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Noise & Vibration Assessment for
Proposed Residential Development

at

Former Speedway Stadium
Station Road
Long Eaton
Nottingham

for

Davidsons Developments Ltd

Report No. R09.1725/DRK
Date: 4th December 2009

Consultant: D.R. Kettlewell MSc MIOA MAE I.Eng

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**NOISE & VIBRATION ASSESSMENT:
PROPOSED RESIDENTIAL DEVELOPMENT**

AT

**FORMER SPEEDWAY STADIUM
STATION ROAD
LONG EATON
NOTTINGHAM**

Report prepared by:

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On behalf of:

DAVIDSONS DEVELOPMENTS LTD

**Report undertaken & checked by:
D R Kettlewell MSc MIOA MAE I.Eng – Principal Consultant:**

Date: 4th December 2009

SUMMARY

1. The location for the proposed residential development is situated on land formerly known as Long Eaton Speedway Stadium off Station Road in Long Eaton, Nottinghamshire. The stadium site has been cleared and is currently vacant.
2. The land area is adjacent to Nottingham Road to the north and Station Road to the south. Adjacent to the western boundary is Springfield Avenue, which connects Station Road to an industrial park. Running parallel with Springfield Avenue, at a distance of approximately 20 metres, is an elevated section of railway line. The southern boundary is adjacent to existing residential properties, to the east is Grange Primary School and to the northeast a public house.
3. The nearest industrial activity relates to the Stadium Industrial Park units, which are located along the north-to-north western boundary.
4. The landform is generally flat across the site with existing earth embankments towards the centre of the land area. The noise climate is generally formed by local and distant road traffic noise; intermittent goods train noise and low-level distant sound from children playing at school.
5. Noise associated with the industrial unit related in general to local vehicle movements and deliveries. There was no significant general or impact noise audible from the industrial park during the survey.

Consultation:

6. We have contacted the Local Environmental Health Officer at Erewash Borough Council to obtain advice on appropriate noise criteria for this type of development and any comments regarding the site. It was agreed that the relevant noise criteria for the assessment of noise would relate to the following:
 - a) PPG24: 1994 'Noise and Planning' for transportation noise assessment.
 - b) For industrial noise assessment BS4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas.'
 - c) For internal noise for living rooms and bedrooms reference to World Health Organisation criteria (1999) 'Guidelines for Community Noise' and BS8233: 1999 'Sound Insulation and noise reduction for buildings – Code of Practice'.

Vibration criteria would relate to the following standards:

- d) For vibration relating to nuisance criteria we would refer to BS6472-1: 2008 'Guide to evaluation of human exposure to vibration in buildings'.
7. To provide adequate information for the Local Authority, we have undertaken the following assessment in respect of noise and vibration:
- (a) Undertake 24 hour manned noise survey at the site at four fixed monitoring positions.
 - (b) Undertake a 24-hour vibration survey at the nearest site boundary to the railway line.
 - (c) Measure background noise at the site away from the influence of the industrial noise source.
 - (d) Assess the impact of industrial noise during the operational period at the nearest private garden areas.
 - (e) Assess the impact of transportation noise during the daytime and night-time period on external garden areas and internal room noise levels of proposed dwellings.
 - (f) Assess the impact of vibration on the proposed residential areas in terms of train and road vehicle movements.
 - (g) Where appropriate, provide recommendations for noise and vibration control to reduce any impact to an acceptable level.

Existing Noise Climate:

8. The results of the investigations into the existing noise climate have established the following:

In accordance with PPG24 planning guidance, the existing noise levels at the proposed site are shown to generally fall within noise exposure category NEC 'A' or 'B'.

Category A: *"for proposals in this category noise need not be considered as a determining factor in granting planning permissions, although the noise level at the high end of the category should not be regarded as desirable."*

Category B: *"for proposals in this category noise should be taken into account when determining planning applications and, where appropriate conditions imposed to ensure an adequate level of protection against noise."*

The only area that falls within NEC 'C', relates to land area within approximately 25 metres of Nottingham Road at the northern boundary.

9. In accordance with a BS4142: 1997 assessment, the nearest private garden area to the Stadium Industrial Park is likely to indicate the following:
 - (a) Without further amelioration measures, noise levels at the closest dwellings to the Industrial Park are likely to show that 'complaints are unlikely' in accordance with BS4142: 1997. Measures are proposed which will effectively further reduce industrial noise activities further.

Noise Impact on Existing Residents

10. Construction noise is not deemed to be significant given that noise will vary from day to day, existing road traffic noise dominates the noise climate and 'best practicable means' would be employed during construction work activities in accordance with BS5228. The impact of road traffic noise generated within the site on existing nearby residents is not expected to be significant given the existing background noise levels, locality of the site, and number of dwellings proposed. The access roads onto site would be via junctions off Nottingham Road, Station Road and Springfield Avenue. The traffic movements to and from the site are not expected to produce any significant impact via these access routes.

Amelioration of Noise Impact on Garden Areas at the Development

11. The garden areas in relation to the development have been considered in respect of noise based on the provisional design layout. Overall noise levels from road, rail and industrial noise are generally within NEC 'A' or NEC 'B' range of noise levels (according to PPG24: 1994) where noise control measures need to be considered. In relation to noise associated with these noise sources, control measures have been considered. We have provided recommendations within the report to show how appropriate and reasonable noise criteria could be achieved.

Amelioration of Noise Impact on Habitable Rooms at the Development

12. PPG24 guidance relates to noise levels measured on an open site at a height above ground level of 1.2 to 1.5 metres. The guidance and NEC levels are therefore not specifically applicable to external first floor room positions. Allowing for corrections (where appropriate) for the increase in noise at higher floor levels and reflection from the facade we have calculated the noise levels within proposed living rooms and bedrooms. The calculations are based on the methodology provided within BS8233: 1999 'Sound Insulation & Noise Reduction for Buildings – Code of Practice'.

13. In addition to some limited boundary control screening, we have looked at measures to reduce the noise levels within habitable rooms of the proposed development by introducing appropriate glazing and room ventilation systems. The report provides recommendations for the building construction to ensure that internal noise criteria for living rooms and bedrooms are achieved (based on guidance found within PPG24: 1994 and BS8233: 1999).
14. We conclude from our detailed analysis of the results obtained that suitable measures can be adopted to ameliorate noise to an acceptable level according to the requirements of PPG24 and BS4142: 1997.
15. The results of the study also show that ground borne vibration levels from train activities would be well within acceptable limits as indicated by BS6472-1: 2008 and other damage criteria. At the nearest dwelling position the vibration levels are so low that any adverse comment is not expected.

Expert Opinion

16. Taking into account the results of the noise survey, calculations and example of noise mitigation (as detailed in section 8.0), it is our expert opinion that the resultant noise levels within the dwellings and in private garden areas would meet appropriate and reasonable guidance and noise criteria relevant to the proposed development and would therefore provide an adequate level of protection against noise for potential occupants of the dwellings.

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1.0 INTRODUCTION

- 1.1 At the request of Davidsons Developments Ltd, Noise & Vibration Consultants ("NVC") Limited were commissioned to undertake an assessment of noise and vibration sources at the proposed residential development on land off Station Road in Long Eaton. This was to include an assessment of transportation noise, industrial noise and vibration associated with the railway line, local road network and the industrial park.
- 1.2 The report is being provided to support a proposed planning application for the development of approximately 140 residential dwellings.
- 1.3 The report therefore provides detailed information on the existing noise climate and vibration levels and as appropriate, provides recommendations for amelioration measures to reduce the effect of transportation and industrial noise and vibration on the proposed dwellings to an acceptable level.
- 1.4 This study benefits from a site inspection and noise survey, which was carried out on Thursday 26th to Friday 27th November 2009.

The assessment addresses the following issues:

- a) Provides information on daytime and night-time noise levels at the site.
- b) Provides information on daytime and night-time vibration levels at the nearest site boundary to the railway line.
- c) Provides information on existing background noise levels at the site away from the influence of the industrial noise sources.
- d) Assess the impact of industrial noise during the daytime and night-time period at the nearest private garden areas.
- e) Assess the impact of transportation noise during the daytime on external garden areas and daytime and night-time periods on internal room noise levels of proposed dwellings.
- f) Assess the impact of vibration on the proposed residential areas in terms of train movements.
- g) Where appropriate provide recommendations for noise and vibration control to reduce any impact to an acceptable level.

Sources of Information

- 1.5 Information used in this assessment has been obtained from the following sources:
 - Pegasus provided the provisional layout drawing.
 - Planning Policy Guidance Note PPG24 'Noise and Planning': 1994.
 - BS8233: 1999 Sound Insulation and noise reduction for buildings – Code of Practice.

- BS4142: 1997 Method for rating industrial noise affecting mixed residential and industrial areas.
- World Health Organisation criteria (1999) 'Guidelines for Community Noise'
- BS6472-1: 2008 'Guide to evaluation of human exposure to vibration in buildings'.

- 1.6 The above potential noise impacts are considered in the context of the existing background noise at the site, which is predominantly influenced by intermittent train movements, local and distant road traffic noise.
- 1.7 Appendix A provides details of technical terms within the report described in layman terms for ease of reference. There is also a chart showing typical everyday noise levels to assist in understanding the subjective level of noise in terms of decibels.
- 1.8 Appendix E provides an explanation of vibration terminology and explains the principle behind the propagation of ground borne vibration.

2.0 SITE DESCRIPTION

2.1 Introduction

2.1.1 The location for the proposed residential development is situated on land at Station Road, Long Eaton, Nottinghamshire. The stadium site has been cleared from previous development and is vacant.

2.1.2 The land area is adjacent to Nottingham Road to the north and Station Road to the south. Adjacent to the western boundary is Springfield Avenue, which has an elevated section of railway line approximately 20 metres to the west, parallel with the western boundary. The southern boundary is adjacent to existing residential properties, to the east is Grange Primary School and to the northeast is a public house.

2.1.3 The nearest industrial activity relates to the Stadium Industrial Park units, which are located along the north to northwestern boundary.

2.1.4 The landform is generally flat across the site with existing earth embankments towards the centre of the land area. The noise climate is generally formed by local and distant road traffic noise; intermittent goods train noise and low-level sound of children playing at school.

2.1.5 Noise associated with the industrial unit related in general to local vehicle movements and deliveries. There was no significant general or impact noise audible from the industrial park during the survey.

2.1.6 The nearest proposed dwelling facade to the railway line is likely to be approximately 25 metres distance.

2.1.7 The proposed development includes for the construction of approximately 140 dwellings. See Figure 1 attached of proposed preliminary layout.

2.2 General Environs

2.2.1 The main source of existing noise affecting nearest proposed properties relates to the following (in order of significance):

- (i) Intermittent train movements
- (ii) Movement of traffic along local roads.

2.3 Site Access Road

2.3.1 The proposed access roads onto the development would be via entrances off Nottingham Road, Station Road and Springfield Avenue.

2.4 Site Layout

2.4.1 The report will consider issues relating to the site layout and development design including the following (as appropriate):

- (i) Bedroom and Living Room positions relative to the road, rail and industrial noise sources.
- (ii) Noise amelioration for private garden areas.
- (iii) Suitable glazing and ventilation systems.
- (iv) Control of ground borne vibration.

NOISE ASSESSMENT:

3.0 DISCUSSION OF NOISE LEVEL CRITERIA

3.1 Summary of Criteria

3.1.1 Noise has been defined as sound that is unwanted by the recipient. The effects of noise on the neighbourhood are varied and complicated, including such things as interference with speech communication, disturbance of work, leisure or sleep. A further complicating factor is that in any one neighbourhood some individuals will be more sensitive to noise than others.

3.1.2 In 2000, BRE conducted a national study of environmental noise levels for the Department of the Environment ('The National Noise Incidence Study 2000': DEFRA Feb 2002). The study found that 55 (+/- 3%) of the population of England and Wales live in dwellings exposed to day-time noise levels above the WHO level of 55dB $L_{Aeq,day}$. It also found that 63 (+/- 3%) of the population were exposed above the level of 45dB $L_{Aeq,night}$.

Planning Policy Guidance: Planning and Noise (PPG24)

3.1.3 This document is the replacement for Circular 10/73. It builds on the basic principles established in Circular 10/73 and suggests new mechanisms and guidelines for local planning authorities to adopt.

3.1.4 In particular, it provides guidance in the form of noise exposure categories on planning matters for various noise sources, including mixed sources where road traffic for example and another source(s) (e.g. rail noise) affects a location. This method of rating noise according to the category into which it falls is principally aimed at planning for the introduction of new dwellings into an existing noise affected environment.

3.1.5 PPG24 proposes four noise exposure categories (NECs), A - D, for new noise sensitive residential developments near various types of transport related noise sources. These are:

Category A: for proposals in this category noise need not be considered as a determining factor in granting planning permissions, although the noise level at the high end of the category should not be regarded as desirable.

Category B: for proposals in this category noise should be taken into account when determining planning applications and, where appropriate conditions imposed to ensure an adequate level of protection against noise.

Category C: for proposals in this category 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.

Category D: for proposals in this category planning permission would normally be refused.

3.1.6 The recommended noise exposure categories for new dwellings near existing sources are shown below:

Table 3.1: Noise Exposure Categories (NECs) according to PPG24

Noise Levels ⁰ Corresponding to the Noise Exposure Categories for New Dwellings $L_{Aeq,T}$ dB				
Noise Source	Recommended Exposure Categories for Dwellings - $L_{Aeq, T}$ dB			
	A	B	C	D
Road Traffic (07:00-23:00) (23:00-07:00) ¹	< 55 < 45	55 - 63 45 - 57	63 - 72 57 - 66	> 72 > 66
Rail Traffic (07:00-23:00) (23:00-07:00) ¹	< 55 < 45	55 - 66 45 - 59	66 - 74 59 - 66	> 74 > 66
Air Traffic ² (07:00-23:00) (23:00-07:00)	< 57 < 48	57 - 66 48 - 57	66 - 72 57 - 66	> 72 > 66
Mixed Sources ³ (07:00-23:00) (23:00-07:00)	< 55 < 45	55 - 63 45 - 57	63 - 72 57 - 66	> 72 > 66

⁰ Noise Levels: the noise level (s) ($L_{Aeq,T}$) used when deciding the NEC of a site should be representative of typical conditions.

¹ Night time noise levels (2300-0700 hrs): sites where individual noise events regularly exceed 82dB L_{Amax} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8hr}$ (except where the $L_{Aeq,8hr}$ already puts the site in NEC D).

² Aircraft noise: daytime values accord with the contour values adopted by the Department of Transport which relate to levels measured 1.2m above open ground. For the same amount of noise energy, contour values can be up to 2dB(A) higher than those of other sources because of ground reflection effects.

³ Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The mixed source values are based on the lowest numerical values of the single source limits in the table. The 'mixed source' values should only be used where no individual source is dominant.

3.1.7 In applying these noise exposure categories, it states:

"Traditionally, different indices have been used to describe noise from different sources, and limits have been set over different time periods. This has caused confusion, and a move towards consistency has been made here by expressing all noises of $L_{Aeq, T}$ over the periods 07.00-23.00 or 23.00-07.00."

- 3.1.8 This document gives guidance about acceptable limits at the nearest dwelling of:
<45 $L_{Aeq,8hour}$ at night time (23.00-07.00) and
<55 $L_{Aeq,16hour}$ during the daytime (07.00-23.00)
- 3.1.9 The night-time level of 45dB $L_{Aeq,8 hour}$ is based on achieving an internal noise level of 30-35dB $A_{eq,8 hour}$ with a bedroom window open, which is defined as providing an attenuation of 10-15dB(A) [Ref.: Annex 2 of PPG 24]. On the basis of the explanation of this criterion the daytime noise criterion of 55dB $L_{Aeq,16hour}$ must therefore assume achieving an internal noise level of 40-45dB $L_{Aeq,16hour}$.

Road Noise

- 3.1.10 No guidance is provided in PPG24 on methods to assess increased traffic noise from existing roads that results from traffic generated by new developments. However, any change in noise levels along affected roads would be relevant to subsequent planning applications for new housing.

British Standard (BS) 4142: 1997 'Method for Rating industrial noise affecting mixed residential and industrial areas'

- 3.1.11 *BS4142* is based on the measurement of background noise using L_{A90} noise measurements, which are then compared to source noise levels measured in L_{Aeq} . The differential between the L_{A90} and L_{Aeq} measurements, once any corrections have been applied for source noise tonality, distinct impulses etc., determines the likelihood of complaints. If a differential of + 5dB(A) is resultant, then *BS4142* states that the noise is of marginal significance, if the differential is +10dB(A) then complaints are likely. Any assessment of source noise has to take into account the existing ambient noise level in terms of L_{Aeq} and therefore must be corrected for its influence before applying any further tonal corrections and comparing with background noise data.
- 3.1.12 *BS4142* is used to assess fixed industrial installations and provides an indication of the likelihood of complaints. This standard would therefore only be relevant to noise associated with the Stadium industrial park located north of the site.

- 3.2 Other Noise Criteria

BS8233:1999 'Sound insulation and noise reduction for buildings – Code of Practice'

3.2.1 The British Standard BS8233 provides additional guidance on noise levels within buildings. These are based on the WHO recommendations and the criteria given in *BS8233* for unoccupied spaces within residential properties.

