Care Home
Warren Road
Worthing

Noise Assessment

On behalf of

Worthing Care Home Ltd

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1.0 Introduction

1.1. Noise Solutions Ltd has been commissioned to undertake a noise assessment for a proposed care home to be located on Warren Road, Worthing.

1.2. A planning application for the site has previously been permitted (application number AWDM/0769/20) with Conditions. This report addresses the Conditions pertaining to noise and gives acoustic specifications for the external building fabric of the development, in order that internal noise levels meet recognised national and local guidance.

1.3. The provision of suitable areas for external amenity use is also addressed.

1.4. To assist with the understanding of this report a brief glossary of acoustic terms can be found in **Appendix A**. A more in-depth glossary of acoustic terms can be assessed at the following web address http://www.acoustic-glossary.co.uk/.

2.0 Site description

2.1. The development site is located on the north east side of Warren Road, between the junctions with Links Road and Hillside Avenue. The site was formerly occupied by two detached properties at numbers 106 and 108 Warren Road.

2.2. The proposed care home building sits toward the rear (north) of the site, with a landscaped garden area forming a buffer to the boundary with the road.

2.3. The surrounding area is predominantly occupied by other existing detached residential dwellings.

3.0 Policy context

Noise Policy Statement for England

3.1. The Noise Policy Statement for England (NPSE[1]), published in March 2010, sets out the long-term vision of Government noise policy. The Noise Policy aims, as presented in this document, are: "*Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse effects on health and quality of life;*
- *mitigate and minimise adverse effects on health and quality of life; and*

[1] Noise Policy Statement for England, Defra, March 2010

- *where possible, contribute to the improvement of health and quality of life."*

3.2. The NPSE makes reference to the concepts of NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level) as used in toxicology but applied to noise impacts. It also introduces the concept of SOAEL (Significant Observed Adverse Effect Level) which is described as the level above which significant adverse effects on health and quality of life occur.

3.3. The first aim of the NPSE is to avoid significant adverse effects, taking into account the guiding principles of sustainable development (as referenced in Section 1.8 of the NPSE). The second aim seeks to provide guidance on the situation that exists when the potential noise impact falls between the LOAEL and the SOAEL, in which case: *"...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."*

3.4. Importantly, the NPSE goes on to state: "This does not mean that such adverse effects cannot occur."

3.5. The NPSE does not provide a noise-based measure to define SOAEL, acknowledging that the SOAEL is likely to vary depending on the noise source, the receptor and the time in question. NPSE advises that: *"Not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

3.6. It is therefore likely that other guidance will need to be referenced when applying objective standards for the assessment of noise, particularly in reference to the SOAEL, whilst also taking into account the specific circumstances of a proposed development.

National Planning Policy Framework

3.7. A new edition of NPPF was published in February 2019 and came into effect immediately. The original National Planning Policy Framework (NPPF[2]) was published in March 2012, with a revision in July 2018 - this document replaced the existing Planning Policy Guidance Note 24 (PPG 24) "Planning and Noise." The 2019 revised edition contains no new directions or guidance with respect to noise, and hence, all previous references remain extant. The paragraph references quoted below relate to the February 2019 edition.

[2] National Planning Policy Framework, DCLG, March 2012

3.8. Paragraph 170 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by, (amongst others) *"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, water or noise pollution or land stability."*

3.9. The NPPF goes on to state in Paragraph 180 "*planning policies and decisions 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 quality of life;*
> *(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 ...*

3.10. The NPPF document does not refer to any other documents or British Standards regarding noise other than the NPSE.

3.11. Paragraph 2 of the NPPF states that "planning law requires that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise."

3.12. Paragraph 12 of the NPPF states that "The presumption in favour of sustainable development does not change the statutory status of the development plan as the starting point for decision making. Where a planning application conflicts with an up-to-date development plan (including any neighbourhood plans that form part of the development plan), permission should not usually be granted. Local planning authorities may take decisions that depart from an up-to-date development plan, but only if material considerations in a particular case indicate that the plan should not be followed."

3.13. Paragraph 117 states that "Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land".

Planning Practice Guidance – Noise

3.14. An updated Planning Practice Guidance (PPG[3]) for noise was published on 22 July 2019 and provides additional guidance and elaboration on the NPPF. It advises that when plan-making and decision-taking, the Local Planning Authority should consider the acoustic environment in relation to:

[3] Planning Practice Guidance – Noise, https://www.gov.uk/guidance/noise--2, 22 July 2019

- 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.

