THE ENGLISH COGGER
partnership

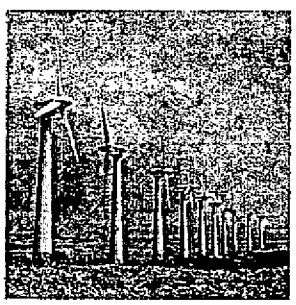
SEAWARD PROPERTIES LTD

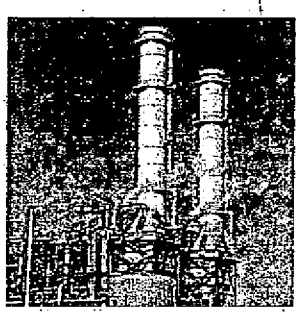
Land off Goodacres, Barnham

Noise and Vibration Assessment

Report No. 01327\R01

ARUN DISTRICT COUNCIL
No. BN 9 10
RECEIVED





consultants in acoustics
and environmental noise

ARUN DISTRICT COUNCIL BN/9/10/

SEAWARD PROPERTIES LTD

Land off Goodacres, Barnham

Noise and Vibration Assessment

Report No. 01327\R01

March 2010

C Heal MEng MIOA

The English Cogger LLP
5 Charlecote Mews
Staple Gardens
Winchester
Hampshire
SO23 8SR

[redacted]

ARUN DISTRICT COUNCIL BN/9/10/

CONTENTS

1 INTRODUCTION 1

2 SITE CONTEXT 1

3 NOISE AND VIBRATION CRITERIA 1

3.1 National Planning Guidance 1

3.2 British Standards and Guidance 2

3.3 Local Policy 4

4 AMBIENT NOISE SURVEY 4

4.1 Instrumentation 4

4.2 Assessment of measured noise levels 5

5 RAILWAY VIBRATION 5

6 ASSESSMENT OF PROPOSED RESIDENTIAL DEVELOPMENT 7

6.1 Mitigation 7

7 SUMMARY AND CONCLUSIONS 8

FIGURES

APPENDIX 1: Definition of noise level parameters

ARUN DISTRICT COUNCIL BN/9/10/

1 INTRODUCTION

Seaward Properties Limited is proposing to develop land off Goodacres, Barnham, West Sussex to provide residential accommodation. The site is adjacent to a mainline railway and The English Cogger Partnership has, therefore, been commissioned to undertake a noise and vibration assessment and to propose a mitigation strategy if necessary.

2 SITE CONTEXT

The site is a triangular plot of land, bounded by residential properties on Haliford Drive to the northwest, a nursery to the east and the West Coastway railway line to the south. The nearest track is approximately 7 m from the site boundary. Access to the site is currently from Goodacres and Barn Rise, off Haliford Drive. It is proposed to develop the land to provide approximately 90 residential dwellings and public open space.

An indicative site plan is shown at Figure 1.

3 NOISE AND VIBRATION CRITERIA

3.1 National Planning Guidance

Guidance on the noise implications of planning proposals is provided in the Department of the Environment (now Communities and Local Government) Planning Policy Guidance Note PPG 24, *Planning and Noise*. This document gives guidance to local authorities on the use of planning powers to minimise the adverse impact of noise and outlines the parameters that should be considered when determining planning applications, either for noise sensitive developments, or for developments that will generate noise.

The overall principle is to ensure a balance between noise sensitive and noise generating developments and to consider the use of planning conditions and appropriate mitigation measures to control the source of, or limit the exposure to, noise. Various types of noise are considered in PPG 24, including transportation noise, noise from industrial or commercial developments and recreational activities.

Where sites for new residential development are affected by transportation noise, or noise from mixed sources (defined as any combination of road, rail, air and industrial noise sources, where no individual source is dominant), Noise Exposure Categories (NECs) and associated planning advice are provided to assist in the determination of the suitability of the site. The NECs for rail traffic noise and the associated planning advice relevant to the site are reproduced below, for reference:

ARUN DISTRICT COUNCIL BN/9/10/

Noise levels[0] corresponding to the Noise Exposure Categories for new dwellings, $L_{Aeq,T}$ dB				
Noise source	**Noise Exposure Category**			
	A	**B**	**C**	**D**
Rail traffic				
07:00-23:00	< 55	55 – 66	66 – 74	> 74
23:00-07:00[1]	< 45	45 – 59	59 – 66	> 66

0 Noise levels: the noise levels used when deciding the NEC of a site should be representative of typical conditions.

1 Night-time noise levels (23:00-07:00): sites where individual noise events regularly exceed 82 dB L_{Amax} (S time weighting) several times in any one hour should be treated as being in NEC C regardless of the $L_{Aeq,\,8h}$ (except where the $L_{Aeq,\,8h}$ already puts the site in NEC D).

