parkerjones acoustics

Penallta Road

Ystrad Mynach

Noise Impact Assessment

22nd April 2025

First Issue

Penallta Road

Ystrad Mynach

Noise Impact Assessment

Revision History

Version	Comments	Author	Checked By	Date
First Issue	First issued version of the report	**Patrick Shuttleworth** Acoustic Consultant BSc (Hons) MIOA	**Chris Parker-Jones** Director and Acoustic Consultant BSc (Hons) MSc MIOA	22nd April 2025

ParkerJones Acoustics Limited

Bristol
11 Bankside Road
Brislington
Bristol
BS4 4LB

London
29 Lincoln's Inn Fields
Holborn
London
WC2A 3EE

Glasgow
126 West Regent Street
Glasgow
G2 2RQ

+44 (0)800 830 3338
+44 (0)117 914 6558
info@parkerjonesacoustics.com
www.parkerjonesacoustics.com

Registered in England and Wales
Company No. 12235614

Executive Summary and Conclusions

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment for a proposed mixed-use development at Penallta Road, Ystrad Mynach (easting: 313987, northing: 195625). The scheme comprises 34 affordable residential flats arranged across three apartment blocks, alongside a detached retail unit, with associated access from Winding Wheel Lane, car parking, and green infrastructure.

In summary, PJA considers that noise impacts on future residents of the development, as well as noise emissions from the proposed retail use, can be appropriately controlled through the implementation of the recommendations set out within this report.

Noise Impact on the Proposed Development

Based on a noise survey conducted at the site, and subsequent noise map modelling, a TAN 11 initial assessment of the site (Section 5.2) indicates that the site is within NEC B. This means that noise should be taken into account.

As per Section 5.3.3, internal ambient noise level (IANL) targets can be met with closed windows and the provision of standard glazing and trickle vents. Glazing and ventilators (unless mechanically ventilated) must meet the minimum sound reduction indices in Table 5.3 of Section 5.3.3, cross referencing against the 'exposure levels' in Figure 5.1.

Trickle ventilators (or mechanical ventilation) can be used to provide background ventilation as an alternative to open windows. This does not mean windows are not openable – most people will wish to open windows during the hotter months despite slightly elevated noise levels internally, and external noise levels are not excessively high to mean that opening the windows would be unacceptable.

As per Section 5.4, noise levels in external amenity areas are seen to be comfortably within the required limits.

Noise Impact on the Surrounding Area

Section 6.0 addresses the potential noise impact from the proposed retail unit on both the existing and proposed residential receptors.

The predicted rating level at the most affected existing receptor (dwellings to the east) is 8 dB below the background noise level, during the operational period. This therefore indicates a negligible noise impact.

It is important to note that the context is different for the proposed new dwellings, as they will not experience the introduction of a new noise source, but rather will be introduced at the same time as the proposed retail unit. Any associated activities will therefore form part of the noise climate for the new dwellings. The calculated rating level exceeds the existing background noise level by only 7 dB for the new receptors. This is seen to be of negligible significance considering that the specific noise level is only 2 dB above background, and the 5 dB correction applied is a worst case.

It is also important to note that the specific noise levels for vehicle movements are low at 44 dB. This is significantly below the level at which external façade noise levels will cause disturbance to occupants of a building. Assuming a typical reduction of 15 dB across an open window, the predicted specific noise level would equate to 29 dB $L_{Aeq\ 1\ HR}$ *within* the affected dwellings. This is comfortably below the recommended upper daytime limit of 35 dB specified within BS 8233. The external level is also comfortably within the WHO recommended limit of 50 dB for external amenity areas. As such, the predicted noise impact is seen to be negligible for the new dwellings.

At the time of writing, no mechanical plant has been shown on drawings. However, it is assumed likely that there will be some sort of plant given the size of the development. As the mechanical plant has not been designed yet, the assessment at this stage is based upon setting a rating level $L_{Ar,Tr}$ for noise emissions from plant based upon the existing background noise level, $L_{A90,Tr}$.

The operational hours of the proposed plant are currently unknown, therefore, plant limits for day and nighttime have been set. These are provided in Table 6.4. It is the responsibility of the developer and design team involved with the mechanical plant design to ensure that the proposed rating levels are not exceeded.

Contents

1.0 Introduction

ParkerJones Acoustics Limited (PJA) has been instructed to undertake a Noise Impact Assessment in support of a proposed mixed-use development at land located at Winding Wheel Lane, Penallta (easting: 313987, northing: 195625), comprising 34 affordable dwellings, a retail unit, and associated green infrastructure, access, parking, and supporting works.

This report has been prepared to:

- Assess the level of environmental noise ingress affecting the proposed dwellings and provide guidance on the necessary specification of the building envelope (e.g. glazing and ventilation) to ensure acceptable internal noise levels for future occupants, as well as appropriate noise levels in any external amenity areas;
- Assess the potential for noise generated by the proposed retail unit, including any fixed mechanical plant and servicing activity, to impact nearby noise-sensitive receptors, including both proposed and existing residential properties.

The objective is to ensure that noise impacts are fully considered and appropriately controlled. Where necessary, mitigation measures have been recommended to minimise identified impacts and support compliance with relevant guidance and planning policy.

The assessment has been undertaken with reference to:

- 'Technical Advice Notes (Wales) 11, Noise – October 1997';
- the Professional Practice Guidance on Planning and Noise (ProPG) (2017);
- BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*; and
- The World Health Organisation (WHO) '*Guidelines for Community Noise*' (1999) and '*Night Noise Guidelines for Europe* (2009) documents; 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).

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.

2.0 Site and Development Description

The proposed development is located at land off Winding Wheel Lane, Penallta (Grid Reference: easting 313987, northing 195625). The site comprises previously developed (brownfield) land, currently open and overgrown with grass, shrubbery, and young trees.

It occupies a visually prominent corner plot at the entrance to both the Cwm Calon housing estate and the Penallta Colliery complex to the north. The site is bounded by:

- Winding Wheel Lane to the north, providing access to small businesses and the Penallta Colliery
- Penallta Road to the south, with open land beyond
- Cwm Calon Road and residential development to the east
- Open land to the west, on the opposite side of Penallta Road

The proposed development includes:

- 34 affordable dwellings across three blocks:
    - Block A (northwest): 10 flats
    - Block B (northeast): 12 flats
    - Block C (southeast): 9 flats and 2 walk-up units
- A detached retail unit located in the southeast corner of the site
- Car parking for the residential blocks and retail unit
- A new vehicular access from Winding Wheel Lane
- Associated green infrastructure, retaining walls, and supporting works

The proposed development layout is shown in Appendix B.

The locations of the unattended noise monitoring positions (P1 and P2) are shown in Figure 2.1 and described further in Section 4.0.

Figure 2.1 – Aerial view of the site and noise monitoring positions, Location plan (bottom left)

3.0 Relevant Guidelines

3.1 Technical Advice Note 11 (TAN 11)

'Technical Advice Notes (Wales) 11, Noise – October 1997' gives guidance on the control of noise to sensitive developments which may be affected by noise and vice versa.

This subsequently states that '*Noise Exposure Categories (NECs) have been derived to assist local planning authorities in their consideration of planning applications for residential development near transport related noise sources.*' '*When assessing a proposal for residential development near a source of noise, local planning authorities should determine into which of the four noise exposure categories (NECs) the proposed site falls, taking account of both day and nighttime noise levels. Local planning authorities should then have regard to the advice in the appropriate NEC.*'

The NEC (Noise Exposure Categories) are summarised within Table 3.1 and Table 3.2, indicating levels for road traffic, as this is considered to be the dominant source in this case.

Table 3.1 – TAN 11 noise exposure categories

NEC	Action
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Table 3.2 - Noise exposure categories for new dwellings near existing noise sources

Noise Levels corresponding to the Noise Exposure Categories for New Dwellings $L_{Aeq,T}$ dB				
Period	Noise Exposure Category (NEC)			
	A	B	C	D
Daytime (07:00 – 23:00)	<55	55-63	63-72	>72
Nighttime (23:00 – 07:00)	<45	45-57	57-66	>66

3.2 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.

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 $L_{Aeq.}$

3.3 BS 8233:2014

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.

This includes internal and external noise criteria for residential developments. The limits with BS 8233:2014 are similar to those in the WHO's *'Guidelines for Community Noise' (1999)* and '*Night Noise Guidelines for Europe' (2009)* documents.

The more recently published ProPG document combines the recommendations of these two guidelines, as discussed in the following section.

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*".

3.4 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.

3.4.1 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 effects against indicative daytime noise levels ($L_{Aeq,16hr}$) and nighttime noise levels ($L_{Aeq,8hr}$) without noise mitigation. This is recreated in Table 3.3.

Table 3.3 – The ProPG initial site noise risk assessment guidelines

Indicative external daytime noise levels $L_{Aeq,16hr}$	Indicative external nighttime 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.