3.15. This guidance introduced the concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). NOAEL differs from NOEL in that it represents a situation where the acoustic character of an area can be slightly affected (but not such that there is a perceived change in the quality of life). UAEL represents a situation where noise is 'very disruptive' and should be 'prevented' (as opposed to SOAEL, which represents a situation where noise is 'disruptive', and should be 'avoided').

3.16. As exposure increases above the LOAEL, the noise begins 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. As the noise exposure increases, it will then at some point cross the SOAEL boundary.

3.17. The LOAEL is described in PPG[4] as the level above which "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".

3.18. PPG identifies the SOAEL as the level above which "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."

3.19. In line with the Explanatory Note of the NPSE, the PPG goes on to reference the LOAEL and SOAEL in relation to noise impact. It also provides examples of outcomes that could be expected for a given perception level of noise, plus actions that may be required to bring about a desired outcome. However, in line with the NPSE, no objective noise levels are provided for LOAEL or SOAEL although the PPG[5] acknowledges that *"…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 particular situation."*

3.20. The relevant guidance in the PPG in relation to the adverse effect levels is summarized below:

[4] Paragraph: 005 Reference ID: 30-005-20190722
[5] Paragraph: 006 Reference ID: 30-006-20190722

Table 1: ProPG Effects Table

Response	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 perceived 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

Response	Examples of Outcomes	Increasing Effect Level	Action
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

3.21. The Planning Practice Guidance[6] states the following in relation to mitigation measures:

> *"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."*

3.22. In addition, the Guide notes that it may also be relevant to consider[7]:

> *"... 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".*

Planning permission AWDM/0769/20

3.23. The application was granted permission in September 2020. Condition 17 relates to noise and states:

> *"With the exception of any demolition works construction work above ground level shall not commence until a scheme for protecting the proposed noise sensitive development from external noise has been submitted to and approved by the Local Planning Authority. All works, which form part of the scheme, shall be completed before any part of the noise sensitive development is occupied. The scheme shall achieve the indoor ambient noise levels for dwellings specified in BS8233:2014. The scheme should include full details of glazing and a strategy to prevent overheating. The scheme shall also include an assessment of external amenity areas and achieve the levels recommended in the World Health Organisation*

[6] Paragraph: 010 Reference ID: 30-010-20190722
[7] Paragraph: 006 Reference ID: 30-006-20190722

community noise guidelines. Following approval and completion of the scheme, a test shall be undertaken to demonstrate that the attenuation measures proposed in the scheme are effective and protect the residential development from noise."

4.0 Acoustic standards and guidance

World Health Organisation, Guidelines for Community Noise, 1999 (WHO)

4.1. The World Health Organisation (WHO) Guidelines for Community Noise (1999) recommends suitable internal and external noise levels based on dose response research. The levels recommended in this guidance could be correlated to the LOAEL. Relevant guidance from this document is presented below.

- Sleep Disturbance (Night-time internal LOAEL): If negative effects on sleep are to be avoided, the equivalent sound pressure level should not exceed 30dBA indoors for continuous noise.

- Interference with Communication (Daytime internal LOAEL): Noise tends to interfere with auditory communication, in which speech is a most important signal. However, it is also vital to be able to hear alarming and informative signals such as door bells, telephone signals, alarm clocks, fire alarms etc., as well as sounds and signals involved in occupational tasks. The effects of noise on speech discrimination have been studied extensively and deal with this problem in lexical terms (mostly words but also sentences). For communication distances beyond a few metres, speech interference starts at sound pressure levels below 50 dB for octave bands centred on the main speech frequencies at 500, 1 000 and 2 000 Hz. It is usually possible to express the relationship between noise levels and speech intelligibility in a single diagram, based on the following assumptions and empirical observations, and for speaker-to-listener distance of about 1 metre:

  a) Speech in relaxed conversation is 100% intelligible in background noise levels of about 35dBA, and can be understood fairly well in background levels of 45dBA.

  b) Speech with more vocal effort can be understood when the background sound pressure level is about 65dBA.

World Health Organisation (WHO) 2009

4.2. The introduction of the Directive on Environmental Noise, obliges Member States to assess and manage noise levels. With the support of the European Commission, the WHO Regional Office for Europe has developed night noise guidelines for Europe to help Member States develop legislation to control noise exposure.

