Land rear of 57 Warminster Road

South Norwood, London, SE25 4DF

Noise Impact Assessment

28th November 2023

Revision 1

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Revision History

Version	Comments	Author	Date
First Issue	First issued version of the report	**Chris Parker-Jones** Director and Acoustic Consultant BSc (Hons) MSc MIOA	13th July 2023
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Executive Summary and Conclusions

This document, a Noise Impact Assessment (NIA), has been written to assess the proposals for the erection of a new three-storey apartment block on land to the rear of the Hawthorns, 57 Warminster Road, South Norwood, London, SE25 4DF.

In summary, having followed a 'good acoustic design process' as referenced with the ProPG, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level, providing the recommendations below are followed.

The latest revision of the site plan has been included in this first revision of the report, but does not materially change the conclusions/recommendations of the original report issued in July 2023, the noise impact is unchanged.

Noise Impact on the Proposed Development

Internal ambient noise level (IANL) targets can be met with closed windows and glazing with a standard/moderate level of acoustic performance. This does not mean that windows should be sealed shut – but does mean that an alternative ventilation system should be used which can meet IANL targets whilst providing adequate background ventilation, i.e., natural ventilation paths such as trickle vents, or mechanical ventilation.

Glazing and ventilators must meet the minimum sound reduction indices in Table 5.5 of Section 5.3.2 (with cross reference to the 'exposure categories' in Figure 5.1 of Section 5.1, recognising that each elevation/set of windows has a differing level of noise exposure.

Noise levels in most external amenity areas (ground floor gardens and the rooftop terrace) will also be within the 50 – 55 dB target range.

Plant Noise Impact on Surrounding Properties

As covered in Section 6.0, noise from the proposed 8 no. external ASHPs have been assessed against the criteria usually conditioned by the Local Planning Authority of a plant noise emission level no greater than 10 dB below the minimum background sound level.

Plant noise emission limits have been based on this criteria and the background sound levels recorded during the noise survey, setting a limit of 23 dB $L_{Aeq,15mins}$ at night (23:00 – 07:00) and 32 dB $L_{Aeq,1hr}$ during the day (07:00 – 23:00).

Outside of the worst-affected neighbouring dwelling window, predicted specific noise levels from the bank of 8 no. ASHPs are 36 dB, and thus, 4 dB above the daytime limit, and 13 dB above the night-time limit.

Therefore, as described in Section 6.6, to reduce emissions outside of neighbouring windows to below 23 dB, a ventilated acoustic enclosure will need to be installed around each individual ASHP (or a larger enclosure encompassing all 8 units). The Applicant should submit a datasheet from the enclosure manufacturer which verifies that it can reduce noise emissions by a minimum of 13 dB(A)..

Contents

1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment as part of a planning application on land to the rear of the Hawthorns, 57 Warminster Road, South Norwood, London, SE25 4DF – for the erection of a new three-storey apartment block.

1.1 Scope of Report

This Report has been written to:

- assess the level of noise ingress from the surrounding area and thus advise on the specification of the building envelope and ventilation system to reduce internal noise levels inside the proposed development to acceptable levels for the future occupants;
- assess the impact of noise on the enjoyment of external amenity areas of the development; and
- assess the risk of plant noise impacting other properties in the area, given that the proposals include an array of ASHPs.

The objective is to ensure that the noise impact is being considered and controlled sufficiently. Therefore, where considered necessary, mitigation measures have been suggested to ensure that identified impacts are minimised.

Whilst every attempt has been made to ensure that this report communicates effectively to a reader who might not have much knowledge of acoustics, some parts are necessarily technical. A glossary of acoustic terminology and concepts is provided in Appendix A.

1.2 Assessment Criteria

This report takes national planning policies into consideration including the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the Planning Practice Guidance on Noise (PPG-N) (summarised in Appendix B), which outline the purpose and long-term vision of planning policy with respect to noise. More specifically, the assessment has been undertaken with reference to:

- the Professional Practice Guidance on Planning and Noise (ProPG) (2017), which provides guidelines regarding suitable internal ambient noise levels and levels with external amenity areas;
- BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, which "provides guidance on the control of noise in and around buildings", which also recommends appropriate criteria for residential developments;
- The World Health Organisation (WHO) '*Guidelines for Community Noise*' (1999) and '*Night Noise Guidelines for Europe* (2009) documents, which again provides relevant criteria for residential developments; and
- BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound', which assesses the risk of adverse impact of noise pollution from a sound source (or sources) of a commercial or industrial nature (i.e., mechanical/electrical plant).

2.0 Site and Development Description

As shown in Figure 2.1, the site of the proposed development is at land to the rear of the Hawthorns (57 Warminster Road), an existing four storey building containing 16 flats. The area to the rear of the building contains a number of trees and hardstanding for car parking. There is a railway line to the east and the surrounding area is widely residential.

The proposals are to erect a new apartment block, extending to three storeys, providing eight residential units with associated refuse and cycle storage and a new, formalised car parking area, as shown by the drawings in Figures 2.2, 2.3, 2.4, and 2.5. The proposals include a bank of 8 no. air source heat pumps situated on an area of the 1st floor flat roof.

Figure 2.1 – Aerial views of the site and surrounding area (top) – street view (bottom left) – location plan (bottom right)

