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NOISE IMPACT ASSESSMENT REPORT – AIR SOURCE HEAT PUMPS

6 LINDFIELD GARDENS, HAMPSTEAD NW3 6PU

FOR

U & L ZAIDMAN

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1. EXECUTIVE SUMMARY

The Client intends to seek planning approval for the installation of two (2 No.) air source heat pumps to service the premises at 6 Lindfield Gardens, Hampstead NW3 6PU.

Sound Licensing has undertaken an environmental noise survey at the site in order to determine prevailing background noise levels that are representative of the nearest noise sensitive properties, which have been identified as the residential premises at 4A Lindfield Gardens and 8A Lindfield Gardens, NW3.

The results of the noise survey are considered reasonable given the location of the measurement position and the existing noise sources in the local vicinity.

Noise calculations of the mechanical plant have been undertaken using all available details and plans provided by the client and obtaining manufacturers' specifications wherever possible. The data and information form the basis of the assessment.

Noise break-out limits for the mechanical plant have been proposed based on the methodologies of British Standard (BS) 4142:2014+A1:2019 and in accordance to Local Authority policy. A robust, worst-case assessment of the noise levels associated to the proposed mechanical plant has been undertaken.

In accordance with BS 4142:2014+A1:2019 guidance, the predicted noise impact due to the operation of the mechanical plant, with recommended mitigation installed, ***"is an indication of the specific sound source having a low impact"***. The predicted noise level of the mechanical plant at the nearest noise sensitive properties is considered to comply with the London Borough of Camden Council's policy.

2. INTRODUCTION

The client has installed two (2 No.) new air source heat pumps at either side of 6 Lindfield Gardens, Hampstead NW3 6PU, the noise from which could have the potential to affect existing noise sensitive properties nearby.

The purposes of this report are:

- To determine prevailing environmental noise levels affecting surrounding properties due to nearby noise sources (e.g. road traffic, aircraft etc);
- Based on the above, to present noise emission limits in accordance with the requirements of BS 4142:2014+A1:2019 and Local Authority policy, and
- To undertake an assessment to demonstrate compliance with the Local Authority noise requirements.

3. SITE DESCRIPTION

Planning permission is being sought for the installation of two (2 No.) air source heat pumps at 6 Lindfield Gardens, Hampstead NW3 6PU (hereafter referred to as 'the site'). The property is a traditionally built three-storey detached building in the London Borough of Camden. It is located in a residential area.

The nearest sensitive residential receptors were noted to be the first-floor windows located on the side façade of 4A Lindfield Gardens and the first-floor windows located on the side façade of 8A Lindfield Gardens at approximate distances of:

4A Lindfield Gardens – 5m (Pump 1) and 22m (Pump 2) from the air source heat pumps respectively
8A Lindfield Gardens – 2.5m (Pump 2) and 19m (Pump 1) from the air source heat pumps respectively

The nearest sensitive receptors are identified in figure 3.1. If the noise impact assessment details that there is an indication of the specific sound source having a low impact at these premises then it can be safely assumed it will be met at other properties of equal distance and/or those further away.

Figure 3.1 shows the site highlighted in **blue** with the nearest noise sensitive premises highlighted in **red**.

Figure 3.1 Site Location and Surrounding Land Use

Source: Google Maps

4. ENVIRONMENTAL NOISE SURVEY METHODOLOGY

An unmanned environmental noise survey was undertaken at a single measurement location at ground floor level to the side of the site. The survey was undertaken between 11:30 hours on the 28th July and 11:30 hours on the 30th July 2021. A survey at this time covers the most sensitive period of time in which the mechanical plant system may be operational.

Ambient, background and maximum noise levels (L_{Aeq}, L_{A90} and L_{Amax} respectively) were measured throughout the noise survey in continuous 15-minute periods. The approximate measurement position is indicated in **orange** on Figure 4.1 below.

Figure 4.1 Site Plan Showing Approximate Location of Measurement Position

Source: Google Maps

The sound level meter microphone was positioned on a tripod at a height of 1.5 metres, 1 metre from the boundary fence. The position is not considered to be in free-field and therefore a 3dB façade correction will be applied. The monitoring position is considered representative of background noise levels at the nearest identified noise sensitive properties. The monitoring position was chosen for equipment security reasons also.

The equipment used for the noise survey is summarised in Table 4.1.

Table 4.1 Description of Equipment used for Noise Survey

Equipment	Description	Quantity	Serial Number
Larson Davis Sound Expert LxT	Type 1 automated logging sound level meter	1	0004720
Larson Davis 377B02	½" microphone	1	159605
Larson Davis	Pre-amplifier	1	042610
Larson Davis CAL200	Class 1 Calibrator	1	12245

The noise survey and measurements were conducted in accordance with BS7445-1:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures'*.

Weather conditions throughout the entire noise survey period were noted to be warm (approx. 12-22° Celsius), partly sunny (30 to 90% cloud cover approximately) with a light wind (<5m/s). These weather conditions were checked against and confirmed by the use of the Met Office mobile application available on smart phone technology. These conditions were maintained throughout the majority of the survey period and are considered reasonable for undertaking environmental noise measurements.

The noise monitoring equipment was field calibrated before and after the noise survey period. No significant drift was recorded (±0.3 dB). Equipment calibration certificates can be provided upon request.

5. NOISE SURVEY RESULTS AND OBSERVATIONS

5.1 Results

A summary of the measured ambient and background noise levels during the proposed operational hours are shown in Table 5.1 below (full monitoring data can be found in Appendix C).

Table 5.1 Measured ambient and typical background sound pressure levels

Date / Period (hours)	Ambient Sound Pressure Level, dB $L_{Aeq,T}$	Typical Background Sound Pressure Level, dB $L_{A90,T}$
28/07/2021(11:30 to 23:00)	**44-58***	**42***
28/07/2021 – 29/07/2021 (23:00 to 07:00)	**36-44***	**35***
29/07/2021(07:00 to 23:00)	**42-55***	**42***
29/07/2021 – 30/07/2021 (23:00 to 07:00)	**33-50***	**36***
30/07/2021(07:00 to 11:30)	**46-55***	**44***

*Façade correction -3dB. Day Time 1-hour measurements and Night Time 15-minute measurements

The typical background noise level at the measurement position during the survey, at the time in which the plant could be operational, is **35dB** $L_{A90,15min}$.

5.2 Observations

Given that the noise survey was unmanned, noise sources could not be identified. However, at the beginning and end of the survey background noise was dominated by noise from the vehicles on the local road network. After analysis of the data no significant abnormal noise source(s) were identifiable. It is considered that the measured noise levels are reasonable given the location of the measurement position.

6. EXTERNAL NOISE EMISSION LIMITS

6.1 Local Authority Requirements

The site lies within the jurisdiction of the Local Authority, Camden Borough Council. The following requirements for mechanical plant have previously been requested by the Local Authority:

"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."

For the purposes of this report, an assessment has been undertaken in line with BS 4142:2014+A1:2019. A design criterion of achieving a minimum 10dB(A) below the background noise level has been adopted in line with the Local Authorities policy. Taking the noise monitoring data in Section 5 and Local Authority requirements above, the following design target has been adopted for mechanical plant as provided in Table 6.1.

