Hawkins environmental

Noise Assessment: Cheshunt Sports Village

LW Developments

2nd September 2016

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Table of Contents

List of Appendices

List of Tables

List of Figures

1. INTRODUCTION

1.1. Overview

Hawkins Environmental Limited has been instructed by LW Developments to undertake a noise assessment for the proposed redevelopment of Cheshunt Football Club, situated in the Cheshunt Area of the Borough of Broxbourne.

During the planning process, it has been identified that the site may require a noise assessment to determine whether the site is suitable for residential use, due to its location close to a number of busy roads and a railway line. Consequently, a noise survey was conducted to characterise the noise climate of the site with the proposed layout. By measuring both the ambient and maximum noise levels it has been possible to determine whether mitigation is necessary to achieve reasonable internal and external noise levels.

All noise measurements were conducted 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'*, with the assessment methodology used to assess noise ingress into the proposed development conducted in accordance with BS 8233: 2014 *'Guidance on sound insulation and noise reduction for buildings',* and the National Planning Policy Framework.

1.2. Site Description

The proposed development site is situated on the northern side of Theobolds Lane, approximately 150m east of the A10 and 1.2km north of the M25. The site currently comprises Cheshunt Football Club, and houses the current football stadium, practice pitches and associated buildings.

The proposed development will see the redevelopment of the site to form at circa 5000 seat football stadium, with 136 flats incorporated into the east and south stands and blocks situated at all four corners. An additional 50 dwellings will be situated to the east of the football stadium, to the west of Montayne Road. Commercial premises will also be situated within the west stand of the football stadium. A location plan of the proposed site can be seen in **Appendix 1,** with a proposed site layout plan in **Appendix 2**.

Although the proposals are for a 5000 seat football stadium, initially the stadium will be limited to 500 seats, with extra capacity to be added at a later date.

2. NOISE CRITERIA

2.1. The Nature, Measurement and Effect of Noise

Noise is often defined as sound that is undesired by the recipient. Whilst it is impossible to measure nuisance caused by noise directly, it is possible to measure the loudness of that noise. 'Loudness' is related to both sound pressure and frequency, both of which can be measured. The human ear is sensitive to a wide range of sound levels. The sound pressure level of the threshold of pain is over a million times that of the quietest audible sound. In order to reduce the relative magnitudes of the numbers involved, a logarithmic scale of decibels (dB) is normally used, based on a reference level of the lowest audible sound.

The response of the human ear is not constant over all frequencies. It is therefore usual to weight the measured frequencies to approximate the human response. The resulting 'A' weighted decibel, dB(A), has been shown to correlate closely to the subjective human response.

When related to changes in noise, a change of ten decibels from say 60 dB(A) to 70 dB(A) would represent a doubling in 'loudness'. Similarly, a decrease in noise from 70 dB(A) to 60 dB(A) would represent a halving in 'loudness'. A change of 3 dB(A) is generally considered to be just perceptible[1]. **Table 2.1** details typical noise levels. A glossary of acoustic terms can be found in **Appendix 3**.

Table 2.1: Typical Noise Levels

Approximate Noise Level (dB(A))	Example
0	Limit of hearing
30	Rural area at night
40	Library
50	Quiet office
60	Normal conversation at 1 m
70	In car noise without radio
80	Household vacuum cleaner at 1 m
100	Pneumatic drill at 1 m
120	Threshold of pain

2.2. The National Planning Policy Framework

In March 2012, the National Planning Policy Framework (NPPF) was published to replace the thousands of pages of national planning policy guidance, including guidance on noise. The intention was to let councils decide their own priorities through their Local Plans and reduce the amount of "red tape" to enable growth and development. Amongst many other documents, the NPPF replaces the 1994 document *Planning Policy*

[1] Communities & Local Government (1994). Planning Policy Guidance 24: Planning & Noise.

Guidance Note 24 (PPG 24) 'Planning and Noise' published by the then Department of Environment, which is now officially withdrawn as official government guidance.

The NPPF includes 12 core planning principles which include:

- Always seek to secure high quality design and a good standard of amenity for all existing and future occupants of buildings;
- Take account of the different roles and character of different areas, promoting the vitality of the main urban areas, protecting the Green Belts around them, recognising the intrinsic beauty of the countryside;
- Contribute to conserving and enhancing the natural environmental and reducing pollution; and
- Take account of and support local strategies to improve health, social and cultural wellbeing for all.

It also states that the planning system "*should contribute to enhance the natural environment, by... preventing both new and existing development from contributing to or being put at risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution…To prevent unacceptable risks from pollution, planning policies and decisions should ensure that new development is appropriate for its location*".

Section 123 of the NPPF talks specifically about noise stating 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 businesses wanting to develop in continuance of their 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."*

The purpose of the NPPF is for Local Planning Authorities to determine for themselves whether a "*new development is appropriate for its location"* or how to determine what constitutes "*a good standard of amenity for all…future occupants of buildings"*.

2.3. Noise Policy Statement for England

The Noise Policy Statement for England(NPSE)[2] provides further guidance on the interpretation of Section 123 of the NPPF and states that:

"Within the context of sustainable development:

- *avoid significant adverse impacts on health and quality of life;*

[2] The Noise Policy Statement for England, March 2010, Defra.

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

NPSE introduces established concepts originally from the field of toxicology that are now being applied to noise impacts. They are:

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

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

2.4. National Planning Practice Guidance on Noise

The NPPG provides more guidance on the assessment of noise for planning purposes and builds on the concepts of NOEL, LOAEL etc introduced in NPSE to establish whether noise is a factor that needs to be taken into account. It states:

"Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

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

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation."

However it goes into more detail about the subjective nature of noise and how the results of any assessment must be treated flexible and pragmatically. The guidance states:

"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. These factors include:

- *the source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;*
- *for non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;*
- *the spectral content of the noise (ie whether or not the noise contains particular high or low frequency content) and the general character of the noise (ie whether or not the noise contains particular tonal characteristics or other particular features). The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.*

More specific factors to consider when relevant:

- *where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;*
- *consideration should also be given to 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 cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations.*
- *In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur.*
- *Where relevant, Noise Action Plans, and, in particular the Important Areas identified through the process associated with the Environmental Noise Directive and corresponding regulations should be taken into account. Defra's website has information on Noise Action Plans and Important Areas. Local authority environmental health departments will also be able to provide information about Important Areas.*
- *The effect of noise on wildlife. Noise can adversely affect wildlife and ecosystems. Further information may be found on Defra's website. Particular consideration should be given to noisy development affecting designated sites.*
- *If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.*
- *The potential effect on an existing business of a new residential development being located close to it should be carefully considered as the existing noise levels from the business may be regarded as unacceptable by the new residents and subject to enforcement action. In the case of an established business, the policy set out in the third bullet of paragraph 123 of the Framework should be followed.*
- *Some commercial developments including fast food restaurants, night clubs and public houses can have particular impacts, not least because activities are often at their peak in the evening and late at*

night. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises but also the noise that may be made by customers in the vicinity."

