Appendix 12.1

Noise and Vibration Units, Standards and Guidance

A12.1 Noise and Noise Units

A12.1.1 Noise is defined as unwanted sound. The range of audible sound is from 0 dB to 140 dB. The frequency response of the ear is usually taken to be about 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dB(A) weighting. This is an internationally accepted standard for noise measurements.

A12.1.2 For variable noise sources such as traffic, a difference of 3 dB(A) is just distinguishable. In addition, a doubling of a noise source would increase the overall noise by 3 dB(A). For example, if one item of machinery results in noise levels of 30 dB(A) at 10 m, then two identical items of machinery adjacent to one another would result in noise levels of 33 dB(A) at 10 m. The 'loudness' of a noise is a purely subjective parameter but it is generally accepted that an increase/decrease of 10 dB(A) corresponds to a doubling/halving in perceived loudness.

A12.1.3 External noise levels are rarely steady but rise and fall according to activities within an area. In an attempt to produce a figure that relates this variable noise level to subjective response, a number of noise metrics have been developed. These include:

- L_{Aeq} noise level - This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in BS 7445 [1] as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'. It is a unit commonly used to describe community response plus, construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.
- L_{A90} noise level - This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.
- L_{A10} noise level - This is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.

A12.2 Vibration and Vibration Units

A12.2.1 Whereas noise is primarily received through the air and perceived by the auditory senses, vibration is lower frequency phenomenon, which is primarily received through the ground or through structures and is perceived by the body as movement. This movement can be felt as sudden shocks or more gentle displacement dependent upon the frequency/ies and magnitude of the source.

A12.2.2 Groundborne vibration from construction sources, such as piling, can be a source of concern for occupants of buildings in the vicinity. The concern can be that the building may suffer some form of cosmetic or structural damage or that ground settlement may arise that could subsequently lead to damage. Research associated with BS 7385, Part 1 [2], concerned with vibration-induced building damage, found that although a large number of case histories were assembled, very few cases of vibration-induced damage were found. However, structural vibration in buildings can be detected by the occupants and can affect them in many ways: their quality of life can be reduced, as also can their working efficiency, although, there is little evidence that whole-body vibration directly affects cognitive processes. It should be noted that there is a major difference between the sensitivity of people feeling vibration and the onset of levels of vibration that damage a structure.

Peak Particle Velocity (PPV)

A12.2.3 Peak particle velocity is defined as '*the maximum instantaneous velocity of a particle at a point during a given time interval*', and has been found to be the best single descriptor for correlating with case history data on the occurrence of vibration-induced damage to buildings and structures. It is normally evaluated at the foundations of a building.

Vibration Dose Value (VDV)

A12.2.4 The effect of structureborne vibration affecting people inside buildings is assessed by determining their vibration dose. Present knowledge indicates that this is best evaluated with the VDV, as promoted through BS 6472 Part 1 [3]. VDV defines a relationship that yields a consistent assessment of intermittent, occasional and impulsive vibration, as well as continuous input, and correlates well with subjective response. The way in which people perceive building vibration depends upon various factors, including the vibration frequency and direction. The VDV is given by the fourth root of the time integral of the fourth power of the acceleration after it has been frequency weighted.

A12.3 Standards and Guidance

Construction

BS 5228

Noise

A12.3.1 BS 5228-1 [4] gives recommendations for basic methods of noise control relating to construction and open sites where work activities/operations generate significant noise levels, including industry-specific guidance. The legislative background to noise control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. BS 5228-1 provides guidance concerning methods of predicting and measuring noise and assessing its impact on those exposed to it.

A12.3.2 BS 5228-1 Annex E contains three example methods for determining the significance of noise effects from construction and demolition activities.

A12.3.3 For projects of significant size such as the construction of a new railway or trunk road, historically, the approach to determining whether construction noise levels are significant or not was based upon exceedance of fixed noise limits which were originally promoted by the Wilson Committee in their report on noise [5] as presented to Parliament in 1963. These noise limits were then included in Advisory Leaflet 72 [6] first published in 1968; the accompanying wording was subsequently revised and the 1976 version is quoted below:

'Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut. The noise can be measured with a simple sound level meter, as we hear it, in A-weighted decibels (dB(A))– see note below. Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

• 70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;

• 75 decibels (dBA) in urban areas near main roads in heavy industrial areas.

These limits are for daytime working outside living rooms and offices. In noise-sensitive situations, for example, near hospitals and educational establishments – and when working outside the normal hours say between 19.00 and 22.00 hours – the allowable noise levels from building sites will be less: such as the reduced values given in the contract specification or as advised by the Environmental Health Officer (a reduction of 10 dB(A) may often be appropriate). Noisy work likely to cause annoyance locally should not be permitted between 22.00 hours and 07.00 hours.'

A12.3.4 The above principle has been expanded over time to include a suite of noise levels covering the whole day/week period taking into account the varying sensitivities through these periods. An example is provided below and these levels are also often used as limits above which noise insulation would be provided if the temporal criteria are also exceeded.

A12.3.5 An alternative and/or additional method to determine the significance of construction noise levels is to consider the change in the ambient noise level with the construction noise. This reflects more conventional EIA methodologies for noise.

A12.3.6 One method is whereby a noise effect is considered significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,\ Period}$, from construction noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact.

Vibration

A12.3.7 BS 5228-2 [7] gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels, including industry specific guidance. The legislative background to vibration control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. Guidance is provided concerning methods of measuring vibration and assessing its effects on the environment.

A12.3.8 Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV range of 0.14 mm/s to 0.3 mm/s. Vibrations above these values can disturb, startle, cause annoyance or interfere with work activities.

A12.3.9 BS 6472 sets down vibration levels at which minimal adverse comment is likely to be provoked from the occupants of the premises being subjected to vibration. It is not concerned primarily with short□term health hazards or working efficiency. Whilst the assessment of the response to vibration in BS 6472 is based on the VDV and weighted acceleration, for construction it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is likely to be more routinely measured based upon the more usual concern over potential building damage. Furthermore, since many of the empirical vibration predictors yield a result in terms of PPV, it is necessary to understand what the consequences might be of any predicted levels in terms of human perception and disturbance.

A12.3.10 Guidance on the human response to vibration from demolition and construction activities that is contained within BS 5228-2 is provided in Table A1.1. With regards to effects upon buildings and structures, BS 5228-2 refers to BS 7385-2.

