Planning Application - New Build Residential Development

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Project: J3973

Issue 2

Site: **Bines Road, Partridge Green, West Sussex.**

Client: **Croudace**

Contents

Tables

Figures

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Issue 1	30/01/2025	Original Issue
Issue 2	31/10/2025	Revised to account for Narrative with Environmental Protection Officer

1 Introduction and Executive Summary

Acoustic South East have been appointed to undertake an acoustic assessment to support a detailed planning submission for 101 new dwellings at Bines Road, Partridge Green in West Sussex. A planning application has been made by the client, Croudace to Horsham District Council and can be reviewed under DC24/1699.

Standards and guidance referenced for this assessment include:

- BS8233 (Sound insulation and noise reduction for buildings) 2014
- World Health Organisation, Guidelines for Community Noise dated 1999 (revised 2018)
- National Planning Policy Framework (NPPF), 2024
- Acoustics Ventilation and Overheating Guidance (AVOG), January 2020
- Building Regulations Approved Document O – Overheating
- BS6472:2008 – Guide to Evaluation of Human Exposure to Vibration in Buildings
- ProPG2017 - Professional Practice Guidance on Planning & Noise

An unattended class 1 sound level meter was left at the site boundary from 16th to 22nd January 2025. The soundscape at the site is consistent with passing traffic and vehicles entering and leaving the star lane industrial estate. Aviation and bird song are also noted at the site.

An initial site risk assessment, consistent with ProPG2017 identifies that the development of the site is a low to medium risk.

Plot 1 is the closest to the road at approximately 16m, whereas the remainder of the Eastern site boundary are set back from the road at 33-47m. The built construction provides an effective barrier to the remainder of the site to enjoy more tranquil conditions.

Noise modelling software has been used to provide the reader with easy to understand 2D noise contours. These relate to external amenity areas, window opening, areas where enhanced mitigation measures might be required as well as a consideration of a simplified assessment for Building Regulations and an overheating assessment.

All garden areas achieved BS8233:2014 requirements and are below 55dB $L_{Aeq,16\ hours}$.

Windows may be opened for the majority of the site, albeit for dwellings in close proximity to the B2135 with an Eastern elevation, an alternative ventilation strategy will be required. Rigorous calculations have been carried out to demonstrate that this is capable of being achieved with either acoustically treated through frame passive slot vents or through wall passive vents.

Windows may also be opened during the night time period for the majority of the site, albeit again, those dwellings with an Eastern façade in close proximity to the B2135 will not be able to open windows during the night time period. Notwithstanding this, windows will be openable on the rear of Plots 38 to Plot 1 on the Eastern boundary close to the B2135 with Table 4 values comfortably achieved.

From the information presented, planning permission should not be withheld on noise grounds.

2 Context, Noise Criteria & Noise Assessment Methodology

2.1 Context

A detailed planning application for 101 new dwellings has been made to Horsham District Council and can be seen on their planning website under reference DC24/1699. As part of the internal consultation process, the Environmental Health Department as technical consultees have requested that a noise impact assessment be produced to support the application.

2.2 Site Location

The site is located to the West of the B2135 and further East is the Star Industrial/Commercial estate. The B2135 is 30mph road adjacent to the application site and runs North to South as single carriageway road.

The application site is bordered in red in Figure 1 below.

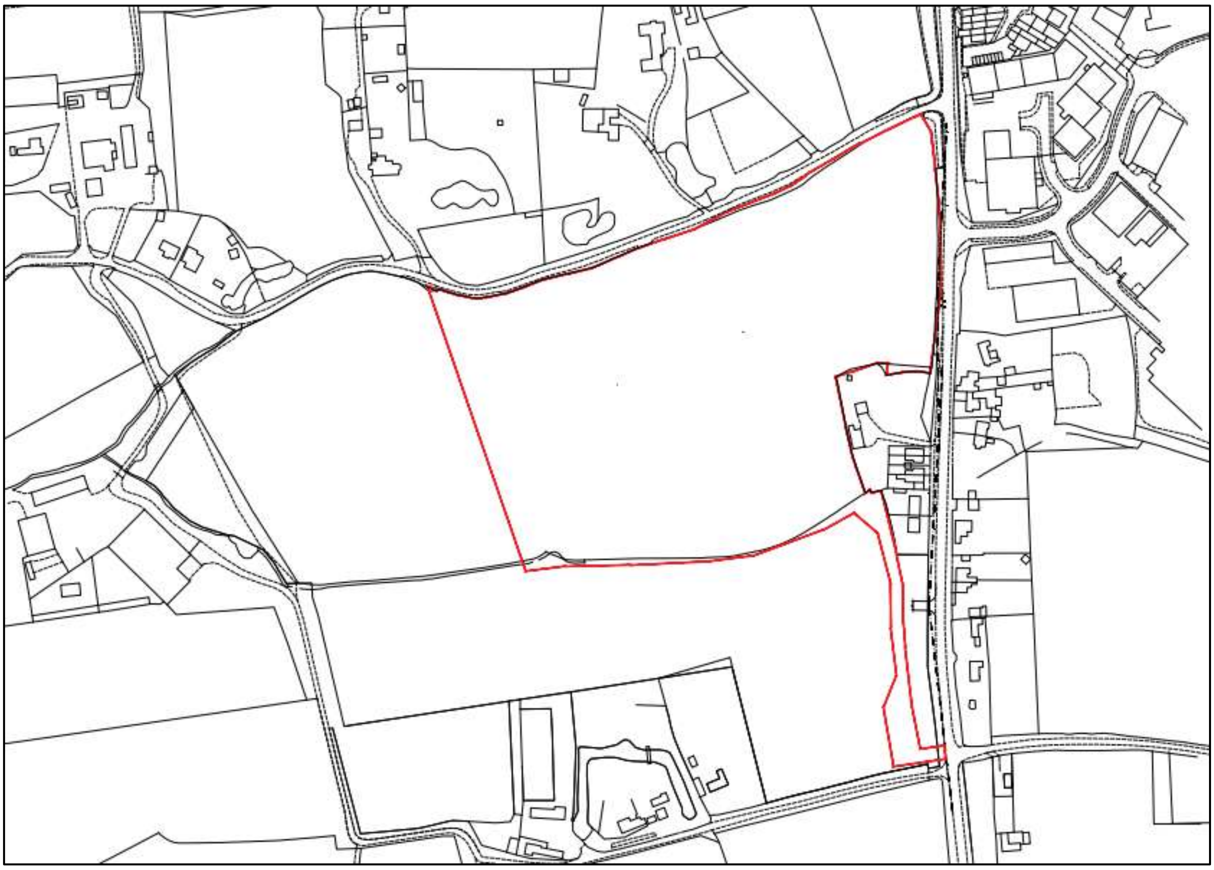


Figure 1. Site Location

2.3 Proposed Site Masterplan

The proposed site layout can be seen in Figure 2 below.

Figure 2. Site Masterplan

2.4 Site Soundscape and Commercial Setting

On setting up and decommissioning the survey equipment, the B2135 was not heavily trafficked. Passing vehicles were counted for a 15-minute period from 11:15:11:30 hours and 56 vehicles passed, of which 23 turned into or came out of the Star Lane commercial estate junction.

2.5 Good Acoustic Design

Good acoustic design has seen the majority of the housing set well back from the B2135. This has been achieved through the use of open space, play areas and landscaping which are used as a natural buffer zone to maximise noise attenuation from the B2135. The layout of the properties also means that those closest to the road, act as massing to protect the remainder of the proposed dwellings on the site from adverse noise levels.

2.6 Planning Policy and Assessment Criteria

2.6.1 National Planning Policy Framework Dec 2024

The National Planning Policy Framework (Dec 2024) defines the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so.

The following paragraphs are relevant within NPPF Section 15 (Conserving and enhancing the natural environment) states the following:

Paragraph 187(e) - Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability, and

Paragraph 198 - Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the 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; and

Paragraph 200– 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.

Of relevance for the agent of change is the Star commercial/industrial estate located further East of the site.

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

Table 4 of BS8233:2014 provides the following guideline values:

Activity	Location	Time period of day	
		07:00-23:00	23:00-07:00
Resting	Living Rooms	35dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

Table 1. BS8233:2014 Criteria

It is relevant to note that Table 4 criteria in BS8233:2014 relates to continuous and anonymous sound.

2.6.3 ProPG2017

Planning guidance (ProPG2017) relates to new residential development and airborne transportation noise, which includes exposure to road traffic, railway and aviation noise. Whilst ProPG, 2017 generally mirrors the requirements of BS8233:2014 and the World Health Organisation Guidelines, 1999, it goes further in setting a limit for inside bedrooms for L_{Amax} events and specifically, no more than 10 L_{Amax} events per night time period above 45dB(A).

The internal bedroom L_{AMax} values will be used in accordance with ProPG2017.

2.6.4 Planning Noise Advice Document Sussex, November 2023

A planning noise advice document which all Sussex local authorities have contributed to and signed up to (including Horsham District Council) remains relevant. The guidance document has been followed in respect of measurement parameters and report presentation of data.

2.6.5 Building Regulations, Approved Document O

Recently introduced Part O of the building regulation requires an assessment of whether bedroom windows can be opened at night. It is assumed that bedroom windows will be closed if either of the conditions below are met:

- Internal noise level exceeds 40dB $L_{Aeq,\ 8hour}$
- L_{Amax} events exceed 55dB L_{Amax} more than 10 times a night.

Whilst this is strictly a Building Regulations function, it is relevant to be able to convey to the client whether bedroom windows are likely to be openable during the night time period.

2.6.6 Gardens/External Amenity Areas

Both BS8233:2014 and the World Health Organisation Guidelines for Community Noise dated 1999, revised 2018 require sound pressure levels in the garden area to be below 55dB $L_{Aeq,\ 16\ hour}$.

Attention is drawn to the British Standard 8233:2014 where it is described that it is not necessary for the whole of the garden space to achieve the stated sound pressure level. The Guidance in 7.7.3.2 states as follows "*Specifically, levels of 55dB $L_{Aeq,16\ hour}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space".*

2.7 Engagement With Horsham District Council – Environmental Health Department

Comments were received from Kevin Beer, as the Environmental Protection officer within Horsham District Councils Environmental Health department. Environmental Protection are technical consultees to the local planning authority.

The consultation responses are a matter of public record and can be viewed on the planning website for the application.