2.5. "Possible Options for the Identification of SOAELs and NOAELs in Support of the NPSE"

This Defra Research Project prepared by AECOM attempts to give values to the concepts of SOAELs and NOAELs, introduced by the NPSE. After the withdrawal of PPG24: Planning and Noise in 2012, which had Noise Exposure Categories, with specific numerical boundaries, the NPSE was heavily criticised for having no specific numerical guidance. Whilst the NPSE and NPPF encourages the development of location specific criteria, in the context of the specific environment, the absence of guidance meant the implementation of the NPSE was difficult. Consequently, the project identifies both specific possible values and possible ranges of values for SOAELs and NOAELs for different noise sources. These values can be seen in **Table 2.2**.

Table 2.2: Possible Values & Range of Values for LOAEL & SOAEL

Source	Effect	LOAEL	SOAEL
Road	Annoyance (Daytime)	56 *(53-59)*	66 *(64-68)*
	Sleep (Night-time)	46 *(43-52)*	56 *(51-64)*
Rail	Annoyance (Daytime)	63 *(61-66)*	72 *(70-74)*
	Sleep (Night-time)	55 *(52-63)*	68 *(61-77)*
Air	Annoyance (Daytime)	52 *(50-54)*	60 *(58-62)*
	Sleep (Night-time)	41 *(40-49)*	53 *(47-60)*

2.6. BS 8233: 2014 *'Guidance on sound insulation and noise reduction for buildings'*

Originally published in 1999, the 2014 edition of BS 8233 significantly updates the guidance in light of the policy changes as a result of the advent of the NPPF and the withdrawal of PPG 24: Planning and Noise, in 2012. The 2014 edition of BS 8233 sees a change in the title of the Standard, moving from a *'Code of Practice'* to *'Guidance'*, as the text *'largely comprises guidance that does not support claims of compliance'*.

BS 8233:2014 indicates that to control external noise ingress into a proposed development, a number of planning stages should occur as follows:

"a) Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels, and evaluate layout options.

b) Determine design noise levels for spaces in and around the building(s).

c) Determine sound insulation of the building envelope, including the ventilation strategy".

BS 8233:2014 suggests design noise levels for various types of building. The recommended noise levels for dwelling houses, flats and rooms in residential use (when unoccupied) can be seen in **Table 2.3** below. This is replicated from Table 4 of Section 7.7.2 of BS 8233:2014. The guidance suggests that *"In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values".* The noise levels in **Table 2.3** are marginally different to those published in BS 8233:1999 *'Sound insulation and noise reduction for buildings –Code of practice'*, but are based on the existing guidance from the current World Health Organisation (WHO) *"Guidelines on Community Noise".*

Table 2.3: Summary of Noise Criteria: BS8233:2014

Activity	Location	07:00 to 23:00	23:00 to 0700
Resting	Living room	35 dB $L_{Aeq.16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq.16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq.16hour}$	30 dB $L_{Aeq.8hour}$

When considering the noise level criteria considered in **Table 2.4**, the following points should be noted:

1. BS 8233: 2014 suggests that the above criteria should be adopted flexibly and that *"where development is considered necessary or desirable... the internal target level may be relaxed by up to 5 dB and reasonable internal conditions still achieved".*
2. The noise levels quoted above are annual averages and *"do not need to be achieved in all circumstances"* e.g. New Years Eve or fireworks night.
3. The noise levels in **Table 2.4** are "*for steady external noise sources"* such as traffic noise or plant noise. This is a departure from the 1999 version of BS 8233, where the recommended internal noise levels were irrespective of the external noise source and therefore included the suggestion that in order to achieve *"reasonable"* noise levels within bedrooms at night, L_{AFmax} noise levels should not exceed 45 dB. Whilst this has been omitted from the 2014 version of BS 8233, it does state that "*Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values."* Therefore, at sites which may be affected by individual noise events, it is more appropriate to use the guidance contained within the WHO *"Guidelines on Community Noise"* which suggest that good sleep will not generally be affected if internal levels of L_{AFmax} 45 dB are not exceeded more than 10-15 times per night.
4. BS 8233:2014 notes that if the design of the building is *"relying on closed windows to meet the guide values, there needs to be appropriate alternative ventilation that does not compromise the facade insulation or resulting noise level".*
5. BS 8233 provides guidance for noise in gardens and outdoor amenity space. It suggests that *"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." The guidance does go on to say that these guideline values are not achievable in all circumstances and in some 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."*

2.7. World Health Organisation Guidelines

BS 8233 is based upon the current World Health Organisation (WHO) *guidance "Guidelines on Community Noise*". A summary of the noise criteria can be seen in **Table 2.5.**

Table 2.4: Summary of Noise Criteria: WHO

Residential Environment	Critical Health Effect(s)	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
Inside bedrooms	Sleep disturbance, night-time	30	45	23:00-07:00
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	60	23:00-07:00

2.8. BS 4242: 2014 *'Methods for rating and assessing industrial and commercial sound'*

British Standard BS 4142: 2014 'Methods for rating and assessing industrial and commercial sound'' provides a method for the measurement and rating of industrial noise or noise of an industrial nature and background noise levels outside dwellings in mixed residential and industrial areas. The rating level (defined in the BS) is used to rate the industrial noise source outside residential dwellings (this is defined as the "specific noise source").

The procedure defined in BS 4142 for predicting the likelihood of complaints is based on establishing the difference between the rating level and the background level outside the residential property of interest. The greater the difference the greater the likelihood of complaints and more specifically:

- *"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.*
- *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."*

The guidance goes on to state 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."* Consequently, when considering the impact within a BS 4142 assessment, it is often also necessary to consider the absolute noise levels experienced at the receptor location within relation to BS 8233 and World Health Organisation guidelines.

2.9. IEMA Guidelines for Environmental Noise Assessment

The 2014 IEMA Guidelines for Environmental Noise Assessment address the key principles of noise impact assessment and are applicable to all development proposals where noise effects may occur. The guidance provides advice with regards to the collection of baseline noise data, prediction of noise levels and how noise should be assessed. The guidance recognises that the effect associated with a particular noise impact will be dependent on a number of factors including but not limited to the sensitivity of the receptor, frequency and duration of the noise source and time of day. However, it stops short of providing specific assessment criteria which developments should achieve but instead suggests that the methodology adopted should be selected on a site by site basis with reference to relevant national and local standards. However, it does provide descriptors used to describe noise impacts, which can be used to assess the impact of changes in traffic flow. The scale can be seen in **Table 2.6** below.

Table 2.5: Classification of magnitude of noise impacts

Criteria for Extent of Noise Impact	Noise Impact Magnitude
> 10 dB	Severe
5 to 10 dB	Substantial
3 to 5 dB	Moderate
1 to 3 dB	Slight
< 1 dB	No Impact

3. NOISE MEASUREMENT STUDY

In order to determine the extent to which the site is affected by noise, a detailed noise measurement study has been carried out on the proposed development site. Noise measurements have been carried out in order to determine the overall $L_{Aeq.16hrs}$ and $L_{Aeq.8hrs}$ for the day and night time periods. In addition, the L_{Amax} L_{A10}, L_{A50}, and L_{A90} noise levels have also been measured.

All noise monitoring was conducted using a Norsonic 140 sound level meter, which conforms to BS EN IEC 61672 as a Class 1 precision measurement system. A Norsonic 1251 field calibrator was used before and after the measurement periods in order to ensure that the equipment had remained within reasonable calibration limits (+/- 0.5 dB). All of the equipment used has current certificates of calibration. **Appendix 4** summarises the equipment used including serial numbers and calibration certificates.

