq, 15min}$	$L_{A90, 15min}$
Friday 27th July 2018	09:13:39	78.4	61.9	60.3	49.8
	09:15:00	95.2	60.1	61.3	51.3
	09:30:00	80.6	60.8	58.9	52.0
	09:45:00	76.3	59.9	57.4	50.7
	10:00:00	71.7	58.5	56.1	50.8
	10:15:00	69.3	59.6	57.1	50.7
	10:30:00	80.7	59.6	57.6	50.4
	10:45:00	89.1	60.5	59.9	51.7
	11:00:00	87.3	60.3	59.7	51.3
	11:15:00	80.8	60.4	59.1	52.1
	11:30:00	68.5	59.7	56.9	51.7
	11:45:00	84.7	60.8	59.4	52.9
	12:00:00	81.9	61.0	59.7	52.3
	12:15:00	92.4	60.1	62.1	51.9
	12:30:00	82.4	60.3	59.3	52.3
	12:45:00	82.4	60.3	58.9	53.2
	13:00:00	76.8	60.5	58.4	51.0
	13:15:00	85.0	60.3	60.9	51.1
	13:30:00	84.7	60.6	60.2	51.3
	13:45:00	74.4	60.3	58.0	51.6
	14:00:00	70.3	59.7	57.4	51.8
	14:15:00	71.7	58.9	56.5	50.9
	14:30:00	72.1	60.0	57.9	52.4
	14:45:00	65.3	59.1	56.4	50.4
	15:00:00	65.6	59.3	56.5	49.7
	15:15:00	72.8	60.4	58.1	52.2
	15:30:00	79.0	59.6	58.1	52.7
	15:45:00	83.6	64.7	64.5	53.5
	16:00:00	74.4	61.6	58.8	53.8
	16:15:00	69.3	62.6	59.4	54.4
	16:30:00	76.1	60.8	59.0	52.7
	16:45:00	74.8	60.2	58.6	53.3
	17:00:00	86.8	65.6	64.0	54.4
	17:15:00	62.6	57.3	54.6	50.0
	17:30:00	72.8	59.6	57.3	51.9
	17:45:00	72.0	58.2	56.3	50.2
	18:00:00	87.8	70.9	68.6	55.4
	18:15:00	81.0	62.5	60.3	54.5
	18:30:00	80.2	60.7	59.9	53.7
	18:45:00	84.5	60.1	59.6	52.5
	19:00:00	66.8	60.3	57.5	51.6
	19:15:00	66.5	60.6	58.0	51.3
	19:30:00	88.2	60.6	61.9	52.3

	19:45:00	75.8	60.6	58.6	53.2
	20:00:00	68.4	60.3	57.9	51.8
	20:15:00	69.5	60.9	58.1	51.6
	20:30:00	72.6	59.4	57.3	51.7
	20:45:00	63.0	59.5	56.6	50.8
	21:00:00	68.0	59.5	57.2	51.2
	21:15:00	82.6	60.9	61.1	50.5
	21:30:00	63.0	59.2	56.5	50.0
	21:45:00	69.9	60.0	57.3	47.7
	22:00:00	69.8	60.0	57.3	51.4
	22:15:00	67.0	59.7	57.0	51.2
	22:30:00	68.3	59.7	57.2	49.7
	22:45:00	76.1	59.7	57.9	50.9
	23:00:00	65.1	59.5	56.7	50.0
	23:15:00	73.1	59.2	56.8	50.4
	23:30:00	70.1	59.3	56.8	49.2
	23:45:00	62.7	59.0	55.8	47.9
Saturday 28th July 2018	00:00:00	66.6	59.0	55.6	46.2
	00:15:00	66.0	58.6	55.2	46.5
	00:30:00	65.4	57.5	54.0	45.7
	00:45:00	73.5	58.3	55.1	47.3
	01:00:00	66.2	57.9	54.5	45.3
	01:15:00	62.3	57.4	53.6	44.4
	01:30:00	64.9	56.8	53.1	45.2
	01:45:00	65.7	57.1	52.9	44.2
	02:00:00	66.1	56.8	53.4	44.8
	02:15:00	73.1	57.3	54.8	45.0
	02:30:00	69.0	57.5	53.7	46.0
	02:45:00	73.1	57.6	54.1	46.5
	03:00:00	80.3	57.9	56.0	46.6
	03:15:00	72.8	57.0	53.4	44.3
	03:30:00	67.7	57.8	53.8	46.2
	03:45:00	70.6	57.6	54.3	45.9
	04:00:00	72.6	58.2	54.2	45.0
	04:15:00	68.5	55.4	51.5	44.2
	04:30:00	66.6	57.0	52.8	44.4
	04:45:00	68.7	54.3	50.8	42.8
	05:00:00	64.3	54.1	50.0	43.1
	05:15:00	63.9	56.3	51.5	42.9
	05:30:00	66.5	56.8	52.7	44.2
	05:45:00	68.1	56.0	51.6	43.3
	06:00:00	70.9	57.9	54.6	45.9
	06:15:00	64.7	57.9	54.0	46.6
	06:30:00	74.6	59.6	56.9	49.2
	06:45:00	68.0	59.7	56.7	51.4
	07:00:00	72.7	60.3	57.6	51.3

