Agar Grove – Phase 2A, Block B

Noise Impact Assessment

On behalf of Camden Council

Project Ref: 330510718 | Rev: 2 | Date: May 2022

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1 Introduction

1.1. Background

1.1.1 This Noise Assessment has been prepared by Stantec and is submitted in support of the planning application made by the London Borough of Camden for Block B which forms part of a wider masterplan for the regeneration of the Agar Grove estate that was granted planning permission in 2013 (and amended in 2020).

1.1.2 To date, Blocks A, F, G and H have been completed, whilst construction works on Blocks I and JKL are underway. This current application seeks permission for a number of minor amendments to the approved Block B element of the scheme.

1.1.3 An environmental sound survey has been undertaken by Stantec (UK) Ltd, to establish the existing environmental sound levels associated with transportation sources incident on the proposed development.

1.1.4 The results of the environmental sound survey have been used to establish façade incident noise levels for the proposed development which form the basis of our assessment of the acoustic requirements of the building façade.

1.1.5 An assessment of the proposed non emergency and emergency plant has also been undertaken.

1.1.6 This report presents the relevant results of the environmental sound surveys, details of our assessment and the proposed acoustic specifications for the critical elements of the building facade.

1.1.7 An explanation of the acoustic terminology used in this report is included in **Appendix A**.

1.2. Scope of Report

1.2.1 The scope of this report is to:

- Identify relevant planning policy relating to noise and vibration.
- Detail appropriate assessment criteria based on the requirements of the local authority and industry standard guidance.
- Present the results of the environmental sound and vibration surveys undertaken at the site.
- Present the results of the detailed assessment of the likely airborne noise ingress into habitable spaces and identify the requirement acoustic performance of critical elements of the building façade in order to achieve the proposed criteria.
- Present the results of the vibration and re-radiated noise impact assessment.
- Present the assessment of proposed non emergency and emergency plant.

1.2.2 Advice and recommendations within this report will need to be integrated, coordinated and ratified with the design by the principal designer and design team to ensure that all other design interfaces, buildability, workmanship and other requirements are considered. Any sketches or drawings provided illustrate acoustic principles only.

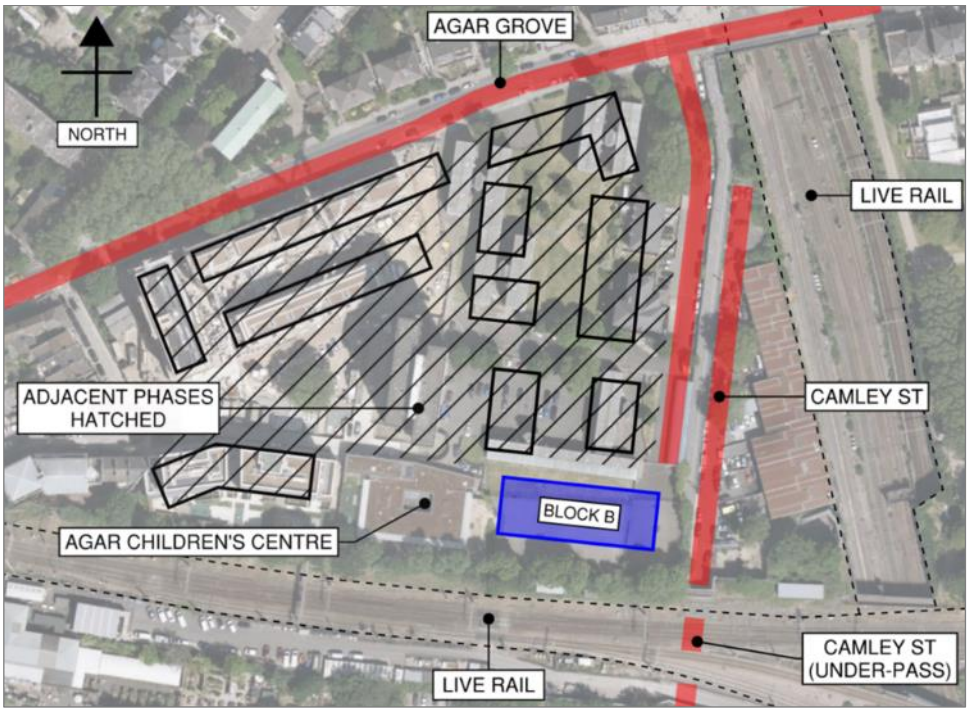
1.3. Site Description and Location

1.3.1 The Agar Grove redevelopment is split into multiple phases. Block B is situated in the southeast corner of the wider development.

1.3.2 The site is bounded to the south by the North London Railway Line, to the east by Camley St, to the north by adjacent phases and to the west by Agar Children's Centre. The site is currently hard-standing and being used as storage for construction materials.

1.3.3 The location of the proposed site is detailed in **Figure 1**.

Figure 1: Site Location Plan



1.4. Acoustic Terminology

1.4.1 A glossary of acoustic terminology used within the report is contained in **Appendix A**.

2 Policy, Guidance and Standards

2.1. National Policy

The National Planning Policy Framework (NPPF)

2.1.1 The revised National Planning Policy Framework (NPPF) (MHCLG, 2021) was published in July 2021. In respect of noise, paragraph 174 states that in relation to conserving and enhancing the natural environment:

> *"Planning policies and decisions should contribute to and enhance the natural and local environment by…*
>
> *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of … noise pollution..."*

2.1.2 In relation to ground conditions and pollution, paragraph 185 states that:

> *"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:*
>
> *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 quality of life;*
>
> • *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…"*

2.1.3 In relation to the integration of new development with existing premises and community facilities, paragraph 187 states that:

> *"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."*

2.1.4 The NPPF indicates that the Noise Policy Statement for England (NPSE) should be used to define the "significant adverse impacts".

Planning Practice Guidance: Noise

2.1.5 The Planning Practice Guide (PPG) was launched in 2014 (with the latest update being in 2019) and provides additional guidance and interpretation to the Government's strategic policies outlined within the NPPF in a regularly updated, web-based resource.

2.1.6 Paragraph: 001 Reference ID: 30-001-20190722, "When is noise relevant to planning?" states:

> *"Noise needs to be considered when development may create additional noise, or would be sensitive to the prevailing acoustic environment (including any anticipated changes to that environment from activities that are permitted but not yet commenced). When preparing plans, or taking decisions about new development, there may also be*

opportunities to make improvements to the acoustic environment. Good acoustic design needs to be considered early in the planning process to ensure that the most appropriate and cost-effective solutions are identified from the outset."

2.1.7 PPG provides advice on how noise impacts should be determined. Paragraph: 003 Reference ID: 30-003-20190722 states the plan-making and decision makes processes should consider:

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

2.1.8 This paragraph also refers to the Noise Policy Statement for England (NPSE), in stating that the overall effect of the noise exposure (including the impact during the construction phase where applicable) should be identified against the significant observed adverse effect level (SOAEL) and the lowest observed adverse effect level (LOAEL) for the given situation.

Noise Policy Statement for England

2.1.9 The Noise Policy Statement for England (NPSE) was published in March 2010 and clarifies the underlying principles and aims of existing policy documents that relate to noise. It also sets 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".

2.1.10 The NPSE states that noise should not be considered in isolation of the wider benefits of a scheme or development, and that the intention is to minimise noise and its effects as far as is reasonably practicable having regard to the underlying principles of sustainable development.

2.1.11 Paragraphs 2.20 and 2.21 define 'significant adverse' and 'adverse' impacts as applied to noise as follows:

"There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

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

LOAEL – Lowest Observed Adverse Effect Level

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

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

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

2.1.12 Paragraph 2.22 clarifies that:

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

2.1.13 The three aims of the NPSE are defined as follows:

> *"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." (Note: Applies when the impact lies somewhere between the LOAEL and SOAEL and does not mean that adverse effects cannot occur)."*
>
> *"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."*

2.1.14 It is necessary to define the LOAEL and SOAEL for the potential source of noise to relate the potential impact to the aims and requirements of the NPSE.

2.2. Local Policy

2.2.1 The Camden Local Plan sets out the Council's planning policies for the period 2016 – 2031.

2.2.2 Policy A4 Noise and vibration of the Local Plan states:

> *"The Council will seek to ensure that noise and vibration is controlled and managed.*
>
> *Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:*
>
> *a. development likely to generate unacceptable noise and vibration impacts; or*
>
> *b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*
>
> *We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development."*

2.2.3 Appendix 3 of the Camden Local Plan details design and assessment criteria for proposed developments aimed at guiding applicants as to the degree of detailed consideration needed to be given to noise in any planning application. The criteria include guidance on the acceptability as follows:

> *"Green – where noise is considered to be at an acceptable level.*
>
> *Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.*
>
> *Red – where noise is observed to have a significant adverse effect."*

Proposed Developments Likely to be Sensitive to Noise

2.2.4 Table B of Appendix 3 of the Camden Local Plan, presented as **Table 2.1** below, provides the noise levels applicable to noise sensitive residential development proposed in areas of existing noise.

Table 2.1: Noise Levels Applicable to Noise Sensitive Residential Development Proposed in Areas of Existing Noise

Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
	Day	<50 dB $L_{Aeq,16hr*}$	50 dB to 72 dB $L_{Aeq,16hr*}$	> 72 dB $L_{Aeq,16hr*}$

Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Noise at 1m from noise sensitive façade/free field	Night	<45 dB $L_{Aeq,8hr*}$ <40 dB $L_{night**}$	45 dB to 62 dB $L_{Aeq,8hr*}$ >40 dB $L_{night**}$	> 62 dB $L_{Aeq,8hr*}$
Inside a bedroom	Day	<35 dB $L_{Aeq,16hr}$	35 dB to 45 dB $L_{Aeq,16hr}$	> 45 dB $L_{Aeq,16hr}$
	Night	<30 dB $L_{Aeq,8hr*}$ 42 dB $L_{Amax,fast}$	30 dB to 40 dB $L_{Aeq,16hr}$ 40 dB to 73 dB $L_{Amax,fast}$	> 40 dB $L_{Aeq,16hr}$ > 73 dB $L_{Amax,fast}$
Outdoor living space (free field)	Day	<50 dB $L_{Aeq,16hr}$	50 dB to 55 dB $L_{Aeq,16hr}$	>55 dB $L_{Aeq,16hr}$
*$L_{Aeq,T}$ values specified for outside a bedroom window are façade levels **L_{night} values specified for outside a bedroom window are free field levels				

Building Services Plant

2.2.5 With respect to building services plant, Appendix 3 of the Local Plan provides guidance on the selection of the LOAEL and SOAEL for industrial and commercial sources. Noise criteria are not provided for plant sources serving residential developments. The guidance is detailed in **Table 2.2**.

