St Clare Business Park
Hampton Hill
Richmond

Environmental Noise Survey and Acoustic Design Statement Report

24902/ADS2Rev2

19 April 2023

For:

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Document Control

Rev	Date	Comment	Prepared by	Authorised by
0	31/05/2022	-	Andrew Fermer Director BSc(Hons), MIOA	Simon Hancock Director BEng(Hons), CEng, MIMechE, MCIBSE, FIOA
1	15/06/2022	Minor amendment to Section 1.0	Andrew Fermer Director BSc(Hons), MIOA	Simon Hancock Director BEng(Hons), CEng, MIMechE, MCIBSE, FIOA
2	19/04/2023	Minor amendment to Section 1.0	 Gareth Evans Director BSc(Hons), MIOA	

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Contents

Attachments

1.0 Introduction

A mixed use scheme is proposed on behalf of Notting Hill Home Ownership Ltd. at the site of St. Clare Business Park in Hampton Hill, Richmond. Demolition of existing buildings and erection of 1no. mixed use building between three and five storeys plus basement in height, comprising 86no. residential flats (Class C3) and 1,290sq.m of commercial floorspace (Class E); 1no. two storey building comprising 595sq.m of commercial floorspace (Class E); 14no. residential houses (Class C3); and associated access, external landscaping and car parking.

Hann Tucker Associates have therefore been commissioned to undertake an environmental noise survey and noise impact assessment in order to assess the suitability of the proposed development for residential use.

This report presents the methodology and findings of our noise survey and assessment in the context of national planning policies and the policy of the Local Authority.

2.0 Objectives

To undertake an environmental noise survey to establish the existing L_{Amax}, L_{Aeq} and L_{A90} environmental road, rail and air traffic noise levels at selected positions.

To undertake a noise assessment, based on the results of the survey, to assess the suitability of the site for residential use with reference to national and local planning policies.

To assess atmospheric noise emissions from the proposed plant to the nearest noise sensitive windows within the proposed development.

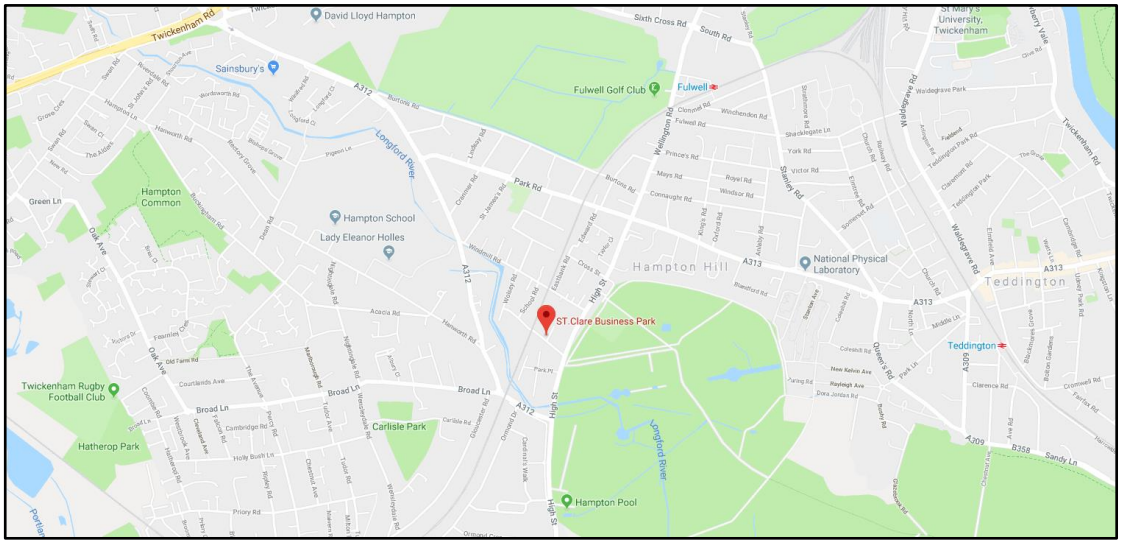
To assess atmospheric noise emissions from the proposed plant to the nearest noise sensitive windows outside the proposed development.

To assess noise break-in from the proposed plant through the roof to the noise sensitive rooms within the proposed development..

3.0 Site Description

3.1 Location

The site is located in Hampton Hill, Richmond, as shown in the Location Map below.



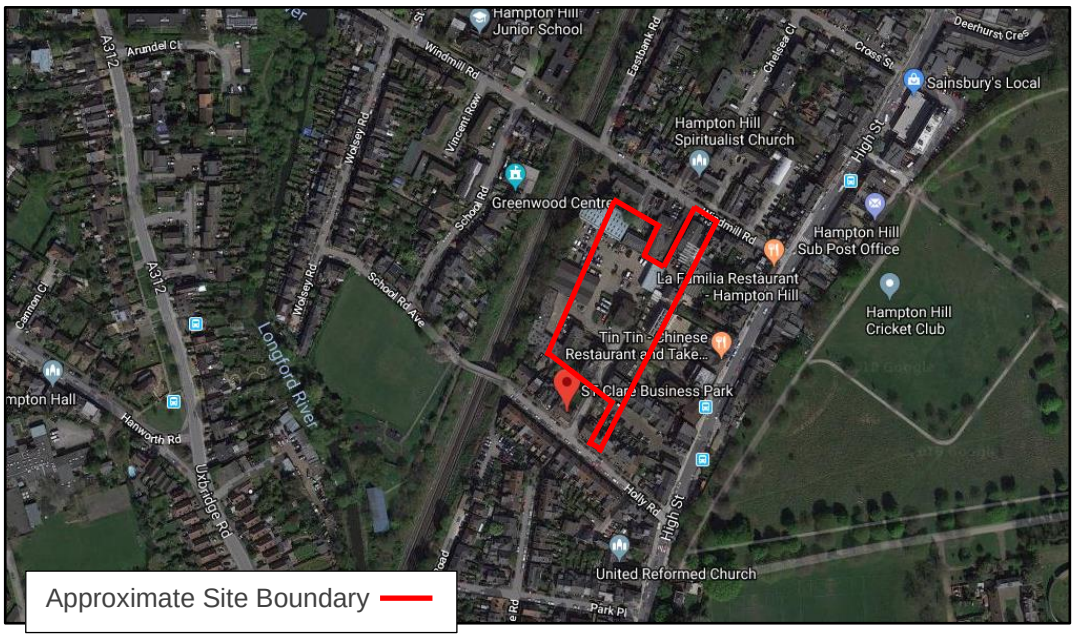
Location Map (© Google 2018)

The site falls within the jurisdiction of The London Borough of Richmond upon Thames.

3.2 Description

The site is currently accessible from Holly Road to the south. It is bounded by the railway line to the west, by properties on Windmill Road to the north, properties on High Street to the east, and properties on Holly Road to the south. Surrounding properties are a mix of residential and commercial and are generally up to 3No. storeys in height.

The site is shown in the Site Plan below.



Site Plan (© Google 2018)

4.0 Acoustic Terminology

For an explanation of the acoustic terminology used in this report please refer to Appendix A enclosed.

5.0 Methodology

The survey was undertaken by Luke Rendell Ba (Hons) MIOA.

5.1 Unmanned Noise Survey

5.1.1 Procedure

Fully automated environmental noise monitoring was undertaken from approximately 11:00 hours on 18 January 2018 to approximately 11:00 hours on 19 January 2018.

During the periods we were on site the wind conditions were calm. The sky was generally patchy cloud. We understand that generally throughout the survey period the weather conditions were similar to the above. These conditions are considered suitable for obtaining representative measurement results.

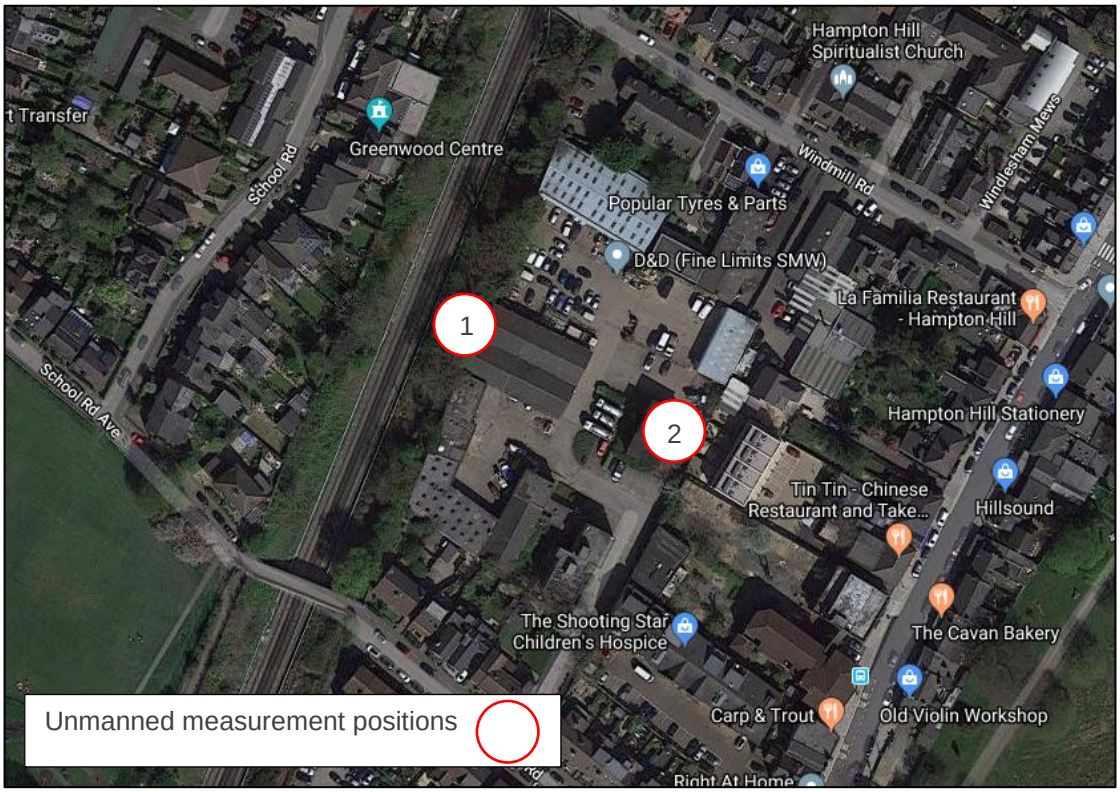
Measurements were taken continuously of the A-weighted (dBA) L_{90}, L_{eq} and L_{max} sound pressure levels over 15 minute periods.

