Noise & Vibration

8

8 Noise and Vibration

8.1 Introduction

8.1.1 This assessment has been prepared by Brookbanks Consultants Ltd to present the findings of an assessment of the effects of the proposed development on noise and vibration during both the construction and post-completion stages.

8.1.2 Environmental noise rarely reaches the sound pressure levels associated with hearing impairment. However, noise can cause annoyance; it is commonly blamed for sleep disturbance and has been linked by researchers to less obvious effects, such as cardiovascular and mental health problems and reduced performance at work or school.

8.1.3 Human subjects, under laboratory conditions, are generally only capable of noticing changes in steady noise levels of no less than 3dB(A).

8.1.4 The proposed development has the potential for noise impacts associated with operational traffic; and also during the construction phase.

8.1.5 The following sections outline the site conditions and assess the appropriateness of the site for the proposed development in accordance with local and national guidance.

8.1.6 The scale used to identify noise sources is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear recognises sound based on pitch and frequencies. Microphones cannot record noise in the same way; to counter this the noise-measuring instrument applies a correction to correspond more closely to the frequency response of the ear. The correction factor is called “A Weighting” and the resulting measurements are written as dB(A). Typical dB(A) noise levels for familiar noise are indicated below.

Table 8.1: Familiar noise levels

Approximate Noise Level	Mitigation, Monitoring & Controls
10 dB	Normal breathing
20 dB	Rustling leaves, mosquito
30 dB	Whisper
40 dB	Stream, refrigerator humming
50 dB	Quiet office
60 dB	Normal conversation
70 dB	In car noise without radio
80 dB	Vacuum cleaner / washing machine
90 dB	Lawnmower
100 dB	Train
110 dB	Pneumatic Drill
120 dB	Thunder
130 dB	Plane taking off
140 dB	Threshold of pain

8.2 Legislation and Policy

The Control of Pollution Act 1974

8.2.1 The Control of Pollution Act 1974 section 62 and 63 contains powers for local authorities to deal with noise and vibration from construction and demolition sites.

The Planning and Compulsory Purchase Act 2004

8.2.2 The Planning and Compulsory Purchase Act 2004 requires local authorities to draw up local development plans setting the broad framework for acceptable development in their area and reconciling the conflicts inherent in development.

8.2.3 Under the Town and Country Planning Act 1990, local planning authorities may include planning conditions to planning applications which could include controls on the emission of noise. Advice on the use of these powers is given to English authorities in the light of the Government's Noise Policy Statement for England in the National Planning Policy Framework.

NPPF/PPG24: Planning and Noise

8.2.4 Planning Policy Guidance 24 (PPG24) was introduced by the Department of the Environment in 1994. PPG24 provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unnecessary restrictions on development or unduly adding to the costs and administrative burdens of business. PPG24 contains advice to local authorities regarding the use of their planning powers to minimise the adverse impacts of noise when considering planning applications for new residential developments.

8.2.5 The Department of Communities and Local Government published the National Planning Policy Framework (NPPF) in March 2012. This was produced to support the reforms of the planning system and to promote sustainable growth. The NPPF withdrew PPG24, however, in the absence of the up to date appraisal criteria, the Noise Exposure Category (NEC) criteria provided by PPG24 are largely accepted as the preferred methodology.

8.2.6 Through discussions with the Environmental Health Officer, it has been agreed that the Noise Exposure Categories (NECs) for residential development indicated within PPG24 remain relevant for the purpose of this assessment.

8.2.7 PPG24 recommends appropriate levels for exposure to different noise sources, as indicated below.

Table 8.2: Noise Exposure Categories

NEC Boundary	Mixed Noise Sources		Planning Advice
	Daytime (07:00-23:00) LAeq 16hr dB	Night Time (23:00-07:00) LAeq 8hr dB	
A	<55	<45	Noise need not be considered as a determining factor in granting planning permission, although noise at the high end of the category should not be regarded as a desirable level.
B	55 – 63	45-57	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	63 – 72	57-66	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	>72	66>	Planning permission should normally be refused.

8.2.8 Paragraph 123 of NPPF indicates that planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Noise Policy Statement for England

8.2.9 The Noise Policy Statement for England of March 2010 (Defra, 2010) provides a more overarching policy statement on the approach to noise in England.

8.2.10 This Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy, to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

8.2.11 The NPSE indicates that noise should not be considered in isolation of the wider benefits of a proposed. The intention is to minimise noise impacts as far as is reasonably practicable.

8.2.12 The explanatory note of NPSE defines the following terms:

"There are two established concepts from toxicology that are currently being applied to noise impacts. They are:

- *NOEL – No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
- *LOAEL – Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected.*
- *SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur."*

8.2.13 The NPSE does not provide a numerical value for the SOAEL, stating at paragraph 2.22:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

National Planning Practice Guidance, 2014

8.2.14 In February 2014 National Planning Practice Guidance (NPPG) was published.

8.2.15 The main objective is to:

"Identify whether the overall effect of noise exposure is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation."

8.2.16 A summary of the effects of noise exposure associated with both noise generating developments and noise sensitive developments is presented within the NPPG as indicated below.

