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NOISE IMPACT ASSESSMENT REPORT– FACADE NOISE ASSESSMENT

382 BATH ROAD, HEATHROW UB7 0DH

FOR

382 BATH ROAD LTD

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Contents Page

1. EXECUTIVE SUMMARY

The Client has obtained planning approval (76608/APP/2022/197) for the construction of four (4 No.) dwelling houses for residential use (C3 Usage) at 382 Bath Road, Heathrow UB7 0DH.

Sound Licensing were instructed to undertake a noise assessment at the site to determine the internal ambient noise levels that would be representative of the proposed residential premises and to assess compliance with Local Authority planning conditions and BS8233:2014 noise guidelines.

A noise survey and assessment has been undertaken for the proposed residential premises. Existing external noise levels at the site have been measured and compared to the relevant criteria. The results of the noise survey are considered reasonable given the location of the measurement positions and the existing noise sources in the local vicinity.

The assessment has indicated that internal noise levels within the proposed units will comply with the BS8233:2014 noise guidelines and Local Authority planning condition (No. 13) through the use of appropriately specified glazing and ventilation systems.

2. INTRODUCTION

The Client proposes to construct four (4 No.) dwelling houses at 382 Bath Road, Heathrow UB7 0DH. The existing ambient noise climate could have the potential to affect the proposed noise sensitive properties.

The purposes of this report are:

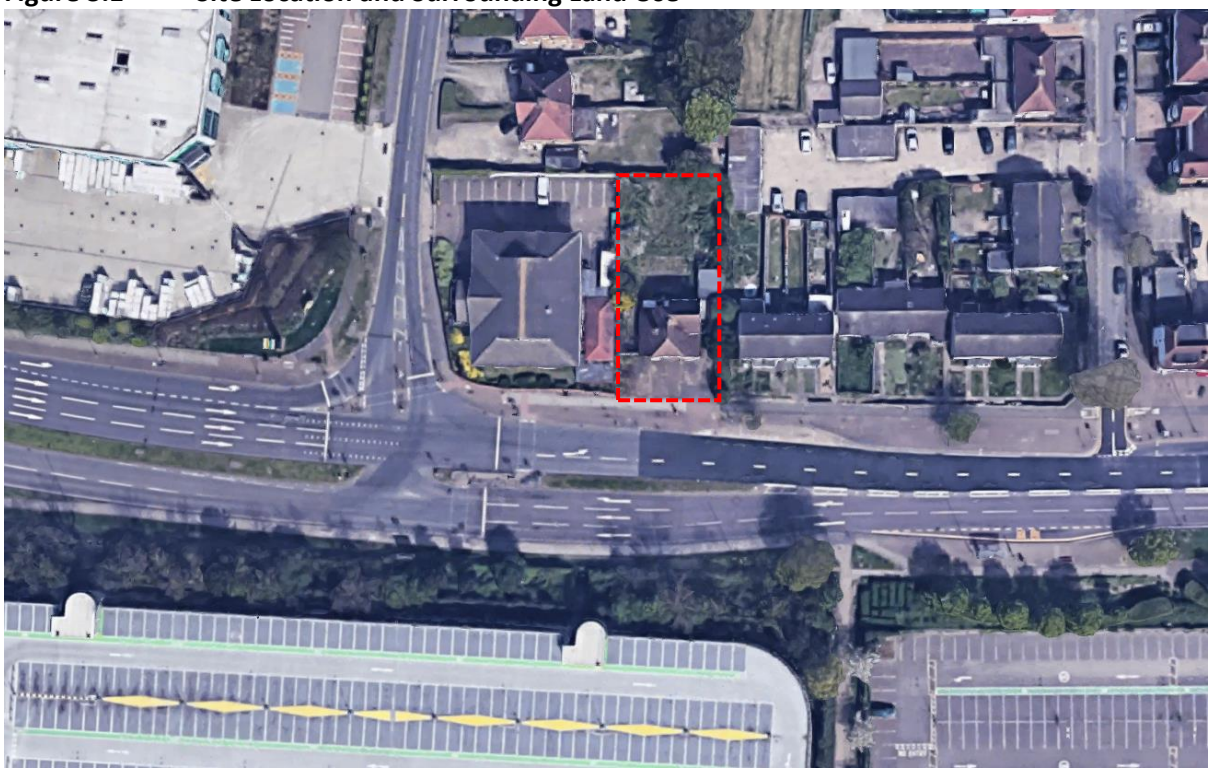
- To determine and assess prevailing ambient and maximum noise levels affecting the development due to nearby noise sources (e.g. road traffic, commercial premises operations, aircraft etc);
- Based on the above, to present the internal noise levels to be achieved within the residential premises in accordance with the BS 8233:2014 standards, and
- To demonstrate that internal noise levels comply with the local authority planning conditions

3. SITE DESCRIPTION

The client has obtained planning approval (76608/APP/2022/197) for the construction of four (4 No.) dwelling houses at 382 Bath Road, Heathrow UB7 0DH (hereafter referred to as 'the site'). The proposed site is located along Bath Road, near a 6-lane junction, and opposite Heathrow Airport carpark.

Figure 3.1 shows the site and its surroundings with the site highlighted approximately in **red**.

Figure 3.1 Site Location and Surrounding Land Use



Source: Google Maps

4. ENVIRONMENTAL NOISE SURVEY METHODOLOGY

An unmanned environmental noise survey was undertaken at two measurement locations at the front and rear of the site. The survey was undertaken between 12:30 hours on 8th November and 11:45 hours on 10th November 2022. A survey at this time represents typical day, evening and night at the site.

Ambient, background and maximum noise levels (L_{Aeq}, L_{A90} and L_{Afmax} respectively) were measured throughout the noise survey in continuous 15-minute periods. The approximate measurement position is indicated in **orange** on Figure 4.1 below.

Figure 4.1 Site Plan Showing Approximate Location of Measurement Positions

Source: Google Maps

The sound level meter microphone at MP1 was positioned on a tripod at the front of the site out of the first-floor window, 1m from the façade of the premises. This position is not considered to be in free field therefore a 3dB façade correction will be applied. The sound level meter microphone at MP2 was positioned on a tripod in the rear garden at a height of 3.5m, 1m from the rear façade of the premises. This position is not considered to be in free field therefore a 3dB façade correction will be applied. The monitoring position is considered representative of noise levels experienced at the proposed property. The monitoring positions were chosen for equipment security reasons also.

The equipment used for the noise survey is summarised in Table 4.1.

Table 4.1 Description of Equipment used for Noise Survey

Monitoring Location	Equipment	Description	Quantity	Serial Number
Proposed Front Façade (MP1)	Larson Davis Sound Expert LxT1	Type 1 automated logging sound level meter	1	0004702
	Larson Davis 377B02	½" microphone	1	159519
	Larson Davis	Pre-amplifier	1	042610
	Larson Davis CAL200	Class 1 Calibrator	1	11706
Proposed Rear Façade (MP2)	Larson Davis Sound Expert LxT1	Type 1 automated logging sound level meter	1	0004720
	Larson Davis 377B02	½" microphone	1	159605
	Larson Davis	Pre-amplifier	1	042612
	Larson Davis CAL200	Class 1 Calibrator	1	11706

The noise survey and measurements were conducted in accordance with BS 7445-1:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures'*.

Weather conditions throughout the entire noise survey period were noted to be mild (approximately 9-15° Celsius), 30-60% cloud cover approximately and a light wind (<5m/s). These weather conditions were checked against and confirmed by the use of the Met Office mobile application available on smart phone technology. These conditions were maintained throughout the majority of the survey period and are considered reasonable for undertaking environmental noise measurements.

The noise monitoring equipment was field-calibrated before and after the noise survey period. No significant drift was recorded (±0.3dB). Equipment calibration certificates can be provided upon request.

5. NOISE SURVEY RESULTS AND OBSERVATIONS

5.1 Results

The time-based ambient and maximum sound pressure levels at the measurement position during the survey are provided in Table 5.1. A full listing of the noise monitoring data recorded during the measurement survey is provided in Appendix C.

Table 5.1 External Noise Monitoring Results Summary

Monitoring Position	Period	Measured External Sound Pressure Level, dB*
MP1 (Front Façade)	08/11/2022 & 10/11/2022 Daytime (07:00 - 23:00)	69dB $L_{Aeq(16Hr)}$
	08/11/2022 – 09/11/2022 Night-time (23:00 - 07:00)	65dB $L_{Aeq(8Hr)}$
	09/11/2022 Daytime (07:00 - 23:00)	68dB $L_{Aeq(16Hr)}$
	08/11/2022 – 10/11/2022 Night-time (23:00 - 07:00)	63dB $L_{Aeq(8Hr)}$
MP2 (Rear Façade)	08/11/2022 & 10/11/2022 Daytime (07:00 - 23:00)	60dB $L_{Aeq(16Hr)}$
	08/11/2022 – 09/11/2022 Night-time (23:00 - 07:00)	52dB $L_{Aeq(8Hr)}$
	09/11/2022 Daytime (07:00 - 23:00)	60dB $L_{Aeq(16Hr)}$
	08/11/2022 – 10/11/2022 Night-time (23:00 - 07:00)	52dB $L_{Aeq(8Hr)}$

*-3dB Façade Correction

5.2 Observations

During the unmanned noise survey, noise sources could not be identified. However, at the beginning and end of the survey background noise was dominated by noise from the vehicles on the local road network and aircraft. These noise sources are considered normal to the site location. It is considered that the measured noise levels are reasonable given the location of the measurement positions.