Table 6.1 Maximum noise emission design target at residential premises

Date / Period (hours)	Typical Background Sound Pressure Level, dB $L_{A90,15min}$	Rating noise level at nearest residential facade, dB $L_{Aeq,T}$
28/07/2021 – 29/07/2021 (23:00 to 07:00)	**35***	**25**

* Façade correction -3dB

6.2 BS 4142:2014+A1:2019

BS 4142:2014+A1:2019 "Methods for rating and assessing industrial and commercial sound" presents a method for assessing the significance and possible adverse impact due to an industrial noise source, based on a comparison of the source noise levels and the background noise levels, both of which are measured or predicted at a noise sensitive receiver e.g. a residential property.

The specific noise level due to the source is determined, with a series of corrections for tonality, impulsivity, intermittency or other unusual characteristic. The rating level is then compared to the background noise level and the significance of the new noise source likelihood of any adverse impact is determined in accordance with the following advice:

"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 occur. 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 the context. 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."

7. AIR SOURCE HEAT PUMPS AND ASSOCIATED NOISE LEVELS

The following items of plant are installed at either side of the premises.

Table 7.0 Air Source Heat Pumps

External Plant Item	Make	Model	Quantity	Reference Noise Level* $L_{p(A)}$
Air Source Heat Pump	Mitsubishi	Ecodan R32 PUZ-HWM140VHA	2	53dB @ 1m

*Reference sound pressure levels. Manufacturer's specifications are provided in Appendix B.

In reference to section 6 of this report, no penalty addition has been applied for intermittency as, with recommended mitigation installed, when the source commences or ceases operation it will not attract the listeners attention within the dwelling. Penalty additions have not been applied for tonality as manufacturers' data shows no significant characteristics, or for impulsiveness as it is considered that these characteristics will not be perceptible sufficient to attract attention at the noise receptors. Penalty additions have not been applied for any other sound characteristics as mechanical plant of this type generally do not demonstrate such features.

7.1 Building Screening

Due to the positioning of the air source heat pumps, there will be significant building screening from both pumps to 4A Lindfield Gardens and from Pump 1 to 8A Lindfield Gardens, so there will be no direct or partial line of sight, therefore attenuation due to barrier loss has also been considered (calculations are provided in Appendix D).

8. NOISE IMPACT ASSESSMENT

This section presents calculations to predict the noise impact of the air source heat pumps, located at the site, at the nearest noise sensitive properties.

8.1 Proposed Operational Hours and Background Noise Levels

The air source heat pumps will operate as required 24 hours-a-day, 7 days-a-week.

The typical background noise level at the measurement position during the survey is **35dB** $L_{A90,15min.}$ The design range is **25dB** $L_{Aeq,T}$ at the façade of the nearest residential premises.

8.2 Nearest Noise Sensitive Properties

The nearest sensitive residential receptors were noted to be the first-floor windows located on the side façade of 4A Lindfield Gardens and the first-floor windows located on the side façade of 8A Lindfield Gardens at approximate distances of:

4A Lindfield Gardens – 5m (Pump 1) and 22m (Pump 2) from the air source heat pumps respectively
8A Lindfield Gardens – 2.5m (Pump 2) and 19m (Pump 1) from the air source heat pumps respectively

8.3 Description of Calculation Process

In accordance with the methodologies of BS 4142:2014+A1:2019, calculations have been undertaken to predict noise levels in which the mechanical plant could be operational at their maximum level. Given the distances between the noise sources and the noise sensitive receptors, point source calculations have been used.

8.4 Noise Level Predictions

Calculations to predict the noise of the mechanical plant operating at the facade of the residential property is given below. Full calculations are provided in Appendix D.

The rating noise level at 4A Lindfield Gardens, with the mechanical plant operating, is predicted to be **34dB $L_{Aeq,T}$** which is **1dB(A) below** the typical background noise level (35dB $L_{A90,15min}$).

In accordance with BS 4142:2014+A1:2019 guidance, the rating noise at 4A Lindfield Gardens ***"is an indication of the specific sound source having a low impact"***. *The lower the rating level is relative to the measured background level, the less likely it is that the specific sound source will have an adverse impact*.

The rating noise level at 8A Lindfield Gardens, with the mechanical plant operating, is predicted to be **45dB $L_{Aeq,T}$** which is **10dB(A) above** the typical background noise level (35dB $L_{A90,\ 1hour}$).

In accordance with BS 4142:2014+A1:2019 guidance, the rating noise at 8A Lindfield Gardens ***"is an indication of the specific sound source having a significant adverse impact"***. *The lower the rating level is relative to the measured background level, the less likely it is that the specific sound source will have an adverse impact.*

In order to meet the required design target, it is recommended that the following mitigation measures are implemented:

8.5 Recommended Noise Mitigation

It is recommended to install permanent acoustic enclosures around the mechanical plant. The enclosure around the unit on the northern façade of the premises should provide a minimum insertion loss of 20dB Rw and the enclosure around the unit on the southern façade of the premises should provide a minimum insertion loss of 9dB Rw.

Custom-made enclosures and acoustic building products can be gained from:
- CAICE (http://www.caice.co.uk/home/content/acoustic-enclosures),
- ENVIRON (http://www.environ.co.uk/products/packaged-plant-solutions.html), and
- WAKEFIELD ACOUSTICS (http://www.wakefieldacoustics.co.uk/our-products/acoustic-enclosures/).

The rating noise level at 4A Lindfield Gardens, with the mechanical plant operating, with recommended mitigation installed, is predicted to be **25dB $L_{Aeq,T}$** which is **10dB(A) below** the typical background noise level (35dB $L_{A90,15min}$).

The rating noise level at 8A Lindfield Gardens, with the mechanical plant operating, with recommended mitigation installed, is predicted to be **25dB $L_{Aeq,T}$** which is **10dB(A) below** the typical background noise level (35dB $L_{A90,\ 1hour}$).

In accordance with BS 4142:2014+A1:2019 guidance, the rating noise, with the recommended mitigation measures installed, ***"is an indication of the specific sound source having a low impact"***. *The lower the rating level is relative to the measured background level, the less likely it is that the specific sound source will have an adverse impact*.

8.5 Vibration

In addition to the control of airborne noise transfer, it is important to consider the transfer of noise as vibration to adjacent properties as well as any sensitive areas of the same building. Vibration from the system is not expected, however, as a precaution plant should wherever possible be installed on suitable type isolators.

Uncertainty

The levels of uncertainty in the data and calculations are considered to be low given the robust exercise undertaken in noise monitoring and the confidence in the data statistical analysis. Manufacturers' data for the plant is highly likely to be robust. Detailed calculations and resultant noise levels at the residential location are considered to be confidently predicted.

9. CONCLUSION

Sound Licensing has undertaken an environmental noise survey at the site in order to determine prevailing background noise levels that are representative of the nearest noise sensitive properties. The operation of the air source heat pumps, in accordance with BS 4142:2014+A1:2019 guidance, with recommended mitigation installed, indicates to creating a low impact. All worst-case scenarios have been applied to the assessment. The predicted cumulative operating noise level of the air source heat pumps is demonstrated to comply with the London Borough of Camden Council's policy.

