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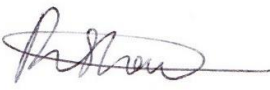
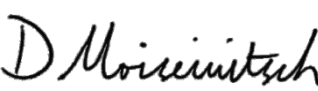
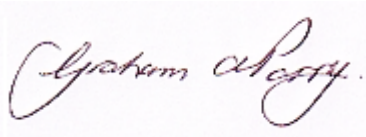
Rainsford Ltd

36A + 38B Church Street, Caversham,
Reading, RG4 8AU

Noise Impact Assessment

Status: Final

Date: 06.12.2022

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Date	06.12.2022
Version Number	A4682/N/006
Status	Final

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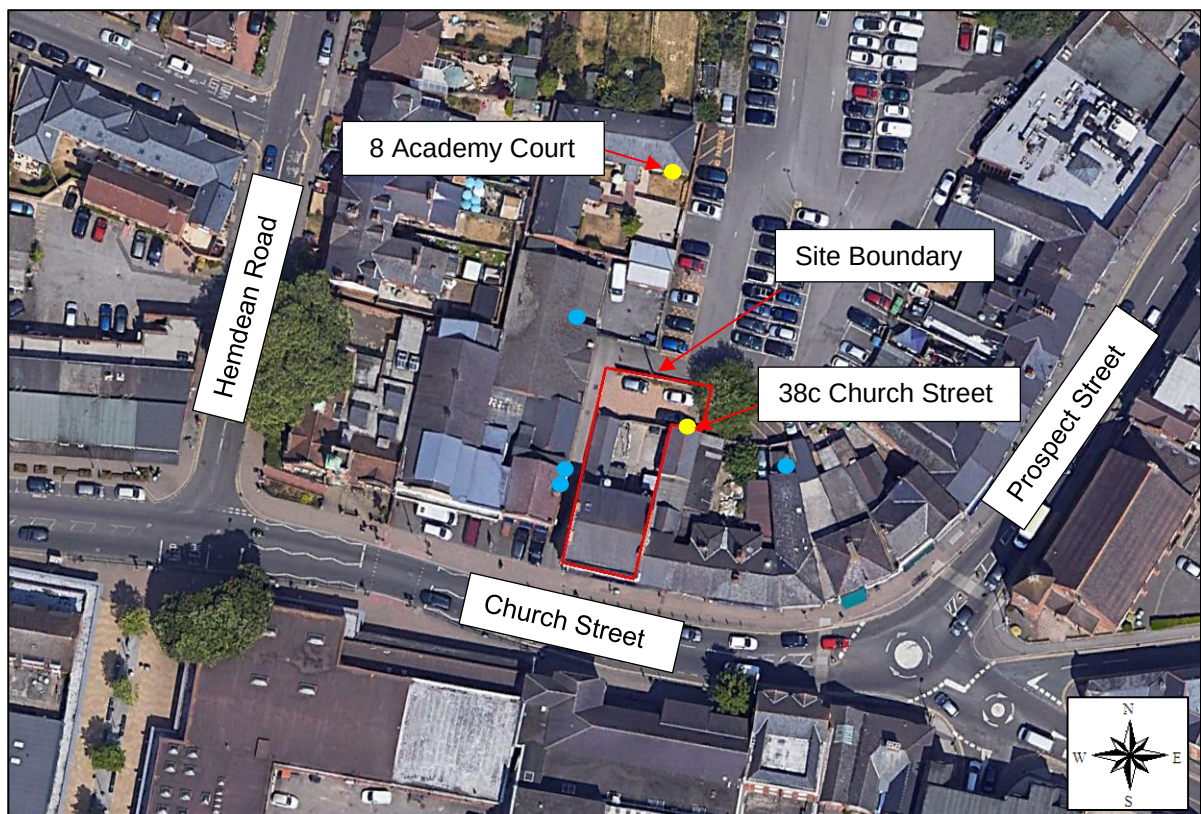
1. INTRODUCTION

ACCON UK Limited (ACCON) has been commissioned by Rainsford Ltd to provide a noise assessment for the proposed development at 36A + 38B Church Street, Caversham, Reading, RG4 8AU. The noise assessment is required for the enhancement of the existing shopfront premises, conversion of an existing seven bedroom flat into three apartments (two one-bedroom apartments on the first floor and a two bedroom apartment on the second floor) and the erection of one Town Houses following the demolition of the single storey rear extension. It is understood that the proposed development will include an Air Source Heat Pump located on the north façade and at ground level.

The site is located within the administrative boundary of Reading Borough Council (RBC).

The site location is identified in **Figure 1.1**. Existing air conditioning units on adjacent premises and the nearest Noise Sensitive Receptors (NSRs) are also identified.

Figure 1.1: Site Layout Plan



Key: ● Air conditioning units ● NSR

The site is situated within a mixed retail and residential area. To the south of the site boundary is Church Street and to the north of the site is a public carpark and the rear of the surrounding retail units. The proposed site plans are provided in **Figure F.1** to **Figure F.45**.

This noise assessment is required to determine the impact of existing noise sources on the proposed residential development. Where appropriate recommendation for noise mitigation is provided.

2. THE NATURE, MEASUREMENT AND EFFECT OF NOISE

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to characterise the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB (A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels, for example, from 60 dB (A) to 70 dB (A), would represent a doubling in 'loudness'. Similarly, a decrease in noise, for example, from 70 dB (A) to 60 dB (A), would represent a halving in 'loudness'. A change of 3 dB (A) is generally considered to be just perceptible¹. **Table 2.1** details typical noise levels.

Table 2.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

A glossary of acoustic terminology is provided in **Appendix 1**.

¹ Institute of Environmental Management and Assessment (2014). Guidelines for environmental noise impact assessment.
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3. NOISE ASSESSMENT CRITERIA

In order to determine the potential constraints on the site in respect to noise, it is necessary to consider the proposed lane use in line with planning policy where it is related to noise.

3.1. National Planning Policy Framework

The revised National Planning Policy Framework (NPPF as amended in July 2021) supersedes the 2012, 2018 and 2019 versions of the NPPF. The purpose of the planning system is to contribute to the achievement of sustainable development. There are three dimensions to sustainable development: economic, social and environmental. The environmental role is to contribute to protecting and enhancing our natural, built and historic environment; and as part of this, make effective use of land, help to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate to adapt to climate change including moving to a low carbon economy.

One of the core planning principles is to contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser value, where consistent with other policies in the Framework. The planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.

Paragraph 185 of the NPPF states:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- a) Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life (see Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food and Rural Affairs, 2010));*
- b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”*

Additionally, Paragraph 187 states:

“Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.”

3.2. Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) aims to “*through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life”.*

Based on concepts from toxicology, it introduces three ‘Effect Levels’ relevant to the assessment of noise. These are:

- **NOEL: No Observed Effect Level:** This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise;
- **LOAEL: Lowest Observed Adverse Effect Level:** This is the level above which adverse effects on health and quality of life can be detected; and
- **SOAEL: Significant Observed Adverse Effect Level:** This is the level above which significant adverse effects on health and quality of life occur.

3.3. Planning Practice Guidance

The Planning Practice Guidance for Noise (PPG-N) was published in March 2014 and most recently updated in July 2019. The PPG-N suggests that the most appropriate and cost-effective solutions to potential noise issues are best identified when good acoustic design needs to be considered early in the planning process.

