

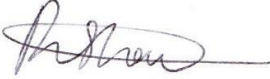
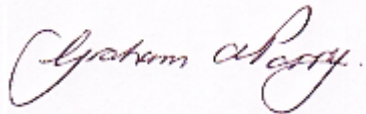
Report for:

John Filbee Properties Ltd

816 Oxford Road, Reading
Noise Impact Assessment

Status: Final

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1. INTRODUCTION

ACCON UK Limited (ACCON) has been commissioned by Weston & Co Architects Ltd on behalf of John Filbee Properties Ltd to carry out a noise assessment for the proposed residential development at 816 Oxford Road, Reading. The noise assessment is required to support a full planning application for the residential development of up to 25 dwellings over two blocks. The site is situated within an existing residential and commercial area.

The site is located within the administrative boundary of Reading Borough Council. A site location plan is presented in **Figure 1.1**.

Figure 1.1: Site Location Plan



This noise assessment is required to determine the impact of existing noise sources on the proposed residential development. Appropriate recommendations for noise mitigation are provided, where required.

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.

3. NOISE ASSESSMENT CRITERIA

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 is 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.

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 have 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 design of residential developments in terms of noise. This assessment shall utilise the guidance within the ProPG to determine the impact of noise on the proposed development.

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”.

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

Table 3.1: Phase 1 – Noise Risk Assessment

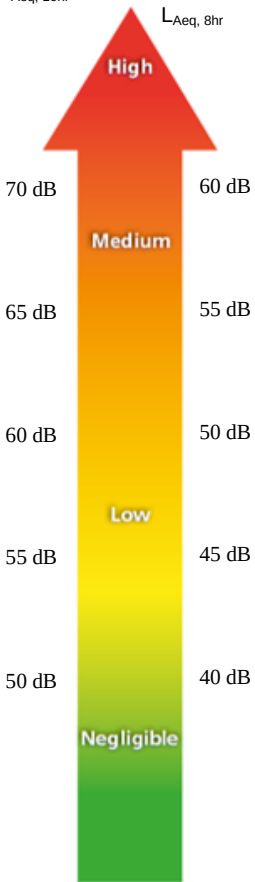
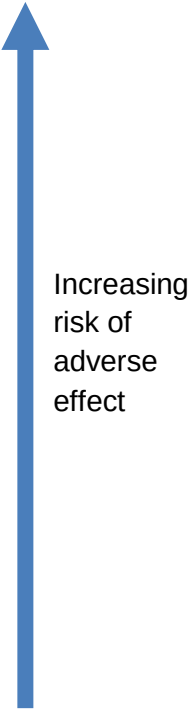
Noise Risk Assessment	Potential Effect Without Noise Mitigation	Pre-Planning Application Advice
Indicative Daytime Noise Levels $L_{Aeq, 16hr}$ Indicative Night-time Noise Levels $L_{Aeq, 8hr}$ 		High noise levels indicate that there is an increased risk that development may be refused on noise grounds. 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.		

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

Table 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 (Table 4 of the BS) for the residential environment are reproduced in **Table 3.3**.

Table 3.3: Indoor Ambient Noise Levels for Dwellings

Activity	Location	Daytime	Night-time
		0700 hrs to 2300 hrs	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

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 3.4**. For each specific environment, the stated noise levels are the maximum noise levels to avoid the health effect noted.

Table 3.4: 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. World Health Organization Environmental Noise Guidelines for the European Region

The World Health Organization (WHO) issued the *Environmental Noise Guidelines for the European Region* (ENG) in October 2018. The guidelines state that the main intended purpose is to “provide recommendations for protecting human health from exposure to environmental noise...” As the guidelines, which are source specific and not environment specific, are intended to be suitable for policy-making they focus on the most used noise indicators L_{den} and/or L_{night} for exposure at the most exposed façade outdoors. The ENG recommends that indoor guideline values within the WHO CNG (see **Section 3.5.3**) and “any values not covered by the current guidelines” should remain valid.

Table 3.5 provides a summary of the WHO ENG recommendations for road traffic noise, railway noise, aircraft noise and wind turbine noise.

Table 3.5: WHO Environmental Noise Guidelines Recommendations

Source	Average Noise Exposure (External)	Night Noise Exposure (External)
Road traffic noise	53 dB L _{den}	45 dB L _{night}
Railway noise	54 dB L _{den}	44 dB L _{night}
Aircraft noise	45 dB L _{den}	40 dB L _{night}
Wind turbine noise	45 dB L _{den}	No recommendation made
Leisure noise	70 dB L _{Aeq,24h}	Not applicable

In addition to the specific recommendations the following guiding principles have been developed:

- *“Reduce exposure to noise, while conserving quiet areas;*
- *Promote interventions to reduce exposure to noise and improve health;*
- *Coordinate approaches to control noise sources and other environmental health risks;*

Inform and involve communities potentially affected by a change in noise exposure”.

3.5.5. 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*

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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

3.6. 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 3.1** presents a copy of the AVO Guide Level 1 risk assessment scale.

Figure 3.1: AVO Guide Level 1 Risk Assessment Guidance

Risk category for Level 1 assessment ^[Note 5]	Potential Effect without Mitigation	Recommendation for Level 2 assessment
LAeq,T ^[Note 3] during 07:00 - 23:00 LAeq,8hr during 23:00 - 07:00 65 dB 55 dB 60 dB 50 dB 55 dB 45 dB High Medium Low Negligible	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.

3.7. Target Noise Levels

The target internal and external noise levels for new residential dwellings have been derived from the ProPG, BS 8233 and the WHO guidelines and primarily relate to noise without specific character (i.e. road traffic).

3.7.1. Internal Noise Levels

Noise levels within habitable rooms (i.e. living rooms and bedrooms) should achieve a daytime noise level below 35 dB $L_{Aeq, 16hr}$ and a night-time noise level of 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.

3.7.2. 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 $L_{Aeq, 16hr}$.

4. NOISE MEASUREMENT SURVEY

A detailed noise measurement survey was carried out at the site in order to determine the extent to which the site is currently affected by noise from road traffic and existing commercial/industrial uses. Noise measurements were carried out in order to characterise the existing noise climate over a 24-hour period. The noise measurements were carried out between 1050 hrs on Tuesday 7th September 2021 and 1100 hrs on Wednesday 8th September 2021. Two noise monitoring positions were utilised. The measurement positions have been identified in **Figure F.1**. The noise measurement at **MP1** was carried out over a three-hour period in accordance with Paragraph 43 *Shortened Measurement Procedure* of the Department of Transport's Technical Memorandum Calculation of Road Traffic Noise (CRTN).