All noise monitoring has been conducted in accordance with the guidance set out in BS 7445-2: 1991 *'Description and measurement of environmental noise Part 2: Guide to the acquisition of data pertinent to land use*'. This standard details information that should be recorded in addition to the actual measured levels such as meteorological data, and a description of the noise source itself.

The survey was conducted on the 3rd and 4th August 2016. The noise monitoring was conducted by Nick Hawkins of Hawkins Environmental Limited. Nick is a Member of the Institute of Acoustics and holds the Institute of Acoustic's Certificate of Competence in Environmental Noise Measurement.

Weather conditions were conducive to successful monitoring. **Table 3.1** summarises the weather conditions during the measurement period.

Table 3.1: Summary of Weather Conditions during the Noise Measurements

General Description	The measurement periods were warm for the time of year, with some sunshine during the day with moderate winds.
Windspeed	Windspeeds were moderate, with average windspeeds around 1.5 m/s, with some gust up to around 2.5 to 3m/s
Temperature	The temperature went down to around 14°C at night, with daytime temperatures up to 21°C.
Precipitation	The measurement period remained dry.

BS 8233:2014 requires the assessment of both the daytime and night time noise levels. Ideally noise measurement equipment is left onsite for twenty-four hours to characterise the noise environment; however at many sites this is not possible and an alternative measurement regime must be employed. At this site, it is an open site; therefore there were no windows at first floor level to attach noise monitoring equipment which could be left overnight. To ensure the equipment was not stolen or vandalised, it was necessary to conduct attended noise measurements at a location representative of the closest part of the proposed residential buildings to the roads.

The Calculation of Road Traffic Noise (CRTN) describes a shortened measurement procedure for road traffic dominated sites, which is an acceptable alternative for a full 16 hour daytime monitoring survey. The shortened measurement procedure requires L_{A10} noise levels to be measured during three consecutive hours between 10:00 and 17:00. The shortened measurement procedure requires that the measured L_{A10} noise levels to be arithmetically averaged to provide an assumed $L_{A10.3hr}$ noise level, from which the $L_{A10.18hr}$ can then be estimated, using the approximation:

$$L_{A10.18hr} \approx L_{A10.3hr} - 1dB$$

The $L_{A10.18hr}$ can then be used to calculate the $L_{Aeq,16hr}$ using the conversation factor given in PPG 24:

$$L_{Aeq,16hr} \approx L_{A10,18hr} - 2dB$$

However, the conversion factor given in PPG 24 should only be utilised when the noise levels are within NECs C or D, as it may otherwise under predict the noise levels in this noise assessment. Consequently, in certain circumstances it is more appropriate to convert from $L_{A10,\ 18hr}$ to a $L_{Aeq,\ 16hr}$ using the conversion formula in the TRL document "*Converting the UK traffic noise index $L_{A10,\ 18hr}$ to EU noise indices for noise mapping*".

In order to characterise night time noise, the Hawkins Approximation of night time noise measurement has been utilised (Hawkins, NC. (2015) *'The use of short duration night-time noise measurements to estimate $L_{Aeq.8hour}$.'* Proceedings of Acoustics 2015, Harrogate, UK. The Institute of Acoustics. Vol. 37. Pt. 2.). The Hawkins Approximation determines that for sites where noise is primarily attributed to road traffic noise, the $L_{Aeq.11pm\text{-}1am}$ is a very accurate approximation to determine the night time $L_{Aeq.8hour}$. Comparisons show that on average this approximation over predicts $L_{Aeq.8hour}$ by just 0.6 dB, yet the instances of under prediction are reduce to less than 10% of noise measurements, ensuring that this Approximation is a valid alternative when full unattended night time noise measurements are not possible.

The noise measurement data is detailed in **Appendix 4** and summarised in **Table 3.2** and **Table 3.3** below. Location 1 was situated on the eastern side of the development site representative of the houses to the east. Location 2 was situated at the southwest corner of the proposed football stadium; this location was considered representative of the closest dwellings to the A10 and Theobolds Lane. For safety, noise measurements were only conducted during the night time at Location 2.

Table 3.2: Summary of the Noise Level Measurements – Location 1

Period (hours)	Measured Noise Level dB			
	$L_{Aeq.T}$	Range $L_{Aeq.5mins}$	Range $L_{Amax.5mins}$	Range $L_{A90.5mins}$
Daytime 1pm to 4pm	53.5	51.8 – 54.7	59.8 – 71.9	49.5 – 51.6

Table 3.3: Summary of the Noise Level Measurements – Location 2

Period (hours)	Measured Noise Level dB			
	$L_{Aeq.T}$	Range $L_{Aeq.5mins}$	Range $L_{Amax.5mins}$	Range $L_{A90.5mins}$
Daytime 1pm to 4pm	55.6	53.7 – 56.3	58.9 – 72.4	51.7 – 54.8
Night time 11pm to 1am	51.4	49.5 – 53.1	53.8 – 67.7	47.2 – 50.3

4. NOISE INGRESS INTO THE PROPOSED DEVELOPMENT

The assessment of the noise ingress into the proposed rooms for residential purposes and the determination of the facade noise insulation has been assessed using BS 8233: 2014 *'Guidance on sound insulation and noise reduction for buildings*'.

4.1. Site Assessment

The noise measurement study has identified that on a day-to-day basis, the primary noise source is road traffic noise attributed to traffic on the A10, but also to a lesser extent on Theobolds Lane. Aircraft noise is also occasionally audible, as well as railway noise, especially railway horns.

The noise measurement survey determined the noise levels to be used in the BS 8233 assessment. **Table 4.1** shows the calculated day and night time noise levels to be used in a BS 8233 noise assessment, using the noise methods described in the previous section.

Table 4.1: Summary of the Day and Night Time Noise Levels for Assessment

Period	Freefield Noise Level L_{Aeq} dB	
	Location 1	Location 1
Daytime 7am to 11pm	52.3	54.6
Night time 11pm to 7am	n/a	51.4

Since the withdrawal of PPG24, the guidance from NPSE regarding NOEL, LOAEL and SOAEL has been used to assess the overall level of likely impact of noise on a proposed development site, albeit without specific noise levels. Unless local policy dictates otherwise, in the absence of further detailed research on levels of noise impact, Hawkins Environmental use the guideline levels contained within *"Possible Options for the Identification of SOAELs and NOAELs in Support of the NPSE",* as demonstrated in **Table 4.2**.

Table 4.2: Noise Impact Levels

	NOEL $L_{Aeq.T}$	LOAEL $L_{Aeq.T}$	SOAEL $L_{Aeq.T}$
07:00 to 23:00	<56	56 – 66	>66
23:00 to 0700	<46	46 - 56	>56

It can be seen from comparing the noise levels in **Table 4.1** to those in **Table 4.2** that the measured freefield night time external noise levels at the development site are less than the SOAEL levels, but greater than the NOEL noise levels. During the day however, noise levels were below the NOEL level. Therefore, overall effects

from the noise on site may be detected and therefore protection from noise should be incorporated into the design of the site.

