7 NOISE AND VIBRATION

7.1 INTRODUCTION

7.1.1 This Supplementary Environmental Information (SEI) Chapter addresses the likely significant environmental effects of changes to the Proposed Development in terms of the construction and operational phases of the Application Site on the noise and vibration climate of the surrounding area.

7.1.2 Firstly, the relevant legislation and policy which has informed the assessment is presented. The methods that have been followed to obtain the baseline information, subsequent assessment of their value and impacts on these are presented. The Chapter then presents a summary of the baseline conditions at the Application Site.

7.1.3 The Chapter then considers the likely significant environmental effects of the existing and future noise climate on the proposed use of the Application Site, the effect of noise from the Application Site on the existing and future noise climate and the effect of construction noise and vibration on existing and proposed noise sensitive receptors.

7.1.4 Appropriate additional avoidance, mitigation or compensation measures necessary to reduce these effects to an acceptable level are identified, and the significance of any residual effects are finally assessed.

7.1.5 This chapter assesses two development scenarios. These include the Allocation Test scenario and the Application Test scenario. The Allocation Test scenario consists of the full Allocated Development of Policy Villages 5 (i.e. 1,600 dwellings and 1,500 jobs). The Application Test scenario has been allocated for development within the Cherwell Local Plan 2011-2031 (adopted 2015) and consists of 297 dwellings of the Policy Village 5 'Former RAF Upper Heyford' Allocation Site. For consistency, the site will be referred to as "the Application Site" throughout this chapter with additional reference to the development scenario where relevant.

7.2 LEGISLATION AND PLANNING POLICY CONTEXT

National Legislation

7.2.1 There is no national legislation which is directly applicable to the Application Site in terms of the assessment of acoustic and vibration effects.

National Planning Policy

National Planning Policy Framework (2012)

7.2.2 The National Planning Policy Framework (NPPF) was published on 27th March 2012 and outlines the Government's environmental, economic and social policies for England. The NPPF sets out a presumption in favour of sustainable development which should be delivered with three main dimensions: economic; social and environmental (Paragraphs 7 and 14). The NPPF aims to enable local people and their councils to produce their own distinctive local and neighbourhood plans, which should be interpreted and applied in order to meet the needs and priorities of their communities.

7.2.3 In respect of noise, the document states:

> **"The planning system should contribute to and enhance the natural and local environment by […] preventing both new and existing**

> **development from contributing to or being put at unacceptable risk from or being adversely affected by unacceptable levels of [...] noise pollution."**

7.2.4 The NPPF goes on to advise that:

> **"Planning policies and decisions should aim to:**
>
> - **Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;**
> - **Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;**
> - **Recognise that development will often create some noise and existing business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and**
> - **Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."**

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

Noise Policy Statement for England (2010)

7.2.6 The NPSE was published in March 2010. The document seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. It also sets out the long-term vision of Government noise policy:

> **"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."**

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

7.2.8 The first two aims of the NPSE follow established concepts from toxicology that are applied to noise impacts, for example, by the World Health Organisation (WHO). They are:

> **NOEL** – No Observed Effect Level – the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise; and
>
> **LOAEL** – Lowest Observed Adverse Effect Level – the level above which adverse effects on health and quality of life can be detected.

7.2.9 The NPSE extends these to the concept of a significant observed adverse effect level.

> **SOAEL** – Significant Observed Adverse Effect Level – the level above which significant adverse effects on health and quality of life occur.

7.2.10 The NPSE notes:

> **"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times."**

Planning Practice Guidance (2016)

7.2.11 The Planning Practice Guidance (PPG) was launched on the 6th March 2014 and provides additional guidance and interpretation to the Government's strategic policies outlined within the NPPF in a web based resource. This is updated regularly.

7.2.12 With regard to noise, the PPG provides guidance on the effects of noise exposure, relating these to people's perception of noise, and linking them to the NOEL and, as exposure increases, the LOAEL and SOAEL.

7.2.13 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.

7.2.14 The LOAEL is described in PPG as the level above which **"noise starts to cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is not 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."**

7.2.15 PPG identifies the SOAEL as the level above which **"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."**

Guidance

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

7.2.16 British Standard 8233, in relation to the Application Site, sets out desirable guideline values in habitable rooms, such as living rooms and bedrooms.

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

7.2.18 The desirable internal ambient levels for dwellings are presented in **Table 7.1**.

Table 7.1: BS 8233 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 $L_{Aeq, 16\ hr}$	-
Dining	Dining Room/Area	40 dB $L_{Aeq, 16\ hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 8\ hr}$	30 dB $L_{Aeq, 8\ hr}$
*Note 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL of $L_{Amax, f}$ depending on the character and number of events per night. Sporadic noise events could require separate values.			
*Note 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative source of ventilation that does not compromise the façade insulation or the resulting noise level.			
*Note 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.			

* A selection of the available notes

7.2.19 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 recognised that these guideline values are not achievable in all circumstances where development might be desirable.**
>
> **In higher noise areas, such as city centre 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."**

British Standard 7445:2003 'Description and Measurement of Environmental Noise – Part 1: Guide to Quantities and Procedures'

7.2.20 British Standard 7445-1 describes methods and procedures for measuring noise from all sources which contribute to the total noise climate of a community environment, individually and in combination. The results are expressed as equivalent continuous A-weighted sound pressure levels, $L_{Aeq, T}$.

7.2.21 British Standard 7445-1 states that sound level meters that are used should conform the Type 1 (or Type 2 as a minimum) as described in BS EN 61674:2013 Electroacoustics. Sound Level Meters should be calibrated according to the instructions of the manufacturer and field calibration should be undertaken at least before and after each series of measurements.

World Health Organisation, Guidelines for Community Noise (1999)

7.2.22 The World Health Organisation (WHO) Guidelines for Community Noise also sets out guidance on suitable internal and external noise levels in and around residential properties. The following internal noise levels are recommended by the WHO:

- 35 dB $L_{Aeq, T}$ in living rooms over a 16-hour day; and
- 30 dB $L_{Aeq, T}$ in bedrooms during the 8-hour night.

7.2.23 With respect to the night-time maximum noise levels, the WHO guidelines state:

> **"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10 – 15 times per night"**

ProPG; Planning and Noise (2017)

7.2.24 The Professional Practice Guidance on Planning and Noise (ProPG) provides guidance on a recommended approach to the management of noise within the planning system in England.

7.2.25 The scope of ProPG is limited to new residential development that will be predominantly exposed to airborne noise from transport sources.

7.2.26 The guidance is most relevant to new flats and houses, although there may be some relevant with regards to other types of residential units, such as care homes and residential institutions.

7.2.27 Noise sources other than airborne transport (i.e. industrial, commercial, entertainment, etc.) and ground-borne noise and vibration are outside the scope of ProPG.

7.2.28 ProPG uses a two-stage assessment method to determine the suitability of a site for residential development. The stages are as follows:

- Stage 1 – An initial noise risk assessment
- Stage 2 – A systematic consideration of four key elements:
    - Element 1 – demonstrating a "Good Acoustic Design Process";
    - Element 2 – observing internal "Noise Level Guideline";

- Element 3 – undertaking an "External Amenity Area Noise Assessment"; and

- Element 4 – consideration of "Other Relevant Issues".

7.2.29 ProPG recommends that noise levels set out in BS 8233 be used for residential development. However, an additional criterion is proposed by ProPG for night-time L_{Amax} levels. ProPG recommends a criterion of 45 dB $L_{Amax, F}$ between the hours of 23:00 - 07:00. ProPG states:

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

Local Planning Policy

7.2.30 The Cherwell Local Plan 2011 – 2031 was re-adopted following a Court Order and an associated addendum to the Local Plan Inspector's Report.

7.2.31 Policy ESD 15: The Character of the Built and Historic Environment states:

> **"New proposals should:**
>
> **[…] Consider the amenity of both existing and future development, including matters of privacy, outlook, natural lighting, ventilation, and indoor and outdoor space. […]"**

7.2.32 Policy Villages 5: Former RAF Upper Heyford states:

> **"[…] Design and layout should reflect the management and mitigation of noise impacts associated with the development. […]"**

7.2.33 Consultation with Cherwell District Council (CDC) has concluded that outdoor amenity areas should meet the lower recommendation of 50 $dBL_{Aeq, 16 hr}$.

7.3 ASSESSMENT APPROACH

Methodology

7.3.1 The assessment considers the likely impacts from noise and vibration generated as a consequence of the construction and operational phases of the Application Site. The impacts have been evaluated for both the identified receptors and the various elements of the Application Site itself.

7.3.2 A detailed daytime and night-time fully automated environmental sound and vibration survey has been undertaken in order to establish the existing environmental sound and vibration climate at suitable locations around the Application Site.

7.3.3 An acoustic model of the Application Site was prepared using SoundPLAN v 7.4. The model was based on the results of the environmental sound survey and the traffic flows for the surrounding road network, derived from the Transport Assessment (see ES Chapter

6). Traffic flows were in Annual Average Weekly Traffic (AAWT) 18-hour format and are presented in **Appendix 7.1**.

7.3.4 The existing mapping and topography of the Application Site has been included in all model scenarios.

7.3.5 The results of the environmental sound survey have been used to calibrate/validate the computer noise model.

7.3.6 The following scenarios were modelled in accordance with guidance from the Calculation of Road Traffic Noise (CRTN):

- 2016 Baseline
- 2022 Application Test – This is the 'with development' scenario and consists of 297 dwellings of the Policy Village 5 'Former RAF Upper Heyford' Allocation Site.
- 2031 Baseline
- 2031 Allocation Test – This is the 'with development' scenario and consists of the full Allocated Development of Policy Villages 5 (i.e. 1,600 dwellings and 1,500 jobs).

