141 HIGH STREET STAPLE HILL, BRISTOL

REPORT ON THE EFFECTS OF ENVIRONMENTAL NOISE

REPORT PREPARED FOR

MR D WRIDE
C/O CRYER & COE LTD
3rd FLOOR, 10-12 GLOUCESTER ROAD
BRISTOL
BS7 8AE

R1615.1 V1 INITIAL

9th NOVEMBER 2023

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Revision	Status	Date	Author	Comment
1	Initial Issue	9/11/2023	Ashley Punter	Issued for team comment

Report Prepared by:

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Consultant

CONTENTS…

1.0 INTRODUCTION…

This document summarises our review of the acoustic design intent for the proposed development known as 141 High Street, Bristol against relevant standards for the internal and external noise affecting the development.

It is our understanding that the project involves the redevelopment of an existing building. The proposal includes a three-storey extension to form residential accommodation, and an additional floor constructed over existing commercial space to also form residential accommodation.

We have assessed the proposed designs against the requirements set out in the relevant British Standards and planning policy.

The most appropriate design criterion for the level of indoor noise within residential use is set out in British Standard 8233 and Approved Document F of the Building Regulations.

This report has been prepared for design team use and for submission to local planning authority to support a planning application, the design team and client for their information.

The specifications and construction descriptions described herein should be regarded as detailing the minimum to achieve suitable acoustic performance. Where products are named, it should be noted that equivalent alternative products may be selected and used.

2.0 DESIGN EVALUATION OBJECTIVES…

2.1 Design Approach

There are various guidelines for controlling internal noise levels applicable to this project set out in planning policy, British Standards and World Health Organisation guidelines.

A review of available guidance is set out in the following sections.

2.2 Design Requirements

A summary of the applicable design standards are as follows:

South Gloucestershire Council: Planning and Noise (SPG Note 1)

South Gloucestershire Local Policy document PSP21 – Environmental Pollution and Impacts. The Policy considers potential impacts from existing sources of pollution, including noise, on proposed developments considered to be sensitive to the effect of pollution. The Policy additionally considers the impact associated with the introduction of a potentially polluting development on existing sensitive receptors. With specific regard to noise the draft local policy states:

Development that would introduce noise-sensitive receptors in locations likely to be affected by existing sources of noise shall be accompanied by an assessment of environmental noise and an appropriate scheme of mitigation measures. In assessing such a scheme, account will be taken of:
1. The location, design and layout of the proposed development; and
2. Measures to reduce noise within the development to acceptable levels including both internal and external areas; and
3. The need to maintain adequate levels of natural light and ventilation to habitable areas of the development.

The policy also refers to national policy guidance referenced below.

Professional Practice Guidance on Planning & Noise (ProPG)
ProPG: Planning & Noise is industry guidance relating to maintaining an appropriate standard of internal ambient noise levels in residential developments. Although only formally applicable in England, ProPG states that it

> "*encourages improvements in the consistency and quality of plan making and decision-taking in relation to acoustic matters. The context is primarily development control, although some of the content is relevant to strategic planning. Similarly, whilst the policy coverage is limited to England, the approach may be useful in other parts of the UK*."

The ProPG document bases its performance requirements on the existing British Standard 8233 – *Guidance on Sound Insulation and Noise Reduction for Buildings* for the internal noise levels.

The ProPG document sets out current best practice guidance for dealing with noise events. The approach adopted is set out in clause A.21 which states:

> ***A.21*** *In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB* $L_{Amax,F}$ *more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.*

It should be noted that some flexibility based on judgement is provided based on the context.

British Standard 8233
This document provides guidance for the control of noise in and around buildings. It is applicable to the design of new and refurbished buildings. This document is referenced by BREEAM and is primarily used for defining indoor noise limits for residential and non-residential uses.

The acoustic design requirements for indoor noise levels applicable to the residential areas are as follows and are maximum levels over the period stated.

Location / Use	Daytime (07:00 to 23:00)	Night-time (23:00 to 07:00)
Communal Living / Dining	35 / 40 dB(A) $L_{Aeq,16hr}$	Not applicable
Bedrooms	35 dB(A) $L_{Aeq,16hr}$	30 dB(A) $L_{Aeq,8hr}$

TABLE 1: RESIDENTIAL INDOOR NOISE LEVEL REQUIREMENTS FROM BS8233:2014

The stated levels are understood to be applicable to the condition where the rooms are ventilated for normal occupation, and no limits apply to the purge ventilation condition.

It is noted that the 2014 edition of BS8233 makes no reference to maximum noise levels.

Clause 7.7.3.2 of this standard defines an appropriate level of outdoor sound offering acceptable amenity as follows,

> *For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable.*

World Health Organisation
The World Health Organisation provides indoor noise level guidelines, including a limit on the maximum noise level experienced in a bedroom at night.

The maximum noise limit was devised as a means of improving health by avoiding awakenings. The guidance recommends the maximum noise level experienced in the bedrooms should not regularly exceed 45 dB(A) L_{AFMax} during the night.

It is worth noting that the 45 dB(A) L_{AFMax} criteria is a recommended level that is not to be exceed more than approximately 10-15 times per night to avoid a negative effect on sleep. (WHO Community Noise Guidelines 1999 Section 3.4 para 10). It is therefore not considered to be a strict upper limit on noise level.

Building Regulations 2010 Approved Document F (ADF): Means of Ventilation
ADF is a technical summary of the statutory requirements for ventilation including in new dwellings.

In relation to noise the document states:

> *"Clause 4.34*
> *The noise caused by ventilation systems is not controlled under the Building Regulations. However, such noise may be disturbing to the occupants of a building and it is recommended that measures be taken to minimise noise disturbance."*

And goes on to state,

> *"To ensure good acoustic conditions, the average A-weighted sound pressure level in noise sensitive rooms, such as bedrooms and living rooms, should not exceed 30 dB $L_{Aeq,T}$ (See Note below). In less sensitive rooms, such as kitchens and bathrooms a higher level would be acceptable e.g. 35 dB $L_{Aeq,T}$. Noise from a continuously running mechanical ventilation system on it's minimum low rate should not normally exceed these levels, and should preferably be lower in order to minimise the impact of the ventilation system.*
> *Note:*
> *The noise index $L_{Aeq,T}$ is used in BS8233:1999, where T is the duration of the measurement.*

A higher rate of ventilation, known as Purge Ventilation is defined in ADF as:

> *Clause 4.15*
> *Purge Ventilation throughout the building to aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating, or accidental releases such as smoke from burnt food or spillage of water. Purge ventilation is intermittent, i.e. required only when such activities occur.*

Since purge ventilation is occasional, no noise limit is defined for the condition.

Summary of Design Targets

Based on the available information set out in by planning, British Standards, and industry guidance the following indoor noise limits are considered appropriate for this development and used as the basis for assessment.

