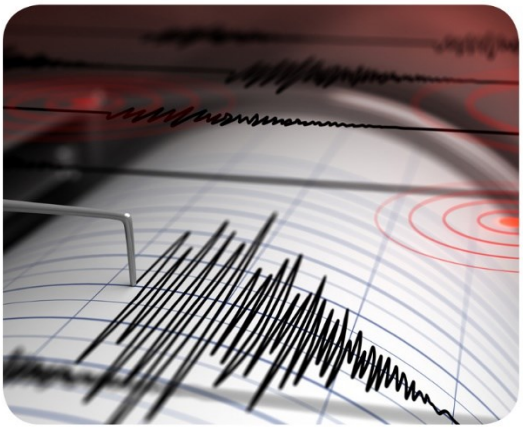

Air & Acoustic Consultants

David Wilson Homes / Barratt Homes

Hither Green Lane, Redditch

Noise Assessment

September 2021

airandacoustics.co.uk

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Noise Assessment

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David Wilson Homes / Barratt Homes

Hither Green Lane, Redditch

Noise Assessment

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1 Introduction

1.1 Brief

1.1.1 Air & Acoustic Consultants Limited have been commissioned by David Wilson Homes / Barratt Homes to undertake a noise assessment in support of a planning application for a proposed residential development, located on Hither Green Lane, Redditch.

1.2 Application Site

1.2.1 The proposed site currently includes part of a golf course and some scrubland. The site is adjacent to the B4101 Dagnell End Road at the northern boundary, residential properties on Hither Green Lane on the eastern boundary and a pub and restaurant on the western boundary.

1.2.2 The national grid reference for the centre of the site is, SP 04400 69404 (British National Grid co-ordinates E: 404400, N: 269404). The site location and surrounding area is illustrated in Figure 1.1.

Figure 1.1: Site Location

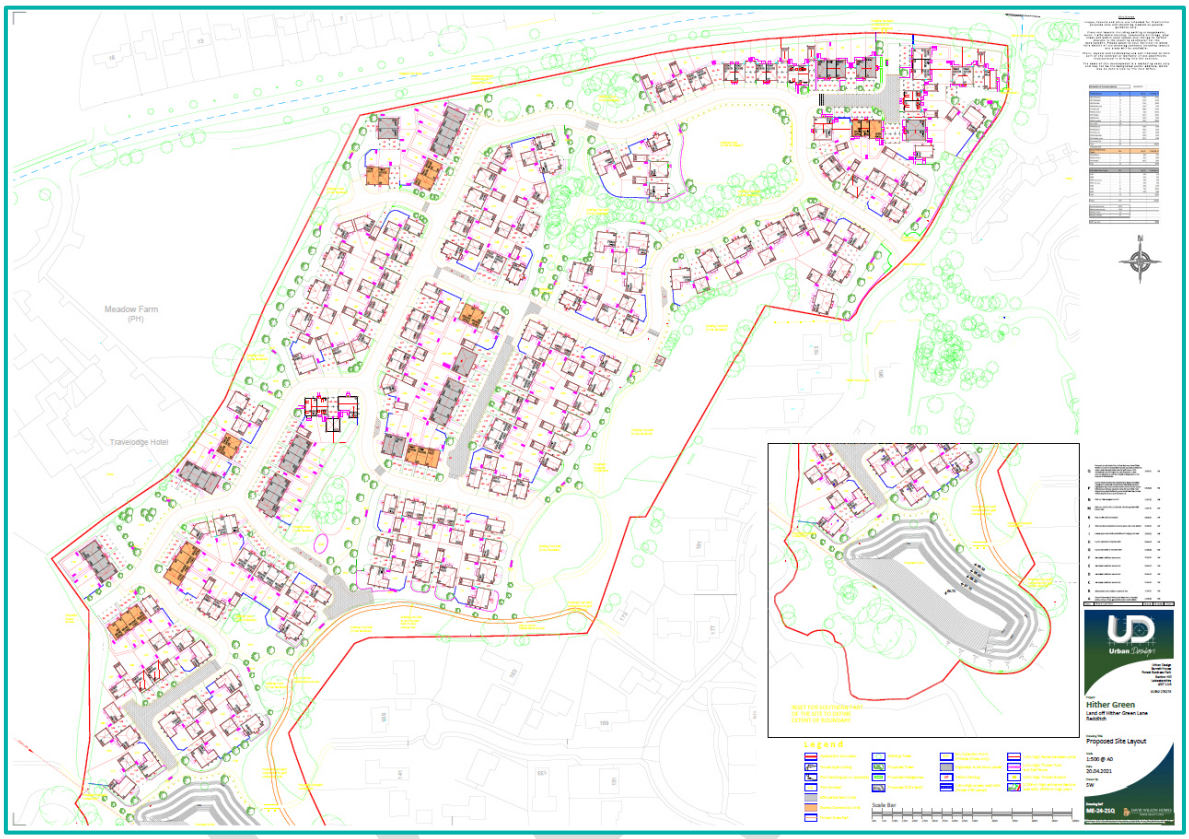
1.2.3 The existing noise climate around the site for both the daytime and night-time periods, is generally dominated by road traffic travelling on the B4101 to the north and the A441 to the west.

1.3 Development Proposals

1.3.1 The application seeks approval for the erection of 216 dwellings across the site.

1.3.2 The development proposals are illustrated in Figure 1.2.

Figure 1.2: Proposed Site Layout



1.4 Assessment Scope

1.4.1 This assessment will assess the noise levels across the proposed development and will determine the likely risks of adverse noise impacts.

1.4.2 To assist with the understanding of this report a glossary of acoustic terms is provided in Appendix A.

1.4.3 The report is structured as follows:

- **Section 2** considers the proposed scheme in relation to the relevant national and local planning policies;
- **Section 3** sets out the proposed impact assessment methodology;
- **Section 4** details the baseline noise environment at the proposed development site;
- **Section 5** considers the construction phase impacts;
- **Section 6** considers the operational phase impacts;
- **Section 7** describes potential mitigation measures for the construction and operational phase(s) (where required); and

- **Section 8** summaries and concludes the assessment.

2 Legislation and Policy Context

2.1 Introduction

2.1.1 The prediction and assessment of the likely noise impacts of the proposed development have been considered against the relevant legislation policy and guidance regarding noise, which are discussed in turn below.

2.2 National Planning Policy Framework (NPPF), 2021

2.2.1 The NPPF sets out the Government's planning policy for England. At its heart is an intention to promote more sustainable development. The NPPF addresses noise as a planning issue primarily through the following statement, at paragraph 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;'*

2.2.2 The NPPF refers to the Noise Policy Statement for England (NPSE) for advice on the achievement of these policy aims, and particularly in connection with the explanation of 'adverse impacts'.

2.3 Noise Policy Statement for England (NPSE), 2010

2.3.1 The NPSE is the overarching government policy on noise. It seeks to clarify the underlying principles and aims in past and existing policy documents, legislation, and guidance in relation to all forms of noise including environmental noise, neighbour noise and neighbourhood noise (but not noise in the workplace).

2.3.2 It uses the established concepts of No Observed Effect Level (NOEL) and Lowest Observed Adverse Effect Level (LOAEL). The NPSE extends these by introducing Significant Observed Adverse Effect Level (SOAEL). This is the level above which significant adverse effects on health and quality of life occur. However, the explanatory note to the NPSE states that it is not possible to identify a single objective value to define SOAEL for noise that is applicable to all sources of noise in all situations. It is likely to be different for different noise sources, for different receptors and at different times.

2.3.3 The NPSE's vision 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.*
>
> *This long-term vision is supported by the following aims:*
>
> - *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, through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."*

2.3.4 The second aim of the NPSE refers to noise impacts that lie somewhere between LOAEL and SOAEL. The NPSE asserts that, while this means that all reasonable steps should be taken to mitigate and minimise adverse effects, this does not mean that such adverse effects cannot occur.

2.4 Planning Practice Guidance (Noise) 2019

2.4.1 The Government has published Planning Practice Guidance on a range of subjects including noise. The guidance forms part of the NPPF and provides advice on how to deliver its policies. The PPG (Noise) reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and British Standards and contains examples of acoustic environments commensurate with various effect levels.

2.4.2 Paragraph 006 of (Reference ID: 30-006-20190722) of the PPG (Noise) explains that:

> *'The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.'*

2.4.3 Paragraph: 004 Reference ID: 30-004-20190722 of the PPG (Noise) describes the different effect levels which are defined and briefly outlined below:

- No Observable Effect Level (NOEL);
- Lowest Observable Adverse Effect Level (LOAEL); and
- Significant Observed Adverse Effect Level (SOAEL).

2.4.4 The PPG (Noise) describes noise that is not noticeable to be at levels below the NOEL. Noise exposures in this range are below the LOAEL and no mitigation is required. The PPG (Noise) suggests that noise exposures above the LOAEL cause small changes in behaviour. Examples of noise exposures above the LOAEL provided in the PPG (Noise) are having to turn up the volume on the television; needing to speak more loudly to be heard; or, where there is no alternative ventilation, closing windows for some of the time because of the noise. In line with the NPPF and NPSE, the PPG (Noise) states that consideration needs to be given to mitigating and minimising effects above the LOAEL, but also to taking account of the economic and social benefits being derived from the activity causing the noise. The PPG (Noise) suggests that noise exposures above the SOAEL cause material changes in behaviour. Examples of noise exposures above the SOAEL provided in the PPG (Noise) are, where there is no alternative ventilation, keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present. In line with the NPPF and NPSE, the PPG (Noise) states that effects above the SOAEL should be avoided and that whilst the economic and social benefits derived from the activity causing the noise must be taken into account, such exposures are undesirable.

2.4.5 The non-numeric guidance contained within the PPG (Noise), based upon the starting point in the NPSE, is summarised in Table 2.1 below.

Table 2.1: Summary of Guidance from NPSE and PPG (Noise)

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Adverse Effect Level			
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. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	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 harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

2.4.6 In line with the NPPF and the NPSE, the guidance confirms that significant adverse effects should be avoided. At the next level down in the hierarchy, where there is an observed adverse effect, the PPG (Noise) confirms that effects should be mitigated and reduced to a minimum, (as far as reasonably practicable). No mitigation measures are required for effects that are considered to be below the lowest observed adverse effect level (LOAEL).

2.4.7 However, along with the NPSE it does not provide any numerical of definition of the NOEL, LOAEL and SOAEL.

2.4.8 The NPSE also refers to the World Health Organisation, (WHO) when discussing noise impacts. The WHO Guidelines for Community Noise (1999) suggest guideline values for internal noise exposure which take into consideration the identified health effects and are set, based on the lowest effect levels for general population. Guideline values for amenity which relate to external noise exposure are set at 50 or

55 dB(A), representing daytime levels below which most of the adult population will be protected from becoming moderately or seriously annoyed, respectively.

2.5 The Control of Pollution Act (1974)

2.5.1 The Control of Pollution Act (1974) gives local authorities powers in relation to noise from construction sites including to serve a notice, (under Section 60) specifying exactly how works should be carried out.

2.5.2 An application for prior consent for the work can be completed under Section 61 of the Act providing a collaborative approach to the development.

2.5.3 A Section 61 application demonstrates to the local authority a pro-active approach to reducing environmental impacts, outlining what methods are in place to minimise disruption to the neighbourhood, thus reducing the number of potentials complaints. By having Section 61 consent, a local authority may not issue a Section 60 notice if the terms of the S61 agreement are not breached. Having a Section 61 consent in place minimises the likelihood of the contractor's work being stopped, as a mitigation plan is already in place.

2.6 Borough of Redditch Local Plan No.4

2.6.1 The Borough of Redditch Local Plan No.4 (BORLP4) is the most important planning document at the local level, as it provides a framework approach for growth of the Borough and forms part of the Borough of Redditch Development Plan.

2.6.2 The Local Plan has no specific policies relating to noise.

3 Assessment Approach

3.1 Operational Impacts

Design Manual for Roads & Bridges LA111 Noise and Vibration

3.1.1 The Design Manual for Road and Bridges LA111 Noise and Vibration, sets out the requirements for assessing the effects of highways noise and vibration from construction, operation, and maintenance projects. This standard may also be applied to existing roads, in certain circumstances.

3.1.2 Traffic noise is a general term used to define the noise from traffic using the local highway network. A traffic stream is made up of a variety of vehicle types which have their own individual noise sources. Close to a highway, individual vehicles can be distinguished in the traffic stream, but further from the highway the influence of individual vehicles is less noticeable as the noise from traffic becomes a continuous sound.

3.1.3 Noise from highway traffic is assessed in terms of the absolute noise levels at noise sensitive receptor locations and in terms of the change in noise levels at said receptors.

3.1.4 For absolute noise levels the LOAELs and SOAELs are set at the levels provided in Table 3.1.

Table 3.1: Operational Noise LOAELs and SOAELs for All Receptors

Time Period	LOAEL	SOAEL
Day (06:00-24:00)	55 dB $L_{A10,18hr}$ façade	68 dB $L_{A10,18hr}$ façade
Night (23:00-07:00)	40 dB $L_{night,\ outside}$ (free-field)	55 dB $L_{night,\ outside}$ (free-field)

3.1.5 LOAELs and SOAELs should be modified where it is proportionate and merited by local circumstances which can include, but are not limited to:

- Noise sensitive receptors that have reduced sensitivity to noise e.g. where the receptors have good noise insulation.
- Noise sensitive receptors that have an increased sensitivity to noise or vibration e.g. if a building is regularly used by people with hearing impairments.

3.1.6 The effect on people from highway traffic can also be reported in terms of nuisance. The assessment of nuisance is based upon a short-term change in road traffic noise of 1 dB, being the smallest that is considered to be perceptible. The long-term change, (typically 15 years after the project is opened) of 3 dB is considered to be perceptible. The magnitude of impact should therefore be considered to be different in the short term and long term.

3.1.7 DMRB indicates the classification of the magnitude of the change in road traffic noise, in the short term as shown in Table 3.2, and long term in Table 3.3.

Table 3.2: DMRB Short Term Magnitude of Change

Short Term Noise Change (dB $L_{A10,18h}$ or L_{night})	Short Term Magnitude
0	No Change
Less than 1.0	Negligible
1.0 – 2.9	Minor

Short Term Noise Change (dB $L_{A10,18h}$ or L_{night})	Short Term Magnitude
3.0 – 4.9	Moderate
Greater than or equal to 5.0	Major

Table 3.3: DMRB Long Term Magnitude of Change

Long Term Noise Change (dB $L_{A10,18h}$ or L_{night})	Long Term Magnitude
0	No Change
Less than 3.0	Negligible
3.0 – 4.9	Minor
5.0 – 9.9	Moderate
Greater than or equal to 10	Major

3.1.8 Where the magnitude of a change in noise level at sensitive receptors is negligible in the short-term, the change is considered not significant. To determine the significance of impacts of projects an initial assessment is made using Table 3.4.

Table 3.4: Initial Assessment of Operational Noise Significance

Significance	Short Term Magnitude of Change
Significant	Major
Significant	Moderate
Not Significant	Minor
Not Significant	Negligible

3.1.9 Where the magnitude of change at a noise sensitive receptors in the short-term is minor, moderate or major Table 3.5, along with the output of Table 3.4 shall be used to determine final significance.

Table 3.5: Determining Final Operational Significance on Noise Sensitive Receptors

Local Circumstance	Influence on Significance Judgement
Noise level change (is the magnitude of change close to the minor/moderate boundary?)	1) Noise level changes within 1 dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. Noise level changes within 1 dB of the bottom of a 'moderate' range can indicate that it is more appropriate to consider a change is not a likely significant effect.
Differing magnitude of impact in the long term to magnitude of impact in the short term	1) Where the long-term impact is predicted to be greater than the short-term impact, it can be appropriate to conclude that a minor change in the short term is a likely significant effect. Where the long-term impact is predicted to be less than the short term it can be appropriate to conclude that a moderate or major change in the short term is not significant. 2) A similar change in the long term and non-project noise change can indicate that the change is not due to the project and not an indication of a likely significant effect.
Absolute noise level with reference to LOAEL and SOAEL (by design this includes sensitivity of receptor)	1) A noise change where all do-something absolute noise levels are below SOAEL requires no modification of the initial assessment. 2) Where any do-something absolute noise levels are above the SOAEL, a noise change in the short term of 1.0dB or over results in a likely significant effect.

Local Circumstance	Influence on Significance Judgement
Location of noise sensitive parts of a receptor	1) If the sensitive parts of a receptor are protected from the noise source, it can be appropriate to conclude a moderate or major magnitude change in the short term and/or long term is not a likely significant effect. 2) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more appropriate to conclude a minor change in the short term and/or long term is a likely significant effect. 3) It is only necessary to look in detail at individual receptors in terms of this circumstance where the decision on whether the noise change gives rise to a significant environmental effect is marginal.
Acoustic context	1) If a project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change in the short term and/or long term is a likely significant effect.
Likely perception of change by residents	1) If the project results in obvious changes to the landscape or setting of a receptor, it is likely that noise level changes will be more acutely perceived by the noise sensitive receptors. In these cases, it can be appropriate to conclude that a minor change in the short term and/or long term is a likely significant effect. 2) Conversely, if the project results in no obvious changes for the landscape, particularly if the road is not visible from the receptor, it can be appropriate to conclude that a moderate change in the short term and/or long term is not a likely significant effect.

3.1.10 The number of properties affected shall not be used to justify change between the initial operational significance and the final operational significance.

Calculation of Road Traffic Noise

3.1.11 The potential change in road traffic noise because of the Proposed Development has been considered in-line with the methodology from the Calculation of Road Traffic Noise (CRTN).

3.1.12 The CRTN method considers road traffic using the Annual Average Weekday Traffic (AAWT) flows for the hours of 06:00 to 00:00 on the selected highway links together with the average speed, percentage of heavy vehicles, road surface type and gradients to output predicted road traffic noise levels in terms of the $L_{A10(18hour)}$ parameter, including a façade correction. The methodology assumes that the receptor is downwind of the source (i.e. the road) in moderate winds.