7.3.7 The results of the environmental sound survey have been used to calibrate the acoustic model. The model calibration results are presented in **Appendix 7.2**.

7.3.8 Assessment of the following elements have been carried out in accordance with relevant standards and guidelines detailed in the associated section:

- External Amenity Noise Levels;
- Internal Ambient Noise Levels; and
- Change in Noise Levels due to the Change in Road Traffic Levels.

7.3.9 Mitigation measures have been recommended where the proposed assessment criteria have been exceeded and an adverse impact considered to be likely.

Significance Criteria

7.3.10 In accordance with the NPPF, NPSE, and PPG for noise, Lowest Observable Adverse Effect Level (LOAEL), Significant Observable Adverse Effect Level (SOAEL), and the No Observable Effect Limit (NOEL) have been proposed for each noise and vibration source under assessment.

7.3.11 In respect to EIA regulations, the positive ('beneficial') and negative ('adverse') effect levels of noise and vibration effects have been related to the significance levels presented in the relevant chapter. Based on the descriptions of the adverse effect levels in the PPG for noise (DCLG, 2014), recommended actions for each significance level have been provided. The noise and vibration significance criteria are presented in **Table 7.2**.

Table 7.2: Noise and Vibration Significance Criteria

Significance Level	Noise and Vibration Adverse Effect Level	Impact and Action (to be applied to potential effects)
Major	SOAEL	Noise causes a material change in behaviour and/or attitude. This level should be avoided.
Moderate	-	Noise can be heard and causes small changes in behaviour or attitude. Noise should be mitigated and reduced to a minimum.
Minor	LOAEL	Noise can be heard but does not cause a change in behaviour or attitude. No specific mitigation measures are required.
Negligible	NOEL	Noise has no effect. No specific measures required.

7.3.12 A beneficial effect may be considered to occur where noise levels fall below the NOEL, where specified (i.e. for the operational road traffic noise assessment where there is no change or a decrease in noise levels). Beneficial effects are identified using the same significance criteria, although related to a reduction in noise and vibration levels when compared to the baseline.

Assessing Significance

7.3.13 This section describes the methodology that has been used to determine the LOAEL and SOAEL for each noise and vibration source under consideration.

Construction Noise and Vibration

7.3.14 British Standard 5228:2009+A1 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' does not provide specific limits for construction noise but does define methods of assessing the significance. The standard also provides practical information on demolition and construction noise and vibration reduction measures promoting a 'Best Practice Means' approach to control noise and vibration. A method for determining the sound levels associated with construction activities is also detailed and considers the numbers and types of equipment operating, their associated Sound Power Level (L_w), and the distance to receptors, along with the effects of any screening.

7.3.15 Based on the guidance detailed in the proposed LOAEL and SOAEL for noise and vibration are given in **Tables 7.3** and **7.4**.

7.3.16 Normal construction hours are assumed to be Monday to Friday between 08:00 to 18:00 and Saturday 08:00 to 13:00 and will be controlled through a Construction Environmental Management Plan (CEMP). For any construction noise and vibration outside of these times, agreement with the local Environmental Health Officer will need to be obtained.

LOAEL and SOAEL for Construction Noise

7.3.17 With respect to the LOAEL, the noise levels proposed correspond to the 'lower cut offs' identified in Part 15 of the BS 5228-1.

7.3.18 With respect to the SOAEL, the noise levels proposed in **Table 7.3** correspond to the levels identified in BS 5228-1, that if exceeded for 'Significant' periods of time (either continuous or sporadic) could result in **'Widespread community disturbance, or interference with activities or sleep is likely to occur'**.

Table 7.3: Construction Noise Effect Levels for Permanent Residential Buildings

Day	Time (hours)	Averaging Period, T	LOAEL $L_{pAeq,\ T}$ (dB)*	SOAEL $L_{pAeq,\ T}$ (dB)*
Monday to Friday	08:00 – 18:00	10 hours	65	75
Saturdays	08:00 – 13:00	5 hours	65	75

*The measured levels should be monitored in order to ensure that the levels in the table are not exceeded for a period of 10 or more days of working in any 15 consecutive days for a total number of days exceeding 40 in any six consecutive months.

LOAEL and SOAEL for Construction Vibration

7.3.19 With respect to the LOAEL, the vibration level proposed corresponds to a level defined by BS 5228-1 as likely to cause complaint in residential environments, but can be tolerated if prior warning and explanation is given to residents (**Table 7.4**).

7.3.20 With respect to the SOAEL, the vibration level proposed corresponds to a level defined by BS 5228-1 as likely to be intolerable for more than a brief exposure.

Table 7.4: Construction Vibration Effect Levels for Permanent Residential Buildings

Day	Time (hours)	LOAEL PPV mm/s	SOAEL PPV mm/s
Monday to Friday	08:00 – 18:00	1	10
Saturdays	08:00 – 13:00	1	10

Construction Traffic Noise

7.3.21 Construction traffic noise has been assessed by considering the short-term increase in traffic flows during construction works following the principles of CRTN and the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 7.

7.3.22 The criteria for the assessment of the magnitude of impact due to road traffic noise changes arising from construction works have been taken from Table 3.1 of DMRB and are provided here in **Table 7.5**.

Table 7.5: Change in Noise Levels Due to Construction Traffic Road Noise

Adverse Effect Level	Change in Noise Levels in Short-term due to Construction Traffic (dB)
SOAEL	3.0
LOAEL	1.0
NOEL	0

Operation Stage – LOAEL for Transportation Airborne Noise Affecting Outdoor Amenity Areas

7.3.23 With respect to the daytime noise level, the information used to support the WHO guidelines for Community Noise note that daytime sound levels of less than 50 dB $L_{Aeq, Day}$, cause little or no serious annoyance in the community with an upper limit of 55 dB.

7.3.24 Based on the above, outdoor sound levels of 50-55 dB $L_{Aeq, Day}$ are considered the LOAELs for operational airborne noise.

Operation Stage – SOAEL for Transportation Airborne Noise Affecting Outdoor Amenity Areas

7.3.25 Sound levels of 65 dB $L_{Aeq, Day}$ are considered to be the SOAEL for operational airborne noise from increase in road traffic.

7.3.26 The daytime SOAEL is consistent with the daytime trigger level in the UK's Noise Insulation Regulation.

Operation Stage – LOAEL and SOAEL for Transportation Airborne Noise Affecting Indoor Residential Levels

7.3.27 Incident façade levels should not be considered in isolation of the sound reduction provided by the external building fabric. Planning Policy Guidance states that:

> **"Consideration should also be given whether 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. In both case a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations."**

7.3.28 Based on advice within BS 8233:2014, an indoor noise level of 35 dB $L_{Aeq, 16\ hr}$ during the daytime and 30 dB $L_{Aeq, 8\ hr}$ during the night-time may be considered as the LOAEL for transportation noise.

7.3.29 Similarly, we consider an indoor noise level of 50 dB $L_{Aeq, 16\ hr}$ and 45 dB $L_{Aeq, 8\ hr}$ during the night-time may be considered as the SOAEL for transportation noise.

7.3.30 The WHO Guidelines for Community Noise also identify an external noise level of 60 dB L_{AFmax} as the guideline value for sleep disturbance with the windows open. For this reason, an internal noise level of 45 dB L_{AFmax} (allowing for a 15 dB in external sound levels provided by an open window) is considered the LOAEL for maximum noise levels.

7.3.31 The WHO Night Noise Guidelines for Europe note that adverse effects on sleep can be avoided if the maximum noise level inside the bedroom does not exceed 45 dB L_{AFmax} for more than 10 – 15 times per night. **Table 7.6** summarises LOAEL and SOAEL inside the different areas of permanent residential buildings.

Table 7.6: Internal and External Noise Criteria for Habitable Rooms Due to Transportation Noise

Level	**Proposed LOAEL and SOAEL Levels for Transportation Noise Affecting New Residential Premises**	
	Daytime (07:00 – 23:00 hours)	**Night-time (23:00 – 07:00 hours)**
Internal Noise Levels		
LOAEL	35 dB $L_{Aeq, 16\ hr}$	30 dB $L_{Aeq, 8\ hr}$
		45 dB L_{Amax}
SOAEL	50 dB $L_{Aeq, 16\ hr}$	45 dB $L_{Aeq, 8\ hr}$
External Amenity Areas (Free Field Levels)		
LOAEL	50-55 dB $L_{Aeq, 16\ hr}$	N/A
SOAEL	65 dB $L_{Aeq, 16\ hr}$	N/A

Operation Stage – Road Traffic Noise

7.3.32 The impact of the Application Site on the noise climate of the surrounding area is based on the change in noise levels at noise sensitive receptors due to a change in the volumes of road traffic generated by the Development.

7.3.33 The DMRB suggests that an increase in traffic flow of 25 % will result in an increase in noise level of 1 dB, assuming other factors (such as vehicle speed and mix) remain the same, a change of 3 dB is the minimum perceptible under normal conditions and is accepted as the threshold of human perception of a change in noise levels in the long term. Additionally, an increase or decrease of 10 dB is considered to be a doubling or halving of loudness, respectively.

7.3.34 The DMRB provides two magnitude scales of impact for the change in noise levels in the short-term and in the long-term. These are summarised in **Table 7.7** below.

Table 7.7: Change in Noise Levels Due to Operational Road Traffic Noise

Adverse Effect Level	Change in $L_{A10,\ 18\ hr}$ Noise Levels in Long-term due to Road Traffic	Significance Level
SOAEL	10+	Major
	5 to 9.9	Moderate
LOAEL	3 to 4.9	Minor
	0.1 to 2.9	Negligible
NOEL	0	No Change

7.3.35 A change in noise level in the short-term is assessed by comparing the completion year 'with development' and completion year 'without development' scenarios. A change in noise level in the long-term is assessed by comparing the future assessment year 'with development' and the opening year 'without development' scenarios.