6. GUIDANCE & LOCAL AUTHORITY REQUIREMENTS

6.1 NATIONAL PLANNING POLICY

NOISE POLICY STATEMENT FOR ENGLAND (NPSE)

The Noise Policy Statement for England (NPSE) was published on 15th March 2010. It sets out the long-term vision for government noise policy. The Noise Policy aims, as presented in this document, are: "*Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development*:

- *Avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.'*

It highlights the underlying principles on noise management already found in existing legislation and guidance. The NPSE should apply to all forms of noise including environmental noise.

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

The first aim of the NPSE is to avoid significant adverse effects. The second aim seeks to provide guidance on potential noise impacts that falls between the LOAEL and the SOAEL, in which case:

"…all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development."

Importantly, the NPSE goes on to state that:

'It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.'

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

A revised National Planning Policy Framework (NPPF2) was published in July 2021. The revised edition contains no new directions with respect to noise, and all previous references remain. The references quoted below relate to the new July 2021 edition.

Paragraph 180 states that "planning policies and decisions should aim to:

- *Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'*

Paragraph 47 of the NPPF states that *"planning law requires that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise."*

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

PLANNING PRACTICE GUIDANCE (PPG)

In March 2014, the Department for Communities and Local Government (DCLG) launched a national planning practice guidance (PPG). The guidance advises that when plan-making and decision-taking, the Local Planning Authority should consider the acoustic environment in relation to:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

The section on noise includes a table that summarises 'the noise exposure hierarchy, based on the likely average response' which offers 'examples of outcomes' relevant to the NOEL, LOAEL and SOAEL effect levels described in the NPSE (see above). These outcomes are in descriptive form and the guidance offers no numerical definition of the NOEL, LOAEL and SOAEL, or any further detailed advice regarding methodologies for their determination.

6.2 Local Authority Requirements

The proposed site lies within the jurisdiction of the London Borough of Hillingdon. Planning approval (76608/APP/2022/197) was obtained on 12/09/22 and the following acoustic related condition was attached:

'13. Save for demolition and site clearance works, no above ground works shall take place until a single integrated noise insulation, ventilation, cooling and heating design plan is submitted to and approved in writing by the the local planning authority. This must provide sufficient evidence to demonstrate that the noise level will not exceed 35 dB LAeq 16 hrs 0700-2300 and 30 dB LAeq 1 hr 2300-0700measured inside any room of any dwelling having regard to the guidance set out in British Standards 8233: 2014 'Sound Insulation and Noise Reduction for Buildings' whilst achieving acceptable internal living conditions with respect to ventilation and temperature. Thereafter the proposed dwellings shall be carried out in accordance with the plan and maintained as such for the lifetime of the development.'

BS 8233:2014

BS 8233:2014 provides references and guideline values for desirable indoor ambient noise levels for dwellings as shown in Table 6.2.1 below.

Table 6.2.1 BS 8233:2014 Desirable internal ambient noise levels for dwellings

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

The table is noted to apply to external noise as it affects the internal acoustic environment from sources without a specific character. The above internal ambient noise levels are considered appropriate within this assessment.

7. FAÇADE SOUND INSULATION

With appropriate sound insulation measures and building construction as exampled within this report, the site is more than capable of achieving the recommended internal noise levels inside the residential premises. This section of the report provides recommendations of the building fabric required to achieve the desired internal noise levels. All major building elements should be tested in accordance with BS EN ISO 140-3:1995.

Sound reduction performance calculations have been undertaken to specify the minimum performance required from glazed elements as outlined in Table 7.1. The specification has been adopted to achieve the night time level (23:00 – 07:00 hours) for bedrooms, 30dB $L_{Aeq,8hour}$, and the day time level (07:00 – 23:00) for living rooms and bedrooms, 35dB $L_{Aeq,16hour}$. L_{Amax} values of the night time period have been also applied to the calculated sound reduction index of the glazed elements to confirm the limit of 45 L_{Afmax} is achieved for single events during the night.

Suggested glazing units other than those provided below may also be suitable. The analysis is provided to demonstrate that a design solution is feasible at the site for the purposes of meeting the requirements of the Local Authority.

Table 7.0 Façade Elevations Required Sound Insulation Performance

Monitoring Position	Period	Measured Ambient Noise Level, dB	Internal Noise Level Requirement, dB	Minimum Sound Reduction Performance Requirement, dB Rw+Ctr
MP1 (Front Façade)	Daytime (07:00 - 23:00)	69dB $L_{Aeq(16Hr)}$	35 $L_{Aeq(16Hr)}$	34dB
	Night-time (23:00 - 07:00)	65dB $L_{Aeq(8Hr)}$	30 $L_{Aeq(8Hr)}$	35dB
MP2 (Rear Façade)	Daytime (07:00 - 23:00)	60dB $L_{Aeq(16Hr)}$	35 $L_{Aeq(16Hr)}$	25dB
	Night-time (23:00 - 07:00)	52dB $L_{Aeq(8Hr)}$	30 $L_{Aeq(8Hr)}$	22dB

7.1 Non-glazed elements

The residential development will be constructed of brick/blockwork external walls. The construction would be anticipated to provide a sound reduction performance of at least the figures shown in Table 7.1 when tested in accordance with BS EN ISO 140-3:1995.

Table 7.1 Non-glazed elements assumed sound reduction performance

Element	Octave band centre frequency SRI, dB					
	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz
Non-glazed element SRI	36	40	41	45	52	52

Given the typical extensive build and construction of the external walls, it is predicted that this element would provide significant attenuation to achieve the internal noise levels.

Roof

Roofs generally have a lower SRI than masonry façade walls but they are required to reduce noise from external sources such as aircraft or road traffic. It is proposed to install a traditional apex roof. Typical construction and sound insulation values of roofs can be gained from BS 8233:2014. For example, a traditional pitched roof with tiles on felt with 100mm mineral wool on plasterboard ceiling has an SRI of approximately 43dB *R*w. Given the typical extensive build and construction of the roof it is predicted that this element would achieve the internal noise levels.

7.2 Glazed Elements

A minimum of 35dB $R_w + C_{tr}$ noise reduction is required for all glazed elements in habitable rooms at the front or exposed sides of the proposed development. A minimum of 25dB $R_w + C_{tr}$ noise reduction is required for all glazed elements in habitable rooms at the rear of the proposed development. The performance is specified for the whole window unit, including the frame and other design features such as the inclusion of trickle vents. Glazing performance calculations have been based on achieving the measured ambient (L_{Aeq}) noise levels and for maximum (L_{Amax}) night-time noise levels as given in the noise criteria.

Example glazing specifications which can attain the minimum sound insulation requirements are:

- Pilkington Double Glazed Units – 6/(16)/8.8 – 35dB $R_w + C_{tr}$
- Pilkington Double Glazed units – 4/(6-16)/4 – 25dB $R_w + C_{tr}$

7.3 Ventilation

Further to any new glazing requirements, if required internal noise levels should be considered in the context of room ventilation requirements. At the time of writing, full details regarding any ventilation strategy are not available. Notwithstanding this, the Building Regulations' Approved Document F (2010) presents whole dwelling ventilation rates. In this context ventilation can be provided by passive wall or window ventilators. The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of such passive ventilation systems. 'IP4/99: Ventilators: Ventilation and Acoustic Effectiveness' (October 1999) details a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different through-wall passive ventilators. The measured sound reduction performance, after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator, ranged up to 46dB Dne,w. Attenuation performance for ventilation openings is specified in terms of Dne,w. Passive vents to provide ventilation are therefore available that meet or exceed the sound reduction required by the glazing elements and can be constructed into the proposal accordingly.

8. CONCLUSION

Sound Licensing has undertaken noise monitoring at the proposed development site at 382 Bath Road, Heathrow UB7 0DH. The resultant noise levels have been used to specify glazing requirements to ensure that suitable noise levels are achieved within the proposed residential premises in line with Local Authority planning conditions & BS 8233:2014 noise guidelines.

A minimum of 35dB $R_w + C_{tr}$ noise reduction is required for all glazed elements in habitable rooms at the front or exposed sides of the proposed development. A minimum of 25dB $R_w + C_{tr}$ noise reduction is required for all glazed elements in habitable rooms at the rear of the proposed development.

Example glazing specifications which can attain the minimum sound insulation requirements are:

- Pilkington Double Glazed Units – 6/(16)/8.8 – 35dB $R_w + C_{tr}$
- Pilkington Double Glazed units – 4/(6-16)/4 – 25dB $R_w + C_{tr}$

With appropriate sound insulation measures installed, the habitable rooms in the proposed development are more than capable of achieving the internal noise level criteria specified in planning condition 13 of the planning approval and will also comply with BS8233:2014 guidelines.