3.1.13 Whether or not a significant adverse effect is expected to occur is determined by comparing the predicted noise level, (with the Proposed Development) with the LOAEL and SOAEL values shown in Table 3.6, and considering the increase in noise due to the proposals.

Table 3.6: Desirable Ambient Noise Levels for Dwellings

Effect	Time Period	Threshold Value ($L_{Aeq,T}$)
LOAEL	07:00 – 23:00	50
	23:00 – 07:00	40
SOAEL	07:00 – 23:00	65
External Noise	23:00 – 07:00	55

3.1.14 If the daytime LOAEL threshold is exceeded, the data in Table 3.7 sets out how the magnitude of the impact is described taking account of the change in daytime noise exposure and the resulting exposure.

Table 3.7: Descriptors of Magnitude of Daytime Road Traffic Noise Change

Magnitude	Change in Noise Level	
	Between LOAEL & SOAEL	Above SOAEL
No Change	0	0
Negligible	Up to 2.9 dB(A)	Up to 0.9 dB(A)
Minor	3.0 – 4.9 dB(A)	1.0 – 2.9 dB(A)
Moderate	5.0 – 9.9 dB(A)	3.0 – 4.9 dB(A)
Major	10 dB(A) or above	5 dB(A) or above

3.1.15 If the night-time LOAEL threshold is exceeded, the data in Table 3.8, sets out how the magnitude of the impact is described taking account of the change in night-time noise exposure and the resulting exposure.

Table 3.8: Descriptors of Magnitude of Night-Time Road Traffic Noise Change

Magnitude	Change in Noise Level	
	Between LOAEL & SOAEL	Above SOAEL
No Change	0	0
Negligible	Up to 0.9 dB(A)	Up to 0.9 dB(A)
Minor	1.0 – 2.9 dB(A)	1.0 – 2.9 dB(A)
Moderate	3.0 – 4.9 dB(A)	3.0 – 4.9 dB(A)
Major	5 dB(A) or above	5 dB(A) or above

3.1.16 The predictions have been based on the operation of the proposed development at full capacity.

Professional Practice Guidance on Planning & Noise, New Residential Development, May 2017

3.1.17 The Professional Practice Guidance on Planning & Noise (ProPG) prepared jointly by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH), seeks to secure good acoustic design for new residential development within England's planning system.

3.1.18 The guidance includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. However, the guidance does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy.

3.1.19 The scope of the guidance is also restricted to sites that are exposed predominantly to noise from transportation sources. Where industrial or commercial noise is present on the site but is "not dominant", its contribution may be included in the noise level used to establish the degree of risk. Where industrial or commercial noise is present on the site and is considered to be "dominant", then the risk assessment should not be applied to the industrial or commercial noise component and regard should be had to the guidance in BS 4142:2014+A1:2019.

3.1.20 The ProPG advocates a 2-stage approach covering:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of four key elements.

3.1.21 The four key elements to be undertaken in parallel during Stage 2 of the assessment are:

1. Demonstrating a "Good Acoustic Design Process";
2. Observing internal "Noise Level Guidelines";
3. Undertaking an "External Amenity Area Noise Assessment"; and
4. Consideration of "Other Relevant Issues".

3.1.22 The overall approach is underpinned by the preparation of an "Acoustic Design Statement" (ADS), for which guidance is contained in ProPG Supplementary Document 2, Good Acoustic Design. An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk, and an ADS should not be necessary for a site assessed as negligible risk. The ProPG's Supplementary Document 1, Planning & Noise Policy Guidance provides additional information regarding other planning guidance.

3.1.23 The site's day and night-time noise exposures are used to define whether the site falls into a negligible, low, medium, or high-risk noise category. A site considered as negligible risk is likely to be acceptable from a noise perspective and need not normally be delayed on noise grounds.

3.1.24 Elements 1 and 2 of the Stage 2 assessment utilises the noise levels at new dwellings to determine good acoustic design, avoid 'unreasonable' acoustic conditions and prevent 'unacceptable' acoustic conditions. The internal noise level guidelines used by ProPG are largely those previously set out under BS 8233:2014, reproduced in Table 3.9, however with some additional guidance intended to assist with the determination of 'unreasonable' and 'unacceptable' acoustic conditions.

3.1.25 The Initial ProPG Noise Site Noise Risk Assessment process noise levels and guidance notes are provided detailed, but for clarity, this details some additional guidance which advises that in noise sensitive rooms the night-time noise level should not exceed 45 dB L_{AFmax} more than ten times is used to restrict events over this level are highlighted, by the use of blue italic font.

3.1.26 Element 3 of the ProPG's Stage 2 assessment is applicable to External Amenity Area Noise Assessment, similarly, extends the current guidance applicable to outdoor areas in the following manner:

- *3(i) If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.*
- *3(ii) The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$.*
- *3(iii) These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.*
- *3(iv) Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.*
- *3(v) Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially offset if the residents are provided, through the design of the development or the planning process, with access to:*

- *a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
- *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
- *a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- *a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5-minute walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations.*

3.1.27 The final element of Stage 2 is an assessment of other relevant issues, which may include the following matters:

- 4(i) Compliance with relevant national and local policy;
- 4(ii) Magnitude and extent of compliance with ProPG;
- 4(iii) Likely occupants of the proposed development;
- 4(iv) Acoustic design vs unintended adverse consequences; and
- 4(v) Acoustic design vs wider planning objectives.

3.1.28 Upon completion of the ProPG's Stage 1 and 2 assessments, the findings should enable one of four possible recommendations to be presented to the decision maker, i.e. to the Local Planning Authority (LPA), namely, to grant permission without conditions, grant with conditions, 'avoid' or 'prevent'.

BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

3.1.29 British Standard BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings' draws on the results of research and experience to provide information on the design of buildings to provide internal acoustic environments appropriate to their functions. It deals with control of noise from outside the building, noise from plant and services within it, and room acoustics in non-critical situations.

3.1.30 BS 8233:2014 defines a range of indoor ambient noise levels for spaces when they are unoccupied. A summary of the noise levels recommended in Table 4 of BS 8233:2014 guidance, for rooms used for resting and sleeping has been replicated in Table 3.9 below and represent levels for sources without a specific acoustic character.

Table 3.9: Desirable Ambient Noise Levels for Dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35dB $L_{Aeq, 16hour}$	-
Dining	Dining room	40dB $L_{Aeq, 16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq, 16hour}$	30dB $L_{Aeq, 8hour}$
External Noise	Amenity Spaces	50 - 55dB $L_{Aeq, 16hour}$	-

3.1.31 BS 8233:2014 provides the following guidance regarding acceptable noise levels in external amenity areas:

> *'7.7.3.2 Design criteria for external noise*
>
> *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 recognised 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.'*

3.1.32 The lower values shown in Table 3.9 above, are generally regarded as the LOAEL for steady external sound, i.e. no adverse effect due to the impact of the sound would be expected. If the sound has certain characteristics, it could be appropriate to consider a lower value as the LOAEL.

3.1.33 BS 8233:2014 also states that:

> "*Where development is necessary or desirable the internal target levels can be relaxed by up to 5dB and reasonable internal conditions achieved.*"

3.1.34 Table 7 from the BS8233:2014 guidance, (replicated in Table 3.10) contains the maximum noise levels for reliable speech communication. This table can be used to gauge the effect of a new noise source at a nearby receptors.

Table 3.10: Maximum Steady Noise Levels for Reliable Speech Communication

Distance Between Talker and Listener (m)	Noise level dB(A)	
	Normal Voice	Raised Voice
1	57	62
2	51	56
4	45	50
8	39	44

World Health Organisation Guidelines for Community Noise (1999)

3.1.35 The World Health Organisation's Guidelines for Community Noise has been considered regarding the potential impact from any maximum short-term noise levels.

3.1.36 The WHO Guidelines indicate that sound pressure levels at the outside façades of living spaces should not exceed 60 dB L_{AFmax} so that people may sleep within bedrooms with windows open. These values assume the noise reduction with a window partially open is 15 dB, resulting in an internal noise level of 45 dB L_{AFmax}. The guidelines state that for good sleep, indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10 – 15 times per night. It is generally accepted that 60 dB L_{AFmax} at the façade represents a LOAEL.

Acoustics Ventilation and Overheating Residential Design Guide January 2020

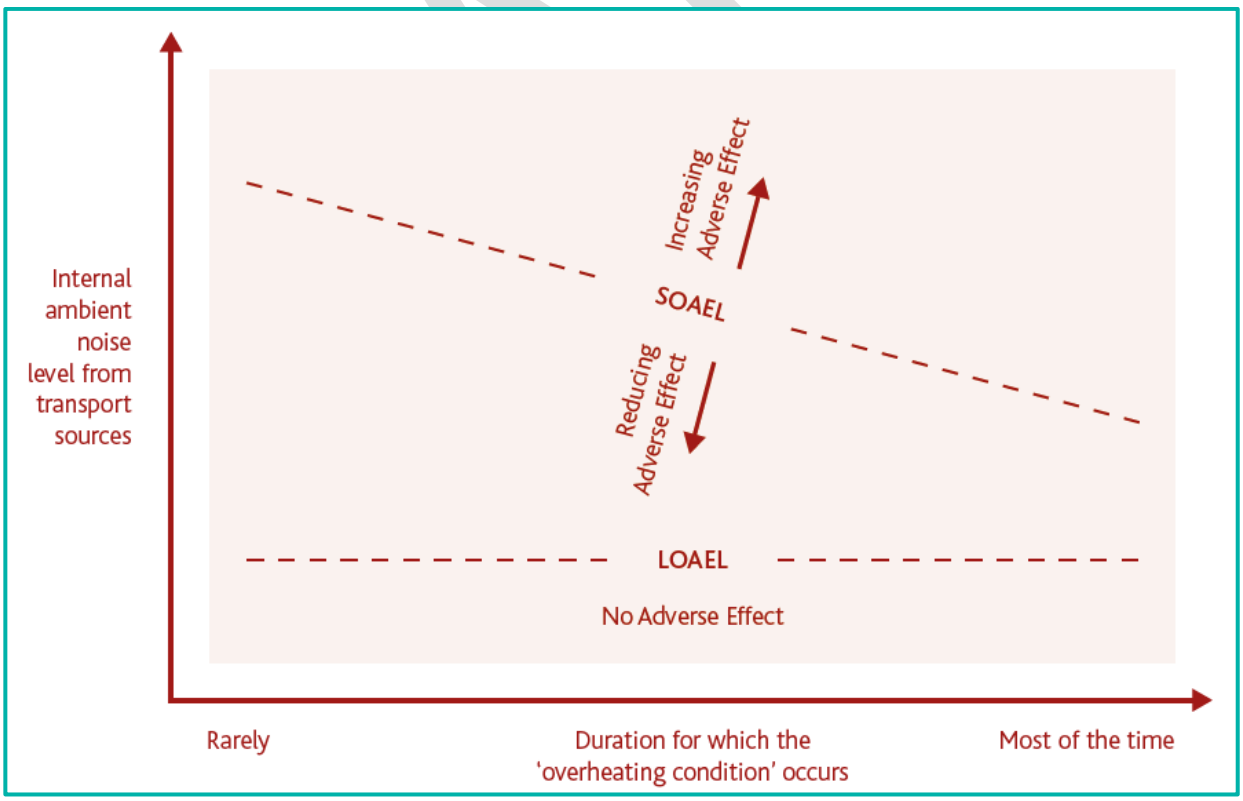
3.1.37 The Acoustic, Ventilation and Overheating Guide, (AVO Guide) provides methods of reconciling the, sometimes competing requirements of acoustics and ventilation/overheating and is intended to demonstrate good acoustic design as defined by ProPG.

3.1.38 Often the conclusions of acoustic assessments require closed windows to achieve suitable internal noise levels whereas the conclusions of overheating assessments require open windows to achieve suitable internal temperatures especially during the overheating condition which can often occur in summer months. This is increasingly relevant in well insulated, well-sealed new build properties.

3.1.39 The guidance sets out that under the overheating condition it may be appropriate to allow open windows, with the resulting increase in internal noise levels, and that occupants would accept this to provide additional cooling during the overheating condition. It is also desirable not to provide mechanical ventilation for all residential developments because this is less acceptable from a sustainability perspective.

3.1.40 The procedure by which this is achieved is to allow internal noise levels to exceed the normal LOAEL but not the SOAEL. The SOAEL may also change based on how often the windows of a residential property must be left open to mitigate the overheating condition, this is presented graphically in Figure 3.1; which is taken from the AVO Guide.

Figure 3.1: Internal Acoustic Criteria Relaxation to Mitigate Overheating



3.2 Construction Impacts

3.2.1 The activities associated with the construction phase of the proposed development has the potential to generate noise which may have an adverse impact on the surrounding area.

3.2.2 Guidance on the prediction and assessment of noise from development sites is given in British Standard BS 5228 -1:2009 + A1:2014[i] (BS 5228-1).

3.2.3 Construction noise can have disturbing effects on the surrounding neighbourhood. The effects are varied and are complicated further by the nature of the site works, which will be characterised by different noise sources which will change location throughout the construction period. The duration of site operations is also an important consideration. Higher noise levels may be acceptable if it is known that the levels will occur for a limited period

3.2.4 BS:5228-1 provides guidance on significance criteria for assessing the potential noise impacts associated with the construction phase of projects. There are two methods specified; the ABC method and the 5 dB(A) change method.

3.2.5 The ABC method involves categorising receptors using their ambient noise level according to Table 3.11.

Table 3.11: BS 5228-1 ABC Method

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq,T}$)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00-07:00)	45	50	55
Evenings and weekends	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75
NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), the a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. NOTE 3 Applied to residential receptors only			
[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. [B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. [C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. [D] 19:00-23:00 weekdays, 12:00-23:00 Saturdays and 07:00-23:00 Sundays			

3.2.6 The 5 dB(A) change method assesses the change in noise levels as a result of the construction works. It states;

> *"Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise*

[i] BS 5228-1:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites. Part 1: Noise. BSI

alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect.

These evaluative criteria are generally applicable to the following resources:

- *residential buildings;*
- *hotels and hostels;*
- *buildings in religious use;*
- *buildings in educational use;*
- *buildings in health and/or community use.*

For public open space, the impact might be deemed to cause significant effects if the total noise exceeds the ambient noise ($L_{Aeq,T}$) by 5 dB or more for a period of one month or more. However, the extent of the area impacted relative to the total available area also needs to be taken into account in determining whether the impact causes a significant effect.

3.3 Noise Modelling

3.3.1 The potential levels of sound from the existing noise environment have been predicted across the proposed site using the environmental noise modelling software CadnaA for the relevant receptor locations.

3.3.2 Noise modelling methods and inputs that have been used are provided in Table 3.12.

Table 3.12: Noise Modelling Inputs and Details

Noise Modelling Input	Details
Calculation Algorithm	CRTN for road traffic noise ISO9613 for all other sources
Ground Levels	OS terrain 50 data
Noise Sources	Road traffic noise from B4101 calibrated to monitoring position 2 Road traffic noise from A441 calibrated from a combination of traffic flow data and monitored noise levels Car parking noise calibrated to monitoring position 1
Time Periods	Daytime 07:00 – 23:00 & Night-time 23:00 – 07:00
Height of Receivers	Ground Floor – 1.5 m First Floor – 4.0 m
Proposed Site Layout	ME-24-21Q
Existing Building and Receptor Locations	Digitised from Google aerial imagery
Existing feature locations and base map	Google aerial imagery
Ground absorption	0.8 for soft ground, 0.0 for roads
Project co-ordinate system	OSGB 36 EPSG:27700

3.4 Noise Model Validation

3.4.1 To confirm that the modelled noise levels are representative of the real-world ambient conditions, the model has undergone a validation process. Validation compares the measured noise levels with the predicted results from the noise model. The comparison of the measured and modelled noise levels is compared in Table 3.13.

Table 3.13: Noise Model Validation

Position	Daytime 07:00 – 23:00 (dBA)			Night-time 23:00 – 07:00 (dBA)		
	Measured level $L_{Aeq, 16h}$	Modelled level $L_{Aeq, 16h}$	Variance	Measured level $L_{Aeq, 8h}$	Modelled level $L_{Aeq, 8h}$	Variance
L1	52.4	52.7	0.3	48.3	48.3	0.0
L2	61.2	61.2	0.0	54.5	54.5	0.0

3.4.2 Table 3.13 demonstrates the modelled predicted noise level represents a good representation of the monitored levels. L2 is the best represented which is to be expected because this monitor is the closest to the B4101, which is the main source of noise across the site.

3.5 Assessment Receptors

3.5.1 The noise receptors considered in the assessment include a selection of the most exposed façades of the proposed residential units as well as the worst affected gardens, the locations of receptors are shown in Table 3.14 and illustrated in Figure 3.2.

Table 3.14: Noise Sensitive Receptors (Residential)

Receptor	Height (m)	Description	Receptor Location Description
R01	1.5/4.0	Unit 94	SW Façade
R02	1.5/4.0	Unit 94	NW Façade
R03	1.5/4.0	Unit 93	NW Façade
R04	1.5/4.0	Unit 93	NE Façade
R05	1.5/4.0	Unit 68	West Façade
R06	1.5/4.0	Unit 70	North Façade
R07	1.5/4.0	Unit 59	NE Façade
R09	1.5/4.0	Unit 53	North Façade
R10	1.5/4.0	Unit 45	North Façade
R11	1.5/4.0	Unit 42	North Façade
R12	1.5/4.0	Unit 42	East Façade
R13	1.5/4.0	Unit 39	North Façade
R14	1.5/4.0	Unit 215	North Façade

Figure 3.2: Modelled Noise Sensitive Receptor Locations

3.5.2 Not all consented properties are represented by a receptor because of the size of the development, but figures showing the façade mitigation requirements are provided in Appendix D which cover all residential properties.

