SUPPLEMENTARY PLANNING GUIDANCE

The Adopted 2004 Plan for the Environment, Ealing's Unitary Development Plan, provides the policy context for decisions on planning applications and other proposals concerning development and transport in the London Borough of Ealing.

These policies are clarified and amplified where appropriate by Supplementary Planning Guidance (SPG). This Guidance may bring together planning and other considerations (e.g. Building Regulations, Environmental Health, Transport) which need to be taken into account by people proposing development or affected by development. The guidance can be used in determining planning applications, and it has the legal status of a 'material consideration', which the local planning authority is entitled to take into account in making decisions.

Supplementary Planning Guidance (SPG) continues in force as long as the Unitary Development Plan policy that it supplements is in force. Under the Planning and Compulsory Purchase Act 2004, unitary development plans will be progressively replaced by new Development Plan Documents in a Local Development Framework. The local planning authority may choose to produce Supplementary Planning Documents (SPD) to supplement development plan policies in the Local Development Framework.

SPG 10

Noise And Vibration

CONTENTS

1. Introduction

When considering proposals that will either generate noise or vibration and/or developments that are sensitive, developers and planners are required to consider the detailed criteria and measurements contained within this guidance. The information relates to *Policy 4.11: Noise and Vibration* contained within *Chapter 4: Urban Design,* in the Adopted 2004 Plan for the Environment.

When considering new developments care is to be taken to ensure that the potential or existing noise/vibration levels in the area are acceptable. As appropriate, attenuation against noise and vibration may be required. Such attenuation can be achieved in a number of ways through land use, the design of the building and the use of rooms. However where appropriate standards cannot be achieved, planning permission will normally be refused.

The detailed criteria and measurements used within this document are complex. However information regarding the planning requirements for noise and vibration must be readily available, hence the preparation of this supplementary planning guidance. It should therefore be used by individuals and organisations making planning applications in a noisy location or for uses that may generate noise. Detailed information relating to the measurement of sound and other relevant background information can be found in the Appendices.

2. Noise and Vibration Assessments

There are two situations where details should be submitted, preferably prior to the Planning Application, to assess the noise and vibration levels. These are:

I. Proposed development generating noise and or vibration (noise brought to people)
II. Where there are proposals for noise sensitive development (people brought to noise)

Where appropriate an approved Acoustic Consultant should be engaged and the assessment should satisfy the following requirements:

(1) Noise measurements or predictions to be made at **1.2m to 1.5m** above ground at the position of the proposed dwellings under free field conditions and also at upper floor levels, if significant differences in noise exposure are found at the various proposed floor levels.
(2) Where appropriate, measurements should be made with a light wind blowing from the noise source towards the receiver, with a vector component not exceeding **2m/s**. Alternatively an addition of **2 decibels (dB)** can be added to measurements or predictions made with still conditions, to allow for the effects of a positive wind vector.
(3) Where significant adverse changes to the current noise and/or vibration levels are expected, due to the proposed alteration of transport networks or the provision of new networks or terminals, the forecast levels relating to the period **15 years** ahead should be specified.
(4) Vibration measurements for developments near railways should cover all train types in use or expected to be in use and where goods trains will operate the heaviest categories should be assessed (e.g. trains carrying quarry stone, ballast etc.)
(5) Details of the design control measures required to bring noise and vibration levels within the design criteria specified at sections 3 and 4 below should be included.
(6) All assumptions made should be specified and the methods of measurement, calculation and prediction should comply with the standards set out in this document. These should be set out in order to enable the Council to audit the calculations. The references used to create these standards can be found within Appendix 7.
(7) Potential disturbance from noise and vibration, emitted during construction and demolition works connected with the development, should be addressed by following the recommendations at BS5228, and submitting details to demonstrate that the advice at Appendix 4 will be met.

Note: *It is recommended that the consultant contacts the Environmental Heath Section, before carrying out the measurements or calculations.*

3. New Development proposed near existing dwellings and other noise/vibration sensitive developments/areas[1]

This section has been divided into two sections

A) BS 4142: 1997 Methodology
B) New Proposals outside the remit of BS 4142: 1997

A) BS 4142:1997 Methodology

Paragraph 19 of PPG 24 advises that the likelihood of complaints about noise from industrial development can be assessed using the standard BS 4142 1997 Method for rating industrial noise affecting mixed residential and industrial areas. The Council adopts the procedure at BS 4142:1997 for assessing the impact of industrial noise.

The British Standard gives methods for determining:

I. The rating noise level for sources at factories or industrial premises, or sources of an industrial nature in commercial premises, near an affected building façade.
II. The background noise level, near an affected façade.
III. Whether or not complaints are likely, using the difference between (I.) and (II.) (after corrections).

In carrying out the measurement and calculations of BS 4142 1997, the Council expects the standards recognised within table 3A1, 3A2 and 3A3 to be met.

***Notes**: The standard applies to existing premises or new or modified premises but it is stated that it is general in character and may not cover all situations. The accuracy of measuring equipment must be to minimum specified British Standards and equipment must be performance checked at specified intervals (2 years) and to specified standards.*

In addition to being applied to straightforward cases where industrial plant machinery is in use, the standard has been applied in the following cases, and the Council adopts these categories:

- Premises where there are manoeuvring lorries which are loaded or unloaded by forklift trucks (or tailgate).
- Premises where there are manoeuvring lorries on which an on board refrigeration plant is run or charges.
- Extract ventilation plant at restaurants (see Table 3A3).
- Loaders, dumpers and haulage vehicles etc operating in yards handling building materials or at waste disposal sites etc.
- Waste Disposal Sites (See Appendix 2).

[1] In all cases, design criteria relating to the insulation of the building envelope should include the provision of adequate ventilation (see section 7).

Table 3A1) Measurement and Calculation of the Specific Noise, Residual Noise and Background under BS 4142:1997

- Measure 3.5m from ground floor, or at 1m from a first floor façade and any higher facades.
- Measure L_{Aeq} of representative sample of specific noise (offending noise in quiet or with the residual noise subsided to its lowest level).
- Assess the duration time or cycle time for the specific noise over a one-hour period (day) or 5 minute period (night).
- Measure L_{Aeq} of a representative sample of the residual noise subsided to the typical low level pertaining when measuring the specific noise.
- Correct specific noise sample for influence of residual noise. (Re Table 1 BS4142).
- Adjust, corrected specific noise sample to $L_{Aeq,1hr}$ (day) or $L_{Aeq,5m}$ (night).
- Measure the background noise level without the specific (offending noise) sufficiently long enough to obtain a representative value, in $L_{A90.}$ (Since background noise levels vary throughout a 24 hour period it is necessary that noise levels are assessed for separate periods (eg day and night) chosen to suit the hours of operation of the proposed development. Similar considerations should be applied to developments that will emit significant noise at the weekend as well as during the week).
- To corrected specific L_{Aeq} add correction of 5 dB if offending noise has discreet tones, or is impulsive or irregular enough to attract attention - this gives the Rating Noise Level.

