Hawkins environmental

Noise Assessment: 107 Gray's Inn Road, London

Charles Darwin House Limited

21st February 2014

Report Details:

Report Title	Noise Assessment: 107 Gray's Inn Road, London
Client	Charles Darwin House Limited
Client Address	c/o The Biochemical Society Charles Darwin House 12 Roger Street London WC1N 2JU
Project Number	H1822

Version History:

Version No.	Date Issued	Comments	Author	Checked
V01	23rd October 2013	Original Issue	Nick Hawkins MIOA MIAQM	Nick Hawkins MIOA MIAQM
V02	21st February 2014	Addition of plant details	Nick Hawkins MIOA MIAQM	Nick Hawkins MIOA MIAQM

Table of Contents

List of Appendices

List of Tables

List of Figures

1. INTRODUCTION

1.1. Overview

Hawkins Environmental Limited has been instructed by Charles Darwin House Limited to undertake a noise assessment for the proposed redevelopment of 107 Gray's Inn Road, Bloomsbury, situated in the London Borough of Camden.

During the planning process, it has been identified that plant to be installed as part of the proposed development may have the potential to have an impact on surrounding residential properties. Consequently, a noise survey was conducted to characterise the noise climate of the site and a subsequent noise assessment was carried out to assess the acceptability of any plant noise.

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 plant noise egress from the proposed development has been assessed in accordance with British Standard BS 4142: 1997 *'Method for rating industrial noise affecting mixed residential and industrial areas'.*

1.2. Site Description

The proposed development site is situated on Gray's Inn Road in Bloomsbury, to the south of Kings Cross Station. The development site is currently a four storey office building. A location plan of the proposed site can be see in **Appendix 1**.

The site is situated on the western side of Gray's Inn Road, with large offices opposite on the eastern side, as well as office buildings to the immediate north and south. To the rear of the development site, to the west, a number of dwellings on Brownlow Mews direct face the development site.

The main noise sources on site can be attributed to road traffic on Gray's In Road. To the rear of the development site, where the plant is proposed, whilst noise from road traffic is still audible, aircraft noise and plant noise are also dominant sources of noise. During the site survey all of the existing air conditioning units associated with 107 Gray's Inn Road were turned off; however noise from plant associated with other properties were clearly audible and at times dominant.

The proposed development will an additional storey added to the existing four storey office building. The existing building will also be refurbished and plant to the rear of the premises will also be replaced.

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 2**.

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 though 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 into 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 development 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 itself 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[2] provides further guidance on the interpretation of Section 123 of the NPPF and states that

"Within the context of sustainable development:

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

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

2.4. WHO Guidelines and BS 8233

Guidance on absolute limits for noise inside and outside of buildings is provided in BS 8233:1999 'Sound insulation and noise reduction for buildings –Code of practice'. Similar guidance can also be found in the current World Health Organisation (WHO) "Guidelines on Community Noise". A summary of the noise criteria can be seen in **Table 2.4** and **Table 2.5.**

Table 2.2: Summary of Noise Criteria: BS8233

Criterion	Typical situations	Good Level $L_{Aeq,T}$	Reasonable Level $L_{Aeq,T}$	Reasonable Peak L_{Amax}
BS 8233 Reasonable resting/sleeping conditions	Living rooms	30	40	-
	Bedrooms	30	35	45

Whilst it is always good practice to endeavour to achieve the "good" level of BS 8233, the British Standard does state that in normal circumstances, only the "reasonable" level needs to be achieved.

Table 2.3: 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

2.5. BS 4142

British Standard BS 4142: 1997 '*Method for rating industrial noise affecting mixed residential and industrial areas'* 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 BS4142 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 indicates that complaints are likely;
- A difference of around +5 dB is of marginal significance;
- If the rating is more than 10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.

2.6. The London Plan

The London Plan[3], published in July 2011, provides an overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. The Plan brings together the Mayor's strategies, including policy on a range on environmental issues, such as climate change, air quality, noise and waste. London boroughs' local plans need to be in general conformity with the London Plan, and its policies guide decisions on planning applications by councils and the Mayor.

Policy 7.1 specifically relates to noise and states:

"Development proposals should seek to reduce noise by:

a) minimise the existing and potential; adverse impacts of noise on, from, within, or in the vicinity of, development proposals;

b) separating new noise sensitive development from major noise sources wherever practicable through the use of distance, screening, or internal layout in preference to sole reliance on sound insulation;

c) promoting new technologies and improving practices to reduce noise at source."