3.6 Uncertainty and Limitations

3.6.1 Regarding the noise survey measurements, the baseline survey was conducted over a 7-day period to obtain a representative sample of the baseline noise environment. Baseline surveys conducted over a number of days reduce the uncertainty of the resulting measured noise levels.

3.6.2 The noise monitoring positions were located at parts of the site most likely to be exposed to noise. There was a monitoring location located adjacent to Dagnell End Road B4101 and there was also a monitoring position at the edge of the proposed site, adjacent to the hotel and restaurant.

3.6.3 The calibration drift on the meters was very small; less than 0.1 dB for all measurements. All equipment was within laboratory calibration in accordance with the relevant standards (calibrators every year and sound level meters every 2 years).

3.6.4 Predictions have been made using CadnaA which is an industry standard and incorporates the required standards for noise propagation.

3.6.5 In summary, it is considered that whilst there will always be a level of inherent uncertainty in any assessment, where possible, potential sources of uncertainty have been minimised and it is considered to be a representative and robust assessment of the likely impacts.

4 Baseline Conditions

4.1 Noise Monitoring

4.1.1 A baseline noise survey was undertaken between Thursday 17th June and Wednesday 23rd June 2021. The survey consisted of two long-term monitoring positions as detailed below:

- L1 – Western boundary of the site, adjacent to the hotel – unattended long-term; and
- L2 – Northern boundary of the site, adjacent to the B4101 – unattended long-term.

4.1.2 All measurements were taken using class 1 sound level meters. The microphones' measurement positions were in the acoustic free field and were mounted on a pole at 1.5 m above the ground. Calibration checks were performed at the start and end of the survey; no significant drift in calibration was observed.

4.1.3 The details of the monitoring equipment used is set out in Table 4.1 and the monitoring positions are illustrated in Figure 4.1.

Table 4.1: Noise Monitoring Equipment

Equipment Type	Manufacturer	Model	Serial Number	Calibration Due
Sound Level Meter	Larson Davis	Model Lxt1	4473	01/2023
Pre-Amplifier		PRMLxT1	36007	
Microphone		377BO2	153565	
Sound Level Meter	Larson Davis	Model Lxt1	5817	01/2023
Pre-Amplifier		PRMLxT1	55725	
Microphone		377BO2	310663	
Calibrator	Larson Davis	Cal 200	17574	01/2022

Figure 4.1: Noise Monitoring Locations

4.1.4 The weather conditions during the survey were generally influenced by low speed winds with varying direction. The average daily temperature stayed between 12 and 18 °C for the whole survey period, there was rain on the first four days. Average wind speeds for the monitoring period were below 5 m/s.

4.1.5 The information provided in Table 4.2, uses data from Weather Underground. The weather station is located to the west of the proposed site on Weights Lane (Station ID: IREDDI8).

Table 4.2: Summary of Weather Conditions

Date	Temp (°C)	Wind Speed (m/s)		Wind Direction	Total Precipitation (mm)
		Average	Peak		
17/06/21	17.7	0.8	4.5	NNW	1.52
18/06/21	13.4	0.9	6.2	NNE	7.37
19/06/21	14.2	0.9	6.9	ESE	3.05
20/06/21	12.5	1.1	4.4	East	2.29
21/06/21	12.9	1.3	8.5	NE	0.00
22/06/21	13.8	0.9	5.9	NE	0.00
23/06/21	15.7	0.7	4.4	NW	0.00

4.2 Noise Survey Results

4.2.1 A summary of the long-term monitored noise levels is presented in Table 4.3 and Table 4.4, for L1 in the western part of the site, illustrated in Figure 4.1. The data is presented as an average for the day and night periods but also as a range of the measured 15-minute sound indices during these periods.

Table 4.3: Noise Monitoring Results – L1, West, unattended long-term

Date	Period	Average Monitored Noise Levels (dBA)					
		L_{Aeq}	L_{AE}	L_{AFmin}	L_{AFmax}	L_{A10}	L_{A90}
17/06/21	Day 07:00 - 23:00*	48.7	78.2	40.5	67.8	50.2	44.3
	Night 23:00 - 07:00	48.4	77.9	34.8	65.4	52.3	38.9
18/06/21	Day 07:00 - 23:00	51.7	81.2	45.6	68.4	53.2	48.4
	Night 23:00 - 07:00	49.6	79.1	30.6	71.8	51.5	35.3
19/08/21	Day 07:00 - 23:00	46.3	75.9	38.8	65.3	47.6	41.4
	Night 23:00 - 07:00	48.0	77.6	39.7	64.4	51.0	42.1
20/06/21	Day 07:00 - 23:00	47.3	76.8	38.8	68.5	49.3	42.1
	Night 23:00 - 07:00	47.2	76.8	35.6	66.2	50.5	39.4
21/06/21	Day 07:00 - 23:00	48.9	78.4	42.2	62.6	51.0	45.4
	Night 23:00 - 07:00	47.9	77.5	37.1	67.8	50.9	40.5
22/06/21	Day 07:00 - 23:00	57.8	87.4	41.6	72.2	62.0	45.0
	Night 23:00 - 07:00	48.4	77.9	38.0	69.4	50.9	41.9
23/06/21	Day 07:00 - 23:00*	48.6	78.2	42.5	63.9	51.3	45.2
	Night 23:00 - 07:00	-	-	-	-	-	-
Overall	Day 07:00 - 23:00	52.4	81.9	42.1	68.4	55.7	45.1
	Night 23:00 - 07:00	48.3	77.9	36.8	68.3	51.2	40.2

*Based on Partial Data

Table 4.4: Noise Monitoring Results Ranges L1, West, unattended long-term

Date	Period	Range of Monitored Noise Levels (dBA)					
		L_{Aeq}	L_{AE}	L_{AFmin}	L_{AFmax}	L_{AF10}	L_{AF90}
17/06/21	Day 07.00 – 23.00*	44 - 53	73 - 83	31 - 44	52 - 77	46 - 54	37 - 47
	Night 23.00 – 07.00	34 - 59	63 - 89	27 - 44	47 - 76	37 - 64	29 - 47
18/06/21	Day 07.00 – 23.00	45 - 58	74 - 87	34 - 49	55 - 79	47 - 59	38 - 52
	Night 23.00 – 07.00	33 - 58	63 - 88	26 - 35	46 - 83	37 - 62	28 - 40
19/08/21	Day 07.00 – 23.00	41 - 54	71 - 83	32 - 43	50 - 75	44 - 54	37 - 47
	Night 23.00 – 07.00	32 - 56	62 - 85	25 - 49	44 - 72	35 - 61	27 - 50
20/06/21	Day 07.00 – 23.00	39 - 56	68 - 86	30 - 43	51 - 82	42 - 58	33 - 45
	Night 23.00 – 07.00	32 - 58	62 - 88	26 - 45	45 - 77	33 - 62	28 - 48
21/06/21	Day 07.00 – 23.00	44 - 52	73 - 81	33 - 46	54 - 71	47 - 54	37 - 49
	Night 23.00 – 07.00	34 - 58	64 - 87	29 - 45	45 - 77	36 - 61	31 - 48

Date	Period	Range of Monitored Noise Levels (dBA)					
		L_{Aeq}	L_{AE}	L_{AFmin}	L_{AFmax}	L_{AF10}	L_{AF90}
22/06/21	Day 07.00 – 23.00	45 - 74	75 - 104	34 - 46	55 - 85	47 - 79	39 - 50
	Night 23.00 – 07.00	36 - 56	66 - 86	29 - 48	46 - 83	39 - 57	32 - 51
23/06/21	Day 07.00 – 23.00*	46 - 51	76 - 81	39 - 45	56 - 70	49 - 55	42 - 47
	Night 23.00 – 07.00	-	-	-	-	-	-

*Based on Partial Data

4.2.2 A summary of the long term monitored noise levels is presented in Table 4.5 and Table 4.6, for L2 in the northern part of the site, illustrated in Figure 4.1. The data is again presented as an average for the day and night periods but also as a range of the measured 15-minute sound indices during these periods.

Table 4.5: Noise Monitoring Results – L2, North, unattended long-term

Date	Period	Average Monitored Noise Levels (dBA)					
		L_{Aeq}	L_{AE}	L_{AFmin}	L_{AFmax}	L_{A10}	L_{A90}
17/06/21	Day 07.00 – 23.00*	60.0	89.5	37.4	79.3	64.4	42.4
	Night 23.00 – 07.00	54.0	83.6	33.2	72.9	57.8	36.7
18/06/21	Day 07.00 – 23.00	62.9	92.4	42.8	77.6	67.7	46.3
	Night 23.00 – 07.00	52.7	82.3	27.4	73.4	54.4	31.1
19/08/21	Day 07.00 – 23.00	60.1	89.7	36.6	79.9	64.7	40.4
	Night 23.00 – 07.00	54.2	83.7	39.8	74.4	55.0	41.6
20/06/21	Day 07.00 – 23.00	59.9	89.5	35.1	77.2	64.8	40.2
	Night 23.00 – 07.00	54.3	83.8	32.9	73.1	58.2	36.1
21/06/21	Day 07.00 – 23.00	61.1	90.6	38.8	77.8	65.7	43.3
	Night 23.00 – 07.00	56.3	85.9	35.2	74.2	60.6	37.9
22/06/21	Day 07.00 – 23.00	61.7	91.3	38.3	86.1	65.6	42.9
	Night 23.00 – 07.00	55.0	84.5	32.2	80.1	49.6	35.8
Overall	Day 07.00 – 23.00	61.2	90.7	39.0	81.2	65.8	43.2
	Night 23.00 – 07.00	54.5	84.0	35.4	74.0	57.7	37.9

*Based on Partial Data

Table 4.6: Noise Monitoring Results Ranges – L2, North, unattended long-term

Date	Period	Range of Monitored Noise Levels (dBA)					
		L_{Aeq}	L_{AE}	L_{AFmin}	L_{AFmax}	L_{AF10}	L_{AF90}
17/06/21	Day 07.00 – 23.00*	55 - 63	84 - 92	31 - 40	72 - 90	56 - 67	35 - 48
	Night 23.00 – 07.00	31 - 61	61 - 91	25 - 42	43 - 80	33 - 67	27 - 45
18/06/21	Day 07.00 – 23.00	54 - 66	83 - 95	32 - 48	72 - 86	53 - 70	34 - 50
	Night 23.00 – 07.00	28 - 59	58 - 88	23 - 31	39 - 79	30 - 64	25 - 35
19/08/21	Day 07.00 – 23.00	54 - 64	83 - 93	29 - 43	72 - 90	55 - 67	33 - 45
	Night 23.00 – 07.00	31 - 59	60 - 89	23 - 48	48 - 81	33 - 62	26 - 49

Date	Period	Range of Monitored Noise Levels (dBA)					
		L_{Aeq}	L_{AE}	L_{AFmin}	L_{AFmax}	L_{AF10}	L_{AF90}
20/06/21	Day 07.00 – 23.00	52 - 63	81 - 92	28 - 39	71 - 88	48 - 68	30 - 44
	Night 23.00 – 07.00	29 - 62	58 - 91	24 - 41	37 - 81	31 - 67	27 - 44
21/06/21	Day 07.00 – 23.00	54 - 64	84 - 94	32 - 43	72 - 88	53 - 69	35 - 47
	Night 23.00 – 07.00	32 - 64	61 - 93	28 - 43	41 - 84	34 - 68	30 - 46
22/06/21	Day 07.00 – 23.00	55 - 71	84 - 100	30 - 46	72 - 102	55 - 69	34 - 49
	Night 23.00 – 07.00	53 - 58	83 - 87	28 - 35	72 - 85	44 - 51	33 - 39

*Based on Partial Data

4.2.3 Sound levels across the site were observed to be dominated by road traffic noise on the B4101 and the A441, this was especially true at L2, which was closest to the B4101. At L1 the road traffic noise was less loud but still dominant, nothing could be heard from the restaurant and hotel.

4.2.4 Time history graphs for all of the monitoring positions are given in Appendix E and include the L_{Aeq}, L_{A90} and L_{AFmax} for each 15-minute period.

4.3 Maximum Night-time Noise Events

4.3.1 For each monitoring location the 15th highest L_{AFmax} noise event during the night-time has been identified. This data will contribute to the assessment of night-time L_{AFmax} noise events that have the potential to cause sleep disturbance.

4.3.2 The monitoring locations were both close to trees and bushes and are likely to contain wildlife and therefore be affected by the dawn chorus, which starts approximately 30 mins before sunrise and lasts for approximately one hour, sunrise during the survey was at 04:45. In the context of this report noise from the natural environment is not considered a cause of sleep disturbance so the dawn chorus period has been removed. The period removed is 04:05 – 05:25.

Table 4.7: Fifteenth Highest L_{AFmax} Night-time Noise Event Per Night

Date	15th Highest L_{AFmax} Night-time Noise Level (dBA)	
	L1	L2
17/06/21	60.4	73.6
18/06/21	65.7	72.7
19/06/21	61.3	74.5
20/06/21	59.8	73.1
21/06/21	70.6	76.1
22/06/21	65.1	70.2
Overall	70.6	76.1

4.3.3 The maximum noise levels for each night were higher at L2, which was closer to the B4101, this suggests that road traffic on the B4101 is likely to have been the source of the night-time maximum noise levels at this location.

4.3.4 At L1 the levels are higher than would be expected from road traffic on the B4101 and are likely to have been influenced by the hotel and restaurant and nearby wildlife. The level measured on the night of the

21st June is considerably higher than other measurements but has still been included because it may be associated with a once weekly event at the hotel and restaurant like bin collections or deliveries.

5 Construction Impact Assessment

5.1.1 At this stage of the scheme, details regarding the construction traffic movements and the type, number and size of construction equipment are not available. Therefore, it is not possible to predict, with any great degree of accuracy, the possible effects arising from construction activities associated with the site.

5.1.2 For the purposes of a generic construction noise assessment, the associated works can be divided into three main phases:

- Earthworks;
- Concreting; and
- Main build.

5.1.3 On weekdays, typical construction working hours are anticipated to be 07:30 – 17:30, and potentially 07:00 – 18:30 in the summer months. On Saturdays, working hours are expected to be between 07:30 and 13:00 hours. Work on Sundays/Bank Holidays will only take place in exceptional circumstances. The demolition and construction work will be carried out under the Considerate Constructors Scheme, which, as one of its objectives, aims to reduce adverse noise impacts on nearby residents.

5.1.4 During the construction phase, there would be a slight increase in HGV movements on the surrounding highway network. However, this will be a temporary impact and will decrease as the development progresses towards completion.

5.1.5 Overall, based on the experienced gained from similar sites, and on the existing ambient noise levels at the closest residential receptors, it is anticipated that although the main construction phases may be audible at times, they will result in no more than a minor adverse impact, only during the daytime. It should also be noted that this effect will only be temporary, whilst the construction phase(s) are moving forward.

5.1.6 Following the BS 5228-1:2009+A1:2014 ABC classification method, during the daytime working hours mentioned above, the nearby sensitive receptors would fall into Category A, with a threshold noise level criteria of 65 dB(A) during the daytime.

6 Operational Impact Assessment

6.1 Operational Road Traffic Noise

6.1.1 The potential adverse effects from changes in road traffic noise have been assessed by considering the increase in traffic volume resulting from the proposed development operating at full capacity for the daytime period.

6.1.2 The increases are based on the traffic flow predictions provided by the transport consultants for the project, the data used is reproduced in Appendix B.

6.1.3 The access point for the site is in Hither Green Lane, to the east of the site.

6.1.4 The basic noise level (BNL) calculation results for each section of highway close to the proposed development, are presented in Table 6.1. The existing scenario is the baseline flow levels for 2021 and the future scenario is the predicted opening year of 2027.

Table 6.1: Basic Noise Level Calculation

Road Designation	Existing BNL (dBA)	Future BNL (dBA)	Change in BNL (dB)
B4101 (East of Hither Green Lane)	69.6	69.7	+0.1
B4101 (West of Hither Green Lane)	70.1	70.2	+0.1
Hither Green Lane	56.0	56.3	+0.3
A441	71.1	71.2	+0.1

6.1.5 The predicted change in BNL for the roads are an increase between 0.1 dB and 0.3 dB which is negligible according to the DMRB guidance in Table 3.2.

6.2 Operational Development (Internal Noise Levels)

6.2.1 This assessment considers the impacts of the existing ambient noise levels on the noise sensitive receptors contained in the consented development. The receptors presented are a sample of the façades most exposed to the existing noise sources, predictions for all receptors are provided in Appendix D.

6.2.2 The predicted façade noise levels at each of the assessment receptors are presented in Table 6.2, the daytime, night-time and night-time maximum noise levels have been presented. The levels have been compared against the relevant BS 8233:2014 and WHO criteria levels for living rooms and bedrooms. A summary of sound level criteria is provided below:

- Living rooms (daytime) $L_{Aeq,T}$ 35 dB(A);
- Bedrooms (daytime) $L_{Aeq,T}$ 35 dB(A);
- Bedrooms (night-time) $L_{Aeq,T}$ 30 dB(A);
- Bedrooms (night-time) L_{AFmax} 45 dB(A); and
- Outdoor amenity areas $L_{Aeq,1hr}$ 55 dB(A).

6.2.3 The colours in the final column of Table 6.2 show the overall level of façade mitigation that will be required, green is no mitigation, orange is closed windows and alternative ventilation and red is acoustic glazing to a specific level with alternative ventilation.