Location / Use	Source	Daytime (07:00 to 23:00)	Night-time (23:00 to 07:00)
Resting / Living	External Sources	≤ 35 dB(A) $L_{Aeq,16hr}$	No limit
	Ventilation System [1]	≤ NR30 and ≤ 35 dB(A) $L_{Aeq,16hr}$	
Dining	External Sources	≤ 40 dB(A) $L_{Aeq,16hr}$	No limit
	Ventilation System [1]	≤ 40 dB(A) $L_{Aeq,16hr}$	
Bedrooms	External Sources	≤ 35 dB(A) $L_{Aeq,16hr}$	≤ 30 dB(A) $L_{Aeq,8hr}$ AND ≤ 45 dB(A) $L_{AFMax,10x}$
	Ventilation System [1]	≤ 30 dB(A) $L_{Aeq,16hr}$	≤ NR25 and ≤ 30 dB(A) $L_{Aeq,T}$
All	Purge Ventilation	No limit	
Outside	Mechanical Systems [2]	No greater than 10 dB below pre-development background sound level $L_{A90,T}$ at nearest receptor location in accordance with BS4142:2014	
External Amenity Space	All	Not applicable to this development	

TABLE 2: DESIGN ASSESSMENT BASIS FOR INDOOR AND OUTDOOR NOISE

{Note 1} The noise levels from ventilation systems are to be assessed when operating at the "*Whole dwelling ventilation rate*" defined in ADF.

{Note 2} It should be noted that the requirement for outside mechanical noise relative to pre-development background sound would apply at the nearest neighbouring property to each mechanical noise source, whereas the 50 dB(A) $L_{Aeq,T}$ requirement outside an opening in the façade is used to assess the impact of the system on the occupants of the same property.

3.0 PROPOSED BUILDING CONSTRUCTIONS…

3.1 External Walls

The external walls are assessed based on a variety of finishes with a consistent underlying construction, as follows:

- The external walls are based on using cavity masonry, which uses either a facing brick or block outer leaf (rendered) depending on the finish, full fill cavity insulation with a block inner leaf and plasterboard lining.

The wall constructions are estimated to achieve in excess of 50 dB R_w+C_{tr} which is considerably more than the sound insulation offered by the glazed elements, and ventilation provision.

Due to the high level of sound insulation of the solid elements, the walls do not form a critical path for the acoustic design.

Although not a planning matter, we recommend the detailing of the external walls be kept under review in respect of sound flanking between residential units.

3.2 Windows & Doors

The windows are specified to be Part L compliant, and include glazing with the following specifications:

- 8.8mm / 20mm / 12.8mm double glazing in standard frames

The acoustic performance of these window types can be confirmed by the manufacturer to be capable of achieving a sound reduction index of at least 42 dB $R_w+C_{tr,}$ under laboratory conditions.

3.3 Ventilation

Ventilation is provided via a decentralised mechanical extract ventilation system.

The ventilation system will operate continuously to provide the whole dwelling ventilation rate with air made up through trickle vents in the windows. In addition to this system the rooms can be purge ventilated by boosting the supply/extract rate, and / or open windows for boost / purge ventilation.

3.4 Roofs

The roof constructions include:

- Traditional timber trusses with slate / concrete tiles and a waterproof membrane.

In all cases the construction of the roof is not a critical aspect of the acoustic design due to the lower levels of sound insulation offered by the ventilation paths.

4.0 SITE NOISE SURVEY…

4.1 Existing Site Noise Level

An unmanned noise survey of the site has been conducted to establish the current exposure to external noise. Full details of our survey with descriptions and photos of the measurement locations are provided as Appendix A to this report.

The survey included day and night-time hours over three consecutive days. These measurements have been carried out continuously with a logging period of 2 seconds and post-processed to obtain relevant parameters.

The existing background and ambient sounds at site during the survey are dominated by road traffic noise, notably sirens from emergency vehicles.

Table 3 summarises the existing external noise levels measured at the facade.

Location (See Appendix A)	Noise Level dB(A) $L_{Aeq,T}$		Typical {1} Maximum Level dB(A) L_{AFMax}
	16-hour Day 07:00 – 23:00	8-hour Night 23:00 – 07:00	8-hour Night 23:00 – 07:00
1	73	63	85

TABLE 3: EXISTING NOISE LEVELS AT SITE (FACADE)

{Note 1} The L_{AFMax} level is based on a level exceeded no more than 10 times per night-time period using 1-minute intervals, as indicated in Figure 10.

5.0 NOISE EXPOSURE MODELLING…

5.1 Methodology

We have undertaken prediction of the noise exposure of the site and the proposed building form using calculations based on the method described in ISO 9613-2 *Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation*.

The ISO propagation model calculates the sound pressure level from a source sound power level in each 1/1 octave band and subtracts various attenuation factors as follows,

$$L_{ft}(DW) = L_w + D_c - \left(A_{div} + A_{atm} + A_{gr} + A_{bar} + A_{misc}\right)$$

Where

$L_{ft}(DW)$ is the equivalent continuous downwind octave-band sound pressure level (dB)
L_w is the octave band sound power level (dB)
D_c is a directivity correction that describes the extent by which the $L_{ft}(DW)$ deviates in a specified direction from the level of an omni-directional sound source (dB)
A_{div} is the attenuation due to geometrical divergence (dB)
A_{atm} is the attenuation due to atmospheric absorption (dB)
A_{gr} is the attenuation due to the ground effects (dB)
A_{bar} is the attenuation due to a barrier (dB)
A_{misc} is the attenuation due to miscellaneous other effects such as foliage, industrial sites and housing (dB).

The A-weighted total level is obtained by summing the contributions from each source and combining the octave band sound pressure levels with the appropriate weighting.

Our calculations are performed using a proprietary software package, Predictor V2023 available from Softnoise, and it should be noted that the model is an approximation of the real situation. The calculated values are based on geometry information included in the model, some of which is approximate.

The model has included detailed CAD data for the proposed new building and surroundings.

The model has assumed a ‘hard’ ground surface generally and has included the effects of air absorption at 273 K at 101 kPa and 60% humidity. The existing site model has included hard ground across the site which as this gave the best correlation with the measured survey data.

5.2 Existing Site Noise Model

To assess the site and establish the key areas for consideration of the acoustic design we have extrapolated the measured noise levels across the development site.

The modelling has followed the procedures set out in section 5.1 using the derived design data during the day and night periods.

An aerial view of the existing site model is shown in Figure 1.

FIGURE 1: AERIAL VIEW OF THE EXISTING SITE MODEL ($L_{AEQ\ 16HRS}$)

The contours are calculated at 4 m above local ground level.

5.3 Proposed Site Noise Model

To define the performance of the building envelope and demonstrate an acceptable internal environment is possible within the development we have calculated the external noise exposure based on the proposed building forms.

An aerial view of the proposed site model is shown in Figure 2.

