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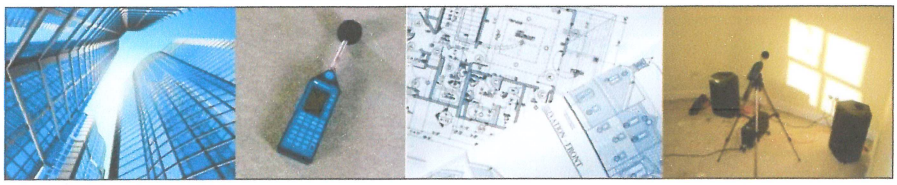

5 STATION ROAD
ROYAL WOOTTON BASSETT
WILTSHIRE
SN4 8GB

ENVIRONMENTAL NOISE ASSESSMENT

v.1

Client:
HARBOURSIDE PROPERTIES LIMITED
Ash Cottage
Red Barn Farm
Wroughton
Wiltshire
SN4 9LT

27th March 2023
Ref: M5319

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Project Reference	M5319
Issue No.	1
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Date	27th March 2023

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1. SUMMARY

1.1 An assessment of ambient noise has been undertaken at a proposed residential development, at 5 Station Road, Royal Wootton Bassett, Wiltshire, SN4 8GB.

1.2 The objective of the exercise is to demonstrate that the building is suitable for residential development and how, in principle, an acceptable level of acoustic amenity may be provided.

1.3 The existing ambient noise climate affecting the site has been established (Section 3), and the survey has confirmed a typical variation in daytime and night-time levels. The assessment has also quantified the level of noise emanating from an adjacent substation.

1.4 Section 4 provides a description of the relevant national planning policies and defines the criteria which would commonly be applied to projects of this nature.

1.5 Means of attenuating the external noise levels have been submitted (Section 5), in the form of a specification for the façade glazing and means of acoustically ventilating the building. The specifications also include details for the roof construction and external doors. Performance targets for each element are confirmed in Tables 5.2 – 5.4.

1.6 If these measures are adopted, internal noise levels will meet the stated targets.

1.7 In respect of noise from the adjacent electricity substation, an assessment of the residual levels within the building – in its current, unfinished state – concludes that levels would be within the guideline noise limits set out by the Chartered Institute of Building Services Engineers. No further remediation is therefore required.

1.8 An assessment of noise in the garden area indicates that an acoustic fence would be recommended, as a minimum, for the south-west and north-east boundary, 1.8m above the garden level.

1.9 Overall, it is concluded that, with the recommended measures in place, occupants of new property can be provided with an acceptable acoustic environment.

2. INTRODUCTION

2.1 An assessment of environmental noise has been undertaken at 5 Station Road, Royal Wootton Bassett, Wiltshire, SN4 8GB, on behalf of Harbourside Properties Limited.

2.2 The existing building is located immediately next to Station Road, a link between the High Street and routes to Swindon & Marlborough. It faces a derelict hotel and the entrance to a builders merchants (the yard itself being set back from the road). It is also noted that there is a small electricity sub-station located at the rear of the plot (see Figure 1 – Site Location)



2.3 It is proposed that the existing building, formally a public convenience and town gaol, be converted to create a two storey detached property (see Figure 2 – Proposed Floor Plans).

2.4 An earlier planning application (20/06861) to create two dwellings within the existing shell was rejected on grounds which included the following concern:

> *The proposed development would result in inadequate amenity for future occupants of the proposed dwellings by virtue of unacceptable levels of internal daylighting, internal living space, potential noise disturbance and inadequate levels of private amenity space. The proposals are therefore contrary to the requirements of Core Policy 57(vii) of the adopted Wiltshire Core Strategy Jan 2015; Policy 7 of the Royal Wootton Bassett Neighbourhood Plan; and Paragraphs 127 (f) and 180 the National Planning Policy Framework July 2019.*

2.5 However, the informative to the refusal then offered the following clarification regarding noise:

> *The applicant is requested to note that part of the reason for refusal as it relates to noise disturbance may potentially be capable of being overcome subject to the outcome of a noise impact assessment and submission of a report in that regard.*

2.6 The objective of this report, therefore, is to provide the necessary substantiation to confirm that the building may be converted for residential use as proposed, in a manner which protects the amenity of future occupants.

2.7 Formally, the objectives of the current exercise may be summarised as follows:

(i) To determine the existing ambient noise climate within the vicinity of the development,
(ii) To assess likely noise levels at the facades of the new house, and to specify a suitable façade construction to ensure acceptable conditions,
(iii) To consider external noise levels and advise on any requirements for screening.

2.8 This report details the investigations carried out in respect of each of these objectives and summarises the conclusions which have been reached.

3. SURVEY OF EXISTING NOISE LEVELS

3.1 The first step in the assessment of potential impact is to measure and describe the existing ambient noise levels affecting the site.

3.2 From a site investigation, it was evident that the primary sources of interest were road traffic passing on Station Road (including vehicles entering and leaving the builders yard), and noise from the electricity substation to the rear.

3.3 It was not deemed practical to leave a noise monitor on site for an extended period, due to the security of the site. Therefore a short-sample noise survey was conducted in accordance with the Department of Transport Calculation of Road Traffic Noise document.

3.4 The survey was undertaken between 10.00 and 15.00 on 12th December 2022.

3.5 A Rion NL-52 Type 1 sound level meter was set up within the garden of the site, to the north of the building and immediately adjacent to the pavement (thus at the line of the building façade). The microphone was set on a tripod, nom. 2m above the ground level of the garden and therefore above the boundary wall (see Figure 1).

3.6 The equipment was configured to measure 5minute samples of the following acoustic parameters:

L_{Aeq} The A-weighted equivalent continuous sound pressure level which, over the sample period, contains the same acoustic energy as the time-varying signal being recorded.

L_{Amax} The A-weighted maximum sound pressure level recorded during each sample period (as measured on fast response).

L_{A90} A statistical parameter, representing the A-weighted noise level exceeded for 90% of each sample period. This gives the measure of the underlying noise and is commonly used to describe the ambient background noise.

3.7 The equipment was calibrated before and after the survey and showed no significant variance. Details of the equipment used are shown in Table 3.1.

Type	Manufacturer	Description	Serial number	Last Calibration Date	Calibration Certificate No:
NL-52	Rion	Sound Level Meter	142660	15.04.21	2021-0406
1251	Norsonic	Calibrator	32602	15.04.21	2021-0409

Table 3.1 – Meter Calibration

3.8 Weather conditions throughout the survey period were still, cold and dry.

3.9 Figure 3 shows the variations in noise levels during the survey period, and Table 3.3 confirms the measured levels during each of the standard day time and night-time periods.

$L_{Aeq,\ 10.00-15.00}$	Typical $L_{Amax,\ fast}$
63 dB(A)	80 dB(A)

Table 3.3 – Summary of Ambient Noise Measurements

3.10 The L_{Amax} levels shown in the tables are the peak values based on the 90th percentile and may exclude exceptional 'one-off' events that may have occurred.

3.11 The 2002 TRL report (PR/SE/451/02) 'Converting the UK traffic noise index LA10,18h to EU noise indices for noise mapping' details the method converting samples of day time samples of road traffic noise into the more usual parameters of $L_{Aeq\ 0700-2300}$ and $L_{Aeq\ 2300-0700}$. Using this relationship, the sampled noise would suggest day and night time noise levels of:

64 dB(A) $L_{Aeq,\ 0700-2300}$

56 dB(A) $L_{Aeq,\ 2300-0700}$

3.12 The second part of the survey was to establish the level of noise arising from the electricity substation at the north-west corner of the site. Here, the potential issue is not one of volume, but of tonality.