The interpretation of these NECs, in terms of the granting of planning permission, is shown below:

NEC	Planning advice
A	Noise should 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	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	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	Planning permission should normally be refused.

Whilst the level of protection against noise for NECs B and C is not specifically defined in PPG 24, reference can be made to the appropriate British Standards and other guidance for criteria.

3.2 British Standards and Guidance

3.2.1 Airborne noise

The British Standard BS 8233: 1999, *Sound insulation and noise reduction for buildings – Code of Practice* provides criteria for noise levels in the built environment, those for residential development being based on the recommendations of the World Health Organisation. The criteria for unoccupied spaces within residential properties are tabulated below, for reference:

ARUN DISTRICT COUNCIL BN/9/10/

Criterion	Typical situation	Design range, L_{Aeq} dB	
		Good	Reasonable
Reasonable conditions for sleeping and resting	Living rooms	30	40
	Bedrooms	30	35
For a reasonable standard in bedrooms at night, individual noise events (measured with the F time-weighting) should not normally exceed 45 dB L_{Amax}			

The Standard also states that:

In gardens and balconies etc, it is desirable that the steady noise level does not exceed 50 dB $L_{Aeq,T}$ and 55 dB $L_{Aeq,T}$ should be regarded as the upper limit.

Recommendations for mitigation to enable these targets to be achieved are provided in the Standard, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

3.2.2 Vibration

Where a site is affected by noise from railways, PPG 24 refers to the criteria given in BS 6472: 1992. Since PPG 24 was published, this standard has been replaced by BS 6472-1: 2008, *Guide to evaluation of human exposure to vibration in buildings, Part 1: Vibration sources other than blasting*. BS 6472 gives guidance on the magnitudes of vibration at which adverse comment may begin to arise, taking account of the time of day and the use of the space. The basis for the criteria is the threshold of perceptibility and a baseline frequency curve for each orthogonal axis is defined. Complaints would not be expected to occur if vibration is at the threshold of perceptibility and limits for the probability of adverse comment for residential buildings during the day are specified. At night, the tolerance thresholds are approximately half of the value of the daytime limits. Where vibration events are intermittent, such as those due to train pass-bys, a vibration dose value (VDV) that takes account of the magnitude, duration and frequency of occurrence can be calculated. The VDVs above which there is a likelihood of adverse comment in residential accommodation are reproduced in the table below:

Period	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
16 hour daytime	0.2 – 0.4 $m/s^{1.75}$	0.4 – 0.8 $m/s^{1.75}$	0.8 – 1.6 $m/s^{1.75}$
8 hour night-time	0.13 $m/s^{1.75}$	0.26 $m/s^{1.75}$	0.51 $m/s^{1.75}$

3.2.3 Re-radiated noise

Whilst nationally recognised criteria for re-radiated noise from railways and other sources have not been established, an overall limit on maximum noise levels of 45 dB L_{Amax} in bedrooms at night has been recommended by the World Health Organisation and incorporated in the British Standard BS 8233: 1999, as discussed above.

ARUN DISTRICT COUNCIL BN/9/10/

3.3 Local Policy

The current development plan is made up from retained policy in the Chichester District Council Local Plan adopted in April 1999 and the South East Plan. In retained housing policy H3 it is stated:

> *"Proximity to hazardous sites or areas affected by serious noise, vibration or other pollution will not be permitted. In exceptional circumstances such development may be permitted where satisfactory and appropriate remedial measures are taken. Adequate standards of internal noise insulation will also be required where residential uses are created or intensified."*

In practice, the criteria for assessing whether 'sites or areas are affected by serious noise' or vibration will be based on the guidance given in PPG 24, which refers to BS 8233 for specific recommendations on noise levels in the built environment, and BS 6472 for sites affected by railway vibration.

4 AMBIENT NOISE SURVEY

An environmental noise survey has been undertaken at the site to determine the PPG 24 NECs discussed in section 3, above. Ambient and statistical noise levels were monitored continuously in 5-minute periods between 17 and 19 March 2010 at two locations at 7 m from the nearest railway track on the southern boundary and at 65 m from the southern boundary. The microphones were placed at a height of 1.5 m above ground. A time history of noise levels in 5-second periods was also measured with the sound level meter at 65 m to identify individual train movements.

The weather during this period was calm with a light southerly wind of generally less than 2 m/s. There was, however rainfall between 2100 on 18 March and 0100 on 19 March and from 1300 on 19 March. The rainfall is unlikely to have affected noise levels from the railway, but will have increased the background noise levels between these periods.

