GREENWOOD PLACE AND HIGHGATE ROAD SITE

Community Resource Centre, Centre for independent living and new residential units

Noise Impact Assessment

September 2013

Camden

Tibbalds
Multidisciplinary Team

CampbellReith
consulting engineers

REC

Resource & Environmental Consultants Ltd

Noise Impact Assessment

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

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

REC Acoustics

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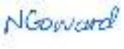
Signature				
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EXECUTIVE SUMMARY

Noise Surveys

A series of Noise Surveys have been completed in order to measure the impact of road traffic noise, rail traffic noise, Fire Station noise, commercial and entertainment noise upon the proposed mixed-use 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 identified that the key sources of noise impacting upon the development are road traffic using Highgate Road to the north east of the Site and the railway line to the south east of the Site. Noise from the J Murphy and Sons Limited Commercial Yard and Fire Station is also intermittently audible. Potential noise from the adjacent A&A storage building and the entertainment venue known as The Forum to the south east have also been considered. Accordingly appropriate consideration has been given towards the mitigation measures required to ensure a commensurate level of protection against noise for future residents/occupiers.

The Noise Impact Assessment has set Mechanical and Electrical Plant Noise Emission Limits for any proposed plant items which may form part of the commercial element of the development.

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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'.

This Noise Impact Assessment has been undertaken to identify the key sources of noise around the Site which may have the potential to impact upon the proposed noise-sensitive residential and healthcare elements of the development. This Noise Impact Assessment has also set Mechanical and Electrical (M&E) Plant Noise Emission Limits in the interests of protecting existing and proposed amenity levels from any M&E plant which may be incorporated into the commercial element of the development.

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.

1.3 Limitations

The limitations of this report are presented in Appendix I.

1.4 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.

3.3 British Standard BS4142: 1997: Method for Rating Industrial Noise Affecting Mixed-use Residential and Industrial Areas

This standard is intended to be used to assess whether noise from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises is likely to give rise to complaints from people residing in nearby dwellings.

The procedure contained in BS4142 for assessing the likelihood of complaints is to compare the measured or predicted noise level from the source in question, the 'specific noise level' immediately outside the dwelling, with the background noise level. Where the noise contains a 'distinguishable discrete continuous note (whine, hiss, screech, hum etc.) or if there are distinct impulses in the noise (bangs, clicks, clatters or thumps), or if the noise is irregular enough to attract attention' then a correction of +5dB is added to the specific noise level to obtain the 'rating level'.

The likelihood of noise provoking complaints is assessed by subtracting the background noise level from the rating noise level. BS4142 states:

> *"A difference of around 10dB or higher indicates that complaints are likely. A difference of around 5dB is of marginal significance. A difference of -10dB is a positive indication that complaints are unlikely."*

For the daytime, this assessment is carried out over a 1-hour period, and over a 5-minute period at night. The day and night-time periods are not defined in the Standard but it states that night should cover the times when the general adult population are preparing for sleep or are actually sleeping. For the purposes of this assessment it is assumed that the day and night periods reflect those stated in the now revoked PPG24, i.e. day is 07:00 to 23:00 hours and night 23:00 to 07:00 hours.

3.4 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.

3.5 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.

3.6 Calculation of Road Traffic Noise 1988

The Calculation of Road Traffic Noise (CRTN) memorandum, produced by the Department of Transport, describes the procedures for calculating noise from road traffic. Section III of this memorandum details the shortened measurement procedure whereby measurements of the L_{10} parameter are made over any three consecutive hours between 10:00 and 17:00. From the arithmetic average of the three 1-hour values, the $L_{10,18hr}$ noise levels is derived before calculation of the $L_{Aeq,16hr}$ value.

3.7 Transport Research Laboratory – Converting the UK Traffic Noise Index $L_{A10,18hr}$ to EU Noise Indices for Noise Mapping

This document provides a method for converting the $L_{A10,18hr}$ level to the L_{night} level using the following formula, applicable to non-motorway roads.

$$L_{night} = 0.90 \times L_{A10,18hr} - 3.77dB$$

3.8 Department of Health Technical Memorandum 08-01: Acoustics

Given that Greenwood Centre will consist of facilities which relate to healthcare, it is necessary to consider the criteria noise targets specified in this document. The Health Technical Memorandum covers the acoustic design criteria that are important for healthcare premises and the control of noise and vibration during construction. Table 3.5 sets out recommended criteria for key areas for noise intrusion for completed buildings.

Table 3.5: Noise Intrusion Criteria

Room Type	Example	Criteria for noise intrusion to be met inside the spaces from external sources (dB)
Ward – Single Person	Single-bed ward, single-bed recovery areas and on-call room, relatives' overnight stay	40 $L_{Aeq,1hr}$ daytime 35 $L_{Aeq,1hr}$ night 45 $L_{Amax,f}$ night
Ward – Multi-bed	Multi-bed wards, recovery areas	45 $L_{Aeq,1hr}$ daytime 35 $L_{Aeq,1hr}$ night 45 $L_{Amax,f}$ night
Small office-type spaces	Private offices, small treatment rooms, interview rooms, consulting rooms	40 $L_{Aeq,1hr}$
Open Clinical Areas	A&E	45 $L_{Aeq,1hr}$
Circulation spaces	Corridors, hospital street, atria	55 $L_{Aeq,1hr}$
Public Areas	Dining Areas, waiting areas, playrooms	50 $L_{Aeq,1hr}$
Personal Hygiene (en suite)	Toilets, showers	45 $L_{Aeq,1hr}$
Personal Hygiene (public and staff)	Toilets, showers	55 $L_{Aeq,1hr}$
Small food preparation areas	Ward kitchens	50 $L_{Aeq,1hr}$
Large food preparation areas	Main kitchens	55 $L_{Aeq,1hr}$
Large meeting rooms (>35m^2 floor area)	Lecture theatres, seminar rooms, classrooms	35 $L_{Aeq,1hr}$
Small meeting rooms (<35m^2 floor area)	Meeting rooms, seminar rooms, classrooms, board rooms	40 $L_{Aeq,1hr}$
Operating theatres	Operating theatres	40 $L_{Aeq,1hr}$ 50 $L_{Amax,f}$
Laboratories	Laboratories	45 $L_{Aeq,1hr}$

In terms of external noise, the document only accounts for noise generated by healthcare buildings and not external noise sources, such as main roads, impacting upon external amenity areas associated with proposed healthcare buildings. In the absence of any specific guidance for external amenity areas, the criteria specified by the EHO of the LBC shall be adopted which is as follows:

- Noise in external amenity areas shall not exceed 55dB L_{Aeq} with reference to WHO Guidelines.

This noise criteria level also accords with the criteria detailed in Table 3.5 for Circulation spaces.

Table 3.6 specifies the adopted noise criteria levels, based on the supplied information for room / area types proposed within the Greenwood Centre and the noise level criteria detailed in Table 3.5. The criterion has been considered for the rooms / areas which face towards the railway line.