3.13 Measurements were taken externally at a distance of 2m, and internally within the shell of the existing building. The roof and walls were in place, but windows were merely boarded at the time. As such, it was considered that any such readings now would yield a worst case assessment of likely noise within the finished house.

3.14 Table 3.4 provides a summary of these measurements, and Figure 4 provides clarity on the frequency content of the sound

Location of Measurement	Overall Volume, $L_{Aeq,\ t}$
External, 2m from transformer	48 dB(A)
Internally, first floor level	30 dB(A)

3.15 It was noted that the internal noise level was affected by road traffic noise and, whilst all effort was made to record in the absence of passing vehicles, the value of 30 dB(A) included a significant contribution from other sources.

3.16 Externally, it is noted that the overall level of noise generated by the substation is significantly lower that the ambient traffic noise affecting the building façade (when extrapolated from 2m to 5m, some 20 dB(A) lower during the day).

3.17 The signal externally shows modest peaks at the dominant electrical frequencies of 50 and 100 Hz and a more prominent peak at the harmonic frequency of 200 Hz. Internally, this peak is less pronounced (attenuated efficiently by the building structure) but there are more obvious peaks at 50 Hz and 100 Hz.

3.18 Section 5 of this report will discuss these noise levels, in respect of their suitability for residential building.

4. ASSESSMENT OF NOISE LEVELS

4.1 National Planning Policy Framework (July 2021)

4.1.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced.

4.1.2 Planning law requires that applications for planning permission be determined in accordance with the development plan unless material considerations indicate otherwise. The National Planning Policy Framework must be considered in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

4.1.3 The purpose of the planning system is to contribute to the achievement of sustainable development. At an extremely high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs.

4.1.4 Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

a) an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure.

b) a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

4.1.5 These objectives should be delivered through the preparation and implementation of plans and the application of the policies in this Framework; they are not criteria against which every decision can or should be judged. Planning policies and decisions should play an active role in guiding development towards sustainable solutions, but in doing so should take local circumstances into account, to reflect the character, needs and opportunities of each area.

4.1.6 So that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development.

4.1.7 Paragraph 185 of the NPPF states:

185. 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 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[1]

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; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes, and nature conservation.

4.1.8 The Framework continues:

187. 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.

188. The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.

[1] Refers here to the NPSE, discussed in Section 4.2 of this report.

4.2 Noise Policy Statement for England (June 2010)

4.2.1 The document "Noise Policy Statement for England" sets out the following vision for on-going noise policy:

"Promote good health and quality of life through the effective management of noise within the context of Government policy on sustainable development."

4.2.2 This vision should be achieved through the following Noise Policy Aims:

"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."

4.2.3 To achieve these objectives the Noise Policy Statement sets out three noise levels to be defined by the assessor:

- **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. Where levels lie between the LOAEL and SOAEL, the Statement requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, as set out in the NPPF.
- **SOAEL** - Significant Observed Adverse Effect Level
  This is the level above which significant adverse effects on health and quality of life occur. It notes, however, that "it is not possible to have a single objective noise-based measure that describes SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times."

4.2.3 Paragraph 2.7 states that "... the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a policy, development or other activity may have not been given adequate weight when assessing the noise implications."

4.2.4 This provides clear guidance that noise must not be considered in isolation but as part of the overall scheme, taking into account the overall sustainability and associated impacts of the proposed development; there is no benefit in reducing noise to an excessively low level if this

creates or increases some other adverse impact. Similarly, it may be appropriate in some cases for noise to have an adverse impact if this is outweighed by the reduction or removal of some other adverse impact that is of greater significance to the development.

4.2.5 The Noise Policy Statement considers that noise levels above the SOAEL would be seen to have, by definition, significant adverse effects and would be considered unacceptable. Where the assessed noise levels fall between the LOAEL and the SOAEL noise levels, the Policy Statement requires that:

> *"all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development...This does not mean that such adverse effects cannot occur."*

4.2.6 Where noise levels are below the LOAEL it is considered there will be no adverse effect. Once noise levels are below the NOEL there will be no observable change. An indication of the numerical definition of LOAEL may be derived from the following guidance.

4.3 DHCLG Guidance Note, 'Noise' (July 2019)

4.3.1 The Department of Housing Communities and Local Government provided further guidance to support the NPPF. The section, Noise, published in October 2019 advises:

When is noise relevant to planning?

Noise needs to be considered when development may create additional noise or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced). When preparing plans, or taking decisions about new development, there may also be opportunities to make improvements to the acoustic environment. Good acoustic design needs to be considered early in the planning process to ensure that the most appropriate and cost-effective solutions are identified from the outset.

Can noise override other planning concerns?

It can, where justified, although it is important to look at noise in the context of the wider characteristics of a development proposal, its likely users and its surroundings, as these can have an important effect on whether noise is likely to pose a concern.

How can noise impacts be determined?

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.

What are the observed effect levels?

- *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.*

Although the word 'level' is used here, this does not mean that the effects can only be defined in terms of a single value of noise exposure. In some circumstances adverse effects are defined in terms of a combination of more than one factor such as noise exposure, the number of occurrences of the noise in a given time period, the duration of the noise and the time of day the noise occurs.

How can it be established whether noise is likely to be a concern?

At the lowest extreme, when noise is not perceived to be present, there is no effect. As the noise exposure increases, it will cross the 'no observed effect' level. However, the noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude, or other physiological responses of those affected by it. The noise may slightly affect the acoustic character of an area but not to the extent there is a change in quality of life. If the noise exposure is at this level, no specific measures are required to manage the acoustic environment.

As the exposure increases further, it crosses the 'lowest observed adverse effect' level boundary above which the noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. The noise therefore starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

Increasing noise exposure will at some point cause the 'significant observed adverse effect' level boundary to be crossed. Above this level the noise causes a material change in behaviour such as keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present. If the exposure is predicted

to be above this level the planning process should be used to avoid this effect occurring, for example through the choice of sites at the plan-making stage, or by use of appropriate mitigation such as by altering the design and layout. While such decisions must be made taking account of the economic and social benefit of the activity causing or affected by the noise, it is undesirable for such exposure to be caused.

At the highest extreme, noise exposure would cause extensive and sustained adverse changes in behaviour and / or health without an ability to mitigate the effect of the noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be avoided.

4.3.2 Table 4.1 summarises the noise exposure hierarchy, based on the likely average response:

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not Present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g., turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Table 4.1 – Noise Exposure Hierarchy

4.3.3 The guidance further advises:

What factors influence whether noise could be a concern?

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 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 – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night.
- for a new noise making source, how the noise from it relates to the existing sound environment.
- for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise.
- the spectral content of the noise (i.e., whether or not the noise contains particular high or low frequency content) and the general character of the noise (i.e., whether or not the noise contains particular tonal characteristics or other particular features), and.
- the local arrangement of buildings, surfaces and green infrastructure, and the extent to which it reflects or absorbs noise.

More specific factors to consider when relevant include:

- the cumulative impacts of more than one source of noise.
- whether any 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 (and the effect this may have on living conditions). In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations.
- In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur.
- Noise Action Plans (where these exist), and the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations should be considered. Defra's website has information on Noise Action Plans and Important Areas. Local authority

environmental health departments will also be able to provide information about Important Areas.

- the effect of noise on wildlife. Noise can adversely affect wildlife and ecosystems. Consideration needs to be given to the potential effects of noisy development on international, national, and locally designated sites of importance for biodiversity.
- where external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.
- some commercial developments including restaurants, hot food takeaways, night clubs and public houses can have impacts, not least because activities are often at their peak in the evening and late at night. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises but also the noise that may be made by customers in the vicinity.

