



Ian Sharland

LIMITED

Noise & Vibration Control Specialists

Ashfield House
Back Lane
Marlborough
Wiltshire SN8 1JJ
Telephone: (01672) 515761
Facsimile: (01672) 512761
Email: office@iansharland.co.uk



LOWER ACRE SITE ONE HORTON HEATH EASTLEIGH

ENVIRONMENTAL NOISE ASSESSMENT
TO DISCHARGE CONDITIONS 30 & 31
APPLICATION REF: F/20/89500

v.2

Client:

EASTLEIGH BOROUGH COUNCIL

Eastleigh House
Upper Market Street
Eastleigh
SO50 9YN

21 September 2023

Ref: M5055

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Reviewed	Richard Sharland MA MSc CEng MIOA
Signature	
Author	Eddie Oxborough MSc MIOA
Signature	
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1. SUMMARY

- 1.1 An assessment of ambient noise has been undertaken for the proposed residential development on the Lower Acre site, One Horton Heath
- 1.2 Planning permission has been granted for the construction of some 383 houses and flats. The scheme will also include the development of the existing road layout around and through the site.
- 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. Acoustic modelling (by others) has also been conducted to predict the additional traffic noise associated with use of the new link roads.
- 1.4 Means of attenuating the external noise levels have been submitted (Section 5), in the form of a specification for the façade construction, the glazing and the means of acoustically ventilating the buildings. The report schedules the particular specifications to be adopted across the site, and calculations have been provided here to confirm compliance with the stated design targets.
- 1.5 In respect of ventilation for overheating purposes, it is confirmed that a natural ventilation strategy is to be adopted across the development. Section 5 discusses the acoustic implications across the various blocks of apartments and housing.
- 1.6 In respect of external amenity areas, the modelling has incorporated a series of 1.8m and 2m acoustic barriers. The results of this exercise confirm that the proposals, copied herein Figure 9, will be sufficient to provide adequate protection to all plots.

2. INTRODUCTION

- 2.1 An assessment of environmental noise has been undertaken for the Lower Acre Site on the One Horton Heath development, in Eastleigh.
- 2.2 The site, currently farmland, is subject to a majority development of which the Lower Acre Site will comprise a development of some 383 new dwellings (a mixture of houses and apartments) and a new link road running from north to south (see Figures 1 & 2).
- 2.3 Condition 30 of the Planning Consent requires confirmation that the scheme will be designed to ensure that existing noise on the site, along with additional road traffic noise generated by the new link road, will be controlled to levels which will protect the residential amenity of the occupiers:
- 30 *Within 3 months of commencement of development (excluding the site clearance), a detailed noise mitigation and management scheme, detailing in full the noise reduction specifications for the top surface of the link road within the site, acoustic wall/fence/bund provisions, alternative methods of ventilation and enhanced glazing, including the specific product and their acoustic performance, shall be submitted to and approved in writing by the local planning authority. The agreed measures shall then be fully installed in accordance with the approved details prior to first occupation of the buildings for which they are specified and thereafter retained and maintained to the satisfaction of the local planning authority.*
- 2.4 Condition 31 seeks evidence, prior to first occupation, that all measures have been implemented satisfactorily:
- 31 *Prior to first occupation of each building, evidence of all acoustic mitigation provided under the Condition 30 shall be submitted to the Local Planning Authority. Where in the opinion of the Local Planning Authority the development falls short of the design guidelines, performance and reliability, availability and maintainability, provision for remediation shall be agreed in writing by the Local Planning Authority and fully implemented within all agreed timescales. Verification methods shall be agreed beforehand by the Local Planning Authority and shall include testing and demonstration through empirical means.*
- 2.5 The current exercise has therefore been commissioned to detail the acoustic measures which will be incorporated into the constructional specification of the development, in compliance with condition 30.

2.6 The objectives of the exercise here may be summarised as follows:

- (i) to determine the existing noise climate by means of site surveys across the land.
- (ii) to predict levels at the facades of the new flats and houses, as the cumulative total of the exiting noise sources and the additional noise generated by traffic on the new link road.
- (iii) to confirm appropriate standards for residential amenity, both inside and outside the properties.
- (iv) to set out the measures which will be required to attenuate the predicted noise levels to the required levels, including appropriate forms of mechanical ventilation where necessary.
- (v) To consider noise levels in external amenity areas and advise on any requirements for site screening.
- (vi) To outline the methods by which the acoustic measures may be evidenced, in accordance with Condition 31.

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

3. SITE NOISE LEVELS

Pre-Existing Site Conditions

- 3.1 The first step in the assessment of potential impact was to measure and describe the existing ambient noise levels affecting the site.
- 3.2 A noise survey was undertaken in two parts from Wednesday 25th August 2021 to Saturday 4th August 2021.
- 3.3 A Rion NL-52 Type 1 sound level meter was set up on the northern and then on the southern boundary of the site and left to record the normal variation of noise over this ten-day period (see Figure 3 – Sound Level Meter Locations).
- 3.4 In both cases, the microphone was set on a tripod, 1.5m above ground level, in free field conditions.
- 3.5 The equipment was configured to measure 5-minute samples of the following acoustic parameters:
- LAeq 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).
- LA90 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.
- 3.6 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

- 3.7 Weather conditions throughout the survey are summarized within Table 3.2.

Date	Average Temperature (°C)	Events	Average Wind Speed m/sec	Wind Direction
Wednesday 25/8/21	17	None	3.5	NE
Thursday 26/8/21	18	None	4.4	NE
Friday 27/8/21	15	None	31.	NE
Saturday 28/8/21	16	None	3.5	N
Sunday 29/8/21	15	None	3.5	N
Monday 30/8/21	16	None	4.4	NE
Tuesday 31/8/21	16	None	3.5	NE
Wednesday 1/9/21	16	None	3.5	NE
Thursday 2/9/21	17	None	3.1	NE
Friday 3/9/21	15	None	2.2	NE
Saturday 4/9/21	15	None	2.6	N

Table 3.2 – Weather Conditions

3.8 Figures 4 & 5 show 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 at each of the measurement locations:

P1 – NORTHERLY POSITION			
Period	Daytime $L_{Aeq, 07.00 - 23.00}$	Night-time $L_{Aeq, 23.00 - 07.00}$	Night-time Typical $L_{Amax, fast}$
Wednesday 25/8/21	48.5	39.6	59
Thursday 26/8/21	48.5	39.9	58
Friday 27/8/21	51.5	40.0	55
Saturday 28/8/21	51.2	38.8	55
Sunday 29/8/21	51.0	36.4	54
Monday 30/8/21	45.7	36.8	52
Tuesday 31/8/21	48.5	39.6	59

P2 – SOUTHERLY POSITION			
Period	Daytime $L_{Aeq, 07.00 - 23.00}$	Night-time $L_{Aeq, 23.00 - 07.00}$	Night-time Typical $L_{Amax, fast}$
Tuesday 31/8/21	44.6	40.2	59
Wednesday 1/9/21	45.9	41.9	56
Thursday 2/9/21	47.2	39.8	59
Friday 3/9/21	44.8	38.2	59

Table 3.3 – Summary of Measurements

- 3.9 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 during the night.
- 3.10 Overall, there is relatively little variation in noise across the site, allowing the following conservative estimate to be applied to all areas:

Period	Daytime $L_{Aeq, 07.00 - 23.00}$	Night-time $L_{Aeq, 23.00 - 07.00}$	Night-time Typical $L_{Amax, fast}$
Pre-existing Site Noise Levels	51 dB(A)	42 dB(A)	59 dB(A)

Table 3.4 - Summary of Background Noise Levels

- 3.11 The significance of these values will be discussed below.

New Road Traffic Noise

- 3.12 In order to establish the likely additional noise which will be generated by road traffic associated with the new road around the site, Eastleigh Borough Council have commissioned Hydrok Consulting to prepare a noise model of the site.
- 3.13 Their assessment has considered the proposed layout of the site, the topography of the site, alongside the proposed road construction¹ and projected road traffic along new and upgraded roads.
- 3.14 The results of their study are summarised here in Figures 6 – 8. These provide façade noise predictions expressed as:

Day time 16-hour $L_{Aeq, 0700 - 2300}$
Night time 8-hour $L_{Aeq, 2300 - 0700}$
Night time typical $L_{Amax, 2300 - 0700}$

- 3.15 The range of values varies significant across the site, as indicated below follows:

40 – 67 dB(A) Day time 16-hour $L_{Aeq, 0700 - 2300}$
35 – 59 dB(A) Night time 8-hour $L_{Aeq, 2300 - 0700}$
39 – 88 dB(A) Night time typical $L_{Amax, 2300 - 0700}$

- 3.16 The significance of these levels, combined with the measurements of pre-existing noise, will be discussed below.

¹ Appendix 1 discusses the proposed road construction, and the implications of alternative options.

4. PLANNING GUIDANCE & RELEVANT ACOUSTIC STANDARDS

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 life²*
- 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.

² Refers here to the NPSE, discussed in Section 4.2 of this report.

4.2 Noise Policy Statement for England (March 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".

- 4.2.4 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 not have been given adequate weight when assessing the noise implications".

- 4.2.5 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.
- 4.2.6 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."

- 4.2.7 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 July 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

3.4.3 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) LAeq, 16 hr	-
Dining	Dining room/Area	40 dB(A) LAeq, 16 hr	-
Sleeping	Bedroom	35 dB(A) LAeq, 16 hr	30 dB(A) LAeq, 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)³. 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) LAeq, 16 hr	-
Dining	Dining room/Area	53 dB(A) LAeq, 16 hr	-
Sleeping	Bedroom	48 dB(A) LAeq, 16 hr	43 dB(A) LAeq, 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) $L_{Aeq, t}$.
- 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.

³ Reference PPG24 Planning & Noise, which adopted a mid-range value of 13 dB(A)

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 Volume 1: Dwellings describes three types of ventilation, summarised in the table below:

Type of Ventilation	Definition in ADF	Location/reason for ventilation	Required
Whole Dwelling Ventilation ⁴	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

4.6.2 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 now covered by Approved Document O Overheating. ADF states:

This document <ADF> sets minimum standards for purge ventilation for rapidly diluting indoor air pollutants and extracting water vapour where necessary in habitable rooms in dwellings. For domestic-type buildings, Part O may require a higher

⁴ Not to be confused with 'background ventilation'. ADF defines the term 'background ventilator' as a trickle vent.

standard than the guidance given in this document for purge ventilation to remove excess heat. In this case, the higher of the two standards should be followed.