Table 3A2) Assessment of Likelihood of Complaints under BS 4142:1997

1. Assess the likelihood of complaints by subtracting the measured background noise level L_{A90} from the rating level $L_{Aeq,60m}$ or $L_{Aeq,5m.}$

2. The greater the difference, the greater the likelihood of complaints
   + 10dB or more - complaints are likely
   + 5dB of marginal significance
   - 10dB or more - complaints unlikely

Table 3A3) Criteria for BS 4142 Assessments

Major industrial sources

The rating noise level of the noise emitted from the proposed development, determined by the procedure at BS 4142 1997, should be at least 5 dB(A) below the background $L_{A90,1hr}$ noise level, measured or calculated at 3.5 m from ground floor facades and1m from upper floor facades at the nearest affected premises.

Small items of industrial equipment at commercial premises

Although BS 4142 usually applies, the Council may specify the following criteria, in relation to small-scale commercial development. Noise control for machinery audible beyond the boundary of the site to be designed to satisfy an acoustic standard, not exceeding LFNR 35 $L_{eq,5mins}$ 1900 – 0700 hrs on Mondays to Fridays, LFNR 40 $Leq_{,5mins}$ 0700-1900 hrs Mondays to Fridays, and LFNR 35 $L_{eq,5mins}$ for any time period on Saturdays, Sundays and Bank Holidays, measured or calculated at 1m from the nearest facade of the nearest affected noise sensitive premises with all items of plant operating together and at full power, and a 5dBA penalty added for tonal noise content.

Low Frequency Noise Rating (LFNR 35) approximates to background L_{90} Linear one third octave band levels for sheltered sites, during evening and night-time periods on weekdays and at anytime on Saturdays, Sundays and Bank Holidays and LFNR 40 during daytime on Mondays to Fridays. The background NR level may be ascertained by a measurement, but the measurement period should include a weekend, if it is intended to operate plant during this time. Timer switches should be installed to prevent plant operating at night, or on Saturdays, Sundays or Bank Holiday, if it is not meant to do so.

B) New Proposals ouside the remit of BS 4142: 1997

1. Commercial Developments, e.g. Night Clubs, Public Houses, Places of Worship and Mini Cab Offices, Drive-through take away and restaurants

Paragraph 20 of PPG 24 states: 'Commercial developments such as fast food restaurants, discos, night clubs and public houses pose particular difficulties, not least because associated activities are often at their peak in the evening and late at night'. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises, but also the attendant problems of noise that may be made by customers in the vicinity. The disturbance that can be caused by traffic and associated car parking should not be underestimated.

The relevant PPG does not specify any method for assessing the impact of these noises and there are no British standards relating to the assessment of noise from amplified music or vehicle noise in car parks etc. However the Institute of Acoustic Good Practice Guide on the Control of Noise from Pubs and Clubs gives guidance on the control of the different sorts of noises which may arise and in particular recommends that where entertainment takes place on a regular basis, music and associated sources, should not be audible inside noise-sensitive property at any time.

A study by Stirling JR and Craik RJM, "Amplified Music as a Noise Nuisance", Proceedings of the Institute of Acoustics, Volume 8, Part 4, 1986, found the following from an experimental survey of householders, listening to amplified music across a partition:

- When the music level was equal to the background level, representing an increase of + 3 dB for background and music together, between 60 and 90 % of householders were found to be dissatisfied with the level of music heard.
- When the music was played at 10 dB below background, representing an increase of 0.5 dB for the background and music together, 60 % of householders were found to be dissatisfied.
- When the music was played at 15 dB below background, representing an increase of 0.1 dB for the background and music together, 2% of householders were found to be dissatisfied and the level was judged as being acceptable.

Notes: *In BS 8233: 1999, Sound insulation and noise reduction for buildings – Code of Practice it is stated:*

- *Paragraph 8.4.8.1 "Dwellings that adjoin other buildings that generate noise levels greater than normal domestic activities may require constructions offering better performance than those described in the documents that support the Building Regulations".*
- *Paragraph 7.6.2.3 "In rooms in which dancing may take place on one side of a division wall and speech making on the other, a wall of less than 60 dB Rw insulation may not give adequate protection.*

In assessing such uses the Council has adopted the following standards and criteria:

B1 Amplified music and speech – insulation of building envelope

In the case of amplified music and speech break-out from premises, the Councils' policy is to control the disturbance by ensuring that the insulation of the premises and volume and bass setting inside are adequate. This will also require an adequate mechanical ventilation system to supply sufficient fresh air for patrons in the warmest weather, thus ensuring that sound proofed doors and windows remain closed (see section 7). The fitting of a limiter device to control the bass and overall noise levels at source may also be required.

a) Amplified music transmitted from a source not attached to a sensitive premises - criteria

The noise control shall be designed so that the background noise level ($L_{90,15min}$ Linear for the one third octave band levels of 50 to 160 Hz and the overall linear noise level), as measured at one metre outside the nearest affected façade of the nearest affected premises with the amplified music and/or vocals switched off, shall not be increased when the music or vocals are played at the typically highest level and a measurement is repeated in L_{90} Linear at the same position over any 5 minute period, with the music, vocals and current background noise measured together.

Breakout of amplified music from a source attached to a sensitive premises – criteria

b) The noise control shall be designed so that the background noise level ($L_{90,15min}$ Linear for the one third octave band levels of 50 to 160 Hz and the overall linear noise level), as measured in the centre of a habitable room attached to the source, with the amplified music and/or vocals switched off, shall not be increased when the music or vocals are played at the typically highest level and a measurement is repeated in L_{90} Linear at the same position over any 5 minute period, with the music, vocals and current background noise measured together.

B2 Breakout of impulsive noise from patrons and associated vehicles and delivery vehicles (other than those vehicles falling within the remit of BS4142) – Criteria for sleeping and resting.

$L_{Amax,1hr\ (fast\ response)}$ noise level for [car engine starting] [manoeuvring] [door slams] [[other] , shall not to exceed the following criteria:-

- 60 dBA at 3.5 m from the nearest façade of the nearest affected dwelling during the period 1900 to 0700 hrs, where less than 15 noise events are predicted for the period.
- 55 dBA at 3.5 m from the nearest façade of the nearest affected dwelling during the period 1900 to 0700 hrs, where greater than 15 noise events are predicted during the period and/or low background noise levels prevail, a combination of noise and vibration is produced and sources with significant low frequency content are present.
- 65 dBA at 3.5 m from the nearest façade of the nearest affected dwelling during the period 0700 to 1900 hrs.

2. Other Uses e.g. Sports and recreation including open air pop concerts, shooting grounds, model aircraft, motor sports etc.

Paragraph 22 of PPG 24 states: 'For these activities (which include open air pop concerts), the local planning authority will have to take account of how frequently the noise will be generated and how disturbing it will be, and balance the enjoyment of the participants against nuisance to other people. Partially open buildings such as stadia may not be in frequent use. Depending on local circumstances and public opinion, local planning authorities may consider it reasonable to permit higher noise emission levels than they would from industrial development, subject to a limit on hours of use and control of noise emissions (including public address systems) during unsocial hours.'