	07:15:00	66.9	58.9	55.8	49.2
	07:30:00	76.3	59.7	57.1	49.2
	07:45:00	78.7	59.5	57.7	48.6
	08:00:00	72.9	59.7	56.5	48.9
	08:15:00	73.1	60.4	57.7	50.9
	08:30:00	71.3	60.5	57.8	51.4
	08:45:00	70.2	59.8	56.8	49.9
	09:00:00	69.8	59.5	56.7	50.3
	09:15:00	71.5	59.9	57.1	52.1
	09:30:00	74.8	59.4	57.2	52.6
	09:45:00	75.9	59.9	58.0	54.3
	10:00:00	78.0	60.8	58.6	54.2
	10:15:00	69.3	60.4	58.3	55.3
	10:30:00	70.4	59.3	57.2	53.6
	10:45:00	73.9	59.3	57.4	53.1
	11:00:00	80.7	59.7	59.4	52.6
	11:15:00	83.6	60.6	58.7	53.5
	11:30:00	70.8	59.4	57.2	53.2
	11:45:00	67.0	58.4	56.2	51.3
	12:00:00	65.5	58.8	56.5	52.1
	12:15:00	78.8	59.1	57.3	52.9
	12:30:00	81.8	59.2	57.6	52.2
	12:45:00	81.5	59.5	58.0	53.8
	13:00:00	75.2	60.3	58.2	53.9
	13:15:00	83.2	59.9	60.2	53.9
	13:30:00	72.1	58.7	56.9	54.0
	13:45:00	86.3	60.5	59.5	54.2
	14:00:00	79.2	59.1	57.5	53.9
	14:15:00	73.9	60.0	58.1	54.0
	14:30:00	77.9	62.0	60.1	54.7
	14:45:00	79.0	61.8	59.9	55.7
	15:00:00	78.6	60.2	58.5	54.5
	15:15:00	73.4	60.4	58.3	54.1
	15:30:00	74.7	61.0	58.6	53.9
	15:45:00	80.0	60.9	59.0	54.6
	16:00:00	81.7	61.4	59.8	53.1
	16:15:00	86.3	61.1	59.6	54.5
	16:30:00	77.5	60.5	59.1	52.7
	16:45:00	77.2	61.6	59.6	54.7
	17:00:00	74.9	61.4	59.0	55.0
	17:15:00	75.6	60.8	58.6	54.5
	17:30:00	77.9	62.4	60.3	55.3
	17:45:00	75.2	61.7	59.3	54.2
	18:00:00	79.1	62.1	60.4	55.0
	18:15:00	76.1	61.1	58.9	54.6
	18:30:00	73.6	60.5	58.4	55.0