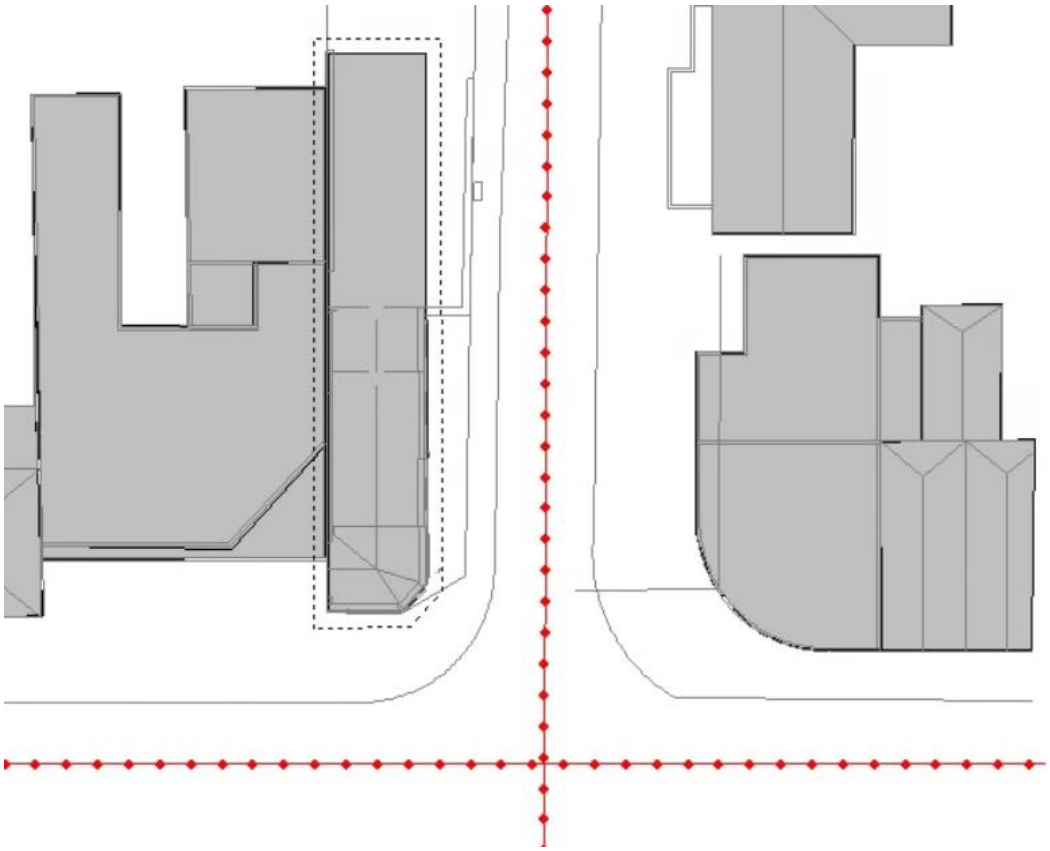

FIGURE 2: AERIAL VIEW OF THE PROPOSED SITE MODEL

5.4 Modelling Results

Using our model of the proposed development, we have estimated how the noise exposure varies on each elevation of the development.

It is apparent from inspection of the measured levels, and the criteria, that the most onerous design case is achievement of the night-time L_{AFMax} sound levels. Achievement of the L_{AFMax} criterion will also lead to achievement of all other indoor noise criteria.

For brevity only the L_{AFMax} noise levels are shown in Figure 3.

More detailed information on the modelling is provided in the appendix, and the findings and implications are summarised in the following sections.

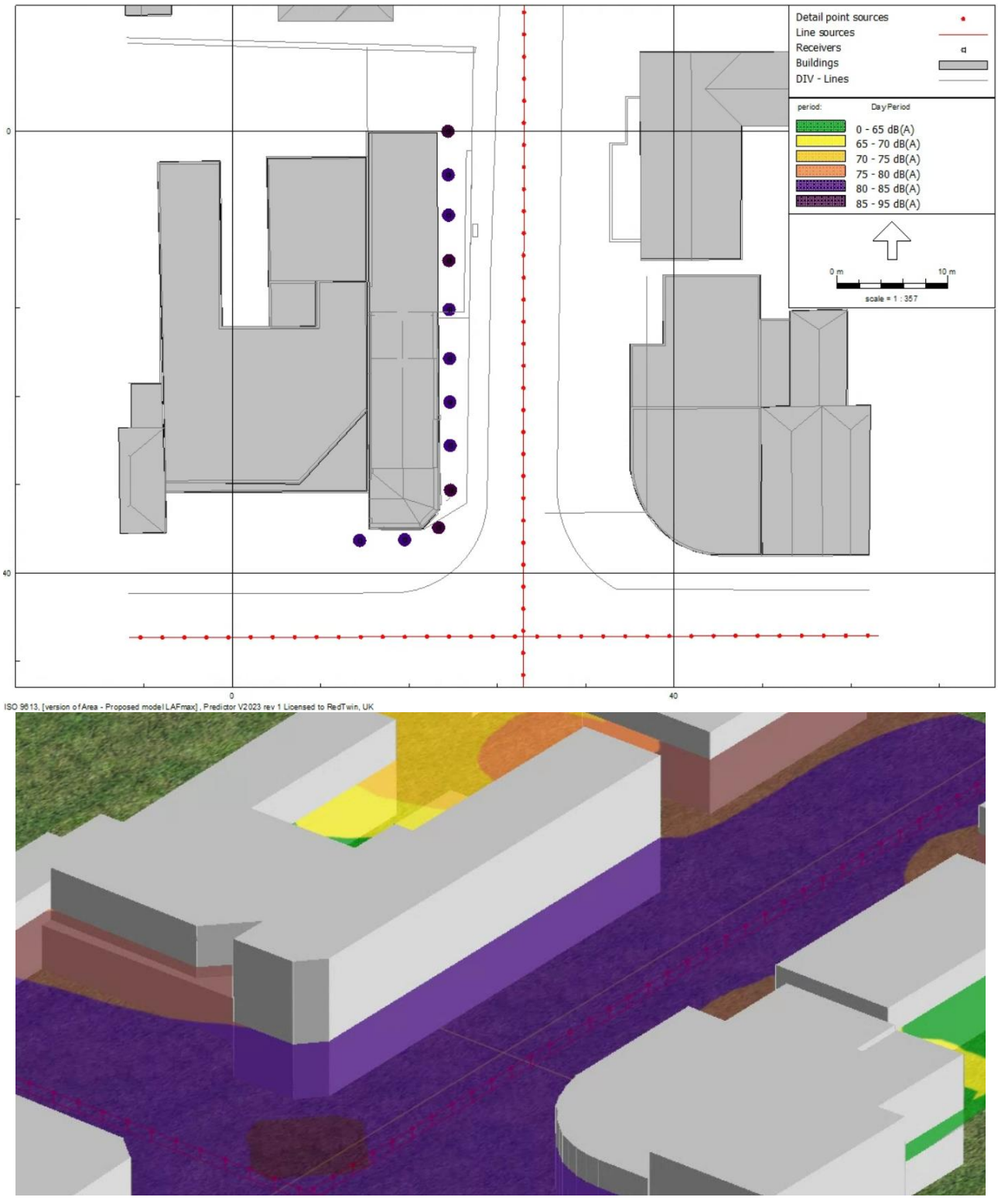

FIGURE 3: NOISE LEVELS ACROSS THE SITE (NIGHT $L_{AFMAX,10X}$) (TOP: PLAN VIEW, LOWER: 3D VIEW FROM SOUTH-EAST

The noise levels at each room/window can be derived from the model. There are no windows serving the Northern and Western Elevations, with all windows fronting the main roads to the East and South.