PPG does not specify any method for assessing the impact of these noises. It makes reference to Codes of Practice such as the Code of Practice on Noise from Model Aircraft and mentions that other codes, issued by Governing Bodies for Sports, may be of assistance to Local Authorities. The Council adopts the codes and draft codes applying to noise from concerts, shooting grounds and model aircraft, and will use these recommendations in assessing the impact of such noises and specifying conditions. (See relevant documents)

Where there is no appropriate Code of Practice available (e.g. noise from 5 a side football pitches and associated car park use), the Council will adopt the following criteria:

$L_{Amax,1hr(fast\ response)}$ noise level for the sport / recreational event including car park noise, shall not to exceed the following criteria:-

- 60 dBA at 3.5 m from the nearest façade of the nearest affected dwelling during the period 1900 to 0700 hrs, where less than 15 noise events are predicted for the period.
- 55 dBA at 3.5 m from the nearest façade of the nearest affected dwelling during the period 1900 to 0700 hrs, where greater than 15 noise events are predicted during the period and/or low background noise levels prevail, a combination of noise and vibration is produced and sources with significant low frequency content are present.
- 65 dBA at 3.5 m from the nearest façade of the nearest affected dwelling during the period 0700 to 1900 hrs.

4. New Dwellings and other Noise Sensitive Developments (e.g. Schools and Hospital etc) proposed near existing noise and/or vibration sources

A. Noise Exposure Categories

PPG 24 advice states the following: "*Where new dwellings are proposed near noise and/or vibration from roads, railways, airports or mixtures of these including non dominant industrial noise, the noise and vibration should be assessed to determine the noise exposure category which the site falls into (NEC)"*

The Council has adopted the following noise exposure categories and the Council's decision concerning an assessed NEC level will be based on the advice given at PPG 24:

Noise Levels Corresponding to the Noise Exposure Categories (NEC) for New Dwellings L_{AeqT} dB

NEC	*Times*	*road traffic*	*rail traffic*	*air traffic*	*mixed sources*	*Advice on treatment of planning applications in areas of each NEC*
A	07.00 - 23.00 23.00 - 07.00	<55 <45	<55 <45	<57 <48	<55 <45	**Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level**
B	07.00 - 23.00 23.00 - 07.00	55 - 63 45 - 57	55 - 66 45 - 59	57 - 66 48 - 57	55 - 63 45 - 57	**Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protections against noise**
C	07.00 - 23.00 23.00 - 07.00	63 - 72 57 - 66	66 - 74 59 - 66	66 - 72 57 - 66	63 - 72 57 - 66	**Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise**
D	07.00 - 23.00 23.00 - 07.00	>72 >66	>74 >66	>72 >66	>72 >66	**Planning permission should normally be refused**

Notes: *For interpretation of this table see notes at Appendix 3, which also includes a reference to the adopted air transport contours for 2016, which are shown at Appendix 5.*

B. Criteria for adequate protection for new buildings

Where noise mitigation is required design control measures should ensure that the noise criteria specified below is met (taken from WHO (99), BS 8233 and Sound Control for Homes 93) (see also section 7).

Externally generated noise due to transport noise sources, affecting new housing, hostels and hotels	
Area	***Noise Criteria***
Private and Communal Gardens	Levels should be as low as practicable and not greater than 50dB $L_{Aeq,1hr}$ 0700-2300hrs
Bedrooms	Not greater than 30dB $L_{Aeq,1hr}$ 2300-0700 hrs Not greater than 45 dB $L_{Amax,1hr(fast)}$ 2300 – 0700 hrs
Living rooms & dining rooms	Not greater than 35dB LAeq,1hr 0700-2300 hrs.
Kitchens/bathrooms/utility rooms	Not greater than 45dB $L_{Aeq,1hr}$ 0700 - 2300hrs
Note 1: *At BS 8233: 1999, at paragraph 7.6.1.2 it is stated – "…….As well as protection for buildings, barriers or bunds should be considered to protect the gardens. In gardens and balconies etc., it is desirable that the steady noise level does not exceed 50 $L_{Aeq,T}$ dB and 55 $L_{Aeq,T}$ dB should be regarded as the upper limit".* ***Note 2:*** *Internal building services noise generated from ventilation systems and lifts etc should meet the same criteria as specified above.*	

For dominant industrial sources the rating noise level of the noise emitted from the proposed development, determined by the procedure at BS 4142 1997, should be at least 5 dB(A) below the background $L_{A90,1hr}$ noise level, measured at the most sensitive period when the plant will be operated (e.g. evenings and weekends), measured or calculated at 3.5 m from the ground floor, and 1m from the upper floor of the nearest façade of the nearest affected premises.

Note*: Internal building services noise generated from ventilation systems of lifts etc should meet the same criteria as specified above.*

Externally generated noise affecting other new noise sensitive buildings		
Type of Development	***Area***	***Noise Criteria***
Educational Buildings	Workshops and practical areas	<50dB $L_{Aeq,\ 1\ hr}$, 07.00-23.00 hrs
	Libraries & individual study spaces	<45dB $L_{Aeq,\ 1\ hr}$, 07.00-23.00 hrs
	Small lecture or seminar rooms, and offices	<40dB $L_{Aeq,\ 1\ hr}$, 07.00-23.00 hrs
	Classrooms, lecture rooms & language laboratories	<35dB $L_{Aeq,\ 1\ hr}$, 07.00-23.00 hrs
	Music & drama spaces	< 30dB $L_{Aeq,\ 1\ hr}$, 07.00-23.00 hrs
Public Libraries		< 45dB $L_{Aeq,\ 1\ hr}$ 09.00-22.00 hrs
Law Courts & Council Chambers		<35dB $L_{Aeq,\ 1\ hr}$, 0900-23.00 hrs
Concert Hall, Opera House & Large Theatre		<25dB $L_{Aeq,\ 1\ hr,}$ 07.00-23.00 hrs
Small Theatres		<30 dB $L_{Aeq,\ 1\ hr}$, 07.00-23.00 hrs
Hospitals, Clinics and Welfare Buildings	Wards (including day recovery rooms)	<30 dB $L_{Aeq,\ 1\ hr}$, 23.00-07 00 hrs
	Operating theatres, reception areas	<35 dB $L_{Aeq,\ 1\ hr}$, 07.00- 23.00 hrs
	Kitchens, laundry, physiotherapy, X ray utility and store rooms	<45 dB(A) L_{eq} 1 hour 07.00- 23.00hrs
Office Buildings	Private offices & small conference rooms	< 40dB(A) L_{eq}, 1 hour, 07.00- 23.00hrs
	Large offices	< 45dB(A) Leq, 1 hour, 07.00- 23.00hrs

Note 1: *The revised approved document E of the Building Regulations came into force in July 2003. One of the consequences is that new and refurbished schools will have to meet strict standards for noise levels, insulation and room acoustics. These standards are set at Section 1 of the DfES Building Bulletin 93, "Acoustic Design of Schools", February 2003. Building Control Officers of Local Authorities will have responsibility to ensure that the standards are complied with. A liaison will take place between Environmental Health and Building Control at Ealing for the purpose of ensuring that classrooms are adequately insulated against transportation noise sources. Noise from schools to surrounding areas is still controlled under planning legislation.*

Note 2: *National Health Service Estates, has produced a series of Hospital Building Notes.*

5. Vibration: From New or Existing Sources affecting sensitive buildings.

The Council's criteria for vibration from any new or existing source affecting a dwelling or other sensitive building is as follows:

Highest vibration dose value (m/s$^{1.75}$) measured on the foundations in any of the three orthogonal directions not to exceed the following values.				
Type of Building	Hospitals, Theatres, Labs, etc	Residential	Offices	Workshops
Day 16 hr G/F	0.085	0.17	0.34	0.64
Day 16 hr F/F & above	0.04	0.08	0.16	0.32
Night 8 hr G/F	0.076	0.11	0.30	0.60
Night 8 hr F/F & above	0.037	0.05	0.15	0.30
***Note**: The values given relate to an undeveloped site and allow for an amplification factors of 1.2 at ground level in proposed building and 2.5 at first floor level and above. For measurements within buildings, the permitted values may be derived by applying these multiplying factors.*				

