Noise Impact Assessment

The Bird in Hand, Kilburn

Reference: 50-785-R1-1

Date: January 2023

NOISE IMPACT ASSESSMENT

The Bird in Hand
Kilburn

Prepared for:

KK4 Limited

Report Ref: 50-785-R1-1
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EXECUTIVE SUMMARY

BACKGROUND

Site Address	Bird in Hand, West End Lane, Kilburn NW6 1XL
National Grid Reference	E 525449 N 183779398547
Proposed Development	The proposal comprises refurbishment of a three-storey pub (1 unit) including a basement and 9 newly built apartments with communal Air Source Heat Pumps.
Report Objectives	To identify, measure and assess the potential impact of the proposed Air Source Heat Pumps on existing and proposed residential receptors in the immediate vicinity of the Site. The report follows current and relevant British Standards in order to provide a robust assessment.

ASSESSMENT

Surveys Completed	An unattended background and ambient sound survey has been undertaken out of an existing 1st floor window in order to quantify baseline levels of noise at the site and representative of existing receptors. The survey was conducted over a full weekday and weekend period.
Assessments	E3P has undertaken detailed 3D noise modelling of all the proposed sources in order to predict noise levels at rear gardens and facades of existing and proposed receptors for the daytime and night-time periods, in accordance with BS 4142:2014+A1:2019. Consideration has also been given to the MSC Assessment.
Mitigation Requirements	The assessment has shown that the predicted the rating level exceeds the background sound level during the night-time period at the closest receptors. As such, two options have been provided; 1: acoustic barriers on the roof, assuming higher sound power levels, or 2: quieter ASHP models of 58 dB L_w or less to negate the need for mitigation measures. Where barriers are needed, these will be approximately 1 m to 1.8 m in height but will be depending on the actual sound power levels of the ASHPs.

CONCLUSIONS

This assessment has shown that, with the proposed site in operation, there should be no adverse impact upon existing residential receptor as long as guidance is followed on the selection of the ASHPs or allowance is given for mitigation to the ASHPs.

As such, noise should not be a determining factor in the determination of the planning application.

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1. INTRODUCTION

1.1. BACKGROUND

E3P were commissioned by KK4 Limited to undertake a Noise Impact Assessment for the installation of Air Source Heat Pumps (ASHP) as part of a proposed residential development at the Bird in Hand, West End Lane, Kilburn, to be referred to hereafter as '*the site*'.

This assessment looks to determine the key noise sources associated with the development and undertake an assessment of any impacts upon existing noise sensitive receptors.

1.2. PROPOSED DEVELOPMENT

The Site is located within a residential area of Kilburn. The proposal comprises refurbishment of a three-storey pub (1 unit) including a basement and 9 newly built apartments. The development is located in the London Borough of Camden with a total NIA of approximately 770 sqm. A spart of the development, 10No. ASHPs are proposed on the roof of the new apartment block. These items of plant have the potential to adversely effect existing and proposed receptors.

The assessment has been undertaken in accordance with the following planning drawings:

- Proposed Roof Plan (2019-008_PL2106 Rev B) dated 23rd January 2023.

1.3. LIMITATIONS

Where a noise or vibration survey is required to inform an assessment, E3P will endeavour to ensure that all noise and vibration measurements taken are robust, representative and reliable in order to inform an accurate assessment at the time.

E3P will endeavour to capture all existing and proposed sources of sound and vibration at the time of the surveys and/or assessments. However, should new sources of sound be introduced, existing sources modified/changed, or characteristics of the sound be altered following completion of such, E3P cannot be held accountable for this.

Where mitigation measures are specified in this report, it should be noted that these measures are relative to a specific sound or vibration source, both in terms of the measured sound pressure and vibration level and the character of the sound source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, E3P cannot be held responsible for any subsequent variations in the proposed mitigation performance, for either absolute levels or frequency content.

2. ASSESSMENT METHODOLOGY

2.1. NATIONAL PLANNING POLICY FRAMEWORK

To prevent unacceptable risks from pollution, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be considered.
The national planning policy framework states that planning policies and decisions should 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 noise 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.
- 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.