4.3. The guidelines are based on scientific evidence on the effects of noise and the thresholds above which these effects appear to harm human health.

4.4. There is limited evidence that night noise is related to hypertension, heart attacks, depression, changes in hormone levels, fatigue and accidents.

4.5. The WHO report summarises the threshold levels of night noise above which a negative effect starts to occur or above which the impact becomes dependent on the level of exposure. For example, the threshold level for waking in the night and/or too early in the morning was 42 dB.

4.6. It also establishes that there are differences in the intensity and frequency of noise depending on the source, which lead to different impacts. Road traffic is characterised by low levels of noise per event, but as there are a high number of events, on average it has a greater effect on awakenings than air traffic, which has high levels of noise per event but fewer events.

4.7. Integrating these findings, the report proposed a guideline target limit of outdoor night noise of 40 dB (annual average defined as 'L_{night}' in the Environmental Noise Directive). There is not sufficient evidence that the biological effects observed below this level are harmful to health but adverse effects are observed above 40 dB.

BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings.

4.8. This Standard provides recommended guideline values for internal noise levels within dwellings which are similar in scope to guideline values contained within the World Health Organisation (WHO) document, Guidelines for Community Noise (1999[8]). These guideline noise levels are shown in Table 2, below:

Table 2 BS 8233 Desirable Internal Ambient Noise Levels for Dwellings

Activity	Location	07:00 to 23:00 hours	23:00 to 07:00 hours
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

4.9. BS 8233:2014 advises that: *"regular individual noise events…can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values."*

[8] World Health Organisation Guidelines for Community Noise, 1999

4.10. The standard also provides advice in relation to design criteria for external noise. It states that:

> *"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.*
>
> *Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate.*
>
> *Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation.*
>
> *In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."*

Building Regulations

4.11. Part L of the Building Regulations mandates that buildings become more airtight, and Part F stipulates ventilation requirements. Even though there appears to be a contradiction in this, Part L limits uncontrollable ventilation, while Part F ensures that ventilation requirements are provided in a controlled manner.

Ventilation requirements for dwellings

Background ventilation

4.12. Three types of ventilation are required under Part F. Whole building ventilation provides nominally continuous air exchange which may be reduced or ceased when the building is not occupied. It can be provided via background ventilators operating alone, or together with:

- passive stack ventilators;
- continuous mechanical extract; or
- continuous mechanical supply and extract with heat recovery.

4.13. Extract ventilation is applicable to rooms where most water vapour and/or pollutants are released (e.g. kitchens and bathrooms). It can be provided by intermittent fans, passive stack or continuous mechanical extract with or without mechanical supply and heat recovery.

4.14. The four systems described in Part F do not present solutions which utilise the use of opening windows for background ventilation. Opening windows do not provide a controllable means of ventilation and also pose security risks.

Purge ventilation

4.15. Purge ventilation is required throughout the building to aid the removal of high concentrations of pollutants and water vapour. It is commonly provided simply by opening windows and doors.

4.16. Even though purge ventilation is recommended via opening windows, the temporary and intermittent occurrence of this does not normally result in an unacceptable increase of internal noise levels.

4.17. Part F goes on to say[9] that "Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations."

Summary in relation to ventilation

4.18. In summary, background ventilation for new residential dwellings should be provided via one of the four systems in Approved Document F. The composite external building fabric should be designed to ensure that appropriate internal noise levels due to external incident noise are met during background ventilation.

4.19. Purge ventilation for bedrooms should be provided via open windows. The slight increase of internal noise levels should be considered acceptable.

[9] Paragraph 4.15 in Approved Document F

5.0 Assessment methodology

Existing noise levels

5.1. ACA Acoustics have previously undertaken an assessment of noise levels at the site. Their report reference 200303-R001 dated 26th March 2020 gives incident noise levels in terms of daytime $L_{eq,16hr}$, night-time $L_{eq,8hr}$ and night-time L_{max} used in their assessment of the required external building fabric performance. Octave band data is presented in their calculations.

5.2. Table 3 below shows the octave-band L_{eq} and L_{max} levels used in the assessment. It is assumed that these levels represent the worst-case levels incident at the façade facing Warren Road.

