Development of Waste Treatment Facility, Reception and Recycling Hall; Mechanical Biological Treatment (MBT) Facility; Advanced Conversion Technology (ACT) Facility; Power Generation and export facility; Education and Office Accommodation; Landscaping; and Access

Sinfin Lane, Derby

On behalf of Resource Recovery Solutions (Derbyshire) Ltd

Environmental Statement

Chapter 12:
Noise and Vibration

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12.1 Introduction

12.1.1 This chapter provides an assessment of the potential noise and vibration effects arising from the construction and operation of the proposed facility and includes the following sections:

1. National, Regional and Local Guidance Documents and Consultation – a summary of relevant information provided by national, regional and local guidance documents. A summary of the consultation undertaken with the Councils (Derbyshire County Council and Derby City Council) is also provided.

2. *Assessment Methodology* – methodology used to predict and assess the noise and vibration effects and the criteria used to determine their significance.

3. *Baseline Assessment* – daytime and night-time baseline noise levels are provided in order to describe the baseline noise climate in the vicinity of the proposed site. A description of the significant noise sources that affect the area in the vicinity of the proposed site is also provided.

4. Incorporated Enhancement and Mitigation - mitigation measures that have been incorporated within the project in order to minimise noise and vibration effects arising from the construction and/or operation of the facility.

5. *Identification and Evaluation of Likely Significant Effects* – quantitative and qualitative assessments of noise and vibration levels at the nearest noise sensitive receptors (NSRs) during the construction and operation of the facility and the determination of the significance of any resulting effect. Recommendation of proposed mitigation measures, where appropriate, in order to minimise any potential negative effects arising from the construction and/or operation of the facility and an assessment of residual effects, following incorporation of proposed mitigation measures, arising from the construction and/or operation of the facility.

12.1.2 A summary of relevant British Standards (BS) and guidance that have been used to inform the assessment is provided in Appendix 12.1.

12.2 National, Regional and Local Guidance Documents and Consultation

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

12.2.1 National planning guidance is contained within Planning Policy Guidance Note 24: Planning and Noise (PPG 24) [1]. PPG 24 offers guidance to local authorities on the assessment of noise and its potential impact on noise sensitive dwellings.

12.2.2 Sections 19 and 20 of Annex 3 of PPG 24 cite the use of British Standard 4142 'Method for Rating industrial noise affecting mixed residential and industrial areas' (BS 4142) [2] 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.'*

(Note that BS 8233: 1987 has been superseded by BS 8233: 1999 and MPG 11 has been superseded by MPS 2 [3] in England)

12.2.3 The Standard advocates the use of L_{Aeq}. 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.

12.2.4 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.

12.2.5 BS 4142 requires a 'representative background noise level' to be adopted for the assessment. There is no BS or Government 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.

IPPC Sector Guidance Note – Combustion Activities

12.2.6 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 [4] 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.'

Guidelines for Community Noise and Sleep Disturbance Criteria

12.2.7 'Guidelines for Community Noise' (GCN) [5] 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.

12.2.8 For daytime levels, it is considered that:

'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.'

12.2.9 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).'

12.2.10 The time base for the L_{Aeq} values provided above are 16-hours for the daytime effects and 8-hours for the night-time effects. This implies that $L_{Aeq,16h}$ and $L_{Aeq,8h}$ are the appropriate parameters to assess reaction of people to changes in ambient noise level.

East Midlands Regional Plan

12.2.11 The current East Midlands Regional Plan [6] was published in March 2009. It provides a comprehensive spatial strategy for the East Midlands Region to guide the future distribution of activities such as house building, business development and sport and leisure related developments.

12.2.12 The Plan does not make specific reference to noise from waste treatment facilities. However, Policy 38, Regional Policies for Waste Management, states:

'Waste facilities should be sited to avoid the pollution or disturbance of designated conservation sites of international importance. Increased traffic levels on roads near to sensitive sites should be avoided.'

Derbyshire County Council and Derby City Council (the Councils)

Minerals and Waste Development Framework

12.2.13 The Councils are responsible for preparing a Minerals and Waste Development Framework for the area of Derbyshire outside the Peak District National Park. The adopted Minerals Local Plan [7] and the adopted Waste Local Plan [8] are part of the Development Framework.

Waste Local Plan

12.2.14 The Waste Local Plan includes the following policies that refer to noise and/or environmental effects that are implied to include noise:

'Policy W6 Pollution and related nuisances

4.16 Waste development will be permitted only if the development would not result in material harm caused by contamination, pollution or other adverse environmental or health effects to:

- *people or communities;*
- *the site of the development;*
- *nearby land uses; or*
- *the wider environment.'*

Derby and Derbyshire Joint Structure Plan

12.2.15 The Derby and Derbyshire Joint Structure Plan [9] sets out the strategic planning policies for the County of Derbyshire, including the City of Derby, but excluding the Peak District National Park. The Plan was jointly prepared by the Councils and was adopted in January 2001. From 27 September 2007, following a Government Direction, only the following policies will be used, the others having expired: GSD6, T14, TC and S1, L and T2, ENV2, ENV4, ENV8, ENV13, H9 - H17 inclusive, E1, E9 - E17 inclusive. None of the policies listed above refer to noise or vibration.

Adopted City of Derby Local Plan Review

12.2.16 The Adopted City of Derby Local Plan Review, 2006 [10], contains a section on Environment that is relevant to the assessment of noise. Policy E12 states:

'Planning permission will not be granted for development which would generate pollutants that would be unacceptably detrimental to the health and amenity of users of the development, users of adjoining land or the environment; or where the level of existing pollutants would be unacceptably detrimental to the health and amenity of users of the proposed development.'