7.3.36 The road traffic assessment will be in accordance with the supplied traffic flow information.

Operation Stage – Road Traffic Vibration

7.3.37 The DMRB provides broad advice on the assessment of road traffic vibration, noting that ground-borne vibration resulting from road traffic is difficult to accurately predict and that it is extremely unlikely to cause damage to buildings. Notwithstanding this, the DMRB does recognise that ground-borne vibration can cause disturbance to residents where the sub-grade is soft, the road surface is uneven and/or when dwellings are within a few metres of the carriageway.

7.3.38 The DMRB provides guidance on ambient levels of vibration as Peak Particle Velocities (PPV), stating that for traffic vibration a PPV of 0.3 mm/s measured on a floor in the vertical direction is on the threshold of perceptibility. As such, the threshold criterion for traffic induced vibration is a PPV rise to above a level of 0.3 mm/s or where an existing PPV above 0.3 mm/s is predicted to increase. PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and are typically below 1 mm/s. DMRB states that it is unlikely that structural damage to buildings will occur below 10 mm/s.

7.3.39 DMRB recommends that the effects of vibration should be considered where appropriate. In the case of ground-borne vibration, the likelihood of perceptible vibration being caused is particularly dependent upon the smoothness of the road surface. Research has shown that vibration levels caused by heavy vehicles travelling at 110 km/h over a 25 mm hump (i.e. a large discontinuity consistent with a poorly backfilled trench) could cause perceptible vibration at up to 40 m from the road. This would infer that it is unlikely that significant levels of vibration would be generated at distances greater than this. Also, with a newly laid road surface it is a requirement of new highway construction specification that the surface would be smooth and free from any discontinuities of this magnitude. DMRB Vol.11, Section 3, Part 7 HA 213/11 Annex 5, paragraph A5.26 states such vibrations are unlikely to be important when considering disturbance from new roads and an assessment would only be necessary in exceptional circumstance.

7.3.40 The DMRB covers the potential for airborne noise, from heavy goods vehicles, to cause vibration nuisance close to main roads, as an indication of the scale of impact relative to noise effects, the guidance in DMRB paragraph HA 213/11, Annex 6, paragraph A6.21, states that for a given level of noise exposure the percentage of people bothered "very much" or "quite a lot" by vibration is 10 % lower than the corresponding figure for noise nuisance. On average traffic vibration is expected to affect a very small percentage of people at exposure levels below 58 dB $L_{A10,\ 18\ h}$. Also, the significance of any change in airborne traffic vibration can be considered proportional to the significance of change in traffic noise. As such the assessment of airborne can be considered to be included within the assessment of airborne noise.

7.3.41 On the basis of the above, proposed LOAEL and SOAEL values to be used for assessment of the Proposed Development are stated in **Table 7.8** below for operational road traffic vibration.

Table 7.8: Proposed LOAEL and SOAEL due to Operational Road Traffic Vibration

Lowest Observed Adverse Effect Level PPV mm/s	Significant Observed Adverse Effect Level PPV mm/s
0.3	3

Scoping Criteria

7.3.42 The purpose of this assessment is to present the likely impact of the Application Site on the local sound and vibration climate during the construction and operational stages.

Study Area

7.3.43 The Study Area for the construction stage is defined by the noise and vibration sensitive receptors that have the potential to be affected by sound and vibration caused by construction activities.

7.3.44 For the operational stage of the development the Study Area also includes the noise sensitive receptors in the local area that are most likely to be affected by the change in noise levels caused by the operation of the Application Site.

Noise and Vibration Sensitive Receptors

7.3.45 In this context receptors are defined as those aspects of the environment sensitive to changes in the baseline sound and vibration climate. The sensitivity of a particular receptor depends upon the extent to which it is susceptible to such changes.

7.3.46 Due to the size of the development and the surrounding area a selection of noise and vibration sensitive receptors have been identified. **Table 7.10** provides details of noise and vibration sensitive receptors identified. **Figure 7.1** details the approximate locations of the identified receptors along with a reference letter as defined in **Table 7.9** below.

Table 7.9: Noise Sensitive Receptors

Reference	Receptor
A	Dwellings and Existing School along Camp Road
B	Dwellings along Somerton Road
C	Dwellings along Station Road, Lower Heyford
D	Dwellings in Somerton
E	Dwellings along Lower Heyford Road
F	Dwellings in Middleton Stoney
G	Dwellings along Somerton Road (North of Airfield)
H	Dwellings in Ardley

7.3.47 For clarity, individual receptors have been grouped where appropriate; however, in all cases where there are a number of grouped receptors, impacts at the worst case receptor within the group have been considered.

7.3.48 There are receptors further from the Application Site that may experience changes in noise and vibration levels due to changes in road traffic levels. Due to the potential number of receptors they have not been specifically identified but have been considered as part of the wider assessment of the impact of the change in road traffic levels.

7.3.49 Accordingly, the acoustic and vibration assessment considers the following potential effects:

- Demolition and Construction Phase Noise – impact on existing receptors;
- Demolition and Construction Phase Vibration – impact on existing receptors; and
- Operational Phase Noise – impact on existing and proposed receptors.

Limitations to the Assessment

7.3.50 Due to the size of the development and the surrounding area, a limited selection of noise sensitive receptors has been identified to represent the worst case change to the environmental noise climate.

7.3.51 Due to the outline nature of the application, the assessments undertaken are appropriate in the context of available information at the time.

7.3.52 Precise details of the types of construction methods and plant likely to be used during the construction phases have yet to be formulated. Therefore, at this stage in the scheme's design, it is not possible to state precisely where plant will operate and for how long during the working day.

7.3.53 It is assumed that outdoor incident noise levels in external areas used for amenity (i.e. gardens/balconies) are only of concern during the daytime hours, as people are unlikely to make frequent use of the outdoor amenity areas during night-time hours.

7.4 BASELINE CONDITIONS

The Current Baseline

Environmental Sound Survey

7.4.1 An environmental sound survey was undertaken between approximately 10:15 hours on 14th June 2017 and 12:30 hours on 15th June 2017 at two locations across the Application Site. The environmental sound survey methodology was agreed by the local Environmental Health Officer.

7.4.2 Due to the nature of the unmanned survey, it is not possible to accurately comment on the weather conditions throughout the entire survey period. However, at the beginning and end of the survey period the wind conditions were moderate and the sky was generally clear. It is understood that generally throughout the survey periods the weather conditions were mainly clear with some cloud coverage[1]. These conditions are considered suitable for obtaining representative environmental noise levels.

7.4.3 Measurements of the A-weighted (dBA) L_{10}, L_{90}, L_{eq}, and L_{max} sound pressure levels were taken continuously at 15-minute intervals over a 24-hour period between 14th June 2017 and 15th June 2017.

7.4.4 Unattended continuous environmental sound measurements were undertaken at the two locations. **Table 7.10** describes the survey locations and **Figure 7.2** presents the approximate locations of the sound survey positions.

Table 7.10: Sound Measurement Locations

Measurement Location	Description	Dominant Noise Source
LT 1	The microphone was located in the south-west corner adjacent to Kirtlington Road. The microphone was located in a free field position approximately 8 m from the carriageway edge and 1.5 m from ground level.	Road Traffic Noise from Kirtlington Road
LT 2	The microphone was located to the north of the Application Site along Camp Road. The microphone was located in a free field position approximately 3 m from the carriageway edge and 1.5 m from ground level.	Road Traffic Noise from Camp Road

7.4.5 Locations LT 1 and LT 2 were selected in order to establish the typical incident road traffic noise levels in relation to the Application Site at locations considered representative of the likely proposed residential dwellings.

7.4.6 A large range of statistical noise parameters was acquired, but the A-weighted sound parameters $L_{Aeq, T}$, $L_{A90, T}$ and L_{AFmax} are considered to be the most relevant in the context of planning and noise (these parameters are described in **Appendix 7.3**)

[1] https://www.wunderground.com/history/airport/EGUB/2017/6/14/DailyHistory.html?req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=

7.4.7 The instrumentation used to measure the environmental sound climate is presented in **Appendix 7.4**.

7.4.8 On-site calibration checks were performed before and after all measurements with no significant deviation being observed. The sound level meters and calibrators have valid laboratory calibration certificates, which are available upon request.

7.4.9 Manufacturer's windshields were fitted over the microphone at all times during the survey periods.

7.4.10 The noise survey was completed in general accordance with the guidance in BS 7445: 'Description and Measurement of Environmental Noise. Guide to Quantities and Procedures'.

Unattended Environmental Noise Survey Results

7.4.11 Results of the environmental noise survey are presented in **Appendix 7.5**. The results have also been plotted on Time History Graphs enclosed in **Appendix 7.6**. These present the 15-minute A-weighted (dBA) L_{10}, L_{90}, L_{eq}, and L_{max}, levels at the measurement positions throughout the duration of the survey. A summary of these results is presented in **Table 7.11** below.

Table 7.11: Summary of Sound Survey Results

Location	Period, T	$L_{Aeq, T}$ (dBA)	Typical $L_{Amax, T}$ (dBA)	Typical $L_{A90, T}$* (dBA)
LT 1	Daytime (07:00 – 23:00)	54	N/A	34
	Night-time (23:00 – 07:00)	48	70	20
LT 2	Daytime (07:00 – 23:00)	65	N/A	35
	Night-time (23:00 – 07:00)	57	80	22

*Based on an average of the 10th highest measured L_{Amax} level

7.5 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

7.5.1 This section identifies the potential effects of the Application Site, factoring in mitigation by design, but in the absence of further mitigation. The effects are identified separately for the construction and post-completion stages

7.5.2 Following this initial assessment, appropriate mitigation measures are set out to address any significant adverse effects identified.