Table 8.3: Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the	Observed Adverse Effect	Mitigate and reduce to a minimum

Perception	Examples of Outcomes	Increasing Effect Level	Action
	acoustic character of the area such that there is a perceived change in the quality of life.		
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

8.2.17 The guidance identifies that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation. These factors include:

- The source and absolute level of the noise together with the time of day it occurs.
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- The spectral content of the noise (i.e whether or not the noise contains particular high or low frequency content) and the general character of the noise

8.2.18 More specific factors to consider when relevant:

- Where applicable, the cumulative impacts of more than one source should be taken into account
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows
- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed

8.2.19 In relation to how noise can be mitigated, this is dependent on the type of development being considered and the character of the proposed location. In general, for noise making developments, there are four broad types of mitigation:

- Engineering: reducing the noise generated at source and/or containing the noise generated;

- Layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission through the use of screening by natural or purpose built barriers, or other buildings;

- Using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night, and;

- Mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building.

8.2.20 There are further considerations relating to mitigation of noise on residential developments. The noise impact may be partially off-set if the residents of those dwellings have access to:

- A relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;

- A relatively quiet external amenity space for their sole use or a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings

- A relatively quiet, protected, external publically accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).

Application of NPSE

8.2.21 For the purposes of this assessment, the recommended external noise levels have been defined as follows:

- External Noise
  - NOEL: noise levels less than 50 dB
  - LOAEL: noise levels between the 50 dB and 55dB
  - SOAEL: noise levels above the upper 55 dB
- Internal Noise
  - NOEL: noise levels less than 30 dB
  - LOAEL: noise levels between the 30 dB and 35dB
  - SOAEL: noise levels above the upper 35 dB

British Standard 8233:2014; Sound Insulation and Noise Reduction for Buildings

8.2.22 BS8233:2014 gives recommendations for the control of noise in and around buildings and suggests appropriate criteria and internal noise limits for habitable rooms of residential dwellings. In accordance

with the requirements of BS8233, the following internal and daytime noise limits will need to be net with sensitive rooms of the residential dwellings:

- 35dB LAeq (16 hour) during the daytime in living rooms; and
- 30dB LAeq (8 hour) during the night time in bedroom areas.
- 55 dB LAeq,T for noise in external amenity areas.

Calculation of Road Traffic Noise

8.2.23 The Calculation of Road Traffic Noise (CRTN) is the standard UK procedure for defining measurement and calculation methods for assessing road traffic noise. The procedures assume typical traffic and noise propagation conditions, which are consistent with moderately adverse wind speeds and direction during the specified periods.

8.2.24 All predicted noise levels are expressed in terms of LA10 (1-hour) or LA10 (18-hour) between 0600 and 2400. The LA10 (18-hour)) is the arithmetic average of the values of LA10 hourly data for each of the eighteen 1-hour periods between 0600 and 2400.

British Standard 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites

8.2.25 BS5228: 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' sets out the methodology to predict construction noise and the control of noise and vibration. It provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it, and also recommendations for basic methods of vibration control.

8.2.26 The standard provides guidance for identifying the significance of noise and vibration levels from surface construction activity. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the addition of construction noise.

8.2.27 There are no national noise criteria for limiting noise from construction sites. BS5228 Annex E gives guidance on the significance of noise effects from construction and recommends the ABC method to establish construction noise limits.

8.3 Methodology

8.3.1 The PPG24 assessment considers the noise environment across the Site and therefore the study area has been taken as the application boundary. A wider study to assess the impact within the local road network is based on the CRTN procedures and has been based on the study area adopted within the Transport Assessment which identifies the roads experiencing the highest increase in flows.

Consultation

8.3.2 During the development of this assessment the following statutory bodies and interested parties have been consulted regarding the proposals:

- Karen Cattle; EHO West Suffolk Council

8.3.3 This included the agreement that PPG24 and BS8233:2014, being based on the CRTN, is the most appropriate method to assess the noise environment.

8.3.4 Through the discussions with the Environmental Health Officer, it has been agreed that a noise survey is required for the site due to sensitive receptors being identified.

Significance Criteria

8.3.5 The format of this section of the ES follows a standard study pattern, by setting out an appraisal of the baseline conditions, followed by a description of the proposed development features and an identification of the potential environmental effects due to the proposed development. The importance of each mechanism and an assessment of each potential effect are then considered along with any mitigation measures and recommendations for further investigations where necessary.

8.3.6 Methods of assessment have been employed that are consistent with current guidance and recommendations in the form of statutory documents and recognised publications to ensure that the findings represent a robust approach to the assessment.

8.3.7 The criteria for determining the sensitivity of receptors is provided in Table 8.4 below.

Table 8.4: Sensitivity of Receptor

Sensitivity	Typical Descriptors
Very High	Internationally or nationally protected endangered species which is also known to be noise sensitive (i.e. noise may change breeding habits or threaten species in some other way)
High	Dwellings, habitats supporting locally important wildlife communities that are sensitive to noise
Medium	Schools, hospitals, quiet recreation areas
Low	Officers, cafes/bars with external areas
Negligible	Industrial, retail

8.3.8 The DMRB Volume 11, Section 3, Part 7: Environmental Assessment Procedure is used for the assessment of operational noise impacts for road schemes and gives guidance on the magnitude of impact from noise changes upon the local environment. The significance of predicted increases in road traffic noise as a result of the proposed development has been assessed according to the criteria described below.

8.3.9 The tables below outline the criteria for determining the magnitude in relation to changes in traffic noise, with short term relating to the first occupation of the development with longer term relating to 10 years after opening.