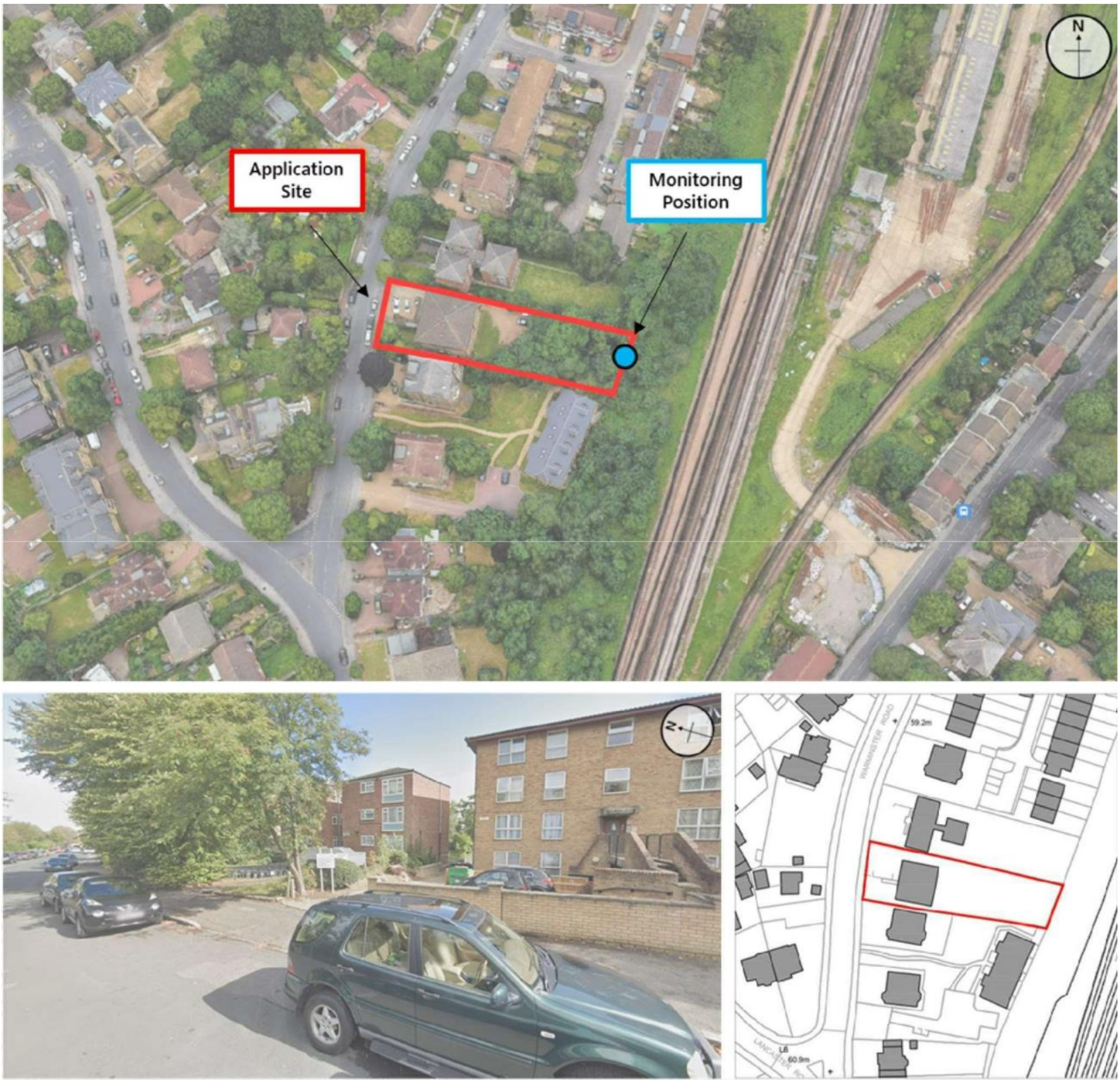


Figure 2.2 – Proposed site roof plan

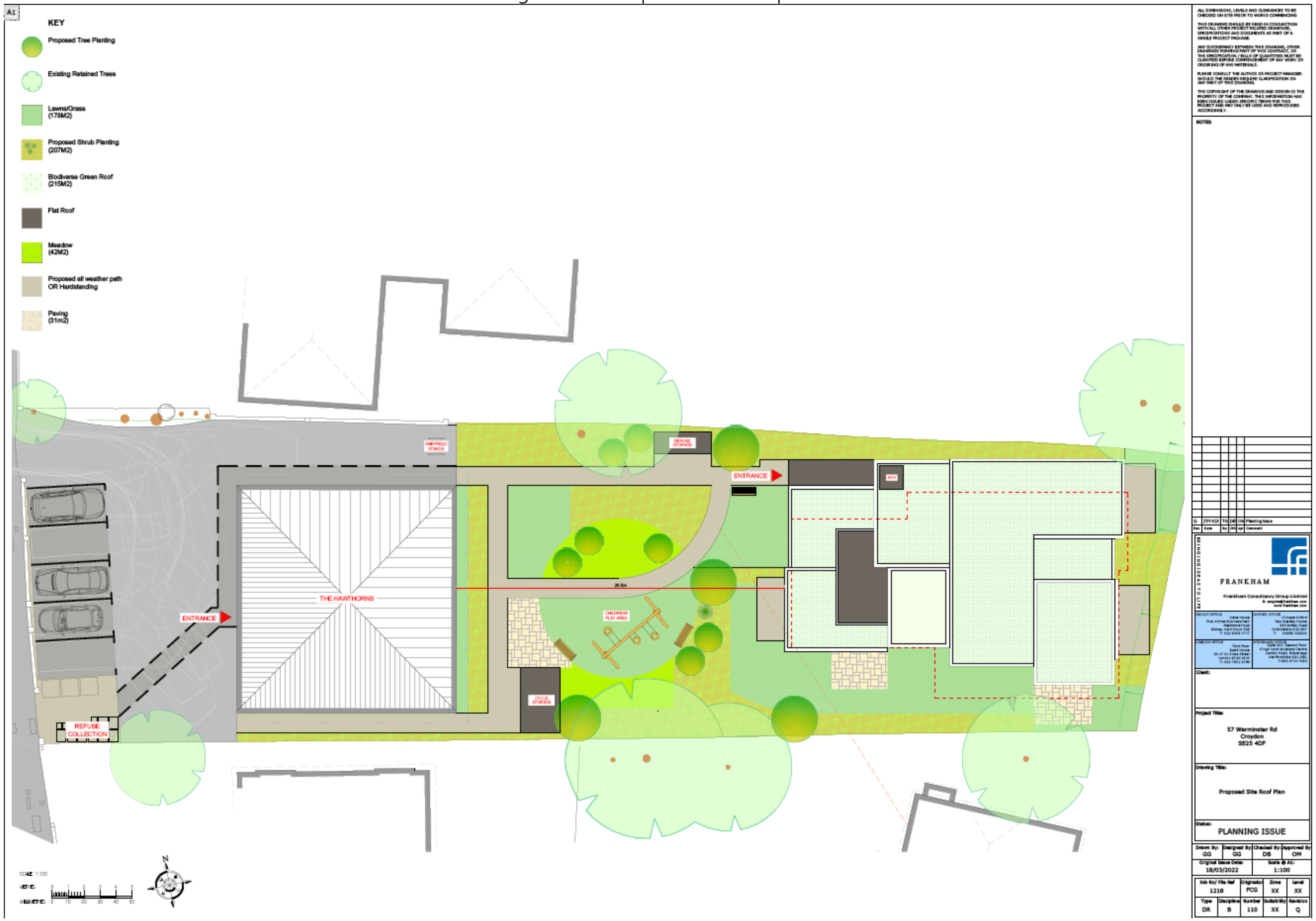
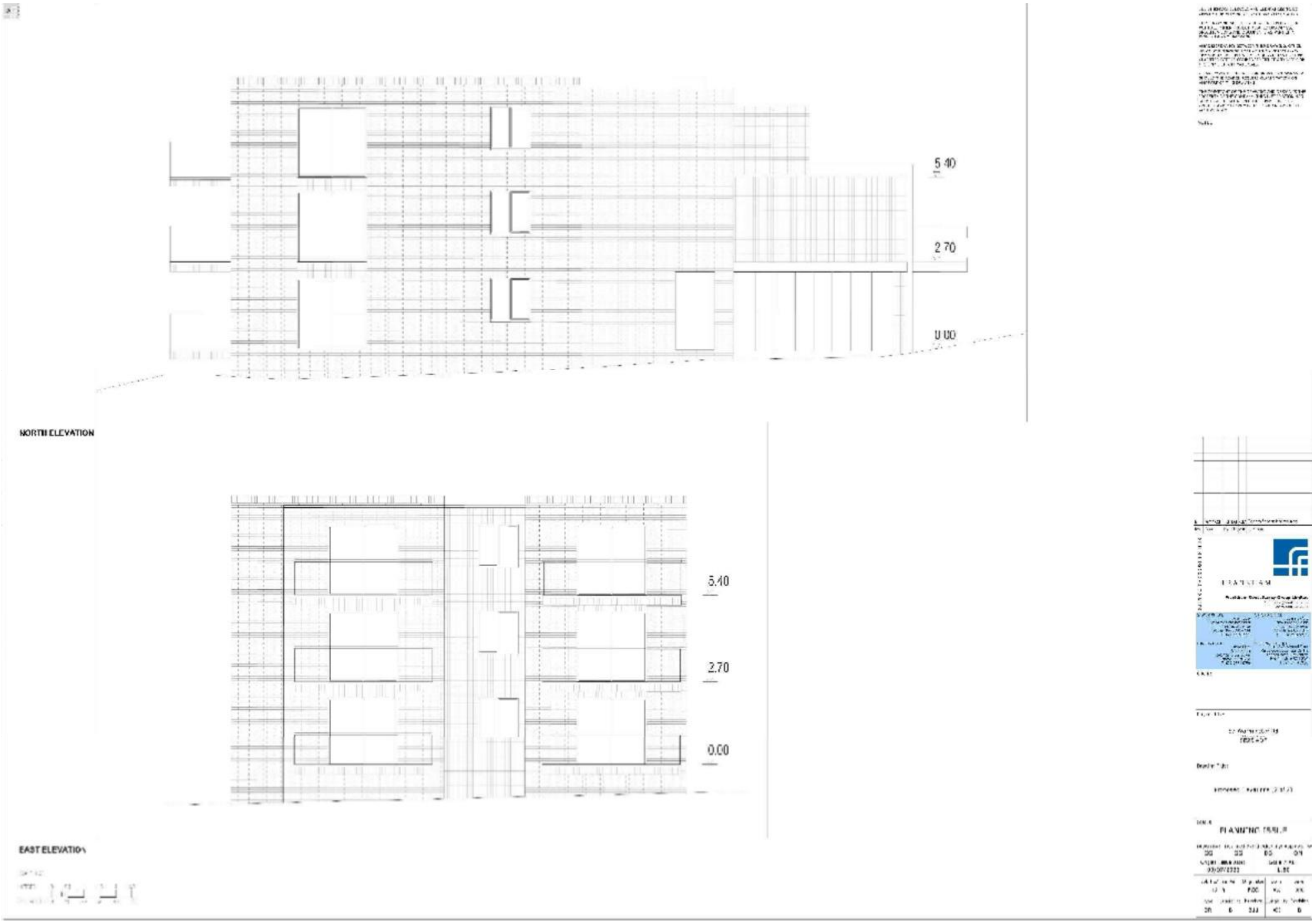


Figure 2.3 – Proposed floor plans

Figure 2.4 – Proposed south and west elevations

Figure 2.5 – Proposed north and east elevations



3.0 Relevant Guidelines

3.1 The Professional Practice Guidance on Planning and Noise (ProPG)

The ProPG, published in 2017, extends on the guidance and numerical targets within BS 8233:2014 and WHO guidelines, providing new and extended recommendations where these standards (frequently used for assessing residential developments throughout the UK) are considered to fall short. Therefore, it is considered to be the most relevant and up to date design standard for assessing the noise impact on new residential developments.

A full summary of the standard (including the 'good acoustic design' process) is given in Appendix B.4.

3.1.1 Stage 1: Initial Site Noise Risk Assessment

The ProPG recommends that an initial site noise risk assessment should be undertaken based on indicative external noise levels on the existing site, without accounting for the impact of any new or additional mitigation measures that may subsequently be included in development proposals. Figure 1 of the ProPG relates the increasing risk of adverse effects against indicative daytime noise levels ($L_{Aeq,16hr}$) and night-time noise levels ($L_{Aeq,8hr}$) without noise mitigation. This is recreated in Table 3.1.

Table 3.1 – The ProPG initial site noise risk assessment guidelines

Indicative external daytime noise levels $L_{Aeq,16hr}$	Indicative external night-time noise levels $L_{Aeq,8hr}$	Potential risk of adverse effect without noise mitigation
≤ 50 dB	≤ 40 dB	Negligible / No adverse effect [1]
> 50 dB and ≤ 60 dB	> 40 dB and ≤ 50 dB	Low
> 60 dB and ≤ 70 dB	> 50 dB and ≤ 60 dB	Medium
> 70 dB	> 60 dB	High

NOTES:

The noise level limits are an interpretation of Figure 1 in the ProPG, which is presented as a diagram rather than a table and does not explicitly state the limits at which each risk category exists.

[1] An indication that there may be more than 10 noise events at night with $L_{Amax,F}$ > 60 dB means the site should not be regarded as a negligible risk.

3.1.2 Stage 2: Full Assessment

The ProPG provides several 'elements' to the Stage 2 assessment:

- Element 1 – Good acoustic design process
- Element 2 – Internal noise level guidelines
- Element 3 – External amenity area noise assessment
- Element 4 – Assessment of other relevant issues

Element 2 – Internal Noise Level Guidelines

The ProPG provides internal ambient noise level targets based on BS 8233:2014 and WHO guidelines, as shown in the table below.

Table 3.2 – The ProPG internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,F}$ [1]
[1] a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night			

The ProPG indicates that the guidance can be relaxed by up to 5 dB where development is considered necessary or desirable, despite high external noise levels.

Whilst it is desirable to achieve the recommended IANLs with windows open, an assessment can be made with closed windows and open ventilators (i.e., trickle vents) which provide *"whole dwelling ventilation"* (as defined by Building Regulations Approved Document F). Closed windows do not mean sealed shut/un-openable windows, as occupants would favour the ability to open the windows (especially during the hotter months of the year) even if the resultant internal acoustic conditions aren't as satisfactory.

Element 3 – External Amenity Area Noise Assessment

The ProPG also provides guidance for outdoor amenity noise levels based on WHO and BS 8233:2014 guidelines. This applies to gardens, balconies, roof terraces, and patio areas.

"If 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.

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 $L_{Aeq,16hr}$.

These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces. Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.

Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:

- *a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
- *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
- *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, publicly accessible, external 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 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.*

LPAs will be best placed to provide guidance on the meaning of "relatively quiet" in any given location as this concept will inherently vary from one place to another. In addition, it may not be necessary for the whole of an external amenity area to be relatively quiet, nor for it to be relatively quiet all of the time. It is proposed that it may be helpful to define "relatively quiet" for the purposes of Element 3 as any situation where the typical average hourly daytime LA90 is more than 10 dB below the typical average hourly daytime LAeq noise levels in the immediate locality. However, other definitions of "relatively quiet", including the use of other noise metrics or a locally set absolute noise level, may also be suitable depending on local circumstances."

3.2 BS 8233:2014

3.2.1 Internal Ambient Noise Levels

BS 8233:2014 '*Guidance on Sound Insulation and Noise Reduction for Buildings*' suggests appropriate criteria and limits for different situations. It is primarily intended to guide the design of new buildings, or refurbished buildings undergoing a change of use.

Table 4 of BS 8233:2014 provides 'desirable' internal ambient noise level (IANL) limits for dwellings from *"steady external noise sources"*. BS 8233:2014 also notes 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 internal conditions still achieved."* These targets are summarised in Table 3.3 below.

Table 3.3 – BS 8233:2014 internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)		Night-time (23:00 – 07:00)	
		Desirable conditions	Reasonable conditions	Desirable conditions	Reasonable conditions
Resting	Living Room	35 dB $L_{Aeq,16hr}$	40 dB $L_{Aeq,16hr}$	-	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	45 dB $L_{Aeq,16hr}$	-	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	40 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$	35 dB $L_{Aeq,8hr}$

Annex G.1 of BS 8233:2014 suggests that "*if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB*".

Whilst it is desirable to achieve the recommended IANLs with windows open, this is not stipulated as a mandatory requirement within the guidance of BS 8233:2014 which states *"if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level. If applicable, any room should have adequate ventilation (e.g., trickle ventilators should be open) during assessment."*

Therefore, a noise limit directly outside of the nearest residential windows could be set based upon the values above plus 15 dB, as per below:

- Desirable internal conditions – Façade noise levels <50 dB $L_{Aeq,16hr}$
- Reasonable internal conditions – Façade noise levels <55 dB $L_{Aeq,16hr}$

3.2.2 External Amenity Ambient Noise Levels

BS 8233:2014 indicates that in external areas used for amenity space, it is desirable that external noise levels do 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.

Although in many areas, i.e., next to a strategic transport network, a compromise between elevated noise levels and the convenience of living in these locations may be acceptable. In such a case, the development should be designed to 'achieve the lowest practicable levels' in these external amenity spaces but should not be prohibited.

The advice in BS8233:2014 states that the resulting noise levels outside are never a reason for refusal as long as levels are designed to be as low as practicable.

3.3 WHO Guidelines

The WHO document *Guidelines for Community Noise 1999* ('GCN') sets out guidance as to noise levels at which there will be an unacceptable impact on the occupants of residential developments.

For steady continuous noise, the GCN recommends an indoor guideline value for bedrooms of 30 dB $L_{Aeq,8hr}$ and 45 dB L_{AFmax} for a single sound event to prevent sleep disturbance. The document also states, 'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dBA LAmax more than 10-15 times per night, (Vallet & Varnet 1991).'

Regarding external noise, the GCN states:

- 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 $L_{Aeq.}$

3.4 BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations (i.e., residential windows) within the context of the existing sound environment.

The method is based upon assessing the predicted noise emissions from plant/equipment against the existing background sound levels at NSRs, the latter of which is determined by a noise survey conducted at the site.

The predicted noise emissions are termed as a 'rating level', which is the 'specific sound level' from plant (the actual measurable noise level), plus 'penalties' which account for whether the noise has distinguishing characteristics such as tonality, intermittency, impulsivity, or is generally distinguishable from the ambient noise environment. Such features may attract attention and be considered annoying, hence sounds with these qualities should be penalised over sounds at the same specific noise level which is less intrusive.

BS 4142:2014 states that *"the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact.*

Further explanation of the standard is given in Appendix B.5.

4.0 Noise Survey

4.1 Methodology

PJA has attended the site and surrounding area to conduct an environmental noise survey between Thursday the 30th of March and Monday the 3rd of April 2023. The results of the survey have been used to quantify the typical residual noise levels that would be incident on the site and subsequently the proposed development on a day-to-day and night-by-night basis.

A single 'long term' measurement position was installed at the location denoted in Figure 2.1, positioned on the top of the eastern site boundary palisade fencing (in sight of the railway) at a height of approximately 2m above ground.

The sound level meter was set to log noise levels over continuous 5-minute averaging periods with a 1-second time history rate. The monitoring equipment was left unattended with the exception of setup and collection of the equipment.

The following noise indices were recorded (amongst others):

- $L_{Aeq,T}$: The A-weighted equivalent continuous noise level over the measurement period T. This parameter is typically considered as a good representation of the average ambient sound level;
- $L_{AFmax,T}$: The maximum A-weighted noise level during the measurement period T and the best representation of short high noise levels 'events' – i.e., emergency services sirens;
- $L_{A90,T}$: The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level' and is therefore used in determining the representative background noise level – or noise levels from continuous noise sources such as plant; and
- $L_{A10,T}$: The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level' and a good representation of traffic noise contributions.

Appendix C contains further information on the methodology of the survey; including the equipment used; photographs from site; and the weather conditions.

4.2 Results

A graph of the measured noise levels is given in Figure 4.1 overleaf, with a summary provided in Table 4.1 below.