We have interrogated our model and established there is a 1 dB difference in noise exposure between the ground floor and second floor. For the sake of simplicity, and due to the small reduction in noise exposure, we therefore propose a 'one size fits all' approach to the design specification.

A summary of the worst-case design noise levels and required reduction is provided in Table 4

Elevation	Floor Level (Centre of Window Height Above Ground m)	Design level $L_{AfMax,10x}$	Minimum Level Difference Required (dB $D_{A,Tr}$)
All Elevations	All Floors	85	40

TABLE 4: SUMMARY OF WORST-CASE DESIGN NOISE LEVELS AND REQUIRED REDUCTION TO INSIDE

6.0 DESIGN ASSESSMENT…

6.1 Method of Derivation of Façade Elemental Specification

To assess the resulting indoor noise levels from a given façade specification requires converting between a Sound Level Difference ($D_{A,Tr}$) and a Sound Reduction Index (R_w) which relies on the relative areas of each element (e.g. window, wall, vent etc) together with the room dimensions and finishes.

We have combined the performance of the elements based on manufacturer's claimed laboratory test data for each item, and the relative area of each element in accordance with the method described in BS EN ISO 12354-3:2000 *Building Acoustics – Estimation of Acoustic Performance of Buildings from the Performance of Elements - Part 3: Airborne Sound Insulation Against Outdoor Sound*, and BS8233.

6.2 Sound Reduction Required Through Facade

The level differences required through the façade area summarised in Table 4. Taking an engineering approach we have based our derivation of performance on achieving a level difference of at least 40 dB $D_{A,Tr}$ on the road facing elevation.

6.3 Room Geometry

We have based our assessment on typical dimensions for the flat types for living rooms and bedrooms.

The internal room parameters used in our assessment are summarised in Table 5 which are approximate at this stage.

Room Type	Approximate Element Areas (m^2)			Approx. Room Volume (m^3)	Average Reverberation Time 63-8k Hz (s)
	Wall	Window	Roof		
Living Space	10.5	11.2	--	65	0.5
Bedroom	4.6	2.5	--	27	0.5

TABLE 5: ROOM GEOMETRY USED IN ASSESSMENT

6.4 Façade Element Specifications

The construction specifications considered in this assessment are as follows:

> **Specification 1** – Specific enhancement of the building facade for acoustic performance to include double glazed acoustically rated laminated glass. Normal ventilation is not provided by opening windows. Purge ventilation is via opening windows or boost setting.

The minimum specification of the elements for each design is summarised in Table 6.

Room Type	Minimum Sound Insulation Target for Elements			
	Walls dB R_w+C_{tr}	Glazing dB R_w+C_{tr}	Roof dB R_w+C_{tr}	Ventilation Openings dB $D_{ne,w}+C_{tr}$
Specification Type 1				
Living / Bedrooms	50	42	--	46

TABLE 6: MINIMUM SOUND INSULATION PERFORMANCE TARGETS FOR FAÇADE ELEMENTS

The laboratory-based specification of building elements should be ascertained by testing and have been undertaken in a laboratory accredited to undertake sound insulation testing to BS EN ISO 10140-5 (e.g. UKAS or equivalent). All testing should have been undertaken in accordance with BS EN ISO 10140 Part 1 and Part 2 or equivalent. For the avoidance of doubt the laboratory measured performance of windows shall include the effects of the framing as well as the glass.

Within our calculations we include a correction to the sound insulation performance of the façade elements to account for site installation and construction tolerance of (minus) -3 dB from the laboratory measured performance. All specifications provided herein are laboratory measured performances.

6.5 Example Construction Types

We have reviewed the derived performance of the envelope elements from Table 7 to provide some examples of suitable products which can be considered by the design team. Alternative products with equivalent performance can also be considered and used.

Element	Example Construction Description	Performance
Specification Type 1		
Wall	Facing brick or block outer leaf, full fill cavity insulation, block inner leaf with plasterboard lining	50 dB R_w+C_{tr}
Window 1	Sealed double glazing unit in an 8.8 mm / 20 mm airspace / 12.8 mm glass configuration in standard frames.	42 dB R_w+C_{tr}
Vent 1	Whole house ventilation system with acoustically treated intake and exhaust openings (e.g. Caice acoustic window ventilators)	46 dB $D_{ne,w}+C_{tr}$

TABLE 7: SUMMARY OF EXAMPLE CONSTRUCTIONS

The performance specifications are achievable using standard building products.

The above proposals for acoustic performance should be considered for acceptability with all other design and planning constraints before inclusion in construction issue drawings or being released for procurement.

6.6 Resulting Indoor Noise Levels

The calculated indoor noise levels based on the calculated noise exposure levels, the room types and their dimensions and the specifications proposed are summarised in Table 8.

Room Description	Target Indoor Noise Levels (dB(A))	Estimated Indoor Noise Levels (dB(A))	Targets Achieved (Y/N)
Living Space	35 $L_{Aeq,16hr}$	33 $L_{Aeq,16hr}$	Y
Bedroom	35 $L_{Aeq,16hr}$ 30 $L_{Aeq,8hr}$ 45 $L_{AfMax,10x}$	33 $L_{Aeq,16hr}$ 23 $L_{Aeq,8hr}$ 45 $L_{AfMax,10x}$	Y Y Y

TABLE 8: SUMMARY OF ESTIMATED INDOOR NOISE LEVELS

All rooms can be expected to achieve indoor noise levels due to external sound of no greater than 35 dB(A) $L_{Aeq,16hr}$ during the day, and bedrooms can be expected to achieve an indoor noise level of no greater than 30 dB(A) $L_{Aeq,8hr}$ at night without also exceeding 45 dB(A) $L_{AFmax,}$ regularly (typically 10-15 times).

The achieved standards are in keeping with relevant local and national planning policy.

Subject to achievement of the mechanical services noise limits set out in section 2.2, our conclusions will remain valid.

The minimum performance of elements forming the building envelope for the residential units have been derived. The implementation of the acoustic design relies solely on the building fabric to achieve appropriate internal ambient noise levels, which is in full accordance with the guidance documents.

6.7 Outdoor Amenity Space

We have calculated the noise levels anticipated within outdoor amenity spaces (Eastern elevation balconies) due to the prevailing site noise exposures.

These predictions do not take into consideration noise generated within the development (i.e. by the occupants).

The scheme is not expected to achieve an outdoor amenity noise level of under 50 dB(A) $L_{Aeq,16hr}$, in any external amenity space, with all external amenity spaces experiencing noise levels above 55 dB(A) $L_{Aeq,16hr}$.

Whilst excess noise is not ideal, we are of the opinion that it is not practical to reduce noise levels in the external amenity areas due to their limited size and the proximity of the external noise sources.

However, it is recommended that consideration is given to the installation of clear screening (e.g. glazing) or the provision of a 'winter garden' type arrangement, both options of which are expected to provide an improvement on the likely experience of the future occupiers of the development.

