Aval Consulting Group.
Civil, Environment & Structural Engineers

Noise Impact Assessment

4-6 Ham Street, Richmond, TW10 SHT

Woodward Nursery School

January 2024

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1. Introduction

1.1 Overview

Aval Consulting Group Ltd has been commissioned to carry out a noise impact assessment at 4-6 Ham Street, Richmond, TW10 SHT, for the proposal of change of use from disused pub to a nursery school. This is hereby referred to as the ‘purposed development’.

1.2 Objective

The local authority requires evidence from a noise impact assessment that prevailing noise levels at the proposed site will not exceed internal noise levels suitable for habitation. BS:8233 guidance suggests that prior to developing a scheme, details of the measures should be considered so that internal sound levels within all habitable rooms do not exceed 35 dB(A) $L_{Aeq,16hours}$ (07:00- 23:00); and internal sound levels within all bedrooms that do not exceed 30 dB(A) $L_{Aeq,\ 8hours}$ (23:00-07:00).

The purpose of the noise impact assessment is to ensure that the proposed scheme and its usage are suitable for habitation in relation to the prevailing noise in the surrounding area’s environment. If needed, outline mitigation measures will be provided.

Predicted noise impact will be determined at the proposed development through the following assessments:

- 24-hour background survey
- Predicted internal noise levels as per BS:8233
- Noise limits from Acoustic design of schools: performance standards: Building Bulletin 93 (BB93)
- Assessment of night-time noise events/exceedances as per ProPG and WHO Guidelines for Community Noise
- Construction Measures as per BS:5228

1.3 Site Proposal and Location

Figure 1.1 shows the proposed development location. The site is currently a disused 2 storey pub, with residential developments adjacent and opposite the road. There are no nearby railway lines near the property and Grey Court School at around 180m away from the site. It was noted that noise from the school could be heard whilst on site.

The predominant noise sources on site were observed to be:

- Traffic noise on Ham Street
- Traffic noise on Ham Common
- Noise from Grey Court School

Figure 1.1 Site location (Source : Google Maps)

2. Relevant Noise Standards

This section summarises all legislation, policy, statutory and non-statutory guidelines relevant to the proposed development. Furthermore, the latest regional and local planning policy guidance specifically applicable to the proposed development has been reviewed.

2.1 The 'National Planning Policy Framework (NPPF)

The updated 2021 version of the 'National Planning Policy Framework (NPPF)'[1] contains information and general guidance to Local Authorities in relation to considering and taking into account noise. The National Planning Policy Framework (NPPF) guidance reinforces that noise should be taken into account considering planning policies and decisions. Some of the guidance contained in the 'National Planning Policy Framework (NPPF)' includes the following:

- Paragraph 174e: "…*preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability*…"
- Paragraph 185a,b: "*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should*:

  (a) *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life…*

  (b) *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;…*"
- Paragraph 187: *Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues, and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.*

In conjunction with the 'National Planning Policy Framework (NPPF)', 'The Noise Policy Statement for England (NPSE)'[2], dated March 2010, states the following regarding a long-term vision of government noise policy:

"Noise Policy Statement for England Aims:

- *The first aim of the NPSE:*

  Avoid significant adverse impacts on health and quality of life from environmental, neighbour, and neighbourhood noise within the context of Government policy on sustainable development.
- *The second aim of the NPSE:*

  Mitigate and minimize adverse impacts on health and quality of life from environmental, neighbour, and neighbourhood noise within the context of Government policy on sustainable development.

[1] The National Planning Policy Framework (2021) https://www.gov.uk/guidance/national-planning-policy-framework
[2] Noise Policy Statement for England (NSPE) https://www.gov.uk/government/publications/noise-policy-statement-for-england

- *The third aim of the NPSE:*

  Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour, and neighbourhood noise within the context of Government policy on sustainable development."

In terms of the NPSE, the impact of noise can be categorised by the following terms:

- NOEL – No Observed Effect Level – The level where no effect can be detected
- LOAEL – Lowest Observed Adverse Effect Level – The level where adverse effects on health and quality of life can be detected
- SOAEL – Significant Observed Adverse Effect Level – The level where significant adverse effects on health and quality of life may occur.

The NPSE further states 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."

No specific guidance is detailed or given in the 'National Planning Policy Framework (NPPF)', or 'The Noise Policy Statement for England (NPSE)' in terms of acceptable acoustic criteria/noise criteria in order to achieve the 'NOEL, LOAEL, or SOAEL'. Therefore, it is considered necessary to refer to alternate national guidance, preferably standardised or regulated such as an appropriate British Standard (BS), or in the absence of this, alternate World Health Organisation (WHO) guidelines, etc.

The British Standard 8233: Sound Insulation and Noise Reduction for Buildings/Code of Practice BS 8233: Sound Insulation and Noise Reduction for Buildings/Code of Practice states that for different spaces, there might be a range of noise levels that are considered acceptable.

2.2 WHO 'Guidelines for Community Noise'

Where noise is assessed against the 'Absolute Level', then this can be split into separate daytime and night-time legislation. The WHO 'Guidelines for Community Noise' state in 4.2.7 "Annoyance Responses" that:

"During the daytime, few people are seriously annoyed by activities with L_{Aeq} levels below 55 dB; or moderately annoyed with L_{Aeq} levels below 50dB. Sound pressure levels during the evening and night should be 5-10 dB lower than during the day…."

The guidance goes on to provide a daytime[3] internal acoustic criteria relative to critical health effect(s) that of 35 dB $L_{Aeq,16\ hour}$, and a night-time[4] level of 30 dB $L_{Aeq,8\ hour}$ / 45 dB L_{AFmax} linked with dwelling indoors. Therefore, assuming a maximum external noise level of 50 dB $L_{Aeq,t}$ during the daytime, (considering a 15 dB reduction in noise via a partially open window) an internal noise level of 35 dB $L_{Aeq,t}$ should be achieved.

During the night-time periods, a further publication; WHO Night Noise Guidelines For Europe' published in 2009 states that:

"Below the level of 30 dB $L_{night,outside}$, no effects on sleep are observed except for a slight increase in the frequency of body movements during sleep due to night noise. There is no sufficient evidence that the biological effects observed at the level below 40 dB $L_{night,outside}$ are harmful to health. However, adverse health effects are observed at the level above 40 dB $L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives. Therefore, 40 dB $L_{night,outside}$ is equivalent to the LOAEL for night noise….. The LOAEL of night noise, 40 dB $L_{night,outside}$, can be considered a health-based limit value of the night noise guidelines (NNG) necessary to protect the public,

[3] daytime is typically between 07:00 h and 23:00 h.
[4] night-time is between 23:00 h and 07:00 h.

including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise."

Therefore, where absolute levels need to be referenced, a maximum daytime noise limit of 50 dB $L_{Aeq,t}$ can be considered, with the LOAEL for night of 40 dB $L_{night,outside}$ being considered.

2.3 IEMA (Institute of Environmental Management & Assessment)

IEMA also defines the sensitivity of receptors according to the table below

Very Substantial	Greater than 10 dB L_{Aeq} change in sound level perceived at a receptor of great sensitivity to noise
Substantial	Greater than 5 dB L_{Aeq} change in sound level at a noise-sensitive receptor, or a 5 to 9.9 dB L_{Aeq} change in sound level at a receptor of great sensitivity to noise
Moderate	A 3 to 4.9 dB L_{Aeq} change in sound level at a sensitive or highly sensitive noise receptor, or a greater than 5 dB L_{Aeq} change in sound level at a receptor of some sensitivity
Slight	A 3 to 4.9 dB L_{Aeq} change in sound level at a receptor of some sensitivity
None/Not Significant	Less than 2.9 dB L_{Aeq} change in sound level and/or all receptors are of negligible sensitivity to noise or marginal to the zone of influence of the proposals

Table 2.1 Effect Descriptors (Guidelines For Environmental Noise Assessment, 2014)

2.4 Acoustic design of schools: performance standards – Building bulletin 93 – V17 2015

The Building Regulations require that all spaces should meet the performance standards for indoor ambient noise level, airborne and impact sound insulation, and reverberation time.

These values are for rooms that are finished, furnished for normal use, but unoccupied. Where rooms are to be used without furnishings, the performance standards normally apply in the empty condition. Normal furnishing is not anticipated to have any significant effect on indoor ambient noise levels or sound insulation but may reduce measured reverberation times by providing diffusion and absorption.