2.7. London Plan – Housing Supplementary Planning Guidance

The Housing SPG, published in November 2012 highlights the elements of the London Plan that are relevant to housing development, and where applicable, provides more detail. The SPG states:

"Noise - Baseline

Standard 5.3.1 (and Policy 7.15) – The layout of adjacent dwellings and the location of lifts and circulation spaces should seek to limit the transmission of noise to sound sensitive rooms within dwellings.

Policy 7.15 Reducing Noise and Enhancing Soundscapes requires development proposals to seek to reduce noise and manage the effects of noise. It is another important aspect of retreat and privacy in a dwelling. Noise from the street and adjoining properties can cause stress, sleep disturbance and friction between neighbours as recognised in the NPPF154.

[3] The London Plan - Spatial Development Strategy for Greater London (July 2011), Mayor of London.

2.3.35 All dwellings should be built with acoustic insulation and tested to current Building Regulations standards155. However, acoustic insulation should not be relied upon as the only means of limiting noise and the layout and placement of rooms within the building should be considered at an early stage in the design process to limit the impact of external noise on bedrooms and living rooms. The impact of noise should also be considered in the placement of private external spaces."

2.8. Local Policy

The London Borough of Camden's Development Policies 2010-2025[4] document states in Policy DP28 Noise and Vibration that *"The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for: a) development likely to generate noise pollution..."*

The policy document goes on to describe noise thresholds at which development related noise levels will be acceptable:

"Table E: Noise levels from plant and machinery at which planning permission will not be granted:

Noise description and location of measurement	***Period***	***Time***	***Noise level***
Noise at 1 metre external to a sensitive façade	*Day, evening and night*	*0000-2400*	*5dB(A) <L_{A90}*
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade.	*Day, evening and night*	*0000-2400*	*10dB(A) <L_{A90}*
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade.	*Day, evening and night*	*0000-2400*	*10dB(A) <L_{A90}*
Noise at 1 metre external to sensitive façade where L_{A90}>60dB	*Day, evening and night*	*0000-2400*	*55dBL_{Aeq}"*

The above noise levels are consistent with the approach formally adopted on a national scale by BS 4142.

[4] Camden Local Development Framework - Camden Development Policies - Adoption version 2010

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 background noise levels (L_{A90}) over a twenty-four hour period. In addition, the L_{Amax} L_{A10}, L_{A50}, and L_{Aeq} 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 3** 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 17th and 18th October 2013. 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

Time	Pressure hPa	Temperature °C	Humidity %	Wind Speed m/s	Wind Direction	Rainfall mm
1200	1024.9	17.3	71	<0.5	NNE	0
1300	1025.1	17.5	70	<0.5	NNW	0
1400	1025.3	17.0	71	<0.5	NW	0
1500	1025.7	17.0	72	<0.5	NNW	0
1600	1025.6	17.3	72	<0.5	NNW	0
1700	1025.7	16.9	72	<0.5	ESE	0
1800	1025.8	16.3	74	<0.5	SSE	0
1900	1026.2	15.8	74	<0.5	SSE	0
2000	1026.8	15.3	75	<0.5	SE	0
2100	1027.4	14.9	75	<0.5	SE	0

Time	Pressure hPa	Temperature °C	Humidity %	Wind Speed m/s	Wind Direction	Rainfall mm
2200	1027.6	14.5	81	<0.5	SE	0
2300	1027.8	13.9	85	<0.5	SE	0
0000	1027.8	13.5	87	<0.5	NE	0
0100	1027.9	13.4	88	<0.5	SE	0
0200	1028.2	13.4	88	<0.5	SE	0
0300	1028.3	13.4	88	<0.5	SE	0
0400	1028.0	13.6	88	<0.5	SE	0
0500	1027.6	13.8	87	<0.5	SSE	0
0600	1027.6	13.4	87	<0.5	SSE	0
0700	1027.4	12.6	89	<0.5	SSE	0
0800	1027.3	12.5	90	<0.5	SSE	0
0900	1027.5	13.6	88	<0.5	SE	0
1000	1027.3	14.3	85	<0.5	SE	0
1100	1027.1	15.4	84	<0.5	N	0
1200	1026.6	16.2	83	<0.5	NNW	0
1300	1025.9	16.2	81	<0.5	NE	0