Table 2.2: Plant Noise Criteria

Existing Noise Sensitive Receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Dwellings	Garden used for main amenity (free field and outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings	Outside bedroom window (facade)	Night	'Rating level' 10 dB* below background and no events exceeding 57 dB L_{Amax}	'Rating level' between 9 dB below and 5 dB above background or noise events between 57 dB and 88 dB L_{Amax}	'Rating level' greater than 5 dB above background and/or events exceeding 88 dB L_{Amax}
*10 dB should be increased to 15 dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.					

2.2.6 With respect to emergency plant, the Local Plan states:

> *Emergency equipment such as generators which are only to be used for short periods of time will be required to meet the noise criteria of no more than 10 dB above the background level ($L_{90\ 15\ minutes}$). During standby periods, emergency equipment will be required to meet the usual criteria for plant and machinery. Conditions to this effect may be imposed in instances where emergency equipment forms part of the application.*

Vibration

2.2.7 Table A of Appendix 3 of the Camden Local Plan (partially reproduced in **Table 2.3**) provides vibration levels at which planning permission will not normally be granted.

Table 2.3: Vibration Levels at Which Planning Permission Will Not Normally be Granted

Vibration description and location of measurement	Period	Time	Vibration Levels (Vibration Dose Values)
Vibration inside dwellings	Day and evening	07:00 – 23:00	0.2 to 0.4 VDV $m/s^{1.75}$
	Night	23:00 – 07:00	0.13 VDV $m/s^{1.75}$

2.3. Guidance and Standards

British Standard 8233: 2014 'Guidance on Sound Insulation and Noise Reduction for Buildings'

2.3.1 BS 8233, in relation to this development, sets out desirable guideline values in habitable rooms, such as living rooms and bedrooms.

2.3.2 The guideline values relate to steady external noise without a specific character, previously termed 'anonymous noise'. According to the standard, noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate. Examples of noise with a character may include tonal/intermittent plant noise emissions, music playback, and workshop noise. Examples of external steady noise sources may include environmental noise sources such as busy road traffic.

2.3.3 The desirable internal ambient noise levels for dwellings are presented in **Table 2.4**.

Table 2.4: BS 8233 Desirable Internal Ambient Noise Levels for Dwellings

Activity	Location	Desirable Internal Ambient Noise Level	
		07:00 to 23:00 hours	23:00 to 07:00 hours
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$
*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 source of ventilation that does not compromise the façade insulation or the resulting noise levels.			
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 5dB and reasonable internal conditions still achieved.			
*A selection of the available notes			

2.3.4 The Standard also provides advice in relation to desirable levels for external noise. It states that:

> *"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an*

upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable.

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 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

Professional Practice Guidance on Planning and Noise, 2017

The Professional Practice Guidance on Planning and Noise (ProPG) provides guidance on a recommended approach to the management of noise within the planning system in England and is limited to new residential development that will be predominantly exposed to airborne noise from transport sources.

With respect to internal ambient noise levels in habitable rooms, ProPG recommends that noise levels set out in BS 8233 are used for residential development. However, an additional criterion is proposed by ProPG for night-time L_{Amax} levels as follows:

"[…] 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 45 dB $L_{Amax, F}$ 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."

British Standard 4142:2014 +A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

2.3.5 BS 4142:2014 +A1:2019 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

2.3.6 The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of noise amounting to a nuisance is beyond the scope of the standard.

2.3.7 The standard should not be used to assess sound from the passage of vehicles on public roads and railway systems; recreational activities; music and other entertainment; shooting grounds; construction and demolition; domestic animals; people; public address systems for speech and other sources falling within the scopes of other standards or guidance. The standard cannot be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels.

2.3.8 The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level and the context in which the sound occurs/will occur. It is noted that a BS 4142 assessment is reliant on measuring relevant background sound levels.

2.3.9 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level and considering the following:

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and

2.3.10 The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

BS 6472-1:2008 'Guide to Evaluation of Human Exposure to Vibration from Buildings – Part 1: Vibration Sources Other Than Blasting

2.3.11 BS 6742-1:2008 details guidance with respect to the evaluation of human response to vibration sources (other than blasting).

2.3.12 The Standard sets out a methodology to assess the likely subjective response to vibration, based on evaluating the probability of adverse comment against the quantifiable Vibration Dose Value (VDV). The VDV defines a relationship that produces consistent assessment of continuous, intermittent, occasional and impulsive vibration and the subsequent human response.

2.3.13 Human response to vibration is dependent on various factors, including the frequency and direction of vibration. To address this, the Standard specifies frequency weightings that are applied to horizontal and vertical vibration measurements. The weighting curves are applied to the raw acceleration time history data, in order to calculate the VDV.

2.3.14 The VDV is expressed as a single value over a stated time period. For assessment purposes these periods are typically taken to be a 16-hour daytime period (07:00 to 23:00 hours) and an 8-hour night-time period (23:00 to 07:00 hours).

2.3.15 The VDV is much more strongly influenced by the vibration magnitude, than the duration of the vibration. A doubling of the vibration magnitude is equivalent to an increase in exposure duration by a factor of 16.

Parallel Effects

2.3.16 The Standard refers to parallel effects which can affect the extent to which people in buildings react to vibration at a given VDV. The following parallel effects are referred to in the standard:

Structure-borne noise (re-radiated noise): Low frequency noise (<100Hz) can arise from the vibration of building structures, caused by ground-borne vibration or acoustic excitation from external sources and is sometimes heard within a building.

Airborne noise: Airborne noise can be heard at the same time as the vibration is felt. This can affect a person's response to the perceived vibration.

Induced rattling: The occurrence of rattling windows, furniture, fittings or ornaments can emphasise vibration perception.

Measurement

2.3.17 The objective of the measurements is to quantify the VDV for the daytime and/or night-time evaluation periods.

2.3.18 Where the direction of the dominant vibration is unknown, measurements should be recorded in all three orthogonal axes.

2.3.19 The measurement location should be selected to establish the vibration level at the point of entry to the body. Vibration should usually be measured on the floor of the room implicated, within one-third and two-thirds of the width/length.

Assessment

2.3.20 According to the Standard, a judgement is made to determine the probability of adverse comment, based on the VDV falling within a corresponding range as presented in **Table 2.5**, which has been reproduced from the Standard.

Table 2.5: Vibration Dose Values Corresponding to Probability of Adverse Comment in a Residential Building

Time Period	**Low Probability of Adverse Comment*1 ms-1.75**	**Adverse Comment Possible ms-1.75**	**Adverse Comment Probable *2 ms-1.75**
Daytime (07:00 – 23:00 hours)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Night-time (23:00 – 07:00 hours)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

*1 Below these ranges adverse comment is not expected
*2 Above these ranges adverse comment is very likely

Re-Radiated Noise

2.3.21 Currently no British Standards exist which detail a method by which to assess ground-borne or structure-borne noise (which manifests itself as re-radiated noise) such as that induced by trains. Reference has therefore been made to relevant guidance.

Association of Noise Consultants (ANC) Guidelines

2.3.22 Whilst there is no specific guidance on methods of evaluation for re-radiated noise, there is some consensus regarding re-radiated noise induced by trains, collated in the Association of Noise Consultants (ANC) Guidelines 'Measurement and Assessment of Ground Borne Noise & Vibration', 2nd Edition, published in 2012.

2.3.23 Exposure to re-radiated noise can give rise to both activity disturbance and general annoyance. Dose response relationships defining relationships between parameters such as duration, level and number of events have not been well established. Therefore, human response criteria are typically based on the activity event noise level.

2.3.24 Early proposals for maximum acceptable levels of ground borne noise inside dwellings, defined in the American Public Transport Association (APTA) guidelines published in 1981, are still in widespread use. The 'design goals' are reproduced in **Table 2.6** below:

Table 2.6: APTA Guidelines for Ground Borne Noise Inside Residential Dwellings

Community Area	**Maximum A-weighted Sound Pressure Level, dB(A)**	
	Single Family Dwelling	**Multi-family dwelling**
Low Density Residential	30	35
Average Density Residential	35	40
High Density Residential	35	40
Commercial	40	45
Industrial/Highway	40	45

2.3.25 London Underground Limited studied the relationship between ground borne noise levels and complaint thresholds in 1969, following the opening of the Victoria Line. A threshold of around 40 dB L_{Amax} (slow (S) or fast (F) time constant not defined) was determined although it was noted that many people have been exposed to higher levels than this without complaint.

2.3.26 Local Authorities in London and South East England published the 'Local Authority Noise & Vibration Standards for Railways' in anticipation of the Channel Tunnel Rail Link in 1993. According to these guidelines ground borne noise inside dwellings should not exceed 35dB L_{AFmax}, whilst criteria for non-residential buildings should be considered on an individual basis.

2.3.27 The Railway Order for the DART underground was granted in December 2011 and included a number of planning conditions with supplementary limits for ground borne noise. Impact classifications were defined based on other major railway projects in the UK and Ireland e.g. Crossrail, the Jubilee Line, Dublin Metros North and High-Speed 1 and are reproduced in **Table 2.**.

Table 2.7: DART Underground Ground Borne Noise Impact Criteria for Residential Receptors

Impact Classification	**Groundborne Noise Level, dB $L_{Amax,slow}$ (measured indoors, near the centre of any dwelling room on the ground floor)**	
Negligible	<35	Not Significant
Low	35-39	
Medium	40-44	Significant Impact
High	45-49	
Very High	>49	

2.3.28 The same impact criteria (without a significance descriptor) as those presented in **Table 2.7**. have been proposed for HS2 in 'Volume 5 Technical Appendices (CT-001-000/1) of the HS2 London - West Midlands Environment Statement'.

2.3.29 Calculations of re-radiated noise levels are subject to a relatively high level of uncertainty with guidance documents noting an uncertainty of up to 10 dB.

