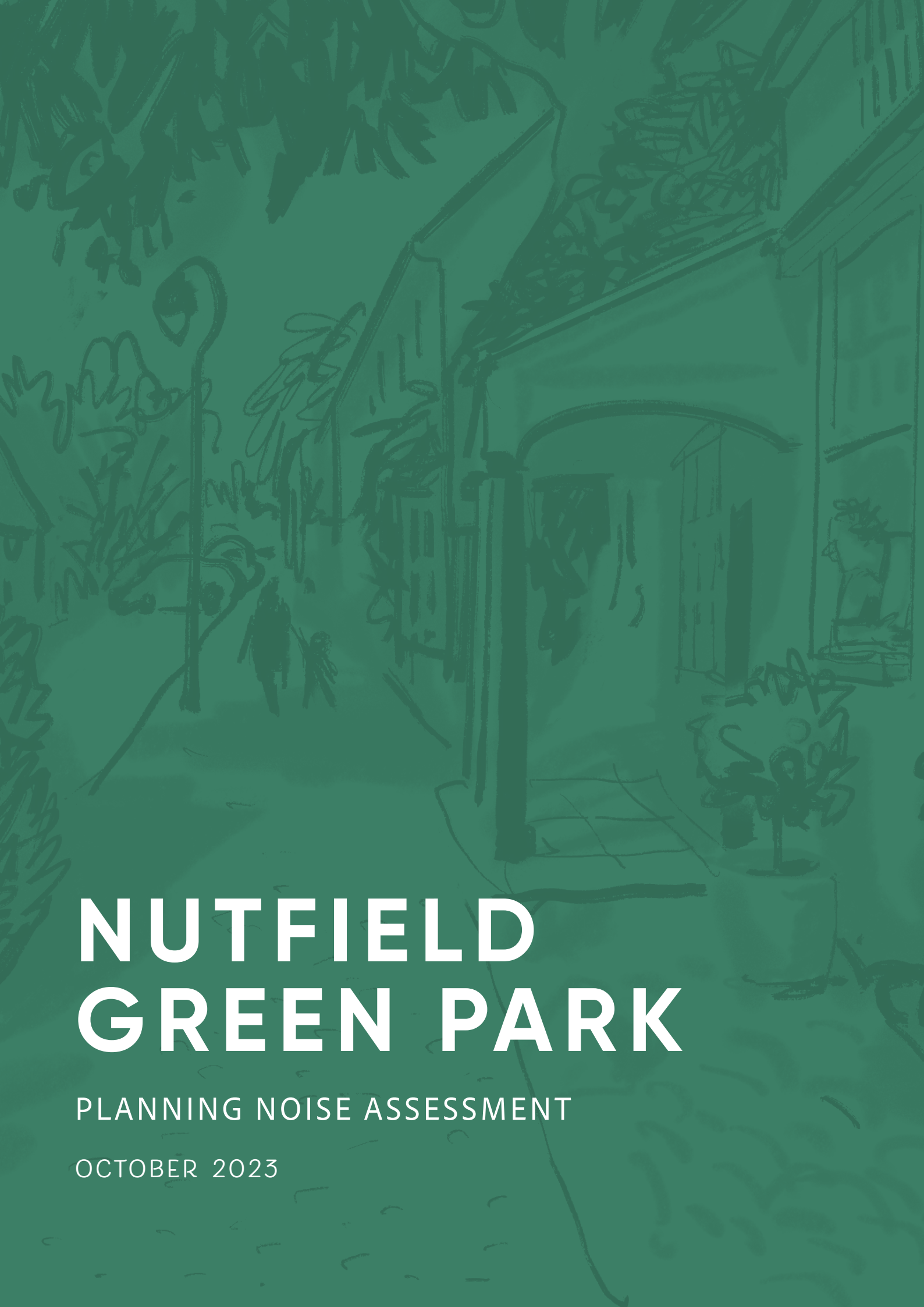

NUTFIELD GREEN PARK

PLANNING NOISE ASSESSMENT

OCTOBER 2023

Nutfield Green Park
Tandridge

Planning Noise Assessment

On behalf of

Nutfield Park Developments Limited

Project Reference: 90678 | Revision: 01 | Date: 24th May 2023
Revised 11th October 2023

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Appendices

1.0 Introduction

1.1. Noise Solutions Ltd (NSL) has been commissioned to undertake a planning stage noise assessment to support the outline planning application for the development of the site of the former Laporte Works Site, Nutfield Road, Nutfield, Surrey, for new homes (Use Class C3) and Integrated Retirement Community (Use Classes C2, E(e), F2), creation of new access, landscaping and associated works to facilitate the development, in phases which are severable (Outline with all matters reserved, except for Access).

1.2. This report presents the results of environmental noise and vibration surveys, the applicable policies and guidance, and noise and vibration assessments demonstrating the suitability of the site for the proposed development.

1.3. To assist with the understanding of this report a brief glossary of acoustic terms can be found in **Appendix A**. A more in-depth glossary of acoustic terms can be assessed at the following web address http://www.acoustic-glossary.co.uk/.

2.0 Site layout and development proposals

2.1. The site of the proposed development lies to the north of the A25 and to the west of Church Hill, in Nutfield, at the former Laporte Works Site, Nutfield Road, Nutfield, Surrey.

2.2. The development of the site is proposed for new homes (Use Class C3) and Integrated Retirement Community (Use Classes C2, E(e), F2), creation of new access, landscaping and associated works to facilitate the development.

2.3. **Appendix B** contains an aerial photograph showing the site and surrounding area. A plan of the proposals is shown in **Appendix C**.

3.0 Policy context

3.1. A significant change in national noise policy has occurred in recent years. The following sections describe the current applicable assessment methodology which guides planning decisions.

Noise Policy Statement for England

3.2. The Noise Policy Statement for England (NPSE[1]), published in March 2010, sets out the long-term vision of Government noise policy. The Noise Policy aims, as presented in this document, are: "*Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

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

3.3. The NPSE makes reference to the concepts of NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level) as used in toxicology but applied to noise impacts. It also introduces the concept of SOAEL (Significant Observed Adverse Effect Level) which is described as the level above which significant adverse effects on health and quality of life occur.

3.4. The first aim of the NPSE is to avoid significant adverse effects, taking into account the guiding principles of sustainable development (as referenced in Section 1.8 of the NPSE). The second aim seeks to provide guidance on the situation that exists when the potential noise impact falls between the LOAEL and the SOAEL, in which case: *"...all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development."*

3.5. Importantly, the NPSE goes on to state that: "This does not mean that such adverse effects cannot occur."

3.6. The NPSE does not provide a noise-based measure to define SOAEL, acknowledging that the SOAEL is likely to vary depending on the noise source, the receptor and the time in question. NPSE advises that: *"Not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."*

3.7. It is therefore likely that other guidance will need to be referenced when applying objective standards for the assessment of noise, particularly in reference to the SOAEL, whilst also taking into account the specific circumstances of a proposed development.

National Planning Policy Framework

3.8. A new edition of NPPF was published in September 2023 and came into effect immediately. The original National Planning Policy Framework (NPPF[2]) was published in March 2012, with

[1] Noise Policy Statement for England, Defra, March 2010
[2] National Planning Policy Framework, DCLG, March 2012

subsequent revisions made periodically - this document replaced the existing Planning Policy Guidance Note 24 (PPG 24) "Planning and Noise." The 2023 revised edition contains no new directions or guidance with respect to noise. The paragraph references quoted below relate to the September 2023 edition.

3.9. Paragraph 174 of the NPPF states that the planning system should contribute to and enhance the natural and local environment by, (amongst others) *"preventing new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, water or noise pollution or land instability."*

3.10. The NPPF goes on to state in Paragraph 185:

"planning policies and decisions 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 quality of life;
b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason ...

3.11. The NPPF document does not refer to any other documents or British Standards regarding noise other than the Noise Policy Statement for England (NPSE[3]).

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

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

3.14. Paragraph 119 states that *"Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land".*

[3] Noise Policy Statement for England, DEFRA, March 2010

Planning Practice Guidance – Noise

3.15. An updated Planning Practice Guidance (PPG[4]) for noise was published on 22 July 2019 and provides additional guidance and elaboration on the NPPF. It advises that when plan-making and decision-taking, the Local Planning Authority should consider the acoustic environment in relation to:

- 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.

3.16. This guidance introduced the concepts of NOAEL (No Observed Adverse Effect Level), and UAEL (Unacceptable Adverse Effect Level). NOAEL differs from NOEL in that it represents a situation where the acoustic character of an area can be slightly affected (but not such that there is a perceived change in the quality of life). UAEL represents a situation where noise is 'very disruptive' and should be 'prevented' (as opposed to SOAEL, which represents a situation where noise is 'disruptive', and should be 'avoided').

3.17. As exposure increases above the LOAEL, the noise begins to have an adverse effect and consideration needs to be given to mitigating and minimising those effects, taking account of the economic and social benefits being derived from the activity causing the noise. As the noise exposure increases, it will then at some point cross the SOAEL boundary.

3.18. The LOAEL is described in PPG[5] as the level above which *"noise starts to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard"*.

3.19. PPG identifies the SOAEL as the level above which *"noise causes a material change in behaviour such as keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present."*

[4] Planning Practice Guidance – Noise, https://www.gov.uk/guidance/noise--2, 22 July 2019
[5] Paragraph: 005 Reference ID: 30-005-20190722

3.20. In line with the Explanatory Note of the NPSE, the PPG goes on to reference the LOAEL and SOAEL in relation to noise impact. It also provides examples of outcomes that could be expected for a given perception level of noise, plus actions that may be required to bring about a desired outcome. However, in line with the NPSE, no objective noise levels are provided for LOAEL or SOAEL although the PPG[6] acknowledges 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."*

3.21. The relevant guidance in the PPG in relation to the adverse effect levels is summarized in Table 1 below:

Table 1 PPG-Noise guide to effect levels

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not Present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not Intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. 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			
Present and Intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum

[6] Paragraph: 006 Reference ID: 30-006-20190722

Response	Examples of Outcomes	Increasing Effect Level	Action
Significant Observed Adverse Effect Level			
Present and Disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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
Present and very Disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

3.22. The Planning Practice Guidance[7] states the following in relation to mitigation measures:

> *"For noise sensitive developments, mitigation measures can include avoiding noisy locations in the first place; designing the development to reduce the impact of noise from adjoining activities or the local environment; incorporating noise barriers; and optimising the sound insulation provided by the building envelope."*

3.23. In addition, the Guide notes that it may also be relevant to consider[8]:

> *"... whether any adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time (and the effect this may have on living conditions). In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations".*

[7] Paragraph: 010 Reference ID: 30-010-20190722
[8] Paragraph: 006 Reference ID: 30-006-20190722

Local Policy

3.24. The NPPF is very clear in that local authorities must update their local plans (one year from publication of the NPPF) and that if the local plan contains policies which do not closely align with the aims of the NPPF, then a decision must be made based on an assessment which shows compliance with the NPPF. Therefore, it is of paramount importance that local authorities have updated local plans which closely align with the aims in the NPPF.