Table 6.2: Façade Noise Level Predictions

Receptor ID	Predicted Façade Noise Level (dBA)			Required Mitigation	
	Daytime $L_{Aeq,16hour}$	Night-time $L_{Aeq,8hour}$	Night-time Maximum L_{AFmax}	Level Difference (dBA)	Class
R01 GF	50.5	41.0	46.0	15.5	
R01 1F	52.4	43.0	48.0	17.4	
R02 GF	50.4	41.0	51.9	15.4	
R02 1F	52.5	43.1	54.3	17.5	
R03 GF	51.3	42.3	69.4	24.4	
R03 1F	52.9	43.9	69.7	24.7	
R04 GF	50.2	41.1	66.8	21.8	
R04 1F	52.2	43.1	67.3	22.3	
R05 GF	51.5	44.2	66.6	21.6	
R05 1F	53.8	46.5	68.2	23.2	
R06 GF	58.8	52.2	75.3	30.3	
R06 1F	61.1	54.5	76.5	31.5	
R07 GF	56.9	50.4	73.5	28.5	
R07 1F	59.3	52.8	74.9	29.9	
R08 GF	54.5	47.9	70.5	25.5	
R08 1F	58.6	52.0	74.2	29.2	
R09 GF	52.6	46.0	68.0	23.0	
R09 1F	57.2	50.6	72.7	27.7	
R10 GF	54.3	47.7	68.8	23.8	
R10 1F	59.1	52.6	74.8	29.8	
R11 GF	50.2	43.7	65.2	20.2	
R11 1F	56.1	49.6	71.9	26.9	
R12 GF	51.7	45.0	67.9	22.9	
R12 1F	54.1	47.3	69.6	24.6	
R13 GF	46.7	39.8	63.0	18.0	
R13 1F	49.4	42.7	64.9	19.9	

6.2.4 The worst case predicted daytime $L_{Aeq,16hr}$ is 61.1 dB(A) which represents an internal daytime (with a partially open window) level of 46.1 dB(A), which is 11.1 dB(A) above the allowed daytime value of 35 dB(A).

6.2.5 The worst-case predicted night-time $L_{Aeq,8hour}$ is 54.5 dB(A), which represents an internal night-time (with a partially open window) level of 39.5 dB(A), which is 9.5 dB(A) above the allowed night-time value of 30 dB(A).

6.2.6 The worst-case predicted night-time L_{AFmax} is 76.5 dB(A), which represents an internal night-time (with a partially open window) maximum event level of 61.5 dB(A), which is 16.5 dB(A) above the allowed night-time maximum event level of 45 dB(A).

6.2.7 The column displaying the level difference for each receptor shows the level of noise reduction that will need to be provided to ensure internal noise levels are less than the values in Table 3.9. A value of less than +15 dB suggests that the internal noise level criteria will be met for that receptor during all three scenarios (daytime, night-time and night-time maximum) with a partially open window providing a 15 dB reduction.

6.2.8 It should be noted that internal noise levels only need to be controlled in normally occupied rooms, it is not a requirement to protect unoccupied rooms such as utility spaces and toilets from noise.

6.2.9 The specific mitigation requirements are discussed in Section 7.

6.3 Acoustics Ventilation and Overheating

6.3.1 The acoustics ventilation and overheating guide provides guidance on the conflicting requirements of suitable internal noise levels and overheating in residential properties and can be applied to external sources of transport noise or mechanical services serving the dwelling.

6.3.2 The internal noise levels outlined in Table 3.9 should be achieved when providing adequate ventilation as defined by Approved Document F whole dwelling ventilation. It can be reasonable to allow higher levels of internal noise when higher rates of ventilation are required during the overheating condition.

6.3.3 During the overheating condition it may be appropriate to allow internal noise levels above the LOAEL, however noise levels should not be allowed above the SOAEL. In this situation the SOAEL would change depending on how often the overheating condition occurs. If the overheating condition occurs regularly then internal noise levels may only be relaxed by a maximum of 5 dB, which may increase as the overheating condition occurs less frequently. Figure 3.1 shows this graphically and is taken from the AVO guide.

6.3.4 A minority of properties are predicted to require mitigation to ensure internal noise levels are suitable, this may be through the use of closed windows and alternative ventilation. For the proposed properties closest to the sources of noise it may not be possible to rely on windows for cooling during the overheating condition but will depend on the frequency with which this type of cooling may be required. However, the majority of properties will not require any mitigation of noise levels and will be able to rely on open windows for cooling during the overheating condition.

6.4 Operational Development (External Amenity Noise Levels)

6.4.1 Figure C.4 in Appendix C displays noise contours showing the predicted noise levels in external amenity areas compared with the desirable criterion level of 50 dB(A) $L_{Aeq,1hr}$ or the upper guideline criterion level of 55 dB(A) $L_{Aeq,1hr}$.

6.4.2 The figure shows that 17 external amenity areas are predicted to exceed the upper guideline limit of 55 dB(A), with the highest predicted level being 60.3 dB(A). These external amenity areas are close to the B4101 and are not afforded protection by any of the proposed houses.

7 Mitigation Measures

7.1 Construction

7.1.1 Operators should be properly trained in the use of equipment, made aware of any noise mitigation requirements, and where necessary, be supervised so that reasonable care is taken to minimise their noise impact. BS 5228-1:2009+A1:2014 provides advice on minimising noise from construction activities.

7.1.2 The construction phase of the development may be controlled with a Construction Environmental management Plan (CEMP) which the contractor should regularly brief the construction staff on, so that they are considerate of the surrounding residents and operate the construction plant in a manner which controls noise (where practicable). Once the exact construction methods and plant to be employed are confirmed, any specific mitigation measures will be identified. Such measures could include, but are not limited to:

- Avoidance of the use of horns and excessive revving of engines;
- Vehicles, generators, concrete pumps, air compressors and other constant noise sources being turned off when not required, or at least throttled back to a minimum;
- Plant to operate at low speeds, where possible, and incorporate automatic low speed idling;
- Selection of 'silenced' plant and equipment where practicable;
- Locating noisy plant and equipment as far away from sensitive receptors as reasonably possible;
- Reducing impulsive noise generating activities such as slamming doors, noisy brakes, impacts etc.;
- Screening either in the form of localised temporary acoustic fencing where the distances between source and receptor cannot be managed, or on the site boundary; and
- All plant being properly maintained (greased, blown silencers replaced, saws kept sharpened, teeth set and blades flat, worn bearings replaced, etc.).

7.2 Operational Mitigation (Internal Noise Levels)

7.2.1 Daytime internal sound levels for the worst-case units, closest to the B4101, would exceed the allowed internal noise levels by up to 16.5 dB(A), with open windows. Therefore, the majority of the proposed residential properties closest to the B4101 and a small number closest to the A441 will require closed windows under normal operation along with suitable alternative ventilation. A small number will also require acoustic glazing of up to 32 dB $R_w + C_{tr}$. This generally only applies to the facades facing the road traffic noise sources, façades facing away will experience lower noise levels and will generally experience suitable internal noise levels.

7.2.2 A small number of properties adjacent to the Meadow Farm Inn will also require closed windows under normal operation to protect from noise levels associated with the movement of vehicles in the car park.

7.2.3 A scheme of the noise mitigation requirements by façade is provided in Appendix D.

7.2.4 Table 7.1, provides examples of enhanced glazing specifications that could achieve the required attenuation and demonstrates that the required attenuation values are realistically achievable.

Table 7.1: Weighted Sound Reduction Index for Different Glazing Configurations

Example Configuration	Insertion Loss (dB)							R_w+C_{tr}
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	
4 mm/16 mm/8mm	-	25	22	32	41	45	46	30
4 mm/16 mm/10mm	-	27	23	33	41	48	51	31
10 mm/16 mm/6mm	-	24	24	32	37	37	44	32
6 mm/16 mm/9.5 laminated	-	24	26	39	45	42	50	33
8 mm/16 mm/8.8 laminated	-	24	31	40	49	51	63	35
8 mm/16 mm/10.8 laminated	-	24	31	41	46	46	59	36
8 mm/16 mm/12.8 laminated	-	25	34	41	44	46	62	37

7.2.5 As the sound reduction performance of glazing systems can vary from manufacturer to manufacturer, the actual sound reduction performance of the chosen glazing system should first be confirmed with the glazing system supplier.

7.2.6 The noise levels across the site are dominated by road traffic so any specification for the acoustic performance of glazing should include the road traffic correction + C_{tr}.

7.2.7 Background ventilation must be provided in accordance with the Building Regulations Approved Document F. To achieve this, window mounted trickle vents, or through-wall ventilators that are acoustically attenuated to provide an equivalent sound reduction to the glazing, may be installed.

7.2.8 The sound reduction performance of acoustic ventilators is usually specified as a $D_{n,e,w}$ rating. If passive ventilation (window mounted or through-wall) is to be installed, in order to provide a sound reduction equivalent to that of the specified glazing, the $D_{n,e,w}$ value of the vent (when open) should be at least 7 dB higher than the specified sound insulation of the glazing.

7.2.9 Examples of the sound reductions that can be provided by different window and through-wall passive vents are shown in Table 7.2.

Table 7.2: Example Sound Insulation Data for Acoustic Passive Ventilators

Model	Sound Reduction Index for Passive Ventilators		
	Glazing (R_W)	Vent Open ($D_{n,e,w}$)	Vent Closed ($D_{n,e,w}$)
Standard non-acoustic trickle vent	-	23	~40
Titon SF Xtra V25 + Standard Canopy	-	35	~50
Titon SF Xtra Sound Attenuator V25 + C25	30	36	55
Titon SF Xtra Sound Attenuator V75 + Standard Canopy	36	40	53

7.2.10 The sound insulation performance of the external building fabric must be at least that of any specified glazing and ventilation system. Furthermore, the glazing attenuation specified previously must be achieved by the glazing system as a whole and include all framing and furniture.

7.3 Operational Development (External Amenity Noise Levels)

7.3.1 The external amenity areas that are located closest to the B4101 are predicted to experience noise levels in excess of the 55 dB(A) $L_{Aeq,1hour}$. Mitigation for the external amenity areas can be in the form of either noise barriers or landscaped bunds located at the ends of each of the gardens.

7.3.2 The specification for all of the noise barriers is provided below:

- Minimum of 1.8 m high;
- No gaps or holes in the barrier, below the barrier or between panels; and
- Minimum surface density of 12 kg/m^2

8 Summary & Conclusions

8.1 Baseline

8.1.1 The existing noise climate at the site is dominated by traffic on the nearby B4101 road with minor additions from the A441 and the car park of the Meadow Farm Inn.

8.1.2 The baseline noise environment at the proposed site has been established with a baseline noise survey. The survey consisted of two unattended measurements over a 7-day period.

8.2 Construction Phase

8.2.1 The specific details of the construction methodology are not known at this stage; however, the potential construction impacts have been considered, based upon the nature and scale of the consented development, and appropriate mitigation measures have been given.

8.2.2 Assuming the appropriate mitigation measure are employed, the potential construction impacts can be minimised, to the point that any adverse impacts will be temporary in nature and result in the LOAEL in terms of potential impacts.

8.3 Operational Phase

8.3.1 The operational noise levels have been predicted using a CadnaA noise propagation model, to allow for a comparative assessment, in line with the relevant British Standards, Guidance documents and Planning Policy.

8.3.2 The assessment has undertaken predictive modelling of the potential noise impacts from the existing noise environment. The predictions show that under reasonable worst-case conditions the most exposed properties closest to the B4101, A441 and the Meadow Farm Inn have the potential to exceed the BS8233 and WHO criteria for internal noise levels.

8.3.3 For the worst affected properties the internal noise level criteria can be met with a suitable glazing and ventilation strategy that does not rely on open windows under normal conditions. Predictions show that most of the external amenity spaces associated the properties will be exposed to less than 55 dB(A) and the majority will be exposed to less than 50 dB(A). Noise barriers will be required in order to reduce external amenity noise levels to suitable levels in 17 external amenity areas.

8.3.4 With the inclusion of the proposed mitigation measures the potential for adverse impacts is considered to be low this would also represent NOEL to LOAEL.

APPENDICES

APPENDIX A – DEFINITION OF TERMS

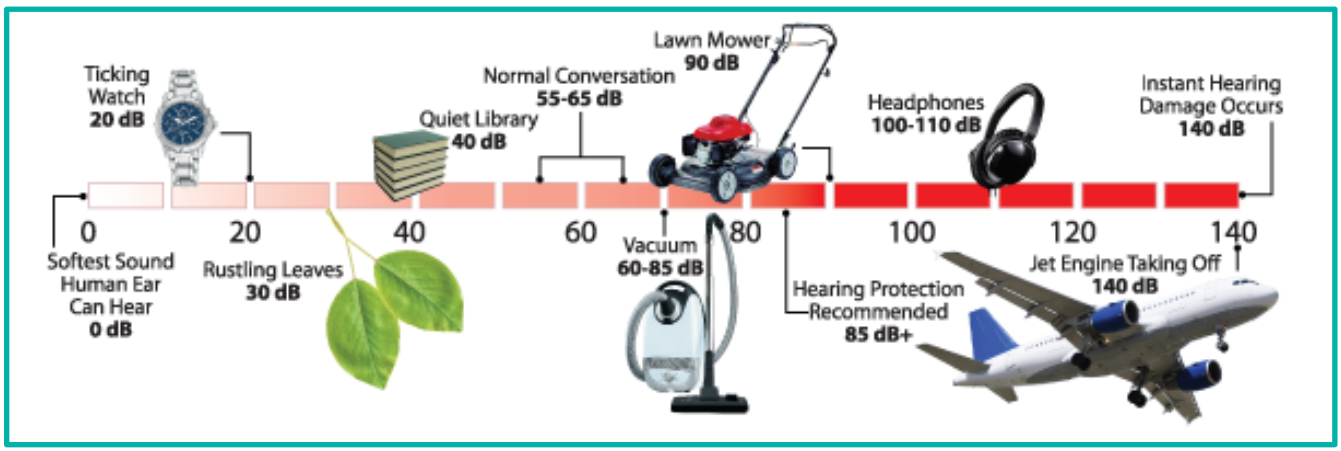
Sound Pressure - Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.

Sound Pressure Level - The sound level is the sound pressure relative to a standard reference pressure of 20 μPa ($2x10^{-5}$ Pascals) on a decibel scale.

Decibels dB - Noise is commonly defined as unwanted sound. The range of audible sound is from 0 dB to 140 dB, which is taken to be the threshold of pain. The sound pressure detected by the human ear covers an extremely wide range. The decibel (dB) is used to condense this range into a manageable scale by taking the logarithm of the ratio of the sound pressure and a reference sound pressure.

The decibel scale is logarithmic and therefore when two noise sources are present together, they must be combined logarithmically, therefore, when two sound sources of the same sound pressure level are combined the resultant level is 3dB(A) higher than the single source. However, in subjective terms the ear can distinguish a difference in 'loudness' between two simple noises sources when there is a 3dB(A) difference between them. I emphasis, loudness, not a measure of annoyance. Again, for simple sources, when two sounds differ by 10dB(A) one is said to be twice as loud as the other.

Figure A.1: Examples of Typical Noise Levels



Noise Level Indices - Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.

'A' Weighted Decibels dB(A) - The frequency response of the ear is usually taken to be about 18Hz (number of oscillations per second) to 18,000Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than at the lower and higher frequencies, and because of this, the low and high frequency component of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most used, and which correlates best with the subjective response to noise, including that of music, is the dB(A) weighting. This electronic filter matches the variation in the frequency sensitivity of the meter to that of the human ear. This is an internationally accepted standard for noise measurements.

Table A.1: Other Standard Noise Units:

Symbol	Name	Definition
$L_{Aeq,T}$	Equivalent Continuous Sound Level	The A-weighted sound pressure level of a steady sound that has, over a given period, the same energy as the fluctuating sound under investigation. The LAeq provides a single value to express the average sound energy over the measurement period and is the most widely used indicator for environmental noise.
$L_{Amax,T}$	maximum 'A' weighted noise level	This is the maximum 'A' weighted noise level recorded during the measurement period, (T).