3.4.2 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 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 3.4 – The ProPG internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Nighttime (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."

3.5 BS 4142:2014+A1:2019

BS 4142:2014+A1:2019 *'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.

3.5.1 Definitions

BS 4142:2014+A1:2019 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.

3.5.2 Specific Sound Source

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'.

3.5.3 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).

3.5.4 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.

3.5.5 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.

3.5.6 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."*

4.0 Noise Survey

4.1 Methodology

PJA has attended the site and surrounding area to conduct an environmental noise survey between Thursday the 3rd and Wednesday the 9th of April 2025. 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.

Two 'long term' measurement positions (P1, P2) were installed at the locations denoted in Figure 2.1. The microphones were erected to heights of around 2m.

The sound level meters were 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 the setup and collection of the equipment. The following noise indices were recorded (amongst others):

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 photographs taken from site; the equipment used; and the weather conditions.

4.2 Results

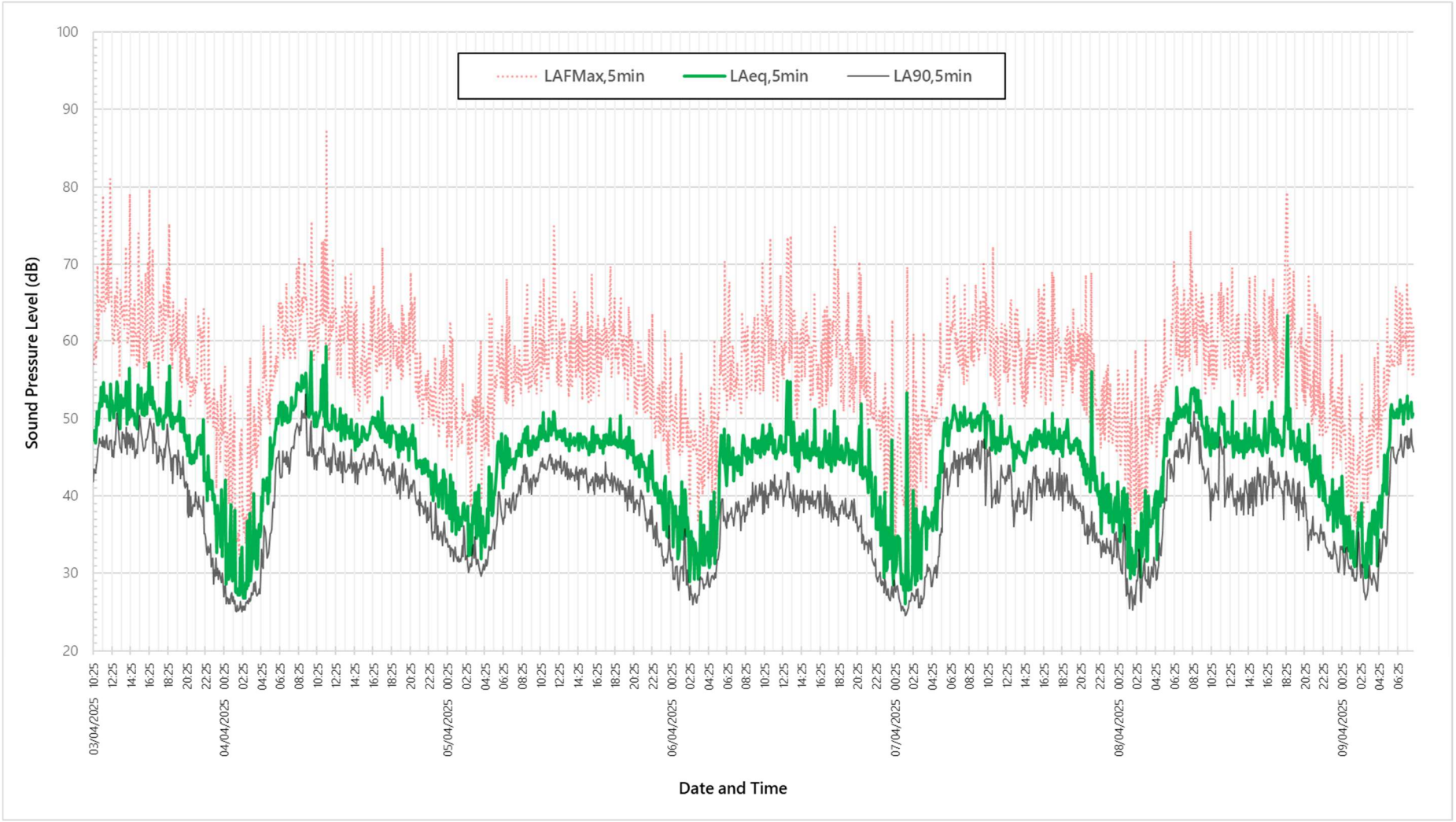
4.2.1 Position P1

A graph of the measured noise levels across the entire monitoring period at P1 is given in Figure 4.1 overleaf, with a summary provided in Table 4.1. As seen in Figure 4.1 the noise climate at P1 is seen to be dominated by road traffic, with a typical diurnal fluctuation.

Table 4.1 – Summary of measured noise levels – Position P1

Period	Logarithmic Average $L_{Aeq,T}$ (dB)	10th Highest $L_{AFmax,5min}$ (dB)	Minimum $L_{A90,5min}$ (dB)	Median $L_{A10,5min}$ (dB)
Daytime (07:00 – 23:00) **T = 16-hours**				
Thursday 3rd April; 10:25 - 23:00	51	72	32	53
Friday 4th April; 07:00 - 23:00	50	70	34	51
Saturday 5th April; 07:00 - 23:00	47	66	34	49
Sunday 6th April; 07:00 - 23:00	46	69	29	48
Monday 7th April; 07:00 - 23:00	48	67	32	50
Tuesday 8th April; 07:00 - 23:00	49	69	33	50
Nighttime (23:00 – 07:00) **T = 8-hours**				
Thursday 3rd April / Friday 4th April; 23:00 - 07:00	43	58	25	39
Friday 4th April / Saturday 5th April; 23:00 - 07:00	41	60	30	42
Saturday 5th April / Sunday 6th April; 23:00 - 07:00	40	58	26	40
Sunday 6th April / Monday 7th April; 23:00 - 07:00	43	62	25	38
Monday 7th April / Tuesday 8th April; 23:00 - 07:00	44	60	25	41
Tuesday 8th April / Wednesday 9th April; 23:00 - 07:00	44	60	27	40