Tandridge District Council

3.25. In the decision notice for a previous application for a development on a wider site including the proposed development land[9], Tandridge District Council noted:

> *5) The additional marked increase in activity and traffic would result in further noise and general disturbance to the residential amenities of nearby properties. This combined with the active quarry and landfill sites would result in significant harm to neighbouring residential amenities contrary to Policies CSP18 and DP7 and the provisions of the National Planning Policy Framework 2021.*
>
> *6) The proposed development would introduce further sensitive receptors into the area which would be subjected to heightened noise and general disturbance due to the presence of active quarry and landfill sites resulting in harm the amenities of future occupier's contrary to policies CSP18 and DP7 of the Local Plan and the provisions of the National Planning Policy Framework 2021.*

3.26. Policy CSP18 *Character and Design*, in the *Tandridge District Core Strategy* adopted 15th October 2008, states:

> *The Council will require that new development, within town centres, built up areas, the villages and the countryside is of a high standard of design that must reflect and respect the character, setting and local context, including those features that contribute to local distinctiveness. Development must also have regard to the topography of the site, important trees or groups of trees and other important features that need to be retained.*
>
> *Development must not significantly harm the amenities of the occupiers of neighbouring properties by reason of overlooking, overshadowing, visual intrusion, noise, traffic and any other adverse effect.*

[9] TA/2021/1040, dated 21st September 2021

The Council will have regard to "Surrey Design" and Village Design Statements in determining planning applications. The Council will apply the principle of "good enough to approve rather than bad enough to refuse".

The Council will protect the wooded hillsides in the built-up areas by ensuring that new development does not adversely affect the character of these areas and that there is no overall loss of tree cover.

Within built up areas and villages existing green spaces that contribute to biodiversity, the quality of life, the character or amenities of the area or those that separate built up areas will be protected and where possible enhanced for the benefit of biodiversity and/or recreation.

3.27. Policy DP7 *General Policy for New Development*, in the *Tandridge Local Plan Part 2: Detailed Policies 2014-2029,* adopted in July 2014, states:

A. All new development will be expected to be of a high quality design. Development should integrate effectively with its surroundings, reinforcing local distinctiveness and landscape character. Innovative designs will be encouraged where appropriate.

B. Where the principle of the proposed new development – whether on a site that is previously developed or green field – is in accordance with other policies in the Development Plan, permission will be granted where the following matters are effectively addressed:

Design of Development

…

4. Design Guidance: The proposal conforms with the guidelines as set out in adopted Conservation Area Appraisals, Village Design Statements, and Design Guidance in the form of Supplementary Planning Guidance (SPGs) and Supplementary Planning Documents (SPDs);

…

Safeguarding Amenity

6. Amenity: The proposal does not significantly harm the amenity of neighbouring properties by reason of pollution (noise, air or light), traffic, or other general disturbance;

…

8. Environment: The proposals provide a satisfactory environment for the occupiers of both the existing and new development;

…

3.28. Detailed Policy *DP22: Minimising Contamination, Hazards and Pollution* states:

…

Noise

C. The Council will require noise generating forms of development or proposals that would affect noise-sensitive development to be accompanied by a statement detailing potential noise generation levels and any mitigation measures proposed (such as containment of the noise generated, screening barriers or restrictive activities/hours of operation) to ensure that all noise is reduced to an acceptable level. Where a development proposal is able to demonstrate that acceptable noise levels will be achieved, the application will be supported.

D. For proposals involving new residential development sited close to transport derived noise sources, applications will be considered against the noise exposure categories as outlined in the Noise Exposure Categories table (see supporting text), as well as other material considerations where necessary.

E. For proposals involving residential and other noise sensitive development that would be sited close to commercial/industrial noise sources (i.e. where transport is not the dominant noise source), the Council will consider applications against the current version of BS4142 in order to assess the likelihood of complaints from future occupiers and therefore the acceptability of the proposed development.

…

3.29. Section 22 of the Detailed Policies document includes guidance on acceptable noise levels affecting residential development, based on the concept of Noise Exposure Categories (NEC). This approach was formerly used in Planning Practice Guidance 24: Planning and Noise, which has been withdrawn, being replaced by the NPPF in 2012.

3.30. The NEC boundaries set out in the document, and the accompanying notes, are shown in Figure 1 and Figure 2.

Noise Exposure Categories

Noise Levels[a] Corresponding To The Noise Exposure Categories For New Dwellings LAeq,T dB					
Noise Source	**Time**	**Noise Exposure Category**			
		A	**B**	**C**	**D**
Road Traffic	07.00-23.00	<55	55-63	63-72	>72
	23.00-07.00[b]	<45	45-57	57-66	>66
Rail Traffic	07.00-23.00	<55	55-66	66-74	>74
	23.00-07.00[b]	<45	45-59	59-66	>66
Air Traffic[c]	07.00-23.00	<57	57-66	66-72	>72
	23.00-07.00[b]	<48	48-57	57-66	>66
Mixed Sources[d]	07.00-23.00	<55	55-63	63-72	>72

Figure 1 Noise Exposure Categories (part 1)

	23.00-07.00[b]	<45	45-57	66	>66
General guidelines as to acceptability of residential development scheme based on noise levels					
NEC A	Noise is unlikely to be a determining factor in the decision of an application.				
NEC B	Noise levels will be taken into account when determining planning applications and, where appropriate, conditions may be imposed to ensure an adequate level of protection against noise.				
NEC C	Permission will not normally be granted for residential development unless there are very special circumstances demonstrating that the benefit of the development will outweigh the harm by way of noise. If approval is granted, conditions will be applied to ensure an adequate level of protection against noise.				
NEC D	Permission will not be granted for residential development.				

[a]***Noise levels:*** *the noise level(s) (LAeq,T) used when deciding the NEC of a site should be representative of typical conditions.*

[b]***Night-time noise levels (23.00 - 07.00):*** *sites where individual noise events regularly exceed 82 dB LAmax (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the LAeq,8h (except where the LAeq,8h already puts the site in NEC D).*

[c]***Aircraft noise:*** *daytime values accord with the contour values adopted by the Department for Transport which relate to levels measured 1.2m above open ground. For the same amount of noise energy, contour values can be up to 2 dB(A) higher than those of other sources because of ground reflection effects.*

[d]***Mixed sources:*** *this refers to any combination of road, rail, air and industrial noise sources. The "mixed source" values are based on the lowest numerical values of the single source limits in the table. The "mixed source" NECs should only be used where no individual noise source is dominant.*

Figure 2 Noise Exposure Categories (part 2)

3.31. The Tandridge District Council *Local Plan 2033*, submitted for Regulation 22 review in January 2019, includes the following:

> *TLP18: Place-Making and Design*
>
> *The Council will require that new development is of a high standard of design that must reflect and respect the character, setting and local context, including those features that contribute to local distinctiveness.*
>
> *…*
>
> *Development proposals will be required to adhere to the principles of good design as set out in national policy and locally recognised design guides, and give particular attention to all of the following considerations:*
>
> *…*

XII. The development does not significantly harm the amenities of the occupiers of existing development by reason by overlooking, overshadowing, visual intrusion, noise, traffic or any adverse impact.

4.0 Acoustic Standards and Guidance

Institute of Acoustics Professional Practice Guidance

4.1. The Institute of Acoustics published a guidance document for new residential development in May 2017, in conjunction with the ANC and the Chartered Institute of Environmental Health, "*to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England*".

4.2. The document advocates a two-stage process for consideration of noise affecting new residential developments. Stage 1 is an initial risk assessment of the proposed development site, based on the ambient noise levels in the area. Stage 2 recommends consideration of four main elements:

- demonstration of a "good acoustic design process"
- observation of internal noise guidelines
- an assessment of noise affecting external amenity areas
- consideration of other relevant issues

4.3. The initial risk assessment considers the indicative day-time and night-time equivalent continuous noise levels which indicates an "increasing risk of adverse effect" with increasing noise levels[10].

4.4. For Stage 2, the ProPG document recommends that the guidance in BS 8233:2014 is followed.

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

4.5. This Standard provides recommended guideline values for internal noise levels within dwellings which are similar in scope to guideline values contained within the World Health Organisation (WHO) document, Guidelines for Community Noise (1999[11]). These guideline noise levels are shown in Table 2, below:

[10] Figure 1, IoA ProPG for New Residential Development, May 2017
[11] World Health Organisation Guidelines for Community Noise, 1999

Table 2 BS 8233:2014 Desirable Internal Ambient Noise Levels for Dwellings

Activity	Location	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 $L_{Aeq,8h}$

4.6. BS 8233:2014 advises that: *"regular individual noise events…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."*

4.7. The standard also provides advice in relation to design criteria 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.*
>
> *…*
>
> *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."*

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

4.8. British Standard (BS) 4142:2014+A1:2019 describes a method for rating and assessing sound of an industrial or commercial nature, which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;

- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and

- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

4.9. The procedure contained in BS 4142:2014+A1:2019is to quantify the "specific sound level", which is the measured or predicted level of sound from the source in question over a one hour period for the daytime and a 15 minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.

4.10. The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal or impulsive elements. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.

4.11. The penalty for tonal elements is between 0dB and 6dB, and the standard notes: "Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible."