3.2.2 The guidance in section 7 of *BS8233* provides examples of design criteria for different conditions and locations and it states:

"For dwellings, the main criteria are reasonable resting/sleeping conditions in bedrooms and good listening conditions in other rooms. Occupants will usually tolerate higher levels of anonymous noise, such as that from road traffic, than noise from neighbours, which may trigger complex emotional reactions that are disproportionate to the noise level. For simplicity, only anonymous noise is considered in Tables 5 and 6."

The guidance provides "good" and "reasonable" design ranges for anonymous noise sources.

3.2.3 For noise levels inside Living Rooms the range is from 30 to 40 L_{AeqT} and for bedrooms during night-time periods the design range is from 30 to 35 L_{AeqT} (Table 3.3).

Table 3.3: BS8233: 1999 Internal noise level guidance for dwellings

Criterion	Typical Situation	Design Range (L_{Aeq} , dB)	
		Good	Reasonable
Reasonable conditions for sleeping and resting	Living Rooms	30	40
	Bedrooms	30	35

Assessment Guidelines: Road Traffic Noise

3.2.4 From the results of the background noise survey (see Tables 5.1 to 5.3 and Appendix B) and observations at the site, it is clear that the noise climate in and around the vicinity of the proposed development is dominated by local road traffic noise from Station Road and Nottingham Road and occasional train movements to the west.

3.2.5 No guidance is provided in PPG24 on methods to assess increased traffic noise from existing roads that results from traffic generated by new developments. However, any change in noise levels along affected roads would be relevant to subsequent planning applications for new housing.

3.3 Construction Noise Criteria

- 3.3.1 For construction noise PPG 24 draws attention to British Standard BS 5228: 2009. This is an approved code of practice under the Control of Pollution Act and consequently there is a legal requirement for construction noise to be controlled according to the recommendations given in BS 5228. The Standard does not give noise limits for construction sites, but emphasis is placed on ensuring that the best practical means are adopted to control noise on site.

Proposed Design Noise Criteria:

- 3.3.2 To satisfy planning and amenity requirements for this type of development the proposed noise criteria will need to reflect the requirements established within the following relevant standards and guidance:

BS4142: 1997 ['Method for rating industrial noise affecting mixed residential and industrial areas']

- 3.3.3 To meet the requirements of this standard and to prevent the likelihood of complaints, Local Authorities normally require any noise contribution from industrial noise sources to be no greater than +5dB(A) L_{Aeq} above background noise levels (i.e. for daytime activities). This takes into account any noise character correction (e.g. where noise is impulsive, distinct or tonal), which may attract attention.

Planning Policy Guidance Note (PPG24): 1994 'Planning and Noise'

- 3.3.4 This guidance is applicable where residential housing is being introduced into an area containing an existing noise source. The basic requirements established within PPG24 to meet acceptable internal and external noise levels is as follows:

Daytime in gardens (0700-2300 hours) - <55dB(A) $L_{Aeq,16\text{ hours}}$
Daytime in living rooms (0700-2300 hours) - <40dB(A) $L_{Aeq,16\text{ hours}}$
Night-time in bedrooms (2300-0700 hours) - <35dB(A) $L_{Aeq,8\text{ hours}}$

- 3.3.5 To bring in line with BS8233: 1999 the following internal noise criteria is proposed:

Daytime in living rooms (0700-2300 hours) - <35dB(A) $L_{Aeq,16\text{ hours}}$
Night-time in bedrooms (2300-0700 hours) - <30dB(A) $L_{Aeq,8\text{ hours}}$

- 3.3.6 To protect bedroom areas from any potential train movements at night-time and to ensure the restoration of sleep we refer to advice provided within PPG24: 1994, WHO guidance and BS8233: 1999 for achieving a L_{Amax} level of 45dB within bedrooms.

Consultation:

- 3.3.7 We have contacted the Local Environmental Health Officer at Erewash Borough Council to obtain advice on appropriate noise criteria for this type of development and any comments regarding the site. It was agreed that the relevant noise guidance and standards for the assessment of noise would relate to the following:
- a) PPG24: 1994 'Noise and Planning' for transportation noise assessment. It was agreed that a suitable noise level for living rooms would be 35dB(A) $L_{Aeq,16 \text{ hours}}$ and for night-time in bedrooms a level of 30dB(A) $L_{Aeq,8 \text{ hours}}$. For private garden areas a level of 55dB(A) $L_{Aeq,16 \text{ hours}}$ would be appropriate.
 - b) For industrial noise assessment BS4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas.'
 - c) For internal noise for living rooms and bedrooms reference to World Health Organisation criteria (1999) 'Guidelines for Community Noise' and BS8233: 1999 'Sound Insulation and noise reduction for buildings – Code of Practice'. The levels given in a) above, are in accordance with guidance given in BS8233.
 - d) For vibration relating to nuisance criteria we would refer to BS6472-1: 2008 'Guide to evaluation of human exposure to vibration in buildings'.

4.0 SITE NOISE SURVEY

4.1 Instrumentation and Fieldwork Details

Environmental Noise Survey (See Appendix B)

- 4.1.1 To establish the daytime and night-time average levels for the purpose of determining the Noise Exposure Categories (NECs) in accordance with PPG24 guidance, a 24 hour noise survey was undertaken at a number of fixed monitoring positions across the site.

Industrial Noise Survey (See Appendix B)

- 4.1.2 To assess the effect of the industrial site (located northwest of the proposed development boundary) background noise levels were undertaken during the daytime periods (on a spot roaming measurement basis) adjacent to the site but away from the influence of the industrial noise (in accordance with BS4142: 1997). To establish typical site operating noise levels from the existing industrial site, noise monitoring was undertaken at the nearest proposed dwelling facade position. Frequency spectral analysis of any peak noise sources was obtained during the survey for assessment.

Instrumentation:

<i>Manufacturer</i>	<i>Description</i>	<i>Type</i>	<i>Calibration Due date</i>	<i>Serial No.</i>
Cirrus	Integrating sound level meter	831A	Oct 2010	B14325FF
Pulsar	Integrating sound level meter	Model 63	Feb 2010	40196
Pulsar	Integrating sound level meter	Model 30	Feb 2010	T222641
Cirrus	Integrating sound level meter	704B	Oct 2010	B14196F
Norsonic	Precision Real Time Analyser	118	April 2010	31992
Cirrus	Electronic calibrator	CR: 531A	Oct 2010	039042

- 4.1.3 The noise meters used during the survey are precision grade type 1 or 2 meters to IEC 651 standard and accuracy.

Calibration Setting: 94 dB
Meter Setting: Fast Response

Fieldwork Details:

Site: Long Eaton Stadium, Station Road, Long Eaton
Date of test: Thursday 26th – Friday 27th November 2009.
Calibration: Before and After: 94 dB

Survey Description and Procedure:

- 4.1.4 The noise meters were mounted on tripods and fixed to a height of 1.5 metres above ground level, fitted with a wind/rain shield. The meters were calibrated prior to and after measurements to ensure accuracy of results.

Environmental Noise Survey

- 4.1.5 Sound pressure levels were recorded at three fixed positions across the site. This enabled us to establish ambient noise data during a typical weekday. Mr D. R. Kettlewell of Noise & Vibration Consultants Ltd undertook these measurements on the 26th to 27th November 2009.
- 4.1.6 Measurements were recorded over a period of 24 hours at positions shown on Figure 1. Data logging of L_{Aeq} , L_{A10} , L_{A90} and L_{Amax} were recorded at 15-minute intervals.
- 4.1.7 Position 1 was located approximately 15 metres from the corner of Station Road and Springfield Avenue along the southwestern boundary (see Figure 1). Position 2 was located at approximately 5 metres from the northwestern boundary close to the boundary with the Stadium Industrial Park. Position 3 was adjacent to the northern boundary close to Nottingham Road. Position 4 location was adjacent to Station Road towards the centre of the site. Refer to Figure 1 for relative measurement positions.
- 4.1.8 Some additional short term (synchronised) noise monitoring was also undertaken at other locations for information on the variation of noise at other positions across the site. This included measurements of octave band frequency analysis for the purpose of room calculations in accordance with BS8233: 1999.

Industrial Noise Monitoring

Background Noise Monitoring

- 4.1.9 Background noise measurements were taken away from the influence of the industrial area at a position where there was no significant audible noise from the industrial site. This included octave band frequency analysis. These measurements were recorded over a 5 minute periods during daytime. See figure 1 for the monitoring locations.
- 4.1.10 Background noise readings were taken at a height of 1.2m to 1.5m from the ground. Readings of L_{Aeq} , L_{A10} , L_{A90} and L_{Amax} and octave band frequency spectra were recorded at the spot roaming measurement positions.
- 4.1.11 Appendix B attached, details all measurements taken showing the resultant levels at the selected measurement position.

Industrial Noise

- 4.1.12 To establish the influence of the industrial noise, measurements were recorded at the nearest potential dwelling position relative to the industrial noise.

4.1.13 Broadband noise measurements and one third octave band centre frequencies were recorded as required at these positions.

4.1.14 Appendix B attached details all measurements taken showing dB(A) and frequency analysis at the selected measurement positions.

4.2 Calibration

4.2.1 The noise meters were calibrated with the electronic calibrator prior to commencement and on completion of the survey. No significant drift in calibration was observed.

4.3 Meteorological Conditions

4.3.1 Weather details were recorded during the period of the survey and are detailed below:

26th – 27th November 2009

4.3.2 Dry, variable cloud cover with a light southerly wind (1-2m/s). Temperature 5-9deg C.

4.3.3 During the night-time the weather remained dry, clear skies with a light south to south westerly wind and temperature varying between 4-6deg C.

4.3.4 The above climatic conditions were suitable for monitoring environmental noise levels in accordance with advice given in BS7445: 2003 'Description and measurement of environmental noise'

5.0 SURVEY RESULTS AND CALCULATIONS

5.1 Introduction

5.1.1 The results of average measurements taken at the fixed monitoring positions at site are presented below in Tables 5.1 to 5.2 and detailed measurements in Appendix B.

5.1.2 The results of noise measurements taken at other locations on the site are also presented in Table 5.3 and Appendix B.

5.1.3 For calculation of noise levels within the rooms of the proposed dwellings, we have used the methodology given in Tables 3 and 4 of BS 8233: 1999.

5.1.4 Graphs 5.1 to 5.3 show indicative frequency spectra of train movements and road traffic noise.

5.1.5 We have calculated the noise level within ground floor living room and first floor bedrooms to represent the highest likely noise levels.

5.1.6 The results of the noise prediction calculations to the most sensitive internal Living Rooms and Bedroom positions with the recommended double glazing are presented below in Table 5.5 below.

5.1.7 An assessment of industrial noise is provided in Table 5.4 and further assessment at paragraph 5.20.

Noise Survey Results

Table 5.1: Average Noise levels at fixed monitoring positions during Daytime:

Location	Time Period	LAeq dB	LA10 dB	LA90 dB	LAmix dB	NEC
1. Station Rd/Springfield Av	0700-2300	56.5	55.7	46.8	58-93	B
2. Stadium Ind Park	0700-2300	52.1	51.8	46.6	51.4-81.6	A
3 Adj. to Nottm Rd	0700-2300	65.9	68.4	58.3	68.3-84.1	C
4. Station Road	0700-2300	59.1	61.1	48.5	64.4-84.3	B

Table 5.2: Average Noise levels measured at the fixed monitoring positions during Night-time:

Location	Time Period	LAeq dB	LA10 dB	LA90 dB	LAmix dB	NEC
1. Station Rd/Springfield Av	2300-0700	50.6	46.6	40.4	49.2-78.4	B
2. Stadium Ind. Park	2300-0700	49.7	45.7	42.4	46.2-77.9	B
3. Adj to Nottm Rd	2300-0700	58.9	60.2	41.6	68.3-79.4	C
4. Station Road	2300-0700	50.8	50	41.1	44.3-77.9	B

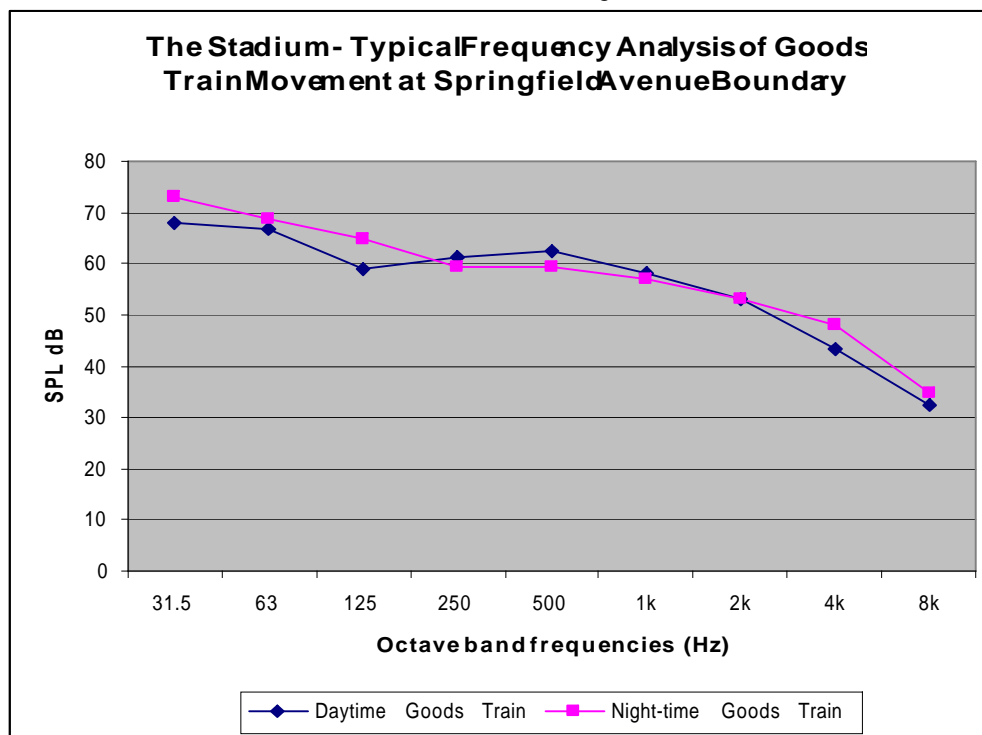
Table 5.3: Spot Roaming Noise Measurements

Position	LAeq (dB)	Equivalent 16hr Av. LAeq (dB)	NEC
5. Site gate	51.7	52.4	A
6. 1m Station Rd	62	60.7	B
7. Adjacent to Primary School	60.4	59.1	B
8. 20m Nottingham Road	58	57	B
9. 40m Nottingham Road	58.9	58.4	B
10. School boundary (children playing)	55.3	54.9	A
11. Station Road (behind wall)	51.9	52.7	A
12. Corner Station Rd/Springfield Avenue	53.7	56.4	B
13. Springfield Avenue 60m Station Rd	51.7	54.1	A

Train Noise:

- 5.1.8 Sample noise measurements of train 'pass-by' events have been undertaken including frequency analysis for assessing noise levels within living rooms and bedrooms. The following graph shows typical frequency spectra for daytime and night-time event periods.

Graph 5.1: Octave Band Frequency Analysis during train movement at the south western boundary

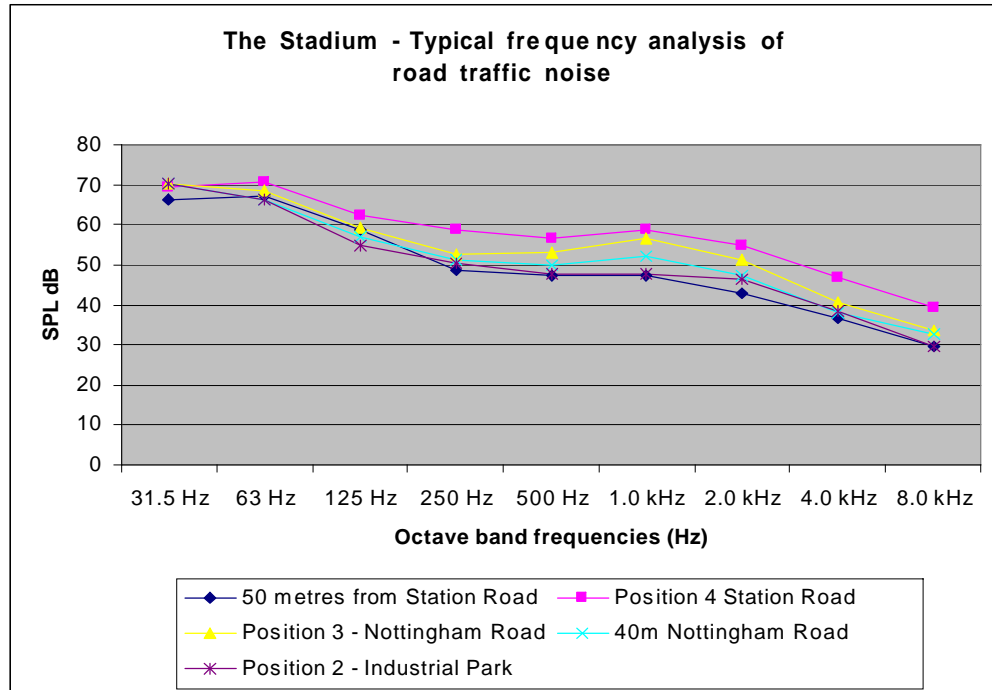


- 5.1.9 Graph 5.1 shows typical frequency spectra during goods train movement adjacent to the site, which occurs on an intermittent basis during the daytime and night-time periods. It was noted that the goods trains that use this section of railway line travel relatively slow and were therefore not significant in terms of noise.