6. Sound Attenuation and Design Criteria

General Design Control Measures

The Council adopts the advice set out in Sound Control for Homes, BRE and CIRIA, 1993, where applicable – see part B (pages 23-25). In addition to this design control measures should include the following where appropriate:

a	Orientation of sensitive rooms and balconies and gardens away from noise by barrier dwelling blocks, single aspect courtyard schemes and staggered rows of terraced housing etc.
b	(a) Designing the layout and internal arrangement in blocks of flats, maisonettes etc, to ensure that: ▪ similar rooms in individual dwellings are stacked above each other or adjoin each other. ▪ halls are used as buffer zones between sensitive rooms and staircases ▪ large family units are not situated above individual flats or bed sitting rooms.
c	Provision of noise barrier walls and fences where necessary (see item below for specification required).
d	Insulation of the building envelope of noise sensitive buildings and also buildings generating noise.
e	Anti-vibration treatment of the foundations NB design of anti-vibration mounts must take proper account of expected forcing frequencies and resonances, predicted to be transmitted into the proposed dwellings.

Construction Details for Materials Making up the Building Envelope

The following constructions may be required to achieve an acceptable value for the composite sound reduction index of the building envelope and alternative ventilation may be required to ensure that the insulation remains effective (see section 7):

- Building envelope materials comprising brickwork and/or blockwork etc, sound proofed doors and acoustic secondary glazing to minimise the impact of significant noise, produced by transport noise services. For aircraft noise this may entail the use pitched tiled roofs with an under-ceiling and insulation, and wide air space acoustic secondary glazing.
- For places of public entertainment connected to sensitive buildings, a box in box construction may be required, where the noise source and sensitive receivers are in the same building. For receivers not connected to the place of entertainment etc., the installation of soundproof lobbies with double doors and acoustic secondary glazing and a mechanical ventilation system may be required. The installation of a noise limiter device may also prove beneficial, as this can fix the internal noise to the level of insulation provided. The limiter may also be connected to the external doors so that opening the doors cuts the music.

Calculation of the Sound Reduction Index for the Building Envelope Insulation

BS 8233 1999 and BRE & CIRIA Sound Control for Homes, 1993, provide examples of how the composite sound reduction index for a building envelope should be calculated, for the purpose of demonstrating compliance with target internal noise levels for sensitive building to be protected against the noise generated.

BS 8233 1999 states that the use of sound reduction index values (Rw) for the proposed building envelope will suffice for a rough calculation, using the overall calculated or measured single figure noise level, but that this is likely to underestimate the level calculated inside a room by up to 5 dBA. Where this calculation estimates that

the noise will be within 5 dBA of the limit, a more rigorous calculation should be carried out using octave bands, as explained in section 6.7.2. The Council requires that the worse case one hour single figure source noise level is used and if required the worst case one hour noise spectrum. This data can be obtained from a site survey, or from approved documents. In the case of aircraft noise sources, the following worst case one hour data should be used, when calculating the composite sound reduction index for sensitive buildings beneath the flight-path:

Octave band centre frequency Hz	**dB Linear - $L_{eq,1hr}$**	
	60 dB contour	**57 dB contour**
63	73	70
125	72	69
250	69	66
500	67	64
1000	62	59
2000	57	54
4000	45	42
Total $L_{Aeq,1hr}$ for spectrum 16 – 8K Hz	**67**	**64**

Vibration Isolation of Foundations of New Buildings

The design of anti-vibration mounts must take proper account of expected forcing frequencies and resonance's within the proposed dwellings.

Design and Specification for Noise Barriers

Barriers may be made of many different materials ranging from brick, metal, earth and timber etc. Mainland Europe, in contrast to the UK, has developed over this past 30 years, a substantial market for high performance and ascetic durable noise barriers. There has been a much stronger approach than in the UK to find truly environmental solutions to noise.

Until recently in the UK, barriers were mostly constructed of timber and there was an assumption that basic timber fences could be used as adequate barriers against traffic and other noise sources, for example 19mm close boarded fences. Such simple designs have been proved to be mostly ineffective, particularly where noise with significant low frequency content is present, due to inadequate account being taken of the density of different species of timber, leading to selection of timbers which warped, with gaps widening under hot weather conditions. In addition there was a lack of in-adequate testing of the timber barrier sections before they were erected.
The regulations have been tightened up requiring correct specifications for noise barriers, based on certified laboratory tested acoustic performance, to ensure that effective long lasting barriers are built, that significantly reduce noise levels and public complaint.

For the precise design guidance and specifications that must be achieved where barriers are required to be erected for the purpose of mitigating against noise see Appendix 6.

7. Ventilation Design Criteria

A. People brought to noise

Design criteria relating to the insulation of building envelopes should include the provision of adequate ventilation, in order that occupants may be supplied with adequate levels of fresh air in warm weather, should they choose to shut windows or be require to keep windows shut to screen out noise.

1. In the case of habitable rooms the following would be appropriate:

NEC Category B:

- An acoustic secondary glazed window capable of providing a staggered opening indirect air path, or with a closed secondary glazed window and a trickle ventilator along with a controllable sound insulated air brick provided in each habitable room on any exposed elevation.

NEC Category C:

- A closed secondary glazed window.
- Including a sound attenuating mechanical ventilator, with an external cowl or grill supplying fresh air to the ventilator and comprising a variable speed air supply unit, located in an external façade, and having at least two specified settings.
- Including a permanent sound attenuating air outlet vent.

All systems are to comply with the specifications laid down at Schedule 1 in the Noise Insulation Regulations. Although any other system of ventilation such as whole house ventilation would be appropriate provided the Building Control Inspector accepted it.

Notes:
1. Where air quality is poor, fresh air must be drawn from the non polluted side of the proposed buildings.
2. All windows should be fitted with replaceable neoprene compression seals, or other suitable seals approved by this authority and multi-point locks.
3. For the case of kitchen and bathrooms with ventilation requirements, these are specified under the Building Regulations.

B. Noise Brought to people

Amplified music or voices at places of entertainment or religious uses etc:

- An air conditioning system should supply sufficient air changes per hour in the warmest weather for the maximum numbers allowed and any external plant audible beyond the boundaries should be designed to satisfy a criteria not exceeding LFNR 35 dB $L_{eq,5min}$ when measurements are made at one metre from the nearest façade of the nearest affected dwelling or other sensitive building.

C. Commercial premises and factories

Mechanical ventilation should be provided to prevent the need to open doors and windows in warm weather, with the result that any required sound insulation is degraded.

APPENDIX 1:
Notes on the Measurement of Sound

Sound Pressure Level and Loudness of Sound

The sound pressure level (SPL) is measured in decibels. This is a scale comparing the logarithmic ratio of the sound pressure (P) under investigation to a reference sound pressure level (Po), such that:

$$\text{SPL dB} = 20 \log (P/P_o) \text{ where } P_o = 2 \times 10^{-5} \text{ N per m}^2$$

A logarithmic ratio was selected as it was considered that subjective response of the brain was proportional to the logarithm of the stimulus. The pressure fluctuations associated with sound transmission are small compared to barometric pressure and a specialist instrument, a sound level meter is required to compute the logarithm pressure ratio given above.