Table A1.1: Human Response to Vibration from Construction and Demolition Activities

Vibration Level (mm/s)	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

BS 7385 – Parts 1 and 2

A12.3.11 BS 7385: Parts 1 and 2 provide guidance on the evaluation and measurement for vibration in buildings. Part 1 [8], Guide for measurement of vibrations and evaluation of their effects on buildings, provides advice on measurement, measurement instrumentation, location and fixing of transducers and data evaluation. Annexes also provide advice on classifying buildings with regard to their likely sensitivity; estimating peak stress from peak particle velocity; random data; a bibliography is also provided.

A12.3.12 Part 2, Guide to damage levels from groundborne vibration, provides guidance on the levels of vibration above which building structures could be damaged. It identifies the factors that influence the vibration response of buildings, and describes the basic procedure for carrying out measurements. It also states that there is a major difference between the sensitivity of people feeling vibration and the onset of levels of vibration, which damage structures; and that levels of vibration at which adverse comment from people is likely are below levels of vibration, which damage buildings, except at lower frequencies.

A12.3.13 Table A1.2 provides the vibration limits contained within BS 7385 Part 2 above which cosmetic damage could occur and have been adopted as the thresholds of significant effect for construction vibration. Minor damage is possible at vibration magnitudes that are greater than twice those given in Table A1.2 and major damage to a structure may occur at values greater than four times the tabulated values.

Table A1.2 – Threshold Vibration Values for the Evaluation of Cosmetic Building Damage (BS 7385 Part 2)

Building Classification	Frequency Range of Vibration (Hz)	PPV mm/s	
		Transient Vibration	Continuous Vibration
Unreinforced or light framed structures Residential or light commercial type buildings	4 Hz to 15 Hz	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz
	15 Hz and above	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	4 Hz and above	50	25

Note: the limits refer to vibration measured in the foundations of a building.

A12.3.14 BS 7385 provides the following guidance with reference to other structures:

- important buildings that are difficult to repair (for example listed buildings) may require special consideration on a case-by-case basis. A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.
- structures below ground level (for example underground water pumping stations or water and gas pipelines) are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition.

BS 6472

A12.3.15 BS 6472: *'Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting'* provides guidance on human response to vibration experienced in buildings. BS 6472-1 provides separate weighting curves related to human response for vibration in the spinal vertical and the horizontal directions.

A12.3.16 The VDV is evaluated at the point of entry to the subject. If direct measurement is not possible, for example, on a building that has not yet been built, then BS 6472-1 states that it will be necessary to estimate the vibration environment to be expected within the building. Appendix D of BS 6472-1 contains guidance on the estimation of building vibration response.

A12.3.17 The VDVs associated with various probabilities of adverse comment within residential buildings are provided in Table A1.3. For offices and workshops, BS 6472-1 states that multiplying factors of 2 and 4, respectively, should be applied to the values provided in Table A1.3. The criteria are presented as ranges due to the widely differing susceptibility to vibration evident among members of the population and also their differing expectations of the vibration environment. BS 6472-1 states that adverse comment is not expected for VDVs below the ranges in Table A1.3.

Table A1.3 – Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings

Place	Low probability of adverse comment (m/s1.75)	Adverse comment possible (m/s1.75)	Adverse comment probable (m/s1.75)
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hours night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Operation

Planning Policy Guidance 24 (PPG 24) – Planning and Noise and BS 4142 - Method for Rating industrial noise affecting mixed residential and industrial areas, 1997

A12.3.18 Sections 19 and 20 of Annex 3 of Planning Policy Guidance Note 24: Planning and Noise (PPG 24) [9] cite the use of British Standard 4142 'Method for Rating industrial noise affecting mixed residential and industrial areas' (BS 4142) [10] to assess noise from industrial and commercial developments. The Standard provides a method for rating industrial noise affecting mixed residential and industrial areas and has been extensively used by local authorities and consultants to rate noise from fixed installations, such as plant noise. Paragraph 19 of PPG 24 states the following:

'The likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS 4142: 1990. Tonal or impulsive characteristics of the noise are taken into account by the 'rating level' defined in BS 4142. This 'rating level' should be used when stipulating the level of noise than can be permitted. The likelihood of complaints is indicated by the difference between the noise from the new development (expressed in terms of the rating level) and the existing background noise. The Standard states that: 'A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance.' Since background noise levels vary throughout the a 24 hour period it has been necessary to assess the acceptability of noise levels for separate periods (e.g. day and night) chosen to suit the hours of operation of the project. Similar considerations apply to developments that would emit significant noise at the weekend as well as during the week. In addition, general guidance on acceptable

noise levels within buildings can be found in BS 8233: 1987, and guidance on the control of noise from surface mineral workings can be found in MPG 11.'

A12.3.19 The Standard advocates the use of L_{Aeq}, a level that is directly measurable. The L_{Aeq} is either measured or calculated at a receptor location and this is termed the 'specific noise level'. The specific noise level may then be corrected for the character of the noise, if appropriate, and it is then termed the 'rating level'. A correction of +5 dB is made if the noise contains any discrete tones e.g. hums or whistles, any impulsive characteristics such as crashes, bangs or thumps or if the noise is irregular enough in character to attract attention.

A12.3.20 When used to rate the likelihood of complaints, the rating level is determined and the L_{A90} background noise level is subtracted from it. Where positive differences occur, the greater the difference between the two levels, the greater the likelihood of complaints. Where negative differences occur, the greater the difference between the two levels, the lesser the likelihood of complaints. A difference of around +10 dB or higher indicates that complaints are likely; a difference of around +5 dB is of marginal significance; and a difference of -10 dB is a positive indication that complaints are unlikely. These descriptions are summarised in Table A1.4.

Table A1.4 – BS 4142 Significance Criteria

BS 4142 Assessment Level dB(A) **(Rating level relative to background level)**	**BS 4142 Semantic** **(as described in BS 4142)**
< - 10	*'If the rating level is more than 10 dB below the measured background level then this is a positive indication that complaints are unlikely'*
- 10 to + 5	No BS 4142 description but the more negative the difference, the less the likelihood of complaints.
+ 5	*'A difference of around +5 dB is of marginal significance'*
+ 5 to + 10	No BS 4142 description but the more positive the difference, the greater the likelihood of complaints.
> + 10	*'A difference of around 10 dB or more indicates that complaints are likely'*

A12.3.21 BS 4142 states that measurement positions should be outside buildings in free-field conditions, where the microphone is at least 3.5 m from any reflecting surfaces other than the ground and at a preferred height of between 1.2 m and 1.5 m above ground level. However, where it is necessary to make measurements above ground floor level, the measurement position, height and distance from reflecting surfaces should be reported, ideally measurements should be made at a position 1 m from the façade of the relevant floor.