On 17th April 2025, comments were made from Kevin Beer to Jason Hawkes as the planning case officer. The comments concerned the fact that external amenity areas of plot 1 might exceed 50dB $L_{Aeq,16\ hour}$, with the local planning authority favouring that the garden noise levels should be below 50dB $L_{Aeq,\ 16\ hour}$.

The following points were sent to the client for forwarding onto the local planning authority.

- The site is a busy road network which contains a single point of access to a large industrial estate area (Star Industrial Estate) and has mixed vehicle types. The report does note approximately half of the vehicles seen in a 15-minute period were either entering or departing the industrial estate.

- The narrative to Jason Hawkes seems to be a mixed message in that on one hand it comments to plot 1 requiring robust mitigation measures to remain in place for the life of the development, but then it also goes onto suggest that plot 1 should be deleted or moved.

- It is arguable that at present the garden with a 2m fence-line achieves 50dB $L_{Aeq,\ 16\ hour}$ or below in 3 of the 5 receptor positions.

- The ProPG2017 document does not make reference to noise levels for external amenity spaces being below 50dB $L_{Aeq,\ 16\ hour}$, so it is not entirely clear why Horsham District Council wish to see this achieved (see section 3 of ProPG2017, page 17). The ProPG2017 document is clearly more recent than the WHO Guidelines, 1999 and removes any desirable elements providing a more objective approach of 50-55dB $L_{Aeq,\ 16\ hour}$.

> *3(ii) "The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$."*

Figure 3. Extract from ProPG2017 ref External Amenity Levels

- The road as a line source will attenuate poorly and moving the plot is not considered necessary as the incident sound is capable of being mitigated against.

- In section 2.6.6 it states that it is not necessary for the whole garden to achieve the stated SPL, but “should be achievable in some areas of the space”. It is important to note in section 5.1 (noise model inputs) it is stated that the model was generated and calibrated on the noisiest daytime and night time sound pressure levels to ensure that it remains robust. It is apparent from Figure 4 (Noise levels table) that such levels do not occur all of the time.

- Figure 8 already indicates that some of the garden plot is already below 50dB $L_{Aeq,\ 16\ hour}$.

- Figure 17 already shows some of the outcomes of the rigorous calculations to protect Plot 1 and these are relatively easily achieved with standard thermal double glazing and through wall acoustic vents.

- Notwithstanding the above, it is noted that HDC wish to see daytime SPL below 50dB $L_{Aeq,\ 16\ hour}$ for the plot 1 garden area. To facilitate an understanding of this, five receptor positions were placed into the plot 1 garden area and a number of model scenarios run with the fence raised to different heights to demonstrate that the garden is capable of being enjoyed at below 50dB $L_{Aeq,16\ hour}$. These have been achieved using the noise modelling software and 2D plans accompany the predictions to demonstrate the attenuation achieved and where this relates to the garden space.

Space	Fence Height			
	2m	2.5	2.75	3
Plot 1 Garden 1	46.2	45.2	44.7	44.2
Plot 1 Garden 2	50.0	48.7	48.0	47.4
Plot 1 Garden 3	50.4	48.9	48.1	47.5
Plot 1 Garden 4	51.6	50.0	49.2	48.4
Plot 1 Garden 5	53.4	51.3	50.3	49.5

Figure 4. Noise Modelling Outcomes Refined for Plot 1 Garden Area

In summary, it is argued that there is not a requirement to modify or delete plot 1 as the external spaces and the building envelope are suitable of being protected to safeguard future amenity for the occupiers. It is arguable that a maximum garden fence line of 2.5m would provide more than sufficient external amenity levels for the future occupants.

No additional documentation or responses from the Environmental Protection Team were noted.

2.8 Methodology and Rationale

The road and the adjacent commercial/industrial estate were measured over a week-long period and deliberately included a weekend using a class 1 sound level meter. The data was processed and a computer noise model generated using IMMI software to be able to demonstrate the likely propagation across the application site.

2D noise contours were used to illustrate the attenuation of sound from the main road, the B2135 which runs adjacent to the application site. The noise modelling was generated to review garden areas, openable windows and areas where non-standard mitigation measures might be necessary to protect end residents.

3 Sound Surveys

The location for the long-term sound survey was identified by walking the application site boundary North to South. The northern position (north of Star Lane junction) was noted to exhibit greater sounds from the commercial/industrial estate typical of industrial use, ie fork lift truck bleeper, fork clatter.

The long-term survey measurements were made in Freefield conditions with Fast and A weighted filters applied. The class 1 sound level meters used within the surveys were calibrated at the beginning and end of the survey to ensure that the meters were operating correctly and that the data produced is capable of being relied upon.

The resolution period for measurements was 5 minutes due to the size of the memory of the sound level meter.

The long-term sound level meter used dry cell batteries and was placed into a locked weatherproof peli case to prevent tampering and/or theft.

The positioning of the survey equipment can be seen in Figures 3 below and utilise WhatThreeWords to enable the positions to be further quantified.

Short term attended simultaneous measurements were also made to determine how the soundscape differs around the site.

Survey(s) carried out by	Scott Castle BSc(Hons) Env Health, MCIEH CEnvH MIOA
Equipment Used	Norsonic 118 Sound Level Meter – Mounted on Monopole
Equipment Used	Castle Acoustic Calibrator – Serial No. 041173
Location	Norsonic 118 Sound Level Meter – 2m above ground level WhatThreeWords: princely.meal.paraded TQ18961/18830
Duration	16th January 2025 to 22nd January 2025

Table 2. Survey Details (Sound)

Figure 5. Survey Location

4 Results of the Sound Survey

Continuous sound pressure levels ($L_{Aeq,T}$) are reported herein, however L_{Amax} events and values will be discussed post noise modelling and analysis.

4.1 Unattended Measurements (Freefield Data)

4.1.1 LT1

Bines Road			
Logarithmically Averaged Day and Night time Periods (External - Freefield)-dB(A)			
$L_{Aeq,\ 16\ hour}$- 07:00-23:00		**$L_{Aeq,\ 8\ hour}$ 23:00-07:00**	
Day 1	61.3	Night 1	52.2
Day 2	59.5	Night 2	50.0
Day 3	58.3	Night 3	48.4
Day 4	61.3	Night 4	52.5
Day 5	61.5	Night 5	53.1
Day 6	62.1	Night 6	53.5
Arithmetic Average	**60.6**	**Arithmetic Average**	**51.6**

Figure 6. LT1 Measured External Freefield Values

5 Noise Modelling Software (IMMI)

In order to see how noise varies at different positions around the proposed development it is possible to produce a noise contour map. A computer noise model has been completed using the computer package IMMI. Drawings of the area have been used to complete the noise models and the topography of the location recreated. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors.

The noise modelling software predicts freefield and A weighted dB values.

5.1 Noise Model Inputs

The noise model was calibrated by constructing a version of the existing site, complete with the buildings.

With the initial model constructed, a line source was added to replicate Bines Road.

The noise model was calibrated based on a worst-case day and night time measurement from the survey position of LT1 (62dB $L_{Aeq,16\ hour}$, 54dB $L_{Aeq,8\ hour}$). The calibration of the line source(s) involves adjusting the sound power level attributes of the line source until such time that the survey position reads in line with the worst-case daytime and night time sound pressure level.

With the line source calibrated, the proposed masterplan was added into the model and the properties then constructed.

All dwellings were added as 8m in height above ground level.

Privacy fences between gardens were not added, apart from plots 1 to 3 to determine the impact of road traffic noise on the garden areas close to the road.

Landscaping/barrier conditions were not added into the model with only a 2m fence added between plot 1-3 and the West of plot 38 to the North.

To simplify the assessment, rather than using numerous receptor points and data values, 2D colour contours have been used to determine relevant outcomes including daytime and night time noise exposure, garden assessment, openable daytime windows and a Building Regulations Approved Document O simplified overheating assessment.

Receptor points have been added for those properties close to Bines Road to understand what Sound Reduction Index or SRI is required to protect future occupants.

5.2 Configuration of the 2D Noise Modelling

The 2D noise contour renders are presented without any mitigation measures applied. The daytime and night time exposures are self-explanatory in Figures 5 and 6.

The external amenity area assessment in Figures 7 and 8 has used 2D noise contours to identify amenity areas below 50dB $L_{Aeq,16\ hour}$, between 50 and 55dB $L_{Aeq,\ 16\ hour}$ and exceeding 55dB $L_{Aeq,\ 16\ hour}$. Such external sound pressure levels are consistent with the values discussed in section 2.6.6 above.

For the daytime openable window assessment, the 2D noise contours applied an external figure of below 48dB and above 48dB $L_{Aeq,\ 16\ hours}$. This is based on the industry standard for an open window providing 13dB of attenuation between outside (freefield) sound pressure levels and internal reverberant conditions. Therefore, if the daytime internal sound pressure level is 35dB $L_{Aeq,16\ hour}$ (BS8233:2014), then 13dB added to this makes for 48dB $L_{Aeq,\ 16\ hour}$ externally.

Given that BS8233:2014 contains a 5dB tolerance, Figures 9 and 10 also provide an assessment of 40dB plus 13dB, ie 53dB $L_{Aeq,\ 16\ hour}$ externally.

For a simplified overheating assessment (see Figure 11), the continuous internal sound pressure level not to be exceeded with an open window is 40dB $L_{Aeq,\ 8\ hour}$. The overheating assessment however allows for a wider window opening to mitigate thermal overheating and allows for a 10dB attenuation for an open window. Therefore, the colour coordination allows for 40dB $L_{Aeq,8hour}$ internally, plus 10dB to make 50dB $L_{Aeq,\ 8\ hour}$ externally. Where 50dB $L_{Aeq,8\ hour}$ is exceeded, it is assumed that the bedroom windows would be closed and an alternative method of thermal mitigation employed.