Road Traffic Noise:

5.1.10 Graph 5.2 shows typical frequency spectra for road traffic noise, which generally affects the southeastern boundary end of the site.

Graph 5.2 Frequency Analysis of road traffic noise



5.1.11 The road traffic along Station Road was intermittent in frequency, Nottingham Road was relatively consistent in terms of traffic flow and vehicles only occasionally travelled along Springfield Avenue.

Industrial Noise:

5.1.12 Subjective observations of industrial noise from the Stadium Trading Estate were not significant and any noise observed related to the loading and offloading of vehicles in the car parking area.

5.1.13 Noise measurements taken with and without road traffic and train movements have indicated the following results:

Table 5.4: Industrial noise and background noise results

Position	Time	Activity	LAeq dB	LA90 dB
Daytime Operation				
Position 2 - boundary with car park	12:06	Industrial Noise – offloading vehicle (incl. residual noise)	52.6	48.2
Position 2	17:02	Industrial Noise (incl. residual noise)	51.5	46.8
Position 2	12:45 & 17:30	Residual noise only (i.e. no ind. noise)	51.4 & 50.6	46.6 & 46.7

Protecting Residents Within Dwellings

5.1.14 To ensure that the occupants of the proposed dwellings are protected from the adjacent train, road and industrial noise sources, we have used the average and L_{Amax} noise measurements to calculate the noise level in the nearest potential living room and bedroom. This assumes the proposed glazing system and building control measures are implemented. The 'worst case' frequency spectra has been used to calculate the internal noise levels. We have corrected the noise levels at first floor height by +1.5dB(A) (increase based on site measurements at higher level above ground) and +3dB(A) for façade reflection .

5.1.15 For the room calculations, the following external noise levels have been used for the predictions, based on the survey results:

Table 5.5: Predicted External Noise Levels at Sensitive Room Positions from Road, Rail Traffic & Industrial Noise (including reflective component and height correction and mitigation measures)

Position	External Façade Noise Level LA _{eq} dB	L _{Amax} (Night-time) dB
First row of houses adjacent to Station Road	62.1 (ground floor-day)* 55.3 (1 st floor-night)*/**	- 77.9
First row of houses adjacent to Springfield Avenue	59.5 (ground floor-day)* 55.1 (1 st floor-night)*/**	- 77.9
First row of houses adjacent to Nottingham Road	68.9 (ground floor-day)* 63.4 (1 st floor-night)*/**	- 79.4
First row of houses behind industrial park	55 (ground floor-day)* 50.6 (1 st floor-night)*/**	- 73.4
Second row of houses adjacent to Station Road	59.8 (ground floor-day)* 53 (1 st floor-night)*/**	- 75.6
Second row of houses adjacent to Springfield Av	55.6 (ground floor-day)* 51.2 (1 st floor-night)*/**	- 74
Second row of houses adjacent to Nottingham Rd	65 (ground floor-day)* 59.5 (1 st floor-night)*/**	- 75.5

*Increase allowed for façade reflection at free field monitoring positions is +3dB(A).

** Additional +1.5dB(A) Leq allowed for height difference where bedroom above ground floor level.

5.1.16 Table 5.6 below shows the results of noise calculations in the nearest sensitive rooms from road, rail and industrial noise. This is based on site measurements with allowances for façade reflection and height increase (as appropriate) with the recommended noise control measures in place.

Table 5.6: Calculated noise within sensitive rooms of the dwelling (includes noise control measures proposed)

Position	Time Period	Predicted noise level LAeq dB from road, rail & industrial noise (internally)	Predicted noise level L _{max} dB from road & rail (internally-night)
First row of houses adjacent to Station Road	Daytime (living room)	33	-
	Night-time (bedroom)	23	45
First row of houses adjacent to Springfield Avenue	Daytime (living room)	30	-
	Night-time (bedroom)	23	45
First row of houses adjacent to Nottingham Road	Daytime (living room)	35	-
	Night-time (bedroom)	29	45
First row of houses behind industrial park	Daytime (living room)	26	-
	Night-time (bedroom)	20	44
Second row of houses adjacent to Station Road	Daytime (living room)	31	-
	Night-time (bedroom)	21	45
Second row of houses adjacent to Springfield Av	Daytime (living room)	27	-
	Night-time (bedroom)	20	44
Second row of houses adjacent to Nottingham Rd	Daytime (living room)	35	-
	Night-time (bedroom)	28	45

5.1.17 The assumed acoustic performance of the glazing and room ventilation systems, to be provided by the developer (based on octave band frequency performance) is provided in section 7.0.

Protection of Private Garden Areas:

5.1.18 Table 5.7 below show the results of noise calculations in respect of garden areas from road, rail and industrial noise. This is based on site noise measurements with the recommended noise control measures in place. The screening attenuation has been calculated based on site measurements and 'Calculation of Railway Noise' (CRN) rather than CRTN as the train noise is the dominant noise source.

Table 5.7: Calculated noise within garden areas of the development from road, rail and industrial noise (with control measures)

Position	External Noise Level LAeq _{1hr} dB (in garden including mitigation)
First row of houses adjacent to Station Road	45-52
First row of houses adjacent to Springfield Avenue	44-50
First row of houses adjacent to Nottingham Road	50-54
First row of houses behind industrial park	46-50
Second row of houses adjacent to Station Road	44-50
Second row of houses adjacent to Springfield Av	44-46
Second row of houses adjacent to Nottingham Rd	48-52

Industrial Noise

5.1.19 Table 5.8 below shows the results of noise calculations in respect of assessing industrial noise within proposed private garden areas.

Table 5.8: Calculated noise contribution within potential garden areas of the proposed dwellings from industrial noise.

Position	Predicted noise contribution LAeq _{1 hour} dB	Criteria LAeq _{1 hour} dB LA90 + 5dB(A)
Position 2 – Adjacent to Industrial Park	44.2-46.1	51-52

* Corrected for residual noise

5.1.20 The results of the calculations show that, with the proposed dwelling construction, boundary screening and dwelling layout, the external garden noise levels would fall within acceptable noise criteria relating to areas of mixed residential and industrial areas.

BS4142: 1997 Assessment:

5.1.21 BS4142 is used as guidance in the determination of the likelihood of complaints in areas having a mixed residential and industrial content.

5.1.22 The method basically involves the measurement of background noise using an L_{A90} level at the potential complainants property boundary with the noise source/s switched off and then a measurement at the same position with the noise source/s switched on using an L_{Aeq} level. The level difference is calculated and a correction factor added if the noise source contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum etc.) or distinct impulses (bangs, clicks, clatters, or thumps) or is irregular enough to attract attention.

5.1.23 An assessment of the industrial noise levels measured using BS4142: 1997 is provided and is relevant to the daytime period in gardens when the highest industrial noise is operating.

Table 5.9: Daytime assessment Position 2:
with industrial noise operating (no additional screening)

	Results	Results
Typical Measured Noise Level (with residual noise)	52.6dB LAeq	51.5dB LAeq
Typical Residual Noise Level	51.4dB LAeq	50.6dB LAeq
Corrected level	46.1dB LAeq**	44.2dB LAeq**
Impulse, tonal correction	0 to +5dB(A)*	0 to +5dB(A)*
Rating level	46.1dB or 51.1dB LAeq	44.2dB or 49.2dB LAeq
Background noise level	46.6dB LA90	46.6dB LA90
Excess of rating over Background noise level	-0.5 to +4.5dB(A)	-2.4 to +2.6dB(A)
Conclusion:	Complaints unlikely	Complaints unlikely

* This correction is subjective

** Based on logarithmic subtraction

6.0 DISCUSSION OF RESULTS

6.1 Conclusions

6.1.1 Subjective observations at site indicate that the noise climate is dominated by local road traffic noise and occasional goods train noise.

6.1.2 The results of site noise measurements show that the existing noise levels at the nearest facade and garden areas of the proposed property are likely to fall within the following Noise Exposure Categories:

Table 6.1: NEC Levels (refer to Appendix C noise maps)

Position	Time Period	NEC Category (According to PPG24)
Up to approx 30m from Station Road boundary	Daytime	B
Beyond approx 30m from Station Road boundary	Daytime	A
Up to approx 25m from Nottingham Road boundary	Daytime	C
From approx 25m to 70m from Nottingham Road boundary	Daytime	B
Beyond approx 70m from Nottingham Road boundary	Daytime	A

6.1.3 Category A: *"for proposals in this category noise need not be considered as a determining factor in granting planning permissions, although the noise level at the high end of the category should not be regarded as desirable."*

6.1.4 Category B: *"for proposals in this category noise should be taken into account when determining planning applications and, where appropriate conditions imposed to ensure an adequate level of protection against noise."*

6.1.5 Category C: *"for proposals in this category 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."*

6.1.6 To mitigate noise from road traffic we have considered acoustic screening of private garden areas closest to Nottingham Road and gardens adjacent to Station Road.

6.1.7 The proposed mitigation measures provide adequate protection against transportation noise to ensure that the development meets the requirements of PPG24: 1994 and a 'good' design level according to BS8233: 1999.

Industrial Noise

- 6.1.8 The results of background noise measurements indicate that typical noise levels (in terms of average L90) are around 46-47dB(A) for daytime periods in proximity to the industrial park. This would mean that the resultant daytime noise level for fixed industrial noise sources should be designed to a level of approximately 51dB(A) Leq daytime periods at proposed private garden areas.
- 6.1.9 Noise from the industrial site relates, in general, to noise from HGVs and light vehicles and occasional forklift truck movements to offload vehicles during the daytime. Subjectively, the noise climate witnessed was not deemed to be significant.
- 6.1.10 The objective results of a BS4142: 1997 assessment, excluding any additional noise amelioration measures, would indicate that with the industrial site operating (and allowing for a character correction); the resultant noise contribution levels would show complaints to be unlikely.

Transportation Noise

- 6.1.11 We have assessed the impact on proposed residential properties from the effect of road and rail traffic. We have applied guidance relevant to the development (as advised by the Local Authority) i.e. PPG24: 1994 and BS8233: 1999 in respect of private garden areas and within living rooms and bedrooms.
- 6.1.12 Additionally, we have assessed the night-time LAmax levels to ensure restoration of sleep criteria is achieved within bedrooms.

Public House

- 6.1.13 During the survey the only noise associated with the public house related to occasional vehicle parking, which was at a lower level than noise from Nottingham Road.
- 6.1.14 By applying the recommendations detailed in section 8.0 of this report, we conclude that the resultant noise levels in sensitive rooms and gardens of the proposed development would be within relevant guidance and standards relating to transportation and industrial noise.

7.0 CONSTRUCTION NOISE

7.1 Introduction

7.1.1 No specific advice is provided at this stage of the development by the Local Authority. An example of a planning consent condition relative to construction noise is shown below:

'Noise generated by demolition/construction activities should be carried out in line with the 'Good Builders Guide' and BS 5228 'Code of practice on noise and vibration control on construction and open sites'. All work shall be carried out only between the hours of 07.30 and 19.00 on Monday to Fridays and between the hours of 08.00 and 13.00 on Saturdays and at no time on Sundays or Bank Holidays.'

7.2 Construction Activities

7.2.1 Initial site preparation works is likely to involve the movement of soil and the construction of the infrastructure and dwellings.

7.2.2 It is considered that excavators, JCB's and asphalt spreading machines would be required to construct the site.

7.2.3 The above noise sources and their associated activities will vary from day to day and may be in use at different stages of the development for relatively short durations.

7.3 Construction Noise Prediction

7.3.1 We have given below an indication of expected highest noise levels at the nearest receptors based on soil movement and general site activities at the closest approach to existing residential areas.

7.3.2 The calculations use the calculation methodology given in BS 5228: Part 1, 2009. For this method the sound power level of the noise source is defined and the attenuation is calculated between its location and the selected receiver, taking account of distance, ground attenuation and the time that a noise source will be operating.

7.3.3 The results of calculations for soil movement and general site activities are shown below in Table 7.1

Table 7.1: Noise Predictions for Worst Case Construction Noise

Position	Distance to receptor (m)	Activity	Noise Level, dB L _{Aeq}
Nearest Property garden positions and Grange school	10-60	Soil Movement	55-65
	10-60	General site activities	56-64
	20-60	Road Construction	55-63

7.3.4 The noise of activities during of the construction of the site would vary throughout the day and would depend on the particular work being undertaken. The highest community noise levels are likely to be created during the movement of soil and construction of the road surface when they are close to the dwelling garden boundaries. This would be within the level of noise normally found to be acceptable for an activity of this type and duration. The movement of soil may be part of the initial site preparation works and it is unlikely that any other significant sources of noise would be present on the site while these activities were being carried out.

7.3.5 In consideration of the highest levels of construction noise likely (i.e. during short term activities at the closest approach to nearest dwellings) and existing residual noise levels, we would suggest the following approach:

In accordance with BS5228, best practical means would be employed to control the noise generation.

e.g.

- Using equipment that is regularly maintained.
- Where practicable use equipment fitted with silencers or acoustic hoods.
- Maintain boundary brick wall adjacent to Station Road for as long as practicable to provide screening of construction activities.
- Introduce temporary screening (e.g. hoarding) where practicable along Station Road and properties adjacent to Nottingham Road land area. Screen height should be typically around 2.4 metres.
- Restriction of construction hours to non-sensitive times of day would normally form part of the planning consent conditions.
- Restriction on the types of plant being used relating to noise limits for specific operations.
- Sensible routing of the construction plant to avoid the nearest residential properties.

8.0 RECOMMENDATIONS

8.1 *Amelioration of Garden Areas*

8.1.1 The following example of amelioration measures are designed to provide additional attenuation from road, rail traffic and industrial noise such that an adequate and reasonable level of protection is provided.

8.1.2 The design of the site is an important factor when considering mitigation measures, as quite often a good design can integrate certain features or types of dwellings that help minimise noise impacts. We have based the example of control measures on the provisional design layout of the site. If the site changes, please contact NVC to ensure that the measures proposed are not compromised.

8.2 *Boundary Screening*

8.2.1 The following garden boundary areas would require acoustic screening to protect from road, rail and industrial noise. It should be noted that the bottom of the screen is on a similar datum level to the dwelling, if the land height changes please contact NVC to check that the control measures are not compromised:

- a) Nearest dwellings to Nottingham Road will require acoustic screens around the garden areas or strategically placed garages and screening. The screen should be approximately 2.4 metres high and formed from close-boarded fencing or similar solid material having a minimum mass of 7kg/m².
- b) Any gardens directly adjacent to Station Road (i.e. not positioned behind the dwelling) to a height of 2.4 metres. This would be formed from close-boarded fencing or a solid screen. See Figure 2.
- c) To ensure continued protection of noise from trading park-loading area, we would recommend that the existing 2-metre high brick wall should be extended to a height of 2.4 metres along the northwest boundary. See Figure 2.
- d) To give protection from activities associated with the public house along the north eastern boundary we would recommend that the boundary is fitted with a 2.1 metre high acoustic screen as described in a) above. See figure 2.
- e) We assume private garden areas (where appropriate) would be fitted with standard 1.8 metre high close-boarded fencing.

8.3 Dwelling Amelioration Measures:

Room Glazing, Ventilation and Roof Construction

8.3.1 Our calculations of noise entering the residential rooms of the proposed dwellings indicate the following example of room glazing, ventilation and roof construction would be required in order to meet the noise criteria:

Table 8.1: Example of Room Construction

Location	Glazing Configuration (Example)	Ventilation Type	Roof/Ceiling Construction (i.e. top floor)
All Living Room windows except those closest to Nottingham Road	6-16-6 or equivalent acoustic performance Rw = 33dB Rtra=26dB	In-direct 'trickle' vent Dnew = 38dB	n/a
Bedroom windows facing Station Road	6-16-6.8 Pilkington or equivalent acoustic performance Rw = 38dB Rtra=32dB	Acoustic 'trickle' vent Dnew = 40dB	2x 12.5mm plasterboard +200mm loft insulation
Living Room windows facing Nottingham Rd	8.8-16-6 or equivalent acoustic performance Rw=39dB Rtra= 33dB	Acoustic 'trickle' vent Dnew = 40dB	n/a
Bedroom windows facing Nottingham Rd	8.8-16-6 or equivalent acoustic performance Rw=39dB Rtra= 33dB	Acoustic 'trickle' vent Dnew = 40dB	2x 12.5mm plasterboard +200mm loft insulation
2 nd row dwelling bedroom windows facing Station Road	6-16-6 or equivalent acoustic performance Rw = 33dB Rtra=26dB	Acoustic 'trickle' vent Dnew = 40dB	2x 12.5mm plasterboard +200mm loft insulation
2 nd row dwelling bedroom windows facing Nottingham Rd	6-16-6 or equivalent acoustic performance Rw = 33dB Rtra=26dB	In-direct 'trickle' vent Dnew = 38dB	2x 12.5mm plasterboard +200mm loft insulation
First row bedroom windows facing industrial park direction	6-16-6 or equivalent acoustic performance Rw = 33dB Rtra=26dB	In-direct 'trickle' vent Dnew = 38dB	2 x 12.5mm plasterboard +200mm loft insulation
All other bedroom windows	6-16-6 or equivalent acoustic performance Rw = 33dB Rtra=26dB	In-direct 'trickle' vent Dnew = 38dB	1 x 12.5mm plasterboard +200mm loft insulation

All plots:

8.3.2 Example of walls: Cavity wall construction for example, a 102mm facing brick outer leaf, 50mm cavity and 100mm blockwork or similar approved insulation block. Inner wall finished with 12.5mm plasterboard (plaster skimmed), all subject to current Building Regulation requirements.