2.4. Proposed Criteria

Ambient Noise Level Criteria

2.4.1 With reference to the requirements of the Local Authority, **Table 2.8**. details the proposed assessment criteria. The proposed criteria are not statutory unless conditioned by the Local Authority.

Table 2.8: Internal and External Sound Level Assessment Criteria

Location	Assessment Period	Ambient Noise Level	Re-Radiated Noise Levels
Living Rooms / Dining Rooms	Daytime 07:00 – 23:00 hours	35 dB $L_{Aeq,16hours}$	40 $L_{Amax,f}$ (dB)
Bedrooms	Night-time 07:00 – 23:00 hours	30 dB $L_{Aeq,8hours}$ 45dB $L_{Amax,f}$*	50 $L_{Amax,f}$ (dB)
Outdoor Living Space	Daytime 07:00 – 23:00 hours	55 dB $L_{Aeq,16hours}$	-
*Not to be normally exceeded more than 10 times per night			

Plant Noise Assessment Criteria

2.4.2 In the absence of specific guidance with respect to plant serving residential developments, plant noise assessment criteria have been based on those applicable to commercial and industrial developments as detailed in Table 2.2.

Perceptible Vibration Criteria

2.4.3 Based on the relevant Standards, the assessment criteria in **Table 2.9** are proposed:

Table 2.9: Proposed Vibration Assessment Criteria

Adverse Effect Level	Vibration Dose Value $ms^{-1.75}$	
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)
LOAEL	< 0.2	< 0.1
SOAEL	0.4 to 0.8	0.2 to 0.4

3 Environmental Sound and Vibration Survey

3.1. Procedure

3.1.1 An unattended environmental sound survey was undertaken from approximately 12:00 on Thursday 12 May 2022 to approximately 12:00 on Friday 13 May 2022. Measurements were made over 15-minute periods of the L_{Aeq}, L_{A90} and L_{AFMax} sound levels.

3.1.2 The sound level meters were located in environmental cases. The microphones were connected to the meters via an extension cable and fitted with the manufacturer's windshield.

3.1.3 Field calibrations were performed before and after the measurements with no significant fluctuations recorded (< 0.5 dB). Calibration certificates are available upon request.

3.1.4 Vibration measurements were undertaken at a single location on the site. The measurement position is shown in **Figure 2**.

3.1.5 The following vibration measurements were undertaken at the site:

- VIB1 – An unattended vibration survey was undertaken between approximately 13:00 hours on Thursday 12 May 2022 and 08:00 hours on Friday 13 May 2022 to determine existing vibration dose values on-site associated with train movements on the adjacent railway line.

- VIB2 - An attended vibration survey was undertaken between approximately 13:00 hours and 14:30 hours on Thursday 12 May 2022 to determine the existing on-site acceleration levels associated with train movements on the adjacent railway line.

3.1.6 Vibration was recorded simultaneously in each orthogonal axis. The x-axis was approximately parallel to the train line, the y-axis was approximately perpendicular to the train line, with the z-axis approximately vertical.

3.1.7 The instrumentation used in the survey (including calibration information) is listed in **Appendix B**.

3.2. Measurement Locations

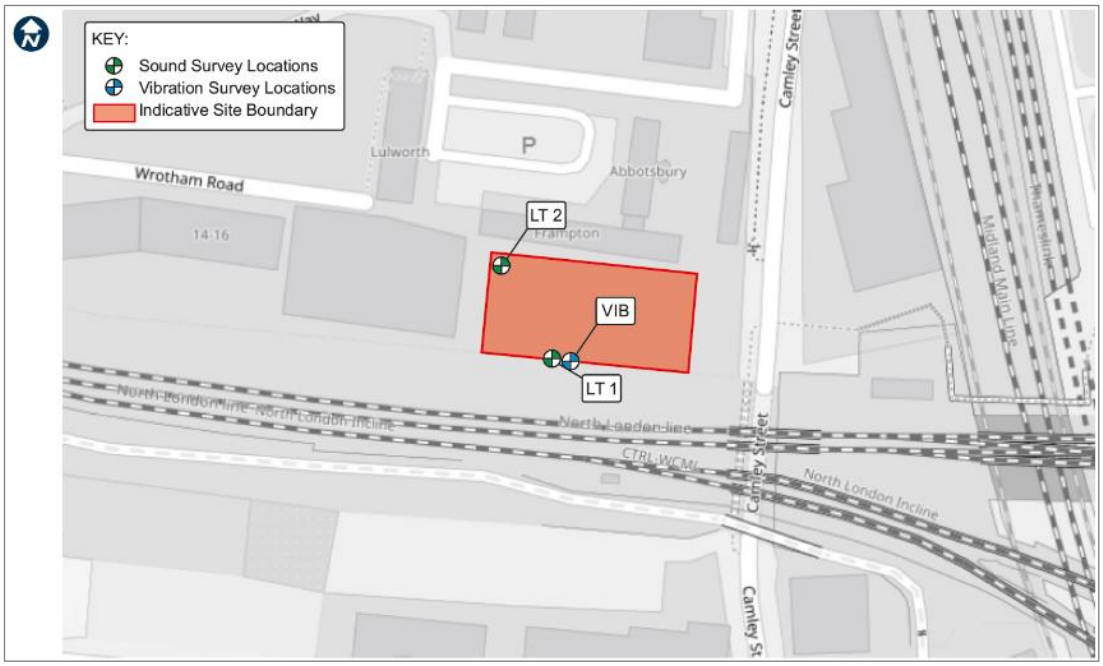
3.2.1 The measurement positions are detailed in **Figure 2** and described in **Table 3.1**.

Table 3.1: Environmental Sound Survey Location Descriptions

Location	Description	Dominant Sound/Vibration Source
LT1	The microphone was located on the southern boundary of the site, approximately 15 m north of the railway line, at a height of 5 m, level with the railway, in a free field position.	Train pass-bys Construction activities on adjacent phases audible but not dominant
LT2	The microphone was located on the northern boundary of the site, approximately 50 m north of the railway line, at a height of 1.5 m in a free field position.	Train pass-bys Construction activities on adjacent phases audible but not dominant
VIB	Measurements at VIB1 were taken by mounting a tri-axial measurement block to the existing concrete ground, approximately 17 m from the nearside railway line. Measurements were taken in five-minute intervals.	Train pass-bys

	Measurements at VIB2 were taken by mounting a magnetic tri-axial mounting block on to a heavy metal base, which was situated on the existing concrete ground, approximately 17 m from the nearside railway line. Measurements were taken within the frequency range between 1-315 Hz continuously for approximately one hour.	

Figure 2: Survey Locations



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3.3. Meteorological Conditions

3.3.1 Due to the nature of the survey (i.e. unattended), it is not possible to accurately comment on the meteorological conditions throughout the entire survey period. However, based on a review of publicly available weather forecasts and observations at the beginning and end of the survey period, the weather conditions are detailed in **Table 3.2.**

Table 3.2: Meteorological Conditions

Date	Description				
	Temperature (°C)	Precipitation (mm)	Cloud Cover (%)	Wind Speed (m/s)	Wind Direction
12/05/22	18	0	20	<5	W
13/05/22	16	0	70	<5	WSW

3.3.2 These conditions are considered suitable for obtaining representative sound/vibration level measurements.

3.4. Assumptions/Limitations

3.4.1 The engineer noticed nothing unusual in terms of the sound climate at the time of the survey. This report refers, within the limitations stated, to the environment of the site in the context of

the surrounding area at the time of the inspections. Environmental conditions can vary, and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

3.5. Environmental Sound Survey Results

3.5.1 Due to the nature of the survey (i.e. unattended), it is not possible to accurately comment on the dominant noise sources or specific noise events during the entire survey period. However, at the beginning and end of the survey period, it was noted that on-site sound levels were dominated by train pass-bys on the North London railway line.

3.5.2 Construction noise from adjacent phases to the north, and distant vehicular movements on the local road network were also audible but not dominant.

3.5.3 A summary of the long-term unattended sound survey results is presented in **Table 3.3**. Time history graphs detailing the full results are contained in **Appendix C**.

Table 3.3: Summary of Measured Environmental Sound Levels

Survey Location	**Period, T**	**Measured Sound Level (dB)**		
		$L_{Aeq,T}$	**Typical* L_{AFMax}**	**Typical** $L_{A90,T}$
LT1	Daytime (07:00 – 23:00 hours)	64	-	44
	Night-time (23:00 – 07:00 hours)	58	80	40
LT2	Daytime (07:00 – 23:00 hours)	60	-	40
	Night-time (23:00 – 07:00 hours)	51	71	37

* Based on the 10th highest measured L_{AFmax} level.

** Calculated based on the statistical distribution of background sound levels during the measurement period in general accordance with guidance in BS 4142:2014+A1:2019

3.6. Vibration Survey Results

3.6.1 Vibration from road traffic was not subjectively perceptible at the monitoring locations. Vibration from train pass-by events was perceptible through the ground at the measurement location.

3.6.2 The results of the environmental vibration survey are contained in **Appendices D and E.** These show the measured VDV time history at position VIB1 and the measured one-third octave band acceleration spectra for train pass-by events measured at position VIB2 in the X, Y and Z axis respectively.

4 Noise Impact Assessment

4.1. Assessment Methodology

4.1.1 Analysis of the proposed external building fabric has been undertaken in order to determine the required acoustic performance of glazing elements to achieve the criteria detailed in **Table 2.8**. Compliance with the acoustic performance specification detailed herein is expected to result in compliance with the proposed acoustic criteria.

4.2. Acoustic Model

4.2.1 An acoustic model has been prepared using SoundPLAN v8.2 to undertake the noise impact assessment. The model includes the effect of topography and existing buildings.