4.2. Determination of Design Noise Levels

The appropriate design noise levels at this site are those identified in **Table 2.4** and replicated in **Table 4.3** below.

Table 4.3: Summary of Noise Criteria: BS8233:2014

Activity	Location	07:00 to 23:00	23:00 to 0700
Resting	Living room	35 dB $L_{Aeq.16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq.16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq.16hour}$	30 dB $L_{Aeq.8hour}$

4.3. Determination of Sound Insulation

The noise measurement survey indicates that attenuation is required and noise does need to be taken into account in the design of the building in order to meet the internal noise criteria contained within BS 8233 and comply with the guidance contained within the NPPF.

The Sound Reduction Index (R_w sometimes noted as SRI) is the level of sound attenuation afforded by a particular material. It is possible to calculate the R_w of a particular facade to determine the internal noise level based upon the noise survey results. It is widely known that a masonry wall will have a R_w of at least 50 dB. sometimes as high as 55 to 60 dB. The R_w of individual glazing solutions will vary considerably. However, typical double glazed window systems will have a R_w of 31 to 33 dB.

Section 6.7 of BS 8233 provides a rigorous calculation method for determining the internal noise levels within a proposed development. **Figure 4.1** shows the published calculation procedure.

Figure 4.1: BS 8233:2014 External to Internal Noise Level Calculation Method

$$L_{eq,2} = L_{eq,ff} + 10\log_{10}\left(\frac{A_0}{S}10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S}10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S}10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S}10^{\frac{-R_{rr}}{10}}\right) + 10\log_{10}\left(\frac{S}{A}\right) + 3 \quad \text{(G.1)}$$

where:

$L_{eq,ff}$ is the equivalent continuous sound pressure level outside the room elements under consideration;

NOTE 3 It is the free-field sound level (i.e. in the absence of the facade), measured or estimated at the intended position of the element under consideration. It is related to the level $L_{eq,1}$ measured within a few millimetres of the actual facade by the relation $L_{eq,ff} \approx L_{eq,1} - 6$, and to the level $L_{eq,2m}$ measured 2 m away from the facade by the relation $L_{eq,ff} \approx L_{eq,2m} - 3$.

NOTE 4 The calculation method assumes the source is traffic noise and a facade shape correction factor is not required. BS EN 12354-3 provides a more detailed calculation method where these assumptions are not valid.

A_0 is a reference absorption area of 10 m² and is independent of frequency;

S_f is the total facade area in square metres (m²) of the room in question;

S_{wi} is the area in square metres (m²) of the windows of the room;

S_{ew} is the area in square metres (m²) of the external wall of the room;

S_{rr} is the area in square metres (m²) of the ceiling of the room;

S is the total area in square metres (m²) of elements through which sound enters the room, i.e. $S_f + S_{rr}$;

$D_{n,e}$ is the insulation of the trickle ventilator measured according to BS EN ISO 10140;

NOTE 5 Where more than one ventilation unit is required to achieve the background ventilation, the $D_{n,e}$ of the combined ventilators should be used in the calculation.

R_{wi} is the sound reduction index (octave band value) of the window (see Annex C);

R_{ew} is the sound reduction index (octave band value) of the external wall (see Annex C);

R_{rr} is the sound reduction index (octave band values) of the roof/ceiling (see Annex C);

A is the equivalent absorption area of the receiving room being considered (see Annex C);

3 is a correction factor.

Using the above equation, it is possible to calculate the internal noise levels based on typical construction details. However, in suburban areas such as this, it is possible to use the quick approximation given in PPG 24 to first check whether standard double glazing will be sufficient. PPG 24 states that for road traffic noise, a primary standard double glazed window unit in a standard wall will provide approximately 33 dB attenuation when compared to the external facade level (note that a facade noise level is 3dB higher than the measured freefield noise levels; therefore when comparing a freefield noise level, the attenuation will be approximately 30 dB).

Assuming Location 2 represents the worst case noise levels on the development site, the internal noise levels have been calculated using the approximation contained within PPG 24; **Table 4.4** shows the results of these calculations. **Table 4.4** shows that even with standard double glazed windows, internal noise levels within all

room types will be below the maximum levels described in BS 8233:2014. Therefore, no further mitigating measures are required when considering road traffic noise.

Table 4.4 shows that with a window partially open, internal noise levels will be in excess of the maximum levels described in BS 8233:2014. As a consequence, it will be necessary to ensure that ventilation is adequate such that that design of the building does not rely on windows being opened to ensure that the dwellings are well ventilated (with the exception of purge ventilation).

4.4. Football Noise

Noise attributed to the use of the football stadium and the 3G pitch to the north of the development site have been investigated. Noise measurements were conducted adjacent to the 3G pitch on the evening of the 3rd August of a football match between Arsenal Ladies and Tottenham Hotspur Ladies, the latter of which also uses the facilities at Cheshunt FC. The noise level measurements taken on the evening of the 3rd are considered to be representative of both the use of the 3G pitch, but also of current noise levels within the Cheshunt FC stadium, since a crowd of around 150 people were in attendance to watch the match between Arsenal Ladies and Tottenham Hotspur Ladies, which is typical also of a Cheshunt FC match.

Noise measurements indicate that at around 3m from the pitch behind the goal, noise levels from football were typically around 56 dB, with L_{Amax} noise levels arising from the whistle to be 67 to 74 dB(A), depending on the location on the pitch the referee is located. However, period noise levels rise to around 63 dB when cheering occurs, for example when a goal is scored or at the final whistle.

It is understood that the closest dwellings (the northeast corner block of the stadium and the dwellings on the northeast boundary of the site) will be at its closest around 20m from the 3G pitch; based on simple distance attenuation, at the façade of the closest properties, noise levels will be around 16 dB lower than measured at a distance of 3m from the pitch, i.e. 47 dB or less. Given that most uses of the 3G will not have spectators, and some may not be refereed, it is anticipated that these noise levels represent a worst-case scenario. Given that road traffic noise has been measured to be greater than this level during the daytime, it is not anticipated that additional mitigation is required to reduce noise levels from the 3G pitch, although to reduce noise levels even further, or to provide additional comfort for future residents, the possibility of a small barrier along the southern side of the 3G pitch could be investigated, as given the elevated position of the 3G pitch, this is likely to provide additional attenuation from football noise.

Regarding noise from the football stadium itself, dwellings will be located in blocks at all four corners and behind the southern and eastern stands of the new stadium. However, it is proposed that in these six blocks, generally no habitable rooms within the dwellings will face the football pitch or the stands. Based on current noise levels within the stadium, which are likely to be similar those measure at the Arsenal Ladies and Tottenham Hotspur Ladies football match, noise levels within these dwellings around the stadium are likely to be below levels within BS 8233, even with standard double glazing. However, it is important that the dwellings are built with future capacity crowds in mind. Staff at Hawkins Environmental have previously been involved in noise measurements at Bristol Rovers FC, where noise was measured at a League 2 match between Bristol Rovers at the Memorial Ground against Macclesfield Town, where the crowd size was just over 5000 spectators, i.e. fairly representative of the proposed capacity at Cheshunt FC. Noise measurements conducted at the perimeter of the ground, where there was a direct line of site to the pitch was typically around L_{Aeq} 76 dB and L_{Amax} 88 dB, with the maximum noise levels due to applause from home goals and occasional public

address system use. Noise measurements conducted at the perimeter of the ground, behind the stands, where it is likely to be representative of facades of the flats in the blocks on the perimeter of the stadium, were typically lower at around L_{Aeq} 64 dB and L_{Amax} 82 dB. However, behind the main stand at the Memorial Stadium, in a location that could be considered representative of the housing to the east of the new football stadium at Cheshunt FC, noise levels were much lower at around L_{Aeq} 54 dB and L_{Amax} 68 dB, which is approximately the ambient daytime noise levels at this location at present.