The weather conditions recorded on Tuesday 7th September 2021 were dry with 0% cloud cover. The wind was recorded from a south easterly direction with speeds of less than 1 m/s and a temperature of 32°C.

At the end of the noise measurement period there was 0% cloud cover and a southerly wind with speeds of less than 1 m/s. There was a temperature of 28°C. Based on the data obtained from Weather Underground³, the weather conditions throughout the noise survey were suitable for noise measurements.

The noise measurements utilised two Svantek 971 Class 1 Sound Level Meters. Both of these meters hold current certificates of calibration, which are available upon request. The equipment was field calibrated before and after the noise measurement period to ensure that it had remained within reasonable calibration limits (± 0.5 dB). **Table 4.1** details the noise measurement locations and the noise sources observed during the noise survey.

Table 4.1 Noise Measurement Locations

Location Reference	Location Description	Measurement Duration	Observed Noise Sources
MP1	On the south-western boundary of the site, approximately 5 m to the north-east of Oxford Road.	1 x 3-hour period	Road traffic on Oxford Road was the dominant noise source.
MP2	On the north-eastern boundary of the site.	24-hours	The use of power tools at Clifton Motors to the east of the site was the dominant noise source. Distant road traffic noise from Oxford Road was also audible.

³ <https://www.wunderground.com/dashboard/pws/IREAD13/graph/2021-09-7/2021-09-7/daily>, accessed 4th October 2021
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The daytime and night-time free-field noise levels measured at **MP1** and **MP2** are summarised in **Table 4.2** and **Table 4.3**.

Table 4.2 Summary of Free-Field Noise Levels from Satellite Noise Monitoring

Measurement Position	Period (hours)	L _{Aeq, T} (dB)	L _{AFmax} (dB)	Average L _{A10, 5min} (dB)	Average L _{A90, 5min} (dB)
MP1	1055 - 1355	71	99	72	61

Note: The noise measurements were carried out over consecutive five-minute periods. The L_{Aeq, 5min} was subsequently logarithmically averaged over the time period,, the Average L_{A10, 5min} and Average L_{A90, 5min} were arithmetically averaged and the L_{AFmax} is the highest measured noise level in each time period.

Table 4.3 Summary of Free-Field Noise Levels from Semi-Permanent Noise Monitoring

Measurement Position	Period (hours)	L _{Aeq, T} (dB)	L _{AFmax} (dB)	Average L _{A10, 5min} (dB)	Average L _{A90, 5min} (dB)	Modal L _{A90, 5min} (dB)
MP2	Daytime (0700 hrs – 2300 hrs)	51	83	52	46	46
	Night-time (2300 hrs – 0700 hrs)	47	72 (65)	48	42	40

Note: The noise measurements were carried out over consecutive five-minute periods. The L_{Aeq, 5min} was subsequently logarithmically averaged over the time periods, the Average L_{A10, 5min} and Average L_{A90, 5min} were arithmetically averaged and the L_{AFmax} is the highest measured noise level in each time period with the tenth highest measured noise level in brackets.

The calculation of the L_{Aeq, 16hr} and L_{Aeq, 8hr} noise levels for **MP1** has been carried out utilising the equations developed by TRL and Casella Stanger⁴. A summary of the calculated noise levels are identified in **Table 4.4**.

Table 4.4 Calculated Noise Measurement Results

Monitoring Position	Measured L _{A10, 3hr} (dB)	Measured L _{AFmax} (dB)	Calculated L _{A10, 18hr} (dB)	Calculated L _{Aeq, 16hr} (dB)	Calculated L _{Aeq, 8hr} (dB)
MP1	72	99	71	68	60

⁴ Method for Converting the UK Road Traffic Noise Index LA10, 18hr to the EU Noise Indices for Road Noise Mapping, 2006, TRL and Casella Stanger, report for DEFRA.

5. NOISE IMPACT ASSESSMENT

5.1. Noise Modelling

The CadnaA noise modelling software has been utilised to calculate the external noise levels from road traffic movements 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 methodology in the Department of Transport's Technical Memorandum 'Calculation of Road Traffic Noise' (CRTN) to predict the noise levels from road traffic.

The results of the noise measurement survey detailed in **Section 4** have been utilised to calibrate the noise model of the existing site.

5.2. ProPG Stage 1: Initial Site Noise Risk Assessment

Figure F.2 presents the daytime and night-time ($L_{Aeq, T}$) noise contours for the site at ground floor level (a height of 1.5 m). **Figure F.3** presents the daytime and night-time ($L_{Aeq, T}$) noise contours at second floor level (a height of 8.5 m), which is the highest floor level at Block B. **Figure F.4** presents the daytime and night-time ($L_{Aeq, T}$) noise contours at sixth floor level (a height of 21.5 m), which is the highest floor level.

For the purpose of the initial site noise risk assessment, it has been assumed that the site topography will not be significantly altered from the current topography.

Figure F.2, Figure F.3 and Figure F.4 indicate that the site, at all levels, is generally of a low to medium risk of adverse noise effect during the daytime period. During the night-time, the site is generally of a medium to high risk of adverse noise effect with areas of greatest risk closest to Oxford Road.

5.3. ProPG Stage 2: Noise Impact Assessment

5.3.1. External Noise Levels

The CadnaA noise model has been utilised to calculate the external free-field period noise levels at the facades of the buildings in order to inform the assessment of internal noise levels. The receivers at the proposed buildings have been labelled with reference to the block and façade, such as: ASE: this naming convention is illustrated in **Figure F.5**.

The daytime external noise levels ($L_{Aeq, 16hr}$) predicted using the CadnaA noise model have been compared against the target external noise level range of 50 dB to 55 dB $L_{Aeq, 16hr}$ within amenity areas. Amenity areas could include communal garden areas and private balconies and terraces.

Table 5.1 below identifies the daytime external noise levels for amenity spaces. The amenity space receptors are identified in **Figure F.5** to represent private balconies for each façade of the proposed development.