4.2.2 The assessment and recommendations are based on the following drawings provided by Hawkins Brown.

Table 4.1: Drawings

Title	Document Reference	Date	Revision
East and West Elevation	AGV-HBA-B-ZZ-DR-A-20-0201	March 2022	P3
North Elevation	AGV-HBA-B-ZZ-DR-A-20-0202	March 2022	P4
South Elevation	AGV-HBA-B-ZZ-DR-A-20-0203	March 2022	P4
Internal East and West Elevation	AGV-HBA-B-ZZ-DR-A-20-0204	March 2022	P3
Ground Floor General Arrangement Plan	AGV-HBA-B-00-DR-A-20-0100	May 2022	P5
Level 01 General Arrangement Plan	AGV-HBA-B-01-DR-A-20-0101	May 2022	P4
Level 02 General Arrangement Plan	AGV-HBA-B-02-DR-A-20-0102	May 2022	P4
Level 03 General Arrangement Plan	AGV-HBA-B-03-DR-A-20-0103	May 2022	P2
Level 04 General Arrangement Plan	AGV-HBA-B-04-DR-A-20-0104	May 2022	P2
Level 05 General Arrangement Plan	AGV-HBA-B-05-DR-A-20-0105	May 2022	P2
Level 06 General Arrangement Plan	AGV-HBA-B-06-DR-A-20-0106	May 2022	P2
Level 07 General Arrangement Plan	AGV-HBA-B-07-DR-A-20-0107	May 2022	P3
Level 08 General Arrangement Plan	AGV-HBA-B-08-DR-A-20-0108	May 2022	P4
Level 09 General Arrangement Plan	AGV-HBA-B-09-DR-A-20-0109	May 2022	P2
Level 10 General Arrangement Plan	AGV-HBA-B-10-DR-A-20-0110	May 2022	P2
Level 11 General Arrangement Plan	AGV-HBA-B-11-DR-A-20-0111	May 2022	P2
Level 12 General Arrangement Plan	AGV-HBA-B-12-DR-A-20-0112	May 2022	P4
Level 13 General Arrangement Plan	AGV-HBA-B-13-DR-A-20-0113	May 2022	P2
Level 14 General Arrangement Plan	AGV-HBA-B-14-DR-A-20-0114	May 2022	P2
Level 15 General Arrangement Plan	AGV-HBA-B-15-DR-A-20-0115	May 2022	P2
Level 16 General Arrangement Plan	AGV-HBA-B-16-DR-A-20-0116	May 2022	P2
Level 17 General Arrangement Plan	AGV-HBA-B-17-DR-A-20-0117	May 2022	P2
Level 18 General Arrangement Plan	AGV-HBA-B-18-DR-A-20-0118	May 2022	P2

Title	Document Reference	Date	Revision
Roof Level General Arrangement Plan	AGV-HBA-B-19-DR-A-20-0119	May 2022	P2

4.3. External Ambient Noise Levels

4.3.1 Balconies are to be incorporated as part of the proposed development.

4.3.2 The calculated incident façade levels indicate that balconies located on the southern, westerna and eastern facades are likely to exceed the proposed LOAEL of 55 dB $L_{Aeq,16hours}$ during the daytime period. Balconies on the northern facade are likely to fall below the proposed LOAEL.

4.3.3 With reference to BS8233:2014, Paragraph 7.7.3.2 states that:

> *"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."*

4.3.4 Furthermore, Paragraph 7.7.3.2 also states that:

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

4.3.5 The exceedance of sound levels within balcony areas should therefore be balanced against other factors, such as the convenience of living in such a desirable location and the likely preference of having a balcony exposed to higher sound levels as opposed to no balcony.

4.3.6 It should be noted that due to the nature and proposed layout of the development, it is considered impractical to reposition balconies or significantly reduce sound levels without changing the nature of the space. It should also be noted that this scheme is consistent with the previously approved permission for Block B.

4.3.7 Based on the results of the assessment and the mitigating factors detailed above, external sound levels in the proposed balcony areas should be considered acceptable.

4.4. Ventilation

4.4.1 The requirements for building ventilation in dwellings are detailed in Approved Document F (ADF) and include provision for 'whole dwelling ventilation', 'extract ventilation' and 'purge ventilation'.

- Whole Dwelling Ventilation - Nominally continuous ventilation of rooms or spaces at a relatively low rate to dilute and remove pollutants not removed by operation of extract ventilation or purge ventilation.

- Extract Ventilation - The removal of air directly to the outside. May be provided by passive or mechanical means.

- Purge Ventilation - Manually controlled ventilation at a relatively high rate to rapidly dilute pollutants and/or water vapour. Purge ventilation is typically provided by means of openable windows. Due to the temporary nature of purge ventilation, significant noise impacts are not normally expected.

4.4.2 ADF provides four 'template' systems which comply with the ventilation requirements for new dwellings and can be adopted to demonstrate compliance. These are:

- System 1: Background ventilators and intermittent extract fans.
- System 2: Background ventilators and passive stack ventilation.
- System 3: Continuous Mechanical Extract (MEV) with trickle ventilators providing inlet air.
- System 4: Continuous Mechanical Supply and Extract with Heat Recovery (MVHR).

4.4.3 Each system has different noise implications, however in the context of this assessment external noise ingress via the ventilation system is the primary concern. Generally, for systems 1-3 this is via the ventilators and for system 4 (MVHR) this is via the inlet and exhaust grilles within the dwelling associated with the MVHR system.

4.4.4 It is understood that ventilation to dwellings is to be provided by Mechanical Ventilation Heat Recovery (MVHR) units (i.e. System 4) located within each dwelling. MVHR has much greater resistance to external noise ingress than trickle ventilators and in the context of this site, noise ingress via the MVHR system is not considered to be significant.

4.5. Internal Sound Levels (External Building Fabric Assessment)

4.5.1 Our external building fabric analysis has assumed the following:

Room Absorption

4.5.2 We have assumed the bedrooms and living rooms to be acoustically 'soft' with carpets, curtains and other soft furnishings. For the purposes of our analyses, we have assumed the average equivalent absorption coefficients detailed in **Table 4.2**.

Table 4.2: Average Equivalent Acoustic Absorption Coefficients

Room	**Average Equivalent Acoustic Absorption Coefficient ($\bar{\alpha}$) at Octave-band Centre Frequency (Hz)**				
	125 Hz	**250 Hz**	**500 Hz**	**1 kHz**	**2 kHz**
Bedrooms / Living Rooms	0.18	0.25	0.27	0.31	0.32

Proposed External Building Fabric

4.5.3 We have based our assessment on a typical concrete external wall build-up and concrete roof. Please note that assessment of internal sound transfer falls outside the scope of this report and should be assessed in detail by the relevant specialists.

4.5.4 **Table 4.3** details typical sound reduction indices associated with the assumed external building fabric construction.

Table 4.3: Assumed External Wall Sound Reduction Performance

Construction	Sound Reduction Index (R) at Octave-band Centre Frequency (Hz)				
	125	250	500	1k	2k
Composite wall construction comprising brick faced GRC, cavity, insulation and SFS framed lining	45	45	45	45	50
Concrete roof	37	39	45	52	55

4.5.5 Our calculations have been based on building and window dimensions obtained from drawings detailed in **Table 4.1**.

4.6. Glazing Acoustic Specification and Guidance on Construction

4.6.1 Glazing specifications have been consolidated so that a minimum number of different specifications are provided.

4.6.2 The glazing performance specifications apply to the glazing package as a whole inclusive of glazing, louvres, spandrel panels, framing, opening lights, doors, seal etc. The performance of the glazing system will depend on many factors such as the glazing configuration, size of windows panels, quality of framing, quality of sealing etc.

4.6.3 The proposed windows should be tested in accordance with BS EN ISO 10140-2:2021 and the quoted minimum sound reduction specifications should be met by the system as a whole including frames etc. as appropriate, and not just the glass.

4.6.4 For guidance purposes we would suggest that a construction based around the following configurations is likely to prove commensurate with achieving the sound insulation performance specifications detailed within **Appendix F**.

Table 4.4: Glazing Guidance Constructions

Glazing Zone	Glazing Type	Guidance Glazing Construction
1	Uprated Double Glazing	Uprated Double Glazing comprising 8.4 mm glass / 16 mm cavity / 6 mm laminated glass
2	Conventional Double Glazing	Double glazing comprising 6.4 mm glass / 16 mm cavity / 6 mm glass
3	Conventional Double Glazing	Double glazing comprising 6 mm glass / 16 mm cavity / 4 mm glass

4.6.5 Glazing zones are presented in **Appendix G.**

4.6.6 The guidance construction detailed above is provided for costing purposes only. Selected glazing should be capable of meeting the performance specifications shown in **Appendix F**, with laboratory test certificates being made available in support of the quoted performance. Glazing proposals which simply reflect the guidance constructions indicated in this report will not, in isolation, be sufficient evidence that a glazing configuration will meet the performance specification.

4.6.7 The acoustic specifications will need to be integrated, coordinated and ratified with the design by the principal designer and design team to ensure that all other design interfaces, buildability, workmanship and other requirements are considered.

4.6.8 It should be noted that the acoustic specifications are to demonstrate the ability of the scheme to comply with planning requirements and are not intended to be used as detailed acoustic design specifications. All acoustic specifications should be reviewed and confirmed during the detailed design stage.

4.6.9 Based on the results of the external building fabric assessment, the internal ambient sound levels are likely to meet the proposed criteria during daytime and night-time periods.

5 Vibration Assessment

5.1. Methodology

5.1.1 Measurements were undertaken to determine vibration dose values due to train pass-by events at position VIB1, and to determine acceleration values due to train pass-by events at position VIB2, as outlined in **Section 3**.

5.1.2 For measurements at position VIB2, a typical representative train pass-by event was identified on-site during the survey and by identifying peaks in the time history data.

5.2. Empirical Estimation of Building Response

5.2.1 The vibration levels measured at grade would be modified by the presence of the proposed building. The vibration levels would be modified further as vibration propagates through the building superstructure.

5.2.2 To estimate the likely tactile vibration and re-radiated noise levels that may be experienced by future occupants, it is necessary to estimate the room surface vibration levels within the habitable rooms (receiver rooms). Re-radiated noise levels would also have some dependence on the acoustic properties of the receiver room and the radiation factor of the room surfaces. Similarly, tactile vibration levels experienced by an occupant would have some dependence on the room's furnishings and the occupant's position within the room. However, both tactile vibration and re-radiated noise would primarily be controlled by the level of vibration entering the piles and the propagation through the building superstructure.

5.3. Soil to Foundation Coupling

5.3.1 The coupling between the soil and the foundations will result in reduced vibration levels in the foundations relative to the sub-soil or ground surface. Empirically determined corrections (coupling losses) for various types of foundations can be found in Saurenman, Nelson, Wilson, US Urban Mass Transportation Administration, Office of Rail and Construction Technology 'Handbook of Urban Rail Noise and Vibration Control' (HURNVC).