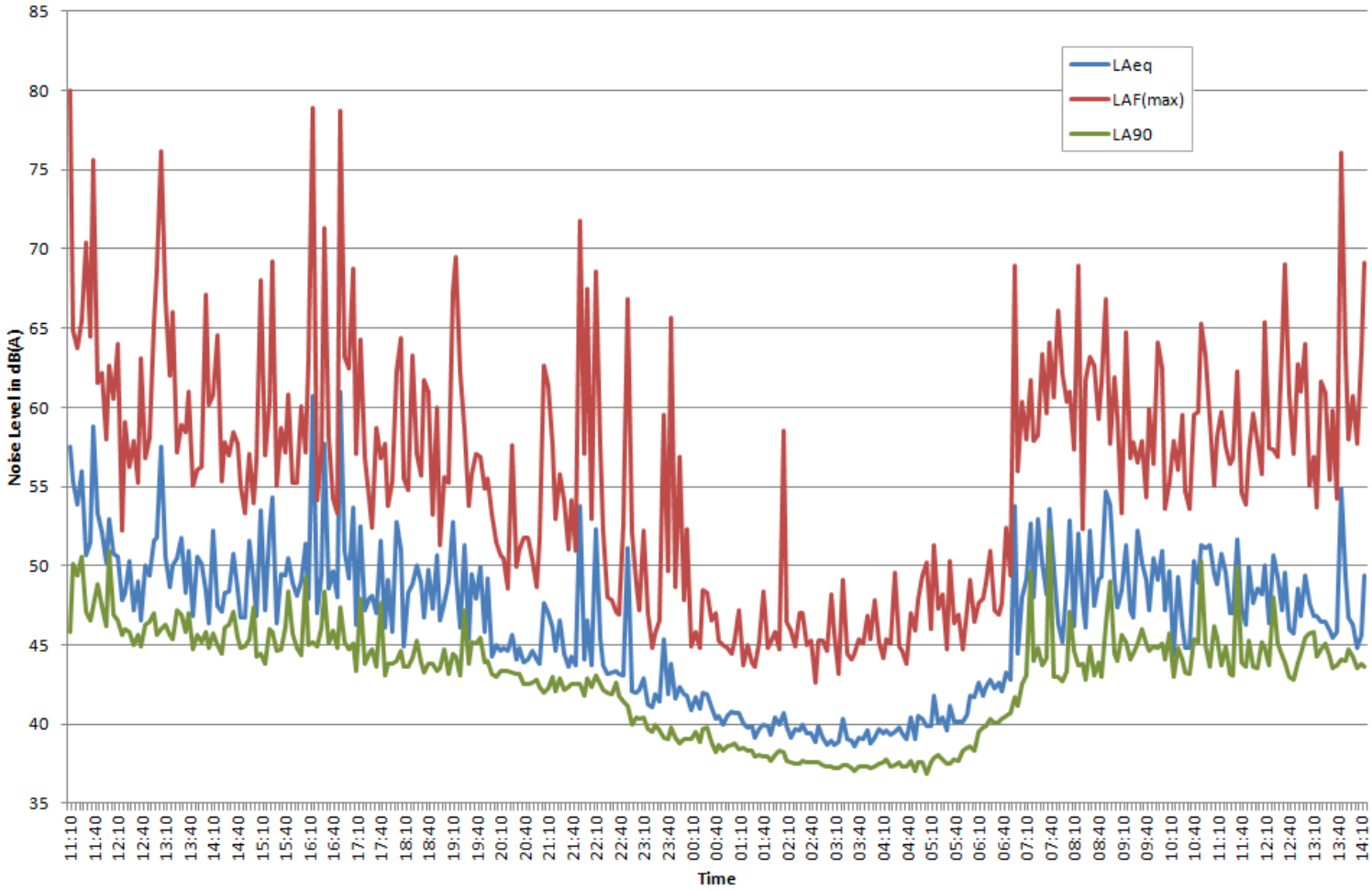
Noise monitoring was conducted from within the courtyard to the rear of the premises in a facade location representative of the closest affected dwellings, situated to the rear of the proposed development.

The twenty-four hour noise measurements are detailed in **Appendix 3** and summarised in **Table 3.2** below, with a graph displaying the noise level data in **Figure 3.1**.