Table 3.6: Adopted Noise Criteria for the Greenwood Centre

Floor	Area / Room	Adopted Criteria (dB)
Ground	N/A*	N/A*
First	Garden	55 $L_{Aeq,1hr}$
	Common / Day Room	40 $L_{Aeq,1hr}$
Second	Common / Day Room	40 $L_{Aeq,1hr}$
	Meeting Room	40 $L_{Aeq,1hr}$
Roof	Garden	55 $L_{Aeq,1hr}$

*At Ground Floor Level, all areas / rooms are screened from the railway line by the intervening commercial building to the west of the Site

4.0 NOISE SURVEYS

REC have conducted the following Noise Surveys:

- Road Traffic Noise Survey: Applicable for the proposed residential development at the Highgate Centre for road traffic using the B518 Highgate Road;
- Fire Station Noise Survey: Applicable for the proposed residential development at the Highgate Centre for fire engines departing;
- Railway Traffic Noise Survey: Applicable for the façade of Greenwood Centre which faces the railway line;
- Commercial Source Noise Survey: Applicable for commercial operations and activities which take place on the J Murphy and Sons Limited Commercial Yard to the south-west of the Site and activities associated with the A&A storage site;
- Entertainment Source Noise Survey: Applicable for activities associated with The Forum to the south of the Site beyond the Christ Apostolic Church; and,
- Background Noise Survey: Applicable for setting plant noise emission limits for any proposed M&E plant items which may form part of the development at either the Highgate Centre or the Greenwood Centre.

4.1 Road Traffic Noise Survey

The Road Traffic Noise Survey was conducted at the Site in order to measure the impact of noise from vehicles using Highgate Road upon the proposed residential development at the Highgate Centre. A road traffic noise survey was not required to assess noise impact on the Greenwood Centre due to the sufficient separation distance between the Greenwood Centre and Highgate Road. Attended road traffic noise measurements were carried out between 13.00 and 16:00 on Tuesday 30th April 2013.

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 eastern façade of the Highgate Centre building from the 1st floor window which constituted a façade measurement. Noise sources at this measurement position consisted of vehicles and people using Highgate Road.

A summary of the measured noise levels from the Road Traffic Noise Survey are presented in Table 4.1.

Table 4.1: Summary of Measured Noise Levels for NMP1

Measurement Position	Period	Measured Sound Pressure Level, facade (dB)			
		$L_{Aeq,T}$	$L_{Amax,fast}$ [1]	$L_{A90,T}$	$L_{A10,T}$
NMP1	Tuesday 30th April 13:00	69.2	82.6	59.3	72.3
	Tuesday 30th April 14:00	68.8		56.8	71.8
	Tuesday 30th April 15:00	69.3		59.3	72.1

1 10th highest $L_{Amax,fast}$ from three 1-hour periods

4.2 Fire Station Noise Survey

The Fire Station Noise Survey was conducted at the Site in order to measure the impact of fire engines departing the Fire Station on Highgate Road upon the proposed residential development. Unattended noise measurements were carried out between 13.00 Tuesday 30th April 2013 and 09:00 1st May 2013, with the time of departing fire engines being noted remotely.

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 eastern façade of the Highgate Centre building from the 1st floor window which constituted a façade measurement. Noise sources at this measurement position consisted of vehicles and people using Highgate Road, with occasional noise from fire engines.

A summary of the measured noise levels from the Fire Station Noise Survey are presented in Table 4.2.

Table 4.2: Summary of Measured Noise Levels for NMP1

Measurement Position	Measured Sound Pressure Level, facade (dB)		On-time (hh:mm:ss)
	$L_{Aeq,T}$	$L_{Amax,fast}$ [1]	
NMP1	71.0	83.6	00:07:10

4.3 Rail Traffic Noise Survey

The railway line lies approximately 78m to the south-west of the Greenwood Centre Site boundary and during the Noise Survey it was observed that East Midlands Trains and First Capital Connect trains were operating on this part of the railway line which connects St Pancras Station to St Albans and beyond. Inspection of the St Pancras website indicates that these two providers operate on the northern areas, whilst Eurostar and Southeastern operate on the southern areas.

The Railway Traffic Noise Survey was conducted on the roof-space of the adjacent building (Deane House) as this location afforded a clear line-of-sight to the railway line, which was not possible from the Greenwood Centre building.

Attended rail traffic noise measurements were carried out over the following periods:

- Between 17:10 – 18:00 on 30th April 2013; and,
- Between 09:50 – 12:00 noon on 1st May 2013.

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 on the roof of Deane House Studios in a free-field position. The microphone was located approximately 10m above ground level. Noise sources consisted of intermittent train pass-bys and occasional commercial noise associated with the J Murphy and Sons Limited Commercial Yard. Noise from the commercial yard was removed from the measurement by use of the coding feature on the sound level meter.

A summary of the measured noise levels for the First Capital Connect Trains from the Railway Traffic Noise Survey are presented in Table 4.3.

Table 4.3: Summary of Measured Noise Levels for NMP2 – First Capital Connect

Provider / Type	Direction	Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by Measurement Duration (hh:mm:ss)	Measurement Distance to Centre of Line (m)
First Capital Connect	East (to St Pancras)	62.1	00:00:29	91
		62.8	00:00:31	
		61.5	00:00:39	
		59.7	00:00:26	
		62.6	00:00:26	
		62.5	00:00:29	
		62.4	00:00:27	
		61.3	00:00:44	

		61.3	00:00:44	
		66.3	00:00:14	
		64.1	00:00:22	
		61.3	00:00:44	
		64.1	00:00:21	
		61.2	00:00:32	
	West (To St Albans)	67.4	00:00:47	91
		60.5	00:00:34	
		60.3	00:00:43	
		61.9	00:00:44	
		62	00:00:39	
		62	00:00:39	
		62.7	00:00:15	
		61.3	00:00:37	
		62.1	00:00:30	
		66.3	00:00:37	
		59.8	00:00:37	

A summary of the measured noise levels for the East Midlands Trains from the Railway Traffic Noise Survey are presented in Table 4.4.

Table 4.4: Summary of Measured Noise Levels for NMP2 – East Midlands Trains

Provider / Type	Direction	Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by Measurement Duration (mm:ss)	Measurement Distance to Centre of Line (m)
East Midlands Trains	East (to St Pancras)	67.8	00:00:32	91
		73.3	00:00:14	
		64.9	00:00:42	
		67.7	00:00:44	
		64.4	00:00:36	
		67.9	00:00:80	
		70.3	00:00:51	
		68.6	00:00:37	
		71.8	00:00:11	
		70.1	00:00:36	
	West (To St Albans)	71.1	00:00:34	91
		71.2	00:00:29	
		72	00:00:23	
		68.4	00:00:30	
		68.8	00:00:58	
		72.1	00:00:15	
		68.7	00:00:11	

4.4 Commercial Source Noise Survey

The J Murphy and Sons Limited Commercial Yard lies to the south-west of the Site and consisted of the following key noise sources:

- Jet-washing of vehicles in a dedicated area; and,
- Sawing of material in a dedicated area.

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 on the roof of Deane House Studios in a free-field position. The microphone was located approximately 10m above ground level. Noise sources consisted of intermittent noise from the J Murphy and Sons Limited Commercial Yard and intermittent train pass-bys on the railway line. Noise from the trains was removed from the measurement by use of the coding feature on the sound level meter.

A summary of the measured noise levels from the J Murphy and Sons Limited Commercial Yard are presented in Table 4.5.