The noise climate is most dominated by regular train passings on the railway, followed by birdsong, and distant road traffic. It is seen during the daytime that L_{Aeq} levels fluctuate between 5-minute periods depending on whether a train passed in that time/how many trains have passed/whether a train has passed on the closest line or the furthest, etc.

Table 4.1 – Summary of measured noise levels

Period	Logarithmic Average $L_{Aeq,T}$ (dB)	10th Highest $L_{AFmax,5min}$ (dB)	Median $L_{A90,5min}$ (dB)	Median $L_{A10,5min}$ (dB)
Daytime (07:00 – 23:00) T = 16-hours				
Thursday 30th March; 13:15 - 23:00	62	81	48	65
Friday 31st March; 07:00 - 23:00	61	79	50	64
Saturday 1st April; 07:00 - 23:00	61	78	46	63
Sunday 2nd April; 07:00 - 23:00	59	78	46	59
Monday 3rd April; 07:00 – 11:15	61	76	48	63
Night-time (23:00 – 07:00) T = 8-hours				
Thursday 30th March / Friday 31st March; 23:00 - 07:00	58	76	45	56
Friday 31st March / Saturday 1st April; 23:00 - 07:00	58	75	40	55
Saturday 1st April / Sunday 2nd April; 23:00 - 07:00	55	74	42	54
Sunday 2nd April / Monday 3rd April; 23:00 - 07:00	57	76	39	49

Figure 4.1 – Graph of measured noise levels

5.0 Noise Impact on the Proposed Development

This section details the impact the existing noise environment would have on the proposed development, including the implications this has on the ventilation strategy and the construction types required within the façade to reduce external noise ingress to an acceptable level for the future occupants, and the noise levels in external amenity areas. The assessment has been made following the ProPG methodology outlined in Section 3.1 and Appendix B.4.

Firstly, the existing ambient noise environment at the site is assessed with the support of an environmental noise survey (Section 4.0) – to quantify external noise levels outside of the proposed residential facades and in all external amenity areas.

A ProPG 'Stage 1' Assessment is made – an initial site noise assessment to assess the levels of risk prior to any mitigation being installed.

A ProPG 'Stage 2' Assessment is then made following the 'good acoustic design process' defined in the standard.

5.1 External Noise Levels

A noise model/map for the existing site and proposed development has been constructed using the CadnaA® software package, a commonly used 3-D noise modelling software that implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The intention of noise modelling/mapping for this assessment is to accurately determine the noise levels across the entire site. This is considered more accurate than simply applying the results from the monitoring positions to the whole development, as the different elevations have varying levels of exposure to noise.

The model is based upon the results of the environmental noise survey in Section 4.0, by placing a receptor point at each survey monitoring position and adjusting the model parameters to match these results as closely as possible (in terms of the highest $L_{Aeq,16hrs}$ and $L_{Aeq,8hrs}$, and the 10^{th} highest night-time $L_{AFmax,5min}$.

Therefore, effectively the noise map for the existing site is 'calibrated'.

The proposed site has then been added to the model [1], which has then been run to predict the façade exposure levels at 1m outside of all the residential windows across the proposed development for each floor in terms of the $L_{Aeq,16hr}$ for the daytime and the $L_{Aeq,8hr}$ and L_{AFmax} for the night-time periods respectively.

Screenshots from the noise model and further information on the model parameters are provided in Appendix D.

1 - The noise mapping herein reflects floorplans from July 2023, which have been superseded in November 2023. As the building plan has only undergone minor changes, the results of the mapping are still relevant.

The model has first been set up to reflect the noise climate at the existing site:

- Figure D.1 – shows 3D views of the model setup of the existing site;
- Figure D.2 – shows the daytime ambient noise level $L_{Aeq,16hr}$ - at a grid height of 2m;
- Figure D.3 – shows the night-time ambient noise level $L_{Aeq,8hr}$;
- Figure D.4 – shows the 10th highest maximum noise level L_{AFmax} at night;

The proposed development has then been added to the model:

- Figure D.5 – shows 3D views of the model setup with the proposed development in place.
- Figure D.6 – shows external daytime $L_{Aeq,16hr}$ levels within gardens/patio areas (1.5m height) and on balconies at 1st, 2nd, and 3rd floor levels.
- Figure D.7 - shows the predicted façade exposure levels outside the windows of the proposed buildings in terms of the daytime $L_{Aeq,16hr}$ – on the upper floor as a worst-case.
- Figure D.8 - shows the night-time ambient $L_{Aeq,8hr}$ façade exposure outside of upper floor windows.
- Figure D.9 – shows the façade exposure in terms of the 10th highest maximum noise level L_{AFmax} outside of upper floor windows at night.

To assess the required sound reduction performance for the building envelope, façade exposure categories have been defined as shown in Figure 5.1. These are based on the floor-by-floor façade noise levels determined from the noise modelling.

Table 5.1 defines the external façade noise levels for each exposure category.

Figure 5.1 – Façade exposure categories

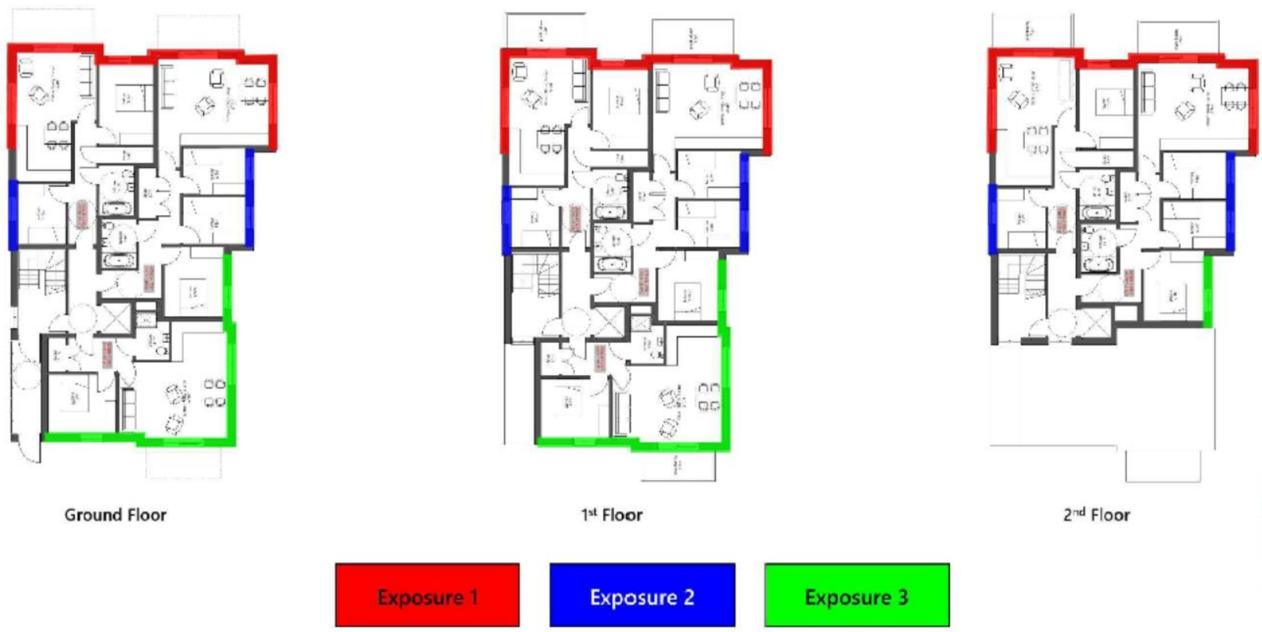


Table 5.1 – External noise levels of each façade exposure category

Exposure Category	External Noise Level incident on the façade		
	Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Night-time average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Night-time maximum [1] (23:00 – 07:00) dB L_{AFmax}
Exposure 1	58 – 63	54 – 59	72 – 77
Exposure 2	58 – 60	54 - 56	72 – 74
Exposure 3	50 - 55	45 - 51	63 - 69
1. 10th highest value per night.			

5.2 Stage 1: Initial Site Noise Risk Assessment

As described in Section 3.1.1, the ProPG recommends that an initial assessment of the risk of adverse noise impact is made without accounting for the impact of any new or additional mitigation measures that may subsequently be included in development proposals.

Based on the daytime $L_{Aeq,16hr}$ and night-time $L_{Aeq,8hr}$ levels in Table 5.1, it is seen that the 'potential risk of adverse effect without noise mitigation' when comparing the levels to those in Table 3.1 are:

- Daytime - Medium on Exposure 1, Low on Exposures 2 and 3; and
- Night-time – Medium on Exposures 1 and 2, Low on Exposure 3.

5.3 Stage 2: Internal Ambient Noise Levels

5.3.1 Element 1 – Good Acoustic Design Process

ProPG suggests that a 'good' acoustic design process should explore other methods of mitigating noise which doesn't wholly rely on using the building envelope (see Appendix B.4 of this report). Table 5.2 analyses the feasibility of the suggested mitigation measures for this site.

Table 5.2 – Analysis of noise mitigation measures as part of a 'good' acoustic design process as defined by the ProPG

Mitigation Method	Analysis
Maximising the spatial separation of noise source(s) and receptor(s).	The building is in a constrained location due to the parking area behind the existing building – hence there is not much scope for increasing the distance from the railway.
Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.	There are few existing structures providing screening. Whilst the railway is down an embankment, the upper floors of the development will still be in sight of it.
Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.	Fencing/walling is proposed around parts of the perimeter and between external amenity areas.
Using the layout of the scheme to reduce noise propagation across the site.	As per above – fencing on the boundary with the railway will reduce noise emissions to ground floor windows and gardens.
Investigating the necessity and feasibility of reducing existing noise levels and relocating existing sources.	Not possible given the noise sources are roads and railways outside of the Applicant's control.
Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.	Kitchen / living rooms are placed on the most exposed facades facing the railway (Exposure 1). Bedrooms are set further back on quieter facades.
Using the building envelope to mitigate noise to acceptable levels.	See the following section.

5.3.2 Element 2 – Internal Noise Level Guidelines

Internal Noise Limits

The criteria for internal ambient noise levels (IANLs) is based on the criteria of the ProPG. In summary, IANL contributions inside the bedrooms and living rooms of the residential dwellings should be no greater than those in Table 5.3.

The criteria are considered to be in line with the Lowest Observed Adverse Effect Level (LOAEL) referenced in national planning policy (Appendix B).

Table 5.3 – Internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,F}$ [1]
1 - no more than 10 times a night			

Internal Levels with Open Windows

The weakest elements of a façade in terms of sound reduction are the windows/glazing. This is particularly true when windows are open. BS 8233:2014 indicates that a partially open window will typically achieve a reduction from outside to inside of 15 dB.

Based on this 15 dB reduction, and the external levels in Table 5.1, the predicted internal levels on each façade with windows open are shown in Table 5.4. It is seen that the internal noise limits are exceeded on all exposure categories, albeit marginally on Exposure 3 (ProPG and BS 8233 suggest 'reasonable' conditions are still achieved if the internal limits are exceeded by 5 dB).

This is not unusual in a central urban location, or even in many rural locations. Whilst internal limits would be exceeded with windows open, it should not be assumed that windows have to be sealed shut, as many occupants will favour the ability to open their windows at will during the hotter months of the year.

Table 5.4 – Predicted internal noise levels with open windows

Exposure Category	Predicted internal noise level with a partially open window		
	Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Night-time average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Night-time maximum (23:00 – 07:00) dB L_{AFmax}
Exposure 1	43 – 48	N/A (No bedrooms on this exposure)	
Exposure 2	43 – 45	39 - 41	57 – 59
Exposure 3	35 - 40	30 – 36	48 - 54
Bedroom Criteria	≤35	≤30	≤45
Kitchen/Living Criteria	≤35	-	-

Internal Levels with Closed Windows and Alternative Ventilation

The ProPG states "*where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g., trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded*".

Given the expected exceedance of IANL targets with open windows, an alternative form of background ventilation (i.e., trickle vents or mechanical ventilation) must be provided so that IANL targets can be met whilst providing background ventilation to the dwellings with the windows closed (but openable at the occupants' discretion, rather than through necessity).

Alternative forms of natural background ventilation (such as trickle vents) are also a weak point but can be treated to achieve a much higher level of sound reduction than an open window – so that IANL targets *can* be met whilst still having natural ventilation openings in an 'open' position.
Closed windows (and external walls and roofs) can be treated to achieve the necessary level of sound reduction through the specification of the glazing/construction.

Table 5.5 provides the minimum sound reduction indices for glazing [2] and ventilators (the weakest elements acoustically) – to meet IANL targets with windows closed but alternative ventilators open/ventilation systems operating to provide background ventilation. Alternatively, mechanical ventilation could be installed as an alternative to acoustically rated trickle vents – particularly if overheating is identified as an issue.