6.8 Assessment of Other Relevant Issues

6.8.1 Likely Occupants of the Development

With the provisions described to mitigate external noise within the development, we are of the opinion that there are no restrictions on the type of occupant that could reside within the development on the basis of noise.

6.8.2 Acoustic Design v Unintended Adverse Consequences

Potential adverse consequences of a system dependent entirely on the building fabric to reduce noise ingress including having windows closed can lead to a lack of connection with the external environment.

Furthermore, due to the design being dictated by the maximum noise events experienced on site, the achievement of the targeted indoor noise levels will supress the sound levels experienced between each noise event. The quiet conditions that occur may lead to privacy issues between adjacent rooms and properties.

The differences between maximum and average noise levels on the site are not unusual (at c. +12 dB(A)), and there would not be an unusual outcome in terms of privacy from using the building envelope to control external noise. Compliance with the building regulations for sound insulation between dwellings is considered a reasonable mitigation of this risk.

7.0 MECHANICAL SERVICES NOISE…

7.1 Internal Noise

The design of the ventilation system includes a decentralised MEV system.

Based on the most onerous of the indoor noise criteria, in the bedrooms, the MEV system is required to achieve an internal noise level of no greater than:

- NR25 in bedrooms

Whilst it is not technically correct to compare dB(A) with NR, there is an approximate relationship defined in BS8233:2014 Annex B which suggests the dB(A) value is 6 dB greater than the NR value, and hence NR25 would be approximately 30 dB(A).

The design of the MEV system is by others and this aspect of the design should be confirmed at a later stage.

8.0 CONCLUSIONS…

We have undertaken an assessment of the noise exposure of the proposed redevelopment at 141 High Street Staple Hill.

We have considered the development against the relevant criteria set out in the prevailing development planning policies and also against relevant guidance documentation and British Standards relating to indoor noise.

We have derived a minimum acoustic specification for the external windows that are expected to achieve appropriate internal noise levels taking into consideration the nature and form of the buildings.

All residential dwellings are specified to have a continuously operating local MEV system.

The derived acoustic specifications are not overly onerous and can be readily achieved with standard building materials and products.

APPENDIX A – NOISE SURVEY DETAILS…

Address: 141 High Street, Staple Hill, BRISTOL, BS16 5HQ

Date: 25th October to 27th October 2023

Measurement Locations

Location No 1 — The microphone was attached to the façade of the building using a combination of timber battens, on the elevation facing the junction of Broad Street and High Street, Soundwell Road and Victoria St. The microphone was elevated above local ground level by approximately 5 m so that it was mid-way up the first floor level.

The measurement locations are indicated in FIGURE 11 with a photograph in FIGURE 4.

FIGURE 4: PHOTOGRAPH OF SURVEY MEASUREMENT LOCATION NO 1 (UN-MANNED)

Equipment – Location No 1 {Green Kit}

Brüel & Kjær 2250 hand held analyser, serial No 2685348, with a Brüel & Kjær Type 4189 Microphone, serial No 3005055. The microphone was fitted with a ZC0032 preamplifier and a UA-1404 windshield. The hand held analyser and microphone were laboratory calibrated on 29th March 2022 (Certificate No. U40608). The sensitivity of the equipment was checked before and after the survey using a Brüel & Kjær Type 4231 Acoustic Calibrator, serial No 2725385 which was laboratory calibrated on 3rd November 2022 (Certificate No U42326) and a drift in sensitivity of 0.06 dB was observed during the survey. No adjustments have been made to the measured data.

Personnel

The survey was set up, collected and part attended by Ian Matthews of Red Twin Limited.

Weather
The weather was suitable for noise measurement with light winds and generally dry conditions throughout. There was some rainfall recorded at c. 6am on Thursday 26th. There was mixed cloud cover throughout with largely clear skies on Thursday 26th.

Weather observations for the survey period have been obtained from the Met Office station at Fishponds, approximately 1.1 km to the west, which are reproduced in Figure 5.

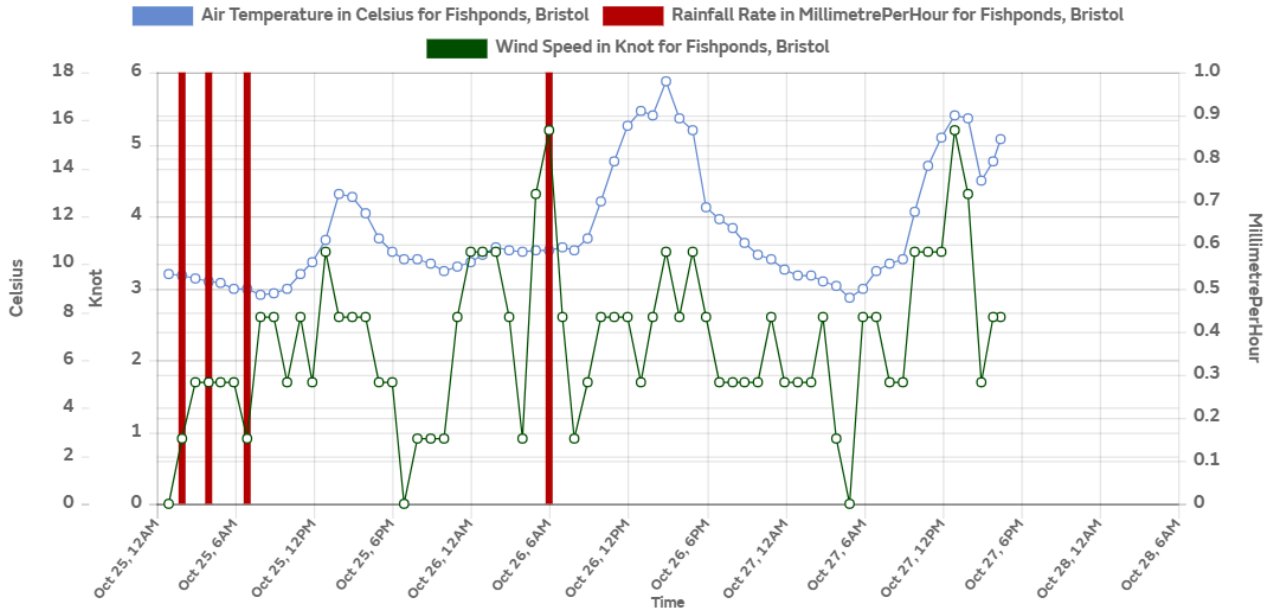

FIGURE 5: MET OFFICE WEATHER OBSERVATIONS (FISHPONDS) DURING SURVEY

Conditions were generally acceptable for noise measurement work and in full accordance with BS7445.

Survey Comments
The main source of sound affecting the site is road traffic navigating the major junction outside. The High street and Soundwell Road is a bus route, and notable the ambulances from the Soundwell ambulance station (BS15 1PX) regularly pass through the junction with sirens on.

The pedestrian crossing emits a tone while cars are stopped which is clearly audible.

Results
Due to the large amount of data collected it lends itself to presentation in graphical form rather than in tables. Data from the unmanned measurements are presented in the following figures and the key parameters are summarised in Table 9. The full data is available upon request.