Table 3.2: Summary of the Noise Level Measurements

Period (hours)	Facade Noise Level L_{Aeq} dB	Facade Noise Level L_{A90} dB
07:00-19:00	50.3	44.9
19:00-23:00	47.2	43.0
23:00-07:00	41.6	38.4

Figure 3.1: Noise Measurements – Rear Facade



4. PLANT NOISE IMPACT ASSESSMENT

4.1. Plant Noise Levels

It is proposed to install nine air conditioning units to the rear of the proposed development. Four will be situated on top of the existing plant room, and five further units are to be positioned above the existing exit on the northern end of the rear facade. Dunwoody LLP, the consulting engineers on the project, have determined that the sound pressure levels at 1 m from the units would be 64, 64, 56 and 56 dB(A) for the four units on top of the plant room, and 66, 66, 63, 63 and 56 dB(A) for the five units around the exit.

4.2. Noise Level at Closest Properties

Based on the Sound Power Levels of the proposed plant, it is possible to calculate the sound pressure levels at the closest residential properties, if the distance between the receptor and the plant is known. The closest windows to the proposed air conditioning units will be situated to the rear of 9a Brownlow Mews. It has been identified that there will be a 1.8m high noise barrier along the parapet edge above the plant room, behind which four of the units would be situated and which would act as a noise barrier. It is understood that a louvered screen may be used at this location; if this is the case, it will be necessary to ensure that the noise attenuation afforded by the louver still ensures a receptor noise levels that complies with Camden's policy on noise.

To reduce noise levels for the other five units, it is proposed to install acoustic enclosures around the air conditioning units. Since the units will be wall mounted, a single enclosure around all of the units would not be feasible; therefore it is proposed to install an Environ Lite Acoustic Enclosure around each individual wall mounted unit. These enclosures can reduce noise levels by 26 dB(A) and are designed such that they do not obstruct air flow, so do not compromise performance of the unit (further details can be seen at http://www.environ.co.uk/products/packaged-plant-solutions.html). A copy of the acoustic test report for the enclosures can be seen in **Appendix 5**. It should be noted that other enclosures or mitigating methods may be suitable; however they should be assessed to ensure that they meet the minimum requirements of Camden's policy on noise.

The noise levels have been calculated using the methodology contained within ISO 9613: 1996: *Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation*. Where appropriate, barrier reductions have been calculated and included the results, as well as the affects of building reflections on facade locations. The results can be seen in **Table 4.1**.

Table 4.1: Calculation of Receptor Noise Levels

Plant Reference	A	B	C	D	E	F	G	G	I
Location	Plant Room Roof				Wall Mounted on Rear Facade				
Sound Power Level at 1m in dB(A)	64	64	56	56	66	66	63	63	56
Source to receiver distance (direct) in m	6.5	6.5	6.5	6.5	4.5	4.5	4.5	4.5	4.5
Source to receiver distance (parallel to ground) in m	6.5	6.5	6.5	6.5	4.5	4.5	4.5	4.5	4.5
Height of source in m	4.5	4.5	4.5	4.5	3.8	3.8	3.8	3.8	3.8
Height of receiver in m	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Distance Attenuation in dB(A)	16.3	16.3	16.3	16.3	13.1	13.1	13.1	13.1	13.1
Barrier Description	1.8 High Barrier Above Plant Room				Environ Lite Acoustic Enclosure				
Barrier Attenuation in dB(A)	21.6	21.6	21.6	21.6	26.0	26.0	26.0	26.0	26.0
Individual Plant Noise Level in dB(A)	**26.1**	**26.1**	**18.1**	**18.1**	**26.9**	**26.9**	**23.9**	**23.9**	**16.9**
Total Receptor Noise Level in dB(A)	**36.9**								

4.3. Adherence to Noise Thresholds

The previous section of this report has determined the noise levels at the closest receptor locations. Under the London Borough of Camden's noise policy, noise levels from the plant should not be louder than 10 dB below background noise levels, if the noise has a distinguishable discrete continuous note (whine, hiss, screech, hum) or if the noise has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade, otherwise noise levels from the plant should not be louder than 5 dB below background noise levels. Dunwoody LLP's acoustic data for the nine units do not identify any distinguishable discrete continuous notes or distinct impulses; therefore under Camden's guidance, noise from the air conditioning units should not be louder than 5 dB below background noise levels. It has been identified that the units will only be in operation between 8am and 8pm each day; therefore the lowest background noise level according to Camden's method of assessment is the evening L_{A90} which was measured to be 43.9 L_{A90}. It should be noted that due to the presence of other continuously operated plant in the area, background noise levels are very steady during the work day, at around 44 to 44.5 dB(A) L_{A90}.**Table 4.2** below compares the predicted noise levels against the quietest measured background noise level. It shows that plant noise from the proposed plant configuration will be 7.0 dB(A) below the lowest measured background noise levels during the period of plant operation; therefore noise levels from the plant are unlikely to be a nuisance and they do comply with Table E of the London Borough of Camden's Policy DP28 on Noise and Vibration.