When proposed developments could include activities that would be covered by the licensing regime, local planning authorities will need to consider whether the potential for adverse noise impacts will be addressed through licensing controls (including licence conditions). Local planning authorities should not however presume that licence conditions will provide for noise management in all instances and should liaise with the licensing authority.

Can planning policies include noise standards?

Plans may include specific standards to apply to various forms of proposed development and locations in their area. Care should be taken, however, to avoid these being applied as rigid thresholds, as specific circumstances may justify some variation being allowed.

What factors are relevant if seeking to identify areas of tranquillity?

For an area to justify being protected for its tranquillity, it is likely to be relatively undisturbed by noise from human sources that undermine the intrinsic character of the area. It may, for example, provide a sense of peace and quiet or a positive soundscape where natural sounds such as birdsong or flowing water are more prominent than background noise, e.g., from transport.

Consideration may be given to how existing areas of tranquillity could be further enhanced through specific improvements in soundscape, landscape design (e.g., through the provision of green infrastructure) and/or access.

How can the risk of conflict between new development and existing businesses or facilities be addressed?

Development proposed in the vicinity of existing businesses, community facilities or other activities may need to put suitable mitigation measures in place to avoid those activities having a significant adverse effect on residents or users of the proposed scheme.

In these circumstances the applicant (or 'agent of change') will need to clearly identify the effects of existing businesses that may cause a nuisance (including noise, but also dust, odours, vibration and other sources of pollution) and the likelihood that they could have a significant adverse effect on new residents/users. In doing so, the agent of change will need to take into account not only the current activities that may cause a nuisance, but also those activities that businesses or other facilities are permitted to carry out, even if they are not occurring at the time of the application being made.

The agent of change will also need to define clearly the mitigation being proposed to address any potential significant adverse effects that are identified. Adopting this approach may not prevent all complaints from the new residents/users about noise or other effects but can help to achieve a satisfactory living or working environment and help to mitigate the risk of a statutory nuisance being found if the new development is used as designed (for example, keeping windows closed and using alternative ventilation systems when the noise or other effects are occurring).

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.

How can planning address the adverse effects of noise sources, including where the 'agent of change' needs to put mitigation in place?

This will depend on the type of development being considered the type of noise involved and the nature of the proposed location. In general, for developments that are likely to generate noise, there are 4 broad types of mitigation:

- engineering: reducing the noise generated at source and/or containing the noise generated.
- layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission using screening by natural or purpose-built barriers, or other buildings.
- using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night, and.

- mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building.

For noise sensitive developments, mitigation measures can include avoiding noisy locations in the first place; designing the development to reduce the impact of noise from adjoining activities or the local environment; incorporating noise barriers; and optimising the sound insulation provided by the building envelope. It may also be possible to work with the owners/operators of existing businesses or other activities in the vicinity, to explore whether potential adverse effects could be mitigated at source. Where this is the case, it may be necessary to ensure that these source-control measures are in place prior to the occupation / operation of the new development. Where multiple development sites would benefit from such source control measures, developers are encouraged to work collaboratively to spread this cost. Examples of source control measures could include increased sound proofing on a building (e.g., a music venue) or enclosing an outdoor activity (e.g., waste sorting) within a building to contain emissions.

Care should be taken when considering mitigation to ensure the envisaged measures do not make for an unsatisfactory development.

Are there further considerations relating to mitigating 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 facade (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 designated because of its tranquillity) that is nearby (e.g., within a 5-minute walking distance).

4.4 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

4.4.1 There is much guidance on the levels of intrusive noise which would be considered acceptable within residential accommodation such as this. Typical advice is found in British Standard 8233:2014 "Guidance on Sound Insulation and Noise Reduction for buildings." Following similar guidance in the 1999 World Health Organisation report "Guidelines for Community Noise", the Standard sets out the following limits for indoor ambient noise levels within living rooms and bedrooms of residential accommodation. This suggests:

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	35 dB(A) $L_{Aeq, 16\ hr}$	-
Dining	Dining room/Area	40 dB(A) $L_{Aeq, 16\ hr}$	-
Sleeping	Bedroom	35 dB(A) $L_{Aeq, 16\ hr}$	30 dB(A) $L_{Aeq, 8\ hr}$

Table 4.2 - BS8233 Indoor Guideline Values

4.4.2 It is usually considered that an open window will provide a reduction of some 10-15 dB(A)[2]. Therefore the 'good' internal standards quoted above would broadly equate to the following targets immediately outside the buildings:

Activity	Location	0700 - 2300	2300 - 0700
Resting	Living Room	48 dB(A) $L_{Aeq, 16\ hr}$	-
Dining	Dining room/Area	53 dB(A) $L_{Aeq, 16\ hr}$	-
Sleeping	Bedroom	48 dB(A) $L_{Aeq, 16\ hr}$	43 dB(A) $L_{Aeq, 8\ hr}$

Table 4.3 - BS8233 Derived Facade Guideline Values

4.4.3 BS8233 recognises that, where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB, and reasonable conditions will be achieved.

4.4.4 It should be noted that the levels quoted in BS8233 are intended to reflect the acceptability of steady, continuous noise. Sources of intermittent and tonal noise may generate greater annoyance for a similar overall magnitude. Whilst BS8233 does not explicitly state a correction for those circumstances, it may be appropriate to consider that the Good and Reasonable standards would be achieved with levels which are perhaps 5 dB lower than stated in the table above.

4.4.5 It is also noted that BS8233 was written from a view of designing new buildings to protect occupants from existing noise sources. This does necessarily infer, however, that the acceptability of an occupant to an absolute level noise within a building will be different if the introduction of the noise source post-dates the construction of the building.

4.5 World Health Organisation Guidelines

4.5.1 Further advice is provided in the 1999 WHO report "Guidelines for Community Noise".

4.5.2 This indicates that the steady noise level in external amenity areas, such as gardens or outdoor living areas should not exceed 55 dB(A) $L_{Aeq, t}$, and should preferably be designed below 50 dB(A) $L_{Aeq, t}$.

[2] Reference PPG24 Planning & Noise, which adopted a mid-range value of 13 dB(A)

4.5.3 The document also provides guidance on the impact of peak noise levels on sleeping conditions. This suggests that levels above 45 dB(A) L_{Amax} inside a bedroom would be disturbing to sleep. With windows open, this would equate to a level of approximately 58 dB(A) L_{Amax} externally.

4.6 Approved Document F Ventilation

4.6.1 Approved Document F of the Building Regulations (2010 edition, including all revisions) sets out the requirements for ventilation in dwellings. ADF describes three types of ventilation, summarised in the table below:

Type of Ventilation	Definition in ADF	Location/reason for ventilation	Required
Whole Dwelling Ventilation[3]	Whole building ventilation (general ventilation is normally continuous ventilation of rooms or spaces at a relatively low rate to dilute and remove pollutants and water vapour not removed by operation of extract ventilation, purge ventilation or infiltration, as well as supplying outdoor air into the building. For an individual dwelling this is referred to as 'whole dwelling ventilation.'	To provide fresh air to the building and to dilute and disperse residual water vapour not dealt with by extract ventilation as well as removing other pollutants which are released throughout the building	Continuously
Extract Ventilation	Extract ventilation is the removal of air directly from a space or spaces to the outside. Extract ventilation may be provided by natural means, e.g., by passive stack ventilation) or by mechanical means (e.g., by an extract fan or central system)	From rooms where most water vapour and/or pollutants are released, e.g., due to activities such as cooking or bathing. This is to minimise their spread to the rest of the building	Continuously or intermittently
Purge Ventilation	Purge ventilation is manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollution and/or water vapour. Purge ventilation may be provided by natural means (e.g., an openable window) or by a mechanical means (e.g., a fan)	Throughout the building to aid the removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating, or accidental released such as smoke from burnt food or spillage of water	Occasionally

Table 4.4 – ADF Types of Ventilation

[3] Not to be confused with 'background ventilation. ADF defines the term 'background ventilator' as a trickle vent.