2.2. NATIONAL PLANNING PRACTICE GUIDANCE

Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

Local planning authorities' plan-making and decision-making should take account of the acoustic environment and in doing so consider:

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

In line with the explanatory note of the NPSE, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase, where applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

The "observed effect levels" are as follows:

- **Significant observed adverse effect level:** This is the level of noise exposure above which significant adverse effects on health and quality of life occur.
- **Lowest observed adverse effect level:** This is the level of noise exposure above which adverse effects on health and quality of life can be detected.
- **No observed effect level:** This is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Table 2.1 summarises the noise exposure hierarchy, based on the likely average response.

TABLE 2.1 NOISE EXPOSURE HIERARCHY

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, or having to close windows for some of the time because of the noise where there is no alternative ventilation. 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, having to keep windows closed most of the time because of the noise where there is no alternative ventilation. 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 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 (auditory and non-auditory).	Unacceptable adverse effect	Prevent

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any situation. These factors include the following:

- The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day. The adverse effect can also be greater simply because there is less background noise at night.
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise can be important.
- The spectral content of the noise and the general character of the noise. The local topology and topography should also be considered along with the existing and, where appropriate, the planned character of the area.

More specific factors to consider when relevant:

- Where applicable, the cumulative impacts of more than one source should be considered along with the extent to which the source of noise is intermittent and of limited duration.
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases, a suitable alternative means of ventilation is likely to be necessary.
- If external amenity spaces are an intrinsic part of the overall design, then the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.3. BS 4142: 2014+A1:2019 'METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND'

This standard describes methods for rating and assessing sound of an industrial or commercial nature which includes:

- Sound from industrial and manufacturing processes.
- Sound from fixed installations which comprise mechanical and electrical plant and equipment.
- Sound from the loading and unloading of goods and materials at industrial and / or commercial premises; and
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from processes or premises, such as that from forklift trucks, or that from train or ship movements on or around an industrial or commercial Site.

The procedure detailed in the standard compares the measured or predicted specific noise level from any of the above with the background sound level at a residential dwelling. The measured background sound level at a receptor should be reliable and should not necessarily ascertain a lowest measured background sound level, but rather to quantify what is typical.

The specific noise level also acknowledges the reference time intervals depending upon whether the noise source operates during daytime (1-hour) or night-time (15-minute) periods.

There are several 'penalties' which can be attributed to the specific sound level depending upon the 'acoustic features' of the sound level under investigation as follows:

Tonality

- +2 dB: where the tonality is just perceptible.
- +4 dB: where the tonality is clearly perceptible; and
- +6 dB: where the tonality is highly perceptible.

Impulsivity

- +3 dB: where the impulsivity is just perceptible.
- +6 dB: where the impulsivity is clearly perceptible; and
- +9 dB: where the impulsivity is highly perceptible.

Intermittency

- +3dB: where the intermittency is readily distinctive against the acoustic environment.

In addition to the above, there is a penalty for 'other sound characteristics' of +3 dB where a sound exhibits characteristics that are neither tonal nor impulsive, though are readily distinctive against the acoustic environment. BS 4142 goes on to state that the rating level is equal to the specific sound level if there are no such features present or expected to be present.

Assessment of the rating level relative to the background sound level can yield the following commentary:

- Typically, the greater this difference (between the rating level and the background sound level), the greater the magnitude of 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 the context; and
- 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. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

It is common that a Local Planning Authority (LPA) will specify their own criterion and, where this is the case, this criterion will usually take precedence over a simple comparison of the rating level against the background sound level.

3. SURVEY RESULTS

3.1. UNATTENDED BACKGROUND AND AMBIENT SOUND SURVEY

E3P have undertaken an unattended background and ambient sound survey in a position out of an existing 1st floor window of the Bird in Hand over a full weekday and weekend period. The survey was conducted over the following time period:

- 12:00 Friday 27th January to 13:00 Monday 30th January 2023.

The following noise measurement position was chosen for the Background Sound Survey:

- Noise Measurement Position 1 (NMP1): Located out of the south east facing 1st floor window of the Bird in Hand, in façade conditions, 1 m from the facade. Sound sources consisted of road traffic on the local road network and distant rail traffic.

Table 3.1 details the range of measured background sound levels and statistical levels for the purposes of the BS 4142 assessment. Daytime levels correspond to hourly time periods and night-time to the 15-minute level. Full hourly dataset is available in Appendix II.