Figure 4.1 – Graph of measured noise levels – Position P1



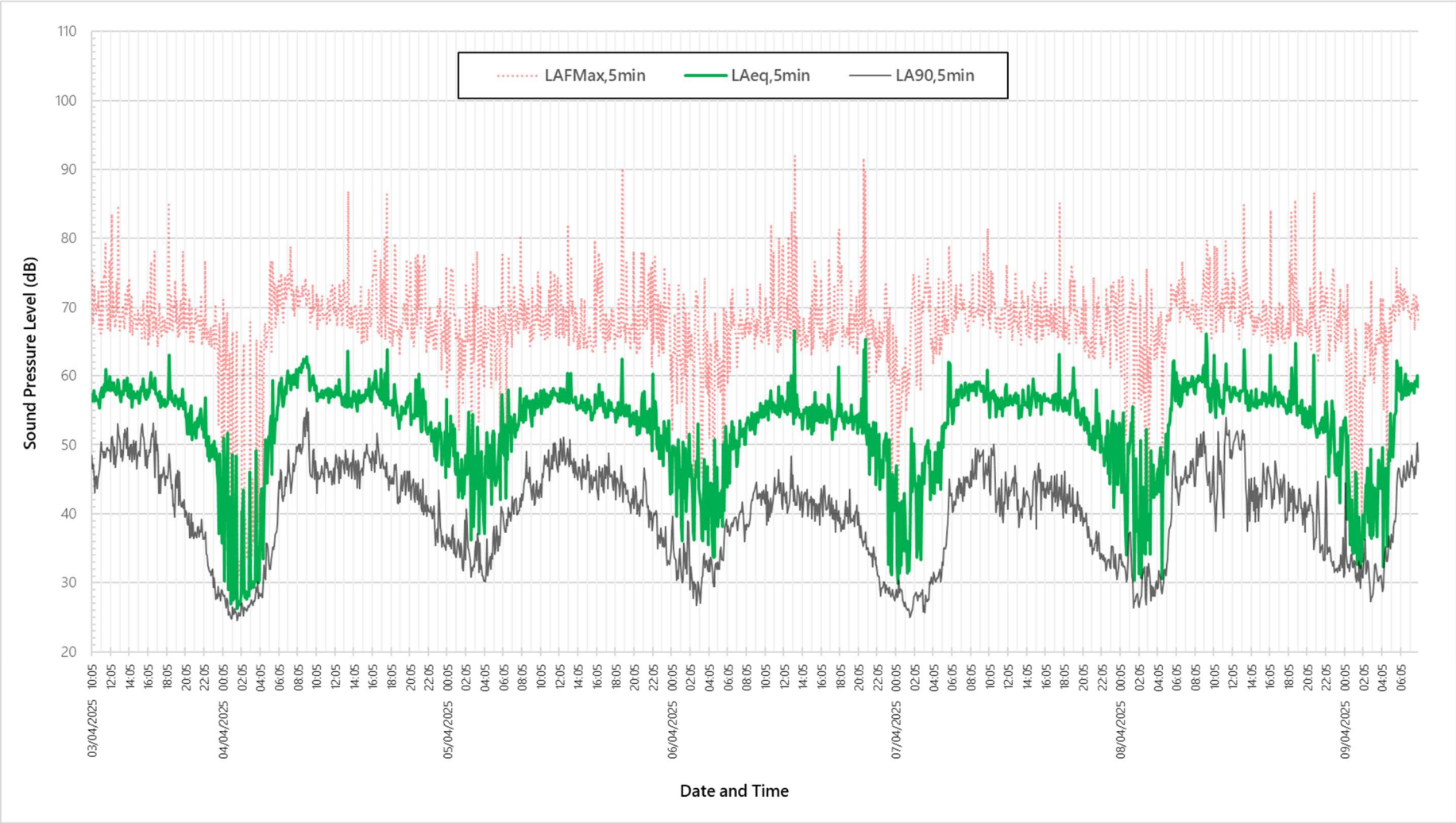
4.2.2 Position P2

A graph of the measured noise levels across the entire monitoring period at P2 is given in Figure 4.2 overleaf, with a summary provided in Table 4.2. As at P1, noise levels at P2 are mostly affected by road traffic.

Table 4.2 – Summary of measured noise levels – Position P2

Period	Logarithmic Average $L_{Aeq,T}$ (dB)	10th Highest $L_{AFmax,5min}$ (dB)	Minimum $L_{A90,5min}$ (dB)	Median $L_{A10,5min}$ (dB)
Daytime (07:00 – 23:00) **T = 16-hours**				
Thursday 3rd April; 10:05 - 23:00	57	75	31	61
Friday 4th April; 07:00 - 23:00	58	77	35	61
Saturday 5th April; 07:00 - 23:00	56	77	35	59
Sunday 6th April; 07:00 - 23:00	55	80	28	58
Monday 7th April; 07:00 - 23:00	56	75	32	61
Tuesday 8th April; 07:00 - 23:00	58	79	32	61
Nighttime (23:00 – 07:00) **T = 8-hours**				
Thursday 3rd April / Friday 4th April; 23:00 - 07:00	51	73	25	40
Friday 4th April / Saturday 5th April; 23:00 - 07:00	50	72	30	49
Saturday 5th April / Sunday 6th April; 23:00 - 07:00	48	71	27	46
Sunday 6th April / Monday 7th April; 23:00 - 07:00	52	74	25	39
Monday 7th April / Tuesday 8th April; 23:00 - 07:00	53	74	26	45
Tuesday 8th April / Wednesday 9th April; 23:00 - 07:00	53	72	27	42

Figure 4.2 – Graph of measured noise levels – Position P2



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, as well as the enjoyment of external amenity areas.

The following summarises the main steps of action in the assessment method:

- Firstly, the existing ambient noise environment at the site is assessed with the support of an environmental noise survey;
- A 3D noise map model is constructed of the existing site and 'calibrated' to closely match the results of the noise survey.
- The model is updated to include the proposed development and therefore accurately predict external noise levels outside of all facades and in external amenity areas;
- An initial site risk assessment is conducted in accordance with TAN 11 and the ProPG;
- Noise ingress into living spaces is then assessed against the IANL limits of the ProPG (and local planning policy), to determine the sound reduction requirements of the building envelope and determine whether background ventilation can be provided by open windows, trickle ventilators, or mechanical ventilation (to meet IANL limits);
- Finally, noise levels in external amenity areas are assessed in line with the WHO criteria.

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, at each façade and on each floor of the building(s) associated with the proposed development. This is considered more accurate than simply applying the results from the monitoring position 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, by placing receptor points at the survey monitoring positions 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 nighttime $L_{AFmax,5min}$ values which are exceeded 10 times per night.

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

The model has then been run to predict the façade exposure levels 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 10th highest $L_{AFmax,5min}$ for the nighttime periods respectively.

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

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 $L_{Aeq,16hr}$ – for the existing site, at a height of 2m (the approximate measurement height).
- Figure D.3 – shows the nighttime ambient noise level $L_{Aeq,8hr}$ – for the existing site, at a height of 2m.
- Figure D.4 – shows the 10th highest maximum noise level $L_{AFmax,5min}$ – for the existing site, at a height of 2m.

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 the predicted façade exposure levels during the daytime - $L_{Aeq,16hr}$.
- Figure D.7 - shows the predicted façade exposure levels during the nighttime - $L_{Aeq,8hr}$.
- Figure D.8 – shows the predicted façade exposure levels during the nighttime - $L_{AFmax,5min}$ (10th highest).
- Figure D.9 – shows the predicted noise levels within external amenity areas - $L_{Aeq,16hr}$.

5.2 Stage 1: Initial Site Noise Risk Assessment

TAN 11 requires that the Noise Exposure Category (NEC) of the site is derived, prior to any subsequent assessments. An overview of the NEC thresholds and associated advice is provided in Section 3.1. The site has been split into 2 Noise Exposure Categories, as defined in Section 5.3.3. The results of the assessment indicate that the development will be within:

- Daytime – NEC B in Exposure 1 and NEC B in Exposure 2,
- Nighttime – NEC B in Exposure 1 and NEC B in Exposure 2.

The site is therefore seen to be within NEC B. This means that noise should be taken in to account. TAN 11 suggests that "conditions should be imposed to ensure a commensurate level of protection against noise". Section 5.3.3 looks at mitigation via the building envelope to reduce external noise ingress to an acceptable level.

As described in Section 3.4, the ProPG also 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 predicted daytime $L_{Aeq,16hr}$ and nighttime $L_{Aeq,8hr}$ levels, it is seen that the 'potential risk of adverse effect without noise mitigation' when comparing the levels to those in Table 3.3 are:

- Daytime – Low in Exposure 1 and Low in Exposure 2,
- Nighttime – Medium in Exposure 1 and Low in Exposure 2.

5.3 Stage 2: Internal Ambient Noise Levels

5.3.1 Element 1 – Good Acoustic Design Process

A 'good' acoustic design process should first explore other methods of mitigating noise which doesn't wholly rely on using the building envelope. Table 5.1 analyses the feasibility of the suggested mitigation measures for this site.

Table 5.1 – Analysis of noise mitigation measures as part of a 'good' acoustic design process

Mitigation Method	Analysis
Maximising the spatial separation of noise source(s) and receptor(s).	In this case it is seen that maximum spatial separation has been achieved between the proposed dwellings and the surrounding roads.
Investigating the necessity and feasibility of reducing existing noise levels and relocating existing sources.	Reducing traffic or relocating road noise sources is not possible.
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 no existing structures between the dwellings and the surrounding roads.
Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.	An un-feasibly tall barrier would be required in order to create screening to upper floor levels and therefore this is not seen to be a feasible strategy.
Using the layout of the scheme to reduce noise propagation across the site.	In this case, roads are located on both sides of the development site and as such, the layout of the scheme does not significantly alter noise exposure.
Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.	It is seen to be necessary to locate noise sensitive rooms (i.e living rooms and bedrooms) on all facades.
Using the building envelope to mitigate noise to acceptable levels.	See Section 5.3.3.

5.3.2 Element 2 – Internal Noise Level Guidelines

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 the table below.

Table 5.2 – Internal ambient noise level (IANL) upper limits

Activity	Location	Daytime (07:00 – 23:00)	Nighttime (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			

5.3.3 Building Envelope

To assess the required sound reduction performance for the building envelope, façade exposure levels have been defined as shown in Figure 5.1.

Figure 5.1 – Façade exposure levels

The weakest elements of a façade in terms of sound reduction are the windows/glazing. This is particularly true when windows are open (as an open window will typically provide around a 15 dB reduction). 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 with natural ventilation in areas where the targets would be exceeded when opening the windows.

It is seen that IANLs will be met with open windows in some, but not all areas of the site. It is not uncommon for external noise levels to mean that internal targets are exceeded with open windows. It should also not be assumed that windows in these areas need to be sealed shut, as many occupants will favour the ability to open their windows at will, particularly during the hotter months of the year, and external noise levels are seen to be sufficiently low as to allow for this.

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 for the most exposed facades, 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.

Table 5.3 provides the minimum sound reduction indices for glazing [1] 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.

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.