Consultation

12.2.17 The baseline noise monitoring methodology and locations were agreed with the Councils in advance of the surveys. The methodology and criteria for the noise and vibration assessment was submitted to the Pollution Control department of the Councils via email on 16 January 2009. With regards to the assessment methodology, a reply was received form the Councils on 11 February 2009 that stated *'the methodology and criteria appear reasonable.'*

12.2.18 The following assessment criteria were agreed:

- Rating levels at residential receptors not to exceed baseline background noise levels (as defined in BS 4142);
- Freefield rating levels, $L_{Ar,Tr}$ (as defined in BS 4142), not to exceed 50 dB between 07:00 and 23:00 hours at receptors where the baseline background noise level is less

than 50 dB;

- Facade rating levels, $L_{Ar,Tr}$ (as defined in BS 4142), not to exceed 45 dB between 23:00 and 07:00 hours at receptors where the baseline background noise level is less than 45 dB;
- No change in ambient noise level at residential NSRs, $L_{Aeq,16h}$ (07:00 to 23:00 hours).

12.2.19 It was agreed that significant operational vibration effects would be unlikely and, on this basis, no further assessment is required.

12.2 Assessment Methodology

Baseline Survey Methodology

12.2.20 The noise assessment methodology requires a comparison to be made between the baseline daytime and night-time noise levels at the noise sensitive receptors (NSRs) and the future noise levels that would be expected to occur, at those locations, with the facility being constructed and then operated. Baseline noise levels were determined by a field study.

12.2.21 The field study comprised of three long term unattended noise surveys and four short-term attended surveys at separate locations in the area. The noise monitors were installed at locations that were representative of the nearest NSRs to the facility, which are houses to the west, northwest, north and south of the site. The survey locations are shown in Figure 12.1.

12.2.22 One long term survey logged measurements over a period of six days, the other two over a period of two weeks. For the short-term surveys, three, 15-minute measurements were made at each location during the daytime. All surveys were undertaken at freefield locations with the microphone at a height of 1.5 m above ground level.

12.2.23 The instrumentation was calibrated both prior to and immediately following the surveys to ensure that no significant drift had occurred over the survey period. All instrumentation was within the manufacturers' periods of calibration and calibration certificates are available on request.

12.2.24 BS 4142 requires a *'representative background noise level'* to be adopted for the assessment of noise effects during the operation of the facility. One approach that is commonly adopted, and has been adopted for this project, is to use the average L_{A90} for the daytime period between 07:00 and 23:00 hours and the night-time period between 23:00 and 07:00 hours, i.e. the arithmetic mean of the 15-minute data from the long term surveys within the appropriate time period.

12.2.25 The assessment also considers the changes in ambient ($L_{Aeq,T}$) noise levels during the

construction and operation of the facility. These assessments have used the logarithmic average of the 15-minute L_{Aeq} between 07.00 and 19.00 hours, 07.00 and 23.00 hours and 23.00 and 07.00 hours for the assessments of noise during construction, daytime operation and night-time operation, respectively.

12.2.26 Only data that were measured when the wind speeds were at or less than 5 m/s were included in the datasets used to derive the baseline noise levels. BS 4142 implies that measurements can be taken in wind speeds up to 5 m/s, i.e. it states *'For the purposes of this standard, windshields are generally effective up to wind speeds of 5 m/s*'. It is considered that, by only using data obtained when wind speeds are at or less than 5 m/s, data will be obtained that is robust and valid in accordance with BS 4142.

12.2.27 Wind data was obtained from metcheck.com for the meteorological station at Derby Airfield. The airfield is approximately 6-miles southwest of the site. A logging anemometer was installed at one of the long term survey locations. The data indicate that there were no periods throughout the long term and short-term surveys for which the mean hourly wind-speed exceeded 5 m/s.

Construction Assessment Methodology

12.2.28 Noise levels due to the construction phase have been predicted using SoundPLAN noise modelling software, which implements the methodology contained within BS 5228-1 [11]. Source terms have been obtained from BS 5228-1 based on a list of plant provided by the client.

12.2.29 The following significance criterion is based upon one of three example methodologies contained within Annex E of BS 5228-1 and has been used as the threshold of significance for this assessment:

Table 12.1: Threshold of Significance for Construction Noise

Noise Change, $L_{Aeq,T}$ (dB)	Is the Change Significant?
<= 5	No
> 5	Yes

Note 1: T is daily working hours of the site
Note 2: Applies to residential receptors

12.2.30 The limits provided in Table 12.1 are subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$, from construction noise alone, for the daytime, evening and night-time periods, respectively. There are no suggested criteria for non-residential receptors, such as business premises or recreational areas.

12.2.31 The following semantic scale has been adopted to assess the significance of the effects of noise change associated with construction HGVs on local roads:

Table 12.2: Semantic Scale for Describing Noise Change – Thresholds of Significance (Non-permanent Construction Traffic)

Predicted Noise Change		Scale Rating
Decrease of more than 6 dB	Significant decrease	Significant Positive Effect
Increase or Decrease of 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	

12.2.32 It is considered that the only construction sources that would have the potential to give rise to significant vibration effects would be driven or vibratory piling (bored or augured piles would be unlikely to give rise to significant levels of vibration). Significant vibration effects due to HGVs are unlikely provided that the access roads do not contain significant discontinuities.

12.2.33 Vibration levels arising from the construction phase have been predicted using methods contained within BS 5228-2 [12]. Table 12.3 provides the vibration limits contained within BS 5228-2 above which cosmetic damage could occur and have been adopted as the thresholds of significant effect for construction vibration to buildings. The Standard states that the vibration limits above which minor and major damage could occur are twice and four times those given in Table 12.3.

Table 12.3: Threshold Vibration Values for the Evaluation of Cosmetic Building Damage (BS 5228-2)

Building Classification	Frequency Range of Vibration (Hz)	Vibration Level, PPV mm/s	
		Transient Vibration	Continuous Vibration
Unreinforced or light framed structures	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
Residential or light commercial type buildings	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.

12.2.34 Consideration has also been given to the expected human response to construction vibration based upon guidance contained within BS 5228-2. The thresholds of significance that have been adopted for the assessment are provided in Table 12.4.