The measured noise levels are shown in Figures 2 to 4 at the end of this report and an explanation of the acoustic terminology used in the survey assessment is provided in Appendix 1.

4.1 Instrumentation

At the southern boundary, noise levels were measured using a Rion sound level meter, type NL-32 (serial number 002406670), with a Rion type NX-22J Sound Monitor Card installed (serial number 00630553, version 2.1) and a Rion type UC-53A ½-inch free field microphone (serial number 305924) and a Rion type NH-21 pre-amplifier (serial number 10711) fitted. The microphone was fitted with a windshield during the measurements. The sound level meter, microphone and preamplifier were last calibrated in a calibration laboratory on 12-13 November 2008 and calibration and conformance certificates are available.

ARUN DISTRICT COUNCIL BN/9/10/

At 65 m from the boundary, noise levels were measured using a Larson Davis type 824 Precision Sound Level Meter and Real Time Analyser (serial number 824A 1344), fitted with a Larson Davis type 2541 ½-inch free field microphone (serial number 4418) and Larson Davis type PRM 902 preamplifier (serial number 3544). The microphone was fitted with a windshield during the measurements. The sound level meter, microphone and preamplifier were last calibrated in a calibration laboratory on 7-9 June 2008. Calibration and conformance certificates are available.

Prior to and on completion of the survey, the calibration of the sound level meters and microphones was checked using a Rion type NC-74 Sound Level Meter Calibrator (serial number 00830811). The Calibrator was last calibrated on 15 November 2008, in accordance with the requirements of ISO 10012 and a calibration and conformance certificate is available. No change in the calibration level occurred during the survey.

4.2 Assessment of measured noise levels

The overall 16-hour daytime and 8 hour night-time noise levels, which are used to derive the NEC's, have been calculated from the measured data and are shown in the table below.

Location	Daytime noise level, dB $L_{Aeq,\ 16\ hour}$	Night-time noise level, dB $L_{Aeq,\ 8\ hour}$	NEC
Southern boundary	58	54	B
65 m from boundary	47	43	A

The maximum noise levels measured during night-time period range between 70 and 80 dB $L_{Amax,\ fast}$ from train pass-bys at on the southern boundary and between 51 and 60 dB $L_{Amax,\ fast}$ at 65 m from boundary. These are below the level at which the site should be treated as NEC C regardless of the 8-hour L_{Aeq}.

From the above it is calculated that the boundary between NEC A and B occurs at approximately 50 m from the nearest railway track by allowing for attenuation with distance from a line source.

It can be seen that the southern part of the site is in NEC B, and the guidance provided for residential development in this category is that *'Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise'.*

5 RAILWAY VIBRATION

Vibration measurements were taken during train pass-bys at distances of 1 m and 5 m from the southern boundary using an accelerometer fixed magnetically to a ground spike forced into the ground. The measurements were taken for periods of 10-12 seconds for eight trains at each distance.

ARUN DISTRICT COUNCIL BN/9/10/

5.1.1 Instrumentation

Vibration was measured using a Larson Davis type 2900B Dual Channel Real Time Analyser (serial number 0927), fitted with a PCB Piezotronics model 353M198 ICP accelerometer (serial number P65520) and Larson Davis model PRA950-L2 ICP power supply (serial number 0333). The analyser was last calibrated in a calibration laboratory on 14-16 October 2008 and calibration certificates are available. The accelerometer was last calibrated on 15 September 2000 and a calibration certificate is available.

5.1.2 Vibration Assessment

The vibration levels have been assessed in accordance with the methodology specified in BS 6472-1: 2008, to determine the estimated vibration dose value (eVDV $m/s^{1.75}$). The average acceleration level for train pass-bys at a distance of 1 m from the boundary was approximately 0.003 m/s^2 and at 5 m from the boundary was only just measurable above the background vibration of 0.0025 m/s^2. The low levels are attributable to the relatively low trains speeds as all trains stop at Barnham and they are predominantly electric trains. The numbers of events occurring during a 16-hour day and an 8-hour night have been identified from the timetable and from the time history of measured noise levels. There are approximately 240 timetabled movements during the day and 50 timetabled movements at night. The exposure values for the daytime and night-time vibration exposure levels are calculated from these movements to be 0.03 $m/s^{1.75}$ and 0.02 $m/s^{1.75}$ respectively. Values for vibration are, therefore, well below the range for which there is a low probability for adverse comment, for both day and night-time periods.

5.1.3 Structureborne Noise

The measured vibration levels have been used to estimate structureborne noise levels, using the methodology outlined in the Association of Noise Consultants publication *Measurement & Assessment of Groundborne Noise & Vibration* (Fresco, 2001). Account has been taken of losses in energy at the interface between the building foundations and the ground and losses in the building structure itself for a 2-storey masonry construction.