Table 5.1 External Amenity Area Noise Levels

Receptor	Block	External Noise Level $L_{Aeq, 16hr}$ (dB)	Within or Below Target Noise Level Range?
ANE1	A	40 – 49	✓
ANE2	A	41 - 49	✓
ANE3	A	42 - 53	✓
ASW1	A	64 - 67	X
ASW2	A	65 - 67	X
ASW3	A	65 - 67	X
BNE1	B	45 - 47	✓
BNE2	B	44 – 47	✓
BNE3	B	44 - 46	✓
BSW1	B	56	X
BSW2	B	55	✓
BSW3	B	53 - 55	✓

Amenity areas for the ground floor of BNE1, BNE2 and BNE3 are gardens. All other amenity areas are balconies.

It can be identified in **Table 5.1** that balconies and terraces which have a direct line of sight to Oxford Road are unlikely to be within the target noise level range. Balconies and gardens on other facades are predicted to experience noise levels below 55 dB $L_{Aeq, 16hr}$.

A noise reduction of 1 to 2 dB may be achievable by providing solid balustrades to the balconies. It is also recommended where possible, that acoustically absorptive materials are provided to the soffit of balconies to reduce reflections of noise within balconies below. However, noise levels in the worst-affected balconies are likely to remain above the upper target noise level of 55 dB $L_{Aeq, 16hr}$ without being fully enclosed. In these circumstances, BS 8233 advises that *“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.”*

It should be noted that the residents of flats with balconies on noisier facades also have access to a quieter communal area immediately to the rear (north-east) of Block A. There is also a nearby public park (McIlroy Park), which is located within a distance of approximately 1.1 km from 816 Oxford Road. Noise levels to the north-east of Block A should readily achieve the target of 50 dB to 55 dB $L_{Aeq, 16hr}$ or lower, as demonstrated in **Table 5.1**.

5.3.2. 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 for outside to inside of 15 dB”.

The highest predicted noise levels will be as a result of maximum noise levels (L_{AFmax}). For the L_{AFmax} at MP1, as it was not possible to leave the equipment overnight, the noise data has been processed in order to remove any extraneous noise sources that are unlikely to occur during the night-time period, for example people talking near the sound level meter, and the tenth highest maximum noise level has been identified as a worst case for the night-time maximum noise levels. The predicted tenth highest noise level at MP1 was 81 dB. The tenth highest measured L_{AFmax} noise level at MP2 was 65 dB⁵. **Table 1** of **Appendix 2** presents the predicted free-field daytime and night-time external and internal noise levels at the building facades assuming open windows for ventilation. The L_{AFmax} from MP1 and MP2 were distance corrected to obtain the noise level at the building façade. Where the target internal noise levels are exceeded with open windows for ventilation, the minimum combined façade sound reduction which would be required to ensure that the target noise levels would be achieved is provided.

It can be determined from the information in **Table 1** of **Appendix 2** that rooms with windows on the south-western façade of Block A will require the highest levels of building envelope sound reduction.

5.3.3. Glazing

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), and therefore the glazing and any ventilation openings will be the weakest elements of the building façade. **Table 5.2** below indicates the different types of glazing specifications for the required attenuation of the proposed buildings.

Table 5.2 Glazing Specifications

Required Attenuation	Example of Glazing
Up to 28 dB(A)	Typical double-glazed window systems (i.e. in a 4 mm glass, 6 mm to 16 mm air gap, 6 mm glass formation)

⁵ The tenth highest L_{AFmax} during the night-time has been utilised for the internal noise level assessment because ProPG and WHO guidelines state that 45dB L_{AFmax} should not be exceeded more than ten times during the night-time period.

29 dB(A)	Glazing in a 10 mm glass, 6 mm to 16 mm air gap, 4 mm glass formation, or similar
32 dB(A)	Glazing in a 10 mm glass, 6 mm to 16 mm air gap, 6 mm glass formation
34 dB(A)	Saint-Gobain Stadip laminated glazing in a 8 mm glass, 16 mm air gap, 8.8 mm glass formation ⁽¹⁾

Note (1): Other brands of high-performance glazing or other configurations of glazing could be also utilised for the development.

5.4. Acoustics, Ventilation and Overheating

Whole dwelling ventilation, which is defined in the Building Regulations Approved Document F (ADF) as the dilution and removal of pollutants and water vapour, should be achievable through the provision of open windows, acoustic trickle ventilators, acoustically treated through-wall ventilators or mechanical means of whole house ventilation.

Purge ventilation is typically only required for short periods of times to let out smoke or an odour. When purge ventilation is required by opening windows, exposure to noise will only increase for very short period of time and is not considered to be a material consideration for the proposed development.

The requirement to achieve the target internal noise levels with windows closed may result in the unintended adverse consequences associated with thermal comfort.

In respect of thermal comfort, noise can be considered an issue as windows may otherwise need to be left open for an extended period of time, for example, on warm summer days and nights. In Britain, the requirement for keeping windows open for thermal comfort is typically limited to a relatively small number of days during May to September.

The following advice is provided in ProPG Paragraph 2.34:

“Special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment”.

ProPG also states in paragraph 2.36:

“it should be noted that overheating issues will vary across the country and any specific design solutions will need to be developed alongside advice from energy consultants”.

5.4.1. Level 1 Site Risk Assessment

The Level 1 AVO Assessment has identified that the internal ambient noise level of habitable rooms for the majority of Block B would be of a low risk. The north-east façade of Block A (ANE) and the south-west façade of Block B, which has a line of sight to Oxford Road (BSW1), would be of a medium risk. The façade directly overlooking Oxford Road of Block A would be of a high risk. A more detailed Level 2 assessment is recommended for rooms on

the high risk façade to determine whether internal noise levels meet the guideline values within the AVO Guide during the overheating scenario.

5.5. Commercial Noise Assessment

5.5.1. Specific Sound Levels

When ACCON personnel attended the site, commercial activity was taking place at Clifton Motors (a car repair garage). A car with its engine being revved was witnessed and has been utilised to carry out a BS 4142 assessment. Specific sound levels have been calculated from the data obtained at **MP2**.

5.5.2. Background Sound Levels

The typical (modal) background sound level ($L_{A90, 5min}$) in **Table 4.3** at **MP2** during the daytime period has been utilised. **MP2** is considered to be most representative of the background sound levels for the majority of the proposed site.