APPENDIX A – Acoustic Terminology

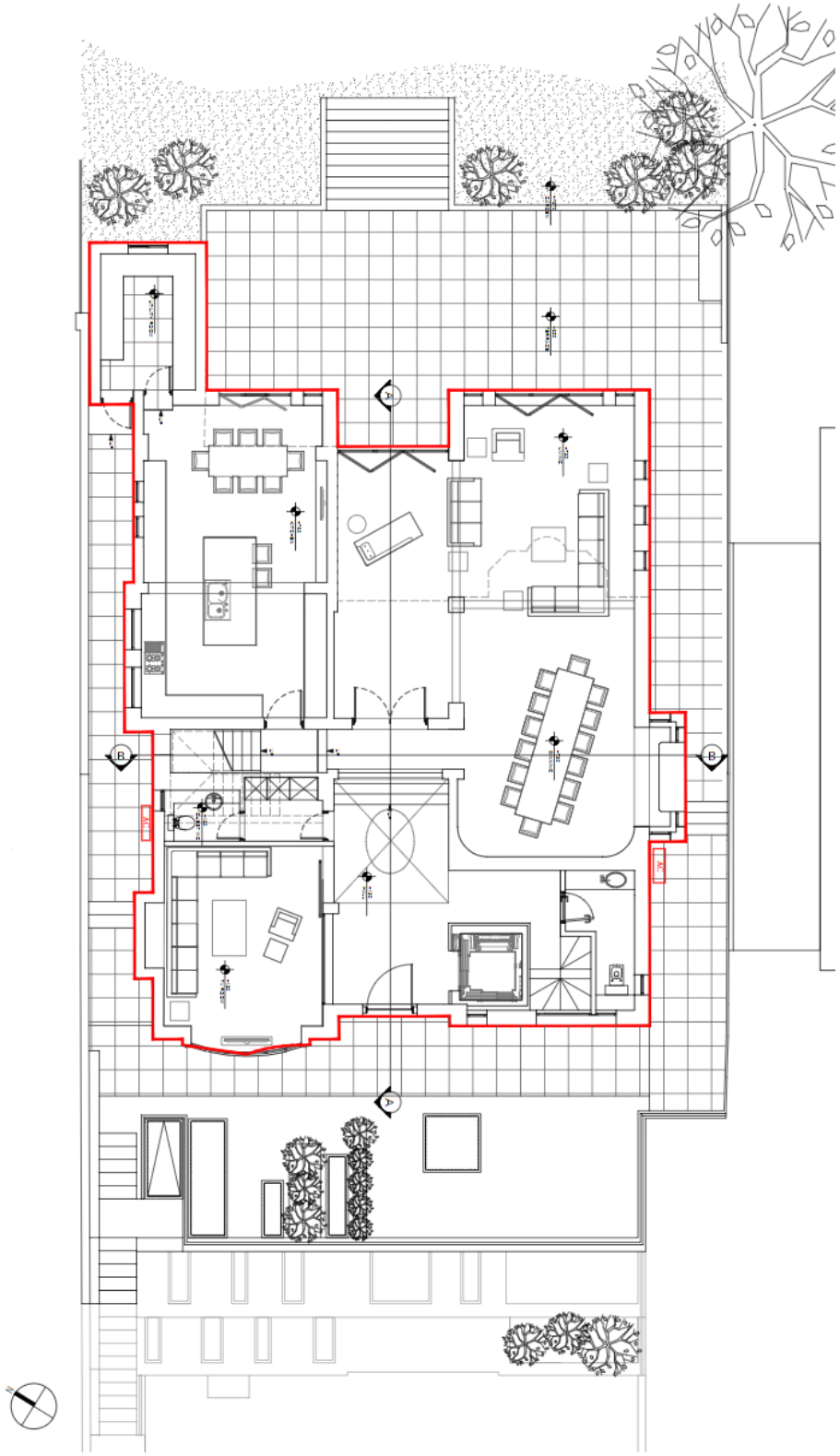
Parameter	Description
Acoustic environment	Sound from all sound sources as modified by the environment
Ambient sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far
Ambient sound level, La = LAeq,T	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T
Background sound level, LA90,T	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels
Decibel (dB)	A logarithmic scale representing the sound pressure or power level relative to the threshold of hearing ($20x10^{-6}$ Pascals).
Equivalent continuous A-weighted sound pressure level, LAeq,T	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t2 – t1, has the same mean-squared sound pressure as a sound that varies with time
Measurement time interval, Tm	Total time over which measurements are taken
Rating level, LAr,Tr	Specific sound level plus any adjustment for the characteristic features of the sound
Reference time interval, Tr	Specified interval over which the specific sound level is determined
Residual sound	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound
Residual sound level, Lr = LAeq,T	Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T
Specific sound level, Ls = LAeq,Tr	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr
Specific sound source	Sound source being assessed

References:

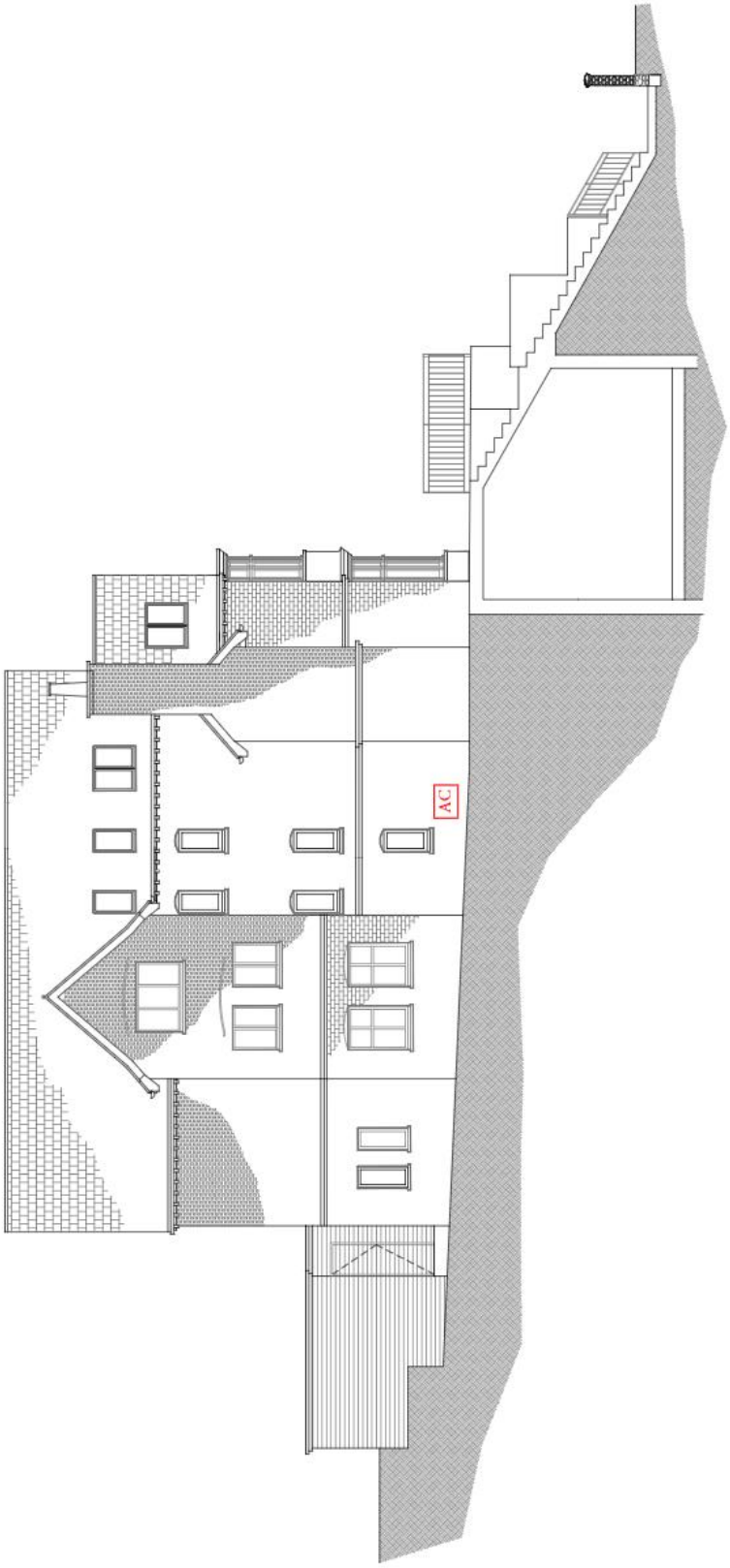
BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