4.12. The penalty for impulsive elements is between 0dB and 9dB, and the standard notes: "Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."

4.13. The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:

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;

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.

4.14. The standard does state that "adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

4.15. The standard goes on to note that: "Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

4.16. In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

> *"An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context."*

4.17. BS 4142:2014+A1:2019 requires uncertainties in the assessment to be considered, and where the uncertainty is likely to affect the outcome of the assessment, steps should be taken to reduce the uncertainty.

Vibration Criteria

4.18. Guidance on acceptable levels is taken from BS 6472-1:2008 '*Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting*'. Guidance on the likelihood of structural or cosmetic damage is given in BS 7385-2:1993 '*Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration*'.

4.19. BS 6472-1:2008 provides guidance on predicting human response to vibration in buildings over the frequency range 0.5 Hz to 80 Hz. It describes frequency weighting curves for human beings exposed to whole-body vibration. It uses the principle of vibration dose values, VDV, to estimate the probability of adverse comment that might be expected from human beings experiencing vibration in buildings.

4.20. Table 1 in the Standard, given in Table 3 below, sets out vibration dose value ranges likely to result in various levels of disturbance.

Table 3. Vibration dose value ranges which might result in adverse comment within residential buildings (BS 6472:2008 Part 1 table 1)

Probability of adverse comment			
Place and time	**Low**	**Possible**	**Probable**
Residential buildings, 16 h day (0700-2300)	0.2 – 0.4 m $s^{-1.75}$	0.4 – 0.8 m $s^{-1.75}$	0.8 – 1.6 m $s^{-1.75}$
Residential buildings, 8 h night (2300-0700)	0.1 – 0.2 m $s^{-1.75}$	0.2 – 0.4 m $s^{-1.75}$	0.4 – 0.8 m $s^{-1.75}$

4.21. BS 7385-2:1993 contains guidance on damage levels from ground-borne vibration, and notes that the probability of damage tends towards zero at 12.5 mm s^{-1} peak component particle velocity.

Building Regulations Parts L and F

4.22. Part L of the Building Regulations mandates that buildings become more airtight, and Part F stipulates ventilation requirements. Even though there appears to be a contradiction in this, Part L limits uncontrollable ventilation while Part F ensures that ventilation requirements are provided in a controlled manner.

4.23. The 2021 edition of Approved Document F came into effect on 15 June 2022. Volume 1 sets out the requirements for ventilation of dwellings.

4.24. Paragraph 1.9 describes a ventilation strategy comprising extract ventilation of bathrooms and kitchens, whole house ventilation to provide fresh air and "remove water vapour and pollutants not removed by extract ventilation" and purge ventilation used intermittently to "remove high concentrations of pollutants produced by occasional activities (e.g. fumes from painting)". The use of purge ventilation to control overheating is described in Part O, as noted below.

4.25. The assessment within the main part of this report deals with controlling intrusive noise in the "whole house ventilation" scenario.

4.26. While the use of open windows to remove intermittent fumes would inevitably result in increased intrusive sound levels compared to when windows are closed, this is considered not to be significant in acoustic terms because activities producing the fumes to be removed would tend to be short in duration and under the control of the occupants and therefore not likely to take place when occupants are trying to sleep.

Building Regulations Part O

4.27. Approved Document O1: Overheating mitigation of the Building Regulations 2010, came into force on 15 June 2022. Section 3 in the Approved Document includes the following:

Noise

3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

3.3 Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).

b. 55dB L_{AFmax}, more than 10 times a night (between 11pm and 7am).

3.4 Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants' Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use.

NOTE: Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).

5.0 Environmental noise surveys

5.1. Noise surveys were undertaken by NSL on Thursday 4th May and Friday 5th May 2023. In the absence of suitable locations for continuous noise logging within the development land, unattended measurements at the eastern edge of the site were accompanied by attended short term surveys at four positions within the site. The survey was undertaken in order to establish the prevailing environmental noise levels across the site, and to corroborate the results of the previous noise survey on the site referenced above. The surveys were undertaken using the methodology described in the Calculation of Road Traffic Noise[12] (CRTN) manual.

5.2. Measurement positions L1-L5 are shown in **Appendix B**.

5.3. Full details of the surveys are provided in **Appendix D**, with a time history graph of the unattended measurements, hourly data from the attended surveys and calculations of daytime and night-time sound levels using the CRTN method.

[12] Department of Transport and Welsh Office, 1988

5.4. It was noted that noise from aircraft was a significant noise source during the daytime. Review of night-time aircraft movements in the area[13] show that there are very few overflights at night, with none at low altitude. The highest overnight maximum (L_{AFmax}) noise levels measured are therefore considered to be primarily attributable to vehicles passing close to the monitoring position, and noise levels would therefore reduce with distance from the roads. Lower overnight maximum levels are likely to be due to more distant traffic and would therefore be similar across the whole development site.

5.5. The relevant results of the survey have been summarised in Table 4 below.

Table 4 Summary of survey results

Measurement location	Measurement period	Range of recorded sound pressure levels (dB)			
		$L_{AFmax\ (15mins)}$	$L_{Aeq(15mins)}$	$L_{A10(15mins)}$	$L_{A90(15mins)}$
L1	Short duration	65-74	55-57	58-59	48-50
L2	Short duration	56-80	45-59	47-56	41-45
L3	Short duration	60-83	48-60	50-56	44-45
L4	Short duration	85-88	73-74	77-79	49-53
L5	Daytime (07.00 – 23.00 hours)	78 - 96	57 - 71	49 - 75	38 - 52
	Night-time (23.00 – 07.00 hours)	43 - 88	36 - 67	36 - 70	32 - 46

5.6. The data presented above are the free-field levels recorded from the meter in each case.

5.7. At all positions the main noise source was observed to be road traffic and aircraft. Contrary to the assertion in note 5 in the Refusal Notice, there was no evidence of noise from quarrying or landfill activities at any of the survey locations, or audible when moving between survey positions.

5.8. Octave band sound pressure level measurements were made at all locations in order to assist with the calculation of the internal ambient noise levels within the proposed residential dwellings. The survey data is summarised in Table 5.

[13] https://webtrak.emsbk.com/lgw2

Table 5 Summary of free field environmental sound pressure levels at octave band centre frequencies at the survey locations

	Period	Incident sound pressure levels (dB) at Octave Band Centre Frequencies (Hz)								
		63	125	250	500	1000	2000	4000	8000	dB(A)
L1	Median octave band $L_{eq\ 15min}$	65	60	54	50	52	47	41	31	
L2	Median octave band $L_{eq\ 15min}$	56	52	49	46	44	35	34	25	
L3	Median octave band $L_{eq\ 15min}$	57	53	49	47	44	40	41	34	
L4	Median octave band $L_{eq\ 15min}$	69	67	69	68	71	63	53	47	
L5	Daytime $L_{Aeq,\ 16\ hours}$	67	63	62	62	65	57	50	49	67
	Night-time $L_{Aeq,\ 8\ hours}$	58	54	53	54	57	50	44	41	59
	Night-time L_{AMax},*	88	78	79	82	84	74	78	77	87
	Night-time L_{AMax},**	75	68	70	63	58	58	62	61	68

**Typical highest L_{Max} level not regularly exceeded during night-time period – local traffic*

***Typical L_{Max} level from other noise sources*

Previous noise survey

5.9. A previous environmental noise survey was undertaken by Vibrock Ltd in September 2020, to inform the environmental statement submitted in support of a previous application for the development of a wider site. The results of the survey are given in Vibrock's report R21.9876/2/AP and are summarised in Figure 3 and Figure 4. It should be noted that survey positions 7 and 8 in the Vibrock report are to the north of the wider development and are not relevant to the current development proposals. Measurement positions E1-E6 are shown in **Appendix B**.

Figure 3. Table 11 in Vibrock survey report

Table 11: Summary of Baseline Noise Levels

Location	Period	Time (T)	$L_{Aeq,T}$ dB	$L_{Amax,T}$ dB		$L_{A10,T}$ dB	$L_{A90,T}$ dB
				Average	Highest		
1	Daytime	07:00 - 23:00	62	74	93	66	49
	Daytime	07:00 - 19:00	63	75	93	66	50
	Evening	19:00 - 23:00	59	73	89	63	40
	Night-time	23:00 - 07:00	55	72	87	53	36
2	Daytime	07:00 - 23:00	56	67	85	59	46
	Daytime	07:00 - 19:00	57	68	85	59	47
	Evening	19:00 - 23:00	53	64	82	57	39
	Night-time	23:00 - 07:00	49	63	79	50	36
3	Daytime	07:00 - 23:00	46	59	77	46	40
	Daytime	07:00 - 19:00	46	60	76	46	40
	Evening	19:00 - 23:00	43	55	70	44	38
	Night-time	23:00 - 07:00	43	53	74	41	36
4	Daytime	07:00 - 23:00	49	58	74	48	41
	Daytime	07:00 - 19:00	46	59	74	46	40
	Evening	19:00 - 23:00	48	56	71	46	40
	Night-time	23:00 - 07:00	47	53	74	44	38
5	Daytime	07:00 - 23:00	49	59	77	48	43
	Daytime	07:00 - 19:00	49	59	77	48	42
	Evening	19:00 - 23:00	47	58	70	46	40
	Night-time	23:00 - 07:00	46	53	78	43	38
6	Daytime	07:00 - 23:00	51	61	77	51	44
	Daytime	07:00 - 19:00	50	61	77	51	44
	Evening	19:00 - 23:00	48	60	71	49	41
	Night-time	23:00 - 07:00	47	54	76	45	39
7	Daytime	07:00 - 23:00	57	69	91	59	46
	Daytime	07:00 - 19:00	57	70	91	61	46
	Evening	19:00 - 23:00	53	68	82	55	43
	Night-time	23:00 - 07:00	51	62	81	48	41
8	Daytime	07:00 - 23:00	52	66	94	51	43
	Daytime	07:00 - 19:00	52	68	94	51	42
	Evening	19:00 - 23:00	47	59	74	47	41
	Night-time	23:00 - 07:00	47	54	82	45	40

Figure 4. Table 12 in Vibrock report

Table 12: Octave Band Frequency Measurements

Loc.	Date and Start Time	Octave band sound pressure levels ($L_{eq,15mins}$ dB)							
		63 Hz	125 Hz	250 Hz	500 Hz	1.0 kHz	2.0 kHz	4.0 kHz	8.0 kHz
1	10/09/20 11:28	64.7	60.2	56.6	56.5	60.9	54.2	45.3	37.3
2	10/09/20 11:45	65.5	61.5	57.4	53.8	54.9	48.8	39.2	28.0
3	10/09/20 12:06	51.3	47.0	40.0	41.4	37.4	28.5	28.7	27.5
4	10/09/20 12:29	55.1	52.4	50.9	47.4	45.0	42.8	38.9	40.6
5	10/09/20 12:51	54.0	48.6	43.3	42.0	42.2	31.8	29.4	30.0
6	10/09/20 13:18	56.8	44.8	44.8	46.9	46.0	39.5	36.6	36.0
7	10/09/20 13:56	60.5	52.9	47.2	46.4	50.2	43.8	36.6	33.9
8	10/09/20 14:19	54.5	49.2	43.4	41.3	41.0	41.7	38.6	39.5

Comparison of the survey data

5.10. A comparison of the results of the 2020 survey with the 2023 survey data and subsequent predictions shows that the daytime sound levels across the site range from 75dB $L_{Aeq\ 16hr}$ immediately alongside the A25 to 46dB $L_{Aeq\ 16hr}$ in the middle of the site, with night time sound levels in the range 65dB $L_{Aeq\ 8hr}$ to 43dB $L_{Aeq\ 8hr}$ at the same locations.