APPENDIX A – ACOUSTIC TERMINOLOGY

Parameter	Description
Acoustic environment	Sound from all sound sources as modified by the environment
Ambient sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.
Ambient sound level, La = LAeq,T	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T
Background sound level, LA90, T	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels
Decibel (dB)	A logarithmic scale representing the sound pressure or power level relative to the threshold of hearing ($20x10^{-6}$ Pascals).
Equivalent continuous A-weighted sound pressure level, LAeq,T	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t2 – t1, has the same mean-squared sound pressure as a sound that varies with time
Facade level	Sound pressure level 1 m in front of the facade NOTE Facade level measurements of LpA are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the facade.
Free-field level	Sound pressure level away from reflecting surfaces NOTE Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field.
LAmax	Maximum noise level (dB)
Measurement time interval, Tm	Total time over which measurements are taken
Noise criteria	Numerical indices used to define design goals in a given space.
Noise rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves.
Reference time interval, Tr	Specified interval over which the specific sound level is determined
Weighted sound reduction index (Rw)	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. NOTE The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory

References:

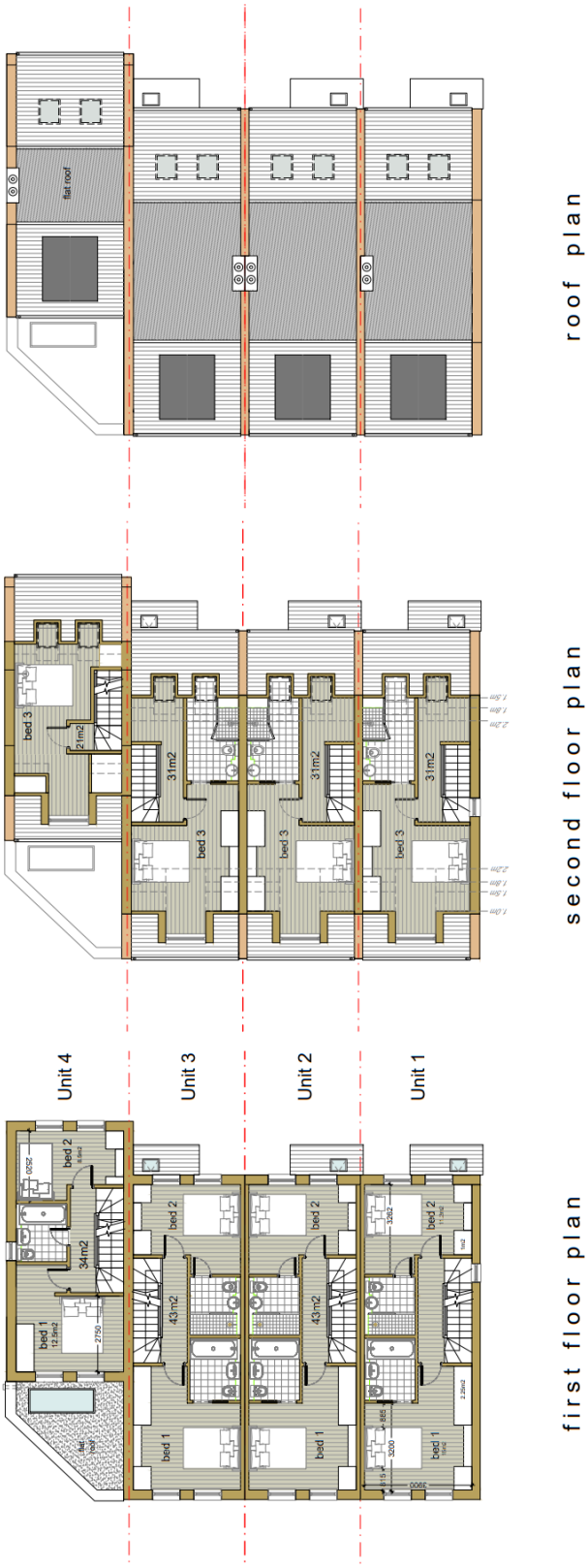
- British Standard 8233:2014 'Guidance on Sound Insulation and noise reduction for buildings'
- National Planning Policy Framework 2021 – Controller of HM Stationery Office
- Noise Planning Statement for England 2010 - Controller of HM Stationery
- Planning & Policy Guidance – Controller of HM Stationery

APPENDIX B - Proposed Plans

Proposed Front Elevation

Proposed Rear Elevation

Proposed Floor Plans



Pilkington Optiphon Data Sheet

Sound insulation data for Pilkington Optiphon™

Glass	Sound reduction index (dB)								
	Octaveband Centre Frequency (Hz)						R_w (C; C_{tr})	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
6.8 mm Pilkington **Optiphon™**	22	26	31	37	40	40	36 (-1; -4)	36	35	32
8.8 mm Pilkington **Optiphon™**	27	29	34	38	40	43	37 (0; -2)	37	37	35
10.8 mm Pilkington **Optiphon™**	26	30	35	39	40	46	38 (-1; -3)	38	37	35
12.8 mm Pilkington **Optiphon™**	29	32	36	41	42	51	40 (-1; -3)	40	39	37
16.8 mm Pilkington **Optiphon™**	31	33	38	41	43	54	41 (-1; -3)	41	40	38
Insulating glass units										
6 mm / 16 mm argon / 6.8 mm Pilkington **Optiphon™**	21	28	37	48	48	54	40 (-2; -6)	40	38	34
6 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	25	27	38	48	47	55	41 (-2; -6)	41	39	35
8 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	21	30	39	47	50	55	42 (-3; -8)	42	39	34
10 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	28	31	42	45	50	58	44 (-2; -6)	44	42	38
10 mm / 20 mm argon / 8.8 mm Pilkington **Optiphon™**	28	36	43	47	49	58	46 (-2; -6)	46	44	40
8.8 mm Pilkington **Optiphon™** / 16 mm argon / 12.8 mm Pilkington **Optiphon™**	28	36	45	53	56	64	48 (-2; -7)	48	46	41
10.8 mm Pilkington **Optiphon™** / 24 mm argon / 16.8 mm Pilkington **Optiphon™**	35	41	48	53	55	65	52 (-2; -6)	52	50	46
12.8 mm Pilkington **Optiphon™** / 20 mm argon / 16.8 mm Pilkington **Optiphon™**	35	45	49	50	54	65	51 (-1; -4)	51	50	47

Measurements undertaken in accordance with BS EN ISO 10140 and Rw (C; C_{tr}) determined in accordance with BS EN ISO 717-1.
For insulating glass units, there is little difference in the sound insulation for cavity widths in the range 6 to 16 mm.
To calculate performance data for Pilkington products, please use our Spectrum online calculator at https://spectrum.pilkington.com/
For glass combinations to achieve an R_w value higher than 52 dB, please contact us for more details.

Pilkington Double Glazing Data Sheet

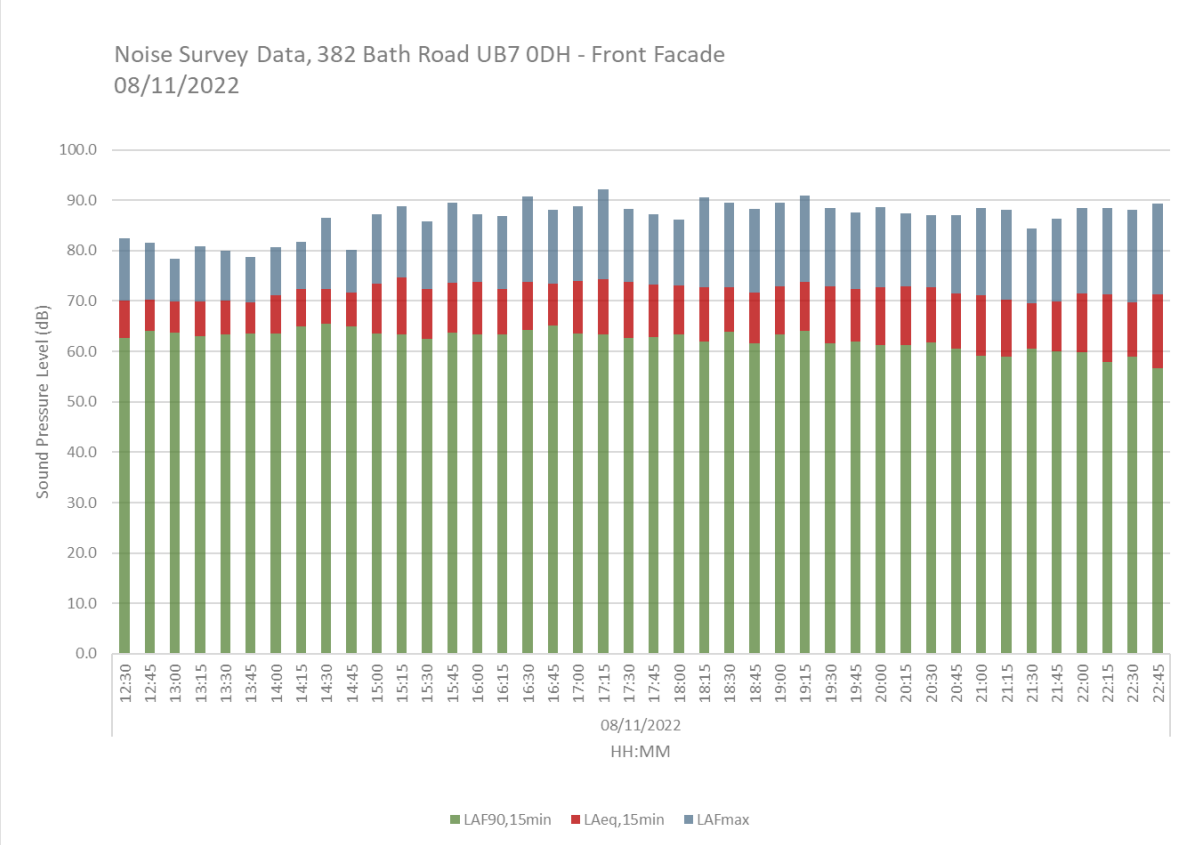
Sound insulation data for standard products