These calculations indicate that the maximum structureborne noise levels within a building at 1 m from the boundary wound be approximately 44 dB L_{Amax} and at 5 m from the boundary would be approximately 36 dB L_{Amax}. These values are less than the criterion set out in Section 3.2.1.

It should be noted that the calculation method is not precise and can only provide an estimate of re-radiated structureborne noise levels, but is considered to be conservative. The assessment indicates that there is unlikely to be a risk of structureborne noise problems.

ARUN DISTRICT COUNCIL BN/9/10/

6 ASSESSMENT OF PROPOSED RESIDENTIAL DEVELOPMENT

The nearest residential properties in the proposed development are approximately 20 m from nearest railway track (14 m from the boundary) as shown in the indicative layout shown at Figure 1. The daytime and night-time noise levels at the nearest properties have been calculated to be 53 dB $L_{Aeq,\ 16\ hour}$ and 49 dB $L_{Aeq,\ 8\ hour}$ by allowing for distance attenuation from a line source. The maximum noise levels at night at the nearest properties have been calculated to be between 61 and 71 dB $L_{Amax,\ fast}$ during train pass-bys.

Criteria for reasonable internal noise levels are given in BS 8233 and reproduced in section 3.2.1. Where façades are directly exposed to noise from the railway, internal noise levels can be assumed to be 10-15 dB lower than these external noise levels, using the attenuation of a façade with a window partially opened for natural ventilation given in Annex 6 of PPG 24, or Table 10 of section 8.4.7 of BS 8233. Internal noise levels would therefore be approximately 38-43 dB $L_{Aeq,\ 16\ hour}$ during the day and 34-39 dB $L_{Aeq,\ 8\ hour}$ at night. Maximum internal noise levels at night would be approximately 46-61 dB $L_{Amax,\ fast}$. The internal noise levels at night in the nearest properties to the railway would, therefore, exceed the criteria for reasonable sleeping and resting conditions with partially open windows and mitigation would be appropriate.

The criterion for gardens and other outdoor spaces given in BS 8233 would generally be met, except within approximately 5 m of the southern boundary.

6.1 Mitigation

An appropriate mitigation strategy would enable the criteria for internal noise levels given in BS 8233 to be met in the properties close to the railway, and could incorporate one or more of the following strategies in the development:

a) site and building layouts that reduce exposure to noise;

b) additional screening;

c) sound insulation of the building envelope.

It is noted that the buildings in the southern part of the site will provide additional screening to the properties further to the north and that the nearest properties are orientated at 90 degrees to the railway, which will marginally reduce the exposure of railway noise in these properties.

Additional screening along the southern boundary would improve noise levels at ground level and in gardens and may therefore be considered, however daytime noise levels are generally within the specified criteria. It is also noted, that a practicable barrier is unlikely to provide sufficient attenuation of maximum noise levels during train pass-bys at night at first floor level and above in the nearest residential properties. A very tall barrier on the southern boundary would also block a considerable amount of light to gardens and properties.

ARUN DISTRICT COUNCIL BN/9/10/

It is therefore considered that the most appropriate mitigation option is improving the sound insulation of the building envelope to ensure that the internal noise levels set out in BS 8223 are met in the most exposed façades by allowing windows to be kept closed. The weakest element in the façades will be the windows, which would need to remain closed to achieve the sound reduction necessary. In order to achieve the internal noise levels specified in BS 8233, windows would need to be kept closed in the south, west and east façades of properties within 40 m of the southern boundary. The maximum noise attenuation required at the nearest properties is approximately 26 dB(A), which is within the level that would be provided by standard double glazed windows.

Rooms would then require an acoustically rated ventilation system as an alternative to opening windows for natural ventilation. The ventilation system should be selected to be compatible with the requirements of Parts F and L of the Building Regulations as well as being designed to ensure that the desired internal noise levels are met. Proprietary acoustic ventilation systems, comprising passive vents for trickle ventilation, or a combination of passive supply and mechanical extract (which can also be used to ventilate bathrooms and kitchens), that maintain the sound insulation requirements of the building envelope are available. Whole house ventilation systems with heat recovery can provide effective ventilation while maintaining the sound reduction required. The supply and extract elements of this type of system should be designed and located such that road traffic noise levels breaking in through the system are controlled to meet the limits specified for the rooms.

7 SUMMARY AND CONCLUSIONS

A noise survey has been carried out at a site off Goodacres, Barnham. The survey shows that the most of the site falls into PPG 24 NEC A, for which noise need not be a determining factor when considering planning permission, however, the land within approximately 50 m of the railway line to the south is in NEC B and is adversely affected by railway noise. A mitigation strategy comprising an attenuated alternative ventilation system, in order that windows can be kept closed, has been recommended. With this provision, it is considered that the proposal will meet the requirements of national guidance and local development policy.