TABLE 3.1 MEASURED BACKGROUND SOUND PRESSURE LEVELS

DATE	TIME PERIOD	RANGE OF MEASURED BACKGROUND SOUND LEVELS, $L_{A90,T}$ (dB)	MODAL MEASURED BACKGROUND SOUND LEVEL, $L_{A90,T}$ (dB)
Friday 27th January 2023	Daytime	41.4-44.7	44
	Night-time	32.2-41.2	34
Saturday 28th January 2023	Daytime	36.7-42.5	38
	Night-time	34.0-37.7	36
Sunday 29th January 2023	Daytime	38.0-43.7	42
	Night-time	34.9-41.6	37

To inform the assessment, the modal background sound level over all night-time periods has been used. It is considered that all ASHPs could operate at night and, as such, the assessment will be based on this quieter period. The modal background sound level is noted to be 36 dB.

During the survey, conditions remained dry and wind speeds rarely exceeded 10 mph.

The equipment outlined in Table 3.2 was used for the noise survey.

TABLE 3.2 NOISE MEASUREMENT EQUIPMENT AND CALIBRATION DATES

MEASUREMENT POSITION	EQUIPMENT DESCRIPTION	MANUFACTURER & TYPE NUMBER	SERIAL NUMBER	CALIBRATION DUE DATE
NMP1	Sound Level Meter	01dB Fusion	12039	30th June 2023
	Pre-amplifier	01dB Pre22	1805124	
	Microphone	GRAS 40CE	330832	
	Calibrator	01dB Cal31	87281	18th January 2024

The sound level meter was field calibrated on site using the above-mentioned calibrator prior to and after noise measurements were taken. No significant drift was witnessed as noted above. Calibration certificates are available upon request.

4. NOISE IMPACT ASSESSMENT

At the time of submission, noise level information or model data for the ASHP was not available. Accordingly, E3P have carried out research on typical models and, namely, referred to 'Acoustic Noise Measurements of Air Source Heat Pumps' commissioned by the Department of Energy & Climate Change in 2011.The study involved measurements of multiple different models and provided calculated sound power levels and tonal analysis of ten separate units.

Accordingly, E3P have taken the average sound power level for the measured units, discounting a unit that is much quieter than the other nine. This resulted in a predicted sound power level of 65 dB for each ASHP. Each ASHP is inputted as a point source at a height of 0.5 m to represent the centre of the fan unit.

With regard to assumptions for the assessment, the following has been considered:

- Ground elevations have been taken as existing by way of a 2 m grid Digital Terrain Model (DTM) which contains public sector information licensed under the Open Government License v3.0.
- Ground absorption is set at 0.5.
- A reflection order of 1 is used.
- Noise levels generated using ISO 9613-1 and ISO 9613-2 "*Acoustics – Attenuation of sound during propagation outdoors*" as incorporated into CadnaA software.

For the BS 4142:2014+A1:2019 assessments, penalties are applied to the specific sound level in order to provide the rating level. These penalties relate to the acoustic features of the sound source. Accordingly, the following objective features have been accounted for in the assessment, in accordance with the objective method detailed in BS 4142:2014+A1:2019, for the units as a whole operation.

TABLE 4.1 ACOUSTIC PENALTIES

SOURCE	CHARACTERISTIC	ATTRIBUTABLE PENALTY	COMMENT
ASHP	Tonality	2 dB	Given the units are new, tonal elements are unlikely but upon review of the research available, a correction of 2 dB is considered robust.
	Impulsivity	-	No impulsivity is expected
	Intermittency	-	No intermittency is expected
	Other Sound Characteristics	-	Other penalties applied.

As well as the BS 4142 assessment, consideration is also given to the Microgeneration Installation Standard (MCS 020) 'MCS Planning Standards for Permitted Development Installations of Wind Turbines and Air Source Heat Pumps on Domestic Premises'. This provides a method to calculate the sound pressure level resultant from air source heat pumps and sets a criterion of 42 dB.