5.1.2 Measurement Positions

The noise level measurements were undertaken at 2No. positions as described in the table below.

Position No	Description
1	The microphone was mounted to a pole and positioned at 1m from the façade of an existing commercial building. This was 1.2m above local ground level at the western site boundary, overlooking the railway line. This position was approximately 15m horizontally from the nearest train passbys and was selected in order to measure the highest noise levels present at the site.
2	The microphone was mounted to a pole and located at 1m from the east facing façade of one of the existing commercial buildings, at 1.2m above local ground level. This position was selected to measure the lowest noise levels present on site for use in selecting plant noise emission criteria.

These positions are shown on the plan below.



Plan Showing Unmanned Measurement Positions (© Google 2018)

5.1.3 Instrumentation

The instrumentation used during the survey is presented in the table below:

Description	Manufacturer	Type	Serial Number	Calibration
Position 1 Type 1 ½" Condenser Microphone	Bruel & Kjaer	4189	2470596	Calibration on 21/11/2017
Position 1 Type 1 Preamp	Larson Davis	PRM902	4214	Calibration on 21/11/2017
Position 1 Type 1 Data Logging Sound Level Meter	Larson Davis	824	3803	Calibration on 21/11/2017
Position 2 Type 1 ½" Condenser Microphone	PCB	377B02	132146	Calibration on 24/07/2017
Position 2 Type 1 Preamp	Larson Davis	PRM902	4215	Calibration on 24/07/2017
Position 2 Type 1 Data Logging Sound Level Meter	Larson Davis	824	3838	Calibration on 24/07/2017
Type 1 Calibrator	Larson Davis	CAL200	3082	Calibration on 03/07/2017

Each sound level meter, including the extension cable, was calibrated prior to and on completion of the surveys. No significant changes were found to have occurred (no more than 0.1 dB).

Each sound level meter was located in an environmental case with the microphone connected to the sound level meter via an extension cable. Each microphone was fitted with a windshield.

5.2 Manned Measurements

5.2.1 Procedure

Manned measurements of train passbys were undertaken from 11:30-12:00 hours on 18 January 2018 at Position 1. Train passbys from each of the two lines were included.

Measurements were taken of L_{Amax} noise levels with both fast and slow weightings simultaneously, to allow comparison between the relevant criteria.

In addition, L_{90}, L_{eq} and L_{max} octave band spectra (from 63Hz to 8kHz) were taken in order to gain a more detailed description of the prevailing noise climate.

5.2.2 Instrumentation

The instrumentation used during the manned measurements is presented in the table below:

Description	Manufacturer	Type	Serial Number	Calibration
Type 1 Data Logging Sound Level Meter	Bruel & Kjaer	2250	3007292	Calibration on 20/03/2017
Type 1 ½" Condenser Microphone	Bruel & Kjaer	4189	3004879	Calibration on 20/03/2017
Type 1 Preamp	Bruel & Kjaer	ZC003 2	23396	Calibration on 20/03/2017

The sound level meter was hand held and was fitted with a Brüel and Kjær microphone windshield.

The sound level meter was calibrated prior to and on completion of the measurements. No significant change was found to have occurred (no more than 0.1 dB).

6.0 Results

6.1 Results of Unmanned Survey

The results have been plotted on Time History Graphs 24902/TH1 to 24902/TH2 enclosed presenting the 15 minute A-weighted (dBA) L_{90}, L_{eq} and L_{max} levels at each measurement position throughout the duration of the survey.

6.1.1 L_{eq} Noise Levels

In order to compare the results of our survey with the relevant guidelines it is necessary to convert the measured $L_{Aeq(15\ minute)}$ noise levels into single figure daytime $L_{Aeq(16\text{-}hour)}$ (07:00-23:00 hours) and night-time $L_{Aeq(8\text{-}hour)}$ (23:00-07:00 hours) levels.

The daytime $L_{Aeq(16\text{-}hour)}$ and night-time $L_{Aeq(8\text{-}hour)}$ noise levels measured at each position are presented in the tables below.

Position	Measured Daytime $L_{Aeq(16\text{-}hour)}$	Measured Night-Time $L_{Aeq(8\text{-}hour)}$
1	61dB	58dB
2	51dB	46dB

However, the above levels are as measured at the measurement positions and include local reflections. In order to compare measured noise levels with the Local Authority criteria it is necessary to subtract 3dB to correct for the measured façade reflection. The corrected free field noise levels are presented in the table below.

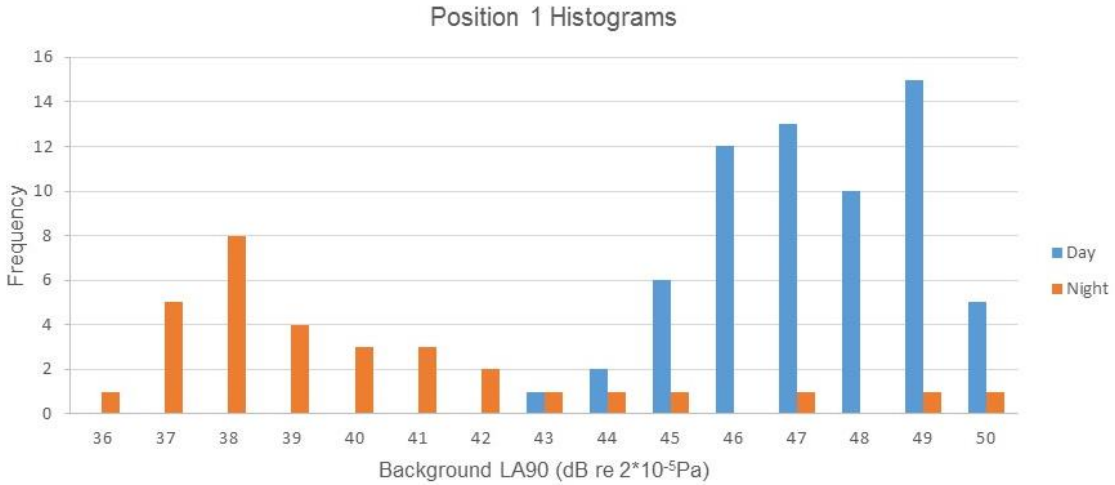
Position	Free Field Daytime $L_{Aeq(16\text{-}hour)}$	Free Field Night-Time $L_{Aeq(8\text{-}hour)}$
1	58dB	55dB
2	48dB	43dB

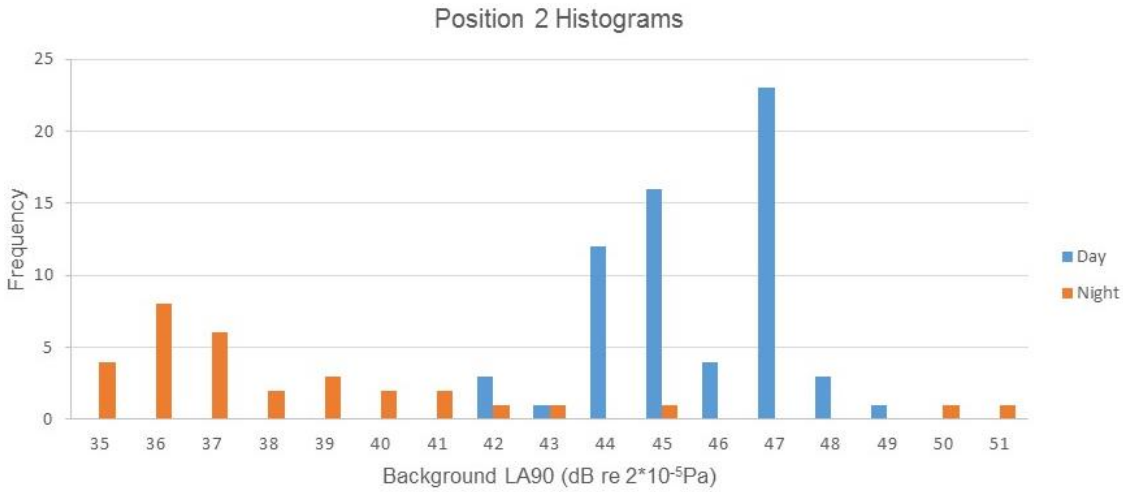
6.1.2 Background L_{90} Noise Levels

The London Borough of Richmond upon Thames requires that noise generating development is assessed in accordance with BS4142:2014. With respect to determining background noise levels this states:

"NOTE 1 To obtain a representative background sound level a series of either sequential or disaggregated measurements ought to be carried out for the period(s) of interest, possibly on more than one occasion. A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."

The histograms detailing the frequency distribution of L_{A90} background sound levels at each position are presented below:





Based on the above statistical analysis, and inspection of the Time History Graphs 24902/TH1 and 24902/TH2 the following table presents the L_{A90} background noise levels deemed to be representative of the noise climate at each position, as per BS4142:2014:

Position	Representative L_{A90} Background Noise Level (dB re 2 x 10^{-5} Pa)	
	Daytime (07:00 – 23:00) Hours	Night-Time (23:00 – 07:00) Hours
1	47	38
2	45	36

6.1.3 Night-time L_{max} Results

Published train timetables indicate that there were 9No. trains travelling between Hampton and Fulwell stations during the night-time period 23:00 hours – 07:00 hours. The corresponding free field corrected L_{Afmax} events at Position 1 ranged between 81-91dB, with 6No. measurement periods exceeding 82dB. The 10th highest L_{Amax} event recorded at Position 1 was 79dB.