The School Premises Regulations and the Independent School Standards also require that consideration be given to operational noise. To comply with the School Premises Regulations and the Independent School Standards open plan spaces should additionally meet the performance standards for speech transmission index.

Guidance on the control of operational noise is provided in 'Acoustic Design of Schools: A Design Guide'. Section 2 describes acoustic tests that can be used to demonstrate compliance with the insitu performance standards in this section. It is strongly recommended that the client should require acoustic testing to be carried out as part of the building contract, because testing of the completed construction is the best practical means of ensuring that it achieves the design intent.

Further guidance is included in 'Acoustic Design of Schools: A Design Guide'. This provides additional information on the acoustic requirements and design of buildings for education purposes, on how to comply with these acoustic standards, and on testing / commissioning procedures. The figures given in the tables for refurbishment should not normally be used for new build unless there are over-riding educational, environmental or health and safety reasons. The refurbishment standards are the minimum acceptable standard for Building Regulations compliance purposes for refurbishments to allow for difficulties of construction and buildings with a short residual life.

However, where possible the target for refurbishment should be at least the new build standard where new elements of the building such as ceilings are installed during refurbishment. For example, there is considerable educational benefit in achieving the reverberation times for new build in refurbished teaching spaces. There may also be considerable benefit in exceeding the Building Regulations standards for new build, for example music accommodation particularly where required for community use and third-party lettings may need to be of a higher standard than that found in most schools. Overall, the Building Regulations standards should be regarded as minimum standards and there is often considerable benefit in improving on them.

3. Noise Survey

3.1 Overview

This section provides the details of the methodological approach taken to assess the anticipated noise levels produced by the site, as well as the prevailing acoustic environment representative of that where existing noise-sensitive receptors are present. The 24-hour monitoring of noise levels at the site establishes the key noise indicators namely $L_{Aeq,T}$, $L_{A90,T}$, $L_{A10,T}$ and L_{AFmax}, as described in Appendix A.

3.2 Background Noise Monitoring and Nearest Receptors

The 24-hour background noise monitoring survey was carried out in the existing site, in a location deemed representative of the background noise level that would be experienced by the nursery receptors in the proposed development.

It is noted that the children will be using the exterior spaces for play on the ground floor and first floor, therefore the nearest receptor would be considered as No. 4 Ham Street and No. 12 Ham Street and No. 27 Selby House.

Both noise monitors were installed in restricted spaces hence free-field conditions were not achieved, therefore, a correction factor of 3dB has been applied.

- Location 1 – Facing towards Ham Street
- Location 2 – Facing towards the rear of the development.

Figure 3.1 Noise monitoring locations

3.3 Noise Survey Periods

Noise monitoring was carried out for 24 hours to determine the prevailing background levels. Details of the survey period have been tabulated below.

Locations	Start Date	Start Time	End Date	End Time
1	3/7/23	10:50	4/7/23	10:50
2	3/7/23	10:50	4/7/23	10:50

Table 3.3 Noise Survey Periods

3.4 Weather Conditions and observations

During the 24-hour survey, it mostly clear, with some cloud in the early evening. Wind speeds reached a maximum of 5 m/s, temperature ranged from an overnight low of 6 C to daytime high of 15 C, 0 mm precipitation was recorded (source: Worldweatheronline). Wind direction from the start to the end was south southeast SSE.

Weather conditions throughout this survey period were deemed suitable for the measurement of environmental noise in accordance with BS7445: Description and Measurement of Environmental Noise.

3.5 Details of Noise Monitoring Equipment

The details of the equipment used for all noise monitoring have been tabulated below. The sound level meter used for this survey was a Class 1 device which has been laboratory calibrated, as well as field calibrated on site before and after monitoring (no calibration drift was recorded).

Equipment	Serial Number
BSWA 308 Class 1 Sound Level Meter	590145
BSWA 308 Class 1 Sound Level Meter	580276
BSWA CA111 Class 1 Calibrator (UKAS)	550282

Table 3.4 Noise Equipment Details

4. Survey Results

4.1 Background noise levels

Measurements were obtained in 1 second intervals and have been summarised below for the daytime and night-time values. A graph is presented in Figure 4.2 for the full 24-hour period (in 5-minute intervals), with a second graph in Figure 4.3 isolating the LAFmax events (1-minute intervals) during the night-time period.

	Noise Monitoring Location 1		Noise Monitoring Location 2	
Indicator All values in dB(A) (3dB correction applied)	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
L_{Aeq}	53	43	48	40
L_{A10}	56	41	51	43
L_{A90}	37	27	39	27
L_{Amax}	87	75	78	70

Table 4.1 Background noise survey results

	Noise Monitoring Location 1	Noise Monitoring Location 2
Indicator All values in dB(A) (3dB correction applied)	Daytime (22:00 – 23:00)	Daytime (22:00 – 23:00)
L_{Aeq}	48	42
L_{A10}	50	45
L_{A90}	40	35
L_{Amax}	74	67

Table 4.2 Lowest Hour background noise survey results

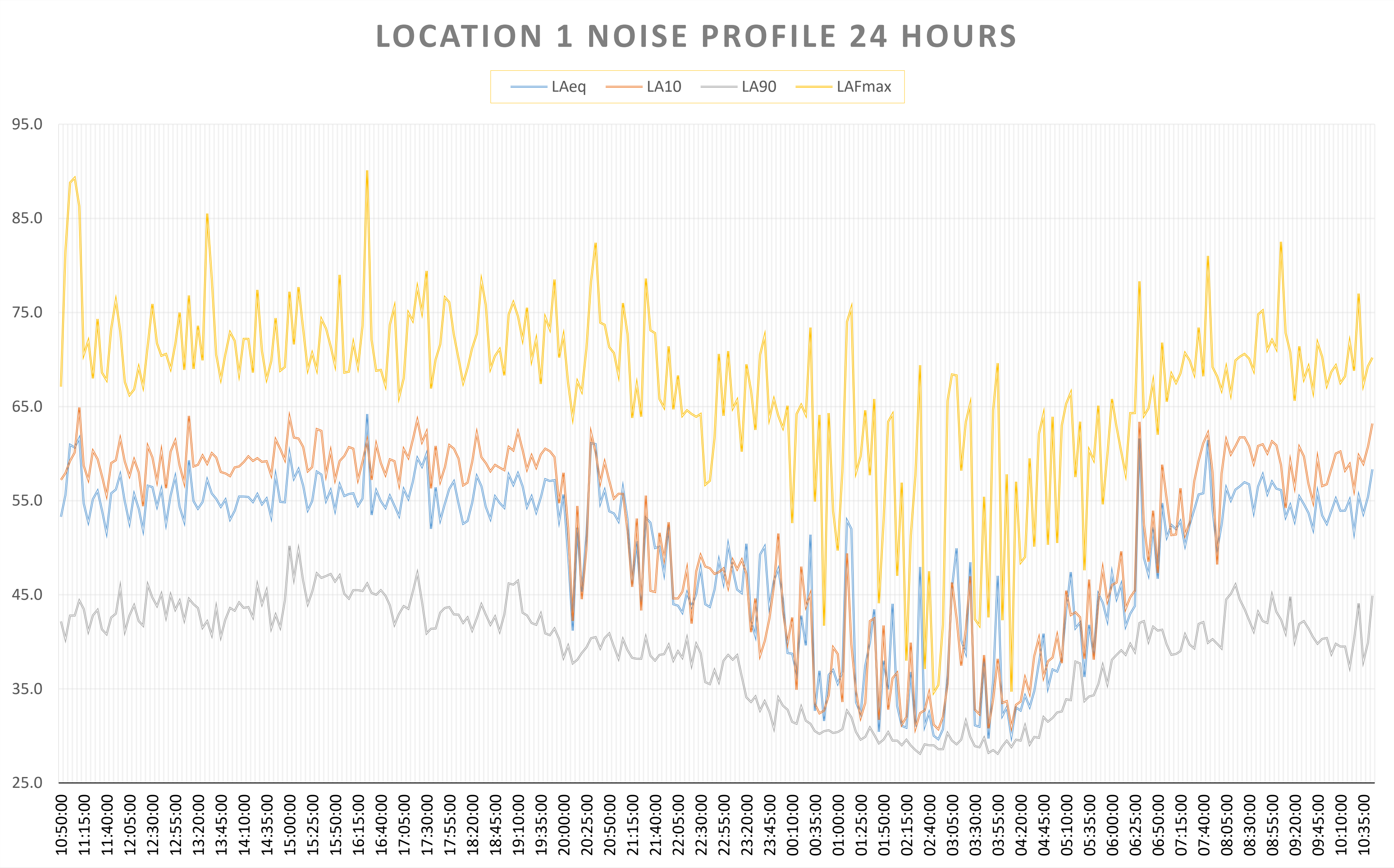
4.2 Playground noise levels

Measurements were obtained from WBM Acoustic Consultants Noise Impact Survey & Assessment report of Rothersthorpe Play Area on 15 August 2017 by Rachel Canham BEng MSc CEng FIOA. As there are no guidelines on the noise measurement of playgrounds, this is considered a representative example of expected results on the purposed development. The surveyor was Rachel Canham. Equipment used was a Norsonic 140 Sound Level Meter (1403136) and a Norsonic 1251 Calibrator (31992) with 0.1 dB(A) drift recorded.