Environmental sounds when measured, as a single figure overall SPL, comprise a complex mixture of frequencies over the range of human hearing (20 Hz to 20,000 Hz in young adults). The ear does not hear discreet frequencies at equal levels of loudness. At low levels of loudness the lower frequencies have to be much louder to be heard at the same level as a 1000 Hz pure tone. Thus a weighting called the A weighting [dB(A)] was adopted to simulate this loudness effect. However, it was originally designed for sounds not exceeding 55 dB, and was not considered suitable for low frequency sounds with high energy such as the bass thump of discotheque music or where heavy good vehicles manoeuvre at low speeds. The Councils' policy is therefore to use criteria based on the linear noise level, for controlling amplified music and speech and not the usual A weighted level.

Significance of increase/decrease in dB(A) level on loudness

The dB(A) unit reflects the relative loudness of sounds and allows sounds of different intensity to be compared. As an approximate rule of thumb the following subjective judgements of the average person would apply:

- 3 dB(A) increase/decrease - just perceptible
- 10 dB(A) increase/decrease - doubling or halving of loudness
- 20 dB(A) increase/decrease - four-fold increase or decrease in loudness
- 30 dB(A) increase/decrease - eight-fold increase or decrease in loudness

Effect of adding to a noise source

Since decibels are determined on a logarithmic scale the results of adding or subtracting decibels does not follow as for arithmetic subtraction or addition.

- If a second machine of the same sound power is bought to a site to join an existing similar machine, (total of 2 machines) this will cause the noise to increase by 3dB(A), a just perceptible change of loudness.
- The addition of nine similar items of plant to join one item of the same sound power to a site (total of 10 machines) will result in a 10 dB(A) increase, a doubling in loudness.

- The doubling or halving of the number of vehicles per hour (stream of road traffic) will result in a 3 dB(A) increase/decrease, a just perceptible change in loudness.

Effect of increasing the measurement distance from a noise source

The change in sound pressure level due to increasing or diminishing the distance from the source depends on whether or not the source is a point source (a relatively small object), a long line source such as a stream of traffic, or a plane source like a factory building.

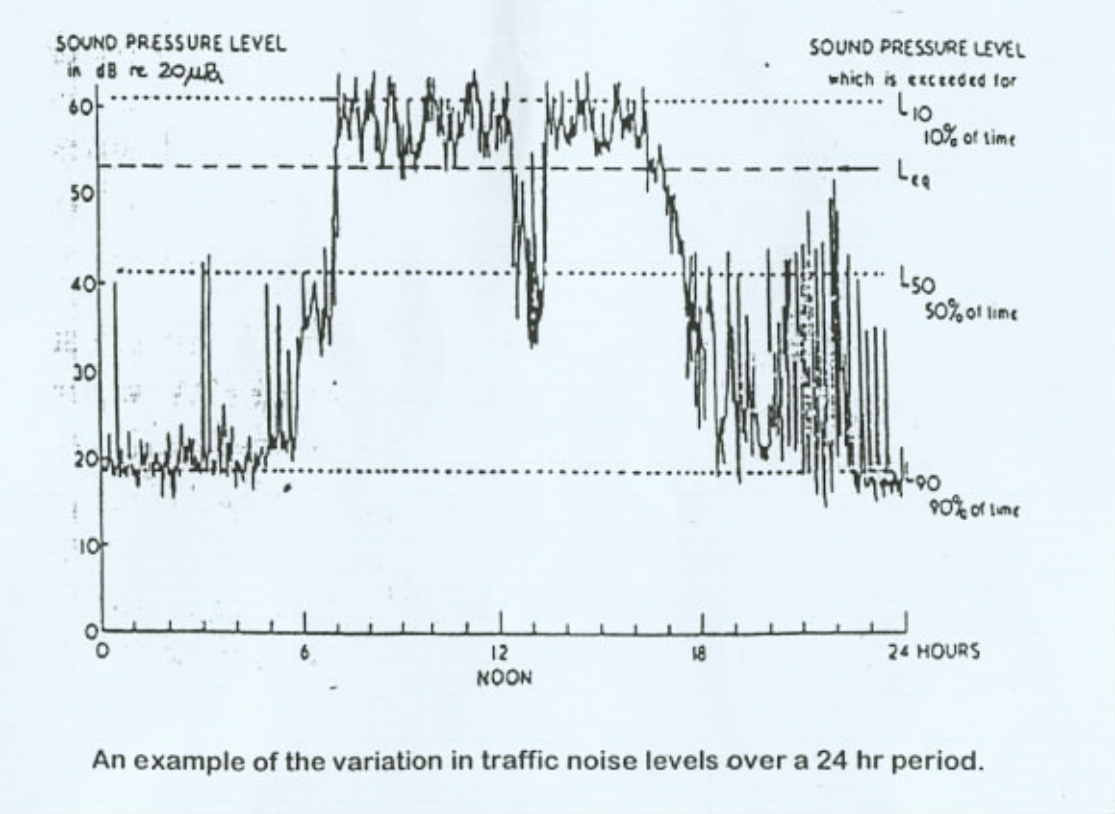
- The doubling of the distance of the sound level meter from a point source (e.g. an item of ventilation plant on a factory roof) will result in a 6 dB(A) decrease in sound pressure level, a substantial change in loudness.

- The doubling of the distance of the sound level meter from a long line source (stream of traffic) will result in a 3 dB(A) decrease in sound pressure level, a just perceptible change in loudness.

- A plane source will have a different decrease with distance.

Definition of Noise Units

The diagram below shows the continuous noise trace for traffic over a 24 hour period. It can be seen in practice that environmental noise fluctuates widely and is never steady. Various indices are used to quantify and describe the impact of the noise.



An example of the variation in traffic noise levels over a 24 hr period.

- **$L_{A10,T}$**: The A weighted level of noise exceeded for 10% of the specified measurement period (T). It gives an indication of the upper levels of fluctuating noise such as that from road traffic. $L_{A10.18h}$ is the arithmetic average of the 18 hourly $L_{A10.1h}$values from 06.00 to 24.00.

- **$L_{A90.T}$**: The A weighted noise level exceeded for 90% of the specified measurement period (T). It represents the quietest periods occurring in the noise measured. In BS 4142: 1997, Method for rating industrial noise affecting mixed residential and industrial areas, it is used to define background noise level.
- **$L_{Aeq,T}$**: The equivalent continuous sound level. It can be seen from the noise trace that the noise fluctuates in level to a marked degree over time. In calculating the **$L_{Aeq,T}$**, the sound level meter computes the notional steady noise level which would have occurred had there been no fluctuation in the noise energy over the measurement period (T).

- **L_{Amax}**: The highest A weighted noise level recorded during a noise event. The time weighting used (fast or slow meter response time) should be stated.

Noise Rating Curves

Tonal noises from industrial sources will generally be more disturbing than noises where no significant tonal effects are present. Discreet tonal noises such as whines, hums, hisses or whistles will usually exhibit a marked peak at one particular one-third octave or octave band making up the overall noise spectrum. There may also be harmonics at multiples of these frequencies.