4.1. MCS ASSESSMENT

The standard provides a methodology to predict noise levels at receptors, via a ten-step process. However, as 3D noise modelling has been used the predicted sound pressure levels are given as an output of the noise model and, as such, the assessment can begin at step 6 'Calculate sound pressure level from the heat pump at the assessment position'. As can be seen in Figure 2, the highest predicted façade rating level is predicted to be 43 dB at facades to the immediate north east. However, this assessment does not require the addition of penalties and, as such, the 2 dB tonal correction is removed.

TABLE 4.2 MCS ASSESSMENT

STEPS	INSTRUCTIONS	RESULTS
6	Calculate sound pressure level at receptor	41 dB(A)
7	Background noise level. For the purposes of the MCS Planning Standard for air source heat pumps, the background noise level is assumed to be 40 dB(A) L_P.	40 dB(A)
8	Determine the difference between STEP 7 background noise level and the heat pump noise level	-1 dB(A)
9	Using the table to obtain an adjustment figure and then add this to whichever is the higher dB figure from STEP 6 and STEP 7. Round to nearest whole number.	44
10	Is the FINAL RESULT in STEP 9 equal to or lower than the permitted development noise limit of 42.0 dB(A)?	**No**

The MCS Assessment has determined a non-compliance with the 42 dB limit and, as such, would not be considered permitted development and has the potential for adverse impact.

4.2. BS 4142 ASSESSMENT

Table 4.3 details the resultant rating level at each receptor, output from the model. The grid noise map can be seen in Figure 2 of Appendix II and details the locations of the assessed receptors.

The modal measured background sound level during night-time periods has been used, specifically 36 dB. This informs a worst-case assessment. Levels correspond to worst case façade noise levels at all floors.

TABLE 4.3 BS 4142:2014+A1:2019 ASSESSMENT

RECEPTOR	PREDICTED RATING LEVEL, $L_{A,r}$ (dB)	BACKGROUND SOUND LEVEL, $L_{A90,15mins}$ (dB)	CRITERION, $L_{A90} = L_{A,r}$ (dB)	DIFFERENCE +/- (dB)
R1 – Retained Dwelling	38	36	36	**+2**
R2 – Holmesdale House	43	36	36	**+7**
R3 – Ribblesdale House	32	36	36	-4
R4 – Marshwood House	34	36	36	-2
R5 – Lorton House	32	36	36	-4
R6 – Bishopsdale House	37	36	36	**+1**
R7 – West End Lane	36	36	36	0

Table 4.3 indicates that the predicted rating level would exceed the background sound level at the retained dwelling on site, Holmesdale House and Bishopdale House during night-time periods.

As such, it is recommended that mitigation measures are installed, on the assumption of the ASHP having a sound power level of 65 dB $L_{W.}$

5. PLANT NOISE EMISSION LIMITS

The above assessment is based on assumptions of noise levels of typical ASHPs. At the procurement stage of the ASHPs, it is recommended that reference be made to the below limits, based on the existing background sound levels at the receptors.

The **combined rating level from all ASHPs must not exceed 36 dB at the closest existing or proposed receptors**.

This translates to a **maximum allowable sound power level of 58 dB L_W of each individual ASHP.**

Where the expected sound power level is to exceed the above, an acoustic enclosure will be necessary to reduce noise levels at the receptors, as shown in Sections 4.1 and 4.2. If this is the case, an updated Noise Assessment will be required.

6. MITIGATION MEASURES

Section 4.2 determined an exceedance of up to 7 dB at nearby receptors on the assumption of the average sound power level of 65 dB for each unit. Where the actual sound power level is lower, an updated assessment is required. Furthermore, as shown in Section 5.0, where sound power levels are 58 dB or less for each unit, no mitigation measures would be needed.

Nevertheless, this section recommends appropriate mitigation based on the assumptions of this report. As such, acoustic barriers on the roof are needed partially around the ASHP area.

An additional noise model has been run, Figure 3, detailing the resultant rating level with the following barriers in place:

- 1.8 m high barrier running from the centre of the ASHP area, across to the north east edge, along the north western edge and down to the corner of the roof.
- 1 m high barrier from the above across to the north west corner.

The above heights are relative to the building height and exact locations are indicative and subject to minor changes depending on the roof structure, etc. Any barrier installed must be sealed at the base, be free from holes and have a minimum mass of 10 kg/m^2.