8.4 Expert Opinion

- 8.4.1 Taking into account the results of the noise survey, calculations and example of noise mitigation (as detailed above), it is our expert opinion that the resultant noise levels within the dwellings and in private garden areas would meet appropriate and reasonable guidance and noise criteria relevant to the proposed development and would therefore provide an adequate level of protection against noise for potential occupants of the dwellings.

VIBRATION ASSESSMENT

9.0 REVIEW OF VIBRATION CRITERIA

9.1 Vibration Damage Criteria

9.1.1 Most of the available data relating to the effects of ground vibration on buildings have been obtained during tests using explosives. From these studies, two regimes of building damage have evolved, those of structural damage involving major failures of whole or parts of buildings and architectural damage involving cracking plaster or other brittle materials. Architectural, sometimes called cosmetic damage is thought to be more annoying than dangerous and would start to occur at lower levels of vibration than structural damage. Recent International and British Standards define and categorise building damage under three main headings:

- a) Cosmetic - the formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces. In addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.
- b) Minor - the formation of large cracks or loosening and falling of plaster or drywall surfaces, or cracks through bricks/concrete blocks.
- c) Major - damage to structural elements of the building, cracks in support columns, loosening of joints, splaying of masonry cracks, etc.

9.1.2 An investigation into the effects of induced vibration undertaken by the British Standards Institution has culminated in BS 7385:1993; Part 2 which gives guide values to prevent cosmetic damage to property of 15 to 20mms⁻¹ between 4 Hz and 15 Hz, whilst above 40 Hz the guide value is 50mms⁻¹. The BSI suggests reducing these figures by a factor of 50% for continuous vibration, for example from rail traffic, thus the values become 7.5-10mms⁻¹ at 4-15 Hz, and 25.0mms⁻¹ at 40 Hz and above.

9.1.3 These vibration criteria are comparable with those of the German Standard DIN 4150, Part 3 1986 which recommends continuous vibration magnitudes of 5.0 mms⁻¹ at a frequency below 10 Hz, with 5.0-15.0 mms⁻¹ at frequencies between 10 Hz and 50 Hz.

9.1.4 In France, the Ministry of Environment and Transport Regulations for mechanical vibration affecting buildings gives a guide value of 5.0mms⁻¹ at frequencies between 10 Hz and 30 Hz, with 5.0-8.0mms⁻¹ at frequencies between 30 Hz and 60 Hz.

9.1.5 With regard to the threshold of cosmetic damage, for continuous vibration such as road or rail traffic, levels below 5.0mms⁻¹ are unlikely to be significant. For a given level of vibration the risk of damage decreases as the frequency of that vibration increases.

9.1.6 BS5228: Part 4: 1992 'Noise control on construction and open sites' states the following: *'It is recommended that, for soundly constructed residential property and similar structures, which are in generally good repair, a conservative threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity (p.p.v.) of 10mm/s for intermittent vibration and 5 mm/s for continuous vibrations. Below these vibration magnitudes, minor damage is unlikely to occur.'*

9.1.7 For the purposes of assessing the potential to cause structural damage the following criteria has been chosen:-

- a) A limiting value for continuous vibration of 5.0mms^{-1} .
- b) A limiting value for intermittent vibration of 10mms^{-1} .

9.1.8 To put this in perspective, a velocity of 0.3 mms^{-1} is quoted as the human threshold of vibration perception and a CONTINUOUS velocity of about 2.5 mms^{-1} is quoted as being annoying.

9.2 Vibration Nuisance Criteria

9.2.1 The fact that the human body is very sensitive to vibration can result in subjective concern being expressed at energy levels well below the threshold of damage.

9.2.2 Structural vibration in buildings can therefore be detected by the occupants and effect them in many ways. For example, their quality of life may be reduced and, if the building is a work place, working efficiency may also be effected.

9.2.3 Guidance on the human response to vibration in buildings may be found in British Standard BS 6472-1: 2008. Weighting curves related to human response to vibration of buildings are presented within this document. Estimates are given on the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. This is based on a vibration dose value (VDV), assessed from frequency weighted vibration measurements and based on a 16 hour day and 8 hour night period.

9.2.4 For the purposes of assessing the potential to cause nuisance the guidance in BS 6472-1: 2008 has been used.

9.2.5 Within this Standard, the thresholds of perception based on a weighted measurement (W_b) a quarter of the people would perceive a vibration of 0.01m.s^{-2} peak, but the least sensitive quarter would only be able to detect a vibration of 0.02m.s^{-2} peak or more.

9.3 Local Planning Authority Vibration Criteria

9.3.1 NVC is not aware of any specific vibration limitations that are imposed by the Local Planning Authority for the site.

10.0 VIBRATION MEASUREMENTS

10.1 Introduction

10.1.1 The methodology described below was employed during the vibration survey. Definitions of all vibration measurement parameters noted during the survey are presented in Appendix E.

10.2 Measurement Technique

10.2.1 Vibration measurements were made, in the three mutually perpendicular axes, during the 24-hour monitoring period. The Vibrock V901 seismograph was set to the 'continuous' setting (at a trigger level of 0.19 mm/sec) and was placed at the southwestern boundary position adjacent to position 1, approximately 1 metre from the site boundary. An additional seismograph (Nomis) was placed further along the western boundary opposite the elevated railway line.

10.2.2 The Vibrock seismograph has monitored the ground borne vibration in terms of Peak Particle Velocity (PPV) and Vibration Dose Value (VDV) using two separate transducers. The transducers were placed firmly on a concrete hard standing area and level. The Nomis seismograph was placed adjacent to the boundary within soft ground using location spikes and incorporated one transducer measuring Peak Particle Velocity (PPV).

10.2.3 The types of train using the railway line consist of goods trains, which occur occasionally during the daytime and night-time.

10.3 Measurement Location

10.3.1 The measurement locations are detailed below and are shown on Figure 1.

10.3.2 The monitoring of ground-borne vibration was carried out at the south west to western site boundary opposite the railway line on the proposed development site.

10.4 Instrumentation

10.4.1 The following instrumentation was used for all vibration measurements:

Manufacturer	Description	Type	Serial No.
Vibrock	Portable Field Seismograph	V901	680
Nomis	Portable Field Seismograph	Mini Supergraph	11141

10.4.2 The following set-up parameters were used on the Seismographs during vibration measurement:

V901	PPV & VDV
Mode:	Continuous
Range:	Up to 10mm/sec (PPV) and up to 0.25m.s ^{-1.75} (VDV)
Scan Time:	10 seconds (Trigger: 0.19mm/sec)

Nomis

	PPV
Mode:	Trigger
Range:	Up to 10mm/sec (PPV)
Scan Time:	3 seconds
	(Trigger: 0.1905mm/sec)

10.5 Survey Dates and Personnel

10.5.1 Vibration levels were measured over 24 hours on 26th to 27th November 2009. Mr D.R. Kettlewell of Noise & Vibration Consultants Limited conducted the survey.

10.6 Meteorological Conditions

10.6.1 Weather conditions were noted during the survey period.

26th – 27th November 2009

10.6.2 Dry, variable cloud cover with a light southerly wind (1-2m/s). Temperature 5-9deg C.

10.6.3 During the night-time the weather remained dry, clear skies with a light south to south westerly wind and temperature varying between 4-6deg C.

11.0 CONCLUSIONS OF VIBRATION SURVEY

11.1 Structural and Cosmetic Damage

11.1.1 NVC consider that a limiting value for continuous vibration of 5.0 mms^{-1} , based on the criteria discussed in Section 9 of this document is a satisfactory magnitude to protect buildings from damage of any description. For intermittent vibrations NVC considers that a limiting value of 10.0 mms^{-1} is a satisfactory magnitude to protect buildings from damage of any description.

11.1.2 A continuous vibration is one in which the cyclic variation in amplitude is repeated many times. An intermittent vibration is one in which a sequence (sometimes regular, sometimes irregular) of transient vibrations occurs with sufficient interval between successive events to permit the amplitude to diminish to an insignificant level in interim periods.

11.1.3 From the results of the vibration surveys, measured PPVs at the boundary would indicate that the type of vibration being monitored is deemed to be an intermittent source. This conclusion is based on the fact that any vibration relates to the movement of trains travelling along the railway line or HGVs travelling along Springfield Avenue. The time duration between events would be sufficiently long enough to allow the amplitude to diminish sufficiently to zero.

11.1.4 The results of the vibration monitoring with the seismograph in continuous mode are shown below:

Table 11.1: Summary of Vibration Monitoring in Continuous Mode

Position	Vibration Source	Resultant VDV ($\text{m.s}^{-1.75}$)	PPV (mm/sec)
1m from south west boundary	Train/HGV – Daytime	Cumulative 16 hour: Horizontal (X) = 0.038 Transverse (Y) = 0.039 Vertical (Z) = 0.03	Range (hourly): 0.2 to 0.275
1m from south west boundary	Train/HGV– Night-time	Cumulative 8 hour: Horizontal (X) = 0.034 Transverse (Y) = 0.034 Vertical (Z) = 0.027	Range (hourly): 0.25

11.1.5 The results show that the recorded measurements during the monitoring period relate to train or HGV movements.

Table 11.2: Summary of Vibration Monitoring in Trigger Mode

Position	Vibration Source	PPV (mm/sec)
1m from west boundary	Train/HGV – Daytime	Range: 0.127 to 0.508
1m from west boundary	Train/HGV– Night-time	Range: 0.127 to 0.699

11.1.6 The vibration magnitudes measured at the boundary position relative to trains travelling along the railway line or HGVs travelling along Springfield Avenue are shown to be well within the limiting criterion of 5.0mms^{-1} PPV for continuous vibration and 10mms^{-1} for intermittent vibration. We can therefore conclude that the occurrence of either cosmetic or structural damage due to train induced vibration is extremely unlikely.

11.2 Vibration Nuisance

11.2.1 British Standard BS6472-1: 2008 "Guide to evaluation of human exposure to vibration in buildings" discusses the possible effects that various types of vibration may have on the inhabitants of any building. Section 6.0 of this document describes methods for the evaluation of such vibration and indicates levels that might result in various probabilities of adverse comment within residential buildings. This is based on a weighted vibration measurement to derive the VDV for either 16 hour (daytime) or an 8-hour (night-time).

Table 1 in the Standard gives the vibration dose values, which might result in various probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $\text{m.s}^{-1.75}$	Adverse comment possible $\text{m.s}^{-1.75}$	Adverse comment probable $\text{m.s}^{-1.75}$
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

11.2.2 In terms of VDV the calculated eVDV value for the duration of exposure to vibration is shown to be $0.039\text{m.s}^{-1.75}$. This is based on the time for the duration of the 16-hour daytime period.

11.2.3 The calculated eVDV value for the duration of exposure to vibration for the 8 hour night-time period is shown to be $0.034\text{m.s}^{-1.75}$.

11.2.4 The results show that according to BS6472-1: 2008 the level of vibration is below the threshold of a 'low probability of adverse comment' and therefore an adverse comment is not expected. This is based on an occupier of residential property during the daytime or night-time.

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FIGURES

Figure 1: Pre-liminary Site Layout & Noise Monitoring Positions



Figure 2: Proposed Screening Positions



APPENDIX A

BASIC ACOUSTIC TERMINOLOGY

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

Sound Pressure Level is a measurement of the size of these pressure fluctuations. It is expressed in decibels (dB) on a logarithmic scale. Each 3 dB increase in sound pressure level represents a doubling of the sound energy. The threshold of hearing is approximately 0 dB.

The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz), that is, cycles per second. The human ear is sensitive to sounds from about 20 Hz to 20,000 Hz. Although sound can be of one discrete frequency - a 'pure tone' - most noises are made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same 'subjective' way. This is the basis of the A-weighted sound level dB(A), normally used to assess the effect of noise on people. The dB(A) weighting emphasises or reduces the importance of certain frequencies within the audible range.

Noise Measurement

The measurement of sound pressure level is only really meaningful where the level of noise is constant. In the typical industrial environment noise levels can vary widely and sometimes short duration high levels of noise are interspersed with periods of relative quiet. The most widely used means of 'averaging' the noise over a period of time is the Equivalent Continuous Sound Level. Normally written as L_{Aeq} this value takes into account both the level of noise and the length of time over which it occurs. There are many meters available which are capable of measuring L_{Aeq} by electronic integration over the measurement period.

The L_{Aeq} or A-weighted equivalent continuous noise level is a measure of the total noise energy over a stated time period and includes all the varying noise levels and re-expresses as an 'average', allowing for the length of time for which each noise level was presented.

The L_{An} parameters are defined as the noise levels which are exceeded for n% of the monitoring period, thus, for example, the L_{A90} parameter is the noise level exceeded for 90% of the 15 minute period, i.e. 13.5 minutes. The L_{A50} parameter is the noise level exceeded for 50% of the hourly period, i.e. 30 minutes, etc. The L_{max} parameter is the maximum RMS A-weighted noise level occurring during the measurement period.

The definition in layman's terms is given below for terminology used in the measurement and results obtained during the survey work.

A-weighting: Normal hearing covers the frequency (pitch) range from about 20Hz to 20,000 Hz but sensitivity of the ear is greatest between about 500Hz and 5000Hz. The "A-weighting" is an electrical circuit built into noise meters to mimic this characteristic of the human ear.

Ambient noise: The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.

Attenuation: Noise reduction

Background noise: The general quiet periods of ambient noise when the noise source under investigation is not there.

Decibel (dB): The unit of measurement for sound based on a logarithmic scale. 0dB is the threshold of normal hearing, 140dB is the threshold of pain. A change of 1dB is only detectable under controlled laboratory conditions.

dB(A) [decibel A weighted]: Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) serves to distinguish sounds of different frequency (or pitch) in a similar way to how the human ear responds. Measurements in dB(A) broadly agrees with an individual's assessment of loudness. A change of 3dB(A) is the minimum perceptible under normal everyday conditions, and a change of 10dB(A) corresponds roughly to doubling or halving the loudness of sound.

dB(C): [decibel C weighted]: Frequency weighting which does not alter low frequency octave band levels by very much compared to 'A' weighting. Similar to linear reading (i.e. linear does not alter frequency spectra at all)

Frequency (Hz): The number of sound waves to pass a point in one second.

L_{Aeq} : This is a noise index used to describe the "average" level of a noise that varies with time (T). It allows for the different sensitivities of the human ear to different frequencies (pitch), and averages fluctuating noise levels in a manner which correlates well with human perceptions of loudness.

$L_{A10,T}$: This noise index gives an indication of the upper limit or peak levels of the fluctuating noise. It is the "A weighted" noise level exceeded for 10 per cent of the specified measurement period (T). e.g. If the measurement period was over 10 hours and the L_{A10} reading was say 60dB, then this means that for 1 hour out of 10 the level went above 60dB.

$L_{A90,T}$: This noise index gives an indication of the lower limit or levels of the fluctuating noise. It is the "A weighted" noise level exceeded for 90 per cent of the specified measurement period (T). e.g. If the measurement period was over 10 hours and the L_{A90} reading was say 50dB, then this means that for 9 hours out of 10 the level went above 50dB.

L_{Amax} : This is the highest A weighted noise level recorded during a noise measurement period.

Residual ambient noise: The ambient noise remaining at a given position in a given situation when the noise source under investigation is not there.