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

Table 5.3 – Minimum sound reduction requirements of the building envelope

Exposure Category	External Noise Level outside of a window			Minimum sound reduction indices/construction examples	
	Daytime average (07:00 – 23:00) dB $L_{Aeq,16hr}$	Nighttime average (23:00 – 07:00) dB $L_{Aeq,8hr}$	Nighttime maximum [1] (23:00 – 07:00) dB L_{AFmax}	Glazing [2] See Appendix E.1	Ventilators [3] see Appendix E.2
Exposure 1	≤60	≤55	≤76	31 dB $R_w + C_{tr}$ i.e; Double glazing, Saint Gobain 4 (10) 10	34 dB $D_{n,e,w} + C_{tr}$ i.e; Acoustic trickle vent, Duco GlasMax – Air Slot 10mm
Exposure 2	≤57	≤52	≤72	27 dB $R_w + C_{tr}$ Standard double glazing, i.e. - 4mm standard float - 12mm air cavity - 4mm standard float	30 dB $D_{n,e,w} + C_{tr}$ i.e., Duco DucoTop 60 SR (over window frame) – Alto AK
Exposure 3	≤55	≤48	≤66	21 dB $R_w + C_{tr}$ i.e., Any Double Glazing	24 dB $D_{n,e,w} + C_{tr}$ i.e; Any Ventilator
Criteria [4]	<35	<30	<45	-	-

1. Estimated 10th highest value per night.
2. A non-exhaustive list of suitable glazing products is given in **Appendix E.1**.
3. A non-exhaustive list of suitable ventilator products is given in **Appendix E.2**. The acoustic performance should meet these values when the vent is open. They may not be required if the development uses mechanical ventilation.
4. Based on the criteria for bedrooms (the most noise-sensitive room type).

5.4 Outdoor Amenity Noise Levels

The WHO Guidelines imply that noise levels in outdoor amenity spaces should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$ for the spaces to be enjoyed as intended.

Figure D.9 in Appendix D shows the predicted external daytime ambient noise level ($L_{Aeq,16hr}$) across the site. It is seen that the required limits are comfortably met in all areas of the site.

5.5 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.

Based on a noise survey conducted at the site, and subsequent noise map modelling, a TAN 11 initial assessment of the site (Section 5.2) indicates that the site is within NEC B. This means that noise should be taken in to account.

As per Section 5.3.3, internal ambient noise level (IANL) targets can be met with closed windows and the provision of standard glazing and trickle vents. Glazing and ventilators (unless mechanically ventilated) must meet the minimum sound reduction indices in Table 5.3 of Section 5.3.3, cross referencing against the 'exposure levels' in Figure 5.1.

Trickle ventilators (or mechanical ventilation) can be used to provide background ventilation as an alternative to open windows. This does not mean windows are not openable – most people will wish to open windows during the hotter months despite slightly elevated noise levels internally, and external noise levels are not excessively high to mean that opening the windows would be unacceptable.

As per Section 5.4, noise levels in external amenity areas are seen to be comfortably within the required limits.

6.0 Noise Impact on the Surrounding Area

This section addresses the potential noise impact from the proposed retail unit on both the existing and proposed residential receptors. The following summarises the main steps of action in the assessment method:

- a representative background sound level $L_{A90,Tr}$ is determined based upon the results of the environmental noise survey for the daytime – during which the operational hours of the development are likely to occur within.
- the specific sound level L_s from operations at the development at 1m outside nearby existing residential windows are predicted by noise map calculations;
- the rating level $L_{Ar,Tr}$ is determined by the application of any 'penalties' which adjust for characteristic features of the sound which may be perceptible and potentially cause annoyance;
- the predicted rating level $L_{Ar,Tr}$ is compared to the background sound level $L_{A90,Tr}$ to determine the likely level of impact in accordance with BS 4142:2014+A1:2019;
- the predicted specific noise levels are also compared against the guidelines of the WHO and BS 8233:2014 to provide further 'context' to the results (as referenced by BS 4142);
- if necessary, mitigation measures are recommended to reduce the noise emissions from the development.

6.1 Operational Noise

6.1.1 Background Sound Level

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

It is anticipated that the proposed retail unit will be operational from 09:00 – 18:00. Examination of the measurement graph at P1 indicates that background noise levels during this period typically range from around 42 – 53 dB L_{A90} (with the exception of Sunday which exhibits marginally lower levels, although it is seen that deliveries will not take place on Sundays). The assessment will therefore be based on the lower level of 42 dB.

Table 6.1 – Derived representative background sound level $L_{A90,T}$ at the nearest residential property

Noise-Sensitive Receptor (NSR)	Period	Representative Background Sound Level $L_{A90,15mins}$ (dB)
1m outside of all residential windows	Potential operational hours 09:00 – 18:00	42

6.1.2 Noise Sources

It is not anticipated that the proposed retail unit will incorporate significant internal noise sources. As such, any potential noise impact from the retail unit is seen to be associated with vehicle movements. External noise is likely to be most significantly generated by:

- Goods vehicles such as large vans and small lorries (3 – 6t) in and out of site for supplies and deliveries.
- Electric forklift trucks and electric side lifters that transport materials to the building.
- Customer/staff vehicles.

The source noise data in Table 6.2 has been used with the noise calculations/modelling. This has been drawn from measurements that PJA has taken from similar sites. The number of movements is estimated at this stage, based on a worst-case 1-hour period, and is likely to represent an overestimation.

Table 6.2 – Source noise levels and operational times of external noise sources

Description	Sound Power Level L_{WA} (dB)	Number of Vehicles	Movements per vehicle over a worst-case 1-hour reference daytime period	Data Source
Goods vehicles (3 – 6t)	96	1	2 movements at 15 km/h	PJA Measurements
Electric Forklift	87	1	15 movements at 15 km/h	BS 5228-1:2009+A1:2014, Annex C, Table D.7 (93) [1]
Cars	85	10	1 movements at 15 km/h	PJA Measurements

Noise emissions from the development have been represented by a series of 'moving point sources' following a defined line of travel – based on the parameters in Table 6.2.

6.1.3 Noise Impact on Existing Residential

Figure D.10 in Appendix D shows the predicted *specific noise level* $L_{Aeq,1hr}$ during a worst-case 1-hour daytime period, accounting for all of the noise sources outlined in the previous section – predicting the specific noise level outside all facades of the nearby existing residential properties. Table 6.3 summarises the result by showing the highest *specific noise level* at the worst affected existing residential façades.

A rating level penalty should be applied when assessing in accordance with BS 4142:2014:

- The noise could be classed as intermittent given the nature of noise from moving vehicles; therefore a 3 dB penalty has been applied;
- The noise *may* have a tonal quality associated with reversing sirens [2] that is perceptible at the receptors, resulting in a 2 dB penalty.

Table 6.3 shows the worst-case rating level in comparison to the minimum background sound level during the potential operational hours.

Table 6.3 – BS 4142 assessment result – worst-case 1-hour daytime period

Receptor	Specific Noise Level $L_{Aeq,T}$ (dB)	Rating Level Penalties (dB)	Rating Level $L_{Ar,Tr}$ (dB)	Representative Background Sound Level L_{A90} (dB)	Difference (dB)
Nearest existing dwellings to the east	29	+5	34	42	**- 8**

As can be seen in Table 6.3, the predicted rating level at the most affected existing receptor (dwellings to the east) is 8 dB below the background noise level, during the operational period. This therefore indicates a negligible noise impact.

6.1.4 Noise Impact on New Residential

Figure D.10 in Appendix D also shows the predicted specific noise levels outside of the *new* residential dwellings which would be built as part of the proposals. This indicates a worst-case level of **44 dB** outside of the closest dwelling. Assuming a 5 dB rating level penalty (as above), this equates to a rating level of **49 dB**.

It is important to note that the context is different for the proposed new dwellings, as they will not experience the introduction of a new noise source, but rather will be introduced at the same time as the proposed retail unit. Any associated activities will therefore form part of the noise climate for the new dwellings. The calculated rating level exceeds the existing background noise level by only 7 dB, which is seen to be of negligible significance considering that the specific noise level is only 2 dB above background, and the 5 dB correction is seen to be a worst case.

2 - Mobile plant such as forklifts that operate exclusively on site can be mitigated with the use of broadband alarms, but it may not be possible to implement such alarms on all goods vehicles which aren't exclusive to the site.

It is also important to note that the specific noise levels for vehicle movements are low at 44 dB. This is significantly below the level at which external façade noise levels will cause disturbance to occupants of a building. Assuming a typical reduction of 15 dB across an open window, the predicted specific noise level would equate to 29 dB $L_{Aeq\ 1\ HR}$ *within* the affected dwellings. This is comfortably below the recommended upper daytime limit of 35 dB specified within BS 8233. The external level is also comfortably within the WHO recommended limit of 50 dB for external amenity areas. As such, the predicted noise impact is seen to be negligible for the new dwellings.

6.2 Plant Noise

At the time of writing, no mechanical plant has been shown on drawings. However, it is assumed likely that there will be some sort of plant given the size of the development.