4.6.3 There are various types of ventilation described in ADF, including:

Ventilation System	Provision with ADF System / Purpose		
	Whole Dwelling Ventilation	Extract Ventilation	Purge Ventilation
Background ventilation and intermittent extract fans	Background ventilators (trickle vents)	Intermittent extract fans	Typically provided by opening windows
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
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

4.6.4 With regard to the provision of purge ventilation within habitable rooms, the approved document notes that 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 Whilst ADF does give advisory residential noise limits during normal conditions (not boost)⁵, it does not itself confirm limits for noise during purge ventilation.

4.7 Approved Document O – Overheating (2021)

4.7.1 The Approved Document provides advice on the design of buildings to counter overheating.

4.7.2 The Document does highlight the potential conflict between overheating ventilation and the protection against noise:

Noise

3.2 *In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).*

3.3 *Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:*

a. 40dB L_{Aeq,T}, averaged over 8 hours (between 11pm and 7am).

⁵ In line with BS8233 guidance.

b. 55dB LA_{Fmax}, more than 10 times a night (between 11pm and 7am).

3.4 Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use. Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).

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

- 4.8.1 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.
- 4.8.2 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.
- 4.8.3 This proposition is based on the fact that overheating will occur for only part of the time, during which there may 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).
- 4.8.4 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.
- 4.8.5 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

- 4.8.6 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.
- 4.8.7 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 frequently and a sizeable proportion of the population is highly annoyed and sleep disturbed'.
- 4.8.8 The table below therefore may be taken to represent the threshold for SOAEL:

Location	0700 - 2300	2300 - 0700
Living Room	63 dB(A) L_{Aeq} , 16 hr	-
Bedrooms	63 dB(A) L_{Aeq} , 16 hr	55 dB(A) L_{Aeq} , 8 hr

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

5. RECOMMENDATIONS FOR NOISE ATTENUATION MEASURES

INTERNAL AREAS

5.1 Section 4.4.1 of this report has provided guidance for internal noise levels within residential rooms as stated within BS8233.

5.2 It is therefore recommended that all residential dwellings be designed to achieve the following levels when windows are closed:

Living Rooms:	35 dB(A) LAeq, 07.00 – 23.00
Bedrooms:	30 dB(A) LAeq, 23.00 – 07.00, and 45 dB(A) LAmax, 23.00 – 07.00

5.3 It may be safely accepted that a dwelling which incorporates a cavity masonry external construction, standard double glazing rated at 27 dB Rw + Ctr (e.g. 4/16/4 double glazed unit) and trickle ventilators rated at 35 dB D_{n,e,w} in the open position will provide an outside to inside sound level difference of at least 27 dB(A).

5.4 Therefore, where external façade noise levels are no more than 27 dB above the criteria in Para 5.2, the broad specification of Para 5.3 may be adopted.

5.5 A review of the noise maps indicates that the majority of plots will fall into this category. There will, however, be a number of dwellings which do not. Table 5.1 schedules these plots, alongside the outside to inside sound level difference which is required when windows are closed.

5.6 The table also confirms a recommended glazing standard (Level 2 or Level 3) which would comply with the requirements. Level 1 is the default 4/16/4, 27 dB R_w + C_{tr} configuration applying to all other plots.

Plots	Façade	Predicted Façade Noise Level, dB(A) LAeq, t	Target Level Difference, dB(A)	Proposed Glazing Type
LIVING ROOMS				
4-7	East only	64	29	Level 2
32-33	East only	66	31	Level 2
49-50	East only	66	31	Level 2
51, 52, 66, 67	North & East	66	31	Level 2
68-67	East only	64	29	Level 2
79-80	East only	67	32	Level 2
81-82	East only	67	32	Level 2
94	East only	67	32	Level 2
95-96	East only	66	31	Level 2
97-98	South only	67	32	Level 2
99	South only	66	31	Level 2
210 - 213	West only	63	28	Level 2
318-329	West only	66	31	Level 2
375	West only	64	29	Level 2
376-383	West only	66	31	Level 2
A2, 119-124	South only	64	29	Level 2
A3, 125-143	South-west & South-east only	64	29	Level 2
B161-180	West only	67	32	Level 2
C222-230	West only	63	28	Level 2
Plots	Façade	Predicted Façade Noise Level, dB(A) L _{Amax}	Target Level Difference, dB(A)	Proposed Glazing Type
BEDROOMS				
1 – 3	North & East only	79	34	Level 2
4 - 7	East only	82	37	Level 3
30 - 31	South & East only	78	33	Level 2
32 & 33	North, South & East only	84	39	Level 3
49 & 50	North, South & East only	85	40	Level 3
51, 52	North, South & East only	84	39	Level 3
66, 67	North, South & East only	84	39	Level 3
68 & 69	North, South & East only	83	38	Level 3
79 & 80	North, South & East only	86	41	Level 3
81 & 82	North, South & East only	87	42	Level 3
92 - 94	North, South & East only	88	43	Level 3
95 - 98	North, South & East only	87	42	Level 3
99	North, South & East only	85	40	Level 3
318 - 329	West only	75	30	Level 2
372 - 375	West only	75	30	Level 2
376 - 383	West only	75	30	Level 2
A2, 119-124	South-west & South-east only	81	36	Level 3
A3, 125-143	South-west & South-east only	74	29	Level 2
B, 161-180	West only	75	30	Level 2

Table 5.1 – Predicted Façade Noise Levels & Glazing Requirements

5.7 Table 5.2 confirms the specific details of the glazing, as octave band sound reduction values:

	Minimum Sound Reduction, dB, at Octave Band Centre Frequency (Hz)							Overall Rating & Possible Configuration
	63	125	250	500	1K	2K	4K	
Level 1 (Default)	21	21	18	26	37	42	33	27 dB Rw + Ctr 4 / 16 / 4
Level 2	24	30	25	34	45	44	52	34 dB Rw + Ctr 6 / 12 / 8.4A
Level 3	26	31	38	45	45	45	58	40 dB Rw + Ctr 10 / 20 / 8.4A

Table 5.2 – Glazing Performance Requirements

5.8 All plots will feature Mechanical Ventilation Heat Recover units and will therefore not require trickle vents within window frames.

5.9 The acoustic loss through a typical MVHR system (from external grill, through the ducting system and heat recover unit, to the room grill) is typically 40 dB(A) for road traffic noise.

5.10 With reference to the target sound level differences given in Table 5.1, it is recommended that the external grills for the following houses be located on the west elevation of the buildings (else, 600mm long duct silencers should be included behind the grills).

32, 33, 49, 50, 51, 52, 66, 67, 68, 69, 79, 80, 81, 82, 92, 93, 94, 95, 96, 97, 98, 99
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Table 5.3 – Plots Requiring West Facing External MVHR Grills

5.11 The external façade construction will be constructed as

Houses:

- 100mm masonry (e.g. brick, rendered block)
- 50mm cavity
- 140mm insulated timber stud, 9mm OSB to cavity face
- 12mm ply to room face of studs
- 25mm battens and 12.5mm plasterboard

Flats:

- 100mm masonry (e.g. brick, rendered block)
- Min. 100mm partially insulated cavity,
- 140mm concrete blockwork

5.12 The roof construction to the houses and flats will be as follows:

Houses:

- Tiles over felt on timber battens.
- Pitched rafters.
- 600mm thermal insulation between roof joists
- 12.5mm plasterboard to underside

Flats:

- Single ply membrane over 140mm thermal insulation
- 22mm decking over 250mm timber joists.
- 2 x 12,5mm plasterboard to underside of joists.
- Nom. 450mm service zone and 12.5mm plasterboard on MF grid

5.13 Where the houses and flats require Level 3 glazing, the roof constructions should be enhanced as follows:

Houses:

Upgrade ceiling from 12.5mm Wallboard to 2 x 15mm SoundBloc.

Flats:

Upgrade ceiling from 2x12.5mm Wallboard to 2 x 15mm SoundBloc

5.14 For clarity, the plots requiring these upgrades are as follows:

Plots	Plot
4 - 7	81 & 82
32 & 33	92 – 94
49 & 50	95 – 98
51, 52	99
66, 67	A2, 123
68 & 69	A2, 124
79 & 80	-

Table 5.4 – Plots Requiring Ceiling Upgrades

5.15 With regard to recessed downlighters in upper-floor habitable rooms (applying to the houses and flats listed in Table 5.4), the light fittings should be selected on the basis of an acoustic rating. The products should be tested to demonstrate that they sustain the acoustic performance of a double boarded (33 dB Rw) ceiling layer (<2dB change). Where the preferred supplier can not provide appropriate evidence, an acoustic downlighter hood should be adopted.

5.16 Appendix 2 contains predictions from the Marshall Day INSUL software package to indicate the likely Sound Reduction Index for each of these wall and roof build-ups (note, 3 dB have been subtracted from the predicted values, reflect stated accuracy of the software).

Comfort Cooling/Overheating Ventilation

5.17 The ventilation strategy for the development is one of MVHR units for background ventilation and boost ventilation, with open windows being adopted to mitigate issues of overheating. This approach is heavily led by issues of sustainability, and the wish to avoid secondary mechanical equipment wherever possible (see accompanying planning submissions).

5.18 When windows are open for such purposes, internal noise levels will normally rise. It is usually taken that a partially open window will provide an attenuation of broadly 10 – 15 dB(A) – a value of 13 dB(A) being commonly adopted.

5.19 There are two criteria which could be applied to judge when acoustic conditions internally would rise above a reasonable standard. The first is the Acoustics Ventilation & Overheating Residential Design Guide (AVOG), published jointly by the Institute of Acoustics and the Association of Noise Consultants (Section 4.8).

5.20 This suggests that the threshold for wholly acceptable conditions would be external façade noise levels of:

Day time 0700 – 2300	53 dB(A) LAeq
Night time 2300 – 0700	48 dB(A) LAeq, and 63 dB(A) LAmax

5.21 The analysis of external noise levels indicates that all properties facing onto the new east and west access roads will experience levels above these thresholds.