7.5.3 Once all mitigation measures have been considered, the residual effects are then assessed and detailed.

Construction

Demolition and Construction Noise

7.5.4 Demolition and construction noise has the potential to cause an adverse impact at existing noise sensitive receptors.

7.5.5 Precise details of the types of construction methods and plant likely to be used during the construction phases have yet to be formulated. Therefore, at this stage in the scheme's design, it is not possible to state precisely where plant will operate and for how long during the working day.

7.5.6 In accordance with guidance set out in BS 5228, noise levels have been calculated for a maximum worst case situation over 1-hour assuming that plant will operate at its closest point to each receptor in the absence of mitigation. In practice, noise levels would tend to be lower due to greater separation distances and screening effects, and they would also tend to reduce over a 10 – 12 hour working day due to periods of plant inactivity.

7.5.7 The main demolition phases are likely to include breakers, crushers and site clearance. Any internal stripping out prior to demolition is unlikely to be a significant source of noise or vibration for local receptors.

7.5.8 The main construction phases are likely to include site levelling/clearance, ground excavation/drainage channel creation, concreting, building construction and road construction. The building construction phase, and the servicing and fitting out of new buildings, is normally not a significant source of noise or vibration for local receptors.

7.5.9 Details of typical demolition and construction plant noise levels at the standard reference distance of 10 m provided by BS 5228 Part 1 (BSI, 2014b), in the absence of noise controls such as screening and operational constraints, are given below in Table 7.12. Highest noise levels tend to be associated with plant that will be employed during demolition, earthmoving and concreting.

Table 7.12: Typical Demolition and Construction Plant Noise Levels

Plant	**Typical $L_{Aeq, T}$ at 10 m (dB)**
Crusher	84
Breaker	92
Earth Moving	84
Supply Vehicles	80
Auger Piling	85
Truck Concrete Mixer	80
Poker Vibrators	84

Plant	**Typical $L_{Aeq, T}$ at 10 m (dB)**
Crane	74
Vibratory Roller	76
Asphalt Spreader	80
Wheeled Loader	76
Compressors	74
Welding Generators	42

7.5.10 Prior to there being specific details on the phasing and siting of construction activities, this information has been used to derive indicative noise levels at selected distance bands from the Application Site boundary using the data and procedures of BS 5228, and the results are presented in **Table 7.13**.

Table 7.13: Predicted Indicative Demolition and Construction Noise Levels $L_{Aeq, 1 hr}$

Activity	**$L_{Aeq, 1 hr}$ Noise Levels (dB) at Various Distances from Demolition/Construction Site (Phase) Boundary**						
	10 m	**15 m**	**20 m**	**30 m**	**40 m**	**50 m**	**100 m**
Demolition	93	89	87	83	81	78	73
Earth Moving	85	81	79	75	73	71	65
Concreting	86	82	80	76	74	72	66
Road Pavement	80	76	74	70	68	66	60

7.5.11 Any plant operating along a construction site boundary would have the ability to generate noise levels above the suggested daytime SOAEL of 75 dB $L_{Aeq, 10 hr}$ up to distances of approximately 30 m from the construction site/phase boundary. Therefore, construction plant operating on any particular site will have the potential to affect noise-sensitive dwellings located immediately adjacent to the Application Site boundary, such as noise sensitive receptors located at Position A on **Figure 7.1**. However, in practice, the main construction activities such as ground excavation works and new build construction will tend to take place slightly further into the Application Site, or only affect a limited number of dwellings for a temporary period at any given time during each construction phase. Plant will only have to progress a relatively short distance away from each existing receptor before noise levels fall below the typical construction noise criterion.

7.5.12 In these assumed worst case circumstances, without mitigation, the effect of construction is likely to be a temporary moderate adverse impact which is not deemed to be significant.

Demolition and Construction Traffic Noise

7.5.13 Construction traffic noise can be assessed by considering the short-term increase in traffic flows during the construction works following the principles of CRTN and the DMRB, Volume 11, Section 3, Part 7.

7.5.14 Construction traffic flows have been predicted based on construction occurring over an 11 year period (2018 – 2028). The flows are then averaged over this build out period. Based on the flows provided it is unlikely that there will be an increase in road traffic flows due to construction traffic of any more than 25 %. In view of the guidance set out in DMRB this increase in road traffic flow would result in a negligible increase in noise levels of < 1dB during the construction period due to construction traffic.

Demolition and Construction Vibration

7.5.15 British Standard 5228 indicates that construction activities (particularly piling) generate vibration impacts when they are located less than 20 m from noise sensitive locations. The impact depends on the type of piling, ground conditions, and receptor distance.

7.5.16 Based on calculations procedures presented in BS 5228, a vibration sensitive receptor which is located within 20 m of piling activity could be subject to significant impact.

7.5.17 In comparison to the BS 7385 vibration thresholds for cosmetic damage to structures, the example vibration levels from piling are below the BS 7385 thresholds for cosmetic damage to structures (i.e. surrounding residential structures). As such, it is considered unlikely that cosmetic damage to the adjacent sensitive structures will occur.

7.5.18 It is worth noting that the above assessment of potential construction vibration effects is based upon a theoretical worst case assessment that driven piles will be required within 20 m of existing nearby sensitive receptors.

Operation

External Noise Levels – Proposed Dwellings – Allocation Test Scenario

7.5.19 It is assumed that outdoor incident noise levels in external areas used for amenity (i.e. gardens/balconies) are only of concern during the daytime hours, as people are unlikely to make frequent use of the outdoor amenity areas during night-time hours.

7.5.20 **Figure 7.3** presents the daytime $L_{Aeq,\ 16\ hr}$ noise level contours across the Application Site at a height of 1.5 m for the 2031 With Development “Allocation Test” scenario. The 2031 With Development “Allocation Test” scenario is considered to be the worst-case scenario due to having higher flows across the network.

7.5.21 The results show that the majority of the Application Site is likely to meet the LOAEL criteria for external amenity areas.

7.5.22 However, for areas of residential development proposed directly adjacent Camp Road and Kirtlington Road, the suggested daytime SOAEL are likely to be exceeded.

7.5.23 The impact is deemed to be negligible, except areas adjacent to Camp Road and Kirtlington Road, where there is a minor adverse impact.

External Noise Levels – Proposed Dwellings – Application Test Scenario

7.5.24 **Figure 7.4** presents the daytime $L_{Aeq,\ 16\ hr}$ noise level contours across the Application Site at a height of 1.5 m for the 2031 With Development "Application Test" Scenario. The results are slightly lower to the levels presented for the "Allocation Test" scenario and therefore the Allocation Test is the worst case scenario upon which mitigation should be considered.

Internal Noise Levels – Proposed Dwellings – Allocation Test Scenario

7.5.25 The calculated incident sound levels provided in **Figures 7.3** and **7.5** have been reviewed and used to determine the likely internal sound levels in the proposed dwellings, across the Application Site.

7.5.26 Exact construction proposals are yet to be determined, however a preliminary assessment has been undertaken based on typical construction details (brick/block cavity wall/timber frame constructions with conventional double-glazed windows, trickle ventilators and tiled roofs).

7.5.27 **Table 7.14** details the approximate reductions that could typically be expected from the assumed building fabric constructions.

Table 7.14: Typical Sound Reductions of Various Building Fabric Constructions

Construction	**Typical Attenuation (dB)**
Conventional Double Glazing (4/16/4)*	30
Conventional Trickle Ventilator	30
Brick/Block Cavity Wall	50
Timber Frame with Lightweight Cladding	43
Tiles on Timber Joists with Plasterboard Ceilings and Thermal Insulation	40-45

*4mm Glass / 16 mm Air Gap / 4 mm Glass

7.5.28 Based on the results of the noise survey and acoustic modelling and the assumed building fabric constructions, the suggested desirable internal noise levels are likely to be met during both the daytime and night-time periods for the majority of the Application Site. Properties fronting onto Camp Road and Kirtlington Road are unlikely to meet internal noise criteria without further mitigation.

7.5.29 The impact is deemed to be negligible, except areas adjacent to Camp Road and Kirtlington Road where there is a minor adverse impact**.**

Internal Noise Levels – Proposed Dwellings – Application Test Scenario

7.5.30 The calculated incident sound levels provided in **Figures 7.4** and **7.6** have been used to determine the likely internal sound levels in the worst case proposed dwellings, across the Application Site. The results and conclusions are similar to those presented for the "Allocation Test" scenario.

Road Traffic Noise Assessment – Allocation Test Scenario

7.5.31 The assessments of road traffic noise implement the noise prediction procedures as detailed in CRTN. The assessment uses criteria to compare changes between the existing traffic noise levels and the potential future traffic noise levels at nearby noise sensitive receptors.

7.5.32 The noise assessment considers the 18-hour AAWT information presented in **Appendix 7.1**, and will compare the future baseline traffic flows against the predicted future traffic flows associated with the Application Site.

7.5.33 **Figure 7.7** presents the change in the $L_{10,\ 18\ hr}$ noise levels due to road traffic. The comparison is made between the 2031 Without Development and the 2031 With Development "Allocation Test" scenario. Both scenarios include committed developments within.

7.5.34 With the Proposed Development in place the impact on all of the existing dwellings within the local area around the Application Site remain below the proposed LOAEL criteria and are deemed minor/negligible.

Road Traffic Noise Assessment – Application Test Scenario

7.5.34.1 Due to the larger development, the Allocation Test is considered the worst case. Road traffic impacts associated with the Application Test are not considered to be significant and are below those presented in the Allocation Test scenario.