Based on the assumption that generally no habitable rooms will be facing into the football stadium and that common areas (such as hallways) are to flank the wall between the dwellings and football stadium, which it is understood is the current plan, noise transmission through the wall should not be an issue, as there will be no direct party wall between the football stadium and the dwellings. However, one must assume that the noise levels measured at the perimeter of the Memorial Stadium ground behind the stands at Bristol Rovers, is likely to be representative of noise levels at the windows in the blocks of flats on the perimeter of the stadium at Cheshunt FC. Consequently, during football matches, noise levels of L_{Aeq} 64 dB could be experienced at the windows of the flats within the football stadium itself. Based on the frequency content of measured football noise, a window with a R_w of 36 dB(A) should be sufficient to ensure suitable internal noise levels within the flats when a football match is taking place, with a capacity crowd of around 5000 spectators.

It should be noted that there will be a very small number of flats in the corner blocks that have been designed so that they purposefully face onto the pitch. It is acknowledged that these dwellings may experience high noise levels; however, as with other contemporary examples of flats of this type (for example recently at Leyton Orient FC), typically people who choose to live in flats overlooking a football stadium are likely to be interested in the football matches and be significantly more accommodating of noise levels within the stadium; therefore it is considered that no additional attenuation is required.

It should be noted that when regarding noise from the football stadium, whilst it is being designed with a 5000 capacity crowd in mind, currently attendances are typically no greater than 250 people and are unlikely to exceed 1000 people in the short to medium term. Consequently, noise within the dwellings from football noise are actually likely to be much lower than quoted. Furthermore, football noise only occurs at certain times of the week and not every day and certainly not at night and therefore people are likely to be more accepting of temporary increases in noise level. In addition, anyone choosing to live within a working football stadium are likely to have some expectation of at least some football related noise and therefore, providing noise levels do not cause a significant disturbance for future residents, some football noise is likely to be tolerated.

4.5. Gun Noise

It has been noted that a gun club is located adjacent to the development site. It is understood that the gun club operate on a Wednesday and Friday afternoon/evening. The site was visited on two occasions on a Wednesday and a Friday and although the club was open, gun noise was not audible. It should be noted that the rifle range is orientated such that the guns are fired away from the proposed dwellings and that the range building and a bund of around 3m in height are both situated between the firing position and the closest receptors; therefore it is considered that gun noise is substantially shielded from the proposed development site. Anecdotal evidence from workers at Cheshunt FC suggest that gun noise is occasional audible and is described as a distant *"popping"* sound. Although it is not possible to quantify the gun noise, since it is recommended that dwellings within the stadium (and therefore closest to the gun club) would have a window R_w

of at least 36 dB, plus will be ventilated such that windows do not need to be opened, it is expected that noise levels from the gun club will be below the levels recommended in BS 8233.

4.6. External Noise Evaluation

BS 8233 provides guidance for noise in gardens and outdoor amenity space. It suggests that *"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."* The guidance does go on to say that these guideline values are not achievable in all circumstances and in some 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."*

At the development site, the worst-case $L_{Aeq.16hours}$ was measured to be 54.6, which is lower than the upper guideline value of 55 dB. Since significant areas of the gardens and outdoor amenity area would benefit from greater shielding from road noise than the noise measurement location, this could be considered a worse-case noise measurement location. Therefore it is possible to conclude that external noise levels in the gardens and outdoor amenity space will be considered to be acceptable.

Table 4.4: Summary of BS 8233 Calculations and Minimum Window R_w

Room Type	Day L_{Aeq}				Night L_{Aeq}				Minimum Window R_w	Ventilation Required?
	External	Internal			External	Internal				
		BS 8233 Max.	Windows Closed	Windows Open		BS 8233 Max.	Windows Closed	Windows Open		
Living room	54.6	35.0	24.6	39.6	-	-	-	-	Standard	Yes
Bedroom	54.6	35.0	24.6	39.6	51.4	30.0	21.4	36.4	Standard	Yes

5. NOISE IMPACTS OF THE PROPOSED DEVELOPMENT

5.1. Traffic Impacts

The effects of the development on the existing environment are considered in terms of development generated traffic. WSP has provided a transport assessment and has predicted traffic generation as a consequence of the 186 new dwellings and associated commercial space. Using the changes in traffic flow, the changes in noise levels have been calculated using the methodology contained within the Calculation of Road Traffic Noise (CRTN). **Table 5.1** summarises the results of these calculations for four representative receptor locations.

Table 5.1: Summary of Traffic Noise Impacts at Representative Receptor

Receptor Location	Change in $L_{A10, 18hr}$
Hennons, Theobolds Ln	0.0
Rush Lodge, Theobolds Ln	0.0
70 Theobolds Lane	0.7
1 Cranbourne Road	0.7

Table 5.1 shows that in general, the increase in traffic noise levels are less than 1 dB(A) $L_{A10,18hr.}$ A change of less than 3 dB(A) is normally considered to be imperceptible. The greatest change would be observed on Theobolds Lane, away from the A10. **Table 5.2** shows the Noise Impact Magnitude, based on the criteria contained within the 2014 IEMA Guidelines for Environmental Noise Assessment.

Table 5.2 shows that the impact on existing receptors as a consequence of the proposed development is considered to have no impact.

Table 5.2: Summary of Traffic Noise Impact Magnitude

Receptor Location	Noise Impact Magnitude
Hennons, Theobolds Ln	*No Impact*
Rush Lodge, Theobolds Ln	*No Impact*
70 Theobolds Lane	*No Impact*
1 Cranbourne Road	*No Impact*

Regarding the impact of traffic from the stadium, it is not possible to specifically predict traffic impacts associated with the expansion of the football stadium. It is proposed to extend the stadium so that it could seat 5000 spectators, although initially only 500 seats will be installed. Currently, crowds of 150 to 250 spectators are experienced at home games. The car parking provision will be no greater than is currently experienced and therefore additional traffic flow in the vicinity of the development site are not expected to increase significantly. Furthermore, since traffic flow events only occur on a set number of days per year; therefore, when considering the impact over the whole year, discrete events are not expected to have a significant impact on traffic flows in the area. WSP has developed a Stadium Event Management Plan that is used to manage traffic flows and have identified that in the longer term, offsite parking provision may be required, but the local impacts of football traffic flow are likely to be limited.

5.2. Plant Noise Impacts

The proposed development will see the creation of employment space and a new football stadium, both of which could potentially require plant that could make a noise that could cause an impact to new or existing residents of the area. At this stage in design process, the noise output of specific items of plant have yet to be determined and the design, exact location and layout of these building and land uses have yet to be determined; therefore, it is not possible to provide a full and detailed assessment of the likely impact of plant noise.