Table 3: Summary of external noise levels

Façades	Period	Incident sound pressure levels (dB) at Octave Band Centre Frequencies (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
South elevation	Daytime $L_{eq, 16\ hours}$	67	65	61	59	59	55	50	44	63
	Night-time $L_{eq, 8\ hours}$	62	60	56	54	54	50	45	39	58
	Highest typical night-time L_{Max}	74	72	68	66	66	62	57	51	70

6.0 Internal noise assessment

Building fabric assessment

6.1. In order to assess the suitability of the site for the proposed dwellings it is important to predict the internal noise levels within habitable rooms.

6.2. The composite acoustic performance required of any portion of the building envelope will depend on its location relative to the principal noise sources around the site and the nature of the spaces behind it (noise criteria, size, room finishes etc.).

6.3. The variation in incident noise levels on the different façades, along with differences in internal layouts and size of glazed areas, implies that a number of different sound insulation performance levels may be required in order for a specific internal ambient noise level to be reached. Logistically, this could result in increased costs for the development due to bespoke solutions, effects on programme and increase of errors during construction. National policy on noise does not insist on compliance with a specific level but rather it suggests that reasonable practicable mitigation measures should be put in place in order to approach a certain target level (assuming the non-mitigated impact is predicted to lie above this target level) when this level is below the SOAEL. Slight exceedances of this level are deemed acceptable under national policy on noise which supports sustainable development.

6.4. The detailed calculation methodology described in BS 8233:2014 has been used in the assessment. Table 4 below presents the input data used to predict the resultant internal noise level in the habitable rooms. To calculate the internal noise levels, and thereby determine the acoustic performance required for glazing, the rooms with the worst-case combination of window area and room volume (and at the loudest elevation) have been assessed. This assessment therefore concentrates on a bedroom on the south elevation; all other elevations can be considered to be less onerous.

Table 4 Source data for the noise break-in assessment

Window location	Room type	Floor area (m^2)	Room volume (m^3)	Window area (m^2)
South elevation	Bedroom	17	43	2.4

6.5. Based on the information above, and the noise spectrum data shown in Table 3, the resulting internal sound levels may be calculated. The following paragraphs set out the acoustic performance requirements such that internal sound levels complying with BS 8233:2014 guidance can be achieved. Resultant internal sound levels are summarised in Table 7.

6.6. Different types of glazing will control noise to differing amounts and will vary according to the type of noise that should be reduced. The performance of glazing is established by measurement in the laboratory.

6.7. The minimum glazing and ventilation specifications required to provide the internal noise levels recommended in BS 8233:2014 are shown in Table 5. The minimum acoustic performance required for each glazing and ventilator type is shown in Table 6.

Table 5 Glazing and ventilation types

Facade	Room type	Façade specification	
		Glazing type	Ventilator type
South	Bedroom	Type A	Typical non-acoustic

Glazing and ventilator performance

6.8. Octave band performances required for the glazing categories above are shown in Table 6. Performance requirements for windows must be met inclusive of frames, seals etc.

Table 6 Octave band performance specification for external building elements

Item		Attenuation (dB) at octave band centre frequency (Hz)					
		125	250	500	1000	2000	4000
Type A Glazing (typically 4/16/4)	SRI	24	20	25	34	37	40
Typical non-acoustic trickle ventilator	D_{ne}	32	32	31	33	31	31
Non-vision wall Cavity brick-block construction (or cladding with similar acoustic performance)	SRI	41	45	45	54	58	55

6.9. These are minimum sound reduction indices and higher acoustic specifications could be used if required for other reasons.

6.10. The results of the assessment are shown in Table 7. The noise levels meet the guidance in BS 8233:2014 and therefore the second aim of the NPPF will be met in relation to internal amenity.

Table 7 Predicted internal sound pressure levels (closed windows, inclusive of minimum glazing and ventilation type)

Facade	Room type	Period/ Parameter	Internal sound level, dB	Criterion, dB	Excess, dB
South	Bedrooms	Daytime $L_{Aeq\ 16hr}$	34	35	-1
		Night-time $L_{Aeq\ 8hr}$	29	30	-1
		Night-time L_{Amax}	41	45	-4

6.11. It should be noted that glazing configurations and other constructions described above are for guidance and costings purposes only. It will be the responsibility of the manufacturer to provide evidence of compliance with the required octave band sound reduction performances.

6.12. It is noted that the above analysis is based on windows remaining closed and with background ventilation provided by trickle ventilators.

Noise from and through mechanical ventilators

6.13. Where provided for non-acoustic reasons (such as to provide suitable control of air quality), mechanical ventilators must include suitable attenuation to control intrusive noise. The attenuation must control intrusive noise (entering through fresh air and exhaust ducts) and noise generated by the fan(s) to no higher than 25 dB L_{Aeq} and no higher than 40dB L_{Amax}.