6.2 Results of Manned Measurements

For comparison with the design criterion of 45dB L_{Afmax} the unmanned sound level meters were set to a fast time weighting. The manned measurements recorded data with both fast and slow time weightings simultaneously. The difference between measured L_{Asmax} and L_{Afmax} noise levels for train passbys on the near and far tracks was found to be approximately 2dB.

7.0 Discussion Of Noise Climate

Subjectively the dominant noise sources were bird song, light noise from commercial premises still operational (conversation, hand tools), trains from the adjacent railway line (approximately 2 to 4 trains per hour), and an occasional distant rumble assumed to be due to air traffic from Heathrow airport approximately 7km to the north-west.

8.0 Relevant Planning Policies and Guidance

8.1 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was published in March 2010 (i.e. before the NPPF). The NPSE is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long term vision of Government noise policy which is to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

That vision is supported by the following NPSE noise policy aims which are reflected in three of the four aims of planning policies and decisions in paragraph 123 of the NPPF (see paragraph 8.2 (b) below):

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

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

The Explanatory Note to the NPSE has three concepts for the assessment of noise in this country:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

LOAEL – Lowest Observable Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

None of these three levels are defined numerically and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent an SOAEL for noise is acknowledged in the NPSE and the NPSE asserts that not stating specific SOAEL levels provides policy flexibility in the period until there is further evidence and guidance.

The NPSE concludes by explaining in a little more detail how the LOAEL and SOAEL relate to the three NPSE noise policy aims listed above. It starts with the aim of avoiding significant adverse effects on health and quality of life, then addresses the situation where the noise impact falls between the LOAEL and the SOAEL when *"all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development."* The final aim envisages pro-active management of noise to improve health and quality of life, again taking into account the guiding principles of sustainable development which include the need to minimise travel distance between housing and employment uses in an area.

8.2 National Planning Policy Framework (NPPF)

The following paragraphs are from the NPPF (published July 2021):

185. 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.

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."

Paragraph 185 also references the Noise Policy Statement for England (NPSE). This document does not refer to specific noise levels but instead sets out three aims:

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

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

Paragraph 2 of the NPPF states that "planning law required that applications for planning permission must be determined in accordance with the development plan unless material considerations indicate otherwise."

Paragraph 12 of the NPPF states that "The presumption in favour of sustainable development does not change the statutory status of the development plan as the starting point for decision making. Where a planning application conflicts with an up-to-date development plan (including any neighbourhood plans that form part of the development plan), permission should not usually be granted. Local planning authorities may take decisions that depart from an up-to-date

development plan, but only if material considerations in a particular case indicate that the plan should not be followed."

8.3 Planning Practice Guidance on Noise

Planning Practice Guidance (PPG) under the NPPF has been published by the Government as a web based resource at http://planningguidance.planningportal.gov.uk/blog/guidance/. This includes specific guidance on Noise although, like the NPPF and NPSE the PPG does not provide any quantitative advice. It seeks to illustrate a range of effect levels in terms of examples of outcomes as set out in the following table:

Perception	Examples of Outcomes	Increasing effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable hard, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

8.4 The London Plan (2021)

The London Plan was published March 2021.

Policy D14 Noise states:

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.*

*3.14.1 The **management of noise** is about encouraging the right acoustic environment, both internal and external, in the right place at the right time. This is important to promote good health and a good quality of life within the wider context of achieving sustainable development. The management of noise should be an integral part of development proposals and considered as early as possible. Managing noise includes improving and enhancing the acoustic environment and promoting appropriate soundscapes. This can mean allowing some places or certain times to become noisier within reason, whilst others become quieter. Consideration of existing noise sensitivity within an area*

is important to minimise potential conflicts of uses or activities, for example in relation to internationally important nature conservation sites which contain noise sensitive wildlife species, or parks and green spaces affected by traffic noise and pollution. Boroughs, developers, businesses and other stakeholders should work collaboratively to identify the existing noise climate and other noise issues to ensure effective management and mitigation measures are achieved in new development proposals.

*3.14.2 The **Agent of Change Principle** places the responsibility for mitigating impacts from existing noise-generating activities or uses on the new development. Through the application of this principle existing land uses should not be unduly affected by the introduction of new noise sensitive uses. Regard should be given to noise-generating uses to avoid prejudicing their potential for intensification or expansion.*

*3.14.3 The management of noise also includes promoting **good acoustic design of the inside of buildings**. Section 5 of BS 8223:2014 provides guidance on how best to achieve this. The Institute of Acoustics has produced advice Pro:PG Planning and Noise (May 2017) that may assist with the implementation of residential developments. BS4214 provides guidance on monitoring noise issues in mixed residential/industrial areas.*

*3.14.4 Deliberately **introducing sounds** can help mitigate the adverse impact of existing sources of noise, enhance the enjoyment of the public realm, and help protect the relative tranquillity and quietness of places where such features are valued. For example, playing low-level music outside the entrance to nightclubs has been found to reduce noise from queueing patrons, leading to an overall reduction in noise levels. Water features can be used to reduce the traffic noise, replacing it with the sound of falling water, generally found to be more pleasant by most people.*

*3.14.5 Heathrow and London City Airport Operators have responsibility for noise action plans for airports. Policy T8 Aviation sets out the Mayor's approach to **aviation-related development**.*

*3.14.6 The definition of **Tranquil Areas, Quiet Areas and spaces of relative tranquillity** are matters for London boroughs**.** These are likely to reflect the specific context of individual boroughs, such that Quiet Areas in central London boroughs may reasonably be expected not to be as quiet as Quiet Areas in more residential boroughs. Defra has identified parts of Metropolitan Open Land and local green spaces as potential Quiet*

Areas that boroughs may wish to designate."

8.5 London Plan Sustainable Design and Construction

The London Plan Sustainable Design and Construction SPG provides additional information in the following key areas:

- The sources of noise;
- Ways to mitigate noise emitted by developments;
- Ways to mitigate the impact of noise on developments; and
- Some detailed design considerations.

This document has now been revoked.

8.6 Local Planning Policy

The site falls under the jurisdiction of London Borough of Richmond. Their current criteria are contained within the draft SPD 'Development Control for Noise Generating and Noise Sensitive Development'. This requires that a three stage approach be carried out. Stage 1 is a site noise risk assessment as follows:

"An initial noise site assessment should be conducted by a competent noise practitioner at the earliest opportunity, preferably before any planning application is submitted. The noise assessment should seek to determine the appropriate Noise Risk Category (NRC figure 2) of the site, without proposed mitigation, prior to development. This assessment should include the acoustic effect of any site features that will remain (e.g. retained buildings, changes in ground level) and exclude the acoustic effect of any site features that will not remain (e.g. buildings to be demolished, fences and barriers to be removed) if development proceeds. The initial risk assessment should not include any new noise mitigation measures that may be proposed as part of a subsequent planning application."

The related figure is reproduced below:

External Transportation Noise Risk Assessment (measured/predicted, empty site, pre-mitigation)

Noise Risk Category*	Potential Effect if unmitigated	Pre-Planning Application Guidance
0 – Negligible $L_{Aeq,16hr}$ < 50dB $L_{Aeq,8hr}$ < 40dB	No adverse effect on health and quality of life	Development proposal is likely to be acceptable from a noise perspective. Noise assessment /report required to demonstrate no adverse impacts Good acoustic design encouraged to improve existing environment
1 – Low $L_{Aeq,16hr}$ 50-63dB $L_{Aeq,8hr}$ 40-55dB	Adverse effect on health and quality of life	Noise environment likely to cause adverse impacts Noise assessment /report required to demonstrate how adverse impacts will be minimised and how good acoustic design will be implemented. Planning conditions and other measures to control noise are likely to be required.
2 – Medium $L_{Aeq,16hr}$ 63-69dB $L_{Aeq,8hr}$ 55-60dB L_{AFmax} <82dB	Significant adverse effect on health and quality of life	Noise environment likely to cause significant adverse impacts and development may be refused unless Noise assessment /report required to demonstrate how significant adverse impacts will be avoided and other adverse impacts minimised and how good acoustic design will be implemented Planning conditions and other measures to minimise noise will be necessary.
3 – High $L_{Aeq,16hr}$ > 69dB $L_{Aeq,8hr}$ > 60dB L_{AFmax} <82dB	Unacceptable adverse effect on health and quality of life	Noise environment likely to cause unacceptable adverse impacts and development likely to be refused even if a good acoustic design process is followed, unless there is an overriding case for development in the context of Government policy on sustainable development.

Notes:

a. *The indicative noise levels should be assessed without including the acoustic effect of any scheme-specific noise mitigation measures.

b. *The indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".

c. $L_{Aeq,16hr}$ is for daytime 0700 – 2300, $L_{Aeq,8hr}$ is for night-time 2300 – 0700.

d. An indication that there may be more than 10 noise events at night (2300 – 0700) with LAmax,F > 60 dB means the site should not be regarded as negligible risk

e. A site should be regarded as high risk if the LAmax, F exceeds, or is likely to exceed 80 dB more than 20 times a night.

Stage 2 requires demonstrating that internal noise criteria can be met in line with BS8233:2014 as follows:

Table 1: Internal Ambient Noise Levels for Dwellings

Situation	Location	07:00 – 23:00 hrs.	23:00 – 07:00 hrs.
Resting	Living room	35 dB LAeq,16 hour	–
Dining	Dining room/area	40 dB LAeq, 16 hour	–
Sleeping (daytime resting)	Bedroom	35 dB LAeq,16 hour	30 dB LAeq, 8 hour

Stage 3 requires an assessment of external amenity areas as follows:

'The acoustic environment of external amenity areas shall always be assessed and noise levels should ideally not be above the range 50 to 55dB $L_{Aeq,16hr}$. It may be necessary to carefully

locate and design amenity areas and/or to provide acoustic screening in order to meet this goal.'