APPENDIX B – Data Sheets and Figures

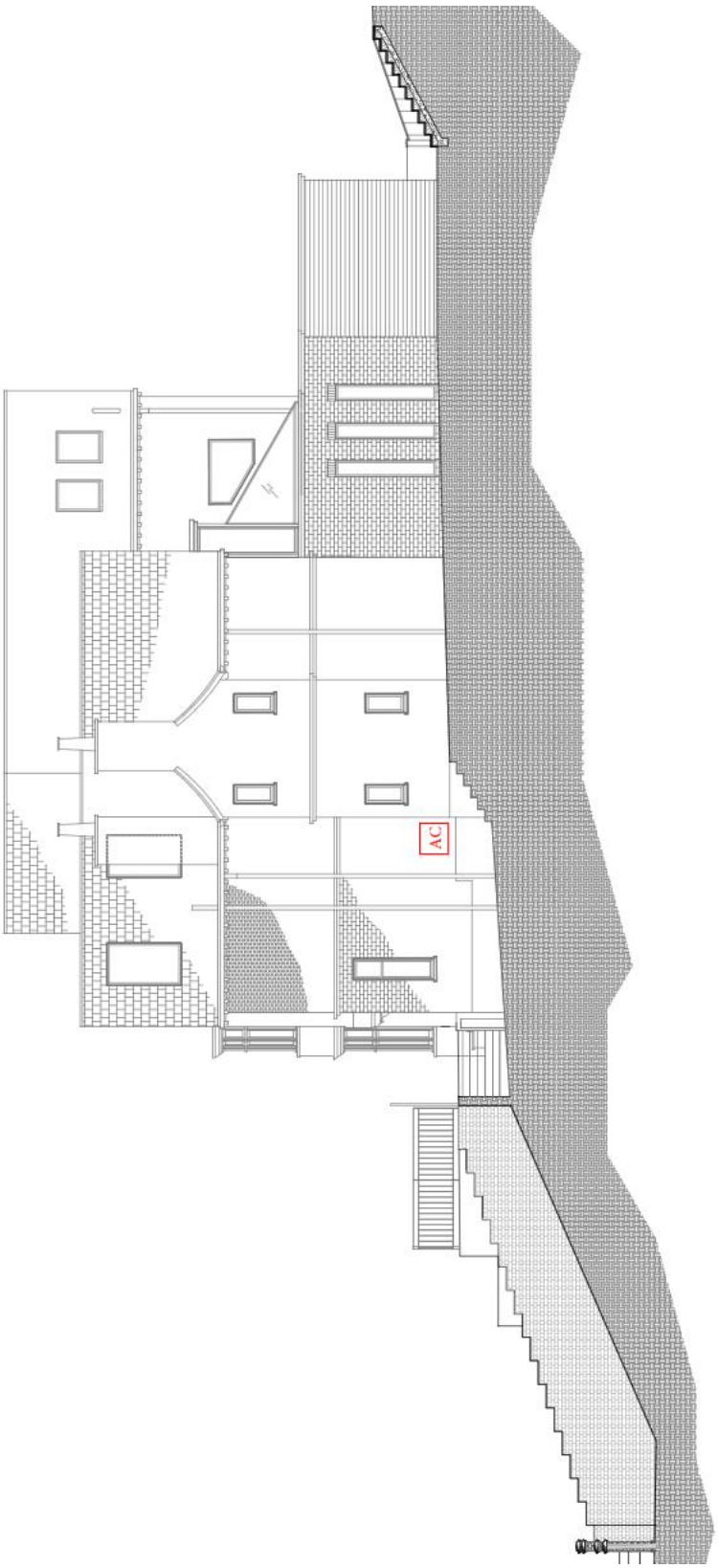
Ground Floor Plan and Air Source Heat Pump Locations



North-West Elevation



South-East Elevation



Mitsubishi Ecodan R32 PUZ-HWM140VHA Data Sheet

Heating | Product Information

MITSUBISHI ELECTRIC

PUZ-HWM140VHA(-BS)

Ecodan R32
Monobloc Air Source Heat Pump

R32

Key Features:	Key Benefits:
A+++ high efficiency system	Ultra low running cost
Compact design	Minimal installation space required
Maintains full heating capacity at low temperatures	Confident and quick product selection
Zero carbon solution	Help to tackle the climate crisis
MELCloud enabled	Remote control, monitoring, maintenance and technical support