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R_w (C; C_{tr})	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
4 mm Float Glass	17	20	26	32	33	26	29 (-2; -3)	29	27	26
6 mm Float Glass	18	23	30	35	27	32	31 (-2; -3)	31	29	28
8 mm Float Glass	20	24	29	34	29	37	32 (-2; -3)	32	30	29
10 mm Float Glass	23	26	32	31	32	39	33 (-2; -3)	33	31	30
12 mm Float Glass	27	29	31	32	38	47	34 (0; -2)	34	34	32
6 mm Laminated Glass	20	23	29	34	32	38	32 (-1; -3)	32	31	29
8 mm Laminated Glass	20	25	32	35	34	42	33 (-1; -3)	33	32	30
10 mm Laminated Glass	24	26	33	33	35	44	34 (-1; -3)	34	33	31
12 mm Laminated Glass	24	27	33	32	37	46	35 (-1; -3)	35	34	32
16 mm Laminated Glass	26	31	30	35	43	51	36 (-1; -3)	36	35	33
Insulating glass units										
4 mm / (6 - 16 mm) / 4 mm	21	17	25	35	37	31	29 (-1; -4)	29	28	25
6 mm / (6 - 16 mm) / 4 mm	21	20	26	38	37	39	32 (-2; -4)	32	30	28
6 mm / (6 - 16 mm) / 6 mm	20	18	28	38	34	38	31 (-1; -4)	31	30	27
8 mm / (6 - 16 mm) / 4 mm	22	21	28	38	40	47	33 (-1; -4)	33	32	29
8 mm / (6 - 16 mm) / 6 mm	20	21	33	40	36	48	35 (-2; -6)	35	33	29
10 mm / (6 - 16 mm) / 4 mm	24	21	32	37	42	43	35 (-2; -5)	35	33	30
10 mm / (6 - 16 mm) / 6 mm	24	24	32	37	37	44	35 (-1; -3)	35	34	32
6 mm / (6 - 16 mm) / 6 mm Laminated	20	19	30	39	37	46	33 (-2; -5)	33	31	38
6 mm / (6 - 16 mm) / 10 mm Laminated	24	25	33	39	40	49	37 (-1; -5)	37	36	32

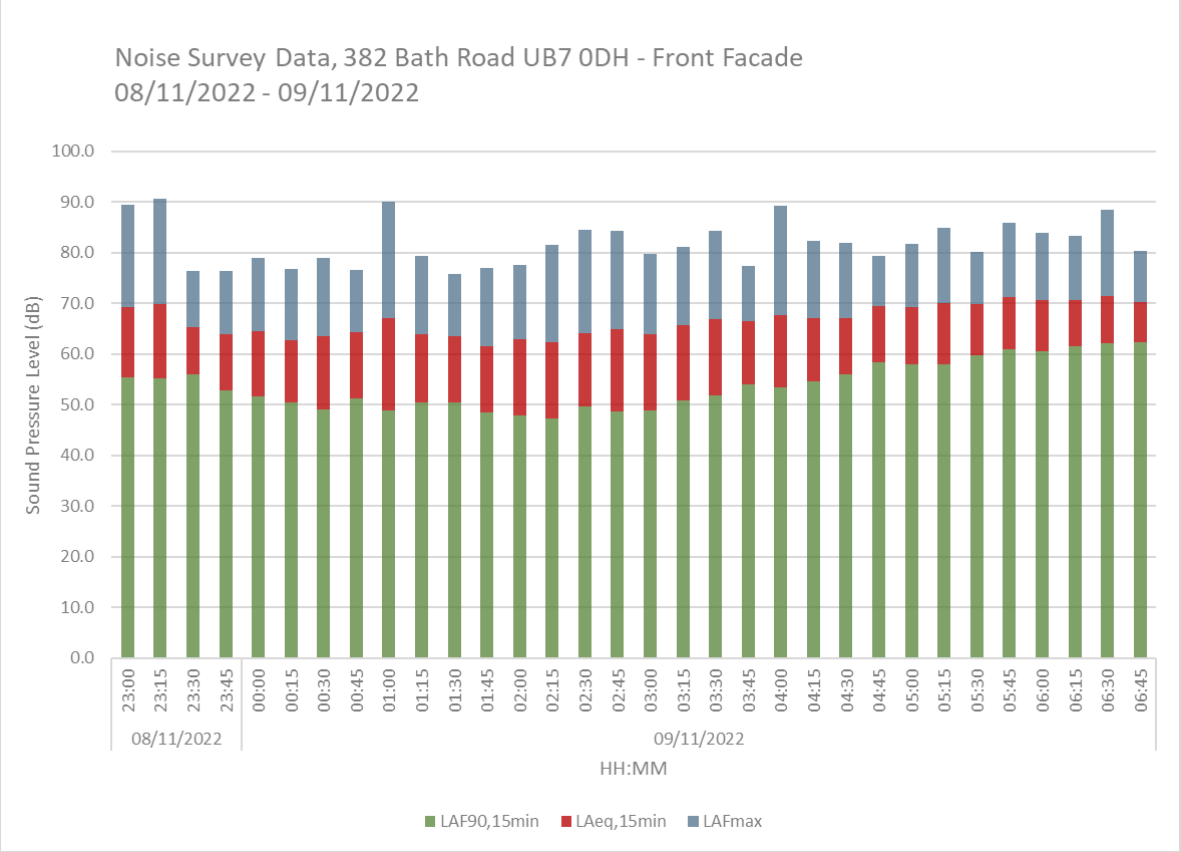
The above are generally accepted values for generic products taken from EN 12758. They are conservative values that can be used in the absence of measured data.
Data for laminated glass is based on pvb interlayers (excluding acoustic pvb interlayers). Glass thickness for laminated glass excludes interlayer thickness.
Data can be adopted for air or argon gas-filled cavities