Table 4.5: Summary of Measured Commercial Noise Levels

Noise Source	Measured Noise Level $L_{Aeq,T}$ (dB)	Measurement 'on-time' (hh:mm:ss)
Jet-washing	53.7	00:00:26
Sawing	63.6	00:00:34
Sawing	64.8	00:00:26
Jet washing	62.2	00:00:12

On-site observations concluded that no noise associated with the A&A storage building was audible during the surveys therefore no measurements were recorded. The future impact of the potential re-development of the A&A storage site is discussed in the Mitigation section of this report.

4.5 Background Noise Survey

A Background Noise Survey has been conducted in order to measure existing background noise levels at the rear of the Highgate Centre during the quietest daytime and night-time periods.

Unattended background noise measurements were carried out at the western façade of the Highgate Centre building between 14:00 on Wednesday 1st May 2013 and 09:00 on Thursday 2nd May 2013. This survey duration has allowed for measurement of the quietest daytime and night-time periods which are normally 21:30 – 23:00 for the daytime period and 01:00 – 04:00 for the night-time period respectively.

The following noise measurement position was chosen for the Background Noise Survey:

- Noise Measurement Position 3 (NMP3): Located at the rear of the existing Highgate Centre building on the western façade from a 1st floor window. The microphone was located 4m above ground level and 1m from the building façade thus constituting a façade noise measurement. Noise sources consisted of distant road traffic only.

A summary of the lowest measured 1-hour background noise level for the daytime and night-time periods are presented in Table 4.6.

Table 4.6: Summary of Lowest Measured 1-hour Background Noise Levels for NMP3

Measurement Position	Measured Period	Lowest Measured Background Noise Level $L_{A90,1hr}$, façade (dB)
NMP3	Daytime	50.6
	Night-time	48.4

4.6 Entertainment Source Noise Survey

The Forum entertainment venue lies to the south of the Site beyond the Christ Apostolic Church and the following key noise sources are associated with this venue:

- Music break-out; and,
- People talking/shouting outside

Source noise measurements were taken between 21:30 – 23:00 on 16th June 2013 as agreed with the EHO at LBC. This date was chosen due to it being a music event considered to give rise to the greatest noise impact when compared to other types of event held at this venue. As the event started at 22:00 this time period was chosen to include people entering the venue beforehand and music break-out during the event.

The following noise measurement position was chosen for this Noise Survey:

- Noise Measurement Position 4 (NMP4): The microphone of the sound level meter was located 20m to the north-west of The Forum, to the west of the Christ Apostolic Church . Noise from any extraneous sources was removed from the measurement by use of the coding feature on the sound level meter.

A summary of the measured noise levels from The Forum are presented in Table 4.7.

Table 4.7: Summary of Measured Entertainment Noise Levels

Noise Source	Measured $L_{Aeq,T}$ (dB)	Measured $L_{Amax,f}$ (dB)	Measurement 'on-time' (hh:mm:ss)
Loud Music	52.1	68.7	00:02:16
People Talking/Shouting	55.2	78.9	00:37:21
Extraneous Noise	57.0	83.2	00:39:58

As the Forum is operational during daytime and night-time hours, the daytime measured source noise levels have been used to represent the night-time period also. On-site observations concluded that noise associated with The Forum consisted of music break-out from an open doorway along the northern façade of The Forum building, and people talking/shouting outside, in the vicinity of the doorway.

All Noise Surveys were completed using the following specification noise measurement equipment shown in Table 4.8.

Table 4.8: Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
NMP1 & 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
NMP3	Sound Level Meter	CEL-633C	1539299	21st March 2015
	Pre-amplifier	CEL-495	1801	
	Microphone	CEL-251	2400	
	Calibrator	CEL-120	1239635	21st 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:

- Road Traffic Noise Impact: Applicable for the proposed residential development at the Highgate Centre for road traffic using the B518 Highgate Road;
- Fire Station Noise Impact Assessment: Applicable for the proposed residential development at the Highgate Centre for fire engines entering the B518 Highgate Road;
- Railway Traffic Noise Impact: Applicable for the façade of Greenwood Centre which faces the railway line;
- Commercial Noise Impact: Applicable for the façade of Greenwood Centre which face operations on the J Murphy and Sons Limited Commercial Yard to the south west of the Site;
- Entertainment Noise Impact: Applicable for the proposed residential dwellings in the Highgate Centre and,
- Future Mechanical Plant Noise Limits: Applicable for the proposed residential dwellings in the Highgate Centre.

5.1 Road Traffic 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. Communal balconies are proposed along the western façade. 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 overlook Highgate Road.

As the balconies and facades vary by distance from the centre of Highgate Road, the measured noise levels must be distance corrected. In determining the level of noise at the balcony and façade, the following equation has been used to determine the resulting noise level from the daytime and night-time 'average' noise levels:

$$L_{Aeq,2} = L_{Aeq,1} - (10 \times \log (D2/D1)$$

Where $L_{Aeq,2}$ = noise level under investigation
$L_{Aeq,1}$ = measured noise level
D2 = distance under investigation
D1 = measurement distance

The following equation has been used to determine the resulting noise level from the night-time measured maximum noise level:

$$L_{Amax,fast,2} = L_{Amax,fast,1} - (20 \times \log (D2/D1)$$

Where $L_{Amax,fast,2}$ = noise level under investigation
$L_{Amax,fast,1}$ = measured noise level
D2 = distance under investigation
D1 = measurement distance

Table 5.1 determines the daytime noise levels on the balconies from road traffic using Highgate Road. Based on provided visuals of the proposed development, it has been assumed that all balconies on floors ground – third are fully enclosed 'winter gardens' and floors fourth – sixth have been assessed for both 'winter gardens' and open balconies/roof gardens with a 1.1m high guard rail. 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 shows calculated noise levels inside 'winter gardens' for floors ground – sixth. It has been assumed that standard thermal double glazing will be specified for the 'winter gardens', providing 27dB R_{TRA} attenuation for the façade facing Highgate Road.

Table 5.1: Calculation of Daytime Road Traffic Noise Levels from Highgate Road for Outdoor Living Areas – Enclosed 'Winter Gardens'

Floor	Period	Calculated Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Measurement Distance from Centre of Road (m)	Distance to Balcony (m)	Calculated External Noise Level $L_{Aeq,T}$ (dB)	Calculated Level inside 'winter garden' balcony $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Ground	(07:00 – 23:00)	69.1	8.5	6.5	70.2	43.2	55	-11.8
First	(07:00 – 23:00)	69.1	8.5	8.5	69.1	41.2	55	-13.8
Second	(07:00 – 23:00)	69.1	8.5	10.5	68.1	41.1	55	-13.9
Third	(07:00 – 23:00)	69.1	8.5	12.5	67.4	40.4	55	-14.6
Fourth	(07:00 – 23:00)	69.1	8.5	14.5	66.7	39.7	55	-15.3
Fifth	(07:00 – 23:00)	69.1	8.5	16.5	66.2	39.2	55	-15.8
Sixth	(07:00 – 23:00)	69.1	8.5	18.5	65.7	38.7	55	-16.3

Table 5.1 shows that calculated the $L_{Aeq,T}$ inside 'winter gardens' at ground – sixth floor fall considerably below the required external noise criteria level of 55dB $L_{Aeq,T}$.

Table 5.2 shows calculated noise levels for open balconies/roof gardens at fourth – sixth floor with a 1.1m high guard rail.