5.5.3. BS 4142 Assessment

Table 5.3 presents the results of a BS 4142 assessment for the observed operation of Clifton Motors at **MP2**. The specific sound level was a result of a motor vehicle being revved, which is likely to be a relatively infrequent occurrence.

Table 5.3 Daytime BS 4142 Assessment

Results	Noise Level at MP2	Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level $L_{A90, T}$ (dB)	46	8.1, 8.2	A background sound level during the daytime period.
Specific Sound Level $L_{Aeq, 1hr}$ (dB)	44	7.3	Determined from the measured noise levels at MP2 and on site observations
Acoustic Feature Correction (dB)	+3	9.1, 9.2, 9.3	An Acoustic Feature Correction of +3dB for Intermittency
Rating Sound Level $L_{Aeq, 1hr}$ (dB)	47	9.1	(Specific Sound Level + Acoustic Feature Correction)
Excess of Rating Sound Level over	+1		

Results	Noise Level at MP2	Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level			
Initial Estimate of Impact	Low Impact		

The assessment of the available data identifies that there would be an indication of a low impact on the proposed development.

Motor vehicle garages will typically use a range of different high noise level tools during the work day. ACCON has previously measured noise levels of 81 dB $L_{Aeq, T}$ at one metre distance for an electric torque wrench. This has been distance corrected to the nearest proposed façade. As a worst case scenario it has been assumed that it will be used for a 5-minute period in any one hour.

Table 5.4 Daytime BS4142 Assessment: Electric Torque Wrench

Results	Noise Level at MP2	Relevant Clauses of BS 4142:2014	Commentary
Background Sound Level $L_{A90, T}$ (dB)	46	8.1, 8.2	A background sound level during the daytime period.
Specific Sound Level $L_{Aeq, 1hr}$ (dB)	51	7.3	Distance corrected to 10 m to represent the nearest façade
Acoustic Feature Correction (dB)	+3	9.1, 9.2, 9.3	An Acoustic Feature Correction of +3dB for Intermittency
Rating Sound Level $L_{Aeq, 1hr}$ (dB)	54	9.1	(Specific Sound Level + Acoustic Feature Correction)
Excess of Rating Sound Level over Background Sound Level	+8		
Initial Estimate of Impact	Adverse Impact		

It is proposed to install a 2 m acoustic fence with no gaps and a minimum density of 10 kg/m³ or brick wall between the site boundary and Clifton Motors to reduce the noise impact on the lower floors of the proposed dwellings.

Although there is an adverse impact from the assessment of the use of an electric torque wrench, the noise levels within habitable rooms that overlook Clifton Motors will be approximately 15 dB lower with open windows, which is likely to result in a low impact.

5.5.4. Discussion of Context

When considering the impact of noise using BS 4142 it is necessary to consider the context of the noise.

The dominant noise source throughout the daytime is road traffic noise. Clifton Motors operates during the daytime period of 0900 hrs to 1800 hrs. Therefore, only a daytime assessment has been carried out.

The calculation of specific sound levels has utilised the measurement data for MP2 during the period that was observed by ACCON personnel as a car being revved by Clifton Motors. This is similar in character to the movement of traffic on Oxford Road therefore, is not considered to be a change in noise character.

For the specific sound level of an electric torque wrench, data previously measured by ACCON has been utilised.

5.5.5. Discussion of Uncertainty

ACCON carried out a 24-hour semi-permanent noise measurement and on-site observations on a weekday to obtain typical background sound levels representative of proposed noise sensitive receptors. It is considered that the noise measurement was carried out on a reasonably typical day for background sound levels. The weather conditions were considered to be suitable at the time of noise survey.

It is considered that the effects of uncertainty have been minimised as far as possible based on the information available to support this assessment.

6. ACOUSTIC DESIGN STATEMENT

An environmental noise survey has been carried out at the site and a detailed noise model has been prepared for the proposed development. The noise model has been calibrated utilising on-site noise measurements.

6.1. Initial Site Noise Risk Assessment

The initial site noise risk assessment has identified that the site is of a low to medium risk of adverse noise effect during the daytime and a medium to high risk of adverse noise effect during the night-time.

6.2. External Noise Levels

The assessment of external noise levels identifies that balconies overlooking Oxford Road are predicted to exceed the upper target noise level. Solid balustrades to all balconies and acoustic absorption to the underside of balconies, where relevant, would assist in reducing the noise levels in these amenity areas. The noise levels are likely to remain above the upper target noise level of 55 dB $L_{Aeq, 1hr}$, however, the majority of residents will have access to a relatively quiet communal external area and also to a relatively quiet, external publicly accessible amenity space which is located within a distance of 1.1 km of the site.

6.3. Internal Noise Levels

It has been identified that in the north-east of Block A and B, internal noise levels would be achieved with open windows for ventilation with respects to the 5 dB relaxation in ProPG.

Windows to habitable rooms for ground floor to third floor, in the south-west facades of Block A should achieve a minimum sound reduction of 34 dB(A), and for fourth floor and fifth floor, windows should achieve a minimum sound reduction of 32 dB(A). In the south-west, north-west and southeast of Block B, a minimum sound reduction of 28 dB(A) is required which should be achievable through standard double glazed windows.

Recommendations of glazing specifications which should achieve this level of sound reduction have been provided in **Section 5.3.3**.

6.4. Recommendations to the Decision Maker

On the basis of the above, and the commercial noise assessment provided in **Section 5.5**, it is recommended that there should be no objection to granting planning consent for the proposed development on noise grounds.