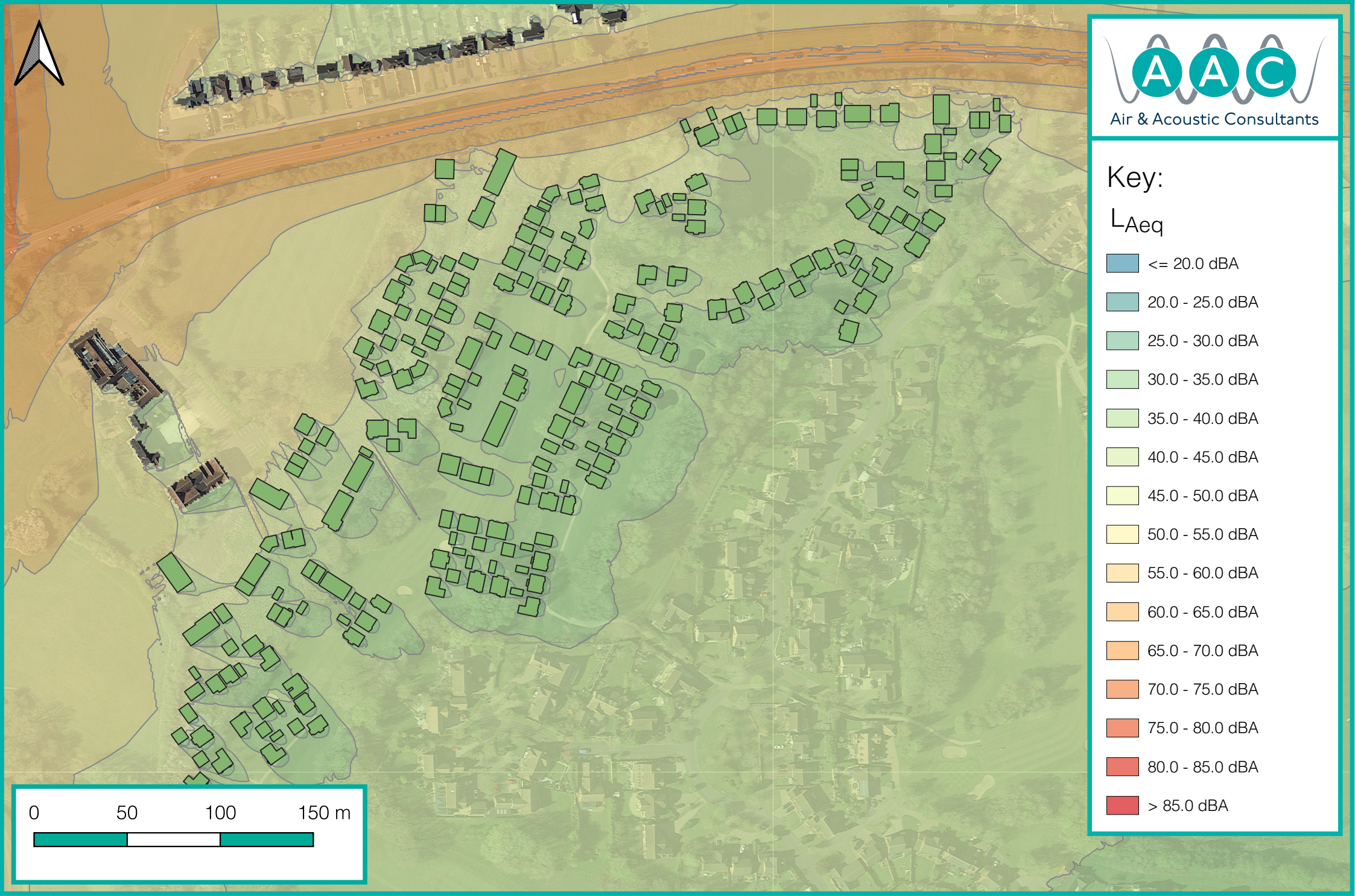
Symbol	Name	Definition
$L_{A90,T}$	the 'A' weighted noise level	This is the 'A' weighted noise level exceeded for 90% of the measurement period (T). This is normally used to describe the background noise.
$L_{A10,T}$	the 'A' weighted noise level exceeded for just 10 % of time	This is the 'A' weighted noise level exceeded for just 10 % of the measurement period, (T). This is normally used to describe traffic noise.
$L_{A90,T}$	the 'A' weighted noise level exceeded for just 90 % of time	A noise level index. The noise level exceeded for 90% of the time over the period T. L90, can be considered to be the "average minimum" noise level and is often used to describe the background noise.
L_S	Specific noise level.	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.
$L_{Ar,Tr}$	Rating noise level	The specific noise level plus any adjustments for characteristic features of the noise.
$D_{n,c,w}$	Laboratory Insulation Rating	A single-number rating of the laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it.
$D_{nf,w}$	Weighted normalised flanking level difference	A single-number that quantifies the in-situ airborne sound insulation between rooms, when the transmission only occurs through a specified flanking path.
$D_{nT,w}$	Weighted standardized level difference	Single-number quantity that characterizes the in-situ airborne sound insulation between rooms.
R_w	Weighted sound reduction index.	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies in a laboratory.
C_{tr}		Correction term applied against the sound insulation single-number values (R_w, D_w and $D_{nT,w}$) to provide a weighting against low frequency performance.
NOEL	No Observed Effect Level	Noise Policy Statement for England (2010) - The noise 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	Noise Policy Statement for England (2010) - The noise level above which adverse effects on health and quality of life can be detected.
SOAEL	Significant Observed Adverse Effect	Noise Policy Statement for England (2010) - The noise level above which significant adverse effects on health and quality of life occur.

APPENDIX B – TRAFFIC DATA

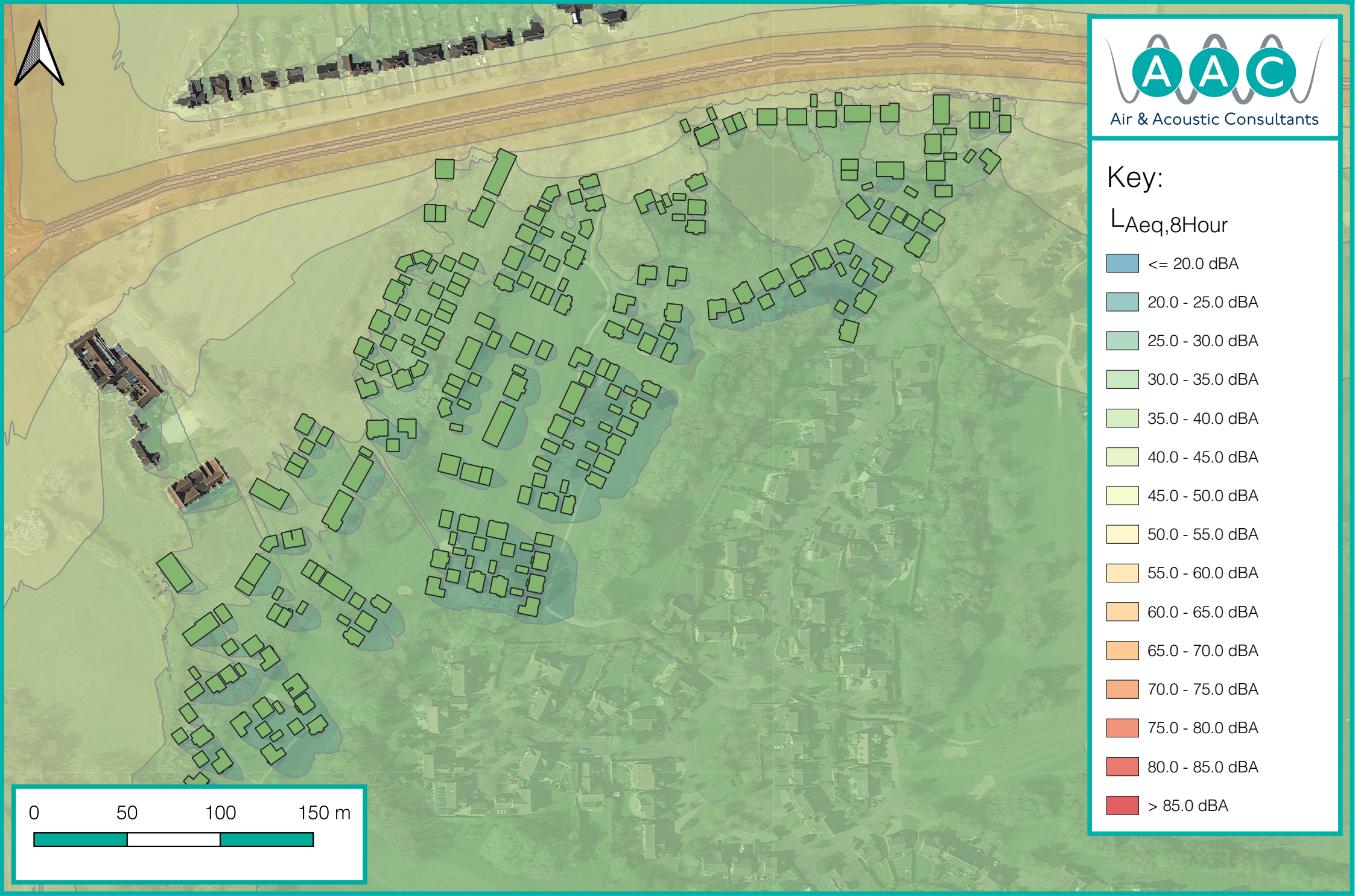
Link Number	Link Name	Posted Speed Limit (mph)	2021 Base 18 Hr AAWT			2022 Base 18 Hr (Opening Year)		
			Total	HGV	HGV %	Total	HGV	HGV %
1	A441 (north of Dagnell End Road)	40	-	-	-	-	-	-
2	Dagnell End Road (east of A441)	40	-	-	-	-	-	-
3	Dagnell End Road (west of Hither Green Lane)	60	7607	69	0.9%	7661	69	0.9%
4	Dagnell End Road (east of Hither Green Lane)	60	6770	74	1.1%	6818	74	1.1%
5	Hither Green Lane (south of Dagnell End Road)	30	1425	15	1.1%	1435	15	1.0%
6	Hither Green Lane (north of site access)	30	1425	15	1.1%	1435	15	1.0%
7	Site Access	30	-	-	-	-	-	-
8	Hither Green Lane (south of site access)	30	1425	15	1.1%	1435	15	1.0%
9	A441 (south of Dagnell End Road)	40	-	-	-	-	-	-
10	A441 (north of Weights Lane/A441 roundabout)	40	21207	476	2.2%	21357	480	2.2%
11	Weights Lane	40	5246	98	1.9%	5284	99	1.9%
12	Odell Street	30	1362	30	2.2%	1372	30	2.2%
13	A441 (south of Weights Lane/A441 roundabout)	40	20836	574	2.8%	20984	578	2.8%
14	A441 (north of Middlehouse Lane/A441 roundabout)	30	20794	597	2.9%	20942	601	2.9%
15	Middlehouse Lane	30	18214	501	2.8%	18343	505	2.8%
16	Retail Access	30	5568	45	0.8%	5608	46	0.8%
17	A441 (south of Middlehouse Lane/A441 roundabout)	40	24526	496	2.0%	24700	500	2.0%
18	Millrace Road	30	7363	50	0.7%	7415	50	0.7%
19	A441 (north of Redditch Ringway)	40	-	-	-	-	-	-
20	Redditch Ringway	40	-	-	-	-	-	-
21	A441 (south of Redditch Ringway)	40	-	-	-	-	-	-
22	A441(north of A4023)	40	24754	469	1.9%	24970	473	1.9%
23	A441(south of A4023)	70	33449	581	1.7%	33740	586	1.7%

APPENDIX C – NOISE CONTOURS

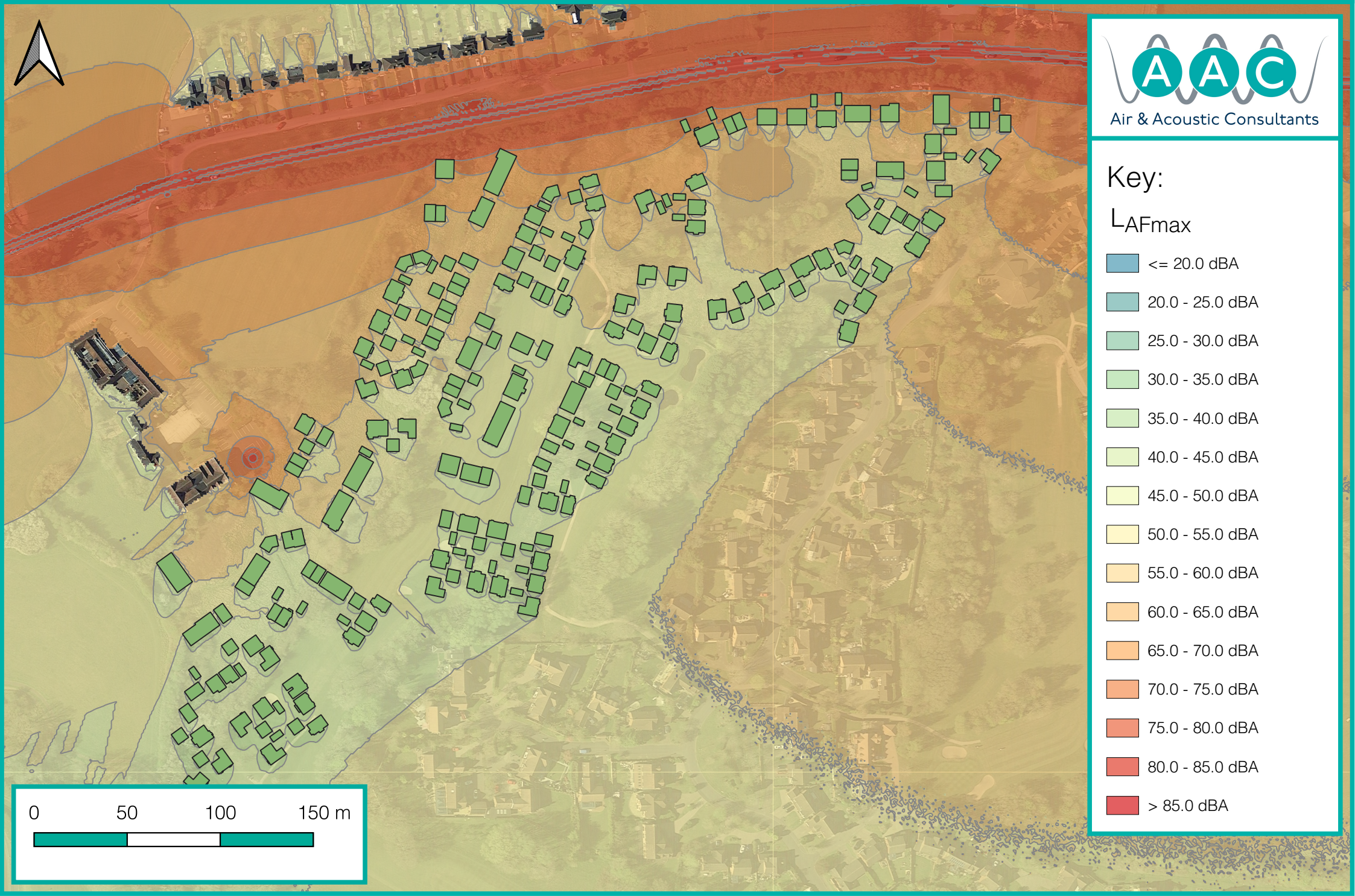
Daytime 07:00-23:00 Noise Contours C.1



Night-time 23:00-07:00 Noise Contours C.2



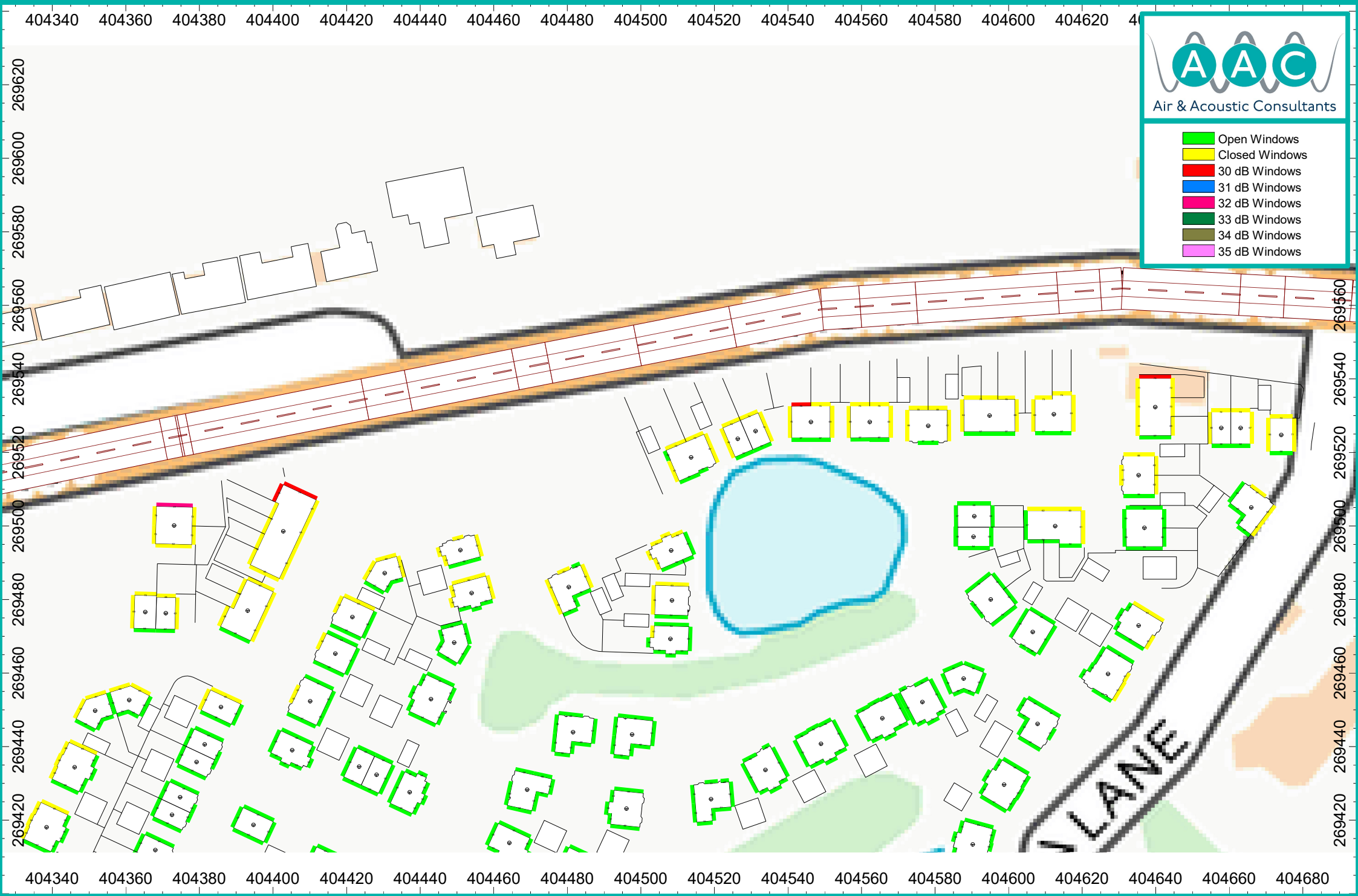
Night-time Maximum 23:00-07:00 Noise Contours C.3