Table 5.2: Calculation of Daytime Road Traffic Noise Levels from Highgate Road for Outdoor Living Areas – Open balconies/Roof Gardens

Floor	Period	Calculated External Noise Level with no Barrier (dB)	Guard Rail Barrier Attenuation (dB)	Calculated External Noise Level with 1.1m Guard Rail (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Fourth	(07:00 – 23:00)	66.7	16.4	50.3	55	-4.7
Fifth	(07:00 – 23:00)	66.2	16.5	49.7	55	-5.3
Sixth	(07:00 – 23:00)	65.7	16.6	49.1	55	-5.9

Table 5.2 indicates that the WHO external criteria noise level is achieved for all balconies / roof gardens overlooking Highgate Road with a 1.1m high guard rail in place.

Table 5.3 calculates the daytime and night-time internal noise levels within the apartments fronting Highgate Road 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. In accordance with the advice contained in BS 8233, it is necessary to calculate the free-field noise level immediately at the façade and so the measured façade noise levels have been converted to equivalent free-field noise levels by deducting 3dB.

Table 5.3: Calculation of Daytime and Night-time Road Traffic Noise Levels from Highgate Road Within Apartments – Windows Closed

Floor	Period	Calculated Noise Level (dBA)	Distance from Centre of Road (m)	Distance to Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Ground	(07:00 – 23:00)	66.1	8.5	6.5	67.2	34.2	30	+4.2
	(23:00 – 07:00)	57.2	8.5	6.5	58.4	25.4	30	-4.6
		79.6	8.5	6.5	81.9	48.9	45	+3.9
First	(07:00 – 23:00)	66.1	8.5	8.5	66.1	33.1	30	+3.1
	(23:00 – 07:00)	57.2	8.5	8.5	57.2	24.2	30	-5.8
		79.6	8.5	8.5	79.6	46.6	45	+1.6
Second	(07:00 – 23:00)	66.1	8.5	10.5	65.1	32.1	30	+2.1
	(23:00 – 07:00)	57.2	8.5	10.5	56.3	23.3	30	-6.7

		79.6	8.5	10.5	77.8	44.8	45	-0.2
Third	(07:00 – 23:00)	66.1	8.5	12.5	64.4	31.4	30	+1.4
	(23:00 – 07:00)	57.2	8.5	12.5	55.5	22.5	30	-7.5
		79.6	8.5	12.5	76.3	43.3	45	-1.7
Fourth	(07:00 – 23:00)	66.1	8.5	14.5	63.7	30.7	30	+0.7
	(23:00 – 07:00)	57.2	8.5	14.5	54.9	21.9	30	-8.1
		79.6	8.5	14.5	75.0	42.0	45	-3.0
Fifth	(07:00 – 23:00)	66.1	8.5	16.5	63.2	30.2	30	+0.2
	(23:00 – 07:00)	57.2	8.5	16.5	54.3	21.3	30	-8.7
		79.6	8.5	16.5	73.8	40.8	45	-4.2
Sixth	(07:00 – 23:00)	66.1	8.5	18.5	62.7	29.7	30	-0.3
	(23:00 – 07:00)	57.2	8.5	18.5	53.8	20.8	30	-9.2
		79.6	8.5	18.5	72.8	39.8	45	-5.2

Table 5.3 indicates that the ground to fifth floor apartments, with habitable rooms facing Highgate Road, will exceed the criteria for certain habitable rooms 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 5.4 calculates the internal noise levels with a partially open window.

Table 5.4: Calculation of Daytime and Night-time Road Traffic Noise Levels from Highgate Road within Apartments – Windows Open

Floor	Period	Calculated Noise Level (dBA)	Distance from Centre of Road (m)	Distance to Facade (m)	Calculated External Noise Level (dBA)	Calculated Internal Noise Level (dBA)	BS 8233 Internal Noise Criteria (dBA)	Difference +/- (dBA)
Ground	(07:00 – 23:00)	66.1	8.5	6.5	67.2	55.2	30	+25.2
	(23:00 – 07:00)	57.2	8.5	6.5	58.4	46.4	30	+16.4
		79.6	8.5	6.5	81.9	69.9	45	+24.9

First	(07:00 – 23:00)	66.1	8.5	8.5	66.1	54.1	30	+24.1
	(23:00 – 07:00)	57.2	8.5	8.5	57.2	45.2	30	+15.2
		79.6	8.5	8.5	79.6	67.6	45	+22.6
Second	(07:00 – 23:00)	66.1	8.5	10.5	65.1	53.1	30	+23.1
	(23:00 – 07:00)	57.2	8.5	10.5	56.3	44.3	30	+14.3
		79.6	8.5	10.5	77.8	65.8	45	+20.8
Third	(07:00 – 23:00)	66.1	8.5	12.5	64.4	52.4	30	+22.4
	Night-time (23:00 – 07:00)	57.2	8.5	12.5	55.5	43.5	30	+13.5
		79.6	8.5	12.5	76.3	64.3	45	+19.3
Fourth	(07:00 – 23:00)	66.1	8.5	14.5	63.7	51.7	30	+21.7
	(23:00 – 07:00)	57.2	8.5	14.5	54.9	42.9	30	+12.9
		79.6	8.5	14.5	75.0	63	45	+18.0
Fifth	(07:00 – 23:00)	66.1	8.5	16.5	63.2	51.2	30	+21.2
	(23:00 – 07:00)	57.2	8.5	16.5	54.3	42.3	30	+12.3
		79.6	8.5	16.5	73.8	61.8	45	+16.8
Sixth	(07:00 – 23:00)	66.1	8.5	18.5	62.7	50.7	30	+20.7
	(23:00 – 07:00)	57.2	8.5	18.5	53.8	41.8	30	+11.8
		79.6	8.5	18.5	72.8	60.8	45	+15.8

Table 5.4 indicates that all apartments, with habitable rooms facing Highgate Road, will exceed the required BS 8233 internal noise criteria levels for certain habitable rooms and so Section 6.0 details appropriate mitigation in order to control external to internal noise break-in.

5.2 Fire Station Noise Impact Assessment

It is necessary to quantify the level of noise generated by fire engines departing the fire station located at 20 Highgate Road, operated by London Fire Brigade. The Fire Station lies approximately 30m south-east of the Highgate Centre.

During the Noise Survey the fire station operated once however this assessment has considered its potential noise impact during the daytime and night-time periods.

Table 5.5 calculates the equivalent 1-hour noise level.

Table 5.5: Summary of Measured Fire Engine Noise Levels

Measured Sound Pressure Level, facade (dB)		On-time	Calculated Equivalent 1-Hour Noise Level $L_{Aeq,1hr}$ (dB)
$L_{Aeq,t}$	$L_{Amax,fast}$		
71.0	83.6	00:07:10	61.8

Table 5.6 compares this 1-hour noise level with the WHO external noise criteria level for 'winter garden' type balconies. Given the distance from the source to the receiver, the calculated noise level has been taken as that at each floor balcony.

Table 5.6: Calculation of Daytime Fire Engine Noise Levels from Highgate Road for Outdoor Living Areas – Enclosed 'Winter Gardens'

Floor	Period	Calculated Daytime Noise Level $L_{Aeq,1hour}$ (dB)	Calculated Level inside 'winter garden' balcony $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Ground	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2
First	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2
Second	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2
Third	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2
Fourth	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2
Fifth	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2
Sixth	Daytime (07:00 – 23:00)	61.8	34.8	55	-20.2

Table 5.6 indicates that the WHO external noise criteria noise level is achieved for all 'winter garden' type balconies which face the fire station.

