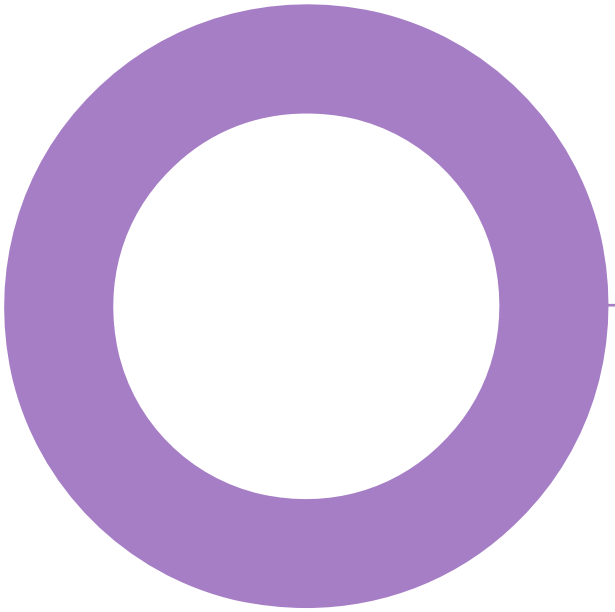
HOARE LEA

Former Stag Brewery. Mortlake.
Reselton Properties Limited.

ACOUSTICS
NOISE IMPACT ASSESSMENT

REVISION 11 – 14 JULY 2020



Audit sheet.

Rev.	Date	Description	Prepared	Verified
00	02/02/2018	For Comment	TH	BRD
01	05/02/2018	For Issue	TH	BRD
02	09/02/2018	For Issue	TH	-
03	09/03/2018	Measurement positions updated	TH	-
04	13/09/2019	Updated application including: - Updated basis of assessment (NPPF, BCO & Richmond Local Plan); - Details of survey conducted in July 2019 included; - Updated noise emission limits within Table 13; - Updated façade requirement assessment based on new cinema use – Table 14; - Updated items of building services plant and updated assessment to reflect new plant in Tables 16 & 17; and - Consideration of balconies and external amenity areas included within Sections 6.2 and 6.3.	TH	BRD
05	11/10/2019	Minor amendments including MUGA comments	TH	-
06	24/10/2019	Figure 4 updated	TH	-
07	17/01/2020	Updated application including: – Figure 4 updated; and – Section 8 updated.	TH	-
08	08/04/2020	Updated application including: – Figure 4 updated; – Tables 14 and 15 updated; and – Section 7 updated.	TH	-
09	20/04/2020	Updated application including: – Updated executive summary & introduction; and – Updated Figure 1.	TH	-
10	21/05/2020	Minor amendments following legal review.	TH	-
11	14/07/2020	Updated introductory text	TH	

Document reference: REP-1006369-TH-20200714-Noise Impact Assessment-Rev11

Contents.

Executive summary

Hoare Lea has conducted a noise impact assessment as revised submission document to the noise impact assessment submitted Applications A, B and C (refs. 18/0547/FUL, 18/0548/FUL and 18/0549/FUL), in respect of the former Stag Brewery Site in Mortlake within the London Borough of Richmond Upon Thames. The noise impact assessment considers the proposed noise sensitive uses within the Proposed Development.

The following summarises the assessment procedure and findings contained within this report:

- Background noise levels typical of the daytime and night-time as measured by Waterman IE have been used to define building services plant noise emission limits at the nearest residential dwellings at the Proposed Development.
- During the daytime and night-time, the combined building services plant noise emission contribution limit advised is 36 dB(A) and 28 dB(A) respectively, one metre from the nearest residential façade of the Proposed Development.
- An assessment of the building envelope acoustic performance is provided and indicates that the ventilation strategy should allow for full mechanical ventilation of all spaces as the level differences required are above those achievable by simple means of natural ventilation. Windows may be openable for purge ventilation.
- Notional glazing requirements and indicative primary glazing configurations have been provided for guidance purposes only. Detailed calculations will be required to be undertaken to determine refined glazing requirements during subsequent design stages.
- An assessment of noise associated with the proposed items of plant has been undertaken. Outline attenuation requirement for each item of plant have been provided and will be sufficient to limit noise emissions to the derived limits at the nearest adjacent on-site residential receptor during the daytime and night-time.
- An assessment of noise associated with the proposed MUGA and 3G sports pitch has been undertaken. The assessment confirms that the proposed façade treatment and ventilation strategy will be sufficient to reduce noise associated with the MUGA and sports pitch to an appropriate level.
- Whilst not required to reduce the noise impact of the MUGA and sports pitch, a commitment has been made to include the following mitigation measures which will further reduce the noise impact:
    - A weld mesh (twin bar super rebound fence) with EPDM rubber inserts and fixings to reduce rattle and ball impact noise during play;
    - A maintenance scheme to prevent deterioration in performance of the sports facilities that could result from damaged panels, loose brackets, worn AV bushing and squeaky gates; and
    - A 2.5m acoustic barrier along the western and northern boundary of the sports pitch.

1. Introduction.

This noise impact assessment has been prepared by Hoare Lea as a revised submission document to the noise impact assessment submitted under Applications A, B and C (refs. 18/0547/FUL, 18/0548/FUL and 18/0549/FUL) ('the Applications'), in respect of the former Stag Brewery Site in Mortlake ('the Site') within the London Borough of Richmond Upon Thames ('LBRuT'). The Applications are for the comprehensive redevelopment of the Site. This document has been prepared on behalf of Reselton Properties Limited ('the Applicant'). A summary of the Applications is set out below:

a. Application A – hybrid planning application for comprehensive mixed-use redevelopment of the former Stag Brewery site consisting of:
    i. Land to the east of Ship Lane applied for in detail (referred to as 'Development Area 1' throughout); and
    ii. Land to the west of Ship Lane (excluding the school) applied for in outline detail (referred to as 'Development Area 2' throughout).
b. Application B – detailed planning application for the school (on land to the west of Ship Lane).
c. Application C – detailed planning application for highways and landscape works at Chalkers Corner.

This document replaces the noise impact assessment.

The Applications were submitted in February 2018 to LBRuT. The Applications are related and were proposed to be linked via a Section 106 Agreement. In May 2019, a package of substitutions was submitted to LBRuT for consideration, which sought to address comments raised by consultees during determination. On 29 January 2020, the Applications were heard at LBRuT's Planning Committee with a recommendation for approval. This scheme is thereafter referred to as "the Original Scheme".

The Committee resolved to grant Applications A and B, and refuse Application C. The granting of Applications A and B was subject to the following:

a. Conditions and informatives as set out in the officer's report, published addendum and agreed verbally at the meeting;
b. Amendments to the Heads of Terms and completion of a Section 106 Legal Agreement which was delegated to the Assistant Director to conclude;
c. No adverse direction from the Greater London Authority ('GLA'); and
d. No call in by the Secretary of State for Housing, Communities and Local Government.

The Applications have been referred to the GLA and the Mayor has given a direction that he will take over the determination of the Applications and act as local planning authority in relation to all three applications.

The Applicant has engaged with the GLA in respect of the proposed amendments to the scheme, referred to throughout this document as the 'Revised Scheme'. As a result of these discussions, a number of changes have been made to the scheme proposals which are summarised as follows:

a. Increase in residential unit provision from up to 813 units (this includes the up to 150 flexible assisted living / residential units) to up to 1,250 units;
b. Increase in affordable housing provision from 17% to up to 30%;
c. Increase in height for some buildings, of up to three storeys compared to the Original Scheme;
d. Change to the layout of Buildings 18 and 19, conversion of Block 20 from a terrace row of housing to two four storey buildings;
e. Reduction in the size of the western basement, resulting in an overall reduction in car parking spaces of 186 spaces and introduction of an additional basement storey beneath Building 1 (the cinema);;

f. Other amendments to the masterplan including amendments to internal layouts, re-location and change to the quantum and mix of uses across the Site, including the removal of the nursing home and assisted living in Development Area 2;

g. Landscaping amendments, including canopy removal of four trees on the north west corner of the Site; and

h. Associated highways works may be carried out on adopted highways land.

The submission documents have tested an affordable housing provision of 30%. However, it should be noted that the final affordable housing level is subject to further viability testing and discussions with the GLA.

Minor amendments have also been made to the road and pedestrian layouts for the school (Application B). No other amendments are proposed to Application B. No amendments are proposed to the physical works proposed under Application C, although alternative options within the highway boundaries for mitigating the highway impact of the amended proposals have been assessed within the relevant substitution documents for Applications A and B and are the subject of ongoing discussions with the GLA and TfL.

A more detailed summary is included within the Planning Statement Addendum and Design and Access Statement Addendum submitted with the Revised Scheme documents.

These changes are being brought forward as substitutions to Applications A, B and C (refs. 18/0547/FUL, 18/0548/FUL and 18/0549/FUL), which are related applications (to be linked via a Section 106 Agreement).

It is important to note that no changes are proposed to the physical works proposed under Application C – the only change to this application is that the supporting documents (which include all documents submitted under Applications A and B) have been updated in the context of the proposed changes to the scheme as sought under Applications A and B. Application C was resolved to be refused by LBRuT at Committee on 29 January 2020. As a result, whilst the works proposed in Application C are still an available option, the Applicant has progressed alternative approaches for addressing and mitigating the impacts on surrounding highways, and these have been tested within the relevant substitution documents for Applications A and B. All of these options are subject to ongoing discussions and testing with TfL. They are all within the existing highway boundaries and if agreed would not, in themselves, require planning consent.