The PPG-N provides the following advice on how to determine the noise impact on development:

“Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

- *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.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever 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. As noise is a complex technical issue, it may be appropriate to seek experienced specialist assistance when applying this policy.” (Paragraph 003 Reference ID 30-003-20190722)

The document goes on to acknowledge the levels of noise exposure at which an effect may occur as provided in the NPSE and introduces a fourth effect level:

- UAE: Unacceptable Adverse Effect: Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise lead to psychological stress or physical effects.

Where residential development is proposed in the vicinity of existing businesses, community facilities or other activities that produce noise, the PPG-N advises that the applicant (or 'agent of change') will need to clearly identify the effects of the existing businesses that may cause a nuisance (including noise) and clearly define the mitigation measures being proposed to address any potential significant adverse effects that are identified. The agent of change needs to not only consider the current activities of the business, but the permitted activities too, even if they are not occurring at the time of the application being made. The PPG-N acknowledges that *"It can be helpful for developers to provide information to prospective purchasers or occupants about mitigation measures that have been put in place, to raise awareness and reduce the risk of post-purchase/occupancy complaints."* (Paragraph 009 Reference ID 30-009-20190722).

It is important to understand that as the PPG-N does not specifically provide any advice with respect to noise levels/limits for different sources of noise, it is appropriate to consider other sources of advice and guidance documents when considering whether new developments would be sensitive to the prevailing acoustic environment and the PPG-N signposts a number of appropriate guidance documents.

3.4. Reading Borough Council

Reading Borough Council's Local Plan was adopted in November 2019. Policy EN16 Pollution and Water Resources identifies that noise sensitive developments should not be subject to high levels of noise. The relevant parts of policy EN16 and CC8 has been reproduced below.

"EN16: POLLUTION AND WATER RESOURCES

Proposals for development that are sensitive to the effects of noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution."

Paragraph 4.2.90 also identifies that the Professional Practice Guidance on Planning and Noise (ProPG) provides appropriate guidance on the design of residential developments in respect of noise.

CC8: SAFEGUARDING AMENITY

"Development will not cause a detrimental impact on the living environment of existing residential properties or unacceptable living conditions for new residential properties, in terms of:

[Bullet points 1 – 4 not relevant to Noise]

- *Noise and disturbance;*
- *Artificial lighting;*
- *Vibration"*

3.4.1. Pre-application Advice (Reference EP/725630)

Pre-application advice from Environmental Protection were received from Rebecca Moon, the Environmental Health Officer (EHO) at RBC on 10th January 2022. Relevant parts of the pre-application advice has been reproduced below.

"Noise Impact on Development

The front façade of the development is likely to be affected by road noise from the busy Church Street, and the rear of the development will be affected by noise from mechanical plant such as kitchen extraction. In addition, there may be internal noise transfer from the ground floor commercial uses to the first floor flat.

A noise assessment should be submitted in support of applications for new residential proposed in noisy areas.

The noise assessment will be assessed against the recommendations for internal noise levels within dwellings and external noise levels within gardens / balconies in accordance to BS 8233:2014 and WHO guidelines for Community Noise. The report should identify any mitigation measures that are necessary to ensure that the recommended standard is met.

Where appropriate, the noise assessment data should also include noise events (L_{Amax}) and the design should aim to prevent noise levels from noise events exceeding 45 dB within bedrooms at night. Noise levels above 45 dB are linked with sleep disturbance.

It may be possible through clever design to reduce the need for additional noise mitigation measures, for example, ensuring that noise sensitive rooms are located on the quieter facades and bathrooms, kitchens, hallways and cupboard etc on the noisiest facades.

Noise mitigation is likely to focus on the weak point in the structure; glazing. Given that the acoustic integrity would be compromised should the windows be opened, ventilation details must also be provided, where mitigation relies on closed windows. Ventilation measures should be selected which do not allow unacceptable noise ingress and should provide sufficient ventilation to avoid the need to open windows in hot weather, however non-openable windows are not considered an acceptable solution due to the impact on living standards."

3.4.2. Consultation with Reading Borough Council

The proposed noise measurement survey and assessment methods were sent to Rebecca Moon at RBC for comment by email on 29th June 2022. The proposed methodology was accepted in an email dated 29th June 2022.

3.5. Noise Guidance

3.5.1. Professional Practice Guidance on Planning and Noise: New Residential Development

The Professional Practice Guidance (ProPG) on *Planning and Noise for New Residential Development* was published in May 2017 and was produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England.

The recommended approach detailed in the ProPG includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. The recommended approach provides opportunities to incorporate effective design interventions that will enable residential development to proceed in areas that might otherwise have been considered unsuitable.

The ProPG provides advice for Local Planning Authorities and developers, and their respective professional advisers. It aims to complement Government planning and noise policy and guidance. In particular, it strives to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in and around new residential developments;
- Outline what should be taken into account in deciding planning applications for new noise-sensitive developments;
- Improve understanding of how to determine the extent of potential noise impact and effect; and
- Assist the delivery of sustainable development.

The two sequential stages of the recommended approach are:

- Stage 1: an initial noise risk assessment of the proposed development site; and
- Stage 2: a systematic consideration of four key elements.

The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- Element 1: demonstrating a “Good Acoustic Design Process”;
- Element 2: observing internal “Noise Level Guidelines”;
- Element 3: undertaking an “External Amenity Noise Assessment”; and
- Element 4: consideration of “Other Relevant Issues”.

Figure 3.1 below identifies the guidance given in the ProPG when undertaking the risk assessment stage for a site.

Figure 3.1: Phase 1 – Noise Risk Assessment

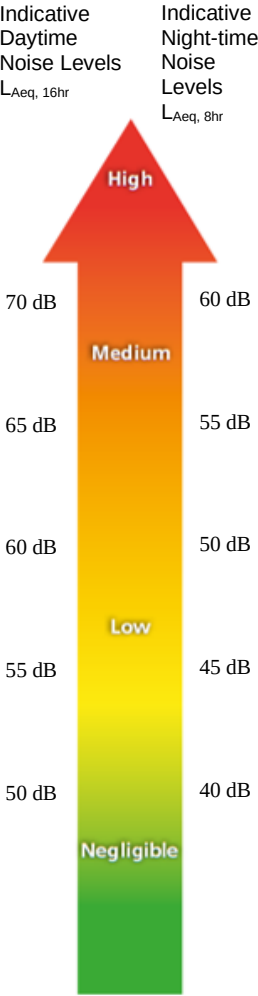
Noise Risk Assessment	Potential Effect Without Noise Mitigation	Pre-Planning Application Advice
Indicative Daytime Noise Levels $L_{Aeq, 16hr}$ Indicative Night-time Noise Levels $L_{Aeq, 8hr}$ 	Increasing risk of adverse effect	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice. As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrates that a significant adverse noise impact will be avoided in the finished development. At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.
	No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.
Notes: - Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures. - Indicative noise levels are the combined free-field noise levels from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant". $L_{Aeq, 16hr}$ is for daytime 0700 - 2300, $L_{Aeq, 8hr}$ is for night-time 2300 - 0700. - An indication that there may be more than 10 noise events at night (2300 - 0700) with $L_{AFmax} > 60$ dB means the site should not be regarded as negligible risk.		

Figure 3.2 below identifies the internal noise level criteria provided in the ProPG.