The assessment has been based upon a simplified calculation method where only the weakest elements are considered (glazing and ventilators), as the sound reduction provided by the masonry external wall would inherently be considerably higher. The calculation method effectively treats the whole façade as being glazed – this means that a slightly higher and thus more-robust sound reduction index is determined for glazing/trickle ventilators given that a full composite noise ingress calculation in accordance with BS 12354 would include for the high level of external wall performance, and thus require a lesser rating from the glazing to achieve the same overall composite sound reduction index. Hence this approach is seen to be a worst-case one which achieves a better end result for the future occupants.

The required sound reduction indices for bedrooms are most influenced by the internal night-time maximum noise level target. For example, on Exposure 2, the reduction required to meet the L_{AFmax} night-time target in bedrooms is 29 dB, compared to 25 dB to meet the daytime $L_{Aeq,16hr}$ limit, and 26 dB for the night-time $L_{Aeq,8hr}$ limit.

A non-exhaustive list of example glazing constructions and ventilator products such as trickle vents and air bricks have been provided in Appendix E, which are capable of achieving the required $R_w + C_{tr}$ and $D_{n,e,w} + C_{tr}$ indices.

2 - which also apply to external walls and roofs – albeit these will almost always achieve a much higher level of reduction than glazing

Table 5.5 – Minimum sound reduction requirements of the building envelope

Exposure Category	Room Type	External Noise Level @ 1m outside of a window			Minimum sound reduction indices/construction examples	
		Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Night-time average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Night-time maximum [1] (23:00 – 07:00) dB L_{AFmax}	Glazing [2] See Appendix D.1	Ventilators [3] see Appendix D.2
Exposure 1	Kitchen / Living	58 – 63	-	-	28 dB $R_w + C_{tr}$ Standard double glazing with glass panes of different thicknesses, i.e. - 4mm standard float - 12mm air cavity - 6mm standard float	31 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoTop 60 Grando AK
	Internal limit	≤35	-	-	-	-
Exposure 2	Bedroom	58 – 60	54 - 56	72 – 74	29 dB $R_w + C_{tr}$ Standard double glazing with glass panes of different thicknesses, i.e. - 4mm standard float - 12mm air cavity - 6mm standard float	32 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoTop 60 SR Medio AK+
	Internal limit	≤35	≤30	≤45	-	-
	Bathroom	58 – 60	-	-	25 dB $R_w + C_{tr}$ Standard double glazing with glass panes of different thicknesses, i.e. - 4mm standard float - 12mm air cavity - 6mm standard float	28 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoTop 60 SR Medio AK+
	Internal limit	≤35	-	-	-	-
Exposure 3	Bedroom	50 - 55	45 - 51	63 - 69	25 dB $R_w + C_{tr}$ Any double glazing	28 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoTop 60 SR Corto AK+
	Internal limit	≤35	≤30	≤45	-	-
	Kitchen / Living Bathroom	50 - 55	-	-	20 dB $R_w + C_{tr}$ Any glazing	23 dB $D_{n,e,w} + C_{tr}$ Any trickle vent
	Internal limit	≤35	-	-	-	-

Exposure Category	Room Type	External Noise Level @ 1m outside of a window			Minimum sound reduction indices/construction examples	
		Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Night-time average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Night-time maximum [1] (23:00 – 07:00) dB L_{AFmax}	Glazing [2] See Appendix D.1	Ventilators [3] see Appendix D.2

1. 10th highest value per night.
2. A non-exhaustive list of suitable glazing products is given in Appendix D.1. Standard double glazing will usually achieve a minimum sound reduction of 26 dB R_w + C_{tr}.
3. A non-exhaustive list of suitable ventilator products is given in Appendix D.2. The acoustic performance should meet these values when the vent is open. They may not be required if the development uses mechanical ventilation. Low-performance trickle vents will usually achieve a minimum sound reduction of 25 dB $D_{n,e,w}$ + C_{tr}.

5.3.3 Element 3 – External Amenity Area Noise Assessment

The ProPG indicates that "*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 D.6 in Appendix D indicates that *all* external amenity areas at ground floor level should have areas which are below 55 dB $L_{Aeq,16hr}$. This is based upon the fencing/walling around the gardens being 1.8m in height and closed-boarded.

Areas on the rooftop terrace will also be within the 50 – 55 dB target range.

Levels on some of the balconies may be slightly higher at around 55 – 60 dB. However, these areas are not considered to be 'intrinsic' / essential external amenity areas and given that residents have access to other external amenity areas which *are* <55 dB (the ground floor gardens and rooftop terrace), this impact is considered to be acceptably off-set.

5.3.4 Element 4 – Assessment of other Relevant Issues

Table 5.6 – Assessment of other relevant issues

Issues	Comments
4(i) compliance with relevant national and local policy	The building envelope has been designed so that internal noise targets will be compliant with the ProPG / BS 8233, which are believed to be regularly referenced by the Local Planning Authority in planning conditions for similar residential developments. This includes a specification which accounts for high night time 'maximum' noise levels, which exceeds the required level of reduction to meet daytime ambient and night-time ambient limits.
4(ii) magnitude and extent of compliance with ProPG	
4(iii) likely occupants of the development	Given the size of the flats, it is expected that occupants will likely either be living alone or with 1 other person, i.e., young professionals. The noise-sensitivity of this group is likely to be less than for example, the elderly, or families.
4(iv) acoustic design v unintended adverse consequences	Alternative ventilation will be provided to allow internal noise limits to be met without relying on opening the windows. Facades will not be 'sealed'.
4(v) acoustic design v wider planning objectives	PJA are not aware of the local council's planning objectives but do note that area is characterised by an array of other residential properties. Therefore, a new residential property is not considered unusual.

5.4 Summary

In summary, having followed a 'good acoustic design process' as referenced with the ProPG, PJA believes that the noise impact on future occupants at the proposed development can be controlled to an acceptable level, providing the recommendations herein are followed.

Internal ambient noise level (IANL) targets can be met with closed windows and glazing with a standard/moderate level of acoustic performance. This does not mean that windows should be sealed shut – but does mean that an alternative ventilation system should be used which can meet IANL targets whilst providing adequate background ventilation, i.e., natural ventilation paths such as trickle vents, or mechanical ventilation.

Glazing and ventilators must meet the minimum sound reduction indices in Table 5.5 of Section 5.3.2 (with cross reference to the 'exposure categories' in Figure 5.1 of Section 5.1, recognising that each elevation/set of windows has a differing level of noise exposure.

Noise levels in most external amenity areas (ground floor gardens and the rooftop terrace) will also be within the 50 – 55 dB target range.

6.0 Plant Noise Emissions

The control of external noise emissions from building services/plant (in this case, the proposed ASHPs to be installed per dwelling) is necessary to ensure that an adverse impact is not created on existing noise-sensitive properties in the surrounding area.

6.1 Criteria

PJA note that similar applications for domestic air conditioning systems and air source heat pumps in the Croydon Council area typically have a condition that requires the equivalent continuous sound level $L_{Aeq,15mins}$ from any new plant to not exceed the L_{A90} minus 10 dB at the boundary with the closest residential property.

6.2 Background Sound Levels

In accordance with BS 4142:2014, the predicted rating level should be assessed against a 'representative' background sound level.

For a worst-case assessment, the minimum values of the background sound level $L_{A90,5mins}$ of the survey have been set as the representative background sound level - see Table 6.1.

Table 6.1 – Derived representative background sound level $L_{A90,T}$ at nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Period	Representative Background Sound Level $L_{A90,T}$ (dB)
All nearby residential properties	Daytime (07:00 to 23:00)	42
	Night-time (23:00 – 07:00)	33

6.3 Noise Emission Limits

As per the typical local authority criteria, the plant noise emissions should not exceed the background noise level minus 10 dB when measured at the nearest neighbouring properties boundary.

Table 6.2 – Maximum plant noise level at nearby noise-sensitive receptors

Noise-Sensitive Receptor (NSR)	Period	Maximum Plant Specific Noise Level $L_{Aeq,T}$ (dB)
Boundary of neighbouring residential properties	Daytime (07:00 to 23:00) Tr = 60-minutes	32
	Night-time (23:00 – 07:00) Tr = 15-minutes	23

6.4 Proposed Plant

As shown by the drawings in Figure 2.3 (Section 2.0), the proposals include the installation of 8 no. external air source heat pumps on the 1st floor roof.

It is anticipated that the units will be a Mitsubishi PUZ-WM60VAA(-BS) Ecodan R32 Monobloc Air Source Heat Pump, with dimensions of 1,050mm wide x 480mm depth x 1,020mm high.

According to the manufacturer data [3] [4], the units have a maximum sound power level of 58 dB(A) and a sound pressure level of 45 dB(A) at 1m in front of the unit – in both cooling and heating modes. The octave band noise levels are supplied in Table 6.3.

Table 6.3 – Source noise emission data for the proposed ASHPs

Make/Model	Mode	Sound Pressure Levels @ 1m [5]								Sound Power Level dB(A)
		dB at Octave Band Centre Frequencies, Hz							dB(A)	
		63	125	250	500	1 k	2 k	4 k		
Mitsubishi PUZ-WM60VAA(-BS)	Heating	48	47	49	44	36	34	27	45	58
	Cooling	54	48	44	44	38	38	31	45	

6.5 Predicted Noise Emissions

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package that implements a wide range of national and international standards, guidelines, and calculation algorithms, including those set out in ISO 9613-2:1996. A full explanation of the noise modelling is provided in Appendix D, along with images and noise maps/results from the model.

Figure D.10 in Appendix D shows the predicted specific noise levels ($L_{Aeq,15min}$) outside of noise-sensitive windows of buildings in the surrounding area.

Table 6.4 summarises the assessment result at the worst affected noise-sensitive receptor window.

It is seen that mitigation would be required to reduce noise emissions to a level that is compliant with the limits in Table 6.2, given that it is 4 dB over the daytime limit, and 13 dB over the night-time limit.

3 - https://library.mitsubishielectric.co.uk/pdf/book/Ecodan_PUZ-WM60VAA_Monobloc_Air_Source_Heat_Pump_Product_Information_Sheet#page-1-2
4 - https://library.mitsubishielectric.co.uk/pdf/book/ATW_Databook_R32_2020
5 - Measured at 1m in front of the unit and 1.5m above ground . Measured in a semi anechoic chamber (reflective ground but no reflective vertical sources).

Table 6.4 – Predicted plant noise emissions

Location	Period	Specific Noise Level $L_{Aeq,T}$ (dB)	Specific Noise Limit $L_{Aeq,T}$ (dB)	Compliant?
1m outside of the nearest noise-sensitive window	Daytime (07:00 to 23:00)	36	≤32	No (+4 dB)
	Night-time (23:00 – 07:00)		≤23	No (+13 dB)

6.6 Mitigation

Some form of mitigation will be required for plant noise emissions to be reduced to a level that is compliant with the criteria stipulated by the Local Planning Authority, i.e., no greater than a background sound level of 23 dB L_{A90} outside of the worst-affected neighbouring window.

At least a 13 dB reduction will be required to meet this limit.

It is unlikely that noise would be sufficiently mitigated by either a) moving the units to a different location, b) changing to a quieter alternative, or c) installing a barrier/fence around the units to create an open topped enclosure.

The required level of reduction *can* be achieved by installing a full ventilated acoustic enclosure. Such an enclosure is usually metal clad with an inner layer of acoustically absorbent insulation – with a staggered air path (louvres placed to the side of the fan opening, rather than directly in front).

These enclosures typically achieve noise reductions of anywhere between 12 and 26 dB(A).

A suitable enclosure could be sourced from Environ, who produce domestic acoustic enclosures for condensers that are able to achieve a sound transmission loss of 22 dB(A). More information on this enclosure (and alternatives) is given in Appendix F, including the manufacturer claimed transmission losses. This enclosure would be sufficient to meet the noise limit in this case.

Acoustic enclosures are typically installed around individual ASHPs, but it may be possible to obtain a bespoke enclosure which houses all 8 of the units.

The Applicant should submit a datasheet from the enclosure manufacturer which verifies that it can reduce noise emissions by a minimum of 13 dB(A).