Accordingly, Application C remains 'live' within this substitution package.

This report provides a description of the results from the noise survey, the defined external noise limits for building services plant, advice regarding the building envelope and ventilation strategy and an assessment indicating how the new mechanical services plant associated with the development will comply with the external noise limits at the new noise sensitive uses introduced as part of the Proposed Development.

To aid in the understanding of the assessment, definitions of technical terms used have been included in Appendix A.

2. Site description.

2.1 Existing site.

The Site comprises the following elements:

- The former Stag Brewery which sits between Lower Richmond Road and the river Thames, to the north of Mortlake Green;
- Land at Chalkers Corner;
- Land to the east of Ship Lane; and
- Land to the west of Ship Lane.

The former Stag Brewery Site is bounded by Lower Richmond Road to the south, the river Thames and the Thames Bank to the north, Williams Lane to the west and Bulls Alley (off Mortlake High Street) to the east. The Site is bisected by Ship Lane. The Site currently comprises a mixture of large-scale industrial brewing structures, large areas of hardstanding and playing fields.

The surrounding buildings to the wider site are generally residential in nature, with existing residential dwellings along Lower Richmond Road, Watney Road and Thames Bank. In addition to the south along Mortlake High Street is the Richmond English School and Mortlake Business Centre and along Lower Richmond Road is the Jolly Gardeners public house.

The proposed sites (indicative only) are identified in Figure 1 overleaf.

2.2 Local noise environment.

The surrounding noise climate is predominantly formed of road traffic noise from the immediate road network around the site, in particular Lower Richmond Road and Mortlake High Street to the south, but also Clifford Avenue to the west.

The noise climate was also observed to include contributions from aircraft serving Heathrow Airport (approximately 11 km to the west).

Figure 1: Existing site (indicative only). © Google Earth.

3. Basis of assessment.

3.1 National planning policy framework (NPPF): 2019.

The revised National Planning Policy Framework (1) published in July 2018 and updated in February and June 2019 sets out the Government's current planning policies for England and how these are expected to be applied. The NPPF supersedes the previous NPPF published in March 2012.

With regards to local noise and vibration, paragraph 180 states:

"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 environmental, 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 impact 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; and*
c. *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSfE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

The NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have *'a single objective noise-based measure…that is applicable to all sources of noise in all situations'.* It further advises that the sound level at which an adverse effect occurs is *'likely to be different for different noise sources, for different receptors and at different times'.*

In the absence of specific guidance for assessment of environmental noise within the NPPF and the NPSfE, it is considered appropriate to base assessment on current British Standards and national guidance. These are considered to be Local Authority guidance, BS 4142 (2), BS 8233 (3) and the World Health Organisations (4) (WHO) guidelines.

3.2 BS 4142: 2014 – Methods for rating and assessing industrial and commercial sound.

Current Government advice to Local Planning Authorities in both England and Wales makes reference to BS 4142 as being the appropriate guidance for assessing commercial operations and fixed building services plant noise. This British Standard provides an objective method for rating the likelihood of complaint from industrial and commercial operations. It also describes means of determining noise levels from fixed plant installations and determining the background noise levels that prevail on a site.

The assessment of impacts is based on the subtraction of the measured background noise level from the rating level determined. The rating level is the source noise level (either measured or predicted) corrected for tone or character (if necessary). The difference is compared to the following criteria to evaluate the impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact.
- A difference of around +5 dB indicates is likely to be an indication of an adverse impact.
- Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact.

This method is only applicable for external noise levels.

3.3 BS 8233: 2014 – Guidance on sound insulation and noise reduction for buildings.

BS 8233: 2014 provides guidance for control of noise in and around buildings and suggests appropriate criteria and limits for different situations. The criteria and limits are primarily intended to guide the design of new or refurbished buildings undergoing a change of use.

Table 4 within BS 8233 provides desirable internal ambient noise levels for spaces in residential dwellings when they are unoccupied.

Activity	Location	Daytime (0700 to 2300)	Night-Time (2300 to 0700)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining Room / Area	40 dB $L_{Aeq,16hr}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$

Table 1: Indoor ambient noise levels in spaces for dwellings.

Supplementary Note 2 and 4 to Table 4 within BS 8233 are copied below for reference:

'NOTE 2 – the levels shown in Table 4 are based on the existing guidelines issued by the WHO…'

'NOTE 4 – regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night.'

Guidance provided within the superseded BS 8233: 1999 (5) stated that *'for a reasonable standard in bedrooms at night, individual noise events (measured with F-time weighting) should not normally exceed 45 dB L_{Amax}.'* This follows current guidelines issued by the WHO.

BS 8233 also provides guidance for indoor ambient noise levels in non-domestic buildings. These are replicated in Tables 2 and 3 below.

Objective	Typical Situations	Design Range $L_{Aeq,T}$ dB
Typical noise levels for acoustic privacy in shared spaces	Open Plan Office	45 – 50

Table 2: Indoor ambient noise levels in spaces when they are unoccupied and privacy is also important.

Activity	Location	Design Range $L_{Aeq,T}$ dB
Speech or telephone communications	Department store Cafeteria, canteen, kitchen	50 – 55
Study and work requiring concentration	Library, gallery, museum	40 – 50
	Staff / meeting room, training room	35 – 45
	Executive office	35 – 40

Table 3: Typical noise levels in non-domestic buildings.

3.4 The British Council for Offices (BCO) Guide to Specification 2019.

The British Council for Offices Guide provides guidance on sustainability, cost and value, building form, engineering systems and finishes within commercial offices. In particular, the BCO Guide provides advice within Section 11 regarding the acoustic environment within an office building, as summarised below.

External noise intrusion levels should not be more than the following ratings when measured in terms of $L_{eq,T}$.

- Open plan offices: NR 40 ($L_{eq,T}$)
- Speculative offices: NR 38 ($L_{eq,T}$)
- Cellular offices / meeting rooms: NR 35 ($L_{eq,T}$)

In addition, $L_{A01,1hr}$ noise intrusion levels should not normally be more than 55 dB in open plan / speculative offices or 50 dB in cellular offices.

3.5 Building Bulletin 93.

Building Bulletin 93 (BB93) (6) is the current Building Control requirement document for the acoustic design of schools and its performance standards are applicable for secondary schools. The document provides performance standards suitable to provide acoustic conditions in schools that facilitate clear communication of speech between teachers and students, and that do not interfere with study activities.

BB93 states that the sound insulation performance of the building envelope needs to be sufficient to reduce the external environmental noise in sensitive areas to the internal ambient noise levels in Table 1. The indoor ambient noise level includes noise contributions from external sources outside the school premises (including road, rail and air traffic) and building services.

Table 4 below provides the performance standards for typical secondary school spaces as shown within BB93 when they are unoccupied and unfurnished.

Type of room	Upper limit for the indoor ambient noise level $L_{Aeq,30min}$ dB
Secondary school: classrooms, general teaching areas, seminar rooms, tutorials rooms, language laboratories	35

Table 4: Performance standards for indoor ambient noise levels within secondary schools.

3.6 Regional planning policy.

3.6.1 The London Plan – Intend to Publish – December 2019.

The London Plan Intend to Publish version updated in December 2019 sets out an overall strategic plan for London for the development of the capital over the next 20 to 25 years. The Plan brings together the Mayor's strategies, including policy on a range of environmental issues, such as climate change, air quality, noise and waste. London Boroughs' local plans need to be in general conformity with the London Plan, and its policies guide decisions on planning applications by councils and the Mayor. In respect of noise, the Draft London Plan contains two policies, *Policies D13 and D14.*

3.6.1.1 Policy D13 – Agent of Change.

Policy D13 states the following:

A. *"The Agent of Change principle places the responsibility for mitigating impacts from existing noise and other nuisance-generating activities or uses on the proposed new noise-sensitive development. Boroughs should ensure that Development Plans and planning decisions reflect the Agent of Change principle and take account of existing noise and other nuisance-generating uses in a sensitive manner when new development is proposed nearby.*

B. *Development should be designed to ensure that established noise and other nuisance-generating uses remain viable and can continue or grow without unreasonable restrictions being placed on them.*

C. *New noise and other nuisance-generating development proposed close to residential and other noise-sensitive uses should put in place measures to mitigate and manage any noise impacts for neighbouring residents and businesses.*

D. Development proposals should manage noise and other potential nuisances by:

1) ensuring good design mitigates and minimises existing and potential nuisances generated by existing uses and activities located in the area
2) exploring mitigation measures early in the design stage, with necessary and appropriate provisions including ongoing and future management of mitigation measures secured through planning obligations
3) separating new noise-sensitive development where possible from existing noise-generating businesses and uses through distance, screening, internal layout, sound-proofing, insulation and other acoustic design measures.

E. Boroughs should refuse development proposals that have not clearly demonstrated how noise and other nuisances will be mitigated and managed."