Table 5.7 compares this 1-hour noise level with the WHO external noise criteria level for open balconies and roof gardens.

Table 5.7: Calculation of Daytime Fire Engine Noise Levels from Highgate Road for Outdoor Living Areas – Open Balconies/Roof Gardens

Floor	Period	Calculated Daytime Noise Level $L_{Aeq,1hour}$ (dB)	Guard Rail Barrier Attenuation (dBA)	Calculated External Noise Level with 1.1m Guard Rail $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Fourth	Daytime (07:00 – 23:00)	61.8	16.4	45.4	55	-9.6
Fifth	Daytime (07:00 – 23:00)	61.8	16.5	45.3	55	-9.7
Sixth / Roof Gardens	Daytime (07:00 – 23:00)	61.8	16.6	45.2	55	-9.8

Table 5.7 indicates that the WHO external noise criteria noise level is achieved for all open balconies and roof gardens which face the fire station with a 1.1m guard rail in place.

Table 5.8 calculates the daytime and night-time noise levels within the apartments fronting Highgate Road using standard thermal double glazing due to the impact of fire engine noise. 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. In accordance with the advice contained in BS 8233, it is necessary to calculate the free-field noise level immediately at the façade and so the measured façade noise levels have been converted to equivalent free-field noise levels by deducting 3dB.

Table 5.8: Calculation of Daytime and Night-time Fire Engine Noise Levels from Highgate Road within Apartments – Windows Closed

Floor	Period	Calculated Free-field Noise Level (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference +/- (dB)
Ground	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6
First	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6
Second	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6

Third	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6
Fourth	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6
Fifth	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6
Sixth	Daytime (07:00 – 23:00)	58.8	25.8	30	-4.2
	Night-time (23:00 – 07:00)	58.8	25.8	30	-4.2
		80.6	47.6	45	+2.6

Table 5.8 indicates that the ground to sixth floor apartments, with habitable rooms facing the Fire Station will exceed the criteria for the maximum noise levels (applicable to bedrooms) 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 5.9 calculates the internal noise levels with a partially open window.

Table 5.9: Calculation of Daytime and Night-time Road Traffic Noise Levels from Highgate Road within Apartments – Windows Open

Floor	Period	Calculated Free-field Noise Level (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference +/- (dB)
Ground	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8
	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6
First	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8

	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6
Second	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8
	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6
Third	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8
	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6
Fourth	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8
	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6
Fifth	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8
	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6
Sixth	Daytime (07:00 – 23:00)	58.8	46.8	30	+16.8
	Night-time (23:00 – 07:00)	58.8	46.8	30	+16.8
		80.6	68.6	45	+23.6

Table 5.9 indicates that all apartments facing the Fire Station will exceed the required BS 8233 internal noise criteria limits for certain habitable rooms and so Section 6.0 details appropriate mitigation in order to control external to internal noise break-in.

5.3 Railway Traffic Noise Impact Assessment

The measured noise levels for the train pass-bys, for each train type, have been converted to the 16-hour daytime periods by using the following equation formula:

$$L_{Aeq,16hr} = \text{Average SEL} - (10 \times \log (60 \times 60 \times 16) + 10 \times \log N$$

Where *Average SEL = Average Sound Event Level for Train Type / Provider*
60 x 60 x 16 = No. seconds in a 16-hour daytime period
N = No. Train pass-bys in a 16 hour daytime period

It is not necessary to calculate the 8-hour night-time noise level, or consider the instantaneous maximum noise level from the railway line as Greenwood Centre is a day-centre only.

The total number of train pass-bys, for both First Capital Connect and East Midlands Trains, have been obtained using internet-based train timetables.

Table 5.10 details the calculated daytime noise levels for East Midlands Trains.

Table 5.10: Determination of Noise Levels – East Midlands Trains

Direction	Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by (Measurement) Duration (mm:ss)	Calculated Average SEL (dB)	Daytime Timetable Movements	Calculated Daytime Noise Level $L_{Aeq,16hr}$ (dB)
Eastbound	67.8	32	83.9	122	57.2
	73.3	14			
	64.9	42			
	67.7	44			
	64.4	36			
	67.9	80			
	70.3	51			
	68.6	37			
	71.8	11			
	70.1	36			
Westbound	71.1	34	84.3	119	57.5
	71.2	29			
	72	23			
	68.4	30			
	68.8	58			
	72.1	15			

	68.7	11			

Table 5.11 details the calculated daytime noise levels for First Capital Connect trains.

Table 5.11: Determination of Noise Levels – First Capital Connect

Direction	Measured Sound Pressure Level $L_{Aeq,t}$ (dB)	Pass-by (Measurement) Duration (mm:ss)	Calculated Average SEL (dB)	Daytime Timetable Movements	Calculated Daytime Noise Level $L_{Aeq,16hr}$ (dB)
Eastbound	62.1	29	77.0	197	52.4
	62.8	31			
	61.5	39			
	59.7	26			
	62.6	26			
	62.5	29			
	62.4	27			
	61.3	44			
	61.3	44			
	66.3	14			
	64.1	22			
	61.3	44			
	64.1	21			
	61.2	32			
Westbound	67.4	47	77.9	224	53.8
	60.5	34			
	60.3	43			
	61.9	44			

	62	39			
	62	39			
	62.7	15			
	61.3	37			
	62.1	30			
	66.3	37			
	59.8	37			

Table 5.12 summarises the calculated daytime noise levels for both train providers.

Table 5.12: Determination of Daytime Noise Levels – All Trains

Provider	Direction	Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Total Daytime Noise Level $L_{Aeq,16hr}$ (dB)
East Midlands Trains	Eastbound	57.2	61.7
	Westbound	57.5	
First Capital Connect	Eastbound	52.4	
	Westbound	53.8	

Table 5.13 compares the predicted daytime noise levels for balconies and roof gardens for the Greenwood Centre with the required WHO external noise criteria level. Supplied visuals show that guard rails are proposed for balconies and roof gardens facing towards the railway. For the purposes of this assessment these have been assumed to be 1.1m high providing approximately 8dB(A) noise attenuation of railway noise.

Table 5.13: Comparison of Predicted Garden Noise Levels with External Target Noise Level

Floor	Calculated Daytime Noise Level $L_{Aeq,16hr}$ (dB)	Calculated External Noise Level with 1.1m Guard Rail $L_{Aeq,T}$ (dB)	WHO External Noise Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dBA)
Ground	N/A*	N/A*	55	-
First	64.7	56.7	55	+1.7
Second	64.7	56.7	55	+1.7

Third (roof garden)	64.7	56.7	55	+1.7
	*Ground floor garden areas is screened from railway line by intervening commercial buildings			

Table 5.13 indicates that the external amenity areas for the Greenwood Centre for first - third floors will exceed the required WHO external noise criteria level by +1.7dB(A). Accordingly Section 6.0 considers recommended mitigation measures.

In calculating the internal noise levels, the now revoked Planning Policy Guidance Note 24 (PPG24) states that standard thermal double glazing, when set into a brick-block wall, will attenuate noise levels from diesel trains by 32dB and this level has been used in the calculations. The calculated external free-field noise level has been used in determining the internal noise levels for comparison with the determined noise levels detailed in Table 5.13.