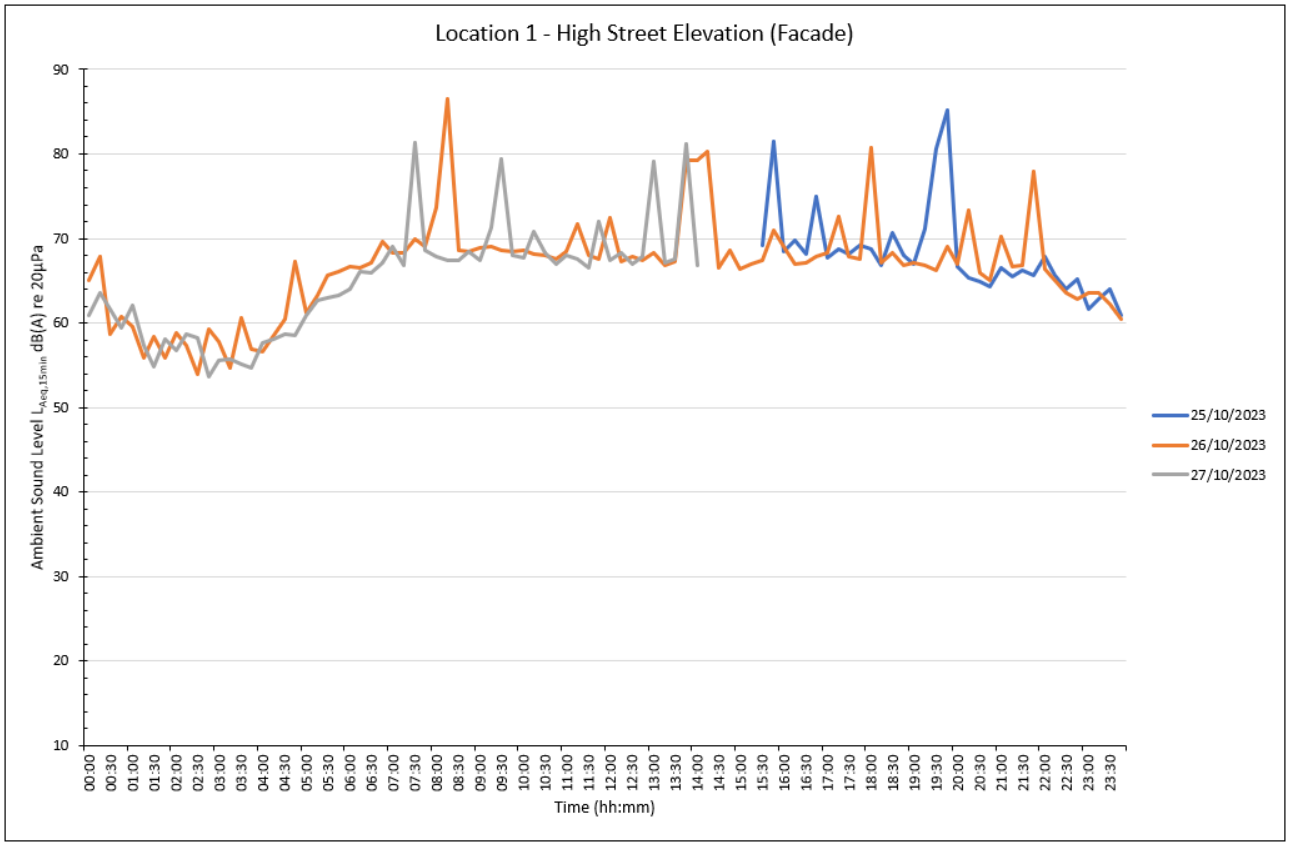

FIGURE 6: LOCATION NO 1 UNMANNED SURVEY DATA (LAEQ,15MIN)

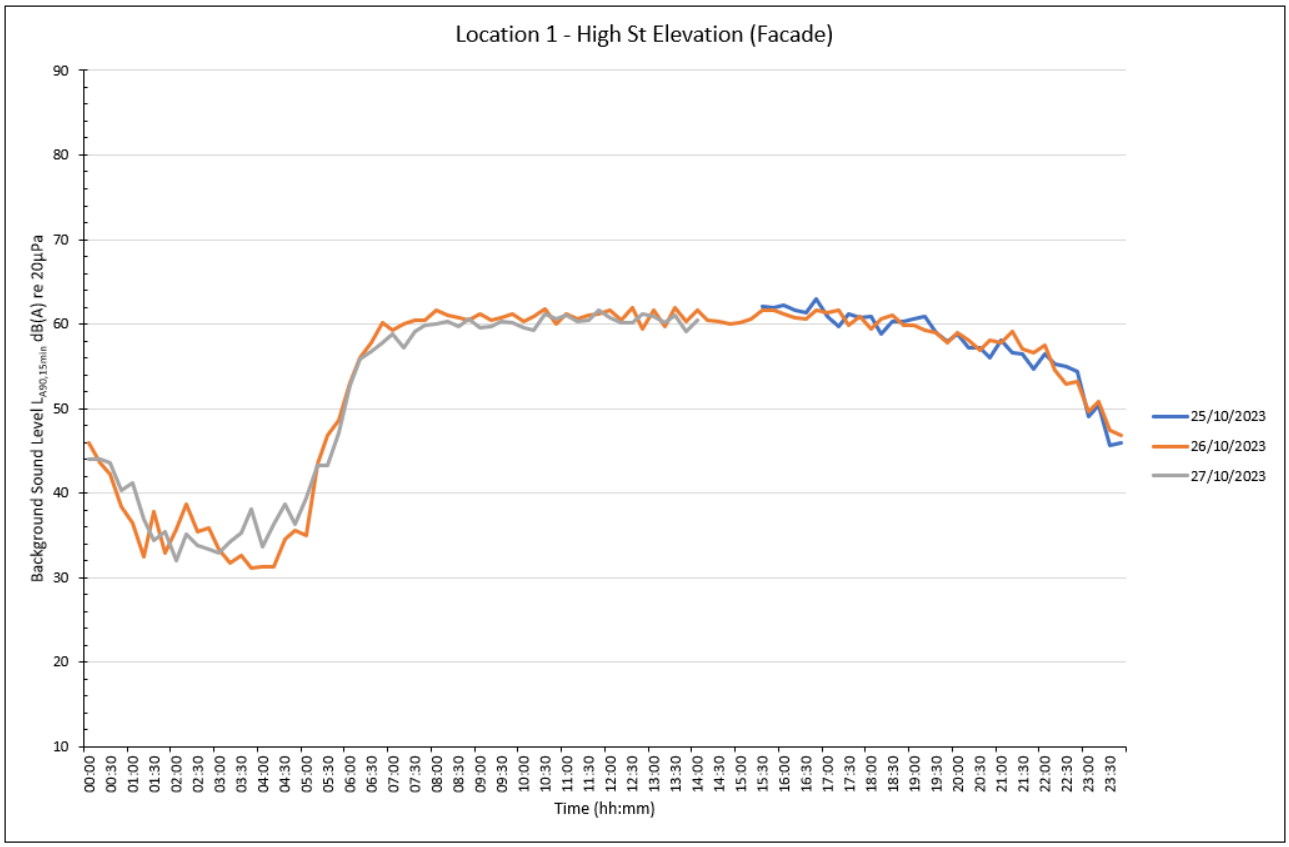

FIGURE 7: LOCATION NO 1 UNMANNED SURVEY DATA (LA90,15MIN)

