REC
Resource & Environmental Consultants Ltd

Noise Impact Assessment Addendum Report

Greenwood Place and Highgate Road Site: Community Resource Centre, Centre for Independent Living and Residential units

REC Report: 90225r8
Issued: 29th November 2013

Prepared for:
CampbellReith on behalf of the London Borough of Camden

REC Acoustics

SAFEcontractor APPROVED

ISOQAR REGISTERED 0026 UKAS MANAGEMENT SYSTEMS
Certificate Number 9661
ISO 9001

National Consultancy, Locally Delivered

QUALITY ASSURANCE

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks	Draft for comment			
Date	29th November 2013			
Prepared by	John Goodwin			
Qualifications	BSc (Hons), MIOA			
Signature				
Checked by	Natalie Goward			
Qualifications	BA (Hons), AMIOA, AIEMA			
Signature				
Authorised by	Paul Furmston			
Qualifications	BSc (Hons)			
Signature				
Project number	90255r8			
Doc. Ref – QR3-3 Issued – Jan -13 By – A Edgar				

REC Offices

Manchester
Osprey House
Pacific Quay
Broadway
Manchester
M50 2UE
Tel: 0161 868 1300

London Stansted
Environment House
Bullock Lane
Takeley
Bishop's Stortford
Hertfordshire
CM22 6TA
Tel: 01279 879 416

Birmingham
Unit 19 Bordesley Trading Estate
Bordesley Green Road
Birmingham
B8 1BZ
Tel: 0121 326 7007

Dundee
Unit 1.7 Discovery House
Gemini Crescent
Dundee
DD2 1SW
Tel: 01382 561 985

Plymouth
Unit 13, Barn Close, Langage Business Park
Plymouth
Devon
PL7 5HQ
Tel: 0844 561 6735

Swindon
Unit 58, Shrivenham Hundred Business Park
Majors Road
Watchfield
Swindon
SN6 8TY
Tel: 01793 784 935

Newcastle
Unit 20, Hubway House
Bassington Industrial Estate
Bassington Lane
Cramlington
Northumberland
NE23 8AD
Tel: 0167 0700 927

Northern Ireland
69A Killyman Street
Moy
County Tyrone
BT71 7EA
Tel: 02887 789 180

Southampton
Environment House
Segensworth Business Centre
Segensworth Road (West)
Fareham
Hampshire
PO15 5RQ
Tel: 01329 847 783

Cardiff
Unit1, Phase 11
Greenmeadow Spring Business Park
Tongwynlais
Cardiff
Wales
CF15 7AB
Tel: 02920 529 822

Glasgow
16 Langlands Place
Kelvin South Business Park
East Kilbride
Glasgow
G75 0YF
Tel: 01355 573 350

London
85 Tottenham Court Road
London
W1T 4TQ
Tel: 02034 022 352

Port Talbot
Unit 19 Kenfig Industrial Estate
Margam
Port Talbot
SA13 2PE
Tel: 01659 749 823

Stirling
11 Murchison Park
Doune
Stirling
FK16 6AY
Tel: 0845 676 9303

www.recltd.co.uk

REC
Resource & Environmental Consultants

EXECUTIVE SUMMARY

Noise Surveys

A series of Noise Surveys have been completed in order to assess the impact of noise associated with The Forum and night bus activities upon the proposed residential element of the development.

Noise Impact Assessment

The Noise Impact Assessment has been completed with due regard to the requirements of the London Borough of Camden's Environmental Health Department.

The Noise Impact Assessment has included potential noise impacts due to music break-out from The Forum, patrons leaving the venue and using the smoking area, and use of the night bus stop adjacent to the Highgate Centre. Accordingly appropriate consideration has been given towards the mitigation measures required to ensure a commensurate level of protection against noise for future residents.

Mitigation

This assessment has recommended upgraded glazing specifications and alternative ventilation to opening windows for habitable rooms with line of sight to The Forum or the night bus stop on Highgate Road. This is in-line with the mitigation measures specified in the full Noise Impact Assessment (ref.90225r7).

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Limited have been commissioned by CampbellReith on behalf on the London Borough of Camden to undertake a Noise Impact Assessment for a proposed mixed-use development on two plots of land located off Highgate Road and Greenwood Place in Kentish Town, Greater London, NW5 1JY to be referred to hereafter as 'the Site'.

Noise surveys were previously carried out on Friday 14th June 2013 when there was a "Lovebox and Red Bull Music Academy Special" event on between 21:00-04:00. At the request of the Environmental Health Officer at the London Borough of Camden, further noise surveys have been carried out due to The Forum licensing hours being extended to 06:00 for up to six events per year.

This Noise Impact Assessment has been undertaken as an addendum to the full report ref. 90225r7 in order to provide additional information relating to the potential noise impact associated with The Forum and operation of a night bus stop adjacent to the Site on Highgate Road.

The Noise Impact Assessment has been completed with due regard to the requirements of the London Borough of Camden.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.2 Limitations

The limitations of this report are presented in Appendix I.

1.3 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 SITE DESCRIPTION

2.1 Site Location & Existing Site Description

The Site is split into two separate areas, divided by the A&A storage building.

Site Area 1

One Site area is located at 19-37 Highgate Road, Kentish Town, London NW5 1JY and covers an area measuring 0.1187 ha. The Site currently comprises a two storey building known as The Highgate Centre which forms the principle frontage of the Site facing Highgate Road. The Highgate Centre currently provides a range of Mental Health day services. The Site has a frontage to Greenwood Place to the northwest. The Site abuts the site occupied by the A&A storage building to the southwest, and the church yard of the Christ Apostolic Church to the south east.

Site Area 2

The second Site area is located at 25/37 Greenwood Place. The Site currently comprises The Greenwood Centre; a single-storey building which provides a range of services for people with disabilities and the elderly. High-rise office units are located to the north-west of the Site. To the south and south west lies the J Murphy and Sons Limited Commercial Yard with a main railway line beyond serving St Pancras to St Albans.

2.2 Proposed Development Description

Site Area 1

Proposals include for the redevelopment of the Highgate Centre for residential end-use and there may be the opportunity to incorporate retail or commercial uses as part of the ground floor level. It is understood that private 'winter garden' type balconies will accompany the residential units which front onto Highgate Road with communal balconies facing the A&A Building. It is also understood that roof gardens will be installed as part of the development. The Highgate Centre will be up to 7 storeys high.