5.11. Sound levels measured at similar locations in both surveys, i.e. E2 and L1, and E5 and L3, were very similar, indicating no significant change in the acoustic environment in the area between the two surveys.

5.12. It is therefore considered appropriate to use the results of both surveys to inform the noise assessments.

Background sound levels

5.13. From the Vibrock survey data, background sound levels toward the middle of the site, furthest from the existing roads, are in the range 40-44dB L_{A90} during the daytime and 36-38dB L_{A90} at night. Daytime background sound levels are 46-49dB L_{A90} toward the southwest corner of the site, closest to the A25, though there is no significant corresponding increase in the night-time background sound level.

6.0 Noise Assessment

Noise data used in assessment

6.1. Review of the noise survey data has enabled the proposed development areas to be allocated into one of four categories, as summarised in Table 6 and shown in **Appendix E.**

Table 6 Noise categories

Zone		Incident sound pressure level, dB		
		Day $L_{Aeq\ 16hr}$	Night $L_{Aeq\ 8\ hr}$	10th-highest event L_{AfMax}
GREEN	All façades	Up to 50	Up to 50	Up to 68
BLUE	Façades exposed to A25	50-55	Up to 50	Up to 68
	Façades screened from A25 by building orientation	Up to 50	Up to 50	Up to 68
MAGENTA	Façades exposed to A25	55-60	50-55	Up to 72
	Façades screened from A25 by building orientation	Up to 50	Up to 50	Up to 68
RED	Façades exposed to A25	55-60	50-55	Up to 78
	Façades screened from A25 by building orientation	Up to 50	Up to 50	Up to 68

Initial risk assessment

6.2. As noted in Table 6 and **Appendix E**, the highest sound levels are 60 dB $L_{Aeq,16hr}$ during the daytime and 55 dB $L_{Aeq,8hr}$ at night, at the façades closest to overlooking the A25, with lower levels across the majority of the areas of proposed development.

6.3. The highest daytime sound levels are around the boundary between the "low" and "medium" ranges of noise levels in Figure 1 of the IoA ProPG document, while the highest night-time sound levels are within the "medium" range.

6.4. The ProPG document notes that:

> *At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS[14] which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.*
>
> *As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.*

[14] Acoustic Design Statement (i.e. this report)

6.5. The ProPG document notes that even where there are noise levels in the "high" range the risk may be reduced by following a "good acoustic design process" which "confirms how the adverse impacts of noise will be mitigated and minimised."

Noise Exposure Category assessment

6.6. As noted in Table 6 and **Appendix E**, the highest sound levels are 60 dB $L_{Aeq,16hr}$ during the daytime and 55 dB $L_{Aeq,8hr}$ at night, at the façades closest to overlooking the A25, with lower levels across the majority of the areas of proposed development.

6.7. The highest sound levels are therefore within NEC "B" in the Tandridge District Council guidance and therefore:

> *"Noise levels will be taken into account when determining planning applications and, where appropriate, conditions may be imposed to ensure an adequate level of protection against noise"*

Building fabric assessment

6.8. The exact positions and orientations of each residential dwelling is to be determined during detailed design.

6.9. To specify the building envelope acoustic performance required to meet the established criteria, it is appropriate to firstly identify those parts of the site where typical standard constructions would be acceptable. These are considered to be:

- Standard thermal double-glazed windows, typically two panes of 4mm thick glass with 16mm deep cavity;
- Non-acoustic trickle ventilator as described in Building Regulations Part F;
- Traditional brick-block cavity walls with slate/tile roof and plasterboard ceiling under roof joists.

6.10. For bedrooms within the RED zone and exposed to noise from the A25, an enhanced glazing and ventilator specification is required

6.11. The assumed airborne sound insulation values for these constructions are shown in Table 7.

Table 7 Proposed building envelope specifications

Item		Attenuation (dB) at Octave Band Centre Frequency (Hz)							
		63	125	250	500	1000	2000	4000	8000
Type A Glazing [typically 4mm glass /16mm cavity /4 mm glass]	SRI	21	24	20	25	34	37	40	40
Standard trickle ventilator	D_{ne}	30	32	32	31	33	31	31	31
Non-vision wall – all areas Cavity brick-block construction (or cladding with dry-lining with similar acoustic performance)	SRI	35	41	45	45	54	58	55	55
RED zone, exposed to A25									
Type B Glazing [typically 10mm glass /16mm cavity /6 mm glass]	SRI	19	24	24	31	39	39	43	43
Acoustic trickle ventilator	D_{ne}	30	27	30	35	34	46	40	40

6.12. It should be noted that glazing configurations and other constructions described above are for guidance and costings purposes only. It will be the responsibility of the manufacturer to provide evidence of compliance with the octave band sound reduction performance for and installed, glazed unit. All material specifications are to be finalised during the detailed design process.

6.13. The detailed calculation methodology described in BS 8233:2014 has been used in the assessment. Table 8 below presents the input data used to predict the resultant internal noise level in the habitable rooms. Since final house layouts are to be developed typical data has been used, though it should be noted that the information used is considered to be pessimistic and therefore the resulting assessment errs on the side of caution.

Table 8 Source data for the noise break-in assessment

Typical living room	
Room Volume (m³)	50
Room Furnishings	Curtains, sofa, carpet floor finish
Area of window (m²)	5.2
Area of wall (m²)	7.3
Typical bedroom	
Room Volume (m³)	27
Room Furnishings	Curtains, bed, carpet
Area of window (m²)	2.6
Area of wall (m²)	14.2
Typical bedroom in extra care facility	
Room Volume (m³)	19
Room Furnishings	Curtains, bed, vinyl floor finish
Area of window (m²)	2.5
Area of wall (m²)	3.8

Internal sound levels

6.14. Resulting internal sound levels based on the above are shown in Table 9. It should be noted that these are worst-case values for windows where external sound levels are at the upper end of the range within the areas described above; for elevations further from the roads external and internal sound levels will be lower than shown in the table.

Table 9 Predicted internal sound pressure levels (windows closed)

Zone, façade and Room type	Period / Parameter	External sound pressure level*, dB	Predicted internal sound pressure level, dB	Criterion, dB	Difference, dB
GREEN ZONE – All façades, All other zones screened from A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	50	23	35	-12
Bedroom	Daytime $L_{Aeq\ 16hr}$	50	23	35	-12
	Night-time $L_{Aeq\ 8hr}$	50	23	30	-7
	Night-time L_{Amax}	68	41	45	-4
Extra Care bedrooms (in GREEN ZONE)					
Bedrooms in Extra Care facility	Daytime $L_{Aeq\ 16hr}$	50	24	35	-11
	Night-time $L_{Aeq\ 8hr}$	50	24	30	-6
	Night-time L_{Amax}	68	42	45	-3
BLUE ZONE – façades exposed to A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	55	28	35	-7
Bedroom	Daytime $L_{Aeq\ 16hr}$	55	28	35	-7
	Night-time $L_{Aeq\ 8hr}$	50	23	30	-7

Zone, façade and Room type	Period / Parameter	External sound pressure level*, dB	Predicted internal sound pressure level, dB	Criterion, dB	Difference, dB
	Night-time L_{Amax}	68	41	45	-4
MAGENTA ZONE – façades exposed to A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	60	33	35	-2
Bedroom	Daytime $L_{Aeq\ 16hr}$	60	33	35	-2
	Night-time $L_{Aeq\ 8hr}$	55	28	30	-2
	Night-time L_{Amax}	72	43	45	-2
RED ZONE – façades exposed to A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	60	33	35	-2
Bedroom	Daytime $L_{Aeq\ 16hr}$	60	31	35	-4
	Night-time $L_{Aeq\ 8hr}$	55	26	30	-4
	Night-time L_{Amax}	78	45	45	+0

**highest external sound level for façade type and room combination*

6.15. It can be seen that, with the proposed minimum acoustic specifications for the external building fabric, internal noise levels meet the criteria set out in recognised Standards and Guidance noted previously.

Noise from and through mechanical ventilation systems

6.16. In the event that mechanical ventilation systems, e.g. MVHR, are provided for non-acoustic reasons, for example as part of an energy reduction strategy, noise intrusion through the system, and emitted by it to the ventilated rooms, must be considered.