Table 12.4: Threshold Vibration Values for the Evaluation of Human Response to Vibration from Construction Activities

Vibration Level, PPV mm/s	Significance
< 1.0	Not Significant
> 1.0 and < 3.0	Minor Adverse
> 3.0 and < 10.0	Moderate Adverse
> 10	Major Adverse

Note: although not explicitly stated, it is assumed that the limits refer to vibration measured at the point of entry to the subject (i.e. in the floor)

Operation Assessment Methodology

12.2.35 Noise levels arising from the operation of the facility have been predicted using SoundPLAN noise modelling software, implementing the methodology contained within ISO 9613-2 [13]. Source terms for the most significant items of external plant have been provided by Energos and Entsorga on behalf of the client. The Sound Reduction Index (SRI) of the facades of the building has been obtained from published literature. The source terms adopted for the assessment of the facility are provided in Appendix 12.2.

12.2.36 The operational effects of static sources have been assessed using the methodology contained within BS 4142. In addition, consideration has also been given to the ambient noise change that would occur as a result of both static and mobile sources associated with the introduction of the facility.

12.2.37 BS 4142 states that if the rating level from a facility exceeds the background noise level by 5 dB then this is of 'marginal significance'. Consideration has been given to sleep disturbance criteria as contained within GCN, which states:
'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).'

12.2.38 The IPPC Technical Guidance Note applicable to Energy from Waste Facilities, S5.01 contains advice with regard to BAT requirements for noise and vibration. The guidance states that the operator should *'justify where Rating Levels ($L_{Aeq,T}$) from the installation exceed the*

numerical value of the Background Sound Level ($L_{A90,T}$)' and that '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.

12.2.39 The following semantic scale has been adopted to assess the significance of the effects of noise change associated with the delivery HGVs on local roads.

Table 12.5: Semantic Scale for Describing Noise Change – Thresholds of Significance (Operational Traffic)

Predicted Noise Change		Scale Rating
Decrease of more than 3 dB	Significant decrease	Significant Positive Effect
Increase or Decrease of Less than 3 dB	No Significant change	No Effect
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	

12.2.40 On the basis of the above, the significance of operational noise effects will be based upon the following criteria:

- rating level, $L_{Ar,Tr}$, (as defined in BS 4142) exceeds background noise level, L_{A90};
- freefield rating level, $L_{Ar,Tr}$ (as defined in BS 4142) (07.00 to 23.00 hours), exceeds 50 dB and the baseline daytime ambient level is 50 dB, $L_{Aeq,16h}$ (07.00 to 23.00 hours), or less;
- façade rating level, $L_{Ar,Tr}$ (as defined in BS 4142) (23.00 to 07.00 hours), exceeds 45 dB and the baseline night-time ambient is level 45 dB, $L_{Aeq,8h}$ (23.00 to 07.00 hours), or less;
- ambient noise change from the facility $L_{Aeq,16h}$ (07.00 to 23.00 hours) or $L_{Aeq,8h}$ (23.00 to 07.00 hours) exceeds 0 dB; or
- noise change from operational traffic exceeds 3 dB.

12.2.41 Significant operational vibration effects are unlikely and, therefore, a quantitative assessment is not required.

12.3 Baseline Assessment

Site Description

12.3.1 The proposed site is on Sinfin Lane, Derby and lies between existing industrial and commercial buildings. Adjacent land uses include commercial units to the north and east, areas in industrial use to the south and southwest and allotments and residential uses to the

northwest. A plan of the area around the site is provided in Figure 12.1.

12.3.2 The site is bounded to the north and east by railway lines. The railway to the north is a passenger and freight line from Derby Midland Station running southwest and the line to the east is a siding for freight trains delivering to or collecting from industrial units to the east. The A5111 is north of the site and Sinfin Lane is a major access road to the industrial areas of south Derby off the A5111, running approximately north to south.

12.3.3 The closest residential properties are adjacent to the site boundary in the northwest corner. The nearest NSRs are:

- a terrace of five houses on Sinfin Lane adjacent to the northwest corner of the site (Railway Cottages);
- two semi-detached houses adjacent to the southwest corner of the site (Etla and Alma);
- houses on Caxton Street, Dryden Street and Kitchener Avenue that back onto the Sinfin Lane allotments, the closest being approximately 150 m from the edge of the site;
- houses on Victory Road, which are approximately 250 m to the east of the site;
- houses on Sinfin Lane, which are approximately 200 m to the north of the site;
- houses on Thackeray Street, which are approximately 350 m to the south of the site; and
- houses on Osmaston Park Road, which are approximately 300 m to the north of the site.

12.3.4 Although not considered noise sensitive, the allotments to the northwest of the site have been included in the assessment for completeness.

Baseline Noise Surveys

Location 1 (Long term) – Rear of 3 Railway Cottages, Sinfin Lane

12.3.5 The survey was undertaken from 13:15 hours Friday 17th April to 11:00 hours Friday 1st May 2009 using a 01dB Solo Type 1 sound level meter. The survey was installed at the rear of the garden of 3 Railway Cottages. The survey measured values of 15-minute $L_{Aeq,T}$, L_{A90}, $L_{Amax,S}$ and L_{A10} continuously throughout the survey period. A logging anemometer measured the mean wind speed throughout the survey period.

12.3.6 Baseline noise levels are influenced by noise from road traffic, trains passing adjacent to the site and extract fans from the Rolls Royce industrial buildings to the south of the site. The dominant noise source is road traffic noise on Sinfin Lane. The results of the long term noise

survey are provided in Table 12.6 and provided graphically in Figure 12.2.Table 12.6 : Long term Noise Survey Results - Location 1: Rear of 3 Railway Cottages, Sinfin Lane