As the mechanical plant has not been designed yet, the assessment at this stage is based upon setting a rating level $L_{Ar,Tr}$ for noise emissions from plant based upon the existing background noise level, $L_{A90,Tr}$. The rating level is the specific noise level L_s plus the addition of any 'penalties' which account for the characteristic features of the sound which may attract attention to it, such as tonality, impulsivity, intermittency, and any other sound characteristics that "are readily distinctive against the residual acoustic environment".

The operational hours of the proposed plant are currently unknown, therefore, plant limits for day and nighttime have been set.

It will then be the responsibility of the developer and design team involved with the mechanical plant design to ensure that the proposed rating levels are not exceeded.

6.2.1 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 6.4.

Table 6.4 – Derived representative background sound level $L_{A90,T}$ at nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Time Period	Representative Background Sound Level $L_{A90,T}$ (dB)
1m outside of all residential windows and 1.5m above ground level in external amenity areas (gardens, patios)	Daytime (07:00 to 23:00)	28
	Nighttime (23:00 – 07:00)	25

6.2.2 Maximum Rating Levels

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

BS 4142:2014 states in general 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. 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."

PJA recognises that a rating level limit is often subject to a planning condition. Typically, this condition is based upon the rating level from plant being below the representative background sound level. Therefore, PJA proposes the rating level limits given in the table below.

Table 6.5 – Maximum rating level $L_{Ar,Tr}$ for all nearby residential NSRs

Noise-Sensitive Receptor (NSR)	Time Period	Maximum Rating Level $L_{Ar,Tr}$ at 1m from the outside of the nearest residential window (dB)
1m outside the façade of all nearby residential properties	Daytime (07:00 to 23:00)	28
	Nighttime (23:00 – 07:00)	25

6.2.3 Site Suitability

At this stage, the plant design has not been fully developed. If any new plant is to be installed, it is anticipated that the rating level limits can be achieved with practical and common solutions.

MVHR systems are likely to require an in-duct silencer (noise attenuator) which is around 600 - 1200mm in length on the atmospheric side. This is not an unusual requirement as such measures are included in the large majority of ventilation systems.

Noise from small extract fans, i.e., toilet extract fans, are likely to be relatively quiet without requiring mitigation.

Small domestic ASHP units (which are less than 1.2m tall) from Mitsubishi, Panasonic, and Daikin typically have a breakout sound pressure level of around 50 – 60 dB @ 1m in front of the fan outlet. Larger units (around 1.6 – 2m tall) can be much louder at around 75 dB @ 1m above the unit (as the fan outlet is usually at the top on larger units). Hence from a noise perspective, it is better to have several small units rather than a single large unit.

These are not considered to be unusual or onerous requirements. PJA recognise that this aspect is likely to be conditioned with the requirement for a further assessment to demonstrate that the noise limits will be achieved once the project reaches the technical design stage.

Appendix A – Acoustic Terminology and Concepts

A.1 – Glossary

Table A.1 – Glossary of acoustic terminology

Term	Description
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.
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) as defined above.
$L_{A90,T}$	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'.
$L_{AFmax,T}$	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.

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 – Development Plans

Figure B.1 – Proposed site plan

Appendix C – Noise Survey Details

C.1 – Survey Equipment

The monitoring equipment used for the survey is detailed in the table below. The sound level meters were calibrated before and after the survey, with no significant drifts of greater than 0.5 dB observed. The sound level meters have been calibrated to a traceable standard within the 24 months preceding the survey, and the calibrator has 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.

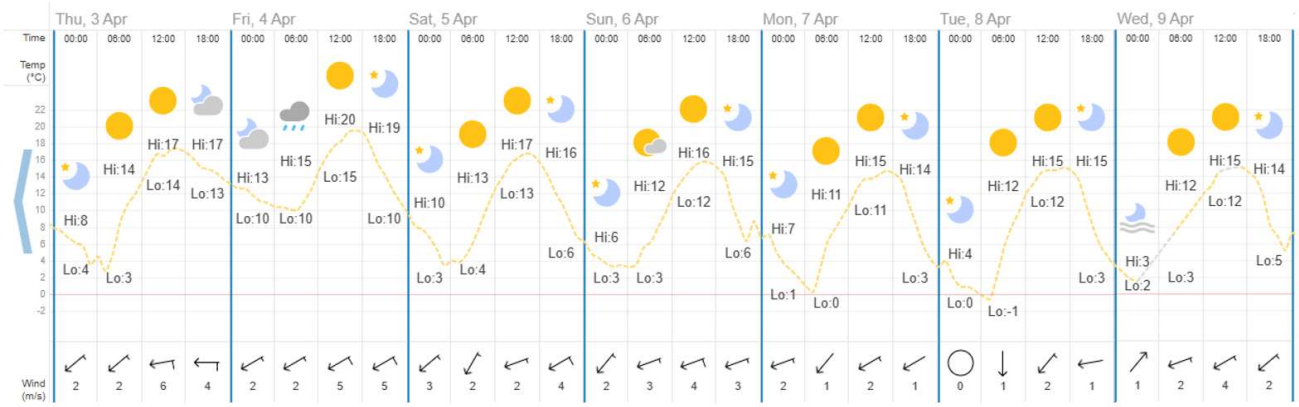
Table C.1 – Equipment used for the noise survey

Name	Serial Number	Last Calibrated	Calibration Due
SVAN 949 Class 1 Sound Level Meter	9720	Dec-23	Dec-25
SV22 Class 1 Microphone	4012386	Dec-23	Dec-25
SVAN 949 Class 1 Sound Level Meter	9719	Dec-23	Dec-25
SV22 Class 1 Microphone	4011862	Dec-23	Dec-25
Cirrus CRL511E Class 1 Acoustic Calibrator	035235	May-24	May-25

C.2 – Meteorological Conditions

During the survey, weather conditions were for the most part, dry (with some periods rain). Wind speeds reached highs of up to 6 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/@13283466/historic.

Figure C.1 – Meteorological conditions during the survey



C.3 – Photographs

Figure C.2 – Photographs of the noise monitoring positions, P1 (top) and P2 (bottom)

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. 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 nighttime (8-hour) L_{Aeq} noise levels across the site, and the typical nighttime L_{Amax} levels.

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 on roads and buildings, 1 on greenfield land, and 0.5 on mixed ground;
- a maximum reflection factor of two where buildings and barriers are assumed to have a 'smooth' reflective façade, as a worst-case;
- that noise sources do not have strong radiation patterns and therefore radiate equally in all directions;
- façade receptor points representing the worst case floor;
- other receptor points representing the survey positions – with daytime levels shown in black and nighttime levels in red.
- atmospheric sound absorption based upon a temperature of 10°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 and the model setup.