Figure 3.2: ProPG Noise Levels

Activity	Location	0700-2300 Hours	2300-0700 Hours
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB L_{AFmax} ^{Note 4}

Notes:

1. The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.
2. The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table.
3. These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.
4. Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or L_{AFmax} , depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB L_{AFmax} more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).
5. Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.
6. Attention is drawn to the requirements of the Building Regulations.
7. Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (**see Section 3.D**).

3.5.2. British Standard BS 8233:2014

BS 8233 *Guidance on sound insulation and noise reduction for buildings* has a number of design criteria for intrusive external noise without a specific character. The guidelines are designed to achieve reasonable resting/sleeping conditions in bedrooms and good listening conditions in other rooms. The most appropriate noise levels for the residential environment are reproduced in **Table 3.1**.

Table 3.1: Indoor Ambient Noise Levels for Dwellings

Activity	Location	Daytime 0700 hrs to 2300 hrs	Night-time 2300 hrs to 0700 hrs
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Although there are no limits set for external noise levels in BS 8233 the following guidance is provided at paragraph 7.7.3.2:

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.”

3.5.3. World Health Organization Guidelines for Community Noise (1999)

The World Health Organization (WHO) has developed the *Guidelines for Community Noise* (CNG) designed to minimise the adverse effects of noise. The guidelines relevant to residential noise exposure are detailed in **Table 3.2**. For each specific environment, the stated noise levels are the maximum noise levels to avoid the health effect noted.

Table 3.2: WHO Community Noise Guideline Values

Specific Environment	Critical Health Effect(s)	Period Noise Level	Maximum Noise Level
Outdoor Living Area	Serious annoyance, daytime and evening	55 dB $L_{Aeq,16hr}$	-
	Moderate annoyance, daytime and evening	50 dB $L_{Aeq,16hr}$	-
Dwelling, Indoors	Speech intelligibility and moderate annoyance, daytime and evening	35 dB $L_{Aeq,16hr}$	
Inside bedrooms	Sleep disturbance, night-time	30 dB $L_{Aeq,8hr}$	45 dB L_{AFmax}
Outside bedrooms	Sleep disturbance with window open	45 dB $L_{Aeq,8hr}$	60 dB L_{AFmax}

The WHO guidelines state, with respect to the L_{Amax} threshold, that “for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night (Vallet and Vernet 1991)”. Therefore, ACCON consider that it is appropriate to assess against the tenth highest L_{AFmax} level during the night-time period as opposed to the highest level in order to represent typical L_{AFmax} levels and provide a realistic compromise between protection from sleep disturbance and achievable mitigation.

3.5.4. British Standard BS 4142 2014 + A1:2019

BS 4142 *Methods for rating and assessing industrial and commercial sound* provides a method for the measurement and rating of industrial type noise sources and background noise levels outside dwellings. The rating level (defined in the BS) is used to rate the noise level of the source (this is defined as the ‘specific sound level’) outside residential dwellings.

The rating level is determined by assessing the character of the noise and applying an acoustic feature correction, if appropriate, to the specific sound level. Corrections are applied for the tonality, impulsivity and intermittency of the noise source which can all increase the impact of noise.

The initial assessment described in BS 4142 to determine whether an adverse impact is likely is based on establishing the difference between the rating level and the background noise level outside the residential property of interest. The British Standard states that the following points should be considered:

- “Typically, the greater this difference, 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 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."*

Where it is considered that the initial assessment of the impact needs to be modified due to the context in which the noise is occurring, BS 4142 suggests that all pertinent factors are taken into consideration, including:

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

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

Where residual sound² levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

- 2) *The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.*
- 3) *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*
 - i. *facade insulation treatment;*
 - ii. *ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and*
 - iii. *acoustic screening.*

There is also a requirement within BS 4142:2014 to consider the uncertainty in the measurement and assessment procedure.

² The residual sound is defined as the ambient sound level at the assessment location in the absence of the specific sound source

3.5.5. Acoustics Ventilation and Overheating Guide

The Acoustics Ventilation and Overheating Guide (AVO Guide) was published in January 2020. It is intended to be used by acoustics practitioners as well as all those involved in the planning, development, and design and commissioning of new dwellings. It aims to assist designers to adopt an integrated approach to the acoustic design within the context of the ventilation and thermal comfort requirements. The AVO Guide is intended to demonstrate good acoustic design as described in the ProPG when considering internal noise level guidelines.

For the purpose of the document, overheating is taken to mean:

“the phenomenon of excessive or prolonged high temperatures in homes, resulting from internal or external heat gains, which may have adverse effects on the comfort, health or productivity of occupants.”

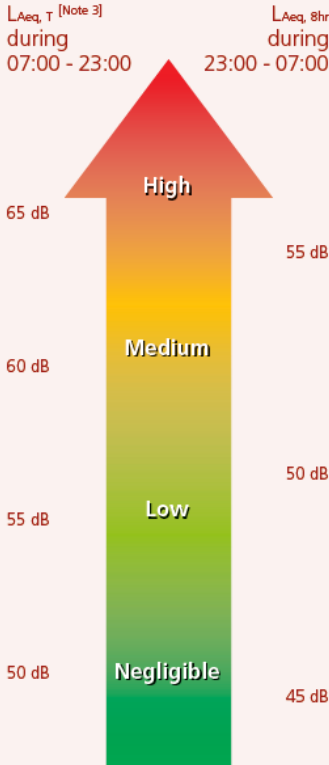
The AVO Guide is intended for new residential development predominantly exposed to transportation noise sources. The approach can also be considered for other types of residential development such as residential institutions, care homes, etc. although it needs to be remembered that some of the occupants of these types of premises can be more sensitive to indoor environmental conditions.

The AVO Guide includes:

- An explanation of the ventilation requirements under The Building Regulations as described in *Approved Document F – Means of Ventilation 2010 Edition* (ADF) along with typical ventilation strategies and associated noise considerations;
- An explanation of the overheating assessment methodology described in CIBSE *Design methodology for the assessment of overheating risk in homes* (TM59);
- A potential acoustic scale and guidance relating to different ventilation and overheating conditions, for both environmental noise ingress and building services noise; and
- A worked example of the application of the AVO Guide including indicative design constraints for different ventilation and overheating mitigation strategies.

The AVO Guide provides a two-level assessment procedure for the overheating condition. The first level assessment is a site risk assessment based on external noise levels and the assumption that the opening of windows is the primary means of mitigating overheating which is the assessment that will be carried out in this assessment. A scale is provided which is related to the ProPG initial site noise risk assessment. **Figure 3.3** presents a copy of the AVO Guide Level 1 risk assessment scale.

Figure 3.3: AVO Guide Level 1 Risk Assessment Guidance

Risk category for Level 1 assessment ^[Note 5]	Potential Effect without Mitigation	Recommendation for Level 2 assessment
 High Medium Low Negligible 65 dB 55 dB 50 dB 45 dB $L_{Aeq,T}$ [Note 3] during 07:00 - 23:00 $L_{Aeq,8hr}$ during 23:00 - 07:00	Increasing risk of adverse effect Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect	Recommended Optional Not required

Note 1: The noise levels suggested assume a steady road traffic noise source but may be adapted for other types of transport. All levels are external free-field noise levels.

Note 2: The values presented in this table should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships.

Note 3: A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise sources, the occupancy profile and times at which overheating might be likely to occur. Further guidance can be found within the 2014 IEMA Guidelines.

Note 4: Where 78 dB LAFmax is normally exceeded during the night-time period (2300 hrs to 0700 hrs), a level 2 assessment is recommended.