Site Area 2

The Greenwood Centre element of the scheme will deliver purpose built accommodation over 3 storeys for a range of community service providers who provide care for people with learning disabilities, mental health issues and dementia. This part of the development will have no residential use. It is understood that balconies will form part of this development which will face the railway line together with roof gardens.

3.0 ASSESSMENT CRITERIA

3.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) provides very brief guidance on planning and noise. Section 122 of the document states:

> *'Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of development.'*

This has been considered throughout the assessment where applicable.

The NPPF replaces Planning Policy Guidance (PPG) Note 24.

3.2 Local Authority Guidance and Criteria – London Borough of Camden Environmental Health Department

London Borough of Camden's (LBC) Development Policy DP28 recognises the importance of noise and vibration in the borough due to Camden's high density and mixed -use nature.

DP28 – Noise and vibration states that:

'The Council will seek to ensure that noise and vibration is controlled and managed and will not grant permission for:

a) Development likely to generate noise pollution; or

b) Development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.

Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.

The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds.

The Council will seek to minimise the impact on local amenity from the demolition an construction phases of development. Where these phases are likely to cause harm, conditions and planning obligations may be used to minimise the impact.'

LBC have regard to the following Noise Thresholds set out in Tables 3.1, 3.2 and 3.3.

Table 3.1: Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted

Noise Description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1m external to a sensitive façade	Day	07:00 – 19:00	74 dB $L_{Aeq, 12hr}$	72 dB $L_{Aeq, 12hr}$
Noise at 1m external to a sensitive façade	Evening	19:00 – 23:00	74 dB $L_{Aeq, 4hr}$	72 dB $L_{Aeq, 4hr}$
Noise at 1m external to a sensitive façade	Night	23:00 – 07:00	66 dB $L_{Aeq, 8hr}$	66 dB $L_{Aeq, 8hr}$

Table 3.2: Noise levels on residential sites adjoining railways and roads at and above which noise attenuation measures will be required.

Noise Description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1m external to a sensitive façade	Day	07:00 – 19:00	65 dB $L_{Aeq, 12hr}$	62 dB $L_{Aeq, 12hr}$
Noise at 1m external to a sensitive façade	Evening	19:00 – 23:00	60 dB $L_{Aeq, 4hr}$	57 dB $L_{Aeq, 4hr}$
Noise at 1m external to a sensitive façade	Night	23:00 – 07:00	55 dB $L_{Aeq, 1hr}$	52 dB $L_{Aeq, 1hr}$
Individual noise events several times an hour	Night	23:00 – 07:00	>82 dB $L_{Amax,s}$	>82 dB $L_{Amax,s}$

Table 3.3: 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 1m external to a sensitive façade	Day	00:00 – 24:00	5dB(A) <L_{A90}
Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1m external to sensitive façade	Day, evening and night	00:00 – 24:00	10dB(A) <L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1m external to a sensitive façade	Day, evening and night	00:00 – 24:00	10dB(A) <L_{A90}
Noise at 1m external to sensitive façade where L_{A90} >60dB	Day, evening and night	00:00 – 24:00	55dB L_{Aeq}

In addition to obtaining the relevant policy on noise, REC have contacted the relevant Environmental Health Officer (EHO), Maya Rhodes of LBC in order to agree the methodology for the Noise Surveys and assessment criteria. The following criteria have been agreed:

- The internal noise levels within bedrooms shall not exceed the BS 8233 'good' internal target noise level which is 30dB $L_{Aeq,8hr}$;
- The internal noise levels within living rooms shall not exceed the BS 8233 'good' internal target noise level which is 30dB $L_{Aeq,16hr}$;
- Noise in external amenity areas shall not exceed 55dB L_{Aeq} with reference to WHO Guidelines; and,
- The design criteria for plant noise will be at least 5dB(A) below the existing background noise measurement (L_{A90}) level unless the plant will have a noise that has a distinguishable, discrete continuous note (whine, hiss, screech or hum) and /or if there are distinct impulses (bangs, clicks, clatters, thumps), then at least 10dB below would be required. Noise levels are as measured, 1m external to the sensitive façade.

It was confirmed by the EHO via email on 18th April 2013 that vibration assessment is not warranted for the Site due to an adequate separation distance between the railway and the Site boundary.

Additional consultation was undertaken with the EHO in order to agree the methodology for the additional noise surveys and subsequent noise impact assessment. This was agreed via email on 18th November 2013.

It was requested by the EHO that octave bands should be included in the assessment to demonstrate that 'good' internal noise levels in accordance with BS 8233 can be achieved. Also, a robust assessment for L_{Amax} spectrum values of night-time peaks should be incorporated into the assessment.

3.3 British Standard BS 8233:1999: Sound Insulation and Noise Reduction for Buildings – Code of Practice

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in Table 3.4.

Table 3.4: BS 8233 Recommended Internal Noise Levels

Criterion	Typical Situation	Design Range $L_{Aeq,T}$ dB	
		Good	Reasonable
Suitable resting / sleeping conditions	Living Room	30	40
	Bedroom	30	35
For a reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not normally exceed 45dB L_{Amax}			

BS 8233 goes on to recommend noise levels for gardens. According to BS 8233, it is desirable that the steady noise level does not exceed $L_{Aeq,T}$ 50dB, and 55dB should be regarded as the upper limit.

3.4 World Health Organisation's (WHO) 'Guidelines for Community Noise'

As with 'good' and 'reasonable' criteria in BS 8233, the L_{AFmax} criterion is largely concordant with the WHO guidelines which states:

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

With regards to external noise levels in outdoor noise, the WHO states the following:

> *"During the daytime, few people are seriously annoyed by activities with L_{Aeq} levels below 55dB; or moderately annoyed with L_{Aeq} levels below 50dB."*

These external noise levels are widely adopted by Local Planning Authorities in the UK in order to protect external residential amenity which covers garden areas, balconies for residential apartments and communal garden areas.

4.0 NOISE SURVEYS

REC have conducted additional Noise Surveys between 22:00 Friday 22nd – 04:00 Saturday 23rd November 2013. This survey period was selected due to a music event at The Forum between 20:00 – 02:00. Noise Measurements were taken at two positions in order to assess music noise breakout from The Forum, noise from patrons associated with The Forum and operation of the night bus service which has a bus stop adjacent to the Site.

4.1 The Forum Noise Survey

The following noise measurement position was chosen for this noise survey:

- Noise Measurement Position 1 (NMP1): The microphone of the sound level meter was located 1m from the south eastern façade of the Highgate Centre building at height of approximately 4.5m from the ground which was considered representative of the 1st floor window and constituted a façade measurement.