Table 5.14: Calculation of Internal Noise Levels – Windows Closed

Floor	Room	Calculated External Noise Level $L_{Aeq,T}$ (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dBA)	Calculated Internal Noise Level $L_{Aeq,T}$ (dB)	Internal Noise Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dBA)
Ground	Common Room / Day Room	N/A	32	-	-	-
First	Common Room / Day Room	61.7	32	29.7	40	-10.3
Second	Daytime Living Rooms	61.7	32	29.7	40	-10.3

Table 5.14 indicates that the calculated internal target noise levels accord with the required internal noise criteria level.

During summer months it may be necessary to open windows in order to provide a supply of fresh air and Table 5.15 determines the internal noise levels. BS 8233 suggests that the sound reduction index of a partially open window will attenuate noise by approximately 12dB.

Table 5.15: Calculation of Internal Noise Levels – Windows Open

Floor	Room	Calculated External Noise Level $L_{Aeq,T}$ (dB)	Attenuation Afforded by Partially Open Window (dBA)	Calculated Internal Noise Level $L_{Aeq,T}$ (dB) (dB)	Internal Noise Criteria Level (dBA)	Difference +/- (dBA)
Ground	Common Room / Day Room	N/A	12	-	-	-
First	Common Room / Day Room	61.7	12	49.7	40	+9.7
Second	Daytime Living Rooms	61.7	12	49.7	40	+9.7

Table 5.15 indicates that the required internal target noise levels will be exceeded if windows are opened and so the following Section 6.0 considers appropriate mitigation.

5.4 Commercial Noise Impact Assessment

BS4142 is prescriptive for its intended use, stating:

> *'This British Standard describes a method of determining the level of a noise of an industrial nature, together with procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity.'*

Accordingly BS4142 is normally applied for residential development where people can live during the daytime and night-time periods. Greenwood Centre is a 'day centre' and so it is reasonable to not apply the method described in BS4142 for assessing noise levels from the J Murphy and Sons Limited Commercial Yard. Instead, it is more appropriate to compare the noise levels from the J Murphy and Sons Limited Commercial Yard with the absolute noise level criteria detailed in Table 3.6.

The measured source noise levels from the various activities at the J Murphy and Sons Limited Commercial Yard have been converted to a combined 1-hour noise level.

Table 5.16: Calculation of Internal Noise Levels – Windows Closed

Noise Source	Measured Noise Level (dB)	Measurement 'on-time' (hh:mm:ss)	Corrected 1-Hour Noise Level $L_{Aeq,1hr}$ (dB)	Combined 1-Hour Noise Level $L_{Aeq,1hr}$ (dB)	WHO Criteria for External Areas $L_{Aeq,T}$ (dB)	Difference +/- (dBA)
Jet-washing	53.7	00:00:26	32.3	47	55	-8.0
Sawing	63.6	00:00:34	43.4			
Sawing	64.8	00:00:26	43.4			
Jet washing	62.2	00:00:12	37.4			

Table 5.16 indicates that the noise level generated by operations in the J Murphy and Sons Limited Commercial Yard meet the WHO external noise criteria level.

5.5 Entertainment Noise Impact Assessment

Source noise measurements of The Forum were taken at a distance of 20m. These measured levels have been corrected to a distance of 40m from the source to represent the closest dwelling façade of the Highgate Centre. These corrected levels are shown in Table 5.17.

Table 5.17: Calculation of Measured Noise Levels at The Highgate Centre

Noise Source	Measured $L_{Aeq,T}$ (dB)	Measured $L_{Amax,f}$ (dB)	Measurement 'on-time' (hh:mm:ss)
Loud Music	46.1	62.7	00:02:16
People Talking/Shouting	49.2	72.9	00:37:21
Extraneous Noise	51.0	77.2	00:39:58

The highest measured noise levels associated with The Forum activities were due to people talking/shouting. These measured levels have been used in the calculations as a worst case assessment. Table 5.18 compares these noise levels with the WHO external noise criteria level for 'winter garden' type balconies. Given the distance from the source to the receiver, the calculated noise level has been taken as that at each floor balcony.

Table 5.18: Calculation of Daytime Entertainment Noise Levels from The Forum for Outdoor Living Areas – Enclosed 'Winter Gardens'

Floor	Period	Calculated Daytime Noise Level $L_{Aeq,1hour}$ (dB)	Calculated Level inside 'winter garden' balcony $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Ground	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8
First	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8
Second	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8
Third	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8
Fourth	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8
Fifth	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8
Sixth	Daytime (07:00 – 23:00)	49.2	22.2	55	-32.8

Table 5.18 indicates that the WHO external noise criteria noise level is achieved for all 'winter garden' type balconies which face The Forum.

Table 5.19 compares the measured noise levels with the WHO external noise criteria level for open balconies and roof gardens.

Table 5.19: Calculation of Daytime Entertainment Noise Levels from The Forum for Outdoor Living Areas – Open Balconies/Roof Gardens

Floor	Period	Calculated Daytime Noise Level $L_{Aeq,1hour}$ (dB)	Guard Rail Barrier Attenuation (dBA)	Calculated External Noise Level with 1.1m Guard Rail $L_{Aeq,T}$ (dB)	WHO External Criteria Level $L_{Aeq,T}$ (dB)	Difference +/- (dB)
Fourth	Daytime (07:00 – 23:00)	49.2	16.4	32.8	55	-22.2
Fifth	Daytime (07:00 – 23:00)	49.2	16.5	32.7	55	-22.3
Sixth / Roof Gardens	Daytime (07:00 – 23:00)	49.2	16.6	32.6	55	-22.4

Table 5.19 indicates that the WHO external noise criteria noise level is achieved for all open balconies and roof gardens which face The Forum with a 1.1m guard rail in place.

Table 5.20 calculates the daytime and night-time noise levels within the apartments fronting Highgate Road using standard thermal double glazing due to the impact of The Forum noise. 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. In accordance with the advice contained in BS 8233, it is necessary to calculate the free-field noise level immediately at the façade and so the measured façade noise levels have been converted to equivalent free-field noise levels by deducting 3dB.

Table 5.20: Calculation of Daytime and Night-time Noise Levels from The Forum within Apartments – Windows Closed

Floor	Period	Calculated Free-field Noise Level (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference +/- (dB)
Ground	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1
First	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1
Second	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1
Third	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1
Fourth	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1
Fifth	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1
Sixth	Daytime (07:00 – 23:00)	49.2	16.2	30	-13.8
	Night-time (23:00 – 07:00)	49.2	16.2	30	-13.8
		72.9	39.9	45	-5.1

Table 5.20 indicates that the ground to sixth floor apartments, with habitable rooms facing The Forum will not exceed the criteria for the maximum noise levels (applicable to bedrooms).

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 5.21 calculates the internal noise levels with a partially open window.