Note 5: The risk of an adverse effect occurring will also depend on how frequently and for what duration the overheating condition occurs.

Note 6: To evaluate the risk category for a dwelling, all three aspects of external noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated. The highest risk category for any of these aspects applies.

3.5.6. Approved Document O

Approved Document O (ADO) in respect of overheating was published 15th December 2021 and last updated on 25th February 2022 and takes effect on 15th June 2022 states:

3.1 *The standards in this section may mean that the standards of the simplified method cannot be met. For example, if external noise is an issue, it is unlikely that windows would be opened by an occupant and therefore the minimum free areas of the*

simplified method cannot be met. In such cases, dynamic thermal modelling should be used.

- 3.2 *In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).*
- 3.3 *Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits. a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am). b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am).*

3.6. Target Noise Levels

The target external and internal noise levels for new residential dwellings have been derived from the ProPG, BS 8233, the WHO guidelines and guidance from Reading Borough Council.

3.6.1. External Noise Levels

Noise levels within private amenity areas (i.e. communal gardens, private gardens, balconies and terraces) should achieve a noise level within or below the range of 50 dB to 55 dB $L_{Aeq, 16hr}$ in respect of traffic noise.

3.6.2. Internal Noise Levels

Noise levels within habitable rooms (i.e. living rooms and bedrooms) should achieve a daytime noise level not exceeding 35 dB $L_{Aeq, 16hr}$ and a night-time noise level not exceeding 30 dB $L_{Aeq, 8hr}$. Maximum noise levels (L_{AFmax}) should not normally exceed 45 dB internally more than 10 times during the night-time.

3.6.3. Noise from Plant Noise Sources

The target should be to achieve a difference between the rating level and background sound level where the rating level does not exceed the background sound level as this is an indication of the specific sound source having a low impact, depending on context.

4. NOISE MEASUREMENT SURVEY

A noise measurement survey was carried out in order to determine the extent to which the site is currently affected by noise.

Noise measurements were carried out between 1030 hrs on Wednesday 6th July 2022 and 1030 hrs on Thursday 7th July 2022. Two semi-permanent noise monitoring positions were utilised. The noise measurement positions have been identified in **Figure 4.1**.

Figure 4.1: Noise Measurement Positions



The weather conditions on 6th July 2022 were dry with approximately 30% cloud cover. The wind was recorded at less than 1 m/s and a temperature of 22°C was recorded.

At the end of the measurement period on 7th July 2022, there was 100% cloud cover, with wind speeds less than 1 m/s and a temperature of 20°C.

The noise measurements utilised two Svantek 971 Class 1 Sound Level Meters. The sound level meters hold current certificates of calibration, which are available upon request. The equipment was filed calibrated before and after the measurement period to ensure that it had remained within reasonable calibration limits (± 0.5 dB).

Measurement Position 1 (**MP1**) was located at first floor level on the southern façade of the building, overlooking Church Street. The microphone was mounted at a distance of 1 m away from the building façade at a height of approximately 4 m above ground level. The ambient noise climate was dominated by road traffic on Church Street.

Measurement Position 2 (**MP2**) was located at first floor level in the rear courtyard of the development site. The microphone was mounted at a height of approximately 4 m above ground level. The noise climate was dominated by continuous plant noise from air

conditioning units operating at the surrounding businesses. Road traffic noise from Church Street was also audible.

A summary of the measured free-field noise levels are identified in **Table 4.1**. The free-field noise levels have been calculated by applying a correction of -3 dB to convert the measured façade noise levels to free-field noise levels.

Table 4.1: Summary of Measured Free-field Noise Levels

Position	Period (hours)	L _{Aeq, T} (dB)	L _{AFmax} (dB)	Average L _{A10, T} (dB)	Average L _{A90, T} (dB)
MP1	0700 hrs – 2300 hrs	69	94	70	58
	2300 hrs – 0700 hrs	61	80	60	37
MP2	0700 hrs – 2300 hrs	55	74	55	48
	2300 hrs – 0700 hrs	43	64 (61)	44	37

Note: The levels stated are logarithmic average for L_{Aeq, T} and arithmetic average for L_{A10, T} and average L_{A90, T}. the L_{AFmax} is the average of the highest hourly maximum sound levels measured during the measurement period. The L_{AFmax} in brackets is the tenth highest L_{AFmax} noise levels measured during the measurement period.

The hourly façade uncorrected noise measurement results for MP1 and MP2 are provided in **Appendix 2**.

5. NOISE IMPACT ASSESMENT

5.1. Stage 1: ProPG Initial Site Noise Risk Assessment

The noise survey demonstrated that the daytime noise level at the front of the development, overlooking Church Street is 69 $L_{Aeq, 16hr}$ and the night-time noise level is 61 $L_{Aeq, 8hr}$. These measured noise levels at the southern façade indicate that the site is generally of a medium to high risk of adverse noise effect from road traffic noise during the daytime and night-time periods. However, the site is also subject to relatively high L_{AFmax} levels more than ten times per night and therefore the risk of adverse noise effect is increased to high.

5.2. Stage 2: Noise Impact Assessment

5.2.1. External Noise Levels

The predicted daytime external noise levels ($L_{Aeq, 16hr}$) will be compared against the target external noise level range of 50 dB to 55 dB $L_{Aeq, 16hr}$ or below within amenity areas. Amenity areas could include areas such as private terraces and balconies. It should be noted that the external noise level range relates to traffic noise and the north of the proposed development is affected by noise from air conditioning units. However, the plant noise is operating continuously and therefore has a lower impact than if the characteristic of the plant noise was intermittent.

Table 5.1 identifies the daytime external noise levels within external amenity spaces on the north façade of the proposed development.

The daytime $L_{Aeq, 16hr}$ at MP2 has been utilised as a worst-case noise level for external amenity areas and is considered to be representative of the proposed balconies and terraces for the north façade of the development.

Table 5.1: External Amenity Area Noise Levels

Façade	External Noise Level $L_{Aeq, 16hr}$ (dB)	Within or Below Target Noise Level Range?
North	55	✓

It can be identified in **Table 5.1** that balconies and terraces should experience noise levels within the target range of 50 - 55 dB $L_{Aeq, 16hr}$ and therefore noise mitigation specific to external noise levels is not required.

Optional external noise mitigation measures are discussed in **Section 7.1**.

5.2.2. Internal Noise Levels

BS 8233 states that *"if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB"*. The WHO guidelines also state that a slightly open window would result in a [sound] reduction from outside to inside of 15 dB".

Table 5.2 presents the measured external noise levels for the south and north façade of the proposed development, the noise measurements at MP1 are considered to be representative

of the south façade and MP2 is considered to be representative of the north façade. **Table 5.2** also identifies the minimum combined facade sound reduction required to achieve the target internal noise levels.

Table 5.2: Noise Levels to Habitable Rooms with Open Windows

Façade	Measured External Noise Levels (dB)			Predicted Internal Noise Levels (dB) With Open Windows			Minimum Combined Façade Sound Reduction Required dB(A)
	Daytime $L_{Aeq, 16hr}$	Night-time $L_{Aeq, 8hr}$	Night-time L_{AFmax}	Daytime $L_{Aeq, 16hr}$	Night-time $L_{Aeq, 8hr}$	Night-time L_{AFmax}	
South Façade	69	61	80	54	46	65	35
North Façade	55	43	61	40	28	46	20

Table 5.2 identifies the predicted internal noise levels with windows open, assuming that a partially open window provides 15 dB sound reduction. It can be seen that the predicted internal noise levels with windows open exceed the target internal noise levels set out in **Section 3.6.2**. Therefore, the assessment considers the façade reduction required to achieve the internal noise level criteria with closed windows. The highest level of sound reduction required is 35 dB(A) for the southern façade to ensure that the target internal noise levels are not exceeded in bedrooms at night.