	18:45:00	71.8	60.5	58.3	54.4
	19:00:00	83.3	60.6	58.7	53.3
	19:15:00	75.6	60.2	58.1	53.7
	19:30:00	88.4	60.0	59.1	53.5
	19:45:00	68.5	60.4	58.1	53.7
	20:00:00	87.5	60.8	62.0	54.0
	20:15:00	74.9	60.4	58.3	54.2
	20:30:00	83.8	60.1	60.1	52.4
	20:45:00	68.3	59.0	56.6	51.0
	21:00:00	77.2	59.2	57.4	52.1
	21:15:00	74.7	59.2	57.0	52.7
	21:30:00	76.9	59.4	57.5	51.7
	21:45:00	74.1	59.7	57.8	50.9
	22:00:00	83.8	59.1	57.2	51.1
	22:15:00	70.9	59.2	56.9	50.6
	22:30:00	75.6	59.5	57.4	53.3
	22:45:00	65.6	59.5	57.1	52.0
	23:00:00	85.4	59.5	59.5	52.6
	23:15:00	66.1	59.5	57.0	51.0
	23:30:00	66.1	58.6	56.1	51.5
	23:45:00	70.3	59.5	56.6	50.5
Sunday 29th July 2018	00:00:00	64.2	58.8	55.7	49.0
	00:15:00	82.8	59.2	59.4	48.8
	00:30:00	70.5	58.8	55.6	47.6
	00:45:00	64.4	58.1	54.8	47.6
	01:00:00	72.5	59.1	56.8	48.2
	01:15:00	63.2	57.8	54.5	47.3
	01:30:00	65.2	58.1	54.6	46.3
	01:45:00	70.3	57.8	54.0	45.9
	02:00:00	66.4	58.1	54.5	46.1
	02:15:00	68.2	57.6	53.8	45.6
	02:30:00	69.4	58.1	54.5	46.1
	02:45:00	63.5	56.8	53.0	44.7
	03:00:00	72.2	57.2	53.8	45.4
	03:15:00	68.7	57.2	53.8	45.4
	03:30:00	74.5	57.0	53.6	45.6
	03:45:00	72.9	55.8	52.2	43.4
	04:00:00	67.3	56.5	52.2	43.1
	04:15:00	72.0	56.2	52.2	44.4
	04:30:00	73.1	57.3	53.2	43.9
	04:45:00	70.2	56.9	53.2	44.4
	05:00:00	80.7	57.1	54.5	45.1
	05:15:00	72.8	58.3	54.9	46.5
	05:30:00	67.6	57.1	53.3	44.7
	05:45:00	72.1	57.9	54.2	44.9
	06:00:00	71.6	57.0	53.3	45.3

	06:15:00	70.9	58.1	54.3	46.4
	06:30:00	72.4	59.0	55.7	47.5
	06:45:00	71.8	59.6	55.9	46.6
	07:00:00	80.1	59.3	56.2	48.4
	07:15:00	73.8	60.1	57.1	50.0
	07:30:00	85.0	63.6	61.7	53.9
	07:45:00	72.0	60.8	58.1	53.2
	08:00:00	77.9	62.4	60.1	51.9
	08:15:00	73.0	61.0	57.8	51.3
	08:30:00	80.6	61.9	59.3	52.4
	08:45:00	78.7	62.0	59.0	51.8
	09:00:00	71.5	61.8	59.1	53.4
	09:15:00	76.8	62.1	59.5	52.2
	09:30:00	73.7	61.9	59.6	54.4
	09:45:00	71.4	62.4	59.8	55.0
	10:00:00	83.8	62.6	61.0	55.8
	10:15:00	76.6	62.3	60.1	54.0
	10:30:00	83.8	63.8	62.3	55.3
	10:45:00	71.8	61.7	59.5	53.5
	11:00:00	80.0	63.7	61.8	55.6
	11:15:00	77.1	61.6	59.4	53.1
	11:30:00	74.8	62.2	59.9	54.9
	11:45:00	76.0	61.6	59.6	54.3
	12:00:00	79.1	62.3	60.8	54.0
	12:15:00	83.0	63.0	62.0	55.9
	12:30:00	82.2	62.9	60.9	54.9
	12:45:00	80.0	63.9	62.0	56.1
	13:00:00	77.0	63.1	61.2	55.7
	13:15:00	78.9	62.7	60.9	55.3
	13:30:00	79.2	63.1	61.4	55.7
	13:45:00	80.5	63.3	61.7	56.1
	14:00:00	82.7	63.0	61.8	55.6
	14:15:00	79.0	63.1	61.1	55.3
	14:30:00	76.6	62.0	60.1	55.9
	14:45:00	82.7	63.0	61.5	55.0
	15:00:00	83.7	63.6	62.0	55.8
	15:15:00	85.3	63.7	62.0	53.4
	15:30:00	78.4	63.5	61.7	56.1
	15:45:00	76.4	62.2	60.3	54.7
	16:00:00	81.1	62.2	59.9	54.5
	16:15:00	78.6	62.1	59.8	54.7
	16:30:00	76.8	61.8	59.8	54.5
	16:45:00	79.0	61.8	59.7	54.2
	17:00:00	79.8	62.8	61.1	55.8
	17:15:00	82.8	61.2	59.5	54.4
	17:30:00	79.0	61.7	59.8	55.2