3.6.1.2 Policy D14 – Noise.

Policy D14 states the following:

A. "In order to reduce, manage and mitigate noise to improve health and quality of life, residential and other non-aviation development proposals should manage noise by:

1) avoiding significant adverse noise impacts on health and quality of life
2) reflecting the Agent of Change principle as set out in Policy D13.
3) mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses
4) improving and enhancing the acoustic environment and promoting appropriate soundscapes (including Quiet Areas and spaces of relative tranquillity)
5) separating new noise-sensitive development from major noise sources (such as road, rail, air transport and some types of industrial use) through the use of distance, screening, layout, orientation, uses and materials – in preference to sole reliance on sound insulation
6) where it is not possible to achieve separation of noise-sensitive development and noise sources without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through applying good acoustic design principles
7) promoting new technologies and improved practices to reduce noise at source, and on the transmission path from source to receiver.

B. Boroughs, and others with relevant responsibilities, should identify and nominate new Quiet Areas and protect existing Quiet Areas in line with the procedure in Defra's Noise Action Plan for Agglomerations."

3.7 Local planning policy.

3.7.1 London Borough of Richmond Upon Thames, Local Plan, Adopted July 2018.

The LBRuT Local Plan adopted in July 2018 sets out policies and guidance for the development of the borough over the next 15 years.

In respect of noise, the local plan contains two policies; *Policy LP 8 – Amenity and Living Conditions* and *Policy LP 10 – Local Environmental Impacts, Pollution and Land Contamination.*

3.7.1.1 Policy LP 8 – Amenity and Living Conditions.

Policy LP 8 states the following:

'All development will be required to protect the amenity and living conditions for occupants of new, existing, adjoining and neighbouring properties. The Council will:

1. *Ensure the design and layout of buildings enables good standards of daylight and sunlight to be achieved in new development and in existing properties affected by new development, where existing daylight and sunlight conditions are already substandard, they should be improved where possible;*
2. *Ensure balconies do not raise unacceptable overlooking or noise or disturbance to nearby occupiers; height, massing or siting, including through creating a sense of enclosure;*
3. *Ensure that proposals are not visually intrusive or have an overbearing impact as a result of their height, massing or siting, including through creating a sense of enclosure;*
4. *Ensure there is no harm to the reasonable enjoyment of the use of buildings, gardens and other spaces due to increases in traffic, servicing, parking, noise, light, disturbance, air pollution, odours or vibration or local micro-climatic effects."*

3.7.1.2 Policy LP 10 – Local Environmental Impacts, Pollution and Land Contamination.
Policy LP 10 states the following:

'A. The Council will seek to ensure that local environmental impacts of all development proposals do not lead to detrimental effects on the health, safety and the amenity of existing and new users or occupiers of the development site, or the surrounding land. These potential impacts can include, but are not limited to, air pollution, noise and vibration, light pollution, odours and fumes, solar glare and solar dazzle as well as land contamination.

Developers should follow any guidance provided by the Council on local environmental impacts and pollution as well as on noise generating and noise sensitive development. Where necessary, the Council will set planning conditions to reduce local environmental impacts on adjacent land uses to acceptable levels.

Noise and Vibration

C. The Council encourages good acoustic design to ensure occupiers of new and existing noise sensitive buildings are protected. The following will be required, where necessary:

2. *A noise assessment of any new plant and equipment and its impact upon both receptors and the general background noise levels;*
3. *Mitigation measures where noise needs to be controlled and managed;*
4. *Time limits and restrictions for activities where noise cannot be sufficiently mitigated;*
5. *Promotion of good acoustic design and use of new technologies;*
6. *Measures to protect the occupiers of new developments from existing sources.'*

3.8 Proposed standards.

Given the lack of specific guidance contained within the LBRuT's adopted planning policy, it is deemed appropriate to base assessment on guidance contained within relevant standards and guidance. These are considered to be BS 8233: 2014, the BCO Guide, BB 93 and BS 4142: 2014.

3.8.1 Environmental noise – internal noise levels.

On the basis of guidance contained within BS 8233: 2014 and BB 93, the development shall be designed to enable achievement of the internal noise levels stated within Table 5 overleaf.

Location	Daytime (0700 to 2300)	Night-Time (2300 to 0700)
Residential dwellings		
Living room	35 dB $L_{Aeq,16hr}$	-
Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ & 45 dB $L_{Amax,T}$
Dining rooms	40 dB $L_{Aeq,16hr}$	-
School		
Classrooms, general teaching areas	35 dB $L_{Aeq,30min}$	-
Commercial spaces		
Retail / restaurant space	40 dB $L_{Aeq,T}$	-
Open plan office space	45 dB $L_{Aeq,T}$ & 55 dB $L_{Amax,T}$	-
Cinema*	30 dB $L_{Aeq,T}$ & 35 dB $L_{Amax,T}$	-

Table 5: Proposed internal noise levels.

*Note *: These are generic internal noise levels. Specific criteria may be required at a later stage by the Cinema Operator.*

3.8.2 Building services – noise.
On the basis of guidance contained within BS 4142: 2014, noise emissions from building services plant shall be limited to at least 10 dB below the measured background noise levels.

4. Environmental noise survey.

An acoustic survey was carried out by Waterman Infrastructure & Environment (Waterman IE) in June 2016 and July 2019. Full details of the noise surveys undertaken by Waterman IE are provided within the ES Noise & Vibration Chapter, however, for ease of reference, a summary of each survey is provided within this Section.

4.1 Noise survey – June 2016.

4.1.1 Methodology

The noise survey comprised five days of unattended automatic noise measurements at four strategic locations from Friday 24th June 2016 to Wednesday 29th June 2016. For ease of reference, the table summarising the measurement locations and the figure identifying the measurement locations are replicated in Table 6 below and Figure 2 overleaf.

Monitoring Location (Figure 9.1)	Description	Observations and Predominant Noise Sources
LT1	Free-field measurement at the south-western Site boundary overlooking Lower Richmond Road (the A3003). Microphone located 1.2 m Above Ground Level (AGL).	Noise climate dominated by constant vehicular traffic on Lower Richmond Road / Mortlake High Street. Although intermittent in comparison, noise from low flying aircraft movements into Heathrow Airport (located approx. 11 km to the west) was significant, with approximately one plane every minute going over the Site. Contributory noise from human activities, distant road noise and distant aircraft also influence the noise climate to some extent.
LT2	Façade measurement on the second floor of the Stag Brewery Co. building at the south-eastern Site boundary overlooking Mortlake High Street. Microphone located 6.0 m AGL.	
LT3	Façade measurement on the boundary wall to the north-east of the Site overlooking the River Thames. Microphone located 4.0 m AGL.	Noise climate dominated by aircraft noise, as detailed above. Contributory noise from local and distant road traffic and occasional passing cyclists and joggers on the footpath over the river.
LT4	Free-field measurement at the south-western boundary of the Site orientated towards Clifford Avenue / Chiswick Bridge (the A316). Microphone located 2.5 m AGL.	Noise climate influenced by constant vehicular traffic on Clifford Avenue. Contributory noise from domestic activates from nearby residential dwellings.
ST1	Free field measurement at the centre of existing sports ground.	Noise climate influenced by distant road traffic noise and some intermittent low flying aircraft noise.
ST 2	Free field measurement north western corner of existing sports ground adjacent to Williams Lane.	Noise climate influenced by distant road traffic noise associated with Clifford Avenue and some intermittent low flying aircraft noise.
ST 3	Free field measurement north western corner of existing sports ground adjacent to Williams Lane.	Noise climate influenced by constant vehicular traffic on Clifford Avenue.
ST 4	Free field measurement adjacent to Ship Lane.	Noise climate influenced by distant road traffic noise and some intermittent low flying aircraft noise.
ST 5	Free field measurement adjacent to Ship Lane.	Noise climate influenced by distant road traffic noise and some intermittent low flying aircraft noise.

Monitoring Location (Figure 9.1)	Description	Observations and Predominant Noise Sources
ST 6	Free field measurement on southern site boundary adjacent to Lower Richmond Road.	Noise climate influenced road traffic noise associated with Lower Richmond Road.
ST 7	Free field measurement on eastern site boundary with Bulls Alley.	Noise climate influenced road traffic noise associated with Lower Richmond Road.
ST 8	Fee field noise measurement on Lower Richmond Road at Chalkers Corner.	Noise climate influenced road traffic noise associated with Lower Richmond Road.

Table 6: Noise monitoring locations – June 2016 (ref: Waterman IE).