ADDITIONAL FIGURES

Figure F.1: Noise Measurement Positions

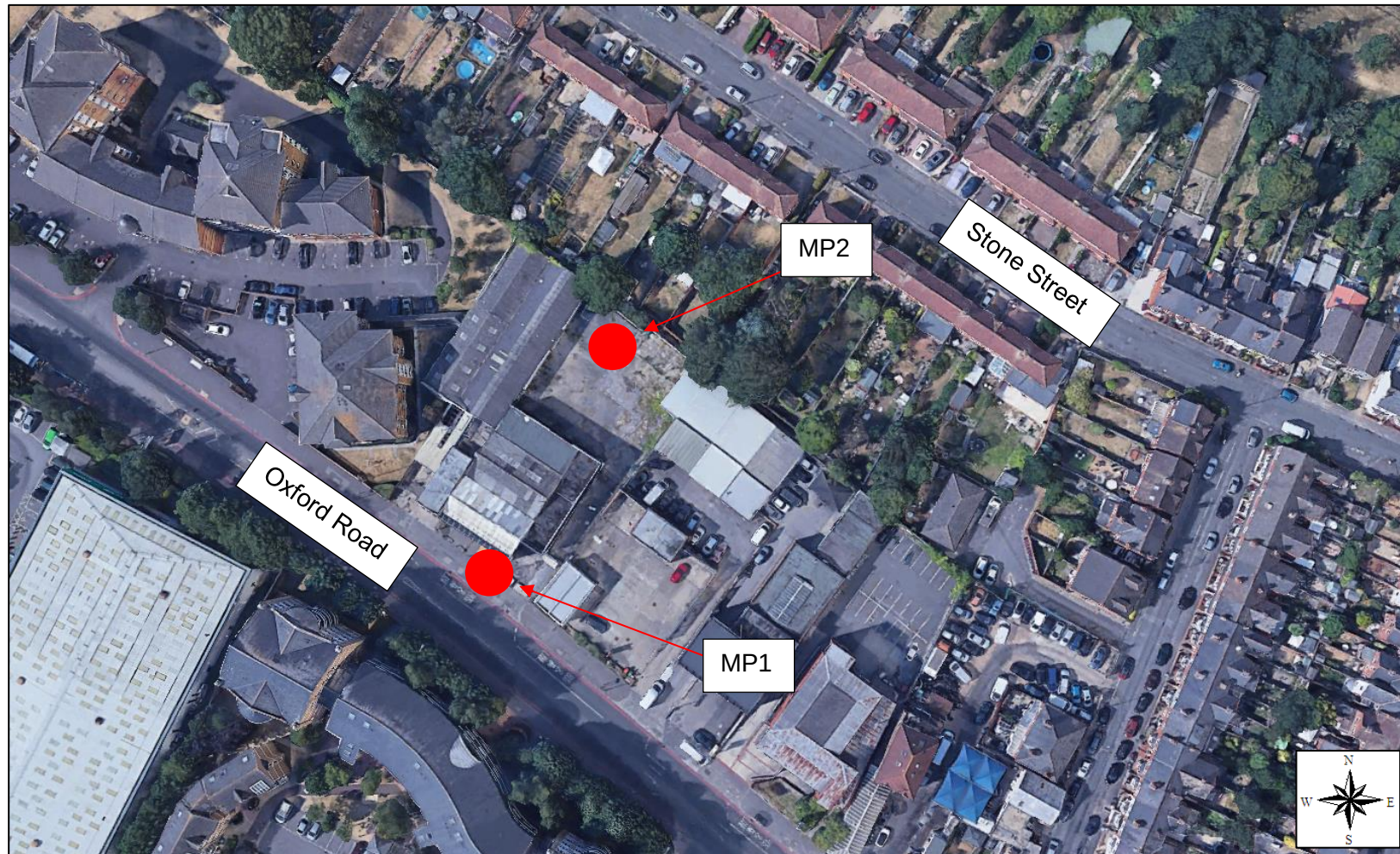


Figure F.2: ProPG: Initial Site Noise Risk Assessment Ground Floor (Height 1.5 m)