	17:45:00	74.7	61.6	59.5	53.9
	18:00:00	70.7	61.0	58.8	53.2
	18:15:00	66.0	60.9	58.7	54.4
	18:30:00	70.0	61.3	59.1	54.1
	18:45:00	74.1	60.7	58.7	53.7
	19:00:00	69.4	61.0	58.6	53.7
	19:15:00	74.0	61.3	59.0	53.7
	19:30:00	67.8	61.4	58.7	53.2
	19:45:00	69.9	60.7	58.4	51.8
	20:00:00	69.9	61.1	58.5	53.1
	20:15:00	71.7	61.4	59.0	51.9
	20:30:00	69.1	60.6	58.0	52.0
	20:45:00	75.8	60.9	58.7	50.9
	21:00:00	69.8	60.3	57.7	52.0
	21:15:00	69.1	60.1	57.7	50.5
	21:30:00	75.0	59.2	57.0	51.8
	21:45:00	66.7	59.4	56.7	50.3
	22:00:00	69.3	60.1	57.0	49.2
	22:15:00	71.0	59.7	56.7	50.2
	22:30:00	73.6	60.3	57.2	49.6
	22:45:00	76.8	59.5	56.7	49.8
	23:00:00	64.0	58.9	56.2	49.8
	23:15:00	65.4	59.4	56.5	49.9
	23:30:00	67.8	58.5	54.9	46.4
	23:45:00	68.8	58.9	55.1	46.8
Monday 30th July 2018	00:00:00	64.3	57.7	54.0	45.6
	00:15:00	66.2	57.3	53.4	45.1
	00:30:00	68.9	56.5	52.7	44.8
	00:45:00	65.7	57.0	52.9	43.7
	01:00:00	69.9	55.7	51.7	42.7
	01:15:00	63.9	56.4	51.7	41.9
	01:30:00	61.5	54.5	49.9	41.5
	01:45:00	67.5	54.8	50.4	41.3
	02:00:00	62.9	53.4	49.2	41.2
	02:15:00	64.0	54.4	50.3	40.9
	02:30:00	65.2	52.7	48.6	41.0
	02:45:00	63.0	52.9	48.5	40.9
	03:00:00	61.7	52.2	48.0	41.0
	03:15:00	66.1	54.5	50.3	40.9
	03:30:00	66.0	52.0	48.9	41.4
	03:45:00	64.9	51.4	48.0	41.4
	04:00:00	64.1	54.1	49.5	41.4
	04:15:00	65.7	52.7	49.2	41.4
	04:30:00	64.2	54.6	50.3	42.1
	04:45:00	65.2	55.3	50.9	42.6
	05:00:00	62.0	55.2	50.6	43.0