ARUN DISTRICT COUNCIL BN/9/10/

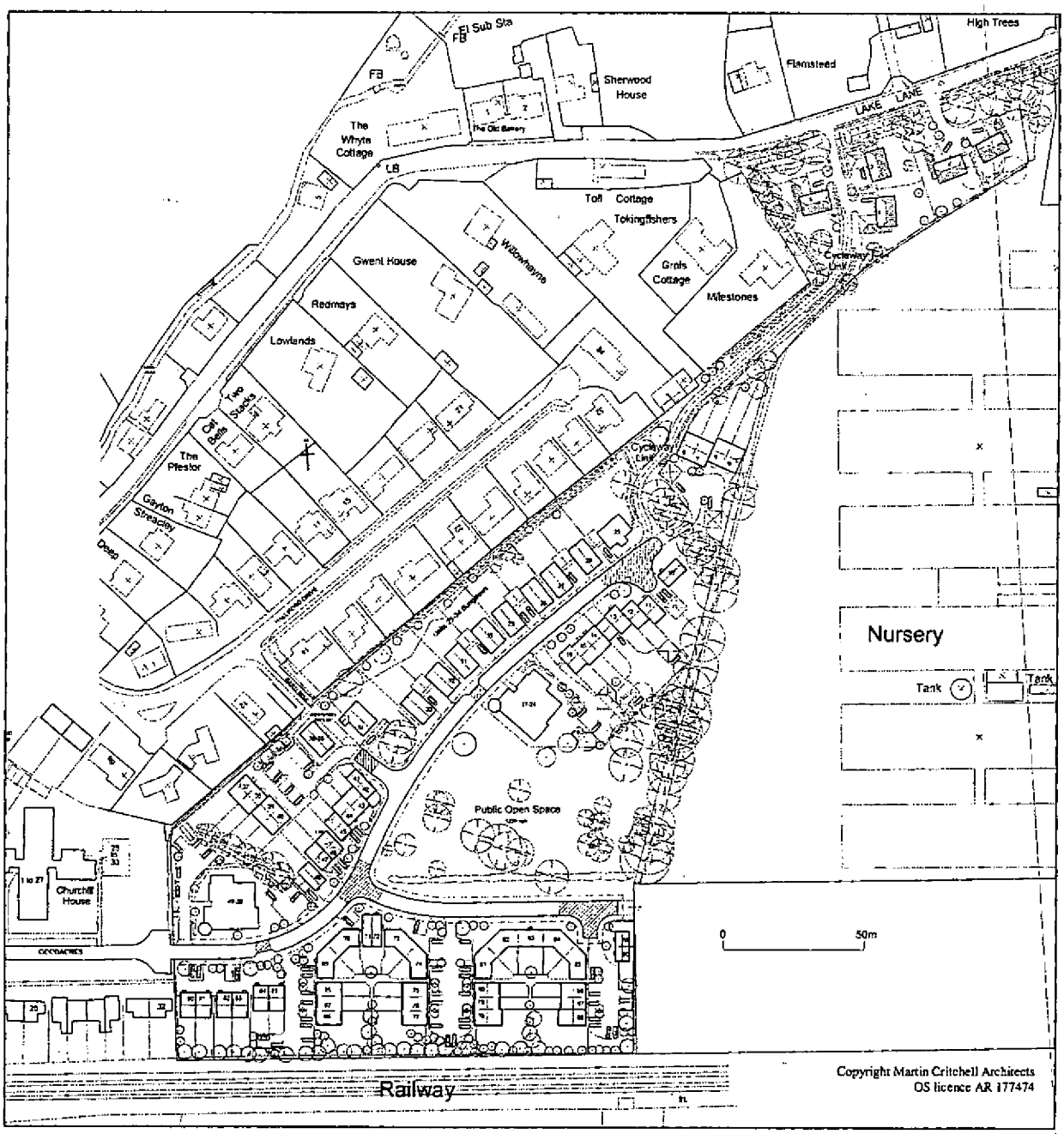


Figure 1: Site plan showing indicative layout

ARUN DISTRICT COUNCIL BN/9/10/

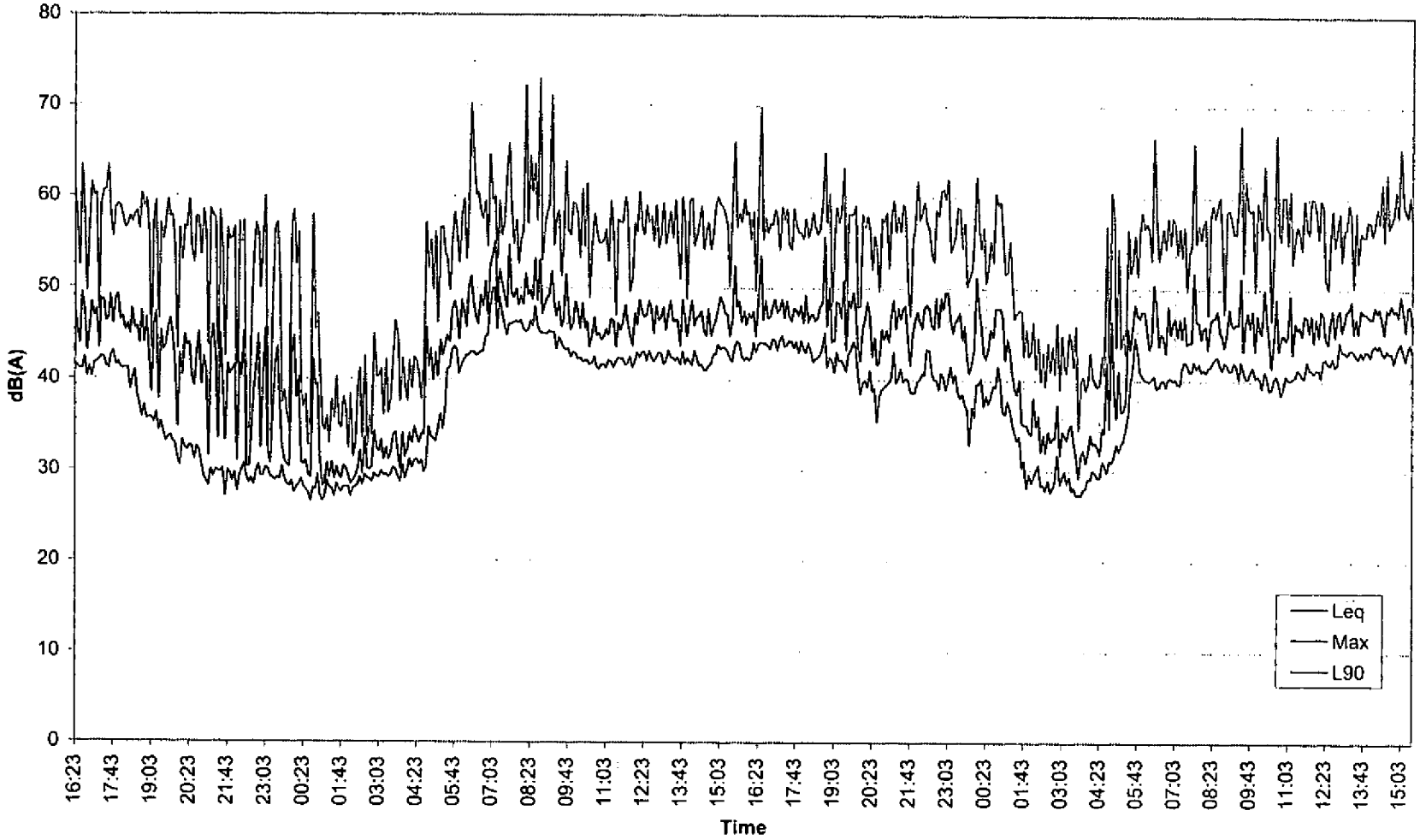


Figure 2: Measured noise levels at 70 m from railway

ARUN DISTRICT COUNCIL BN/9/10/

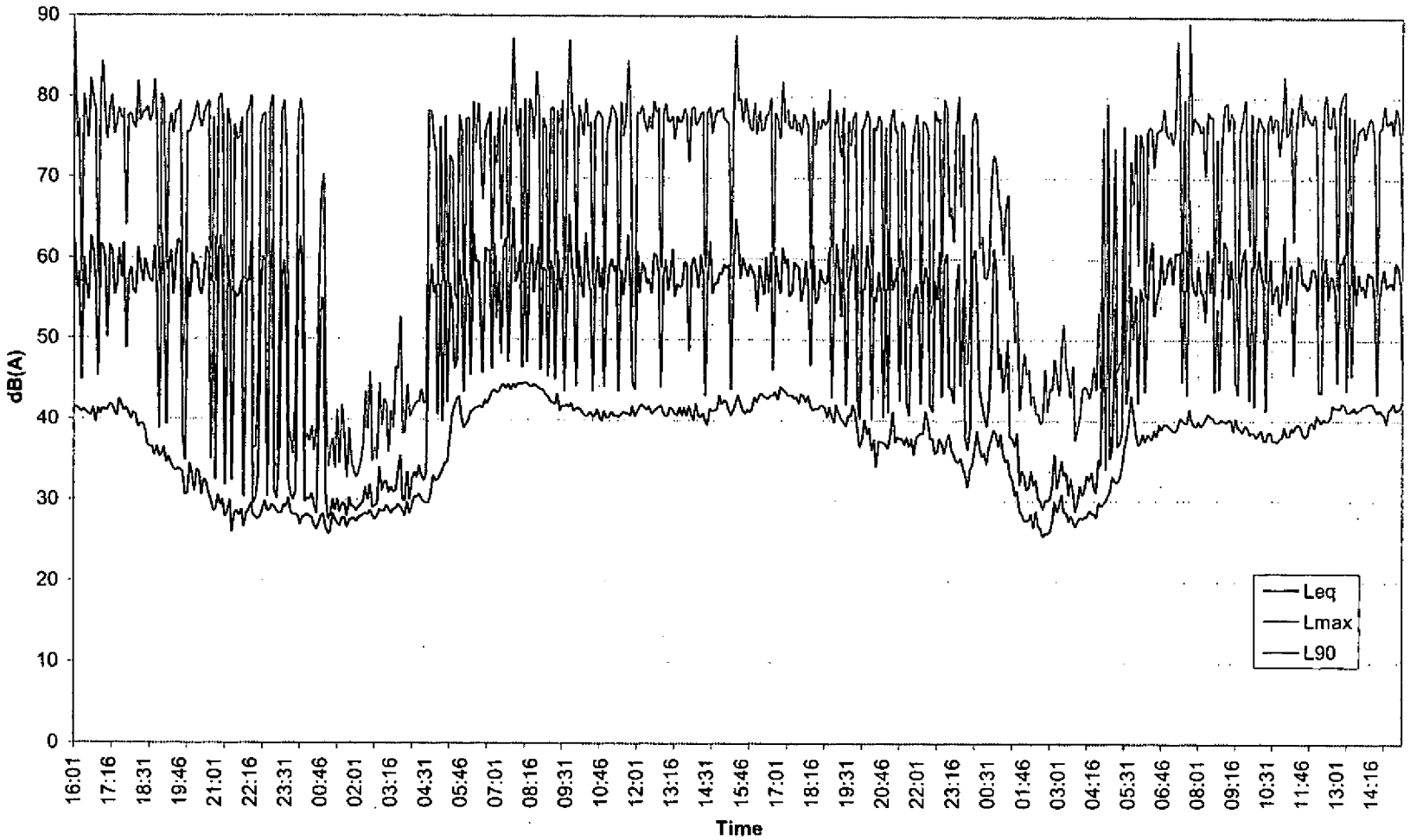


Figure 3: Measured noise levels at 7 m from railway

ARUN DISTRICT COUNCIL BN/9/10/

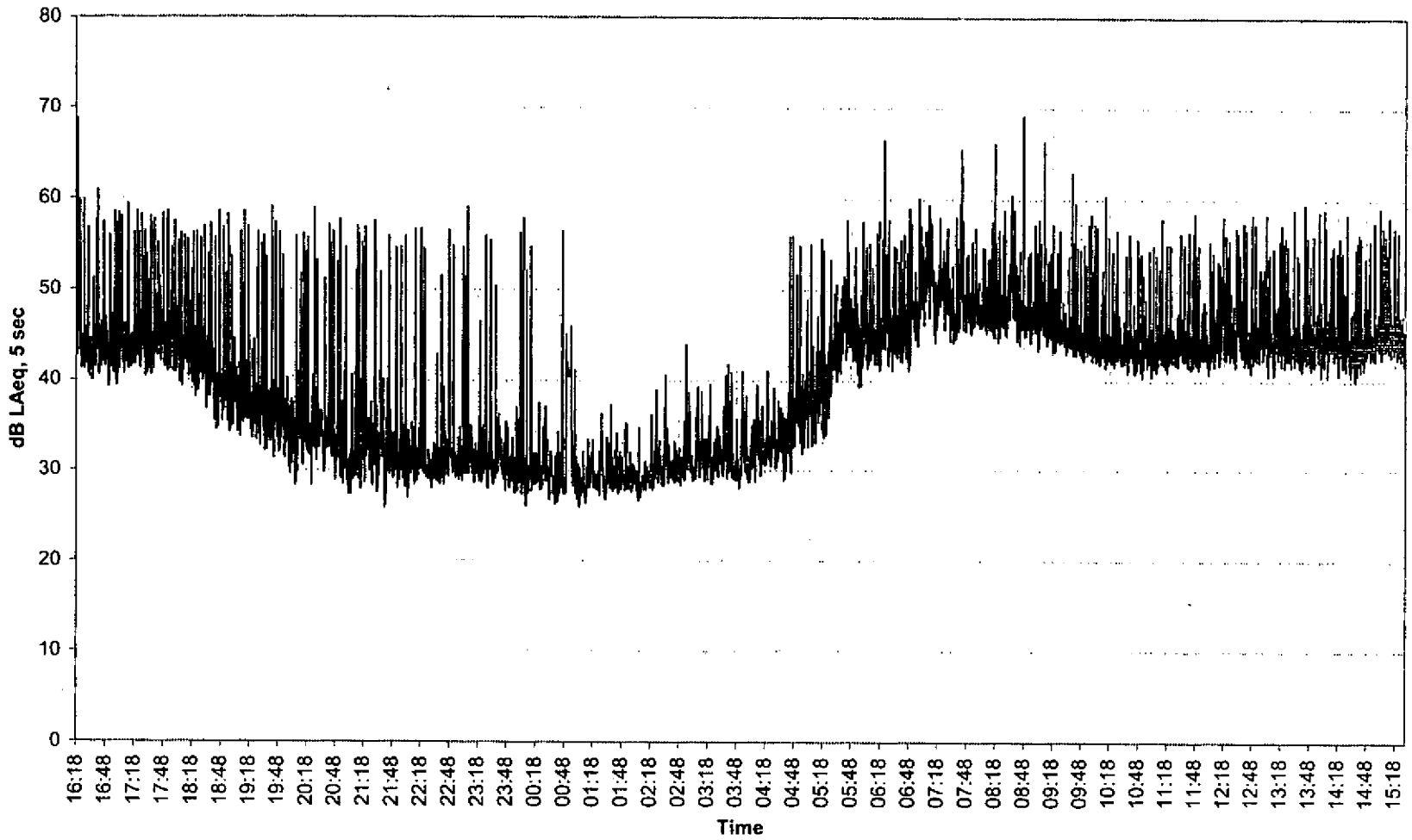


Figure 4: Time history of measured noise levels at 7 m from railway between 17 and 18 March 2010

ARUN DISTRICT COUNCIL BN/9/10/

APPENDIX 1

Definition of Noise Level Parameters

Definition of Noise Level Parameters

Environmental noise is normally described in terms of the single figure A-weighted sound pressure level, in decibels (dB). The A-weighting corresponds to the