Survey Location was approximately 2m from the end of the play area and deemed to be in free-field conditions, hence no penalties have been applied.

Survey Results	$L_{Aeq, 5 mins}$	$L_{Amax,f}$
Morning break, children playing outside, 16 children with 3 members of staff	62-68 dB Average 65 dB	78-88 dB
Children arriving, outdoor play (around 11 children) + staff supervision	64-66 dB Average 65 dB	81-84 dB

Table 4.2 Playground noise survey results from WBM Acoustic Consultants in February 2017


LOCATION 1 NOISE PROFILE 24 HOURS
LAeq
LA10
LA90
LAFmax
95.0
85.0
75.0
65.0
55.0
45.0
35.0
25.0
10:50:00
11:15:00
11:40:00
12:05:00
12:30:00
12:55:00
13:20:00
13:45:00
14:10:00
14:35:00
15:00:00
15:25:00
15:50:00
16:15:00
16:40:00
17:05:00
17:30:00
17:55:00
18:20:00
18:45:00
19:10:00
19:35:00
20:00:00
20:25:00
20:50:00
21:15:00
21:40:00
22:05:00
22:30:00
22:55:00
23:20:00
23:45:00
00:10:00
00:35:00
01:00:00
01:25:00
01:50:00
02:15:00
02:40:00
03:05:00
03:30:00
03:55:00
04:20:00
04:45:00
05:10:00
05:35:00
06:00:00
06:25:00
06:50:00
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10:10:00
10:35:00

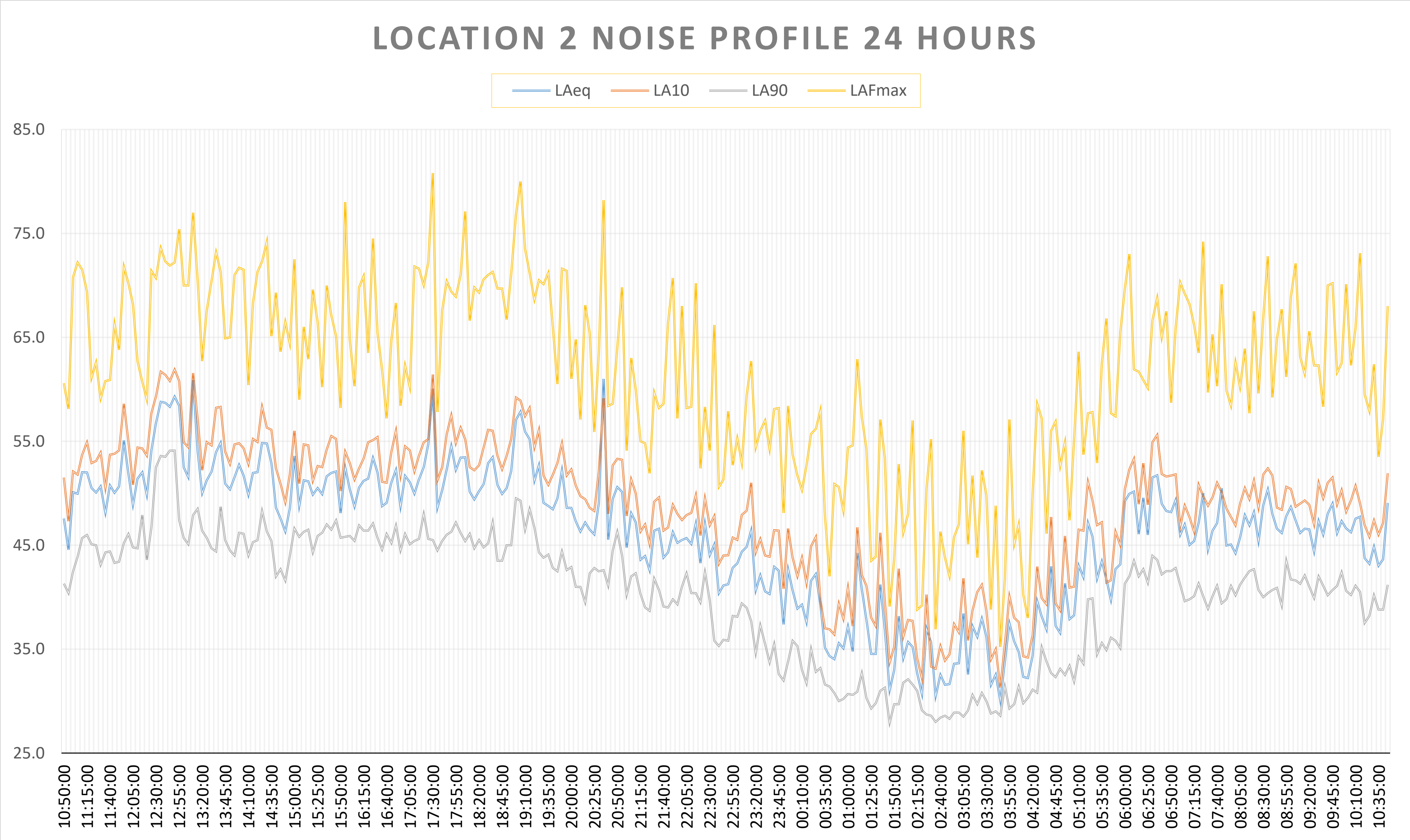
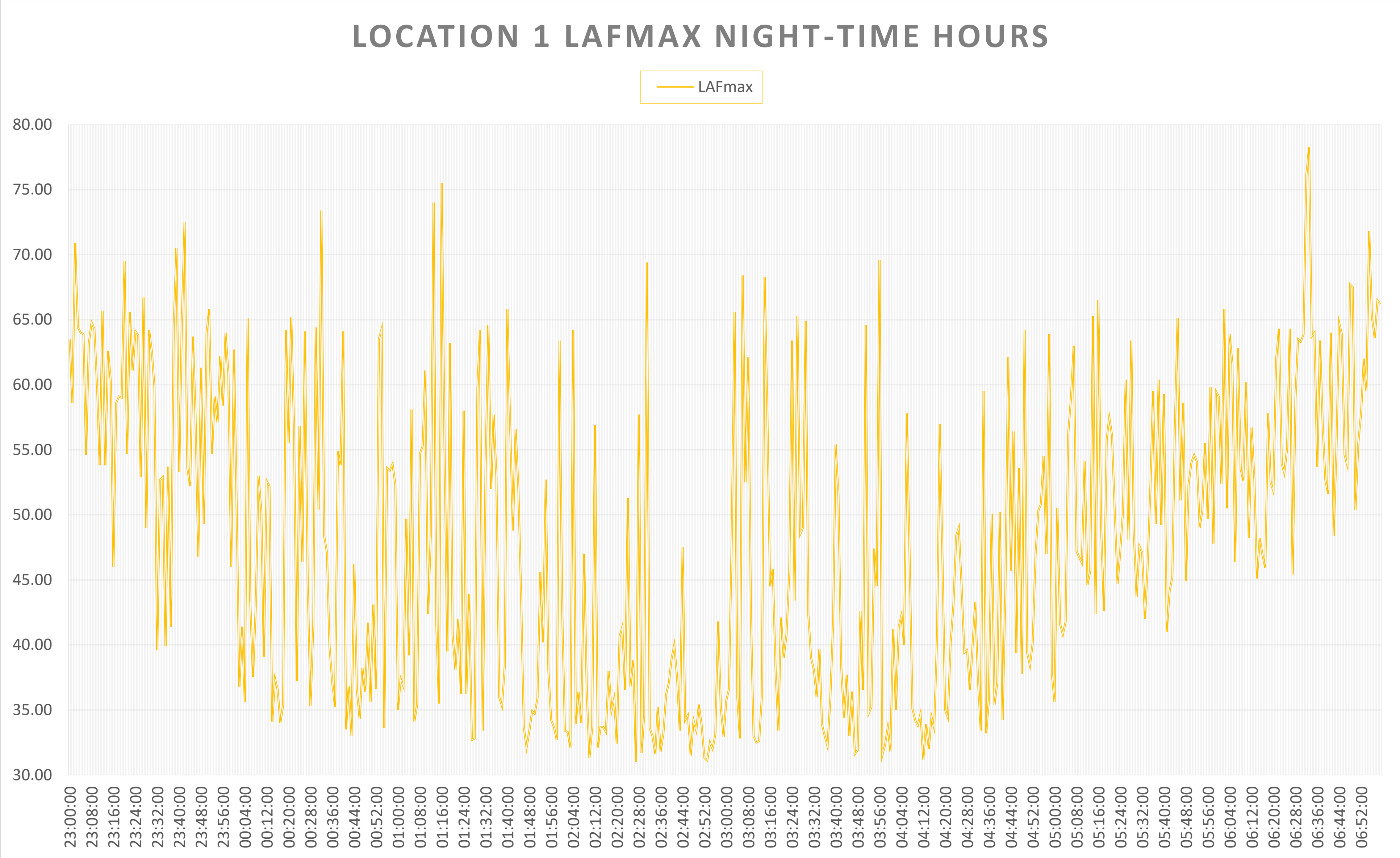