	05:15:00	71.1	56.7	52.5	43.5
	05:30:00	64.5	56.9	52.4	44.4
	05:45:00	66.9	59.3	55.0	45.5
	06:00:00	64.6	59.8	55.7	47.5
	06:15:00	67.0	63.0	59.2	49.2
	06:30:00	73.9	62.7	60.3	50.5
	06:45:00	66.3	60.6	57.8	50.1
	07:00:00	72.0	61.2	58.6	51.7
	07:15:00	65.7	60.3	57.5	50.7
	07:30:00	76.2	60.7	58.7	51.4
	07:45:00	77.0	61.3	59.4	53.0
	08:00:00	70.3	60.3	57.5	51.8
	08:15:00	98.5	65.0	68.4	53.5
	08:30:00	92.5	61.9	62.3	52.8
	08:45:00	98.7	62.9	69.1	53.1
	09:00:00	75.0	61.1	58.8	52.8
	09:15:00	78.4	60.1	58.3	52.5
	09:30:00	73.1	60.8	58.5	51.9
	09:45:00	71.4	60.3	57.8	51.9
	10:00:00	80.2	60.7	59.3	52.9
	10:15:00	78.0	60.3	58.3	51.1
	10:30:00	79.7	61.1	59.6	53.8
	10:45:00	85.6	62.6	62.0	53.7
	11:00:00	71.7	60.9	58.3	52.4
	11:15:00	71.9	61.1	58.7	52.7
	11:30:00	77.2	60.3	58.4	51.8
	11:45:00	81.0	60.9	59.1	53.0
	12:00:00	98.8	61.1	64.1	51.5
	12:15:00	68.8	60.3	58.1	54.0
	12:30:00	71.1	60.7	58.3	53.1
	12:45:00	71.6	67.4	61.5	53.1
	13:00:00	77.0	63.5	61.3	51.9
	13:15:00	73.1	61.2	58.4	53.1
	13:30:00	78.0	61.3	59.8	52.9
	13:45:00	76.6	64.6	60.9	53.7
	14:00:00	71.6	63.5	61.2	57.7
	14:15:00	70.3	65.6	61.8	58.0
	14:30:00	93.6	64.0	62.8	55.8
	14:45:00	80.6	62.7	60.2	55.1
	15:00:00	82.1	62.1	60.1	55.2
	15:15:00	80.5	62.8	61.0	55.4
	15:30:00	83.3	63.7	61.8	57.0
	15:45:00	83.8	62.7	61.0	56.7
	16:00:00	74.6	60.7	58.7	53.6
	16:15:00	84.6	61.0	59.8	54.2
	16:30:00	87.6	60.1	61.8	53.1

	16:45:00	73.2	62.0	59.6	55.1
	17:00:00	84.4	61.4	60.7	53.7
	17:15:00	81.0	60.7	59.7	52.6
	17:30:00	74.8	60.4	58.1	52.5
	17:45:00	71.7	62.3	60.2	55.8
	18:00:00	79.8	61.0	59.6	54.9
	18:15:00	74.7	61.4	59.1	52.9
	18:30:00	83.0	61.1	60.3	53.1
	18:45:00	70.5	61.0	58.7	53.3
	19:00:00	72.1	59.7	57.9	53.2
	19:15:00	75.9	60.6	58.6	50.9
	19:30:00	77.7	60.7	58.7	52.6
	19:45:00	80.1	60.3	58.8	51.4
	20:00:00	66.2	59.6	57.1	51.1
	20:15:00	71.0	59.8	57.5	51.9
	20:30:00	64.7	60.0	57.4	51.0
	20:45:00	70.2	59.7	57.3	51.4
	21:00:00	65.6	59.2	56.6	50.2
	21:15:00	66.3	58.6	56.0	49.8
	21:30:00	72.5	59.4	56.9	48.5
	21:45:00	63.4	59.1	55.9	48.7
	22:00:00	70.2	59.4	56.4	49.2
	22:15:00	63.3	58.6	55.7	48.8
	22:30:00	71.6	59.0	56.0	48.2
	22:45:00	66.9	59.1	56.1	48.8
	23:00:00	77.3	58.4	56.5	47.1
	23:15:00	76.9	59.0	56.7	46.8
	23:30:00	75.4	59.2	57.0	46.3
	23:45:00	62.9	57.1	53.2	44.5
Tuesday 31st July 2018	00:00:00	82.5	57.9	56.6	43.8
	00:15:00	65.1	56.3	52.3	44.6
	00:30:00	62.8	56.2	51.8	42.1
	00:45:00	62.2	54.7	50.4	42.3
	01:00:00	66.8	55.2	50.9	42.0
	01:15:00	61.4	55.0	50.3	41.7
	01:30:00	65.8	54.9	50.9	41.9
	01:45:00	62.5	53.7	49.0	41.1
	02:00:00	65.8	54.7	50.4	40.3
	02:15:00	64.5	52.1	48.5	40.1
	02:30:00	63.9	54.0	49.6	40.5
	02:45:00	64.2	52.7	48.7	40.0
	03:00:00	70.5	52.2	49.4	39.5
	03:15:00	68.5	54.0	50.4	40.7
	03:30:00	64.6	52.1	48.4	40.4
	03:45:00	67.2	51.6	49.1	40.5
	04:00:00	63.4	54.8	50.6	40.6