Table 8.5: Magnitude of effect (short term)

Magnitude	
Major	5 +
Moderate	3 – 4.9
Minor	1 – 2.9
Negligible	0.1 – 0.9

Table 8.6: Magnitude of effect (long term)

Magnitude	Change in Traffic Noise (dB)
Major	10 +
Moderate	5 – 9.9
Minor	3 – 4.9
Negligible	0.1 – 2.9

8.3.10 BS5228: 'Code of Practice for noise and vibration control on construction and open sites' is the methodology for the prediction of construction noise, and control of noise and vibration. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the addition of construction noise for the purposes of the proposed development. This significance can be assessed using the criteria below.

Table 8.7: Magnitude of change

Magnitude	Change in Traffic Noise (dB)
Major	5 +
Moderate	0.1 – 4.9

8.3.11 For construction noise effects, the ABC method set out in BS5228 has been used. The approach is based on the following table from BS5228, which identifies the thresholds for significant effects for residential properties.

Table 8.8: Construction noise threshold of significant effect

Assessment Category and Threshold Value Period dB LAeq	A	B	C
Night-time (23:00-07:00)	45	50	55
Evening and weekends (19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays)	55	60	65
Daytime (07:00-19:00)	65	70	75

Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category B values.

Note 1: A significant effect has been deemed to occur if the LAeq noise level for the period during construction exceeds the threshold level for the Category appropriate to the ambient noise level.
Note 2: If the ambient noise level exceeds the threshold values given in the table, then a significant effect has been deemed to occur if the LAeq noise levels for the period increase by more than 3 dB due to construction noise.
Note 3: For receptors that are not dwellings, the effects have been assessed using criteria appropriate to the circumstances, such as the duration that people are expected to be at the receptor and the activities that are undertaken there.

8.3.12 For operational effects, the sensitivity of the receptor and the magnitude of the impact have been combined using the matrix in Table 8.9 to determine the significance of the effect. Where the matrix offers more than one significance option, professional judgement has been used to decide which option is most appropriate.

Table 8.9: Assessment Matrix

Sensitivity	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major or Substantial
Very High	Minor	Moderate or Major	Major or Substantial	Substantial

8.3.13 The terms in Table 11.9 have the following definitions:

- Substantial: Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.

- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.

- Moderate: These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.

- Minor: These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.

- Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

8.3.14 Effects of moderate, major or substantial significance represent effects considered to be significant in terms of the EIA guidance.

8.4 Baseline Conditions

Baseline Noise Monitoring

8.4.1 Existing Noise measurements have been carried out adjacent to the roads on the boundary and running through the Site. The results have been used to validate the 3D noise mapping produced by SoundPLAN.

8.4.2 Daytime and night time noise levels have been monitored over a 24 hour period, together with manned recording.

8.4.3 All acoustic measurement equipment used during the noise surveys conformed to Type 1 specification of British Standard 61672: 2003: Electroacoustics, Part 1 Specifications.

Table 8.10: Surveying equipment

Equipment Description	Manufacturer	Serial number
Sound Level Meter	Norsonic 118	30559
Sound Level Meter	Cassella 480	089653
Acoustic Calibrator	Norsonic 1251	32856

8.4.4 The surveys were completed in accordance with relevant guidance such as BS7445:2003 'Description and Measurement of Environmental Noise'. The survey recorded LAeq, LAmax, LA10 and LA90 noise levels for both day time and night time. The monitoring locations are indicated on Figure 8.1.

8.4.1 The results of the noise monitoring are illustrated below. The points of monitoring where adjacent to the highway and therefore reflect the highest noise levels generated by the traffic levels, with traffic being identified as the predominant noise source.