5.3.2 It is understood that the proposals do not include detailed foundation drawings at this stage. Based on the proposed height of the building of up to 18 storeys, piled foundations have been assumed for the purpose of the assessment.

5.4. Floor to Floor Attenuation

5.4.1 Vibration levels would be attenuated due to propagation upwards through the structure. Corrections for the floor-to-floor attenuation can be found in K Ishii and H Tachibana 'Field Measurement of Structure-Borne Sound in Buildings', Acoustical Society of America Reprint No. L10.

5.5. Proposed Receptor Locations

5.5.1 Based on the general arrangement plans AGV-HBA-B-00-A-20-0100 to AGV-HBA-B-00-A-20-119, it is understood that the building has the potential to be up to 18 storeys (including lower ground level) overlooking the railway line, with bedrooms and living spaces from level 02 and above.

5.5.2 The assessment has been undertaken at second floor level based on the vibration data measured at positions VIB1 and VIB2. Positions VIB1 and VIB2 are the same distance from

the nearest railway line as the nearest point of the proposed development to the railway line, with VIB1 and VIB2 being approximately 17 m from the nearest railway line.

5.6. Calculated Results

5.6.1 **Table 5.1** details estimated re-radiated noise levels for the worst-case areas within the ground and second floor of the proposed development respectively. VDV levels are presented as measured at the measurement location.

Table 5.1: Estimated Tactile Vibration and Re-Radiated Noise Levels

Location	**Estimated Re-radiated Noise Level* (dB L_{Afmax}) Ground Floor**	**Vibration Dose Value $VDV_{b/d,day/night}$**					
		Daytime (07:00 – 23:00 hours)			**Night-time (23:00 – 07:00 hours)**		
		X	**Y**	**Z**	**X**	**Y**	**Z**
Ground Floor	30-36	0.02	0.04	0.04	0.02	0.03	0.03
Second Floor	25-32						

*Calculated re-radiated noise levels are subject to limitations as outlined in Section 2.5 of the literature review.

5.7. Discussion

5.7.1 The results indicate that the VDV is likely to fall below the level for low probability of adverse comment at ground floor level at VIB1, indicating that adverse comment would not be expected due to tactile vibration.

5.7.2 At ground and second floor level of the proposed building, the results indicate that re-radiated noise levels are likely to be below the proposed LOAEL, and adverse effects are not expected.

6 Plant Noise Impact Assessment

6.1.1 An assessment has been undertaken in general accordance with BS4142:2014+A1:2019 to determine the likely noise impact associated with the proposed building services plant.

6.2. Noise Sensitive Receptors

6.2.1 The assessment has been undertaken at the nearest worst effected noise sensitive receptors, which are considered to be a residential dwelling located to the north and north-west of the site.

6.2.2 We note the presence of the Agar Children's Centre to the west of the site. However with plant located on the 7th and 18th floor, the impact is not considered to be significant as the Centre will not overlook the plant and would be screened by the roof and building of the proposed development.

6.2.3 The location of the receptors are identified on **Figure 3** and described in **Table 6.1**.

Figure 3: Noise Sensitive Receptors

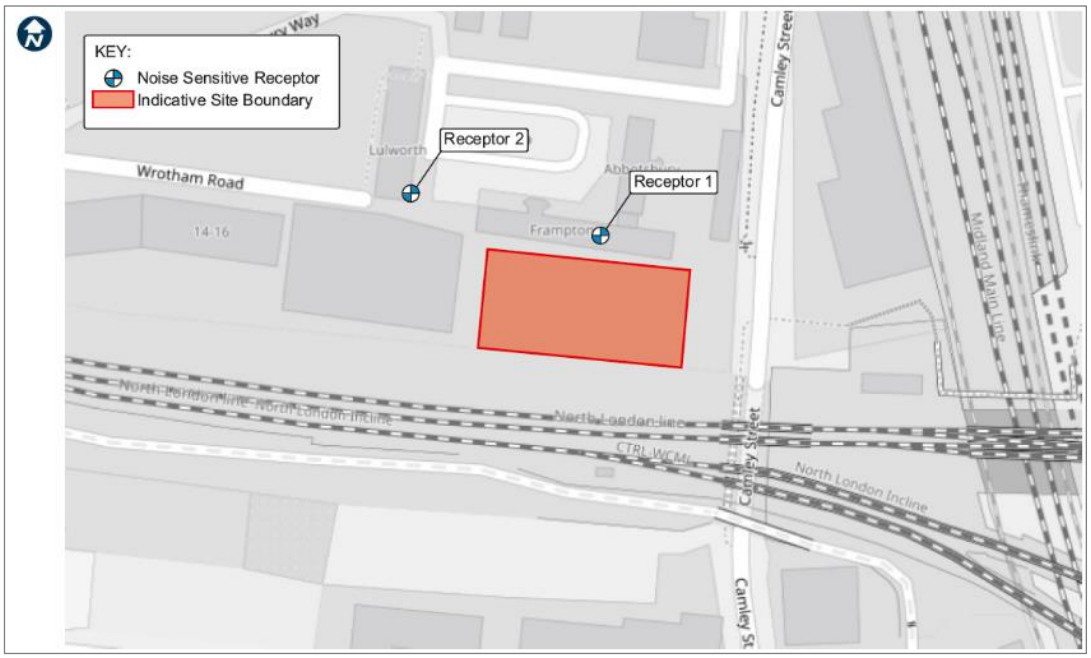


Table 6.1: Noise Sensitive Receptors

Receptor	Description
1	Residential uses at Frampton House to the north of the site. The development is 4 storeys high.
2	Residential uses at Lulworth House to the north-west of the site. The development is 18 storeys high.
3 (Not Shown on Figure)	Proposed residential uses overlooking 7th floor plant area.

6.3. Plant Noise Data

6.3.1 The assessment has been based on source sound level data provided to us by Max Fordham. For the purposes of the assessment, we have assumed that plant is operating at maximum duty. The details of the proposed plant items are presented in **Tables 6.2** and **6.3** below.

Table 6.2: Proposed Plant Details

Plant Reference	Manufacturer	Model	No. of Units
Outdoor Condenser Units	Mitsubishi	PURY-M200YNW-A1	2
Environmental Control Fans	Vent Engineering	Ventec EF315	3
Emergency Generator	Shenton Group	PHG650Vo	1
Smoke Fans (Emergency)	Vent Engineering	Ventec EF315	3

Table 6.3: Plant Data

Plant Reference	Data Type	Maximum Sound Level at Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Outdoor Condenser Units	Lp at 1m	77	61	61	58	51	47	44	42
Environmental Control Fans	Inlet Induct Lw	85	79	73	73	74	70	66	63
	Breakout Lw	78	75	63	54	52	50	48	33
Emergency Generator	LpA at 7m	70							
Smoke Extract Fans (Emergency)	Inlet Induct Lw	85	79	73	73	74	70	66	63
	Breakout Lw	78	75	63	54	52	50	48	33

6.3.2 Plant will be split between the 7th floor and 18th floor roofs as follows:

7th Floor Roof

- 2No. Outdoor Condenser Units
- Emergency Generator
- 1No. Environmental Control Fan
- 1No. Smoke Extract Fan (Emergency)

18th Floor Roof

- 2No. Environmental Control Fan
- 2No. Smoke Extract Fan (Emergency)

6.4. Assessment Assumptions

6.4.1 The assessment is based on the following:

- The environmental control fans operate simultaneously and have the potential to operate at any time during the daytime and night-time period.
- Emergency plant will run only during emergencies and testing. Testing is expected to take place on a monthly basis for a period of 10 minutes. Testing would only take place between 09:00 and 17:00 hours.
- The outdoor condenser units serve the commercial uses and will run during daytime hours only (07:00 – 19:00 hours).

6.5. Calculation Procedure

6.5.1 Calculations have been undertaken to determine the rating sound levels associated with the operation of the plant at the nearest noise sensitive receptor.

6.5.2 The rating sound level has been obtained by combining the calculated specific sound level for each individual source.

6.6. Background Sound Levels

6.6.1 For the purposes of undertaking the assessment, the background sound level at all identified receptors is 40 dB $L_{A90,15mins}$ during the daytime (07:00 – 23:00) and 37 dB $L_{A90,15mins}$ during the night-time (23:00 – 07:00).

6.6.2 For the commercial plant, the background sound level at all identified receptors is 50dB $L_{A90,15mins}$ during the operational period (07:00 – 19:00).

6.6.3 For emergency plant, the background sound level at all identified receptors is 50dB $L_{A90,15mins}$ during the potential testing period (09:00 – 17:00).

6.7. Acoustic Feature Corrections, Screening and Attenuation

6.7.1 Based on the operational data provided, the sources are not judged to emit noise that is tonal, impulsive or intermittent in nature.

6.7.2 The emergency generator is enclosed by an acoustic screen approximately 2.1m high.

6.7.3 Attenuators have yet to be specified for the smoke extract fans and environmental control fans. For the purposes of this assessment, it is assumed that all fans are fitted with an atmospheric side attenuator achieving the following minimum sound insertion loss values. We would expect the losses to be achieved with a 900mm attenuator with a free area of 50%.

Table 6.4: Attenuator Insertion Loss Values

Minimum Insertion Loss Value (dB) at Octave Band Centre Frequency (Hz)							
63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
4	7	13	19	23	23	16	13

6.8. Results and Discussions

6.8.1 **Table 6.5** presents the results of the assessment for non-emergency plant. At all receptors, plant noise emissions fall below the local authority's criteria and is therefore considered acceptable.

Table 6.5: Plant Noise Impact Assessment Results – Non-Emergency Plant

Plant Reference	**Sound Pressure Level (dB) at Noise Sensitive Receptor (Daytime / Night-time)**		
	1	**2**	**3**
Outdoor Condenser Units (2No.)	28 / -	21 / -	37 / -
Environmental Control Fans (3No)	27 / 27	18 / 18	N/A
Cumulative Sound Pressure Level (dB, $L_{Aeq,15mins}$)	30 / 27	23 / 18	37 / -
Background Sound Level (dB, $L_{A90,15mins}$)	40 / 37	40 / 37	50 / -
Exceedance (dB)	-10 / -10	-17 / -19	-13 / -
Local Authority Classification (see Table 2.2)	Green	Green	Green

6.8.2 Table 6.6 presents the results of the assessment for emergency plant. At all receptors, plant noise emissions fall below the local authority's criteria.