Specific noise: The noise source under investigation for assessing the likelihood of complaints

Examples of typical noise levels

Source/Activity	Indicative noise level [dB(A)]
Threshold of hearing	0
Rural night-time background	20-40
Quiet bedroom	35
Wind farm at 350m	35-45
Busy road at 5km	35-45
Car at 65km/h at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/h at 100m	65
City Traffic at 5m	75-85
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

APPENDIX B

Results of Existing Noise Climate

Noise Survey Results

Date: 26th November 2009
Location: Former Long Eaton Speedway Stadium **TABLE 1**
Client: Davidsons
Project: Residential Development
Data: **Position 1 - Corner of Station Road and Springfield Avenue**
Instrumentation: Cirrus 704B Integrating sound level meter (B14196F)
Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
08:00	15:00	58.1	59.4	50.8	74.5	
08:15	15:00	56.6	57.3	50.5	75.1	Intermittent road traffic noise
08:30	15:00	58.9	58	49.7	79.7	
08:45	15:00	56.3	57.6	50.2	71	
09:00	15:00	55.5	57.1	48.5	70.2	
09:15	15:00	58.3	60	48.1	76.3	Intermittent road traffic noise
09:30	15:00	53.7	55.9	47.6	66.7	
09:45	15:00	61.6	58.2	48.4	82.7	0954 Goods Train
10:00	15:00	55.8	57.7	49	71.6	
10:15	15:00	57.8	59.1	49.4	73	1017 & 1022 Goods Train
10:30	15:00	56.5	58.8	47.7	71.3	
10:45	15:00	57.3	60.4	48.1	70.2	1049 Goods Train
11:00	15:00	55.3	56.3	48.3	75	
11:15	15:00	53.8	56.3	47.4	65.6	
11:30	15:00	54.1	56.4	47.8	68.3	
11:45	15:00	57.5	57	48.4	73.5	1149 Goods Train
12:00	15:00	56.5	57.8	48.1	72	
12:15	15:00	54.5	56.6	48.4	66.8	
12:30	15:00	55.1	56.9	48.6	69.3	1240 Goods Train
12:45	15:00	54.6	56	47.3	72.1	
13:00	15:00	53.1	55.3	46.4	65.1	
13:15	15:00	56.2	57	47.6	72.7	1316 Goods Train
13:30	15:00	54.5	56.7	47.7	69.1	
13:45	15:00	53.9	56.1	47.4	66.2	
14:00	15:00	53.1	55.2	46.6	64.8	Intermittent road traffic noise
14:15	15:00	55.1	57.2	46.6	70.7	
14:30	15:00	56.1	56.2	46.3	70.9	
14:45	15:00	54.3	55.2	46.3	72.1	Intermittent road traffic noise
15:00	15:00	55.7	56.2	47.4	72.8	
15:15	15:00	55.9	56.4	46.9	71.7	1520 Goods Train
Average 0800-1530		56.3	57.1	48.1	64.8-82.7	

Noise Survey Results

Date: 26th November 2009
Location: Former Long Eaton Speedway Stadium **TABLE 2**
Client: Davidsons
Project: Residential Development
Data: **Position 1 - Corner of Station Road and Springfield Avenue**
Instrumentation: Cirrus 704B Integrating sound level meter (B14196F)
Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
15:30	15:00	56.3	56.2	47	70.1	1530 Goods Train
15:45	15:00	53.6	56.2	46.8	65.7	
16:00	15:00	55.9	57	46.4	72.1	
16:15	15:00	69.7	63.2	48.5	93	1617,1624,1627 Goods Train
16:30	15:00	53.4	55.5	47.1	66.6	
16:45	15:00	53.2	55.8	46.3	66.2	Intermittent road traffic
17:00	15:00	56	57	48.7	74.9	
17:15	15:00	54.2	55.8	47.7	70.2	
17:30	15:00	53.2	55.5	47.7	64	
17:45	15:00	53	54.8	48.1	64	Intermittent road traffic
18:00	15:00	53.7	55.6	47.9	66.6	1812 Goods Train
18:15	15:00	56.1	55	47.2	74.8	1823 Goods Train
18:30	15:00	54.7	55.3	48.2	70.5	1833 Goods Train
18:45	15:00	52.6	54.6	48.2	62	
19:00	15:00	52.6	54.6	48.1	62	
19:15	15:00	51.5	53.5	47.4	59.6	
19:30	15:00	50.2	52.4	46.5	59.2	
19:45	15:00	51.5	54.1	46.5	60.2	
20:00	15:00	50.3	52.8	46.2	58	Intermittent road traffic
20:15	15:00	50.4	53.2	46	60.4	
20:30	15:00	56.4	53.4	45	75.7	
20:45	15:00	50.9	53.3	44.1	65.9	
21:00	15:00	54.8	53.7	43.6	70.5	
21:15	15:00	51.4	53	43	66.7	Intermittent road traffic
21:30	15:00	48.3	50.7	41.3	62.4	
21:45	15:00	47.1	50	40.7	62.3	Intermittent road traffic
22:00	15:00	49.2	51	41.4	65.7	
22:15	15:00	53.4	52.3	39.3	73	2222 Goods Train
22:30	15:00	50.1	50.6	39.6	71.1	
22:45	15:00	50.8	53	40.2	64.3	Intermittent road traffic
Average 1530-2300		57.1	54.3	45.5	58-93	

Noise Survey Results

Date: 26th-27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 3**
Client: Davidsons
Project: Residential Development
Data: **Position 1 - Corner of Station Road and Springfield Avenue**
Instrumentation: Cirrus 704B Integrating sound level meter (B14196F)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
23:00	15:00	48.4	49.4	39.9	65.6	Intermittent road traffic
23:15	15:00	45.9	48.6	40.8	57.1	2320 Goods Train
23:30	15:00	56.7	50.7	40.2	76.5	2340 Goods Train
23:45	15:00	44.6	47.1	40.2	57	
00:00	15:00	44.9	46.6	40.7	59	
00:15	15:00	43.6	44.2	40.1	55.6	
00:30	15:00	61.1	49.5	40.1	78.4	0040 Goods Train
00:45	15:00	44.3	46.6	39.7	55.5	
01:00	15:00	47.7	45.9	39.1	62.2	
01:15	15:00	42.2	42.9	39.1	54	
01:30	15:00	52.8	46.3	38.7	67.7	
01:45	15:00	41.8	42.9	37.1	54	
02:00	15:00	41.9	41.2	37.4	59.1	
02:15	15:00	39.3	40	37.2	49.2	
02:30	15:00	42.8	44.6	39.1	53.4	
02:45	15:00	52.1	45.8	38.3	70.4	
03:00	15:00	43.8	44.4	39.3	60.6	
03:15	15:00	43.1	44.3	38.8	58.9	
03:30	15:00	41.9	43.5	39	54	
03:45	15:00	42.5	43	37.9	57.5	
04:00	15:00	41.8	42	38.2	57.4	
04:15	15:00	42.6	42.9	40.2	54.6	
04:30	15:00	43.2	43.8	40.7	53.7	
04:45	15:00	55.7	50.6	40.6	71.4	
05:00	15:00	44	45.1	41.1	54.8	
05:15	15:00	45.4	46.9	41.7	57.8	
05:30	15:00	48.2	51	43.1	62.5	Intermittent road traffic
05:45	15:00	48.3	51.2	44.1	59.2	0548 Goods Train
06:00	15:00	50.2	52.2	44.2	68.6	0600,0607 Goods Train
06:15	15:00	50.1	51.9	44.7	68.2	
06:30	15:00	49.4	52	45.1	61.4	Intermittent road traffic
06:45	15:00	53.9	53.7	45.8	73.1	0651 Goods Train
Average 2300-0700		50.6	46.6	40.4	49.2-78.4	

Noise Survey Results

Date: 27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 4**
Client: Davidsons
Project: Residential Development
Data: **Position 1 - Corner of Station Road and Springfield Avenue**
Instrumentation: Cirrus 704B Integrating sound level meter (B14196F)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
07:00	15:00	51	53.9	45.3	61.6	
07:15	15:00	52.5	54.8	46.4	65.8	
07:30	15:00	53.3	55.9	47.1	65.5	Intermittent road traffic
07:45	15:00	54.4	56.7	47.9	62.4	Intermittent road traffic
Average 0700-0800		52.9	55.3	46.7	61.6-65.8	
Average 0700 - 2300		56.5	55.7	46.8	58-93	B
Average 2300-0700		50.6	46.6	40.4	49.2-78.4	B

Noise Survey Results

Date: 26th November 2009

Location: Former Long Eaton Speedway Stadium **TABLE 5**

Client: Davidsons Developments Ltd

Project: Residential Development

Data: **Position 2 - Northwest Boundary Adjacent to Industrial Park**

Instrumentation: Cirrus 831A Integrating Sound Level Meter (B14325FF)

Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
08:15	15:00	49.8	50.6	48.8	52.9	
08:30	15:00	54.3	54.9	48.9	75.5	
08:45	15:00	51.2	53.0	48.6	62.2	
09:00	15:00	52.5	54.6	47.8	71.1	
09:15	15:00	55.8	57.2	47.6	76.8	Intermittent road traffic noise
09:30	15:00	49.8	51.2	47.3	63.2	
09:45	15:00	59.9	55.8	47.4	81.6	0954 Goods Train
10:00	15:00	52.2	54.1	48.9	70.8	
10:15	15:00	55.8	58.0	47.8	74.0	1017 & 1022 Goods Train
10:30	15:00	53.2	55.8	47.2	72.3	
10:45	15:00	56.2	58.9	47.6	75.5	1049 Goods Train
11:00	15:00	51.0	53.0	47.4	64.5	
11:15	15:00	52.3	54.3	47.9	68.4	
11:30	15:00	50.2	52.5	46.8	61.3	
11:45	15:00	56.2	54.7	47.9	73.4	1149 Goods Train
12:00	15:00	51.9	54.0	47.0	69.8	Vehicle being offloaded
12:15	15:00	50.8	53.1	47.0	64.7	Vehicle being offloaded
12:30	15:00	53.1	54.9	47.5	68.1	1240 Goods Train
12:45	15:00	51.4	53.8	46.6	66.9	No sign. noise
13:00	15:00	47.7	48.6	46.3	59.9	
13:15	15:00	54.8	52.8	46.6	72.6	1316 Goods Train
13:30	15:00	51.0	53.5	47.0	63.8	
13:45	15:00	49.8	52.0	46.1	65.3	
14:00	15:00	50.1	52.1	47.2	62.0	
14:15	15:00	52.0	54.1	46.8	68.5	
14:30	15:00	53.1	51.8	45.9	69.5	Intermittent road traffic noise
14:45	15:00	49.8	51.1	46.2	66.2	
15:00	15:00	51.3	54.0	47.4	67.2	
15:15	15:00	53.7	52.8	47.0	68.9	1520 Goods Train
Average 0815-1530		53.3	53.7	47.3	52.9-81.6	

Noise Survey Results

Date: 26th November 2009
Location: Former Long Eaton Speedway Stadium **TABLE 6**
Client: Davidsons Developments Ltd
Project: Residential Development
Data: **Position 2 - Northwest Boundary Adjacent to Industrial Park**
Instrumentation: Cirrus 831A Integrating Sound Level Meter (B14325FF)
Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
15:30	15:00	55.1	52.6	47.1	70.2	1530 Goods Train
15:45	15:00	51.7	51.9	46.9	69.6	
16:00	15:00	53.0	54.0	46.4	78.8	
16:15	15:00	56.0	58.2	47.6	75.1	1617,1624,1627 Goods Train
16:30	15:00	49.0	50.2	46.6	62.9	
16:45	15:00	50.0	51.6	46.1	68.0	
17:00	15:00	51.5	54.3	46.8	65.5	Vehicle travel & load
17:15	15:00	48.7	48.6	46.4	64.3	Vehicle moves away
17:30	15:00	50.6	51.3	46.7	78.0	No sign, noise
17:45	15:00	48.6	49.8	47.3	58.5	
18:00	15:00	51.4	52.7	47.9	67.2	1812 Goods Train
18:15	15:00	55.5	49.8	47.1	74.7	1823 Goods Train
18:30	15:00	53.7	50.6	47.1	72.1	1833 Goods Train
18:45	15:00	48.5	49.4	47.3	55.1	
19:00	15:00	49.1	50.5	47.5	58.6	
19:15	15:00	48.6	49.6	47.1	62.0	
19:30	15:00	47.7	48.5	46.7	51.4	
19:45	15:00	49.0	50.2	46.7	64.6	
20:00	15:00	47.6	48.5	46.2	56.0	
20:15	15:00	48.3	49.6	46.3	58.4	
20:30	15:00	53.0	49.6	45.8	74.3	Intermittent road traffic
20:45	15:00	47.1	48.2	45.1	60.2	
21:00	15:00	53.6	51.0	44.6	70.9	Intermittent road traffic
21:15	15:00	46.5	47.7	44.4	63.8	
21:30	15:00	47.5	47.6	43.1	66.4	
21:45	15:00	44.5	45.4	43.4	51.6	
22:00	15:00	46.0	47.7	43.5	59.4	
22:15	15:00	52.7	47.4	43.6	71.6	2222 Goods Train
22:30	15:00	45.2	47.2	42.2	58.3	
22:45	15:00	49.9	48.6	42.7	66.4	Intermittent road traffic
Average 1530-2300		51.0	50.1	45.9	51.4-78.8	

Noise Survey Results

Date: 26th-27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 7**
Client: Davidsons Developments Ltd
Project: Residential Development
Data: **Position 2 - Northwest Boundary Adjacent to Industrial Park**
Instrumentation: Cirrus 831A Integrating Sound Level Meter (B14325FF)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
23:00	15:00	48.0	45.2	42.3	68.1	
23:15	15:00	44.3	45.3	42.7	63.3	2320 Goods Train
23:30	15:00	55.2	46.3	42.2	75.7	2340 Goods Train
23:45	15:00	44.3	45.6	42.1	54.9	
00:00	15:00	44.4	45.5	42.8	56.7	
00:15	15:00	43.3	44.3	41.9	49.2	
00:30	15:00	60.3	48.0	42.4	77.9	0040 Goods Train
00:45	15:00	44.0	45.0	42.2	51.8	
01:00	15:00	49.0	45.9	41.3	63.6	
01:15	15:00	42.7	44.1	41.1	47.1	
01:30	15:00	51.3	47.0	41.5	67.1	
01:45	15:00	41.7	42.9	40.1	48.5	
02:00	15:00	41.6	42.5	40.2	48.6	
02:15	15:00	41.2	42.1	39.9	46.5	
02:30	15:00	42.0	43.1	40.6	47.8	
02:45	15:00	52.2	45.9	40.2	70.4	
03:00	15:00	42.3	43.2	41.1	46.2	
03:15	15:00	42.5	43.6	40.7	53.6	
03:30	15:00	42.6	43.5	40.9	54.2	
03:45	15:00	41.9	42.8	40.5	50.2	
04:00	15:00	42.2	43.1	40.8	46.8	
04:15	15:00	43.3	44.1	42.3	49.9	
04:30	15:00	43.6	44.5	42.4	48.1	
04:45	15:00	55.6	52.5	42.8	71.8	
05:00	15:00	44.6	45.7	43.0	51.8	
05:15	15:00	45.2	46.2	43.8	52.2	
05:30	15:00	46.2	47.7	43.9	56.2	
05:45	15:00	46.6	47.6	45.4	51.5	0548 Goods Train
06:00	15:00	48.0	49.3	45.9	63.1	0600,0607 Goods Train
06:15	15:00	47.8	48.8	46.5	52.1	
06:30	15:00	48.0	48.9	46.4	57.9	
06:45	15:00	52.4	50.6	47.4	71.5	0651 Goods Train
Average 2300-0700		49.7	45.7	42.4	46.2-77.9	

Noise Survey Results

Date: 27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 8**
Client: Davidsons Developments Ltd
Project: Residential Development
Data: **Position 2 - Northwest Boundary Adjacent to Industrial Park**
Instrumentation: Cirrus 831A Integrating Sound Level Meter (B14325FF)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
07:00	15:00	47.9	48.8	46.5	59.3	
07:15	15:00	49.5	50.4	46.8	72.7	
07:30	15:00	49.1	50.0	47.2	60.3	
07:45	15:00	51.1	53.5	47.8	70.0	Intermittent road traffic
08:00	15:00	52.0	54.2	48.4	67.6	Intermittent road traffic
Average 0700-0815		50.1	51.4	47.3	59.3-72.7	
Average 0700 - 2300		52.1	51.8	46.6	51.4-81.6	A
Average 2300-0700		49.7	45.7	42.4	46.2-77.9	B

Noise Survey Results

Date: 26th November 2009

Location: Former Long Eaton Speedway Stadium **TABLE 9**

Client: Davidsons

Project: Residential Development

Data: **Position 3 - 2m Northern Boundary Adjacent to Nottingham Road**

Instrumentation: Pulsar Model 63 Integrating sound level meter (40196)

Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
08:45	15:00	65.3	67.6	57.5	68.3	Road traffic noise
09:00	15:00	67.6	70.5	58.3	76.7	
09:15	15:00	67.5	70.0	60.9	74.6	
09:30	15:00	67.0	69.6	59.6	76.7	Road traffic noise
09:45	15:00	67.3	70.0	60.3	76.2	
10:00	15:00	66.9	69.4	60.6	74.0	
10:15	15:00	66.6	69.2	59.2	73.8	
10:30	15:00	66.9	69.3	60.7	75.5	Road traffic noise
10:45	15:00	66.4	69.2	59.8	73.5	
11:00	15:00	67.2	69.5	59.6	81.6	
11:15	15:00	66.5	69.0	60.7	72.3	
11:30	15:00	66.7	69.3	60.4	72.1	Road traffic noise
11:45	15:00	66.2	68.7	59.3	73.4	
12:00	15:00	66.1	68.5	59.5	72.7	
12:15	15:00	66.5	69.0	59.4	74.6	Road traffic noise
12:30	15:00	66.1	68.5	60.3	75.5	
12:45	15:00	66.7	69.2	60.4	74.3	
13:00	15:00	66.6	68.9	60.9	72.6	
13:15	15:00	66.2	68.7	59.8	73.5	
13:30	15:00	66.1	68.6	59.0	75.5	Road traffic noise
13:45	15:00	66.8	69.4	60.0	75.6	
14:00	15:00	66.0	68.3	60.5	71.0	
14:15	15:00	66.5	68.5	61.1	79.3	
14:30	15:00	66.2	68.7	60.8	76.1	
14:45	15:00	66.3	68.8	60.4	73.3	Road traffic noise
15:00	15:00	66.8	69.0	59.5	80.3	
15:15	15:00	65.3	67.7	59.5	76.9	
Average 0845-1530		66.5	69.0	59.9	68.3-81.6	