7.6 MITIGATION AND ENHANCEMENT

Additional Mitigation

Construction Stage

7.6.1 British Standard BS 5288: Parts 1 and 2 are to be adopted as the basic code of practice for the management of construction noise for the Application Site.

7.6.2 Construction Environmental Management Plans (CEMPs) will be prepared in advance of construction, as described in Chapter 2 of the ES (2016), that set out measures to manage the construction works. The following advice is based upon guidance provided in BS 5228 and will be applied as appropriate through the CEMPs, which would be secured through a suitable planning condition in order to minimise noise from the construction activities affecting noise sensitive receptors:

- Appropriate operational hours, to exclude work during the night-time and during Sundays and public holidays;

- Ensuring the use of quiet working methods, the most suitable plant and reasonable hours of working for noisy operations, where reasonably practicable;

- Locating noisy plant and equipment as far away from dwellings or sensitive receptors as reasonably possible and where practical, carry out loading and unloading in these areas;

- Screening plant to reduce noise which cannot be reduced by increasing the distance between the source and the receiver (i.e. by installing noisy plant and equipment behind large site buildings;

- Compressors should be fitted with properly lined and sealed acoustic enclosures where environmental noise disturbance may arise and these should be kept closed whenever the machines are in use;

- Orienting plant that is known to emit noise strongly in one direction so that the noise is directed away from dwellings or sensitive receptors, where possible;

- Closing acoustic covers to engines when they are in use or idling;

- Work to keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern; and

- Lowering materials slowly, whenever practicable, and not dropping them.

7.6.3 Mitigation measures would be reviewed and a further quantitative assessment of construction noise mitigation would be undertaken when a principal contractor has been appointed for each phase of the development and detailed method statements and the detailed construction programme are available.

7.6.4 With appropriate mitigation measures in place, the effect is deemed to be negligible.

Operational Phase

Dwellings – External Amenity Areas

7.6.5 Noise levels have been predicted across the development during the daytime. It shows that the majority of the Application Site would experience noise levels of below 55 dB $L_{Aeq,16hrs}$. However, dwellings overlooking Camp Road and Kirtlington Road are likely to exceed 55 dBA $L_{Aeq,16hour}$. Therefore, mitigation measures are likely to be required for external private amenity areas positioned in these locations.

7.6.6 For the majority of dwellings adjacent to Camp Road and Kirtlington Road, the planning layout presents gardens positioned behind the dwellings they serve and this is likely to provide sufficient shielding from the road source such that further external amenity criteria are met. For gardens which have a direct line of sight onto Camp Road and Kirtlington Road, 1.8m screen walls are proposed as boundary treatments. We would recommend that these walls are solid with no gaps with a surface density of at least 10kg/m^2 in order that they provide appropriate acoustic shielding. With this boundary treatment, the LOAEL in external amenity areas is likely to be met.

7.6.7 With appropriate mitigation measures in place, the effect is deemed to be negligible.

Dwellings - Internal Noise Levels

7.6.8 Based on the initial assessment, properties fronting onto Camp Road and Kirtlington Road are likely to require uprated acoustic glazing and ventilation.

7.6.9 A detailed assessment would be undertaken during detailed design in order to ascertain the exact acoustic specification requirements for the various elements of the external building fabric. The final design proposals during the detailed stage may differ from the suggested constructions identified in **Table 7.14**.

7.6.10 Typically, the acoustic performance of double glazing can be improved by increasing the air gap and/or the glass thickness with particular improvements achieved using differing glazing thicknesses for inner and outer panes.

Ventilation can be upgraded by introducing acoustic trickle vents or mechanical ventilation systems.

Table 7.15: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Condition
1	Inclusion of appropriate boundary treatments to private amenity areas adjacent to Camp Road and Kirtlington Road	X		
2	CEMP to minimise construction noise impacts			X
3	Building façade design to meet internal noise criteria			X

7.7 CUMULATIVE AND IN-COMBINATION EFFECTS

7.7.1 The traffic flow data included within the 2031 acoustic models includes the cumulative sites as set out in Chapter 2 of this ES and has therefore already been included within the assessment.

7.8 SUMMARY

Introduction

7.8.1 This assessment addresses the likely significant environmental effects of the construction and operational phases of the Application Site on the acoustic and vibration climate at noise sensitive receptors around the Application Site.

7.8.2 The assessment also considers the likely significant environmental effects of the existing and future sound climate on the proposed use of the Application Site.

Baseline Conditions

7.8.3 An environmental sound survey was conducted on the 14th and 15th June 2017 to determine the current noise climate. The dominant noise sources within the area are the surrounding road network, namely Camp Road.

Likely Significant Effects

7.8.4 An assessment was conducted on the impact of the future traffic flows on the Application Site to determine if internal and external noise criteria could be met. The assessment concluded that impact on the majority of the Application Site would be not significant, however properties fronting onto busy roads may require further mitigation.

7.8.5 Construction from the development was assessed to determine the impact on existing receptors. The level of impact construction noise from the Application Site will have on existing receptors is deemed to be not significant.

7.8.6 Traffic flows from the development have been assessed to determine the impact on the existing road network and the potential increase of noise on existing receptors. The level of impact development traffic will have on existing receptors is deemed to be not significant.

Mitigation and Enhancement

7.8.7 Proposed residential properties fronting onto Camp Road and Kirtlington Road may require mitigation in the form of appropriate boundary treatments. For gardens with a direct line of sight to Camp Road and Kirtlington Road, 1.8m high barriers along the boundary of the garden are likely to allow private external amenity guidance levels to be met.

Cumulative Impact

7.8.8 Construction periods of the proposed development could overlap with neighbouring sites. However, it is envisaged that each development would have its own CEMP and minimise noise break out from its site such that cumulative impacts are likely to be not significant.

7.8.9 The traffic flow data for 2031 incorporates cumulative traffic growth and has already been included within the assessment and is therefore not a significant cumulative effect

Conclusion

7.8.10 The assessment has demonstrated that with the use of appropriate mitigation measures, the Application Site is suitable for development and would not result in any significant noise or vibration effects. A summary of the effects of noise and vibration are presented in **Table 7.16**

7.9 REFERENCES

- Department for Communities and Local Government (2012) "*National Planning Policy Framework*", HMSO.
- Department for Environment, Food and Rural Affairs (2010) "*Noise Policy Statement for England*", HMSO.
- Department for Communities and Local Government (2014) "*Planning Practice Guidance Noise*", HMSO.

- British Standards Institution (2003) "*BS 7445:2003 Description and Measurement of Environment Noise – Part 1: Guide to Quantities and Procedures*" BSI.
- Department of Transport Welsh Office (1988) "*Calculation of Road Traffic Noise*" HMSO.
- Department for Environment, Food and Rural Affairs (2006) "*Method for Converting The UK Road Traffic Noise Index LA10,18h To The EU Noise Indices for Road Noise Mapping*" TRL, Casella Stanger.
- British Standards Institution (2014) "*BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 1 Noise*" BSI.
- British Standards Institution (2014) "*BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites Part 2 Vibration*" BSI.
- British Standards Institution (2014) "*BS 8233:2014 Guidance on sound insulation and noise reduction for buildings*" BSI.
- World Health Organisation (1999) "*Guidelines for community noise*" WHO.
- The Highways Agency (2011) "*Design Manual for Roads and Bridges Volume 11 Environmental Assessment Section 3 Environmental Assessment Techniques Part 7 Noise and vibration*" HMSO.
- British Standards Institution (2014) "*BS 4142:2014 Methods for rating and assessing industrial and commercial sound*" BSI.

Table 7.16 Summary of Effects

Potential effect	Significance (pre-mitigation)	Mitigation measure	Significance of residual effect
Construction stage			
Demolition and Construction Noise	**Minor - Moderate**	Proposed CEMP	**Negligible**
Demolition and Construction Vibration	**Minor - Moderate**	Proposed CEMP	**Negligible**
Demolition and Construction Traffic Noise	**Minor - Moderate**	Proposed CEMP	**Negligible**
Operational stage			
External Amenity Area Noise Levels	**Negligible - minor**	Private external amenity areas directly adjacent to Camp Road and Kirtlington Road are likely to require further mitigation in the form of appropriate boundary treatments. The inclusion of 1.8m high barriers along the boundary of the garden are likely to allow private external amenity guidance levels to be met.	**Negligible**
Internal Ambient Noise Levels	**Negligible (with appropriate design considerations)**	Planning Condition – compliance with required standards at the detailed design stage (with external building fabric calculations undertaken as required) to ensure internal ambient noise levels meet the required levels.	**Negligible**
The Change in Noise Levels due to the Increase in Road Traffic Noise	**Minor / Negligible**	None	**Minor / Negligible**

Appendix 7.1 - Traffic Data

Movement Number	2016 Base 18 hr AAWT	2016 Base % HGV	2031 Ref 18 hr AAWT	2031 Ref % HGV	2031 Allocation Test 18 hr AAWT	2031 Allocation Test % HGV
1	11172	5	13327	5	15320	5
2	4602	3	5476	3	6330	3
3	5577	6	7269	6	10854	4
4	11652	5	13389	5	13401	5
5	2895	7	4908	6	10749	3
6	4967	4	5706	4	5706	4
7	2595	6	2983	6	3073	6
8	2345	9	3894	7	8400	4
9	572	2	761	2	1098	2
10	2459	2	2929	2	3258	2
12	4644	4	5334	4	5338	4
15	3848	4	5734	4	9813	3
16	8582	4	11995	3	16089	3
17	2189	10	4567	6	11556	4
18	31198	12	39086	11	45810	9
19	25993	14	30842	14	33185	13
20	12549	6	18675	5	27594	4
21	9305	6	12981	5	12981	5
22	7855	6	14764	5	16758	4
23	10162	5	12736	4	14820	4
24	8395	4	10922	4	15016	3
27	2721	8	4312	6	9001	4
28	332	0	382	0	382	0
29	595	1	1364	1	3430	1