Table 6.6: Plant Noise Impact Assessment Results –Emergency Plant

Plant Reference	**Sound Pressure Level (dB) at Noise Sensitive Receptor**	
	1	**2**
Emergency Generator	55	55
Smoke Extract Fans (3No)	27	18
Cumulative Sound Pressure Level (dB, $L_{Aeq,15mins}$)	55	55
Background Sound Level (dB, $L_{A90,15mins}$)	50	50
Exceedance (dB)	+5	+5

7 Conclusions

7.1.1 Stantec (UK) Ltd has been commissioned by Arcadis LLP to undertake a noise impact assessment in relation to Phase 2A at Agar Grove.

7.1.2 An environmental sound survey has been undertaken by Stantec (UK) Ltd, to establish the existing environmental sound levels associated with transportation sources incident on the proposed development.

7.1.3 The results of the environmental sound survey have been used to prepare an acoustic model. The model was used to establish façade incident noise levels for the proposed development which form the basis of our assessment of the acoustic requirements of the building façade.

7.1.4 Assessment criteria have been proposed based on the requirements of the Local Authority.

7.1.5 The results of the vibration assessment indicate that the VDV is likely to fall below the level for low probability of adverse comment at ground floor level at VIB1, indicating that adverse comment would not be expected due to tactile vibration. At ground and second floor level of the proposed building, the results indicate that re-radiated noise levels are likely to be below the proposed LOAEL, and adverse effects are not expected.

7.1.6 Analysis of the proposed external building fabric has been undertaken in order to determine the acoustic performance of the glazed and ventilation elements. Compliance with the acoustic performance specification detailed herein is expected to result in compliance with the proposed acoustic criteria.

7.1.7 The acoustic specifications will need to be integrated, coordinated and ratified with the design by the principal designer and design team to ensure that all other design interfaces, buildability, workmanship and other requirements are considered.

7.1.8 It should be noted that the acoustic specifications are to demonstrate the ability of the scheme to comply with planning requirements and are not intended to be used as detailed acoustic design specifications. All acoustic specifications should be reviewed and confirmed during the detailed design stage.

7.1.9 An assessment of the proposed non emergency and emergency plant has been undertaken. The assessment indicates that the noise from the building services plant is expected to achieve the requirements of the local authority.

7.1.10 Based on the results of the assessments undertaken and the implementation of the recommended mitigation measures, the site should be considered suitable for residential development in relation to noise considerations and is consistent with the current planning permission.

Appendix A Acoustic Terminology

Parameter	Description
Acoustic Environment	Sound at the receiver from all sound sources as modified by the environment.
Ambient Sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. Comprises of the residual sound and the specific sound when present.
Ambient Sound Level ($La = L_{Aeq,T}$)	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.
A-Weighted Decibel (dBA)	A decibel level that has been corrected for the A-Weighting curve.
A-Weighting	Octave band and 1/3 octave band filters that correlate to the response of the human hearing system to sound pressure levels at different frequencies.
Background Sound	The level of sound measured in the absence of extraneous noise sources.
Background Sound Level ($L_{A90,T}$)	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using a fast time-weighting and quoted to the nearest whole number of decibels.
Decibel (dB)	A logarithmic unit used to describe the ratio between the measured level and a reference level of 0 dB. The ratio can be sound pressure, intensity or power. The reference value for sound pressure is 20 µPa and for sound power is 1 ρW.
Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$)	Value of the time-averaged A-weighted sound pressure level, in decibels (dB), of a continuous steady sound for the duration of the specified time interval, T.
Façade Level	The sound pressure level at a distance of 1 metre from the façade
Fast Time Weighted	The speed at which the instrument responds to changes in amplitude of the measured signal. The response time of a fats time-weighted instrument is 0.125 seconds.
Free-Field Level	The sound pressure level measured away from any reflective surfaces.
Frequency (f)	The number of cycles of pressure fluctuations within a given period of time. Measured in Hertz.
Hertz (Hz)	The unit of frequency or pitch of a sound. One hertz is equal to one cycle per second.
$L_{10,T}$	The noise level exceeded for 10 % for a given time interval, T. Generally used to describe traffic noise.
L_{Amax}	The maximum A-weighted level measured during a given time period.
Octave Band	Band of frequencies where the upper limit of the band is twice the frequency of the lower limit. E.g., the 1000 Hz band contains noise energy at all frequencies from 707 to 1414 Hz.
Percentile Level ($L_{AN,T}$)	The A-Weighted Sound Pressure Level which is exceeded for N% of the specified time interval. E.g., the LA90,1hour is the A-weighted sound level exceeded for 90% of 1 hour/
Reference Time Interval (T)	Specified interval over which the specific sound level is determined.
Sound Pressure	The difference between the pressure caused by a sound wave and the ambient pressure of the medium the sound wave is passing through. Measured in Pascals.

Sound Pressure Level (L_p)	The logarithm of the ratio of a given sound pressure (p) to the reference sound pressure (p0). The reference value for sound pressure is 20 µPa. Defined as: $$L_p = 20log\left(\frac{p}{p_0}\right)$$
Sound Sources	Sounds generated by nature or human activity.

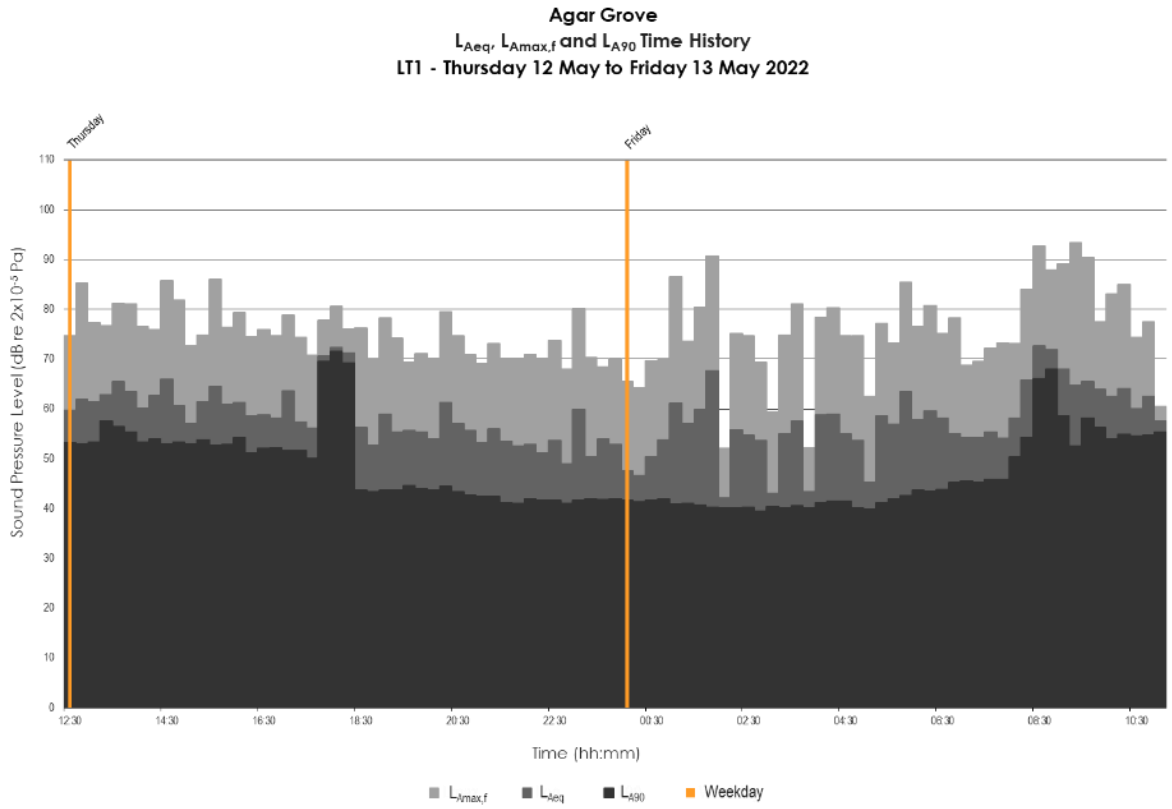
Appendix B Instrumentation

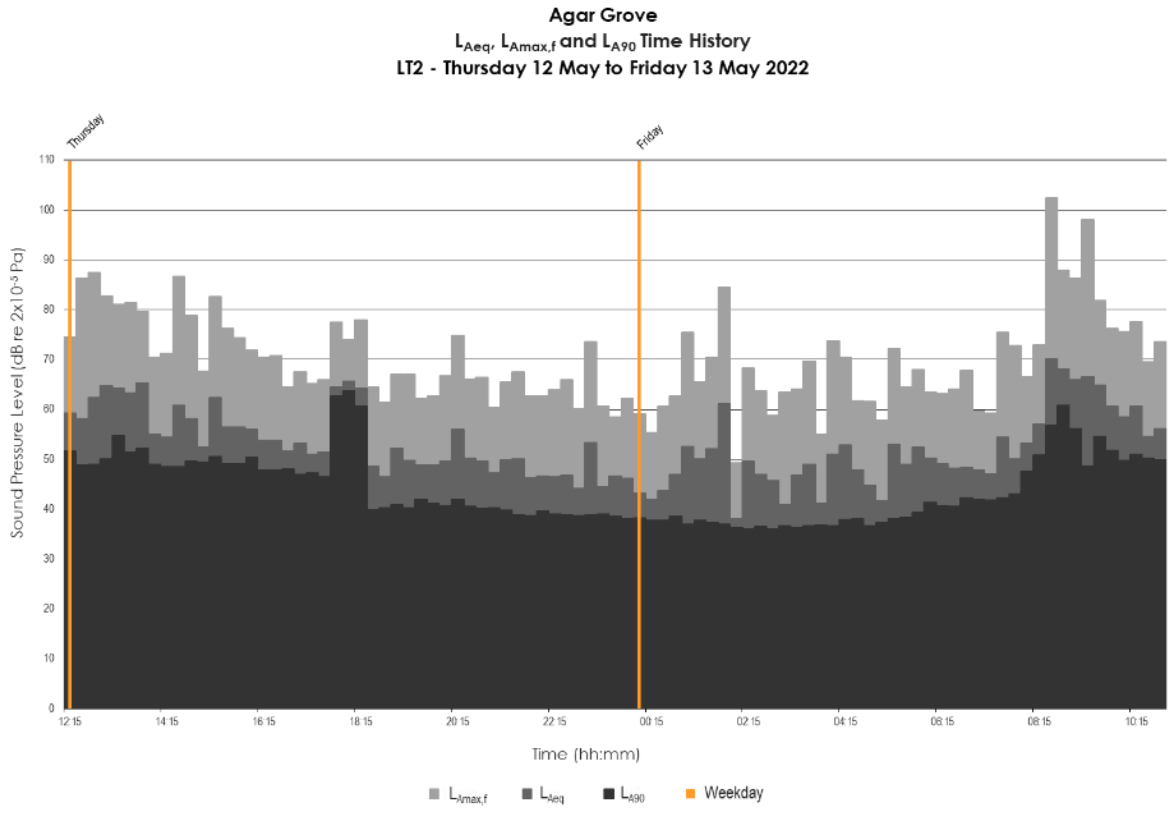
B.1.1 The instrumentation used in the survey is listed in Table B1.