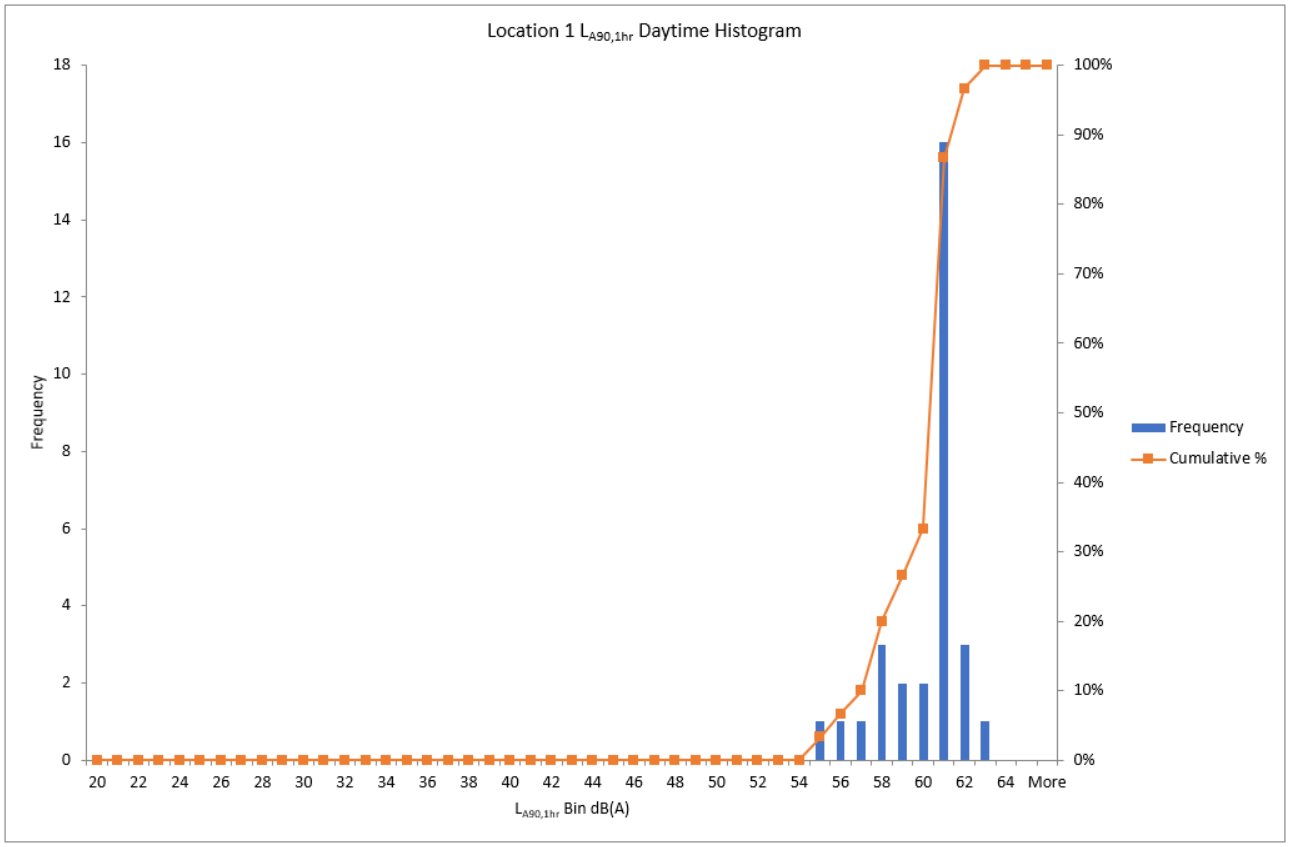

FIGURE 8: BACKGROUND SOUND HISTOGRAM DURING DAYTIME (LA90,1HR)

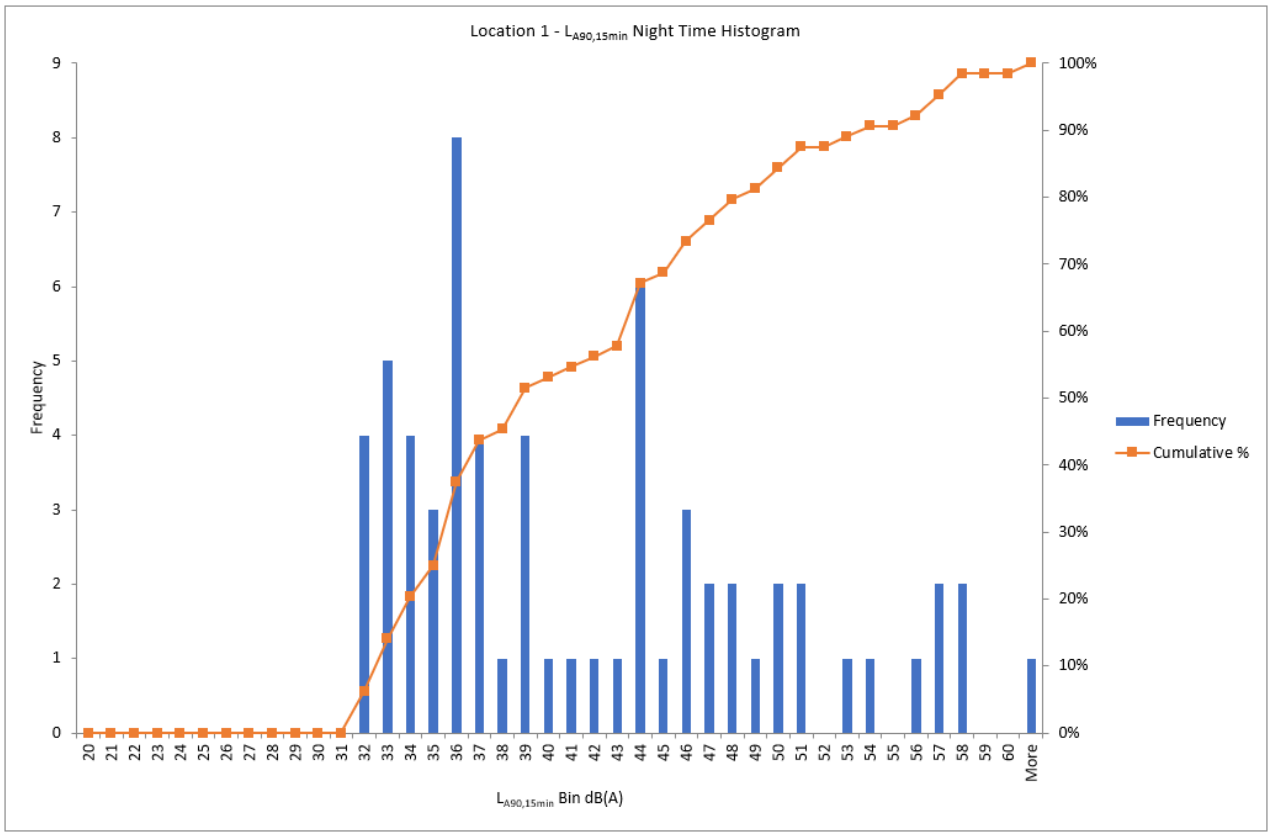

FIGURE 9: BACKGROUND SOUND HISTOGRAM AT NIGHT (LA90,15MIN)