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
Airborne sound	Airborne sound is sound that is transmitted through the air. Airborne sound can be transmitted through elements, by causing the element to vibrate (imperceptible to the eye), in turn transmitting vibrations into the air on the other side. Most noise in a typical acoustic assessment is 'airborne' sound and is generated by sources such as speech, music and transport.
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio of the root-mean-square pressure of the sound and a reference pressure (2x10-5 Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e., 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
C_{tr}	A weighting curve applied to level differences to account for low-frequency noise, typically associated with traffic noise. This is often applied as an addition to $D_{nT,w}$ and R_w ratings used to describe levels of sound insulation.
D_w / $D_{nT,w}$	The D_w weighted level difference used to characterize the sound insulation between rooms in a building as they are. Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions. A $D_{nT,w}$ is a D_w which is then 'normalised' to account for the reverberation time of the room (the 'nT'), recognising that the level difference is dependent on how reverberant the receiver room is and that every room will have a slightly different reverberation time, hence the $D_{nT,w}$ *is* adjusted to reference conditions.
Flanking	Transmission of sound energy through paths adjacent to the building element being considered. For example, when considering a separating wall, as well as transmitting directly through the wall, sound can also travel around the wall by the floor, ceiling, corridor wall, and external wall.
Frequency	Sound is generally assessed over the frequency range of 63 Hz to 4000 Hz (4 kHz), although humans can potentially hear between 20 Hz and 20 kHz. Frequency is often divided into ('first') octave bands for analysis, with the range above considered within 7-octave bands with centre frequencies at 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz and 4 kHz. 'Third' octave bands split this further into smaller frequency bands.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period. This parameter is typically considered as a good representation of the 'average' overall noise level. It is referred to technically as the A-weighted equivalent continuous sound level and is a dB(A).
$L_{A90,T}$	The A-weighted noise level that is exceeded for 90% of the measurement period T. This parameter is often considered as the 'average minimum level'.
$L_{A10,T}$	The A-weighted noise level that is exceeded for 10% of the measurement period T. This parameter is often considered as the 'average maximum level' and a good representation of traffic noise contributions.
$L_{AFmax,T}$	The maximum A-weighted noise level during the measurement period T.
R_w	Weighted sound reduction index. A single number rating of the sound insulation performance of a specific building element. R_w is measured in a laboratory. R_w is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.
Sound insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to the ability of a material to stop sound travelling through it.
Structure-borne sound	Transmission of sound energy as vibrations inside the structure of a building. Can be used an alternative term to impact sound, however, structure-borne will usually refer to noise transmitted into a structure from mechanical sources, rather than human sources.

A.2 – Subjective Changes in Sound Level

Table A.2 – Subjective loudness from an increase or decrease in sound pressure level

Change in sound pressure level	Relative change in sound power energy (multiplier)		Change in apparent subjective loudness (for mid-frequency range)
	Decrease	Increase	
3 dB	1/2	2	'Just perceptible'
5 dB	1/3	3	'Clearly noticeable'
10 dB	1/10	10	'Half or twice as loud'
20 dB	1/100	100	'Much quieter, or louder'

Appendix B – Relevant Planning Policies

B.1 – National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. The NPPF provides a framework within which local people and their council can produce their own distinctive local and neighbourhood plans. With explicit reference to noise, the NPPF states that *"Planning policies and decisions should contribute to and enhance the natural and local environment by … preventing new and existing development from contributing to, being put at unacceptable risk from … noise pollution"*.

B.2 - Noise Policy Statement for England (NPSE)

The NPPF refers to the Noise Policy Statement for England (NPSE), which applies to most forms of noise including environmental noise. The NPSE sets out the long-term vision of Government policy which is to *"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."*. It aims that *"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."*

The use of the terms *"significant adverse"* and *"adverse"* are key phrases within the NPSE. The guidance establishes the concept of how the level of adverse effect on health and quality of life can be referenced including:

- 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.
- SOAEL – Significant Observed Adverse Effect Level - This is the level above which *significant adverse* effects on health and quality of life occur.

Under the first aim of the NPSE ("avoid significant adverse impacts on health and quality of life"), an impact in line with SOAEL should be avoided. Under the second aim ("mitigate and minimise adverse impacts on health and quality of life"), where the impact lies somewhere between LOAEL and SOAEL, requiring that all reasonable steps are taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development, but does not mean that such adverse effects cannot occur.

B.3 - Planning Practice Guidance on Noise (PPG-N)

The Planning Practice Guidance on Noise (PPG-N) is part of a suite of web-based guidance which is intended to support the implementation of the policies in the NPPF and the NPSE.

It aids in expanding on the definitions form the NPSE of NOEL, LOAEL and SOAEL, by linking these terms to 'examples of outcomes', i.e., changes in behaviour and/or attitude to noise. The table below summarises the guidance from PPG-N in this regard.

Table B.1 – Noise exposure hierarchy based on the likely average response – adapted from PPG-N

Perception	Examples of outcomes	Increasing effect level	Action
NOEL - No Observed Effect Level [1]			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. 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
LOAEL - Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g., turning up the 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL - Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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 a change in the acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate the effect of noise leading to psychological stress or physiological effects, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g., auditory and non-auditory	Unacceptable Adverse Effect	Prevent
[1] This line is an assumption of the adverse effect level and is not explicitly referenced by PPG-N, though this appears to be a safe assumption.			

B.4 – The Professional Practice Guidance on Planning and Noise (ProPG)

The ProPG, published in 2017, is a design guide for new residential development that are exposed predominantly to airborne noise from transport sources. It was produced *"to provide practitioners with guidance on the management of noise within the planning system in England"*, though it is not an official code of practice or official interpretation of the law or government policy.

However, the ProPG extends on the guidance and numerical targets within BS 8233:2014 and WHO guidelines, as well as national planning policy, providing new and extended recommendations where these standards are considered to fall short. Therefore, it is considered to be the most relevant and up to date design standard for assessing the noise impact on new residential developments.

The ProPG *"advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging…*

…The two sequential stages of the overall approach are:

- *Stage 1 – an initial noise risk assessment of the proposed development site; and*
- *Stage 2 – a systematic consideration of four key elements….*

The approach is underpinned by the preparation and delivery of an "Acoustic Design Statement" (ADS). An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk."

B.4.1 - Stage 1: Initial Site Noise Risk Assessment

The ProPG recommends that an initial site noise risk assessment should be undertaken based on indicative external noise levels on the existing site, without accounting for the impact of any new or additional mitigation measures that may subsequently be included in development proposals. Figure 1 of the ProPG relates the increasing risk of adverse effect against indicative daytime noise levels ($L_{Aeq,16hr}$) and night-time noise levels ($L_{Aeq,8hr}$) without noise mitigation. This is recreated in the table below.

Table B.2 – The ProPG initial site noise risk assessment guidelines

Indicative external daytime noise levels $L_{Aeq,16hr}$	Indicative external night-time noise levels $L_{Aeq,8hr}$	Potential risk of adverse effect without noise mitigation
≤ 50 dB	≤ 40 dB	Negligible / No adverse effect [1]
> 50 dB and ≤ 60 dB	> 40 dB and ≤ 50 dB	Low
> 60 dB and ≤ 70 dB	> 50 dB and ≤ 60 dB	Medium
> 70 dB	> 60 dB	High

NOTES:

The noise level limits are an interpretation of Figure 1 in the ProPG, which is presented as a diagram rather than a table and does not explicitly state the limits at which each risk category exists.

[1] An indication that there may be more than 10 noise events at night with $L_{Amax,F}$ > 60 dB means the site should not be regarded as a negligible risk.

B.4.2 – Stage 2: Good Acoustic Design Process

The ProPG talks about a *"good acoustic design process"*, that will be suitable in the majority of situations likely to be encountered in practice, with the aim of a more consistent approach from designers through the use of the document. In short, "good acoustic design" means that the acoustic design should:

- be considered early in the development control process;
- take an integrated approach to achieve 'optimal' acoustic conditions both internally and externally, which does not just focus on compliance with noise exposure standards, but aims to avoid compromises for other sustainable design objectives that may adversely affect living conditions and quality of life;
- avoid "unreasonable" and prevent "unacceptable" acoustic conditions, without overdesigning or 'gold plating' the new development; and
- consider the viability of alternative solutions rather than solely rely on the building envelope to provide sufficient sound insulation, which may adversely affect living conditions.

B.4.3 – Stage 2: Noise Management Measures

The ProPG recommends that the design of sealed shut/un-openable windows should be avoided where possible, as occupants would favour the ability to open the windows even if the resultant internal acoustic conditions are unsatisfactory.

Therefore, every effort should be made in the first instance to mitigate noise through alternative solutions before simply using the building envelope to mitigate noise. Supplementary Document 2 of the ProPG therefore advises that the following hierarchy of noise management measures (in descending order of preference) should be followed:

- Maximising the spatial separation of noise source(s) and receptor(s).
- Investigating the necessity and feasibility of reducing existing noise levels and relocating existing sources.
- Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.
- Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
- Using the layout of the scheme to reduce noise propagation across the site.
- Using the orientation of buildings to reduce the noise exposure of noise sensitive rooms.
- (and finally) Using the building envelope to mitigate noise to acceptable levels.

Any reliance on the use of the building envelope alone to mitigate noise levels should be justified. In many cases there is "justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources".

B.4.4 – Stage 2: Internal Ambient Noise Levels

Whole Dwelling Ventilation

The ProPG provides internal ambient noise level targets based upon Table 4 of BS 8233:2014, with a few additions in guidance. These are summarised in the table below.

The ProPG suggests that the development layout should be designed such that internal noise level targets can be achieved with open windows in as many areas as possible, on the basis that residents will value the ability to open windows at will. It is generally stated within guideline documents (including the ProPG) that an open window will typically provide up to a 15 dB(A) reduction in noise from outside to inside.

However, an assessment can be made with closed windows and open ventilators (i.e., trickle vents) which provide *"whole dwelling ventilation"* (as defined by Building Regulations Approved Document F).

Table B.3 – The ProPG internal ambient noise level guidelines

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,F}$ [1]
[1] a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night			

The following summarises the ProPG guidance which relates to the table above.

- Internal L_{Aeq} targets:
  - assume normal daytime fluctuations in external noise;
  - are based on average annual data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events such as bonfire night or New Year's Eve; and
  - can be relaxed by up to 5 dB where development is considered necessary or desirable, despite high external noise levels. However, most people will regard exceeding the targets by more than 5 dB on a regular basis as 'unreasonable' and exceeding by more than 10 dB as 'unacceptable'.
- Internal $L_{Amax,F}$ targets:
  - are set on the basis that regular individual noise events (such as aircraft and passing trains) can cause sleep disturbance; and
  - are not an absolute limit but a threshold by which 'good acoustic design' is achieved by not exceeding this threshold more than 10 times a night. However, where it is not practical to achieve this guideline, the judgement of acceptability will depend on the noise level, source, number, distribution, predictability and regularity of noise events.

Purge Ventilation

The guidelines above are generally not applicable under *"purge ventilation"* conditions (as defined by ADF), as this should only occur occasionally.

Mechanical Services

The ProPG indicates that *"where mechanical services are used as part of the ventilation or thermal comfort strategy for the scheme, the impact of noise generated by these systems on occupants should also be assessed."* It does not, however, give an explicit set of noise level targets for any form of mechanical ventilation (continuous, extract or purge).

B.5 - BS 4142:2014

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'* is intended to be used to assess the potential adverse impact of sound of an industrial and/or commercial nature, at nearby noise-sensitive receptor (NSR) locations within the context of the existing sound environment.

B.5.1 - Definitions

BS 4142:2014 provides the following definitions which are relevant at this pre-construction stage of assessment:

- Background Sound Level, $L_{A90,T}$: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
- Rating Level, $L_{Ar,Tr}$: Specific sound level plus any adjustment for the characteristic features of the sound.
- Reference Time Interval, T_r: Specified interval over which the specific sound level is determined. This is 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).
- Specific Sound Level, L_s = $L_{Aeq,Tr}$: Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.
- Specific Sound Source: Sound source being assessed.

The BS 4142:2014 definition of sound of an industrial and/or commercial nature includes "*sound from fixed installations which comprise mechanical and electrical plant and equipment*". The scope of BS 4142:2014 is not intended for sound from the passage of vehicles on public roads; people; and 'other sources falling within the scopes of other standards or guidance'.

B.5.2 - Specific Sound Level

The specific sound level L_s is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r, of 60-minutes during the day (07:00 – 23:00) and 15-minutes at night (23:00 – 07:00).

B.5.3 - Rating Level

The rating level $L_{Ar,Tr}$ is the specific sound level L_s plus any 'penalties' which account for the characteristic features of the sound.

BS 4142:2014 provides the following with respect to the application of penalties to account for *"the subjective prominence of the character of the specific sound at the noise-sensitive locations and the extent to which such acoustically distinguishing characteristics will attract attention"*.

- *Tonality – For sound ranging from not tonal to predominantly tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible;*

- *Impulsivity – A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible;*
- *Intermittency – When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied; and*
- *Other Sound Characteristics – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."*

PJA consider the word 'perceptible' to be important, and variable depending on the context of a site. For example at a site with a relatively high background sound level of 50 dB(A), an 'impulsive' sound source with a specific sound level of 30 dB(A) at an NSR is unlikely to be perceptible and should probably not be penalised.

However, the same source at a site with a lower background level of 30 dB(A) would be perceptible, and therefore a penalty of 3 or 6 dB could be applied to the rating level, with possibly a 9 dB penalty being applied if the specific sound level were to rise from 30 to 40 dB(A). Therefore the context is important in applying rating level penalties.