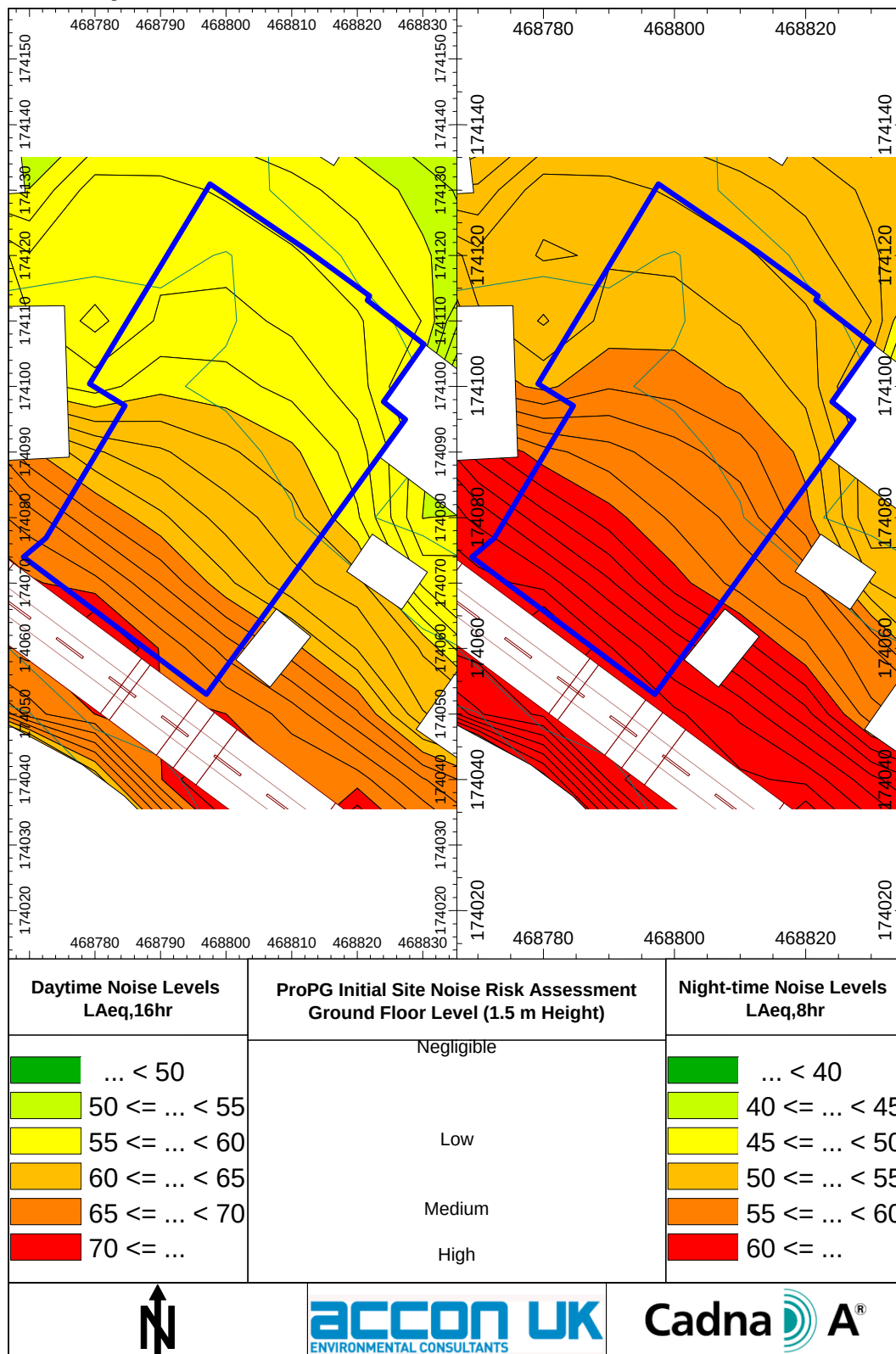


Figure F.3: ProPG: Initial Site Noise Risk Assessment Second Floor (Height 8.5 m)

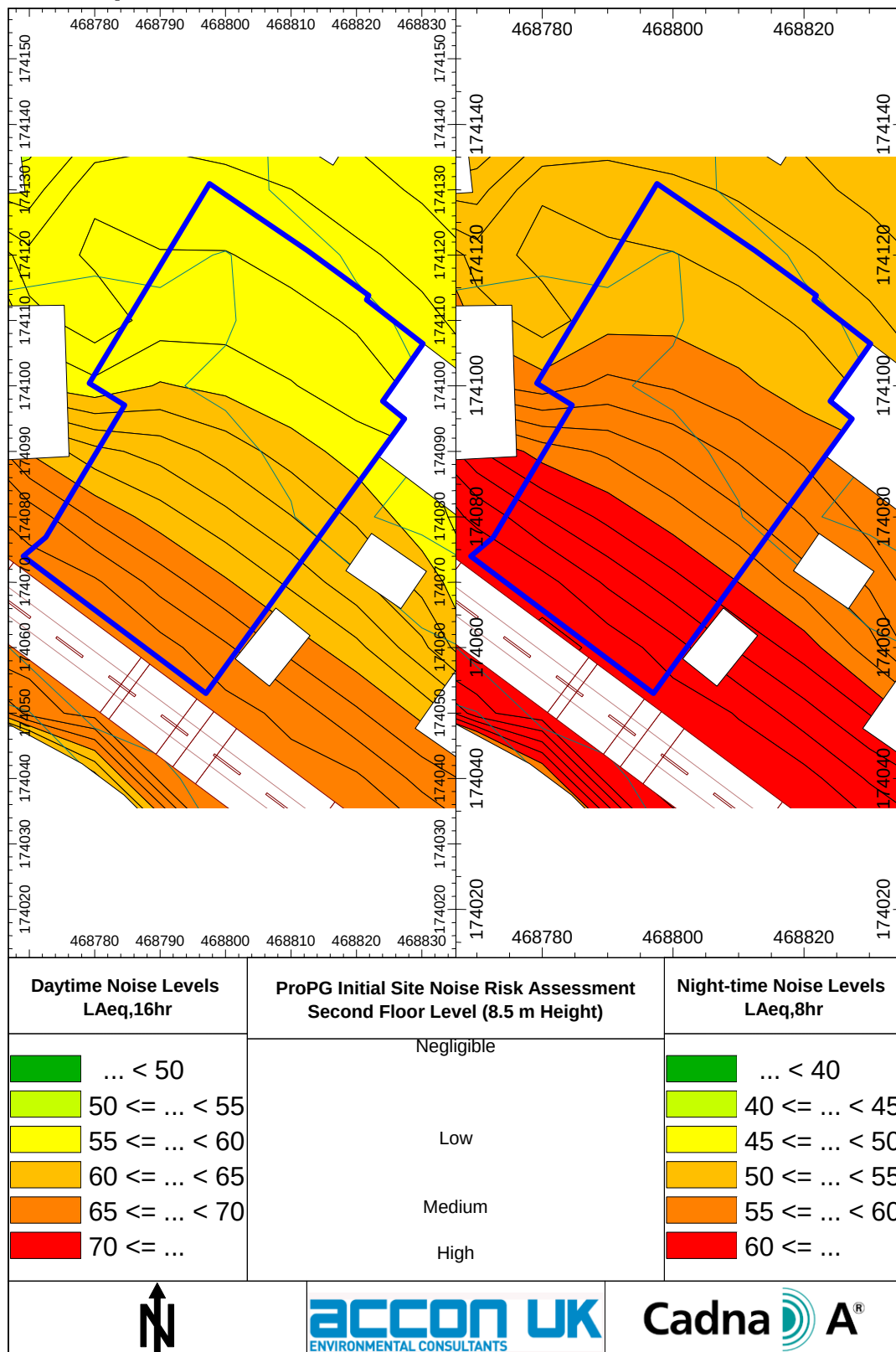


Figure F.4: ProPG: Initial Site Noise Risk Assessment Fifth Floor (Height 21.5 m)