8.7 World Health Organisation

The current Environmental Noise Guidelines 2018 for the European Region (ENG) supersede the Guidelines for Community Noise from 1999 (CNG). Nevertheless, the ENG recommends that all CNG indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) remain valid.

A summary of the guidance from the ENG and CNG is shown in the table below.

Source	CNG guideline indoors all sources	ENG guideline outdoors noise from specific source only
Road traffic noise	35 $L_{Aeq,\ 16h}$	53 dB L_{den}
	30 $L_{Aeq,\ 8h}$	45 dB L_{night}
Railway noise	35 $L_{Aeq,\ 16h}$	54 dB L_{den}
	30 $L_{Aeq,\ 8h}$	44 dB L_{night}
Aircraft noise	35 $L_{Aeq,\ 16h}$	45 dB L_{den}
	30 $L_{Aeq,\ 8h}$	40 dB L_{night}

With regard to single-event noise indicators, Section 2.2.2 of the WHO Environmental Noise Guidelines 2018 state:

"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level ($L_{A,max}$) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by $L_{A,max}$. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators."

8.8 British Standard BS8233: 2014

British Standard 8233: 2014 "Guidance on sound insulation and noise reduction for buildings" provides guidance for the control of noise in and around buildings.

8.8.1 Internal Areas

BS8233:2014 Section 7.7.2 titled "Internal ambient noise levels for dwellings" states:

"In general for steady external noise sources, it is desirable that internal ambient noise levels do not exceed the following guideline values:

Activity	Location	Desirable Internal Ambient Criteria	
		07:00 – 23:00	23:00 to 07:00
Resting	Living Rooms	35 dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Note 1 The above table provides recommended levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

Note 2 The levels shown in the above table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in the above table.

Note 3 These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks nigh or News Year's Eve.

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. Sporadic noise events could require separate values.

Note 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.

Note 6 Attention is drawn to the Building Regulations.

Note 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved."

8.8.2 External Amenity Areas

BS823:2014 Section 7.7.3.2 titled "Design criteria for external noise" states:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$[1], with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens, and terraces, which might be intended to be used for relaxation. In high-noise areas consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

8.9 ProPG : Planning & Noise : 2017

8.9.1 The primary goal of the ProPG is to assist the delivery of sustainable development by promoting good health and well-being through the effective management of noise. It seeks to do that through encouraging a good acoustic design process in and around proposed new residential development having regard to national policy on planning and noise. It is applicable to noise from existing transport sources (noting that good professional practice should have regard to any reasonably foreseeable changes in existing and/or new sources of noise). The recommended approach is also considered suitable where some industrial or commercial noise contributes to the acoustic environment provided that is "not dominant".

8.9.2 This ProPG advocates a systematic, proportionate, risk based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging.

8.9.3 The two sequential stages of the overall approach are:

- Stage 1 – an initial noise risk assessment of the proposed development site; and

- Stage 2 – a systematic consideration of four key elements.

8.9.4 The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- Element 1 – demonstrating a "Good Acoustic Design Process";
- Element 2 – observing internal "Noise Level Guidelines";
- Element 3 – undertaking an "External Amenity Area Noise Assessment"; and
- Element 4 – consideration of "Other Relevant Issues".

8.9.5 The ProPG considers suitable guidance on internal noise levels found in "BS8233:2014: Guidance on sound insulation and noise reduction for buildings". Table 4 in Section 7.7.2 of the standard suggests that "in general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values". The standard states (Section 7.7.1) that "occupants are usually more tolerant of noise without a specific character" and only noise without such character is considered in Table 4 of the standard.

Activity	Location	07:00 – 23:00 Hours	23:00 – 07:00 Hours
Resting	Living Room	35dB $L_{Aeq,16hr}$	-
Dining	Dining Room / Area	40dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hr}$	30dB $L_{Aeq,16hr}$ **45dB $L_{Amax,F}$**

NOTE 1 the Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the L_{Aeq} target levels recommended in the Table.

NOTE 3 These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

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

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10dB, they are likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (See Section 3.D).

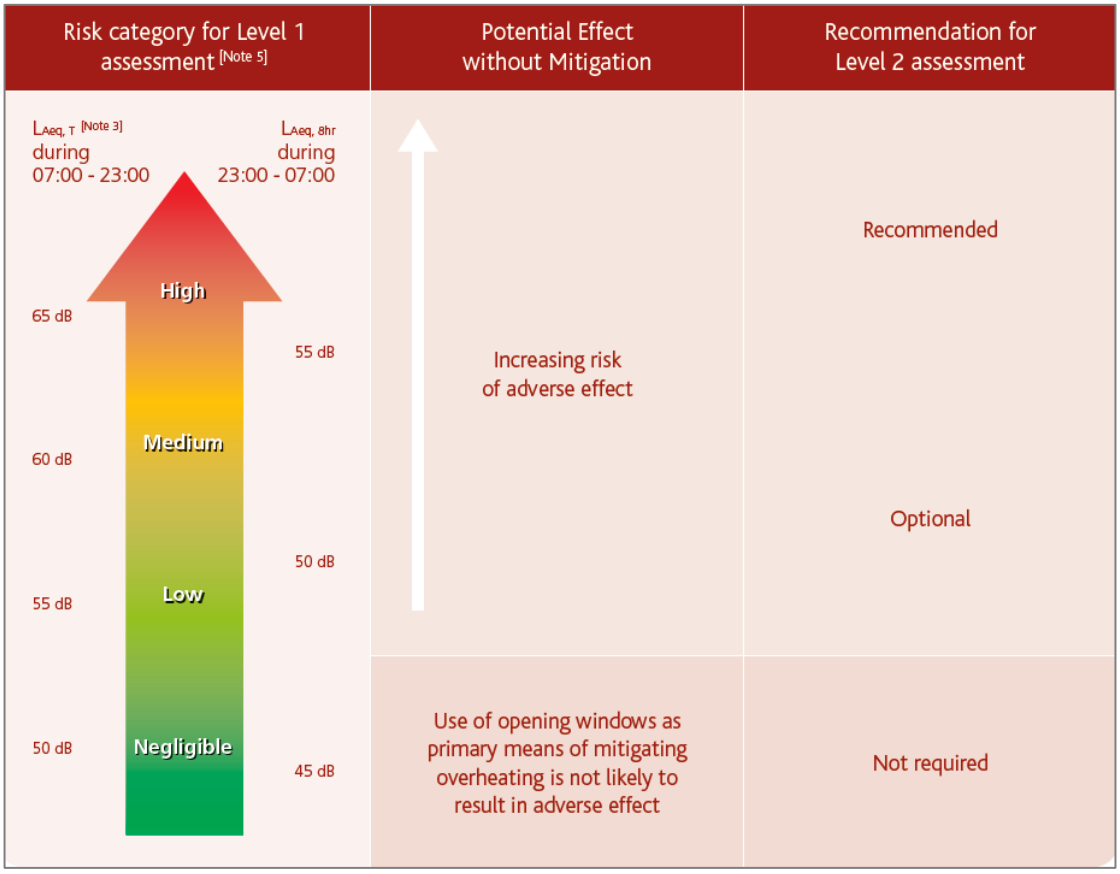
Figure 2. ProPG Internal Noise Level Guidelines (additions to BS8233:2014 shown in blue).

8.10 Acoustics Ventilation and Overheating – Residential Design Guide (AVO)

The Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA) published the Acoustics Ventilation and Overheating – Residential Design Guide (AVO) in January 2020).

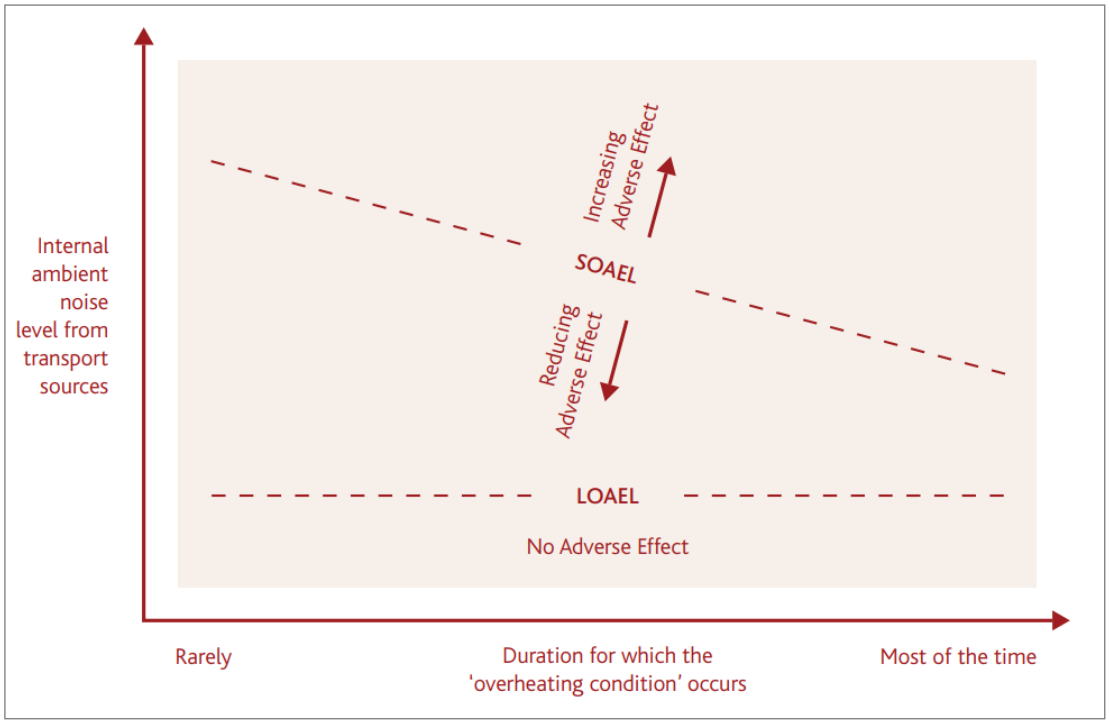
This provides guidance on the interdependence between acoustics, ventilation and overheating.