Date and Day at Start of Period		Daytime (07.00 to 19.00 hours)		Daytime (07.00 to 23.00 hours)			Night-time (23.00 to 07.00 hours)		
		$L_{Aeq,12h}$ (dB)	*Hours in Data-set*	$L_{Aeq,16h}$ (dB)	L_{A90} (dB)	*Hours in Data-set*	$L_{Aeq,8h}$ (dB)	L_{A90} (dB)	*Hours in Data-set*
17/04/2009	Friday	57	*5.75*	56	53	*9.75*	54	51	*8*
18/04/2009	Saturday	57	*12*	61	53	*16*	54	51	*8*
19/04/2009	Sunday	*		61	52	*16*	54	52	*8*
20/04/2009	Monday	64	*12*	65	54	*16*	54	52	*8*
21/04/2009	Tuesday	58	*12*	57	50	*16*	54	51	*8*
22/04/2009	Wednesday	60	*12*	60	53	*16*	54	52	*8*
23/04/2009	Thursday	62	*12*	61	55	*16*	55	52	*8*
24/04/2009	Friday	62	*12*	61	55	*16*	55	52	*8*
25/04/2009	Saturday	67	*12*	65	53	*16*	54	52	*8*
26/04/2009	Sunday	*		56	51	*16*	54	51	*8*
27/04/2009	Monday	55	*12*	60	52	*16*	54	51	*8*
28/04/2009	Tuesday	57	*12*	56	52	*16*	54	52	*8*
29/04/2009	Wednesday	57	*12*	64	54	*16*	55	52	*8*
30/04/2009	Thursday	85	*12*	84	55	*16*	55	52	*8*
01/05/2009	Friday	58	*4.25*	58	54	*4.25*	0	0	*0*

* Sunday has not been calculated as no construction is expected.

Location 2 (Long term) – Sinfin Lane Allotments

12.3.7 The survey was undertaken from Wednesday 13th February to Monday 19th February 2008 using a Rion NL-32 Type 1 sound level meter. The baseline noise levels are influenced by road traffic from the nearby roads and trains on the local railway line. The dominant noise source is road traffic noise on Sinfin Lane. The results of the long term noise survey are provided in Table 12.7 and provided graphically in Figure 12.2.

Table 12.7 : Long term Noise Survey Results – Location 2: Sinfin Lane Allotments

		Daytime (07.00 to 19.00 hours	Daytime (07.00 to 23.00 hours)		Night-time (23.00 to 07.00 hours)	
		$L_{Aeq,12h}$ (dB)	$L_{Aeq,16h}$ (dB)	L_{A90} (dB)	$L_{Aeq,8h}$ (dB)	L_{A90} (dB)
13/02/2008	Wednesday				48	41
14/02/2008	Thursday	54	54	51	51	47
15/02/2008	Friday	55	55	52	51	48
16/02/2008	Saturday	52	52	48	46	42
17/02/2008	Sunday	*	47	43	47	43
18/02/2008	Monday	52	52	48	47	41

* Sunday has not been calculated as no construction is expected.

Location 3 (Long term) – Rear of 94 Victory Road

12.3.8 The survey was undertaken from 12:30 hours Friday 17th April to 10:15 hours Friday 1st May 2009 using a 01dB Solo Type 1 sound level meter. The survey was installed at the rear of the garden of 94 Victory Road. The survey measured values of 15-minute $L_{Aeq,T}$, L_{A90}, $L_{Amax,S}$ and L_{A10} continuously throughout the survey period. A logging anemometer measured the mean wind speed throughout the survey period.

12.3.9 The dominant noise sources include road traffic on Victory Road and a continuous industrial drone from the buildings to the west of the Victory Road. The results of the long term noise survey are provided in Table 12.8 and provided graphically in Figure 12.2.

Table 12.8 : Long term Noise Survey Results - Location 3: Rear of 94 Victory Road

Date and Day at Start of Period		Daytime (07.00 to 19.00 hours)		Daytime (07.00 to 23.00 hours)			Night-time (23.00 to 07.00 hours)		
		$L_{Aeq,12h}$ (dB)	*Hours in Data-set*	$L_{Aeq,16h}$ (dB)	L_{A90} (dB)	*Hours in Data-set*	$L_{Aeq,8h}$ (dB)	L_{A90} (dB)	*Hours in Data-set*
17/04/2009	Friday	53	*6.5*	53	49	*10.5*	48	44	*8*
18/04/2009	Saturday	53	*12*	52	47	*16*	47	42	*8*
19/04/2009	Sunday	*		56	45	*16*	47	42	*8*
20/04/2009	Monday	52	*12*	51	47	*16*	48	44	*8*
21/04/2009	Tuesday	53	*12*	52	48	*16*	50	44	*8*
22/04/2009	Wednesday	51	*12*	51	47	*16*	50	44	*8*
23/04/2009	Thursday	52	*12*	52	48	*16*	50	44	*8*
24/04/2009	Friday	54	*12*	53	49	*16*	49	43	*8*
25/04/2009	Saturday	51	*12*	50	46	*16*	48	43	*8*
26/04/2009	Sunday	*		49	44	*16*	48	43	*8*
27/04/2009	Monday	54	*12*	53	48	*16*	51	45	*8*
28/04/2009	Tuesday	53	*12*	53	48	*16*	50	43	*8*
29/04/2009	Wednesday	55	*12*	55	49	*16*	50	44	*8*
30/04/2009	Thursday	54	*12*	53	50	*16*	49	43	*8*
01/05/2009	Friday	53	*3.5*	53	49	*3.5*	0	0	*0*

* Sunday has not been calculated as no construction is expected.

Location 4 (Short-term) – Sinfin Lane

12.3.10 The survey was undertaken on the pavement at the northern end of the Sinfin Lane allotments. At this location, noise levels were influenced by road traffic noise on Sinfin Lane. The results of the short-term noise survey are provided in Table 12.9.

Table 12.9 : Short-term Noise Survey Results – Location 4: Sinfin Lane

Time	Meas. Time	$L_{Aeq,T}$ (dB)	$L_{Amax,F}$ (dB)	L_{A90} (dB)
26/02/2008 10:59:22	15-min	70	81	59
26/02/2008 12:25:58	15-min	71	81	61
26/02/2008 13:56:00	15-min	74	97	63
Mean		**72**		**61**

Location 5 (Short-term) – Caxton Street

12.3.11 The survey was undertaken at the eastern end of Caxton Street adjacent to the southwest corner of the Sinfin Lane allotments. At this location, levels are influenced by noise from the road traffic on Sinfin Lane and trains on the railway to the south. The dominant noise source is road traffic noise on Sinfin Lane. The results of the short-term noise survey are provided in Table 12.10.