Figure 4.2 Background survey 24-hour noise profile graphs


LOCATION 1 LAFMAX NIGHT-TIME HOURS
LAFmax
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
23:00:00
23:08:00
23:16:00
23:24:00
23:32:00
23:40:00
23:48:00
23:56:00
00:04:00
00:12:00
00:20:00
00:28:00
00:36:00
00:44:00
00:52:00
01:00:00
01:08:00
01:16:00
01:24:00
01:32:00
01:40:00
01:48:00
01:56:00
02:04:00
02:12:00
02:20:00
02:28:00
02:36:00
02:44:00
02:52:00
03:00:00
03:08:00
03:16:00
03:24:00
03:32:00
03:40:00
03:48:00
03:56:00
04:04:00
04:12:00
04:20:00
04:28:00
04:36:00
04:44:00
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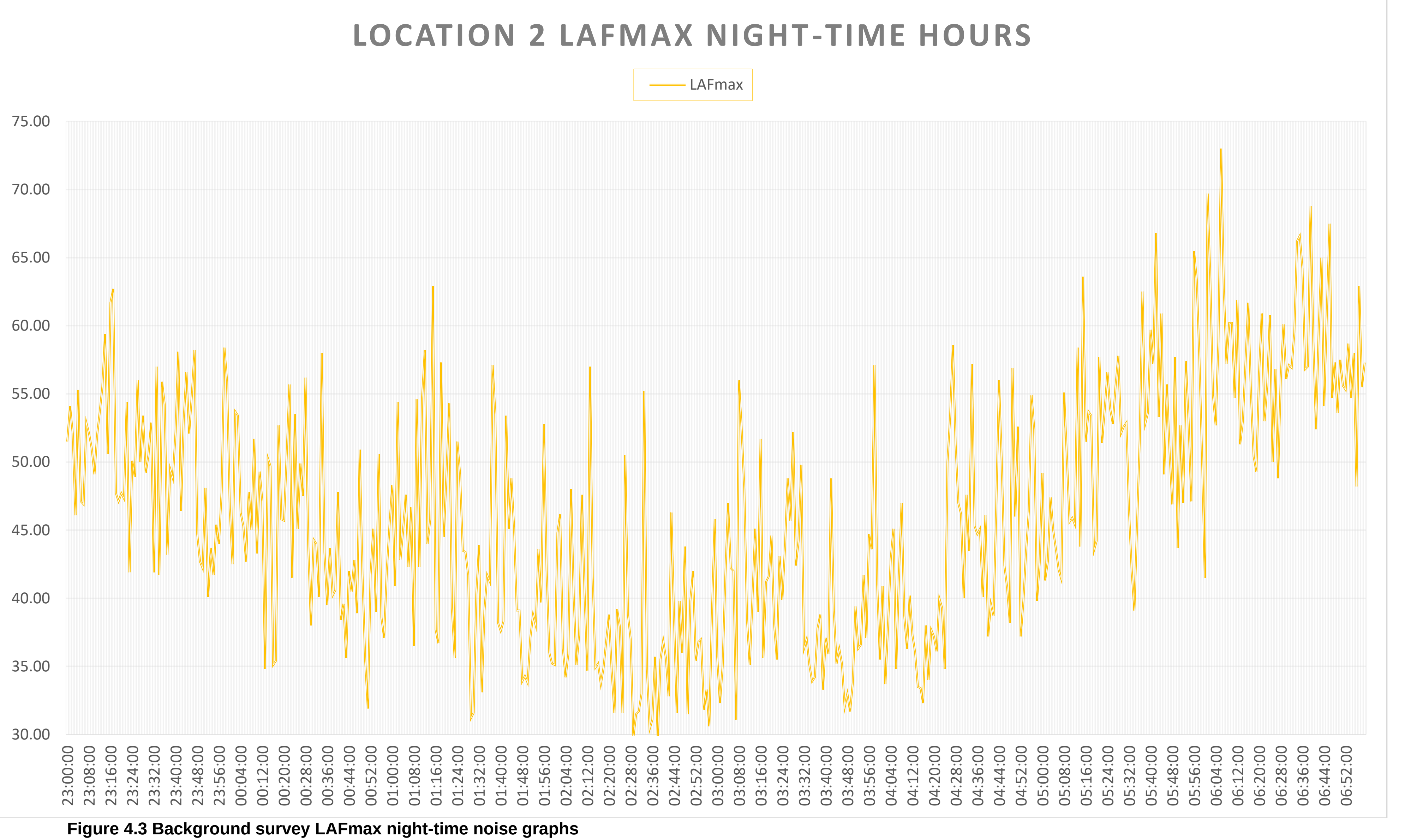


Figure 4.3 Background survey LAFmax night-time noise graphs

5. Noise Impact Assessment

The measured external noise levels have been compared with the BB93 target internal noise levels (see Section 2 of this Report) to derive the required noise reduction of façade/windows. As the purposed development is considered a change of use, indoor ambient noise levels for refurbishments have been used to assess the noise impact. Night-time levels have not been considered for this assessment as the purposed development is not commencing to operate during the night-time.

The internal target levels for Nursery School Rooms are based on guidelines laid out by BB93:

- Upper limit for the indoor ambient noise levels for new builds: 35 dB(A)
- Upper limit for the indoor ambient noise levels for refurbishments: 40 dB(A)

5.1 Attenuation Requirements based on External Noise for façade towards Ham Street and side facades.

Referring to Section 4 of this Report and considering the nature of the noise from the external surroundings, the prevailing levels of noise recorded were compared to the BB93 criteria mentioned in the above paragraph.

It was found that a minimum attenuation level of 53 – 40 = **13 dB** is required during daytime.

Therefore, based on the highest outcome from the above assessments, a noise reduction of **13 dB(A)** is required to prevent noise disturbance internally during the daytime hours.

5.2 Attenuation Requirements based on External Noise for façade towards the rear of the development.

Referring to Section 4 of this Report and considering the nature of the noise from the external surroundings, the prevailing levels of noise recorded were compared to the BB93 criteria mentioned in the above paragraph.

It was found that a minimum attenuation level of 48 – 40 = **8 dB** is required during daytime.

Therefore, based on the highest outcome from the above assessments, a noise reduction of **8 dB(A)** is required to prevent noise disturbance internally during the daytime hours.

5.3 Office Attenuation Requirements based on External Noise for façade towards Ham Street.

Referring to Section 4 of this Report and considering the nature of the noise from the external surroundings, the prevailing levels of noise recorded were compared to the BB93 criteria.

It is noted that the commercial office units only operate during the daytime, and typically within the hours of 8am – 6pm. Therefore, only daytime readings have been considered. 35 dB is the limit for offices.

Hence was found that a minimum attenuation level of 53 – 35 = **18 dB** is required during daytime.

Therefore, based on the highest outcome from the above assessments, a noise reduction of **18 dB(A)** is required to prevent noise disturbance internally during the daytime hours.