The guidance recommends a two-level assessment to estimate the potential impact on occupants in the case of windows being open to mitigate overheating. The Level 1 assessment relates to the levels of incident environmental noise across a proposed site. The site can be put into “risk categories” depending on the levels of external noise as set out below:



Where a Level 2 assessment is recommended the AVO guide states that the Significant Observed Adverse Effect Level (SOAEL), which is the noise level above which significant adverse effects on health and quality of life occur, is dependent on how frequently and for what duration the overheating condition occurs (i.e. how often the windows need to be open to mitigate overheating). However, the document refers to the overheating condition being “rare” or “most of the time” rather than providing specific durations; therefore this is open to interpretation.

The graph presented below demonstrates how the SOAEL changes depending on how often the windows are required to be open to mitigate overheating.



Based on the above, the SOAEL in a Level 2 assessment will change depending on how often the overheating condition occurs.

8.11 Commercial Criteria

British Standard 8233: 2014 “Guidance on sound insulation and noise reduction for buildings” states that it is desirable that internal ambient noise levels inside commercial developments do not exceed the following guideline values:

Criterion	Typical Situations	Design Range (dB $L_{Aeq,T}$)	Approximate NR equivalent (dB $L_{eq,T}$)
Speech or telephone communications	Department store, cafeteria	50-55	NR45-NR50
	Concourse, corridor, circulation space	45-55	NR40-NR50
Reasonable conditions for study and work requiring concentration	Cellular Office	45-50	NR40-NR45
	Meeting room, executive office	35-40	NR30-NR35

The development includes 1760m^2 of commercial space, consisting of workshops, co-work space, and offices. Therefore based on the above we propose external noise intrusion levels

(whether from road, rail or aircraft sources), should, after attenuation by the composite building envelope, not exceed NR35 $L_{eq,}$ unless no meeting rooms or executive offices are proposed to be located against the façade, in which case higher noise levels would be permissible.

9.0 Proposed Design Target Internal Noise Levels

On the basis of the Local Authority criteria and BS8233:2014 we propose the following internal noise levels be adopted as design targets in the proposed habitable rooms:

Activity	Location	Desirable Internal Ambient Criteria	
		07:00 – 23:00	23:00 to 07:00
Resting	Living Rooms	35 dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB L_{Afmax}
Study and work requiring concentration	Offices	NR35 $L_{eq,16hour}$	-

Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target noise levels may be relaxed (subject to the requirements of any planning conditions) by up to 5 dB and reasonable internal conditions still achieved.

It should be noted that the office criterion is less stringent than the residential criteria and therefore demonstrating compliance with the residential criteria also demonstrates compliance with the office criterion.

10.0 Noise Risk Assessment

With reference to Sections 6.0 and 8.5 the free field corrected $L_{Aeq,16hour}$ and $L_{Aeq,8hr}$ noise levels at Positions 1 and 2 place the site in ‘Low Noise Significance Risk’ category. In addition, the free field corrected L_{Amax} noise levels did not exceed 80dB more than 20 times during the night-time at either position, although the 9No. night-time train passbys at Position 1 were above 80dB L_{Afmax}.

According to the SPD, The ‘Low Noise Significance Risk’ category suggests that ‘the development site is likely to be acceptable from a noise perspective, provided that good acoustic design is followed and demonstrated in an Acoustic Design Statement which confirms how the adverse effects of noise will be minimised in the completed development. The following sections therefore assess both internal and external noise levels and recommend mitigation where necessary.

11.0 Achievable Internal Noise Levels

We have predicted the levels that would be achievable in the worst-case dwellings with windows partially opened and also with windows closed.

11.1 Windows Partially Open

It is generally accepted that the typical noise reduction achieved with partially opened windows is around 15dBA (ref. BS 8233:2014 Annex G.1). This value is the difference between dBA levels measured outside and inside typical dwellings, therefore 3dBA should be added to free field noise levels to determine outside levels.

A simple assessment thus indicates the following noise levels may be expected within the proposed worst case habitable rooms with partially opened windows.

Description	Predicted Worst Case Internal Noise Levels with Windows Partially Opened			
	Position 1		Position 2	
	Daytime $L_{Aeq(16\text{-}hour)}$	Night-time $L_{Aeq(8\text{-}hour)}$	Daytime $L_{Aeq(16\text{-}hour)}$	Night-time $L_{Aeq(8\text{-}hour)}$
Façade noise level	61dB	58dB	51dB	46dB
Noise reduction for partially open window	-15dB	-15dB	-15dB	-15dB
Predicted internal noise levels	46dB	43dB	36dB	31dB

11.2 Windows Closed

It is generally accepted that the typical noise reduction achieved by conventional thermal double glazing is 36dBA for electric train noise. This value is taken from PPG24 (now superseded) and is the difference between dBA levels measured outside and inside typical dwellings, therefore 3dBA should be added to free field noise levels to determine outside levels.

A simple assessment thus indicates the following L_{Aeq} noise levels may be expected within the proposed worst case dwellings with conventional thermal double glazing.

Description	Predicted Worst Case Internal Noise Levels with Windows Closed			
	Position 1		Position 2	
	Daytime $L_{Aeq(16\text{-hour})}$	Night-time $L_{Aeq(8\text{-hour})}$	Daytime $L_{Aeq(16\text{-hour})}$	Night-time $L_{Aeq(8\text{-hour})}$
Façade noise level	61dB	58dB	51dB	46dB
Noise reduction for conventional thermal double glazing	-36dB	-36dB	-36dB	-36dB
Predicted internal noise levels	25dB	22dB	15dB	10dB

However whilst this same simple assessment indicates that in the worst case rooms, an internal noise level of L_{Afmax} 45dB would only be exceeded approximately 10 times per night, the highest internal L_{Afmax} noise level from the loudest measured train passby is calculated to be 58dB. It may therefore be appropriate to uprate the glazing and ventilators on the worst case façades to mitigate noise from the loudest train passbys at night. We have predicted the typical L_{Afmax} noise levels that would be achievable in the worst-case habitable rooms of the proposed development with the following uprated glazing, as detailed in the table below.

Indicative Minimum Sound Reduction Specification (R_w) (Railway facing facades only)	Example Configuration (For Guidance Only)
40	10/16/6.4 Laminated Double Glazing

Please note that ventilators, either passive or mechanical will need to be designed to maintain the above performance.

Our assessment, using the procedures of BS8233, is based upon the noise levels presented in Section 6.1.1, the glazing and ventilators in the table above, and upon the cladding system (excluding the glazing) achieving a performance of at least R_w 50dB, which for example could be achieved with a typical masonry cavity wall.

Based on the above, our calculations indicate that approximately the loudest 4No. night-time train passbys measured during our survey would cause internal L_{Amax} noise levels above 45dB. The estimated internal L_{Afmax} from the loudest passby is 48dB. We suggest this should be considered to be acceptable.

11.3 Ventilation & Overheating Assessment

The preceding sections of this report present solutions to satisfy the proposed internal ambient noise limits within dwellings during normal ventilation conditions where windows are closed but ventilators or MVHR systems (to meet Part F minimum ventilation requirements) are

operational.

The aforementioned Acoustics Ventilation and Overheating – Residential Design Guide provides guidance regarding noise and overheating. Our interpretation of the information contained within the AVO guidance is as follows#

Daytime $L_{Aeq,\ 16\ Hour}$	**Night-time $L_{Aeq,\ 8\ Hour}$**	**Night-time L_{AFmax}**	**Level 1 Noise & Overheating Risk Outcome**	**Suggested Action**
≤48 dB	≤43 dB	Does not normally exceed L_{AFmax} more than 10 times per night	Negligible	Noise can be heard but does not cause any change in behaviour. Openable windows should be suitable
>48 dB to ≤53 dB	>43 dB to ≤48 dB	-	Low	Limited behavioural change is expected, and reasonable internal noise levels should be achieved. Openable windows likely to be suitable.
>53 dB to ≤63 dB	>48 dB to ≤55 dB	-	Medium	Increasing likelihood of impact on reliable speech communication. Carry out Level 2 risk assessment. Windows may be able to be opened for limited amounts of time to mitigate overheating.
>63 dB	>55 dB	Typically exceeds 78 dB L_{AFmax}	High	Windows are unlikely to be able to be opened for any amount of time to mitigate overheating. Carry out Level 2 risk assessment.

We have undertaken a Level 1 assessment based on the AVO, to highlight the potential areas in which opening windows to mitigate overheating should be assessed in more detail. Based on the results of the environmental noise survey, the results of the Level 1 assessment indicate that the façades facing the railway can be categorised as medium risk.

The AVO guide advises that a Level 2 Assessment should be undertaken where facades fall within the high and medium risk categories (red and yellow). This assessment should include an estimate of how frequently and for what duration the overheating condition occurs, without reliance on openable windows.

Where façades fall within the high and medium risk categories (red and yellow), habitable rooms should be designed so as to avoid the reliance on openable windows to satisfy overheating

targets. This may be achieved by use of solar rated glazing, black out blinds, or through fenestration design. In addition, the AVO guide (Table B-5) suggests mitigation measures in the form of attenuated or plenum windows, attenuated louvres or vents for overheating and sound attenuating balconies. This can be assisted with mechanical ventilation too, such as MVHR with a manual summer boost function. Air conditioning can also be considered, however, the introduction of mechanical solutions should be considered carefully; not only with regard to cost and maintenance, but sustainability and the environment, which are likely to be more prominent drivers for any new development with the LPA's jurisdiction.

12.0 External Amenity Areas

The acoustic environment of external amenity areas that are an intrinsic part of the overall design should ideally not be above the range 50-55dB $L_{Aeq,16hr}$.

The free field $L_{Aeq,16hr}$ at Positions 1 and 2 were 58dB and 48dB respectively. This demonstrates that an appropriate acoustic environment can be achieved in external amenity areas if they are screened from the railway line, as was the case at Position 2.