Movement Number	2016 Base 18 hr AAWT	2016 Base % HGV	2031 Ref 18 hr AAWT	2031 Ref % HGV	2031 Allocation Test 18 hr AAWT	2031 Allocation Test % HGV
30	11566	4	13788	4	15313	4
31	1294	2	1529	2	1699	2
32	1605	4	1845	4	1845	4
33	11834	4	14064	4	15464	3
34	4685	2	5484	2	5813	2
35	6372	3	7418	3	7747	3
36	12645	3	14996	3	16396	3
37	11906	5	14171	5	16164	4
38	1528	1	1755	1	1755	1
39	1437	4	1651	4	1651	4
40	6606	4	7666	4	7907	4
41	2753	2	3162	2	3162	2
42	6072	5	7054	5	7295	4
43	6774	3	7783	3	7783	3
44	10365	5	11987	5	12228	5
45	4613	5	5658	5	5658	5
46	3327	4	4902	3	4902	3
47	8225	5	11136	4	13221	4
48	3582	9	5325	7	6268	6
49	5690	3	7136	3	8268	3
50	85332	13	99821	13	102384	13
51	1723	8	1978	8	1978	8
52	6306	2	7884	2	9098	2
53	82878	15	96684	14	98304	14

Movement Number	2016 Base 18 hr AAWT	2016 Base % HGV	2031 Ref 18 hr AAWT	2031 Ref % HGV	2031 Allocation Test 18 hr AAWT	2031 Allocation Test % HGV
54	77838	16	90403	16	90577	16
55	17919	16	20860	15	21549	15
56	12769	23	14679	23	14679	23
57	44536	13	54216	12	60302	11
58	42227	13	50863	12	55408	11
59	11148	7	13461	7	13461	7
60	45080	12	54792	11	59337	10
61	16339	5	20876	4	20876	4
62	6898	13	8925	12	10470	10
63	85721	16	99135	16	100887	16
64	101314	15	117468	15	120764	15
65	122630	15	141492	15	142772	15
66	10490	4	15431	4	15431	4
67	7592	3	15673	2	17417	2
68	11998	3	16961	4	17133	4
69	0	0	0	0	533	1
70	3844	10	5899	8	9855	5
71	0	0	0	0	1012	1
72	4139	10	6296	8	10638	5
73	0	0	0	0	317	1
74	4137	10	6290	8	10764	5
75	212	1	390	1	923	1
76	4216	10	6442	8	11119	5
77	0	0	0	0	317	1

Movement Number	2016 Base 18 hr AAWT	2016 Base % HGV	2031 Ref 18 hr AAWT	2031 Ref % HGV	2031 Allocation Test 18 hr AAWT	2031 Allocation Test % HGV
78	4213	10	6445	8	11243	5
79	212	1	455	1	933	1
80	4292	10	6621	8	11602	5
81	0	0	237	1	237	1
82	4290	10	6721	8	11701	5
83	0	0	231	1	231	1
84	4292	10	6782	8	11763	5
85	4774	9	7570	7	12576	5
96	1256	1	2215	1	2215	1
97	648	4	1305	3	5885	1
88	5025	9	8174	7	13687	4
89	0	0	713	1	698	1
90	5115	9	8415	7	13960	4
91	1094	0	1583	0	2817	0
92	5386	8	8902	6	14500	4
93	346	0	502	0	502	0
94	5426	8	8975	6	14568	4
95	2271	0	2271	0	2271	0
96	5615	8	9207	6	14801	4
97	71	1	71	1	238	1
98	5641	8	9311	6	14968	4
99	297	1	394	1	394	1
100	5779	8	9491	6	15148	4
101	71	1	71	1	71	1

Movement Number	2016 Base 18 hr AAWT	2016 Base % HGV	2031 Ref 18 hr AAWT	2031 Ref % HGV	2031 Allocation Test 18 hr AAWT	2031 Allocation Test % HGV
102	104	1	394	1	685	1
103	5917	8	9769	6	15601	4
104	255	1	255	1	422	1
105	33	1	33	1	33	1
106	5933	8	9804	6	15636	4
107	0	0	0	0	414	1
108	5077	6	8822	5	14812	3
109	0	0	0	0	12022	5
111	2608	12	3485	10	327	0
Somerton Road	531	8	609	8	609	8

Appendix 7.2 – SoundPLAN v7.4 Model Calibration

Table 7.2.1 compares the results of the acoustic model with the results of the environmental sound survey. As the model uses methods within CRTN to calculate sound levels across the Application Site, only survey locations situated next to the existing highways have been used for calibration purposes. Calibration within ± 3 dB is generally considered acceptable by the industry.

Table 7.2.1: Model Calibration

Location	Daytime $L_{Aeq,\ 16\ hr}$ dB (07:00 – 23:00)			Night-time $L_{Aeq,\ 8\ hr}$ dB (23:00 – 07:00)		
	Measured	Modelled	Difference	Measured	Modelled	Difference
LT 1	54	55	1	48	48	0
LT 2	65	65	0	57	57	0

Appendix 7.3 – Glossary of Acoustic Terminology

Parameter	Description
Acoustic Environment	Sound from all sound sources as modified by the environment.
Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.
Ambient Sound Level, $L_a=L_{Aeq,T}$	The equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources, near and afar, at the assessment location over a given time interval, T.
Background Sound Level, $L_{A90,T}$	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.
Daytime	The period 07:00 - 23:00 hours.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log^{10} (s_1/s_2)$. 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 20 µPa. 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).
F, 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.

Parameter	Description
Insertion Loss	Insertion loss is the difference in sound pressure level at a single fixed position before and after a noise control element (e.g. enclosure, barrier etc) is installed.
$L_{Aeq,T}$	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_{eq}	The equivalent continuous sound pressure level in dB.
$L_{max,T}$	The maximum sound 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. $L_{A10,\ 18\ h}$ is the A – weighted arithmetic average of the 18 hourly $L_{A10,1\ h}$ values from 06:00 - 24:00.
L_{90}	The noise level exceeded for 90 % of the measured period.
Night-time	The period 23:00 - 07:00 hours.
$ms^{1.75}$	Metres per second to the power of 1.75.
Rating Level	Specific sound level plus any adjustments for the characteristic features of the sound, i.e. acoustic feature corrections.
Reference Time Interval, T_r	Specified time interval over which the specific sound level is determined
Reference Time Interval, T	Specified time interval over which a measurement has been undertaken.
Residual Sound	Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.
Residual Sound Level, $L_r=L_{Aeq,T}$	Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.
Specific Sound Level $L_s=L_{Aeq,Tr}$	Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.
Specific Sound Source	Sound source being assessed.

Appendix 7.4 - Environmental Sound Survey Equipment

Item	Type	Manufacturer	Serial Number	Laboratory Calibration Date	Next Calibration Date
Sound Level Meter	NL-52	RION	542901	30/08/2016	30/08/2018
½" Pre-polarised microphone	UC-59		06478	30/08/2016	30/08/2018
Pre-amplifier	NH-25		42929	30/08/2016	30/08/2018
Sound Level Meter	NL-52		542902	04/01/2016	04/01/2018
½" Pre-polarised microphone	UC-59		07374	04/01/2016	04/01/2018
Pre-amplifier	NH-25		43580	04/01/2016	04/01/2018
Sound Calibrator	NC-74		34546655	14/02/2017	14/02/2018

Appendix 7.5 – Environmental Sound Survey Data

Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
LT 1	14/06/2017	11:30:00	53.8	84.6	33.7
	14/06/2017	11:45:00	52.3	76.5	32.5
	14/06/2017	12:00:00	51.7	73.4	33.2
	14/06/2017	12:15:00	50.5	73.3	34.3
	14/06/2017	12:30:00	49.4	72.1	32.4
	14/06/2017	12:45:00	52.5	77.5	33.6
	14/06/2017	13:00:00	51.7	76	32.8
	14/06/2017	13:15:00	50.2	71	33.8
	14/06/2017	13:30:00	54.6	74	36.8
	14/06/2017	13:45:00	50.1	73.8	33.8
	14/06/2017	14:00:00	52.5	72.9	33.6
	14/06/2017	14:15:00	51.4	73.3	32.9
	14/06/2017	14:30:00	50.9	75.1	32.9
	14/06/2017	14:45:00	52.5	74.6	34
	14/06/2017	15:00:00	51.8	73.7	33.9
	14/06/2017	15:15:00	53.3	75.1	34.8
	14/06/2017	15:30:00	51.5	71.5	34.4
	14/06/2017	15:45:00	50.6	75.4	34
	14/06/2017	16:00:00	53.6	73.6	33.6
	14/06/2017	16:15:00	55.7	77	33.7
	14/06/2017	16:30:00	53.3	75.1	34.4
	14/06/2017	16:45:00	53.5	75.3	36.4
	14/06/2017	17:00:00	51.6	71	33.8
	14/06/2017	17:15:00	54.5	81.8	34.2
	14/06/2017	17:30:00	52.5	76.6	34.3
	14/06/2017	17:45:00	54.2	73.2	35.3
	14/06/2017	18:00:00	53.4	76.1	34.9

Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
	14/06/2017	18:15:00	53.4	74.1	35
	14/06/2017	18:30:00	53.6	74.7	32.9
	14/06/2017	18:45:00	51.3	71.1	33.6
	14/06/2017	19:00:00	51.6	75.1	33.8
	14/06/2017	19:15:00	52	76.6	35
	14/06/2017	19:30:00	50.7	73.9	32.6
	14/06/2017	19:45:00	49.8	70.5	31.6
	14/06/2017	20:00:00	51.3	71.9	30.9
	14/06/2017	20:15:00	51.2	72.4	31.6
	14/06/2017	20:30:00	51.1	74.2	31.9
	14/06/2017	20:45:00	46.1	70.7	30.8
	14/06/2017	21:00:00	50	77.3	29.4
	14/06/2017	21:15:00	65.7	95.8	27.5
	14/06/2017	21:30:00	44	68.1	26.1
	14/06/2017	21:45:00	47.8	70.9	27.8
	14/06/2017	22:00:00	40.1	68.7	28.9
	14/06/2017	22:15:00	49.8	80.1	24.4
	14/06/2017	22:30:00	35.9	58.7	24.2
	14/06/2017	22:45:00	34.6	47.4	23.6
	14/06/2017	23:00:00	31.4	47.6	22.4
	14/06/2017	23:15:00	44.1	68.8	22.1
	14/06/2017	23:30:00	29.6	48.8	20.4
	14/06/2017	23:45:00	45.5	73.6	19.5
	15/06/2017	00:00:00	28.8	45.6	19.6
	15/06/2017	00:15:00	34.8	46.9	20
	15/06/2017	00:30:00	34.4	49.3	19.7
	15/06/2017	00:45:00	35.6	50.5	19.4

Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
	15/06/2017	01:00:00	36.3	51.1	20.2
	15/06/2017	01:15:00	44.7	73.6	18.8
	15/06/2017	01:30:00	40	54.5	20.6
	15/06/2017	01:45:00	19.6	34.8	17.6
	15/06/2017	02:00:00	43	69.4	17
	15/06/2017	02:15:00	37.5	54.6	17.4
	15/06/2017	02:30:00	40.8	53.1	18.1
	15/06/2017	02:45:00	23	41.5	18.5
	15/06/2017	03:00:00	43.3	72.2	19.1
	15/06/2017	03:15:00	40.6	55.1	19.9
	15/06/2017	03:30:00	25	42.8	19.2
	15/06/2017	03:45:00	35.6	58.7	20.3
	15/06/2017	04:00:00	45.5	69.7	30
	15/06/2017	04:15:00	52	67.7	33
	15/06/2017	04:30:00	50.3	63.6	31.2
	15/06/2017	04:45:00	48.6	70.5	29.9
	15/06/2017	05:00:00	44.5	61.4	29.1
	15/06/2017	05:15:00	42.7	68.2	28.9
	15/06/2017	05:30:00	40.7	61	31.9
	15/06/2017	05:45:00	50.8	73.8	33
	15/06/2017	06:00:00	56.8	80.5	35
	15/06/2017	06:15:00	52.6	71.2	36
	15/06/2017	06:30:00	50.7	75.2	37.7
	15/06/2017	06:45:00	56.9	83.9	38.8
	15/06/2017	07:00:00	54.7	76.2	38.2
	15/06/2017	07:15:00	54	72.6	38
	15/06/2017	07:30:00	55	74	39.9

Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
	15/06/2017	07:45:00	55	74.4	37.9
	15/06/2017	08:00:00	55.6	76.5	38.5
	15/06/2017	08:15:00	54.1	73.8	39
	15/06/2017	08:30:00	55.2	76.8	39.5
	15/06/2017	08:45:00	55.2	77.4	37.5
	15/06/2017	09:00:00	58.3	79.2	39.4
	15/06/2017	09:15:00	54.3	73.8	37.9
	15/06/2017	09:30:00	54.2	77.4	37.2
	15/06/2017	09:45:00	45.7	67.9	37.8
	15/06/2017	10:00:00	54.7	77	37.5
	15/06/2017	10:15:00	51.9	73.2	39
	15/06/2017	10:30:00	53.3	71.8	40.4
	15/06/2017	10:45:00	53.5	73.1	42.3
	15/06/2017	11:00:00	54.7	73.6	41.9
	15/06/2017	11:15:00	52.1	70.5	42.2

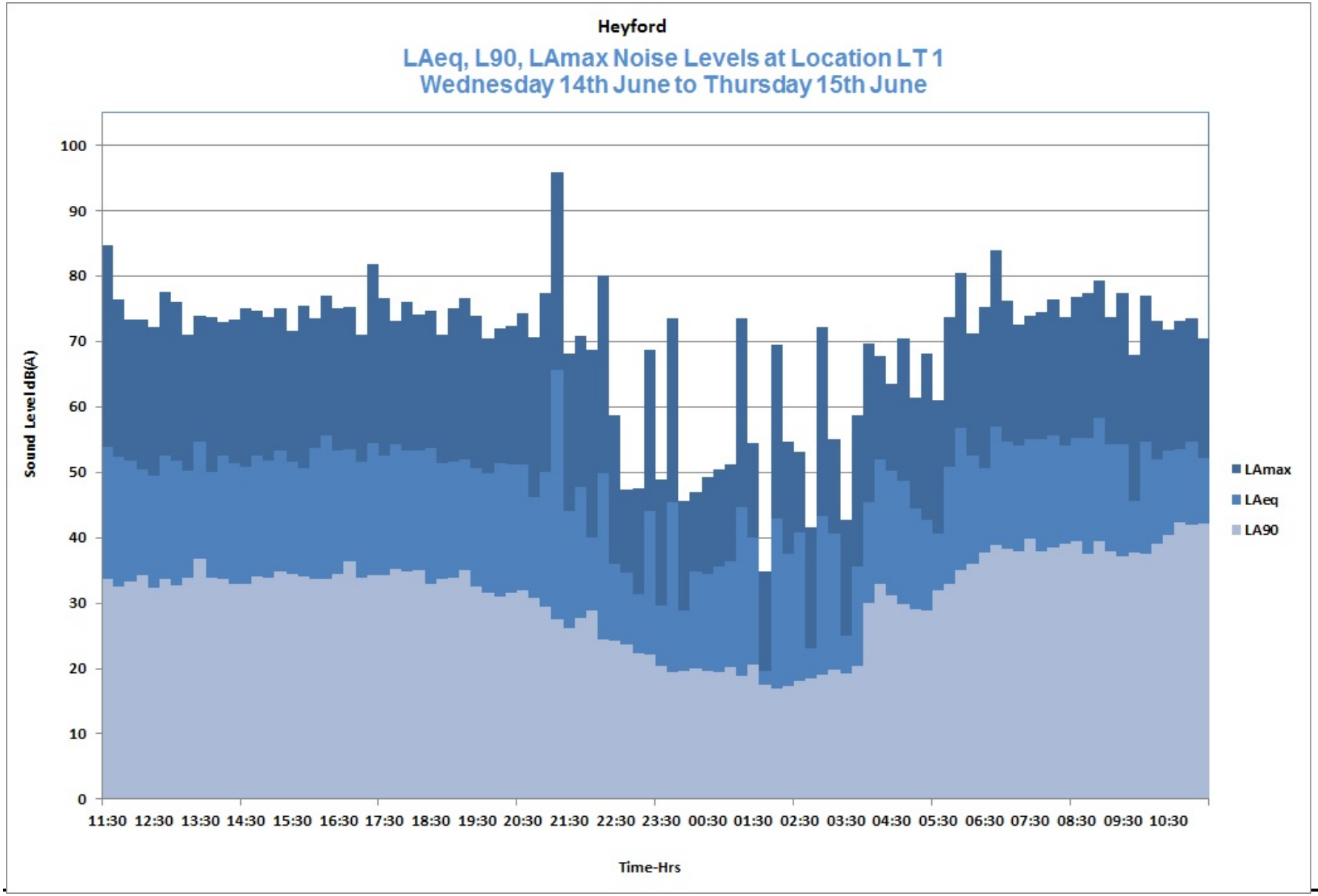
Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
LT 2	14/06/2017	11:30:00	68.9	103.2	42.3
	14/06/2017	11:45:00	61.5	86.5	40.2
	14/06/2017	12:00:00	60.6	79.9	41.5
	14/06/2017	12:15:00	62.4	79.9	39.1
	14/06/2017	12:30:00	62.3	80.4	40.8
	14/06/2017	12:45:00	62.1	81.5	41.3
	14/06/2017	13:00:00	62.6	82	40.8
	14/06/2017	13:15:00	62.7	83.2	41.5
	14/06/2017	13:30:00	64.4	82.6	43.4
	14/06/2017	13:45:00	63.9	84.2	38.6
	14/06/2017	14:00:00	62.3	81	43.1
	14/06/2017	14:15:00	63.3	82	43.2
	14/06/2017	14:30:00	62.6	81.3	42.2
	14/06/2017	14:45:00	63.6	88.4	40.2
	14/06/2017	15:00:00	63.4	85.2	41.8
	14/06/2017	15:15:00	62.9	80.8	41.7
	14/06/2017	15:30:00	65.7	88.7	44.3
	14/06/2017	15:45:00	67	86.5	47
	14/06/2017	16:00:00	64.8	89.8	44.8
	14/06/2017	16:15:00	64.8	80.4	42.7
	14/06/2017	16:30:00	64.7	85.5	43.1
	14/06/2017	16:45:00	64.6	86.5	43
	14/06/2017	17:00:00	67.8	98.7	47.9
	14/06/2017	17:15:00	62.1	79.4	38.4
	14/06/2017	17:30:00	64.7	85.3	42.7
	14/06/2017	17:45:00	63.9	82.8	43.8
	14/06/2017	18:00:00	63.8	81.1	43.6