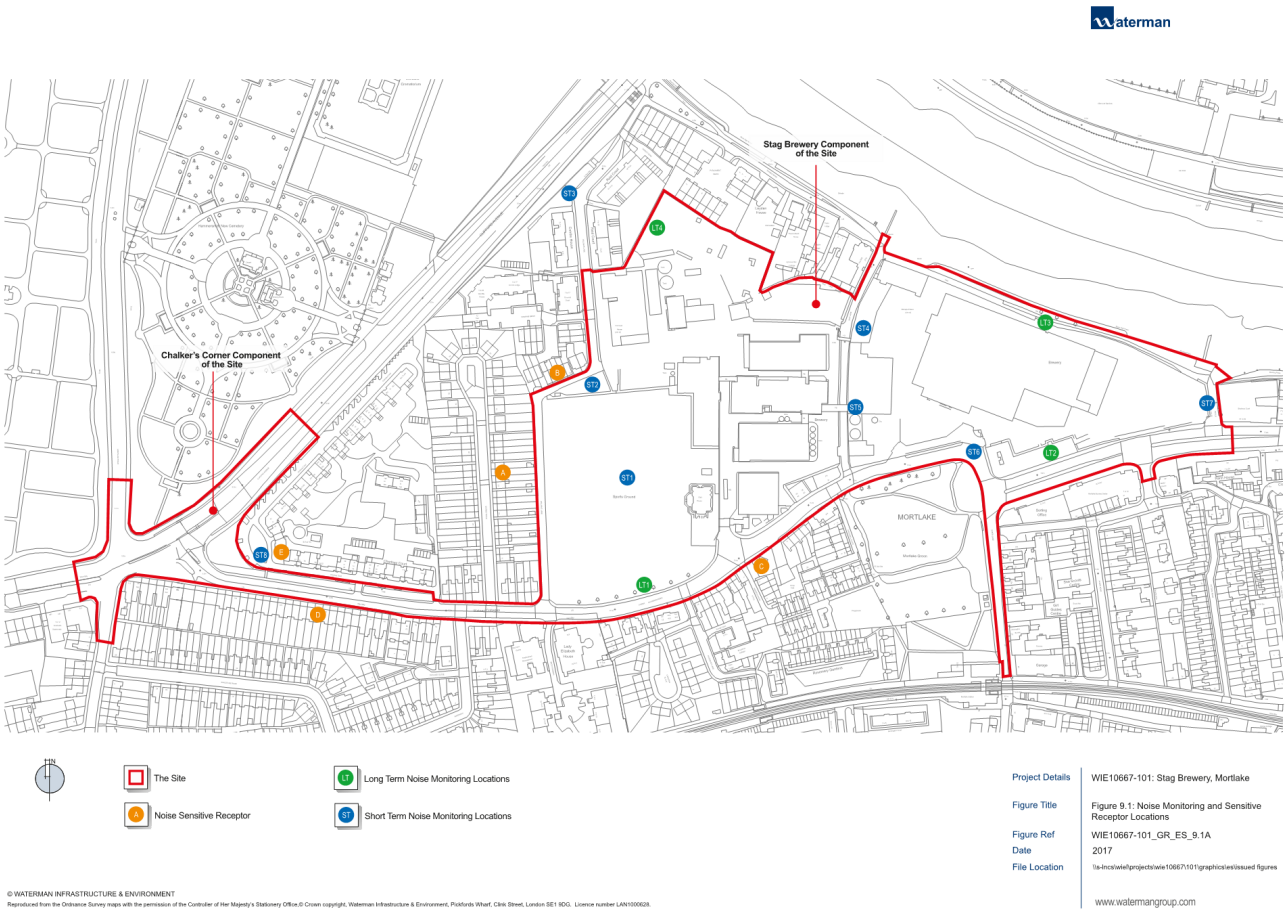


Figure 2: Location plan of the Site and noise monitoring locations – June 2016 (ref: Waterman IE).

4.1.2 Results summary.

A summary of the results from the noise survey conducted by Waterman IE is provided below in Tables 7 and 8 overleaf.

Monitoring Location	Period	Duration	Average $L_{Aeq,T}$ dB	Average $L_{A10,T}$ dB	Average $L_{A90,T}$ dB	90th Percentile $L_{AFmax,5min}$ dB
LT1	Day	12 hr	71	74	59	86
	Evening	4 hr	69	73	52	83
	Night	8 hr	65	65	42	83
LT2	Day	12 hr	70	71	62	89
	Evening	4 hr	68	69	57	85
	Night	8 hr	63	63	43	80
LT3	Day	12 hr	61	63	50	78
	Evening	4 hr	59	61	47	75
	Night	8 hr	55	51	42	73
LT4	Day	12 hr	60	64	48	76
	Evening	4 hr	58	61	46	74
	Night	8 hr	55	50	39	73

Table 7: Summary of unattended baseline noise measurements (free-field) – June 2016 (ref. Waterman IE).

Monitoring Location	Period	Duration	Average $L_{Aeq,T}$ dB	Average $L_{A10,T}$ dB	Average $L_{A90,T}$ dB	Average $L_{AFmax,5min}$ dB
ST1	Day	30 mins	61	64	54	74
ST2	Day	30 mins	66	63	53	76
ST3	Day	25 mins	75	78	65	88
ST4	Day	20 mins	61	65	51	72
ST5	Day	20 mins	61	64	50	77
ST6	Day	30 mins	69	71	64	80
ST7	Day	20 mins	65	68	57	76
ST8	Day	3 hrs	72	76	62	84

Table 8: Summary of attended baseline noise measurements (free-field) – June 2016 (ref. Waterman IE).

4.2 Noise survey – July 2019.

4.2.1 Methodology

The noise survey comprised five days of unattended automatic noise measurements at the same locations as the 2016 survey between Thursday 11th July to Tuesday 16th July 2019. In addition, short term measurements were undertaken at new positions to specifically monitor road traffic along Lower Richmond Road and Clifford Avenue, as well as two CRTN monitoring locations within Chertsey Court and along Williams Lane.

For ease of reference, the table summarising the new measurement locations and the figure identifying the measurement locations are replicated in Table 9 below and Figure 3 overleaf.

Monitoring Location (Refer to Figure 9.1)	Description	Observations and Predominant Noise Sources
ST1	Free-field measurement along Lower Richmond Road (A3003) approx. 3m from carriageway edge. Microphone located approx. 1.2m AGL.	Noise climate dominated by road traffic along Lower Richmond Road. Traffic flow was intermittent with periods of idling due to the traffic lights at the Lower Richmond Road / Clifford Avenue junction.
ST2	Free-field measurement along Clifford Avenue approx. 5m from carriageway edge. Microphone located approx. 1.2m AGL.	Noise climate dominated by road traffic along Clifford Avenue. Traffic flow was intermittent with periods of idling due to the traffic lights at the Lower Richmond Road / Clifford Avenue junction.
CRTN1	Free-field measurement within Chertsey Court car park approx. 50m from Lower Richmond Road / Clifford Avenue Junction. Microphone located approx. 1.2m AGL.	Noise climate in the area dominated by noise from both Lower Richmond Road (A3003) and Clifford Avenue. Occasional cars passing through the Chertsey Court car park and aircraft passing overhead also contributed to the noise climate at this location.
CRTN2	Free-field measurement along Williams Lane approx. 1m from road edge. Microphone located approx. 1.2m AGL.	Noise climate in the area dominated by distant road traffic from Lower Richmond Road and the surrounding transport network. Occasional cars passing along Williams Lane and aircraft passing overhead also contributed to the noise climate at this location.

Table 9: Noise monitoring locations – July 2019 (ref: Waterman IE).

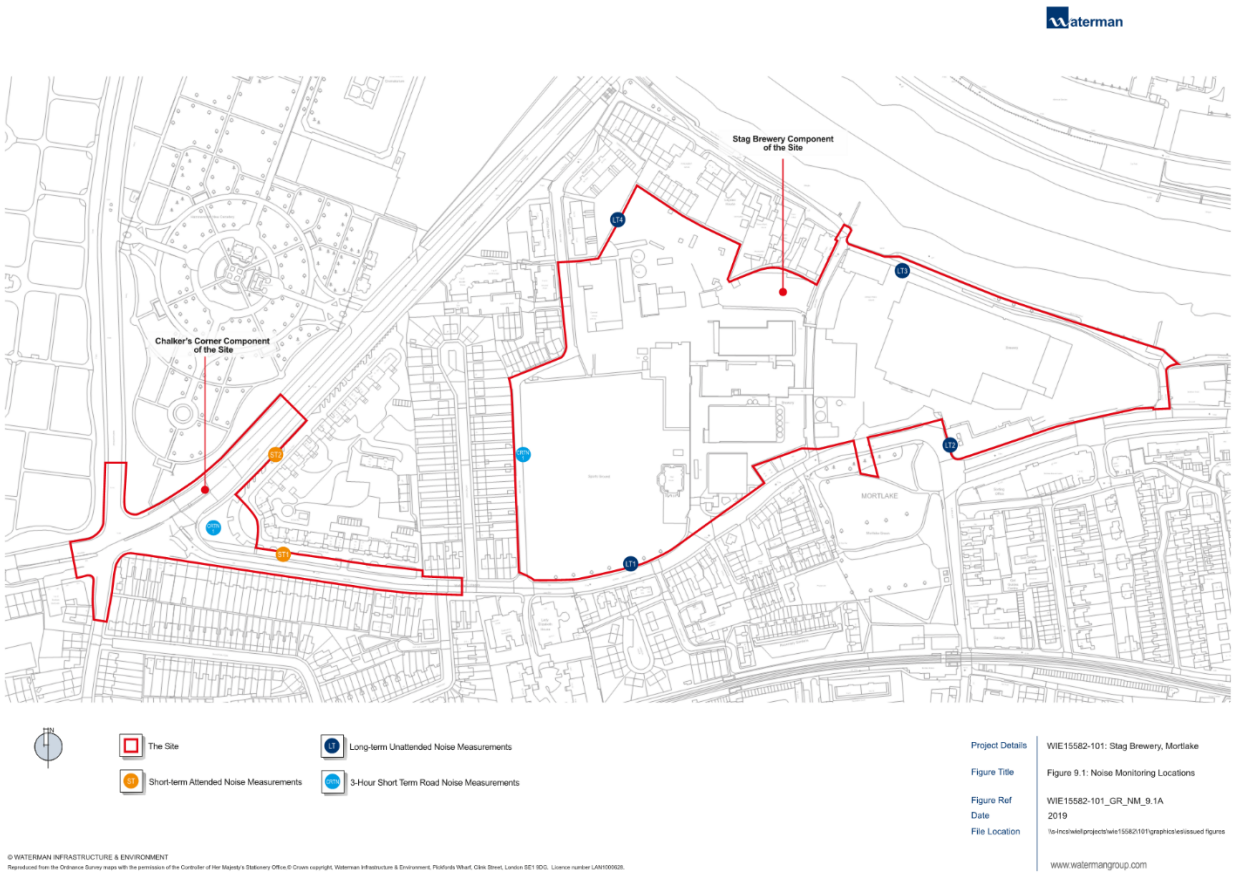


Figure 3: Location plan of the Site and noise monitoring locations – July 2019 (ref: Waterman IE).