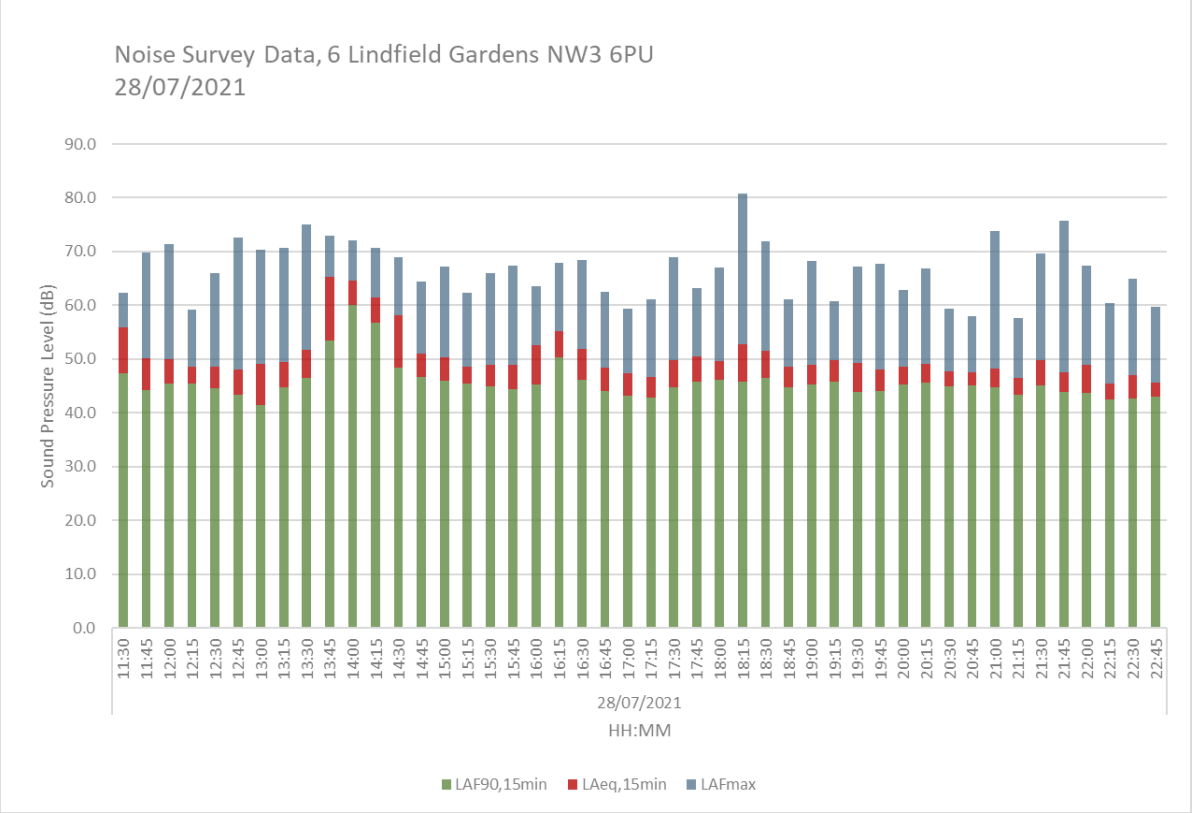
MELCloud

ecodan.co.uk

Mitsubishi Ecodan R32 PUZ-HWM140VHA Data Sheet

OUTDOOR UNIT		PUZ-HWM140VHA(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++
	η_s	131%
	SCOP (MCS)	3.35
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A+++
	η_s	176%
	SCOP (MCS)	4.48
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	130%
HEATING*2 (A-7/W35)	Capacity (kW)	14
	Power Input (kW)	5.71
	COP	2.45
OPERATING AMBIENT TEMPERATURE (°C DB)		-28 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	53
	Power Level (dBA)*4	67
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	40.1
	Water Pressure Drop (kPa)	20
DIMENSIONS (mm)	Width	1020
	Depth	330 + 30*7
	Height	1350
WEIGHT (kg)		132
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	13.8 [35]
	Fuse Rating - MCB Sizes (A)*6	40
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	3.3

APPENDIX C – Noise monitoring Data



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	11:45	50.2	69.8	44.2				18:15	52.8	80.7	45.7		
	12:00	49.9	71.3	45.5	48.8	44.8		18:30	51.6	71.9	46.4		
	12:15	48.6	59.1	45.5				18:45	48.5	61.1	44.7		
	12:30	48.5	65.9	44.6				19:00	48.9	68.2	45.2	49.0	44.8
	12:45	48.0	72.6	43.3				19:15	49.7	60.7	45.8		
	13:00	49.1	70.3	41.5	59.6	48.9		19:30	49.3	67.1	43.9		
	13:15	49.4	70.7	44.8				19:45	48.0	67.7	44.0		
	13:30	51.8	75.1	46.4				20:00	48.6	62.8	45.3	48.3	45.2
	13:45	65.2	72.9	53.5				20:15	49.1	66.8	45.6		
	14:00	64.6	72.0	60.0	61.0	56.0		20:30	47.7	59.4	44.9		
	14:15	61.5	70.6	56.7				20:45	47.5	57.9	45.0		
	14:30	58.2	68.9	48.4				21:00	48.1	73.7	44.8	48.1	44.3
	14:45	51.0	64.4	46.7				21:15	46.5	57.6	43.4		
	15:00	50.3	67.1	46.0	49.2	45.2		21:30	49.7	69.6	45.1		
	15:15	48.6	62.3	45.5				21:45	47.5	75.7	43.8		
	15:30	49.0	66.0	44.9				22:00	48.9	67.4	43.7	47.0	43.0
	15:45	49.0	67.3	44.4				22:15	45.4	60.5	42.5		
	16:00	52.5	63.5	45.2	52.7	47.1		22:30	47.0	65.0	42.7		
	16:15	55.3	67.8	50.3				22:45	45.6	59.7	43.0		
	16:30	51.8	68.4	46.2									
	16:45	48.5	62.4	44.0									
	17:00	47.4	59.4	43.2	48.9	44.3							
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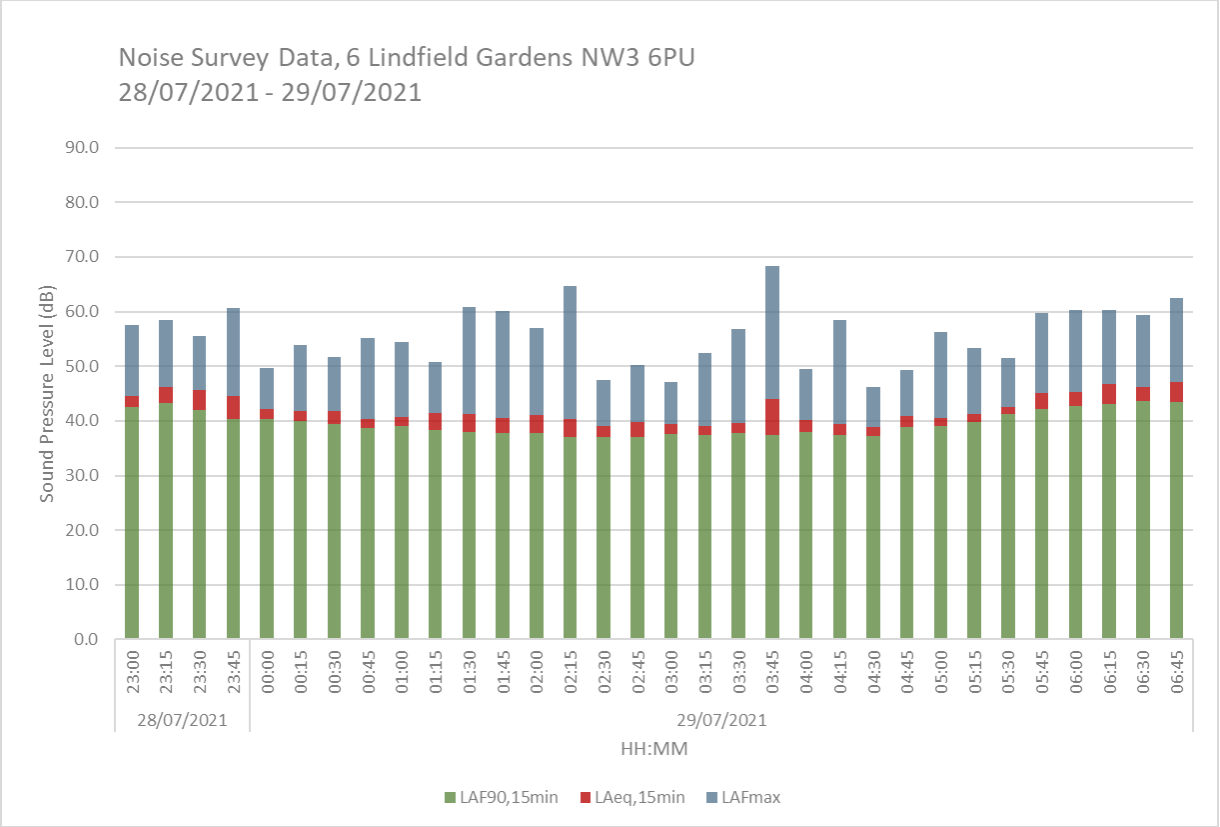