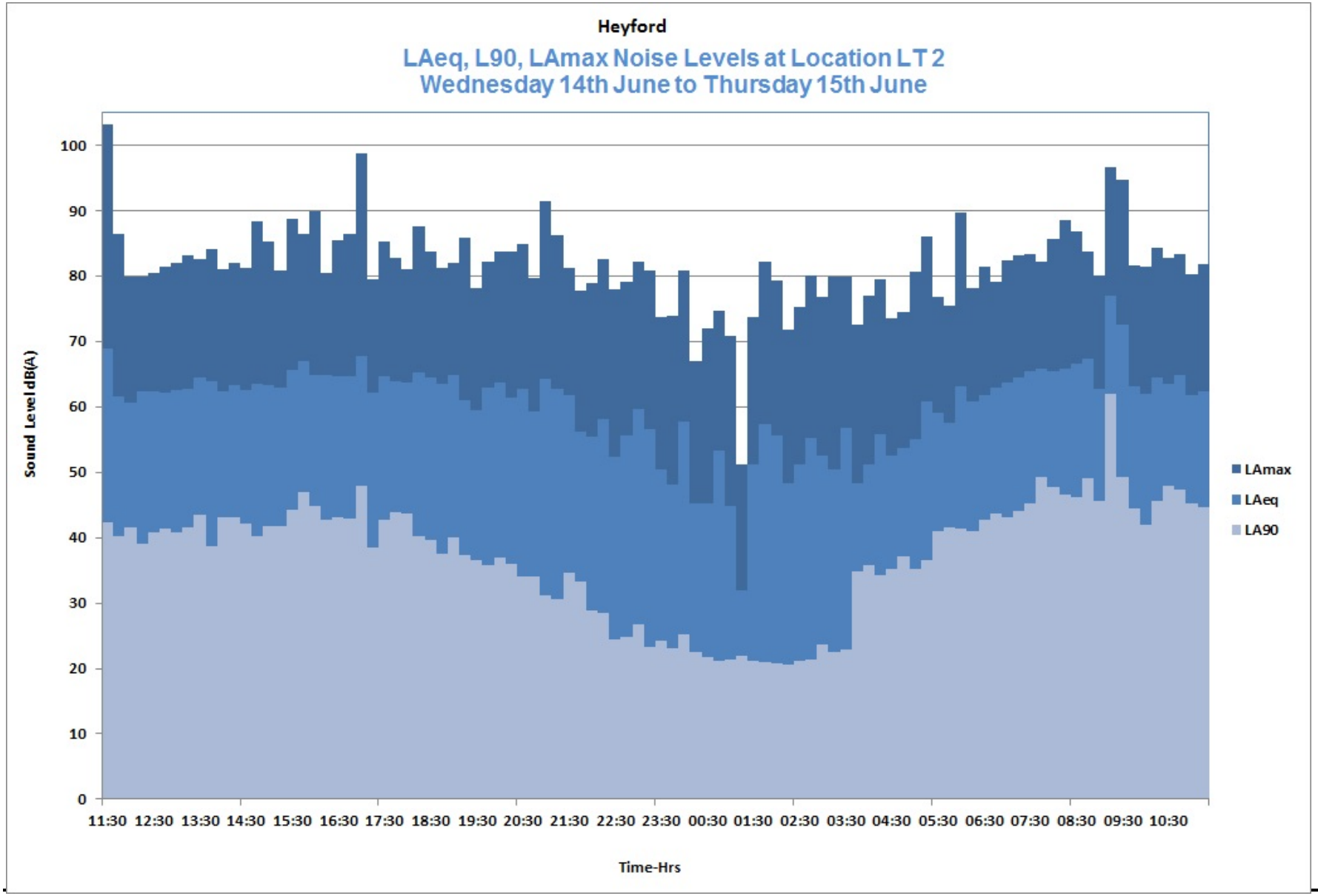
Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
	14/06/2017	18:15:00	65.3	87.5	40.3
	14/06/2017	18:30:00	64.5	83.7	39.6
	14/06/2017	18:45:00	63.5	81.2	37.6
	14/06/2017	19:00:00	64.8	81.9	40.1
	14/06/2017	19:15:00	61	85.9	37.3
	14/06/2017	19:30:00	59.5	78.1	36.5
	14/06/2017	19:45:00	63	82.2	35.8
	14/06/2017	20:00:00	63.8	83.8	36.9
	14/06/2017	20:15:00	61.4	83.8	35.9
	14/06/2017	20:30:00	62.8	84.9	34.1
	14/06/2017	20:45:00	59.2	79.7	34.1
	14/06/2017	21:00:00	64.3	91.5	31.2
	14/06/2017	21:15:00	62.7	86.2	30.6
	14/06/2017	21:30:00	61.8	81.2	34.7
	14/06/2017	21:45:00	56.2	77.8	33.2
	14/06/2017	22:00:00	55.5	78.9	28.9
	14/06/2017	22:15:00	58.1	82.6	28.4
	14/06/2017	22:30:00	52.3	78	24.5
	14/06/2017	22:45:00	55.7	79.1	24.8
	14/06/2017	23:00:00	59.7	82.2	26.7
	14/06/2017	23:15:00	56.6	80.9	23.2
	14/06/2017	23:30:00	50.4	73.8	24.2
	14/06/2017	23:45:00	48.2	74	23
	15/06/2017	00:00:00	57.8	80.9	25.3
	15/06/2017	00:15:00	45.2	66.9	22.5
	15/06/2017	00:30:00	45.3	72	21.8
	15/06/2017	00:45:00	53.3	74.7	21.1

Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
	15/06/2017	01:00:00	44.9	70.8	21.3
	15/06/2017	01:15:00	32	51.1	21.9
	15/06/2017	01:30:00	51.2	73.8	21.1
	15/06/2017	01:45:00	57.3	82.1	21
	15/06/2017	02:00:00	55.7	79.3	20.8
	15/06/2017	02:15:00	48.3	71.7	20.5
	15/06/2017	02:30:00	51.1	75.3	21.1
	15/06/2017	02:45:00	55.3	80.1	21.3
	15/06/2017	03:00:00	52.5	76.8	23.6
	15/06/2017	03:15:00	50.4	79.8	22.5
	15/06/2017	03:30:00	56.8	79.8	22.8
	15/06/2017	03:45:00	48.4	72.5	34.8
	15/06/2017	04:00:00	51.1	77	35.8
	15/06/2017	04:15:00	55.9	79.4	34.2
	15/06/2017	04:30:00	52.6	73.6	35.3
	15/06/2017	04:45:00	53.7	74.4	37.1
	15/06/2017	05:00:00	55.1	80.7	35.3
	15/06/2017	05:15:00	60.9	86.1	36.5
	15/06/2017	05:30:00	59	76.8	41
	15/06/2017	05:45:00	57.5	75.4	41.5
	15/06/2017	06:00:00	63.2	89.6	41.4
	15/06/2017	06:15:00	60.8	78.2	41
	15/06/2017	06:30:00	61.7	81.5	42.7
	15/06/2017	06:45:00	62.9	79.1	43.7
	15/06/2017	07:00:00	63.8	82.3	43.2
	15/06/2017	07:15:00	64.5	83.1	44
	15/06/2017	07:30:00	65.5	83.3	45.3

Location	Date	Time	$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$
	15/06/2017	07:45:00	65.8	82.2	49.3
	15/06/2017	08:00:00	65.4	85.6	47.8
	15/06/2017	08:15:00	65.9	88.5	46.5
	15/06/2017	08:30:00	66.6	86.8	46.1
	15/06/2017	08:45:00	67.3	83.8	49.1
	15/06/2017	09:00:00	62.7	80.1	45.6
	15/06/2017	09:15:00	76.9	96.7	62
	15/06/2017	09:30:00	72.6	94.7	49.3
	15/06/2017	09:45:00	63.2	81.6	44.5
	15/06/2017	10:00:00	62	81.5	41.9
	15/06/2017	10:15:00	64.4	84.3	45.7
	15/06/2017	10:30:00	63.5	82.8	47.9
	15/06/2017	10:45:00	64.8	83.4	47.4
	15/06/2017	11:00:00	61.7	80.3	45.3
	15/06/2017	11:15:00	62.4	81.8	44.6

Appendix 7.6 – Time History Graphs


Heyford
LAeq, L90, LAmax Noise Levels at Location LT 1
Wednesday 14th June to Thursday 15th June
Sound Level dB(A)
100
90
80
70
60
50
40
30
20
10
0
11:30 12:30 13:30 14:30 15:30 16:30 17:30 18:30 19:30 20:30 21:30 22:30 23:30 00:30 01:30 02:30 03:30 04:30 05:30 06:30 07:30 08:30 09:30 10:30
Time-Hrs
LAmax
LAeq
LA90


Heyford
LAeq, L90, LAmax Noise Levels at Location LT 2
Wednesday 14th June to Thursday 15th June
Sound Level dB(A)
100
90
80
70
60
50
40
30
20
10
0
11:30 12:30 13:30 14:30 15:30 16:30 17:30 18:30 19:30 20:30 21:30 22:30 23:30 00:30 01:30 02:30 03:30 04:30 05:30 06:30 07:30 08:30 09:30 10:30
Time-Hrs
LAmax
LAeq
LA90

Appendix 7.7– Figures

Figure 7.1 – Noise Sensitive Receptors

Figure 7.2 – Environmental Sound Survey Locations

Figure 7.3 – 2031 With Development "Allocation Test" Daytime $L_{Aeq,\ 16\ hr}$ Noise Levels

Figure 7.4 – 2031 With Development "Application Test" Daytime $L_{Aeq,\ 16\ hr}$ Noise Levels

Figure 7.5 – 2031 With Development "Allocation Test" Night-time $L_{Aeq,\ 8\ hr}$ Noise Levels

Figure 7.6 – 2031 With Development "Application Test" Night-time $L_{Aeq,\ 8\ hr}$ Noise Levels

Figure 7.7 – 2031 Baseline Compared to 2031 With Development "Allocation Test" $L_{A10,\ 18\ hr}$ Noise Levels