Noise Survey Results

Date: 26th November 2009

Location: Former Long Eaton Speedway Stadium **TABLE 10**

Client: Davidsons

Project: Residential Development

Data: **Position 3 - 2m Northern Boundary Adjacent to Nottingham Road**

Instrumentation: Pulsar Model 63 Integrating sound level meter (40196)

Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
15:30	15:00	66.4	68.8	59.6	78.2	
15:45	15:00	66.3	68.5	61.5	77.3	Road traffic noise
16:00	15:00	66.3	68.5	61.4	76.2	
16:15	15:00	66.3	68.5	62.2	75.7	
16:30	15:00	66.7	68.5	62.5	79.4	
16:45	15:00	66.2	68.7	60.0	73.0	
17:00	15:00	66.7	68.7	63.0	76.1	
17:15	15:00	66.0	68.6	58.2	77.4	
17:30	15:00	66.1	68.2	61.7	74.0	
17:45	15:00	66.3	68.5	61.5	71.9	
18:00	15:00	66.1	68.5	59.3	78.3	Road traffic noise
18:15	15:00	66.3	68.5	60.6	73.9	
18:30	15:00	67.5	68.3	59.6	84.1	
18:45	15:00	65.8	68.4	59.0	72.2	
19:00	15:00	65.5	68.2	59.9	71.0	Road traffic noise
19:15	15:00	65.3	68.0	57.6	74.9	
19:30	15:00	65.4	68.3	56.1	72.4	
19:45	15:00	65.1	68.0	57.1	72.1	
20:00	15:00	64.9	67.9	54.4	76.2	
20:15	15:00	65.4	68.0	56.4	80.4	
20:30	15:00	63.5	67.1	51.9	72.5	Road traffic noise
20:45	15:00	63.6	67.0	53.5	75.9	
21:00	15:00	63.6	67.2	52.9	70.7	
21:15	15:00	64.5	67.7	55.8	74.0	
21:30	15:00	63.2	66.8	53.1	70.2	
21:45	15:00	62.7	66.7	49.4	70.3	Road traffic noise
22:00	15:00	63.0	66.9	50.5	73.7	
22:15	15:00	62.6	66.8	47.9	72.8	
22:30	15:00	62.1	66.0	48.3	76.5	
22:45	15:00	60.4	65.3	45.2	72.3	Road traffic noise
Average 1530-2300		65.2	67.8	56.7	70.2-84.1	

Noise Survey Results

Date: 26th-27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 11**
Client: Davidsons
Project: Residential Development
Data: **Position 3 - 2m Northern Boundary Adjacent to Nottingham Road**
Instrumentation: Pulsar Model 63 Integrating sound level meter (40196)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
23:00	15:00	60.4	64.9	45.6	72.1	Intermittent road traffic noise
23:15	15:00	60.2	64.4	43.5	78.2	
23:30	15:00	59.1	63.0	42.2	79.4	
23:45	15:00	58.5	63.3	41.4	74.5	
00:00	15:00	58.2	63.4	42.0	69.9	
00:15	15:00	56.4	60.8	39.5	70.7	
00:30	15:00	56.3	59.5	40.8	71.4	
00:45	15:00	55.0	56.4	39.9	72.6	
01:00	15:00	52.7	52.0	38.7	70.7	
01:15	15:00	50.4	49.1	38.5	68.3	
01:30	15:00	56.0	55.8	38.6	77.3	
01:45	15:00	53.6	54.8	37.5	70.3	
02:00	15:00	53.4	56.0	37.6	68.7	
02:15	15:00	56.1	58.1	37.0	72.8	
02:30	15:00	55.4	58.0	37.9	71.6	
02:45	15:00	51.7	53.1	37.4	70.9	
03:00	15:00	51.7	52.9	38.3	70.2	
03:15	15:00	55.5	57.6	38.0	75.2	
03:30	15:00	55.7	57.9	37.8	75.8	
03:45	15:00	53.7	57.1	37.7	71.5	
04:00	15:00	54.6	58.7	38.1	68.6	
04:15	15:00	55.5	59.4	39.2	69.8	
04:30	15:00	56.9	61.2	40.6	71.7	
04:45	15:00	55.6	58.7	40.5	71.7	
05:00	15:00	57.7	60.9	41.1	78.5	
05:15	15:00	59.9	64.7	43.8	72.4	
05:30	15:00	62.6	67.0	47.4	74.7	
05:45	15:00	62.0	66.5	47.1	71.6	
06:00	15:00	62.5	66.9	48.3	77.3	Road traffic noise
06:15	15:00	63.7	67.7	51.5	73.9	Road traffic noise
06:30	15:00	64.1	68.1	51.7	74.0	
06:45	15:00	64.9	68.3	53.5	74.6	
Average 2300-0700		58.9	60.2	41.6	68.3-79.4	

Noise Survey Results

Date: 27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 12**
Client: Davidsons
Project: Residential Development
Data: **Position 3 - 2m Northern Boundary Adjacent to Nottingham Road**
Instrumentation: Pulsar Model 63 Integrating sound level meter (40196)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
07:00	15:00	65.5	68.3	56.1	74.7	
07:15	15:00	66.3	68.8	59.9	75.2	
07:30	15:00	66.8	69.1	61.2	80.4	
07:45	15:00	64.8	67.8	57.5	73.4	
08:00	15:00	64.5	67.7	56.5	72.9	
08:15	15:00	65.8	68.2	61.2	77.4	
08:30	15:00	65.2	67.9	60.3	75.3	
Average 0700-0845		65.6	68.3	59.0	72.9-80.4	
Average 0700-2300		65.9	68.4	58.3	68.3-84.1	C
Average 2300-0700		58.9	60.2	41.6	68.3-79.4	C

Noise Survey Results

Date: 26th November 2009

Location: Former Long Eaton Speedway Stadium

TABLE 13

Client: Davidsons

Project: Residential Development

Data: **Position 4 - Station Road**

Instrumentation: Pulsar Model 30 Integrating sound level meter (T222641)

Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
09:15	15:00	62.2	64.6	50.6	77.4	Road traffic noise
09:30	15:00	59.6	62.7	48.9	76	
09:45	15:00	60	62.8	49.9	75	0954 Goods Train
10:00	15:00	60.2	62.8	50.5	73	
10:15	15:00	59.5	62.1	49	72.5	1017 & 1022 Goods Train
10:30	15:00	59.6	62.9	47.6	74.8	
10:45	15:00	59.5	62.2	48.7	72.9	1049 Goods Train
11:00	15:00	58.3	61.7	48	69.6	
11:15	15:00	57.9	61	48.7	69.7	Road traffic noise
11:30	15:00	59.5	61.2	49.6	78.5	
11:45	15:00	58.8	62.1	49	71.7	1149 Goods Train
12:00	15:00	58.8	61.6	48.7	70.9	
12:15	15:00	58.6	61.6	49.2	70	Road traffic noise
12:30	15:00	58.1	61.4	49.2	69.2	1240 Goods Train
12:45	15:00	58.8	61.7	48.6	73.5	
13:00	15:00	58.4	61.3	47.5	73.8	Road traffic noise
13:15	15:00	59.3	62.1	48.8	73.9	1316 Goods Train
13:30	15:00	60.2	62.7	49.4	75.9	
13:45	15:00	59	61.9	49.3	68.6	
14:00	15:00	58.5	61.6	49.1	68.1	Road traffic noise
14:15	15:00	58.5	61.1	47.6	77.8	
14:30	15:00	60.5	61.6	47.6	79.3	
14:45	15:00	58.7	60.9	47.7	79.1	
15:00	15:00	63.1	62	50.5	84.3	Road traffic noise
15:15	15:00	58.9	61.1	50.6	72.4	1520 Goods Train
Average 0915-1530		59.5	61.9	49.0	68.1-84.3	

Noise Survey Results

Date: 26th November 2009

Location: Former Long Eaton Speedway Stadium

TABLE 14

Client: Davidsons

Project: Residential Development

Data: **Position 4 - Station Road**

Instrumentation: Pulsar Model 30 Integrating sound level meter (T222641)

Weather Conditions: Dry, variable cloud cover, light southerly winds (1-2m/s), temp. 5-9degC

Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
15:30	15:00	59.3	61.9	49.4	75.7	1530 Goods Train
15:45	15:00	59.8	62.3	50	73.2	Road traffic noise
16:00	15:00	59.7	62.1	49.8	72.1	
16:15	15:00	63.4	63.1	52.1	83.7	1617,1624,1627 Goods Train
16:30	15:00	59.8	62	51	72.5	
16:45	15:00	59.9	62.1	49	78	
17:00	15:00	61.7	63.3	52.3	79.3	Road traffic noise
17:15	15:00	61.1	63.1	50.5	78.6	
17:30	15:00	59.2	62.2	49.8	69.3	Road traffic noise
17:45	15:00	59.2	61.8	49.4	72.7	
18:00	15:00	58.5	61.5	48.9	69.9	1812 Goods Train
18:15	15:00	58.7	61.7	48.8	71.2	1823 Goods Train
18:30	15:00	58.1	60.7	50.7	68.6	1833 Goods Train
18:45	15:00	58.2	60.5	50.6	74.6	
19:00	15:00	57.5	60.5	49.7	68.8	
19:15	15:00	56.3	59.2	48.3	69.1	Road traffic noise
19:30	15:00	56.3	59.5	48	65.6	
19:45	15:00	56.4	59.7	47	67.3	
20:00	15:00	55.2	58.3	47.4	65.5	
20:15	15:00	55.3	59	46.5	67.9	Road traffic noise
20:30	15:00	58.9	59.4	45.6	78.7	
20:45	15:00	56.4	59.3	45.6	73.5	
21:00	15:00	55.1	58.7	45	66.7	Road traffic noise
21:15	15:00	60.4	59.6	44.3	83.1	Road traffic noise
21:30	15:00	51.4	55.3	42.2	66	
21:45	15:00	52	55.7	42.8	67.2	
22:00	15:00	54.7	58	43.6	71.2	
22:15	15:00	53.8	57.1	41.7	72.6	2222 Goods Train
22:30	15:00	57.3	56.7	42	79.8	
22:45	15:00	53.4	56.8	41.8	68.4	Road traffic noise
Average 1530-2300		58.4	60.0	47.5	65.5-83.7	

Noise Survey Results

Date: 26th-27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 15**
Client: Davidsons
Project: Residential Development
Data: **Position 4 - Station Road**
Instrumentation: Pulsar Model 30 Integrating sound level meter (T222641)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmx (dB)	Observations
23:00	15:00	51.3	55.4	41.2	64.9	Intermittent road traffic noise
23:15	15:00	50.8	55.1	41.7	63.2	2320 Goods Train
23:30	15:00	52.3	56.2	40.7	69.5	2340 Goods Train
23:45	15:00	49.5	51.8	40.9	64.8	
00:00	15:00	50.5	52.6	41.7	68.1	
00:15	15:00	48.3	48.3	40.7	65.1	
00:30	15:00	52.8	54.9	41.2	66.6	0040 Goods Train
00:45	15:00	49.1	51.4	40.5	63	
01:00	15:00	46.2	47.9	39.4	62.7	
01:15	15:00	45	43.9	39.3	59.8	
01:30	15:00	47.5	47.7	39.3	64.9	
01:45	15:00	46.6	47.3	38.5	61.2	
02:00	15:00	45.5	44.4	38.5	61.6	
02:15	15:00	40	40.9	38.3	44.3	
02:30	15:00	45	42.9	39.2	61.8	
02:45	15:00	51.8	46.9	38.6	77.9	
03:00	15:00	47.4	44.5	39.5	66	
03:15	15:00	46.8	44.3	39.2	67.4	
03:30	15:00	43	43.5	39.3	57	
03:45	15:00	47.2	45	38.9	64	
04:00	15:00	47.2	42	38.8	70.4	
04:15	15:00	45.7	43.6	40.8	64.9	
04:30	15:00	46.3	44.9	41.6	63.5	
04:45	15:00	50.8	52.8	41.5	71.2	
05:00	15:00	47.5	47.2	41.9	62.3	
05:15	15:00	50.9	54.7	42.8	65.8	
05:30	15:00	56.1	57.8	44.3	77.4	Intermittent road traffic noise
05:45	15:00	55.1	58.8	44.5	73.1	0548 Goods Train
06:00	15:00	53.8	58	45.3	66.1	0600,0607 Goods Train
06:15	15:00	55.2	58.4	45.3	71.5	Intermittent road traffic noise
06:30	15:00	53.9	57.9	45.7	66.7	Intermittent road traffic noise
06:45	15:00	55.3	59.4	46.6	65.3	0651 Goods Train
Average 2300-0700		50.8	50.0	41.1	44.3-77.9	

Noise Survey Results

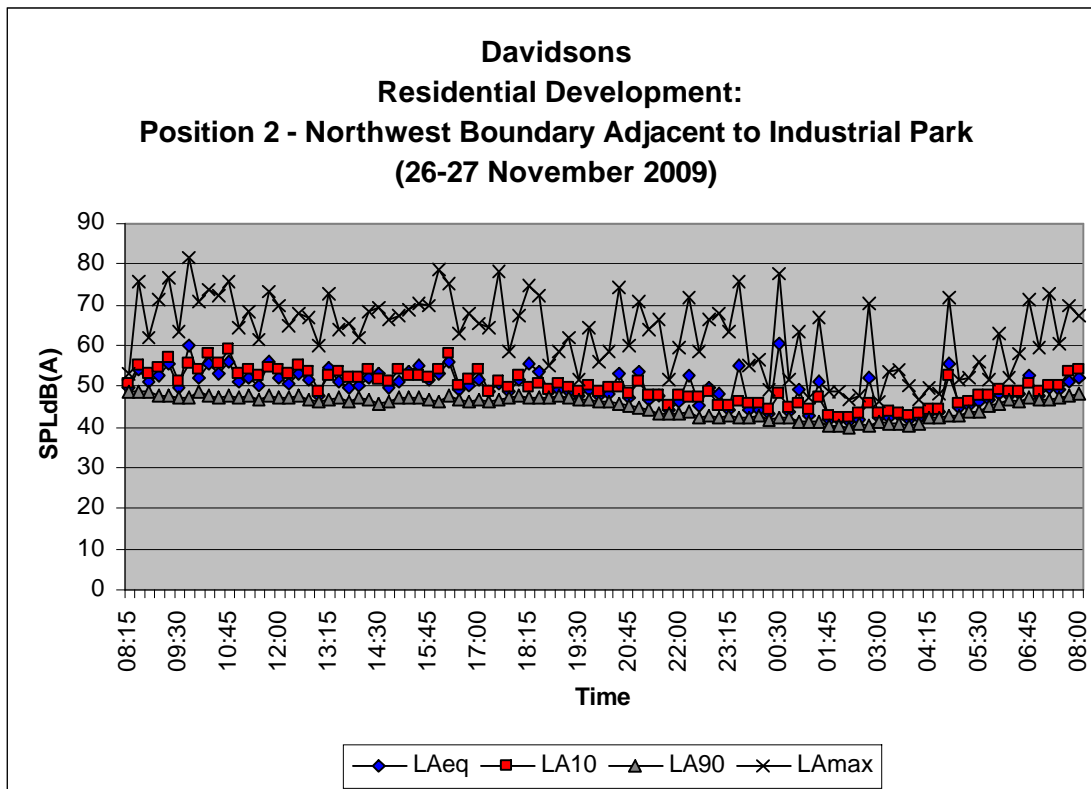
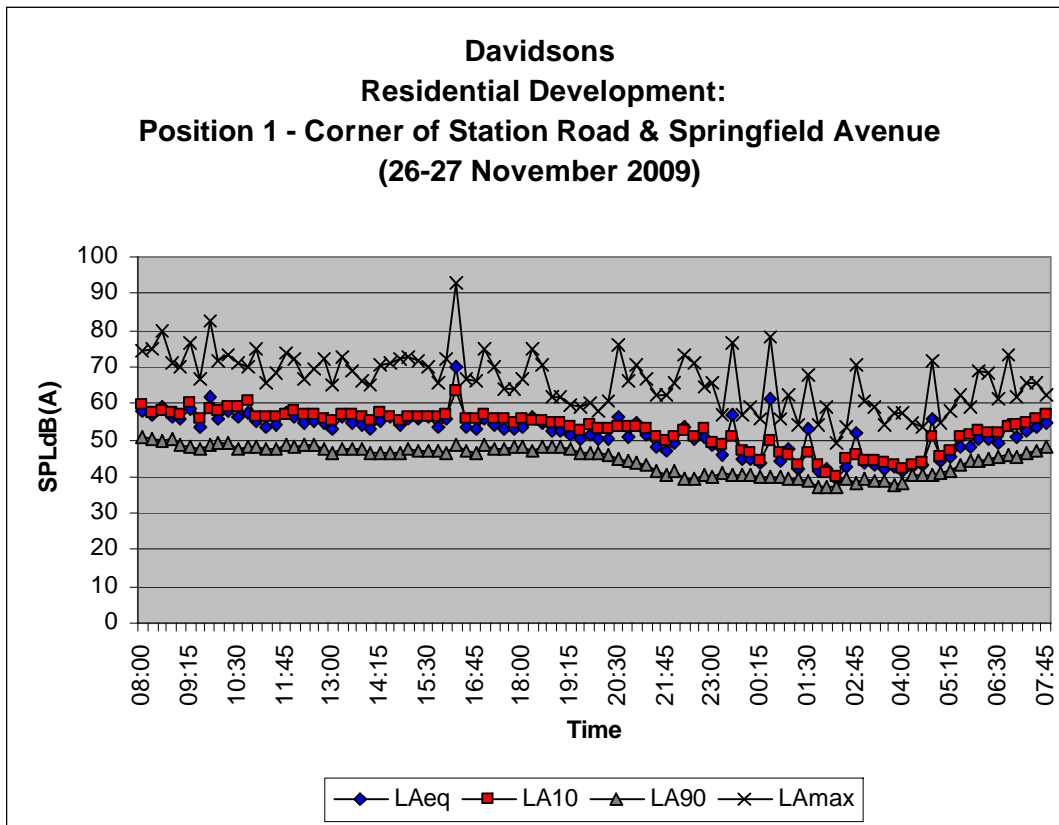
Date: 27th November 2009
Site: Former Long Eaton Speedway Stadium **TABLE 16**
Client: Davidsons
Project: Residential Development
Data: **Position 4 - Station Road**