4.6.2 Critically, ADF states:

> *Ventilation may also provide a means to control thermal comfort, but this is not controlled under the Building Regulations.*

4.6.3 It is important to differentiate between the need to provide 'purge ventilation' as required occasionally under ADF, against the provision of ventilation to help control overheating, which is not covered by the Building Regulations.

4.6.4 There are four types of ventilation described in ADF, as set out in the table below:

Ventilation System	Provision with ADF System / Purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
System 1: Background ventilation and intermittent extract fans	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
System 2: Passive Stack ("natural")	Background ventilators (trickle vents) and passive stack ventilation	Continuous via passive stack	Typically provided by opening windows
System 3: Continuous mechanical extract (MEV)	Continuous mechanical extract – minimum low rate. Trickle vents to provide inlet air	Continuous mechanical extract – minimum high rates. Trickle vents to provide inlet air	Typically provided by opening windows
System 4: Continuous mechanical supply and extract with heat recovery (MVHR)	Continuous mechanical supply and extract – minimum low rate	Continuous mechanical supply and extract – minimum high rate	Typically provided by opening windows

Table 4.5 – ADF Template Systems

4.6.5 With regard to the provision of purge ventilation within habitable rooms, the approved document notes:

> *There may be practical difficulties in achieving this (e.g., if unable to open a window due to excessive noise from outside)*

4.6.5 However, no objective guidance is provided in the Document to quantify an 'excessive' level of noise.

4.7 IOA/ANC Acoustics Ventilation and Overheating – Residential Design Guide

4.7.1 The Institute of Acoustic and Association of Noise Consultants have published the 'Acoustics Ventilation and Overheating – Residential Design Guide' (January 2020) to promote best practice in the design of residential buildings to control overheating in areas of high ambient noise.

4.7.2 When providing design targets inside the dwellings, the AVOG document advises that the internal noise standard of BS8233:2014 (as copied here in Table 5.1) should be achieved when providing adequate ventilation as defined in ADF. However, the document continues to propose that it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

4.7.3 This proposition is based on the fact that overheating will occur for only part of the time, during which there will be a trade-off between acoustic and thermal conditions, given that residents would have some control over their environment (a principle well established in the field of thermal comfort).

4.7.4 The guide indicates that the sound level difference across a façade, with standard opening windows, would be 13 dB(A), but that this figure may be greater if windows are shielded by balconies.

4.7.5 BS8233:2014 states that, if internal noise levels are no more than 5 dB greater than the levels shown here in Table 4.2, this would be a 'reasonable' standard. Therefore, if external noise levels do not exceed the following values when windows are open, conditions should be considered wholly acceptable, and therefore the threshold between No and Low Observed Adverse Effect Levels:

Location	0700 - 2300	2300 - 0700
Living Room	53 dB(A) LAeq, 16 hr	-
Bedrooms	53 dB(A) LAeq, 16 hr	48 dB(A) LAeq, 8 hr

Table 4.6 – Proposed LOAEL Façade Noise Levels with Windows Open

4.7.6 To consider the upper limit, beyond which internal conditions should not be deemed acceptable, reference is made to issue of speech interference. With reference to the numerical values in BS8233 (see Table 4.6 above), the AVOG document adopts an internal daytime limit of 50 dB(A), which would then equate to an external limit of 63 dB(A) when windows are open.

4.7.7 At night, reference is made to the WHO Night Noise Guidelines, which developed the original WHO Guidelines for Community Noise report. This states that if external noise levels exceed 55 dB(A) L_{Aeq}, 'adverse health effects occur frequency and a sizeable proportion of the population is highly annoyed, and sleep disturbed'.

4.7.8 The table below therefore may be taken to represent the threshold for SOAEL:

Location	0700 - 2300	2300 – 0700
Living Room	63 dB(A) LAeq, 16 hr	-
Bedrooms	63 dB(A) LAeq, 16 hr	55 dB(A) LAeq, 8 hr

Table 4.7 – Proposed SOAEL Threshold Façade Noise Levels with Windows Open

5. ASSESSMENT OF ENVIRONMENTAL NOISE LEVELS

5.1 Section 4.4.1 of this report has confirmed the British Standard guidance for internal noise levels within residential properties.

5.2 It is recommended that the house be designed to achieve the following levels with windows closed:

Living Rooms:	35 dB(A) $L_{Aeq,\ 07.00-23.00}$
Bedrooms:	30 dB(A) $L_{Aeq,\ 23.00-07.00}$, and
	45 dB(A) $L_{Amax,\ 23.00-07.00}$

5.3 With reference to the measured environmental noise levels described in Section 3, Table 5.1 defines the predicted external façade noise levels[4], dB(A) and overall performance targets of the new building. These figures are based initially on the targets of Para 5.2 and the measured noise levels given in Paras 3.8 & 3.9. Noise levels have been predicted using INoise V2022 rev1 Enterprise noise mapping software.

Elevation	External Noise Level[5]	Target Noise Level	Nom. Outside to Inside Level Difference
South West			
Living Room	64 dB(A) $L_{Aeq,\ 16hrs}$	35 dB(A) $L_{Aeq,\ 16hrs}$	29 dB(A)
Bedroom	56 dB(A) $L_{Aeq,\ 16hrs}$ 83 dB(A) L_{Amax}	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) L_{Amax}	38 dB(A)
North West			
Living Room	56[6] dB(A) $L_{Aeq,\ 16hrs}$	35 dB(A) $L_{Aeq,\ 16hrs}$	21 dB(A)
Bedroom	56 dB(A) $L_{Aeq,\ 16hrs}$ 83 dB(A) L_{Amax}	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) L_{Amax}	38 dB(A)
South East			
Living Room	61 dB(A) $L_{Aeq,\ 16hrs}$	35 dB(A) $L_{Aeq,\ 16hrs}$	26 dB(A)
Bedroom	53 dB(A) $L_{Aeq,\ 16hrs}$ 83 dB(A) L_{Amax}	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) L_{Amax}	38 dB(A)
North East			
Living Room	54 dB(A) $L_{Aeq,\ 16hrs}$	35 dB(A) $L_{Aeq,\ 16hrs}$	29 dB(A)
Bedroom	46 dB(A) $L_{Aeq,\ 16hrs}$ 73 dB(A) L_{Amax}	30 dB(A) $L_{Aeq,\ 8hrs}$ 45 dB(A) L_{Amax}	28 dB(A)

Table 5.1 – Predicted Facade Noise Levels

[4] Levels include a 3 dB increase over the free-field survey values, to account for the reflection in noise at the façade of the building.
[5] Note, for bedrooms, the peak noise level is the determining factor for the design of the façade.
[6] Allows for a 5 dB reduction provided by the screening of the traffic by the garden wall.