Table 12.10 : Short-term Noise Survey Results – Location 5: Caxton Street

Time	Meas. Time	$L_{Aeq,T}$ (dB)	$L_{Amax,F}$ (dB)	L_{A90} (dB)
26/02/2008 11:20:16	15-min	53	75	47
26/02/2008 12:45:18	15-min	58	77	49
26/02/2008 14:15:17	15-min	55	77	48
Mean		**55**		**48**

Location 6 (Short-term) – Junction of Sinfin Lane and Wilmore Road

12.3.12 The survey was undertaken on the southern corner of the junction between Sinfin Lane and Wilmore Road approximately 20 m to the north of the rear of the end house on Thackery Street. At this location, levels are influenced by noise from road traffic at the junction. The results of the short-term noise survey are provided in Table 12.11.

Table 12.11 : Short-term Noise Survey Results – Location 6: Junction of Sinfin Lane and Wilmore Road

Time	Meas. Time	$L_{Aeq,T}$ (dB)	$L_{Amax,F}$ (dB)	L_{A90} (dB)
26/02/2008 12:04:34	15-min	67	79	61
26/02/2008 13:35:51	15-min	71	81	68
26/02/2008 15:03:37	15-min	67	78	62
Mean		**68**		**64**

Location 7 (Short-term) – Osmaston Park Road

12.3.13 The survey was undertaken on Osmaston Park Road close to the junction with Portland Street opposite Foresters Way. At this location, levels are influenced by noise from road traffic. The results of the short-term noise survey are provided in Table 12.12.

Table 12.12 : Short-term Noise Survey Results – Location 7: Osmaston Park Road

Time	Meas. Time	$L_{Aeq,T}$ (dB)	$L_{Amax,F}$ (dB)	L_{A90} (dB)
26/02/2008 11:42:13	15-min	73	82	66
26/02/2008 13:08:15	15-min	74	84	67
26/02/2008 14:38:50	15-min	74	90	68
Mean		**74**		**67**

12.3.14 The mean differences between the results of simultaneous short-term surveys at locations 2, 4 and 5 have been applied as corrections to the results of the unattended long term survey at location 2 to derive an estimate of the long term baseline noise levels at locations 4 and 5. This is on the basis that the noise levels at all three locations are dominated by the same noise source, which is road traffic noise from Sinfin Lane. The results of the short-term noise surveys at location 2 are provided in Table 12.13.

Table 12.13 : Short-term Noise Survey Results – Location 2: Sinfin Lane Allotments

Time	Meas. Time	$L_{Aeq,T}$ (dB)	$L_{Amax,F}$ (dB)	L_{A90} (dB)
26/02/2008 10:59:22	15-min	50	61	46
26/02/2008 11:20:16	15-min	49	61	46
26/02/2008 12:25:58	15-min	50	64	47
26/02/2008 12:45:18	15-min	51	61	47
26/02/2008 13:56:00	15-min	51	62	48
26/02/2008 14:15:17	15-min	50	59	47

12.3.15 Noise levels at location 1 were affected by noise from adjacent industrial units that is not as significant at locations 2, 3, 4 and 5, which are more distant. The baseline noise levels adopted for the assessment at location 1 are as provided in Table 12.7.

12.3.16 Noise levels at locations 6 and 7 are dominated by nearby road traffic sources that are likely to be insignificant at locations 1, 2 and 3, and, therefore, it is not possible to apply a correction to the short-term data at these locations to obtain estimates of long term noise values. The baseline noise levels at locations 6 and 7 are as provided in Tables 12.11 and 12.12.

12.3.17 To maintain a robust set of assumptions, the lowest baseline daytime and night-time values derived from the three long term datasets for each assessment period have been adopted (i.e. the arithmetic mean of the measured 15-minute data within the period (07.00 to 19.00 hours, 07.00 to 23.00 hours and 23.00 to 07.00 hours for construction daytime, daytime and night-time, respectively) for which the mean wind speed at survey location 1 (survey locations 1 and 3) or Derby Airfield (survey location 2) did not exceed 5 m/s is calculated separately for each daytime and night-time period and the lowest value of that subset is adopted as the baseline

noise level). The baseline noise levels adopted for the assessment are provided in Table 12.14.

Table 12.14 : Baseline Noise Levels

Survey Location Number:	Representative of NSRs:	$L_{Aeq,12h}$ (dB)	$L_{Aeq,16h}$ (dB)	L_{A90} (dB)	$L_{Aeq,8h}$ (dB)	L_{A90} (dB)
		Daytime (07.00 to 19.00 hours)	Daytime (07.00 to 23.00 hours)		Night-time (23.00 to 07.00 hours)	
1	1-5 Railway Cottages, Etla and Alma, Sinfin Lane.	55	56	50	54	51
2	Dryden Street, Kitchener Avenue and allotments.	52	47	43	47	41
3	Victory Road	51	49	44	47	42
4	The northern end of Sinfin Lane and eastern end of Kitchener Avenue	73	68	57	68	55
5	Caxton Street	57	52	44	52	42
6	Thackeray Street	68	68	64	*No Data*	*No Data*
7	Osmaston Park Road	74	74	67	*No Data*	*No Data*

12.4 Incorporated Enhancement and Mitigation

12.4.1 A Code of Construction Practice (CoCP) or Construction Environmental Management Plan (CEMP) would be prepared that would include details of measures that would be undertaken to minimise the impact of construction noise in accordance with Best Practicable Means (BPM).

12.4.2 The project includes a 4 m high bund in the northwestern corner of the site adjacent to the rear gardens of 1 – 5 Railway Cottages that will reduce noise effects to these NSRs during construction and operation of the facility to protect resident's amenity.

12.5 Identification and Evaluation of Likely Significant Effects

Construction Effects

Noise from Construction Activities

12.5.1 The majority of activities associated with the construction of the development would occur during the daytime. The construction of the development may require a concrete pour associated with the construction of the foundations that may require 24-hour working. Four periods during the construction phase that are representative of the periods for which there is

the greatest potential for significant noise effects to occur have been assessed quantitatively:

- earthworks;
- piling;
- night-time concrete pour of foundations; and
- building works.