On-site observations concluded that the noise environment was dominated by road traffic noise which masked music break-out from The Forum which was not audible until after 01:12, when road traffic noise was sufficiently supressed. Subjectively, this was noted as being a low frequency noise. There was also intermittent noise from people walking along Highgate Road with raised voices who were not associated with The Forum.

Table 4.1 details the measured noise levels at NMP1.

Table 4.1: Summary of Measured Noise Levels at NMP1

Noise Source	Measured $L_{Aeq,T}$ (dB)	Measured $L_{Amax,f}$ (dB)	Total Measurement Duration (hh:mm:ss)
Music	54.3	70.9	00:15:28

When Forum noise was audible in the absence of any other extraneous noise sources such as road traffic, the coding feature on the sound level meter was used to precisely identify music noise from The Forum. REC has selected the six most reliable periods when only music from The Forum was audible and these are detailed in Table 4.2.

Table 4.2: Summary of Measured Forum Music Noise Levels

Time	Measured Façade Noise Level (dB)	Octave Band Centre Frequency (Hz) (dB)					
		63	125	250	500	1000	2000
01:13:21 – 01:13:37	$L_{eq,T}$	62.6	50.6	40.7	42.6	39.0	35.3
	$L_{max,f}$	64.3	53.0	43.3	48.7	42.8	40.9
01:14:41 – 01:14:45	$L_{eq,T}$	61.4	50.5	41.4	43.7	45.0	41.5
	$L_{max,f}$	61.8	51.6	41.8	44.6	47.0	43.4
01:16:12 – 01:16:17	$L_{eq,T}$	61.8	48.2	44.4	46.1	45.1	38.6
	$L_{max,f}$	63.5	50.1	46.3	47.9	46.4	40.1
01:22:34 – 01:22:38	$L_{eq,T}$	58.6	47.8	38.2	37.3	36.9	30.7
	$L_{max,f}$	60.1	48.4	39.0	38.0	38.0	32.2
01:26:21 – 01:26:38	$L_{eq,T}$	57.1	48.4	43.9	42.6	41.6	37.9
	$L_{max,f}$	59.9	50.9	48.1	47	44.3	40.8
01:27:35 – 01:27:58	$L_{eq,T}$	60.5	49.2	42.1	42.1	43.8	37.5
	$L_{max,f}$	63.4	52.7	45.0	45.0	47.5	41.0

4.2 Forum Patron Noise Survey

The following noise measurement position was chosen for this noise survey:

- Noise Measurement Position 1 (NMP1): The microphone of the sound level meter was located 1m from the south eastern façade of the Highgate Centre building at height of approximately 4.5m from the ground which was considered representative of the 1st floor window and constituted a façade measurement.

It was noted that there was intermittent noise from people walking along Highgate Road with raised voices who were not associated with The Forum. No noise was audible from people using the smoking area.

The coding feature on the sound level meter was used to measure noise from patrons associated with The Forum only, in the absence of extraneous noise. Table 4.3 details measured noise levels associated with people talking/shouting.

Table 4.3: Summary of Measured Noise Levels at NMP1

Noise Source	Measured $L_{Aeq,T}$ (dB)	Measured $L_{Amax,f}$ (dB)	Total Measurement Duration (hh:mm:ss)
People Talking/Shouting	53.1	66.5	00:03:09

4.3 Night Bus Noise Survey

The following noise measurement position was chosen for this noise survey:

- Noise Measurement Position 2 (NMP2): The microphone of the sound level meter was located 1m from the eastern façade of the Highgate Centre building at height of approximately 4.5m from the ground which was consider representative of the 1st floor window and constituted a façade measurement.

The sound level meter was used to code noise levels associated with the night bus. On site observations concluded that noise due to buses pulling up and leaving the bus stop was audible. There was no noise associated with people embarking or disembarking the night bus.

A summary of the measured noise levels from the night bus movements at NMP2 are presented in Table 4.4.

Table 4.4: Summary of Measured Noise Levels for NMP2

Noise Source	Measured $L_{Aeq,T}$ (dB)	Measured $L_{Amax,fast}$ (dB)	Total Measurement Duration (hh:mm:ss)
Night Bus	67.9	78.5	00:02:41

All Noise Surveys were completed using the following specification noise measurement equipment shown in Table 4.5.

Table 4.5: Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
NMP1	Sound Level Meter	01dB-Metravib Black Solo	65629	19th November 2014
	Pre-amplifier	01dB-Metravib PRE21S	166569	
	Microphone	Microtech Gefell GmbH MCE212	16255	
	Calibrator	01dB-Metravib Cal 21	34924066	16th November 2015
NMP2	Sound Level Meter	01dB-Metravib Black Solo	65211	24th Apr 2015
	Pre-amplifier	01dB-Metravib PRE21S	15667	
	Microphone	Microtech Gefell GmbH MCE212	103328	
	Calibrator	01dB-Metravib Cal 21	34113643	23rd March 2014

The weather conditions during the Noise Surveys were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s. The sound level meters were field-calibrated on Site prior to and after noise measurements were taken.

Figure 1 of Appendix III indicates the Noise Measurement Positions.

5.0 NOISE IMPACT ASSESSMENT

This Section has considered the following assessments:

- The Forum Music and Patron Noise Impact; and,
- Night Bus Noise Impact.

5.1 The Forum Music and Patron Noise Impact Assessment

It is understood that for the Highgate Centre private 'winter garden' type balconies are proposed along the eastern façade, fronting onto Highgate Road. Roof gardens are also proposed across the building roof. As such, this assessment has, firstly, compared the measured noise levels with the agreed WHO external noise criteria level of 55dB(A). Secondly, this assessment has considered the performance of standard thermal double glazing for the apartments which have direct line of sight to The Forum.

The measured noise levels at NMP1 have been considered representative of the nearest proposed dwellings at the Highgate Centre.

Table 5.1 determines the daytime noise levels on the balconies from The Forum music. In the interests of informing a worst-case assessment, the measured façade noise levels have not been corrected to equivalent free-field noise levels as this is the actual level of noise on a balcony due to façade reflection. All balconies/roof gardens have been assessed against the WHO external noise criteria and shall not exceed 55dB $L_{Aeq,T}$.