Table 4.2: Comparison of Plant Noise to Camden's Noise Thresholds

	Background Noise Level (1) L_{A90}	Plant Noise Level(2) L_{Aeq}	Difference between plant level and Background Noise Level
9a Brownlow Mews	43.9	36.9	-7.0

Note: (1) Background level used is the lowest evening 1hour period sampled.

(2) This is the predicted external noise level from the plant

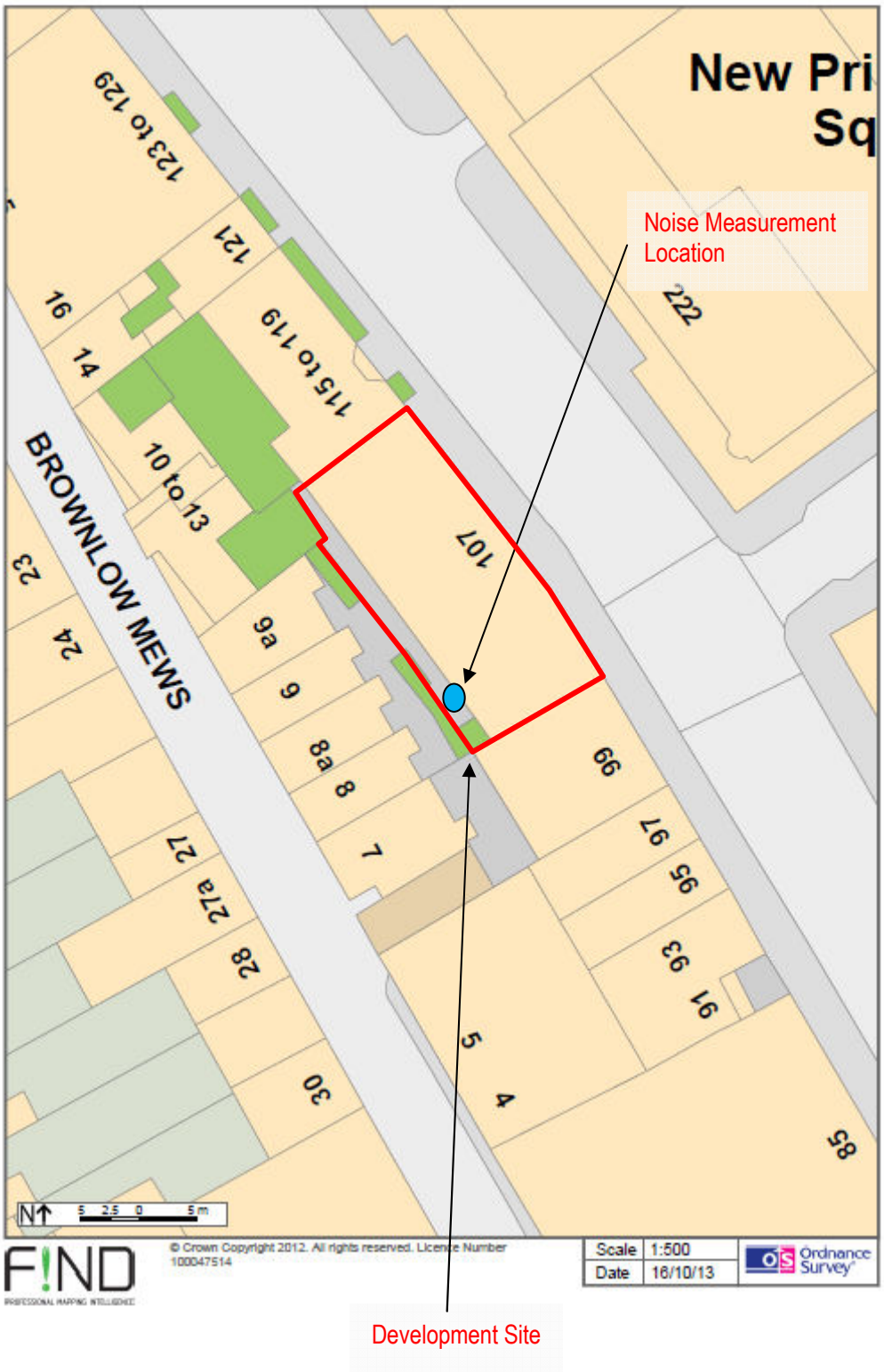
5. OVERALL CONCLUSIONS AND RECOMMENDATIONS