frequency sensitivity of the ear and, therefore, provides an approximation to the subjective response to sound at different frequencies. When a sound level is expressed in this way, the units can be denoted dB(A).

When sound is time varying, it is convenient to express the sound level using an indicator, or descriptor that takes account of this variation. Two types of indicator are in common use, the equivalent continuous sound level and the statistical indicators.

Equivalent continuous sound level

This indicator provides the overall noise exposure to time varying sound and is the energy average of the sound over a specified time period. It is the notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound over the same period. It is denoted $L_{eq,\,T}$, or, if A-weighted, $L_{Aeq,\,T}$, where T is the time period of interest.

Statistical indicators

The statistical indicators are also single figure descriptors, but provide additional information on the temporal variation of the noise level with time. The indicators are expressed as the sound level exceeded for a specified percentage of the time period of interest and the most commonly used are described below:

$L_{A90,\,T}$: the A-weighted noise level exceeded for 90% of the time period T. This indicator is representative of the noise level occurring in the absence of short-term events and is used in the UK to represent the background noise level.

$L_{A10,\,T}$: the A-weighted noise level exceeded for 10% of the time period T. This indicator is used in the UK to define traffic noise, although in PPG 24 the $L_{Aeq,\,T}$ is used. For freely flowing continuous traffic, the $L_{Aeq,}$ T is approximately 3 dB lower than the $L_{A10,\,T}$.

$L_{A1,\,T}$: the A-weighted noise level exceeded for 1% of the time period T. This indicator is representative of any short-term peaks that occur in the time period.

$L_{Amax,\,T}$: the maximum A-weighted noise level that occurred during the time period T. It usually includes an additional subscript, slow (s) or fast (f), ie $L_{Amax,\,slow,\,T}$ or $L_{Amax,\,fast,\,T}$ which denotes the response time used in the analysis algorithm. The fast response tracks the maximum level of a rapidly changing sound more accurately than the slow response and the value is generally higher for impulsive or transient sounds.

$L_{Amin,\,T}$: the minimum A-weighted sound level occurring in the time period T, expressed in a similar way to the $L_{Amax,\,T}$.

ARUN DISTRICT COUNCIL BN/9/10/