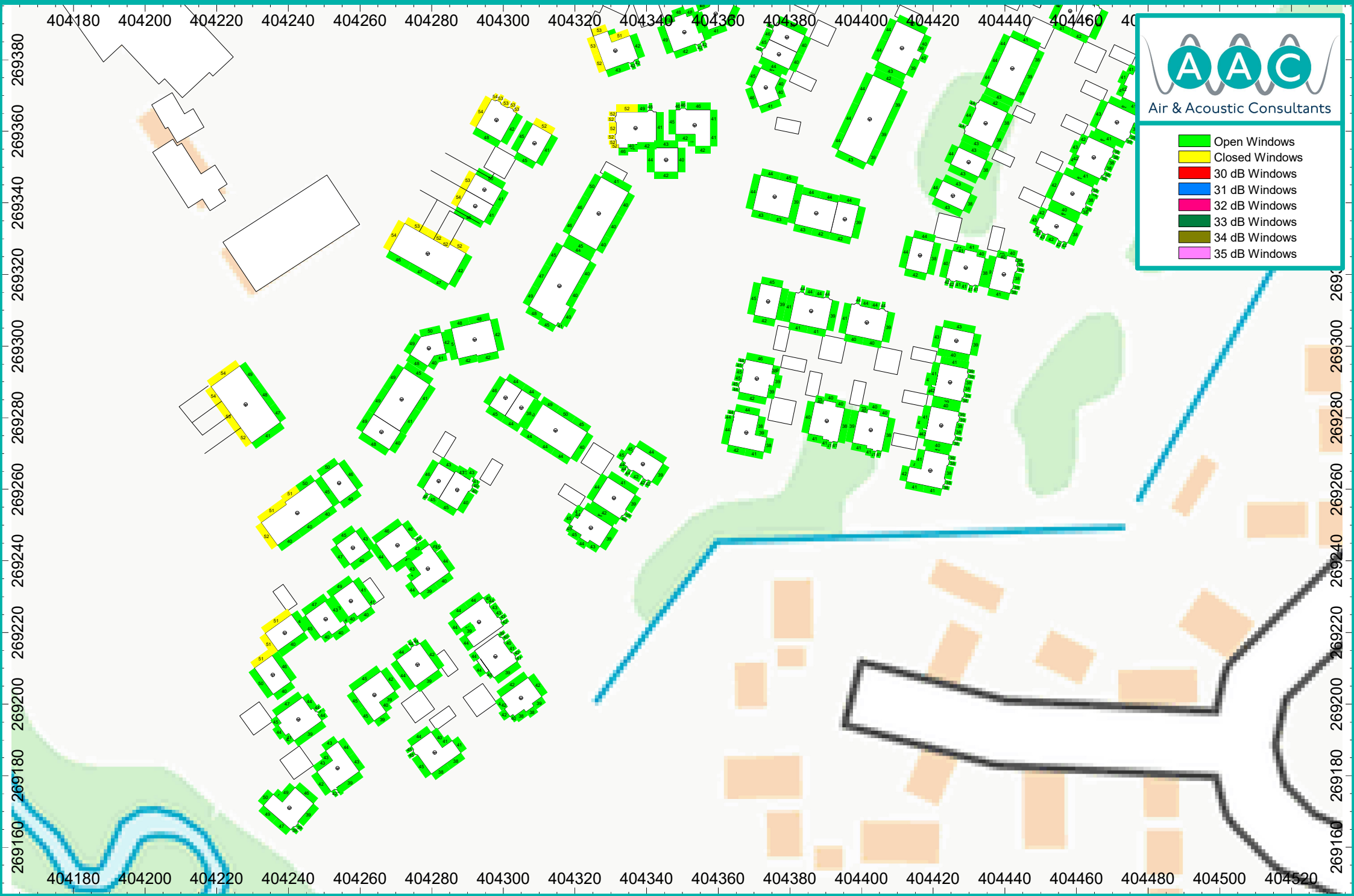
External Amenity Noise Contours C.4

APPENDIX D – NOISE MITIGATION SCHEME

Facade Sound Insulation Schedule North D.1



Facade Sound Insulation Schedule South D.2



Barrier Mitigation D.3

APPENDIX E – NOISE MONITORING TIME HISTORIES

Time History Graph E.1

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	17/06/2021

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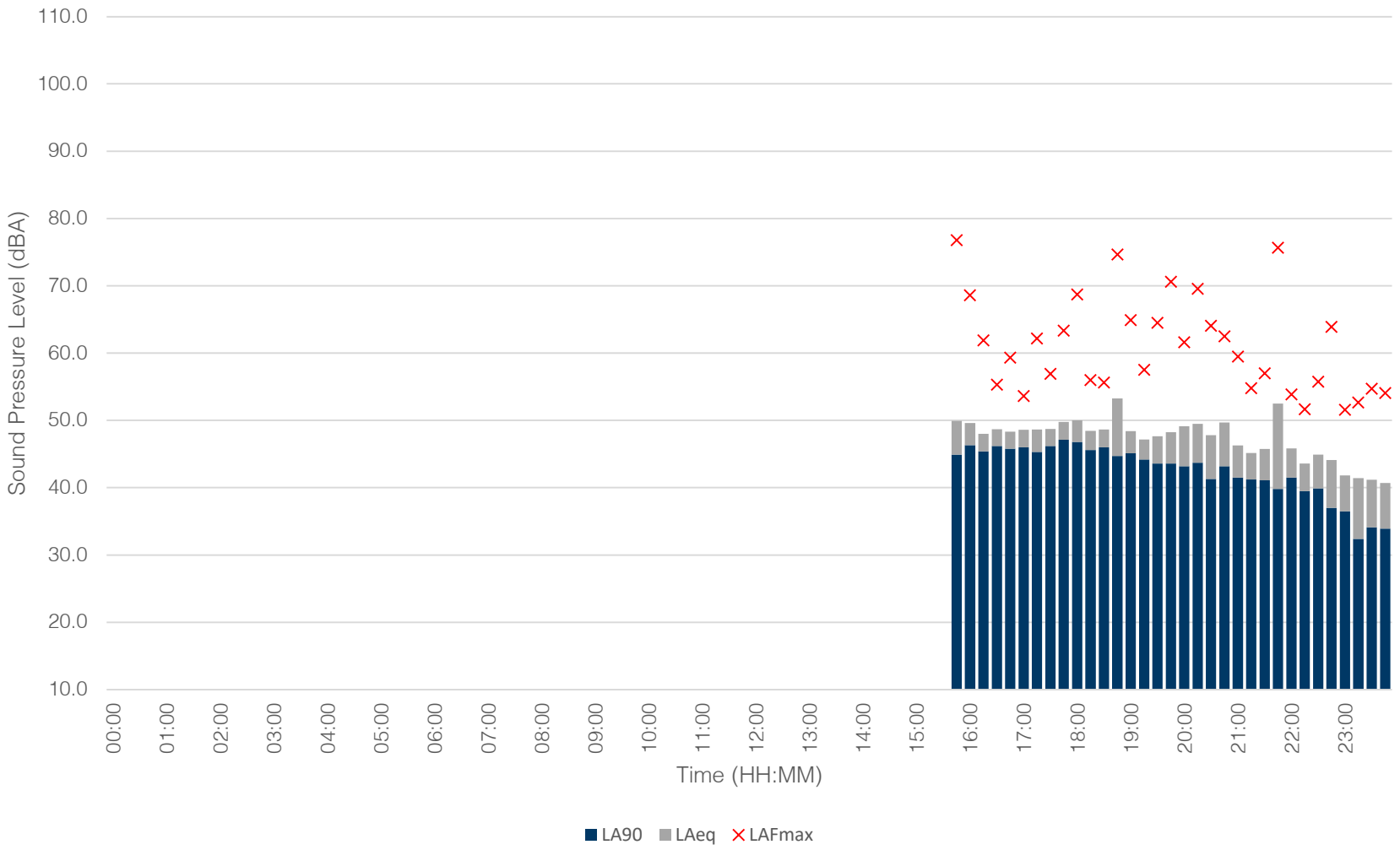
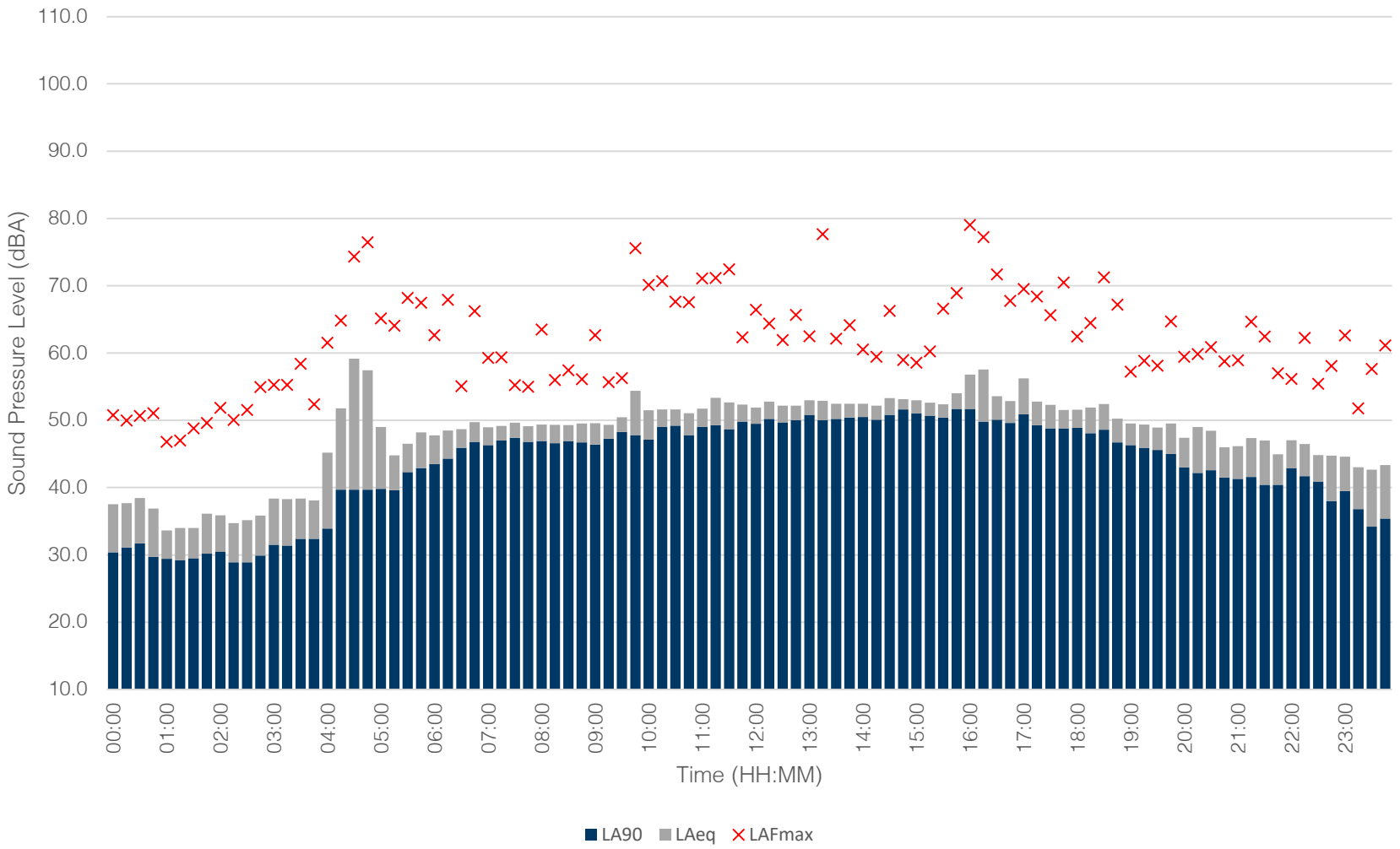