A detailed noise measurement study has been carried out at the site in order to determine whether noise from proposed fixed plant and machinery is likely to have an impact on surrounding sensitive residential receptors.

A noise measurement study has been conducted at the site and determined that the background noise levels during the evening (the quietist time when the plant will be operating) will be in the region of 43.9 L_{A90}. In accordance with the London Borough of Camden's policy on noise, the maximum cumulative noise level permissible at the nearest noise sensitive receptor is 36.9 dB(A). This shows that noise levels from the plant are unlikely to be a nuisance and that noise levels comply with Table E of the London Borough of Camden's Policy DP28 on Noise and Vibration.

Appendix 1
Site Plan

Appendix 1: Site Plan



Appendix 2
Glossary of Acoustic Terms

Appendix 2: Glossary of Acoustic Terms

'A'-Weighting - This is the main way of adjusting measured sound pressure levels to take into account human hearing, and our uneven frequency response.

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.

$L_{Aeq,T}$ - The equivalent steady sound level in dB containing the same acoustic energy as the actual fluctuating sound level over the given period, T. T may be as short as 1 second when used to describe a single event, or as long as 24 hours when used to describe the noise climate at a specified location. $L_{Aeq,T}$ 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_{A10T}. 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_{A50T}.

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_{A90T}. 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.

Appendix 3
Schedule of Equipment

Appendix 3: Schedule of Equipment

Equipment Type	Manufacturer	Serial Number	Calibration Certification Number	Accreditation Body	Date of Last Calibration Check
Nor-140 Type 1 Sound Level Meter	Norsonic	1405199	14002500	Norsonic	August 2012
Nor-1209 Pre-amplifier	Norsonic	15117	14002500	Norsonic	August 2012
Nor-1225 Microphone	Norsonic	151240	14002500	Norsonic	August 2012
Nor-1251 Sound Calibrator	Norsonic	32849	14326	Campbell Associates	August 2013
Nor-1284 Dehumidifier	Norsonic	222	Not Applicable		
Nor- 1212 Weather Protection Kit	Norsonic	Not Applicable			
Nor1408A/5 Extension Cable	Norsonic/Lemo	Not Applicable			

Certificate of Calibration

Certificate No.: 14002500

Object	Sound Analyser Nor-140
Supplier	Norsonic AS
Type	Nor140
Serial number	1405199
Client	GREAT BRITAIN

Calibration complies with the following standard(s)

IEC 61672-1:2002 class 1
IEC 60651 type 1
IEC 60804 type 1
IEC 61260 class 1
ANSI S1.4-1983 (R2001) with amd. S1.4A-1985 class 1
ANSI S1.43-1997 (R2002) class 1
ANSI S1.11-2004 class 1
DIN 45 657, Applicable parts
Norsonic production standard set for the Nor-140

Instrumentation used for calibration traceable to

Electrical Parameters: MT, Norway
Acoustical Parameters: PTB, Germany
Environmental Parameters: IKM, Norway. Justervesenet. Norway