Table 5.1: Calculation of Daytime Noise Levels from Music and Patron Noise for Outdoor Living Areas – Open balconies/Roof Gardens

Noise Source	Period	Calculated External Noise Level with no Barrier (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Music	(07:00 – 23:00)	54.3 $L_{Aeq,15min}$	55 $L_{Aeq,16hr}$	-0.7
People talking/shouting	(07:00 – 23:00)	53.1$L_{Aeq,3min}$	55 $L_{Aeq,16hr}$	-1.9

Table 5.1 indicates that the WHO external criteria noise level is achieved for all balconies / roof gardens with line of sight to The Forum. It should be noted that these noise sources have been assumed to be continuously operational for a full 16 hour period as a worst case assessment.

Table 5.2 calculates the daytime and night-time internal noise levels within the apartments facing The Forum using standard thermal double glazing. The now revoked PPG24 states that standard thermal double glazing when set into a brick-block wall will attenuate noise levels from road traffic by 33dB.

Table 5.2: Calculation of Daytime and Night-time Forum Noise Within Apartments – Windows Closed

Noise Source	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Music	54.3	21.3	30	-8.7
	70.9	37.9	45	-7.1
People talking/shouting	53.1	20.1	30	-9.9
	66.5	33.5	45	-11.5

Table 5.2 indicates that the apartments, with habitable rooms facing The Forum, will achieve the criteria with a minimum of standard thermal double glazing and so no further mitigation is required.

During summer months it is anticipated that occupants may wish to open a window in order to get sufficient through-flow of air. BS 8233 suggests that a partially open window attenuates noise in the order of 10dB – 15dB and so this assessment has adopted 12dB as it represents the average mean value. Table 5.3 calculates the internal noise levels with a partially open window.

Table 5.3: Calculation of Daytime and Night-time Forum Noise Levels within Apartments – Windows Open

Noise Source	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Music	54.3	42.3	30	+12.3
	70.9	58.9	45	+13.9
People talking/shouting	53.1	41.1	30	+11.1
	66.5	54.5	45	+9.5

Table 5.3 indicates that all apartments, with habitable rooms facing The Forum, will exceed the required BS 8233 internal noise criteria levels for habitable rooms with windows open and so Section 6.0 details appropriate mitigation in order to control external to internal noise break-in.

As music noise from The Forum is dominant in the lower frequencies, particularly around the 63Hz octave band (deep bass), detailed break-in calculations have been carried out using the measured noise levels as shown in Table 4.2. Calculations have been carried out for each of the six sample periods. This has been carried out to validate the performance of the glazing at low frequencies.

Detailed break-in calculations have been completed in accordance with the methodology detailed in BS 8233. A summary of the results is shown in Table 5.4. Table 5.4 shows the calculated internal noise levels due to music from The Forum when assessing the frequency component of the noise.

Table 5.4: Calculation of Daytime and Night-time Forum Noise Within Apartments – Windows Closed

Time	Calculated Internal Noise Level (dB)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
01:13:21 – 01:13:37	21.8 $L_{Aeq,t}$	30	-8.2
	24.8 $L_{Amax,f}$	45	-20.2
01:14:41 – 01:14:45	21.8 $L_{Aeq,t}$	30	-8.2
	22.6 $L_{Amax,f}$	45	-22.4
01:16:12 – 01:16:17	22.5 $L_{Aeq,t}$	30	-7.5
	24.3 $L_{Amax,f}$	45	-20.7
01:22:34 – 01:22:38	18.1 $L_{Aeq,t}$	30	-11.9
	19.2 $L_{Amax,f}$	45	-25.8
01:26:21 – 01:26:38	19.8 $L_{Aeq,t}$	30	-10.2
	23.3 $L_{Amax,f}$	45	-21.7
01:27:35 – 01:27:58	20.8 $L_{Aeq,t}$	30	-9.2
	23.9 $L_{Amax,f}$	45	-21.1

Table 5.4 shows that BS 8233 internal noise criteria levels will be achieved with standard thermal double glazing when taking the frequency of the noise into account. Further details on these internal brake-in calculations are shown in Appendix IV of this report.

The noise survey was carried out until 04:00 however as The Forum is licensed to hold up to six events per year with a 06:00 curfew time, the cumulative noise impact due to music noise from The Forum and early morning road traffic noise has been considered. In order to assess this in more detail a noise model has been produced. This enables noise levels at the nearest proposed dwelling to be calculated. The following information has been used in the noise model:

- Highgate Road represented as a line source, 0.5m above ground level;
- $L_{Aeq,8hr}$ used to represent Highgate Road night-time noise levels based on road traffic assessment from full Noise Impact Assessment;
- As a worst case assessment noise has been assumed to emit from the whole façade of The Forum facing towards the Highgate Centre; and,
- Source noise for The Forum has adopted the spectral component from a sample measurement, dominant in low frequency, with an overall Lw of 85.4dB(A) calibrated to measurements at NMP1.

Results from the noise model have shown that as a worst case, noise levels at the nearest proposed façade could be 58.5 $L_{Aeq,t}$ (dB) due to noise from The Forum and early morning road traffic noise.

Table 5.5 details calculated internal noise levels based on standard thermal double glazing, and compares this with the required BS 8233 criteria levels.

Table 5.5: Calculation of Daytime and Night-time Road Forum Noise Levels within Apartments – Windows Closed

Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
58.5	25.5	30	-4.5

Table 5.5 shows that the BS 8233 internal noise criteria level would be achieved during the early morning period due to the cumulative noise impact of noise from The Forum and road traffic noise with windows closed.

Table 5.6 details predicted internal noise levels with a partially open window.

Table 5.6: Calculation of Daytime and Night-time Road Forum Noise Levels within Apartments – Windows Open

Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
58.5	46.5	30	+16.5

Table 5.6 shows that internal noise criteria levels would be exceeded with windows open. Accordingly appropriate mitigation is considered in Section 6.0.

5.2 Night Bus Noise Impact Assessment

It is necessary to quantify the level of noise generated by night buses and passengers embarking and disembarking the bus adjacent to the Highgate Centre on Highgate Road.

Table 5.7 calculates the daytime and night-time internal noise levels within the apartments facing The Forum using standard thermal double glazing. The now revoked PPG24 states that standard thermal double glazing when set into a brick-block wall will attenuate noise levels from road traffic by 33dB.

Table 5.7: Calculation of Daytime and Night-time Night Bus Noise Within Apartments – Windows Closed

Source	Calculated External Noise Level (dB)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Buses pulling up and moving away	67.9 $L_{Aeq,t}$	34.9	30	+4.9
	78.5 $L_{Amax,f}$	45.5	45	+0.5

Table 5.7 indicates that the habitable rooms facing the night bus stop will exceed the required BS 8233 criteria and so Section 6.0 details appropriate mitigation in order to control external to internal noise break-in.