5.22 However, the provision of the MVHR units to all properties will offer residents the facility to use the boost setting to increase ventilation rates through their properties, whilst keeping their windows closed (if they prefer). This would therefore represent a reasonable form of mitigation where external noise levels are high, in accordance with the advice of the AVOG guidelines.

5.23 The secondary requirement is set out in Approved Document O Overheating (Section 4.7). This states the obligation to provide a design solution for overheating which limits internal noise levels in bedrooms at night to a maximum of

Day time 0700 – 2300	No guidance offered.
Night time 2300 – 700	40 dB(A) LAeq, and 55 dB(A) LAmax

5.24 It is confirmed that night time overheating would be countered using top hung opening lights, offering a total open area of some 270,000mm². Reference to the Napier University study NANR116 on the acoustic loss through windows (open and closed) would indicate a sound level difference of some 15 dB(A) across such openings. Therefore the ADO internal targets would equate to the following limits externally:

Day time 0700 – 2300

No guidance offered.

Night time 2300 – 700

55 dB(A) L_{Aeq} , and 70 dB(A) L_{Amax}

5.25 Table 5.5 details the plots which would exceed the threshold of Para 5.22:

Plot	Affected Facades	Excess, dB	Plot	Affected Facades	Excess, dB
Houses					
1	SE & NE	9	90, 91	SW	3
2, 3	NE	4	92, 93, 94	SE, NE & SW	18
4	SE & NE	12	95, 96	All	17
5, 6, 7	SE	12	97,98	SE, NE & SW	17
30, 31	SE, SW & NW	9	99	All	15
32, 33, 34	SE, SW & NW	14	102, 103	NE	1
48, 49, 50	SE, SW & NW	15	210-213	W	1
51, 52	SE & NE	14	318-321	W	4
66, 67	SE & SW	14	322-324	W	5
68/69	SE, SW & NW	13	325-327	W	3
70, 71	NE	5	328-329	W	2
78	NE	2	375	W	5
79/80	SE, NE & SW	16	376-378	W	5
81/82	SE, NE & SW	17	379-381	W	4
83, 84	NE	2	382-383	W	2
Plot		Affected Facades		Excess, dB	
Apartments					
Block A2 - 120, 122, 124		SE		10	
Block A3 - 129, 130(BR2), 134, 135(BR2)139, 140(BR2) 142, 143(BR2)		S		4	
Block B - 163, 164, 168, 169, 173, 174, 178, 179		W		5	

Table 5.5 – Plots Exceeding ADO Thresholds with Open Windows

5.26 It will therefore be for the Building Control Department to provide a derogation against the usual requirements of ADO, based on the current ventilation strategy.

EXTERNAL AMENITY SPACE

- 5.27 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} .
- 5.28 The design and layout of the site has endeavoured to protect private amenity space so far as is practical, locating them behind the line of buildings.
- 5.29 The current scheme includes a series of 1.8m and 2m high acoustic screens, as shown here in Figure 9 (Axis Mason Drg. DR-A-2500,current revision T1). The acoustically critical areas for fencing are as follows:
- Plot 1 – Plot 4, screen linking the two buildings along SE boundary of garden.
Plot 5 – Plot 6, screen closing gap between two buildings.
Plot 7 – Plot 31, screen linking the two buildings along SE boundary of garden.
Plot 33 – Plot 50, screen linking the two buildings along SE boundary of garden.
Plot 65 – Plot 67, screen linking the two buildings along SW boundary of garden.
Plot 69 – Plot 80, screen linking the two buildings along SE boundary of garden.
Plot 82 – Plot 94, screen linking the two buildings along SE boundary of garden.
Plot 95 – Plot 96, screen linking the two buildings along SE boundary of garden.
Plot 97 – Plot 98, screen linking the two buildings along SE boundary of garden.
Plots 372 – 375, screen running around south-west and south-east perimeter of gardens.
- 5.30 These barriers may be constructed in either:
- (i) Not less than 100mm thick brick or concrete block
 - (ii) 25mm thick timber panels, which are either tongued and grooved, or supported by a 25mm x 150mm cover strip behind each joint. Support posts must be designed to sustain the continuous line of the timber barrier, without breaks, and barge boards must be incorporated at the base to seal the bottom edge (See Figure 10).
 - (iii) A proprietary acoustic fence, such as Jackson Acoustic Reflective, or equal approved.
- 5.31 The acoustic modelling by Hydrock (Figures 4 – 6) include the acoustic attenuation of these screens.
- 5.32 A review of the day-time noise levels (Figure 4) confirms that noise levels in all private amenity areas will remain below 55 dB(A) $L_{Aeq, 16 \text{ hrs}}$.