4.2.2 Results summary.

A summary of the results from the noise survey conducted by Waterman IE is provided below in Tables 10 and 11 overleaf.

Monitoring Location	Period	Duration	Average $L_{Aeq,T}$ dB	Average $L_{A10,T}$ dB	Average $L_{A90,T}$ dB	90th Percentile $L_{AFmax,5min}$ dB
LT1	Day	12 hr	71	74	59	86
	Evening	4 hr	71	74	55	87
	Night	8 hr	66	66	41	84
LT2	Day	12 hr	68	69	61	85
	Evening	4 hr	69	69	57	86
	Night	8 hr	63	64	42	77
LT3	Day	12 hr	59	60	51	75
	Evening	4 hr	55	56	49	72
	Night	8 hr	53	50	41	70
LT4	Day	12 hr	56	57	48	74
	Evening	4 hr	55	56	47	73
	Night	8 hr	53	48	38	72

Table 10: Summary of unattended baseline noise measurements (free-field) – July 2019 (ref. Waterman IE).

Monitoring Location	Period	Duration	Average $L_{Aeq,T}$ dB	Average $L_{A10,T}$ dB	Average $L_{A90,T}$ dB	Average $L_{AFmax,5min}$ dB
ST1	Day	1 hour	73	74	62	85
ST2	Day	1 hour	70	73	61	78
CRTN1	Day	3 hours	63	65	57	76
CRTN2	Day	3 hours	58	61	45	74

Table 11: Summary of attended baseline noise measurements (free-field) – July 2019 (ref. Waterman IE).

5. Noise emissions of fixed plant.

Limits for noise levels due to building services serving the proposed development have been defined by Waterman IE on the basis of the measured background noise levels. The plant noise emission limits for the nearest off-site noise sensitive receptors as defined by Waterman IE are replicated in Table 12 below. These limits apply one metre from the nearest noise sensitive area.

Nearest noise sensitive receptor	Period	Representative $L_{A90,5min}$	Plant Noise Emission Limit $L_{Aeq,T}$ dB
6-68 Watney Road & 4-24 William Lane	Daytime (0700 to 2300)	48	38
	Night-time (2300 to 0700)	39	35
1-69 Lower Richmond Road	Daytime (0700 to 2300)	59	45
	Night-time (2300 to 0700)	42	35

Table 12: Building services noise emission limits at nearest off-site noise sensitive receptors.

Noise emission limits for future residential dwellings within the Proposed Development have been defined in accordance with the requirements of the LBRuT, as specified in Section 3.8.2 above.

Nearest noise sensitive receptor	Period	Representative $L_{A90,5min}$	Plant Noise Emission Limit $L_{Aeq,T}$ dB
Future residential dwellings within the Development	Daytime (0700 to 2300)	46	36
	Night-time (2300 to 0700)	38	28

Table 13: Building services noise emission limits at future residential properties within the Development.

6. Building envelope & ventilation strategy.

The sound insulation properties of the building envelope depend upon the external noise levels present at the façade and the proposed design criteria for the internal noise levels of specific rooms, dependant on their use. Table 14 overleaf assumes compliance with the internal noise levels stated in Table 5 and shows the level differences for varying spaces within the proposed development.

The examples shown represent the highest level differences required for each block as identified in Figure 4 below, based on the noise levels measured by Waterman IE.

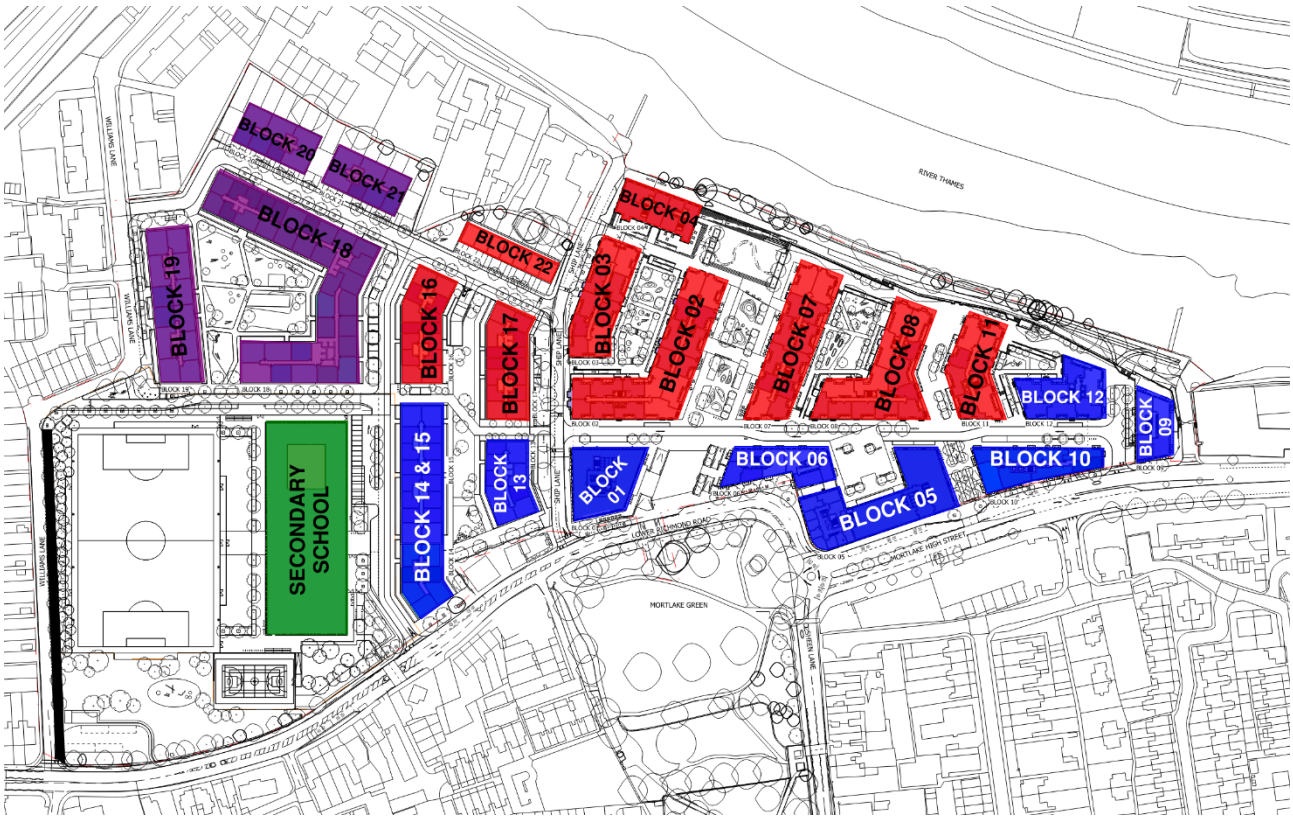


Figure 4: Block locations.

It should be noted that the highest level difference (D) shown for bedrooms and offices within Table 14 takes precedence.

Blocks	Room Use	Noise Levels (dB)		
		Measured External	Proposed Internal (Maximum)	Minimum Level Difference D
Blocks 02, 03, 04, 07, 08, 11, 16, 17 & 22	Commercial	61	40	21
	Living room[1]	61	35	26
	Bedroom[1]	56	30	26
	Bedroom (L_{Amax})[2]	73	45	28
Blocks 01, 05, 06, 09, 10, 12, 13 &15	Cinema auditoria[3]	70	30	40
	Cinema auditoria (L_{Amax})[3]	89	35	54
	Commercial	70	40	30
	Open plan office	70	45	25
	Office (L_{Amax})	89	55	34
	Living room[1]	69	35	34
	Bedroom[1]	63	30	33
	Bedroom (L_{Amax})[2]	80	45	35
Secondary School	Classroom	71	35	36
Blocks 18, 19, 20 & 21	Living room[1]	59	35	24
	Bedroom[1]	55	30	25
	Bedroom (L_{Amax})[2]	73	45	28

Table 14: Notional sound insulation values of proposed façade construction.

Note 1: Living rooms $L_{Aeq,16hr}$ (0700 to 2300) and bedroom $L_{Aeq,8hr}$ (2300 to 0700).

Note 2: Bedrooms $L_{Amax,T}$ (2300 to 0700).

Note 3: The cinema internal noise criteria are notional and will be subject to the Cinema Operator.

Simple natural ventilation through the use of opening windows will provide a level difference (D) in the order of 10 dB. It can be seen from Table 14 above that all internal spaces require greater levels of sound insulation based on the measured external noise levels.

As such, although windows may be openable for purge ventilation, provision for alternative forms of ventilation will need to be made such that windows are not required to be opened for ventilation purposes.

Table 15 below details the minimum required $R_w + C_{tr}$ of all window elements (glazing, seals, frames etc.) to each room on each block.