Table 8.11: Recorded noise environment

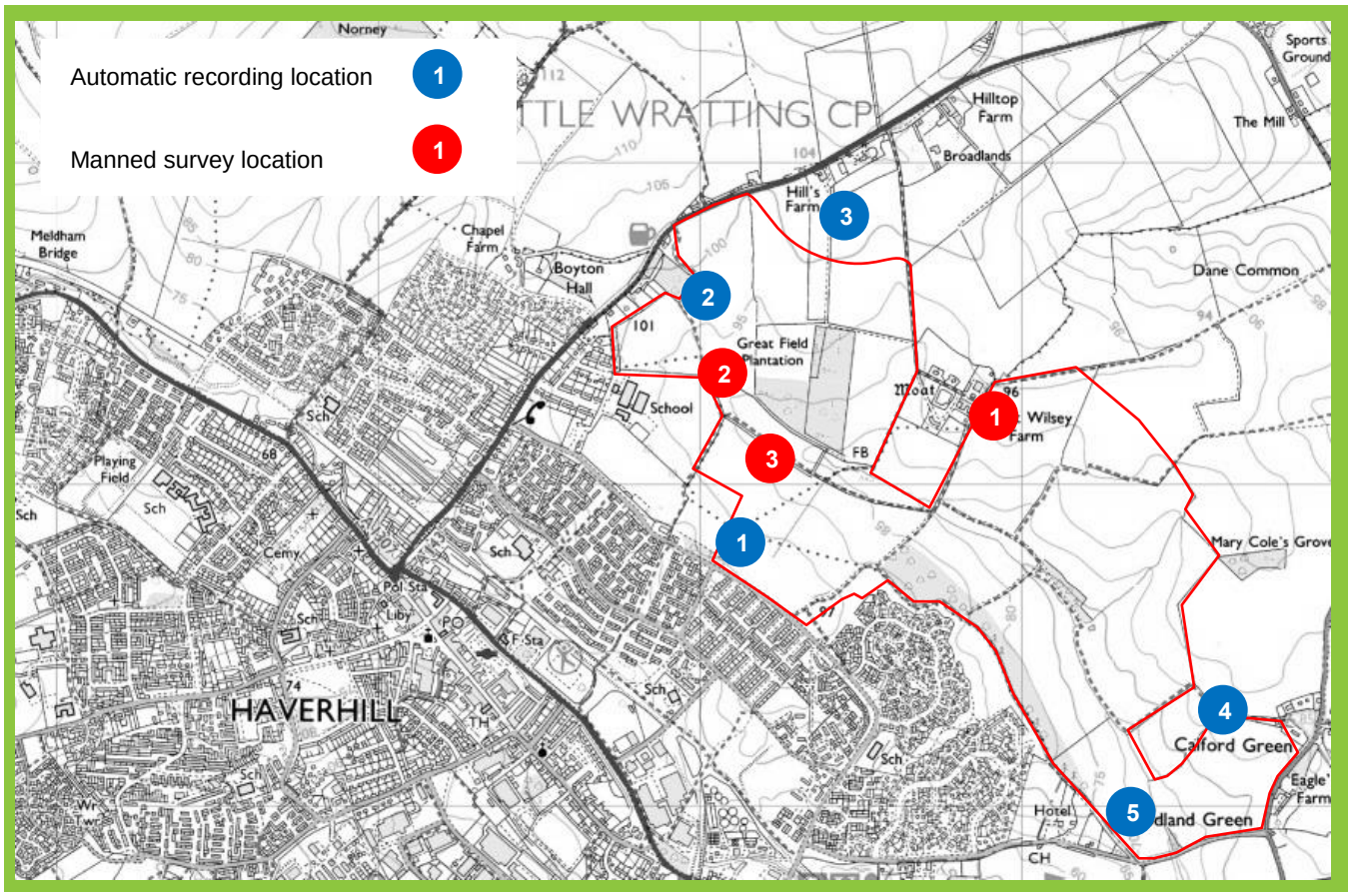
Position	Daytime LAeq 16hr	NEC equivalent	Night time LAeq 8hr	NEC equivalent
1	54	A	46	B
2	39	A	37	A
3	42	A	36	A
4	41	A	37	A
5	52	A	44	A

8.4.2 As expected, the results of the noise monitoring show the highest noise levels adjacent to the Chalkstone Way, with the noise levels lower adjacent to Coupals Road and Water Lane. The lowest noise levels were recorded on the site boundary moving towards the north-eastern boundary of the site. The manned monitoring location results are in line with, and support, the 24 hour existing monitoring completed close to these locations.

8.4.3 The results of the noise monitoring demonstrate that the site boundary primarily lies in NEC A. However the noise levels reduce significantly towards the centre of the site, as shown within the baseline modelling

drawing 10173-NM-01 and 10173-NM-02 within Appendix 8.1, which shows the majority of the site to falls within PPG24 category A and B.

Figure 8.1: Monitoring locations



8.5 Predicted Effects

Assessment of Construction Noise Effects

8.5.1 During the construction stage, it is envisaged that limited demolition, earthworks, installation of necessary services and building construction would form the main noise impacts upon existing residential properties in the environs of the site.

8.5.2 It is considered that the impact of construction traffic would be negligible. The site is accessed from the A143. The temporary increase in traffic due to construction is likely to be undiscernible from daily variations in traffic flow. Further details regarding the levels of construction traffic are provided in the Transport Chapter (Chapter 7).

8.5.3 Although the final details of the construction activities cannot be finalised until construction contractors have been confirmed, construction noise levels have been predicted using the sound pressure levels for

typical construction plant as described in BS5228:2009 Part 1. The sound pressure levels in BS5228 have been presented as a LAeq at a distance of 10m. A high percentage for the 'on-time' (the length of time that the equipment remains active on site) has been assumed so as to present a reasonable worst case.

Table 8.12: List of construction plant and associated sound levels

Plant Description	BS5228 Reference	Sound level at 10m	On time %
Angle Grinder	Table C4 No. 93	80	40
Asphalt Paver	Table C5 No. 33	75	60
Circular Saw	Table C4 No. 72	79	40
Compressor	Table C5 No. 5	75	80
Concrete Pump & Concrete mixer truck discharging	Table C4 No. 28	79	80
Concrete Saw	Table C4 No. 71	85	10
Delivery Lorry	Table C2 No. 35	80	70
Diesel Generator	Table C4 No. 84	74	100
Dozer	Table C5 No. 12	77	60
Dumpers	Table C4 No. 9	77	60
Excavator	Table C5 No. 34	82	75
Percussion Drill	Table C4 No. 69	85	40
Pneumatic Breaker	Table D2 No.2	81	40
Poker Vibrator	Table C4 No. 33	78	80
Road Planer	Table C5 No. 7	82	70
Roller Compactor	Table C5 No. 29	76	60
Telescopic Handler	Table C4 No. 54	79	75
Tower Crane	Table C4 No. 49	77	60
Tracked Excavator	Table C5 No. 18	80	70
Tracked Excavator fitted with Breaker	Table D2 No. 5	91	70
Tracked Mobile Crane	Table C4 No. 52	75	60
Vibratory Roller (22t)	Table C5 No. 28	77	60
Water Pump	Table C2 No. 45	65	75
Welder	Table C3 No. 31	73	40
Wheeled Loader	Table C2 No. 26	79	75

8.5.4 The on-time correction factor has been extracted from Figure F5 within BS5288.

8.5.5 The above table identifies a list of plant that could be used across the site, to identify the likely construction noise, the likely construction process on site has been identified. This includes:

- Site mobilisation

- Road Construction
- Site Clearance
- Building construction

8.5.6 Following this, the likely construction plant to be used during the identified construction processes has then been identified. The combined noise output has been calculated using the following methodology.