5.3 Noise Model Outputs

5.3.1 Daytime

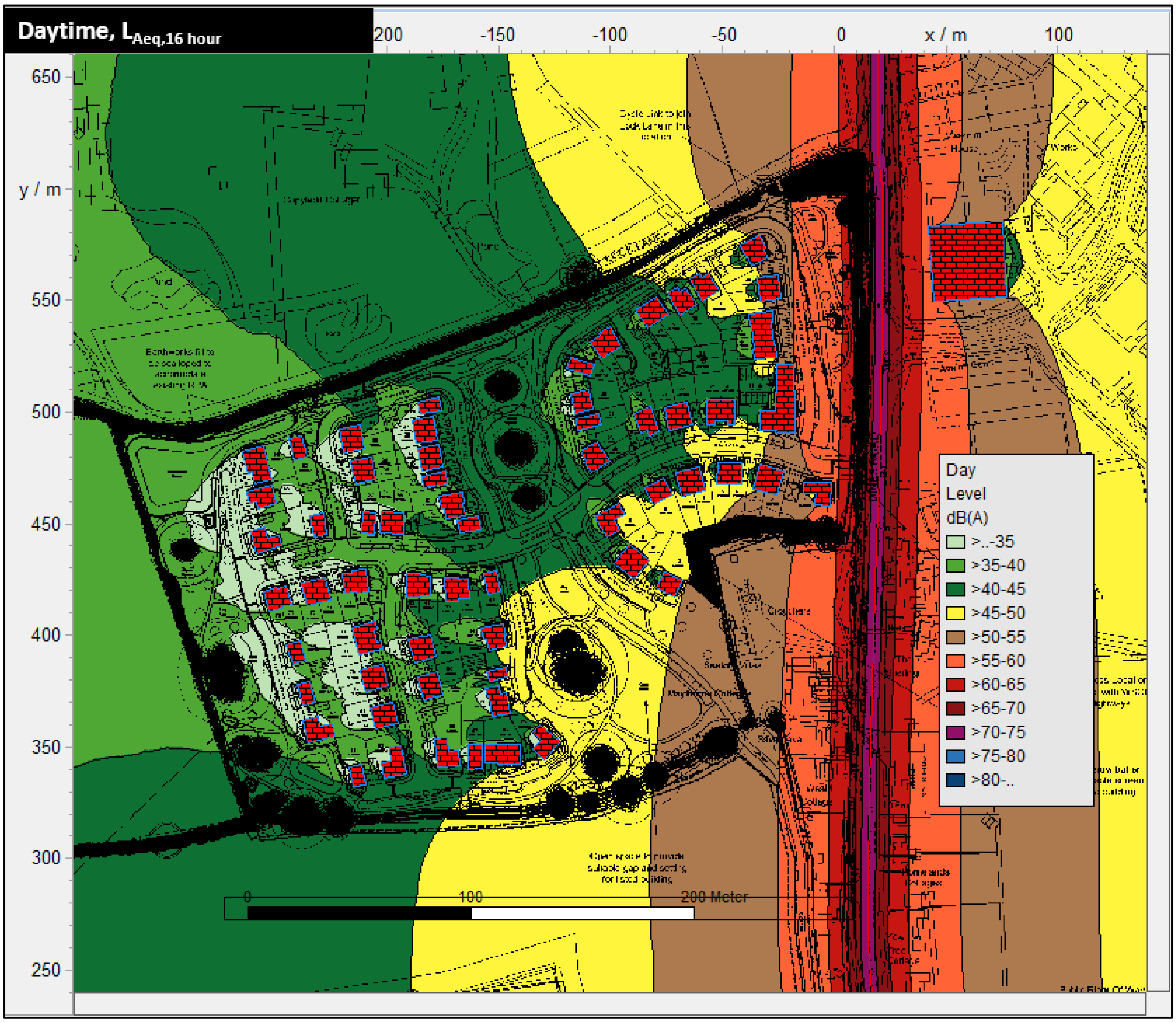


Figure 7. Daytime 2D Noise Contours

5.3.2 Night Time

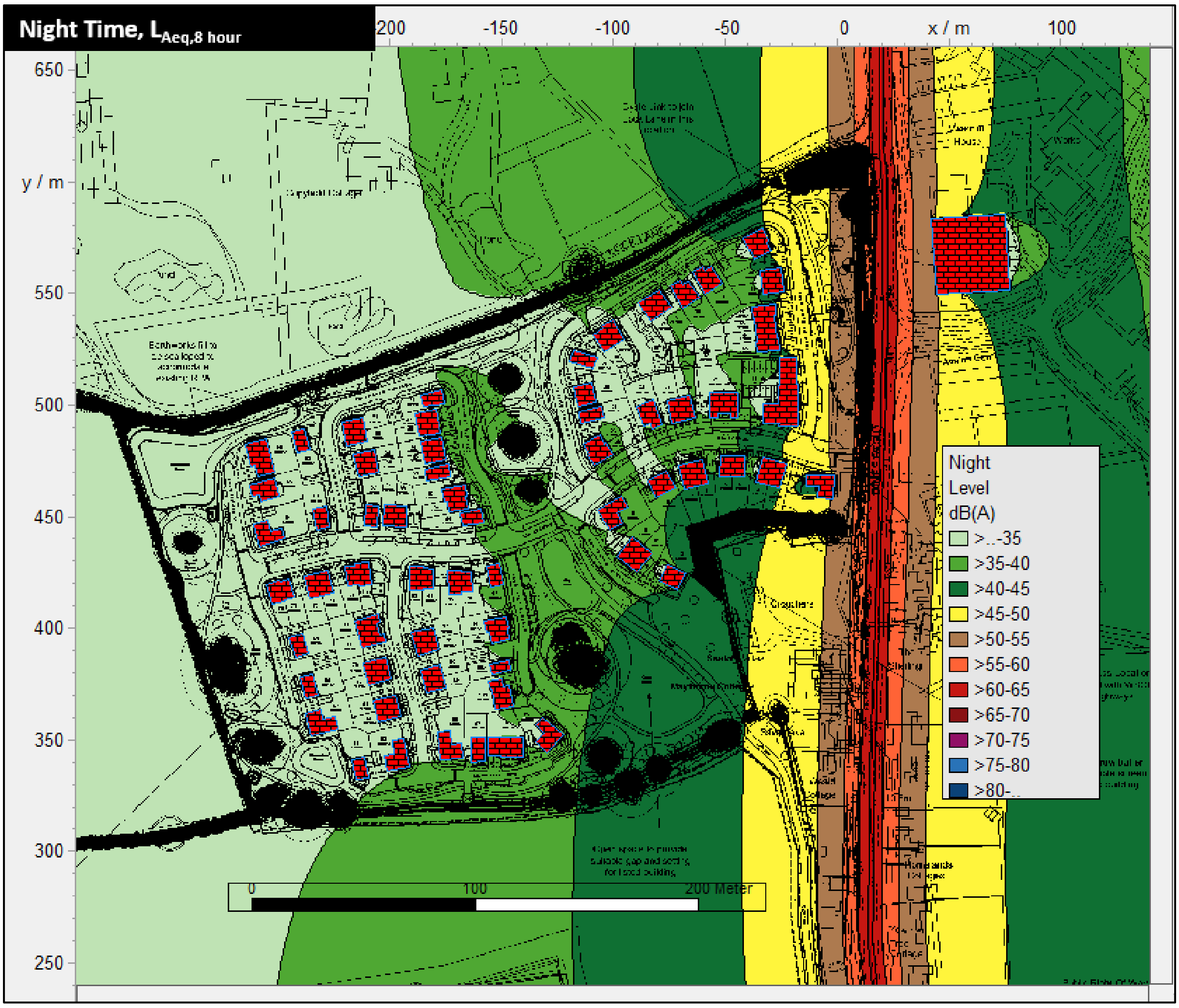


Figure 8. Night Time 2D Noise Contours

5.3.3 Gardens/External Amenity Areas

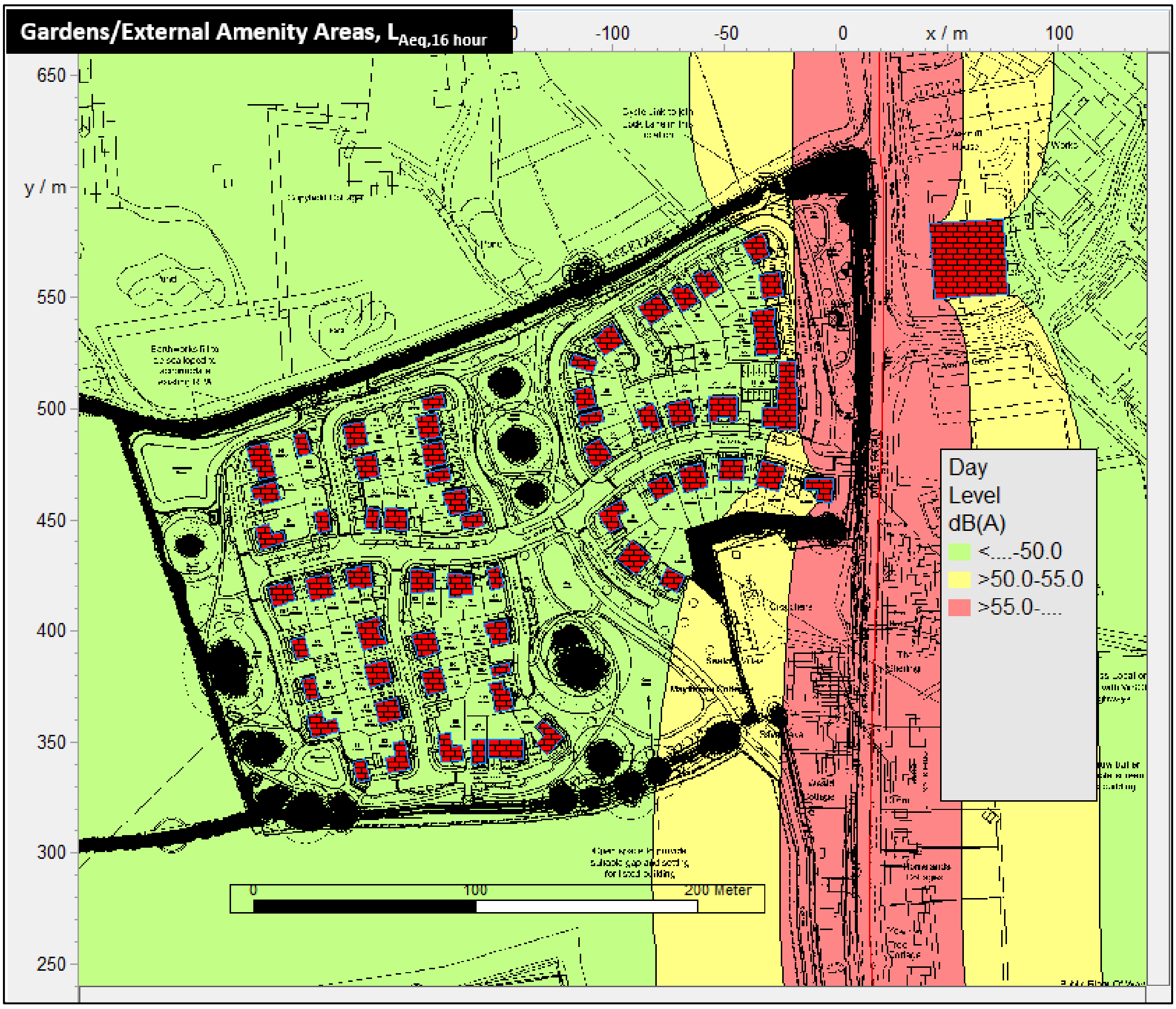


Figure 9. 2D Colour Contours for Garden Areas

For Figure 9 above, it is noted that no boundary fencing had been applied, hence the red areas around Plot 1. A 1.8m privacy fencing between plots 1-4 and a 2m external fence adjacent to the road had been added and the results are apparent in Figure 10 below.