A12.3.22 When assessing the noise from night-time operations, the period of 23:00 to 07:00 hours, as recommended in PPG 24, should be adopted. Whilst BS 4142 may be used to assess the likelihood of night-time noise complaints, it is generally accepted that other appropriate criteria should be adopted for assessing sleep disturbance during night-time periods, such as BS 8233 [11] or the 'Guidelines for Community Noise' (GCN) [12], which was published by the World Heath Organisation (WHO).

A12.3.23 In situations where the L_{A90} background noise level is 'low' (less than 30 dB(A)) and the rating level is 'low' (less than 35 dB(A)), the Standard states that the rating method of BS 4142 is not applicable. In these circumstances, for the night-time period (i.e. it is rare for this situation to occur during the day), it is usually more appropriate to assess the noise impact by considering sleep disturbance criteria and other aspects such as noise change. It should be noted that this is not a BS 4142 or British Standards Institution (BSi) recommendation, as there is no advice given as to an acceptable approach in these circumstances but it is accepted practice for situations of this type.

A12.3.24 BS 4142 requires a 'representative background noise level' to be adopted for the assessment. There is no Government or BS guidance that states what is considered to constitute 'representative' and the night-time period is particularly difficult as it can be subject to a wide variation in noise level between the shoulder night periods.

Sleep Disturbance Criteria

A12.3.25 *'Guidelines for Community Noise'* (GCN) was published by the World Health Organisation (WHO) in 2000 and provides guidance on desirable levels of environmental noise. GCN refers to observation threshold levels at which the lowest observable effects occurred and are not suggestions of noise limits.

A12.3.26 In the 2000 guidelines, the authors suggest that 80 – 90% of the reported cases of sleep disturbance in noisy environments are for reasons other than noise originating outdoors and that:

- *'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night…';*
- *'If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise.'; and*
- *'It should be noted that it should be possible to sleep with a bedroom window slightly open (a reduction from outside to inside of 15 dB).'*

Horizontal Guidance Note IPPC H3: Horizontal Guidance for Noise, 2004

A12.3.27 H3 [13] cites the use of BS 4142 for assessing whether industrial noise is likely to give rise to complaints from residents and states (Part 2, page 57, A2.1.2.1):

- *'This standard does not offer any guidance on BAT, although the alleviation of complaints should be one of the criteria considered in the determination of BAT'.*

IPPC Sector Guidance Note – Combustion Activities

A12.3.28 As of 6th April 2008, the Waste Management Licensing Regulations and the Pollution Prevention and Control (PPC) Regulations were replaced by the Environmental Permitting Regulations 2007. However, the Integrated Pollution Prevention and Control (IPPC) Sector Guidance Notes remain current. The IPPC Technical Guidance Note applicable to Energy from Waste Facilities, S5.01 [14] contains the following advice with regard to noise and vibration:

'Indicative BAT requirements for noise and vibration

- *Describe the main sources of noise and vibration (including infrequent sources), the nearest noise-sensitive locations and relevant environmental surveys which have been undertaken, and the techniques and measures used for the control of noise.*
- *The Operator should employ basic good practice measures for the control of noise, including adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise (for example, bearings, air handling plant, the building fabric, and specific noise attenuation kit associated with plant, equipment or machinery).*
- *The Operator should also employ such other noise control techniques to ensure that the noise from the installation does not give rise to reasonable cause for annoyance, in the view of the Regulator and, in particular, should justify where Rating Levels ($L_{Aeq,T}$) from the installation exceed the numerical value of the Background Sound Level ($L_{A90,T}$).*
- *Further justification will be required should the resulting field rating level ($L_{Ar,Tr}$) exceed 50 dB by day and a facade rating level exceed 45 dB by night, with day being defined as 07:00 to 23:00 and night 23:00 to 07:00.*
- *In some circumstances 'creeping background' (i.e. creeping ambient) may be an issue. Where this has been identified in pre application discussions or in previous discussions with the local authority, the Operator should employ such noise control techniques as are considered appropriate to minimise problems to an acceptable level within the BAT criteria.*
- *Noise surveys, measurement, investigation e.g. on sound power levels of individual items of plant) or modelling may be necessary for either new or existing*

installations, depending upon the potential for noise problems. Where appropriate, the Operator should have a noise management plan as part of its management system.'

ISO 9613

A12.3.29 Operational noise has been predicted using SoundPLAN implementing ISO 9613 [15] for each individual octave or third octave band. The spectral results are then summed to obtain the L_{Aeq} at the receptor. SoundPLAN can also accommodate broadband source data. The calculation is summarised by:

$$L_p = [\ L_w + DI + K_0\ ] - [\ D_s + \Sigma\ D\ ]$$

Where: L_p = sound pressure level at receptor
L_w = sound power level of source
DI = directivity of the source
K_0 = spherical model
D_s = spreading
D = other contributing factors:
- air absorption
- ground absorption and meteorological effects
- volume type absorption
- screening

A12.3.30 K_0 is defined by the spatial angle, Ω, and takes account of the fact that the equations of ISO 9613 are based on spherical spreading whereas in the real world, spreading may be not be spherical, as described above.

Road Traffic Noise

A12.3.31 The main method of calculating road noise is defined in the Calculation of Road Traffic Noise (CRTN) [16]. This method of predicting noise at a reception point from a road scheme, a formal procedure originally issued in accordance with the requirements of the Noise Insulation Regulations 1975 [17], consists of five main parts:

- Divide the road scheme into one or more segments such that the variation of noise within the segment is small
- Calculate the basic noise level at a reference distance of 10 m away from the nearside carriageway edge for each segment
- Assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line

- Correct the noise level at the reception point to take into account site layout feature including reflections from buildings and facades, and the size of the source segment
- Combine the contributions from all segments to give the predicted noise level at the reception point for the whole road scheme

A12.3.32 For this project, the CRTN methodology has been used in a simplified form to predict changes in road traffic noise levels along route sections, i.e. calculations have not been carried out at individual receptors but for sections of road subject to the same changes in traffic flow. On this basis, all receptors along a route section will be subject to the same change in noise level.