D.1 – Existing Site

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

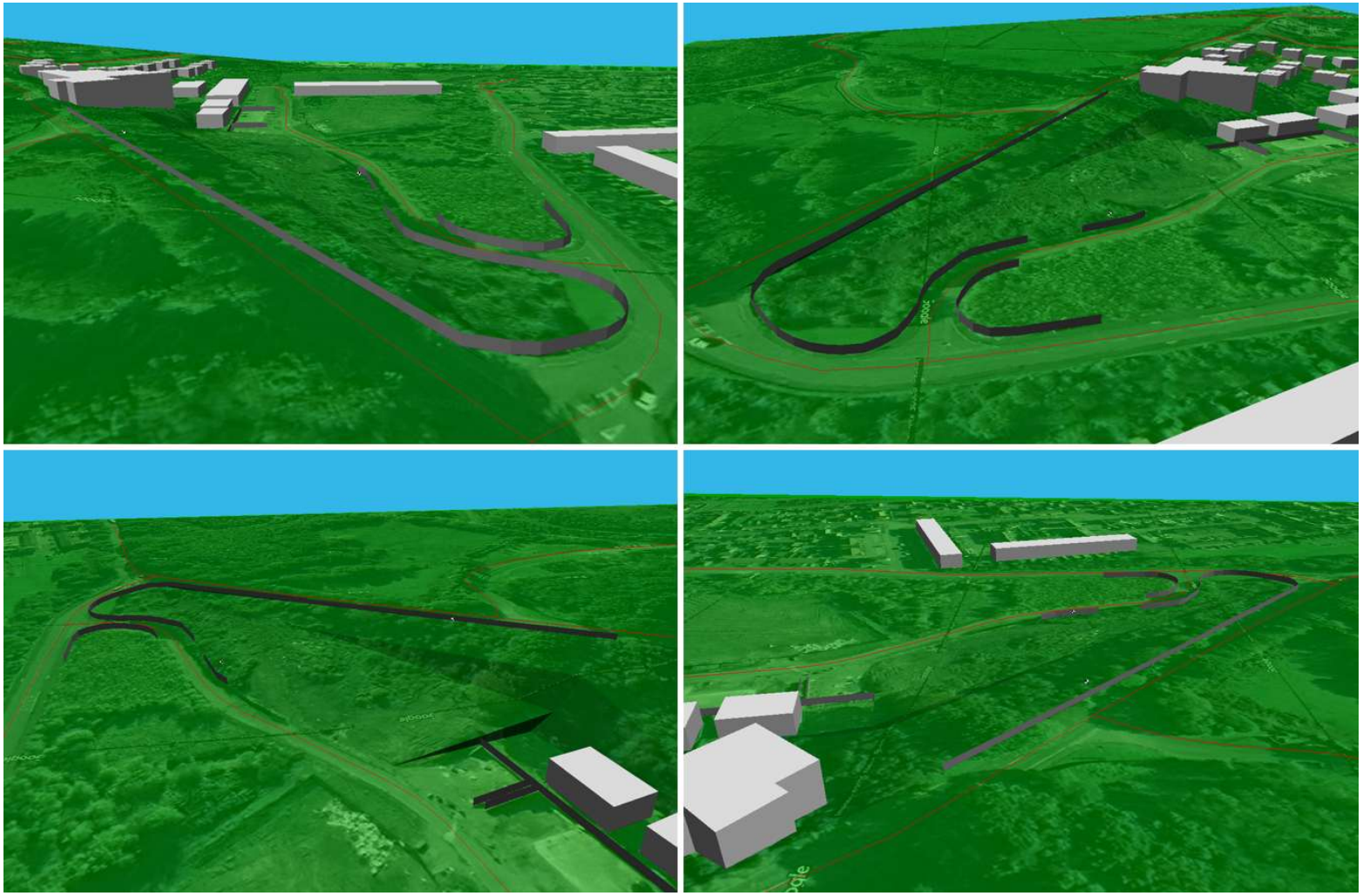
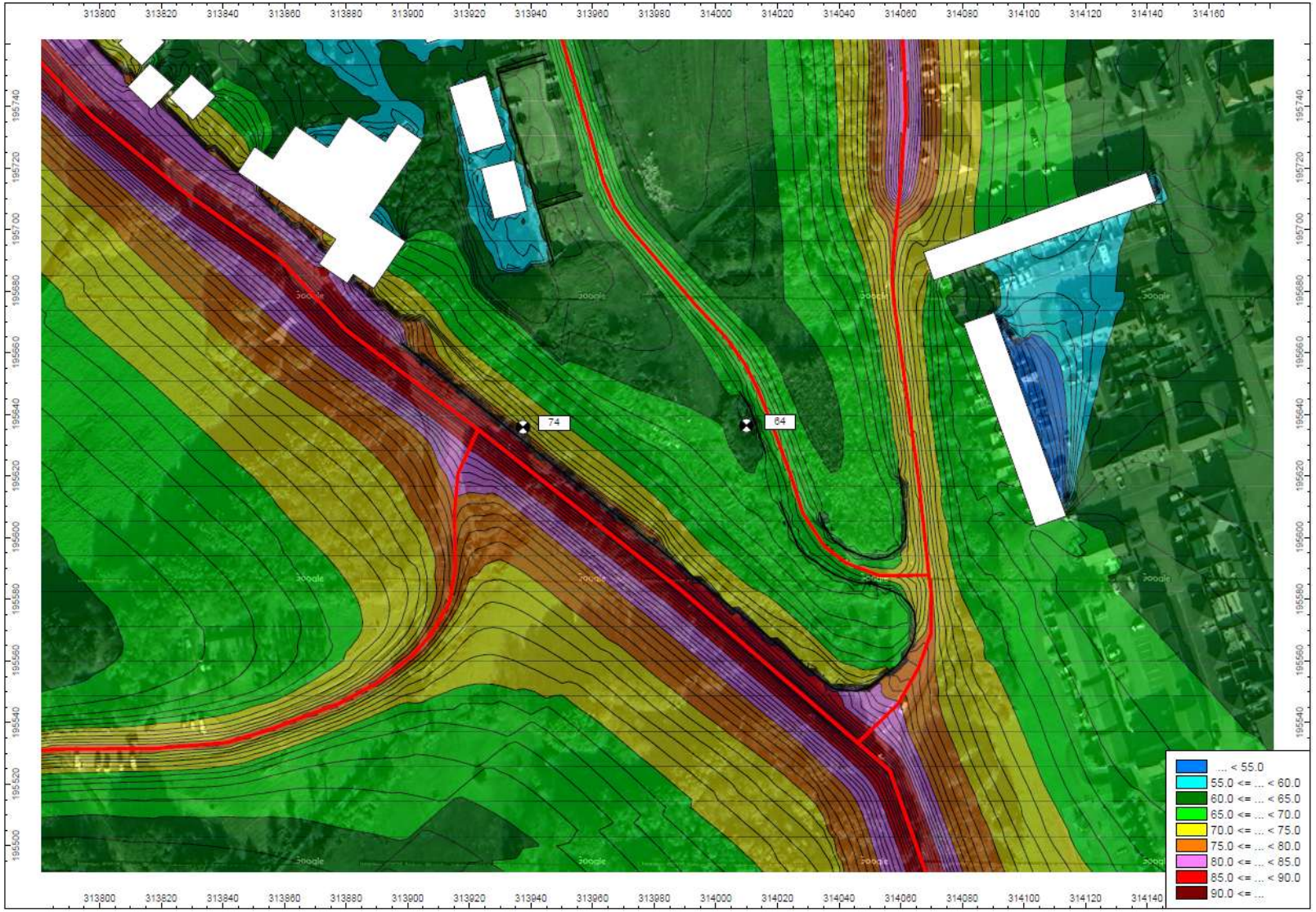


Figure D.2 – Existing site - Predicted dB $L_{Aeq,16hr}$ external ambient noise levels – Daytime (07:00 – 23:00)

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

Figure D.4 – Existing site – Predicted 10th highest dB $L_{AFmax,5min}$ maximum noise levels – Nighttime (23:00 – 07:00)



D.2 – Proposed Development

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

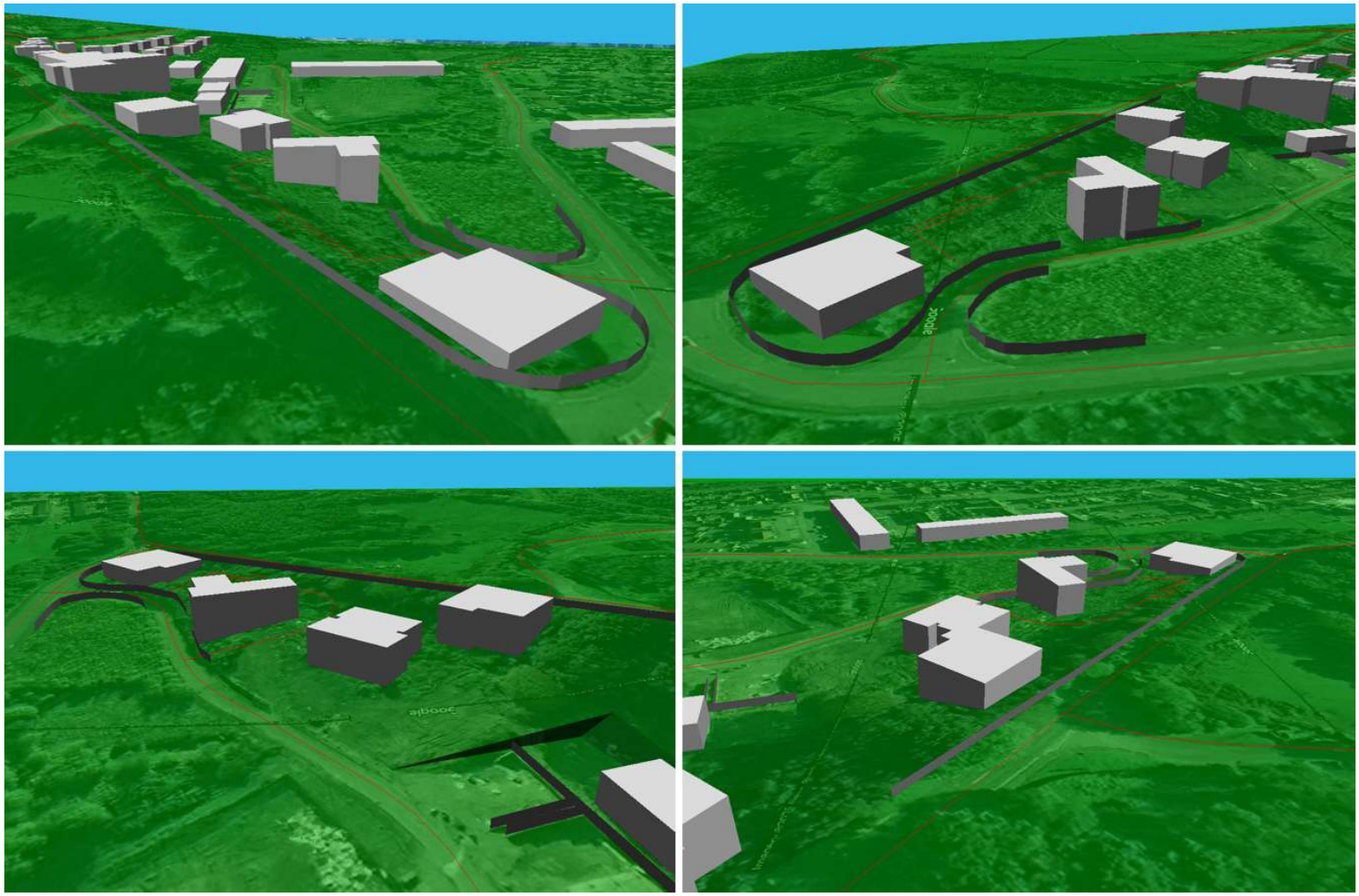


Figure D.6 – Proposed development - Predicted façade dB $L_{Aeq,16hr}$ exposure levels – Daytime (07:00 – 23:00)