An alternative to the above, will be the sourcing of quieter models, with sound power levels of less than 58 dB L_W.

7. CONCLUSION AND RECOMMENDATIONS

E3P were commissioned by KK4 Limited to undertake a Noise Impact Assessment for the retrospective planning application for the installation of ASHPs a top a residential building on West End Lane in Kilburn.

This assessment looked to determine the key noise sources associated with the development and undertake an assessment of any impacts upon existing noise sensitive receptors.

An unattended background and ambient sound survey has been undertaken in order to capture worst case baseline noise levels.

E3P has undertaken detailed 3D noise modelling of all the proposed sources in order to predict noise levels at habitable room windows of existing and proposed receptors, in accordance with BS 4142:2014+A1:2019, at the closest receptors to the site. Consideration to the MCS Assessment for ASHPs has also been given.

The assessment has shown that the predicted the rating level exceeds the background sound level during the night-time period at the closest receptors. As such, two options have been provided; 1: acoustic barriers on the roof, assuming higher sound power levels, or 2: quieter ASHP models of 58 dB L_w or less to negate the need for mitigation measures.

Where barriers are needed, these will be approximately 1 m to 1.8 m in height but will be depending on the actual sound power levels of the ASHPs.

This assessment has shown that, with the proposed site in operation, there should be no adverse impact upon existing residential receptor as long as guidance is followed on the selection of the ASHPs or allowance is given for mitigation to the ASHPs.

As such, noise should not be a determining factor in the determination of the planning application.

END OF REPORT

APPENDIX I
GLOSSARY OF ACOUSTIC TERMINOLOGY

NOISE

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) 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 but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates 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.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be 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 some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. 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 best 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 L_{Aeq}, L_{A90} 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) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions. An indication of the range of sound levels commonly found in the environment is given in the following table.

TABLE A1 TYPICAL SOUND PRESSURE LEVELS

SOUND PRESSURE LEVEL	LOCATION/EXAMPLE
0	Threshold of hearing
20–30	Quiet bedroom at night
30–40	Living room during the day
40–50	Typical office
50–60	Inside a car
60–70	Typical high street
70–90	Inside a factory
100–110	Burglar alarm at 1 m away
110–130	Jet aircraft on take off
140	Threshold of pain

ACOUSTIC TERMINOLOGY

TABLE A2 TERMINOLOGY

DESCRIPTOR	EXPLANATION
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2E-05 Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. "A" weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the "fast" sound level meter response.
L_{10} and L_{90}	If a non-steady noise is to be described, it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the "average maximum level". Similarly, L_{90} is the "average minimum level" and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally, as measured outside and away from buildings.
Fast	A time weighting used in the root-mean-square section of a sound level meter with a 125-millisecond time constant.
Slow	A time weighting used in the root-mean-square section of a sound level meter with a 1000-millisecond time constant.

APPENDIX II
MEASURED SOUND PRESSURE LEVELS

TABLE A.1 HOURLY MEASURED BACKGROUND AND AMBIENT SOUND LEVELS

MEASUREMENT START TIME	MEASURED SOUND PRESSURE LEVEL, $L_{Aeq,1hr}$ (dB)	MEASURED BACKGROUND SOUND LEVEL, $L_{A90,1hr}$ (dB)
27/01/2023 12:00	51.4	44.3
27/01/2023 13:00	49.4	44.0
27/01/2023 14:00	49.1	43.1
27/01/2023 15:00	53.9	43.8
27/01/2023 16:00	48.9	43.0
27/01/2023 17:00	51.1	43.3
27/01/2023 18:00	48.9	43.6
27/01/2023 19:00	50.6	44.7
27/01/2023 20:00	50.7	44.0
27/01/2023 21:00	48.3	43.2
27/01/2023 22:00	47.3	41.4
27/01/2023 23:00	46.0	40.3
28/01/2023 00:00	43.4	37.3
28/01/2023 01:00	43.8	35.3
28/01/2023 02:00	41.6	33.7
28/01/2023 03:00	41.4	33.5
28/01/2023 04:00	47.0	33.0
28/01/2023 05:00	46.6	33.7
28/01/2023 06:00	46.1	35.5
28/01/2023 07:00	47.2	38.0
28/01/2023 08:00	49.7	39.4
28/01/2023 09:00	47.9	40.6
28/01/2023 10:00	45.8	40.3
28/01/2023 11:00	48.7	41.8
28/01/2023 12:00	49.6	42.5
28/01/2023 13:00	48.1	41.3
28/01/2023 14:00	50.3	41.2
28/01/2023 15:00	47.3	40.9
28/01/2023 16:00	48.2	41.2
28/01/2023 17:00	48.2	40.8
28/01/2023 18:00	48.9	40.3
28/01/2023 19:00	47.1	39.9
28/01/2023 20:00	46.0	38.7