During summer months it is anticipated that occupants may wish to open a window in order to get sufficient through-flow of air. BS 8233 suggests that a partially open window attenuates noise in the order of 10dB – 15dB and so this assessment has adopted 12dB as it represents the average mean value. Table 5.8 calculates the internal noise levels with a partially open window.

Table 5.8: Calculation of Daytime and Night-time Night Bus Noise Levels from Highgate Road within Apartments – Windows Open

Source	Calculated External Noise Level (dB)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Buses pulling up and moving away	67.9 $L_{Aeq,t}$	55.9	30	+25.9
	78.5 $L_{Amax,f}$	66.5	45	+21.5

Table 5.8 indicates that all apartments facing the nigh bus stop will exceed the required BS 8233 internal noise criteria limits for habitable rooms with windows open and so Section 6.0 details appropriate mitigation in order to control external to internal noise break-in.

6.0 NOISE MITIGATION

6.1 The Forum Music and Patron Noise

6.1.1 External Habitable Areas

Table 5.1 indicates that the WHO external criteria noise level is achieved for all balconies / roof gardens with line of sight to The Forum. No further mitigation is considered necessary.

6.1.2 Internal Habitable Rooms

Table 5.5 shows that the BS 8233 internal noise criteria level would be achieved during the early morning period due to the cumulative noise impact of noise from The Forum and road traffic noise with windows closed. No further mitigation is considered necessary above the glazing specifications previously specified for habitable rooms with line of sight to Highgate Road, required to provide adequate protection against road traffic noise during the daytime.

The previous Section has identified that if windows are opened, then exceedences of the internal criteria noise levels will occur for all habitable rooms which face The Forum. Accordingly it is necessary to consider an alternative ventilation scheme for these dwellings. It is understood that a mechanical ventilation system with heat recovery (MVHR) is to be adopted in each dwelling. This system will provide continuous background ventilation with a boost facility. This will sufficiently reduce the need to open windows however windows will not be sealed, allowing residents to open intermittently if desired.

Trickle ventilators are not required in the residential building. The ventilation design is based upon incorporating MVHR systems in each dwelling. MVHR is a whole dwelling supply and extract ventilation system with heat recovery. MVHR systems are designed to deliver an adequate volume of heated and filtered outside air into the occupied spaces and to remove vitiated air. A large proportion of the heat contained in the exhaust air stream is recovered and used to heat the incoming fresh air. Air intake openings have been positioned on elevations where outside air quality is good.

In summertime, in order to provide relief from potential overheating, windows can be opened to promote rapid ventilation. Windows can be similarly opened should the occupier need rapid ventilation for other reasons, such as to clear smoke caused by burning toast. Ground floor apartments, facing onto the Highgate Road, will be exposed to high levels of atmospheric pollution arising from road traffic and in these cases comfort cooling units have been included in living rooms and bedrooms as a means of controlling summertime overheating.

A significant benefit arising from adopting a whole dwelling ventilation solution is that windows do not need to be opened for general ventilation purposes. The whole dwelling MVHR system will maintain an acceptable indoor air quality without the need to introduce additional ventilation via open windows or trickle ventilators. Air intake and exhaust openings can be attenuated, if required, to control ingress of outside noise. Window opening is at the discretion of the occupier.

The majority of habitable rooms facing The Forum have alternative windows to those directly facing The Forum. This would reduce any potential noise impact should residents choose to open a window when there is an event on. For rooms where there is no alternative window, these rooms are in a position where they are shielded by the church and therefore line of sight to The Forum is removed, minimising any potential noise impact.

6.2 Night Bus Stop

6.2.1 Internal Habitable Areas

Table 5.7 indicates that the habitable rooms facing the night bus stop will exceed the required BS 8233 criteria. Table 6.1 shows the minimum glazing specification required in order to achieve adequate internal noise criteria levels.

Table 6.1: Required Minimum Glazing Specification for Habitable Rooms Facing The Forum

Period	Calculated External Noise Level $L_{Aeq,T}$ (dB)	Calculated Internal Noise Level $L_{Aeq,T}$ (dB)	BS 8233 Internal Noise Criteria Level (dBA)	Difference with Standard Thermal Glazing (dB)	Required Sound Reduction Index of Glazing Unit R_w+C_{tr} (dB)
(23:00 – 07:00)	67.9 $L_{Aeq,t}$	34.9	30	+4.9	34
	78.5 $L_{Amax,f}$	45.5	45	+0.5	30

Any habitable rooms with line of sight to Highgate Road will require a higher glazing specification as detailed in the full Noise Impact Assessment report. The specifications recommended to protect against daytime road traffic noise impact will provide more than adequate protection against The Forum noise.

Table 5.8 indicates that all apartments facing the night bus stop will exceed the required BS 8233 internal noise criteria limits for habitable rooms with windows open. Alternative ventilation will therefore be required for habitable rooms with line of sight to the night bus stop as detailed in 6.1.2.

7.0 CONCLUSION

REC Limited have been commissioned by CampbellReith on behalf of LBC to undertake a Noise Impact Assessment for a proposed mixed-use development on land located off Highgate Road and Greenwood Place in Kentish Town, Greater London, NW5 1JY.

This Noise Impact Assessment has been undertaken as an addendum to the full The Noise Impact Assessment in order to assess the noise impact associated with The Forum in comprehensive detail.

This assessment has been completed with due regard to the requirements of LBC.

This assessment has shown that noise levels generated by The Forum and the night bus on Highgate Road can be controlled to satisfactory levels in both external and internal habitable areas at the Highgate Centre.

Subject to the incorporation of the recommended mitigation measures as stated in the full Noise Impact Assessment report, it is considered that the Site is suitable for mixed-use development.

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Limited and the Client as indicated in Section 1.2.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. REC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.

