14 Noise and Vibration

14.1 Introduction

14.1.1 This chapter assesses the noise and vibration impacts associated with the construction, and subsequent operation, of the proposed EfW CHP facility.

14.1.2 The construction and operation of the facility have the potential to affect noise levels at existing sensitive receptors adjacent to the site and located along surrounding roads subject to changes in traffic flows.

14.1.3 This assessment considers construction noise and vibration impacts, operational noise generated by the facility and changes in traffic noise levels on the local road network. Decommissioning of the EfW CHP facility is not specifically addressed in this assessment, as noise and vibration impacts will be comparable to those for construction.

14.1.4 There are residential properties to the north and west of the development site, at a significantly greater height than the site.

14.1.5 There are residential properties to the north-east and east of the development site, separated from the site by the existing railway line. The properties to the north-east are at a significantly greater height than the site.

14.1.6 To the south lies Her Majesty's Naval Base (HMNB) Devonport and Devonport Dockyard, with the associated noise sources for such facilities.

14.1.7 A description of the noise and vibration terminology employed within this chapter is provided in Appendix 14.1.

14.2 Relevant Legislation and Policy

National Policy Guidance

14.2.1 Planning Policy Guidance PPG24 'Planning and Noise' [(1)] was introduced by the Department of the Environment in 1994. PPG24 was issued to:

'…provide advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business … It outlines some of the main considerations which local planning authorities should take into account in drawing up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources.'

14.2.2 For new developments that would introduce noise into an area PPG24 confirms, in Annex 3, that it is appropriate to continue using previously established noise assessment methods, for example for 'Noise from road traffic' (Annex 3, paragraph 1), 'Noise from industrial and commercial developments' (Annex 3, paragraphs 19-20) and 'Noise from construction sites' (Annex 3, paragraph 21).

Legislation

14.2.3 Construction noise and vibration impacts are not covered directly by legislation. However, the Control of Pollution Act (CoPA, 1974) [(2)] and Part III of the Environmental Protection Act (EPA, 1990) [(3)] contain sections which can be applied to construction noise and vibration.

14.2.4 Under Section 60 of the CoPA a Local Authority can serve a notice on a contractor in order to control construction works. Under Section 61 of the CoPA a contractor can apply for 'prior consent' to carry out construction works, in order to agree in advance with the Local Authority the details of the works and the methods to be employed to minimise noise.

14.2.5 Under the EPA a Local Authority can serve an abatement notice on a contractor if they consider noise or vibration from construction works to amount to a statutory nuisance. In addition, individuals can also pursue private action under the EPA.

14.2.6 The EPA can also be used by the Local Authority, or a member of the public, to take action against industrial or commercial sources of noise affecting residential properties.

14.3 Assessment Methodology

Baseline Noise Measurements

14.3.1 Measurements have been carried out at locations representative of surrounding sensitive receptors, 1.2 to 1.5 metres above ground level. All monitoring locations were located at least 3.5m from any reflecting surface, other than the ground, and complied with the requirements of British Standard BS 7445: 1991/2003 'Description and Measurement of Environmental Noise' [(4)].

Construction Noise

Prediction Methodology

14.3.2 The noise levels generated by construction activities and experienced by any nearby sensitive receptors, such as residential properties, depend upon a number of variables, the most significant of which are:

- the noise generated by plant or equipment used on site, generally expressed as sound power levels (L_W);
- the periods of operation of the plant on the site, known as its 'on-time';
- the distance between the noise source and the receptor; and
- the attenuation provided by ground absorption and any intervening barriers.

14.3.3 Construction noise predictions have been carried out based on the methodology outlined in BS 5228-1: 2009 'Code of practice for noise and vibration control on construction and open sites. Part 1: Noise' [(5)]. BS 5228 predicts noise as an equivalent continuous noise level averaged over a period such as 1 hour ($L_{Aeq,1h}$).

14.3.4 BS 5228 contains a database of the noise emission from individual items of equipment, activities and routines to predict noise from construction activities at identified receptors. The prediction

method gives guidance on the effects of different types of ground, barrier attenuation and how to assess the impact of fixed and mobile plant.

Significance Criteria

14.3.5 Noise levels generated by construction activities are regulated by guidelines and subject to Local Authority control. No UK national noise limits exist for construction noise. However, guidance on acceptable noise levels is provided in British Standard BS 5228: 2009.