It is noted that no windows are provided to the cinema auditoria in Block 01 and the proposed building structure is masonry. As such, suitable internal noise levels will be achieved within the cinema auditoria.

Blocks	Minimum Required $R_w + C_{tr}$ (dB)				
	Commercial	Open Plan Office	Classroom	Living Room	Bedroom
Blocks 02, 03, 04, 07, 08, 11, 16, 17 & 22	21*	-	-	26*	28*
Blocks 01, 05, 06, 09, 10, 12, 13 & 15	30*	34	-	34	35
Secondary School	36	-	-	-	-
Blocks 18, 19, 20 & 21	-	-	-	24*	28*

Table 15: Minimum required $R_w + C_{tr}$ of glazed elements.

*Note *: Achievable with a standard thermal double-glazing unit.*

It should be noted that at this stage it is assumed that the non-glazed element on all blocks will be capable of achieving a sound reduction of 46 dB $R_w + C_{tr}$. An example of an external wall capable of achieving this requirement is a 100mm cavity wall construction.

Examples of primary glazing configurations capable of achieving the minimum required $R_w + C_{tr}$ detailed within Table 15 are provided below:

- $R_w + C_{tr}$ 30 dB – 10mm glass, 16mm air gap, 4mm glass.
- $R_w + C_{tr}$ 34 dB – 6mm glass, 16mm air gap, 8.8mm acoustic glass.
- $R_w + C_{tr}$ 36 dB – 8mm glass, 16mm air gap, 10.4mm acoustic glass.

It should be noted that at this stage the required glazing sound insulation values have been based on a level difference comparison only. Detailed calculations will be required to be undertaken to determine refined glazing requirements during subsequent design stages of the project when finalised drawings are available. As such, the sound insulation values stated within Table 15 are indicative and for guidance purposes only.

The above guidance has also been based on an open-plan office. If the space is to be sub-divided to create cellular offices, an increased and more detailed glazing specification will be required to enable achievement of the internal ambient noise levels stated within BS 8233:2014 and the BCO Guide for cellular offices and meeting rooms.

Similarly, the requirements for the secondary school have been based on the internal noise level requirements for a standard teaching space (e.g. seminar room, laboratory etc.). Should specialist areas be proposed (e.g. music recital rooms, drama studios, SEN spaces etc.) then an increased glazing specification will be required.

It should also be noted that this assessment has been conducted on the basis that all buildings are constructed. It is understood that the development will be phased and as such, consideration for building façades that are exposed to higher noise levels until later phases are completed will need to be given. This may mean that façade requirements are increased in these circumstances.

6.1 Compliance

In order to confirm the suitability of the proposed glazed and non-glazed elements, evidence of the laboratory sound insulation performance will be required for the entire unit as it will be installed (including glass, frame, seals, mullions and transoms). All acoustic testing shall be undertaken in controlled laboratory conditions in accordance with ISO 10140-2: 2010 – "*Acoustics – Laboratory measurement of sound insulation of building elements. Part 2: Measurement of airborne sound Insulation*". (7)

6.2 Balconies.

The Proposed Development will comprise balconies, which are proposed on Buildings 02, 03, 05, 06, 07, 08, 09, 10, 11 & 12, although these are limited in number on the most exposed façades.

For a seated resident on these balconies, the acoustic screening effect of a glazed balustrade is expected to reduce façade levels by approximately 3 dB(A). This would reduce noise levels for a seated receptor on the majority of balconies that do not have a direct line of site to Mortlake High Street and Lower Richmond Road to less than 55 dB(A). This would therefore achieve the WHO and BS 8233 recommendation for external amenity areas.

For a limited number of balconies overlooking Mortlake High Street and Lower Richmond Road, noise levels will exceed the WHO recommendation for amenity areas. However, it is considered unlikely that in the urban context of the site, noise would significantly impact upon their intended amenity use with similar balconies appearing to be well utilised on developments in the surrounding area which experience similar levels of noise exposure.

6.3 External amenity areas.

Several external amenity areas are also proposed across the site at ground floor level, in particular to the north of the site. For the vast majority of these areas, including the area between blocks 18 & 19, between blocks 2, 3 & 4, between blocks 7 & 8 and between blocks 11 & 12, the built form of the development will provide screening of road traffic noise such that noise levels are expected to be less than 55 dB(A) during the daytime and therefore achieve the WHO and BS 8233 recommendation for external amenity spaces.

7. Building services plant.

As part of the Proposed Development various items of building services plant will be located within several basement level plant rooms and at roof level. A summary of the items of building services plant proposed at this stage is provided below in Table 16.

Phase / block	Approximate location	Items of plant proposed
Phases A, B & C	Basement energy centre	3 no. CHP units
	Phase A basement	Standby generator 2 no. car park extract chambers
	Phase B basement	2 no. car park extract chambers
	Phase C basement	1 no. car park extract chambers
Phase D	Basement energy centre	3 no. CHP units
	Phase D basement	Standby generator 3 no. car park extract chambers
Block 1	Block 1 basement	4 no. AHU
	Block 1 roof	8 no. VRF condensers 1 no. AHU 2 no. VES Ecovent AHU 1 no. kitchen extract fans
Block 2	Block 2 roof	4 no. VRF condensers 11 no. DX condensers 3 no. kitchen extract fans
Block 3	Block 3 roof	4 no. DX condensers
Block 4	Block 4 roof	5 no. VRF condensers 2 no. kitchen extract fans 5 no. DX condensers
Block 5	Block 5 roof	3 no. AHU 1 no. kitchen extract fans 24 no. VRF condenser
Block 6	Block 6 roof	3 no. kitchen extract fans 3 no. VRF condensers
Block 7	Block 7 roof	5 no. kitchen extract fans 5 no. VRF condensers 6 no. DX condensers
Block 8	Block 8 roof	3 no. kitchen extract fans 3 no. VRF condensers 8 no. DX condensers
Block 9	Block 9 roof	2 no. kitchen extract fans 3 no. VRF condensers 1 no. DX condenser
Block 10	Block 10 roof	2 no. kitchen extract fans 2no. VRF condensers
Block 11	Block 11 roof	2 no. kitchen extract fans

Phase / block	Approximate location	Items of plant proposed
		3 no. VRF condensers 4 no. DX condensers
Block 12	Block 12 roof	3 no. kitchen extract fans 4 no. VRF condensers 6 no. DX condensers

Table 16: Proposed items of building services plant.

7.1 Assessment methodology.

An assessment of the noise emissions from the proposed items of building plant for normal operation has been undertaken to ensure compliance with the building services noise emission limits. The manufacturer's acoustic data has been used and is provided in Appendix B attached.

The resultant sound pressure one metre from the nearest residential window of the proposed development has been calculated using the principles of ISO 9613-2 (8) and compared to the defined building services noise emission limits in order to determine suitable mitigation measures.

The methodology used to determine noise emissions at the nearest residential window for each item of plant are as follows:

7. Apply a distance correction to the manufacturer's sound power level ($L_{w(man)}$) for the distance to the noise sensitive receptor (r) assuming hemispherical sound propagation:

$$Distance\ Correction = 20 \log_{10} r + 8$$

8. Derive the screening *(Screen)* provided by the parapet wall in accordance with ISO 9613-2, if appropriate.
9. Apply a directivity correction *(Dir)* based on the angle of view between the source and receiver in accordance with guidance provided within *"Fläkt Woods Practical Guide to Noise Control."*.
10. Derive L_p at receiver location based on the manufacturer's sound power level ($L_{w(man)}$) using the following equation:

$$L_{p(receiver)} = L_{w(man)} - Distance\ Correction - Screen + Dir$$

11. Predict sound pressure level for all units in operation.

7.2 Attenuation requirements.

In order for the proposed plant associated with the Proposed Development to achieve the building services noise emission limits stated in Table 13 at the nearest on-site residential window, provision for the following outline attenuation measures as detailed in Table 17 is required. An example of the full calculation procedure is provided in Appendix B attached.

Phase / block	Approximate location	Items of plant proposed	Mitigation required (inc. notional dimensions)
Phases A, B & C	Basement energy centre	3 no. CHP units	Exhaust silencer approximately 1200mm long on each CHP.
	Phase A, B & C basement	Standby generator	Enclosed set generator with silencer approx. 1200mm long.
		2 no. car park extract chambers	Primary silencer – 20% free area, 3000mm long. Secondary silencer – 33% free area, 1500mm long. Night-time operation limited to 75% daytime load.

Phase / block	Approximate location	Items of plant proposed	Mitigation required (inc. notional dimensions)
Phase D	Basement energy centre	3 no. CHP units	Exhaust silencer approximately 1200mm long on each CHP.
	Phase D basement	Standby generator	Enclosed set generator with silencer approx. 1200mm long.
		3 no. car park extract chambers	Primary silencer – 20% free area, 3000mm long. Secondary silencer – 33% free area, 1500mm long. Night-time operation limited to 75% daytime load.
Block 1	Block 1 basement	4 no. AHU	Silencers on intake and exhaust – no noise data available for selections.
	Block 1 roof	8 no. VRF condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		1 no. AHU	Silencers on intake and exhaust – no noise data available for selection.
		2 VES Ecovent AHU	Silencers on atmospheric connections – 33% free area, 1500mm long. Night-time operation limited to 70% daytime load.
		1 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
Block 2	Block 2 roof	4 no. VRF condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		11 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		3 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
Block 3	Block 3 roof	4 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 4	Block 4 roof	5 no. VRF condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		2 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		5 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 5	Block 5 roof	3 no. AHU	Silencers on intake and exhaust – no noise data available for selection.
		1 no. kitchen extract fan	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.