B.5.4 - Background Sound Level

BS 4142:2014 states that *"in using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."*

BS 4142:2014 further states that *"a representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either minimum or modal value"*. Hence BS 4142:2014 does not provide a 'black and white' method of obtaining the assessment level for background sound $L_{A90,T}$. Note that it is standard practice that the $L_{A90,T}$ is determinable from the results of a baseline sound survey conducted at positions representative of sound levels at the nearest or worst affected NSRs.

B.5.5 - Assessment of Adverse Impact

The assessment of adverse impact contained in BS 4142:2014 is undertaken by comparing the rating level $L_{Ar,Tr}$, to the measured representative background sound level $L_{A90,T}$ outside the sensitive receptor location.

The significance of the impact of an industrial or commercial sound source depends on both the margin by which the rating level $L_{Ar,Tr}$ exceeds the background sound level $L_{A90,T}$ and the context in which the sound occurs. It is therefore essential to place the sound in context. But in general, *"the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

Appendix C – Noise Survey Details

C.1 – Survey Equipment

The monitoring equipment used for the baseline noise survey is detailed in the table below. The sound level meter was calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meter has been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrators have been calibrated to a traceable standard within the 12 months preceding the survey. The equipment complies with the standards of as BS EN 60942:2003 Class 1 device.

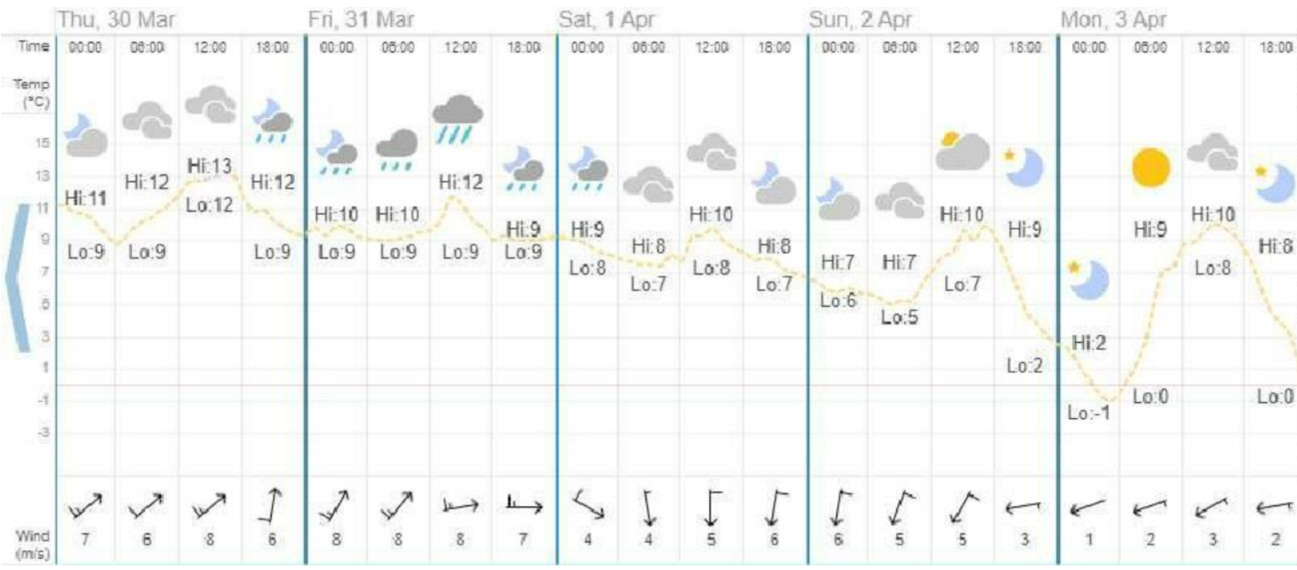
Table C.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
Casella CEL 633C Class 1 Sound Level Meter	2145374	Feb-22	Feb-24
B&K 4189 Class 1 Microphone	2529821	Feb-22	Feb-24
Casella CEL 120-1 Class 1 Acoustic Calibrator	113251	April-22	April-23

C.2 – Meteorological Conditions

During the survey, weather conditions were mostly dry and mild with wind speeds to a maximum of 8 ms^{-1}. The microphone was fitted with a weather protection kit/windshield. These weather conditions are suitable for the measurement of environmental noise in accordance with BS 7445 '*Description and Measurement of Environmental Noise*'. The weather data below has been sourced from https://www.timeanddate.com/weather/uk/croydon/historic.

Figure C.1 – Meteorological conditions during the survey



C.3 – Photograph

Figure C.2 – Photograph of the noise monitoring position

Appendix D – Noise Mapping

The noise predictions within this report have been undertaken using the proprietary software CadnaA® by DataKustik, a 3-D noise mapping package which implements a wide range of national and international standards, guidelines and calculation algorithms, including those set out in ISO 9613-2:1996.

The noise model accounts for the topography of the land based on data available from the Ordnance Survey. All of the objects within the model (buildings, roads, barriers, foliage, etc) have been imported from OpenStreetMap, or drawn in manually where the OSM did not contain sufficient data. The heights of the buildings and roads have been based upon Google Earth Pro, using the 3D view to be able to measure the elevation heights at the tops of objects, and then inserting this manually into the model. Lastly, the scaled site plan, floor plan, and elevation for the proposed development have been accounted for in the model.

The noise model has been used to predict the resulting daytime (16-hour) and night-time (8-hour) L_{Aeq} and 10th highest (per night) L_{AFmax} noise levels across the site.

The noise map model has assumed:

- downwind propagation, i.e., a wind direction that assists the propagation of sound from source to receptor, as a worst-case;
- a ground absorption factor of 0 in all areas as a worst-case;
- a maximum reflection factor of two where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- façade receptor points representing the worst-case floor – placed at 0.05m from the façade (and not accounting for the sound reflection off that façade);
- receptor points in the plots of the existing site based on the position and height of the survey positions;
- a noise contour/map height of 1.5m;
- atmospheric sound absorption based upon a temperate of 10^{o}C and a humidity level of 70%, as per Table 2 of ISO 9613-2:1996.

The images on the following pages contain the results of the mapping.

D.1 – Existing Site

Figure D.1 – Views of the model setup – existing site

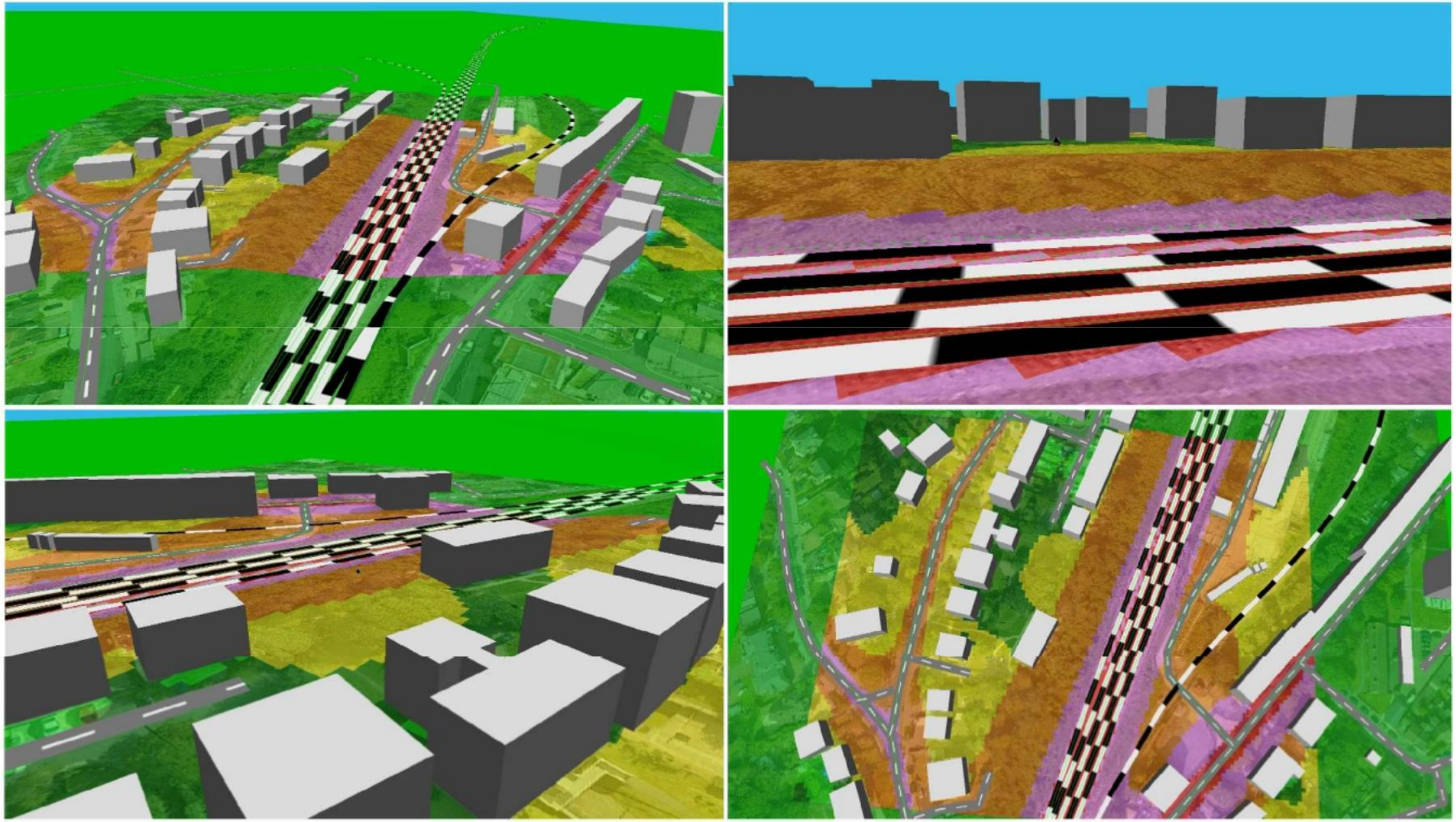


Figure D.2 – Existing site - Predicted dB $L_{Aeq,16hr}$ external ambient noise levels – Daytime (07:00 – 23:00)

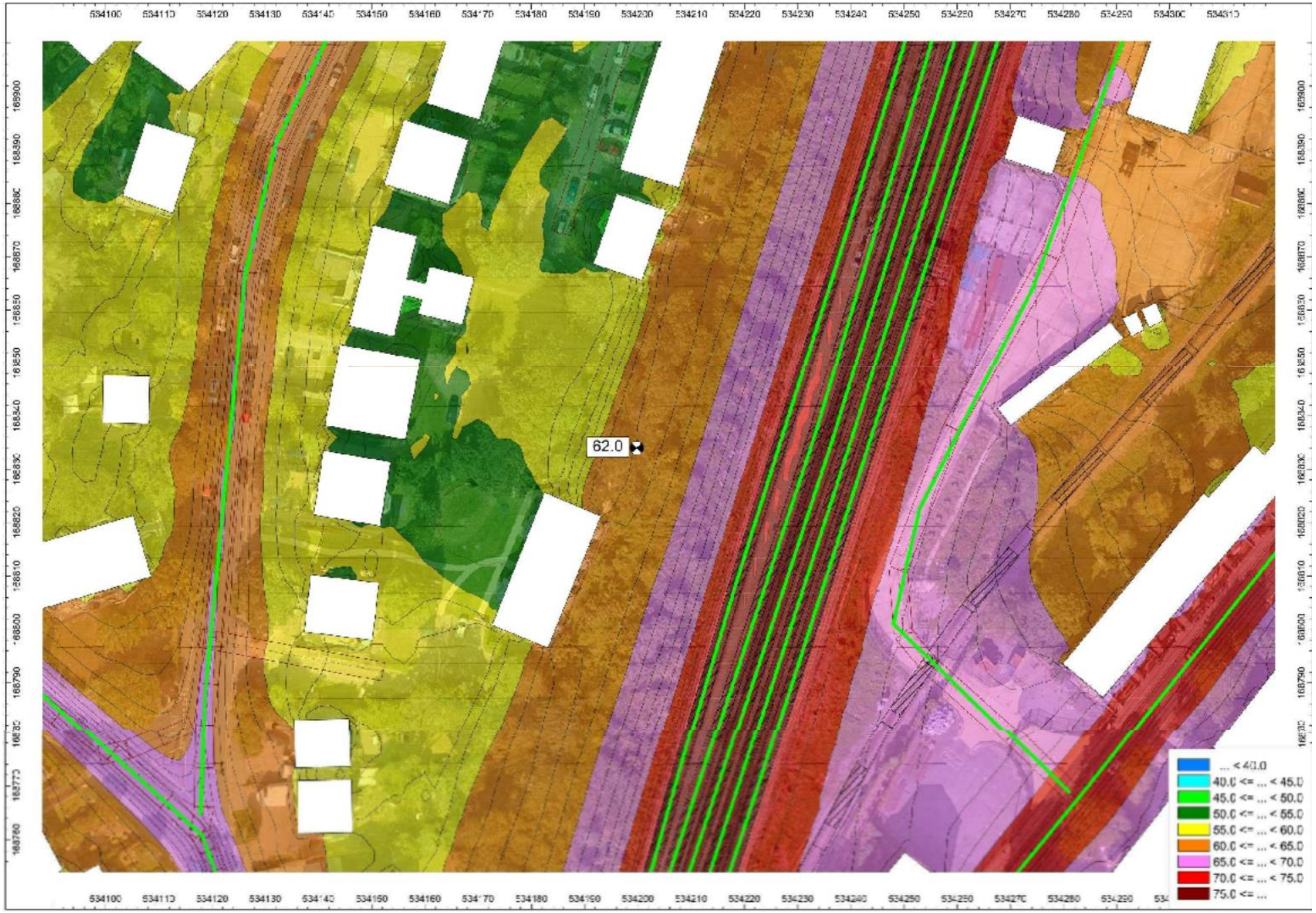


Figure D.3 – Existing site - Predicted dB $L_{Aeq,8hr}$ external ambient noise levels – Night-time (23:00 – 07:00)