A12.3.33 However, CRTN is subject to a minimum flow of 50 vehicles/hour or 1000 vehicles/18 hour day below which the methodology cannot be applied. Where this has occurred, the methodology defined in BS 5228 has been used to calculate L_{Aeq} noise levels from route sections. Calculated levels have then been added to other levels produced by either the construction or operational noise models to provide cumulative effects from both plant and traffic.

A12.3.34 Two scenarios have been considered: traffic changes during construction and during operation. The assessment then considers the change in the noise level without and with the additional traffic.

Noise Change

A12.3.35 In addition to the above, consideration has also been given to the noise change that would occur in the area as a result of the introduction of the facility. Given that noise from the plant would be constant, it would raise the existing background level and an increase of 3 dB(A) or more is assessed as significant.

A12.3.36 Consideration has also been given to the effect on the ambient noise level (L_{Aeq}), with again any change greater than 3 dB(A) being considered significant. The following semantic scale has been adopted to describe permanent noise change:

Table A1.5 – Semantic Scale for Describing Noise Change – Thresholds of Significance (Permanent Sources and Operational Traffic)

Predicted Noise Change		Scale Rating
Decrease of more than 3 dB	Significant decrease	Significant Positive Effect
Less than 3 dB	Not Significant	
Increase of 3 – 5 dB	Minor Increase	Significant Negative Effect
Increase of 6 – 10 dB	Moderate Increase	
Increase of more than 11 dB	Major Increase	

Source of Data: Mackie and Davies [18]

A12.3.37 For construction traffic, it is considered that a greater effect would be tolerated, as the source is only temporary. Therefore, the following semantic scale has been adopted to describe temporary noise change:

Table A1.6 – Semantic Scale for Describing Noise Change – Thresholds of Significance (Construction Traffic)

Predicted Noise Change		Scale Rating
Decrease of more than 6 dB	Significant decrease	Significant Positive Effect
Less than 6 dB	No Significant change	No Effect
Increase of 6 – 10 dB	Minor Increase	Significant Negative Effect
Increase of 11 – 20 dB	Moderate Increase	
Increase of more than 20 dB	Major Increase	

References

1. British Standards Institution. British Standard 7445: Description and measurement of environmental noise, Part 1. Guide to Quantities and Procedures, 2003.

2. British Standards Institution. BS 7385-1. ISO 4866. Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings, 1990.

3. British Standards Institution. British Standard 6472-1: Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting. 2008.

4. British Standards Institution. British Standard 5228: Code of practice for noise and vibration control on construction and open sites. Part 1: Noise. 2009.

5. The Stationery Office Limited. Committee on the problem of noise – Final report. Command paper 2056. July 1963.

6. Department of the Environment. Advisory Leaflet 72. Noise Control on Building Sites. Department of the Environment. 1976.

7. British Standards Institution. British Standard 5228: Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration. 2009.

8. British Standards Institution. BS 7385-2. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration. 1993.

9. Department of the Environment. Planning Policy Guidance (PPG) 24, Planning and Noise, September 1994.

10. British Standards Institution. British Standard 4142: Method for Rating industrial noise affecting mixed residential and industrial areas, 1997.

11. British Standards Institution. British Standard 8233: Sound insulation and noise reduction for buildings - Code of practice. 1999.

12. World Health Organisation (WHO). Guidelines for Community Noise, 2000.

13. Environment Agency. IPPC H3 Horizontal Guidance for Noise. Part 1: Regulation and Permitting. Part 2: Noise Assessment and Control. June 2004.

14. Environment Agency. IPPC S5.01 Guidance for the Incineration of Waste and Fuel Manufactured from or Including Waste. 29 July 2004.

15. International Organization for Standardization. ISO 9613-2:1993: Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation.

16. Department of Transport/Welsh Office. Calculation of Road Traffic Noise. HMSO, 1988.

17. Building and Buildings No. 1763. The Noise Insulation Regulations 1975. Amended 1998 No. 2000. The Noise Insulation (Amendment) Regulations 1988.

18. Mackie and Davies. Studies on Abrupt Changes in Traffic Exposure. 1981.

Appendix 12.2

Operational Noise Model Input Data

Appendix 12.2: Operational Noise Model Input Data

ID:	Name:	Quantum included in model	Internal / External Source	Location	Sound Pressure Level at 1 m (dBA)	Sound Power Level of Equivalent Point Source (dBA)	Source of Data
1	Flue Gas Fan	1	Internal	ATT Hall	83.0	88	Energos
2	Recirculated Flue Gas Fan	1	Internal	ATT Hall	73.0	78	Energos
3	Combustion Air Fan	1	Internal	Aux Systems	89.0	93	Energos
4	Ventilation Fan	1	Internal	ATT Hall	82.5	87	Energos
5	Air Cooled Heat Exchanger	1	External	On Roof	75.0	80	Energos
6	Turbine	1	Internal	Turbine Hall	96.0	104	Energos
7	Generator	1	Internal	Sub-station	85.0	93	Energos
8	Shredder	1	Internal	Refinement Hall	88.3	92	Energos
9	Power Pack, Shredder	1	Internal	Refinement Hall	87.0	91	Energos
10	Hydraulic Skid, Furnace	1	Internal	Aux Systems	83.0	87	Energos
11	Air Compressor	1	Internal	Aux Systems	69.0	73	Energos
12	Thermal Oil Pump	1	Internal	Aux Systems	75.0	79	Energos
13	Cooling Medium Pump	1	Internal	Aux Systems	75.0	79	Energos
14	Thermal Oil Make-up Pump	1	Internal	ATT Hall	75.0	80	Energos
15	Steam Silencer	1	External	On Roof	85.0	90	Energos
16	Feed Water Pump	3	Internal	ATT Hall	75.0	80	Energos
17	Circulation Pump	3	Internal	ATT Hall	71.0	76	Energos
18	Biofilter Fan	12	External	Biofilter	90.0	95	Entsorga
19	Trommel Screen	1	Internal	Refinement Hall	85.0	106	Entsorga
20	Automated Crane	1	Internal	Refinement Hall	78.0	83	Entsorga
21	Automated Crane	1	Internal	ATT Bunker	78.0	83	Entsorga
22	Automated Crane	1	Internal	Bio-Oxidation Hall	78.0	83	Entsorga
23	Primary Shredder	2	Internal	Refinement Hall	95.8	101	Entsorga
24	Conveyor	5	Internal	Refinement Hall	71.0	89	Entsorga