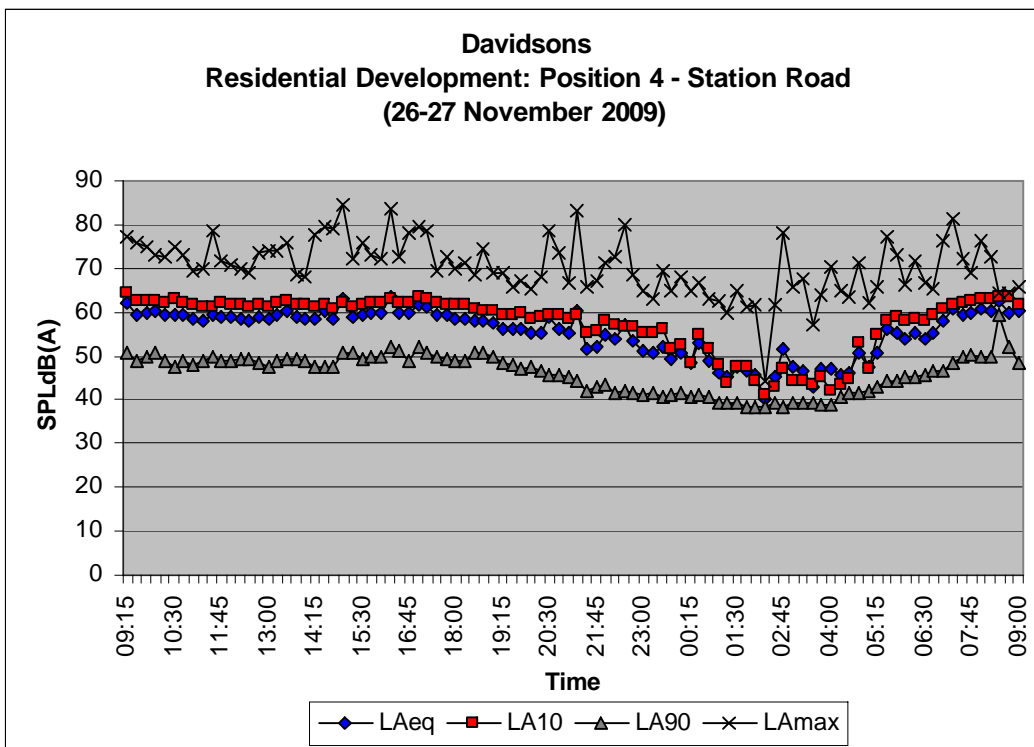
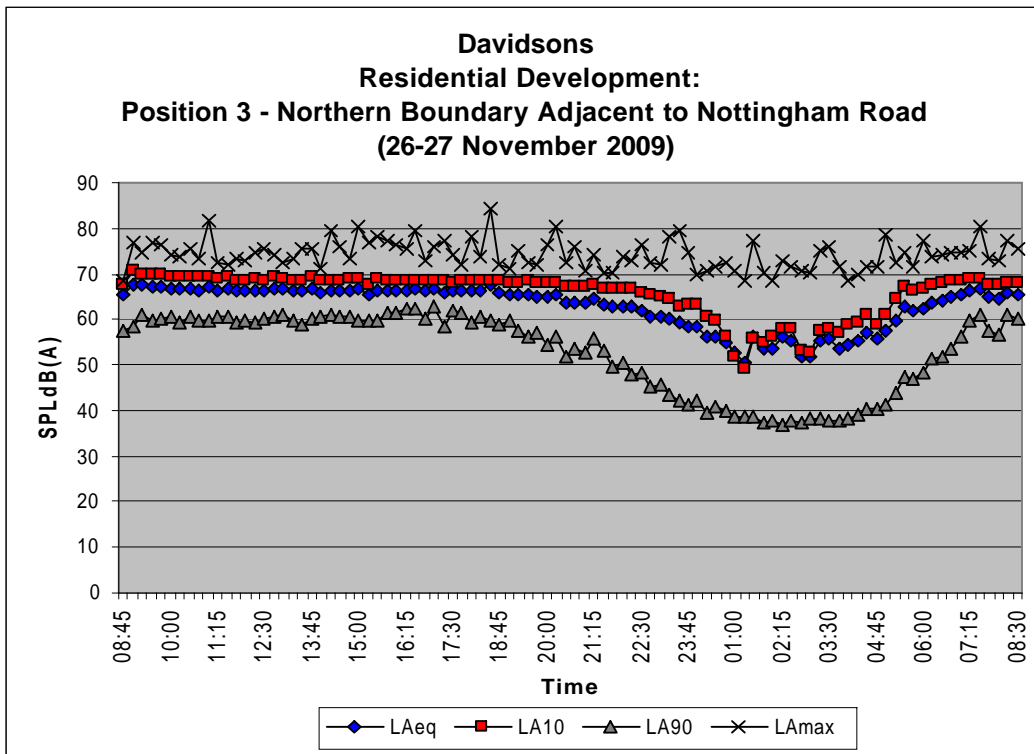
Instrumentation: Pulsar Model 30 Integrating sound level meter (T222641)
Weather Conditions: Dry, clear skies, light south to southwest winds (1-2m/s), temp.4-6degC
Calibration: 94dB

Start Time	Run Time (mins.)	LAeq (dB)	LA10 (dB)	LA90 (dB)	LAmix (dB)	Observations
07:00	15:00	58.1	60.6	46.4	76.1	
07:15	15:00	60.6	61.5	48.2	81.2	
07:30	15:00	59.4	62.1	49.9	72.1	
07:45	15:00	59.9	62.7	50.2	68.9	
08:00	15:00	60.7	63	49.9	76.3	
08:15	15:00	60.5	63.2	49.9	72.7	
08:30	15:00	62.4	63.3	59.5	64.4	
08:45	15:00	59.8	63.6	52.1	64.5	
09:00	15:00	60.1	61.5	48.6	65.6	
Average 0700-0915		60.3	62.4	50.5	64.4-81.2	
Average 0700-2300		59.1	61.1	48.5	64.4-84.3	B
Average 2300-0700		50.8	50.0	41.1	44.3-77.9	B

TABLE 17

Position	LAeq	LAF(max)	LA10	LA90
5. Site gate	51.7	61.7	54	48.7
6. 1m Station Rd	62	73.3	65.9	51.8
7. Adjacent to Primary School	60.4	65.3	62	58.3
8. 20m Nottingham Road	58	71.9	60.7	54.5
9. 40m Nottingham Road	58.9	66.1	60.9	55.2
10. School boundary (children playing)	55.3	66.5	57	52.4
11. Station Road (behind wall)	51.9	60.6	53.7	49.3
12. Corner Station Rd/Springfield Avenue	53.7	63.9	55.2	51.9
13. Springfield Avenue 60m Station Rd	51.7	65.4	54	48.6
14. Position 11	56.7	70	60.1	49.5
Position	LAeq (dB)	Equivalent 16hr Av. LAeq (dB)		NEC
5. Site gate	51.7	52.4		A
6. 1m Station Rd	62	60.7		B
7. Adjacent to Primary School	60.4	59.1		B
8. 20m Nottingham Road	58	57		B
9. 40m Nottingham Road	58.9	58.4		B
10. School boundary (children playing)	55.3	54.9		A
11. Station Road (behind wall)	51.9	52.7		A
12. Corner Station Rd/Springfield Avenue	53.7	56.4		B
13. Springfield Avenue 60m Station Rd	51.7	54.1		A





APPENDIX C

RESULTS OF VIBRATION MONITORING

**PPV & VDV Vibration Measurements of Train Movements
Transducer at South Western Boundary**

Using Vibrock V901 Seismograph

Time	Position	Max PPV (mm/sec)	VDV for each axis (m.s ^{-1.75})		
			x	y	z
26th - 27th November 2009					
0800-0900	1m south western boundary	0.25	0.019	0.018	0.015
0900-1000	1m south western boundary	0.275	0.019	0.019	0.015
1000-1100	1m south western boundary	0.275	0.019	0.019	0.015
1100-1200	1m south western boundary	0.225	0.019	0.019	0.015
1200-1300	1m south western boundary	0.25	0.019	0.019	0.015
1300-1400	1m south western boundary	0.275	0.019	0.019	0.015
1400-1500	1m south western boundary	0.25	0.019	0.019	0.015
1500-1600	1m south western boundary	0.25	0.019	0.019	0.015
1600-1700	1m south western boundary	0.25	0.019	0.019	0.015
1700-1800	1m south western boundary	0.25	0.019	0.02	0.015
1800-1900	1m south western boundary	0.275	0.019	0.02	0.015
1900-2000	1m south western boundary	0.2	0.019	0.02	0.015
2000-2100	1m south western boundary	0.2	0.019	0.02	0.015
2100-2200	1m south western boundary	0.2	0.019	0.02	0.015
2200-2300	1m south western boundary	0.25	0.018	0.018	0.016
0700-0800	1m south western boundary	0.275	0.019	0.02	0.017
26th-27th November 2009					
2300-0000	1m south western boundary	0.25	0.02	0.02	0.015
0000-0100	1m south western boundary	0.25	0.02	0.02	0.015
0100-0200	1m south western boundary	0.25	0.02	0.02	0.016
0200-0300	1m south western boundary	0.25	0.02	0.02	0.016
0300-0400	1m south western boundary	0.25	0.02	0.02	0.016
0400-0500	1m south western boundary	0.25	0.02	0.02	0.016
0500-0600	1m south western boundary	0.25	0.02	0.02	0.016
0600-0700	1m south western boundary	0.25	0.02	0.02	0.016

Calibration Due Date: February 2010

VDV 16-HOUR DAYTIME TOTAL = **X Y Z**
 0.038 0.039 0.03

VDV 8-HOUR NIGHT-TIME TOTAL = **X Y Z**
 0.034 0.034 0.027

Nomis Seismograph Results:

Date	Time	PPV (mm/sec)			Peak Frequency (Hz)
		X	Y	Z	
Daytime					
26 th November	08:19	0.381	0.381	0.254	46.5 & 56.8
" "	08:31	0.381	0.445	0.318	56.8
" "	08:31	0.318	0.381	0.127	64
" "	09:36	0.254	0.381	0.127	85.3
" "	09:53	0.254	0.127	0.254	16.5 & 28.4
" "	09:53	0.254	0.191	0.254	5.8 & 18.2
" "	10:20	0.254	0.254	0.127	64 & 85.3
" "	12:17	0.254	0.191	0.191	56.8
" "	14:40	0.254	0.127	0.191	17
" "	14:59	0.318	0.064	0.191	64
" "	15:32	0.254	0.127	0.191	13.4
" "	15:32	0.254	0.127	0.191	6.1
" "	15:32	0.254	0.127	0.127	11.9
" "	16:22	0.254	0.254	0.191	85.3
" "	17:32	0.508	0.381	0.254	64
" "	17:39	0.445	0.191	0.127	2.6
" "	20:41	0.381	0.127	0.254	64
" "	21:02	0.318	0.127	0.191	56.8
" "	21:02	0.318	0.127	0.191	9.3
" "	21:02	0.254	0.127	0.127	9.8
Night-time					
27 th November	00:42	0.254	0.191	0.254	22.2 & 25.6
" "	00:42	0.254	0.127	0.254	21.3 & 19.6
" "	00:42	0.318	0.127	0.191	18.9
" "	00:42	0.254	0.127	0.191	10.6
" "	00:42	0.254	0.191	0.191	4.4
" "	02:58	0.254	0.127	0.127	16.5
" "	02:58	0.254	0.127	0.127	4.2
" "	02:58	0.254	0.127	0.191	4
" "	03:28	0.699	0.127	0.445	64
" "	04:10	0.318	0.445	0.381	73.1
" "	04:53	0.254	0.127	0.191	46.5
" "	04:53	0.254	0.127	0.127	2.3
" "	04:53	0.254	0.127	0.127	13.8
" "	06:05	0.381	0.572	0.254	12.8
" "	06:13	0.318	0.381	0.254	22.2

Calibration due date: 31.12.09

	DAYTIME			NIGHT-TIME		
	X	Y	Z	X	Y	Z
MAX PPV (MM/SEC):	0.508	0.445	0.318	0.699	0.445	0.445

APPENDIX D

VIBRATION TERMINOLOGY

VIBRATION TERMINOLOGY

Ground Borne Vibrations

For any source of vibration on or near the surface of the ground, energy propagates away from the source via:

- a) elastic body (or compression) waves – which radiate energy into the ground in all directions
- b) surface (or shear) waves – which carry energy along the ground surface, caused when body waves are reflected back into the ground at the ground-surface interface

Thus, at any point away from that source, the ground motion is the sum of all the wave motions at that point. When wave motion has been generated, the waves will be attenuated as they travel away from the source. The two main mechanisms for attenuation are:

- a) enlargement of the wave front as the distance from the source increases, and
- b) internal damping of the transmitting medium (the ground)

Ground borne vibration is therefore made up of a combination of different waves, travelling in different directions, at different speeds and at different frequencies. The frequency component of the vibration will affect the rate at which attenuation occurs since the internal damping of the ground is frequency dependent.

Since vibration enters buildings through the foundations, the hard structure of the building is normally affected to a greater degree than by air borne vibration. Often ground borne vibrations are more noticeable when standing or sitting near the middle of suspended wooden floors.

Ground Borne Vibration Measurement Units

Ground borne vibration is caused when the individual particles making up the strata are caused to oscillate by the passage of a pressure wave. The resulting vibration can be summarized in terms of 4 main parameters:

- a) Velocity – how fast the particles move when they are oscillating. Since the velocity of these particles continually change as the pressure wave passes the most useful value that is often reported is the maximum or peak particle velocity (PPV). PPVs are usually expressed in terms of ms^{-1} or mms^{-1} .
- b) Acceleration – is the rate at which the particle velocity changes during oscillation. It is usually measured in ms^{-2} mms^{-2} or “g’s”. 1g is that acceleration imparted to an object by the earth’s gravitational pull and is approximately 9.81 ms^{-2} .

- c) Displacement – is the distance moved by oscillating particles. This is usually very small and measured in mm or even μm .
- d) Frequency – is the number of oscillations per second which a particle undergoes due to the passage of a vibration wave. It is measured in cycles per second or Hertz (Hz).