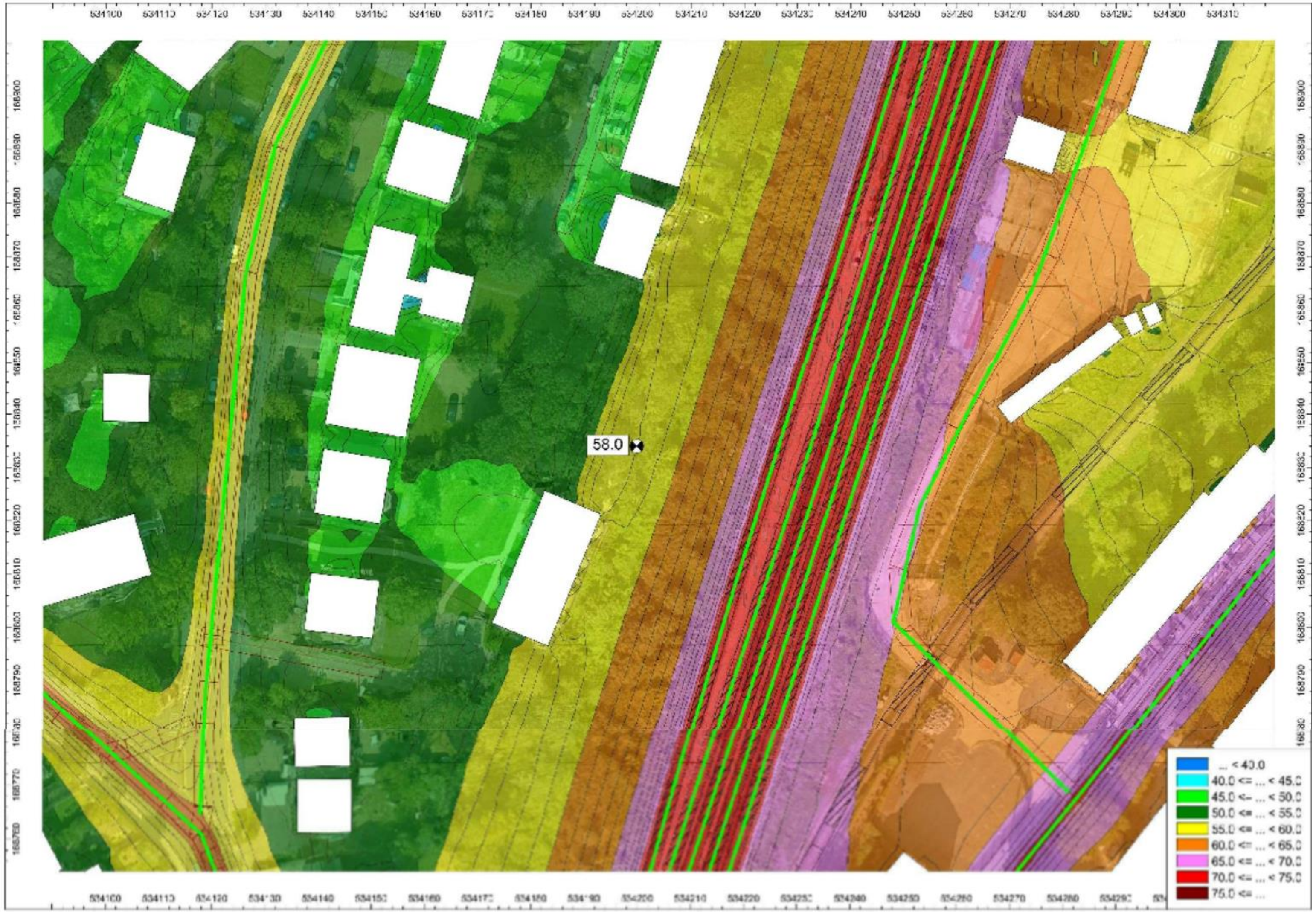
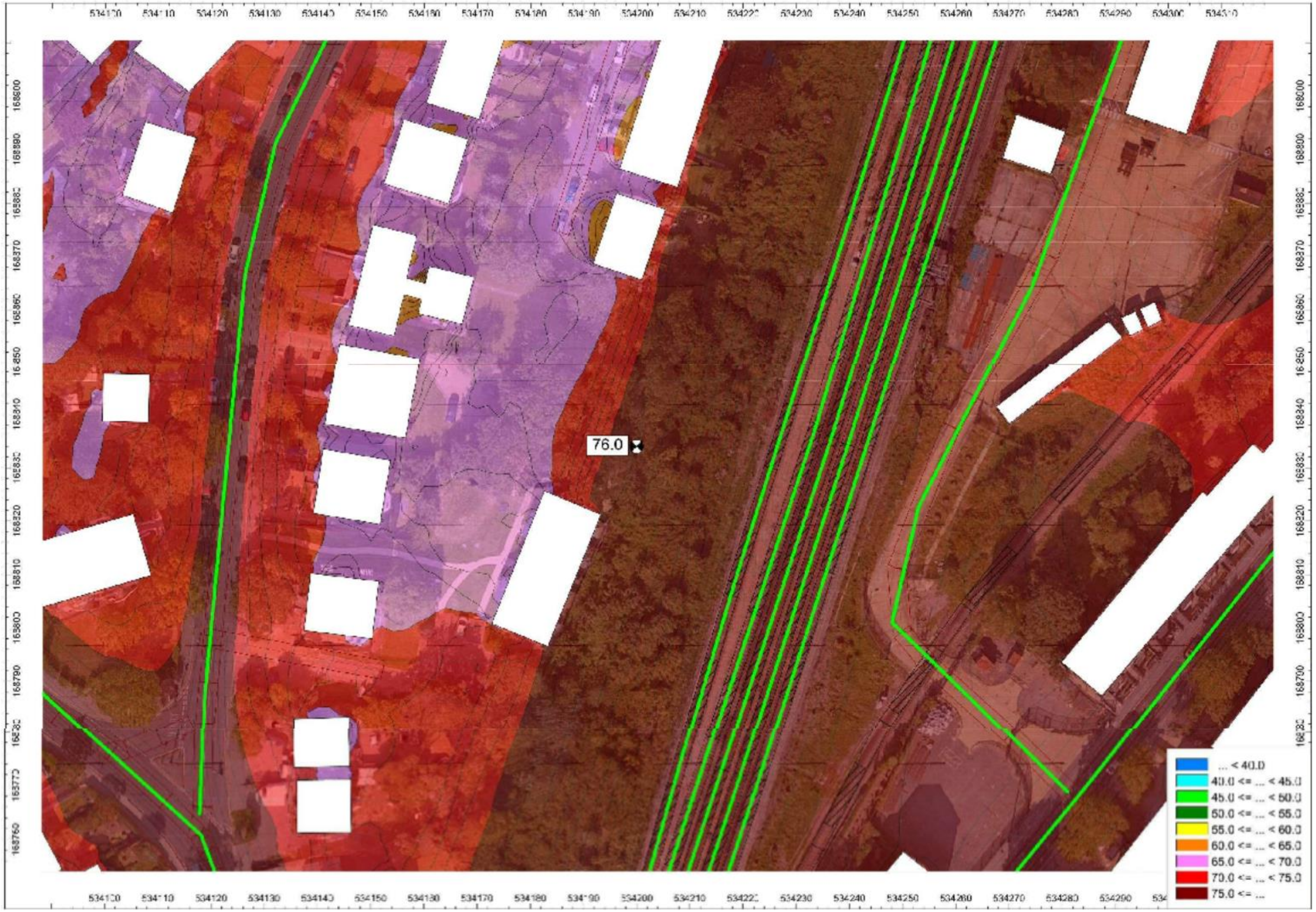


Figure D.4 – Existing site – Predicted 10th highest per night dB L_{AFmax} maximum noise levels – Night-time (23:00 – 07:00)



D.2 – Proposed Development

Figure D.5 – Views of the model setup – proposed development

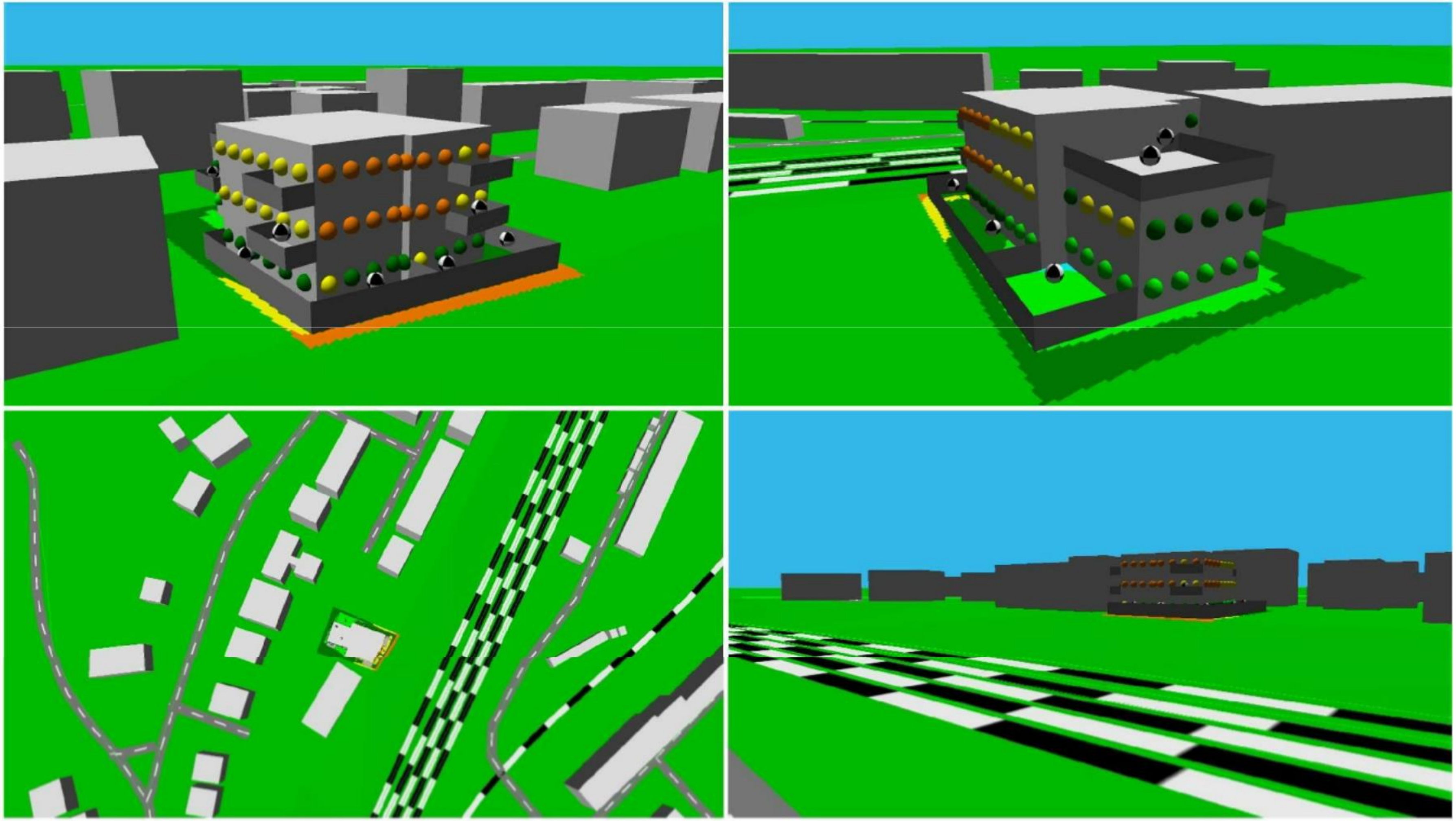


Figure D.6 – Proposed development - Predicted $L_{Aeq,16hr}$ in outdoor amenity areas – Daytime (07:00 – 23:00)