APPENDIX C – Noise Monitoring Data

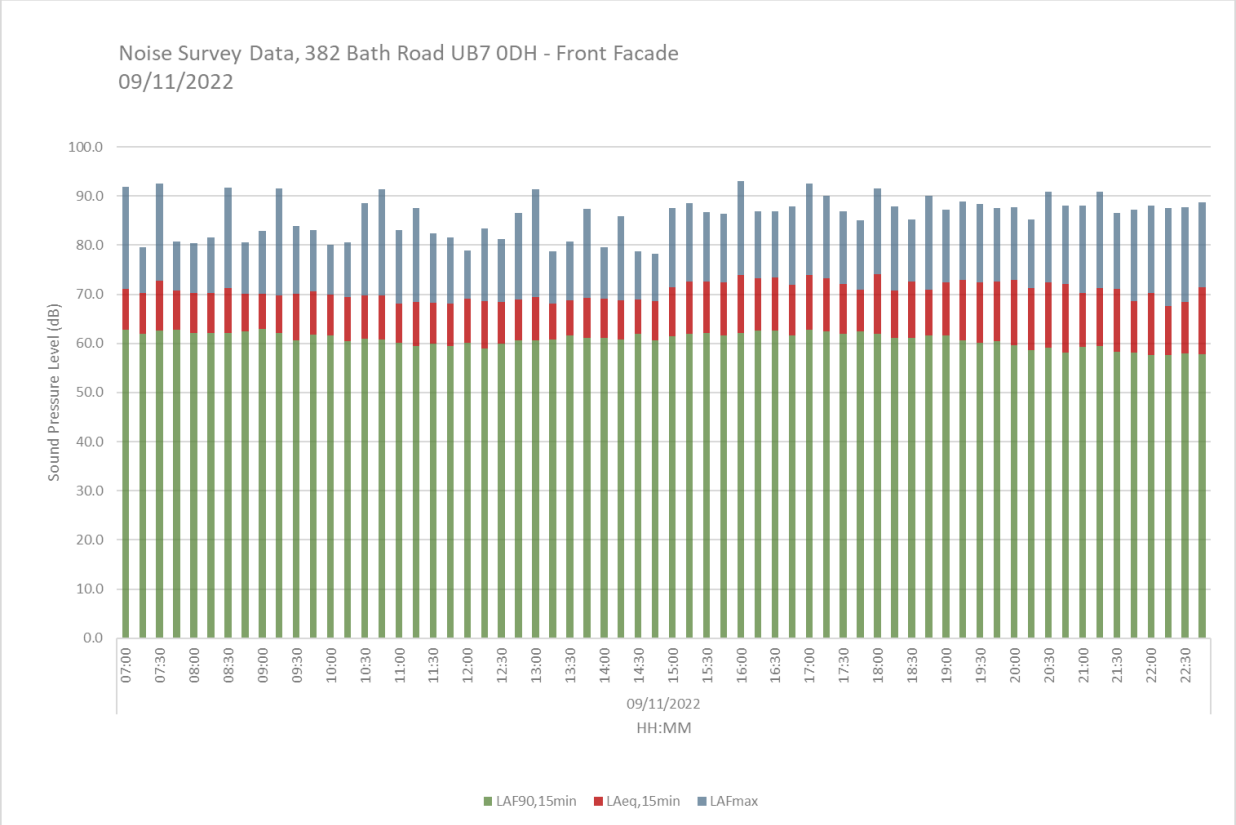
Front Façade



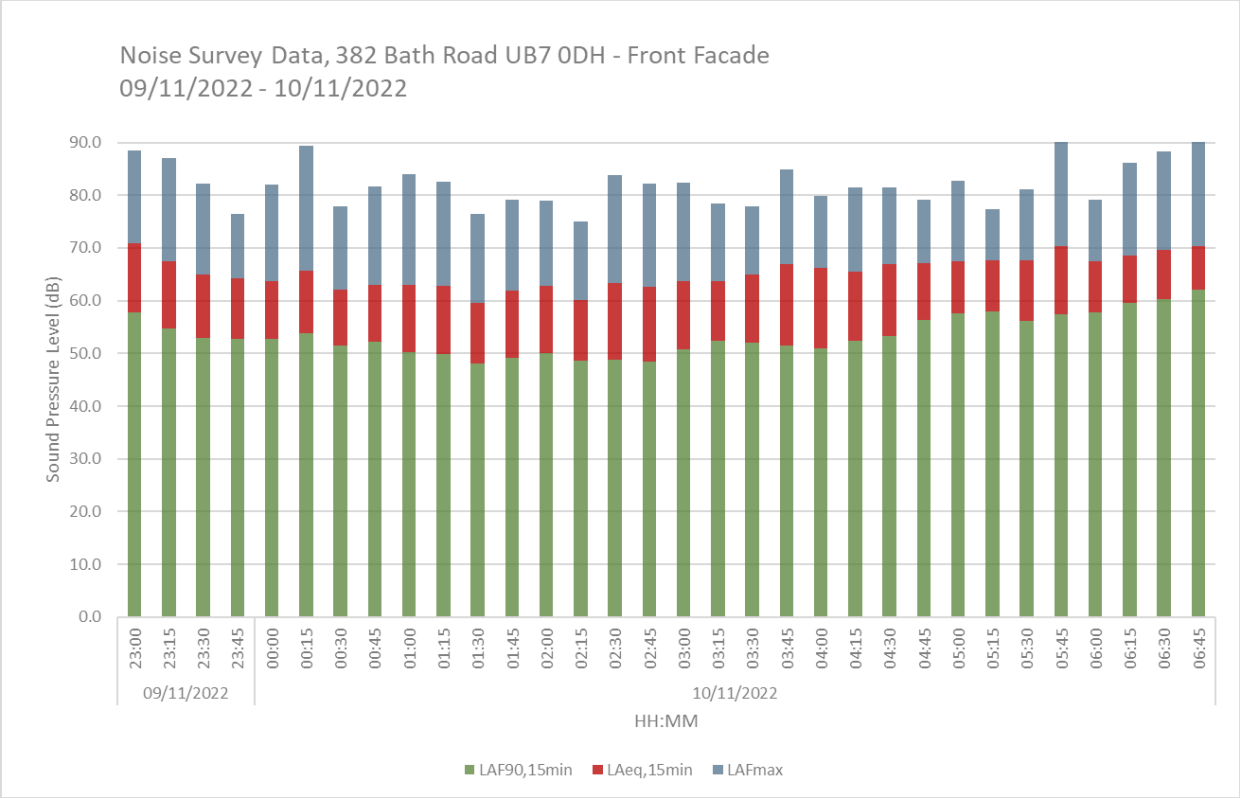
Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$	Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$
08/11/2022	12:30	70.2	82.4	62.7	71.6	08/11/2022	17:45	73.3	87.2	62.9	71.6
	12:45	70.2	81.6	64.0			18:00	73.1	86.1	63.3	
	13:00	69.9	78.4	63.8			18:15	72.7	90.6	62.0	
	13:15	69.9	80.8	63.1			18:30	72.6	89.5	63.9	
	13:30	70.0	80.0	63.3			18:45	71.7	88.3	61.6	
	13:45	69.7	78.7	63.5			19:00	72.9	89.4	63.3	
	14:00	71.2	80.7	63.6			19:15	73.8	90.9	64.0	
	14:15	72.3	81.7	65.0			19:30	73.0	88.4	61.6	
	14:30	72.3	86.5	65.4			19:45	72.3	87.5	62.0	
	14:45	71.6	80.2	64.9			20:00	72.7	88.7	61.2	
	15:00	73.5	87.1	63.5			20:15	73.0	87.3	61.2	
	15:15	74.7	88.8	63.3			20:30	72.8	87.1	61.7	
	15:30	72.3	85.8	62.4			20:45	71.6	87.1	60.5	
	15:45	73.5	89.5	63.8			21:00	71.1	88.4	59.2	
	16:00	73.8	87.2	63.3			21:15	70.2	88.0	58.9	
	16:15	72.3	86.9	63.3			21:30	69.6	84.4	60.6	
	16:30	73.8	90.8	64.3			21:45	69.9	86.3	60.1	
	16:45	73.5	88.0	65.1			22:00	71.4	88.4	59.8	
	17:00	74.0	88.8	63.6			22:15	71.4	88.4	57.9	
	17:15	74.4	92.1	63.4			22:30	69.7	88.1	59.0	
	17:30	73.8	88.3	62.6			22:45	71.4	89.4	56.7	



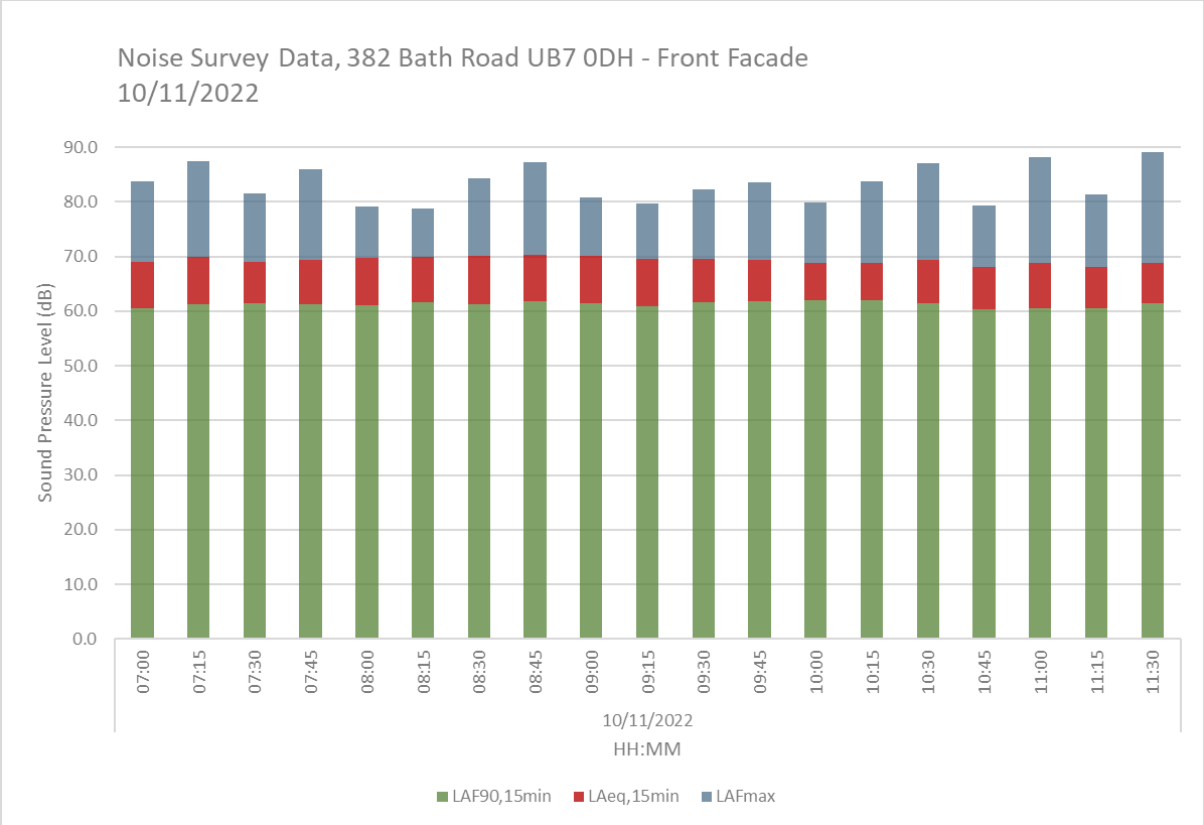
Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,8hour}$
08/11/2022	23:00	69.2	89.4	55.4	
	23:15	69.8	90.6	55.2	
	23:30	65.3	76.4	55.9	
	23:45	63.9	76.5	52.7	
09/11/2022	00:00	64.4	78.9	51.7	
	00:15	62.7	76.8	50.5	
	00:30	63.6	79.0	49.1	
	00:45	64.4	76.6	51.3	
	01:00	67.1	90.0	48.8	
	01:15	63.8	79.4	50.4	
	01:30	63.4	75.8	50.4	
	01:45	61.5	76.9	48.4	
	02:00	62.9	77.5	47.9	
	02:15	62.2	81.5	47.2	
	02:30	64.1	84.6	49.7	
	02:45	65.0	84.3	48.6	
	03:00	64.0	79.7	48.8	67.6
	03:15	65.7	81.1	50.9	
	03:30	66.9	84.3	51.8	
	03:45	66.5	77.3	54.0	
	04:00	67.6	89.2	53.3	
	04:15	67.1	82.3	54.6	
	04:30	67.1	81.9	55.9	
	04:45	69.5	79.3	58.4	
	05:00	69.2	81.7	57.9	
	05:15	70.0	84.8	57.9	
	05:30	69.7	80.1	59.7	
	05:45	71.1	85.9	61.0	
	06:00	70.7	83.9	60.6	
	06:15	70.7	83.2	61.6	
	06:30	71.3	88.4	62.1	
	06:45	70.3	80.3	62.3	



Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$	Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$
09/11/2022	07:00	71.2	91.9	62.8	71.0	09/11/2022	15:00	71.5	87.5	61.5	71.0
	07:15	70.3	79.6	61.9			15:15	72.5	88.5	61.9	
	07:30	72.8	92.6	62.7			15:30	72.7	86.7	62.2	
	07:45	70.7	80.7	62.8			15:45	72.5	86.4	61.7	
	08:00	70.2	80.4	62.2			16:00	73.9	93.1	62.2	
	08:15	70.3	81.5	62.1			16:15	73.2	86.9	62.7	
	08:30	71.3	91.7	62.2			16:30	73.4	86.8	62.6	
	08:45	70.0	80.6	62.5			16:45	71.9	87.8	61.7	
	09:00	70.1	83.0	62.9			17:00	74.0	92.5	62.8	
	09:15	69.7	91.5	62.1			17:15	73.3	90.1	62.4	
	09:30	70.2	83.9	60.7			17:30	72.2	86.8	62.0	
	09:45	70.6	83.0	61.8			17:45	71.0	85.1	62.4	
	10:00	69.9	80.1	61.7			18:00	74.1	91.6	62.0	
	10:15	69.5	80.7	60.4			18:15	70.8	87.9	61.2	
	10:30	69.7	88.6	61.0			18:30	72.6	85.2	61.1	
	10:45	69.8	91.3	60.8			18:45	70.9	90.1	61.7	
	11:00	68.1	83.1	60.2			19:00	72.4	87.2	61.7	
	11:15	68.4	87.5	59.4			19:15	72.9	89.0	60.6	
	11:30	68.3	82.4	60.0			19:30	72.4	88.4	60.2	
	11:45	68.1	81.6	59.5			19:45	72.6	87.5	60.5	
	12:00	69.0	78.9	60.1			20:00	73.0	87.7	59.6	
	12:15	68.7	83.5	59.0			20:15	71.3	85.2	58.6	
	12:30	68.4	81.3	60.0			20:30	72.4	90.8	59.2	
	12:45	68.9	86.5	60.7			20:45	72.2	88.0	58.1	
	13:00	69.4	91.3	60.7			21:00	70.2	88.1	59.3	
	13:15	68.0	78.7	60.8			21:15	71.2	90.9	59.4	
	13:30	68.8	80.8	61.7			21:30	71.0	86.6	58.3	
	13:45	69.3	87.3	61.2			21:45	68.6	87.3	58.2	
	14:00	69.1	79.6	61.2			22:00	70.2	88.1	57.6	
	14:15	68.8	85.9	60.8			22:15	67.6	87.5	57.7	
	14:30	69.0	78.7	62.0			22:30	68.5	87.8	57.9	
	14:45	68.7	78.3	60.7			22:45	71.5	88.7	57.8	

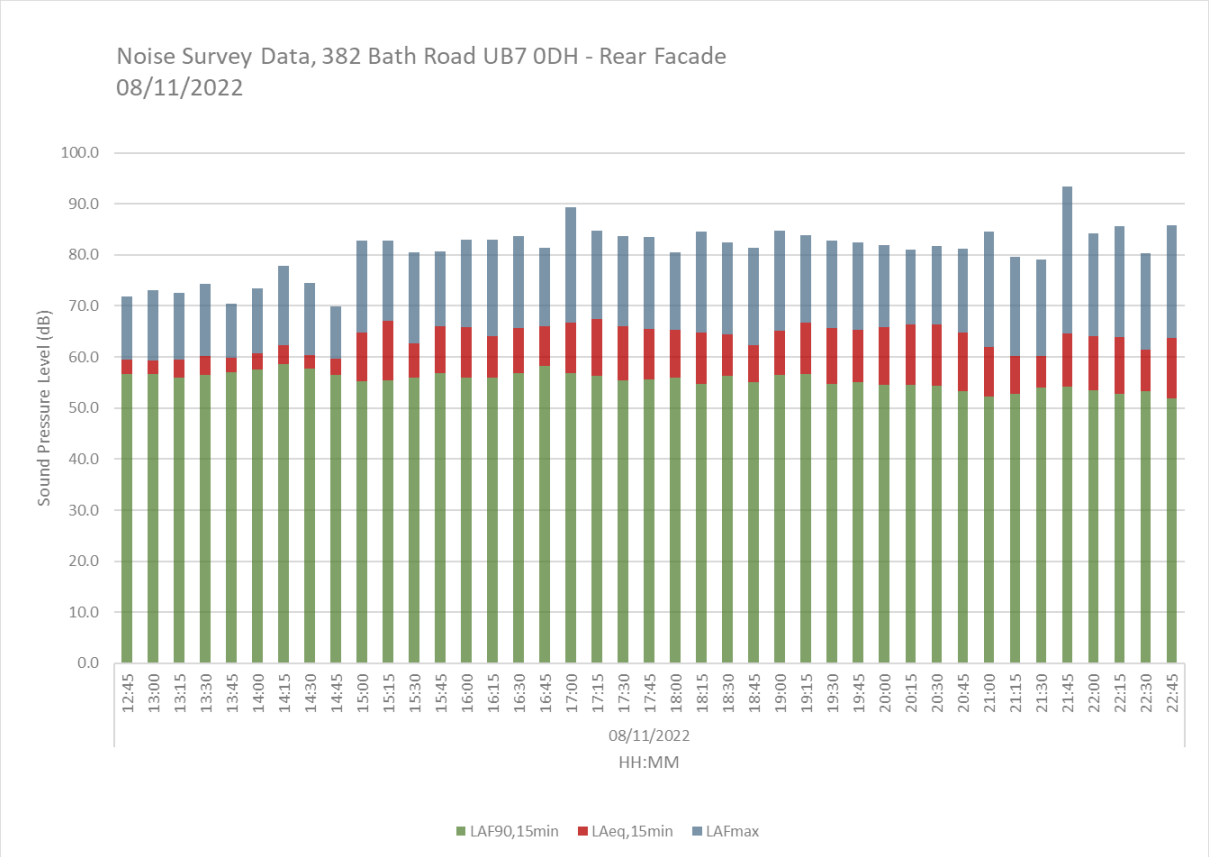


Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,8hour}$
09/11/2022	23:00	70.9	88.5	57.8	66.3
	23:15	67.5	87.1	54.7	
	23:30	65.0	82.1	53.0	
	23:45	64.3	76.5	52.8	
10/11/2022	00:00	63.7	82.0	52.8	
	00:15	65.7	89.4	53.9	
	00:30	62.0	78.0	51.4	
	00:45	63.0	81.7	52.2	
	01:00	62.9	84.0	50.2	
	01:15	62.8	82.6	49.8	
	01:30	59.6	76.5	48.0	
	01:45	62.0	79.1	49.2	
	02:00	62.8	79.0	50.1	
	02:15	60.2	75.0	48.7	
	02:30	63.4	83.8	48.8	
	02:45	62.6	82.3	48.4	
	03:00	63.6	82.4	50.8	
	03:15	63.6	78.4	52.4	
	03:30	64.9	77.9	52.0	
	03:45	66.9	85.0	51.4	
	04:00	66.2	79.9	50.9	
	04:15	65.4	81.4	52.4	
	04:30	66.9	81.4	53.2	
	04:45	67.1	79.1	56.4	
	05:00	67.4	82.7	57.6	
	05:15	67.6	77.4	57.9	
	05:30	67.6	81.1	56.2	
	05:45	70.3	91.8	57.5	
	06:00	67.5	79.2	57.8	
	06:15	68.6	86.1	59.5	
	06:30	69.6	88.3	60.2	
	06:45	70.4	91.1	62.1	