Table B1: Instrumentation

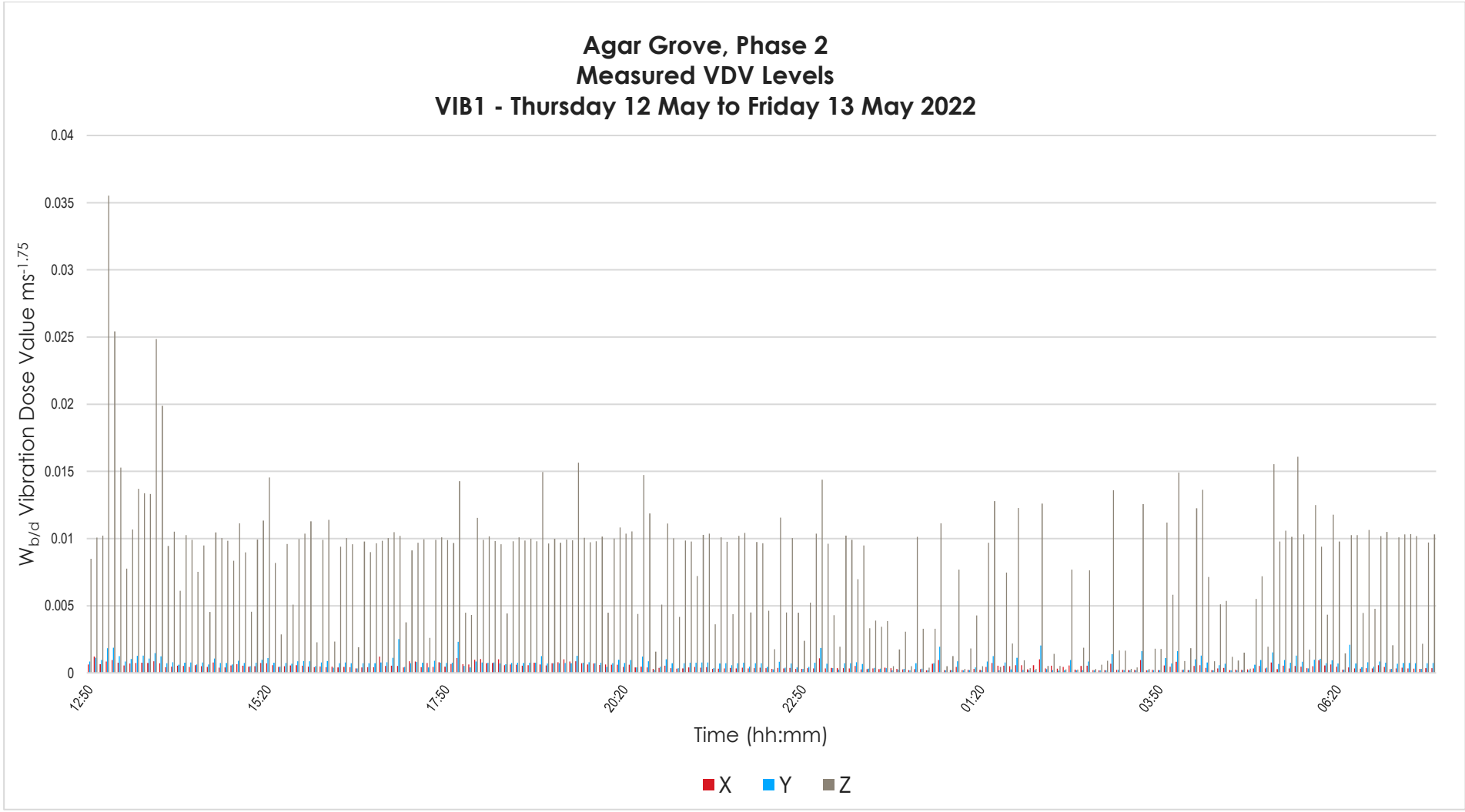
Description	Manufacturer	Type	Serial Number	Laboratory Calibration Date
Sound Level Meter	RION	NL-52	1043456	13/02/2021
½" Pre-polarised microphone		UC-59	7231	13/02/2021
Pre-amplifier		NH-25	43485	13/02/2021
Sound Level Meter	RION	NL-52	654033	10/01/2022
½" Pre-polarised microphone		UC-59	08287	10/01/2022
Pre-amplifier		NH-25	54078	10/01/2022
Sound Calibrator	RION	NC-74	34746693	06/10/2021
Vibration Monitor	RION	VM-54	01150113	17/11/2020
Vibration Monitor	01dB	dB4	11729	N/A
		dB4	12167	N/A
		dB4	12166	N/A
Digital Acquisition System	01dB	dB4	1863	N/A

Appendix C Time History Graphs





Appendix D Vibration Dose Value Time History (Location VIB1)


Agar Grove, Phase 2
Measured VDV Levels
VIB1 - Thursday 12 May to Friday 13 May 2022
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
$W_{b/d}$ Vibration Dose Value $ms^{-1.75}$
12:50
15:20
17:50
20:20
22:50
01:20
03:50
06:20
Time (hh:mm)
X
Y
Z

Appendix E Measured Acceleration of Train Passbys (Location VIB2)