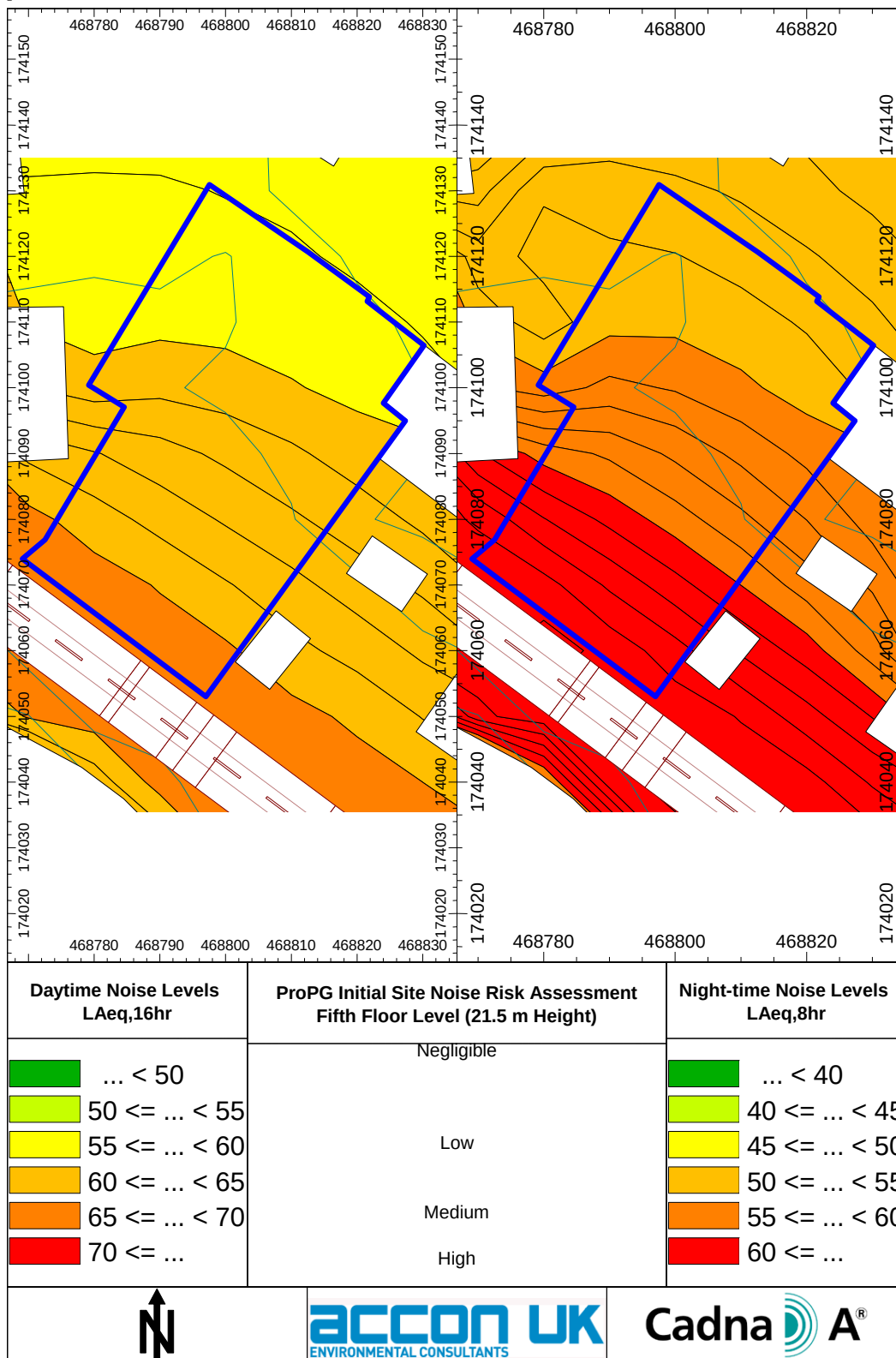
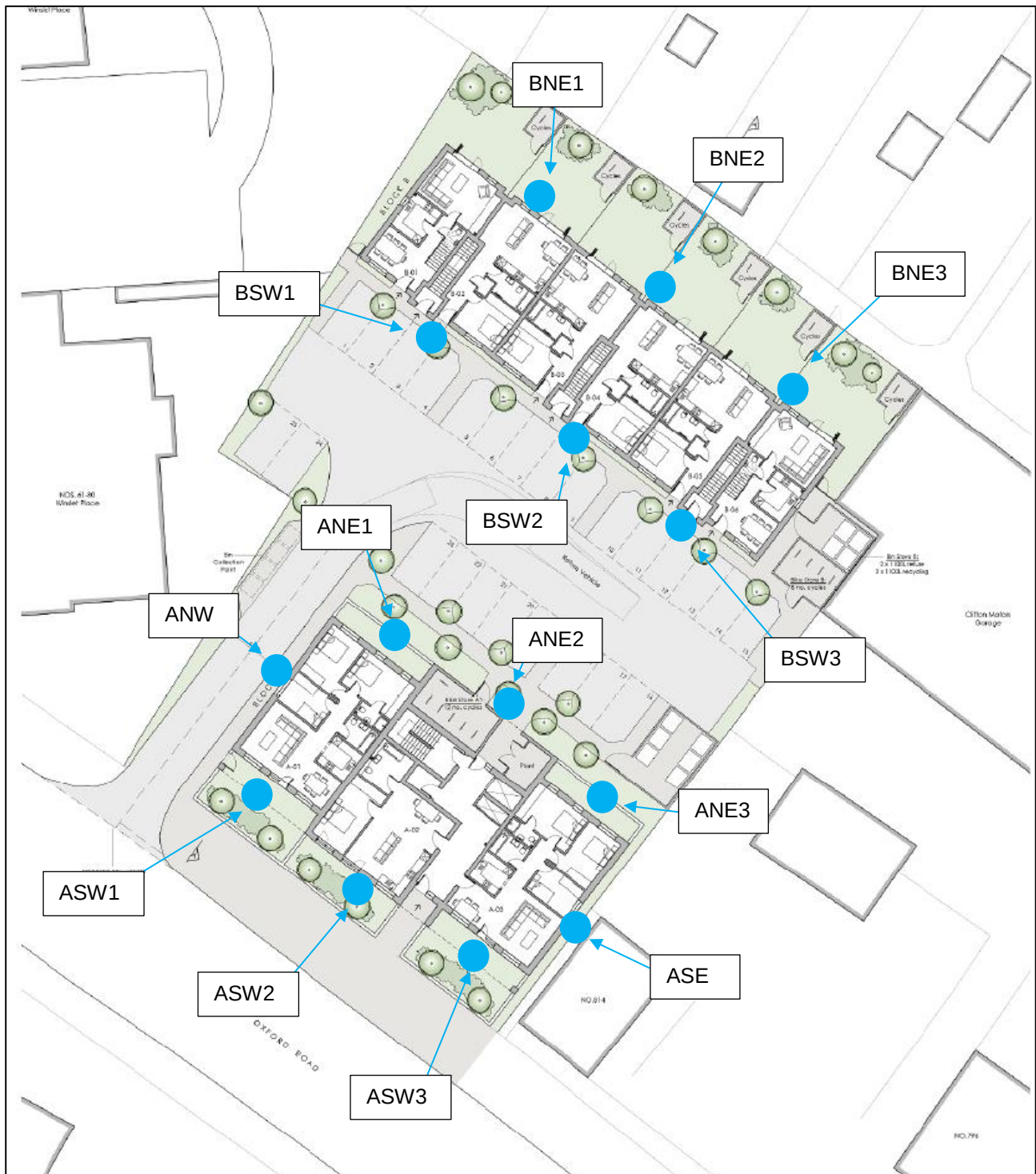