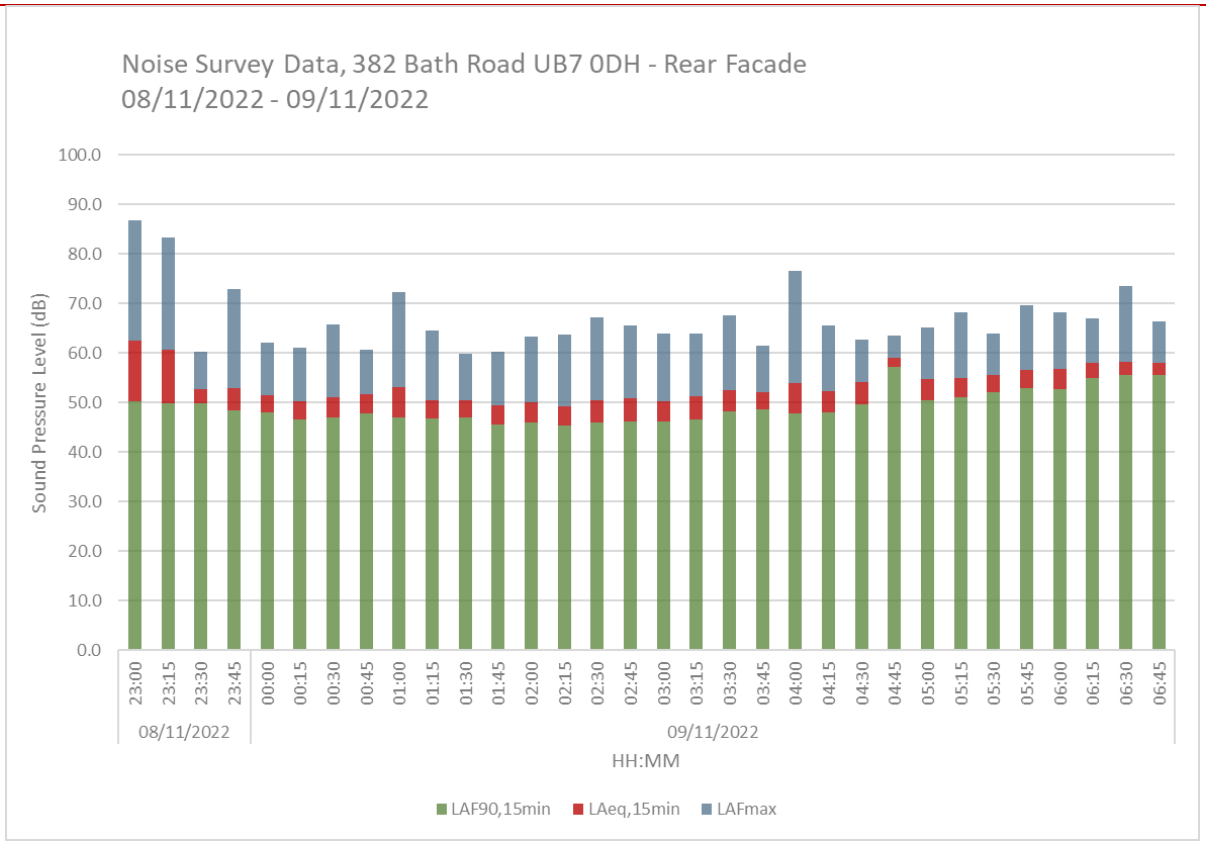


Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$
10/11/2022	07:00	68.9	83.8	60.6	71.6
	07:15	70.0	87.4	61.3	
	07:30	69.0	81.5	61.5	
	07:45	69.5	85.9	61.2	
	08:00	69.8	79.2	61.1	
	08:15	70.0	78.8	61.6	
	08:30	70.2	84.3	61.2	
	08:45	70.3	87.2	61.8	
	09:00	70.2	80.8	61.5	
	09:15	69.6	79.7	60.9	
	09:30	69.5	82.4	61.6	
	09:45	69.5	83.5	61.9	
	10:00	68.9	79.8	62.0	
	10:15	68.8	83.8	62.1	
	10:30	69.3	87.2	61.5	
	10:45	68.2	79.3	60.3	
	11:00	68.8	88.1	60.5	
	11:15	68.0	81.4	60.6	
	11:30	68.8	89.0	61.4	

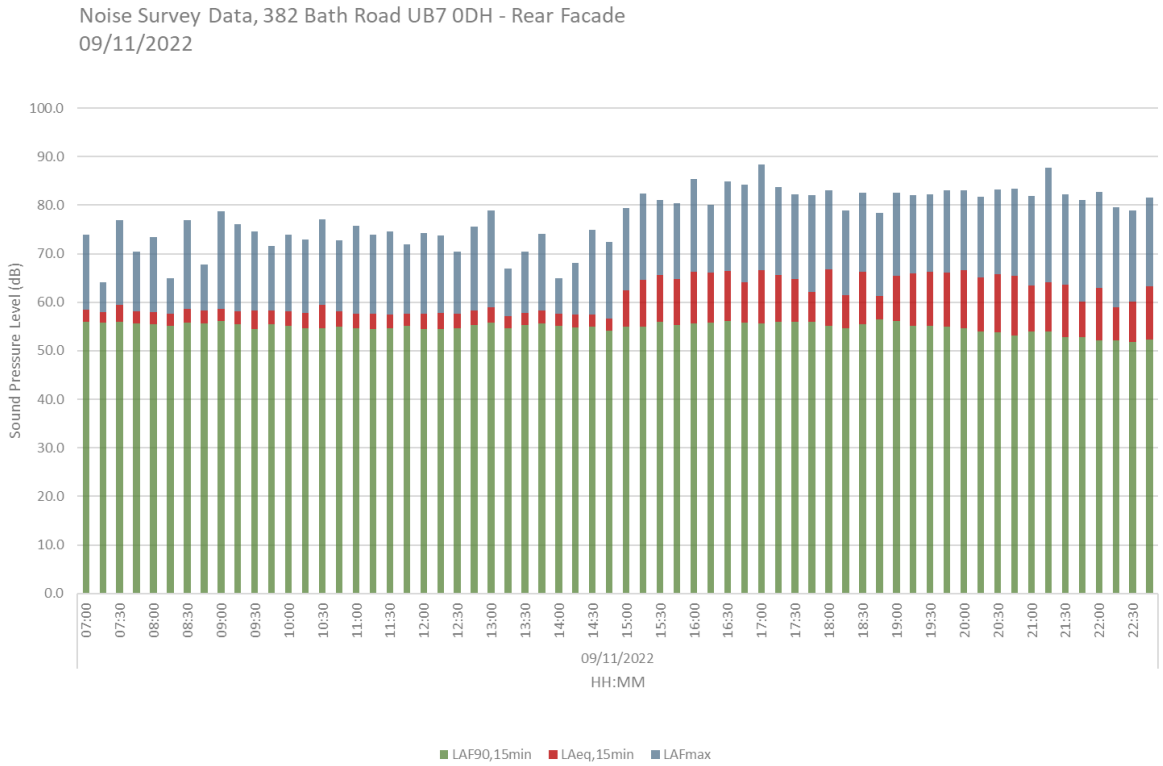
Rear Façade



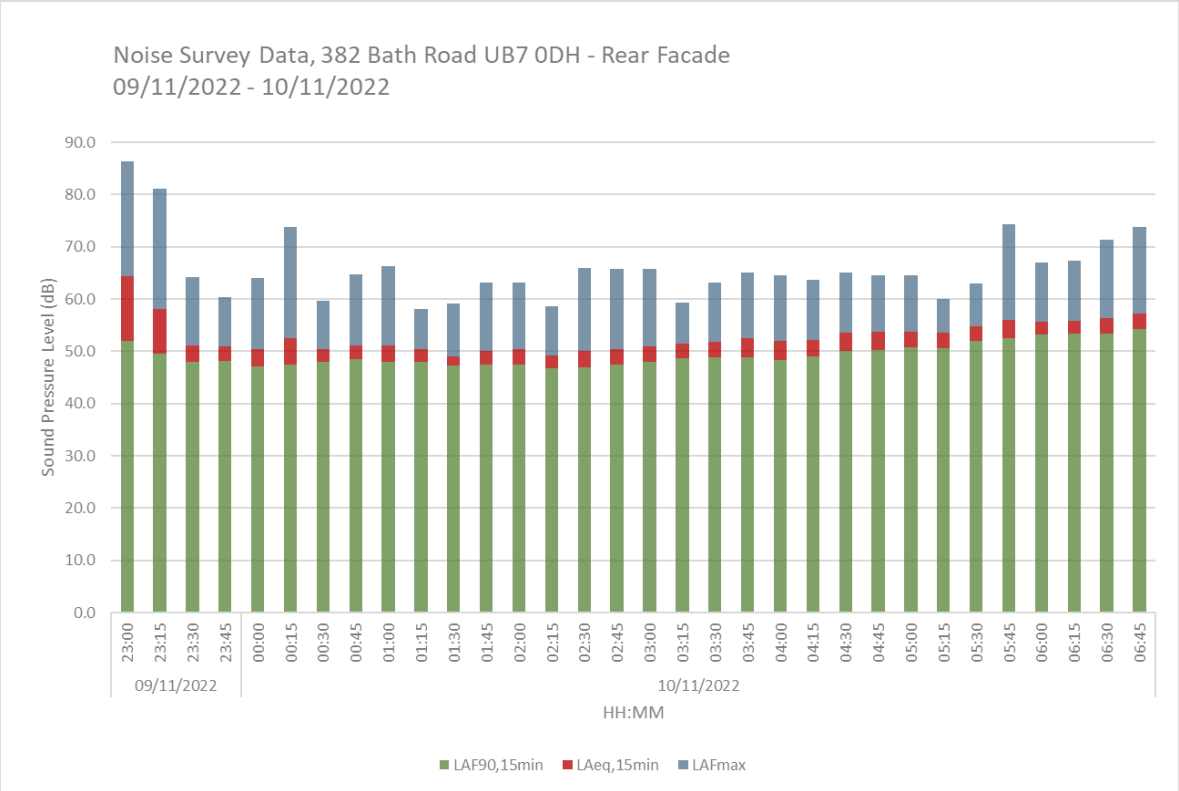
Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$	Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$
08/11/2022	12:45	59.5	71.9	56.6	63.1	08/11/2022	18:00	65.3	80.5	55.9	63.1
	13:00	59.3	73.1	56.6			18:15	64.8	84.5	54.7	
	13:15	59.5	72.6	55.9			18:30	64.4	82.4	56.3	
	13:30	60.1	74.2	56.5			18:45	62.3	81.4	55.1	
	13:45	59.8	70.4	57.0			19:00	65.2	84.8	56.4	
	14:00	60.7	73.4	57.6			19:15	66.8	83.8	56.6	
	14:15	62.2	77.8	58.6			19:30	65.7	82.8	54.8	
	14:30	60.4	74.5	57.8			19:45	65.3	82.4	55.1	
	14:45	59.7	69.9	56.4			20:00	65.9	81.9	54.5	
	15:00	64.8	82.8	55.2			20:15	66.3	81.0	54.5	
	15:15	67.1	82.8	55.5			20:30	66.3	81.8	54.4	
	15:30	62.6	80.4	55.9			20:45	64.7	81.2	53.3	
	15:45	66.1	80.7	56.8			21:00	61.9	84.5	52.3	
	16:00	65.9	82.9	55.9			21:15	60.1	79.6	52.8	
	16:15	64.1	83.0	56.0			21:30	60.3	79.1	54.0	
	16:30	65.7	83.6	56.9			21:45	64.5	93.3	54.1	
	16:45	66.1	81.3	58.3			22:00	64.0	84.2	53.4	
	17:00	66.7	89.4	56.9			22:15	63.9	85.6	52.8	
	17:15	67.5	84.7	56.3			22:30	61.4	80.4	53.3	
	17:30	66.0	83.7	55.4			22:45	63.7	85.8	51.9	
	17:45	65.6	83.5	55.6							