It is recommended that window glazing with a specification to provide 35 dB(A) sound reduction should be installed for all habitable rooms within the development.

Figure F.2 to Figure F.45 identifies the level of sound reduction required for each façade of the buildings.

Noise mitigation measures to achieve the target internal noise levels are discussed in **Section 7.2**.

5.3. Noise Transfer from Ground Floor Commercial Premises

When ACCON personnel attended the site, it was observed that the takeaway on the ground floor was open and operational. However, there was no audible noise transfer observed from the ground floor to first floor.

Although there was no noise transfer observed during the site visit, it is recommended that the airborne sound insulation between the ground floor commercial unit and the first floor dwellings should achieve a 10 dB greater reduction than required for separating floors between dwellings specified in Approved Document E to the Building Regulations. The minimum standard of sound insulation should therefore be $55 \text{ dB } D_{nT,w} + C_{tr}$.

6. BS 4142 ASSESSMENT

The CadnaA noise modelling software has been utilised to calculate the external noise levels from installed plant at the proposed development site. CadnaA is a three-dimensional noise model developed by DataKustik and has been extensively used by ACCON and others to develop noise models for a wide variety of situations and noise sources. CadnaA utilises the ISO 9613-2 calculation methodology to predict the noise levels from industrial plant sources such as MVHR and air conditioning units.

It should be clarified that in this assessment CadnaA has been utilised in order to calculate the specific noise levels at the nearest noise sensitive receptors due to the proposed air source heat pump in **Section 6.2**.

Section 6.1 identifies the potential impact of the existing air conditioning units on future occupants of the proposed development.

Section 6.2 identifies the potential impact of the proposed air source heat pump on existing noise sensitive residential receptors.

6.1. Plant Noise Assessment – Existing Air Conditioning Units

When ACCON personnel attended the site, air conditioning units from other retail units to the rear of the proposed site were operating. It should be noted that the ground floor of the site currently operates as a Chinese takeaway which has a kitchen extract flue to the rear, this was operating between the hours of 1600 and 2300. However, it has been advised by the client that this extract flue will be removed when the ground floor becomes an office and therefore no assessment of the noise impact from the flue has been carried out.

6.1.1. Specific Sound Levels

Specific sound levels from the plant noise sources have been calculated by logarithmically subtracting the residual sound level as measured at MP2 from the ambient sound level. In this respect the ambient sound level is all sources of sound including the air conditioning units and the residual sound level is excluding the air conditioning units.

6.1.2. Background Sound Levels

The background sound level measured at MP2 have been utilised from **Table 4.1** as these are considered to represent the typical background sound levels at the rear of the proposed development without the impact of localised plant sound sources.

6.1.3. BS 4142 Assessment

The BS 4142 assessment has been carried out for the north façade of the site, which is the façade primarily affected by plant noise.

Table 6.1: BS 4142 Assessment - North Façade

Results	Noise Level at the Façade (dB)		Relevant Clauses of BS 4142:2019	Commentary
	Daytime	Night-time		
Background Sound Level $L_{A90, T}$ (dB)	48	37	8.1, 8.2	The background sound level measured at MP2 (Table 4.1)
Specific Sound Level $L_{Aeq, 1hr}$ (dB)	49	40	7.3	The specific sound level has been calculated difference between the ambient sound level and the residual sound level (L_{Aeq})
Acoustic Feature Correction (dB)	+2	+2	9.1, 9.2, 9.3	An Acoustic Feature Correction has been applied for + 2 dB for Just Perceptible Tonality
Rating Sound Level $L_{Aeq, 1hr}$ (dB)	51	42		(Specific Sound Level + Acoustic Feature Correction)
Excess of Rating Sound Level over Background Sound Level	+3	+5		
Initial Estimate of Impact	Tending towards a low Impact	Adverse Impact		

The BS 4142 assessment identifies that the initial estimate of impact would be tending towards an indication of a low impact on the occupiers of the residential dwellings during the daytime period and an indication of an adverse impact during the night-time period.

6.2. Plant Noise Assessment - Air Source Heat Pump

It is understood that an Air Source Heat Pump is to be installed as part of the proposed development. The unit is to be located on the north façade of the proposed development as illustrated in **Figure F.5**. In order to undertake a worst-case noise assessment, it has been assumed that the heat pump will run constantly, and at the maximum available sound power

level. The maximum A-Weighted sound power levels has been obtained from the manufacturer and identified in **Table 5.2** below.

Table 6.2: Air Source Heat Pump – Sound Power Level

Unit	Sound Power Level L_w dB(A)
NIBE F2040-16	61

6.2.1. Specific Sound Levels

The specific sound levels have been calculated at the location of the nearest noise sensitive receptors (NSRs). The specific sound levels and the NSRs are identified in **Table 6.3** below.

Table 6.3: Specific Sound Levels – NSRs

NSR	Specific Sound Level $L_{Aeq,T}$ dB(A)
8 Academy Court - South Facade	16
38c Church Street - North Facade	32

6.2.2. Background Sound Levels

The background sound level measured at MP2 obtained from **Table 4.1** has been considered to be representative of the typical background sound level at the rear of the proposed development, without the impact of localised plant sound sources.

6.2.3. BS 4142 Assessment

The BS 4142 assessment considers the potential impact from the air source heat pump at the nearest NSR, 38c Church Street - North Façade. If it is identified that the air source heat pump is of negligible impact at this NSR then it can be assumed that the potential impact will also be negligible at 8 Academy Court – South façade.

Table 6.4: BS 4142 Assessment - 38c Church Street

Results	Noise Level at the Façade (dB)		Relevant Clauses of BS 4142:2019	Commentary
	Daytime	Night-time		
Background Sound Level $L_{A90,T}$ (dB)	48	37	8.1, 8.2	The background sound level measured at MP2 (Table 4.1)

Results	Noise Level at the Façade (dB)		Relevant Clauses of BS 4142:2019	Commentary
	Daytime	Night-time		
Specific Sound Level L _{Aeq, 1hr} (dB)	32	32	7.3.6	The specific sound level calculated in CadnaA
Acoustic Feature Correction (dB)	+2	+2	9.1, 9.2, 9.3	An Acoustic Feature Correction has been applied for + 2 dB for Just Perceptible Tonality
Rating Sound Level L _{Aeq, 1hr} (dB)	34	34		(Specific Sound Level + Acoustic Feature Correction)
Excess of Rating Sound Level over Background Sound Level	-14	-3		
Initial Estimate of Impact	Negligible	Negligible		

The BS 4142 assessment identifies that the initial estimate of impact due to the proposed air source heat pump would be of negligible impact at the closest NSR, 38c Church Street.

6.2.4. Discussion of Uncertainty

ACCON carried out noise measurements over a 24 hr period commencing on a weekday to obtain typical background sound levels representative of the proposed noise sensitive receptors. It is considered that the noise measurement period was over a reasonably typical weekday period for background sound levels.