14.3.6 Plymouth City Council provides a Code of Practice for the Control of Pollution and Noise from Demolition and Construction Sites [(6)]. The Council's policy includes acceptable hours of work, which are:

- Monday – Friday: 08:00 to 18:00
- Saturday: 08:30 to 13:00

14.3.7 Appendix 2 of the Code of Practice provides noise limits which are reproduced in Table 14.1 below. The limits apply at 1 metre from the façade of any sensitive receptor and are dependant on prevailing ambient noise levels and specific time periods. For example, for weekday daytime working, noise limits are given for the 10 hour working day (08:00 to 18:00), any 3 hour period during the working day, and any 5 minute period during the working day.

14.3.8 Work may be permitted outside of these hours in exceptional circumstances and only by prior agreement with the Council and will be conditional on the contractor informing local residents in advance of the proposed activity. Noise limits are given for evening and night-time periods and for Sundays.

Table 14.1: City of Plymouth Acceptable Construction Noise Levels

Existing ambient L_{Aeq} (measured on fast response over the appropriate hour given in note 2)	Normal weekday working (excluding bank holidays)							
	Daytime (0800-1800)			Evening (1800-2200)			Night-time (2200-0800)	
	L_{Aeq} (10 hrs)	L_{Aeq} (any 3 hrs)	L_{Aeq} (any 5 mins)	L_{Aeq} (4 hrs)	L_{Aeq} (any 1 hr)	L_{Aeq} (any 5 mins)	L_{Aeq} (any 1 hr)	$L_{Amax,fast}$
35	60	64	80	50	53	60	40	45
40	65	69	81	55	58	60	45	50
45	65	69	81	60	63	66	50	55
50	70	74	86	60	63	66	55	60
55	70	74	86	65	68	71	60	65
60	75	79	91	65	68	71	65	70
65	75	79	91	70	73	76	70	75
70	75	79	91	75	78	81	75	80
75	80	84	96	80	83	90	80	85

1 All noise levels are in dB(A) as measured on FAST response.
2 Existing ambient L_{Aeq} should be measured during 0800-1000; 1900-2100; or 0200-0400 as appropriate.
3 Saturday morning levels (0800-1000 hours) should be as for weekday DAYTIME.
4 Saturday afternoons should be as for weekday EVENING.
5 Sundays and Bank Holidays should be as for WEEKDAY NIGHTS.

14.3.9 A significant effect is deemed to occur if the construction noise level exceeds the applicable limit in Table 14.1. A scheme for the assessment of the significance is proposed and presented in Table 14.2.

Table 14.2: Scheme for Assessment of Construction Noise Levels

Construction Noise Level Above Applicable Limit (dB)	Significance
< 1	Negligible
1 < 3	Low
3 < 5	Medium
> 5	High

14.3.10 The significance criteria provided in Table 14.2 have been employed for the assessment of the significance of construction noise levels.

Construction Vibration

Prediction Methodology

14.3.11 The limit of human perception to vibration is in the order of 0.15 mms^{-1} to 0.3 mms^{-1} peak particle velocity (ppv), in the frequency range 0.1 Hz to 1500 Hz. The human body is not equally sensitive to all frequencies of vibration and weighting curves to reflect the frequency dependency of the body have been developed and are contained within ISO Standards. The weighting gives a good correlation between the measured vibration level and the subjective feeling or impact produced by the vibration.

14.3.12 Ground vibrations may cause reactions ranging from 'just perceptible' through 'concern' to 'alarm' and 'discomfort'. The subjective response varies widely and is a function of situation, information, time of day and duration.

14.3.13 Buildings are reasonably resilient to ground-borne vibration and vibration-induced damage is rare. Vibration induced damage can arise in different ways, making it difficult to arrive at universal criteria that will adequately and simply indicate damage risk. Damage can occur directly due to high dynamic stresses, due to accelerated ageing or indirectly, when high quasi-static stresses are induced by, for example, soil compaction.

14.3.14 The vibration ppv due to specific construction works has been estimated at sensitive receptors using example measured source data and the appropriate propagation relationship taken from BS 5228-2: 2009 'Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration' [(7)].