One way of ensuring that that tonal noises, from small items of industrial plant, do not cause nuisance to the occupiers of sensitive buildings, is to require that noise control engineering measures eliminate the discreet frequencies making up the spectrum. This can be done by setting an appropriate noise rating number, including a protection at low frequencies (LFNR), as a maximum, which new plant should achieve at one metre from the nearest façade of the nearest noise sensitive building. The Council uses the typical background noise level, (the quiet background noise level spectrum without the offending noise) to determine the appropriate LFNR number, which should not be exceeded when the new plant comes into operation. Background noise levels at sites sheltered from busy main roads in the Borough fall below 40 dB L_{A90} in the late evening and approach 35 dB L_{A90} in the middle of the night.

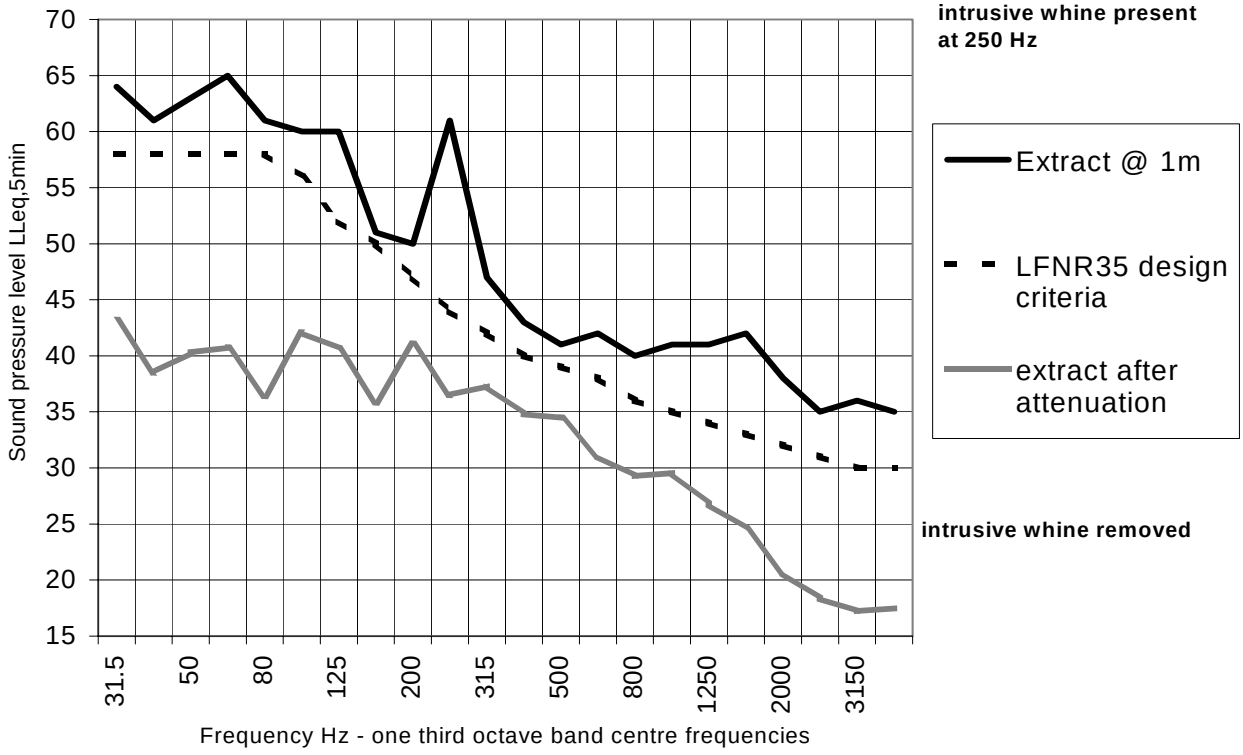
In sites away from main roads in the Borough, the background L_{90} noise level at the facades of dwellings, correlates well with the following noise rating curves:

- LFNR 35 Noise Rating Curve, during the period 1900 to 0700 hrs on weekdays and at any time on Saturdays and Sundays.

- LFNR 40 during the period 0700 to 1900 hrs on weekdays.

An example of design control using Noise Rating Curves is illustrated below:

Graphs show the noise spectra representing an item of plant, having an intrusive tonal whine, before and after attenuation works are carried out to meet the LFNR 35 dB noise criteria, at 1 m from the nearest façade of the nearest affected premises



APPENDIX 2:
Notes on Waste Disposal Sites

Paragraph 23 of PPG 24 states:
"Conditions attached to waste disposal licenses generally set limits on the amount of waste, frequency of deliveries and hours of operation, and prescribe screening requirements. These will have indirect effects on the amount of noise generated, but site licence conditions can also relate specifically to noise control in the interests of protecting local amenity."

The main sources of noise will be from vehicular movement, tipping operations, and site plant. Appropriate planning and licensing conditions might therefore relate to hours of working; the number and therefore capacity of vehicles using the site and their points of ingress and egress; and the provision of acoustic screening.

Useful information in predicting the noise will be found in BS 5228 Part 1: 1984. In addition, general guidance can be found in paragraph 9 of Minerals Planning Guidance, MPG 11: The Control of Noise at Surface Mineral Workings, Department of the Environment, HMSO, 1993.

The need for specific noise controls should be considered, particularly setting limits on the amount of waste, and the hours of operation. Noise will be generated at points of access to both the site and the primary and secondary road system. Levels will increase with frequency of deliveries and the capacity of vehicles using the site.

The Council adopts the prediction procedures at BS 5228 for arriving at the BS 4142 rating noise level and also the advice given in MPG 11 where this is appropriate.

APPENDIX 3:
Notes on Noise Exposure Categories (NECs)

Note 1 *Sites where individual noise events regularly exceed 82 dB(A), L_{max} (slow time weighting), several times in any hour during the period 2300 - 0700hrs should be treated as NEC C.*

Note 2:- *If an industrial noise source is dominant the likelihood of complaints about the noise should be also assessed, using guidance in BS4142:1997, Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.*

Note 3: *It was accepted at the time of the drafting of PPG 24 that developments which would be subjected to Category D transport noise exposures should normally be refused, because the limit for the effectiveness of acoustic glazing was approached at these levels, and social surveys had shown that a high percentage of occupiers were dissatisfied with noise insulation packages. At this time the accepted design level for good comfort in a bedroom was 35 dB L_{Aeq} and 40 dB L_{Aeq} in a living room. Modern acoustic secondary glazing can provide increased attenuation, provided that good sealing is achieved. However it has to be appreciated, that the recommended good standards for bedrooms and living rooms have now be lowered to 30 dB L_{Aeq},at BS 8233: 1999, following the publication of a WHO document, "Guidelines for Community Noise":1999. The Government are intending to review PPG 24.*

Note 4: *The Councils' adopted air traffic NEC categories relate to the predicted average worst mode one day level, which will be received in 2016 with 5 Terminals in operation at London Heathrow Airport and not the current PPG 24 recommended 92 day summer-time $L_{Aeq,16hr}$ contour values, covering the period from 15 June to 15 September, and using average traffic, flight tracks and weather conditions. Under these average conditions the prevailing wind blows from the west for about 78% of the summer, when aircraft take off to the west and are not heard in the Borough of Ealing.*

However, during the other 22% of the average summer, the Borough receives severe disturbance from easterly take-off from runway 09R, along the Brookman's Park - Woburn departure track. The effects of 92 day averaging is to reduce the daily exposure level due to aircraft by about 6 dBA, as averaging takes account of the larger number of days when the aircraft exposure is nil. In addition no account is taken of the increased exposure over the full year which brings over-flying to the Borough for an average of 28% of the time.