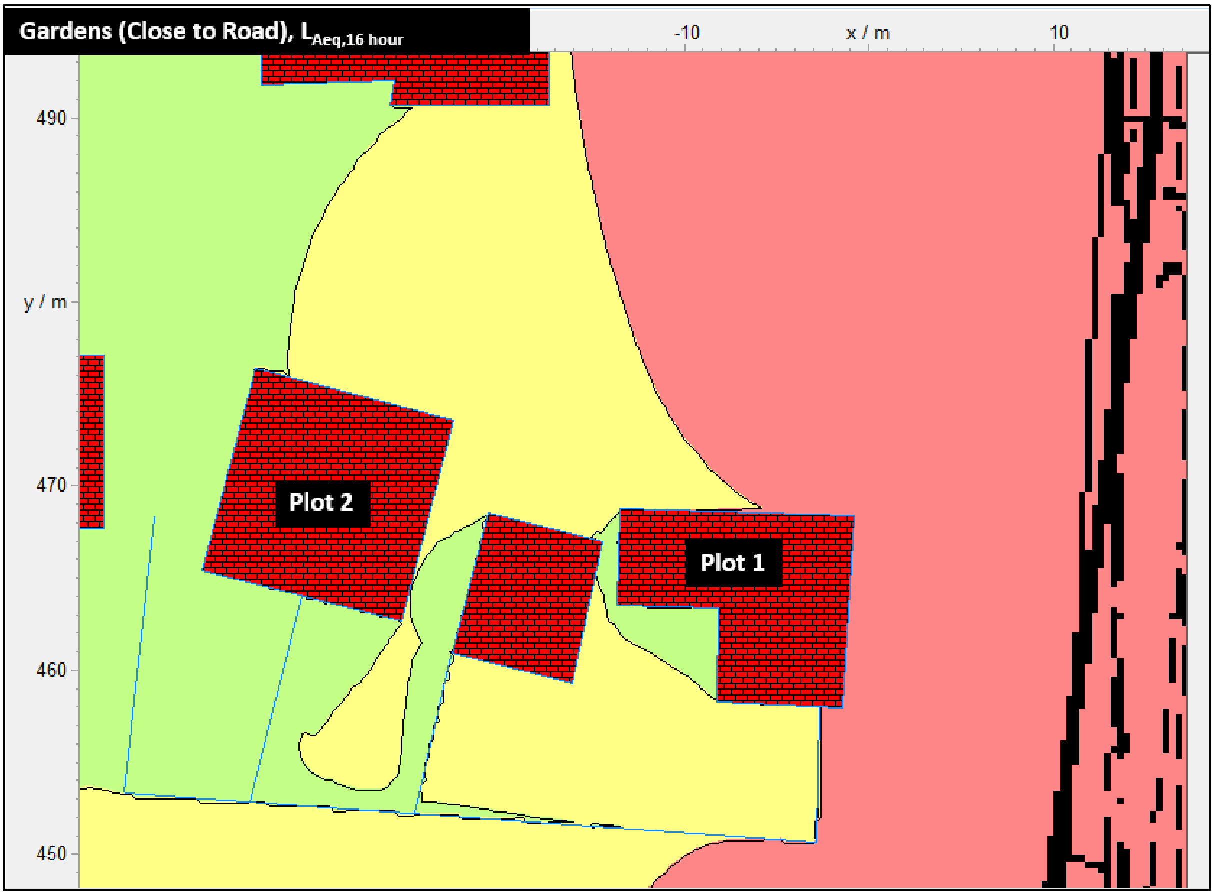
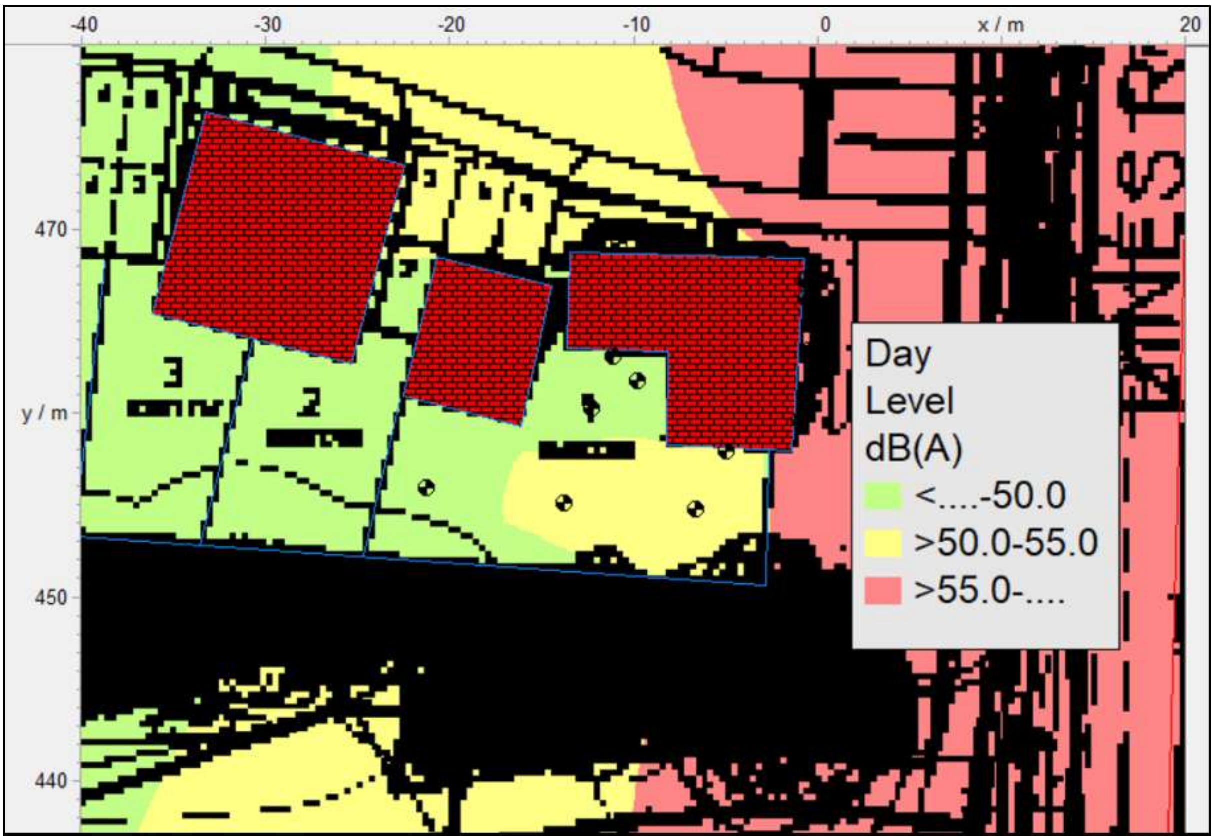


Figure 10. Garden Assessment - Plot 1 with Boundary Fencing Applied (2m Fenceline)

Figure 10 above shows that the criteria set by WHO and BS8233 are achieved even using worst-case levels to calibrate the computer model.

If a lower criterion level is to be considered in this case by Horsham District Council rather than that set by the recognised guidance then it is recommended that the model is calibrated using the energy average values for noise levels in place of the extreme worst-case levels which occur for only a part of the time.

If considered on this basis then the results, compared with Figure 10 above, indicates a large part of the garden to be below 50dB $L_{Aeq,16hr}$ with only a 2m fence line (See Figure 11 below).



2m Fenceline, with Daytime Sound Pressure Levels set to Average, Not Worst Case

Figure 11. Plot 1 with a 2m Fence Line, Model set to Average Daytime Sound Pressure Levels.

Specifically, with a 2m fence line set to average sound pressure levels, there is only 1 of the 5 positions within the plot 1 garden area which exceeds 50dB $L_{Aeq,16\ hour}$ and this is 52dB $L_{Aeq,16\ hour}$. The detailed predictions are presented in Figure 12 below.

Fence Height - 2m	
Garden Plot	**Predicted External SPL- $L_{Aeq,\ 16\ hour}$**
Plot 1 Garden 1	44.8
Plot 1 Garden 2	48.6
Plot 1 Garden 3	49.0
Plot 1 Garden 4	50.2
Plot 1 Garden 5	52.0