Significance Criteria - Nuisance

14.3.15 Guidance on the nuisance effects of vibration is provided in BS 5228-2 Annex B, adapted below as Table 14.3.

Table 14.3: Guidance on Effects of Vibration Levels

Vibration Level	Effect	Significance
0.14 mms^{-1}	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.	Negligible
0.3 mms^{-1}	Vibration might be just perceptible in residential environments.	Low
1 mms^{-1}	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.	Medium
10 mms^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High

14.3.16 The estimated ppv values due to construction works on site are compared to the target limits specified in Table 14.3 to determine the significance of the vibration effects in terms of nuisance.

Significance Criteria – Building Damage

14.3.17 BS 7385-2: 1993 'Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration' [8] provides guidance on vibration levels likely to result in cosmetic damage, and is referenced in BS 5228-2. Limits for transient vibration, above which cosmetic damage could occur, are given in Table 14.4.

Table 14.4: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mms^{-1} at 4 Hz and above	
Un-reinforced or light framed structure Residential or light commercial buildings	15 mms^{-1} at 4 Hz increasing to 20 mms^{-1} at 15 Hz	20 mms^{-1} at 15 Hz increasing to 50 mms^{-1} at 40 Hz and above
Note 1: Values referred to are at the base of the building. Note 2: For un-reinforced or light framed structures and residential or light commercial buildings, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

14.3.18 The guide values relate predominantly to transient vibration which does not give rise to resonant responses in structures. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 14.4 may need to be reduced by up to 50%.

14.3.19 The estimated ppv values due to construction works on site are compared to the target limits specified in BS 7385-2 to determine the significance of the vibration effect in terms of cosmetic building damage.

Operational Plant Noise

Prediction Methodology

14.3.20 A noise propagation model has been developed in the SoundPLAN suite of programs, which implements a range of calculation methods, including the ISO 9613-2 calculation method for industrial noise sources [9]. Input data for the model were sourced from MVV as follows:

- OS base mapping for the site and surroundings (including residential buildings).
- Ground elevation data for the site and surroundings.
- EfW CHP facility plan and elevation drawings.
- Noise protection specification, and accompanying spreadsheet, providing octave band internal noise levels to all buildings, octave band sound power levels for external plant and octave band sound reduction data for building walls, roofs and ventilation louvers [10],[11].
- HGV traffic numbers entering and leaving the site between the plant buildings and the junction with the dockyard North Access Road.

14.3.21 The model consists of a detailed three dimensional representation of the proposed facility and the surroundings and has been employed to calculate noise levels at surrounding sensitive receptors due to noise breakout from the facility buildings, noise emission from external sources and noise emission from HGVs on site.

Significance Criteria

14.3.22 BS 4142: 1997, 'Method for rating industrial noise affecting mixed residential and industrial areas'[12] is commonly used for the assessment of operational fixed plant noise. It has been confirmed with Plymouth City Council Public Protection Service that this method should be employed to assess the operational noise levels from the proposed facility.

14.3.23 The basis of the standard is a comparison between the background noise level in the vicinity of residential locations and the rating level of the noise source under consideration. The relevant parameters in this instance are as follows:

- Background Noise Level – $L_{A90,T}$ – defined in the Standard as 'the 'A' weighted sound pressure level of the residual noise at the assessment position which is exceeded for 90 % of the given time interval, T, measured using time weighting F (fast).
- Specific Noise Level – $L_{Aeq,Tr}$ – the equivalent continuous 'A' weighted sound pressure level of the source in question over a given time interval.
- Rating Level – $L_{Ar,Tr}$ – the specific noise level plus any adjustment made for the characteristic features of the noise.

14.3.24 A correction of +5 dB is made to the specific noise level if one or more of the features noted below is considered to be present (only one +5 dB correction is made regardless of the specific noise level containing one or more of the following characteristics):

- the noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.);
- the noise contains distinct impulses (bangs, clatters or thumps); or
- the noise is irregular enough to attract attention.

14.3.25 Once any adjustments have been made, the background and the rating noise levels are compared. The standard states that the greater this difference is, the greater is the likelihood of complaints, as follows:

- a difference of around +10 dB or more indicates that complaints are likely;
- a difference of around +5 dB is of marginal significance; and
- if the rating level is more than 10 dB below the measured background level, this is a positive indication that complaints are unlikely.

14.3.26 The standard specifies a one hour assessment period during the day and a five minute assessment period during the night.