8.5.7 The construction noise impacts that are to be experienced at the different distances to the receptors have been calculated using the following formula as described in BS5228:

$$k_h = 20 \times LOG \frac{R}{r}$$

Where:

kh = the correction for propagation across hard ground

R = the distance to the receptor location

r = the distance of 10 m at which the SPL has been measured

8.5.8 Where more than one piece of the same equipment is used in a construction activity, the following equation has been used to determine the total noise level generated for that equipment:

Combined noise level = x + 10*log10(N)

Where:

x = noise level from a single piece

N = the number of items of equipment used

8.5.9 To calculate the combined noise level for a construction process the following equation has been used to combine the noise levels from the use of different construction plant:

Combined event= $10*\log10(10^{(L1/10)}) + 10^{(L2/10)} + 10^{(L3/10)} + \ldots..10^{(Ln/10)}$)

Where:

L1 = noise event rom each separate piece of construction plant

8.5.10 A reasonable worst case scenario has been presented by considering propagation across hard ground and by not considering screening provided by topographical features, buildings or other structures.

8.5.11 The potential noise impacts during the construction stage are presented below.

Table 8.13: Site mobilisation noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Delivery Lorry	1	80	74	66	60	54
Tracked Mobile Crane	1	75	69	61	55	49
Telescopic Handler	1	79	73	65	59	53
Wheeled loader	1	78	72	64	58	52
Dozer	1	77	71	63	57	51
Dumpers	2	80	74	66	60	54
Diesel generator	1	74	68	60	54	48
Total		87	81	73	67	61

Table 8.14: Road construction noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Road Planer	1	82	76	68	62	56
Tracked Excavator	1	80	74	66	60	54
Dozer (Spreading fill)	1	77	71	63	57	51
Dumpers	2	80	74	66	60	54
Vibratory Roller (22t)	1	77	71	63	57	51
Asphalt Paver	1	75	69	61	55	49
Diesel Generator	1	74	68	60	54	48
Total		87	81	73	67	61

Table 8.15: Site clearance noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Dumpers	2	80	74	66	60	54
Tracked Excavator	1	80	74	66	60	54
Lorry	1	79	73	65	59	53
Dozer	2	77	71	63	57	51
Compressor	1	75	69	61	55	49
Diesel Generator	1	74	68	60	54	48
Total		86	80	72	66	60

Table 8.16: Building construction noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Tracked Excavator	1	80	74	66	60	54
Diesel Generator	1	74	68	60	54	48
Dumpers	1	80	74	66	60	54
Telescopic Handler	1	79	73	65	59	53
Concrete Pump & Concrete mixer truck discharging	1	79	73	65	59	53
Poker Vibrator	2	78	72	64	58	52
Compressor	2	75	69	61	55	49
Total		87	81	73	67	61

8.5.12 Construction activities can produce high noise levels, particularly close to source. Construction noise tends to fluctuate and is usually of fairly short duration related to particular activities. The construction noise impacts would depend on the proximity of construction activities to nearby receptor locations.

8.5.13 The construction noise impacts predicted above indicate that the impacts could be observed by sensitive receptors within 200m of the site. The predicted noise levels are based on a possible worst case scenario. Propagation across hard ground has been assumed and no screening from topographical features or other structures has been assumed.

8.5.14 The majority of existing residential dwellings lie over 200m from the site, meaning the highest value identified for noise levels at 200m (maximum) would be 61dB, which is below the Category A threshold (ABC method) of 65dB.

8.5.15 As set out in the mitigation section, where necessary, for the small number of dwellings affected, construction plant would be located, as far as is reasonably practicable, away from adjacent occupied buildings or as close as possible to noise barriers or site hoardings located between the plant and the buildings. Such measures to control construction noise would be implemented through the Construction Environmental Management Plan (CEMP), which would also minimise operations during sensitive time periods.

8.5.16 Therefore, given the nature of the construction activities, it is not anticipated that the significance thresholds would be exceeded for long periods of time. Overall, it is considered that the magnitude of the noise impact in relation to the closest receptors would be low and at most would have a negligible effect.

Assessment of Construction Vibration Effects

8.5.17 Ground-borne vibration is often a cause for concern to future residents, especially in relation to construction.

8.5.18 BS6472 presents vibration levels that could induce the probability of human discomfort due to ground-borne vibration. These are more stringent than those recommended for structural damage. Compliance with BS6472 criteria should ensure that building damage is unlikely.

8.5.19 Vibration transmitted from construction activities through the ground to the receiver cannot be reliably calculated at this stage. Factors affecting ground borne vibration such as rock/soil type, water content and solid damping will greatly influence the way in which vibration travels through the ground.

Assessment of Operation Effects – Onsite Noise Environment

8.5.20 The NEC boundaries for the existing situation were modelled initially. This indicated a close relationship between the modelled noise levels and those recorded through the noise survey.

8.5.21 The daytime and night time NEC boundaries for the project were then modelled. The resultant daytime noise contours indicate that the site mainly falls into NEC A with the site boundary falling into NEC B and C. The night time contours indicates that the site lies largely in NEC B.