The dominant noise source throughout the measurement period was existing plant operating to the rear of 36A Church Street. Noise measurements were carried out over a 24-hour period in order to reduce any uncertainty associated with the operating times of the plant noise sources. The assessment has incorporated acoustic feature corrections for tonality. There was no intermittency or impulsivity associated with the plant noise sources.

The noise measurements were carried out in accordance with BS 7445 Part 1 *Description and measurement of environmental noise during weather conditions suitable for noise measurements*.

The calculation of specific sound levels has utilised the noise measurement data and has been carried out using standard acoustic formulae in line with BS 4142. It has been assumed that the sources of plant sound can be reasonably represented by point sources based on their location relative to the noise sensitive receptors, the orientation of the plant sources and any intervening screening structures.

On the basis of the above, it is considered that the effects of uncertainty have been minimised as far as possible.

6.2.5. Discussion of Context – Existing Air Conditioning Units

When considering the impact of plant noise in a BS 4142 assessment it is necessary to consider the context. The proposed development is situated in an area of existing retail and residential uses.

The initial assessment of noise from the existing plant noise sources in the location of the proposed development has indicated a low impact during the daytime period and an indication of an adverse impact during the night-time period on the north façade of the building.

During the night-time, residents will be within their dwellings and therefore it is appropriate to consider the sound insulation specification provided for the building envelope in respect of the proposed dwellings. It can therefore be concluded that the noise impact on the dwellings would be a low impact during the daytime and night-time period.

6.2.6. Discussion of Context – Air Source Heat Pump

The proposed air source heat pump will be located at the ground floor level in an area with existing air conditioning units and other extract plant. In view of this context, the air source heat pumps would not be adding additional sound which is out of character for the area. The initial assessment of noise from the proposed air source heat pump has identified a negligible impact during both the daytime and night-time periods at the nearest NSR. This assessment does not change when taking the context into consideration.

7. NOISE MITIGATION MEASURES

7.1. External Noise Levels

Section 5.2.1 indicates that the external noise levels within the proposed amenity areas would be within the target noise level range.

The PPG-N³ provides a list of potential measures which can be considered in order to mitigate the impact of noise on residential developments. *“Noise impacts may be partially offset if residents have access to one or more of:*

- *A relatively quiet façade (containing windows to habitable rooms) as part of their dwelling;*
- *A relatively quiet external amenity space for their sole use, (e.g. a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced if this area is exposed to noise levels that result in significant adverse effects;*
- *A relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- *A relatively quiet, protected, external publicly accessible amenity space (e.g. a public park or a local green space designed because of its tranquillity) that is nearby (e.g. within a 5 minute walking distance).”*

A nearby public park (Christchurch Meadows) is located within approximately 165 metres of 36A Church Street. This park is considered to be a relatively quiet, protected, external publicly accessible amenity space in accordance with the fourth bullet point of the PPG guidance stated above.

A 1 – 2 dB noise reduction may be achievable by providing solid balustrades. It is also recommended, where possible, that acoustically absorptive materials are provided to the soffit of balconies to reduce reflections of noise to balconies below.

7.2. Internal Noise Levels

Section 5.2.2 has identified the minimum combined building façade sound reductions required for the proposed residential dwellings.

It is assumed that the external wall construction provides a minimum sound reduction of 50 dB R_w (typically achievable by a standard brick and block cavity wall construction, or similar), the glazing and any ventilation openings will be the weakest elements of the building façade.

³ Planning Practice Guidance – Noise, Paragraph: 011 Reference ID: 30-011-20190722
Downloaded from <https://www.gov.uk/guidance/noise--2> on 28/11/2019

Table 7.1 below indicates the glazing specification for the required attenuation of the proposed dwellings.

Table 7.1: Glazing Specifications

Attenuation	Example of Glazing
35 dB(A)	Double Glazing such as those presented below or similar: Pilkington double glazing: 6mm glass/ 16 mm Argon filled air gap/ 8.8 mm laminated glass Optiphon Saint-Gobain double glazing: 8 mm glass/ 16 mm air gap/ 10.8 mm laminated glass Stadip Silence

Ventilation to the habitable rooms should be provided by a ventilation system that will meet the same standard of sound insulation required by the proposed glazing system. Any trickle vents or other ventilation systems with openings into habitable rooms will need to incorporate appropriate acoustic design measures.

7.3. Overheating

For those areas of the site where specific building façade acoustic mitigation measures are likely to be required, the assessment of the internal noise levels should consider the unintended consequences of keeping windows closed. Windows should always be openable for purge ventilation and therefore it will be the choice of the residents to have windows open or closed. However, if overheating effects are likely to result in residents needing to open windows on facades which overlook the primary sources of noise for extended periods of time the internal noise conditions may be considered unreasonable. It may be prudent to consider a mechanical means of ventilation (i.e. ADF System 3 or 4) to assist in moving the air through the dwellings and minimising the number of days that windows need to be opened for comfort cooling.

8. ACOUSTIC DESIGN STATEMENT

8.1. Initial Site Noise Risk Assessment

The initial site noise risk assessment has identified that the site is generally at a medium to high risk of adverse noise effect during the daytime and the night-time period. However, the site is subject to relatively high L_{AFmax} levels more than ten times per night and therefore the risk of adverse noise effect is increased to high.

8.2. External Noise Levels

The assessment of external noise levels relating to traffic noise identifies that the private external amenity areas which are located to the rear of the building, will experience noise levels within the target range of 50 – 55 dB $L_{Aeq, 16hr}$ for the daytime. The BS 4142 assessment identifies that the north façade of the proposed development, where the balconies and terraces are located, would be tending towards an indication of a low impact during the daytime from plant noise.

It should also be noted that there is a nearby public park (Christchurch Meadows) approximately 165 metres of 36A Church Street. Therefore, no mitigation specific to external noise are required.

8.3. Internal Noise Levels

Windows to habitable rooms in the northern façade should achieve a minimum sound reduction of 20 dB(A). A sound reduction of up to 28 dB(A) should be achievable through the provision of standard double-glazed windows.

Windows to habitable rooms on the south façade which overlooks Church Street should have a minimum sound reduction of 35 dB(A).

Recommendations for a glazing specification which achieves these levels of sound reduction have been provided in **Section 7.2**. It is recommended that double glazing providing a minimum sound reduction of 35 dB(A) is installed to all habitable rooms within the proposed development