6.17. The note to Paragraph 1.7 in Approved Document F Volume 1 states:

> *Although there is no requirement to undertake noise testing, achieving the levels in the following guidance would ensure good acoustic conditions. The average A-weighted sound pressure level for a ventilator operating under normal conditions and not at boost rates should not exceed both of the following.*
>
> *a. 30dB LAeq,T* for noise-sensitive rooms (e.g. bedrooms and living rooms) when a continuous mechanical ventilation system is running on its minimum low rate.*
>
> *b. 45dB LAeq,T* in less noise-sensitive rooms (e.g. kitchens and bathrooms) when a continuous operation system is running at the minimum high rate or an intermittent operation system is running*

6.18. It should be noted that an MVHR system is NOT required to provide suitable internal sound levels.

External noise levels

6.19. Throughout the GREEN zones identified, and within the other zones and screened from the A25 by the building orientation and/or appropriate boundary fences, the external daytime sound levels within gardens would be no higher than the 50 dB $L_{Aeq\ 16\ hour}$ guidance value in BS 8233:2014.

6.20. To maximise their acoustic performance, all fences providing acoustic screening – i.e. where the fence is the only barrier between the garden and the A25 - must be solid, with no holes, and with a surface mass of at least 7 kg/m^2.

7.0 Building Regulations Part O

7.1. It is important to note that the building envelope sound insulation specifications and associated advice given in this report are based on meeting the design criteria under the "Whole Dwelling Ventilation" conditions set out in Approved Document F (and formerly referred to as "background ventilation" in previous editions of the AD), as distinct from "Extract Ventilation" or "Purge Ventilation" conditions within the AD, and from the overheating condition (which is only briefly mentioned in AD F).

7.2. In January 2020 the Association of Noise Consultants (ANC) and Institute of Acoustics (IoA) published a Residential Design Guide on Acoustic Ventilation and Overheating ("the AVO Guide"), which sets out some of the acoustic design issues associated with the control of overheating. The night-time thresholds suggested in the AVO Guide have been superseded by the limits set out in Approved Document O.

7.3. The AVO guide suggests that a value of 13dB(A) is used for the noise reduction provided by an open window. Resulting internal noise levels would therefore be as shown in Table 10. It should be noted that the actual reduction will depend on the open area required to control overheating, which will be derived during detailed design.

7.4. Criteria and excess values given in italics are derived from the AVO guidance and are therefore advisory only. Values in normal typeface are from Approved Document O, with the highest excess for each façade shown in bold red.

Table 10 Predicted internal sound pressure levels (windows open)

Zone, façade and Room type	Period / Parameter	External sound pressure level*, dB	Predicted internal sound pressure level, dB**	Criterion, dB	Difference, dB
GREEN ZONE – All façades, All other zones screened from A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	50	37	*50 (AVO guidance)*	-13
Bedroom	Daytime $L_{Aeq\ 16hr}$	50	37	*50 (AVO guidance)*	-13
	Night-time $L_{Aeq\ 8hr}$	50	37	40 (Part O requirement)	-3
	Night-time L_{Amax}	68	55	55 (Part O requirement)	+0
BLUE ZONE – façades exposed to A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	55	42	*50 (AVO guidance)*	-8
Bedroom	Daytime $L_{Aeq\ 16hr}$	55	42	*50 (AVO guidance)*	-8
	Night-time $L_{Aeq\ 8hr}$	50	37	40 (Part O requirement)	-3
	Night-time L_{Amax}	68	55	55 (Part O requirement)	+0
MAGENTA ZONE – façades exposed to A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	60	47	*50 (AVO guidance)*	-3
Bedroom	Daytime $L_{Aeq\ 16hr}$	60	47	*50 (AVO guidance)*	-3
	Night-time $L_{Aeq\ 8hr}$	55	42	40 (Part O requirement)	+2
	Night-time L_{Amax}	72	59	55 (Part O requirement)	**+4**
RED ZONE – façades exposed to A25					
Kitchen-living room	Daytime $L_{Aeq\ 16hr}$	60	47	*50 (AVO guidance)*	-3
Bedroom	Daytime $L_{Aeq\ 16hr}$	60	47	*50 (AVO guidance)*	-3
	Night-time $L_{Aeq\ 8hr}$	55	42	40 (Part O requirement)	+2
	Night-time L_{Amax}	78	65	55 (Part O requirement)	**+10**

**highest external sound level for façade type and room combination*

***Open window providing 13dBA sound reduction*

7.5. It should be noted that these are worst-case values assuming that windows are open continuously to control overheating. Where windows are only open for a proportion of the time the internal noise levels will be lower.

7.6. For bedrooms within the MAGENTA zone and with an unimpeded view of the A25, internal night-time sound levels with open windows may be up to 4dBA above the criteria set out in Approved Document O. An alternative method of ventilation to mitigate the effects of overheating will therefore be required to these bedrooms. A sound insulation value of at least 17dBA (i.e. 13dBA as included within Table 10 + 4dBA improvement) is required. This is likely to be achievable using attenuated louvre ventilators.

7.7. For bedrooms within the RED zone and with an unimpeded view of the A25, internal night-time sound levels with open windows may be up to 10dBA above the criteria set out in Approved Document O. An alternative method of ventilation to mitigate the effects of overheating will therefore be required to these bedrooms. A sound insulation value of at least 23dBA (i.e. 13dBA as included within Table 10 + 10dBA improvement) is required. Again, this is likely to be achievable using attenuated louvre ventilators.

7.8. For all other bedrooms, internal sound levels with open windows are likely to meet the values in Approved Document O.

8.0 Vibration assessment

Vibration survey

8.1. Vibration levels were measured at position L2 shown in **Appendix B.**

8.2. Vibration levels were measured using a SEMEX "Menhir" vibration meter. This is a self-calibrating meter capable of simultaneously measuring vibration in the three orthogonal axes. The equipment was set to record Vibration Dose Values (VDV) and maximum peak component particle velocity (ppv) over 30-second intervals. Vibration measurements were made in three axes (x, y and z).

8.3. The vibration levels measured are reported in **Appendix D**. Measurements were made over a period of approximately 1hr 45 minutes on Friday 19th May 2023. VDV levels, measured over 30-second periods, ranged between 0.0001m $s^{-1.75}$ and 0.0145m $s^{-1.75}$. No perceptible vibration was observed.

Vibration assessment

8.4. Taking the highest of the measured VDV values, and assuming that this level is constant, gives a worst-case VDV level of 0.096 m $s^{-1.75}$ during the daytime and 0.081 m $s^{-1.75}$at night. These are below the range where there is a "low probability of adverse comment" in BS 6472.

8.5. The highest PPV value measured was 8.02mm s^{-1}, with values more-generally in the range 0.01mm s^{-1} to 0.59mm s^{-1} This is significantly below the level at which, according to BS 7385-2:1993, "damage tends towards zero".

8.6. There is therefore no worse than a low probability of adverse vibration effects on occupants of the proposed homes, and a negligible risk of cosmetic damage caused to new buildings.

9.0 Discussion of results

9.1. Where possible uncertainty in the above assessments has been minimised by taking the following steps:

- The meters and calibrators used have a traceable laboratory calibration and meters were field calibrated before and after the measurements.
- Uncertainty in the calculated impacts has been reduced by the use of a well-established calculation method.

10.0 Summary

10.1. Noise Solutions Limited has been commissioned to undertake a planning noise assessment to support the outline planning application for the proposed development of the former Laporte Works Site, Nutfield Road, Nutfield, Surrey. The proposed development includes new homes (Use Class C3) and Integrated Retirement Community (Use Classes C2, E(e), F2), creation of new access, landscaping and associated works to facilitate the development.

10.2. The results of the assessments were analysed and reviewed in line with the aims and advice contained within the National Policy Statement for England, the National Planning Policy Framework and the Planning Practice Guidance and taking into consideration recognised Standards and Guidance for suitable acoustic criteria.

10.3. The assessment shows that suitable internal sound levels can be provided with the provision of suitable glazing and ventilation. Similarly, the required external daytime noise levels are expected to be met when the acoustic screening effects of the proposed dwellings and garden walls and fences is taken into consideration.

10.4. There was no evidence of noise or vibration caused by quarrying or landfill activities in the sites to the west of the proposed development.

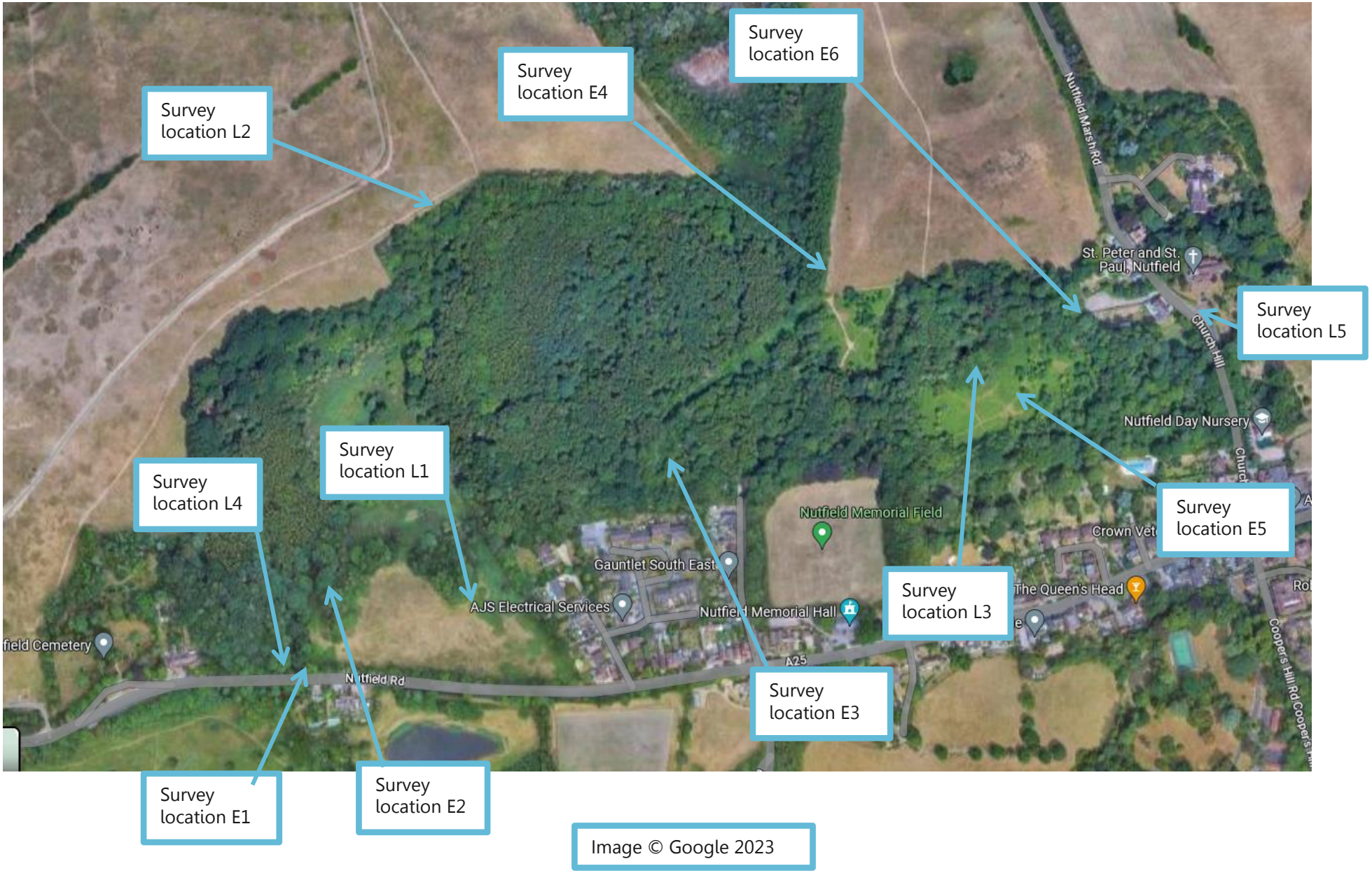
10.5. The site can, therefore, be considered suitable for the proposed development.