FIGURE 1 – SITE LOCATION



FIGURE 2 – PROPOSED SITE PLAN



FIGURE 3 – NOISE SURVEY MEASUREMENT LOCATIONS



FIGURE 4 – MEASURED NOISE LEVELS AT POSITION 1

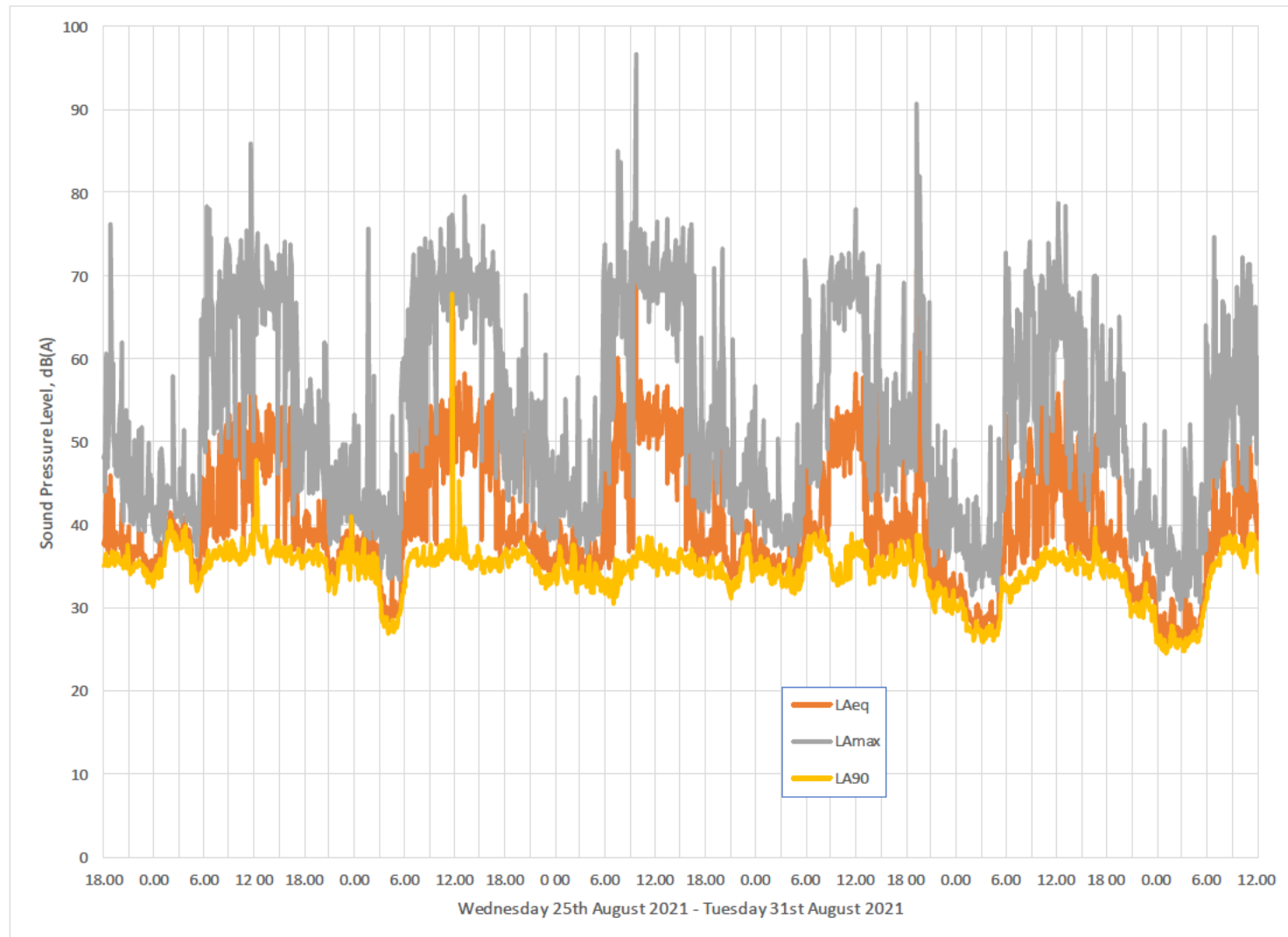


FIGURE 5 – MEASURED NOISE LEVELS AT POSITION 2

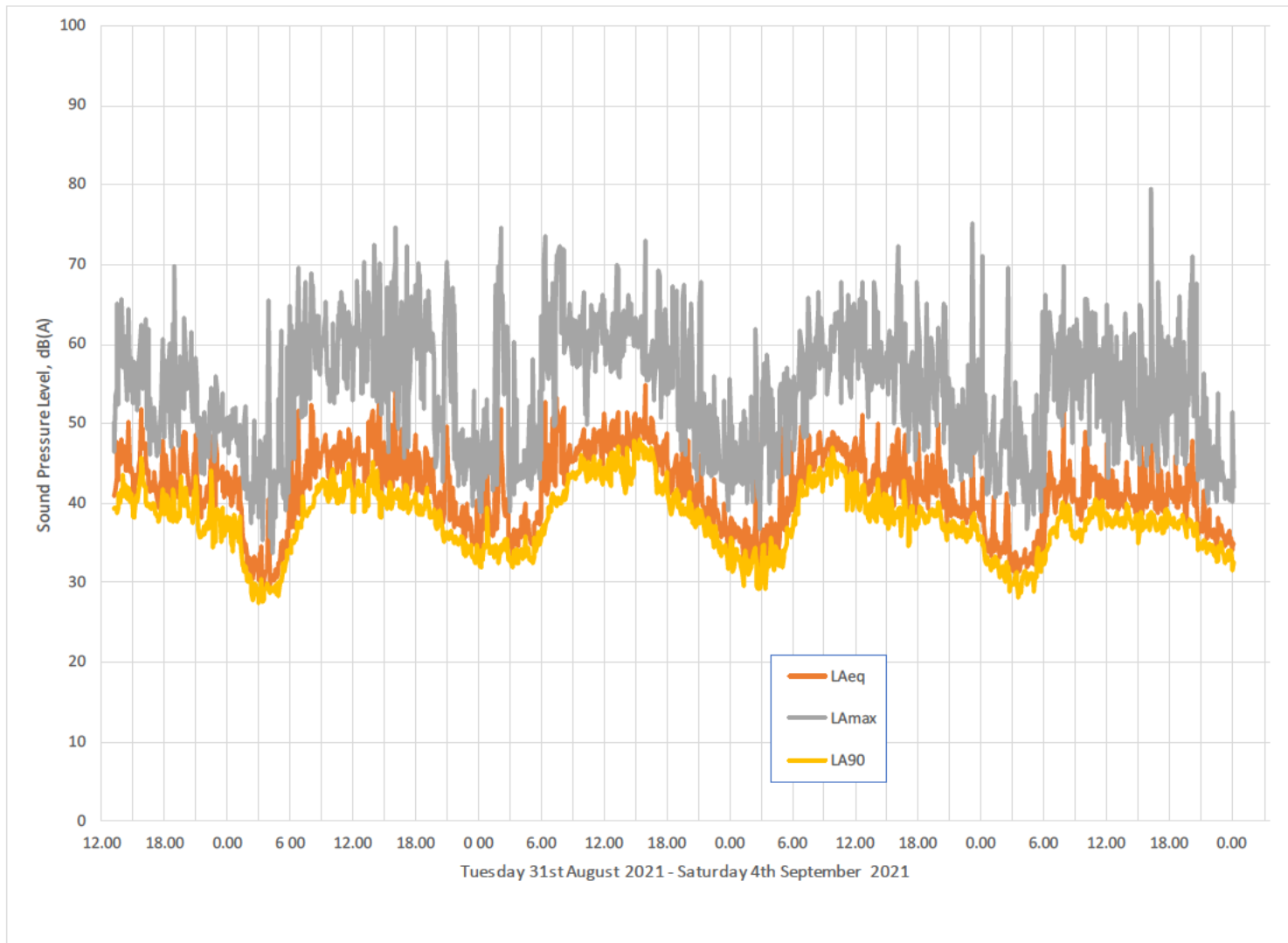


FIGURE 6 – PREDICTIONS OF NEW ROAD TRAFFIC NOISE, DAYTIME LAeq



FIGURE 7 – PREDICTIONS OF NEW ROAD TRAFFIC NOISE, NIGHT TIME LAeq



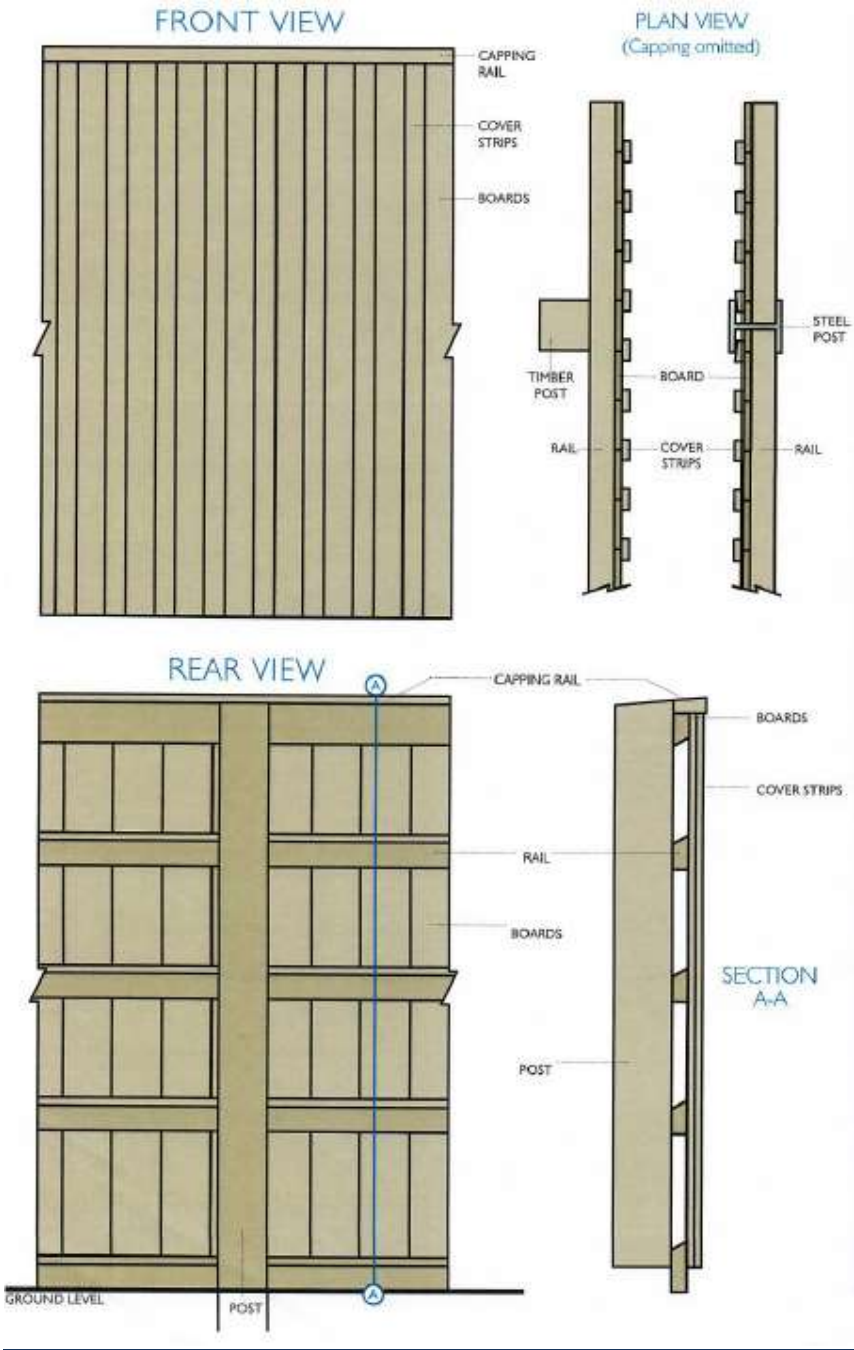
FIGURE 8 – PREDICTIONS OF NEW ROAD TRAFFIC NOISE, NIGHT TIME L_Amax



FIGURE 9 – FENCING STRATEGY



FIGURE 10 – TIMBER ACOUSTIC FENCE CONSTRUCTION DETAILS



APPENDIX 1 – DISCUSSION ON ROAD SURFACE TREATMENT

This appendix considers the requirements of Condition 30 of the planning consent, with particular attention to the manner in which the choice of road surface can affect the acoustic impact of road traffic noise on the new housing development.

Condition 30 states:

Within 3 months of commencement of development (excluding the site clearance), a detailed noise mitigation and management scheme, detailing in full the noise reduction specifications for the top surface of the link road within the site, acoustic wall/fence/bund provisions, alternative methods of ventilation and enhanced glazing, including the specific product and their acoustic performance, shall be submitted to and approved in writing by the local planning authority. The agreed measures shall then be fully installed in accordance with the approved details prior to first occupation of the buildings for which they are specified and thereafter retained and maintained to the satisfaction of the local planning authority.

Reference to the 'top surface of the link road within the site' implies a desire to minimise the levels of noise generated by road traffic using the link road which runs through the site.

This section will summarise the consensus of recent studies on road building, in respect to noise generation. Of course, the choice of road surfacing must be depending upon many factors, including cost and durability. These factors, and their relative importance overall, are beyond the scope of this report.

Road traffic noise is, at source, the function of two primary factors – engine noise and noise from the contact between the tyres and the road. The relative significance of these quantities will vary (amongst many other factors) with the speed of the vehicle across the road. At low speeds (40 km/h), the road/tyre noise may account for some 60% of the noise, whereas at high speeds (100 km/h), this contribution will increase to perhaps 80%.

There has been much research regarding the effect of road surface on the noise generated by moving traffic. In this country, the TRL report PPR443 'A review of current research on road surface noise reduction techniques' describes the results of one such study.

The TRL report describes tyre noise as being composed of impact & shocks, and aerodynamic effects, sometimes known as 'air pumping'.

The first consists of the excitation of the tyre tread elements as they come into contact with the road surface, the vibrational response of the tyre carcass and the subsequent radiation of sound by an area of the vibrating tyre. The vibrations are generated in the tyre by the impacts and deflections that occur at the tread blocks enter and leave contact with the road surface, and as a result of the movement of the tread elements in contact the road base. To that end, the frictional forces between the tyre and the road are very significant in the generation of vibrations and thereafter radiated noise.

The aerodynamic process relates to the movement of the air in the cavities of the tread pattern, generally in the area of the contact patch. The 'air pumping' theory involves the sudden outflow of air trapped in the grooves of the tread pattern and/or the road surface texture when the tyre comes into contact with the road surface, and the sudden in-flow of air when the tyre lifts away. The provision of air paths in the road surface layer can help to dissipate air trapped in the tread grooves and therefore reduce the air-pumping effect.

There is also a noise generation mechanism caused by tyre vibrations induced by the frictional forces created in the contact patch between the tyre and road surface. These mechanisms include factors such as the changing in radial deflection as the tyre rotates and the continuous 'slip and grip' of the two surfaces.

The report discusses the six factors which relate to the acoustic performance of a particular road surface:

- (i) Texture
- (ii) Porosity
- (iii) Stiffness
- (iv) Skid resistance
- (v) Rolling response
- (vi) Acoustic Durability

It then discusses a range of different road surfaces treatment which generally fall into one of two categories:

- (i) Single Layer Porous Asphalt (SLPA)
- (ii) Twin Layer Porous Asphalt (TLPA)

The report summarises the results of three studies into the relative effect of noise generation at high speed. This information is summarised in the extracted table below:

Table 7.1: Comparison of the acoustic performance of different new surfaces

Type of surface		Average RSI _H dB(A)		
		TRL data (Abbot & Nelson, 2001)	Dutch data (Morgan <i>et al.</i> , 2007)	Current HAPAS certificates
Reference Surfaces	20 mm Hot Rolled Asphalt	-0.6		
Thin surfaces	10 mm ULM [PLSD]	-5.5		
	10 mm Safepave	-2.8		
	14 mm Safepave	-1.8		
	14 mm SMA	-4.8		
	14 mm Viatex			-2.7
	14 mm Tuffpave			-3.3
	14 mm Durafalt			-4.6
	10 mm Stratagem			-7.2
Porous surfaces	20 mm single layer porous asphalt	-6.3		
	Twin-layer porous asphalt 2/6 upper layer, 11/16 lower layer		-11.5	
	Twin-layer porous asphalt 4/8 upper layer, 11/16 lower layer		-10.5	

It should be noted that these results relate to vehicles passing at higher speed where, as stated before the relative contribution of tyre noise is greater. The overall benefits at lower speeds may therefore be less pronounced, due to the increasing significance of the engine noise.