Phase / block	Approximate location	Items of plant proposed	Mitigation required (inc. notional dimensions)
		24 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 6	Block 6 roof	3 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		3 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 7	Block 7 roof	5 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		5 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		6 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 8	Block 8 roof	3 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		3 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		8 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 9	Block 9 roof	2 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		3 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		1 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 10	Block 10 roof	2 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		2 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 11	Block 11 roof	2 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		3 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.

Phase / block	Approximate location	Items of plant proposed	Mitigation required (inc. notional dimensions)
		4 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
Block 12	Block 12 roof	3 no. kitchen extract fans	Acoustic enclosure and silencers on intake and exhaust – no noise data available for selection.
		4 no. VRF condenser	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.
		6 no. DX condensers	Acoustic enclosure with attenuated openings to fully surround condensers. Night-time operation limited to 70% daytime load.

Table 17: Outline attenuation requirements.

Provision for the above attenuation requirements will be made within the proposals, however a precise specification of attenuators and screening will be defined during subsequent design stages once finalised plant selections and locations are available to ensure the proposed plant will achieve the defined noise emission limits.

Consideration will also be given to the proposed plant and low frequency noise emissions in accordance with the requirements of NANR45. Whilst finalised plant selections are not available at this stage, the proposed building services plant compares favourably with the octave band reference curve contained within NANR45.

It should be noted that the assessment provided within this Section is considered worst case as it assumes the plant is operating at maximum duty. Therefore, noise levels actually produced are likely to be significantly lower during many periods.

8. Multi-use games area & 3G sports pitch.

As part of the Proposed Development a multi-use games area (MUGA) and 3G sports pitch are proposed to the west of the site as shown in Figure 5 below.

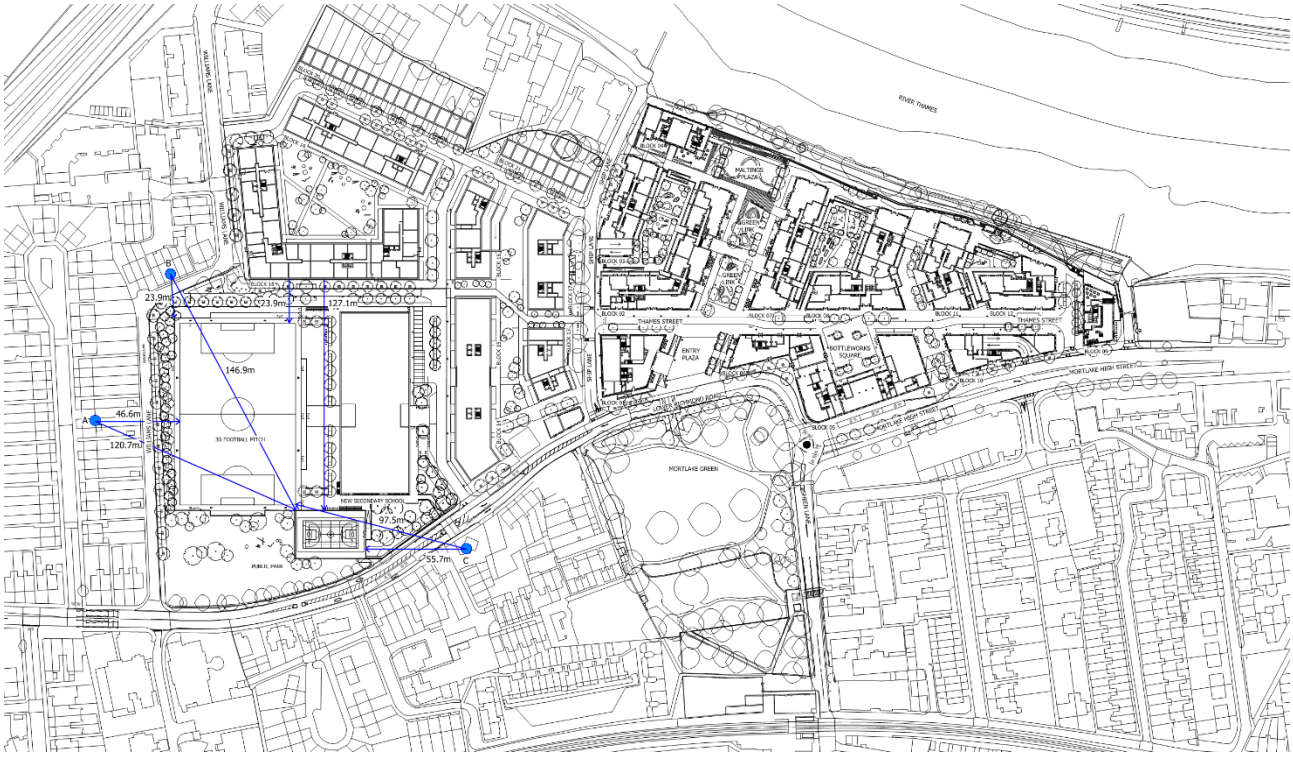


Figure 5: MUGA & 3G sports pitch - typical ground floor plan.

The use of the MUGA and sports pitch will be during the daytime and evening hours only, with typical operational hours of play being restricted to 9pm Monday to Saturday and 8pm on Sundays and Bank Holidays.

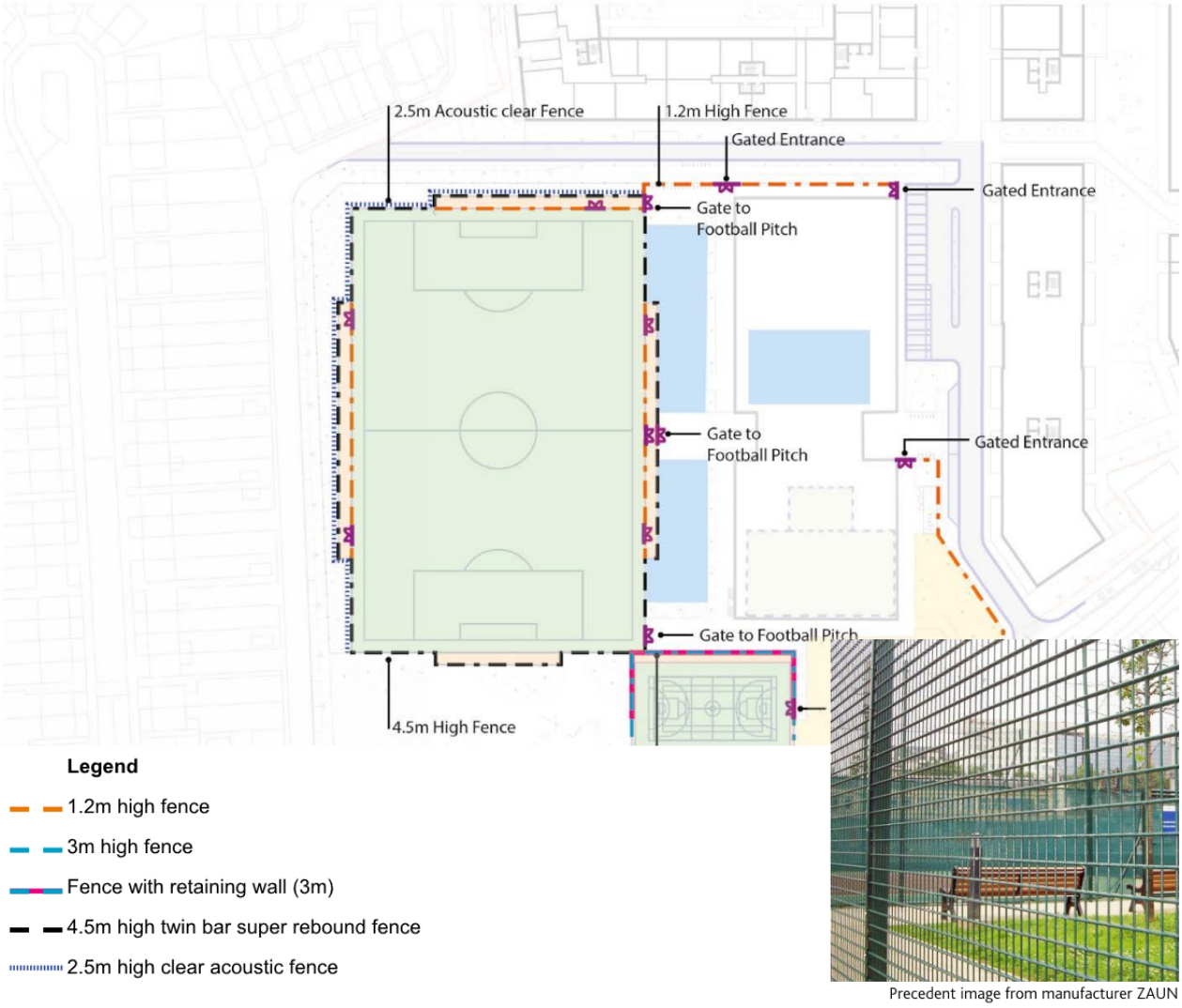
As shown in Figure 5, the nearest new residential receptor proposed as part of the Proposed Development is Block 18 and is approximately 24m from the 3G sports pitch and 127m from the MUGA.