10.6. Based on the findings of this assessment, noise should not be grounds for refusal of outline planning permission for the proposed development.

Appendix A Acoustic terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 $\log_{10}$ (s1/s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A –weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level that is exceeded for 90% of the measurement time interval, T. It gives an indication of the lower levels of fluctuating noise. It is often used to describe the background noise level and can be considered to be the "average minimum" noise level and is a term used to describe the level to which non-specific noise falls during quiet spells, when there is lull in passing traffic for example.

Appendix B Aerial photograph of site showing survey locations



Appendix C Plan of proposed development

Adjacent Properties and Boundaries are shown for illustrative purposes only and have not been surveyed unless otherwise stated.
All areas shown are approximate and should be verified before forming the basis of a decision.
Do not scale other than for Planning Application purposes.
All dimensions must be checked by the contractor before commencing work on site.
No deviation from this drawing will be permitted without the prior written consent of the Architect.
The copyright of this drawing remains with the Architect and may not be reproduced in any form without prior written consent.
Ground Floor Slabs, Foundations, Sub-Structures, etc. All work below ground level is shown provisionally. Inspection of ground condition is essential prior to work commencing.
Reassessment is essential when the ground conditions are apparent, and redesign may be necessary in the light of soil conditions found. The responsibility for establishing the soil and sub-soil conditions rests with the contractor.

- Site Boundary
- Accessible Open Space Component
- Development Component
- Integrated Retirement Community Component
- Primary Drive Component

The Components plan is for illustrative purposes only and not a parameter or planning control plan.

Rev Date Description Initials

PROJECT Nutfield Green Park

TITLE: Components Plan

SCALE: 1:2500 @A1

DATE: 10/2023

DRAWING No: SK 24

DRAWN BY: BPV/LL/AA/ATM

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Appendix D Environmental sound and vibration surveys

Details of environmental sound survey

D.1 Measurements of environmental sound levels were measured at five locations on and around the site between 12:15 hours on Thursday 4th May and 13:45 hours on Friday 5th May 2023.

D.2 The sound level meters were programmed to record the A-weighted L_{eq}, L_{90}, L_{10} and L_{max} noise indices for consecutive 15-minute sample periods for the duration of the survey.

Measurement positions

D.3 One sound level meter was located on a lamppost on Church Hill, to the east of the site (location L5 in the aerial view in **Appendix B**), with its microphone approximately 3m above ground level.

D.4 Additional spot measurements were made at Locations L1 to L4. In each case the meter was mounted on a tripod with the microphone approximately 1.2m above the ground.

D.5 In accordance with BS 7445-2:1991 *'Description and measurement of environmental noise – Part 2: Guide to the acquisition of data pertinent to land use'*, all measurements were undertaken under free-field conditions.

Equipment

D.6 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (+/-0.2 dB) in the calibration level was noted.

Location	Description	Model / serial no.	Calibration date	Calibration certificate no.
L1, L2, L5	Class 1 Sound level meter	Svantek 971 / 111624	20/04/2023	1505154-1
	Condenser microphone	ACO Pacific 7052E / 80036		
	Preamplifier	Svantek SV 18 / 112639		
	Calibrator	Svantek SV 33B / 83850	24/10/2022	1503647-1

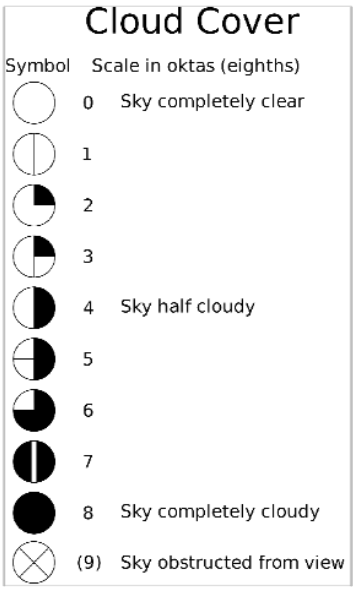
Location	Description	Model / serial no.	Calibration date	Calibration certificate no.
L3, L4	Class 1 Sound level meter	Svantek 977/ 69747	01/08/2022	1503080-1
	Condenser microphone	ACO Pacific 7052E / 70829		
	Preamplifier	Svantek SV12L / 73687		
	Calibrator	Svantek SV30A / 10843	02/11/2022	1503080-2

Vibration meter

Description	Model / serial no.	Calibration date	Calibration certificate no.
Vibration measurement system	SEMEX "Menhir" 18200693	18/11/2022	AcSoft calibration certificate dated 18/11/2022

Weather Conditions

D.7 Weather conditions were determined both at the start and on completion of each survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

Weather Conditions				
Measurement Location	**Date/Time**	**Description**	**Beginning of Survey**	**End of Survey**
As indicated on Appendix B	12:15 4 May – 13:45 5 May 2023	Temperature (°C)	17	14
		Precipitation:	No	No
		Cloud cover (oktas - see guide)	3	6
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Damp	Damp
		Wind Speed (m/s)	1-2	<1
		Wind Direction	SSW	SW
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

Results

D.8 At all locations the noise environment was dominated by road traffic, predominantly on local roads, with aircraft also audible. Traffic on the M23 was just audible when no local traffic was passing.

D.9 The results of the survey are presented in tables and a time history graph below.

Survey position L1

Date & start time	$L_{AFmax\ 1hr}$, dB	$L_{Aeq\ 1hr}$, dB	$L_{A10\ 1hr}$, dB	$L_{A90\ 1hr}$, dB
04/05/2023 12:00	74	55	58	49
04/05/2023 13:00	70	56	58	49
04/05/2023 14:00	72	55	58	49
		Average L_{A10}	58	
		$L_{A10,18hr}$	57	
Calculated using CRTN methodology		**$L_{Aeq,16hr}$**	**55**	
		$L_{Aeq,8hr}$	**48**	

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								dBA
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
04/05/2023 12:00	$L_{eq\ 15min}$	64	60	54	51	52	47	40	29	55
	$L_{fmax\ 15min}$	79	74	71	68	64	62	60	49	67
04/05/2023 12:15	$L_{eq\ 15min}$	65	60	55	51	52	48	41	32	56
	$L_{fmax\ 15min}$	85	75	75	72	74	65	70	65	74
04/05/2023 12:30	$L_{eq\ 15min}$	64	59	53	50	51	47	40	30	55
	$L_{fmax\ 15min}$	78	70	69	65	61	61	60	56	65
04/05/2023 12:45	$L_{eq\ 15min}$	65	59	53	48	51	47	41	34	55
	$L_{fmax\ 15min}$	83	74	69	65	66	64	60	55	68
04/05/2023 13:00	$L_{eq\ 15min}$	65	59	54	50	52	47	41	30	55
	$L_{fmax\ 15min}$	84	77	73	71	67	60	60	53	69

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								dBA
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
04/05/2023 13:15	$L_{eq\ 15min}$	63	60	56	50	51	48	41	31	55
	$L_{fmax\ 15min}$	78	77	76	68	64	59	60	59	67
04/05/2023 13:30	$L_{eq\ 15min}$	65	60	54	50	52	47	41	31	55
	$L_{fmax\ 15min}$	81	77	72	72	64	61	60	55	69
04/05/2023 13:45	$L_{eq\ 15min}$	66	63	56	51	53	48	41	30	57
	$L_{fmax\ 15min}$	83	83	73	72	66	64	64	56	70
04/05/2023 14:00	$L_{eq\ 15min}$	65	60	55	51	53	48	40	31	56
	$L_{fmax\ 15min}$	83	79	75	72	70	69	61	51	72
04/05/2023 14:15	$L_{eq\ 15min}$	64	59	54	50	52	48	40	31	55
	$L_{fmax\ 15min}$	82	76	74	69	65	64	60	53	69
04/05/2023 14:30	$L_{eq\ 15min}$	65	58	53	48	52	47	40	31	55
	$L_{fmax\ 15min}$	81	69	70	64	63	61	64	60	66

Survey position L2

Date & time	$L_{AFmax\ 1hr}$, dB	$L_{Aeq\ 1hr}$, dB	$L_{A10\ 1hr}$, dB	$L_{A90\ 1hr}$, dB
05/05/2023 10:30	75	49	50	41
05/05/2023 11:30	80	54	49	42
05/05/2023 12:30	79	53	52	42
		Average L_{A10}	50	
		$L_{A10,18hr}$	49	
Calculated using CRTN methodology		**$L_{Aeq,16hr}$**	**47**	
		$L_{Aeq,8hr}$	**41**	