Figure 12. Plot 1 Garden Predicted Sound Pressure Levels

5.3.4 Daytime Openable Windows (BS8233:2014-Table 4 Values)

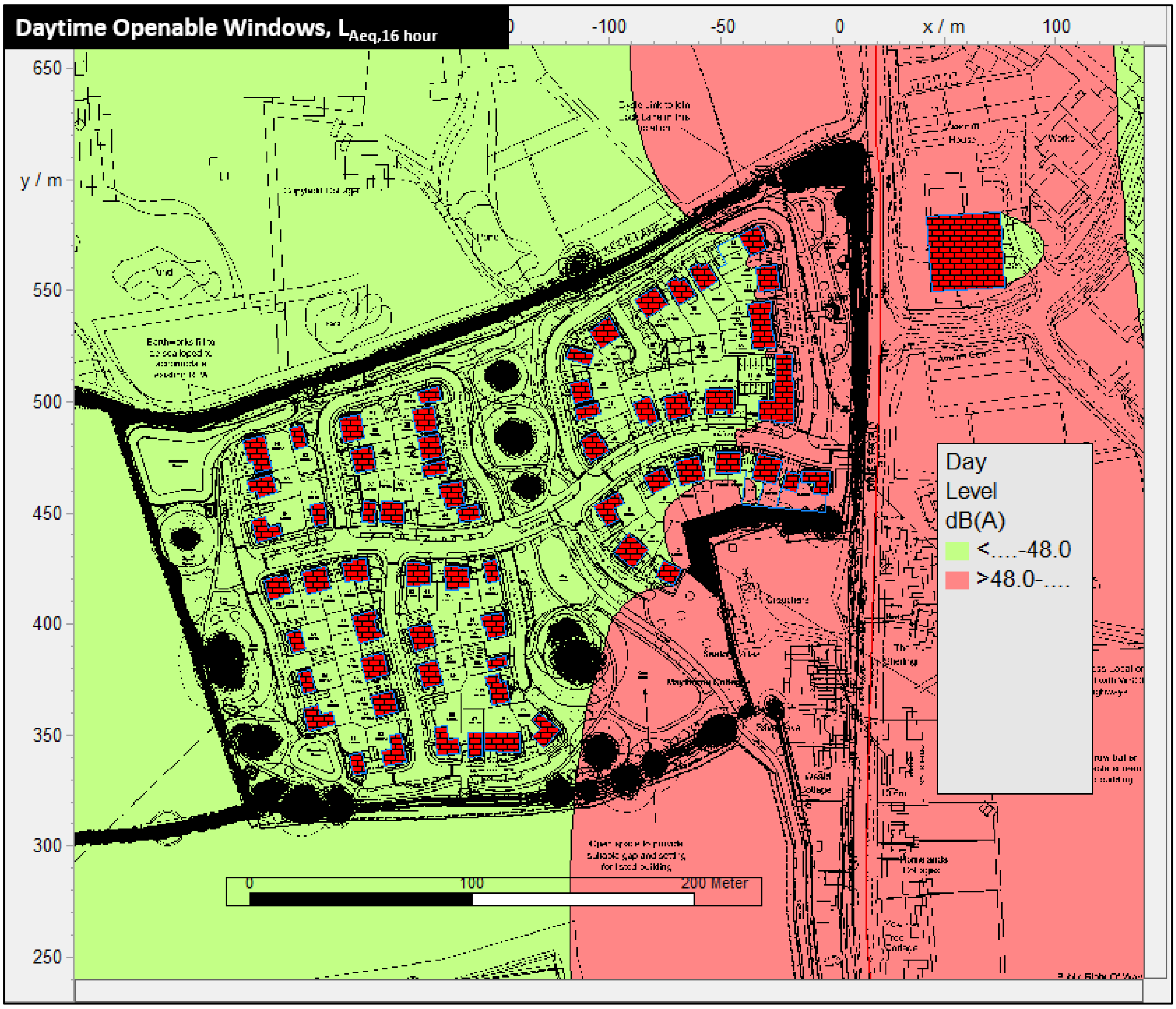


Figure 13. 2D Colour Contours, Daytime Openable Windows

Acoustic South East

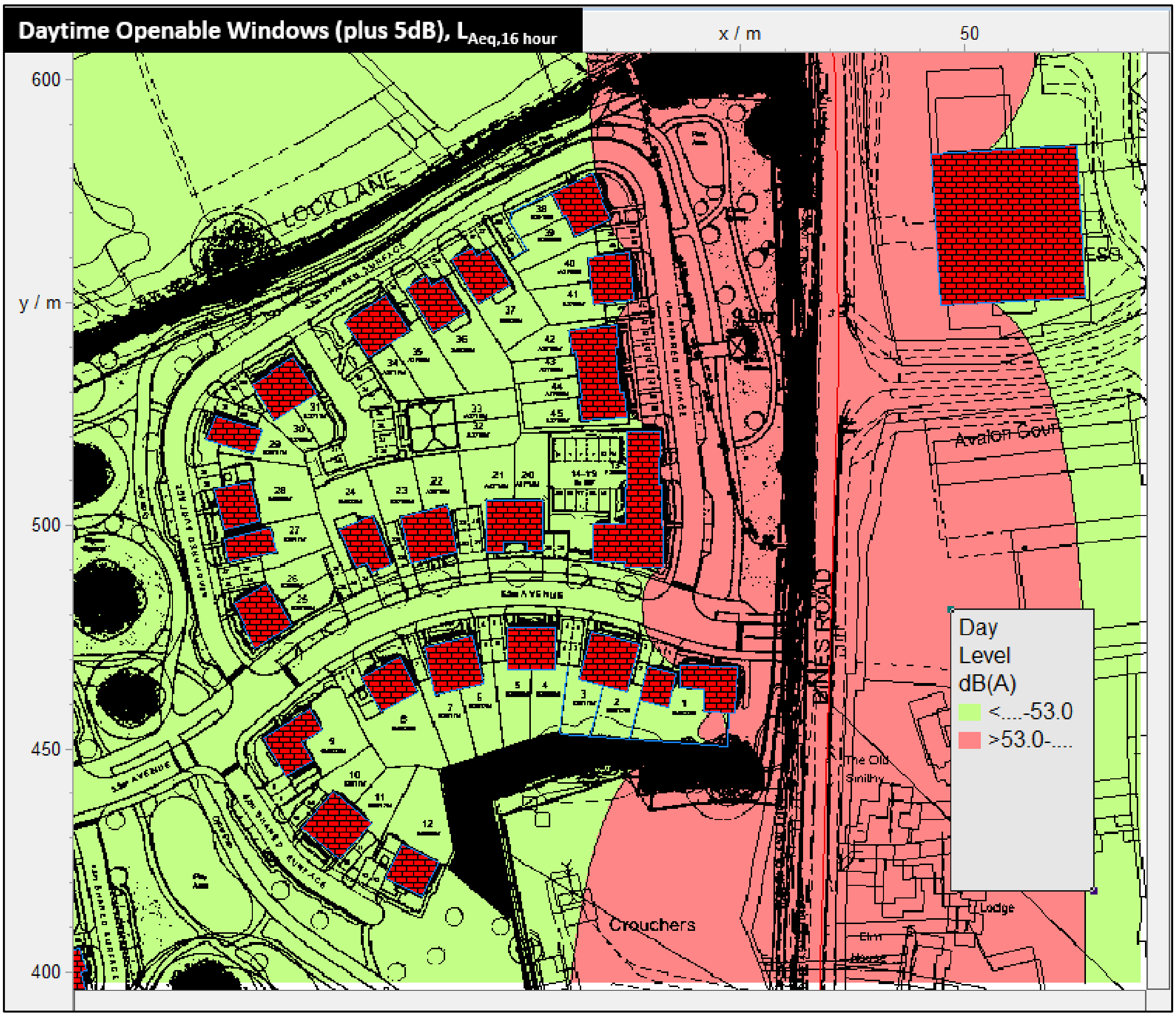


Figure 14. Daytime Window Opening (Plus 5dB Tolerance)

5.3.5 Building Regulations, Approved Document O – Simplified Overheating Assessment

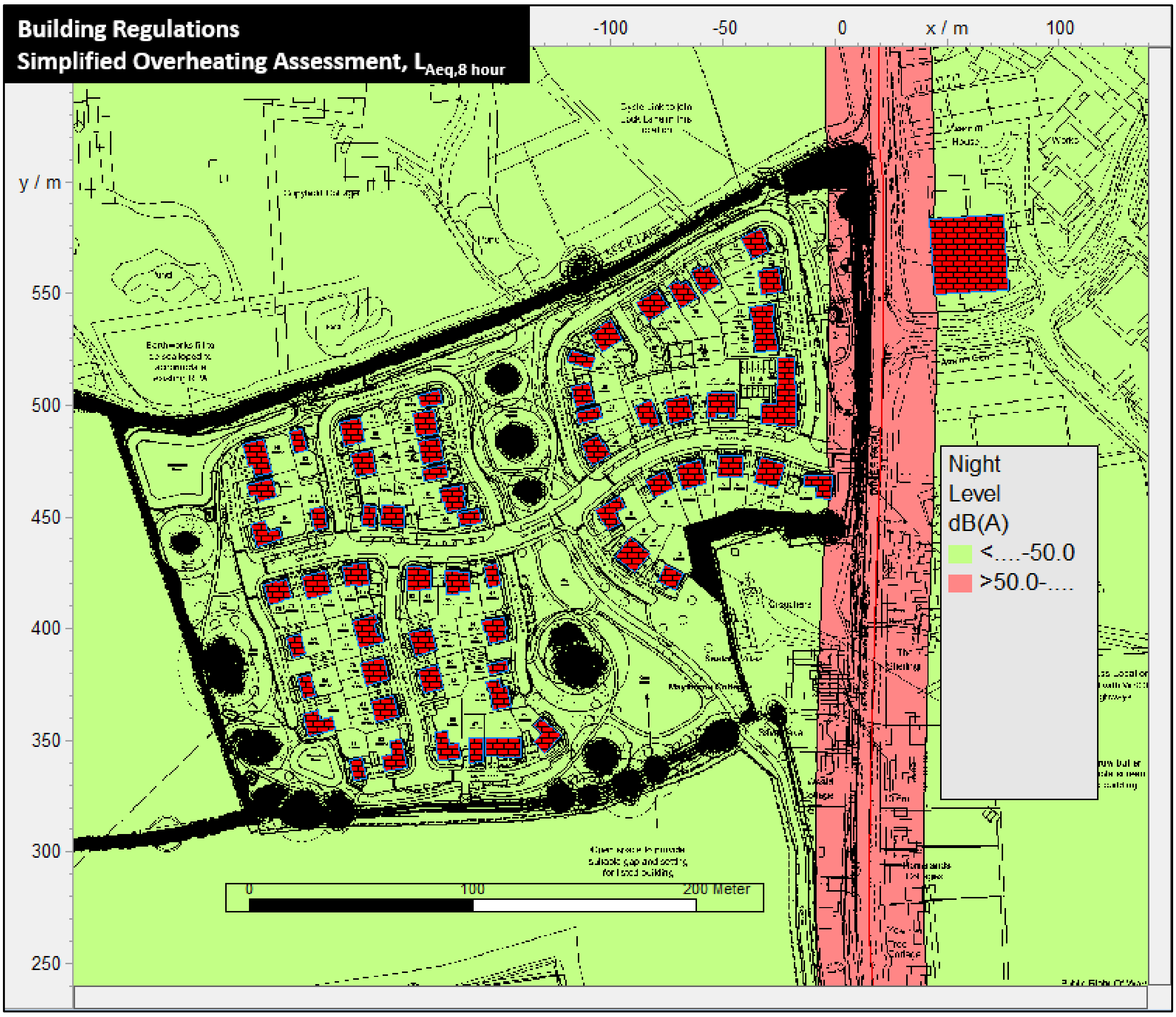


Figure 15. 2D Colour Contours, Areas where a simplified overheating assessment may be applied

Figure 15 above demonstrates, that with the exception of plot 1, all plots have bedroom windows which are openable during the night time period. In accordance with the Association of Noise Consultants Overheating Guidance, a simplified assessment may only be applied to properties where the night time ($L_{Aeq,8hour}$) exposure is 50dB or less. Therefore, on the basis of an open window providing 10dB of attenuation between external freefield and internal reverberant conditions, 40dB is achieved inside bedroom settings during the night time period for continuous sound pressure levels.