At this point, it is worth highlighting the subjective effect of changes in noise level. It is usually described that a change in sound level of 1 or 2 dB would not normally be noticeable. A change of 3 dB would be considered the smallest increment which can normally be detected. A change of 10 dB would be described as a doubling or halving of the subjective loudness.

The TRL report also discusses the significance of surface degradation in some detail. Noise levels on any road will tend to increase over time, due to changes in the surface (those changes being subtly different depending on the detail of the construction). The report therefore addresses the critical question how the indicated improvements will change over time.

There is considerable evidence that the acoustic performance of porous surfaces deteriorates with time. This is due to the ‘clogging’ of the voids with detritus, which reduced the benefits of the sound absorption. One survey in Derbyshire indicated that the improvement fell by about 4 dB(A) over a period of 8 years.

With regard to the thin surface treatments, whilst the initial improvement is lower, the rate of deterioration is also lower. Studies suggests in comparison to the performance after 12 months, noise levels increased by some 2 dB(A) for 20 mm Hot Rolled Asphalt (HRA) over a 5-year period, but double that for 10mm & 14mm thin surfaces. After 10 years of use, the difference between HRA and

14mm aggregate surfaces was about 1 dB(A) only. For 10mm aggregate, the difference was about 2.5 dB(A).

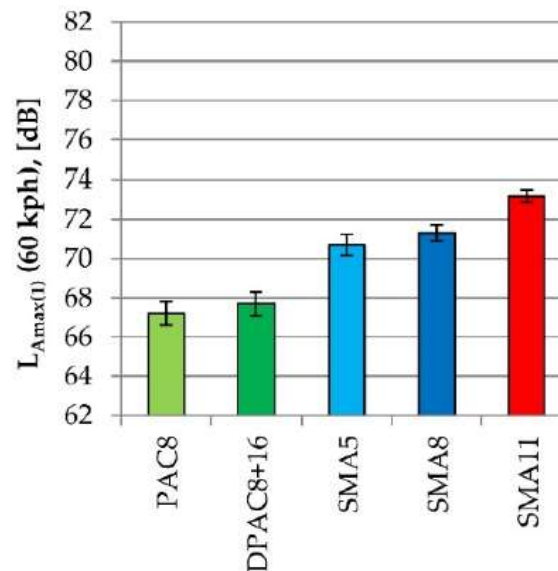
The executive summary of the report provides a concise conclusion to the study. It confirms that low noise surfaces, when initially open to traffic, can provide significant reductions to the UK reference surface, 20mm Hot Rolled Asphalt. At high speeds, reductions of about 6 dB(A) can be achieved with single porous layers, and between 2 and 5.5 dB(A) for thin surfaces (results which are supported research in other European Countries). However, the acoustic performance of all surfaces deteriorates with surface age. There is a simple relationship between age and noise for all surfaces, but the rate of deterioration varies with each surface type. Whereas 20mm Hot Rolled Asphalt may deteriorate at a rate of about 0.2 dB(A) per year, the rate for thin surface treatments would be 0.5 dB(A) per year and, for porous surfaces, about 0.9 dB(A) per year.

A further report from Poland ‘Noisiness of the surfaces on Low-Speed Roads’ (Division of Road Engineering, University of Bialystok, 2016) provides further information relating to the noise generated by vehicles at slower speeds, perhaps more representative to the link road at One Horton Heath. The findings are supportive of the earlier work by the TRL.

The researchers in Poland experimented on a similar range of road surfaces:

- (i) Stone mastic asphalt, with aggregate sizes of 5mm (SMA5), 8mm (SMA8) and 11mm (SMA11)
- (ii) Single layer porous asphalt with maximum aggregate size of 8mm (PAC8)
- (iii) Two layers of porous asphalt with a maximum aggregate size in the top layer of 8mm and the lower layer of 16mm (DPAC8+16)
- (iv) Paving and concrete blocks (not relevant, and therefore not discussed here) .

The table below summarises the results of the peak noise level measurements for the difference surfaces, indicating a maximum difference of 6 dB between the best performing surface of 8mm single payer porous asphalt and the default 11mm stone mastic asphalt.



The difference to the porous materials would be expected to be noticeable (5 – 6 dB), whereas those associated with the smaller aggregate size stone mastic asphalt would be barely detectable in normal listening conditions (1 -2 dB).

As with the TRL study, this report then continues to discuss the effect of surface deterioration over time. The porous surfaces are particularly affected, with the clogging of the air pockets, and locally occurring damage – e.g. potholes and loss of aggregate. One study showed that noise associated with 8mm porous asphalt could increase by some 6 dB(A) over a 4-year period. Whilst SMA surfaces would also show some increase over a similar period, the increase would not be expected to be so significant, and the original benefit of the porous surface would therefore diminish rapidly with time. In one example, noise from an 8mm porous asphalt surface was louder than an 11mm stone mastic asphalt after a 4-year period.

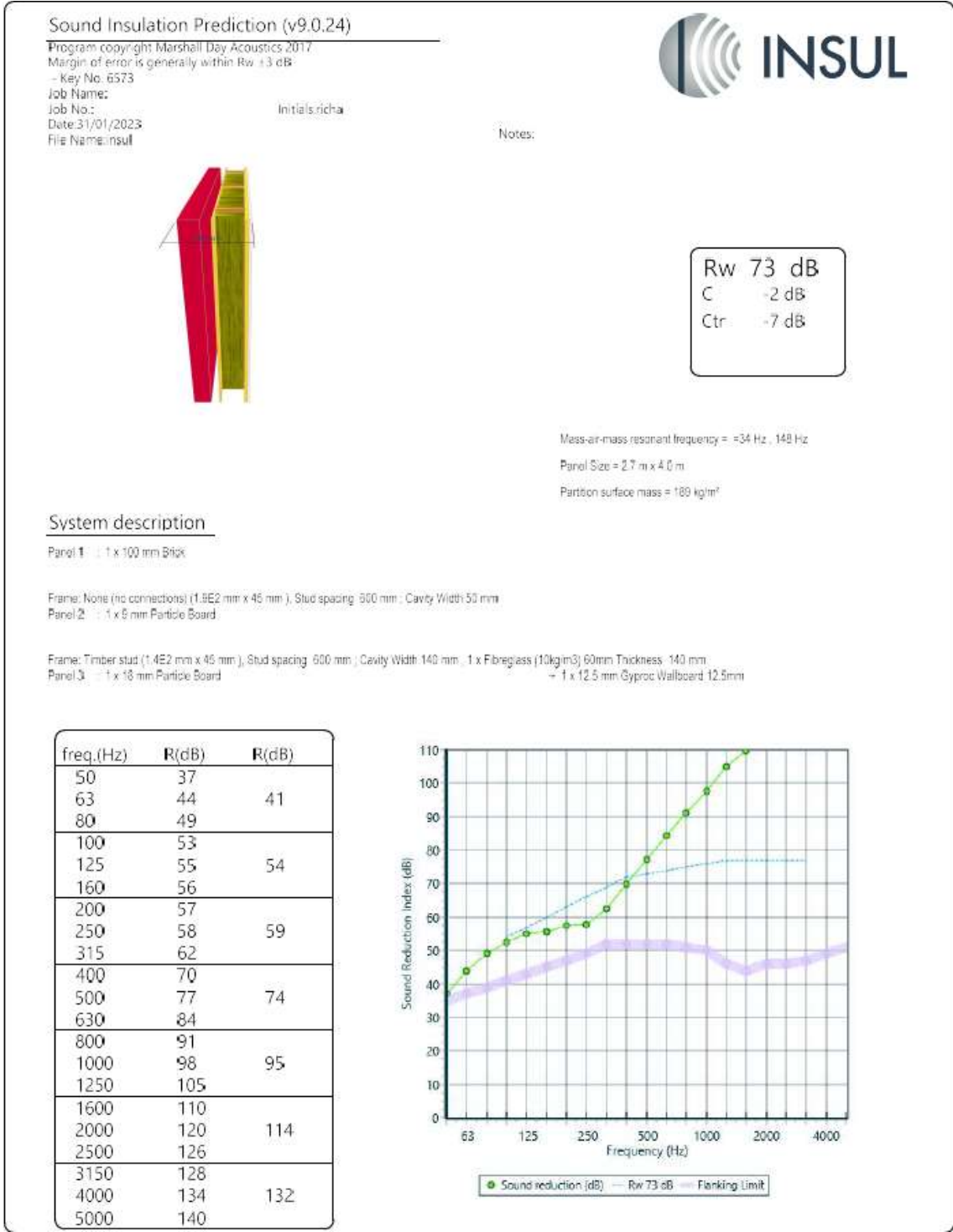
In conclusion, therefore, there may be an acoustic benefit from adopting a low noise road surface, although improvements of 3 dB(A) or more should be targeted if the difference is to be subjectively noticeable. However, the following considerations must also be taken into consideration:

- (i) The acoustic deterioration of noise over time, compared to a standard HRA surface. For example, if a porous surface offers a 6 dB(A) improvement on day one but deteriorates by 0.7 dB per year in comparison to HRA, the noticeable benefit will have been eliminated after some 4 years. At that stage, the road would have to be resurfaced in order to reinstate the acoustic benefit.
- (ii) Any decision over road surface must be determined by a number of non-acoustic considerations including:
 - a. Cost
 - b. Non-acoustic performances
 - c. Longevity (outside of acoustic considerations).