14.3.27 Plymouth City Council Public Protection Service have indicated that the rating level should be no greater than 5 dB(A) above the prevailing background noise level at any residential receptor.

Construction and Operational Road Traffic Noise

Prediction Methodology

14.3.28 The proposed facility will have an impact on traffic flows on existing roads in the area surrounding the site both during construction and once the development is operational. The assessment focuses on the impact at existing residential properties located along surrounding affected roads. These affected roads include the North Access Road to the dockyard.

14.3.29 The magnitude of the impact of the additional traffic generated by the construction and operation of the development has been assessed by calculating the change in the 18 hour traffic noise levels ($L_{A10,18h}$) at a selection of sensitive receptors along affected roads.

14.3.30 The calculations have employed the methodology provided in Calculation of Road Traffic Noise (CRTN) [13], which is the standard methodology adopted in the UK for the calculation of noise levels from road traffic.

Significance Criteria

14.3.31 It is generally accepted that changes in road traffic noise levels of 1 dB(A) or less are imperceptible, and changes of up to 3 dB(A) are required to be perceptible. An increase of 10 dB(A) is generally perceived as a doubling in loudness.

14.3.32 Based on these perceptions, a scheme for the assessment of significance of changes in road traffic noise levels to residential receptors is proposed and presented in Table 14.5.

Table 14.5: Scheme for Assessment of Changes in Road Traffic Noise Levels

Change in Noise Level (dB)	Subjective Response	Significance
< 1	None	Negligible
1 < 3	Perceptible	Low
3 < 5	Noticeable	Medium
> 5	Intrusive	High

14.3.33 The significance criteria provided in Table 14.5 have been employed for the assessment of the significance of changes in road traffic noise levels.

14.4 Baseline Conditions

Monitoring Locations

14.4.1 A meeting was held on site with a member of Plymouth City Council Public Protection Service, at which the proposed noise monitoring locations were accepted as being representative of the surrounding residential areas. An additional monitoring location at a specific residential property was proposed by the Public Protection Service member and included in the baseline noise survey.

14.4.2 Apart from one specific property, access to residential properties was not possible. Short term manned monitoring was carried out at locations adjacent to residential areas. Long term unmanned monitoring was carried out at two locations on the site boundary representative of the noise climate at surrounding residential areas, and at the additional residential property mentioned above.

14.4.3 The noise monitoring locations are detailed in Table 14.6. Figure 14.1 shows a plan of the site and surrounding area with the monitoring locations indicated.

Table 14.6: Noise Monitoring Locations

Measurement Location	Duration	Details
ST1	Short term	Location on Poole Park Road
ST2	Short term	Location on Savage Road
ST3	Short term	Location on Wombwell Crescent
LT1	Long term	Representative of properties on Savage Gardens and on Wolseley Road and Hamoaze Avenue
LT2	Long term	Representative of properties on Talbot Gardens
LT3	Long term	Garden of 38 Moor Lane

Note: Location LT3 is at a considerable distance from the site. This monitoring location was included at the request of Plymouth City Council Public Protection Service.

Instrumentation

14.4.4 Details of the instrumentation employed in the baseline noise survey are provided in Appendix 14.2, Table A14.2.1.

14.4.5 The calibration of the instrumentation was checked before and after each series of measurements. No significant changes (+/- 0.1 dB) were noted.

Meteorological Conditions

14.4.6 Details of weather conditions during the survey are given in Appendix 14.2, Table A14.2.2.

14.4.7 Generally, conditions were within the limits specified in the standards for acceptable noise measurements.

Measured Noise Levels

14.4.8 For the short term monitoring, L_{Aeq} and L_{A90} levels were logged in 5 minute intervals. For the long term monitoring, L_{Aeq} and L_{A90} levels were logged in 15 minute intervals. All noise measurements were taken at between 1.2 and 1.5 metres above ground level, and located at least 3.5 metres from any vertical reflecting surfaces. The reported noise levels are thus free-field levels.

14.4.9 Short term noise measurements were carried out at ST1 (Poole Park Road) between 13:20 and 13:45 on 16/7/10. The measured levels are provided in Table 14.7.

14.4.10 The noise climate at ST1 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

14.4.11 Short term noise measurements were carried out at ST2 (Savage Road) between 12:50 and 13:20 on 16/7/10. The measured levels are provided in Table 14.8.