APPENDIX II GLOSSARY OF ACOUSTICAL TERMINOLOGY

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Pressure Levels

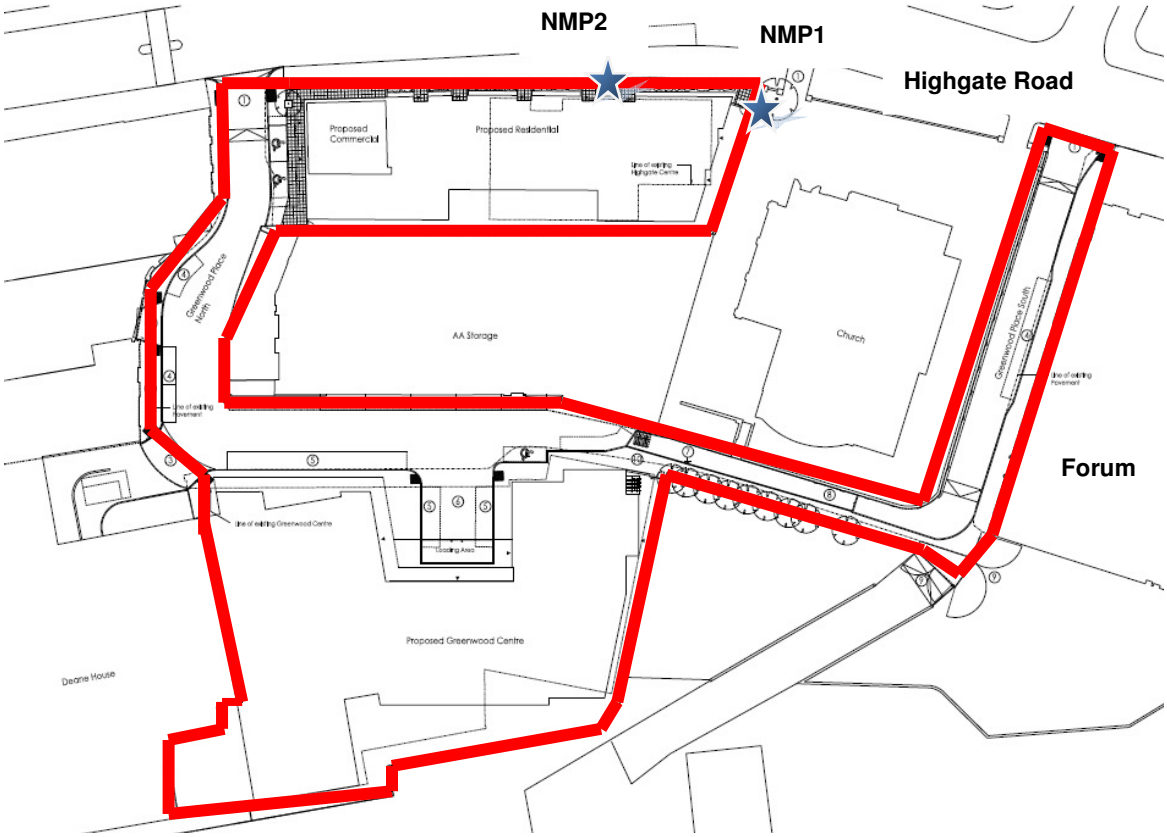
Sound Pressure Level dB(A)	Location
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Acoustic Terminology

Table A2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III FIGURES



REC
Resource & Environmental Consultants

Figure 1

Site Location, NMP1 & 2, Surrounding Noise Sources

APPENDIX IV DETAILED BREAK-IN CALCS

Detailed Internal Nosie Break-in Calculation Sheet for: Greenwood Place

Project:	Greenwood Place
Plot	Façade facing The Forum
Notes	Sample 1 Data

	Measured Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Measured Freefield LAeq 16hr (Living Room) (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Measured Freefield LAeq 8hr (Bedroom) (dB)	62.6	50.6	40.7	42.6	39.0	35.3
Measured 10th highest LAmax,fast (dB)	64.3	53.0	43.3	48.7	42.8	40.9
Corrected Freefield Daytime Noise Level at Façade (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Corrected Freefield Night-time Noise Level at Façade (dB)	62.6	50.6	40.7	42.6	39.0	35.3
Corrected Freefield LAmax,fast Noise Level at Façade (dB)	64.3	53.0	43.3	48.7	42.8	40.9

Building Component Dimensions - Living Room	Dimension (m sq.)
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15
Building Component Dimensions - Bedroom	
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Living Room (Daytime) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Specified Building Component					
Window Frame Mounted Trickle Vent					
Glazing Unit					
Brick Block Wall					
Ceiling					
Living Room Calculated Internal Noise Level (dB)					
A-weighting (dB)					
Total A-Weighted Internal Noise Level (LAeq) (dB)					
Total Combined A-weighted Internal Noise Level (LAeq) (dB)					

Bedroom (Night-time) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Specified Building Component						
Window Frame Mounted Trickle Vent	38	39	40	38	36	39
Glazing Unit	18	23	20	24	35	41
Brick Block Wall	40	40	44	45	51	56
Ceiling	28	28	34	40	45	49
Living Room Calculated Internal Noise Level (LAeq) (dB)	45.4	30.8	19.5	16.7	5.2	-2.4
Living Room Calculated Internal Noise Level (LAmax,fast) (dB)	47.1	33.2	22.1	22.8	9.0	3.2
A-weighting (dB)	-26.2	-16	-9	-3	0	1
Total A-Weighted Internal Noise Level (LAeq) (dB)	19.2	14.8	10.5	13.7	5.2	-1.4
Total A-Weighted Internal Noise Level (LAmax,fast) (dB)	20.9	17.2	13.1	19.8	9.0	4.2
Total Combined A-weighted Internal Noise Level (LAeq) (dB)		**21.8**				
Total Combined A-weighted Internal Noise Level (LAmax) (dB)		**24.8**				

Detailed Internal Nosie Break-in Calculation Sheet for: Greenwood Place

Project:	Greenwood Place
Plot	Façade facing The Forum
Notes	Sample 2 Data

	Measured Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Measured Freefield LAeq 16hr (Living Room) (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Measured Freefield LAeq 8hr (Bedroom) (dB)	61.4	50.5	41.4	43.7	45.0	41.5
Measured 10th highest LAmax,fast (dB)	61.8	51.6	41.8	44.6	47.0	43.4
Corrected Freefield Daytime Noise Level at Façade (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Corrected Freefield Night-time Noise Level at Façade (dB)	61.4	50.5	41.4	43.7	45.0	41.5
Corrected Freefield LAmax,fast Noise Level at Façade (dB)	61.8	51.6	41.8	44.6	47.0	43.4

Building Component Dimensions - Living Room	Dimension (m sq.)
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15
Building Component Dimensions - Bedroom	
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Living Room (Daytime) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Specified Building Component					
Window Frame Mounted Trickle Vent					
Glazing Unit					
Brick Block Wall					
Ceiling					
Living Room Calculated Internal Noise Level (dB)					
A-weighting (dB)					
Total A-Weighted Internal Noise Level (LAeq) (dB)					
Total Combined A-weighted Internal Noise Level (LAeq) (dB)					