5.4 Noise Impact Assessment for the ground floor playground area.

Activity noise levels have been retrieved from WBM consultants' results that was conducted a children's nursery, February 2017 at Kettering, at a distance at approximately 2m from the end of the play area.

The noise measurements were undertaken with children playing in the nursery play area.

It is noted that for the purposed development that classes will use the outdoor space at an allocated time hence the maximum number of children is considered as 16 for the ground floor playground area. The maximum number of children was provided by the client for all play areas. As the source measurement and purposed development have the same number of children, no corrections have been applied.

Noise data from WBM involves 16 children with 3 members of staff, with $L_{Aeq,\,5min}$ of 65 dB and $L_{Amax,f}$ between 78 – 88 dB.

Considering the nature of the noise from the external surroundings, the prevailing levels of noise recorded were compared to the BB93 criteria mentioned in the above paragraph. It was found that a minimum attenuation level of 65 – 37 = **28 dB** is required during daytime.

The prevailing levels of noise recorded were compared to the BB93 criteria mentioned in the above to protect the nursery school rooms inside. It was found that a minimum attenuation level of 65 – 40 = **25 dB** is required during daytime.

5.5 Noise Impact Assessment for the ground floor exterior play area.

It is noted that for the purposed development that Class 2 will use the exterior play area, however there will be a maximum of 8 children will be using the external area.

Noise data from WBM involves 16 children with 3 members of staff, with $L_{Aeq,\,5min}$ of 65 dB and $L_{Amax,f}$ between 78 – 88 dB. 8 children is calculated as L_{Aeq} of 62 dB, dividing the noise by amount of children in the source and after.

Considering the nature of the noise from the external surroundings, the prevailing levels of noise recorded were compared to the BS:8233 criteria mentioned in the above paragraph. It was found that a minimum attenuation level of 62 – 39 = **23 dB** is required during daytime.

The prevailing levels of noise recorded were compared to the BB93 criteria mentioned in the above to protect the nursery school rooms inside. It was found that a minimum attenuation level of 62 – 40 = **22 dB** is required during daytime.

5.6 Noise Impact Assessment for the first-floor play area.

It is noted that for the purposed development that Class 1 will use the exterior play area, however there will be a maximum of 10 children will be using the external area.

Noise data from WBM involves 16 children with 3 members of staff, with $L_{Aeq,\,5min}$ of 65 dB and $L_{Amax,f}$ between 78 – 88 dB. 10 children is calculated as L_{Aeq} of 63 dB dividing the noise by amount of children in the source and after.

Considering the nature of the noise from the external surroundings, the prevailing levels of noise recorded were compared to the BS:8233 criteria mentioned in the above paragraph. It was found that a minimum attenuation level of 63 – 39 = **24 dB** is required during daytime.

The prevailing levels of noise recorded were compared to the BB93 criteria mentioned in the above to protect the nursery school rooms inside. It was found that a minimum attenuation level of 63 – 40 = **23 dB** is required during daytime.

5.7 Noise Impact from Traffic Count.

The main source of noise would be from the cars, with parents dropping off their children and also staff during the AM and PM. Since the purposed development will only be operating during the daytime, there will be no night-time impact from traffic. The corresponding average LA10 noise level during the operational time of the development was measured as 59 dB.

Traffic count conducted by Aval Consulting Group Ltd. shows 6 cars in the AM and 8 cars in the PM. Equalling to 14 cars in total.

Using the formula of predicted noise = 29 + 10log(Q), the predicted noise level during a fully operational site would be 40.4 dB. A distance correction factor (approximately 3m from the source of noise) has been applied to calculate the noise level at the NSR (nursery):

40 – 10log (3/1) = 35dB during daytime. Since the vehicle movements are intermittent in nature, it has been deemed appropriate to have an intermittency penalty of +3dB as per the guidance provided in BS4142 and therefore, the noise impact levels at the NSR were calculated to be 38dB.

As the existing background level is higher than the traffic count, no further mitigation is required.

6. Outline Mitigation Measures

Mitigation measures need to be in place to minimise the potential negative impacts in order to ensure that the internal noise limits are achieved, we would recommend the following scheme of mitigation measures as outlined below.

Although NPSE from the National Planning Policy Framework have presented NOEL, SOEL, etc. There are no distinctive figures hence it was proposed that IEMA table have been used.

6.1 Non-Glazed Elements

The non-glazed building façade elements are being retained in the refurbishment of the proposed development and consist of masonry and concrete. Based on the external noise levels, all external walls must achieve an acoustic performance of > **25 dB** for the facades towards Ham Street and other facades and an acoustic performance of > **23 dB** for the facades towards the rear of the development.

As the current non-glazed elements are being retained, the expected attenuation should provide at least 30 dB of noise attenuation.

6.2 Glazed Elements

It is proposed that glazing with an acoustic performance of > **25 dB** should be implemented for the glazed elements towards Ham Street and other facades.

It is proposed that glazing with an acoustic performance of > 23 **dB** should be implemented for the glazed elements towards Sutton Park Road. Examples of glazing options to achieve this acoustic performance are attached in Appendix C.

Glazed elements at the office facades towards Ham Street requires an acoustic performance of > **25 dB**.

6.3 Mitigation for ground floor playground area

Mitigation for the ground floor playground area to the NSR considered to be 4 Ham Street at a distance of 2m in order to protect the outdoor amenity area of the NSR.

It is purposed that an acoustic fencing with the minimum noise attenuation performance of 28 dB will be required to protect the outdoor amenity area. Examples can be found in Appendix D.

Barrier Calculations have been used to calculate the noise at the NSR property, it was found that a sound power level of 79 dB, calculated using the formula below:

Lw = Lp + 10 Log(A),

Where A = 2*π*R. For half spherical point source radiating in half space.

R is the distance from the source.

Lp is taken as 65 dB.

The noise at the receiver is calculated to be 42 dB, meaning that the attenuation of the façade will have to have a performance of 12 dB which should be easily achieved. Barrier Calculation can be found in Appendix E.

6.4 Mitigation for ground floor exterior play area

Mitigation for the ground floor playground area to the NSR considered to be 27 Selby House at a distance of 2m in order to protect the outdoor amenity area of the NSR.

It is purposed that an acoustic fencing with the minimum noise attenuation performance of 28 dB will be required to protect the outdoor amenity area. Examples can be found in Appendix D.

Barrier Calculations have been used to calculate the noise at the NSR property, it was found that a sound power level of 79 dB, calculated using the formula below:

The noise at the receiver is calculated to be 42 dB, meaning that the attenuation of the façade will have to have a performance of 12 dB which should be easily achieved. Barrier Calculation can be found in Appendix E.

6.5 Mitigation for first floor play area

Mitigation for the ground floor playground area to the NSR considered to be 8 Ham Street at a distance of 2m in order to protect the outdoor amenity area of the NSR.

It is purposed that an acoustic fencing with the minimum noise attenuation performance of 28 dB will be required to protect the outdoor amenity area. Examples can be found in Appendix D.

6.6 Separating Floors and Walls

For nurseries where school rooms share a wall, staircase, corridor, or floor, it is necessary that separating elements are designed in accordance with the BB93.

For refurbishment nursery school rooms that have a medium noise tolerance in the receiving room requires an average an airborne acoustic performance of $D_{nT,w}$ > **40 dB,** and an impact $L_{nT,w}$ < **65 dB**.

The maximum mid-frequency performance reverberation time requirements for nursery school room for refurbishments is T_{mf} seconds **≤ 0.8 s**.

6.7 Ventilation Strategy

6.7.1 Passive and Mechanical

Based on the findings in Sections 4 and 5 of this report, the noise from building services under normal conditions should meet their limits for indoor ambient noise levels from BB93. The table below shows the operating condition, ventilation system and the noise level limits of each variation.

Condition	Ventilation System	Noise Level Limits dB
Normal - ventilation for normal teaching and learning activities	Mechanical	40
	Natural	45
	Hybrid	Mechanical noise value: 40
		Total noise value: 45
Summertime - ventilation under local control of teacher to prevent overheating – allowable during the hottest 200 hrs of the year	Mechanical	45
	Natural or Hybrid	≤55
Intermittent boost – ventilation under local control of teacher for dilution of fumes during practical activities as in practical spaces for science, art, food technology and design and technology	Mechanical	45
	Natural or Hybrid	≤55

Table 6.1 Ventilation system noise level limits.