Additional Noise Sources from RPS Source Term Library

ID:	Name:	Quantum included in model	Internal / External Source	Octave Band Sound Power Level (dB)							
				63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
25	Stack	1	External	104	97	85	67	71	67	67	74
26	Air Cooled Condensers	1	External	100	98	89	86	85	86	76	65

Overall Sound Reduction Index (SRI) of Building Facades and Roof (dB):

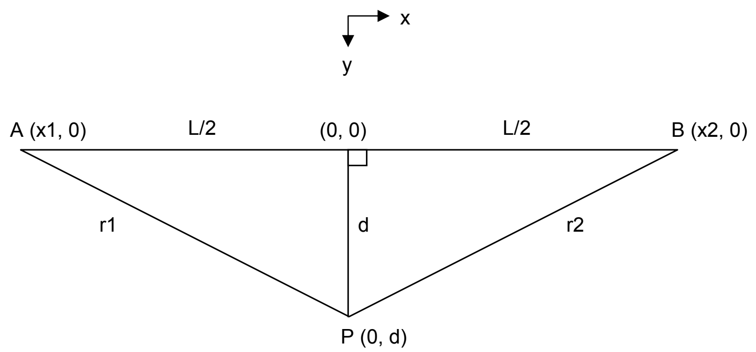
R_W	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
25	10	14	16	20	25	29	23	20

HGVs on Access Road

Measurement of Articulated lorry on access road at Charlton Lane WTS (RPS Ref: JAS3891):

Approximate Distance From Source =	5	m	
Measurement Time =	22	seconds	
$L_{Aeq,T}$ =	71	dB	
Speed of Vehicle =	2.23	m/s	(Site speed limit is 5 mph = 2.23 m/s)

It be shown that, for a point source of constant sound power moving at a constant velocity in a straight line, as illustrated below, the Leq at point P can be related to the sound power per meter of a line source located on the trajectory of the moving source that can be used in a model to represent the emissions of the moving point source over a given time period.



$$L'_W = L_{eq,T} + 10\log\left[\frac{\pi d}{\arctan(L/2d)}\right]$$

d =	5	m
L =	49.06	m

L'_{AW} = **82** dB/m

To model the access road for the facility, the source term must be corrected for the number of vehicles that would occur during the required assessment period and activity on-time (i.e. the time for which vehicles would be present on the access road, which is related to the mean speed of the vehicles)

Correction for number of vehicles = $10 \times \log(Q)$ dB — where Q = number of vehicles in assessment period

Correction for activity on time = $10 \times \log\left(\frac{L_M}{v_M T_M}\right)$ — where L_M = length of source line in model; v_M = mean speed of vehicles in model; and T_M = assessment period in model

Q =	313	vehicles per day	
L_M =	425	m	
v_M =	9	m/s	(20 mph)
T_M =	57600	seconds	(16-hours)

L'_{AW} = **76** dB/m for assessment period

RPS

Reversing Signals

The source term for reversing signals has been derived on the basis of the following supplier's data:

Brigade Alarms: *http://www.reverseinsafety.co.uk/catalogue/index.php*

Fixed medium duty alarm of 97 dB(A) @ 1 m

Assuming a 50% on-time and hemispherical radiation, this is equivalent to:

Reversing Signal, L_W = 102 dB(A)

The reversing signal is included in the model as a line source that describes the trajectory of the rear of the trailer during the manoeuvre with a sound power level for the entire line equal to L_W (as above) and a %on-time commensurate with the duration of the manoeuvre and the assessment period.

Duration of 1 reversing manoeuvre (s)	20
Number of vehicles per day	313
Assessment period (hours)	16
%on-time of model source	11

The supplier's data indicate that reversing signals are typically tuned to approximately 1.25 kHz. On this basis, the source term is modelled using a 1/3rd-octave spectrum with all of the acoustic energy (L_W=102 dB(A)) in the 1.25 kHz band.

Appendix 12.3

Construction Noise and Vibration Assessment

Appendix 12.3: Construction Noise and Vibration Assessment

RPS

Earthworks

Receptor	Floor	Baseline Ambient Noise Level, L_{Aeq} (dB)	Noise Emissions from Construction Site, L_{Aeq} (dB)	Ambient Noise Change (dB)	Adverse Significant Effect?
		Daytime (07:00 to 19:00 hours)		Daytime (07:00 to 19:00 hours)	
1 Railway Cottages	Ground	55	72	17.1	Yes
5 Railway Cottages	Ground	55	72	17.1	Yes
Caxton Street	Ground	57	52	1.2	No
Dryden Street	Ground	52	50	2.1	No
Dryden Street (north)	Ground	52	49	1.8	No
Etla & Alma, Sinfin Lane	Ground	55	58	4.8	No
Kitchener Avenue	Ground	52	51	2.5	No
Kitchener Avenue (east)	Ground	73	56	0.1	No
Victory Road	Ground	51	49	2.1	No
Victory Road (north)	Ground	51	46	1.2	No
Victory Road (south)	Ground	51	48	1.8	No

Piling

Receptor	Floor	Baseline Ambient Noise Level, L_{Aeq} (dB)	Noise Emissions from Construction Site, L_{Aeq} (dB)	Ambient Noise Change (dB)	Adverse Significant Effect?
		Daytime (07:00 to 19:00 hours)		Daytime (07:00 to 19:00 hours)	
1 Railway Cottages	Ground	55	67	12.3	Yes
5 Railway Cottages	Ground	55	66	11.3	Yes
Caxton Street	Ground	57	57	3.0	No
Dryden Street	Ground	52	55	4.8	No
Dryden Street (north)	Ground	52	54	4.1	No
Etla & Alma, Sinfin Lane	Ground	55	62	7.8	Yes
Kitchener Avenue	Ground	52	55	4.8	No
Kitchener Avenue (east)	Ground	73	57	0.1	No
Victory Road	Ground	51	53	4.1	No
Victory Road (north)	Ground	51	49	2.1	No
Victory Road (south)	Ground	51	52	3.5	No

Night-time Concrete Pour

Receptor	Floor	Baseline Ambient Noise Level, L_{Aeq} (dB)	Noise Emissions from Construction Site, L_{Aeq} (dB)	Ambient Noise Change (dB)	Adverse Significant Effect?
		Daytime (23:00 to 07:00 hours)		Daytime (23:00 to 07:00 hours)	
1 Railway Cottages	First	54	62	8.6	Yes
5 Railway Cottages	First	54	62	8.6	Yes
Caxton Street	First	52	51	2.5	No
Dryden Street	First	47	50	4.8	No
Dryden Street (north)	First	47	48	3.5	No
Etla & Alma, Sinfin Lane	First	54	57	4.8	No
Kitchener Avenue	First	47	52	6.2	Yes
Kitchener Avenue (east)	First	68	53	0.1	No
Victory Road	First	47	48	3.5	No
Victory Road (north)	First	47	46	2.5	No
Victory Road (south)	First	47	48	3.5	No