Therefore, bedroom windows may be opened to mitigate thermal overheating during the night time period on the basis of continuous sound pressure levels. An assessment of L_{Amax} and bedroom conditions and overheating is discussed in section 6.5

6 Discussion and Analysis

6.1 Check of the Noise Model

Data was measured at approximately 11m from the roadside. The next closest dwelling to the survey position is Plot 40 at approximately 42.4m from the roadside. With a 10log relationship for a line source (B2135), this would calculate a 5.9dB (10log(42.4/11)) reduction in sound pressure levels for distance attenuation.

Given that the model has been calibrated using a worst-case day, at the survey position this was 62dB $L_{Aeq,\ 16\ hour}$. One would therefore expect to see a 5.9 reduction from this equating to 56.1dB.

The noise model predicts 55.3dB which is only 0.8dB different from a manual calculation. The IMMI noise model is therefore capable of being relied upon for sound propagation across the site.

6.2 Calculation of the Sound Reduction Index

By being aware of how the soundscape impacts the proposed properties, a noise modelling approach predicts external sound pressure levels around the building perimeters. Subsequently, the required Sound Reduction Index (SRI) to achieve satisfactory internal sound pressure levels can be calculated.

There are three drivers which impact the façade sound reduction index or SRI. These are the daytime continuous noise levels measured over 16 hours in $L_{Aeq'T,}$ the night time continuous noise levels over 8 hours, also measured in $L_{Aeq'T.}$ Thirdly, ProPG2017 requires a consideration of the number of L_{Amax} events which will occur in a bedroom during the night time period. Specifically, ProPG2017 requires no more than ten events exceeding 45dB L_{Amax} measured internally. Whichever of these drivers is highest is applied to ensure that the residents are protected from each criterion.

An assessment has been made below of all rooms at first floor levels.

It is relevant to note that living room and bedroom calculations differ, as whilst living rooms are subject to only the daytime predicted sound pressure levels, bedrooms must consider both daytime and night time continuous sound pressure levels as well as L_{Amax} events during the night to protect sleep.

The daytime SRI is the predicted external freefield sound pressure level minus 35dB as per the Table 4 values in BS8233:2014 and the same for the night time values (albeit minus 30dB).

The L_{Amax} SRI is achieved by using the predicted night time external sound pressure level and comparing this with the measured night time survey noise level. The SRI figure is then adjusted to prevent no more than 10 L_{Amax} events per night inside the bedroom environment above 45dB L_{Amax}. The adjustment process takes account of each of the 6 measured night time periods to ensure that no individual night exceeds 10 events of 45dB L_{Amax} inside the bedroom.

The long-term survey position (LT1) has been used to assess night time data and L_{Amax} considerations. The SRI considerations have been split into bedrooms and living rooms for each façade and the data has been split into houses and flats accordingly.

Sound Reduction Index for Roadside Plots North to South					
Location	Predicted Daytime	Predicted Night Time	SRI		
			Day	Night	Night L_{Amax}
Plot 38 GF	53.1	45.1	18.1	15.1	24
Plot 38 FF	54	46	19	16	25
Plot 40 GF	54.2	46.2	19.2	16.2	25
Plot 40 FF	55.3	47.3	20.3	17.3	26
Plot 13 GF	55.1	47.1	20.1	17.1	26
Plot 13 FF	56.5	48.5	21.5	18.5	27
Plot 45 GF	53.2	45.2	18.2	15.2	24
Plot 45 FF	54.4	46.4	19.4	16.4	25
Plot 1 GF	59.2	51.2	24.2	21.2	30
Plot 1 FF	61.4	53.4	26.4	23.4	32

Figure 16. Sound Reduction Index, North to South of Roadside Plots

It is apparent that the Sound Reduction Index (SRI) increases further to the South with Plot 1 located in closer proximity to the B2135.

For living rooms, the SRI would be the daytime SRI only, whereby bedrooms in close proximity to the road would use the higher SRI to accommodate the L_{Amax} events to protect future occupants.

The maximum Sound Reduction Index for the daytime is 26dB (rounded), 23dB (rounded) for night time and 32dB (rounded) for the L_{Amax} events for bedrooms during the night time period.

Table B-2 Potential level differences associated with different ventilation Systems from ADF

Ventilation System from ADF	Cont. equiv. (L_{Aeq}) or events (L_{AFmax})	Level Difference, external free field level – internal reverberant level, dB	
		Typical windows and vent	Higher acoustic performance windows and vent
1, 2	L_{Aeq}	21	31
	L_{AFmax}	22	35
3 (with trickle vent)	L_{Aeq}	23	33
	L_{AFmax}	24	38
4 (no trickle vent)	L_{Aeq}	27	38
	L_{AFmax}	31	45

Figure 17. Table B2 of Acoustics Ventilation and Overheating Guidance (AVOG), Jan 2020

Given that the AVOG considers standard mitigation as having a level difference of 21dB between external freefield and internal reverberant levels, the noise modelling software may be used to plot areas of the site whereby standard windows and vents are likely to be sufficient to protect end users.

This has been done by adding 21dB to 35dB as the internal daytime $L_{Aeq, 16 hour}$ standard, which allows for a contour of 56dB $L_{Aeq,16 hour}$. Those sound pressure levels higher than this which fall into the yellow contour below will likely warrant enhanced mitigation measures.

Note that this only takes account of continuous sound pressure levels as L_{Amax} events will also drive the protection necessary for the bedrooms. It also stands to reason that where there are larger windows or more than one window, it may be necessary to consider an enhanced glazing/ventilation strategy.

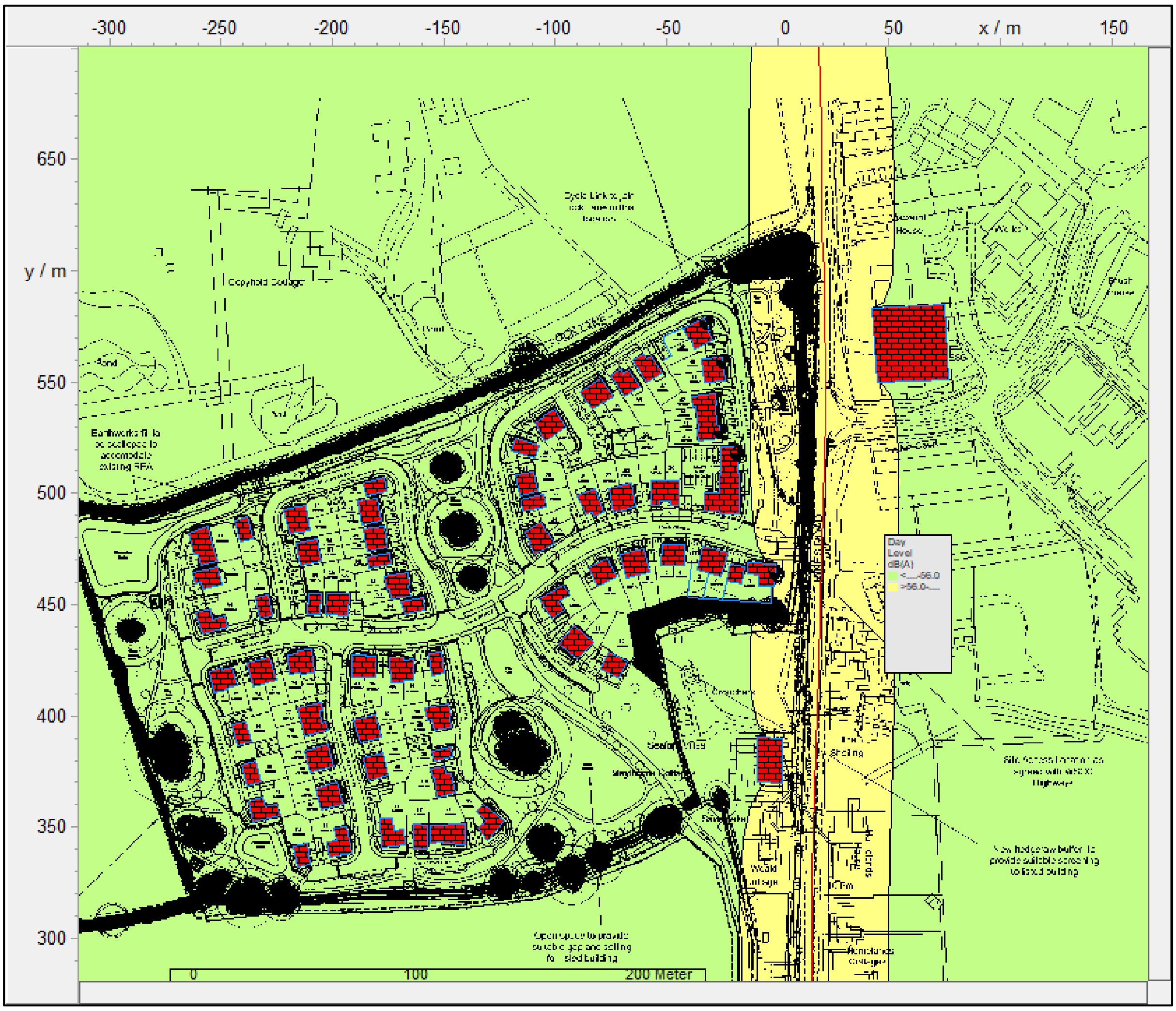


Figure 18. Consideration of Standard Mitigation Measures (21dB level Difference)

6.3 Consideration of External Amenity Areas

Figures 10, 11 and 12 above present information indicating that the garden areas for all plots achieve the requirements of BS8233:2014, ProPG2017 and World Health Organisation Guidelines for Community Noise dated 1999, revised 2018.

It is however noted that Horsham District Council consider that garden levels should achieve 50dB $L_{Aeq,16\ hour}$ or below, which is not consistent with current national guidance and standards.