6.8 Construction Phase Mitigation Measures

6.8.1 Noise

The effects of noise can vary from a person to person. The negative impacts include a sensation of loudness, potential interference with speech communication, disturbance of work or leisure, and disturbance of sleep. It should be noted that within any neighbourhood, some individuals will be more sensitive to noise than others.

In order to assess instantaneous noise levels at any time, the instantaneous A-weighted sound pressure level, L_{pA} can be used. This will give an indication of the loudness and degree of speech interference from noise.

The most commonly used descriptor, however, is the equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$. The time period involved should always be stated as the figure is a mathematical average of all individual contributions of various sources during the reference period T. When assessing noise from individual events that may not always be present during a longer period L_{Aeq}, it can be useful to use a short reference period (e.g. 5min). As an alternative descriptor, the maximum sound pressure level, $L_{A(max)}$, or the one percentile level, L_{A01}, may be used.

Concerning noise levels, it is proposed that the absolute limit would be determined in accordance with BS5228-1:2009 and would be subject to an overall daytime noise limit of 75dB L_{Aeq}.

6.8.2 Vibration

The sensitivity of the human frame to vibration varies according to the axis of vibration relative to the human body (e.g. x, y, or z-axis) and the frequency of vibration. In general, except at very low frequencies, sensitivity is greater in the z-axis (i.e. head to foot). When setting vibration control targets it is reasonable to assume that people will normally be sitting or standing during the day and lying down during the night.

With an impulsive source of vibration, it is usual to measure the peak value attained from the beginning to the end of a drive. It is also usual to measure in terms of peak particle velocity (P.P.V) if the risk of damage to the building is the primary concern and there is also an interest in human reaction. If the concern is purely for human tolerance, then acceleration is the preferred parameter.

Vibrations, even of very low magnitude, may be perceptible to people and can interfere with the satisfactory conduct of certain delicate activities, e.g. operating theatres, use of very sensitive laboratory weighing equipment, etc.

Nuisance from vibration is frequently associated with the assumption that, if vibrations can be felt, then damage is consequently inevitable; however, considerably greater levels of vibration are required to cause damage to buildings and structures than to be perceived by the human body.

Vibrations from site activities to the neighbourhood may, therefore, cause anxiety as well as annoyance and can disturb sleep, work, or leisure activities. As with noise, in any neighbourhood, some individuals will be more sensitive to vibration than others.

6.8.3 Noise and Vibration Monitoring Technology

The following factors are typically used to assess the likelihood of disturbance caused by noise and vibration generating activities.

- Site location

The relative location of a site in relation to noise or vibration-sensitive receivers will be a determining factor. The closer a site is to sensitive premises, the higher the likelihood of complaints due to noise and vibration emanating from the site.

- Ambient noise and vibration levels

It is understood that the site surrounding is generally representative of a typical busy urban mixed-use adjacent to an 'A' road. The ambient noise and vibration are predominantly related to the existing road traffic movement.

- Duration of site operations

In general, the longer the duration of all on-site operations, the more likely it is that noise or vibration from the site will potentially be an issue. In this respect, good public relations are very important. Local residents may be willing to accept a new status of noise and vibration if they know and understand the source and the duration of all operations. Therefore, all site operations are to be carried out according to a stated schedule. Changes are to be notified to the local authority in advance.

- Hours of work

For any noise-sensitive premises, some periods of the day will be more sensitive than others. Times of site operation outside normal weekday working hours will also need consideration.

Noise control targets for the evening period in such cases will need to be stricter than those for the daytime and, when noise limits are set, the evening limit may have to be as low as 10 dB(A) below the daytime limit. Very strict noise control targets should be applied to any site which is to operate at night.

- Site Operation

People's attitudes to noise are always influenced by their attitudes to the noise source itself. Noise and vibration generated from a site will tend to be accepted more willingly by local residents if they consider that the site operator is adopting the best practicable means to avoid unnecessary noise.

- Noise and vibration characteristics

In many cases, the particular identity of noise and vibration will affect people's judgement and appreciation of the signal itself. For example, the presence of a high-amplitude impulsive noise, accompanied by a vibration sensation would render the overall assessment slightly more onerous as "penalties" would need to be employed. These would comprise weightings to signals (e.g. 5dB (A) to a highly tonal or intermittent noise source).

6.8.4 Proposed Control Measures for Construction Noise

The contractor to ensure The Best Practicable Means (BPM) (as defined in Section 72 of the Control of Pollution Act 1974) will be used to reduce noise and vibration levels at all times. Where practicable the control measures set out in BS 5228:2009 + A1:2014 Part 1 & Part 2, Section 8 will also be implemented.

The following noise and vibration control measures to be included as a minimum:

- Choice of methodology/technique for operations (including site layout) will be considered in order to eliminate or reduce emissions at sensitive locations;
- Fixed items of construction plant will be electrically powered in preference to diesel or petrol-driven;
- If any specialise fabrication is required, this will be undertaken off-site if possible;
- Noisy plant will be kept as far away as possible from sensitive areas;
- Each item of the plant used will comply with the noise limits quoted in the relevant European Commission Directive 2000/14/EC/United Kingdom Statutory Instrument (SI) 2001/1701 where reasonably available;

- Equipment will be well-maintained and will be used in the mode of operation that minimizes noise and shut down when not in use;
- Vehicles shall not wait or queue on the public highway with engines running (unless the engine is required to power the operation of the vehicle e.g. concrete wagon);
- Where possible deliveries will be arranged on a just-in-time basis to prevent vehicles from queuing outside of the site and
- All materials will be handled in a manner that minimizes noise.

6.8.5 Temporary Noise Barrier or Noise Insulation

Table E2 of BS 5228-1:2009+A1:2014 provides an example of time periods, averaging times, and noise levels associated with the determination of eligibility for noise insulation.

Noise insulation, or the reasonable costs thereof, will be offered by the developer or promoter to owners, where applied for by owners or occupiers, subject to meeting the other requirements of the proposed scheme, where the construction of the development causes, or is expected to cause, a measured or predicted airborne construction noise level that exceeds either of the following at property lawfully occupied as a permanent dwelling: the noise insulation trigger levels presented in Table E.2 for the corresponding times of day; and a noise level 5 dB or more above the existing pre-construction ambient noise level for the corresponding times of day; whichever is the higher; and for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months."

Table 6.1: An extract from BS Standard (Table E2 of BS 5228-1:2009+A1:2014)

Examples of time periods, averaging times and noise levels associated with the determination of eligibility for noise insulation

Time	Relevant time period	Averaging time, T	Noise insulation trigger level dB $L_{Aeq,T}$ [A]
Monday to Friday	07.00 – 08.00	1 h	70
	08.00 – 18.00	10 h	75
	18.00 – 19.00	1 h	70
	19.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Saturday	07.00 – 08.00	1 h	70
	08.00 – 13.00	5 h	75
	13.00 – 14.00	1 h	70
	14.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Sunday and Public Holidays	07.00 – 21.00	1 h	65
	21.00 – 07.00	1 h	55

[A] All noise levels are predicted or measured at a point 1 m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.

6.8.6 Proposed Vibration Control Measures

This section presents an assessment of the potential risk regarding vibration generated by the construction works detailed in this document and the associated adverse effects on the surrounding area.

Estimated vibration levels have been evaluated against guidance presented in relevant British Standards to assess the likelihood of both structural damages to neighbouring buildings and the human response of the occupants.

Building Damage

According to BS 7385 Part 2 for residential or light commercial buildings, the threshold for the onset of potential cosmetic damage (i.e. formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces) to buildings varies with frequency. This ranges from a PPV of 15 mm/s at 4Hz, rising to 20mm/s at 15 Hz, and to 50 mm/s at and above 40Hz for transient vibration. BS 7385: Part 2 also states that the probability of building damage tends towards zero at 12.5 mm/s peak component particle velocity.

Subjective Response

According to guidance provided in BS 5228 Part 2, the threshold of vibration perceptible to humans lies around 0.14 to 0.3 mm/s. The Standard also indicates that a PPVs of around 1 mm/s in residential environments, as a first estimate, are likely to cause complaints, but can be tolerable provided prior warning and explanation of the works is given to residents; whilst, vibration magnitudes of around 10 mm/s are likely to be intolerable for more than a very brief exposure to this level.