It was acknowledged at the Heathrow Terminal 5 Inquiry that the 92 day averaged $L_{Aeq,16hr}$ contours did not reflect the annoyance received at Ealing from easterly overflying, and that this was a problem that was properly looked at separately. The one day worst mode contours for 1994, shown at Appendix 5 were compiled at the request of the Inquiry Inspector and have been adopted by the Borough as the forecast contours for 2016, with 5 terminals in operation at Heathrow airport. The expert for the Government argued that only the 92 day average contours are calibrated to annoyance, under the findings of the 1982 ANIS social survey, which used a sample of residents living around Heathrow airport and other UK airports. The Inspector in his findings, stated that the conclusions of the ANIS social survey may not be valid, because of the time which has elapsed and called for a new social survey to be conducted. Weighing up the evidence and the Inspector's findings, the Borough requires developers to use the worst mode one day average contours, in assessing the Noise Exposure Category (NEC), where dwellings will be built beneath the flight path.

It should be noted that the adopted worst mode contours relate to current conditions of operation, whereby no easterly flying takes place over the village of Cranford during the daytime period. In the event of this mode of operation changing, new worst mode one day forecast contours would be commissioned and adopted by the Borough, since new areas of the Borough would be affected by over-flying. The same would apply should a third runway be built at London Heathrow Airport, as this would spread the disturbance received in the Borough.

Note 5: *European Union Directive 2002/49/EC "The assessment and management of environmental noise" has the aim of defining a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effect, including annoyance, due to exposure to environmental noise. This is to be achieved progressively by determining the exposure to environmental noise through noise mapping; making information available to the public and adopting action plans by member states based on noise maps to prevent and reduce environmental noise.*

The Government has embarked on a major project to map electronically the main areas and sources of noise across England. It will be followed by detailed analysis of noise effects, options for action, and costs, leading up to a new national policy. As a first step, DEFRA will work in partnership with the Greater London Authority (GLA) and 33 London Borough Authorities to map road traffic noise in Greater London. It will be the most comprehensive survey of traffic noise ever undertaken in London. The sound immission contour mapping (SICM) system will be used to produce computer models based on traffic volumes and to identify hot spots and measures to reduce noise such as traffic management schemes or low noise road surfaces. Later aircraft, trains and industrial sites will be modelled and mapped. Noise maps for the Borough will be made available and this will enable noise exposure categories, to be defined for transportation sources, for day, evening and night periods. Noise maps will indicate the continuous noise due to transportation sources, but will not be able to display the individual events, which make up the overall noise. It will probably not be possible to map the noise exposure for external plant operating at commercial premises and small industrial sites on cost grounds.

APPENDIX 4:
Noise and Nuisance from Building Works

MAJOR NOISE DURING CONSTRUCTION AND DEMOLITION PHASES

Construction and demolition works, audible at the boundary should only be carried on between the hours of 0800 - 1800hrs Mondays to Fridays and 0800 - 1300hrs on Saturdays and at no other time including Sundays and Bank Holidays. The maximum permitted noise level are:

- not greater than 72 dB $L_{Aeq,10hr}$ Mondays to Fridays
- not greater than 72 dB $L_{Aeq,5hr}$ Saturdays

Vibration from demolition, breaking of concrete and piling etc., as measured in the vertical direction on any floor in surrounding noise sensitive buildings, should not exceed an overall peak particle velocity level of 1mm/s.

Prior to commencement of construction and demolition works, details of noise and vibration mitigation measures complying with the best practicable means criteria should be submitted to this section for approval.

Prior to the commencement of any site works, all residential property surrounding the site boundary should be notified in writing of the nature and duration of works to be undertaken, and the name and address of a responsible person, to whom enquiries/complaints should be directed.

Noise and pollution control guidance

The Building Research Establishment has published 5 pollution control guides on the control of particles, vapour and noise from construction sites. These advise on pre-project planning, site preparation, haulage, storage of materials and site operations.

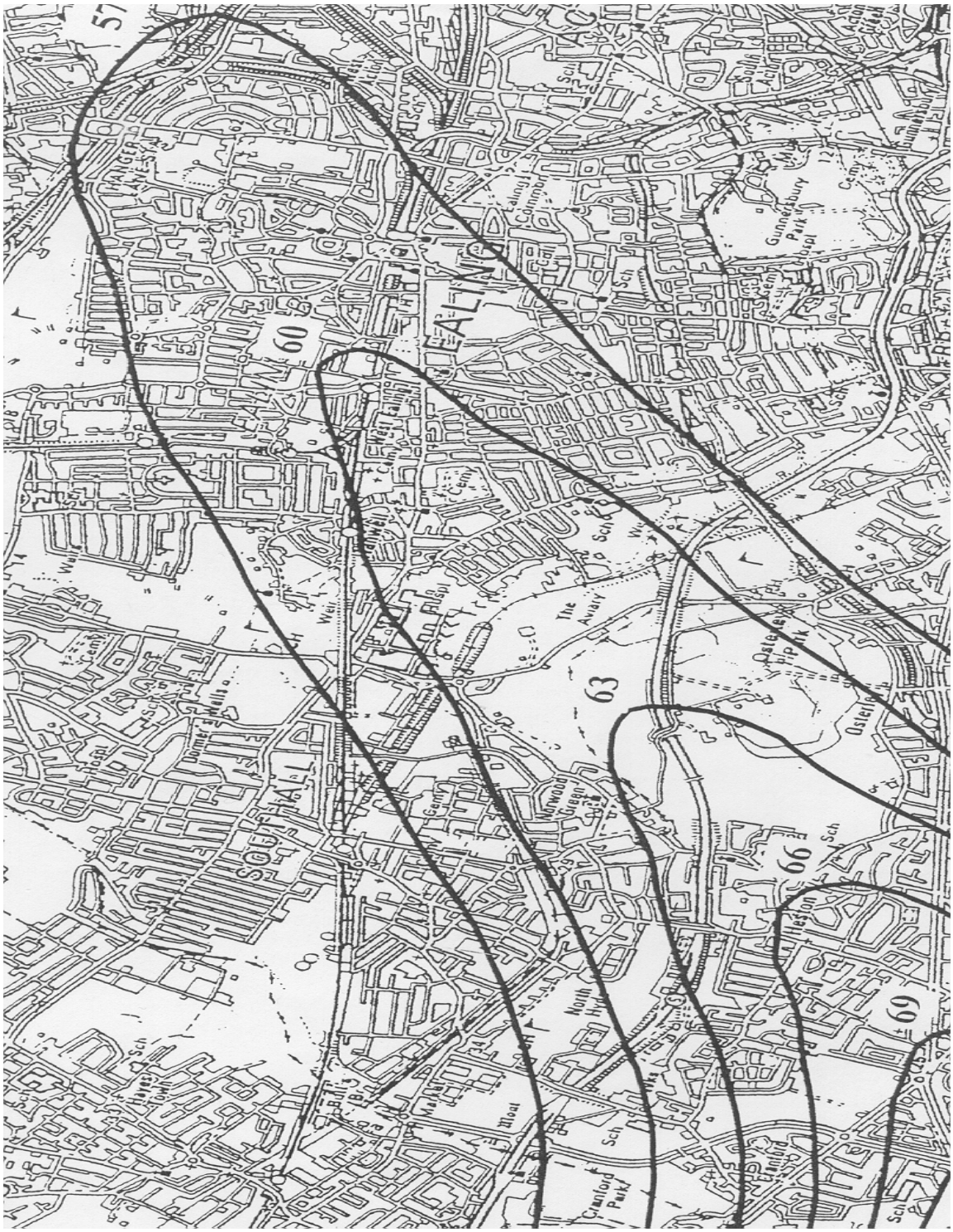
The sections are as follows:
Part 1: pre-project planning and effective management. ISBN1 86081 6541
Part 2: site preparation, demolition, earthworks and landscaping. ISBN 1 86081 655X
Part 3: haulage routes, vehicles and plant. ISBN 1 86081 6568
Part 4: materials handling, storage, stockpiles, spillage and disposal. ISBN 1 86081 6576
Part 5: fabrication processes and internal and external finishes ISBN 1 86081 6584