Table 5.21: Calculation of Daytime and Night-time Noise Levels from The Forum within Apartments – Windows Open

Floor	Period	Calculated Free-field Noise Level (dB)	Calculated Internal Noise Level (dB)	Criteria (dB)	Difference +/- (dB)
Ground	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2
		72.9	60.9	45	+15.9
First	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2
		72.9	60.9	45	+15.9
Second	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2
		72.9	60.9	45	+15.9
Third	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2
		72.9	60.9	45	+15.9
Fourth	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2
		72.9	60.9	45	+15.9
Fifth	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2

		72.9	60.9	45	+15.9
Sixth	Daytime (07:00 – 23:00)	49.2	37.2	30	+7.2
	Night-time (23:00 – 07:00)	49.2	37.2	30	+7.2
		72.9	60.9	45	+15.9

Table 5.21 indicates that all apartments facing The Forum will exceed the required BS 8233 internal noise criteria limits for all habitable rooms and so Section 6.0 details appropriate mitigation in order to control external to internal noise break-in.

5.6 Mechanical Plant Noise Emission Limits Assessment

It is understood that the proposed development will incorporate fixed mechanical plant items however the specific details are unknown. Accordingly it is necessary to set plant noise emission limits based upon the existing background noise climate at the closest residential receptors and in accordance with the criteria set by LBC. Table 5.22 shows the plant noise emission limits when measured or calculated at the façade of the closest residential receptor. These limits are applicable for either a single plant item or multiple plant items.

Table 5.22: Calculation of Plant Noise Emission Limits

Period	Lowest Measured 1-hour Background Noise Level $L_{A90,1hr}$ (dB)	LBC Criteria (dB)	Calculated Noise Emission Limit $L_{A,r}$ (dB)
Day-time (07:00 – 23:00)	50.6	$L_{A,r} = L_{A90,t}$ -10dB	40.6
Night-time (23:00 – 07:00)	48.4		38.4

6.0 NOISE MITIGATION

6.1 Noise Mitigation for Road Traffic Noise – Highgate Centre

6.1.1 External Habitable Areas

Tables 5.1 and 5.2 show that the WHO external criteria level of 55dB(A) can be achieved for 'winter garden' type balconies (floors ground – sixth) and open balconies (with 1.1m high sealed guard rail), and roof garden areas (floors fourth – sixth). Therefore no additional mitigation measures would be required.

6.1.2 Internal Habitable Rooms – Highgate Centre

The previous Section has indicated that the second - fifth floor apartments will exceed the criteria for the daytime noise level (living rooms) and the ground and first floor apartments will exceed the criteria for the daytime noise level and the night-time criteria for the maximum noise levels. The most appropriate method for controlling these exceedences is by installation of upgraded glazing units.

Table 6.1 specifies the typical glazing configuration required in order to reduce the internal noise levels to achieve the required internal criteria level.

Table 6.1: Calculation of Daytime and Night-time Road Traffic Noise Levels from Highgate Road within Apartments – Windows Closed

Floor	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 Additional Acoustic Performance over Standard Thermal Double Glazing (dB)	Typical Glazing Configuration
Ground	(07:00 – 23:00)	67.2	34.2	30	+4.2	5	8 / 20 / 8.4A*
	(23:00 – 07:00)	81.9	48.9	45	+3.9	4	8 / 8 / 8.4A*
First	(07:00 – 23:00)	66.1	33.1	30	+3.1	4	8 / 8 / 8.4A*
	(23:00 – 07:00)	79.6	46.6	45	+1.6	2	12 / 20 / 6
Second	(07:00 – 23:00)	66.1	32.1	30	+2.1	3	6 / 12 / 6.4A*
Third	(07:00 – 23:00)	66.1	31.4	30	+1.4	2	12 / 20 / 6
Fourth	(07:00 – 23:00)	66.1	30.7	30	+0.7	1	12 / 16 / 6
Fifth	(07:00 – 23:00)	66.1	30.2	30	+0.2	1	12 / 16 / 6

*Acoustic laminate glass

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 overlook Highgate Road. Accordingly it is necessary to consider an alternative ventilation scheme for dwellings overlooking Highgate Road. 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.

6.2 Fire Station Noise Mitigation

6.2.1 External Habitable Areas

Tables 5.6 and 5.7 indicate that there are no exceedences of the WHO external noise criteria limit for balconies or roof gardens which face the Fire Station. Therefore no additional mitigation is required provided the 1.1m high sealed guard rails are in place.

6.2.2 Internal Habitable Areas

The previous Section has indicated that exceedences of the required 45dB $L_{Amax,fast}$ internal noise levels during the night-time will occur for bedrooms which face the Fire Station. Given that the mitigation measures required for road traffic noise are more onerous than that for noise from the Fire Station, no additional mitigation measures are required in order to prevent sleep disturbance.

6.3 Rail Traffic Noise Mitigation

6.3.1 External Habitable Areas

Table 5.13 indicates that exceedences of the required external noise criteria level will occur at the Greenwood Centre for balconies and roof gardens which face the railway line.

In calculating the required height of the balcony guardrail or wall, calculation has accounted for a person in a sitting position on the balcony.

Table 6.2: Calculation of Daytime Rail Traffic Noise Levels with a 1.5m Balcony Guardrail for Outdoor Living Areas

Floor	Period	Calculated External Noise Level with no Barrier (dBA)	1.5m Guard rail Barrier Attenuation (dBA)	Calculated External Noise Level with Barrier (dBA)	WHO External Noise Criteria (dBA)	Difference +/- (dBA)
First	(07:00 – 23:00)	64.7	10.0	54.7	55	-0.3
Second	(07:00 – 23:00)	64.7	10.0	54.7	55	-0.3
Third	(07:00 – 23:00)	64.7	10.0	54.7	55	-0.3

Table 6.2 indicates that a 1.5m high guardrail or wall will afford sufficient noise attenuation to meet the required external criteria level in accordance with WHO guidelines.

6.3.2 Internal Habitable Areas

The previous Section has indicated that standard thermal double glazing will be sufficient in controlling external to internal noise levels within habitable rooms which face the railway line for the Greenwood Centre. However, with windows open the required internal target noise criteria will be exceeded for the first and second floors. Accordingly it is necessary to consider an alternative ventilation scheme for any noise-sensitive rooms on these floors.

It is understood that a commercial scaled mechanical ventilation system with heat recovery (MVHR) is to be adopted in the Greenwood Centre. 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 occupiers to open intermittently if desired. In addition to this, in order to minimise overheating during summertime, automatically opening night-time ventilators' in combination with high thermal mass in the occupied spaces is proposed. This will have no adverse noise impact as the building will be unoccupied during the night-time period. It is understood that comfort cooling will also be provided in summer months where necessary.

6.4 Commercial Noise Mitigation

Table 5.16 indicates that the noise level generated by the various activities at the J Murphy and Sons Limited Commercial Yard accord with the required WHO external noise criteria limit, and no noise associated with the A&A Storage facility was audible during the surveys, therefore no mitigation is required.

6.4.1 Potential A&A Storage Site Redevelopment

It is recommended that any future redevelopment of the A&A Storage site should consider the plant noise emission limits as shown in Table 5.22 for any fixed mechanical & electrical plant, in order to prevent any adverse noise impact on noise-sensitive elements of the Site. In order to ensure that the proposed residential use at The Highgate Centre does not impair the potential re-development of the adjacent A&A site, REC understand that it would be preferable to upgrade the glazing specification for habitable rooms facing onto the A&A site to match that proposed along the façade adjacent to Highgate Road (See Table 6.2). In addition it may be prudent to match the ventilation requirements as detailed in paragraph 6.1.2.