Whilst some background noise monitoring has been conducted on the site, it is unlikely to be representative of the potentially worst-affected properties. Consequently, it is seen as premature to set environmental noise limits for plant in accordance with BS 4242: 2014 *'Methods for rating and assessing industrial and commercial sound'*.

Given the type of land uses proposed that may give rise to plant noise, it is unlikely to be a significant constraint upon the development of the site and it is likely that plant noise could easily be mitigated in the detailed design phase. Therefore, plant noise can be addressed at this stage.

6. CONSTRUCTION NOISE

Due to the size of the development and early outline stage of the proposals, a quantitative construction noise and vibration assessment has not been carried out. Instead a qualitative assessment focussing on best practicable means has been completed. In general, the construction works with the greatest potential to generate noise are initial earthworks to level out the site, demolition and the piling of foundations. Building construction itself generally results in lower noise levels.

It is proposed that to minimise construction noise impacts, all construction work should take place in standard construction hours, which are:

Monday – Friday: 07:30 – 18:00

Saturdays: 08:00 - 13:00; and

Sundays and Public Holidays: No construction

It is recommended that the contractor would be required to follow Best Practicable Means to reduce the noise impact upon the local community including the following:

- Operating hours should be adhered to, with local residents being notified of any changes to the operating hours of the site;
- All construction plant and equipment should comply with EU noise emission limits;
- Where practicable, design and use of site hoardings and screens to provide acoustic screening of noise emitting equipment;
- Proper use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good efficient working order;
- Selection of inherently quiet plant where appropriate. All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum;
- Plant and equipment such as flat bed lorries, skips and chutes should be lined with noise attenuating materials. Materials should be handled with care and be placed, not dropped. Materials should be delivered during normal working hours.
- All ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimum noise disturbance, i.e. furthest from receptors or behind close boarded noise barriers. If necessary, acoustic enclosures should be provided and/or acoustic shielding;
- Making positive contact with local residents and providing information on the construction can be the most effective method of reducing the impact of construction noise on sensitive receptors. If

appropriate, the above measures can be incorporated into a construction environmental management plan;

- Construction contractors should be obliged to adhere to the codes of practice for construction working given in BS 5228 and the guidance given therein regarding minimising noise emissions from the site; and
- Reference should be made to the Building Research Establishment, BRE 'Pollution Control' guidelines, Parts 1-57.Noise Monitoring.

7. OVERALL CONCLUSIONS AND RECOMMENDATIONS

A detailed noise measurement study has been carried out at the site in order to determine whether as a result of noise, there are any significant constraints on developing the site for residential purposes.

The study has shown that based on noise from the adjacent road, if the site is to come forward for residential development, noise must be considered and attenuation must be provided.

Using the guidance and calculation methods contained within BS 8233: 2014 '*Guidance on sound insulation and noise reduction for buildings',* it has been shown that the recommended maximum internal noise levels for each room use under BS 8233 can be achieved within the houses on the proposed development site, with standard double glazed windows. However, it is recommended that all flats in the development, which surround the main pitch within the stadium, should have a slightly higher specification of glazing with a R_w of around 36 dB. With this level of protection from noise, suitable internal noise levels can be achieved. Noise measurements have also shown that external noise levels will be below the maximum recommended desirable level.

The assessment has also shown that noise from increases in traffic noise would be considered to have no impact.

Since it has been shown that the proposed development meets the guidance contained within BS 8233: 2014, it is considered that the proposed development adheres to the principles of the National Planning Policy Framework since the new development will not be *"put at risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution"*. Since it has been shown that in terms of noise, the proposals adhere to local and national planning policy, it is considered that the noise environment of the site should not be a constraint on the proposed residential development.

Appendix 1
Site Location Plan

Appendix 1: Site Location Plan

Map Information

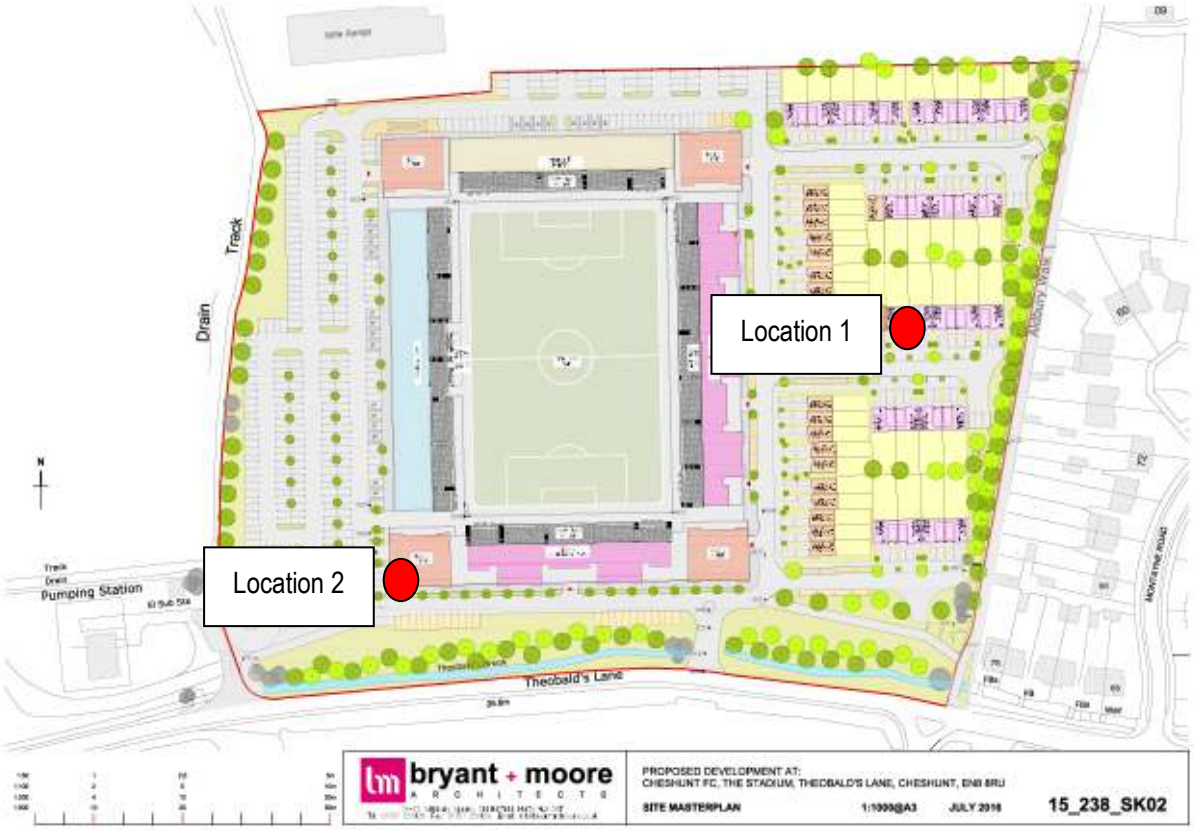
Scale	1:10000
Date:	15/08/16
Reference	H2242
Order No:	1720973