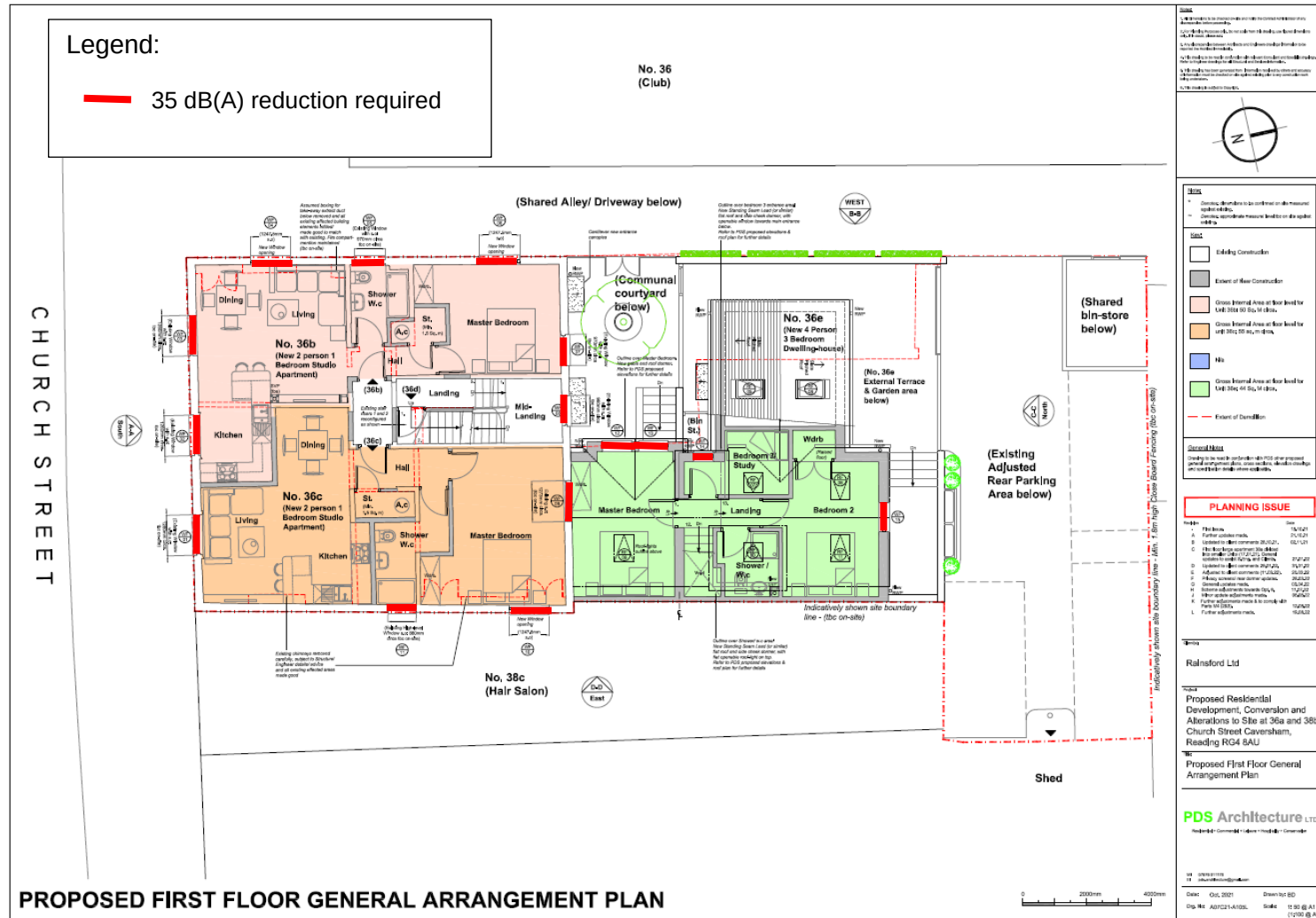
An appropriate ventilation system in accordance with the Building Regulations Approved Document F should be provided having regard to any likely overheating effects which might result in the need to open windows for comfort cooling over extended periods during which internal noise levels are likely to be unreasonable.

8.4. Recommendations to the Decision Maker

On the basis of the above, it is recommended that there should be no objection to granting planning consent for the proposed development on noise grounds.

ADDITIONAL FIGURES

Figure F.3: Proposed First Level with Required Mitigation



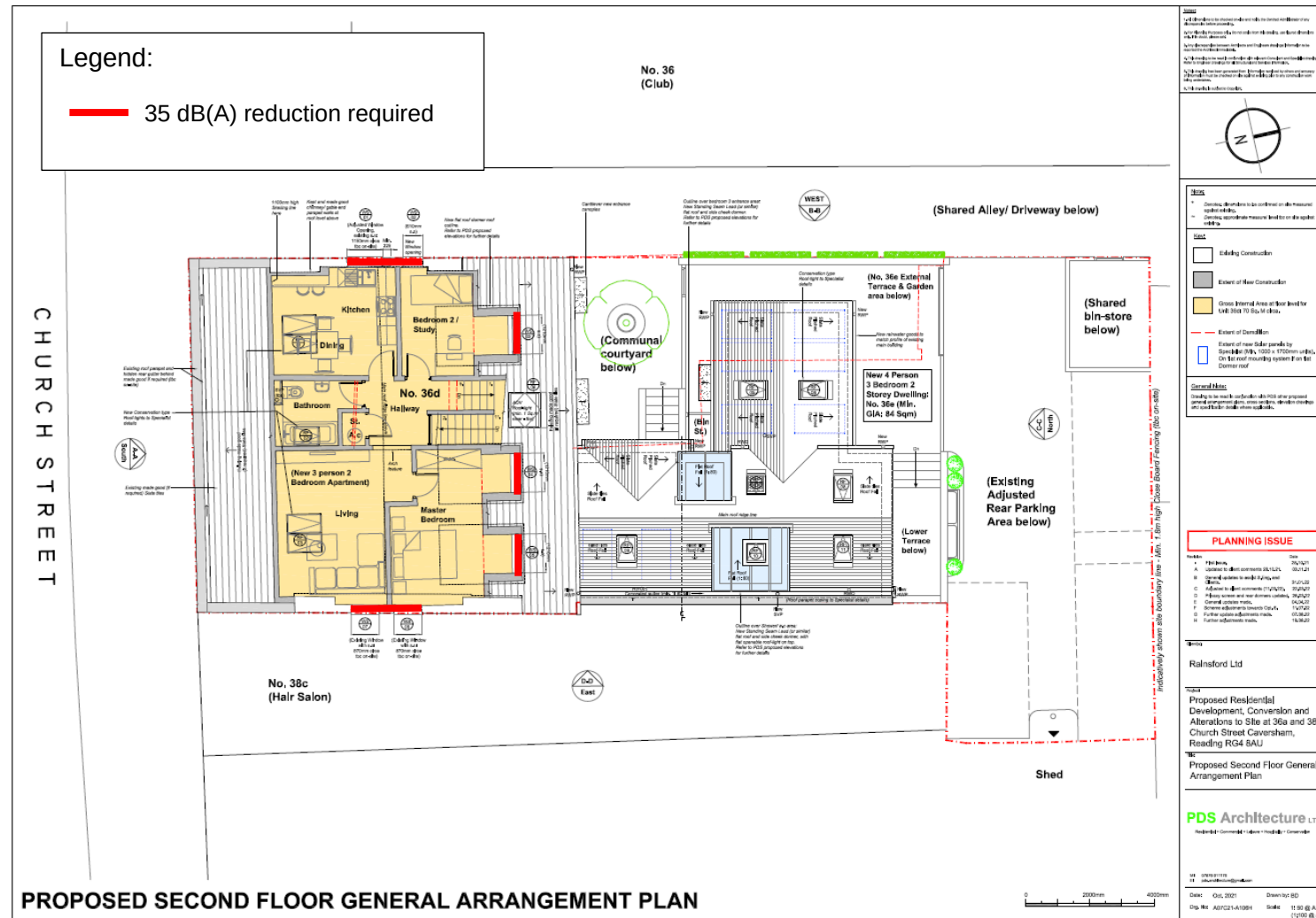
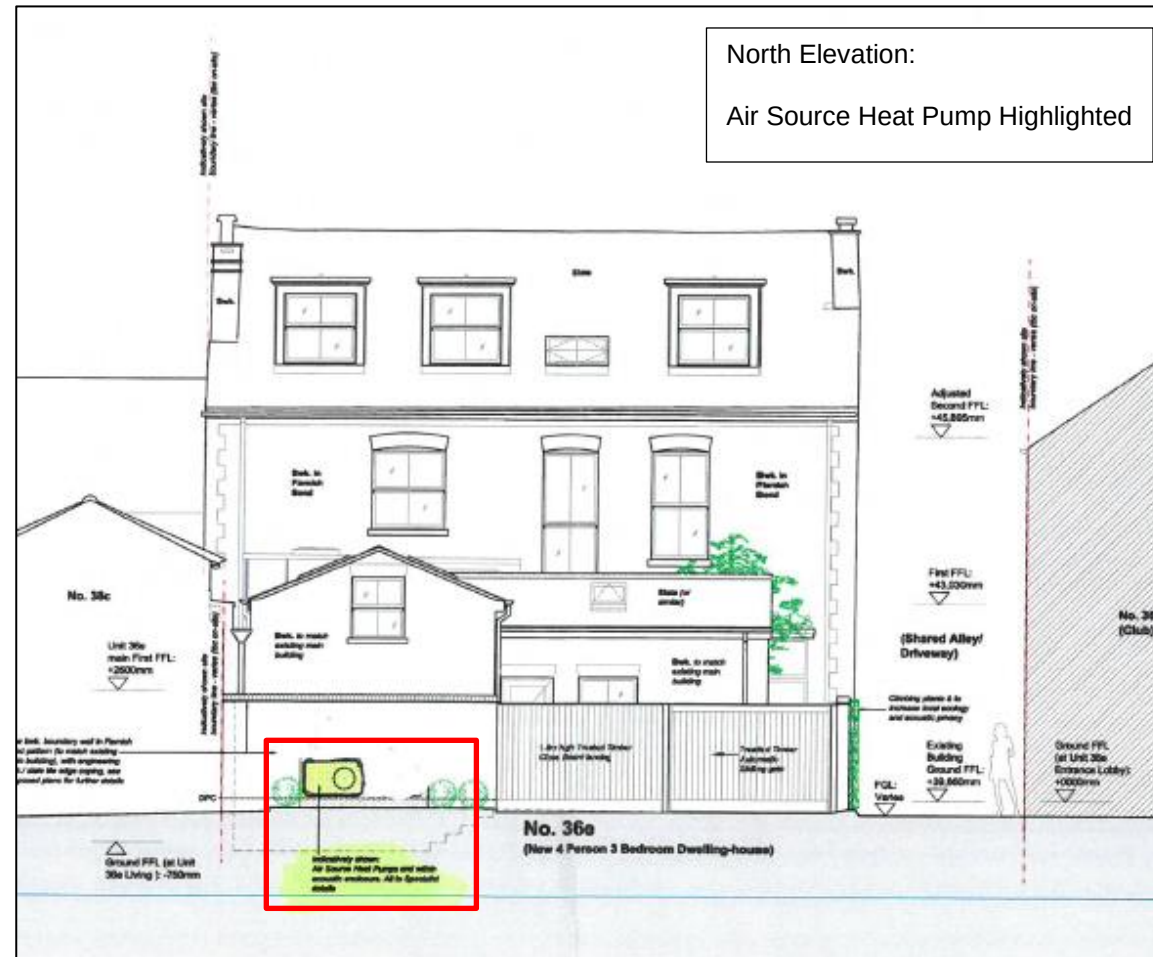