Building Works

Receptor	Floor	Baseline Ambient Noise Level, L_{Aeq} (dB) Daytime (07:00 to 19:00 hours)	Noise Emissions from Construction Site, L_{Aeq} (dB)	Ambient Noise Change (dB) Daytime (07:00 to 19:00 hours)	Adverse Significant Effect?
1 Railway Cottages	Ground	55	53	2.1	No
5 Railway Cottages	Ground	55	53	2.1	No
Caxton Street	Ground	57	43	0.2	No
Dryden Street	Ground	52	42	0.4	No
Dryden Street (north)	Ground	52	40	0.3	No
Etla & Alma, Sinfin Lane	Ground	55	50	1.2	No
Kitchener Avenue	Ground	52	43	0.5	No
Kitchener Avenue (east)	Ground	73	37	0.0	No
Victory Road	Ground	51	40	0.3	No
Victory Road (north)	Ground	51	37	0.2	No
Victory Road (south)	Ground	51	38	0.2	No

Construction Vibration - Vibratory Piling

Receptor		Approximate Distance (m)	Predicted Vibration Level, RPPV (mm/s)		
			Freefield	Foundation	Floor
1 - 5 Railway Cottages		60	0.6	0.5	0.9
Etla & Alma, Sinfin Lane		130	0.2	0.2	0.3
Rolls Royce Factory		75	0.5	0.3	0.7

Note 1: prediction valid for distances up to 100 m

Construction Vibration - Hammered Piling

Receptor	Energy per blow (J)	Approximate Distance (m)	Predicted Vibration Level, RPPV (mm/s)		
			Freefield	Foundation	Floor
1 - 5 Railway Cottages	5000	60	1.0	0.8	1.6
Etla & Alma, Sinfin Lane	5000	130	0.4	0.3	0.6
Rolls Royce Factory	5000	75	0.8	0.6	1.2

Note 1: prediction valid for distances up to approximately 100 m

Appendix 12.4

Operational Noise Assessment

Appendix 12.4: Operational Noise Assessment

RPS

BS 4142 and S5.01 Assessment

Receptor	Receptor Façade	Floor	Baseline Background Noise Level, L_{A90} (dB)		Rating Level, $L_{Ar,Tr}$ (dB)		Rating / Background Level Difference (dB)		Adverse Significant Effect?
			Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	
1 Railway Cottages	E	Ground	50		51		1		Yes
1 Railway Cottages	E	First		51		56		5	Yes
5 Railway Cottages	E	Ground	50		59		9		Yes
5 Railway Cottages	E	First		51		60		9	Yes
Caxton Street	E	Ground	44		51		7		Yes
Caxton Street	E	First		42		51		9	Yes
Dryden Street	E	Ground	43		39		-4		No
Dryden Street	E	First		41		39		-2	No
Dryden Street (north)	E	Ground	43		36		-7		No
Dryden Street (north)	E	First		41		36		-5	No
Etla & Alma, Sinfin Lane	E	Ground	50		55		5		Yes
Etla & Alma, Sinfin Lane	E	First		51		56		5	Yes
Kitchener Avenue	S	Ground	43		40		-3		No
Kitchener Avenue	S	First		41		40		-1	No
Kitchener Avenue (east)	E	Ground	57		38		-19		No
Kitchener Avenue (east)	E	First		55		39		-16	No
Victory Road	W	Ground	44		38		-6		No
Victory Road	W	First		42		37		-5	No
Victory Road (north)	W	Ground	44		33		-11		No
Victory Road (north)	W	First		42		34		-8	No
Victory Road (south)	W	Ground	44		38		-6		No
Victory Road (south)	W	First		42		39		-3	No

RPS

Noise Change Assessment

Receptor	Receptor Façade	Floor	Baseline Ambient Noise Level, L_{Aeq} (dB)		Overall Noise Emissions from Facility, L_{Aeq} (dB)		Ambient Noise Change (dB)		Adverse Significant Effect?
			Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	Daytime (07:00 to 23:00 hours)	Night-time (23:00 to 07:00 hours)	
1 Railway Cottages	E	Ground	56		52		1		Yes
1 Railway Cottages	E	First		54		51		2	Yes
5 Railway Cottages	E	Ground	56		56		3		Yes
5 Railway Cottages	E	First		54		55		4	Yes
Caxton Street	E	Ground	52		48		1		Yes
Caxton Street	E	First		52		47		1	Yes
Dryden Street	E	Ground	47		40		1		Yes
Dryden Street	E	First		47		35		0	No
Dryden Street (north)	E	Ground	47		39		1		Yes
Dryden Street (north)	E	First		47		32		0	No
Etla & Alma, Sinfin Lane	E	Ground	56		55		3		Yes
Etla & Alma, Sinfin Lane	E	First		54		51		2	Yes
Kitchener Avenue	S	Ground	47		40		1		Yes
Kitchener Avenue	S	First		47		35		0	No
Kitchener Avenue (east)	E	Ground	68		38		0		No
Kitchener Avenue (east)	E	First		68		35		0	No
Victory Road	W	Ground	49		38		0		No
Victory Road	W	First		47		33		0	No
Victory Road (north)	W	Ground	49		29		0		No
Victory Road (north)	W	First		47		29		0	No
Victory Road (south)	W	Ground	49		36		0		No
Victory Road (south)	W	First		47		34		0	No

Operational Traffic

Opening Year: 2011	18-hr AAWT (06:00 - 00:00 hours)									
	Without Development				With Development					Noise
Road Section	Total Flow	HGV Flow	% HGV	Speed (km/h)	Total Flow	HGV Flow	% HGV	Speed (km/h)	Dev HGVs	Change (dB)
A5111 (West of Sinfin La)	29417	1009	3.4	50	29498	1075	3.6	50	33	0
Balaclava Road	7686	315	4.1	50	7713	337	4.4	50	11	0
Sinfin Lane (Between Site Access and Wilmore Rd)	16291	658	4.0	50	16328	690	4.2	50	16	0
Sinfin Lane (South of Wilmore Rd)	21151	690	3.3	50	21168	702	3.3	50	6	0
Wilmore Road	11104	254	2.3	50	11123	268	2.4	50	7	0
Sinfin La (Between site and A5111)	16614	755	4.5	50	16887	983	5.8	50	114	0
A5111 Ormaston Road (East of Sinfin La)	27712	767	2.8	50	27886	911	3.3	50	72	0
Victory Road	8962	248	2.8	50	8981	262	2.9	50	7	0
A514 (north of A5111 near Davenport Road)	14890	566	3.8	50	14944	610	4.1	50	22	0
A6 (north of A5111 near Meadow Lane)	20198	735	3.6	50	20258	785	3.9	50	25	0
SUM									**313**	