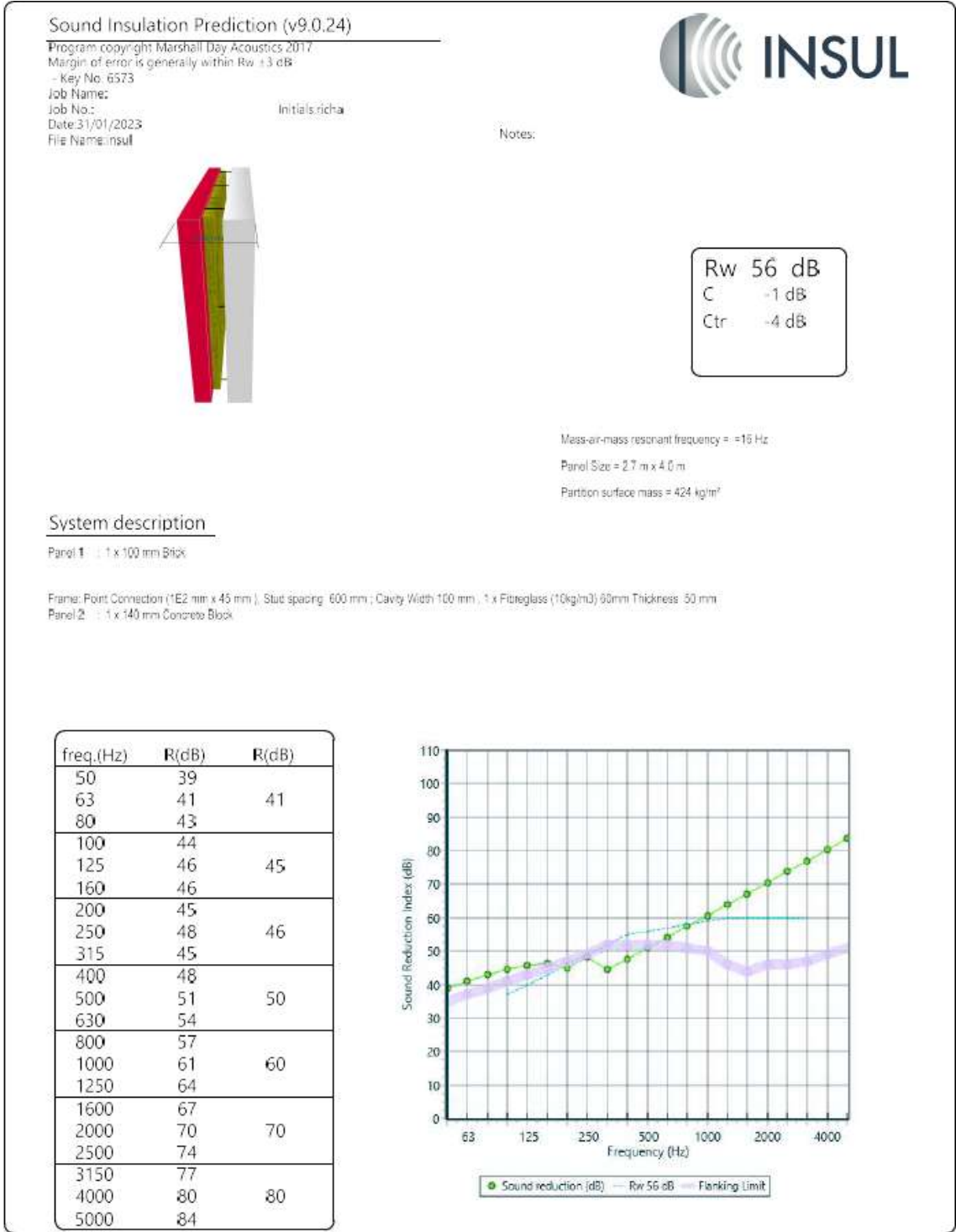
Within the context of the information provided above, it is recommended that the wider Project Team considers the alternative solutions to a normal hot rolled asphalt solution.

APPENDIX 2 – FAÇADE ELEMENT PREDICTIONS

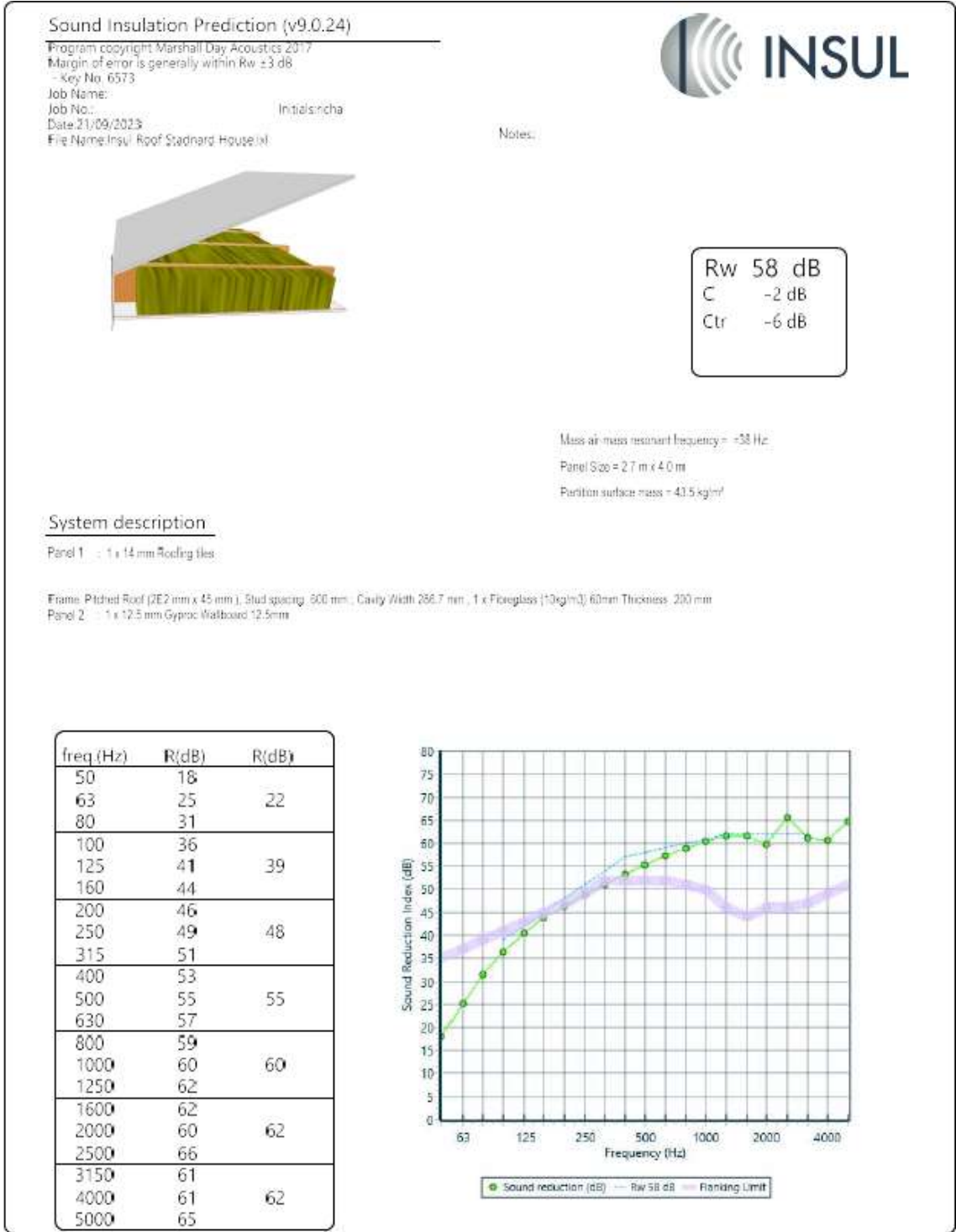
External walls, houses



External walls, flats



Standard Roof, houses



Standard Roof, flats

Sound Insulation Prediction (v9.0.24)

Program copyright Marshall Day Acoustics 2017
Margin of error is generally within $R_w \pm 3$ dB

- Key No. 6573

Job Name:

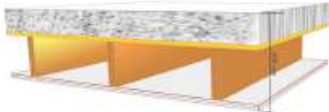
Job No.:

Date: 31/01/2023

File Name: insul

Initials: richa

Notes:



R_w 51 dB
C -1 dB
Ctr -5 dB

Mass-air-mass resonant frequency = 51 Hz, 1293 Hz

Panel Size = 2.7 m x 4.0 m

Partition surface mass = 33.4 kg/m²

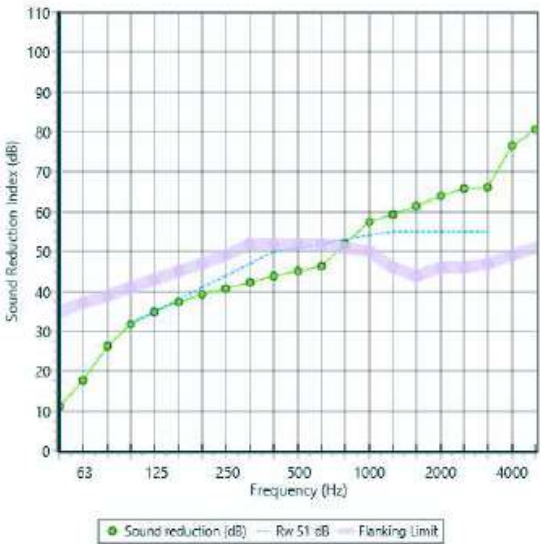
System description

Panel 1 : 1 x 1 mm Rubber

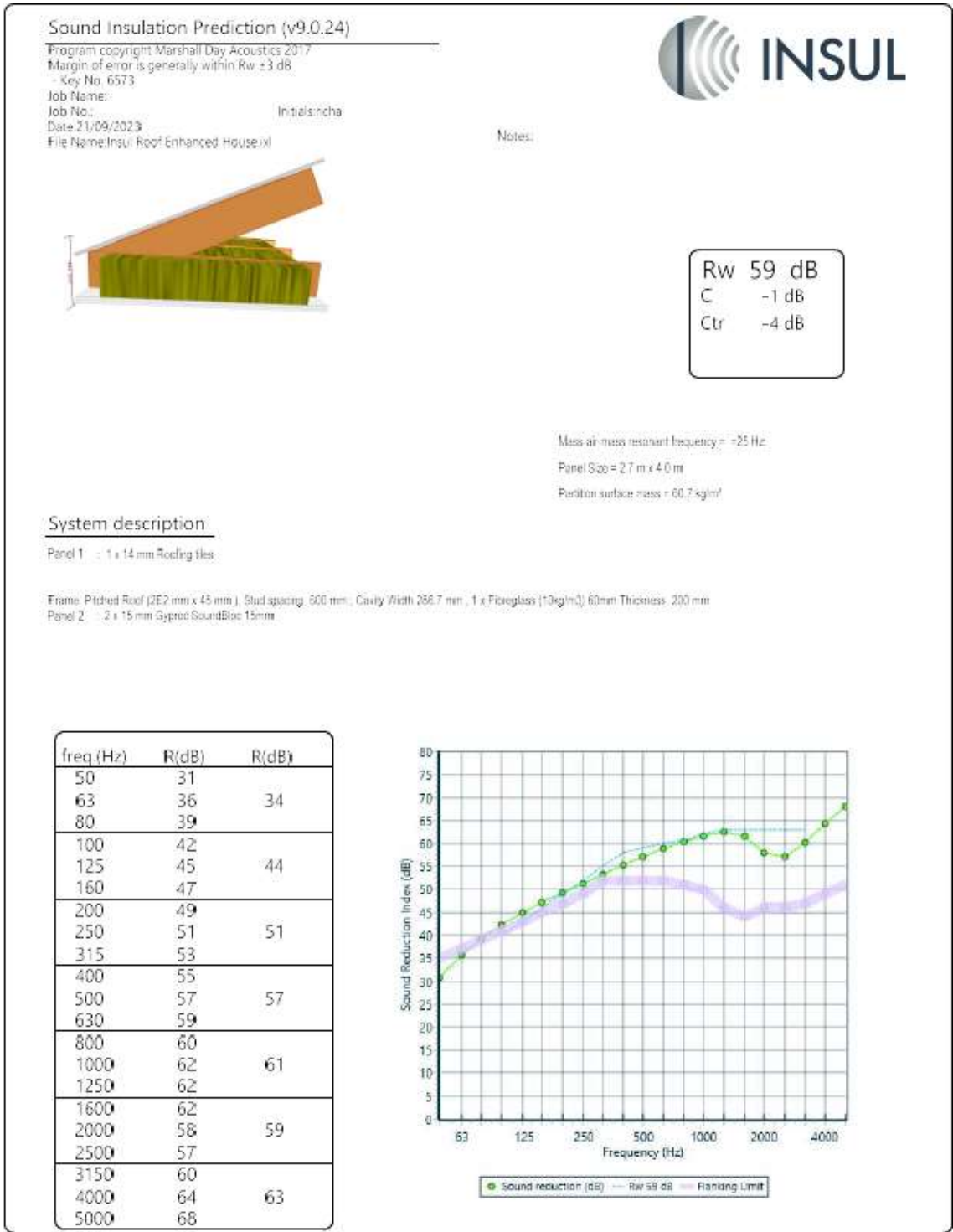
Frame: PIR insulation board (warm roof) ; Cavity Width 140 mm
Panel 2 : 1 x 22 mm Particle Board

Frame: Timber stud (2.5E2 mm x 45 mm) ; Stud spacing 600 mm ; Cavity Width 250 mm
Panel 3 : 2 x 12.5 mm Gyproc Wallboard 12.5mm

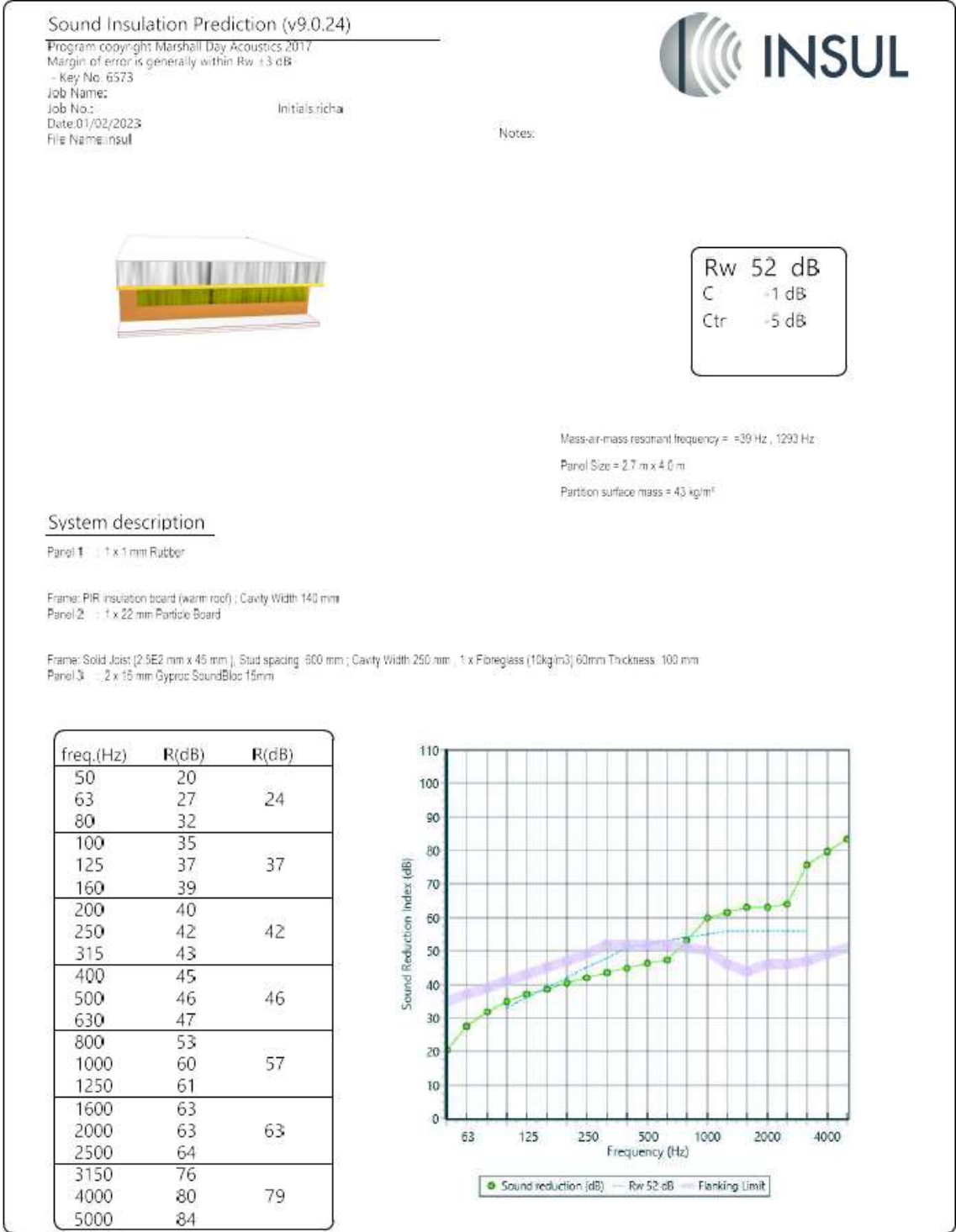
freq.(Hz)	R (dB)	R (dB)
50	11	
63	17	15
80	26	
100	32	
125	35	34
160	37	
200	39	
250	41	41
315	42	
400	44	
500	45	45
630	46	
800	52	
1000	58	55
1250	59	
1600	61	
2000	64	63
2500	66	
3150	66	
4000	77	70
5000	81	



Enhanced Roof, houses



Enhanced Roof, flats



APPENDIX 3 - CALCULATION OF OUTSIDE TO INSIDE NOISE LEVELS

Houses, Living Rooms, Level 1 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Ambient Noise	dB	56	53	49	47	47	44	38	26	51
Projected New Traffic Noise	dB	57	59	58	59	58	55	48	40	62
Façade Noise Level, LAeq, 16hrs	dB	60	60	59	59	58	55	48	40	62
Glazing Specified: 27 dB Rw + Ctr	dB	21	21	18	26	37	42	33	35	
Area of Window	m2	5	5	5	5	5	5	5	5	
Area Correction	dB	7	7	7	7	7	7	7	7	
Reference Reverberation Time	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	34	35	36	29	17	9	11	1	31
SRI External Wall, Houses	dB	38	51	56	65	65	65	65	65	
Area of Wall	m2	20	20	20	20	20	20	20	20	
Area Correction	dB	13	13	13	13	13	13	13	13	
Reference Reverberation Time	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	23	11	4	-4	-5	-8	-15	-23	3
Combined Level from elements	dB	35	35	36	29	17	9	11	1	31
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	38	38	39	32	20	12	14	4	34

Flats, Living Rooms, Level 1 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Ambient Noise	dB	56	53	49	47	47	44	38	26	51
Projected New Traffic Noise	dB	57	59	58	59	58	55	48	40	62
Façade Noise Level, LAeq, 16hrs	dB	60	60	59	59	58	55	48	40	62
Glazing Specified: 27 dB Rw + Ctr	dB	21	21	18	26	37	42	33	35	
Area of Window	m2	5	5	5	5	5	5	5	5	
Area Correction	dB	7	7	7	7	7	7	7	7	
Reference Reverberation Time	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	34	35	36	29	17	9	11	1	31
SRI External Wall, Flats	dB	38	42	43	47	57	65	65	65	
Area of Wall	m2	20	20	20	20	20	20	20	20	
Area Correction	dB	13	13	13	13	13	13	13	13	
Reference Reverberation Time	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	23	20	17	14	3	-8	-15	-23	14
Combined Level from elements	dB	35	35	36	29	17	9	11	1	31
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	38	38	39	32	20	12	14	4	34