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								dBA
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
05/05/2023 10:45	$L_{eq\ 15min}$	56	52	49	46	42	35	40	31	48
	$L_{fmax\ 15min}$	74	68	66	67	60	56	60	54	63
05/05/2023 11:00	$L_{eq\ 15min}$	56	53	50	47	43	37	45	39	50
	$L_{fmax\ 15min}$	70	70	68	66	63	65	74	71	75
05/05/2023 11:15	$L_{eq\ 15min}$	55	50	48	46	42	35	37	38	48
	$L_{fmax\ 15min}$	75	67	69	69	59	50	70	71	70
05/05/2023 11:30	$L_{eq\ 15min}$	55	50	49	46	43	34	35	27	48
	$L_{fmax\ 15min}$	67	66	67	62	54	52	59	48	61
05/05/2023 11:45	$L_{eq\ 15min}$	54	49	46	44	41	32	31	23	45
	$L_{fmax\ 15min}$	69	61	63	62	53	50	54	52	59

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
05/05/2023 12:00	$L_{eq\ 15min}$	60	54	53	52	48	40	29	20	53
	$L_{fmax\ 15min}$	81	71	75	76	72	61	58	48	74
05/05/2023 12:15	$L_{eq\ 15min}$	55	50	46	43	40	32	33	22	45
	$L_{fmax\ 15min}$	68	65	66	53	49	48	54	45	56
05/05/2023 12:30	$L_{eq\ 15min}$	62	58	62	59	54	45	34	22	59
	$L_{fmax\ 15min}$	79	78	85	83	78	68	55	45	80
05/05/2023 12:45	$L_{eq\ 15min}$	54	48	46	43	42	35	27	20	46
	$L_{fmax\ 15min}$	67	62	69	63	53	57	49	48	62
05/05/2023 13:00	$L_{eq\ 15min}$	56	54	51	48	44	34	30	25	49
	$L_{fmax\ 15min}$	68	71	70	64	61	65	59	49	66
05/05/2023 13:15	$L_{eq\ 15min}$	62	59	57	56	53	46	35	26	57
	$L_{fmax\ 15min}$	79	81	77	80	78	73	60	50	79

Survey position L3

Date & time	$L_{AFmax\ 1hr}$, dB	$L_{Aeq\ 1hr}$, dB	$L_{A10\ 1hr}$, dB	$L_{A90\ 1hr}$, dB
05/05/2023 10:45	68	50	53	44
05/05/2023 11:45	83	55	51	44
05/05/2023 12:45	70	51	53	44
		Average L_{A10}	53	
		$L_{A10,18hr}$	52	
Calculated using CRTN methodology		**$L_{Aeq,16hr}$**	**50**	
		$L_{Aeq,8hr}$	**43**	

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								dBA
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
05/05/2023 10:45	$L_{eq\ 15min}$	56	52	50	47	45	42	44	37	51
	$L_{fmax\ 15min}$	71	70	68	67	68	59	63	59	68
05/05/2023 11:00	$L_{eq\ 15min}$	55	52	49	47	44	41	39	31	49
	$L_{fmax\ 15min}$	69	67	68	69	61	56	58	52	66
05/05/2023 11:15	$L_{eq\ 15min}$	56	51	49	46	44	42	43	37	50
	$L_{fmax\ 15min}$	70	68	68	64	60	57	62	56	63
05/05/2023 11:30	$L_{eq\ 15min}$	55	51	48	45	42	39	43	34	49
	$L_{fmax\ 15min}$	66	63	65	62	57	59	62	54	63
05/05/2023 11:45	$L_{eq\ 15min}$	57	53	49	47	45	38	36	31	49
	$L_{fmax\ 15min}$	71	73	65	67	61	61	53	48	66

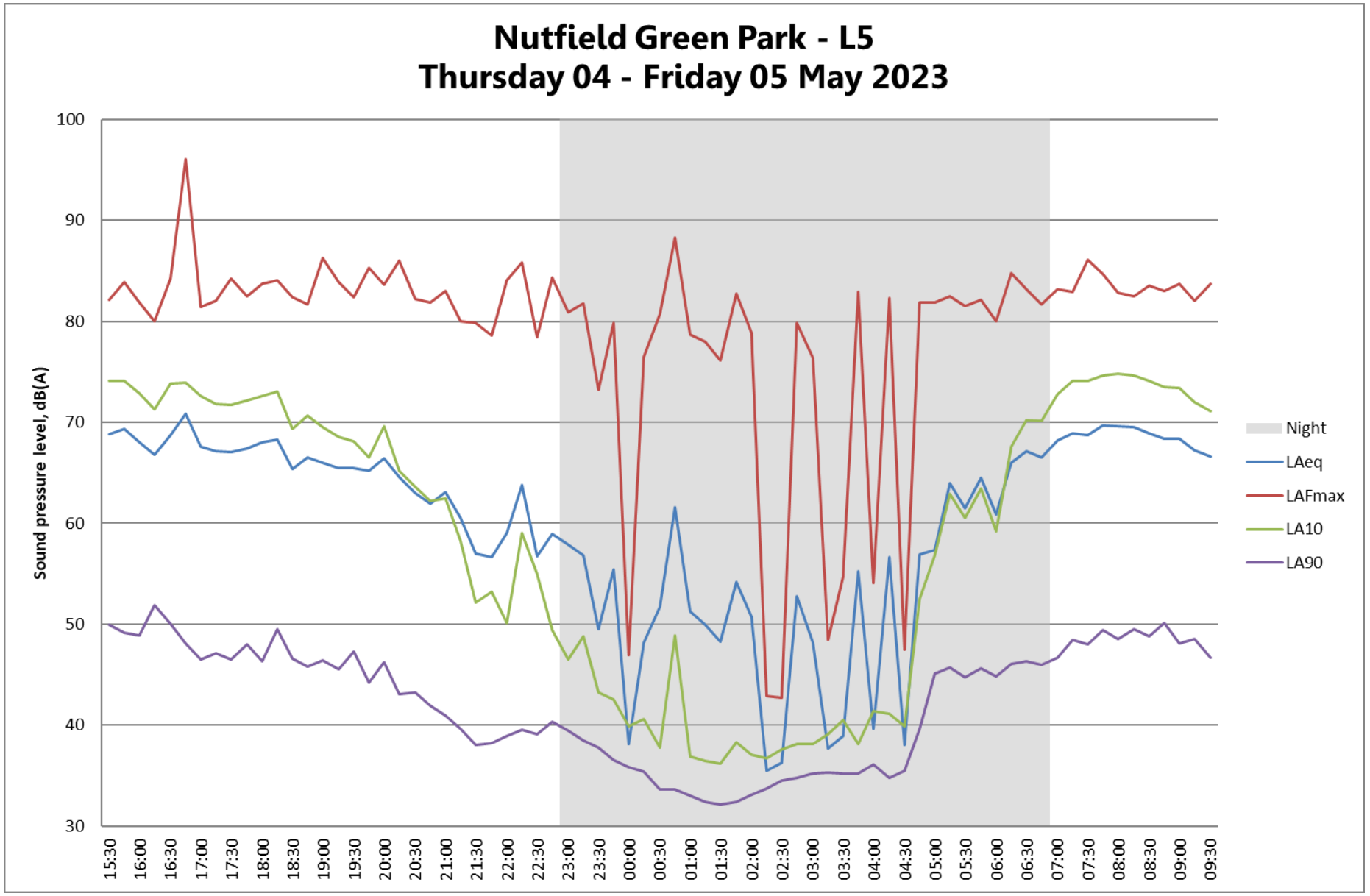
Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
05/05/2023 12:00	$L_{eq\ 15min}$	56	52	47	43	42	38	41	34	48
	$L_{fmax\ 15min}$	67	69	65	60	51	57	57	52	60
05/05/2023 12:15	$L_{eq\ 15min}$	63	60	61	61	54	47	42	36	60
	$L_{fmax\ 15min}$	84	83	84	87	76	71	62	54	83
05/05/2023 12:30	$L_{eq\ 15min}$	56	53	47	42	42	39	47	38	50
	$L_{fmax\ 15min}$	66	61	62	58	54	60	69	63	70
05/05/2023 12:45	$L_{eq\ 15min}$	58	57	53	48	44	38	38	31	50
	$L_{fmax\ 15min}$	68	71	68	67	61	54	53	50	66
05/05/2023 13:00	$L_{eq\ 15min}$	59	56	53	52	48	42	43	33	53
	$L_{fmax\ 15min}$	74	74	71	72	67	59	62	47	70
05/05/2023 13:15	$L_{eq\ 15min}$	58	54	49	48	46	40	40	34	50
	$L_{fmax\ 15min}$	71	70	67	66	68	63	57	49	69
05/05/2023 13:30	$L_{eq\ 15min}$	57	57	52	47	43	36	34	26	49
	$L_{fmax\ 15min}$	69	66	68	67	63	53	51	47	67

Survey position L4

Date & time	$L_{AFmax\ 1hr}$, dB	$L_{Aeq\ 1hr}$, dB	$L_{A10\ 1hr}$, dB	$L_{A90\ 1hr}$, dB
04/05/2023 12:15	88	73	78	50
04/05/2023 13:15	87	73	78	50
04/05/2023 14:15	87	74	78	50
		Average L_{A10}	78	
		$L_{A10,18hr}$	77	
Calculated using CRTN methodology		**$L_{Aeq,16hr}$**	**75**	
		$L_{Aeq,8hr}$	**65**	

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								dBA
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	
04/05/2023 12:15	$L_{eq\ 15min}$	70	67	69	68	71	63	52	46	73
	$L_{fmax\ 15min}$	93	86	87	86	85	86	71	67	88
04/05/2023 12:30	$L_{eq\ 15min}$	68	66	68	67	71	63	52	46	73
	$L_{fmax\ 15min}$	90	85	87	84	85	76	70	67	86
04/05/2023 12:45	$L_{eq\ 15min}$	69	66	68	68	71	63	53	49	73
	$L_{fmax\ 15min}$	93	84	88	84	83	77	73	74	85
04/05/2023 13:00	$L_{eq\ 15min}$	69	67	69	68	71	63	54	47	73
	$L_{fmax\ 15min}$	92	87	88	87	87	78	70	68	88
04/05/2023 13:15	$L_{eq\ 15min}$	69	67	70	68	71	63	53	47	73
	$L_{fmax\ 15min}$	88	89	89	85	86	80	72	69	86
04/05/2023 13:30	$L_{eq\ 15min}$	69	67	68	68	71	63	52	47	73