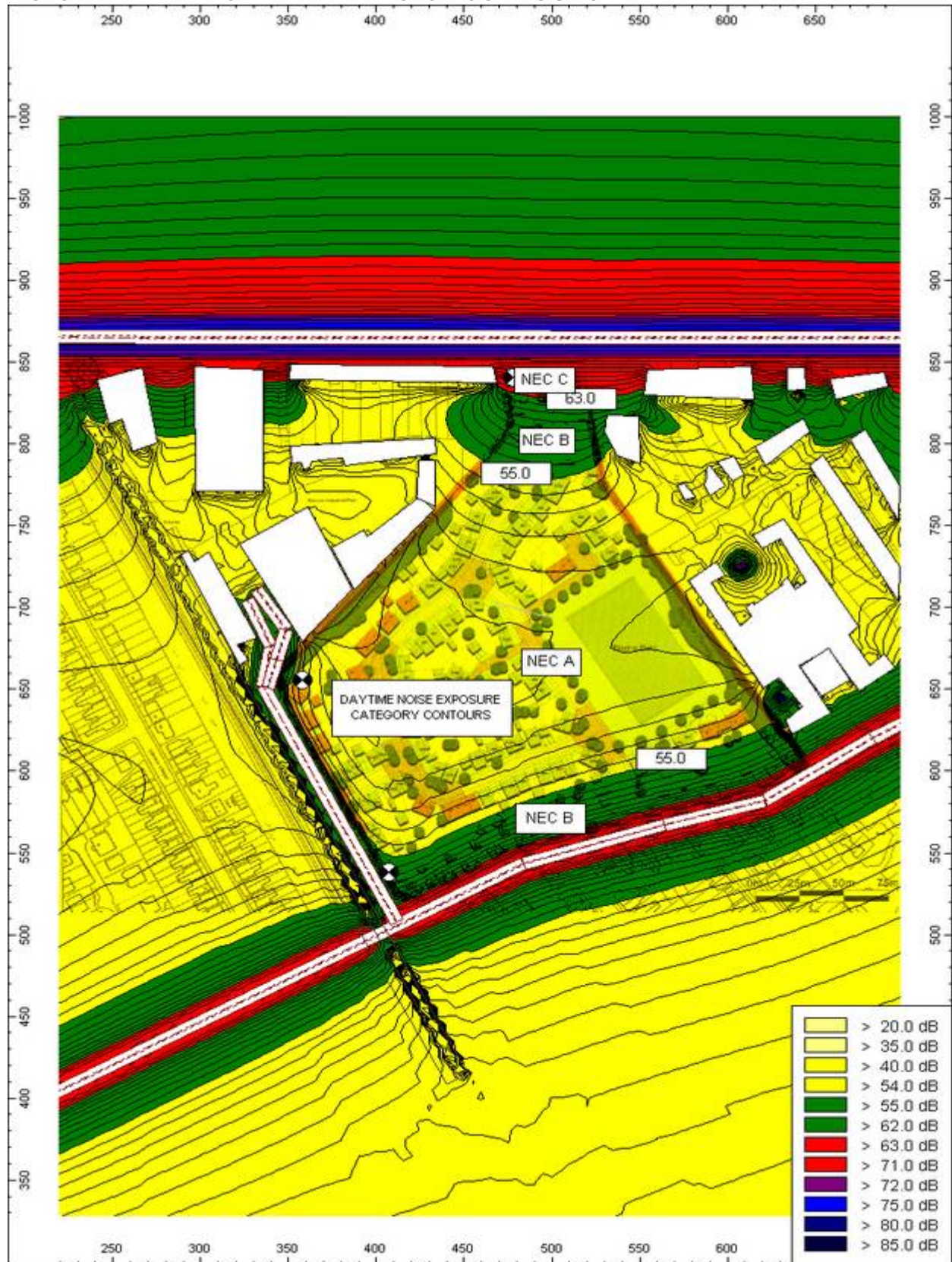
The movement of particles induced to oscillate by vibration waves are usually measured in three mutually perpendicular directions to fully describe the vibration intensity, as particles will be oscillating in three dimensions. These are:

- a) Longitudinal – back and forth particle movement in the same direction that the vibration wave is travelling.
- b) Vertical – up and down movement perpendicular to the direction the vibration wave is travelling.
- c) Transverse – left and right particle movement perpendicular to the direction the vibration wave is travelling.

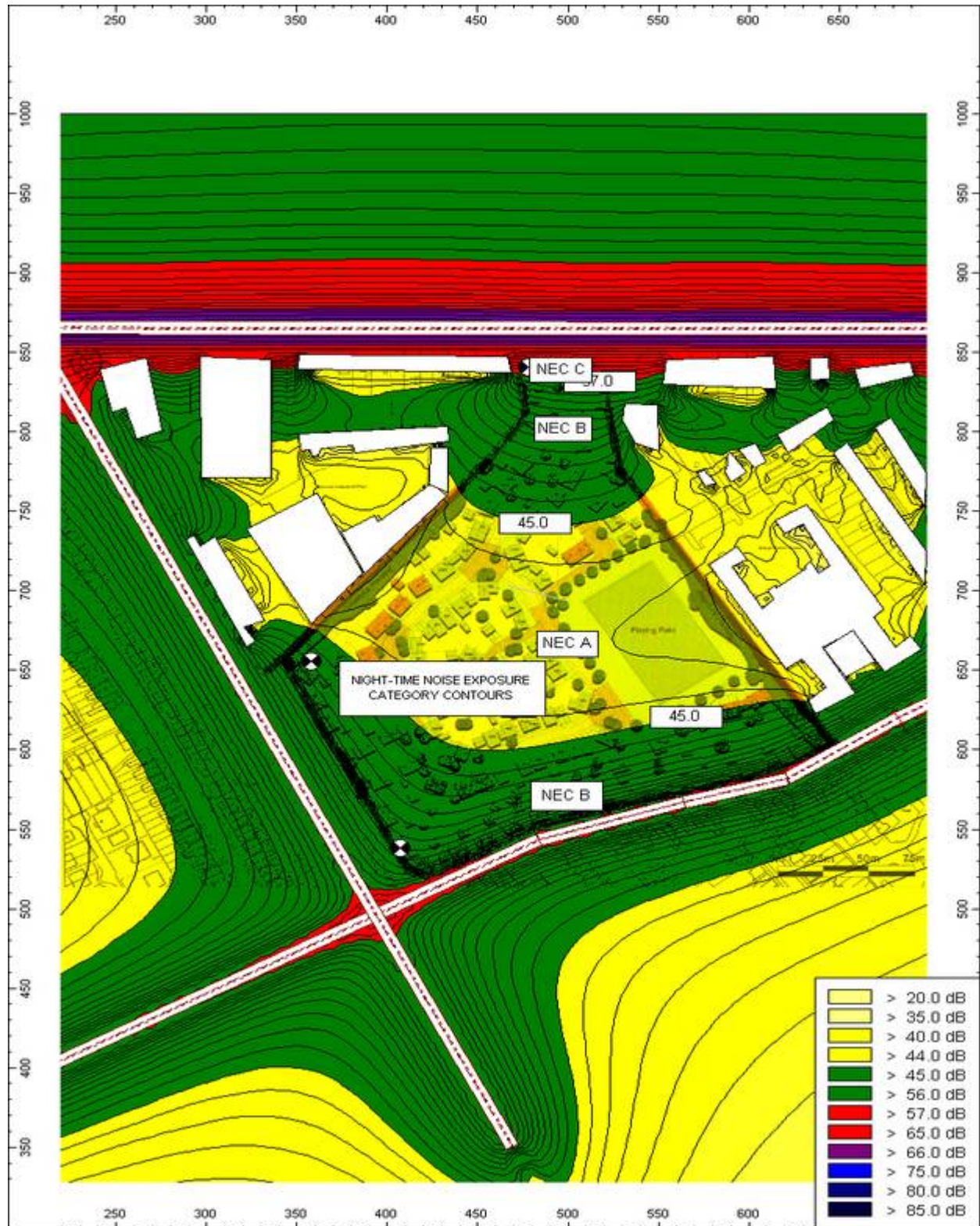
APPENDIX E

NOISE MAPPING

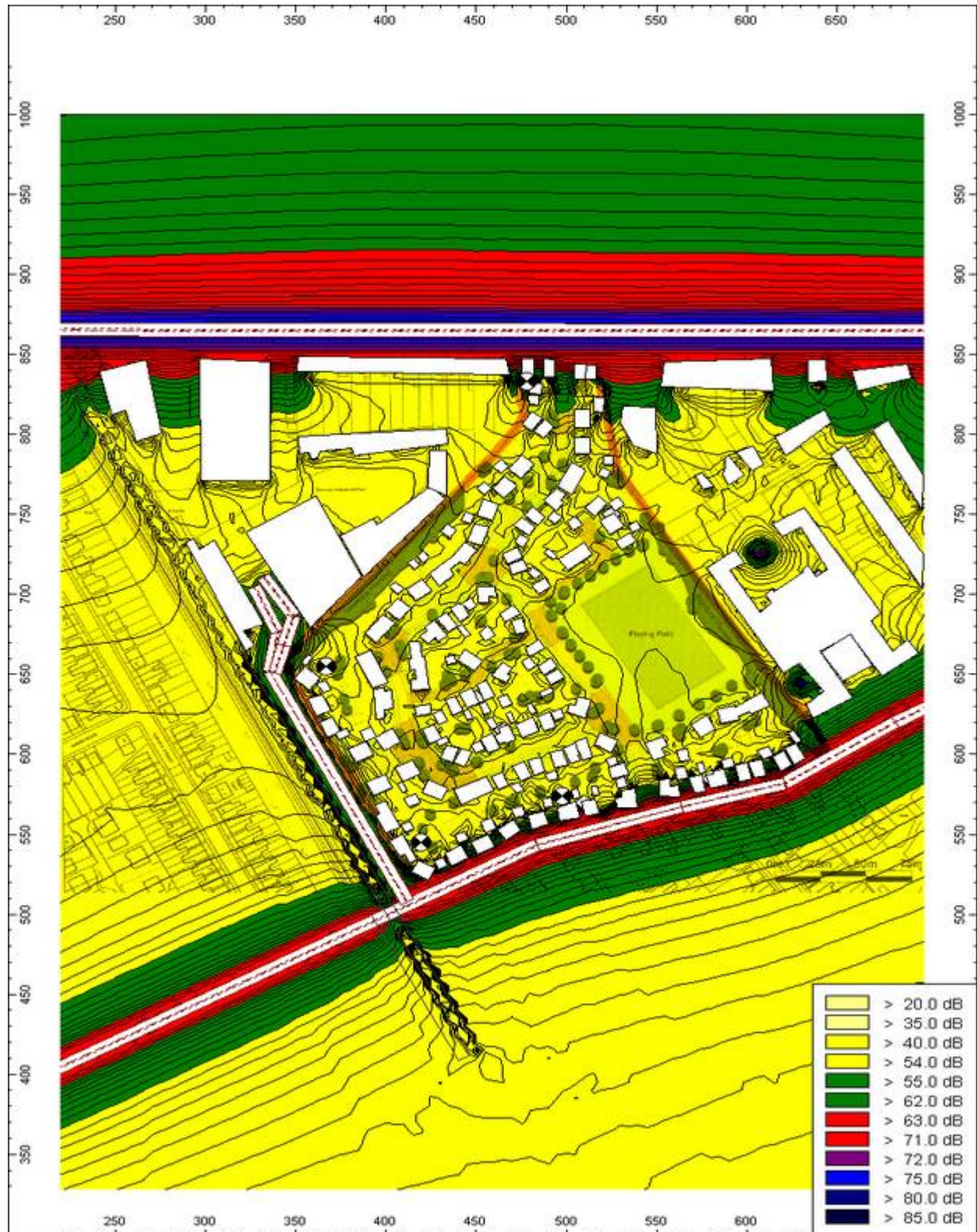
NOISE MAP 1: NEC DAYTIME NOISE CONTOURS



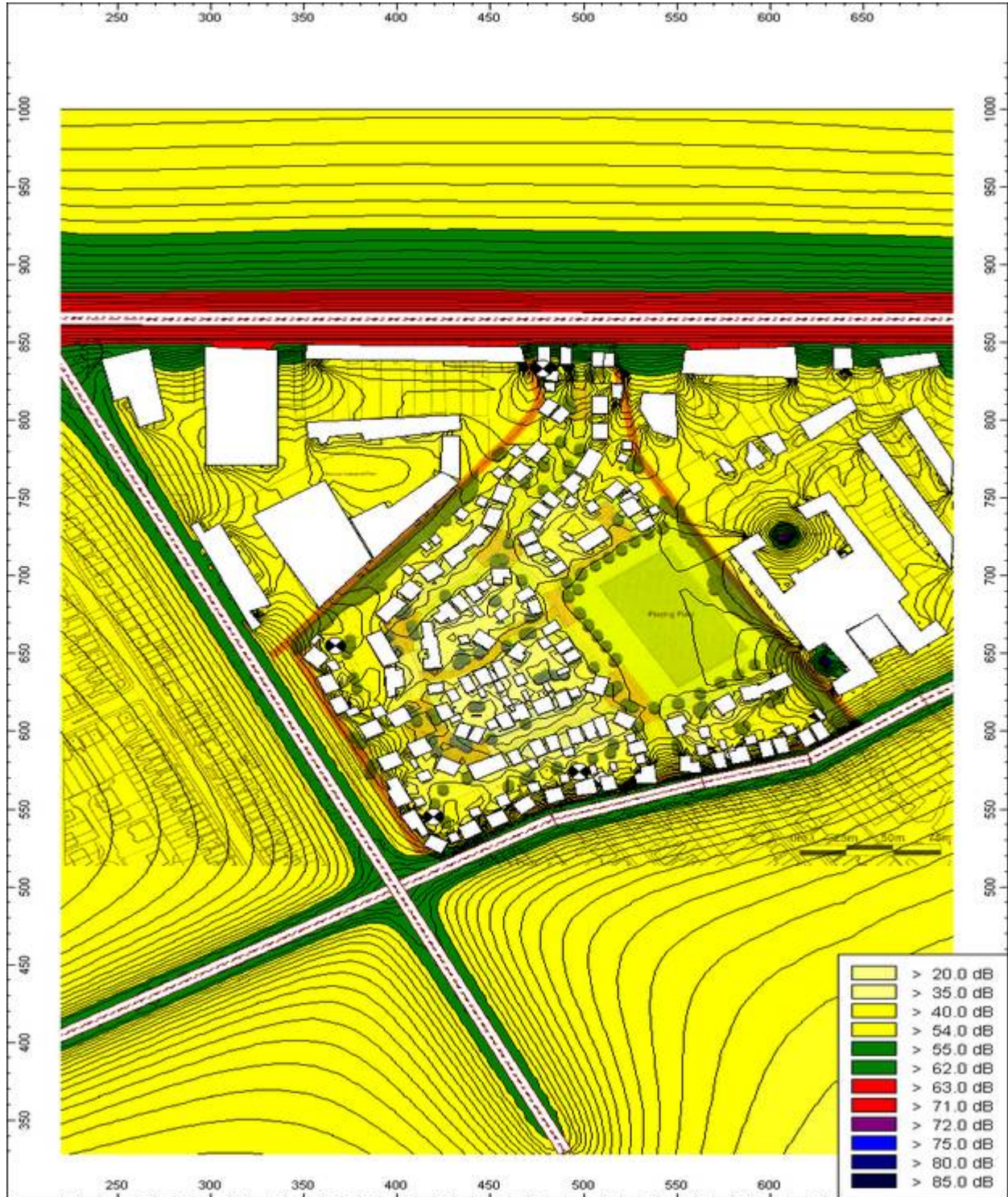
NOISE MAP 2: NEC NIGHT-TIME NOISE CONTOURS



NOISE MAP 3: DAYTIME NEC CONTOURS WITH BUILT SITE & BOUNDARY SCREENING



NOISE MAP 4: NIGHT-TIME NEC CONTOURS WITH BOUNDARY SCREENING



APPENDIX F

CONSULTANT'S EXPERIENCE & QUALIFICATIONS

**Consultant: Dean Robert Kettlewell - MSc MIOA MAE I.Eng
(Director - Principal Acoustic Consultant)**

Précis

As Director and Principal Acoustic Consultant with Noise & Vibration Consultants Ltd, Dean has over 25 years background experience in a wide range of issues relating to environmental, industrial and commercial noise and vibration assessment. He currently manages corporate and unit specific contracts for:

- Assessment of Environmental & Industrial Noise
- Environmental Noise Impact Assessments
- Expert Witness representation for Deafness and 'Vibration White Finger' Claims
- Integrated Pollution Prevention and Control (IPPC) Applications
- Industrial Noise Assessment and Control
- Planning Issues for Residential and Commercial Development
- Noise at Work Regulations Assessments
- Building Acoustics and Sound Insulation Tests
- Wind Farm Noise Impact Assessments
- Entertainment Noise Assessment and Control
- Architectural Acoustics
- Specialist knowledge in the Design of Noise Control Systems
- Ground borne vibration measurement and assessment
- Project Management of Noise Control Systems
- Hand-arm Vibration Assessments

Relevant Work Experience

Director & Principal Consultant - Noise & Vibration Consultants Ltd	2001- to date
Senior Acoustic Consultant - Vibrock Limited	1998 - 2001
Associate & Principal Acoustic Consultant - John Savidge & Associates	1994 - 1998
Technical Manager – LBJ Limited (Noise Control Division)	1990 - 1994
Technical Engineer/ Technical Manager (1988) - Vibac (Noise Control) Ltd	1982 - 1990

Qualifications and Education

M.Sc. Applied Acoustics (Derby University – Distinction)
HNC Electrical & Electronic Engineering
IOA Diploma in Acoustics & Noise Control
IOA Certificate in Law and Administration
Certificate of Competence in Workplace Noise Assessment
Certificate of Competence in Ground Vibration Monitoring
Post Graduate Certificate in Applied Acoustics

Affiliations: Member of Institute of Acoustics (MIOA)
Member of Academy of Experts (MAE)
Member of Association of Noise Consultants (ANC)
Incorporated Engineer (I.Eng)