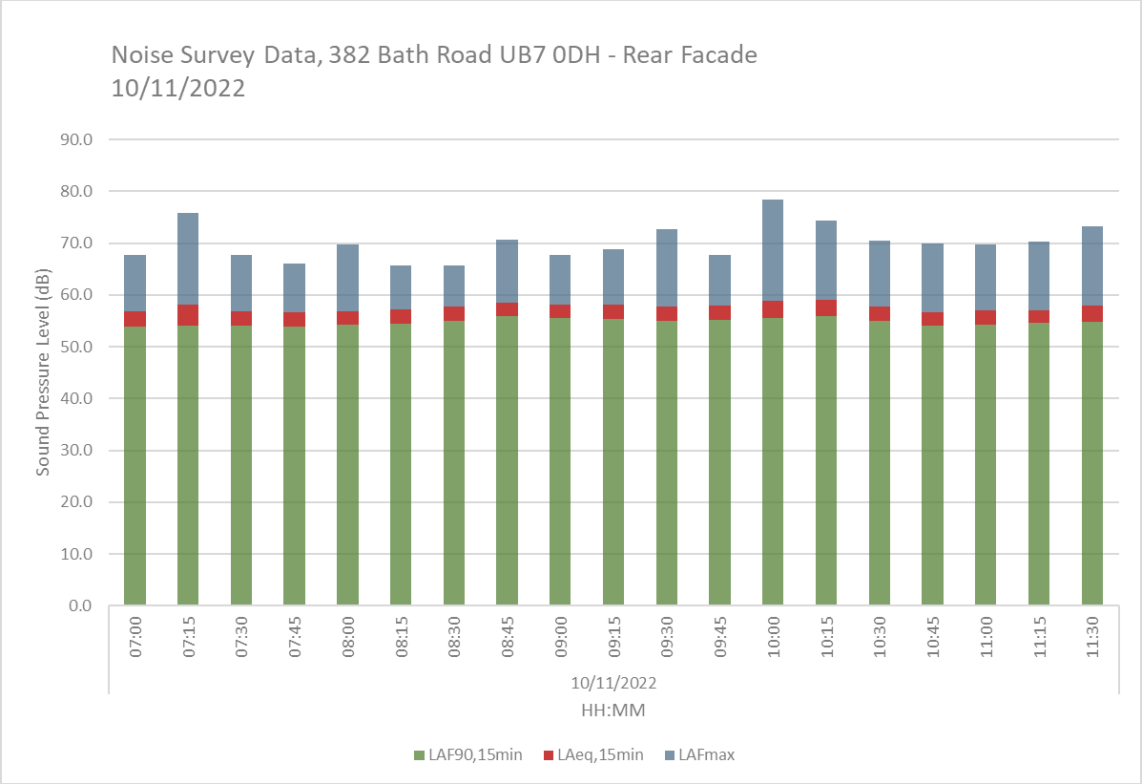
Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,8hour}$
08/11/2022	23:00	62.5	86.9	50.2	
	23:15	60.7	83.2	49.9	
	23:30	52.7	60.2	49.9	
	23:45	52.8	72.8	48.5	
09/11/2022	00:00	51.4	62.1	48.1	
	00:15	50.3	61.1	46.6	
	00:30	51.1	65.7	47.0	
	00:45	51.6	60.6	47.9	
	01:00	53.0	72.3	47.0	
	01:15	50.5	64.6	46.7	
	01:30	50.5	59.8	46.9	
	01:45	49.4	60.3	45.6	
	02:00	50.1	63.3	46.0	
	02:15	49.3	63.8	45.4	
	02:30	50.4	67.1	46.0	
	02:45	50.8	65.5	46.2	
	03:00	50.2	63.9	46.1	55.2
	03:15	51.2	63.8	46.6	
	03:30	52.5	67.6	48.3	
	03:45	52.1	61.5	48.6	
	04:00	53.9	76.5	47.9	
	04:15	52.4	65.6	48.1	
	04:30	54.1	62.7	49.6	
	04:45	58.9	63.6	57.2	
	05:00	54.7	65.0	50.4	
	05:15	55.0	68.2	51.0	
	05:30	55.6	64.0	52.0	
	05:45	56.6	69.6	52.9	
	06:00	56.7	68.2	52.7	
	06:15	58.0	66.9	55.0	
	06:30	58.2	73.6	55.5	
	06:45	58.0	66.3	55.6	



Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$	Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$
09/11/2022	07:00	58.5	74.0	55.9	62.6	09/11/2022	15:00	62.4	79.4	55.0	62.6
	07:15	57.9	64.0	55.8			15:15	64.6	82.4	55.0	
	07:30	59.4	76.9	56.0			15:30	65.6	81.0	55.9	
	07:45	58.1	70.4	55.6			15:45	64.8	80.3	55.3	
	08:00	58.0	73.4	55.4			16:00	66.3	85.3	55.7	
	08:15	57.7	65.0	55.1			16:15	66.1	80.0	55.8	
	08:30	58.6	76.9	55.8			16:30	66.4	84.9	56.1	
	08:45	58.4	67.8	55.7			16:45	64.2	84.2	55.8	
	09:00	58.7	78.7	56.2			17:00	66.6	88.4	55.6	
	09:15	58.1	76.1	55.5			17:15	65.6	83.7	55.9	
	09:30	58.3	74.5	54.5			17:30	64.8	82.2	56.0	
	09:45	58.3	71.5	55.5			17:45	62.1	82.1	55.9	
	10:00	58.2	73.9	55.2			18:00	66.8	83.1	55.1	
	10:15	57.8	72.9	54.6			18:15	61.5	78.9	54.6	
	10:30	59.5	77.1	54.6			18:30	66.3	82.5	55.5	
	10:45	58.1	72.8	54.9			18:45	61.3	78.5	56.4	
	11:00	57.6	75.7	54.7			19:00	65.4	82.5	56.1	
	11:15	57.6	74.0	54.5			19:15	65.9	82.0	55.1	
	11:30	57.5	74.6	54.7			19:30	66.3	82.2	55.1	
	11:45	57.6	71.9	55.2			19:45	66.1	83.0	55.0	
	12:00	57.6	74.3	54.5			20:00	66.7	83.1	54.6	
	12:15	57.8	73.7	54.5			20:15	65.2	81.7	54.0	
	12:30	57.7	70.5	54.6			20:30	65.7	83.3	53.8	
	12:45	58.3	75.6	55.3			20:45	65.4	83.4	53.1	
	13:00	59.0	79.0	55.8			21:00	63.4	81.9	53.9	
	13:15	57.1	67.0	54.7			21:15	64.2	87.7	53.9	
	13:30	57.9	70.5	55.3			21:30	63.7	82.2	52.8	
	13:45	58.3	74.1	55.7			21:45	60.1	81.1	52.8	
	14:00	57.6	65.0	55.1			22:00	63.0	82.7	52.1	
	14:15	57.5	68.0	54.8			22:15	58.9	79.5	52.2	
	14:30	57.4	74.9	54.9			22:30	60.0	78.9	51.9	
	14:45	56.6	72.4	54.1			22:45	63.3	81.6	52.3	



Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,8hour}$
09/11/2022	23:00	64.4	86.3	52.0	
	23:15	58.1	81.1	49.6	
	23:30	51.1	64.2	47.9	
	23:45	50.9	60.4	48.1	
10/11/2022	00:00	50.5	64.1	47.1	
	00:15	52.5	73.8	47.5	
	00:30	50.4	59.6	47.9	
	00:45	51.1	64.8	48.5	
	01:00	51.1	66.2	48.0	
	01:15	50.5	58.1	48.0	
	01:30	49.1	59.1	47.2	
	01:45	50.1	63.2	47.5	
	02:00	50.4	63.1	47.4	
	02:15	49.1	58.6	46.8	
	02:30	50.1	65.9	46.9	
	02:45	50.3	65.7	47.5	
	03:00	51.0	65.8	48.0	54.6
	03:15	51.5	59.2	48.6	
	03:30	51.9	63.1	48.9	
	03:45	52.5	65.1	48.8	
	04:00	52.1	64.5	48.3	
	04:15	52.2	63.6	49.0	
	04:30	53.5	65.0	50.1	
	04:45	53.7	64.6	50.2	
	05:00	53.7	64.6	50.7	
	05:15	53.6	60.1	50.6	
	05:30	54.8	63.0	51.9	
	05:45	56.0	74.3	52.5	
	06:00	55.7	66.9	53.2	
	06:15	55.9	67.4	53.3	
	06:30	56.4	71.3	53.3	
	06:45	57.3	73.8	54.2	



Date	Time	$L_{Aeq,15min}$	L_{AFmax}	$L_{AF90,15min}$	$L_{Aeq,16hour}$
10/11/2022	07:00	56.8	67.7	53.9	63.1
	07:15	58.2	75.9	54.0	
	07:30	56.9	67.7	54.0	
	07:45	56.6	66.1	53.9	
	08:00	56.9	69.8	54.2	
	08:15	57.3	65.7	54.5	
	08:30	57.8	65.6	55.1	
	08:45	58.5	70.6	56.0	
	09:00	58.2	67.8	55.5	
	09:15	58.1	68.8	55.3	
	09:30	57.8	72.6	55.0	
	09:45	57.9	67.7	55.2	
	10:00	59.0	78.5	55.6	
	10:15	59.0	74.3	56.0	
	10:30	57.9	70.6	55.0	
	10:45	56.7	69.9	54.1	
	11:00	57.1	69.7	54.3	
	11:15	57.1	70.3	54.7	
	11:30	57.9	73.2	54.9	