12.5.2 The noise sources and source terms included in the construction models are provided in Appendix 12.3. The results of the construction assessments are provided in Appendix 12.3.

12.5.3 The results of the assessment indicate that significant adverse noise effects will not be expected to occur at the majority of NSRs during the construction of the proposed facility. The results of the assessment indicate that significant adverse noise effects may occur at Railway Cottages during the periods of earthworks, piling and night-time concrete pouring; Etla & Alma, Sinfin Lane, during piling; and at Kitchener Avenue during night-time concrete pouring and, therefore, mitigation will be required during these activities.

Earthworks

12.5.4 The model of the earthworks includes construction of the bund adjacent to Railway Cottages and, therefore, represents a 'worst-case' situation that will only comprise a part of the period of earthworks. During these works, the predicted noise level at Railway Cottages is approximately 72 dB $L_{Aeq,T}$, where T is the working hours of the site, and a noise change of approximately 17 dB may occur.

12.5.5 It is considered appropriate to adopt a higher noise limit for the bund creation works as these activities will be of short duration and provide a significant long term benefit during the rest of the construction period and during the operation of the facility. MPS 2 provides guidance on noise emissions from mineral extraction sites and not noise from construction sites. However, the following advice from MPS 2 demonstrates that there is precedence for adopting an increased noise limit for temporary works that will have a long term benefit:

'Increased temporary daytime noise limits of up to 70 dB(A) L_{Aeq1h} (free field) for periods of up to 8 weeks in a year at specified noise-sensitive properties should be considered to facilitate essential site preparation and restoration work and construction of baffle mounds where it is clear that this will bring longer-term environmental benefits to the site or its environs.'

12.5.6 Noise levels at Railway Cottages will be lower during the rest of the period of earthworks because the bund will provide significant noise screening. BS 5228-1 suggests that:

'… as a working approximation, if there is a barrier or other topographic feature between the source and the receiving position, assume an approximate attenuation of 5 dB when the top of the plant is just visible to the receiver over the noise barrier, and of 10 dB when the noise screen completely hides the sources from the receiver.'

12.5.7 On this basis, the ambient noise change at Railway Cottages may be expected to reduce to approximately 7 – 12 dB following completion of the bund. Nevertheless, mitigation will be necessary to control the impact of noise on Railway Cottages during the period of earthworks and bund creation.

Piling

12.5.8 At this stage of the project, the specific methods of piling have not been determined. The source term used to represent the piling rig is representative of the equivalent continuous noise emissions (i.e. as described by the L_{Aeq} noise index) of both a hydraulic hammer rig and a vibratory piling rig. However, noise emissions from a hydraulic hammer rig will include high impulsive noises that are likely to be significantly more disturbing than the noise emissions from a vibratory piling rig, which will generally comprise continuous noise not dissimilar to a large diesel generator.

12.5.9 Noise emissions from other types of piling, such as bored or continuous-flight-augured, may be approximately 10 dB lower. On this basis, the ambient noise change at Railway Cottages may be expected to reduce to less than 5 dB hence, not significant, if the method of piling required to construct the facility is not by hydraulic hammered piling or vibratory piling. However, if the method of piling required to construct the facility is by hydraulic hammered piling or vibratory piling, then mitigation will be necessary to control the impact of noise on Railway Cottages during the period of piling.

Night-time Concrete Pour

12.5.10 At this stage of the project, it has not been determined whether it will be necessary to undertake the concrete pour continuously, which would necessitate night-time working, albeit for a very limited number of nights. The results of the assessment indicate that a significant noise effect would be expected to occur at Railway Cottages and the middle and western end of Kitchener Avenue.

12.5.11 If concrete pouring activities are required to be undertaken during the night-time, then mitigation will be required to control the impact of noise on Kitchener Road and Railway Cottages.

Noise from Off-site Construction Traffic

12.5.12 The number of delivery HGVs during the construction phase of the development is likely to be insignificant compared to baseline HGV flows associated with the existing industrial uses on Sinfin Lane and in the immediate area. The highest HGV flows associated with the site would occur during the concrete pour and main equipment installation. However, significant noise effects would be unlikely and of short duration.

Vibration from Construction Activities

12.5.13 At this stage of the project, the specific methods of piling have not been determined. The assessment of vibration from construction activities has considered the effects of hammered and vibratory sheet piling on the nearest buildings. Vibration emissions from other types of piling, such as bored or continuous-flight-augured, will be insignificant at the NSRs. The assessment has considered the likelihood of cosmetic damage occurring to buildings adjacent to the site and the likelihood that the levels generated will be tolerated by the occupants within.

12.5.14 The results of the assessment are provided in Appendix 12.3. Vibration levels in the foundations and floors have been estimated based upon assumed scaling factors of 0.75 from freefield to foundation and from foundations to floor.

12.5.15 The results of the assessment indicate that cosmetic damage would be unlikely to occur at any of the buildings adjacent to the site during the period of piling, whatever piling method is required. The results of the assessment indicate that vibration levels may be perceptible, but below the threshold of significance, within Railway Cottages if vibratory piling is required; and would be expected to be perceptible and above the threshold of significance, within Railway Cottages and the closest building of the Rolls Royce factory, if hammered piling is required.

12.5.16 On this basis, mitigation will be required if hammered piling is required to control the impact of vibration at Railway Cottages and the closest building of the Rolls Royce factory.

Operational Effects

Noise

Daytime

12.5.17 The results of the noise assessment are provided in Appendix 12.4. Noise contour plans of the rating level and the overall noise emissions during the daytime are provided in Figures 12.3 and 12.4, respectively.

12.5.18 NSRs at Thackeray Street and Osmaston Park Road are significantly further away from the site and baseline noise levels are not lower than those included in the quantitative assessment

provided in Appendix 12.4. Therefore, if the results of the assessment indicate that significant noise effects are not expected at the NSRs included in the quantitative assessment then this also indicates that significant adverse effects would not be expected at NSRs at Thackeray Street and Osmaston Park Road.