8.5.22 Properties falling within NEC B typically require nothing more than standard thermal double glazing to provide an acceptable noise environment. Table 1 in Annex 6 of PPG24 provides examples of typical noise reductions for a dwelling façade with windows set in a brick/block wall. The table shows various levels of noise reduction provided by different glazing configurations and for different noise sources. The values shown are the level difference (in dBA) between the outside and the inside of a typical dwelling and to represent a worst case, it is assumed that the outside level is a façade measurement. For a road traffic noise spectrum, PPG24 states that standard thermal double glazing will provide a façade sound insulation performance of 33 dB(A).

8.5.23 However, opening windows for ventilation purposes would reduce the insulation provided by the building façade and may cause internal design standards to be exceeded. Therefore, if it is considered necessary to satisfy internal noise standards with a degree of ventilation, mitigation measures may be required to enable occupiers to obtain ventilation with windows closed. This can be achieved through the use of 'trickle' vents within the window frames.

8.5.24 The layout of the project and the internal arrangements of properties will be subject to further detailed design. Before the consideration of double glazing and trickle vents, priority would be given to the internal layout of the properties such that sensitive areas, i.e. bedrooms, are located to avoid facing onto the primary routes directly and consideration would be given to orientating buildings to minimise windows that face onto the noise source.

8.5.25 As set out above, these measures would be adopted as part of the project.

After Completion

Effect during operational phase: long term

8.5.26 Traffic noise predictions have been made using the CRTN prediction methodology. The methodology has been used to predict the magnitude of any change in noise level resulting from the development proposals at the roadside of the local network.

8.5.27 The predicted changes in noise level, identified with respect to the road traffic noise impact assessment criteria, are presented below, indicating the 2026 with and without the completed development impact respectively.

Table 8.17: Predicted noise levels within the local road network

Link	Basic noise without development	Basic noise with development	Noise impact
A143 Haverhill Road (North of Roundabout Access)	14,658	17,105	0.7
A143 Haverhill Road (Roundabout Access to North West Relief Road)	14,658	20,286	1.4
North West Relief Road	12,813	19,098	1.7
A143 Haverhill Road (North West Relief Road to Chalkstone Way)	9,074	12,018	1.2
A143 Wratting Road	14,158	19,898	1.5
A1307 Withersfield Road	19,379	25,568	1.2
A1017 Cambridge Road	24,374	30,564	1.0
A1017 Haverhill Bypass	11,069	11,069	0.0
A143 Lord's Croft Lane	19,355	21,739	0.5
A143 Ehringshausen Way	13,727	14,919	0.4
Chalkstone Way (West of Access)	6,514	10,200	1.9
Chalkstone Way (East of Access)	6,514	10,965	2.3
A143 Stumer Road	9,728	10,662	0.4
Coupals Road	2,816	3,028	0.3
Chalkstone Way (South of Coupals Road)	8,447	8,447	0.0
Water Lane (North of Coupals Road)	4,823	5,035	0.2
Water Lane (South of Coupals Road)	2,321	2,321	0.0
A1017 Rowley Hill	13,292	14,227	0.3
A1017 Stumer Road	13,707	14,642	0.3

8.5.28 This demonstrates that the majority of the receptors will experience a negligible increase with minor increases reported adjacent to the development. It is considered that an increase of less than 3db is not discernible and therefore it is concluded that the development will have a negligible impact.

BS8233 Assessment of Daytime Noise Levels in Living Rooms

8.5.29 BS8233 indicates that a daytime internal noise level of 30dB LAeq represents the desirable noise standard. The calculated noise levels have been used to determine likely noise levels at the worst case locations (the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road).

8.5.30 Table 1 in Annex 6 of PPG24 provides examples of typical noise reductions for a dwelling façade with windows set in a brick/block wall. The table shows various levels of noise reduction provided by different glazing configurations and for different noise sources. The values shown are the level difference (in dBA)

between the outside and the inside of a typical dwelling and to represent worst case, it is assumed that the outside level is a façade measurement. For the road traffic noise spectrum, PPG24 states that standard thermal double glazing will provide a façade sound insulation performance of 33 dB(A).

8.5.31 However, opening windows for ventilation purposes would reduce the insulation provided by the building façade and may cause internal design standards to be exceeded. However, an open window will still provide noise attenuation, with PPG24 highlighting that attenuation of 10-15dB will be delivered.

8.5.32 Trickle vents are widely used as a suitable ventilation method throughout the industry. The introduction of trickle vents has the potential for additional noise leakage. It is considered that this could lead to a difference of between 1dB and 2dB close to trickle vents, however, human subjects, under laboratory conditions, are generally only capable of noticing changes in steady noise levels of more than 3dB. Therefore the impacts of the trickle vents are considered negligible.

8.5.33 The layout of the development and internal arrangements of properties will be subject to further detailed design. Consideration should be given to the internal layout of the properties such that sensitive locations i.e. bedrooms, are located to avoid facing onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road directly and finally consideration should be given to orientating buildings to minimise windows that face onto the noise source.

8.5.34 The parameter plans indicate how the development could be delivered, although the actual location of any housing is to be determined at the reserved matters stage. Therefore, typical housing locations representing the worst cases have been selected.