Houses, Living Rooms, Level 2 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Ambient Noise	dB	56	53	49	47	47	44	38	26	51
Projected New Traffic Noise	dB	62	64	63	64	62	61	53	45	67
Façade Noise Level, LAeq, 16hrs	dB	63	64	63	63	62	61	53	45	67
Glazing Specified: 34 dB Rw + Ctr	dB	24	30	25	34	45	44	52	52	
Area of Window	m2	5	5	5	5	5	5	5	5	
Area Correction	dB	7	7	7	7	7	7	7	7	
Reference Reverberation Time	sec	1	1	1	1	1	1	1	1	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	35	30	35	25	13	13	-3	-11	28
SRI External Wall, Houses	dB	38	51	56	65	65	65	65	65	
Area of Wall	m2	20	20	20	20	20	20	20	20	
Area Correction	dB	13	13	13	13	13	13	13	13	
Reference Reverberation Time	sec	1	1	1	1	1	1	1	1	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	27	15	9	0	-1	-2	-10	-18	7
Combined Level from elements	dB	36	30	35	25	13	13	-2	-10	28
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	39	33	38	28	16	16	1	-7	31

Flats, Living Rooms, Level 2 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Ambient Noise	dB	56	53	49	47	47	44	38	26	51
Projected New Traffic Noise	dB	62	64	63	64	62	61	53	45	67
Façade Noise Level, LAeq, 16hrs	dB	63	64	63	63	62	61	53	45	67
Glazing Specified: 34 dB Rw + Ctr	dB	24	30	25	34	45	44	52	52	
Area of Window	m2	5	5	5	5	5	5	5	5	
Area Correction	dB	7	7	7	7	7	7	7	7	
Reference Reverberation Time	sec	1	1	1	1	1	1	1	1	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	35	30	35	25	13	13	-3	-11	28
SRI External Wall, Flats	dB	38	42	43	47	57	65	65	65	
Area of Wall	m2	20	20	20	20	20	20	20	20	
Area Correction	dB	13	13	13	13	13	13	13	13	
Reference Reverberation Time	sec	1	1	1	1	1	1	1	1	
Room Volume	m3	40	40	40	40	40	40	40	40	
Absorption		13	13	13	13	13	13	13	13	
Absorption Correction	dB	11	11	11	11	11	11	11	11	
Net SPL Inside	dB	27	24	22	18	7	-2	-10	-18	18
Combined Level from elements	dB	36	31	35	26	14	13	-2	-10	28
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	39	34	38	29	17	16	1	-7	31

Houses, Bedrooms, Level 1 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Peak Level Noise, Lmax	dB	64	61	57	55	55	52	46	34	59
Projected New Traffic Peak	dB	69	69	67	68	66	65	63	53	72
External Noise Level Lmax	dB	69	69	67	68	66	65	63	53	72
Glazing Specified: 27 dB Rw + Ctr	dB	16	21	18	26	37	42	33	35	
Area of Window	dB	4	4	4	4	4	4	4	4	
Area Correction	dB	6	6	6	6	6	6	6	6	
Maximum RT in Room	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	49	44	45	38	25	19	26	14	39
SRI External Wall, Houses	dB	38	51	56	65	65	65	65	65	
Area of Wall	dB	6	6	6	6	6	6	6	6	
Area Correction	dB	8	8	8	8	8	8	8	8	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	29	16	9	1	-1	-2	-4	-14	8
SRI Roof, Houses	dB	22	39	48	55	60	60	60	60	
Area of Roof	dB	12	12	12	12	12	12	12	12	
Area Correction	dB	11	11	11	11	11	11	11	11	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	48	31	20	14	7	6	4	-6	23
Combined Level from elements	dB	52	44	45	38	25	19	26	14	39
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	55	47	48	41	28	22	29	17	42

Flats, Bedrooms, Level 1 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Peak Level Noise, L _{max}	dB	64	61	57	55	55	52	46	34	59
Projected New Traffic Peak	dB	69	69	67	68	66	65	63	53	72
External Noise Level L _{max}	dB	69	69	67	68	66	65	63	53	72
Glazing Specified: 27 dB Rw + Ctr	dB	16	21	18	26	37	42	33	35	
Area of Window	dB	4	4	4	4	4	4	4	4	
Area Correction	dB	6	6	6	6	6	6	6	6	
Maximum RT in Room	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m ³	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	49	44	45	38	25	19	26	14	39
SRI External Wall, Flats	dB	38	42	43	47	57	65	65	65	
Area of Wall	dB	6	6	6	6	6	6	6	6	
Area Correction	dB	8	8	8	8	8	8	8	8	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m ³	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	29	25	22	19	7	-2	-4	-14	18
SRI Roof, Flats	dB	12	31	38	42	52	60	65	65	
Area of Roof	dB	12	12	12	12	12	12	12	12	
Shielding to flat roof	dB	10	10	10	10	10	10	10	10	
Area Correction	dB	11	11	11	11	11	11	11	11	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m ³	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	48	29	20	17	5	-4	-11	-21	23
Combined Level from elements	dB	52	44	45	38	25	19	26	14	40
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	55	47	48	41	28	22	29	17	43

Houses, Bedrooms, Level 2 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Peak Level Noise, Lmax	dB	69	66	62	60	60	57	51	39	64
Projected New Traffic Peak	dB	76	76	74	75	73	72	70	60	79
External Noise Level Lmax	dB	76	76	74	75	73	72	70	60	79
Glazing Specified: 34 dB Rw + Ctr	dB	24	30	25	34	45	44	52	52	
Area of Window	dB	4	4	4	4	4	4	4	4	
Area Correction	dB	6	6	6	6	6	6	6	6	
Maximum RT in Room	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	48	42	45	37	24	24	14	4	39
SRI External Wall, Houses	dB	38	51	56	65	65	65	65	65	
Area of Wall	dB	6	6	6	6	6	6	6	6	
Area Correction	dB	8	8	8	8	8	8	8	8	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	36	23	16	8	6	5	3	-7	15
SRI Roof, Houses	dB	22	39	48	55	60	60	60	60	
Area of Roof	dB	12	12	12	12	12	12	12	12	
Area Correction	dB	11	11	11	11	11	11	11	11	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	55	38	27	21	14	13	11	1	30
Combined Level from elements	dB	56	44	45	37	25	25	16	6	39
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	59	47	48	40	28	28	19	9	42

Flats, Bedrooms, Level 2 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Peak Level Noise, Lmax	dB	69	66	62	60	60	57	51	39	64
Projected New Traffic Peak	dB	76	76	74	75	73	72	70	60	79
External Noise Level Lmax	dB	76	76	74	75	73	72	70	60	79
Glazing Specified: 34 dB Rw + Ctr	dB	24	30	25	34	45	44	52	52	
Area of Window	dB	4	4	4	4	4	4	4	4	
Area Correction	dB	6	6	6	6	6	6	6	6	
Maximum RT in Room	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	48	42	45	37	24	24	14	4	39
SRI SRI External Wall, Flats	dB	38	42	43	47	57	65	65	65	
Area of Wall	dB	6	6	6	6	6	6	6	6	
Area Correction	dB	8	8	8	8	8	8	8	8	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	36	32	29	26	14	5	3	-7	25
SRI Roof, Flats	dB	12	31	38	42	52	60	65	65	
Area of Roof	dB	12	12	12	12	12	12	12	12	
Shielding to flat roof	dB	10	10	10	10	10	10	10	10	
Area Correction	dB	11	11	11	11	11	11	11	11	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	55	36	27	24	12	3	-4	-14	30
Combined Level from elements	dB	56	43	45	37	25	24	15	5	39
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	59	46	48	40	28	27	18	8	42

Houses, Bedrooms, Level 3 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Peak Level Noise, Lmax	dB	74	71	67	65	65	62	56	44	69
Projected New Traffic Peak	dB	85	85	83	84	82	81	79	69	88
External Noise Level Lmax	dB	85	85	83	84	82	81	79	69	88
Glazing Specified: 40 dB Rw + Ctr	dB	26	31	38	45	45	45	58	58	
Area of Window	dB	4	4	4	4	4	4	4	4	
Area Correction	dB	6	6	6	6	6	6	6	6	
Maximum RT in Room	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	55	50	41	35	33	32	17	7	40
SRI External Wall, Houses	dB	38	51	56	65	65	65	65	65	
Area of Wall	dB	6	6	6	6	6	6	6	6	
Area Correction	dB	8	8	8	8	8	8	8	8	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	45	32	25	17	15	14	12	2	24
SRI Roof, Houses, Enhanced	dB	34	44	51	57	61	59	63	65	
Area of Roof	dB	12	12	12	12	12	12	12	12	
Area Correction	dB	11	11	11	11	11	11	11	11	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	52	42	33	28	22	23	17	5	32
Combined Level from elements	dB	57	51	41	36	34	33	21	10	41
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	60	54	44	39	37	36	24	13	44

Flats, Bedrooms, Level 3 Glazing:

Frequency	Hz	63	125	250	500	1000	2000	4000	8000	dB(A)
Existing Peak Level Noise, Lmax	dB	74	71	67	65	65	62	56	44	69
Projected New Traffic Peak	dB	85	85	83	84	82	81	79	69	88
External Noise Level Lmax	dB	85	85	83	84	82	81	79	69	88
Glazing Specified: 40 dB Rw + Ctr	dB	27	32	38	45	45	45	58	58	
Area of Window	dB	4	4	4	4	4	4	4	4	
Area Correction	dB	6	6	6	6	6	6	6	6	
Maximum RT in Room	sec	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	54	49	41	35	33	32	17	7	40
SRI SRI External Wall, Flats	dB	38	42	43	47	57	65	65	65	
Area of Wall	dB	6	6	6	6	6	6	6	6	
Area Correction	dB	8	8	8	8	8	8	8	8	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	45	41	38	35	23	14	12	2	34
SRI Roof, Flats Enhanced	dB	21	35	38	43	54	60	65	65	
Area of Roof	dB	12	12	12	12	12	12	12	12	
Shielding to flat roof	dB	10	10	10	10	10	10	10	10	
Area Correction	dB	11	11	11	11	11	11	11	11	
Maximum RT in Room	sec	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Room Volume	m3	30	30	30	30	30	30	30	30	
Absorption		10	10	10	10	10	10	10	10	
Absorption Correction	dB	10	10	10	10	10	10	10	10	
Net SPL Inside	dB	55	41	36	32	19	12	5	-5	34
Combined Level from elements	dB	58	50	43	39	34	32	19	9	42
Tolerance on Calculation	dB	3	3	3	3	3	3	3	3	
Predicted Internal Noise Level	dB	61	53	46	42	37	35	22	12	45

APPENDIX 4 – 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 log ₁₀ (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.
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.
Rw	Single number quantity that characterises the airborne sound insulating properties of a material or building element over a range of frequencies.