Conclusion

6.14. The assessment has demonstrated that, taking into consideration the provision of reasonable practicable measures (i.e. the provision of good quality double glazing), adverse effects of noise can be minimised for the development proposals.

7.0 External amenity assessment

External levels with no screening

7.1. With reference to section 5.2, daytime external noise levels at the building have been established to be 63dB $L_{Aeq,16hr}$. Noise levels across the garden area to the south of the site (i.e. between the building and Warren Road) will therefore be louder and significantly in excess of the WHO / BS 8233:2014 guidance values for external amenity.

7.2. Modelling of noise from Warren Road indicates that, in the absence of any additional barriers or screens, noise levels across the garden area range from around 63 to 67 dB $L_{Aeq,16hr}$. This would be 8 to 12dB above the upper guidance value from BS 8233:2014 for external amenity areas. The garden area to the rear of the building, although smaller, would be around 46dBA, comfortably within the guidance levels, with the area to the north west being 57dBA, marginally in excess of the guidance.

7.3. An indicative noise map is shown in Figure 2 of **Appendix B**

Proposed barrier to boundaries

7.4. With a 1.8m tall solid timber fence along the western site boundary, noise levels at the north west garden area would drop to 53dBA, within the upper guidance value. The front garden area would remain largely unaffected. An indicative noise map is shown in Figure 3 of **Appendix B**.

7.5. If the 1.8m tall solid timber fence were to also run along the southern and south eastern boundaries, noise levels in the front garden area would be around 59 to 60 dB $L_{Aeq,16hr}$, still slightly above the guidance levels.

Proposed havens

7.6. In order for adequate external amenity to be provided, it is proposed to include some localised areas with additional screening. The current landscaping plan from The Landscape Partnership (drawing number 101C) shows seating areas enclosed with low evergreen hedgerow (in an approximate "w" shape). If 2.2m timber screens were to enclose these areas in addition to the screens along the site boundary, modelling indicates that the noise levels within would be 53-55dB $L_{Aeq,16hr}$. This would be in compliance with the BS 8233:2014 guidance levels, as would levels in garden areas to the rear and north west of the building.

7.7. An indicative noise map is shown in Figure 4 of **Appendix B**.

8.0 Summary

8.1. Noise Solutions Ltd has been appointed to undertake an assessment of the external building fabric requirements for the proposed care home at Warren Road, Worthing.

8.2. An assessment has been undertaken in accordance with guidance from BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* and World Health Organisation guidance.

8.3. The assessment has determined that acceptable internal noise levels can be achieved through the selection of suitable glazing and trickle ventilators. Performance specifications have been provided for the external building fabric elements.

8.4. Through the use of mitigation (including selection of suitable glazing) the proposed development complies with accepted acoustic practice and is acceptable in terms of noise.

8.5. Noise modelling of the external garden areas indicates that, with screening along the boundary and to the localised areas as described, compliance with the guidance values in BS 8233:2014 can be achieved.

Appendix A Acoustic terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
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. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	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.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A –weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.