Map data

FIND
PROFESSIONAL MAPPING INTELLIGENCE
Created at findmaps.co.uk

Appendix 2
Site Layout Plan

Appendix 2: Site Layout Plan



Appendix 3
Glossary of Acoustic Terms

Appendix 3: Glossary of Acoustic Terms

Decibel (dB)	This is a tenth (deci) of a bel. Decibel can be a measure of the magnitude of sound, changes in sound level and a measure of sound insulation. Decibels are not an absolute unit of measurement but are an expression of ratio between two quantities expressed in logarithmic form.
dB(A)	A-weighted decibels, i.e. decibel level 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.
Freefield	A situation in which the radiation from a sound source is completely unaffected by the presence of any reflecting boundaries.
Hertz (Hz)	Unit of frequency, equal to one cycle per second. Frequency of sound waves refers to the number of pressure fluctuations per second. Frequency is related to the pitch of a sound.
$L_{Aeq,T}$	The equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period, T. For example, daytime noise is generally measured over a 16 hour period, so T is 16 hours. $L_{Aeq,T}$ can be measured directly with an integrating sound level meter.
L_{A10}	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 10 per cent of a given time and is the $L_{A10.T}$. The L_{A10} is used to describe the levels of road traffic noise at a particular location.
L_{A50}	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 50 per cent of a given time and is the $L_{A50.T}$.
L_{A90}	The 'A'-weighted sound pressure level of the residual noise in decibels exceeded for 90 per cent of a given time and is the $L_{A90.T}$. The L_{A90} is used to describe the background noise levels at a particular location.
L_{Amax}	The 'A'-weighted maximum sound pressure level measured over a measurement period.
R_w (or SRI)	The weighted sound reduction index as a single number laboratory measured rating used to describe the sound insulation of building elements.

Appendix 4
Schedule of Equipment

Appendix 4: Schedule of Equipment

Equipment Set 3056:

Equipment Type	Manufacturer	Serial Number	Calibration Certification Number	Calibration Type	Date of Last Calibration Check	Date of Next Calibration Check
Nor-140 Type 1 Sound Level Meter	Norsonic	1403056	16831	Traceable to NPL London by Campbell Associates	13th August 2014	13th August 2016
Nor-1209 Pre-amplifier	Norsonic	12528	16830	Traceable to NPL London by Campbell Associates	13th August 2014	13th August 2016
Nor-1225 Microphone	Norsonic	14360	16830	Traceable to NPL London by Campbell Associates	13th August 2014	13th August 2016
Nor-1251 Sound Calibrator	Norsonic	32849	19738	Traceable to NPL London by Campbell Associates	1st October 2015	1st October 2016
Nor-1284 Dehumidifier	Norsonic	222	Not Applicable			
Nor- 1212 Weather Protection Kit	Norsonic	Not Applicable				
Nor1408A/5 Extension Cable	Norsonic/Lemo	Not Applicable				

Calibration Report

Certificate Number:-16831

Norsonic Type: 140 Serial no: 1403056

Customer:	**Hawkins Environmental Ltd**
Address:	**70 Wentworth Crescent, Basingstoke, Hampshire. RG22 4WX.**
Contact Person:	**Nick Hawkins.**

Instrument software version: V1.4.6238

Microphone :	Norsonic	Type: 1225	Serial no: 14360	Sens:-24.81dB
Preamplifier	Norsonic	Type: 1209	Serial no: 12528	
Calibrator:	Norsonic	Type: 1251	Serial no: 32649	Level:113.98dB
Wind screen	Norsonic	Type: Nor1451		

Mains adapter was included Interface cable was included

This sound level meter has been calibrated as specified in BS 7580. PART 1: 1997. The results are traceable to NPL, UK.

Measurement Results:

Indication at the calibration check frequency - BS7580 Clause 5.4	Passed
Noise test - BS 7580 Clause 5.5.2	Passed
Level Linearity Test - BS 7580, Clause 5.5.3	Passed
Frequency weightings: A Network - BS 7580 Clause 5.5.4	Passed
Frequency weightings: C Network - BS 7580 Clause 5.5.4	Passed
Frequency weightings: Z Network - BS 7580 Clause 5.5.4	Passed
Time weightings F and S - BS7580 Clause 5.5.5	Passed
Peak response - BS7580 Clause 5.5.6	Passed
RMS accuracy - BS7580 Clause 5.5.7	Passed
Time weighting I - BS7580 Clause 5.5.8	Passed
Integrating Test : Time averaging - BS7580 Clause 5.5.9	Passed
Integrating Test : Pulse range - BS7580 Clause 5.5.10	Passed
Integrating Test : Sound exposure level - BS 7580 Clause 5.5.11	Passed
Overload SPL Test - BS 7580 Clause 5.5.12	Passed
Overload Leq Test - BS 7580 Clause 5.5.12	Passed
Acoustic tests - BS 7580 Clause 5.4 and 5.6	Passed
Summation of acoustic tests - BS 7580 Clause 5.5.4	Passed

Comment:
Correct level with associated calibrator is 113.8dB(A).

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
99.810 kPa	22.8 °C	45.5 %RH

Date of calibration: 13/08/2014
Date of issue: 13/08/2014

Supervisor: Darren Batten TechIOA Engineer

Michael Tadmer

Campbell Associates

Software version: 6.50

Calibration Report

Certificate Number:-16830

Manufacturer: Norsonic
Type: 1225
Serial no: 14360

Customer: Hawkins Environmental Ltd
Address: 70 Wentworth Crescent, Basingstoke, Hampshire. RG22 4WX.
Contact Person: Nick Hawkins.

Measurement Results:

	Sensitivity: (dB re 1V/Pa)	Capacitance: (pF)
1:	-24.82	20.9
2:	-24.81	20.9
3:	-24.81	20.9
Result (Average):	**-24.81**	**20.9**
Expanded Uncertainty:	0.10	2.00
Degree of Freedom:	>100	>100
Coverage Factor:	2.00	2.00

The following correction factors have been applied during the measurement:
Pressure:-0.001 dB/kPa Temperature:0.005 dB/°C Relative humidity:0.000 dB/%RH

Reference Calibrator: WSC2 - GRAS42AA-18277 Volume correction: 0.000 dB
Records:K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\2014\NOR1225_14360_M1.nmf
Measurement procedure: TP05
All results quoted are directly traceable to National Physical Laboratory, London

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.