As discussed in Section 6, the residential dwellings will be designed such that internal noise levels do not exceed 35 dB L_{Aeq}, during the daytime and 30 dB L_{Aeq} and 45 dB L_{Amax} at night from anonymous source of noise such as road traffic.

Given the distance between the sports pitch / MUGA and new residential receptors, the general noise levels from anonymous sources will be greater than those expected from the sports pitch and MUGA. As such, the required façade treatment and ventilation strategy detailed in Section 6 will be sufficient to reduce noise associated with the sports pitch and MUGA to an appropriate level.

Whilst not specifically required to reduce the noise impact of the sports pitch and MUGA, a commitment has been made to include the following mitigation measures, as shown in Figure 6 overleaf, which will further reduce the noise impact:

- A weld mesh (twin bar super rebound fence) with EPDM rubber inserts and fixings to reduce rattle and ball impact noise during play;
- A maintenance scheme to prevent deterioration in performance of the sports facilities that could result from damaged panels, loose brackets, worn AV bushing and squeaky gates; and
- A 2.5m acoustic barrier along the western and northern boundary of the sports pitch.



Precedent image from manufacturer ZAUN

Figure 6: Plan identifying adopted mitigation measures to MUGA & 3G sports pitch.

9. Summary & conclusions.

Hoare Lea has conducted a noise impact assessment as a revised submission document to the noise impact assessment submitted under Applications A, B and C in respect of the former Stag Brewery Site in Mortlake within the London Borough of Richmond Upon Thames.

Background noise levels typical of the daytime and night-time as measured by Waterman IE have been used to define building services plant noise emission limits at future residential receptors as part of the Proposed Development.

During the daytime and night-time, the combined building services plant noise emission contribution limit advised is 36 dB(A) and 28 dB(A) respectively, one metre from the nearest residential façade of the Proposed Development.

An assessment of the building envelope acoustic performance is provided with the minimum level difference (D) in accordance with the internal ambient noise levels stated within BS 8233 and BB 93. The ventilation strategy should allow for the full mechanical ventilation of all spaces as the level differences required are above those achievable by simple means of natural ventilation.

Notional glazing requirements for various internal spaces and indicative primary glazing configurations have been provided however, it should be noted that these performances are for guidance purposes only. Detailed calculations will be required to be undertaken to determine refined glazing requirements during subsequent design stages of the project.

An assessment of noise associated with the outline proposed items of building services plant has been undertaken. Outline attenuation requirements for each item of plant have been provided and will be sufficient to limit noise emissions to the derived limits at the nearest adjacent on-site residential receptor during the daytime and night-time.

An assessment of noise associated with the proposed MUGA and 3G sports pitch has been undertaken. The assessment confirms that the proposed façade treatment and ventilation strategy will be sufficient to reduce noise associated with the MUGA and sports pitch to an appropriate level. Whilst not required to reduce the noise impact of the MUGA and sports pitch, a commitment has been made to include the following mitigation measures which will further reduce the noise impact:

- A weld mesh (twin bar super rebound fence) with EPDM rubber inserts and fixings to reduce rattle and ball impact noise during play;
- A maintenance scheme to prevent deterioration in performance of the sports facilities that could result from damaged panels, loose brackets, worn AV bushing and squeaky gates; and
- A 2.5m acoustic barrier along the western and northern boundary of the sports pitch.

The guidance provided within this report meets the requirements of the London Borough of Richmond upon Thames.

10. References.

1. *National Planning Policy Framework, Department for Communities and Local Government, February & June 2019.*

2. *BS 4142: 2014: 'Method for rating industrial and commercial sound'.*

3. *BS 8233: 2014, "Guidance on Sound Insulation and Noise Reduction for Buildings", BSI.*

4. *World Health Organisation (WHO) - Environmental Noise Guidelines for the European Region, 2018.*

5. *BS 8233: 1999, 'Sound Insulation and Noise Reduction for Buildings - Code of Practice'.*

6. Department for Education and Skills. *Building Bulleting 93, Acoustic Design of Schools.*

7. *ISO 10140-2: 2010, "Acoustics - Laboratory Measurement of Sound Insulation of Building Elements. Part 2: Measurement of Airborne Sound Insulation.".*

8. *ISO 9613-2: 1996, 'Acoustics - Attenuation of Sound during Propogation Outdoors - Part 2'.*

Appendix A – Acoustic terminology.

Sound
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

The Sound Pressure
The Sound Pressure is the force (N) of sound on a surface area (m2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm-2 or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure – p. The power is proportional to the square of the sound pressure.

The Sound Pressure Level
The human ear has an approximately logarithmic response to sound pressure over a very large dynamic range. The lowest audible sound pressure approximately 2 x 10-5 Pa (2 ten billionths of an atmosphere) and the highest is approximately 100 Pa.

It is therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound, where:

$$L_p = 10 \log\left(\frac{p^2}{p_{ref}^2}\right) = 10 \log\left(\frac{p}{p_{ref}}\right)^2 = 20 \log\left(\frac{p}{p_{ref}}\right)$$

Where: L_p *= sound pressure level (dB)*

p *= sound pressure (Pa)*

p_{ref} *= 2 x 10-5 – reference sound pressure (Pa)*

In accordance with the logarithmic scale, doubling the sound pressure level gives an increase of 6 dB.

Decibel (dB)
The decibel is the unit used to quantify sound pressure levels as well as sound intensity and power levels.

In accordance with the logarithmic scale, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.

Sound Pressure Level of Some Common Sources
An indication of the range of sound levels commonly found in the environment is given in the following Table.

Source	Sound Pressure Level dB
Threshold of Hearing	0
Rustling Leaves	20
Quiet Whisper	30
Home	40
Quiet Street	50
Conversation	60
Inside a Car	70
Loud Singing	80
Motorcycle (10m)	90
Lawn Mower (1m)	100
Diesel Truck (1m)	110
Amplified Music (1m)	120
Jet Plane (1m)	130

Frequency
The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz) or cycles per second.

Octave and Third Octave Bands
An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz.

Third octave bands provided a fine resolution by dividing each octave band into three bands. For examples, third octave bands would be 160 Hz, 250 Hz and 315 Hz for the same 250 Hz octave band.

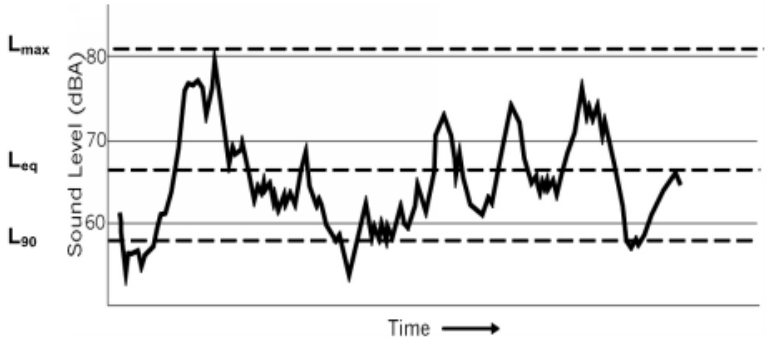
The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequency than to low frequencies within the range. This is the basis of the A-weighting.

A-Weighting
The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies.

An A weighted value would be written as dB(A), or including A within the parameter term.

Noise Units
In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as five minutes, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



$L_{eq,T}$
The $L_{eq,T}$ is a parameter defined as the equivalent continuous sound pressure level over a defined time period 'T'. It is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal.

The $L_{eq,T}$ can be thought of as an 'average' sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an A-weighted noise level in dB(A) and is commonly used to describe all types of environmental noise sources.

$L_{01,T}$
The $L_{01,T}$ is a parameter defined as the sound pressure level exceeded for 1% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter.

$L_{10,T}$
The $L_{10,T}$ is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe road traffic noise.

$L_{90,T}$
The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe the prevailing background noise level.

$L_{max,T}$
The $L_{max,T}$ is a parameter defined as the maximum noise level measured during the specified period 'T'.

Specific Noise Level, $L_{Aeq,Tr}$.
This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

Free Field
A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

Façade
A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

R_w
A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1: 1997.

Appendix B - Example calculation for proposed items of building services plant.

Basement plant.

	Sound pressure level per octave band frequency in Hz (dB)								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Phase A, B, C – Car Park Extract Fan									
L_w	103	109	106	104	99	95	93	89	105
Distance correction (19m)	-19	-19	-19	-19	-19	-19	-19	-19	-
Directivity	+8	+8	+9	+9	+9	+9	+9	+9	-
Attenuation	-38	-55	-55	-50	-50	-50	-50	-50	-
$L_{p(receiver)}$	54	43	35	29	25	22	20	18	34

Roof Plant

	Sound pressure level per octave band frequency in Hz (dB)								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Block 1									
Condenser Units									
L_w	-	87	88	87	83	78	74	69	88
Distance correction (14m)	-	-31	-31	-31	-31	-31	-31	-31	-
Acoustic Enclosure	-	-20	-29	-34	-34	-32	-30	-27	-
$L_{p(receiver)}$	-	36	28	22	18	15	13	11	26
$L_{p(receiver)}$ (8 units)	-	45	37	31	27	24	22	20	35

HOARE LEA

TOM HILLS
ASSOCIATE

+44 1202 654 600
tomhills@hoarelea.com

HOARELEA.COM

Enterprise House
Old School Close
Ferndown
Bournemouth
BH22 9UN
England