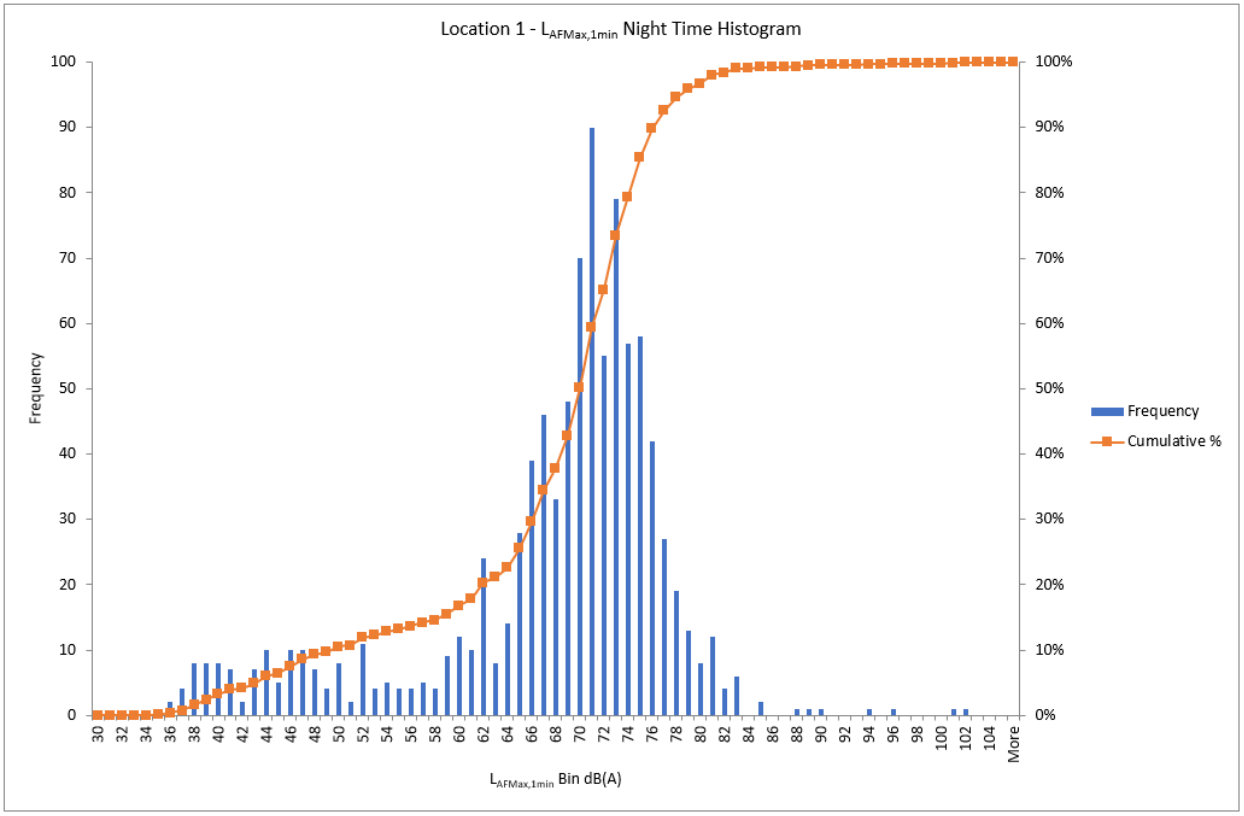

FIGURE 10: MAXIMUM NOISE LEVEL HISTOGRAM AT NIGHT (LAFMAX,1MIN)

The derived design levels at each measurement location, which are subsequently used in our analysis/modelling are summarised in Table 9.

Situation	Unit	Value
Daytime external noise	$L_{Aeq,16hr}$	73
Night-time external noise	$L_{Aeq,8hr}$	63
Night=time external noise	$L_{AfMax,10x}$	85
Daytime background sound level	Median $L_{A90,1hr}$	61
Night=time background sound level	Median $L_{A90,15min}$	36

TABLE 9: SUMMARY OF PROCESSED SURVEY DATA

APPENDIX B – SITE PLANS…

FIGURE 11: SITE AERIAL VIEW INDICATING MEASUREMENT LOCATION (NOT TO SCALE)

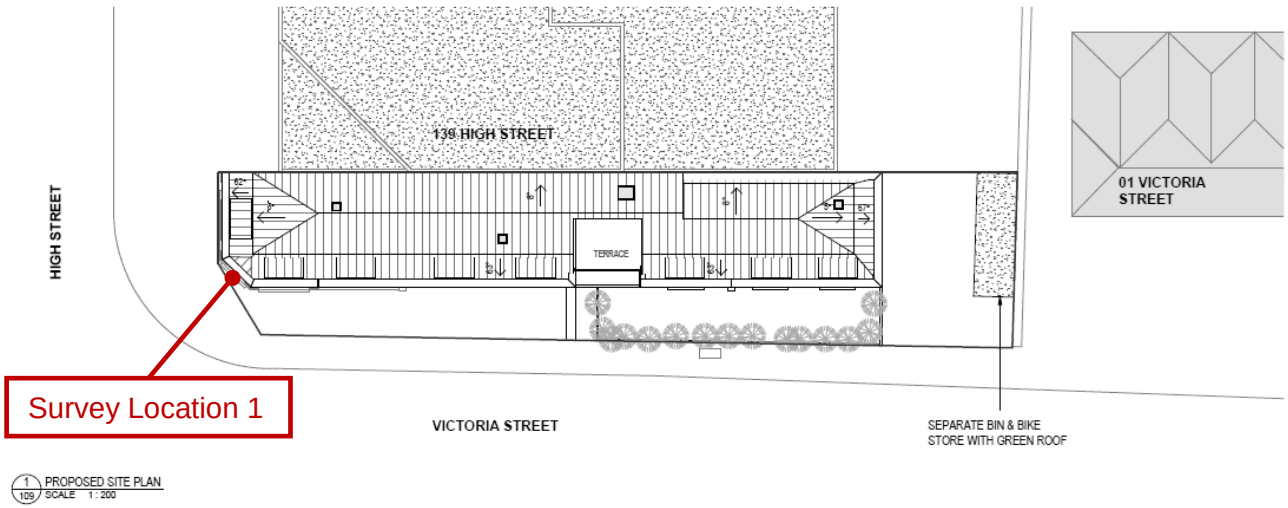

FIGURE 12: PROPOSED SITE LOCATION PLAN INDICATING MEASUREMENT LOCATION (DO NOT SCALE)