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	23:45	44.5	60.7	40.4
29/07/2021	00:00	42.2	49.7	40.4
	00:15	41.9	53.9	40.0
	00:30	41.8	51.6	39.4
	00:45	40.3	55.1	38.6
	01:00	40.7	54.4	39.0
	01:15	41.4	50.8	38.4
	01:30	41.3	60.9	38.0
	01:45	40.5	60.1	37.8
	02:00	41.0	57.0	37.7
	02:15	40.3	64.7	37.0
	02:30	39.1	47.4	37.0
	02:45	39.8	50.2	37.1
	03:00	39.4	47.1	37.6
	03:15	39.1	52.4	37.4
	03:30	39.5	56.8	37.7
	03:45	44.1	68.4	37.5
	04:00	40.1	49.5	37.9
	04:15	39.5	58.4	37.4
	04:30	39.0	46.3	37.2
	04:45	40.9	49.3	38.9
	05:00	40.5	56.3	39.0
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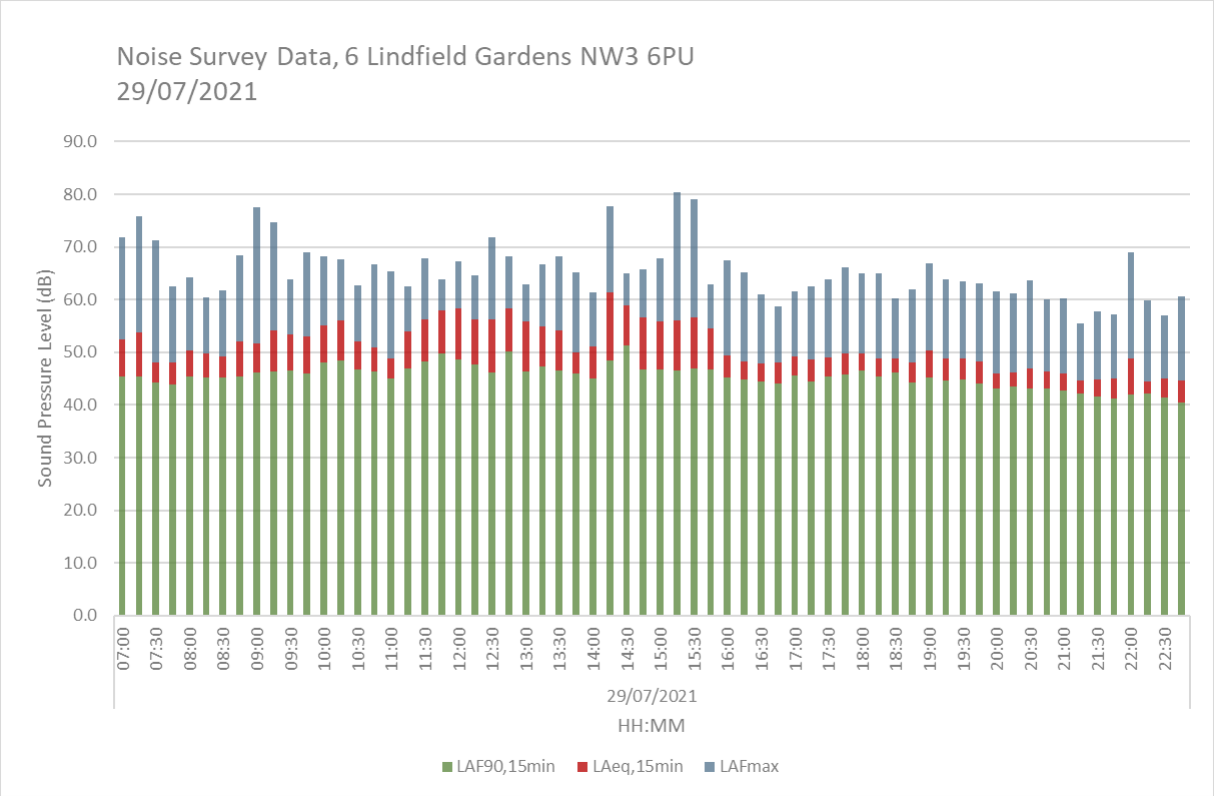