8.5.35 The worst case locations adjacent to the remaining highways have also been considered.

8.5.36 The typical daytime façade noise level fronting Chalkstone Way is 54.2dB. This noise level reduces to 24.2 dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.37 The typical daytime façade noise level fronting the A143 Haverhill Road is 47.6dB. This noise level reduces to 17.6dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.38 The typical daytime façade noise level fronting Water Lane is 47.9dB. This noise level reduces to 17.9dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.39 The typical daytime façade noise level fronting Coupals Road is 54.9dB. This noise level reduces to 24.9dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.40 The typical daytime façade noise level fronting the northern access road near the junction with Haverhill Road is 66.1dB. This noise level reduces to 33.1dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.41 The typical daytime façade noise level fronting the southern access road near the junction with Chalkstone Way is 67.1dB. This noise level reduces to 34.1dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.42 This demonstrates that the expected noise levels all fall within the NOEL limits. Therefore, no additional mitigation measures are considered necessary for these locations.

8.5.43 This indicates that appropriate attenuation can be achievable for all of the properties through the use of thermal double glazing, with facades of properties further into the site being protected and screened by other buildings. Orientating properties and consideration of the internal layout to avoid direct sight lines onto the main roads will further mitigate and reduce internal noise sources.

BS8233 Assessment of Night-Time Noise Levels in Bedrooms

8.5.44 BS8233 indicates that a night-time internal noise level of 30dB LAeq is desired. The calculated noise levels, as previously indicated, have been used to determine likely noise levels at the worst case locations (the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road).

8.5.45 The typical night-time first floor façade noise level fronting Chalkstone Way is 49.3dB. This noise level reduces to 16.3dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standard.

8.5.46 The typical night-time first floor façade noise level fronting the A143 Haverhill Road is 43.2dB. This noise level reduces to 10.2dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standard.

8.5.47 The typical night-time first floor façade noise level fronting Water Lane is 43.5dB. This noise level reduces to 10.5dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standard.

8.5.48 The typical night-time first floor façade noise level fronting Coupals Road is 50.6dB. This noise level reduces to 17.6dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standard.

8.5.49 The typical daytime façade noise level fronting the northern access road near the junction with Haverhill Road is 61.8dB. This noise level reduces to 28.8 dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.50 The typical daytime façade noise level fronting the southern access road near the junction with Chalkstone Way is 62.8dB. This noise level reduces to 29.8dB when taking into account noise reductions through thermal double glazing, which represents the desired internal noise standards.

8.5.51 This demonstrates that the expected noise levels all fall within the NOEL limits. Therefore, no additional mitigation measures are considered necessary for these locations.

Vibration Impact

8.5.52 A judgement has been made that vehicle vibration impacts occur solely during the construction phase. It is reasonable to assume that heavy duty construction plant is present only during the construction phase, with conventional cars and infrequent delivery/refuse vehicles during the operational phase thereafter. Further, vibration of vehicles provides more of an impact when the road corridors are not yet fully constructed; the operational phase contains fully constructed roads which suppress vehicle vibration to negligible limits.

External Noise Standards

8.5.53 The BS8233 highlight the requirement of managing noise in external living spaces. The agreed average noise limit should not exceed 55dB. As a result of this standard, the day time and night time boundaries have been modelled and contained within Appendix 8.1.

8.5.54 With the results of the model, it is anticipated that significant noise mitigation, will not be necessary to reduce the impacts of the traffic noise on the proposed dwellings.

8.5.55 Consideration has also been provided in relation to the external noise environment adjacent to the remaining roads, within the vicinity of the site. It is considered that the houses fronting onto these roads will form a natural noise screen when considering the careful orientation of housing; these can act as a suitable barrier to noise and protect the outdoor living spaces.

8.5.56 This demonstrates that the expected noise levels all fall within the NOEL limits. Therefore, no additional mitigation measures are considered necessary for these locations.

8.6 Mitigation, Monitoring and Residual Effects

Direct and Indirect Noise and Vibration from Construction

8.6.1 To minimise the impact on receptors during the construction process, the following generic noise and vibration mitigation measures need to be implemented as appropriate for all works and would be incorporated into the future Construction Environmental Management Plan (CEMP):

- Construction activities should be confined to times of the day when they are least likely to be disturbing;
- Careful selection of plant, construction methods and programming. Only plant conforming with relevant national or international standards, directives and recommendations on noise and vibration emissions should be used;
- Construction plant should be located, as far as is reasonably practicable, away from adjacent occupied buildings or as close as possible to noise barriers or site hoardings where these are located between the plant and the buildings;
- Static and semi-static plant/equipment (e.g. compressors and generators) should be fitted with suitable enclosures where practicable;
- Personnel will be instructed on best practice to reduce noise and vibration as part of their induction training and as required prior to specific work activities;
- When plant is not being used, it should be shut down and not left to idle;
- Methods of work and vehicular routes will be selected with regard to minimising noise and vibration impact;
- Given the phasing of construction, certain areas of the Proposed Development will be occupied while construction is still underway in adjacent areas. Where possible, the occupancy of completed phases

of construction should be planned in such a way that there is a buffer between occupied areas and areas where construction is being carried out.

8.6.2 Given the nature of the construction activities expected on site, the impact could be significant without mitigation. However the construction noise and vibration impacts can be mitigated effectively through the CEMP.

Direct Façade Noise Levels on the Proposed Dwellings

8.6.3 Following this initial review of the proposed noise environment across the site, taking into account the future traffic levels, the following noise mitigation measures need to be implemented as appropriate:

- Trickle vent ventilation systems and double glazing for residential properties fronting onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road.
- Internal layout of properties to consider the location of lounge and bedroom areas for those properties fronting onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road.
- Site layout to consider the internal layout of residential buildings to reduce sight lines onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road.