We understand the main proposed external amenity space serving the apartments is the podium garden. This is to be screened from the railway line by the apartment buildings and appropriate external noise levels should therefore be achievable in this area.

Gardens serving the proposed houses should be screened from the railway line by imperforate close boarded fences of at least 10kg/m^2.

We also understand that some residential balconies are proposed for apartments overlooking the railway line. External noise levels in these areas are predicted to be above 55dBA $L_{Aeq,16hours}$. However BS8233:2014 states that these areas may be included for uses such as dry washing or growing pot plants, and therefore it would not be appropriate to impose noise limits in these areas. Furthermore these are in addition to the podium garden, and it should also be noted that the site is approximately 100m away from a children's playground and within walking distance of Bushy Park.

13.0 Mitigation Measures

At this stage of the design scheme the precise details of the glazing to be used are not known, nor are the precise details of the ventilation.

13.1 Glazing

The external envelope of the proposed residences will incorporate suitably specified glazing so as to achieve the proposed design target internal noise levels presented above.

The predicted worst case internal noise levels with windows closed meet the proposed criteria.

13.2 Background Ventilation

The predicted worst case internal noise levels with windows closed meet the proposed criteria. It is thus demonstrated that acceptable internal noise levels are achievable with conventional double glazing or, in the case of the façades facing the railway with suitably uprated double glazing.

The predicted worst case internal noise levels with windows partially opened exceed the proposed target levels (as is often the case). The minimum mitigation available to future occupants would be to close their window. Ventilation (incorporating suitable acoustic attenuation) will be provided to comply with the requirements of the Building Regulations Approved Document F whole dwelling ventilation and appropriate thermal design should be undertaken to avoid the need to rely on openable windows to deal with overheating**.** The occupants will thus have the option of keeping windows closed for most of the time and opening windows for purge ventilation.

This form of mitigation is supported within the Pro:PG which advises the following:

2.34 Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. In such circumstances, internal noise levels can be assessed with windows closed but with façade openings used to provide *"whole dwelling ventilation"* in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position (see Supplementary Document 2). Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded.

2.35 It should also be noted that the internal noise level guidelines are generally not applicable under *"purge ventilation"* conditions as defined by Building Regulations Approved Document F, as this should only occur occasionally (e.g. to remove odour

from painting and decorating or from burnt food).

At this stage of the design scheme the precise details of window to be used are not known, nor are the precise details of the ventilation.

The external envelope of the proposed residences will incorporate suitably specified glazing so as to achieve the proposed design target internal noise levels presented above.

Where ventilation is provided through the façade it shall be suitably acoustically attenuated to ensure the achievement of the proposed target internal noise levels is not compromised.

13.3 Purge Ventilation/Overheating

With reference to the aforementioned AVO guidance, habitable rooms should be designed so as to avoid the reliance on openable windows to satisfy overheating targets. This can be achieved by use of solar rated glazing, black out blinds, or through fenestration design. In addition, the AVO guide (Table B-5) suggests mitigation measures in the form of attenuated or plenum windows, attenuated louvres or vents for overheating and sound attenuating balconies. This can be assisted with mechanical ventilation too, such as MVHR with a manual summer boost function. Air conditioning can also be considered. However, the introduction of mechanical solutions should be considered carefully; not only with regard to cost and maintenance, but sustainability and the environment.

14.0 Plant Noise Emission Criteria

The London Borough of Richmond upon Thames requires plant noise criteria to be set in line with BS4142:2014 as follows:

"As a general rule, the Boroughs will seek to achieve the external noise standards detailed in Table 2."

Table 2: New Industrial and Commercial Development - External Noise Standards

Noise Impact From Relevant Proposed Industrial Or Commercial Premises Or Plant	Development Outcome
Rating Level (LAr,Tr) is at least 5 dB(A) below the Background Level LA90	Normally acceptable

Rating level (LAr,Tr) is no more than 5 dB(A) above the Background Level LA90	Acceptable only if there are overriding economic or social reasons for development to proceed
Rating level (LAr,Tr) is more than 5 dB(A) above the Background Level LA90	Normally unacceptable

On the basis of the above and the results of the environmental noise survey, we propose that the following plant noise emission criteria be achieved at 1 metre from the nearest noise sensitive residential window.

Location	Plant Noise Emission Criteria (dB re 2x10-5 Pa)	
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)
Position 1 (west)	42	33
Position 2 (east)	40	31

The above criteria are to be achieved with all of the proposed plant operating simultaneously.

If plant contains tonal or impulsive characteristics the external design criteria should be reduced by 5dBA.

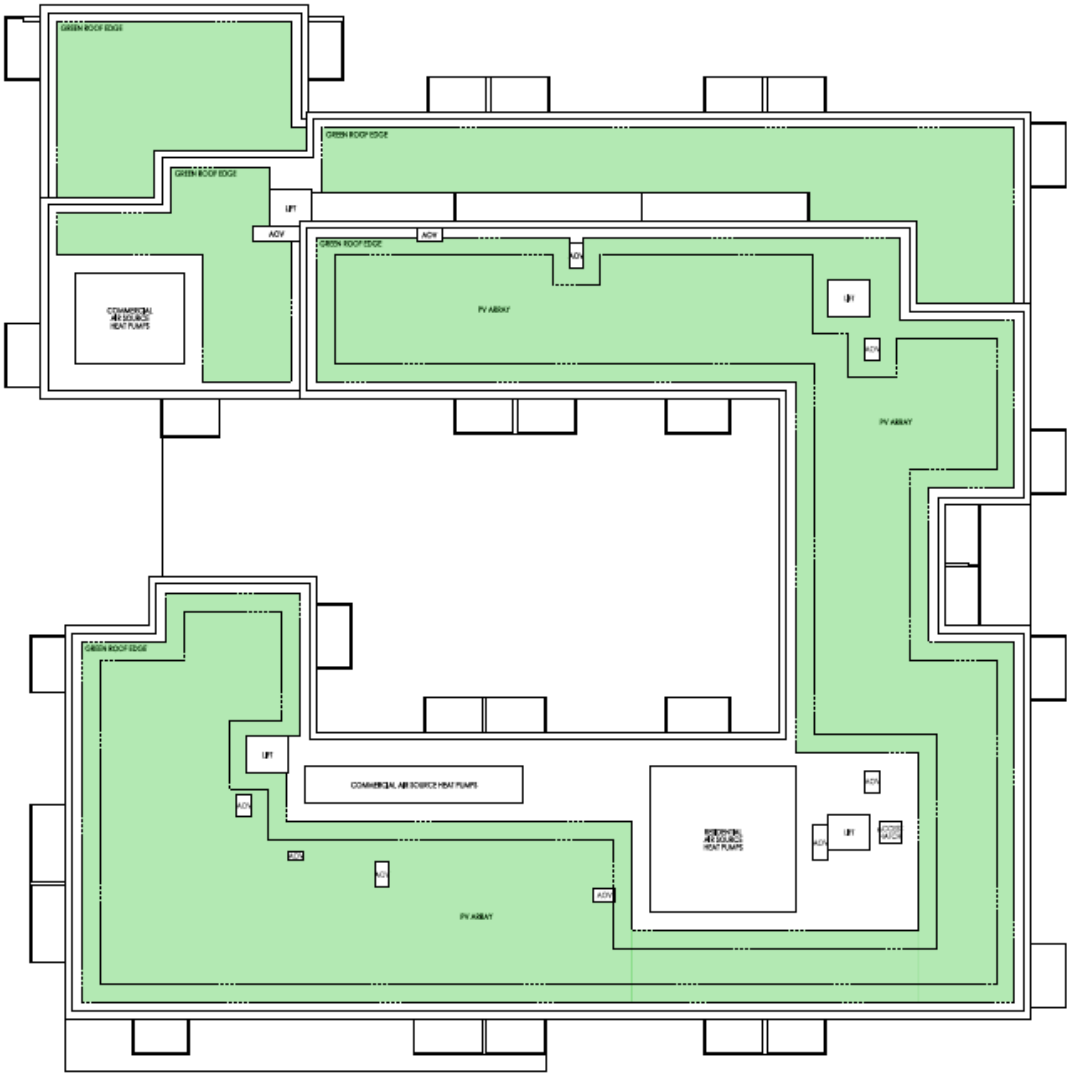
It should be noted that the above are subject to the final approval of the Local Authority.

15.0 Plant Noise Assessment

We understand the proposed plant comprises 18No. external condensers, located in three separate locations as detailed in the table below.

Location	Qty	Plant Make	Model Number
Block B1Third Floor Roof	5	Daikin	RXYSQ10TY
Block B1 Fourth Floor Roof	5	Mitsubishi	CAHV-P500YA-HPB
	6	Daikin	RXYSQ6TY
	2	Daikin	RXYSQ10TY
Block B2	3	Daikin	RXYSQ10TY

The following indicate the proposed roof plant areas:



BLOCK B1: ROOF PLAN

15.1 Plant Noise Data

We understand the manufacturer's noise data for the equipment to be as follows:

Plant Description	Sound Pressure Level (dB re 2x10^{-5} Pa) at 1 metre at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
RXYSQ6TY	56	53	50	48	46	43	39	28	51
RXYSQ8TY	60	63	55	52	49	48	42	34	55
RXYSQ10TY	65	57	54	53	50	47	41	34	55
CAHV-P500YA-HPB	70	65	60	57	51	47	49	45	59

15.2 Plant Noise Assessment

We understand the Daikin condensers serve the commercial properties within the development and will be operational during daytime hours only. The Mitsubishi units provide heating for the apartments and will operate continuously.

The following tables summarise our predictions of atmospheric noise emissions from the proposed plant.

15.2.1 Block B1 Third Floor Roof

The nearest noise sensitive neighbouring residential property to the proposed plant on the Third Floor roof is due east of Block B1 and is a ground plus two storey building at a distance of approximately 15m. The plant is to be installed behind a solid screen that is at least 300mm higher than the highest installed condenser.