The guidance is available from the BRE bookshop on 0207 505 6622 email: enquiries@bre.co.uk . The BRE website is www.bre.co.uk.

Detailed guidance is also available in BS 5228: Noise control on construction and open sites, Parts 1 – 4, on the prediction of noise and vibration which will be received at sensitive premises, selection of plant to meet “best practicable means”, methods of reducing noise etc. Copies available from Her Majesty’s Stationary Office.

The advice given is regarded to be best practice and the Council expects developers and contractors to comply with it.

APPENDIX 5:
Aircraft Noise Contours - Forecast 2016 with Five Terminals



Note: see Appendix 3 Note 4.

APPENDIX 6
Noise Barrier Design Guidance and specifications

The following guidance must be achieved, where barriers need to be erected to mitigate against noise transmission.

Appearance and life expectancy of proposed barrier

- Highways Agency, HA 65/94, A Design Guide for Environmental Barriers – guidance on installation with regard to the appearance of the noise barrier in the environment.
- Highways Agency, HA 66/95, Environmental Barriers, Technical Requirements – requirement to build barriers for 20 years low maintenance and a 40 year operational life.

Testing of the airborne sound insulation of the proposed barrier and also sound absorptive performance where appropriate

BSEN 1794 Parts 1, 2 and 3

- Test to be carried out in a nationally accredited laboratory with a sample panel of the proposed barrier, mounted in the window between two adjoining reverberant rooms, the sample to include the post and the exact fixings and sealants to be used on site.
- Detail report to be submitted on the test conditions, fixings, component sizes and densities.
- Not less than category B insulation to be achieved.
- Not less than category A3 absorption to be achieved and A4 where the barrier is high and in a reverberant location.

Additional specifications to be met

Not withstanding the requirement to meet Categories A3, A4 and B3 under BSEN Parts 1 to 3, the following criteria shall also be met for at specific one-third octave bands.

1/3rd Octave Band (Hz)	**Minimum Sound Absorption Coefficient**	**Minimum Sound Reduction Index**
100	0.5	18
125	0.5	18
160	0.7	18
200	0.8	22
250	0.8	22
315	0.9	22
400	0.9	24
500	0.9	27

Performance and safety of barrier under windloading

BSEN 1794 Parts 1

- Test details or calculation to be submitted to demonstrate that the barrier will have satisfactory performance for wind loading, static loading and safety in collision.

Quality and preservations of timber used in barriers

BS 5589: 1989, Sections 1- 6 and Specification of Highway Works Volume 1, Sections 304, 310 and 311

- Timber quality and preservation to comply with advice at these standards.

Thickness and density of panels and cover strips used in timber barriers

In order to achieve the standards and criteria specified above, it is likely that the timber elements of the proposed barrier will need to be constructed as follows:

Spruce

- *Abutting panels not less than 30 mm thick, with joints sealed by cover strips not less than 30 mm thick, and the strip extending not less than 25 % over adjacent panels.*
- *Tongued and grooved panels to be not less than 35mm.*

Douglas Fir

- *Abutting panels not less than 22 mm thick, with joints sealed by cover strips not less than 22 mm thick, and the strip extending not less than 25 % over adjacent panels.*
- *Tongued and grooved panels to be not less than 27mm.*

APPENDIX 7
Current Standards & References

(1) D.O.E. PPG 24, 1994: Planning Policy Guidance, Planning and Noise.

(2) Department of Transport, Calculation of Road Traffic Noise 1988.

(3) Department of Transport, Calculation of Railway Noise 1995

(4) Department of Transport, Railway Noise and Insulation of Dwellings 1991.

(5) BS 4142: 1997, Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.

(6) BS 7385: Part 1: 1990, ISO 4866: 1990, Evaluation and measurement for vibration in buildings.

(7) BS 6472: 1992: Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)

(8) Appendix A, BRE/CIRIA, Sound Control for Homes, 1993 - worked examples for sound insulation calculations.

(9) BS 8233: 1999: Sound insulation and noise reduction for buildings; Code of practice - worked examples for sound insulation calculations.

(10) Minerals Planning Guidance, MPG 11: The Control of Noise at Surface Mineral Workings, Department of the Environment, HMSO, 1993.

(11) Code of Practice on Environmental Noise Control at Concerts : 1995

(12) In Situ Sound Intensity Technique For Determining Sound Transmission Through Barriers, GR Watts, Transport Research Laboratory, Crowthorne, UK.

(13) The Use of High Performance Noise Barriers in the United Kingdom, JR Johnson & BM Fitzgerald, Environmental Noise Barrier Association.

(14) Stirling JR and Craik RJM, “Amplified Music as a Noise Nuisance”, Proceedings of the Institute of Acoustics, Volume 8, Part 4, 1986

(15) PPG 24 – Planning and Noise, Rupert Thornely-Taylor, IOA Acoustics Bulletin March/April 1998.

(16) DFES Building Bulletin 1993, “Acoustic Design of Schools”

(17) The Management of Sound from Public Houses, Clubs and other Indoor Venues, Proceedings of Institute of Acoustics, Vol19 Part 2 (1997)

(18) Archives for the Centre of Sensory Research Volume 2, Issue 1, 1995, Communicating Noise edited by Birgitte Berghand and Thomas Landwall WHO.

(19) BSEN 1793 – 1: 1998, Road Traffic Noise and reducing devices – Test Method for determining the acoustic performance – Part 1, Intrinsic characteristics of sound

absorption – Part 2, Intrinsic characteristics of airborne sound insulation, Part 3, Normalised Traffic Noise Spectrum

(20) BSEN 1794 – 1: 1998, Road traffic noise reducing devices – non acoustic performance – Part 1: Mechanical Performance and stability requirements.

(21) BS 5228 : Noise control on construction and open sites, Parts 1 – 4

(22) Institute of Acoustics, March 2003, Good Practice Guide on the Control of Noise from Pubs and Clubs.

(23) Bronner, N., and Leventhall, H. G. (1983): Low frequency noise annoyance assessment by Low Frequency Noise Rating (LFNR) Curves. Journal of Low Frequency Noise and Vibration 2, 20 – 28.

Supplementary Guidance, as the title suggests, is to guide development. It is not meant to be definitive, and much of the guidance represents minima which are to be improved on if possible in the interests of good design.

If you would like further advice on this guide, please contact:

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