Figure D.7 – Proposed development - Predicted façade dB $L_{Aeq,16hr}$ exposure levels – Daytime (07:00 – 23:00)

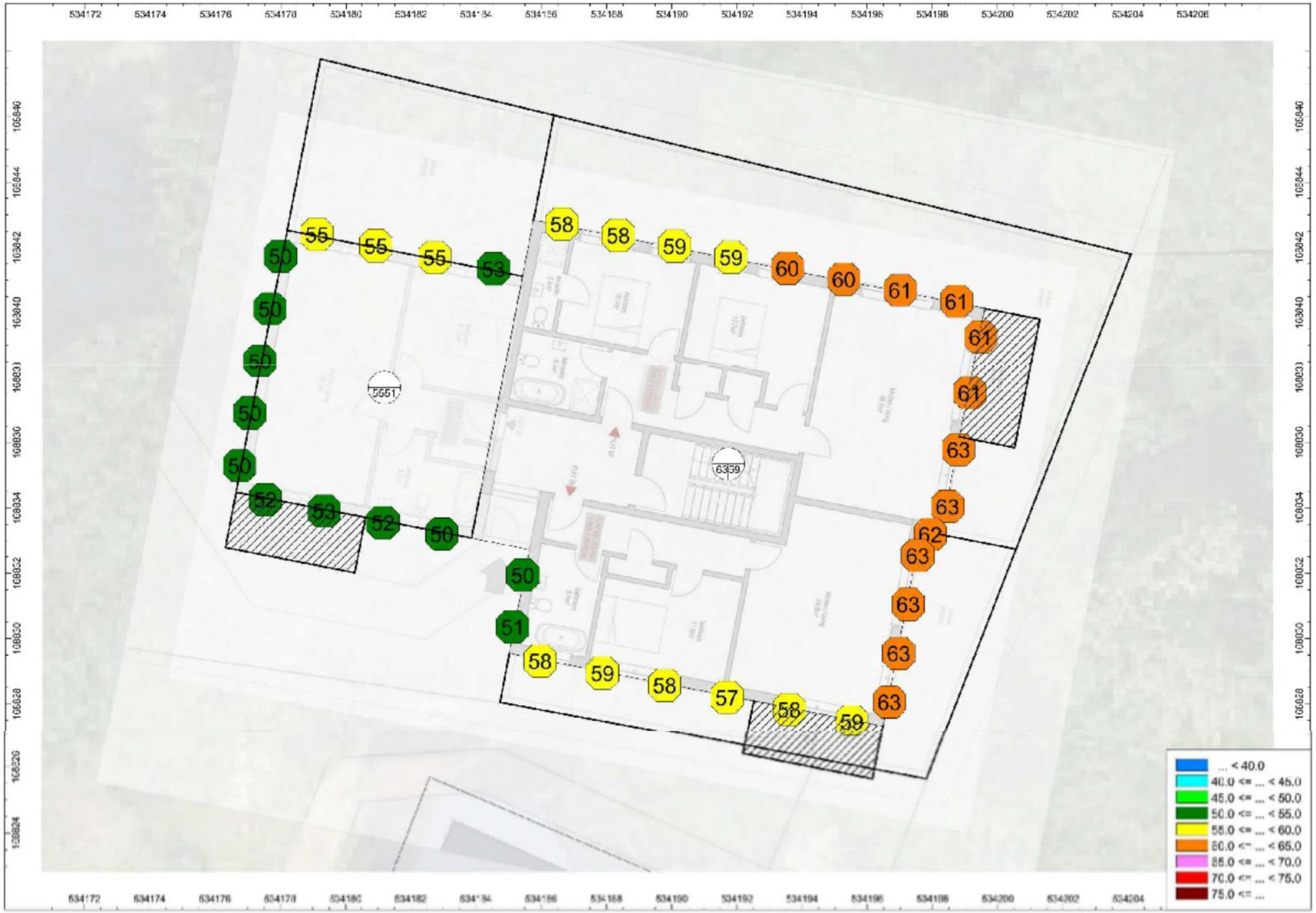


Figure D.8 – Proposed development - Predicted façade dB $L_{Aeq,8hr}$ exposure levels – Night-time (23:00 – 07:00)

Figure D.9 – Proposed development - Predicted 10th highest per night dB L_{AFmax} exposure levels – Night-time (23:00 – 07:00)

D.3 – Plant Noise

Figure D.10 – Predicted plant noise emissions (dB L_{Aeq})

Appendix E – Example Façade Constructions

E.1 - Glazing

Table E.1 – Example secondary glazing constructions (retaining existing glazing) and associated sound reduction indices

Glazing Type	Configuration (Glass/Void/Glass mm)	$R_w + C_{tr}$ (dB)
Double (secondary)	4 (50) 6	34
	4 (100) 6	37
	6 (100) 6	37
	10 (100) 6	39
	4 (150) 6	40
	4 (100) 6.8 laminated/toughened[1]	40
	4 (100) 8.8 laminated/toughened[1]	42
	6 (100) 6.8 laminated/toughened[1]	43
	4 (100) 12.8 laminated/toughened[1]	44
	6 (100) 8.8 laminated/toughened[1]	45
	6 (100) 12.8 laminated/toughened[1]	47
1 – i.e., Pilkington Optiphon or Saint Gobain Stadip Silence		

Table E.2 – Example new double/triple glazing constructions and associated sound reduction indices

Single / Double / Triple	Configuration	Manufacturer	$R_w + C_{tr}$ (dB)
Double	4 (12) 4	Saint Gobain	27
Double	4 (16) 4	Saint Gobain	27
Double	4 (12) 6	Saint Gobain	29
Double	5 (12) 4	Saint Gobain	29
Double	4 (16) 8	Saint Gobain	30
Double	4 (12) 6.8P	Pilkington	30
Double	4 (10) 10	Saint Gobain	31
Double	6 (25) 4	Saint Gobain	31
Double	8 (18) 6	Saint Gobain	32
Double	8.8L (12) 8.8P	Pilkington	32
Double	4 (6) 10	Saint Gobain	33
Triple	4 (12) 4 (12) 8.4S	Saint Gobain	33
Double	4 (16) 8.8P	Pilkington	33
Double	10 (15) 6	Saint Gobain	34
Double	8 (6) 8.8S	Saint Gobain	34
Double	6 (16) 8.8P	Pilkington	34
Double	10 (6) 8.8S	Saint Gobain	35
Double	6 (24) 10	Saint Gobain	35
Double	6 (12) 9.5A	Saint Gobain	35
Triple	8 (12) 4 (12) 8.8P	Pilkington	35
Double	8 (12) 8.8A	Saint Gobain	36
Double	10 (12) 8.8A	Saint Gobain	37
Double	8.4A (16) 10.4A	Saint Gobain	38
Double	8.8P (16) 12.8P	Pilkington	39
Double	10 (16) 12.4A	Saint Gobain	40
Double	12.8A (15) 12.8A	Saint Gobain	41
Double	9.1P (20) 13.1P	Pilkington	42
Double	9.1P (20) 17.1P	Pilkington	43
Double	16.8A (15) 16.8A	Saint Gobain	44
Double	9.1P (20Arg) 17.1P	Pilkington	44
NOTATION A = Stadip Silence S = Stadip	P = Optiphon	L = Optilam	Arg = Argon Cavity
Further data at https://techhub.uk.saint-gobain-building-glass.com/acousticcalculator			

E.2 - Ventilators

For each additional ventilator, the required $D_{n,e,w}$ + C_{tr} should be increased by 10log(n), where 'n' is the number of ventilators. The $D_{n,e,w}$ + C_{tr} must be assessed in the open position.

Table E.3 – Example ventilator products and associated sound reduction indices

Product	$D_{n,e,w}$ + C_{tr} (dB)
Duco DucoTop 60 SR (over window frame) – Corto STD	25
Duco DucoTop 60 SR (over window frame) – Corto AK	26
Duco DucoTop 60 SR (over window frame) – Grando STD	27
Duco DucoTop 60 SR (over window frame) – Corto AK+	28
Duco DucoTop 60 SR (over window frame) – Alto AK	30
Duco DucoTop 60 SR (over window frame) – Basso AK+	30
Titon Invent	30
Duco DucoTop 60 SR (over window frame) – Grando AK	31
Titon Hit & Miss HM5050	31
Duco DucoTop 60 SR (over window frame) – Medio AK+	32
Duco DucoStrip Slimline	32
Duco GlasMax – Air slot 20mm	32
Rytons R2700 Window trickle ventilator (412mm wide)	33
Titon SF 3300 EA Vent	33
Greenwood Slotvent 3000S	33
Duco GlasMax – Air slot 10mm	34
Greenwood 2000D	35
Duco DucoTop 60 SR (over window frame) – Largo AK+	35
Duco DucoMax Corto 15	36
Duco DucoTop 60 SR (over window frame) – Grando AK+	37
Duco DucoMax Medio 25	37
Duco DucoMax Alto 25	38
Titon SF Xtra Sound Attenuator	39
Willan Fresh 100dB	40
Greenwood Airvac Acoustic Air Brick AAB-4000	40
Duco DucoMax Corto 10	41
Duco DucoMax Medio 15	42
Greenwood EHA574	42
Duco DucoMax Alto 15	43
Duco DucoMax Alto 10	45

Appendix F – Acoustic Enclosure

A specialist acoustic enclosure is usually metal clad with an inner layer of acoustically absorbent insulation – with a staggered air path (louvres placed to the side of the fan opening, rather than directly in front). These enclosures are typically capable of achieving noise reductions of anywhere between 15 and 26 dB(A).

A suitable enclosure could be sourced from Environ [6], who produce domestic acoustic enclosures for condensers that are able to achieve a sound transmission loss of 22 dB(A) (albeit typically closer to 18 – 22 dB(A), depending on the frequency spectrum of the noise source). The manufacturer claimed transmission losses from Environ (based upon an environlite ELV1.1.25AC product or similar) are shown in Table F.1 below and in Figure F.2 overleaf. The enclosures look like those in Figure F.1.

Table F.1 – Transmission loss of an *Environ* acoustic enclosure

	Transmission Loss						
	dB at Octave Band Centre Frequencies, Hz						
	63	125	250	500	1 k	2 k	4 k
environlite ELV1.1.25AC acoustic enclosure	11	13	19	28	34	36	36

Figure F.1 – *Environ* acoustic enclosure

Other manufacturers [7] [8] [9] [10] [11] are available who may be able to supply enclosures that achieve a similar loss (Environ data has been presented as it is more publicly available, and the design of these enclosures included a staggered/dog leg type air path through the sides of the enclosure which theoretically make them perform better than other enclosures where the air intake is in front out the fan outlet).

6 - https://www.environ.co.uk/domestic/

7 - https://www.soundplanning.co.uk/acoustic-enclosures/

8 - https://www.bas-ltd.co.uk/

9 - https://www.acoustic-enclosures.uk/product/air-conditioning-and-heat-pump-enclosures

10 - https://acousticenclosuresltd.co.uk/

11 - https://www.environgroup.uk/

Figure F.2 – *Environ* acoustic enclosure – acoustic data

environ
Acoustic Enclosures

Environ Technologies Ltd
Regus House, 1010 Cambourne Business Park
Cambourne, Cambridgeshire, UK, CB23 6DP
Tel: +44 (0)870 383 3344
Fax: +44 (0)1223 598001
www.environ.co.uk

ENVIRON SYSTEM ACOUSTICAL DATA

Noise Measurement Information:

Test: Environ Lite Acoustic Enclosure

Test Standard:

BS EN ISO 140 3 Acoustics Measurement of Sound Insulation in Buildings and of Building Elements Part 1: Airborne Sound Insulation

Sound Level Measuring Equipment:

Norsonic 830 RTA Precision Sound Analyser Type 1
CEL 284/2 Acoustic Calibrator Type 1
JBL Loudspeaker driven by CEL Loudspeaker driven by 830 White Noise Source

Transmission Loss Data:

Transmission Loss — Environ ELV1.1.25AC Acoustic Enclosure							
Octave Frequency in Hertz (dB ref 2 x 10^{-5} Pascal's)							
63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
11	13	19	28	34	36	36	37
Summary Transmission Loss Equates to an Overall Reduction of 22 dB(A)							

Support Information:

Monitoring was carried out using the BS3740 technique, insofar as measurements were taken in each quadrant and the results averaged. Internal Test Room: W 6m x D 16m x H 5m. Background noise in the semi-reverberant test room was such as not to interfere with the practical measurements

IMPORTANT NOTE: acoustic performance based on accuracy of equipment noise & ventilation data

Environ acoustic enclosure designs are protected under patent

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