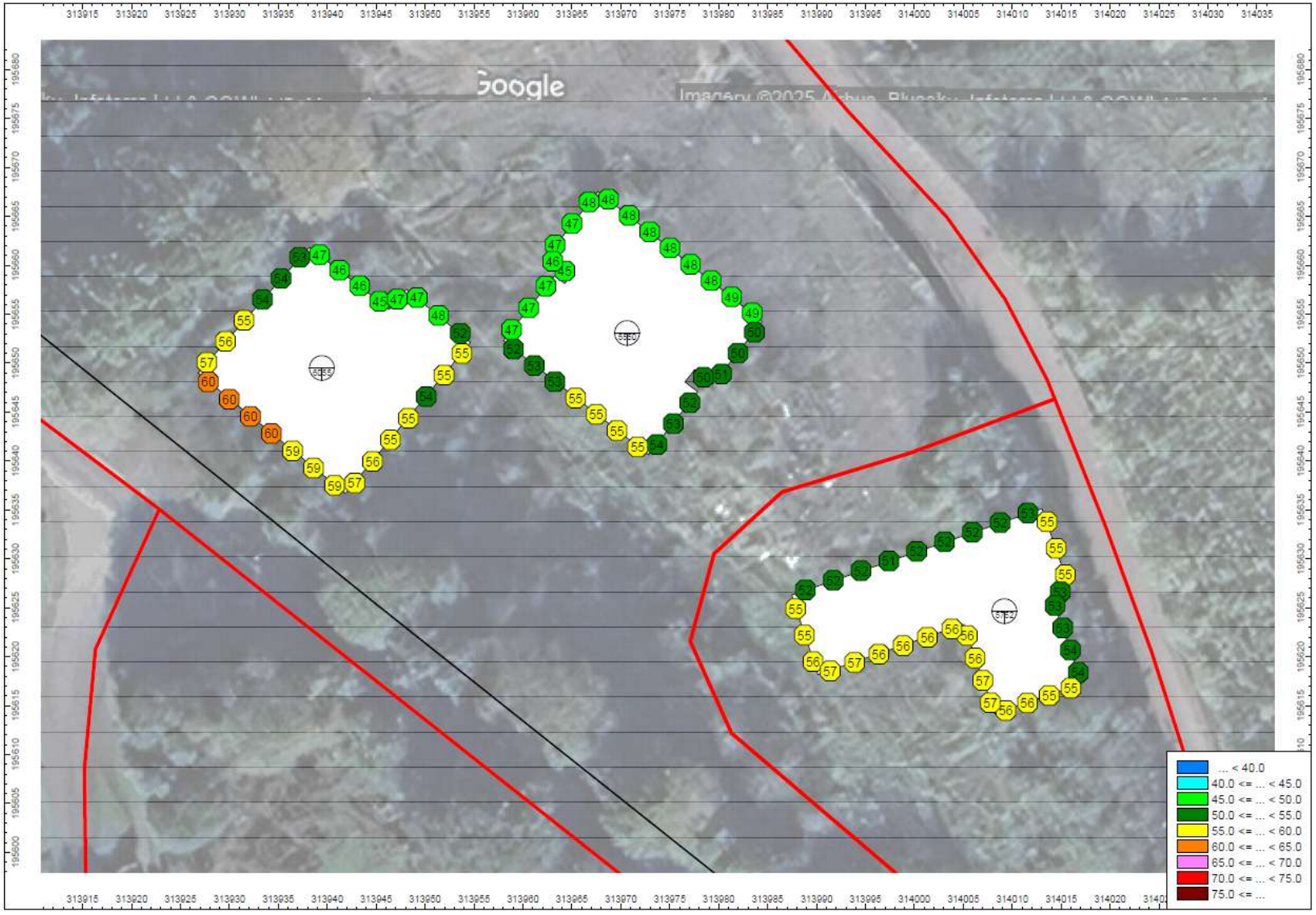


Figure D.7 – Proposed development - Predicted façade dB $L_{Aeq,8hr}$ exposure levels – Nighttime (23:00 – 07:00)

Figure D.8 – Proposed development - Predicted façade 10th highest dB $L_{AFmax,5min}$ exposure levels – Nighttime (23:00 – 07:00)

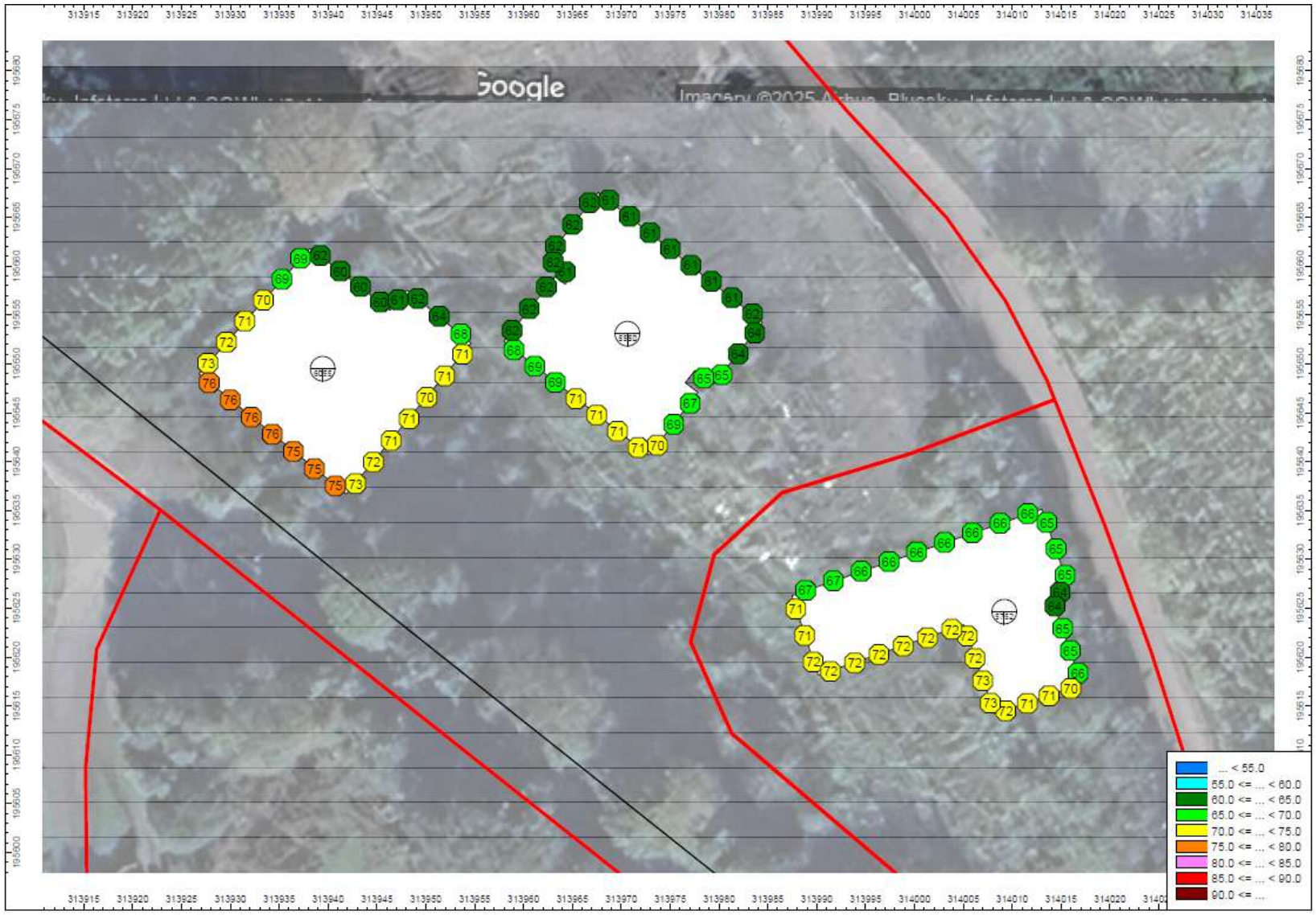


Figure D.9 – Proposed development - Predicted dB $L_{Aeq,16hr}$ external amenity noise levels – Daytime (07:00 – 23:00)