	04:15:00	70.5	65.8	60.7	50.7
	04:30:00	66.9	57.7	53.0	43.7
	04:45:00	63.8	56.1	52.3	43.3
	05:00:00	71.6	60.2	58.0	53.5
	05:15:00	69.3	60.1	57.1	53.3
	05:30:00	66.4	61.1	57.6	52.1
	05:45:00	68.7	61.6	57.3	47.6
	06:00:00	64.7	59.8	56.0	46.7
	06:15:00	68.5	61.0	57.5	48.5
	06:30:00	64.5	60.9	57.9	50.0
	06:45:00	66.7	61.3	58.4	49.5
	07:00:00	71.8	61.5	59.0	52.6
	07:15:00	71.8	61.1	58.6	52.2
	07:30:00	90.7	62.4	64.8	53.2
	07:45:00	71.8	60.7	58.0	53.1
	08:00:00	77.0	60.0	57.8	53.2
	08:15:00	79.5	61.7	59.1	50.4
	08:30:00	78.5	61.5	59.3	52.3
	08:45:00	76.7	61.2	58.9	53.1
	09:00:00	83.0	67.2	64.9	51.1

TABLE B1: UNATTENDED DATA 27TH JULY TO 31ST JULY 2018

APPENDIX C: GLOSSARY OF ACOUSTIC TERMS

Noise

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dBA weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dBA is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dBA. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dBA corresponds to a doubling/ halving in perceived loudness. Noise is measured on a logarithmic scale in decibels (dB) because of the ears' sensitivity to a wide range of pressure changes. The sound pressure level (SPL) of a signal is denoted by the symbol L_p and defined by the equation $L_p = 10 \log (p/p_o)^2$ where p is the root mean square pressure of the signal and p_o is the reference sound pressure (2×10^{-5} Pa).

An indication of the range of sound pressure levels commonly found in the environment is given below:

Location	L_{pA} dB(A)
Normal threshold of hearing	-10 to 20
Music halls and theatres	20 to 30
Living rooms and offices	30 to 50
Inside motor vehicles	50 to 70
Industrial premises	70 to 100
Burglar alarms at 1 m	100 to 110
Jet aircraft on take-off	110 to 130
Threshold of pain	130 to 140

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

i) The L_{Amax} noise level

This is the maximum noise level recorded over the measurement period.

ii) The L_{Aeq} noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 [2] as the " value of the A-weighted sound pressure level of a

continuous, steady sound that, within a specified time internal, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

iii) The L_{A10} noise level

This is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.

iv) The L_{A90} noise level

This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during the quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.

Community response to environmental noise sources is dependent on both acoustic and non-acoustic factors. The acoustic factors include absolute noise level, changes or exceedances of background and ambient levels as well as the characteristics, time, duration and frequency of noise.