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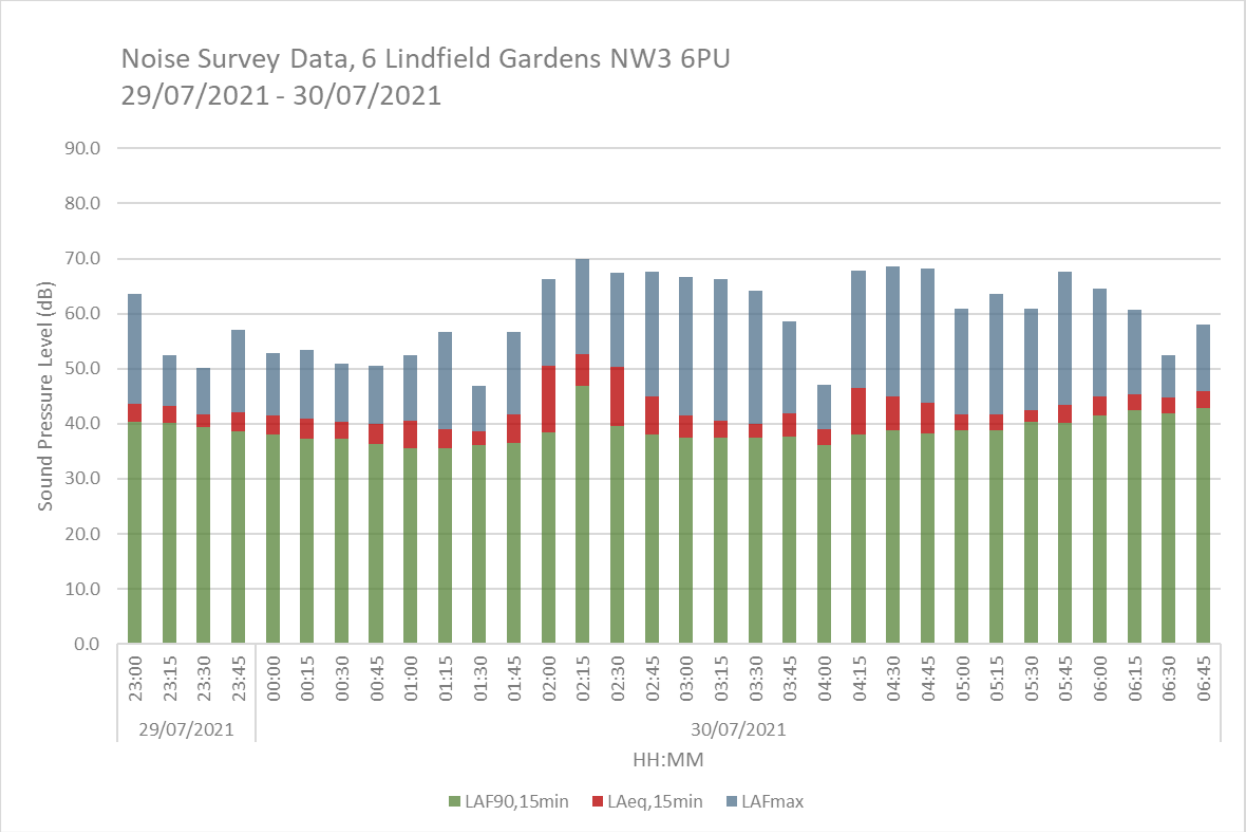
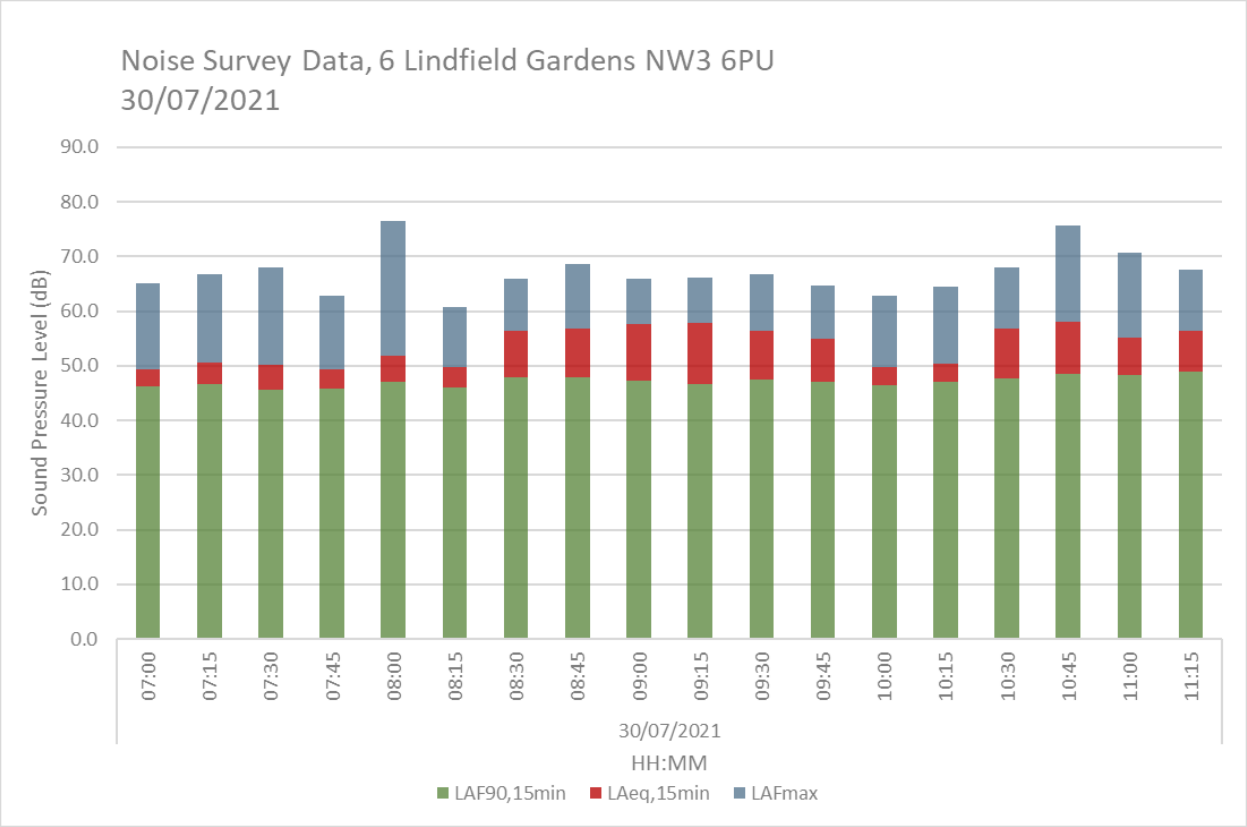
29/07/2021	07:00	52.4	71.9	45.4	51.3	44.8	29/07/2021	15:00	55.8	67.9	46.7	55.8	46.8
	07:15	53.8	75.9	45.4				15:15	56.1	80.3	46.5		
	07:30	48.0	71.3	44.3				15:30	56.6	79.1	47.0		
	07:45	48.1	62.5	43.9				15:45	54.6	62.9	46.8		
	08:00	50.4	64.3	45.4	50.5	45.4		16:00	49.5	67.5	45.3	48.5	44.7
	08:15	49.7	60.4	45.3				16:15	48.2	65.2	44.8		
	08:30	49.2	61.8	45.2				16:30	47.9	61.0	44.4		
	08:45	52.2	68.3	45.5				16:45	48.1	58.7	44.1		
	09:00	51.7	77.6	46.1	53.1	46.2		17:00	49.3	61.5	45.6	49.2	45.4
	09:15	54.1	74.6	46.3				17:15	48.6	62.6	44.5		
	09:30	53.3	63.8	46.6				17:30	49.1	63.8	45.5		
	09:45	53.0	69.0	45.9				17:45	49.8	66.2	45.7		
	10:00	55.0	68.2	48.0	54.0	47.4		18:00	49.7	65.1	46.5	48.9	45.7
	10:15	56.0	67.6	48.4				18:15	48.8	65.1	45.4		
	10:30	52.1	62.7	46.7				18:30	48.9	60.3	46.1		
	10:45	51.0	66.7	46.3				18:45	48.1	61.9	44.3		
	11:00	48.9	65.5	45.0	55.4	47.8		19:00	50.4	66.8	45.2	49.2	44.7
	11:15	54.0	62.5	46.9				19:15	48.8	63.9	44.6		
	11:30	56.3	67.8	48.3				19:30	48.8	63.5	44.8		
	11:45	58.0	63.8	49.7				19:45	48.3	63.1	44.1		
	12:00	58.3	67.4	48.6	57.4	48.4		20:00	46.0	61.6	43.2	46.4	43.3
	12:15	56.3	64.7	47.7				20:15	46.2	61.1	43.6		
	12:30	56.2	71.9	46.1				20:30	46.9	63.7	43.1		
	12:45	58.3	68.2	50.2				20:45	46.3	60.1	43.1		
	13:00	55.9	62.9	46.3	54.2	46.6		21:00	45.9	60.2	42.7	45.1	42.0
	13:15	54.8	66.6	47.4				21:15	44.7	55.5	42.1		
	13:30	54.2	68.3	46.5				21:30	44.8	57.8	41.7		
	13:45	50.1	65.3	46.0				21:45	45.1	57.1	41.2		
	14:00	51.1	61.3	45.1	58.4	48.6		22:00	48.9	69.1	42.0	46.2	41.6
	14:15	61.4	77.8	48.5				22:15	44.5	59.8	42.2		
	14:30	58.9	65.0	51.4				22:30	45.1	57.0	41.5		
	14:45	56.6	65.7	46.7				22:45	44.6	60.6	40.4		



Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$
29/07/2021	23:00	43.7	63.5	40.3
	23:15	43.2	52.4	40.1
	23:30	41.7	50.2	39.4
	23:45	42.1	57.1	38.7
30/07/2021	00:00	41.4	52.8	38.0
	00:15	40.9	53.4	37.3
	00:30	40.3	50.8	37.2
	00:45	39.9	50.4	36.3
	01:00	40.5	52.5	35.5
	01:15	39.1	56.8	35.5
	01:30	38.7	46.9	36.1
	01:45	41.7	56.6	36.5
	02:00	50.6	66.3	38.5
	02:15	52.6	69.9	46.8
	02:30	50.4	67.4	39.6
	02:45	44.9	67.5	38.1
	03:00	41.5	66.7	37.5
	03:15	40.6	66.3	37.4
	03:30	40.0	64.2	37.4
	03:45	42.0	58.6	37.7
	04:00	39.0	47.1	36.2
	04:15	46.5	67.9	38.0
	04:30	44.9	68.5	38.8
	04:45	43.9	68.3	38.3
	05:00	41.7	60.8	38.9
	05:15	41.7	63.6	38.9
	05:30	42.4	60.9	40.4
	05:45	43.3	67.5	40.1
	06:00	45.0	64.5	41.5
	06:15	45.3	60.7	42.4
	06:30	44.8	52.5	41.8
	06:45	45.9	57.9	42.9



Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,1hour}$	$L_{AF90,1hour}$
30/07/2021	07:00	49.4	65.2	46.2	49.9	46.1
	07:15	50.5	66.7	46.6		
	07:30	50.2	68.0	45.7		
	07:45	49.3	62.9	45.8		
	08:00	51.8	76.5	47.1	54.6	47.3
	08:15	49.7	60.7	46.1		
	08:30	56.3	66.0	48.0		
	08:45	56.8	68.7	47.9		
	09:00	57.6	65.9	47.3	56.8	47.1
	09:15	57.9	66.1	46.6		
	09:30	56.3	66.7	47.4		
	09:45	54.9	64.7	47.0		
	10:00	49.8	62.9	46.5	55.2	47.5
	10:15	50.3	64.6	47.0		
	10:30	56.8	68.0	47.7		
	10:45	58.0	75.7	48.6		
	11:00	55.1	70.8	48.3	55.8	48.7
	11:15	56.3	67.7	49.0		

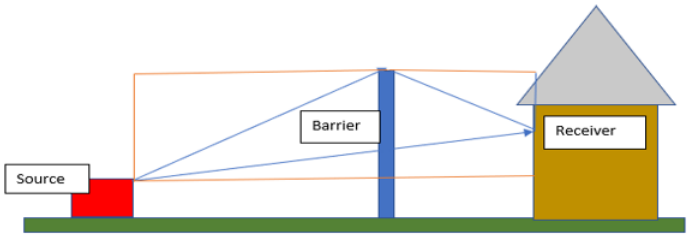
APPENDIX D – Calculations

4A Lindfield Gardens

Pump 1 Barrier Attenuation Calculation

Applicable where barrier breaks line of sight between source and receiver

Example Illustration of Barrier Attenuation



		Metres
Source to Barrier		2
Receiver to Barrier		3
Source to Receiver		5

Path Difference	0

Frequency Hz	63	125	250	500	1000	2000	4000	8000
Barrier Correction	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8

Overall Partial Barrier Attenuation (500Hz) = 5dB

Level distance given a LPA @ a distance (Assumes point source and Hemispherical)

(Pressure Calculations)

LPA = 53 dB at distance of = 1 metre

dB level a 5 metres = 39.0 dB

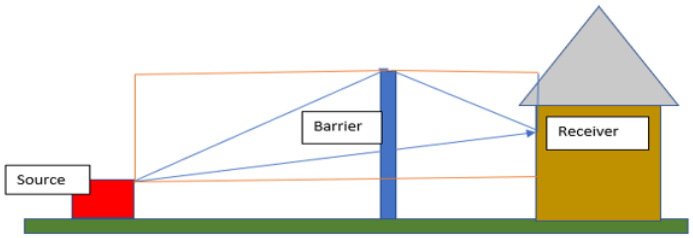
Formula = $L_{PA1} = L_{PA2} - 20 \text{ Log } (d_1/d_2)$

Pump 1 Sound Pressure Level @ 5m – Partial Barrier Attenuation (5dB) = 34dB $L_{Aeq,T}$

Pump 2 Barrier Attenuation Calculation

Applicable where barrier breaks line of sight between source and receiver

Example Illustration of Barrier Attenuation



		Metres
Source to Barrier 1		3
Barrier 1 to Barrier 2		15
Receiver to Barrier 2		6.5
Source to Receiver		22

Path Difference	2.5

Frequency Hz	63	125	250	500	1000	2000	4000	8000
Barrier Correction	13.3	16.0	18.8	21.7	24.7	27.7	30.7	33.7

Overall Barrier Attenuation (500Hz) = 22dB

Level distance given a LPA @ a distance (Assumes point source and Hemispherical)

(Pressure Calculations)

LPA = **53** dB at distance of = **1** metre

dB level a **22** metres = **26.2** dB

Formula = $L_{PA1} = L_{PA2} - 20 \text{ Log } (d_1/d_2)$

Pump 2 Sound Pressure Level @ 22m – Barrier Attenuation (22dB) = 4dB $L_{Aeq,T}$

Adding dB

Levels to be added (Max. of eight)

Enter values	34	4	0	0	0	0	0	0

Total = **34.0** dB

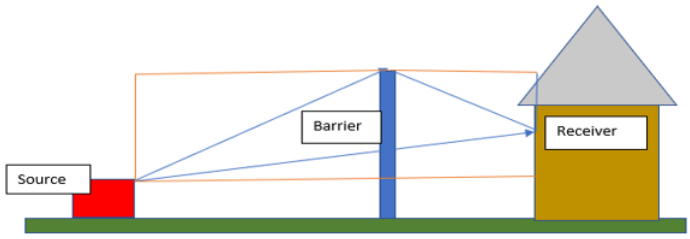
Cumulative Sound Pressure Level @ 4A Lindfield Gardens = 34dB $L_{Aeq,T}$

8A Lindfield Gardens

Pump 1 Barrier Attenuation Calculation

Applicable where barrier breaks line of sight between source and receiver

Example Illustration of Barrier Attenuation



		Metres
Source to Barrier 1		2
Barrier 1 to Barrier 2		15
Receiver to Barrier 2		4.5
Source to Receiver		19

Path Difference	2.5

Frequency Hz	63	125	250	500	1000	2000	4000	8000
Barrier Correction	13.3	16.0	18.8	21.7	24.7	27.7	30.7	33.7

Overall Barrier Attenuation (500Hz) = 22dB

Level distance given a LPA @ a distance (Assumes point source and Hemispherical)

(Pressure Calculations)

LPA = 53 dB at distance of = 1 metre

dB level a 19 metres = 27.4 dB

Formula = $L_{PA1} = L_{PA2} - 20 \text{ Log } (d_1/d_2)$

Pump 1 Sound Pressure Level @ 19m – Barrier Attenuation (22dB) = 5dB $L_{Aeq,T}$

Level distance given a LPA @ a distance (Assumes point source and Hemispherical)

(Pressure Calculations)

LPA = 53 dB at distance of = 1 metre

dB level a 2.5 metres = 45.0 dB

Formula = $L_{PA1} = L_{PA2} - 20 \text{ Log } (d_1/d_2)$

Pump 2 Sound Pressure Level @ 2.5m = 45dB $L_{Aeq,T}$

Adding dB								
	Levels to be added	(Max. of eight)						
Enter values	5	45	0	0	0	0	0	0
	Total =	**45.0** dB						

Cumulative Sound Pressure Level @ 8A Lindfield Gardens = 45dB $L_{Aeq,T}$