Residual Impacts

8.6.4 The assessments completed above have considered both the proposed residential dwellings and the impact on existing properties within the immediate vicinity of the site. As a whole, the assessments do not identify any significant adverse impacts and thus no residual effects are anticipated.

8.7 Non-Technical Summary

8.7.1 Discussions have been held with the Environmental Health Officer to agree the scope of the assessment. Through these discussions it was agreed that a noise survey is required for the site due to sensitive receptors being identified.

Effect during construction phase: short to medium term

8.7.2 For the delivery of the scheme, it is envisaged that landform creation, installation of necessary services and the construction of the residential structures on the site will form the main noise impacts upon the existing residential properties.

8.7.3 Construction activities produce significantly high noise levels, particularly close to source. Construction noise tends to fluctuate and is usually of fairly short duration. The construction noise impacts will depend on the proximity of construction activities to nearby receptor locations.

8.7.4 Given the nature of the construction activities the impact will not be significant in relation to the closest receptor. It is possible that construction activities will occur across the site such the noise levels will be higher such that mitigation will be required.

8.7.5 To minimise the impact on receptors during the construction process, generic noise and vibration mitigation measures need to be implemented as appropriate for all works and would be incorporated into the future Construction Environmental Management Plan (CEMP).

Effect during operational phase: long term

8.7.6 Traffic noise predictions have been made using the CRTN prediction methodology. The methodology has been used to predict the magnitude of any change in noise level resulting from the development proposals at the roadside of the local network. This demonstrates that the majority of the receptors will experience a negligible increase with minor increases reported adjacent to the development. It is considered that an increase of less than 3db is not discernible and therefore it is concluded that the development will have a negligible impact.

8.7.7 Noise level prediction of the existing situation has taken place through computer modelling software SoundPLAN. The daytime and night time NEC boundaries for the proposed future development have been modelled. The resultant daytime and night-time noise contours indicate that the site mainly falls into NEC A/B with boundaries fronting onto the A143 Haverhill Road, Coupals Road and Chalkstone Way falling into NEC C.

8.7.8 BS8233 indicates that a daytime noise level of 30dB LAeq represents a “good” standard and 40dB LAeq as “reasonable” in living rooms. The calculated noise levels have been used to determine likely noise levels and the extent of attenuation required.

8.7.9 The actual location of housing within the built development areas would be determined at detailed design stage. Therefore a potential worst case housing location fronting Chalkstone Way has been selected. This indicates that the day time façade noise levels are 67.1dB. This noise level reduces to 34.1dB when taking into account noise reductions through thermal double glazing, which represents a “reasonable” internal noise standard.

8.7.10 BS8233 indicates that a night-time noise level of 30dB LAeq represents a “good” standard in bedrooms and 35dB as reasonable. The calculated noise levels have been used to determine likely noise levels and the extent of attenuation required. A potential worst case night time façade noise levels is identified as 62.8dB. This noise level reduces to 29.8dB when taking into account noise reductions through thermal double glazing, which represents a “good” internal noise standard.

8.7.11 The dominant source of noise at the school site will be from traffic. The parameters plans does not provide sufficient detail on the orientation of the school building, the internal or external layout in order to assess the impact of noise on the operation of the building against the standards highlighted in BB93. But it has been assessed as a two-storey building(s) with parking areas, hard and soft play areas, sports playing fields and habitat creation.

8.7.12 Based on the results of the noise modelling, this indicates that the school sites are located in NEC boundary C. A receptor located on the potential school building edge and a free field receptor located in the centre of the site indicates a noise level of 66.1dB and 57.8 dB respectively. This indicates that the BB93 upper limit at the boundary could be achieved and internal classroom standard is also met, when considering the inclusion of thermal double glazing.

8.7.13 The noise levels across the school site will be dependent upon the detailed layout of the school, locations of the playing fields and the use of the rooms. Depending on the orientation, the school building could provide noise attenuation benefits to the playground areas.

8.7.14 Mitigation will be provided in the form of:

- Passive ventilation systems and double glazing for only those residential properties falling within NEC C and fronting onto the highways boarding the site.
- Internal layout of properties to consider the location of lounge and bedroom areas for those properties fronting onto the highways boarding the site.
- Site layout to consider the orientation of residential buildings to reduce sight lines onto the highways boarding the site.

Table 8.19: Summary of effects

Receptor	Mitigation Measures Proposed	Residual Impact
Operational		
Proposed residential dwellings	Trickle vent ventilation systems and double glazing for residential properties fronting onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road. Internal layout of properties to consider the location of lounge and bedroom areas for those properties fronting onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road. Site layout to consider the internal layout of residential buildings to reduce sight lines onto the A143 Haverhill Road, Chalkstone Way, Water Lane and Coupals Road.	Negligible
Construction		
Existing and proposed residential dwellings	Application of the CEMP	Negligible

8.8 References

Highways Agency (2008) Design Manual for Roads and Bridges. London, DFT
Calculation of Road Traffic Noise, Department of Transport 1988
DOE PPG24: Planning and Noise (1994)
Communities and Local Government NPPF (2012)
British Standard 8233:2014; Sound Insulation and Noise Reduction for Buildings
British Standard 5228: 'Code of Practice for Noise and Vibration Control on Construction and Open Sites'