	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Type RXYSQ10TY Individual Sound Pressure Level at 1m	65	57	54	53	50	47	41	34	55
Correction for 5No units	7	7	7	7	7	7	7	7	7
Cumulative Sound Pressure Level at 1m	72	65	61	60	57	54	48	41	62
Barrier Loss from Solid Screen	-6	-7	-8	-10	-12	-14	-17	-20	
Distance Correction to Nearest Window (15m)	-19	-19	-19	-19	-19	-19	-19	-19	
Façade Reflection	+3	+3	+3	+3	+3	+3	+3	+3	
Specific Noise Level at Window	50	42	37	34	29	24	15	5	36

Our calculations indicate that the proposed plant should be capable of achieving the proposed daytime plant noise emission criteria in Section 14.0 (Position 2 east).

15.2.2 Block B1 Fourth Floor Roof

The nearest noise sensitive neighbouring residential property to the proposed plant on the Fourth Floor roof is due south of Block B1 and is a ground plus one storey building at a distance of approximately 40m. The plant is to be installed behind a solid screen that is at least 300mm higher than the installed condenser.

Daytime Calculation

	Sound Pressure Level (dB re $2x10^{-5}$ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Type RXYSQ6TY Individual Sound Pressure Level at 1m	56	53	50	48	46	43	39	28	51
Correction for 6No units	8	8	8	8	8	8	8	8	8
Total Sound Pressure Level at 1m for 6No units	64	61	58	56	54	51	47	36	59
Type RXYSQ10TY Cumulative Sound Pressure Level at 1m (+5dB-3No.)	70	62	59	58	55	52	46	39	55
Correction for 2No units	3	3	3	3	3	3	3	3	3
Total Sound Pressure Level at 1m for 2No units	73	65	62	61	58	55	49	42	58
Type CAHV-P500YA-HPB Sound Pressure Level at 1m	70	65	60	57	51	47	49	45	59
Correction for 5No units	7	7	7	7	7	7	7	7	7
Total Sound Pressure Level at 1m for 5No units	77	72	67	64	58	54	56	52	66
Cumulative Sound Pressure Level at 1m	78	73	68	65	59	55	57	53	67
Barrier Loss from Solid Screen	-6	-7	-8	-10	-12	-14	-17	-20	
Distance Correction to Nearest Window (15m)	27	27	27	27	27	27	27	27	-27
Façade Reflection	+3	+3	+3	+3	+3	+3	+3	+3	
Specific Noise Level at Window	48	42	36	31	23	17	16	9	34

Our calculations therefore indicate that the condensers should be capable of achieving the proposed daytime plant noise emission criteria in Section 14.0 (Position 1 west).

Night-Time Calculation

	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Type CAHV-P500YA-HPB Sound Pressure Level at 1m	70	65	60	57	51	47	49	45	59
Correction for 5No units	7	7	7	7	7	7	7	7	7
Distance Correction to Residential Window (40m)	-27	-27	-27	-27	-27	-27	-27	-27	
Barrier Loss from Solid Screen	-6	-7	-8	-10	-12	-14	-17	-20	
Façade Reflection	+3	+3	+3	+3	+3	+3	+3	+3	
Specific Noise Level at Window	47	41	35	30	22	16	15	8	33

The above assumes all 5No condensers operating at maximum duty. In reality, they will run at a lower duty / smaller number during the quietest period of the night, Our calculations therefore indicate the proposed condensers should be capable of achieving the proposed night-time plant noise emission criteria in Section 14.0 (Position 1 west)

15.2.3 Block B2

The nearest noise sensitive neighbouring residential property is due north on Windmill Road and is approximately 12m away. There is a solid fence approximately 2m high in between the plant and the residential property.

	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Type RXYSQ6TY Individual Sound Pressure Level at 1m	56	53	50	48	46	43	39	28	51
Cumulative Sound Pressure Level at 1m (+5dB-3No)	61	58	55	53	51	48	44	33	56
Distance Correction to Office Window (15m)	-18	-18	-18	-18	-18	-18	-18	-18	
Barrier Effect from Fence	-6	-7	-8	-10	-12	-14	-17	-21	
Specific Noise Level at Window	37	33	29	25	21	16	9	0	27

Our calculations indicate that the proposed plant should be capable of achieving the proposed plant noise emission criteria in Section 14.0 (Position 2 east).

15.3 Plant Noise Assessment to Neighbouring Properties in accordance with BS4142:2014

With regards to the neighbouring properties it should be noted that the proposed plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. All proposed external plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems. In order to be robust, however, a +3dB feature correction as advised in BS 4142:2014 has been applied for the possible presence of *"… characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment …."*.

15.3.1 Block B1 Third Floor

The following table shows our BS4142 assessment for the plant on the third floor of Block B1 during the daytime.

Results		Relevant Clause	Commentary
Specific sound level at receptor	$L_{Aeq,1h}$ = 36dB	7.3.6	See table above.
Background sound level	$L_{A90,1h}$ = 47 dB	8.1.1 8.1.3 8.3	The background sound level was measured at the site and was considered to be representative of the typical background sound level.
Assessment made during the daytime so reference period is 1 hour		7.2	
Acoustic feature correction	+3 dB	9.2	A correction of 3dB has been applied as detailed in Section 15.3.
Rating level	39 dB	9.2	Calculated by adding acoustic feature corrections to the specific sound level.
Difference between rating level and background sound level	-8 dB	11	
Assessment indicates a low impact due to plant noise at the receptor		11	The rating level does not exceed the background sound level. **It is estimated to be 8 dB** lower than the background sound level.
Uncertainty of the assessment	Low	10	The background sound level is based on repeatable measurements made at the site. Some uncertainty exists in the acoustic characteristics of the proposed plant, but as the rating level exceeds the background level by -9dB this does not have any significance on the outcome of the assessment.

15.3.2 Block B1 Fourth Floor

The following tables show our BS4142 assessments for the plant on the fourth floor of Block B1 during the daytime and the night-time.

Daytime

Results		Relevant Clause	Commentary
Specific sound level at receptor	$L_{Aeq,1h}$ = 34 dB	7.3.6	See table above.
Background sound level	$L_{A90,1h}$ = 45 dB	8.1.1 8.1.3 8.3	The background sound level was measured at the site and was considered to be representative of the typical background sound level.
Assessment made during the daytime so reference period is 1 hour		7.2	
Acoustic feature correction	+3 dB	9.2	A correction of 3dB has been applied as detailed in Section 15.3.
Rating level	37 dB	9.2	Calculated by adding acoustic feature corrections to the specific sound level.
Difference between rating level and background sound level	-8 dB	11	
Assessment indicates a low impact due to plant noise at the receptor		11	The rating level does not exceed the background sound level. **It is estimated to be 8 dB** lower than the background sound level.
Uncertainty of the assessment	Low	10	The background sound level is based on repeatable measurements made at the site. Some uncertainty exists in the acoustic characteristics of the proposed plant, but as the rating level exceeds the background level by -16dB this does not have any significance on the outcome of the assessment.

Night-Time

The following table shows our BS4142 assessment for the plant on the fourth floor of Block B1 during the night-time.

Results		Relevant Clause	Commentary
Specific sound level at receptor	$L_{Aeq,1h}$ = 33dB	7.3.6	See table above.
Background sound level	$L_{A90,\ 15mins}$ = 36 dB	8.1.1 8.1.3 8.3	The background sound level was measured at the site and was considered to be representative of the typical background sound level.
Assessment made during the night-time so reference period is 15 mins		7.2	
Acoustic feature correction	+3 dB	9.2	A correction of 3dB has been applied as detailed in Section 15.3.
Rating level	36 dB	9.2	Calculated by adding acoustic feature corrections to the specific sound level.
Difference between rating level and background sound level	0 dB	11	
Assessment indicates a low impact due to plant noise at the receptor		11	The rating level does not exceed the background sound level. **It is estimated to be equal to** the background sound level.
Uncertainty of the assessment	Low	10	The background sound level is based on repeatable measurements made at the site. Some uncertainty exists in the acoustic characteristics of the proposed plant, but as the rating level exceeds the background level by -7dB this does not have any significance on the outcome of the assessment.

15.3.3 Block B2

The following table shows our BS4142 assessment for the plant at the rear of Block B2 during the daytime.

Results		Relevant Clause	Commentary
Specific sound level at receptor	$L_{Aeq,1h}$ = 27 dB	7.3.6	See table above.
Background sound level	$L_{A90,1h}$ = 45 dB	8.1.1 8.1.3 8.3	The background sound level was measured at the site and was considered to be representative of the typical background sound level.
Assessment made during the daytime so reference period is 1 hour		7.2	
Acoustic feature correction	+3 dB	9.2	A correction of 3dB has been applied as detailed in Section 15.3.
Rating level	30 dB	9.2	Calculated by adding acoustic feature corrections to the specific sound level.

Results		Relevant Clause	Commentary
Difference between rating level and background sound level	-15 dB	11	
Assessment indicates a low impact due to plant noise at the receptor.		11	The rating level does not exceed the background sound level. **It is estimated to be 15 dB** lower than the background sound level.
Uncertainty of the assessment	Low	10	The background sound level is based on repeatable measurements made at the site. Some uncertainty exists in the acoustic characteristics of the proposed plant, but as the rating level exceeds the background level by -15dB this does not have any significance on the outcome of the assessment.

16.0 Conclusions

A detailed environmental noise survey has been undertaken in order to establish the currently prevailing environmental noise climate around the site.

The environmental noise impact upon the proposed dwellings has been assessed in the context of national and local planning policies. The site is assessed as being in the category of Low Noise Significance Risk.

Appropriate target internal noise levels have been proposed. These are achievable using conventional mitigation measures, noting that uprated glazing and ventilators are recommended for residential facades facing the railway line, in order to mitigate occasional peak noise levels from the loudest train passbys.

Mitigation measures, including the use of suitably specified glazing, acoustically attenuated ventilation and appropriate thermal design have been recommended to reduce to a minimum the adverse impact on health and quality life arising from environmental noise.