Adjustments None

Comments None

Date of calibration	**Calibration interval recommended**
8/1/2012	2 years

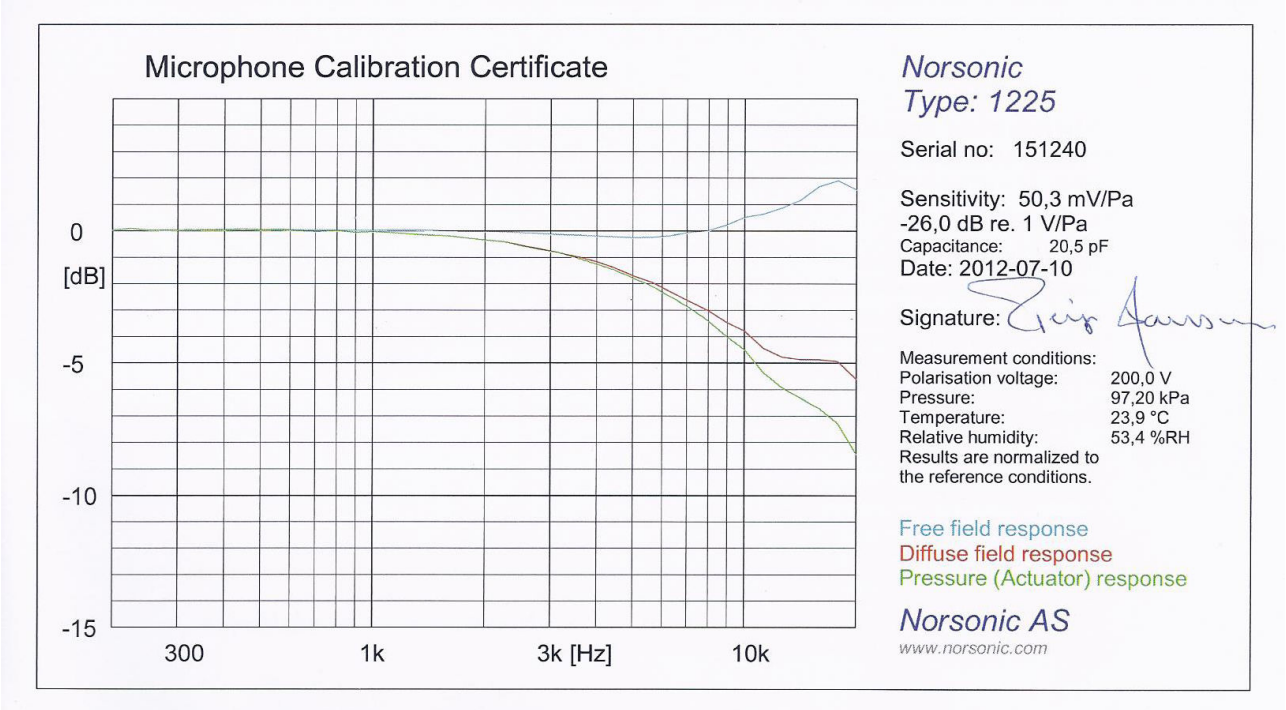
The environmental parameters applicable to this calibration are kept well within limits ensuring negligible deviation on obtained measurement results.

Calibrated by
Anders Amundsen

Sign. AA

Norsonic
P.O. BOX 24, N-3421 LIERSKOGEN, NORWAY

Norsonic AS, P.B 24, 3421 Lierskogen. Visitor address: Gunnersbråtan 2, Tranby, Norway.
Phone +47 32858900 Fax.: +47 32852208. email: norsonic@online.no


Microphone Calibration Certificate
0
[dB]
-5
-10
-15
300
1k
3k [Hz]
10k
Norsonic
Type: 1225
Serial no: 151240
Sensitivity: 50,3 mV/Pa
-26,0 dB re. 1 V/Pa
Capacitance: 20,5 pF
Date: 2012-07-10
Signature:
Measurement conditions:
Polarisation voltage: 200,0 V
Pressure: 97,20 kPa
Temperature: 23,9 °C
Relative humidity: 53,4 %RH
Results are normalized to the reference conditions.
Free field response
Diffuse field response
Pressure (Actuator) response
Norsonic AS
www.norsonic.com

Calibration Report

Certificate No.:14326

Manufacturer: Norsonic
Type: 1251
Serial no: 32849

Customer: Hawkins Environmental Ltd
Department:
Address: 57 Verdi Close, Basingstoke, Hampshire. RG22 4JF.
Order No:
Contact Person: Nick Hawkins - Managing Director

Measurement Results:

	Level: (dB)	P. Stab : (dB)	Frequency: (Hz)	F. Stab : (%)	Distortion: (% TD)
1:	114.07	0.06	999.89	0.00	0.21
2:	114.06	0.06	999.89	0.00	0.21
3:	114.05	0.06	999.89	0.00	0.20
Result (Average):	**114.06**	**0.06**	**999.89**	**0.00**	**0.21**
Expanded Uncertainty:	0.10	0.02	1.00	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 following correction factors have been applied during the measurement:
Pressure:0.0005 dB/kPa Temperature:0.003 dB/°C Relative humidity: None
Reference microphone: WSM2 - GRAS40AG-28653. Volume correction: -0.015 dB
Records:K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2013\NOR1251_32849_M1.nmf
Measurement procedure: TP-01
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.