6.5 Entertainment Noise Mitigation

6.5.1 External Habitable Areas

Tables 5.18 and 5.19 indicate that there are no exceedences of the WHO external noise criteria limit for balconies or roof gardens which face The Forum. Therefore no additional mitigation is required provided the 1.1m high sealed guard rails are in place.

6.5.2 Internal Habitable Areas

The previous Section has indicated that standard thermal double glazing will be sufficient in controlling external to internal noise levels within habitable rooms which face The Forum for the Highgate Centre. However, with windows open the required internal target noise criteria will be exceeded for all floors. Accordingly it is necessary to consider an alternative ventilation scheme for dwellings facing The Forum. 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.

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 to identify the key sources of noise around the Site which may have the potential to impact upon the proposed noise-sensitive elements of the development. This Noise Impact Assessment has also set Noise Emission Limits in the interests of protecting existing and proposed residential amenity from any M&E plant which may be incorporated into the commercial element of the development. The Noise Impact Assessment has been completed with due regard to the requirements of LBC.

This assessment has shown that noise levels generated by Highgate Road, the Fire Station and The Forum can be controlled to satisfactory levels in both external and internal habitable areas at the Highgate Centre. Noise levels generated by the railway line and the J Murphy and Sons Limited Commercial Yard can be controlled to satisfactory levels in both external and internal areas at the Greenwood Centre.

No noise associated with the A&A Storage facility was noted during the noise surveys and would not be expected to cause any adverse noise impact upon the Site based on its current use.

It is recommended that the plant noise emissions limits set in this assessment are considered for any potential redevelopment of the A&A Storage site in the future, in order to minimise any adverse noise impact on the Site. In addition, glazing and ventilation specification could be upgraded in order to minimise the potential for adverse noise impact due to any re-development of the A&A storage site.

It should be noted that the Site lies within a mixed residential and commercial area within Camden and the calculated noise levels for outdoor areas are not unduly high and are considered typical of the noise climate to be found within an inner London area.

Subject to the incorporation of the recommended mitigation measures, 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

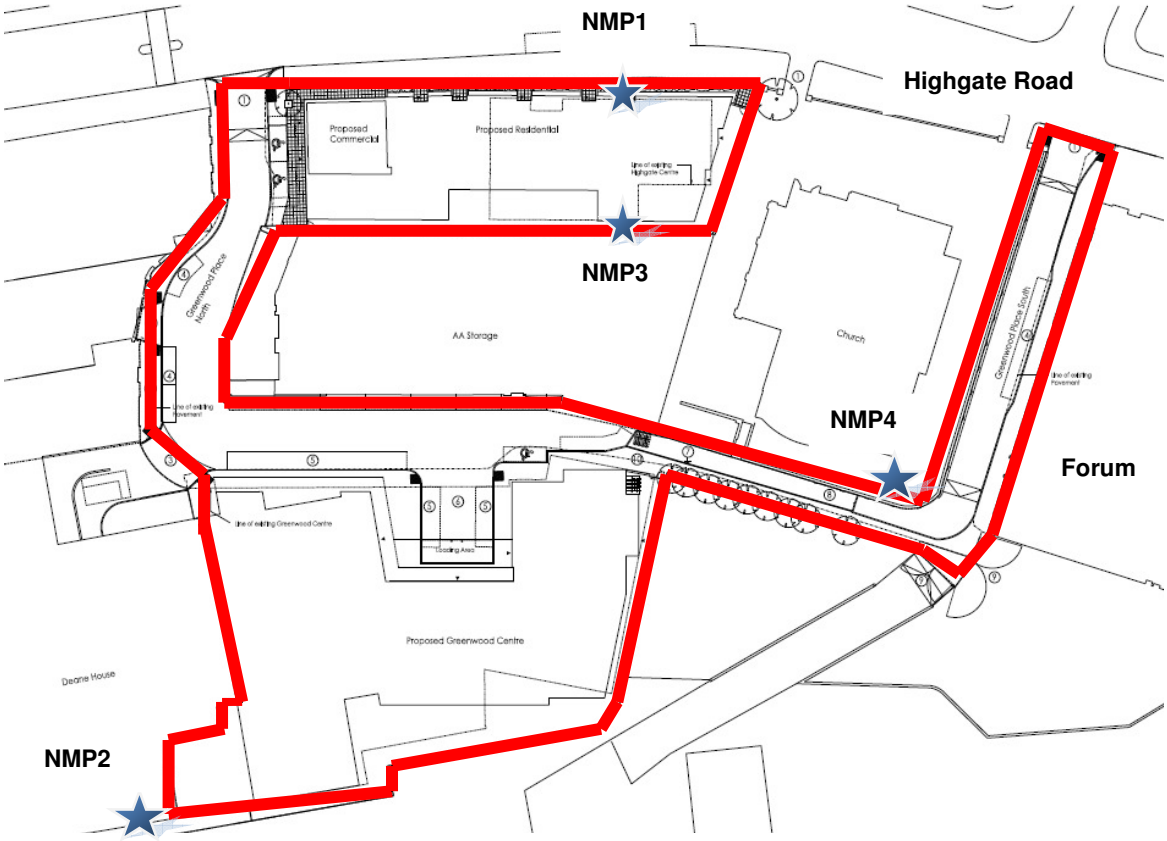

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Figure 1

Site Location, NMP1 – 4, Surrounding Noise Sources

APPENDIX IV SOUND PRESSURE LEVELS

Table A1: Measured Road Traffic Sound Pressure Levels at NMP1

Measurement Start Time	Measured Sound Pressure Level, Facade (dB)			
	$L_{Aeq,1hr}$	$L_{Amax,fast}$	$L_{A90,1hr}$	$L_{A10,1hr}$
30/04/2013 13:00	69.2	82.6	59.3	72.3
30/04/2013 14:00	68.8		56.8	71.8
30/04/2013 15:00	69.3		59.3	72.1

Table A2: Measured Noise Levels at NMP3

Measurement Start Time	Measured Sound Pressure Level, Facade (dB)			
	$L_{Aeq,1hr}$	$L_{Amax,fast}$	$L_{A10,1hr}$	$L_{A90,1hr}$
15:00	58.1	72.9	60.3	53.7
16:00	59.9	85.8	60.6	53.6
17:00	59.0	83.4	60.5	53.8
18:00	70.7	109.0	61.3	53.6
19:00	60.4	86.7	60.0	52.0
20:00	60.2	87.8	60.0	51.6
21:00	58.1	85.0	58.9	51.1
22:00	56.0	68.1	58.8	50.6
23:00	59.0	87.7	58.5	50.1
00:00	58.2	86.1	57.8	49.3
01:00	52.0	64.5	54.4	48.4
02:00	54.7	84.0	54.3	48.5
03:00	57.5	85.2	55.7	49.2
04:00	52.8	67.7	54.9	49.2
05:00	54.9	74.5	57.5	49.6
06:00	58.6	78.3	61.1	51.9

07:00	61.8	85.5	62.4	54.6
08:00	65.4	89.2	61.3	55.0

Table A3: Measured Noise Levels at NMP4

Measurement Start Time	Measured Sound Pressure Level, Facade (dB)			
	$L_{Aeq,1hr}$	$L_{Amax,fast}$	$L_{A90,1hr}$	$L_{A10,1hr}$
16/06/2013 21:30	56.2	83.2	46.6	58.1
16/06/2013 22:30	55.8	74.1	50.6	58.0

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