Building Specification

5.4 The walls to the building are existing solid stone, min. 300mm thick.

5.5 For the other façade elements, analysis indicates the following minimum requirements:

Glazing:

Location / Nominal Configuration	Minimum Sound Reduction, dB, at Octave Band Centre Frequency (Hz)							$R_w + C_{tr}$ dB
	63	125	250	500	1K	2K	4K	
Living Room Glazing:								
4 / 16 / 4	21	21	18	26	37	42	33	27
Bedroom Glazing (incl. roof lights):								
12 / 12 / 8.8A	28	31	35	42	47	53	58	39

Table 5.2 – Glazing Specification

Location	Minimum Sound Reduction, dB, at Octave Band Centre Frequency (Hz)							$D_{n,e,w}$ dB
	63	125	250	500	1K	2K	4K	
Living Room, Front	40	40	36	34	35	44	40	38
Living Room, Rear	40	38	35	35	31	32	35	33
Bedrooms	40	40	36	34	35	44	40	38

Table 5.3 – Passive Ventilator Specification

Element	Minimum Sound Reduction, dB, at Octave Band Centre Frequency (Hz)							R_w dB
	63	125	250	500	1K	2K	4K	
External Doors	18	21	27	37	39	38	40	35
Roof	29	43	52	58	62	59	61	60

Table 5.4 – Other Element Specifications

5.6 It is recognised that the performance specification for the bedrooms is significant, and confirmation will be required to confirm that both vertical windows and roof-lights can be sources to achieve these targets.

5.7 Acoustic vents achieving 33 or 38 dB Dn,e,w are readily available. If the vents are to be located in the window frames (rather than through the walls), reference is made to the range offered by R W Simon Limited.

5.8 With regard to the external doors, a 45mm thick solid timber leaf, set into a rebated frame, with effective weather proof seals all round would be acceptable.

5.9 The roof construction will require roofing tiles over the timber rafters. These should be packed with insulation to a depth of at least 200mm (if the existing rafters are less deep,

timber battens should be provided to increase the void). The ceiling to the underside of the rafters should be provided as 2 x 15mm SoundBloc plasterboard, secured to the rafters with 16mm deep British Gypsum RB1 Resilient bars.

Ventilation

5.10 It is presumed that background ventilation will be accommodated through the provision of trickle ventilators in the window head (or an equivalent passive grill set through masonry walls). These apertures represent a potential acoustic weakness and it is therefore necessary to ensure that the ventilators selected can sustain the acoustic performance of the other parts of the façade. To that end, Table 5.3 has detailed the minimum acoustic performance required from background ventilators around the building.

5.11 In respect of higher rates of ventilation, to deal with comfort cooling and overheating, the default strategy is usually to open windows.

5.12 It is usually taken that a partially open window will provide an attenuation of 10 – 15 dB(A) – a value of 13 dB(A) being commonly adopted.

5.13 It is also reasonably argued that some increase in internal noise would be acceptable if windows are open. Here, a 5dB tolerance would be suggested, reflecting the difference between a 'good' and a 'reasonable' standard indicated in BS8233:2014.

5.14 Therefore it can be assumed that open windows will not compromise a reasonable internal standard if the external noise level is within 18 dB(A) of the BS8233 'good' standard (ref. Para 5.2).

5.15 However, Table 5.1 has confirmed the predicted outside-to-inside sound level differences are greater than 18 dB(A) for all habitable rooms in the building. Therefore, if windows are open, the expectation will be one of high levels of noise internally.

5.16 If the Local Planning Authority judge this to be a material concern with a conversion of this nature, it would be necessary to provide a mechanical alternative which would allow residents to keep windows closed if they preferred.

5.17 The options for this solution would be as follows:

(i) A 'System 4' Mechanical Ventilation Heat Recovery (MVHR) Unit, which draws fresh air through an external grill (to be set at the rear of the property). The air is then ducted through the MVHR unit to room grills in the habitable rooms. Extract grills within the bathroom and kitchen then take exhaust air back through the MVHR unit, and discharge to a second external grill (again located on the quieter side of the building).

(ii) A 'System 3' Mechanical Extract Ventilation (MEV) system serving each habitable room. This draws air from the room and exhausts directly to atmosphere. Make-up air is provided through the passive ventilators (as discussed earlier).

5.18 The Client should consider the preferred approach, and provide confirmation so that the acoustic submission can reflect the particular proposal.

EXTERNAL AMENITY SPACE

5.19 The World Health Organisation indicates that, to protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq}.

5.20 For reference it is confirmed that the predicted noise levels in the garden areas would be between 55 and 60 dB(A) with current boundary treatment.

5.21 In order to reduce levels to the 55 dB(A) threshold, it is recommended that the garden area is shielded on the south-west and north-west boundaries with a close boarded timber fence[7], set 1.8m above the ground level of the garden. Though not strictly required, it may be desirable to extend the barrier around the north-east boundary, to provide screening of the substation also.

[7] Nom. 25mm thick timber boards, square edged and butt jointed, with a 25 x 150mm timber cover strip behind each joint. Vertical posts to be designed to avoid air gaps to the timber boards. At the base, barge boards should be used to close any gaps or direct line-of-sight to the road behind.

6. SUBSTATION NOISE

6.1 Noise levels within the building, in its current unfinished state, indicated a noise from the substation which was no greater than 30 dB(A).

6.2 As an overall volume, this value is within the targets of BS8233 for sleeping conditions.

6.3 However, when judging noise from mechanical equipment, it is more common to consider the sound levels in each frequency band, rather than just the overall volume. The usual measure is a Noise Rating curve, which effectively sets limits in each octave or one-third octave band, and the most commonly referenced guidance is the Chartered Institute of Building Services Engineers Design Guide A – Environment Design.

6.4 For residential bedrooms, the Guide indicates that the acceptable limit would be an overall volume of 30 dB(A), and a maximum Noise Rating of NR25.

6.5 An analysis of the frequency spectrum measured within the building (see Figure 4) would confirm a Noise Rating of NR20[8]

6.6 It is therefore concluded that noise from the substation will not adversely affect the amenity of residents within the building. No further acoustic measures, beyond those set out in Section 5 of this report, are required.

[8] Rating across the range 31.5 Hz to 250 Hz, representing the significant third-octave bands relevant to electrical substation noise. The Noise Rating of the measurement was greater at higher frequencies but this is a function of road traffic noise breaking into the building (something which will be reduced as the building shell is completed).