The revised noise modelling indicates that with the noise model inputs for Bines Road changed from worst case, (which do not occur all of the time), to average sound pressure levels, the majority of Plot 1 remains equal to or below 50dB $L_{Aeq,16\ hour}$.

Attention is drawn to section 7.7.3.2 of BS8233:2014 which states that levels below 55dB $L_{Aeq,16\ hour}$ should be achievable in some areas of the space. Plot 1 as the worst-case plot achieves below 55dB $L_{Aeq,16\ hour}$ for the entirely of the garden space with a 2m fence applied.

6.4 Assessment of Opening Windows

The 2D noise model contours were used to consider what, if any windows are openable during both the daytime and night time periods.

It is important to make the distinction between openable windows and purge ventilation.

All windows should be openable and allow future occupants/residents the freedom to open windows and have a relationship with the outside environment.

It is also relevant to recognise that residents may rapidly ventilate a room space by opening windows which is referred to as purge ventilation. An example being that toast has been burnt and the rapid ventilation by the opening of a window to increase the airflow. Such rapid ventilation or purge ventilation does not have any standards associated with it.

However, for longer term opening of windows, the practice of opening the window would likely increase the internal room soundscapes above the levels stated in table 4 of BS8233:2014.

Attention is drawn to Figures 13 and 14 above which demonstrate that the majority of the site may open their windows, with the exception of those properties with their Eastern facade immediately overlooking/adjacent to the B2135.

It is however noted that the model is based on the highest measured daytime and night time period and there are days which are 2dB quieter than this.

Notwithstanding this, rooms on the rear elevations of Plots 38 to Plot 1 will still be able to open windows with BS8233:2014 Table 4 values comfortably achieved internally. The noise modelling demonstrated a 15dB reduction between the East and West facing facades of Plot 13, indicating that internal values at Plot 13 for example on the Western façade with an open window (13dB reduction) would be circa 27 to 28dB $L_{Aeq,T}$ internally.

Therefore, whilst windows may not be openable on the Western façade, the rear Eastern facades may still enjoy openable windows. Where open windows may not be relied upon, an alternative ventilation strategy will be required.

In general, windows should be openable for purge ventilation (no noise limit) and in the overheating condition for cooling where different limits would apply as detailed in the next section.

6.5 Overheating Assessment – Building Regulations-Approved Document O

Recently introduced Part O of the building regulation requires an assessment of whether bedroom windows can be opened at night. It is assumed that bedroom windows will be closed if either of the conditions below are met:

- Internal noise level exceeds 40dB $L_{Aeq, 8hour}$
- L_{Amax} events exceed 55dB L_{Amax} more than 10 times a night.

In reviewing bedrooms for the overnight periods which exceeded 40B $L_{Aeq,8 hour}$ and more than 10 events above 55dB L_{Amax}, Figure 19 below indicates that those properties overlooking the B2135 are not likely to open bedroom windows during the night time period.

It is reiterated that the Part O overheating assessment relates only to bedroom windows during the night time period. Approved Document O does not relate to ground floor windows and these have been removed from Figure 19 below.

Building Regulations ADO Simplified Assessment					
Location	Predicted Night Time	Open Window (-10dB)	Below 40dB $L_{Aeq, 8hour}$	L_{Amax} Events below 55dB L_{Amax}	Bedroom Windows Openable During the Night
Plot 38 FF	46	36	Yes	No	No
Plot 40 FF	47.3	37.3	Yes	No	No
Plot 13 FF	48.5	38.5	Yes	No	No
Plot 45 FF	46.4	36.4	Yes	No	No
Plot 1 FF	53.4	43.4	No	No	No

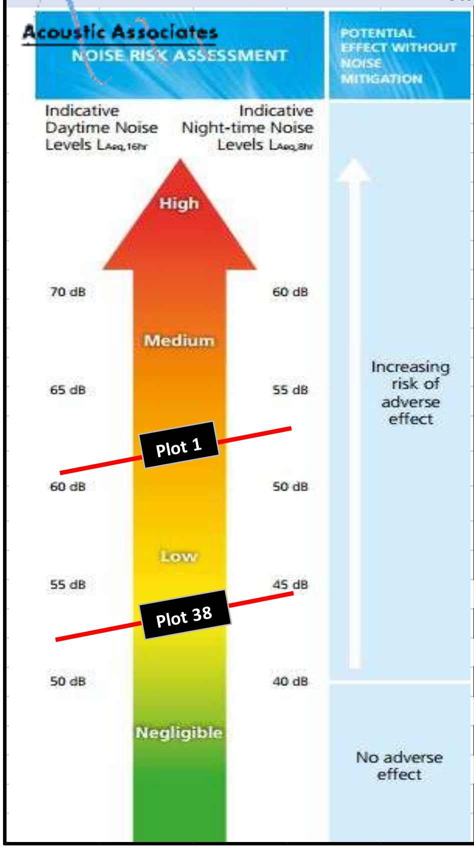
Figure 19. Building Control, Approved Document O-Overheating Assessment (Simplified)

6.6 ProPG2017 Initial Site Risk Assessment

In line with the requirements of ProPG2017, an initial site risk assessment has been undertaken which requires that the worst case/typical 24 hours are represented. Given that the highest daytime and night time data from LT1 were used to populate the noise model, to show a fair coverage of the site and more specifically the plots overlooking the B2135, plots 1 and 38 have been used to populate the initial site risk assessment.

The assessment details a low to medium impact and the grant of planning consent should not be withheld on noise grounds.

Stage 1. Initial Site Risk Assessment



Site:	Bines Road
Date:	29-Jan-25
Individual	Scott Castle
Proposal	Proposed Residential
Survey or Prediction	Survey
Freefield Survey	Yes
Instrumentation used	Norsonic 118
Typical/Worst case 24 hour period	
Location Assessed(Grid Ref)	0
Subjective Noise sources at site	Road traffic noise, aviation, birdsong
Weather conditions	mixed
Result	
No Mitigation Measures	
Daytime ($L_{Aeq,\ 16\ hour}$)	61/53 dB $L_{Aeq,16\ hour}$ (Plot 1/Plot 38)
Night ($L_{Aeq,\ 8\ hour}$)	53/45 dB $L_{Aeq,\ 8\ hour}$ (Plot 1/Plot 38)
Night L_{AMax} Events above 45dB(A)	48 events assuming Rw13 at Survey Location
Outcome	
Level of Risk Posed	Low to Medium
Next Steps	
Stage 2 Full Assessment	No
Signed Off by	Scott Castle
Date	29-Jan-25

Figure 20. ProPG2017 Initial Site Risk Assessment

6.7 Rigorous Calculations

Rigorous calculations, as per Annex G2 of BS8233:2014 consider the worst-case measured external (freefield levels) sound pressure level, but rather than using a simplistic external to internal sound pressure level subtraction, the Sound Reduction Index (SRI) is achieved using ratios of window sizes, facades, glazing specification as well as the proposed ventilation considerations.

Two plots have been considered adjacent to the B2135, with these being plot 38 set back to the North and plot 1 closest to the B2135.

The rigorous calculations have taken account of the following:

- The worst case highest daytime sound pressure levels have been used.
- All rigorous calculations use freefield data.
- The calculations have assumed a masonry cavity wall and lightweight inner blockwork
- 35dB $L_{Aeq,16\ hour}$ has been applied as the daytime criteria for a Kitchen/Lounge/Diner
- Where there are more than one window exposed to the road traffic sound source, the glazing has been summed and assessed against the noisiest façade.
- A kitchen and worst-case bedroom have been considered for each of the two roadside plots.

Outcome of Rigorous Calculations							
Location	Room	External SPL	SRI Required	Glass	Vent	Internal SPL	SRI Achieved
Plot 1	KLD	59	24	4\12\4	Airliner	35	24
Plot 1	Bed 2	61	32	4\12\4	AAC125	28	32
Plot 1	Bed 3	61	32	10\12\4	AAC125	29	32
Plot 38	KLD	53	18	4\12\4	Airliner	27	27
Plot 38	Bed	54	25	4\12\4	Greenwood EA5000EA	26	28

Figure 21. Outcomes of the Rigorous Calculations

The rigorous calculations show that standard thermal double glazing will be sufficient for most units. The exception is the first-floor bedroom (3) in plot 1 which is closest to the B2135 and which has two windows exposed to the road. This will require enhanced glazing to 10/12/4. This is broadly consistent with Figure 18 above which mandated the areas likely required for enhanced mitigation measures.

7 Recommendations

7.1 Glazing

The majority of the site will be capable of using standard thermal double glazing. Whilst Pilkington 4\12\4 has been used within the calculations, should the client wish to pursue alternative glazing providers, then the only comparable metric is referred to as $R_{traffic}$ or R_w+C_{tr} which provides for a low frequency correction.

The $R_{traffic}$ of standard thermal double glazing is 25dB(A).

The $R_{traffic}$ for enhanced 10\12\4 glazing is 29dB(A).

N.B. This is the required R_w+C_{tr} of the frame and glazing together. If the glazing supplier has test results for the glass on its own an R_w+C_{tr} value 2-3dB higher would be required (glazing tested on its own will outperform glazing that is tested within a window frame). Please note R_w+C_{tr} is also referred to as $R_{traffic}$.

7.2 Ventilation

Whilst openable windows have been indicated as acceptable on the majority of the site, through frame or through wall vents will be required for Plot 1 to provide an alternative ventilation strategy. The rigorous calculations have been modelled using the following

Through Frame Vents – Greenwood EA5000mm$^{2.}$

Through Wall Passive vent – Rytons AAC125 lookRyt, 8500mm^2 (bedrooms)

Through Wall Passive vent – Rytons 9x9 Airliner, 12800mm^2 (living rooms).

8 Conclusion

An unattended class 1 sound level meter was left at the site boundary from 16th to 22nd January 2025. The soundscape at the site is consistent with passing traffic and vehicles entering and leaving the star lane industrial estate. Aviation and bird song are also noted at the site.

An initial site risk assessment, consistent with ProPG2017 identifies that the development of the site is a low to medium risk.

Plot 1 is the closest to the road at approximately 16m, whereas the remainder of the Eastern site boundary are set back from the road at 33-47m. The built construction provides an effective barrier to the remainder of the site to enjoy more tranquil conditions.

Noise modelling software has been used to provide the reader with easy to understand 2D noise contours. These relate to external amenity areas, window opening, areas where enhanced mitigation measures might be required as well as a consideration of a simplified assessment for Building Regulations and an overheating assessment.