Date & start time	Parameter	Sound pressure level, dB re 20μPa, at octave band centre frequency, Hz								
		63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBA
	$L_{fmax\ 15min}$	87	90	87	84	85	75	70	73	86
04/05/2023 13:45	$L_{eq\ 15min}$	71	69	69	69	72	64	54	48	73
	$L_{fmax\ 15min}$	90	93	88	85	85	77	74	73	87
04/05/2023 14:00	$L_{eq\ 15min}$	70	69	70	69	72	64	53	47	74
	$L_{fmax\ 15min}$	92	87	91	85	86	79	70	66	87
04/05/2023 14:15	$L_{eq\ 15min}$	69	67	68	68	71	64	53	47	73
	$L_{fmax\ 15min}$	88	83	85	84	83	76	68	73	85
04/05/2023 14:30	$L_{eq\ 15min}$	70	67	68	68	71	64	53	47	73
	$L_{fmax\ 15min}$	92	83	85	84	86	80	72	69	86
04/05/2023 14:45	$L_{eq\ 15min}$	70	70	70	68	72	64	53	48	74
	$L_{fmax\ 15min}$	94	97	92	86	85	78	73	74	87
04/05/2023 15:00	$L_{eq\ 15min}$	70	68	70	69	72	64	54	52	74
	$L_{fmax\ 15min}$	95	90	91	86	85	76	72	80	85


Nutfield Green Park - L5
Thursday 04 - Friday 05 May 2023
Sound pressure level, dB(A)
100
90
80
70
60
50
40
30
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
20:30
21:00
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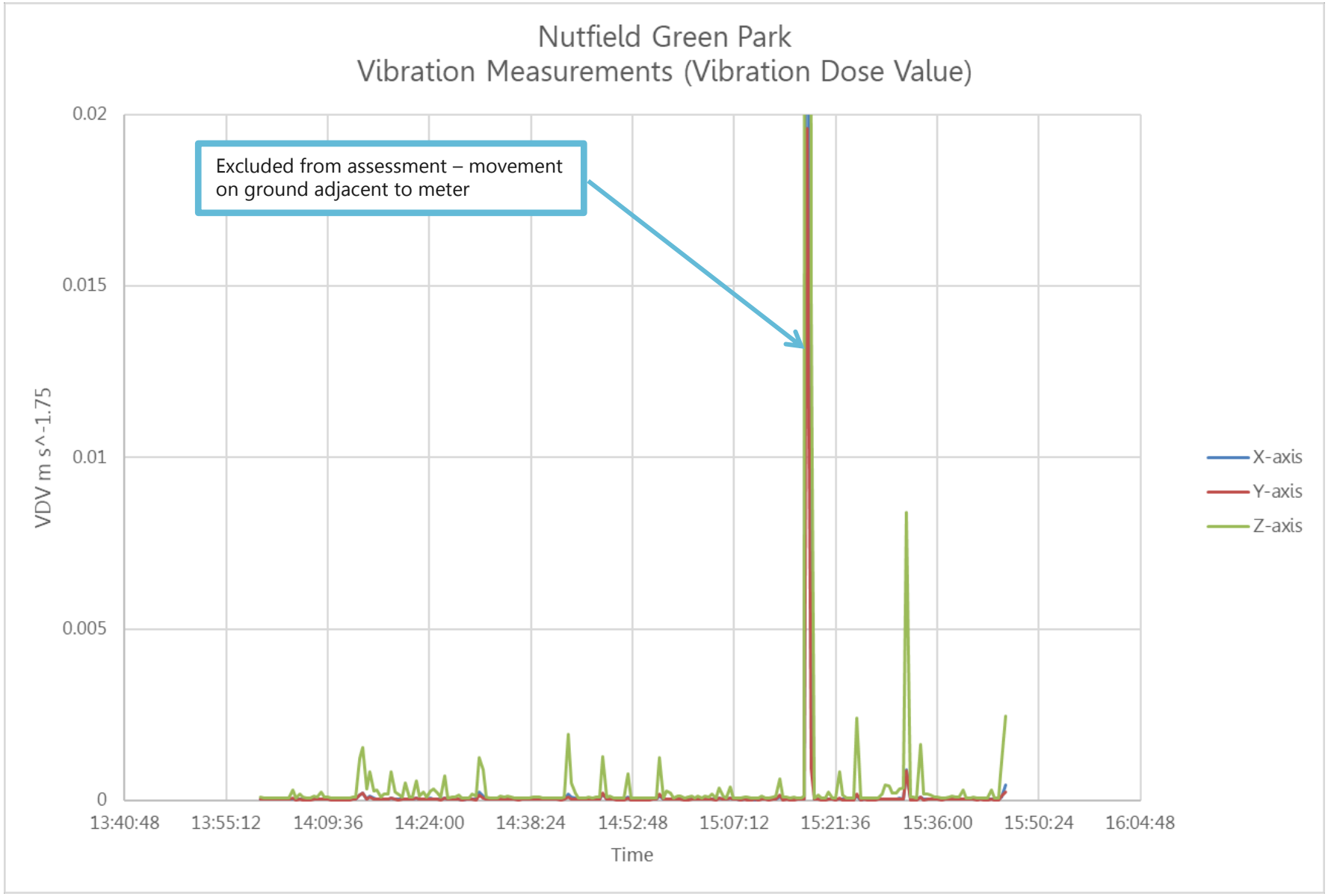
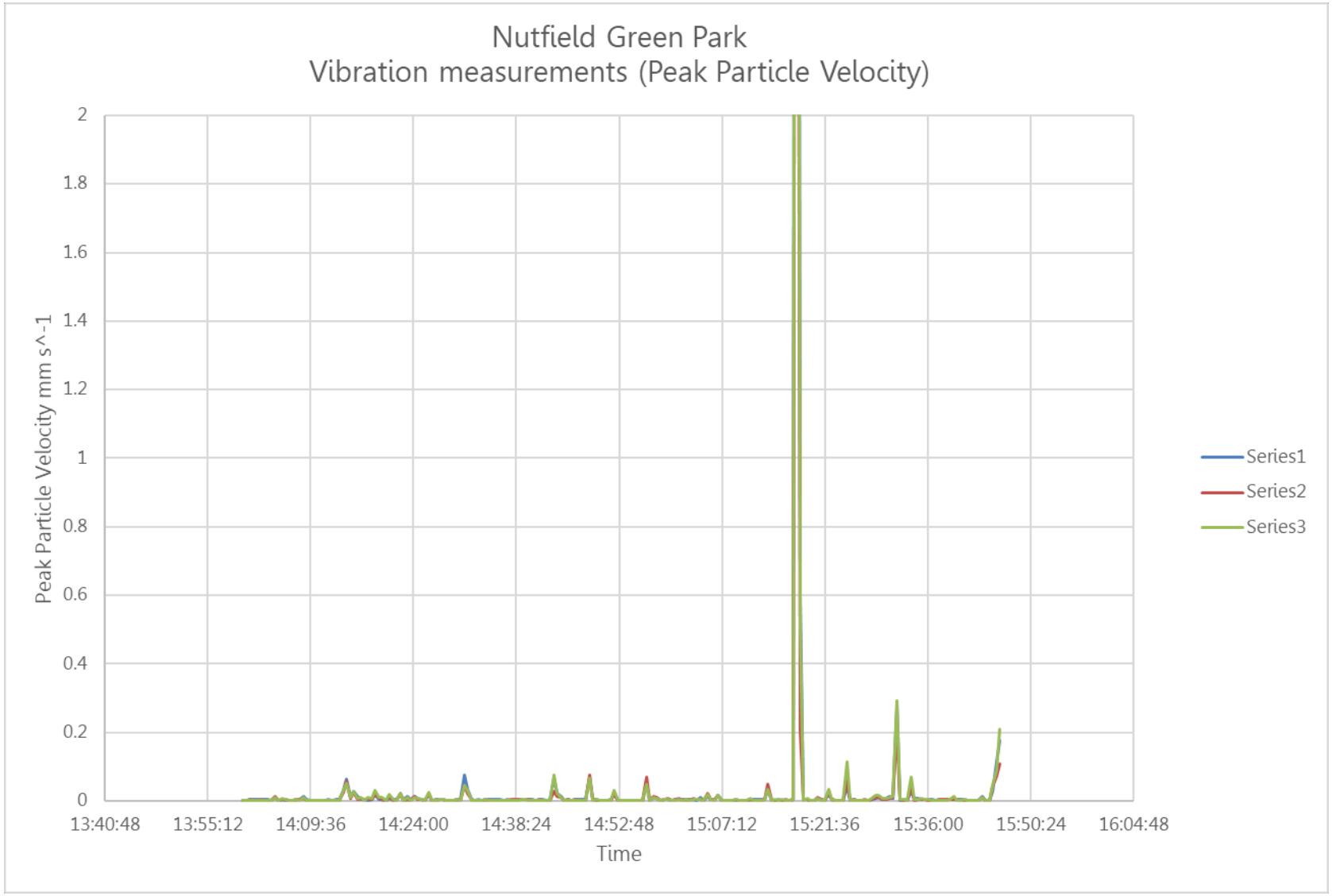
09:00
09:30
Night
LAeq
LAFmax
LA10
LA90


Nutfield Green Park
Vibration Measurements (Vibration Dose Value)
Excluded from assessment – movement on ground adjacent to meter
VDV m s^-1.75
0.02
0.015
0.01
0.005
0
13:40:48
13:55:12
14:09:36
14:24:00
14:38:24
14:52:48
15:07:12
15:21:36
15:36:00
15:50:24
16:04:48
Time
X-axis
Y-axis
Z-axis


Nutfield Green Park
Vibration measurements (Peak Particle Velocity)
Peak Particle Velocity mm s^-1
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
13:40:48
13:55:12
14:09:36
14:24:00
14:38:24
14:52:48
15:07:12
15:21:36
15:36:00
15:50:24
16:04:48
Time
Series1
Series2
Series3

Appendix E Acoustic zone identification