Time History Graph E.2

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	18/06/2021

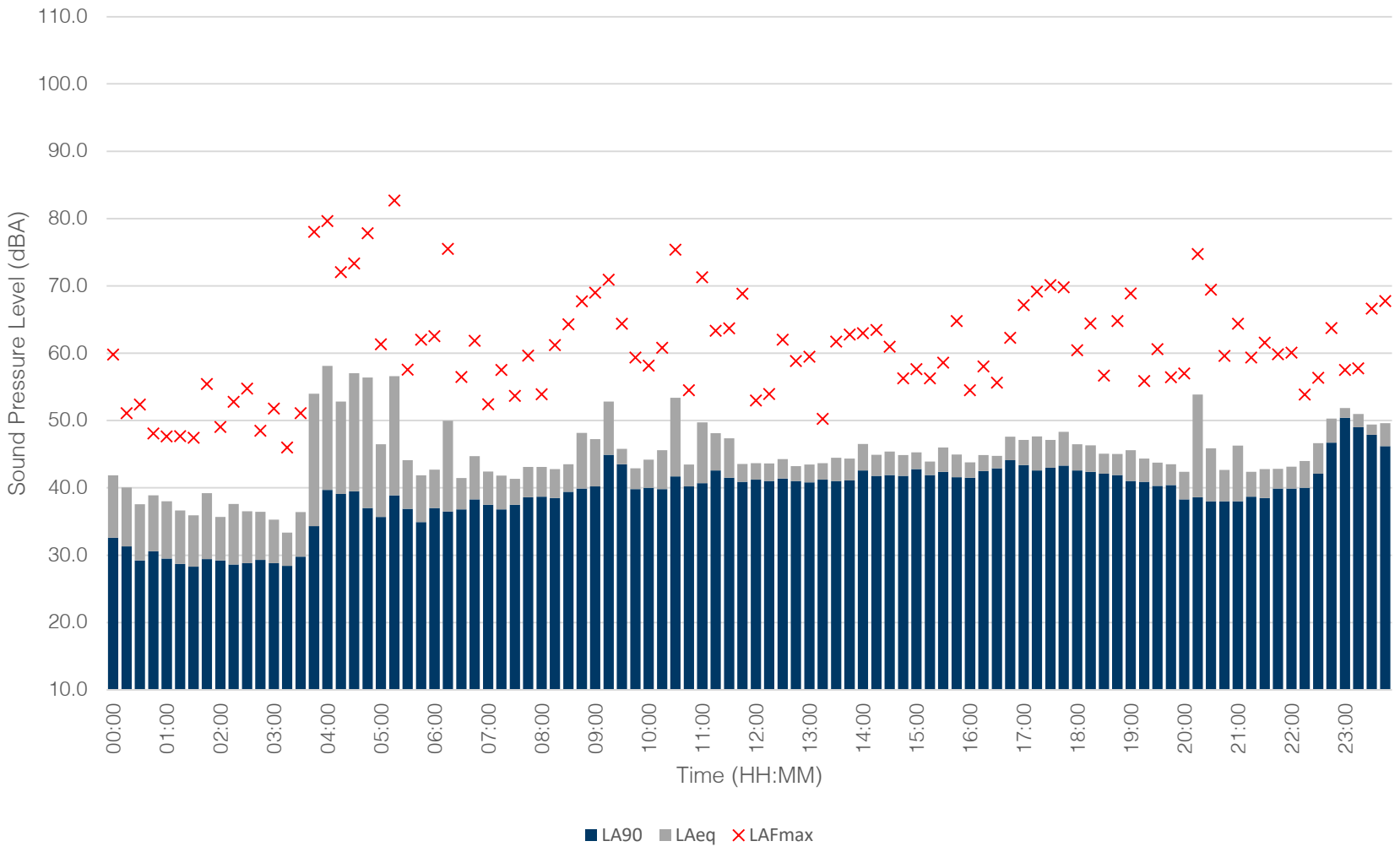
Air & Acoustic Consultants



Time History Graph E.3

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	19/06/2021

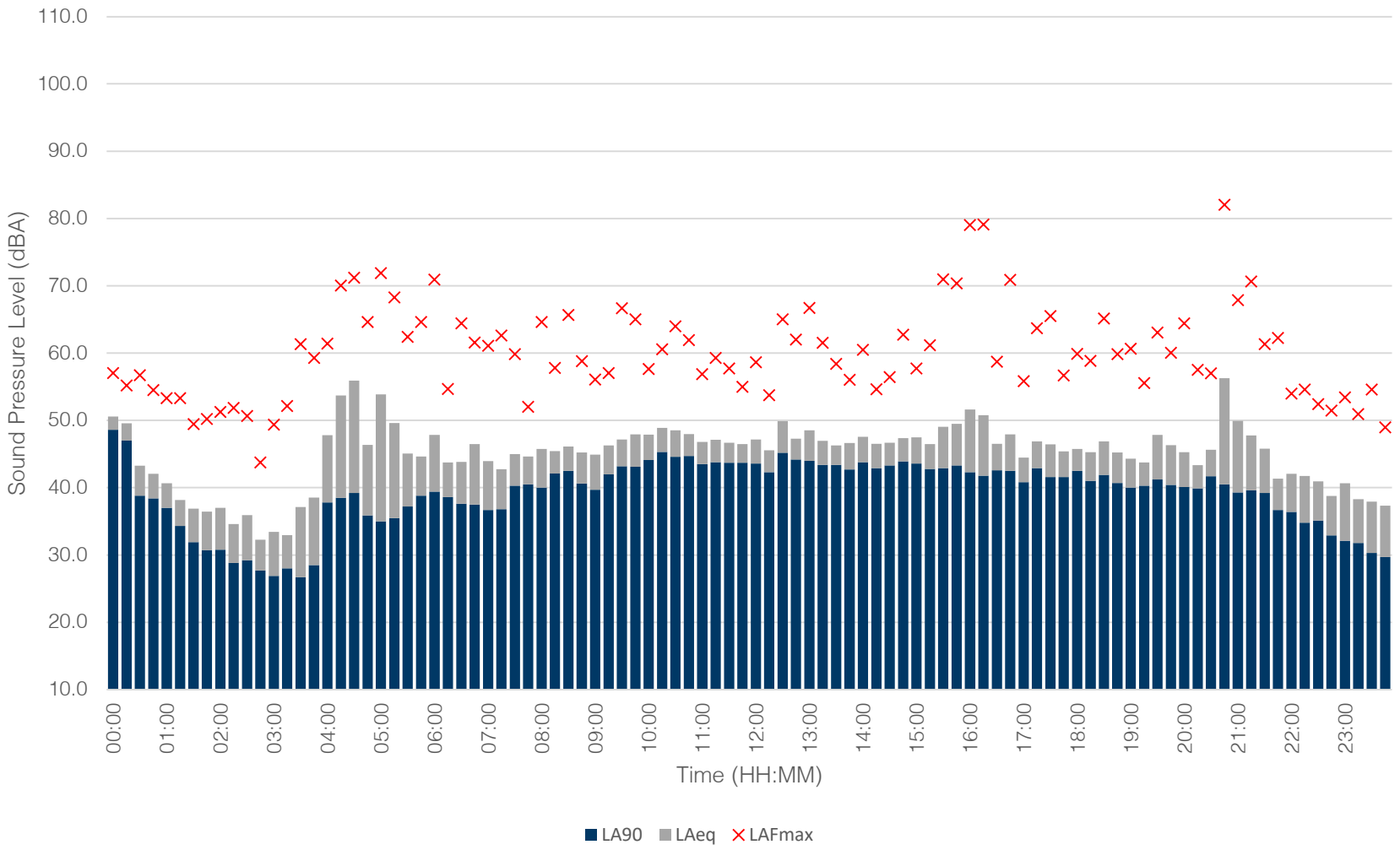
Air & Acoustic Consultants



Time History Graph E.4

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	20/06/2021

Air & Acoustic Consultants



Time History Graph E.5

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	21/06/2021

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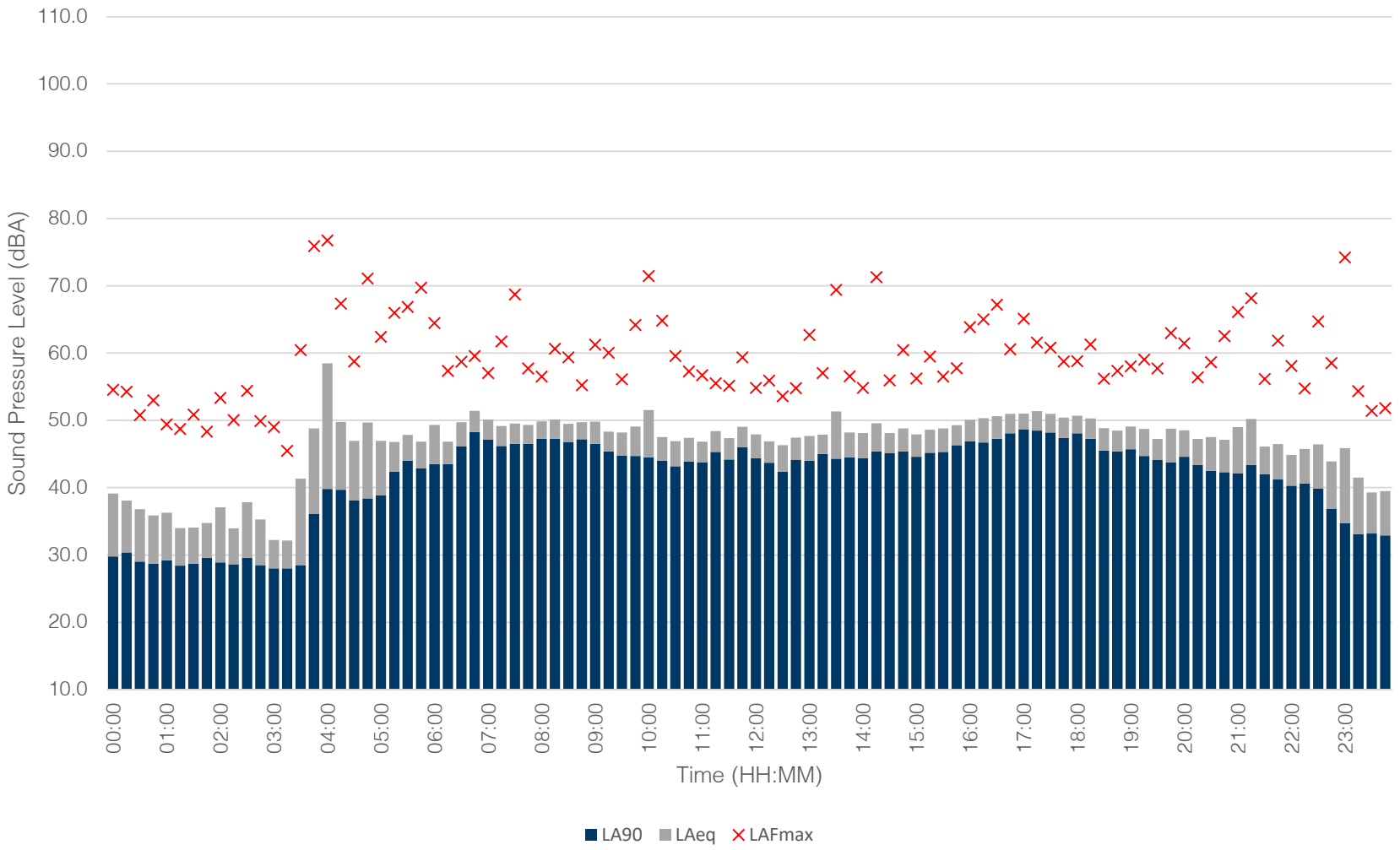
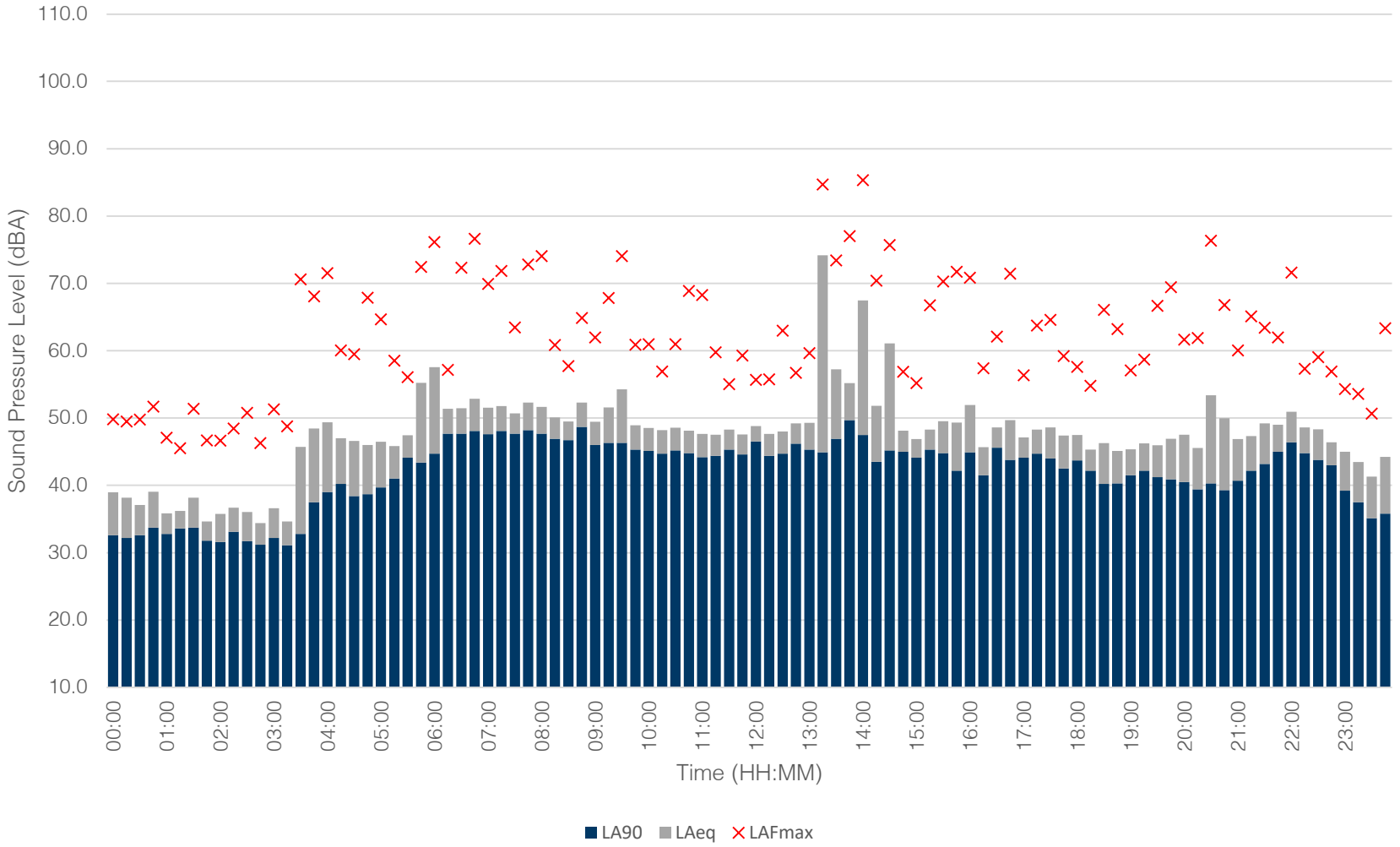


Time History Graph E.6

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	22/06/2021

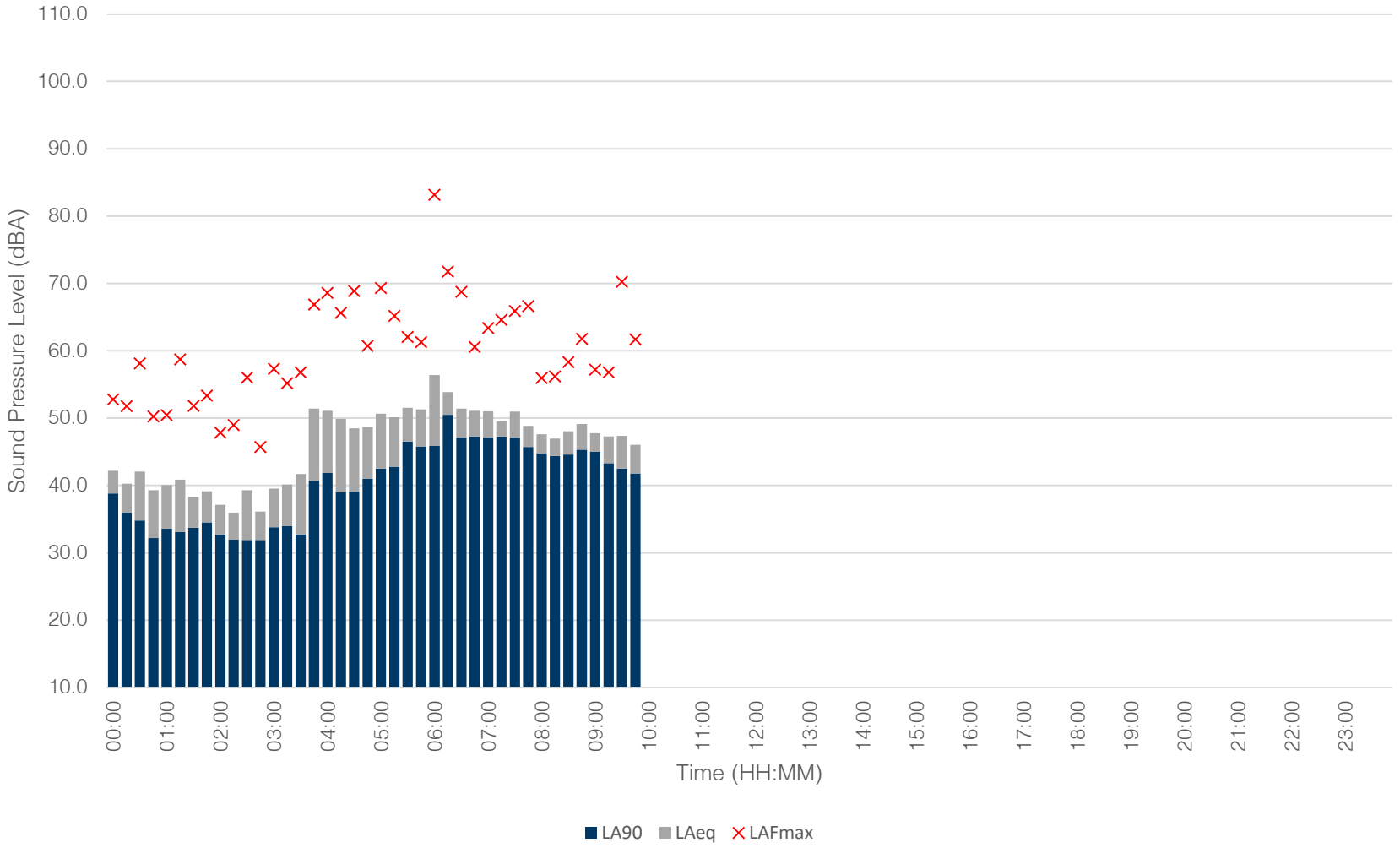
Air & Acoustic Consultants



Time History Graph E.7

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L1
Survey Date:	23/06/2021

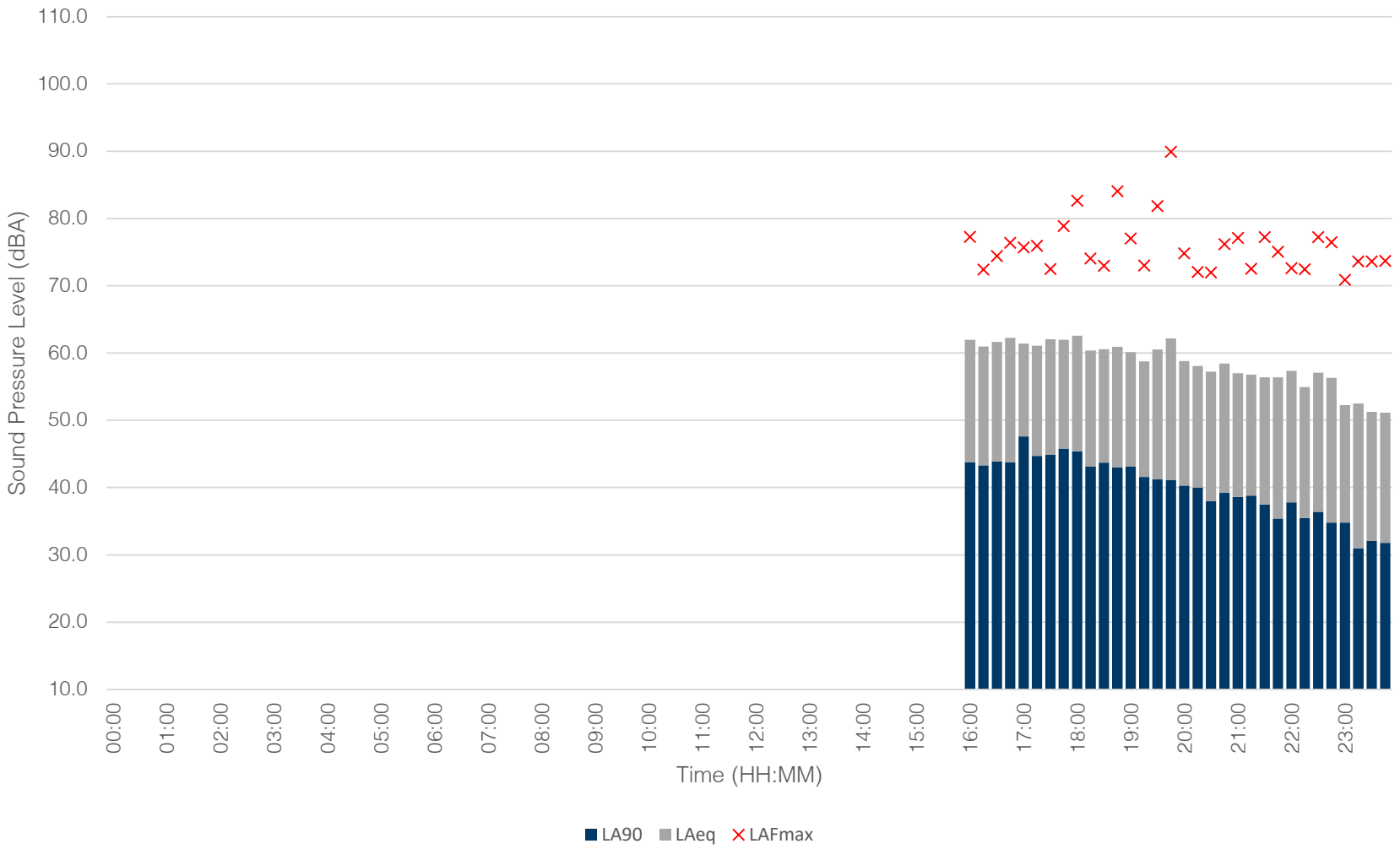
Air & Acoustic Consultants



Time History Graph E.8

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L2
Survey Date:	17/06/2021

Air & Acoustic Consultants



Time History Graph E.9

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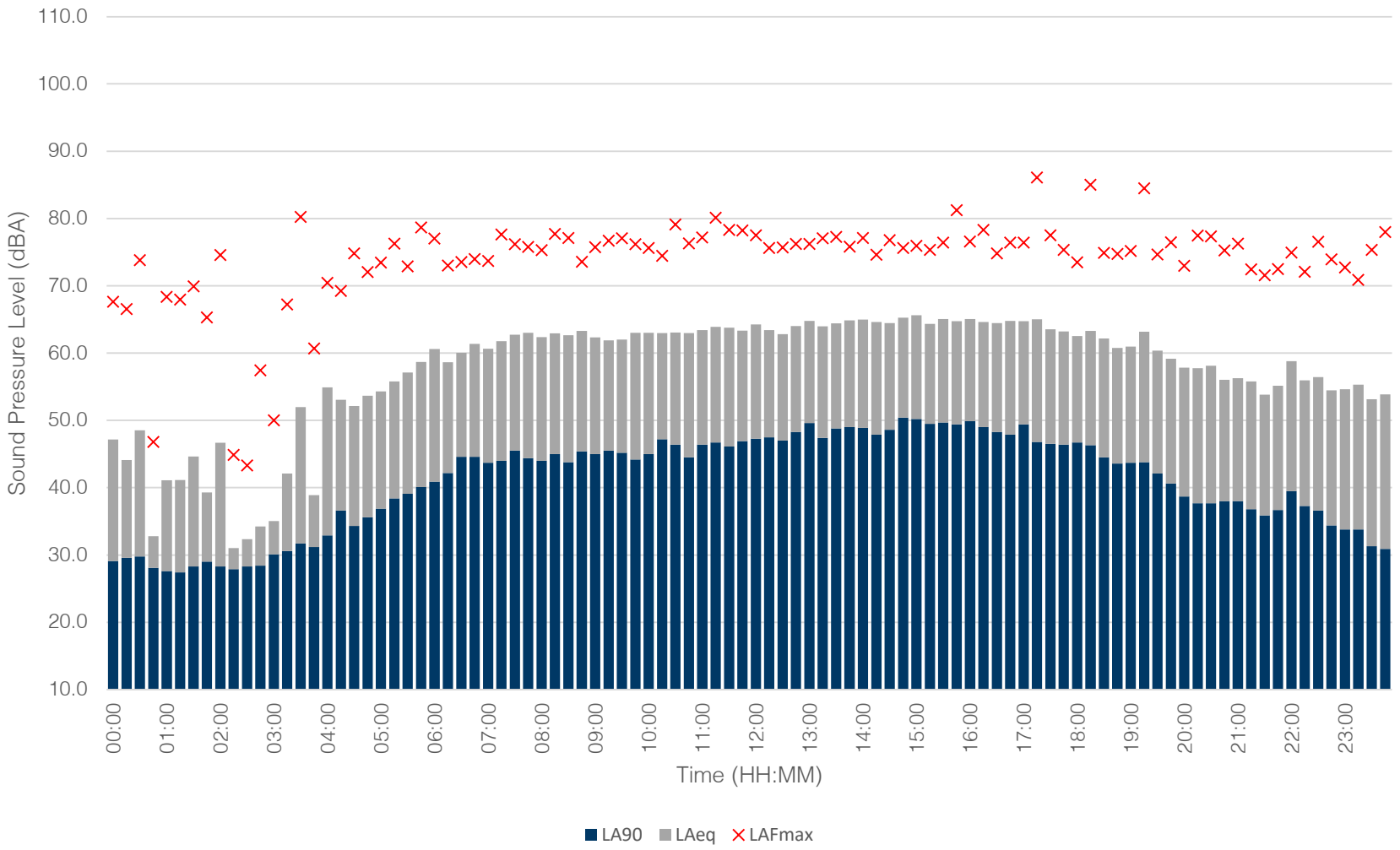
Measurement Location:	L2
Survey Date:	18/06/2021