12.5.19 It is considered that there is a potential for the noise emissions from the facility to contain '*a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.)*' and, therefore, a +5 dB correction has been applied to the predicted specific noise level at NSRs, in accordance with BS 4142.

12.5.20 The results of the assessment for the daytime period indicate that at the majority of NSRs, the rating level would not exceed 50 dB $L_{Ar,Tr}$ or the baseline background noise level and a noise change would not be expected to occur. However, the assessment also indicates that, at Railway Cottages, Etla and Alma, Sinfin Lane; and at Caxton Street the rating level would exceed the baseline background noise level by up to 9 dB (at 5 Railway Cottages) and a noise change of up to 3 dB may occur (at 5 Railway Cottages, Etla and Alma, Sinfin Lane). #

12.5.21 With reference to the assessment criteria adopted for the assessment, a significant adverse effect is deemed to occur if the rating level exceeds the background noise level or the ambient noise change exceeds 0 dB. BS 4142 states that *'A difference of around 10 dB or more indicates that complaints are likely'.* BS 4142 does not provide a description for differences above +5 dB and less than +10 dB but, the inference is that the more positive the difference, the greater the likelihood of complaints. On this basis, mitigation will be required to reduce noise emissions from the facility so that adverse noise effects would not be expected to occur at Railway Cottages, Etla and Alma, Sinfin Lane; and at Caxton Street.

12.5.22 At all NSRs except for Railway Cottages, Etla and Alma, Sinfin Lane; and at Caxton Street, the predicted rating level is at least 3 dB below the measured daytime background noise level. BS 4142 states that *'a difference* [between rating and background noise levels] *of around 10 dB or more indicates that complaints are likely'* and '*a difference* [between rating and background noise levels] *of -10 dB is a positive indication that complaints are unlikely*'.

12.5.23 The overall noise emissions from the facility have been predicted to be approximately 30 – 40 dB $L_{Aeq,\ 16h}$ in the allotments. The results of the baseline noise surveys indicate that existing ambient noise levels are approximately 47 - 55 dB $L_{Aeq,\ 16h}$ at the western end of the allotments and approximately 68 – 76 dB $L_{Aeq,\ 16h}$ at the eastern end, adjacent to Sinfin Lane. On this basis, a significant noise change would not be expected to occur and noise due to the operation of the facility may not be audible to many users of the allotments for much of the time.

12.5.24 GCN provides the following advice with regards to the expected reaction of people in outdoor recreational areas to noise:

'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}.'

Night-time

12.5.25 Noise contour plans of the rating level and the overall noise emissions during the night-time are provided in Figures 12.5 and 12.6, respectively.

12.5.26 The results of the assessment for the night-time period indicate that at the majority of NSRs, the rating level would not exceed 45 dB $L_{Ar,Tr}$ or the baseline background noise level and a noise change would not be expected to occur. However, the assessment also indicates that, at Railway Cottages, Etla and Alma, Sinfin Lane; and Caxton Street the rating level would exceed the baseline background noise level by up to 9 dB and a noise change of approximately 4 dB may occur.

12.5.27 GCN suggests that '*If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise'*. This criterion is equivalent to an external noise level of 45 dB(A), assuming a noise level reduction of 15 dB for a slightly open window. (Note that this is not the same criterion as 45 dB $L_{Ar,Tr}$ contained within S5.01). The predicted noise level at the facades of Railway Cottages; Etla and Alma, Sinfin Lane; and Caxton Street, exceeds 45 dB $L_{Aeq, 8h}$ during the night-time but the lowest baseline ambient noise levels at these NSRs determined from the results of the surveys are 54, 54 and 52 dB $L_{Aeq, 8h}$, respectively and, consequently, it is considered that the likelihood of sleep disturbance would not increase as a results of the operation of the development.

12.5.28 Operational noise effects are considered to be **major adverse** at Railway Cottages, Etla and Alma, Sinfin Lane; and at Caxton Street and **not significant** at the remainder of NSRs and, therefore, mitigation will be required to reduce noise emissions from the facility.

Noise from Off-site Operational Traffic

12.5.29 The assessment of noise effects of increased traffic flow due to vehicles attending the site has been based upon available data from the Transport Assessment. The results of the assessment are provided in Appendix 12.4 and indicate that no noise change would be expected to occur due to an increase in traffic flows associated with the development. Consequently, the effects of noise from operational traffic are **not significant**.

Mitigation

Construction Noise

12.5.30 The results of the construction noise assessments indicate that significant effects are not expected to occur at the majority of the NSRs. However, the assessment indicates that significant effects may occur at Railway Cottages during the periods of earthworks and piling, if hammered or vibratory piling is required; and at Railway Cottages and Kitchener Road, if it is necessary for the concrete pour to be continuous, which would necessitate working during the night-time.

12.5.31 It is suggested that an appropriate aspirational daytime noise limit during the construction of the facility would be 65 dB $L_{Aeq, T}$ evaluated at the rear (eastern) facades of 1 – Railway Cottages, where T is the working hours of the site. However, it is considered that, subject to prior agreement with the Councils, the noise limit could be exceeded for specific activities of limited duration if satisfaction of the limit would significantly reduce the working hours of the site such that the overall duration of the works would be prolonged and, therefore, not reduce the overall noise impact.

Earthworks

12.5.32 The most significant noise effect at Railway Cottages during the period of earthworks would be when the bund adjacent to the properties is being constructed. However, this period would be relatively short compared to the overall period of construction of the development and the bund will significantly reduce noise effects during the remainder of the construction period and the operation of the facility.

12.5.33 Consequently, it is considered that appropriate mitigation will be to reduce noise levels as low as is practicable, commensurate with BPM, and to liaise with the residents of the affected NSRs in advance of and during the works so that the measures that are being taken to reduce noise, the limited duration of the period of bund creation and the expected benefit to them the bund are understood. Measures to reduce noise will include:

- selection of the quietest appropriate plant;
- provision of a temporary noise barrier on the boundary between the site and the NSRs; and
- a requirement to ensure that all plant is well-maintained.