MEASUREMENT START TIME	MEASURED SOUND PRESSURE LEVEL, $L_{Aeq,1hr}$ (dB)	MEASURED BACKGROUND SOUND LEVEL, $L_{A90,1hr}$ (dB)
28/01/2023 21:00	46.0	38.0
28/01/2023 22:00	44.4	36.7
28/01/2023 23:00	43.5	36.6
29/01/2023 00:00	43.4	36.4
29/01/2023 01:00	40.8	35.3
29/01/2023 02:00	39.3	34.4
29/01/2023 03:00	45.1	35.8
29/01/2023 04:00	45.8	35.4
29/01/2023 05:00	44.9	36.0
29/01/2023 06:00	46.8	36.9
29/01/2023 07:00	45.2	38.0
29/01/2023 08:00	49.2	38.9
29/01/2023 09:00	46.8	40.5
29/01/2023 10:00	46.1	41.7
29/01/2023 11:00	46.0	41.8
29/01/2023 12:00	47.3	43.4
29/01/2023 13:00	51.3	43.7
29/01/2023 14:00	49.2	43.3
29/01/2023 15:00	48.7	43.4
29/01/2023 16:00	48.4	42.9
29/01/2023 17:00	48.9	43.6
29/01/2023 18:00	48.1	43.2
29/01/2023 19:00	49.4	42.7
29/01/2023 20:00	46.3	41.9
29/01/2023 21:00	46.2	41.8
29/01/2023 22:00	45.3	41.3
29/01/2023 23:00	44.8	40.5
30/01/2023 00:00	41.9	37.9
30/01/2023 01:00	44.9	37.1
30/01/2023 02:00	43.2	35.2
30/01/2023 03:00	56.1	35.8
30/01/2023 04:00	48.5	36.5
30/01/2023 05:00	48.5	38.1
30/01/2023 06:00	46.7	40.4

MEASUREMENT START TIME	MEASURED SOUND PRESSURE LEVEL, $L_{Aeq,1hr}$ (dB)	MEASURED BACKGROUND SOUND LEVEL, $L_{A90,1hr}$ (dB)
30/01/2023 07:00	50.2	44.2
30/01/2023 08:00	50.0	45.2
30/01/2023 09:00	50.9	44.1
30/01/2023 10:00	55.8	44.8
30/01/2023 11:00	51.6	44.7