Figure F.5: Proposed Site Layout with Receivers



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. 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>
$L_{Aeq,T}$ (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. Typically measured with 'fast' weighting (125 ms) or 'slow' weighting (1 s).</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>
R_w	<i>Weighted sound reduction index, a single number quantity for the airborne sound insulation in buildings and of building elements such as wall, doors and windows. The quantity is intended for rating the airborne sound insulation and for simplifying the formulation of acoustical requirements in building codes, when measured in the presence of flanking sound transmission, denoted R'_w.</i>

Appendix 2

Internal Noise Assessment Results

Table 1: Internal Noise Assessment Results

Façade	Predicted/Calculated External Noise Levels (dB)			Predicted Internal Noise Levels (dB) With Open Windows			Target Internal Noise Levels Achieved?	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}		
Block A								
Ground Floor								
ANE1	40	35	65	25	20	50	Within 5 dB	20 ⁽¹⁾
ANE2	41	36	65	26	21	50	Within 5 dB	20 ⁽¹⁾
ANE3	42	37	65	27	22	50	Within 5 dB	20 ⁽¹⁾
ANW	62	58	74	47	43	59	X	29
ASE	54	50	74	39	35	59	X	29
ASW1	67	64	79	52	49	64	X	34
ASW2	67	64	79	52	49	64	X	34
ASW3	67	63	79	52	48	64	X	34
First Floor								
ANE1	41	36	65	26	21	50	Within 5 dB	20 ⁽¹⁾
ANE2	42	36	65	27	21	50	Within 5 dB	20 ⁽¹⁾
ANE3	52	48	65	37	33	50	Within 5 dB	20 ⁽¹⁾
ASW1	67	63	79	52	48	64	X	34
ASW2	67	64	79	52	49	64	X	34
ASW3	67	64	79	52	49	64	X	34

Façade	Predicted/Calculated External Noise Levels (dB)			Predicted Internal Noise Levels (dB) With Open Windows			Target Internal Noise Levels Achieved?	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}		
Second Floor								
ANE1	43	38	65	28	23	50	Within 5 dB	20 ⁽¹⁾
ANE2	43	38	65	28	23	50	Within 5 dB	20 ⁽¹⁾
ANE3	52	48	65	37	33	50	Within 5 dB	20 ⁽¹⁾
ASW1	67	63	79	52	48	64	X	34
ASW2	67	63	79	52	48	64	X	34
ASW3	67	63	79	52	48	64	X	34
Third Floor								
ANE1	46	40	65	31	25	50	Within 5 dB	20 ⁽¹⁾
ANE2	46	40	65	31	25	50	Within 5 dB	20 ⁽¹⁾
ANE3	53	49	65	38	34	50	Within 5 dB	20 ⁽¹⁾
ASW1	66	62	79	47	47	64	X	34
ASW2	66	62	79	47	47	64	X	34
ASW3	66	62	79	47	47	64	X	34
Fourth Floor								
ANE1	47	42	65	32	27	50	Within 5 dB	20 ⁽¹⁾

Façade	Predicted/Calculated External Noise Levels (dB)			Predicted Internal Noise Levels (dB) With Open Windows			Target Internal Noise Levels Achieved?	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}		
ANE2	47	41	65	32	26	50	Within 5 dB	20 ⁽¹⁾
ANE3	48	42	65	33	27	50	Within 5 dB	20 ⁽¹⁾
ASW1	65	61	77	50	46	62	X	32
ASW2	65	61	77	50	46	62	X	32
ASW3	65	61	77	50	46	62	X	32
Fifth Floor								
ANE1	49	44	65	34	29	50	Within 5 dB	20 ⁽¹⁾
ANE2	49	44	65	34	29	50	Within 5 dB	20 ⁽¹⁾
ANE3	49	44	65	34	29	50	Within 5 dB	20 ⁽¹⁾
ASW1	64	61	77	49	46	62	X	32
ASW2	65	61	77	50	46	62	X	32
ASW3	65	61	77	50	46	62	X	32
Block B								
Ground Floor								
BNE1	45	39	65	30	24	50	Within 5 dB	20 ⁽¹⁾
BNE2	44	38	65	29	23	50	Within 5 dB	20 ⁽¹⁾

Façade	Predicted/Calculated External Noise Levels (dB)			Predicted Internal Noise Levels (dB) With Open Windows			Target Internal Noise Levels Achieved?	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}		
BNE3	44	38	65	29	23	50	Within 5 dB	20 ⁽¹⁾
BSW1	56	52	60	41	37	45	X	27
BSW2	55	51	60	40	36	45	X	26
BSW3	53	49	60	38	34	45	X	24
First Floor								
BNE1	46	40	65	31	25	50	Within 5 dB	20 ⁽¹⁾
BNE2	45	40	65	30	25	50	Within 5 dB	20 ⁽¹⁾
BNE3	45	39	65	30	24	50	Within 5 dB	20 ⁽¹⁾
BSW1	56	52	60	41	37	45	X	27
BSW2	55	51	60	40	36	45	X	26
BSW3	54	50	60	39	35	45	X	25
Second Floor								
BNE1	47	42	65	32	27	50	Within 5 dB	20 ⁽¹⁾
BNE2	47	41	65	32	26	50	Within 5 dB	20 ⁽¹⁾
BNE3	46	41	65	31	26	50	Within 5 dB	20 ⁽¹⁾
BSW1	56	52	60	41	37	45	X	27
BSW2	55	52	60	40	37	45	X	27

Façade	Predicted/Calculated External Noise Levels (dB)			Predicted Internal Noise Levels (dB) With Open Windows			Target Internal Noise Levels Achieved?	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}		
BSW3	55	51	60	40	36	45	X	26

Note (1): The internal noise levels exceed the targets by up to 5 dB during some or all periods. With reference to Figure 3.1, these internal noise levels are not considered to be unreasonable for those periods when windows are opened for overheating mitigation.



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