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
101.169 ± 0.040 kPa	21.8 ± 0.3 °C	54.9 ± 2.4 %RH

Date of calibration: 27/08/2013
Date of issue: 27/08/2013

Supervisor : Darren Batten TechIOA
Engineer :

Campbell Associates
www.campbell-associates.co.uk

Palanivel Marappan B.Eng(Hons), M.Sc
Software version: 6.0b

Appendix 4
Summary of Noise Measurements

Appendix 4: Summary of Facade Noise Measurements

Time	L_{Aeq}	L_{Amax}	L_{A10}	L_{A50}	L_{A90}
1200	49.9	65.2	52.0	48.6	46.4
1300	51.6	76.2	53.0	48.8	45.9
1400	49.0	67.1	51.1	47.6	45.5
1500	50.4	69.2	52.2	48.0	45.5
1600	55.0	78.9	53.1	48.7	46.0
1700	49.5	68.8	50.9	47.2	44.7
1800	49.3	64.4	51.7	47.4	43.9
1900	49.2	69.5	51.4	47.5	44.5
2000	44.6	57.6	45.8	44.2	43.0
2100	47.1	71.8	47.4	43.7	42.4
2200	46.6	68.6	46.3	43.2	42.0
2300	42.5	65.7	43.7	41.5	39.7
0000	41.2	52.3	43.1	40.5	39.0
0100	40.1	48.4	41.9	39.4	38.2
0200	39.7	58.5	41.8	38.7	37.7
0300	39.1	49.1	41.2	38.1	37.3
0400	39.6	49.6	41.8	38.7	37.5
0500	40.4	51.3	42.5	39.4	37.8
0600	45.6	68.9	45.2	41.9	40.0
0700	50.0	66.1	51.5	47.6	44.5
0800	51.0	68.9	51.9	49.2	44.6
0900	49.4	64.7	51.2	48.1	44.9
1000	48.9	65.3	50.2	47.6	44.9
1100	49.3	62.3	51.6	47.1	44.7
1200	48.4	69.0	50.1	46.3	44.4
1300	48.7	76.1	49.1	46.2	44.6
Day	**50.3**	**78.9**	**51.2**	**47.6**	**44.9**
Eve	**47.2**	**71.8**	**47.8**	**44.6**	**43.0**
Night	**41.6**	**68.9**	**42.6**	**39.8**	**38.4**

Appendix 5
Acoustic Enclosure Specification

Appendix 5: Acoustic Enclosure Specification

environ™ Acoustic Enclosures

Environ Technologies Ltd
Regus House, 1010 Cambourne Business Park
Cambourne, Cambridgeshire, UK, CB23 6DP
Tel: +44 (0)870 383 3344
Fax: +44 (0)1223 598001
www.environ.co.uk

environlite ELV1.1.25AC Acoustic Performance Data (March 2010)

Noise Measurement Information:

Test: Environ Lite Acoustic Enclosure — W 1700mm x D 1000mm x H 1550mm

Test Standard:

BS EN ISO 140-3 Acoustics - Measurement of Sound Insulation in Buildings and of Building Elements - Part 1: Airborne Sound Insulation

Sound Level Measuring Equipment:

Norsonic 830 RTA Precision Sound Analyser Type 1
CEL 284/2 Acoustic Calibrator Type 1
JBL Loudspeaker driven by CEL Loudspeaker driven by 830 White Noise Source

Transmission Loss Data:

Transmission Loss — Environ ELV1.1.25AC Acoustic Enclosure							
Octave Frequency in Hertz (dB ref 2 x 10^{-5} Pascal's)							
63	125	250	500	1K	2K	4K	8K
14	16	23	30	37	39	38	39
Summary							
Transmission Loss Equates to an Overall Reduction of 26 dB(A)							

Support Information:

Monitoring was carried out using the BS3740 technique, insofar as measurements were taken in each quadrant and the results averaged. Internal Test Room: W 6m x D 16m x H 5m. Background noise in the semi-reverberant test room was such as not to interfere with the practical measurements

Environ acoustic enclosure designs are protected under patent