Opening Year+15: 2026	18-hr AAWT (06:00 - 00:00 hours)									
	Without Development				With Development					Noise
Road Section	Total Flow	HGV Flow	% HGV	Speed (km/h)	Total Flow	HGV Flow	% HGV	Speed (km/h)	Dev HGVs	Change (dB)
A5111 (West of Sinfin La)	32887	1128	3.4	50	32968	1194	3.6	50	33	0
Balaclava Road	8593	352	4.1	50	8620	374	4.3	50	11	0
Sinfin Lane (Between Site Access and Wilmore Rd)	18213	735	4.0	50	18250	767	4.2	50	16	0
Sinfin Lane (South of Wilmore Rd)	23646	771	3.3	50	23663	783	3.3	50	6	0
Wilmore Road	12414	284	2.3	50	12433	298	2.4	50	7	0
Sinfin La (Between site and A5111)	18574	844	4.5	50	18847	1072	5.7	50	114	0
A5111 Ormaston Road (East of Sinfin La)	30982	857	2.8	50	31156	1001	3.2	50	72	0
Victory Road	10019	277	2.8	50	10038	291	2.9	50	7	0
A514 (north of A5111 near Davenport Road)	16646	633	3.8	50	16700	677	4.1	50	22	0
A6 (north of A5111 near Meadow Lane)	22581	822	3.6	50	22641	872	3.8	50	25	0
SUM									**313**	

Appendix 12.5

Operational Noise Mitigation Assessment

Appendix 12.5: Operational Noise Mitigation Assessment

Receptor (first floor)	5 Railway Cottages		
	Without Mitigation		With Mitigation
Rating Level, $L_{Ar,Tr}$ (dB)	60		49
Background Noise Level, L_{A90} (dB)	51		51
Rating / Background Level Difference (dB)	9		-2
Adverse Significant Effect?	Yes		No
Noise Level, $L_{Aeq, 8h}$ (dB)	55		44
Baseline Ambient Noise Level, $L_{Aeq, 8h}$ (dB)	54		54
Noise Change (dB)	4		0
Adverse Significant Effect?	Yes		No

Model Source Name	Source Type	Noise Contribution (dB)	Mitigation (dB)	Mitigated Noise Contribution (dB)
Biofilter Fan	Point	45.8	-11	34.8
Biofilter Fan	Point	45.3	-11	34.3
Biofilter Fan	Point	45	-11	34
Biofilter Fan	Point	44.7	-11	33.7
Biofilter Fan	Point	44.4	-11	33.4
Biofilter Fan	Point	44.1	-11	33.1
Biofilter Fan	Point	43.3	-11	32.3
Biofilter Fan	Point	43.1	-11	32.1
Biofilter Fan	Point	42.9	-11	31.9
Biofilter Fan	Point	42.8	-11	31.8
Biofilter Fan	Point	42.7	-11	31.7
Biofilter Fan	Point	42.6	-11	31.6
Air Cooled Condenser	Point	31.9		31.9
Steam Silencer	Point	24.2		24.2
Turbine (N)	Area	23.7		23.7
Turbine (R)	Area	21.3		21.3
Stack Outlet	Point	20.6		20.6
Generator (W)	Area	19		19
Air Cooled Heat Exchanger	Point	19		19
Generator (R)	Area	16.9		16.9
Aux1 (W)	Area	13.8		13.8
Generator (N)	Area	12		12
ATT Hall (R)	Area	10.5		10.5
Aux1 (R)	Area	9.7		9.7
ATT Hall (W)	Area	9.2		9.2
Refinement Hall (S)	Area	0		0
Refinement Hall (R)	Area	0		0
Bioxidation Hall (W)	Area	0		0
Refinement Hall (S)	Area	0		0
Bioxidation Hall (S)	Area	0		0
Bioxidation Hall (R)	Area	0		0
Refinement Hall (W)	Area	0		0
Bioxidation Hall (N)	Area	0		0
Refinement Hall (E)	Area	0		0
Fuel Bunker (R)	Area	0		0
Aux2 (R)	Area	-5.9		-5.9
ATT Hall (E)	Area	-6.3		-6.3
Aux2 (E)	Area	-10.5		-10.5

Appendix 12.5: Operational Noise Mitigation Assessment

Receptor (first floor)	1 Railway Cottages		
	Without Mitigation		With Mitigation
Rating Level, $L_{Ar,Tr}$ (dB)	56		46
Background Noise Level, L_{A90} (dB)	51		51
Rating / Background Level Difference (dB)	5		-5
Adverse Significant Effect?	Yes		No
Noise Level, $L_{Aeq, 8h}$ (dB)	51		41
Baseline Ambient Noise Level, $L_{Aeq, 8h}$ (dB)	54		54
Noise Change (dB)	2		0
Adverse Significant Effect?	Yes		No

Model Source Name	Source Type	Noise Contribution (dB)	Mitigation (dB)	Mitigated Noise Contribution (dB)
Biofilter Fan	Point	45.4	-11	34.4
Biofilter Fan	Point	45	-11	34
Biofilter Fan	Point	41.9	-11	30.9
Biofilter Fan	Point	40.4	-11	29.4
Biofilter Fan	Point	38.8	-11	27.8
Biofilter Fan	Point	37.3	-11	26.3
Biofilter Fan	Point	33.1	-11	22.1
Biofilter Fan	Point	32.4	-11	21.4
Biofilter Fan	Point	31.5	-11	20.5
Biofilter Fan	Point	30.9	-11	19.9
Steam Silencer	Point	30.5	-11	19.5
Biofilter Fan	Point	30.1	-11	19.1
Biofilter Fan	Point	29.3		29.3
Air Cooled Condenser	Point	27.6		27.6
Turbine (R)	Area	22.1		22.1
Stack Outlet	Point	21		21
Refinement Hall (R)	Area	0		0
Turbine (N)	Area	20.2		20.2
Aux1 (W)	Area	19.9		19.9
Generator (W)	Area	19.6		19.6
Generator (R)	Area	17.4		17.4
Air Cooled Heat Exchanger	Point	15.9		15.9
Refinement Hall (S)	Area	0		0
ATT Hall (R)	Area	13.9		13.9
Aux1 (R)	Area	13.6		13.6
Generator (N)	Area	12.6		12.6
Bioxidation Hall (W)	Area	0		0
ATT Hall (W)	Area	10.7		10.7
Bioxidation Hall (R)	Area	0		0
Bioxidation Hall (N)	Area	0		0
Bioxidation Hall (S)	Area	0		0
Refinement Hall (S)	Area	0		0
Refinement Hall (W)	Area	0		0
Refinement Hall (E)	Area	0		0
Fuel Bunker (R)	Area	0		0
Aux2 (R)	Area	-6		-6
ATT Hall (E)	Area	-6.1		-6.1
Aux2 (E)	Area	-10.2		-10.2