Bedroom (Night-time) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Specified Building Component						
Window Frame Mounted Trickle Vent	38	39	40	38	36	39
Glazing Unit	18	23	20	24	35	41
Brick Block Wall	40	40	44	45	51	56
Ceiling	28	28	34	40	45	49
Living Room Calculated Internal Noise Level (LAeq) (dB)	44.2	30.7	20.2	17.8	11.2	3.8
Living Room Calculated Internal Noise Level (LAmax,fast) (dB)	44.6	31.8	20.6	18.7	13.2	5.7
A-weighting (dB)	-26.2	-16	-9	-3	0	1
Total A-Weighted Internal Noise Level (LAeq) (dB)	18.0	14.7	11.2	14.8	11.2	4.8
Total A-Weighted Internal Noise Level (LAmax,fast) (dB)	18.4	15.8	11.6	15.7	13.2	6.7
Total Combined A-weighted Internal Noise Level (LAeq) (dB)		**21.8**				
Total Combined A-weighted Internal Noise Level (LAmax) (dB)		**22.6**				

Detailed Internal Nosie Break-in Calculation Sheet for: Greenwood Place

Project:	Greenwood Place
Plot	Façade facing The Forum
Notes	Sample 3 Data

	Measured Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Measured Freefield LAeq 16hr (Living Room) (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Measured Freefield LAeq 8hr (Bedroom) (dB)	61.8	48.2	44.4	46.1	45.1	38.6
Measured 10th highest LAmax,fast (dB)	63.5	50.1	46.3	47.9	46.4	40.1
Corrected Freefield Daytime Noise Level at Façade (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Corrected Freefield Night-time Noise Level at Façade (dB)	61.8	48.2	44.4	46.1	45.1	38.6
Corrected Freefield LAmax,fast Noise Level at Façade (dB)	63.5	50.1	46.3	47.9	46.4	40.1

Building Component Dimensions - Living Room	Dimension (m sq.)
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15
Building Component Dimensions - Bedroom	
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Living Room (Daytime) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Specified Building Component					
Window Frame Mounted Trickle Vent					
Glazing Unit					
Brick Block Wall					
Ceiling					
Living Room Calculated Internal Noise Level (dB)					
A-weighting (dB)					
Total A-Weighted Internal Noise Level (LAeq) (dB)					
Total Combined A-weighted Internal Noise Level (LAeq) (dB)					

Bedroom (Night-time) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Specified Building Component						
Window Frame Mounted Trickle Vent	38	39	40	38	36	39
Glazing Unit	18	23	20	24	35	41
Brick Block Wall	40	40	44	45	51	56
Ceiling	28	28	34	40	45	49
Living Room Calculated Internal Noise Level (LAeq) (dB)	44.6	28.4	23.2	20.2	11.3	0.9
Living Room Calculated Internal Noise Level (LAmax,fast) (dB)	46.3	30.3	25.1	22.0	12.6	2.4
A-weighting (dB)	-26.2	-16	-9	-3	0	1
Total A-Weighted Internal Noise Level (LAeq) (dB)	18.4	12.4	14.2	17.2	11.3	1.9
Total A-Weighted Internal Noise Level (LAmax,fast) (dB)	20.1	14.3	16.1	19.0	12.6	3.4
Total Combined A-weighted Internal Noise Level (LAeq) (dB)		**22.5**				
Total Combined A-weighted Internal Noise Level (LAmax) (dB)		**24.3**				

Detailed Internal Nosie Break-in Calculation Sheet for: Greenwood Place

Project:	Greenwood Place
Plot	Façade facing The Forum
Notes	Sample 4 Data

	Measured Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Measured Freefield LAeq 16hr (Living Room) (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Measured Freefield LAeq 8hr (Bedroom) (dB)	58.6	47.8	38.2	37.3	36.9	30.7
Measured 10th highest LAmax,fast (dB)	60.1	48.4	39.0	38.0	38.0	32.2
Corrected Freefield Daytime Noise Level at Façade (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Corrected Freefield Night-time Noise Level at Façade (dB)	58.6	47.8	38.2	37.3	36.9	30.7
Corrected Freefield LAmax,fast Noise Level at Façade (dB)	60.1	48.4	39.0	38.0	38.0	32.2

Building Component Dimensions - Living Room	Dimension (m sq.)
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15
Building Component Dimensions - Bedroom	
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Living Room (Daytime) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Specified Building Component					
Window Frame Mounted Trickle Vent					
Glazing Unit					
Brick Block Wall					
Ceiling					
Living Room Calculated Internal Noise Level (dB)					
A-weighting (dB)					
Total A-Weighted Internal Noise Level (LAeq) (dB)					
Total Combined A-weighted Internal Noise Level (LAeq) (dB)					

Bedroom (Night-time) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Specified Building Component						
Window Frame Mounted Trickle Vent	38	39	40	38	36	39
Glazing Unit	18	23	20	24	35	41
Brick Block Wall	40	40	44	45	51	56
Ceiling	28	28	34	40	45	49
Living Room Calculated Internal Noise Level (LAeq) (dB)	41.4	28.0	17.0	11.4	3.1	-7.0
Living Room Calculated Internal Noise Level (LAmax,fast) (dB)	42.9	28.6	17.8	12.1	4.2	-5.5
A-weighting (dB)	-26.2	-16	-9	-3	0	1
Total A-Weighted Internal Noise Level (LAeq) (dB)	15.2	12.0	8.0	8.4	3.1	-6.0
Total A-Weighted Internal Noise Level (LAmax,fast) (dB)	16.7	12.6	8.8	9.1	4.2	-4.5
Total Combined A-weighted Internal Noise Level (LAeq) (dB)		**18.1**				
Total Combined A-weighted Internal Noise Level (LAmax) (dB)		**19.2**				

Detailed Internal Nosie Break-in Calculation Sheet for: Greenwood Place

Project:	Greenwood Place
Plot	Façade facing The Forum
Notes	Sample 5 Data

	Measured Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Measured Freefield LAeq 16hr (Living Room) (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Measured Freefield LAeq 8hr (Bedroom) (dB)	57.1	48.4	43.9	42.6	41.6	37.9
Measured 10th highest LAmax,fast (dB)	59.9	50.9	48.1	47.0	44.3	40.8
Corrected Freefield Daytime Noise Level at Façade (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Corrected Freefield Night-time Noise Level at Façade (dB)	57.1	48.4	43.9	42.6	41.6	37.9
Corrected Freefield LAmax,fast Noise Level at Façade (dB)	59.9	50.9	48.1	47.0	44.3	40.8