FIGURE 1 – SITE LOCATION PLAN

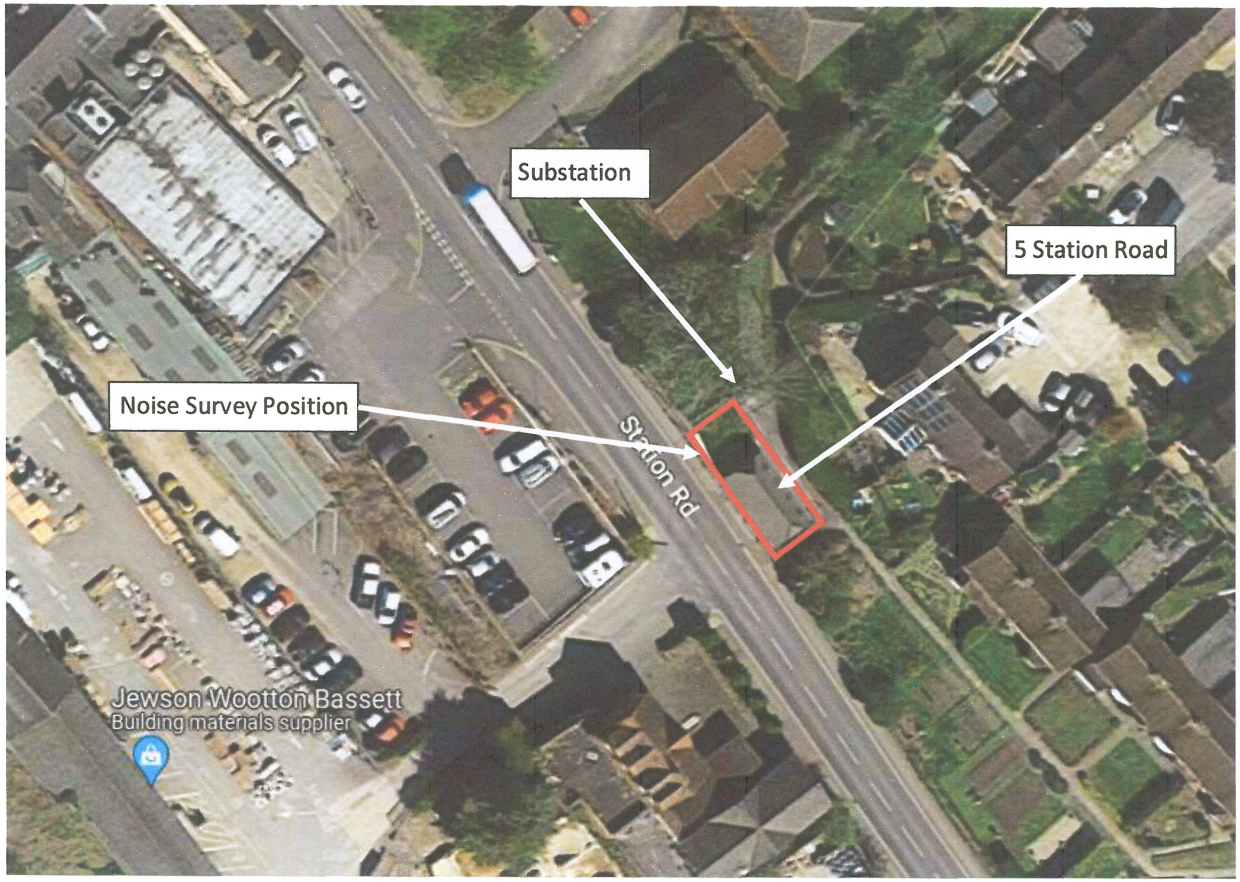


FIGURE 2 – PROPOSED FLOOR PLANS

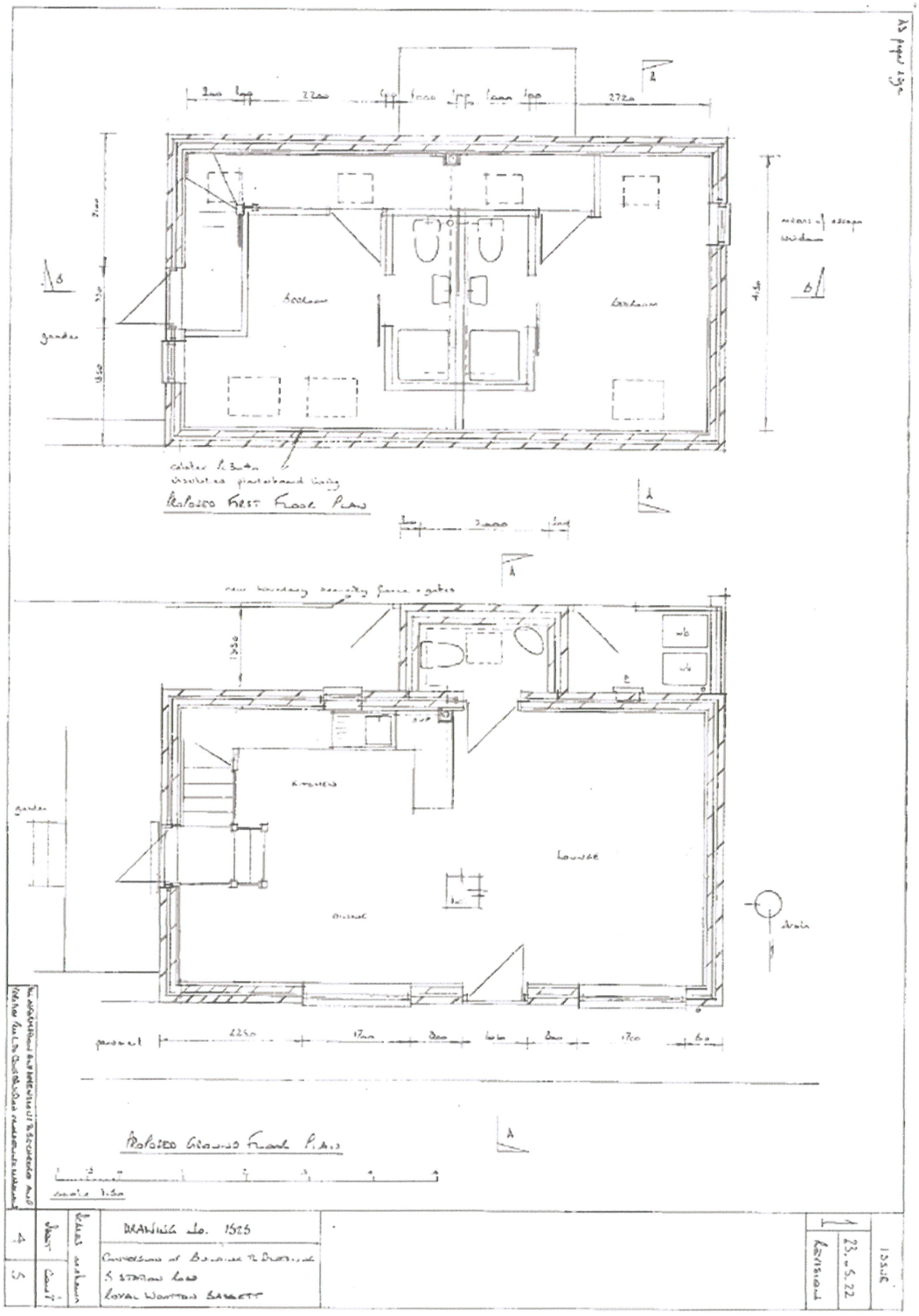


FIGURE 3 – VARIATION OF AMBIENT NOISE LEVELS

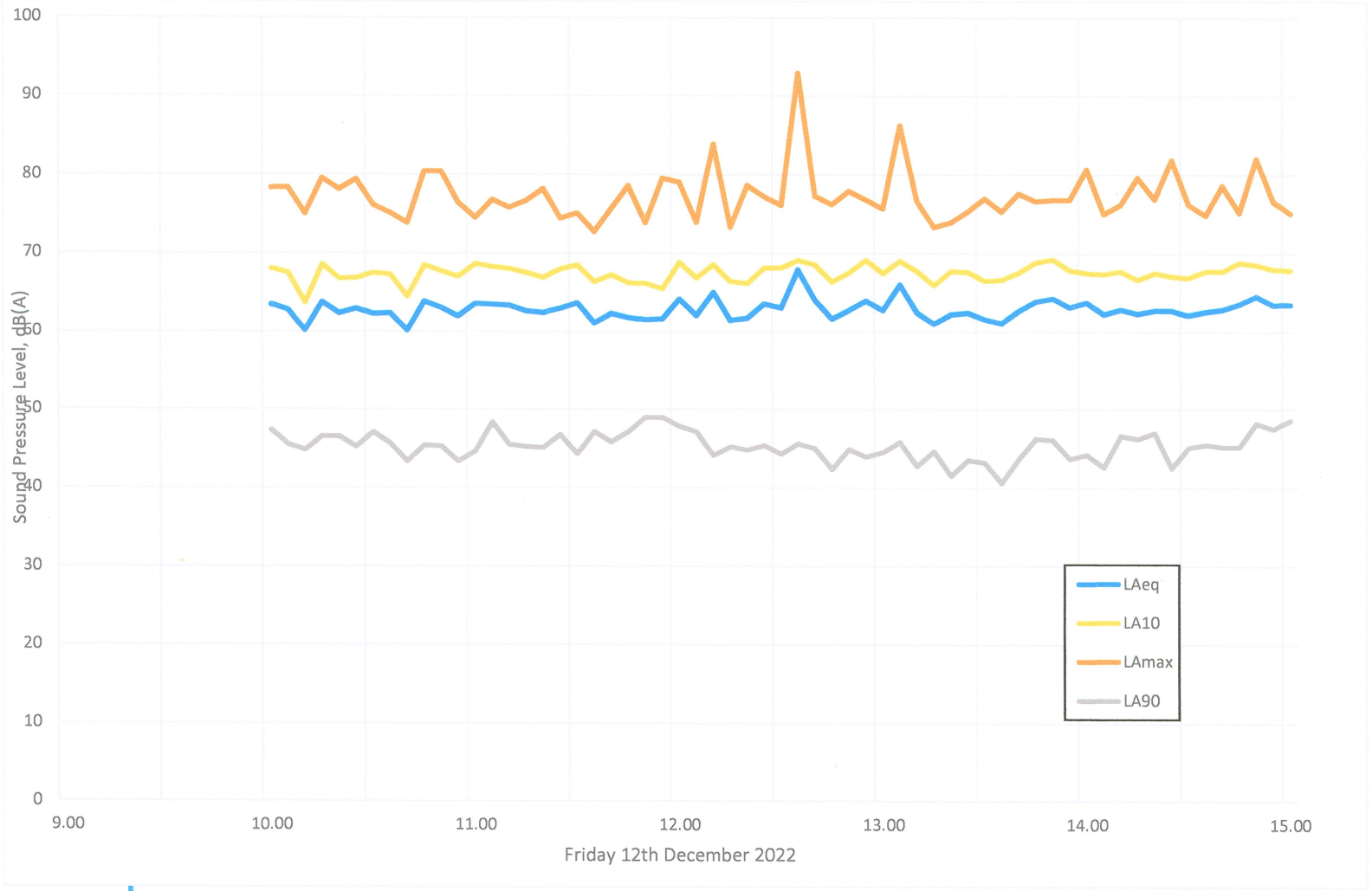
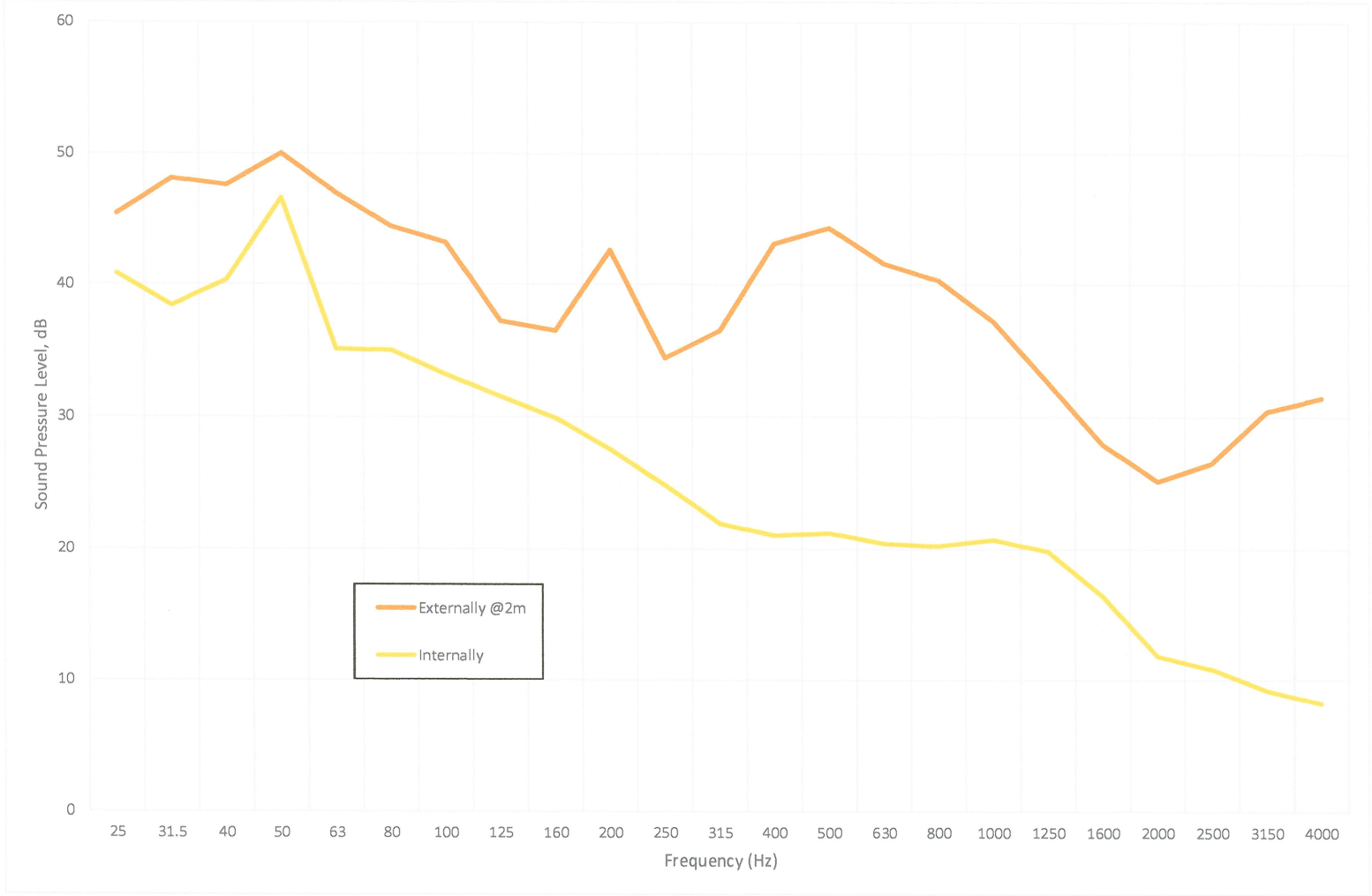


FIGURE 4 – FREQUENCY PROFILE OF SUBSTATION NOISE



APPENDIX 1 – PREDICTED OUTSIDE TO INSIDE NOISE LEVELS

Living Room										
Frequency	**Hz**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
South-West Elevation										
External Noise Level LAeq	**dB**	67	66	62	60	61	55	50	45	**64**
Glazing Specified: 27 dB Rw + Ctr (4/16/4)	dB	21	21	18	26	37	42	33	46	
Area of Windows	m2	3.5	1.32	1.32	1.32	1.32	1.32	1.32	1.32	
Area Correction	dB	5.4	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	
Net SPL Inside	dB	37.1	31.9	30.9	20.9	10.9	-0.1	3.9	-14.1	**25**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	
Area Correction	dB	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	
Net SPL Inside	dB	21.4	15.4	11.4	8.4	-0.6	-16.6	-31.6	-36.6	**9**
Dn,e,w Vents: 38 dB Dn,e,w	dB	40	40	36	34	35	44	40	45	
10logN (number of vents)	dB	3	3	3	3	3	3	3	3	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	
Net SPL inside via vent	dB	25.7	24.7	24.7	24.7	24.7	9.7	8.7	-1.3	**27**