Appendix 12.5: Operational Noise Mitigation Assessment

Receptor (first floor)	Etla & Alma, Sinfin Lane		
	Without Mitigation		With Mitigation
Rating Level, $L_{Ar,Tr}$ (dB)	56		46
Background Noise Level, L_{A90} (dB)	51		51
Rating / Background Level Difference (dB)	5		-5
Adverse Significant Effect?	Yes		No
Noise Level, $L_{Aeq, 8h}$ (dB)	51		41
Baseline Ambient Noise Level, $L_{Aeq, 8h}$ (dB)	54		54
Noise Change (dB)	2		0
Adverse Significant Effect?	Yes		No

Model Source Name	Source Type	Noise Contribution (dB)	Mitigation (dB)	Mitigated Noise Contribution (dB)
Biofilter Fan	Point	43.6	-11	32.6
Biofilter Fan	Point	41.4	-11	30.4
Biofilter Fan	Point	40.5	-11	29.5
Biofilter Fan	Point	39.9	-11	28.9
Biofilter Fan	Point	39.4	-11	28.4
Biofilter Fan	Point	38.8	-11	27.8
Biofilter Fan	Point	38.6	-11	27.6
Biofilter Fan	Point	38.6	-11	27.6
Biofilter Fan	Point	38.5	-11	27.5
Biofilter Fan	Point	38.4	-11	27.4
Biofilter Fan	Point	38.3	-11	27.3
Biofilter Fan	Point	38.2	-11	27.2
Refinement Hall (S)	Area	0		0
Refinement Hall (R)	Area	0		0
Steam Silencer	Point	30.3		30.3
Turbine (R)	Area	28.1		28.1
Turbine (N)	Area	27.5		27.5
Air Cooled Condenser	Point	25.2		25.2
Refinement Hall (S)	Area	0		0
Stack Outlet	Point	18.2		18.2
Air Cooled Heat Exchanger	Point	16.9		16.9
Generator (N)	Area	16.6		16.6
Generator (R)	Area	16.5		16.5
Aux1 (R)	Area	15.2		15.2
Generator (W)	Area	14.9		14.9
Aux1 (W)	Area	13.2		13.2
ATT Hall (R)	Area	12.9		12.9
Refinement Hall (W)	Area	0		0
Bioxidation Hall (S)	Area	0		0
Bioxidation Hall (R)	Area	0		0
Bioxidation Hall (W)	Area	0		0
Refinement Hall (E)	Area	0		0
ATT Hall (W)	Area	2.5		2.5
Fuel Bunker (R)	Area	0		0
Aux2 (R)	Area	1.1		1.1
ATT Hall (E)	Area	-6.1		-6.1
Bioxidation Hall (N)	Area	0		0
Aux2 (E)	Area	-9.9		-9.9

Appendix 12.5: Operational Noise Mitigation Assessment

Receptor (first floor)	Caxton Street		
	Without Mitigation		With Mitigation
Rating Level, $L_{Ar,Tr}$ (dB)	51		41
Background Noise Level, L_{A90} (dB)	42		42
Rating / Background Level Difference (dB)	9		-1
Adverse Significant Effect?	Yes		No
Noise Level, $L_{Aeq,\ 8h}$ (dB)	46		36
Baseline Ambient Noise Level, $L_{Aeq,\ 8h}$ (dB)	52		52
Noise Change (dB)	1		0
Adverse Significant Effect?	Yes		No

Model Source Name	Source Type	Noise Contribution (dB)	Mitigation (dB)	Mitigated Noise Contribution (dB)
Biofilter Fan	Point	36.5	-11	25.5
Biofilter Fan	Point	36.4	-11	25.4
Biofilter Fan	Point	36	-11	25
Biofilter Fan	Point	35.9	-11	24.9
Biofilter Fan	Point	35.9	-11	24.9
Biofilter Fan	Point	35.9	-11	24.9
Biofilter Fan	Point	35.9	-11	24.9
Biofilter Fan	Point	35.4	-11	24.4
Biofilter Fan	Point	35.3	-11	24.3
Biofilter Fan	Point	34.9	-11	23.9
Biofilter Fan	Point	34.9	-11	23.9
Biofilter Fan	Point	33.4	-11	22.4
Steam Silencer	Point	27		27
Refinement Hall (S)	Area	0		0
Refinement Hall (R)	Area	0		0
Turbine (R)	Area	19.1		19.1
Stack Outlet	Point	15.1		15.1
Turbine (N)	Area	14.5		14.5
Refinement Hall (S)	Area	0		0
Air Cooled Condenser	Point	12.9		12.9
Generator (W)	Area	12.7		12.7
Generator (R)	Area	12.2		12.2
Aux1 (R)	Area	11.2		11.2
Aux1 (W)	Area	11.2		11.2
ATT Hall (R)	Area	9.6		9.6
Air Cooled Heat Exchanger	Point	9.5		9.5
Bioxidation Hall (S)	Area	0		0
Generator (N)	Area	4.3		4.3
Bioxidation Hall (R)	Area	0		0
Refinement Hall (W)	Area	0		0
ATT Hall (W)	Area	2		2
Fuel Bunker (R)	Area	0		0
Bioxidation Hall (W)	Area	0		0
Aux2 (R)	Area	-4.3		-4.3
Refinement Hall (E)	Area	0		0
Bioxidation Hall (N)	Area	0		0
ATT Hall (E)	Area	-12.3		-12.3
Aux2 (E)	Area	-15.7		-15.7