Figure E.1: Acceleration Levels – VIB2 X Axis

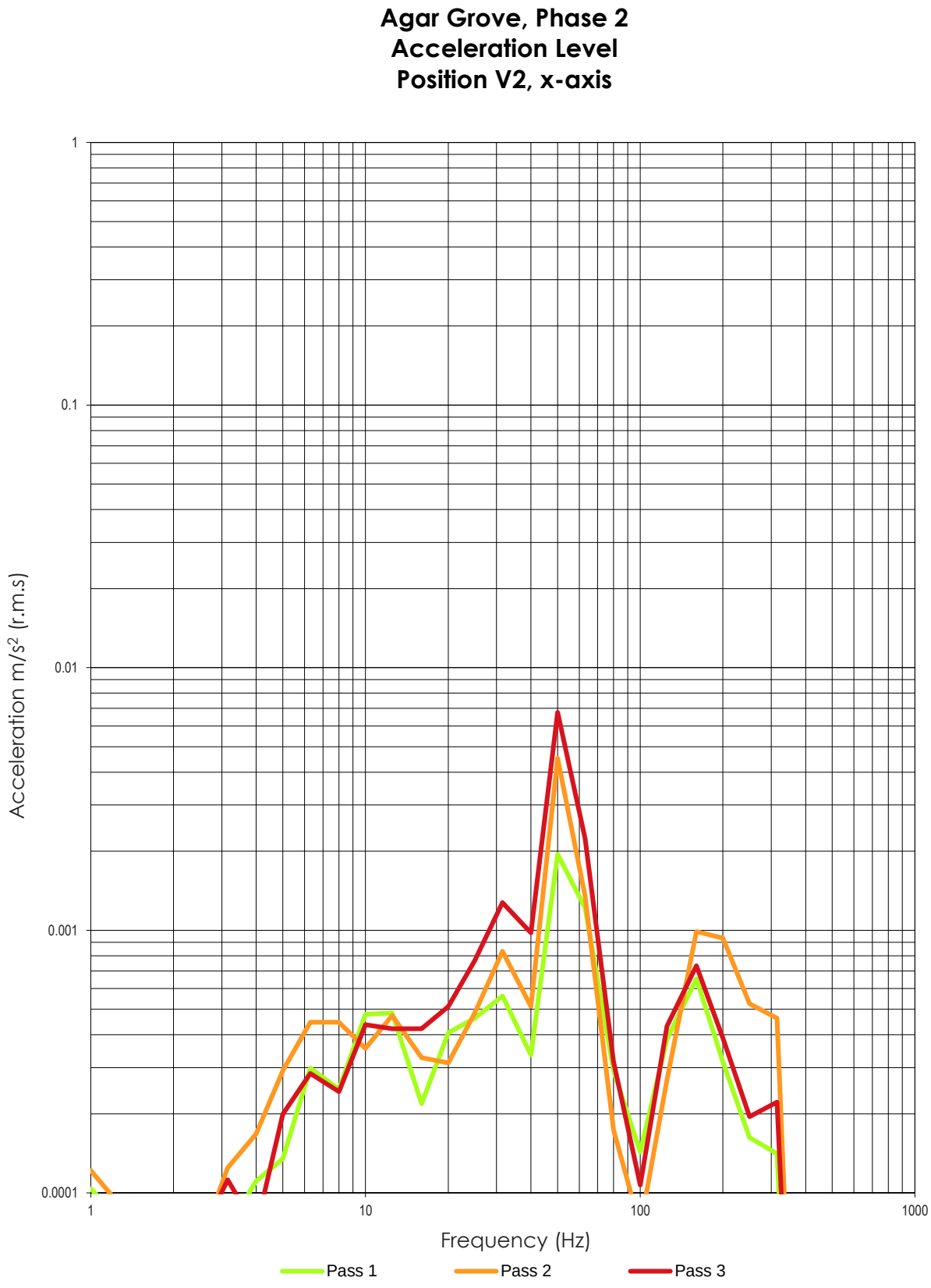


Figure E.2: Acceleration Levels – Y Axis VIB 2

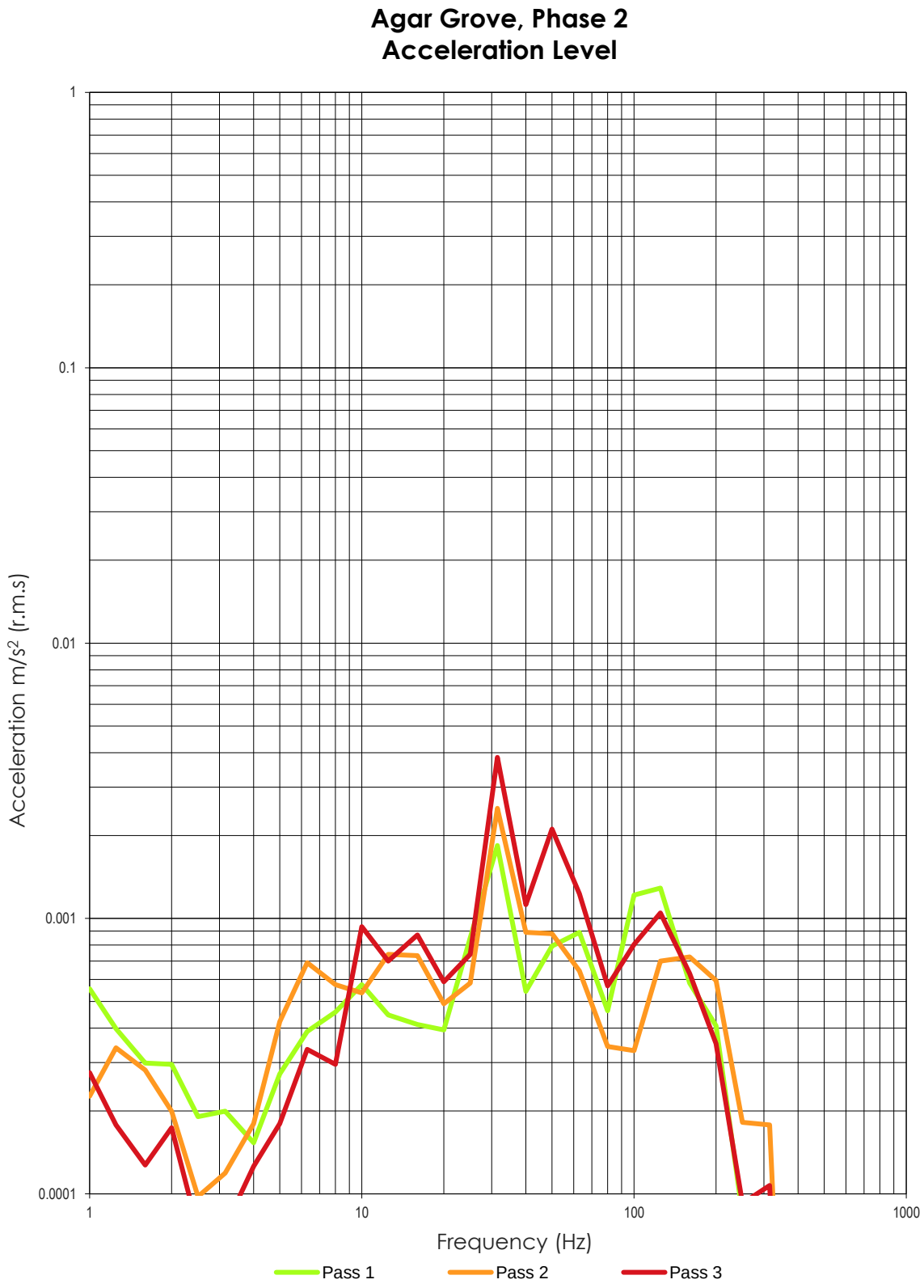
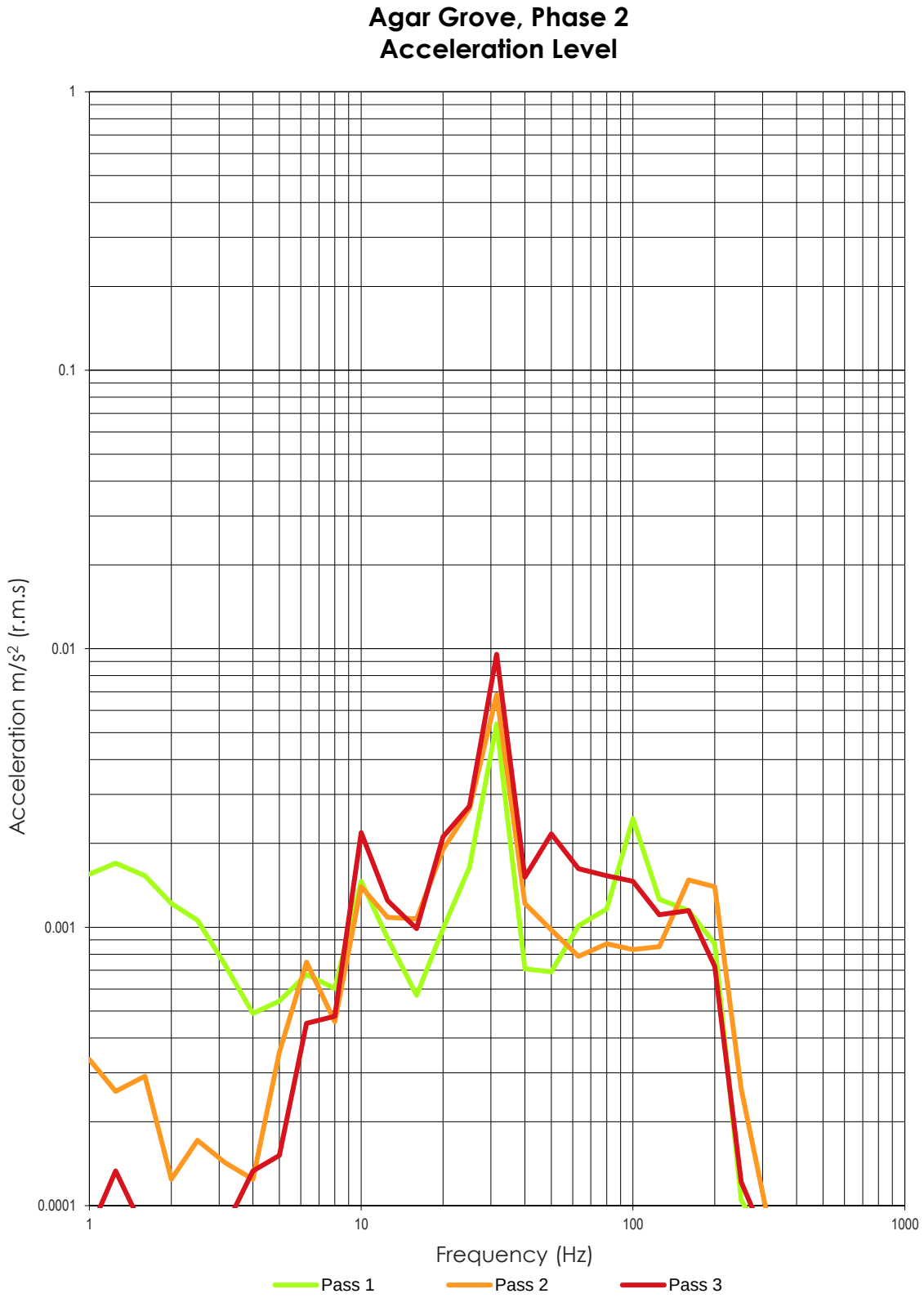


Figure E.3: Acceleration Levels – Z Axis VIB 2



Appendix F External Building Fabric Acoustic

F.1 Performance Specification

F.1.1 The project criteria are expressed in terms of an overall A-weighted dB sound level. Alternative frequency specific performance levels may therefore be acceptable subject to confirmation from Stantec.

F.1.2 Fully detailed test reports from independent acoustic test authorities shall be supplied. All test reports shall be in English or, a full English translation.

F.1.3 Test data should include the 1/3 octave band results from 100 Hz to 3150 Hz inclusive, together with the corresponding octave band results from 125 Hz to 4000 Hz inclusive.

F.1.4 As a result of wind or other atmospheric effects, external building elements should not give rise to rattling, creaking or whistling.

F.2 Glazing Sound Insulation Performance

F.2.1 The complete glazing system (including frames, joints, seals, spandrel panels and opening lights and trickle vents (as appropriate)) shall achieve the following minimum sound reduction indices when tested in accordance with BS EN ISO 10140-2:2021.

Glazing Zone	**Minimum Sound Reduction Index (R) value (dB) at Octave Band Frequency (Hz)**					**R_w***
	125	**250**	**500**	**1k**	**2k**	
G1	24	28	35	36	38	36
G2	19	27	33	35	33	34
G3	19	22	25	33	33	30

*The overall R_w figure is provided for guidance purposes only. The octave-band specification should be referred to in order to check compliance with the requirements.

Appendix G Glazing Zones

East Elevation

West Elevation

Glazing Zone 1
Glazing Zone 2
Glazing Zone 3

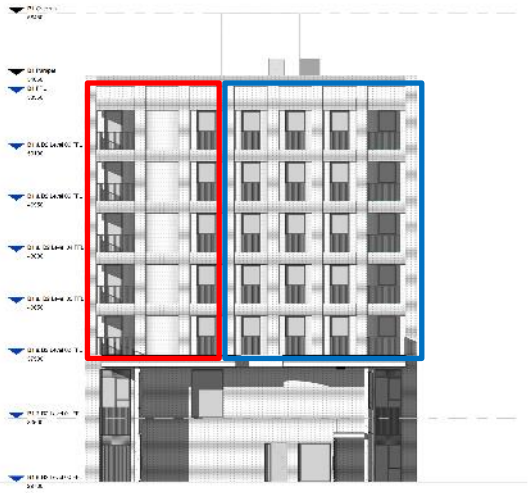
North Elevation

Glazing Zone 1
Glazing Zone 2
Glazing Zone 3

South Elevation

Glazing Zone 1
Glazing Zone 2
Glazing Zone 3

1 Internal West Elevation



Internal East Elevation

Glazing Zone 1
Glazing Zone 2
Glazing Zone 3