12.5.34 Noise levels during the remainder of the period of earthworks may exceed the threshold of significance and, therefore, it will be necessary for liaison with the residents of the affected NSRs to continue and for the quietest appropriate plant to be selected for these works.

Piling

12.5.35 At this stage of the project, the specific methods of piling have not been determined. The results of the assessment indicate that significant noise effects may occur if the required methods of piling include hammered or vibratory piling. However, alternative methods of piling, such as bored or continuous-flight-augured, are significantly quieter than hammered or vibratory piling and 'quiet' methods of hammered and vibratory piling are also available.

12.5.36 Consequently, it is considered that appropriate mitigation is to suggest a planning condition that requires the contractor to demonstrate, to the satisfaction of the Councils, that the piling required in the construction of the facility can be undertaken without significant adverse noise effects.

Night-time Concrete Pour

12.5.37 At this stage of the project, it has not been determined whether it will be necessary to undertake the concrete pour continuously, which would necessitate night-time working, albeit for a very limited number of nights. If night-time working is required, then it is considered that appropriate mitigation will be to reduce noise levels as low as is practicable, commensurate with BPM, and to liaise with the residents of the affected NSRs in advance of and during the works so that the measures that are being taken to reduce noise, the limited duration of the period night-time working and necessity of the works are understood. Measures to reduce noise will include:

- selection of the quietest appropriate plant;
- provision of a temporary noise barriers; and
- a requirement to ensure that all plant is well-maintained.

Construction Vibration

12.5.38 The results of the assessment indicate that, if hammered piling is required, vibration levels may be expected to be perceptible to occupants of 1 – 5 Railway Cottages. Although perceptible, the predicted level is expected to be tolerable for a limited duration provided that prior warning and explanation has been given to residents. On this basis, no further mitigation, in addition to the working practices described within a CoCP or CEMP, would be required.

Operational Noise

12.5.39 Mitigation measures will be put in place to ensure that the operation of the facility does not have a significant adverse noise effect at Railway Cottages, Etla and Alma, Sinfin Lane; and at Caxton Street. The most significant noise source of the development is the biofilter fans. The greatest effect has been predicted to occur at 5 Railway Cottages. At this NSR, the predicted

rating level is 60 dB $L_{Ar,Tr}$ at first floor level during the night-time and the background noise level is 51 dB L_{A90}.

12.5.40 A list of the dominant noise sources that contribute to the rating level at 5 Railway Cottages in the model is provided in Appendix 12.5. The results of the mitigation assessment, which are provided in Appendix 12.5, indicate that, if the noise emissions from the biofilter fans are reduced by 11 dB then the rating levels at Railway Cottages are predicted to be 46 - 49 dB, which does not exceed the night-time background noise level at this NSR and, therefore, a significant effect would not be expected to occur.

12.5.41 The results of the mitigation assessment indicate that the facility can be designed such that rating levels do not exceed the background noise levels and no noise change would be expected to occur at all NSRs during the daytime and night-time.

12.5.42 The required mitigation could be achieved by:

- selection of quieter biofilter fans; and/or
- provision of acoustic enclosures around the biofilter fans.

12.5.43 The required mitigation is achievable and practicable. The biofilter fans are within pipes and draw air from within the facility to the biofilter, through which the air is discharged. Consequently, an acoustic enclosure is not required to provide ventilation to the fan because the outlet if through the biofilter.

12.5.44 If it were not possible, practicable or desired to use biofilter fans with a lower noise emission level than assumed in this assessment, then mitigation would need to be entirely provided by an acoustic enclosure (i.e. at least 11 dB of noise attenuation would be required). Acoustic enclosures are available as 'off the shelf' products from many suppliers and provide various levels of noise attenuation, which is defined in terms of the Sound Reduction Index (SRI), depending upon their particular construction and materials. In general, heavier and thicker materials have a greater SRI than light and thin materials.

12.5.45 Table 12.15 provides the SRI for a basic industrial cladding material that consists of a single sheet of 45 mm depth trapezoidal profile 1.0 mm thick steel panel. (Source: VDI 2571 [14]). The superficial mass of this panel is 11 kg/m^2.

Table 12.15 : SRI of Basic Cladding Panel

Octave Band Centre Frequency (Hz)	**Overall (R_W)**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
SRI of Cladding (dB)	25	10	14	16	20	25	29	23	20

12.5.46 The data provided in Table 12.15 indicates that an acoustic enclosure constructed from single layer cladding panel would reduce noise emissions by approximately 25 dB, which demonstrates that the required mitigation is achievable. Noise emissions from the facility can be controlled though conditions attached to the planning consent which require certain levels to be achieved. The design contractor can then ensure that the design and plant specified achieve these levels.

Residual Effects

12.5.47 On the basis that the recommended mitigation measures are incorporated, no residual noise and vibration effects will be expected to occur during the construction or operation of the facility.

12.6 Conclusions

12.6.1 The potential noise effects due to the construction and operation of the proposed facility at Sinfin Lane, Derby, have been predicted and assessed in accordance with international, national and local standards and guidance. Surveys have been undertaken to determine the baseline noise levels at locations representative of the potentially most affected noise sensitive receptors.

12.6.2 The results of the noise and vibration assessment indicate that, provided that the construction of the facility is undertaken in accordance with Best Practicable Means and the operational facility includes appropriate noise mitigation at source, significant adverse noise or vibration effects would not be expected to occur at sensitive receptors during either the construction or operational phases of the facility.

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Appendices

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	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
Residential or light commercial type buildings	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.

Guidelines for Community Noise and 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 For daytime levels, it is considered that:

- *'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.'*

A12.3.27 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).'*

A12.3.28 The time base for the L_{Aeq} values provided above are 16-hours for the daytime effects and 8-hours for the night-time effects. This implies that $L_{Aeq,16h}$ and $L_{Aeq,8h}$ are the appropriate parameters to assess reaction of people to changes in ambient noise level.

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

A12.3.29 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

A12.3.30 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

A12.3.31 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

A12.3.32 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

A12.3.33 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

A12.3.34 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.

A12.3.35 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.

A12.3.36 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

A12.3.37 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.

A12.3.38 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]

A12.3.39 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	

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