Figure F.5: Proposed Air Source Heat Pump Location



APPENDICES

Appendix 1

Glossary of Acoustic Terminology

Term	Description
'A'-Weighting	<i>This is the main way of adjusting measured sound pressure levels to take into account human hearing, and our uneven frequency response.</i>
Decibel (dB)	<i>This is a tenth (deci) of a bel. A decibel can be a measure of the magnitude of sound, changes in sound level and a measure of sound insulation. Decibels are not an absolute unit of measurement but are an expression of ratio between two quantities expressed in logarithmic form.</i>
Frequency	<i>Frequency is related to sound pitch; frequency equals the ratio between velocity of sound and wavelength.</i>
$L_{Aeq,T}$ (Ambient /Period Sound Level)	<i>The equivalent steady sound level in dB containing the same acoustic energy as the actual fluctuating sound level over the given period, T. T may be as short as 1 second when used to describe a single event, or as long as 24 hours when used to describe the noise climate at a specified location. $L_{Aeq,T}$ can be measured directly with an integrating sound level meter.</i>
$L_{A10,T}$ (Road Traffic Noise Level)	<i>The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 10 per cent of a given time. The $L_{A10,T}$ is used to describe road traffic noise levels at a particular location.</i>
$L_{A90,T}$ (Background Sound Level)	<i>The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 90 per cent of a given time. The $L_{A90,T}$ is used to describe the background noise levels at a particular location.</i>
L_{Amax}	<i>The 'A'-weighted maximum sound pressure level measured over a measurement period.</i>
Rating Level, $L_{Ar,Tr}$	<i>The specific sound level plus any adjustment for the characteristic features of the sound.</i>
Residual Sound Level, $L_r = L_{Aeq,T}$	<i>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.</i>
Specific Sound Level, L_s $= L_{Aeq,Tr}$	<i>The equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.</i>

Appendix 2

Noise Measurement Results

Hourly Façade Noise Measurements at MP1

Time	L _{Aeq,T} (dB)	L _{Amax} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
07:00-08:00	71	90	76	64
08:00-09:00	73	104	74	64
09:00-10:00	75	111	74	63
10:00-11:00	72	97	78	63
11:00-12:00	70	89	73	61
12:00-13:00	69	90	72	62
13:00-14:00	69	88	72	61
14:00-15:00	71	99	72	62
15:00-16:00	69	97	71	61
16:00-17:00	72	101	72	62
17:00-18:00	69	91	71	62
18:00-19:00	77	114	72	62
19:00-20:00	70	97	72	60
20:00-21:00	71	101	72	58
21:00-22:00	69	95	71	55
22:00-23:00	66	87	70	50
23:00-00:00	65	84	69	45
00:00-01:00	62	81	66	39
01:00-02:00	60	83	60	36
02:00-03:00	59	80	58	36
03:00-04:00	56	79	51	35
04:00-05:00	60	81	61	36
05:00-06:00	64	86	67	39
06:00-07:00	69	87	73	52
Daytime (07:00-23:00)	72	97	73	61
Night-time (23:00-07:00)	64	83	63	40

Hourly Façade Noise Measurements at MP2

Time	L _{Aeq,T} (dB)	L _{Amax} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
07:00-08:00	53	78	60	47
08:00-09:00	53	82	56	48
09:00-10:00	52	76	57	48
10:00-11:00	56	80	65	49
11:00-12:00	54	80	55	47
12:00-13:00	54	85	55	48
13:00-14:00	51	68	54	47
14:00-15:00	53	77	55	47
15:00-16:00	52	76	54	46
16:00-17:00	60	74	60	55
17:00-18:00	61	72	62	60
18:00-19:00	62	91	62	60
19:00-20:00	61	71	62	60
20:00-21:00	61	75	62	60
21:00-22:00	60	73	60	56
22:00-23:00	50	74	51	42
23:00-00:00	47	63	50	41
00:00-01:00	48	85	47	40
01:00-02:00	43	64	44	39
02:00-03:00	42	58	44	39
03:00-04:00	42	65	42	38
04:00-05:00	42	60	44	38
05:00-06:00	48	74	49	40
06:00-07:00	49	65	52	43
Daytime (07:00-23:00)	58	77	58	51
Night-time (23:00-07:00)	46	67	47	40



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