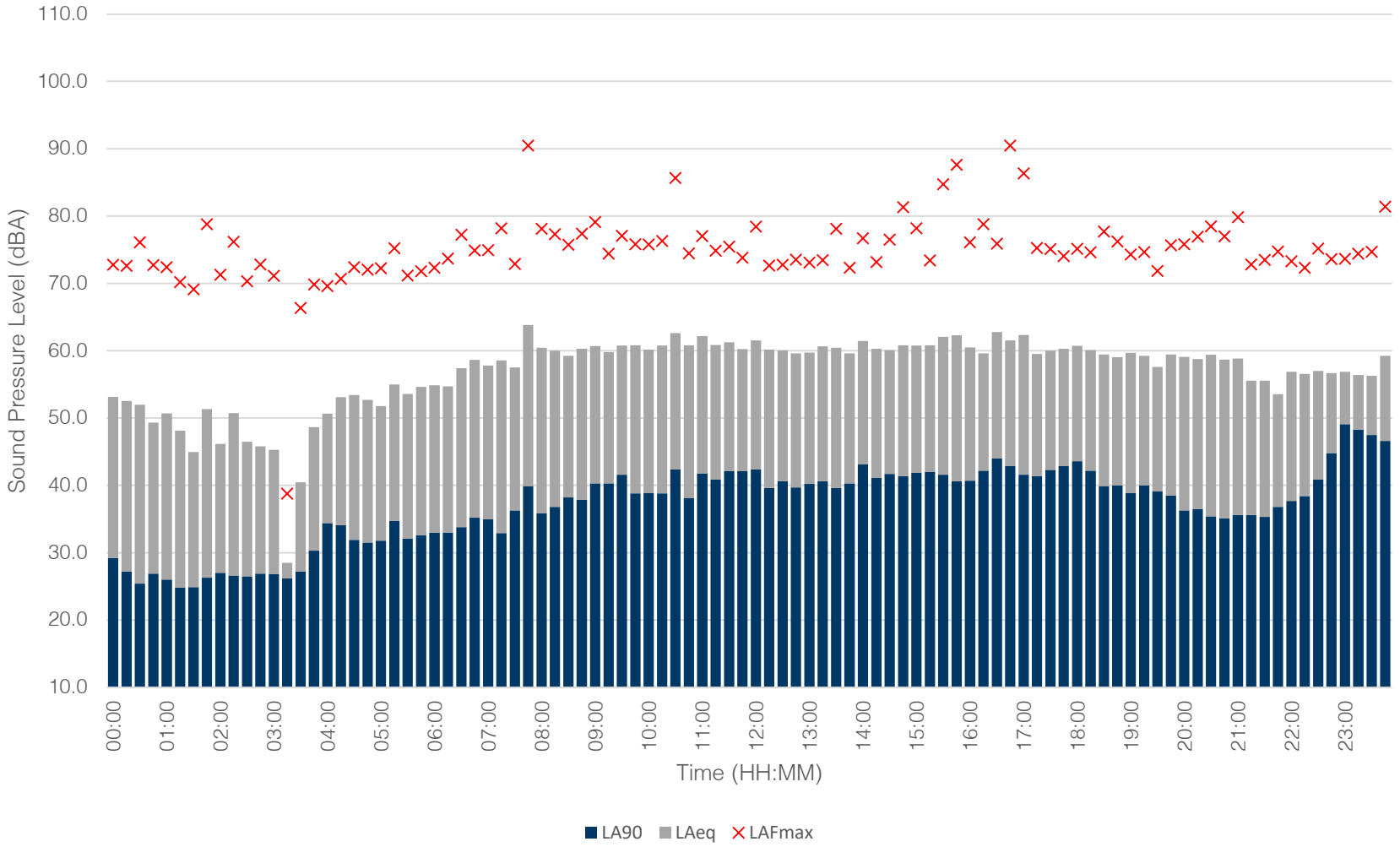
Air & Acoustic Consultants



Time History Graph E.10

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L2
Survey Date:	19/06/2021

Air & Acoustic Consultants



Time History Graph E.11

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L2
Survey Date:	20/06/2021

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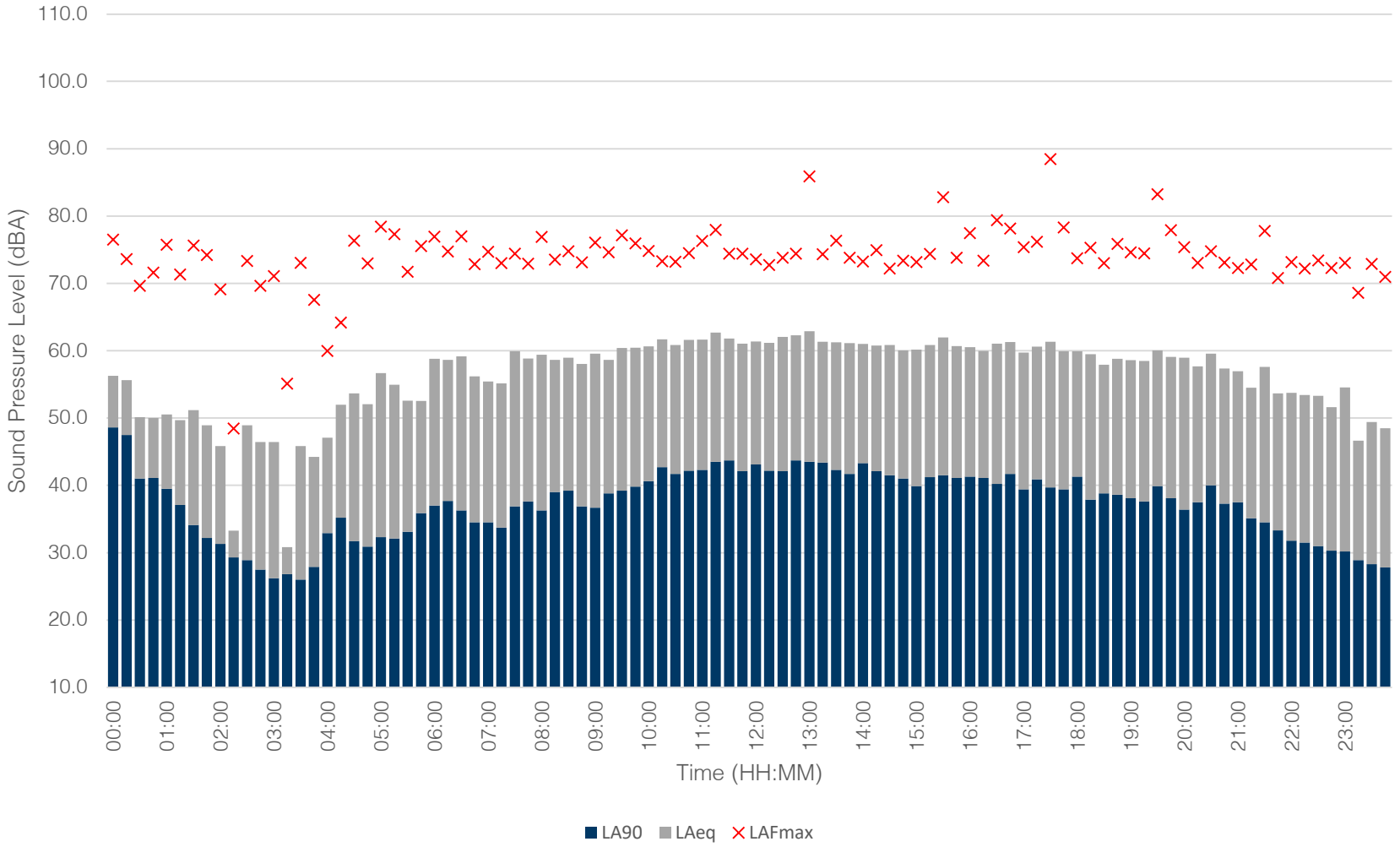

Time History Graph E.12

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L2
Survey Date:	21/06/2021

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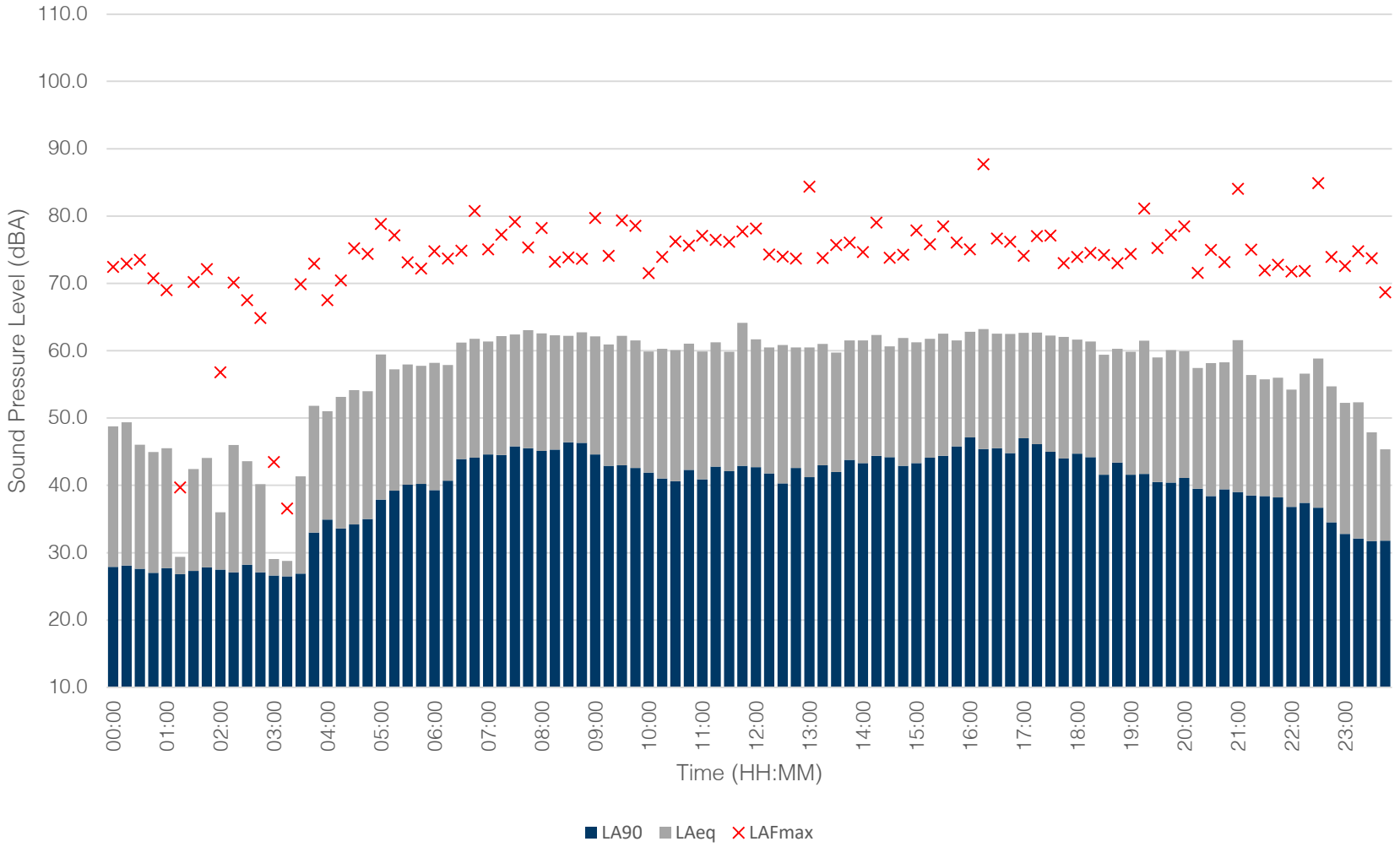

Time History Graph E.13

Project Name:	Hither Green Lane, Redditch
Measurement Location:	L2
Survey Date:	22/06/2021

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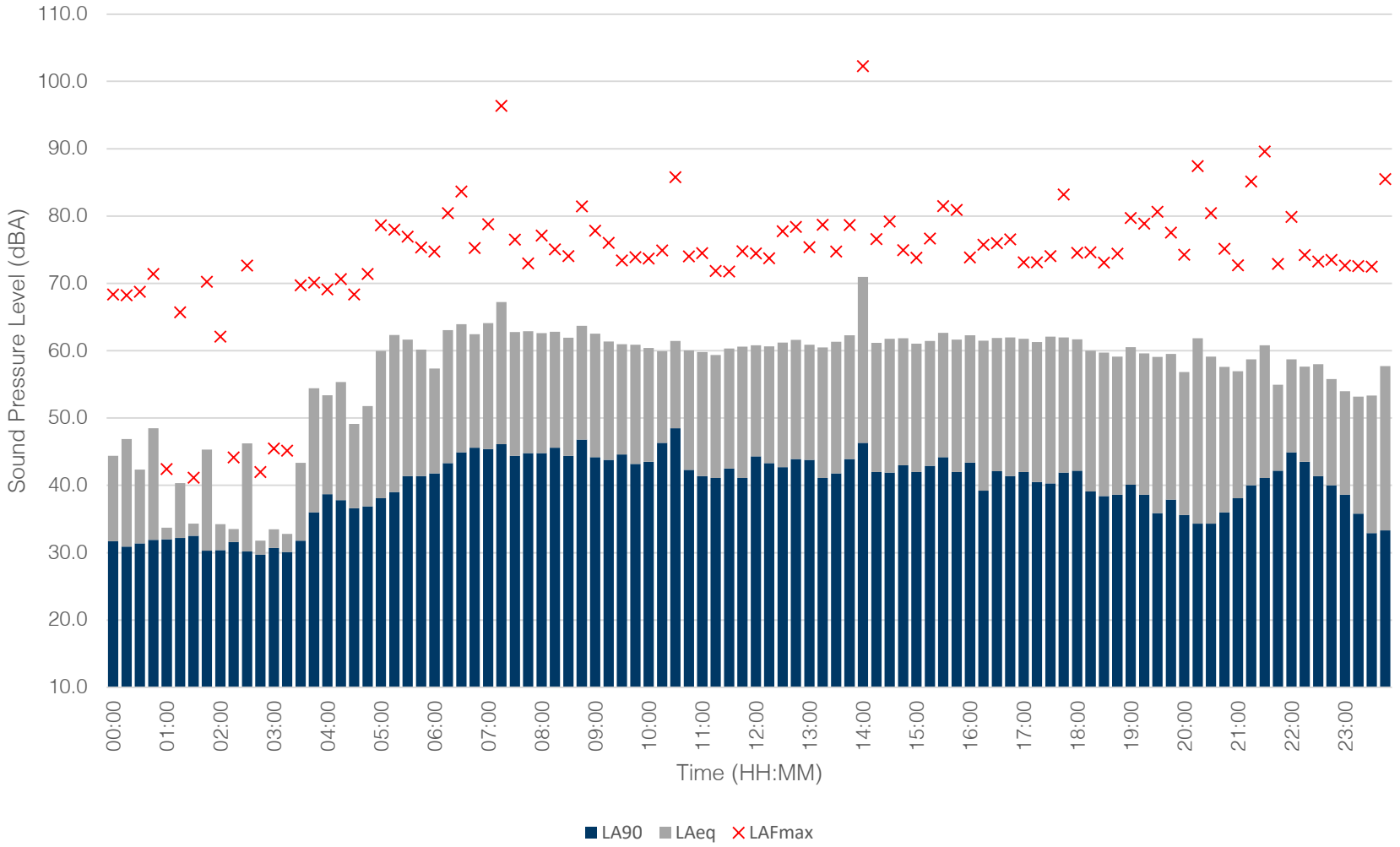

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