Comment:

Environmental conditions:

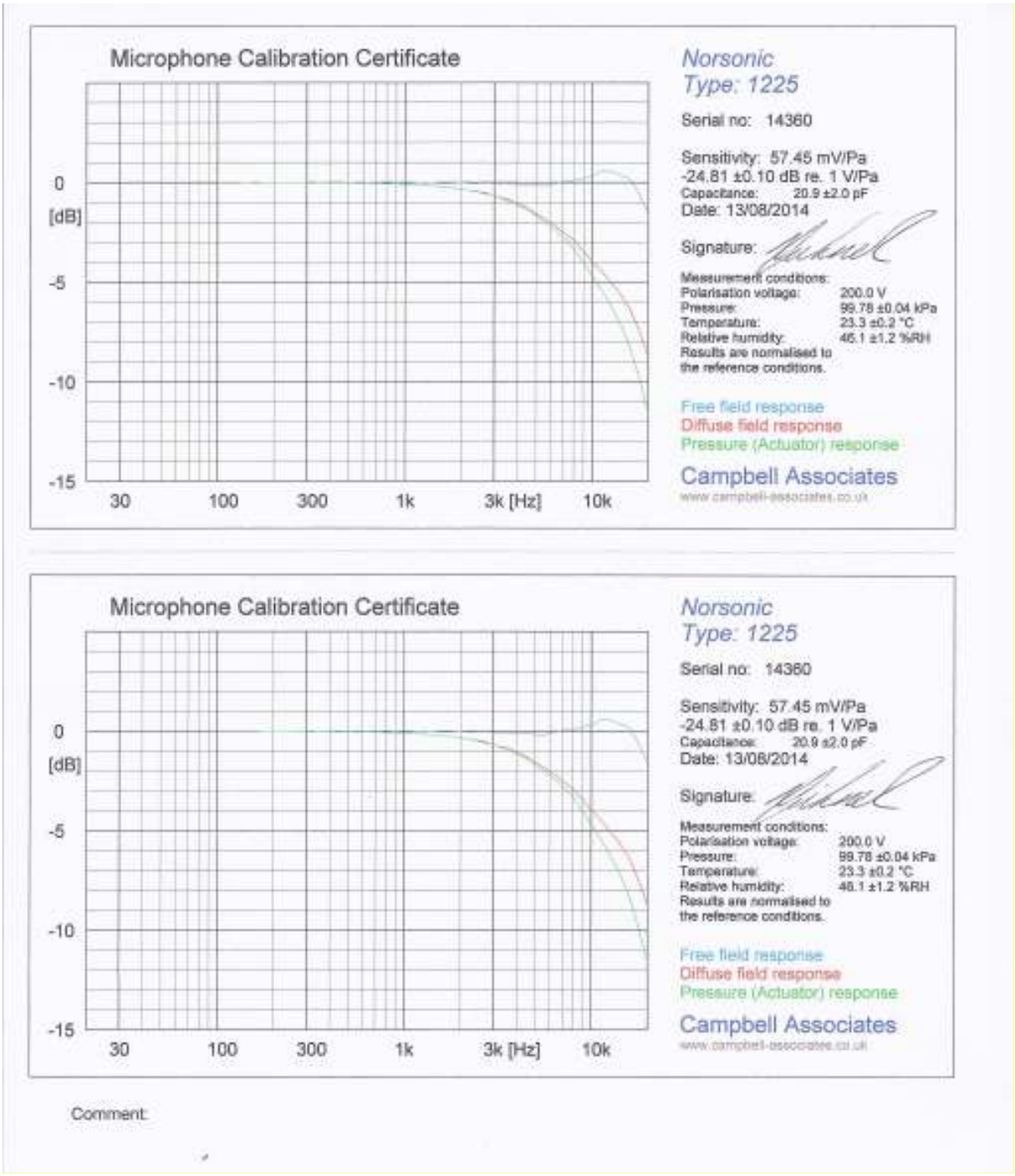
Pressure:	Temperature:	Relative humidity:
99.781 ± 0.040 kPa	23.3 ± 0.2 °C	46.1 ± 1.2 %RH

Date of calibration: 13/08/2014
Date of issue: 13/08/2014

Supervisor : Darren Batten TechIOA
Engineer :

Campbell Associates
www.campbell-associates.co.uk

Michael Tickner
Software version: 6.0h


Microphone Calibration Certificate
0
[dB]
-5
-10
-15
30
100
300
1k
3k [Hz]
10k
Norsonic
Type: 1225
Serial no: 14360
Sensitivity: 57.45 mV/Pa
-24.81 ±0.10 dB re. 1 V/Pa
Capacitance: 20.9 ±2.0 pF
Date: 13/08/2014
Signature:
Measurement conditions:
Polarisation voltage: 200.0 V
Pressure: 99.78 ±0.04 kPa
Temperature: 23.3 ±0.2 °C
Relative humidity: 46.1 ±1.2 %RH
Results are normalised to the reference conditions.
Free field response
Diffuse field response
Pressure (Actuator) response
Campbell Associates
www.campbell-associates.co.uk
Microphone Calibration Certificate
0
[dB]
-5
-10
-15
30
100
300
1k
3k [Hz]
10k
Norsonic
Type: 1225
Serial no: 14360
Sensitivity: 57.45 mV/Pa
-24.81 ±0.10 dB re. 1 V/Pa
Capacitance: 20.9 ±2.0 pF
Date: 13/08/2014
Signature:
Measurement conditions:
Polarisation voltage: 200.0 V
Pressure: 99.78 ±0.04 kPa
Temperature: 23.3 ±0.2 °C
Relative humidity: 46.1 ±1.2 %RH
Results are normalised to the reference conditions.
Free field response
Diffuse field response
Pressure (Actuator) response
Campbell Associates
Comment:

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

Certificate number: 19738

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**Norsonic**
Type:	**1251**
Serial no:	**32849**
Customer:	Hawkins Environmental Ltd
Address:	70 Wentworth Crescent, Basingstoke, Hants. RG22 4WX.
Contact Person:	Nick Hawkins.

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	114.05 dB	0.01 dB	999.67 Hz	0.00 %	<0.3 %
2:	114.04 dB	0.01 dB	999.67 Hz	0.00 %	<0.3 %
3:	114.04 dB	0.01 dB	999.67 Hz	0.00 %	<0.3 %
Result (Average):	**114.04 dB**	**0.01 dB**	**999.67 Hz**	**0.00 %**	**<0,3 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.0005 dB/kPa Temperature: 0.003 dB/°C Relative humidity: 0.000 dB/%RH Load volume : 0.0003 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 Cal\Cal\2015\NOR1251_32849_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	102.552 ± 0.042 kPa	22.0 ± 0.2 °C	47.1 ± 0.9 %RH

Date received for calibration:	24/09/2015
Date of calibration:	01/10/2015
Date of issue:	01/10/2015
Engineer	Michael Tickner
Supervisor	Darren Batten TechIOA

Appendix 5
Summary of Noise Measurements

Appendix 5: Summary of Noise Measurements

Location 1:

Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A50}	L_{A90}
13:00	53.6	71.9	54.7	52.5	51.0
14:00	53.4	69.3	54.9	52.4	50.9
15:00	53.5	68.1	55.8	51.9	50.2
Day	**53.5**	**71.9**	**55.1**	**52.3**	**50.7**
$L_{A10.3hr}$	55.1				
$L_{A10.18hr}$	54.1				
$L_{Aeq.16hr}$	**52.3**				

Location 2:

Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A50}	L_{A90}
13:00	56.2	63.5	58.3	55.5	54.0
14:00	55.6	62.3	57.1	55.2	53.6
15:00	55.0	72.4	57.3	53.9	52.3
Day	**55.6**	**72.4**	**57.6**	**54.9**	**53.3**
23:00	51.4	64.1	53.0	50.6	48.5
00:00	51.4	67.7	53.0	50.3	48.1
Night	**51.4**	**67.7**	**53.0**	**50.4**	**48.3**
$L_{A10.3hr}$	57.6				
$L_{A10.18hr}$	56.6				
$L_{Aeq.16hr}$	**54.6**				
$L_{Aeq.8hr}$	**51.4**				