As the exact equipment that will be used during the construction phase is not known, we propose the following criteria:

- 5 mm/s p.p.v. 'soft' limit; when exceeded, the contractor should temporarily halt works. Works should only be resumed after consultation with the local residents, and with extreme caution and
- 10 mm/s p.p.v. 'hard' limit; when exceeded, the contractor should stop work. Works should only continue after a thorough structural examination of the adjacent property, subsequent consultation with the local residents, and then with extreme caution. Should significant damage be identified, alternative methods of land remediation operations should be adopted.

6.9 Residual Impact

6.9.1 Construction Phase

Following the implementation of mitigation measures in accordance with the BS 5228-1 & 2 guidance, the residual impact is considered negligible. It is proposed that construction operations shall be limited to the following days and hours:

- 08:00 to 18:00hrs Monday to Friday;
- 08:00 to 13:00hrs Saturday;
- No construction operations on Sundays or public holidays;
- HGV movements shall not be permitted outside these hours during the construction phase without prior written approval from the Local Planning Authority; and
- Installation of equipment on-site shall not be permitted outside these hours without prior written approval from the Local Planning Authority.

7. Conclusions

An environmental noise survey has been undertaken for the proposed development at 4-6 Ham Street, Richmond, TW10 SHT, allowing the assessment of daytime likely to be experienced by the proposed development.

Predicted noise levels allowed a robust noise insulation proposal to be made to comply with a minimum value for required attenuation, which would, in turn, provide internal noise levels for all nursery school rooms and commercial office environments of the development commensurate to the relevant design standard, BB93.

Although NPSE from the National Planning Policy Framework have presented NOEL, SOEL, etc. There are no distinctive figures hence it was proposed that IEMA table have been used.

Mitigation measures have also been provided for the construction phase as per BS5228.

No further mitigation measures should be required in order to protect the proposed habitable spaces from external noise intrusion.

It can, therefore, be concluded that the proposed development is not considered to conflict with any national, regional, or local noise planning policy.

Appendix A: Noise Indicators

Decibel scale - dB

In practice, when sound intensity or sound pressure is measured, a logarithmic scale is used in which the unit is the 'decibel', dB. This is derived from the human auditory system, where the dynamic range of human hearing is so large, in the order of 10^{13} units, that only a logarithmic scale is the sensible solution for displaying such a range.

Decibel scale, 'A' weighted - dB(A)

The human ear is less sensitive at frequency extremes, below 125Hz and above 16Khz. A sound level meter models the ears variable sensitivity to sound at different frequencies. This is achieved by building a filter into the Sound Level Meter with a similar frequency response to that of the ear, an A-weighted filter where the unit is dB(A).

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 11 such octave bands whose centre frequencies are defined in accordance with international standards. These centre frequencies are: 16, 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16000 Hertz.

Reference Time Interval, T

The specified time interval over which an equivalent continuous A-weighted sound pressure level is determined.

$L_{Aeq,T}$

The A-weighted equivalent continuous sound level. This is the sound level of a notionally steady sound having the same energy as the fluctuating sound over a specified measurement period, T.

$L_{A10,T}$

The A-weighted sound level exceeded for 10% of the specified measurement period, T.

L_{Amax}

The highest short duration A-weighted sound level recorded during a noise event.

L_{A90}

The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 % of a given time interval, T.

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than a single source and 4 sources produce a 6dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Hearing perception is highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a guide to explain increases or decreases in sound levels for many scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible

6	Clearly noticeable
10	About twice as loud

Transmission path(s)

The transmission path is the path the sound takes from the source to the receiver. Where multiple paths exist in parallel, the reduction in each path should be calculated and summed at the receiving point. Outdoor barriers can block transmission paths, for example traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and construction.

Ground-borne vibration

In addition to airborne noise levels caused by transportation, construction, and industrial sources there is also the generation of ground-borne vibration to consider. This can lead to structure-borne noise, perceptible vibration, or in rare cases, building damage.

Sound insulation - Absorption within porous materials

Upon encountering a porous material, sound energy is absorbed. Porous materials which are intended to absorb sound are known as absorbents, and usually absorb 50 to 90% of the energy and are frequency dependent. Some are designed to absorb low frequencies, some for high frequencies and more exotic designs being able to absorb very wide ranges of frequencies. The energy is converted into both mechanical movement and heat within the material; both the stiffness and mass of panels affect the sound insulation performance.

Appendix B: Proposed Site Plans

Please find latest proposed site plans on the planning portal.

Appendix C: Glazing and trickle vent example mitigation.

PILKINGTON

Pilkington **Optiphon**™

Laminated Glass for noise control

NSG GROUP

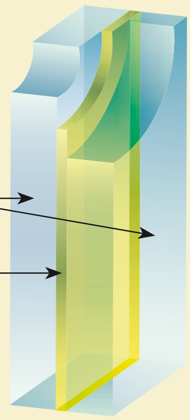
Pilkington **Optiphon**™

Laminated glass for superior noise insulation

Pilkington **Optiphon**™ is the ideal choice of glass in situations where there is excess noise from road, rail or air traffic, or various other sources, such as factories, nightclubs or neighbours.

Pilkington **Optiphon**™ is a high quality acoustic laminated glass incorporating a special PVB (PolyVinyl Butyral) interlayer. It offers excellent noise reduction without compromising on light transmittance or impact performance.

The desired acoustic performance can be achieved through combining various thicknesses of glass with a PVB interlayer. With a large variety of product combinations, Pilkington **Optiphon**™ offers the opportunity to achieve specific noise reduction requirements.



Note: Pilkington **Optiphon**™ can also be manufactured with other products, including coated glass

Benefits

- Special PVB interlayer for enhanced sound insulation performance
- A thinner and lighter glass for the equivalent acoustic performance
- Available in jumbo and LES sizes
- All products achieve safety class 1(B)1 (EN 12600) and are available to meet security classes in accordance with EN 356
- A high acoustic performance can be achieved when used in Insulating Glass Units (IGUs)
- Can also be used to improve noise insulation in a triple glazing construction

As well as reducing intrusive noise, Pilkington **Optiphon**™ can be combined with other Pilkington products for a multi-functional glazing solution with additional benefits, such as:

- Thermal insulation with Pilkington **K Glass**™ / Pilkington **Optitherm**™ (coating in position 3 in IGU)
- Solar control with Pilkington **Suncool**™ (coating in position 2 in IGU)
- Self-cleaning with Pilkington **Activ**™ (coating in position 1 in IGU)

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.

© Mika Huisman

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

Technical Definitions

Sound Reduction Index

R_w is the weighted sound reduction, in decibels, which incorporates a correction for the ear's response.

C and C_{tr} are the spectrum adjustments, which are the values added to R_w to take account of the characteristics of particular sound spectra. Typical noise sources for each spectrum adaptation terms are given below.

Relevant spectrum adaptation term C

Type of noise source:

- Living activities (talking, music, radio, TV)
- Children playing
- Railway traffic at medium and high speed
- Jet aircraft, short distance away
- Motorway traffic >50 mph
- Factories emitting mainly medium and high frequency noise.

Relevant spectrum adaptation term C_{tr}

Type of noise source:

- Urban road traffic
- Railway traffic at low speeds
- Aircraft, propeller driven
- Jet aircraft, long distance away
- Music with low frequency bass sounds
- Factory emitting mainly low and medium frequency noise.

CE marking confirms that a product complies with its relevant harmonised European Norm.
The CE marking label for each product, including declared values, can be found at www.pilkington.com/CE