All garden areas achieved BS8233:2014 requirements and are below 55dB $L_{Aeq,16\ hours}$.

Windows may be opened for the majority of the site, albeit for dwellings in close proximity to the B2135 with an Eastern elevation, an alternative ventilation strategy will be required. Rigorous calculations have been carried out to demonstrate that this is capable of being achieved with either acoustically treated through frame passive slot vents or through wall passive vents.

Windows may also be opened during the night time period for the majority of the site, albeit again, those dwellings with an Eastern façade in close proximity to the B2135 will not be able to open windows during the night time period. Notwithstanding this, windows will be openable on the rear of Plots 38 to Plot 1 on the Eastern boundary close to the B2135 with Table 4 values comfortably achieved.

From the information presented, planning permission should not be withheld on noise grounds.

9 Appendix A – Rigorous Calculations

Non Frequency Dependent Variables			Key for Table Below	
Term	**Derivation**	**Value**	Rwi	Sound Reduction of Window (Octave)
Ao	Given in BS EN 20140-10 = 10 (m^2)	10	Rew	Sound Reduction Index of External Wall (Octa
Sf	Total Facade Area (m^2)	48.3	Rrr	Sound Reduction Index of Roof/Ceiling (Octav
Swi	Window Area (m^2)	12.36	A	Equivalent Absorbtion Area of Rx Room
Sew	External Wall Area (m^2)	35.94	Dn,e	Insulation of Trickle Vent (BS EN 20140-10)
Srr	Ceiling Area (m^2)	0.0001		
S	Total Area sound enters the room (m^2)	48.3001		

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	**Description**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	Free-Field External Noise Level	61	57	55	55	52	45
Dn,e	Ryton 9x9 Airliner (38dB Open)	36	29	31	39	44	52
Rwi	4_12_4	24	20	25	35	38	35
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	UserDefined	28	34	40	45	49	49
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	61	57	55	55	52	45
Ao/S . 10^(-Dn,e/10)	5.2E-05	0.000261	0.000164	2.61E-05	8.24E-06	1.31E-06
Swi/S . 10^(-Rwi/10)	0.001019	0.002559	0.000809	8.09E-05	4.06E-05	8.09E-05
Sew/S . 10^(-Rew/10)	5.91E-05	9.37E-05	2.96E-05	4.69E-06	7.44E-07	2.35E-07
Srr/S . 10^(-Rrr/10)	3.28E-09	8.24E-10	2.07E-10	6.55E-11	2.61E-11	2.61E-11
10log10(S/A)+3	9.425553	8.3782	7.79828	7.79828	8.078568	8.078568
Leq,2	40.95584	40.02209	32.81262	23.27813	17.02847	12.24123
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**24.85584**	**31.42209**	**29.61262**	**23.27813**	**18.22847**	**13.24123**

A-Weigted Level Outside	**59**	
BS8233 Predicted Internal A-Weigted Level	**35**	**Plot 1 KLD**
Prediced Building Envelope SRI	**24**	

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Non Frequency Dependent Variables			Key for Table Below	
Term	**Derivation**	**Value**		
Ao	Given in BS EN 20140-10 = 10 (m^2)	10	Rwi	Sound Reduction of Window (Octave)
Sf	Total Facade Area (m^2)	7.92	Rew	Sound Reduction Index of External Wall (Octa
Swi	Window Area (m^2)	1.2	Rrr	Sound Reduction Index of Roof/Ceiling (Octav
Sew	External Wall Area (m^2)	6.72	A	Equivalent Absorbtion Area of Rx Room
Srr	Ceiling Area (m^2)	11.5	Dn,e	Insulation of Trickle Vent (BS EN 20140-10)
S	Total Area sound enters the room (m^2)	19.42		

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	**Description**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	Free-Field External Noise Level	61	57	55	55	52	45
Dn,e	Rytons AAC125HP Look Ryt	42	37	34	43	57	64
Rwi	4_12_4	24	20	25	35	38	35
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	61	57	55	55	52	45
Ao/S . 10^(-Dn,e/10)	3.25E-05	0.000103	0.000205	2.58E-05	1.03E-06	2.05E-07
Swi/S . 10^(-Rwi/10)	0.000246	0.000618	0.000195	1.95E-05	9.79E-06	1.95E-05
Sew/S . 10^(-Rew/10)	2.75E-05	4.36E-05	1.38E-05	2.18E-06	3.46E-07	1.09E-07
Srr/S . 10^(-Rrr/10)	0.000939	0.000236	2.97E-05	2.97E-05	2.97E-05	2.97E-05
10log10(S/A)+3	5.468565	4.421212	3.841292	3.841292	4.12158	4.12158
Leq,2	37.41853	31.4211	25.31372	17.71805	12.23305	6.070589
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**21.31853**	**22.8211**	**22.11372**	**17.71805**	**13.43305**	**7.070589**

A-Weigted Level Outside	**59**
BS8233 Predicted Internal A-Weigted Level	**28**
Prediced Building Envelope SRI	**32**

Plot 1 Bedroom 2

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Non Frequency Dependent Variables		
Term	Derivation	Value
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	16.2
Swi	Window Area (m^2)	2.2
Sew	External Wall Area (m^2)	14
Srr	Ceiling Area (m^2)	8.4
S	Total Area sound enters the room (m^2)	24.6

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octa
Rrr	Sound Reduction Index of Roof/Ceiling (Octav
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	63	59	57	57	54	47
Dn,e	Rytons AAC125HP Look Ryt	42	37	34	43	57	64
Rwi	10_12_4	25	22	33	40	43	44
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
Leq,ff	63	59	57	57	54	47
Ao/S . 10^(-Dn,e/10)	2.56E-05	8.11E-05	0.000162	2.04E-05	8.11E-07	1.62E-07
Swi/S . 10^(-Rwi/10)	0.000283	0.000564	4.48E-05	8.94E-06	4.48E-06	3.56E-06
Sew/S . 10^(-Rew/10)	4.52E-05	7.16E-05	2.27E-05	3.59E-06	5.69E-07	1.8E-07
Srr/S . 10^(-Rrr/10)	0.000541	0.000136	1.71E-05	1.71E-05	1.71E-05	1.71E-05
10log10(S/A)+3	6.495424	5.448071	4.868151	4.868151	5.148438	5.148438
Leq,2	39.01289	33.75738	25.78498	18.85968	12.76119	5.373901
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**22.91289**	**25.15738**	**22.58498**	**18.85968**	**13.96119**	**6.373901**

A-Weigted Level Outside	**61**
BS8233 Predicted Internal A-Weigted Level	**29**
Prediced Building Envelope SRI	**32**

Plot 1 bedroom 3

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Non Frequency Dependent Variables		
Term	**Derivation**	**Value**
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	19.44
Swi	Window Area (m^2)	2.16
Sew	External Wall Area (m^2)	17.28
Srr	Ceiling Area (m^2)	10.8
S	Total Area sound enters the room (m^2)	30.24

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octa
Rrr	Sound Reduction Index of Roof/Ceiling (Octav
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	**Description**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	Free-Field External Noise Level	56	52	50	50	47	40
Dn,e	Greenwood 5000EA(5230mm2)	39.5	37.3	35.5	32	31	33.5
Rwi	4_12_4	24	20	25	35	38	35
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	Tile on Felt, Pitched Roof, 100mm mineral wool on plasterboard ceiling	28	34	43	43	43	43
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	56	52	50	50	47	40
Ao/S . 10^(-Dn,e/10)	3.71E-05	6.16E-05	9.32E-05	0.000209	0.000263	0.000148
Swi/S . 10^(-Rwi/10)	0.000284	0.000714	0.000226	2.26E-05	1.13E-05	2.26E-05
Sew/S . 10^(-Rew/10)	4.54E-05	7.19E-05	2.27E-05	3.61E-06	5.71E-07	1.81E-07
Srr/S . 10^(-Rrr/10)	0.000566	0.000142	1.79E-05	1.79E-05	1.79E-05	1.79E-05
10log10(S/A)+3	7.391891	6.344538	5.764618	5.764618	6.044905	6.044905
Leq,2	33.09019	28.30081	21.32434	19.7914	17.70566	8.795271
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**16.99019**	**19.70081**	**18.12434**	**19.7914**	**18.90566**	**9.795271**

A-Weigted Level Outside	**54**
BS8233 Predicted Internal A-Weigted Level	**26**
Prediced Building Envelope SRI	**28**

Plot 38 Bedroom

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$

Non Frequency Dependent Variables		
Term	**Derivation**	**Value**
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	44.16
Swi	Window Area (m^2)	6.86
Sew	External Wall Area (m^2)	37.3
Srr	Ceiling Area (m^2)	0.0001
S	Total Area sound enters the room (m^2)	44.1601

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octa
Rrr	Sound Reduction Index of Roof/Ceiling (Octav
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	**Description**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	Free-Field External Noise Level	55	51	49	49	46	39
Dn,e	Ryton 9x9 Airliner (38dB Open)	36	29	31	39	44	52
Rwi	4_12_4	24	20	25	35	38	35
Rew	Cavity Masonry (Brick Cavity with Insulation lightweight block)	41	39	44	52	60	65
Rrr	No Roof	28	34	100	100	100	100
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	**125**	**250**	**500**	**1000**	**2000**	**4000**
Leq,ff	55	51	49	49	46	39
Ao/S . 10^(-Dn,e/10)	5.69E-05	0.000285	0.00018	2.85E-05	9.02E-06	1.43E-06
Swi/S . 10^(-Rwi/10)	0.000618	0.001553	0.000491	4.91E-05	2.46E-05	4.91E-05
Sew/S . 10^(-Rew/10)	6.71E-05	0.000106	3.36E-05	5.33E-06	8.45E-07	2.67E-07
Srr/S . 10^(-Rrr/10)	3.59E-09	9.02E-10	2.26E-16	2.26E-16	2.26E-16	2.26E-16
10log10(S/A)+3	9.036374	7.98902	7.409101	7.409101	7.689388	7.689388
Leq,2	32.74283	31.8779	24.8894	15.59787	9.065071	3.749729
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**16.64283**	**23.2779**	**21.6894**	**15.59787**	**10.26507**	**4.749729**

A-Weigted Level Outside	**53**
BS8233 Predicted Internal A-Weigted Level	**27**
Prediced Building Envelope SRI	**27**

Plot 38 KLD

BS8233 Calculation can be seen below:

$$L_{eq,2} \approx L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3$$