Our assessment indicates that an appropriate acoustic environment can be achieved in external amenity areas if they are screened from the railway line, as is the case with the proposed Podium Garden and for gardens serving houses, which we recommend have close boarded fences of at least 10kg/m^2. As per BS8233:2014 it would not be appropriate to impose noise limits for small residential balconies, and it should be noted that the site is approximately 100m away from a children's playground and within walking distance of Bushy Park.

Plant noise emission criteria have been proposed in line with the requirements of the Local Authority.

An assessment has been carried out to determine the plant noise emissions at the nearest neighbouring noise sensitive windows in accordance with BS4142:2014.

The assessment indicates that the proposed plant should be capable of achieving the proposed environmental noise criteria at the nearest noise sensitive residential windows.

The proposed development is thus considered compliant with the relevant planning policies.

Appendix A

The acoustic terms used in this report are defined as follows:

dB — Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form. The relationships between Decibel levels do not work in the same way that non-logarithmic (linear) numbers work (e.g. 30dB + 30dB = 33dB, not 60dB).

dBA — The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The $_A$ subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted

It should be noted that levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is just perceptible.

$L_{90,T}$ — L_{90} is the noise level exceeded for 90% of the period *T* (i.e. the quietest 10% of the measurement) and is often used to describe the background noise level.

$L_{eq,T}$ — $L_{eq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time period, *T*.

L_{max} — L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

L_p — Sound Pressure Level (SPL) is the sound pressure relative to a standard reference pressure of 2×10^{-5} Pa. This level varies for a given source according to a number of factors (including but not limited to: distance from the source; positioning; screening and meteorological effects).

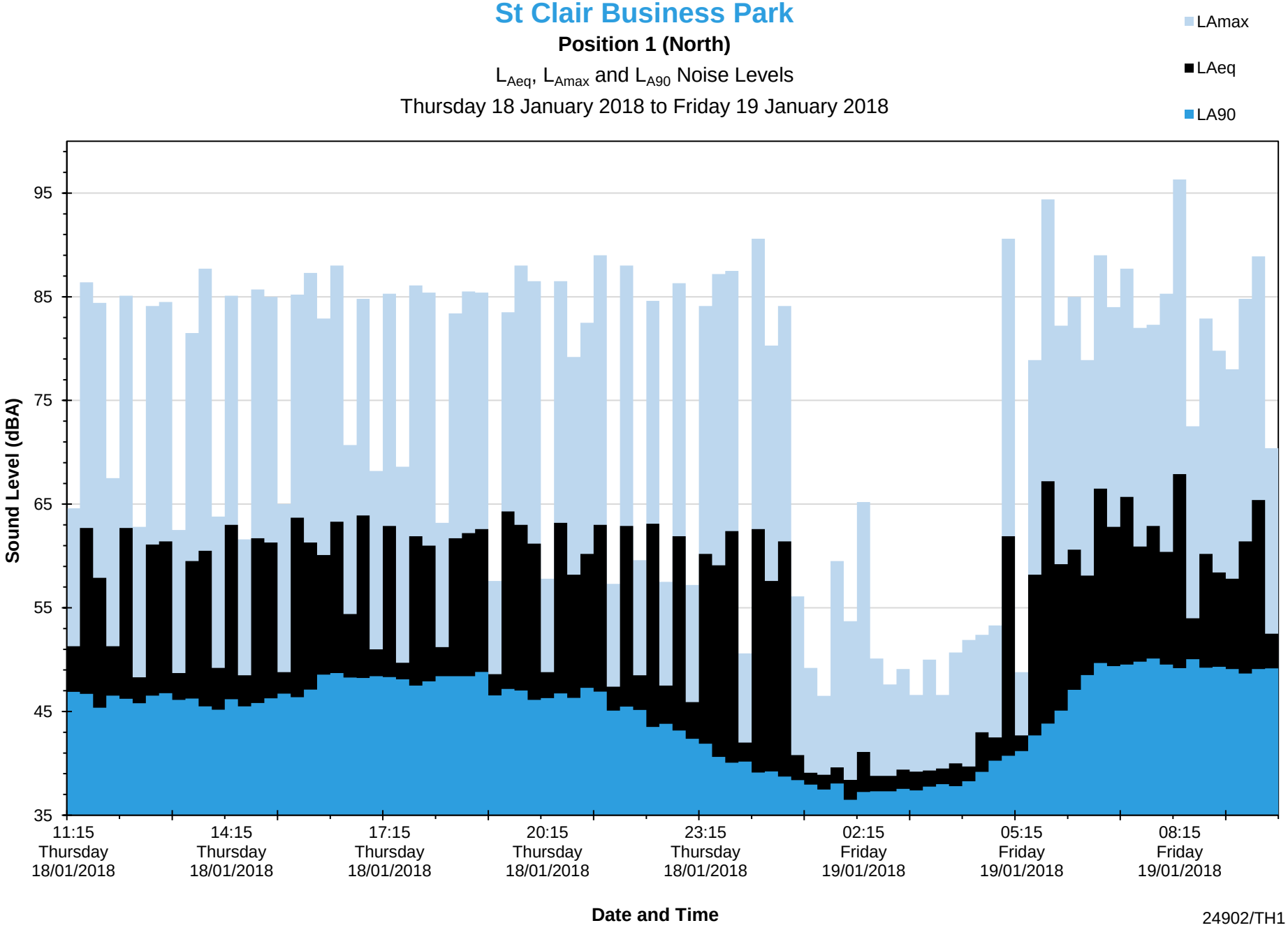
L_w — Sound Power Level (SWL) is the total amount of sound energy inherent in a particular sound source, independent of its environment. It is a logarithmic measure of the sound power in comparison to a specified reference level (usually 10^{-12} W).

St Clair Business Park

Position 1 (North)

L_{Aeq}, L_{Amax} and L_{A90} Noise Levels

Thursday 18 January 2018 to Friday 19 January 2018



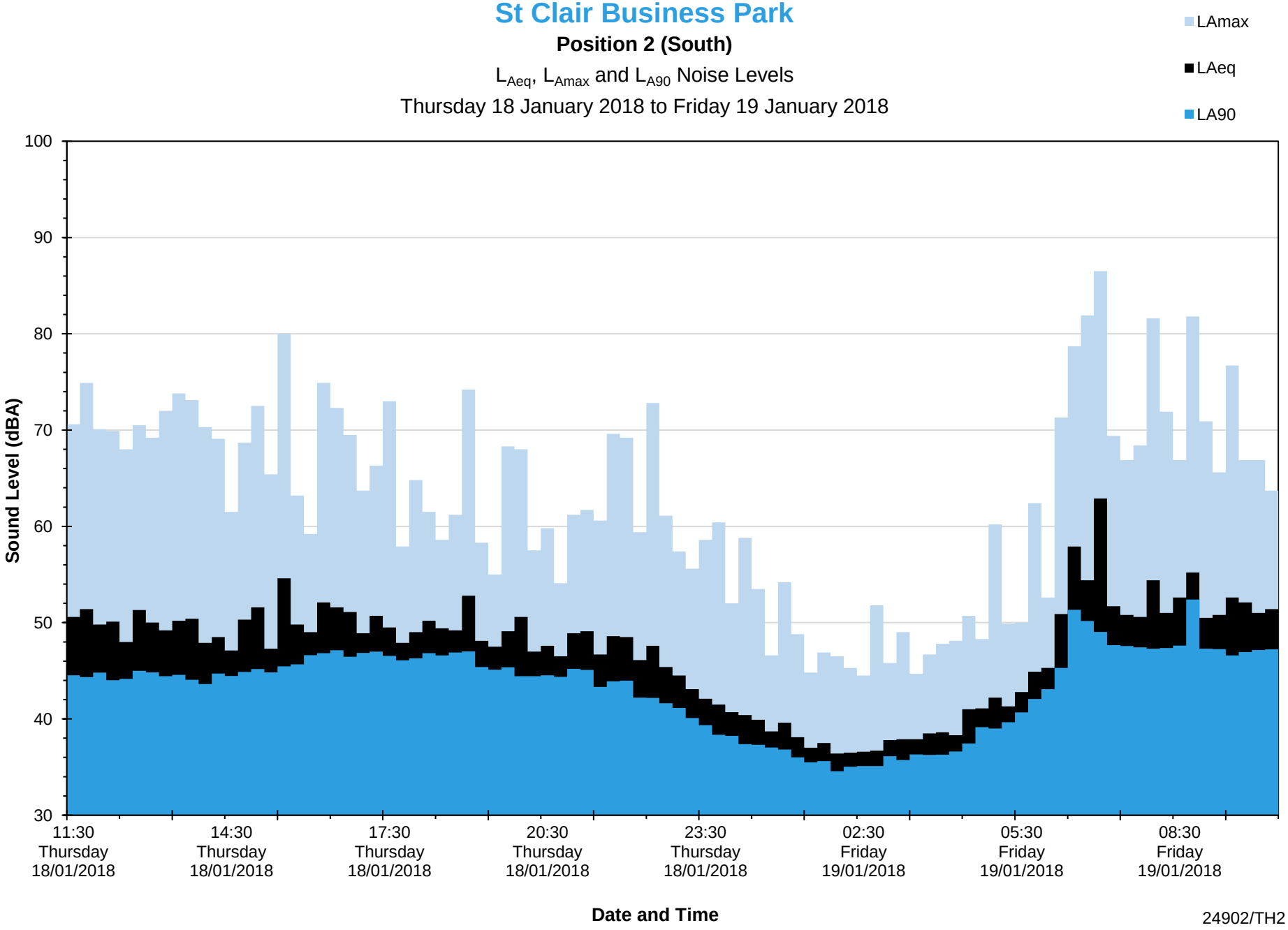
24902/TH1

St Clair Business Park

Position 2 (South)

L_{Aeq}, L_{Amax} and L_{A90} Noise Levels

Thursday 18 January 2018 to Friday 19 January 2018



24902/TH2