Pilkington United Kingdom Limited
Registered office: European Technical Centre, Hall Lane, Lathom, Nr Ormskirk, Lancashire L40 5UF
Telephone 01744 692000 Fax 01744 692880
pilkington@respond.uk.com
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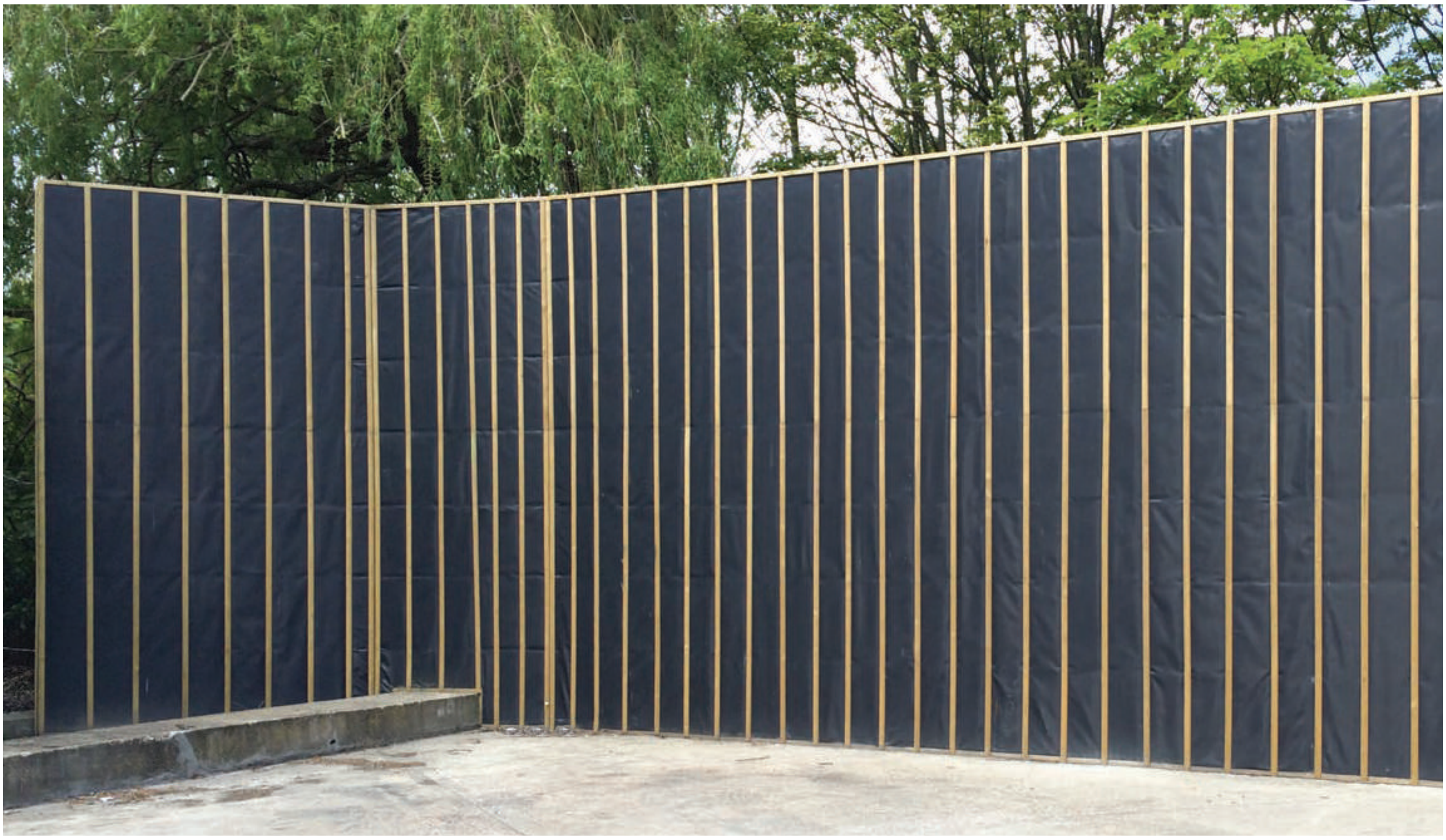
8222 – January 2020

Appendix D: Acoustic Barrier example mitigation.

JAKOUSTIC® ABSORPTIVE

Jacksons Fencing



Jakoustic® Absorptive acoustic fencing has the same interlocking V board construction as Jakoustic® Reflective, but has an additional absorptive layer on one side of the fence, made up of a mineral Rockwool fibre and protective membrane. It is ideal for applications where a noise source is in a tight confined area surrounded by other reflective surfaces.

- Timber construction with planed boards visible on one face
- Unique tuning fork design posts
- Special fixings clamp the acoustic boards between posts
- Can accommodate changes in level or profile
- With timber capping and counter rail
- Jakoustic® fencing with an additional absorptive layer covered with a protective membrane
- Matching pedestrian, swing and tracked sliding gates
- Up to 32dB reduction in noise*
- High privacy barrier
- **25-year Jakcure® guarantee**

*Jakoustic® Plus Absorptive Layer barrier certified laboratory results:

Category B3 rating according to BS EN 1793-2:1998
Category A3 rating according to BS EN 1793-1:1998
Laboratory sound reduction 32 dB Approximate Superficial Mass 28kg/m^2

Jakoustic® Absorptive with steel I-beams

► Heights available with timber tuning fork posts, for general applications away from hills and coasts.

► For barrier heights 2.1m - 3.0m the timber posts are reinforced with a steel spur post, coated black.

HEIGHT (MM)	POST CENTRES (MM)	SPUR POST (MM)	POST LENGTH (MM)
2000	2410	N/A	2900
2500	2410	2000	3400
3000	2410	2500	3900

*For taller heights, see Jakoustic® Commercial and Highway, which is constructed on galvanised steel I beam posts.

APPLICATIONS

✓ Commercial properties

✓ Industrial

✓ Sports venues

✓ Railways

✓ Residential

POST OPTIONS

- Timber tuning fork posts overlength set in concrete as standard

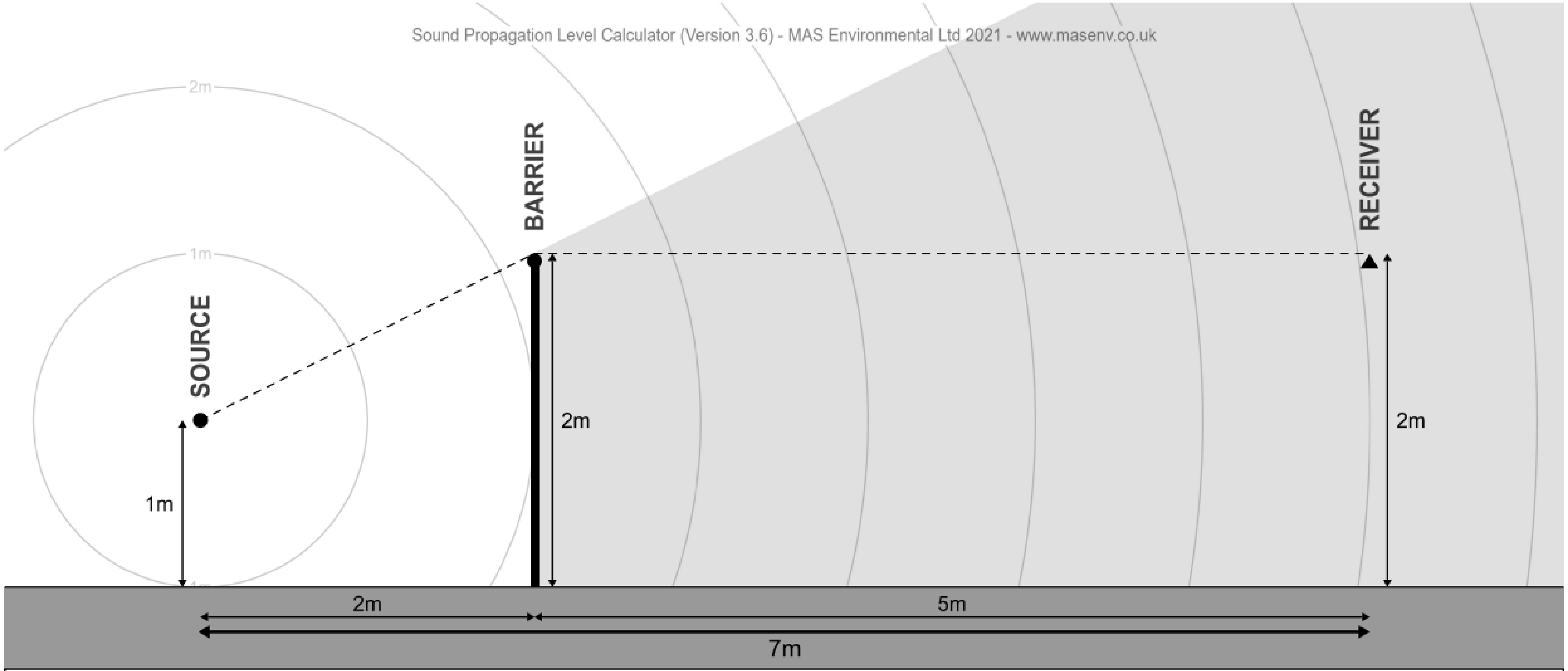
GATES

Matching gates available with an absorptive layer

FINISHES

- Jakcure® treated timber as standard

Appendix E: Barrier Calculation



Frequency - Hz	Source - dB	Receiver - dB
500	79	42.1

Environmental parameters: 20°C Temperature, 70% Humidity, 0 Ground Factor (G)