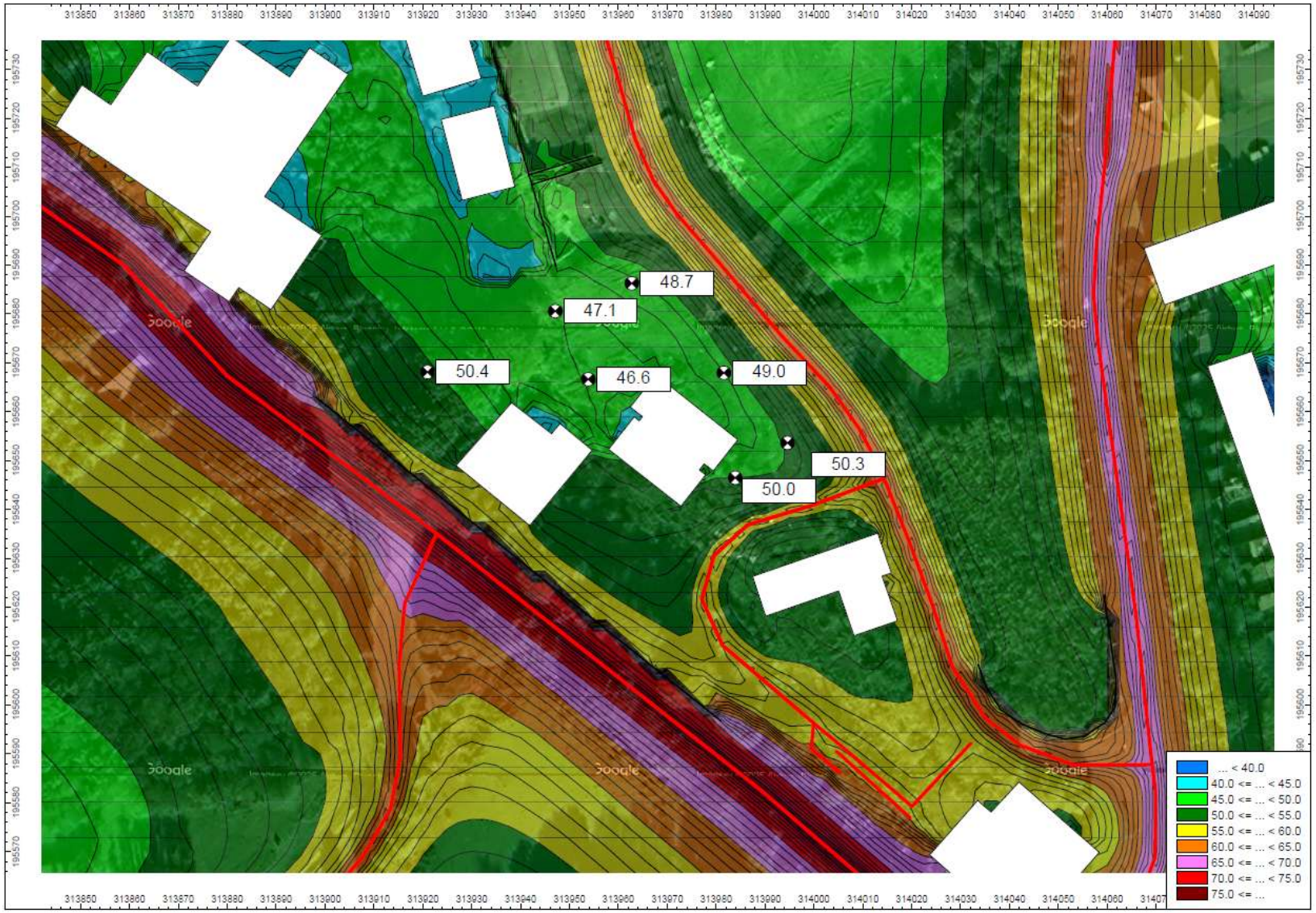
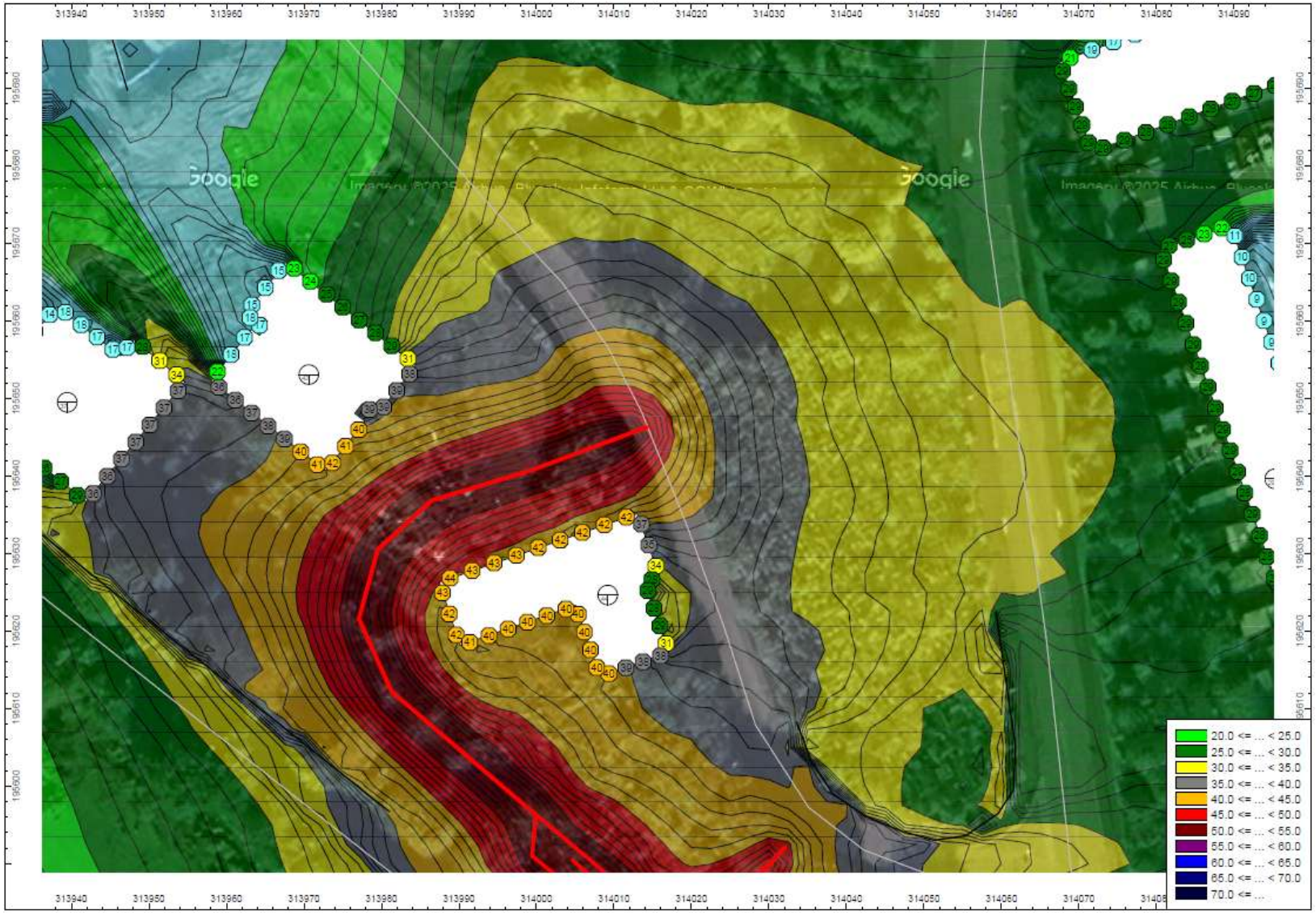


Figure D.10 – Specific noise levels – Commercial unit - $L_{Aeq,1hr}$ – Daytime (09:00 – 18:00)



Appendix E – Example Façade Constructions

E.1 - Glazing

Table E.1 – Example glazing constructions and associated sound reduction indices

Single / Double / Triple	Configuration	Manufacturer	$R_w + C_{tr}$ (dB)
Double	4 (12) 4	Saint Gobain	**26**
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

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.2 – 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**

ParkerJones Acoustics Limited

Bristol
11 Bankside Road
Brislington
Bristol
BS4 4LB

London
29 Lincoln's Inn Fields
Holborn
London
WC2A 3EE

Glasgow
126 West Regent Street
Glasgow
G2 2RQ

+44 (0)800 830 3338
+44 (0)117 914 6558
info@parkerjonesacoustics.com
www.parkerjonesacoustics.com

Registered in England and Wales
Company No. 12235614