Building Component Dimensions - Living Room	Dimension (m sq.)
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15
Building Component Dimensions - Bedroom	
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Living Room (Daytime) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Specified Building Component					
Window Frame Mounted Trickle Vent					
Glazing Unit					
Brick Block Wall					
Ceiling					
Living Room Calculated Internal Noise Level (dB)					
A-weighting (dB)					
Total A-Weighted Internal Noise Level (LAeq) (dB)					
Total Combined A-weighted Internal Noise Level (LAeq) (dB)					

Bedroom (Night-time) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Specified Building Component						
Window Frame Mounted Trickle Vent	38	39	40	38	36	39
Glazing Unit	18	23	20	24	35	41
Brick Block Wall	40	40	44	45	51	56
Ceiling	28	28	34	40	45	49
Living Room Calculated Internal Noise Level (LAeq) (dB)	39.9	28.6	22.7	16.7	7.8	0.2
Living Room Calculated Internal Noise Level (LAmax,fast) (dB)	42.7	31.1	26.9	21.1	10.5	3.1
A-weighting (dB)	-26.2	-16	-9	-3	0	1
Total A-Weighted Internal Noise Level (LAeq) (dB)	13.7	12.6	13.7	13.7	7.8	1.2
Total A-Weighted Internal Noise Level (LAmax,fast) (dB)	16.5	15.1	17.9	18.1	10.5	4.1
Total Combined A-weighted Internal Noise Level (LAeq) (dB)		**19.8**				
Total Combined A-weighted Internal Noise Level (LAmax) (dB)		**23.3**				

Detailed Internal Nosie Break-in Calculation Sheet for: Greenwood Place

Project:	Greenwood Place
Plot	Façade facing The Forum
Notes	Sample 6 Data

	Measured Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Measured Freefield LAeq 16hr (Living Room) (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Measured Freefield LAeq 8hr (Bedroom) (dB)	60.5	49.2	42.1	42.1	43.8	37.5
Measured 10th highest LAmax,fast (dB)	63.4	52.7	45.0	45.0	47.5	41.0
Corrected Freefield Daytime Noise Level at Façade (dB)	0.0	0.0	0.0	0.0	0.0	0.0
Corrected Freefield Night-time Noise Level at Façade (dB)	60.5	49.2	42.1	42.1	43.8	37.5
Corrected Freefield LAmax,fast Noise Level at Façade (dB)	63.4	52.7	45.0	45.0	47.5	41.0

Building Component Dimensions - Living Room	Dimension (m sq.)
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Building Component Dimensions - Bedroom	
Façade Area (inc. Window)	8
Roof Area (facing road)	40
Window Area	3
Area of Ceiling	15

Living Room (Daytime) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)				
	125	250	500	1000	2000
Specified Building Component					
Window Frame Mounted Trickle Vent					
Glazing Unit					
Brick Block Wall					
Ceiling					
Living Room Calculated Internal Noise Level (dB)					
A-weighting (dB)					
Total A-Weighted Internal Noise Level (LAeq) (dB)					
Total Combined A-weighted Internal Noise Level (LAeq) (dB)					

Bedroom (Night-time) - Internal Noise Break-in Calculation

	Octave Band Centre Frequency (Hz)					
	63	125	250	500	1000	2000
Specified Building Component						
Window Frame Mounted Trickle Vent	38	39	40	38	36	39
Glazing Unit	18	23	20	24	35	41
Brick Block Wall	40	40	44	45	51	56
Ceiling	28	28	34	40	45	49
Living Room Calculated Internal Noise Level (LAeq) (dB)	43.3	29.4	20.9	16.2	10.0	-0.2
Living Room Calculated Internal Noise Level (LAmax,fast) (dB)	46.2	32.9	23.8	19.1	13.7	3.3
A-weighting (dB)	-26.2	-16	-9	-3	0	1
Total A-Weighted Internal Noise Level (LAeq) (dB)	17.1	13.4	11.9	13.2	10.0	0.8
Total A-Weighted Internal Noise Level (LAmax,fast) (dB)	20.0	16.9	14.8	16.1	13.7	4.3
Total Combined A-weighted Internal Noise Level (LAeq) (dB)		**20.8**				
Total Combined A-weighted Internal Noise Level (LAmax) (dB)		**23.9**				

REC are a multi-disciplinary health, safety, environmental and energy consultancy. Our national coverage enables our local experts to provide cost effective and pragmatic consultancy services in an efficient and sustainable manner.

REC CHSS *Corporate Health & Safety Services*

- NEBOSH Accredited Training Courses
- IOSH Accredited Training Courses
- IEMA Accredited Training Courses
- Asbestos Training
- Health & Safety Training
- CDM Training
- Health & Safety Consultancy

REC *Renewable Energy*

- Feasibility Studies
- Ground Source Heat Pumps Installation
- Air Source Heat Pump Installation
- System Design and Maintenance
- Solar Photovoltaic (PV) Systems
- Combined Heat and Power Systems

REC *Acoustics*

- Sound Insulation Testing
- Noise at Work Assessment
- Development Related Noise
- Environmental Noise

REC *Environmental Management*

- Environmental Management
- Divestment Services
- Environmental Management Systems
- CDM Co-Ordination
- Environment Permit Application

REC *Asbestos & Legionella*

- Asbestos Management Surveys
- Demolition/Refurbishment Surveys
- Analysis of Asbestos in Soils and Bulk Samples
- Air Testing for Clearances and Reassurance
- Legionella Risk Assessment

REC *Air Quality*

- Air Quality Impact
- Odour Assessment
- Dispersion Modelling
- Stack Emission Testing
- Pollution Monitoring

REC *Geoenvironmental*

- Geotechnical Investigation & Assessment
- Contaminated Land Investigation & Assessment
- Waste Management
- Groundwater Testing
- Environmental Impact Assessment

REC *Flood Risk*

- Flood Risk & Consequence Assessment
- Strategic Flood Risk Assessment (SFRA)
- EIA Technical Chapters
- Assessment of Flood Levels
- Hydrology & Hydrogeology
- Flood Defence Structures
- Drainage Systems (SUDS) Design
- Mitigation Measures
- Soakaway Tests

REC *Ecology*

- Phase 1 Habitat Surveys
- Invasive Species
- Legally Protected Species Surveys
- Mitigation Schemes
- Ecological Impact Assessment (EcIA)
- BREEAM & Code 4 Sustainable Homes
- Habitat Management Plans
- Management planning and targeted Biodiversity Action Plan survey
- Environmental Impact Assessment