External Door (Rw 35 dB)	dB	18	21	27	37	39	38	40	45	
Area of Door	m2	2	2	2	2	2	2	2	2	
Area Correction	dB	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	37	37	37	37	37	37	37	
Absorption		27	12	12	12	12	12	12	12	
Absorption Correction	dB	-14.3	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	
Net SPL Inside	dB	37.7	37.2	27.2	15.2	14.2	9.2	2.2	-7.8	**24**
Combination from South West elevation	**dB**	**41**	**39**	**33**	**27**	**25**	**13**	**11**	**0**	**30**
North-West Elevation										
External Noise Level LAeq	**dB**	59	58	54	52	53	47	42	37	**56**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	
Area Correction	dB	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	
Net SPL Inside	dB	10.6	4.6	0.6	-2.4	-11.4	-27.4	-42.4	-47.4	**-2**
External Door (Rw 35 dB)	dB	18	21	27	37	39	38	40	45	
Area of Door	m2	2	2	2	2	2	2	2	2	
Area Correction	dB	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	37	37	37	37	37	37	37	
Absorption		27	12	12	12	12	12	12	12	
Absorption Correction	dB	-14.3	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	
Net SPL Inside	dB	29.7	29.2	19.2	7.2	6.2	1.2	-5.8	-15.8	**16**
Combination from South West elevation	**dB**	**30**	**29**	**19**	**8**	**6**	**1**	**-6**	**-16**	**16**