Appendix B Indicative noise mapping

Figure 1 – Reference landscape plan



Figure 2 – No barriers

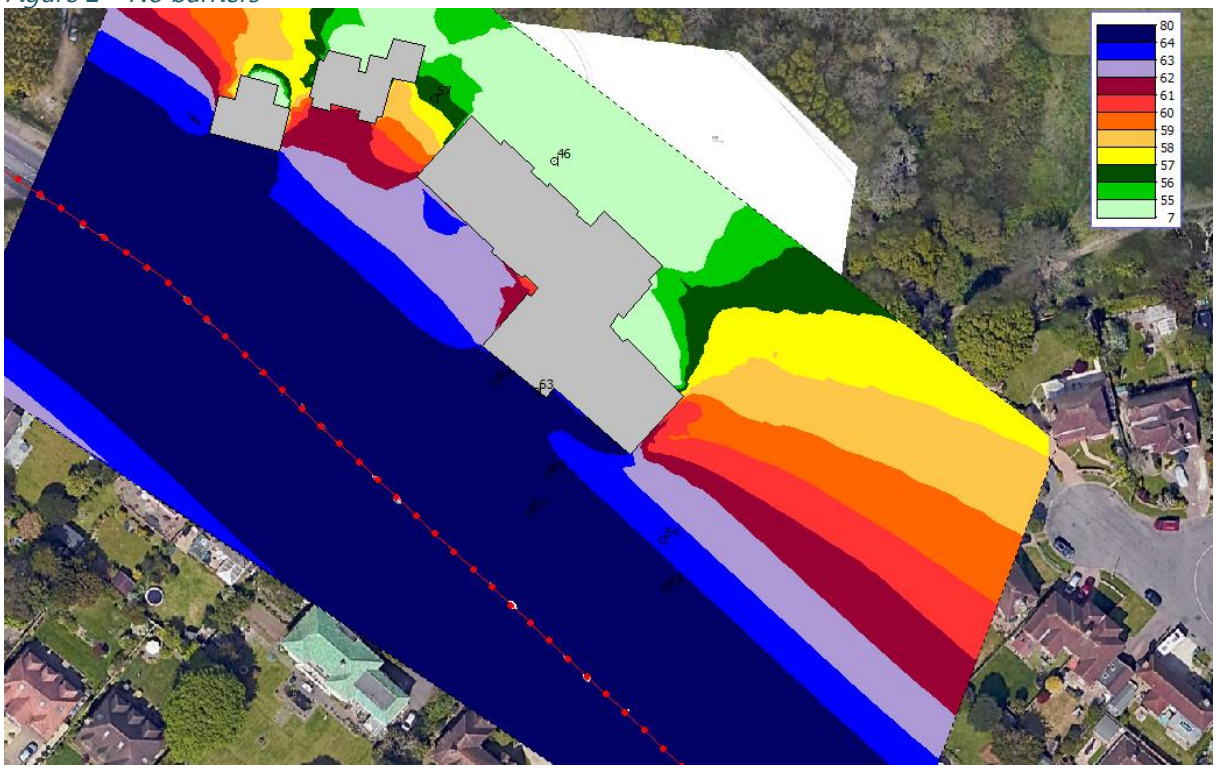


Figure 3 – West boundary barrier only

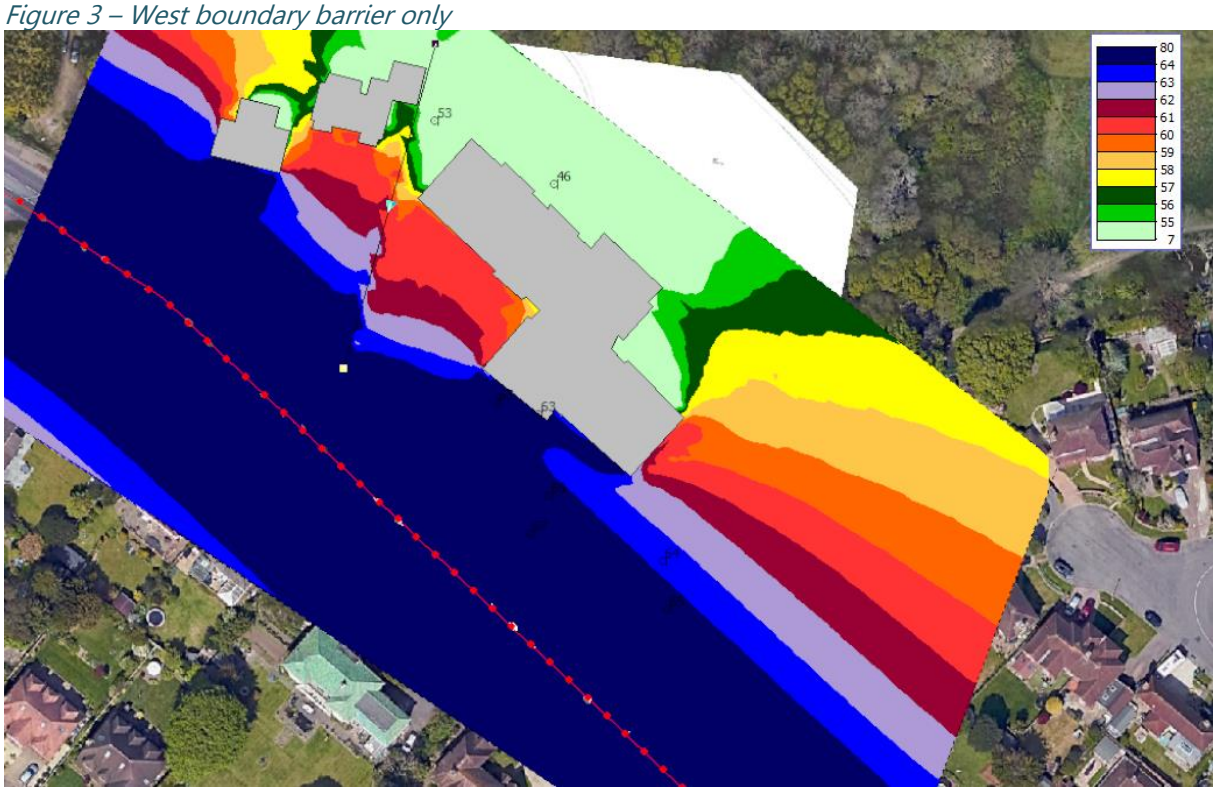
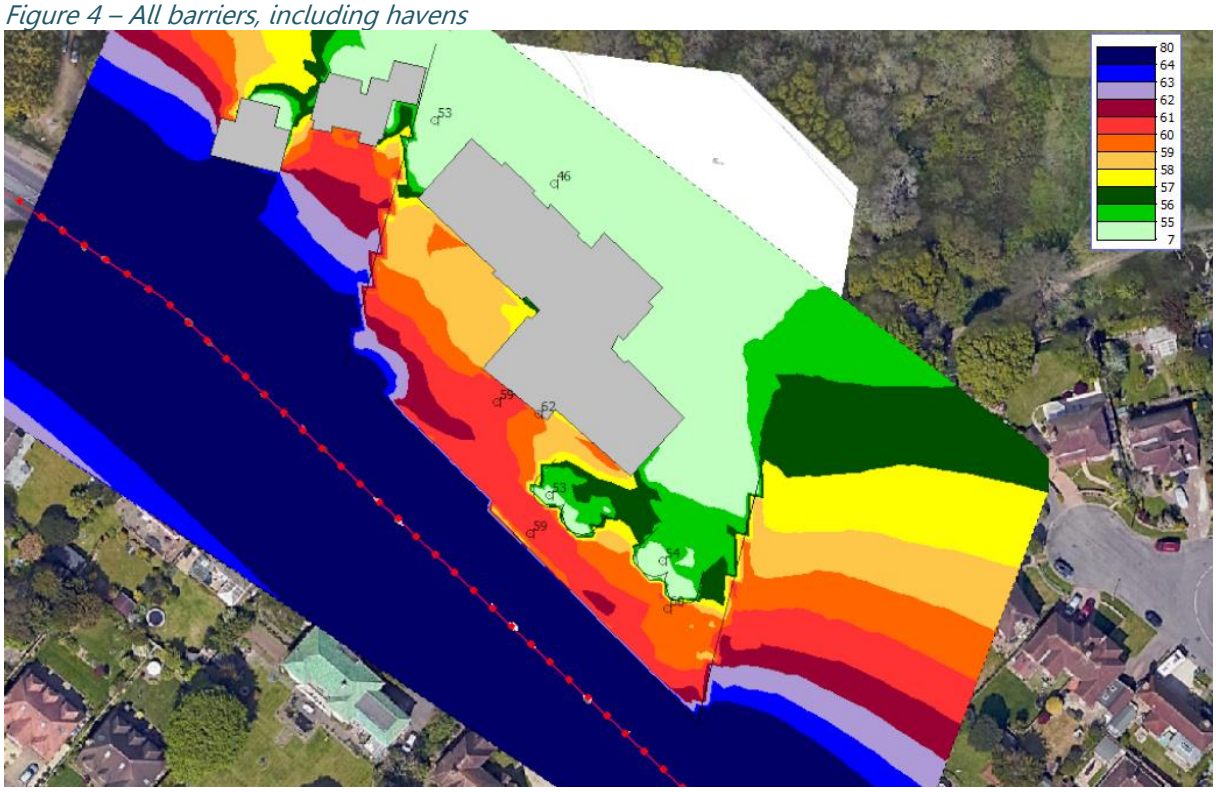


Figure 4 – All barriers, including havens



Appendix C Acoustic fencing

C.1 Acoustic fencing should have a minimum mass per unit area of 15kg/m^2 and be formed from close fitting, tongue-and-groove boards, with no gaps.

Suitable suppliers

https://www.avsfencing.co.uk/

https://www.jacksons-fencing.co.uk/acoustic-fencing