APPENDIX III
FIGURES

Figure 1 - Noise Survey Measurement Positions

Project:
Bird in Hand, Kilburn

Project-No:
50-785

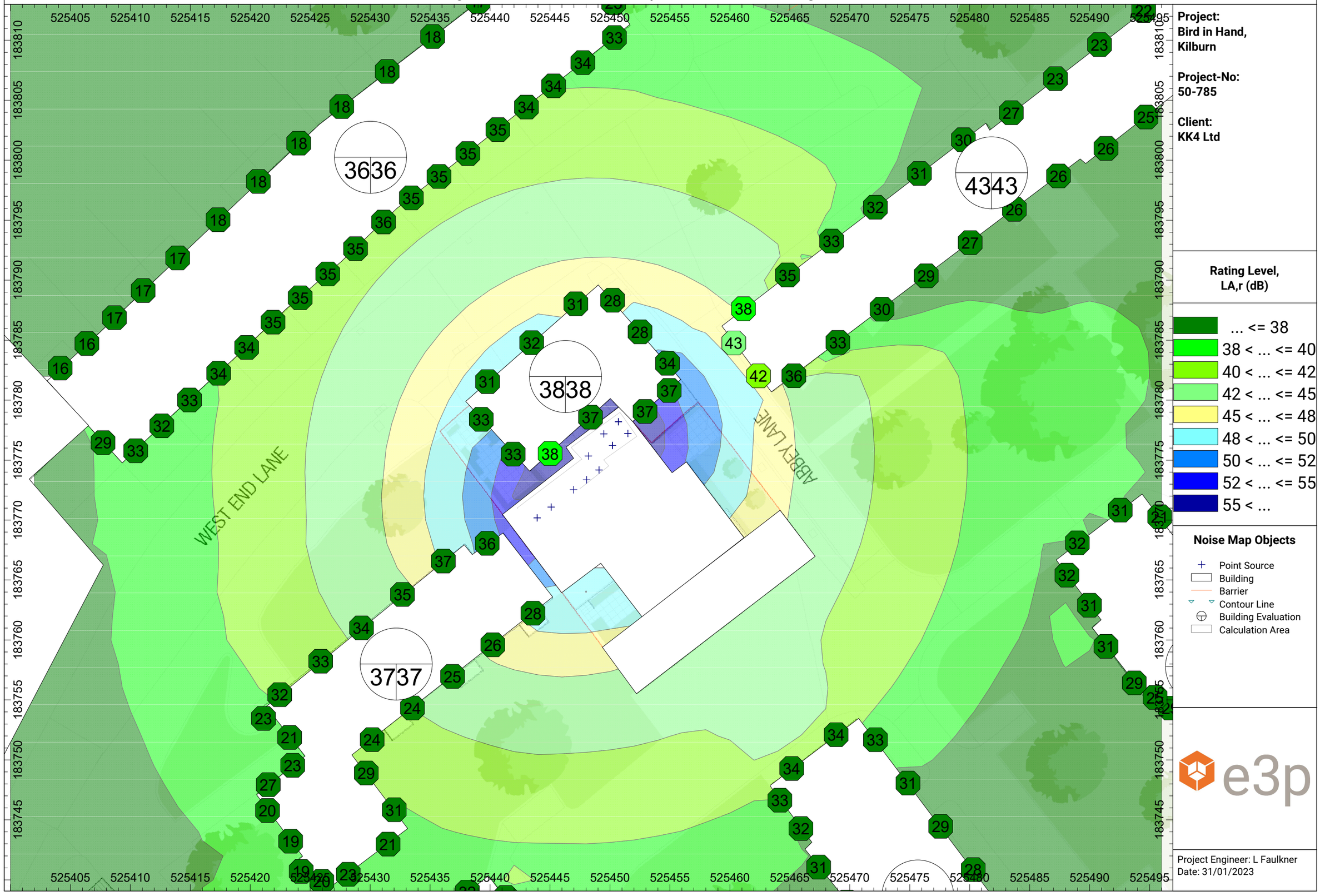
Client:
KK4 Ltd

N

e3p

Project Engineer: L Faulkner
Date: 31/01/2023

Figure 2 - ASHP Sound Grid Noise Map - Calculation at 10m above ground level



Project:
Bird in Hand, Kilburn

Project-No:
50-785

Client:
KK4 Ltd

Rating Level, LA,r (dB)

- ... <= 38
- 38 < ... <= 40
- 40 < ... <= 42
- 42 < ... <= 45
- 45 < ... <= 48
- 48 < ... <= 50
- 50 < ... <= 52
- 52 < ... <= 55
- 55 < ...

Noise Map Objects

- Point Source
- Building
- Barrier
- Contour Line
- Building Evaluation
- Calculation Area

e3p

Project Engineer: L Faulkner
Date: 31/01/2023

Figure 3 - ASHP Sound with Barriers Grid Noise Map - Calculation at 10m above ground level

Project:
Bird in Hand, Kilburn

Project-No:
50-785

Client:
KK4 Ltd

Rating Level, LA,r (dB)

- ... <= 38
- 38 < ... <= 40
- 40 < ... <= 42
- 42 < ... <= 45
- 45 < ... <= 48
- 48 < ... <= 50
- 50 < ... <= 52
- 52 < ... <= 55
- 55 < ...

Noise Map Objects

- Point Source
- Building
- Barrier
- Contour Line
- Building Evaluation
- Calculation Area

e3p

Project Engineer: L Faulkner
Date: 31/01/2023