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
South-East Elevation										
External Noise Level LAeq	**dB**	64	63	59	57	58	52	47	42	**61**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	
Area Correction	dB	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	
Net SPL Inside	dB	15.6	9.6	5.6	2.6	-6.4	-22.4	-37.4	-42.4	**3**
Total from South-East elevation	**dB**	**16**	**10**	**6**	**3**	**-6**	**-22**	**-37**	**-42**	**3**
North-East Elevation										
External Noise Level LAeq	**dB**	57	56	52	50	51	45	40	35	**54**
Glazing Specified: 27 dB Rw + Ctr (4/16/4)	dB	21	21	18	26	37	42	33	46	
Area of Windows	m2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Area Correction	dB	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	
Net SPL Inside	dB	23.4	22.4	21.4	11.4	1.4	-9.6	-5.6	-23.6	**15**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	12	12	12	12	12	12	12	12	
Area Correction	dB	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	-14.3	
Net SPL Inside	dB	10.5	4.5	0.5	-2.5	-11.5	-27.5	-42.5	-47.5	**-2**
Dn,e,w Vents: 33 dB Dn,e,w	dB	40	38	35	35	31	32	35	40	
10logN (number of vents)	dB	0	0	0	0	0	0	0	0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	
Net SPL inside via vent	dB	12.7	13.7	12.7	10.7	15.7	8.7	0.7	-9.3	**18**
Combination from North-East elevation	**dB**	**24**	**23**	**22**	**14**	**16**	**9**	**2**	**-9**	**19**
Combination of All Elevations	dB	**41**	**39**	**34**	**27**	**26**	**14**	**11**	**0**	
Tolerance	dB	3	3	3	3	3	3	3	3	
PREDICTED INTERNAL NOISE LEVEL	**dB**	**44**	**42**	**37**	**30**	**29**	**17**	**14**	**3**	**34**

Bedroom										
Frequency	**Hz**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
South-West Elevation										
External Noise Level LAmax	**dB**	90	86	80	79	79	73	72	62	**83**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	10	10	10	10	10	10	10	10	
Area Correction	dB	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	22	22	22	22	22	22	22	22	
Absorption		7	7	7	7	7	7	7	7	
Absorption Correction	dB	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	
Net SPL Inside	dB	48.5	39.5	33.5	31.5	21.5	5.5	-5.5	-15.5	**32**
Total from South West elevation	**dB**	**48**	**39**	**33**	**31**	**21**	**5**	**-6**	**-16**	**32**
South-East Elevation										
External Noise Level Lamax	**dB**	90	86	80	79	79	73	72	62	**83**
Glazing Specified: 39 dB Rw + Ctr (12/12/8.8A)	dB	28	31	35	42	47	53	58	58	
Area of Windows	m2	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	
Area Correction	dB	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	22	22	22	22	22	22	22	22	
Absorption		7	7	7	7	7	7	7	7	
Absorption Correction	dB	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	
Net SPL Inside	dB	55.3	48.3	38.3	30.3	25.3	13.3	7.3	-2.7	**36**
Dn,e,w Vents: 38 dB Dn,e,w	dB	40	41	42	37	43	46	40	40	
10logN (number of vents)	dB	0	0	0	0	0	0	0	0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	84	84	84	84	84	84	84	84	
Absorption		27	27	27	27	27	27	27	27	
Absorption Correction	dB	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	
Net SPL inside via vent	dB	45.7	40.7	33.7	37.7	31.7	22.7	27.7	17.7	**38**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	10	10	10	10	10	10	10	10	
Area Correction	dB	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	22	22	22	22	22	22	22	22	
Absorption		7	7	7	7	7	7	7	7	
Absorption Correction	dB	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	
Net SPL Inside	dB	48.5	39.5	33.5	31.5	21.5	5.5	-5.5	-15.5	**32**
Combination from South-East elevation	**dB**	**56**	**49**	**41**	**39**	**33**	**23**	**28**	**18**	**41**
Frequency	**Hz**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**
North-East Elevation										
External Noise Level LAmax	**dB**	80	76	70	69	69	63	62	52	**73**
External Wall	dB	43	48	48	49	59	69	79	79	
Area of Wall	m2	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	
Area Correction	dB	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	22	22	22	22	22	22	22	22	
Absorption		7	7	7	7	7	7	7	7	
Absorption Correction	dB	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	
Net SPL Inside	dB	36.6	27.6	21.6	19.6	9.6	-6.4	-17.4	-27.4	**20**
Total from South-East elevation	**dB**	**37**	**28**	**22**	**20**	**10**	**-6**	**-17**	**-27**	**20**

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Roof										
External Noise Level LAmax	**dB**	87	83	77	76	76	70	69	59	**80**
Glazing Specified: 39 dB Rw + Ctr (12/12/8.8A)	dB	28	31	35	42	47	53	58	58	
Area of Windows	m2	2	2	2	2	2	2	2	2	
Area Correction	dB	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	22	22	22	22	22	22	22	22	
Absorption		7	7	7	7	7	7	7	7	
Absorption Correction	dB	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	
Net SPL Inside	dB	53.5	46.5	36.5	28.5	23.5	11.5	5.5	-4.5	**35**
Roof Construction	dB	29	43	52	58	62	59	61	61	
Area of Facing Pitch	m2	5	5	5	5	5	5	5	5	
Area Correction	dB	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	
Likely RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	22	22	22	22	22	22	22	22	
Absorption		7	7	7	7	7	7	7	7	
Absorption Correction	dB	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	-8.5	
Net SPL Inside	dB	56.5	38.5	23.5	16.5	12.5	9.5	6.5	-3.5	**31**
Combination from Roof	**dB**	**58**	**47**	**37**	**29**	**24**	**14**	**9**	**-1**	**36**
Combination of All Elevations	dB	**61**	**52**	**43**	**40**	**34**	**24**	**28**	**18**	**42**
Tolerance	dB	3	3	3	3	3	3	3	3	
PREDICTED INTERNAL NOISE LEVEL	**dB**	**64**	**55**	**46**	**43**	**37**	**27**	**31**	**21**	**45**

APPENDIX 2 – TERMINOLOGY RELATING TO NOISE

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A scale, which considers the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
Leq,T	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
Lmax,T	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L90,T	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
L10,T	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m.
Façade Noise Level	At 1m in front of a large sound reflecting object such as a façade.
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Octave Band	Range of frequencies whose upper limit is twice the lower limit.
DnT,w	The single number quantity that characterises airborne sound insulation between rooms over a range of frequencies.
Rw	Single number quantity that characterises the airborne sound insulating properties of a material or building element over a range of frequencies.