14.4.12 The noise climate at ST2 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

Table 14.7: Measured Noise Levels at Location ST1

Time	L_{Aeq} (dB)	L_{A90} (dB)
13:20:00	57	47
13:25:00	59	47
13:30:00	58	48
13:35:00	53	48
13:40:00	59	47

Table 14.8: Measured Noise Levels at Location ST2

Time	L_{Aeq} (dB)	L_{A90} (dB)
12:50:00	49	47
12:55:00	54	48
13:00:00	60	48
13:05:00	55	46
13:10:00	59	47
13:15:00	53	48

14.4.13 Short term daytime noise measurements were carried out at ST3 (Wombwell Crescent) between 14:05 and 14:40 on 16/7/10. The measured levels are provided in Table 14.9.

Table 14.9: Measured Daytime Noise Levels at Location ST3

Time	L_{Aeq} (dB)	L_{A90} (dB)
14:05:00	58	46
14:10:00	53	43
14:15:00	55	46
14:20:00	50	44
14:25:00	54	44
14:30:00	54	44
14:35:00	55	43

14.4.14 Short term night-time measurements were carried out at ST3 (Wombwell Crescent) between 01:05 and 01:40 on 30/7/10. The measured levels are provided in Table 14.10.

14.4.15 The noise climate at ST3 was dominated by local road traffic during both daytime and night-time periods.

Table 14.10: Measured Night-time Noise Levels at Location ST3

Time	L_{Aeq} (dB)	L_{A90} (dB)
01:05:00	38	35
01:10:00	36	34
01:15:00	37	34
01:20:00	37	34
01:25:00	37	34
01:30:00	35	33
01:35:00	37	36

14.4.16 Long term unmanned measurements were carried out at LT1 between 16/7/10 and 20/7/10. The measured noise levels are presented in Appendix 14.2, Figure A14.2.1.

14.4.17 The measured data were processed to provide average daytime (07:00 to 19:00), evening (19:00 to 23:00) and night-time (23:00 to 07:00) L_{Aeq} values for weekdays and weekends, and reasonable minimum daytime and night-time L_{A90} values (taking into account the variation in noise levels over the quietest daytime and night-time periods and the variation from day to day over the monitoring period). The results are provided in Table 14.11.

Table 14.11: Measured Noise Levels at Location LT1

Weekday / Weekend	Period	L_{Aeq} (dB)	Minimum L_{A90} (dB)
Weekday	Daytime	51	Daytime 40 dB(A) Night-time 34 dB(A)
Weekday	Evening	46	
Weekday	Night-time	42	
Weekend	Daytime	47	
Weekend	Evening	46	
Weekend	Night-time	41	

14.4.18 The noise climate at LT1 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

14.4.19 Long term unmanned measurements were carried out at LT2 between 16/7/10 and 28/7/10. The measured noise levels are presented in Appendix 14.2, Figure A14.2.2.

14.4.20 The measured data were processed to provide average daytime (07:00 to 19:00), evening (19:00 to 23:00) and night-time (23:00 to 07:00) L_{Aeq} values for weekdays and weekends, and reasonable minimum daytime and night-time L_{A90} values (taking into account the variation in noise levels over the quietest daytime and night-time periods and the variation from day to day over the monitoring period). The results are provided in Table 14.12.

14.4.21 The noise climate at LT2 was dominated by general noise from the dockyard and occasional mobile plant activities on the proposed site for the EfW CHP facility.

Table 14.12: Measured Noise Levels at Location LT2

Weekday / Weekend	Period	L_{Aeq} (dB)	Minimum L_{A90} (dB)
Weekday	Daytime	56	Daytime 41 dB(A) Night-time 31 dB(A)
Weekday	Evening	43	
Weekday	Night-time	42	
Weekend	Daytime	49	
Weekend	Evening	44	
Weekend	Night-time	45	

14.4.22 Long term unmanned measurements were carried out at LT3 between 29/7/10 and 3/8/10. The measured noise levels are presented in Appendix 14.2, Figure A14.2.3.

14.4.23 The measured data were processed to provide average daytime (07:00 to 19:00), evening (19:00 to 23:00) and night-time (23:00 to 07:00) L_{Aeq} values for weekdays and weekends, and reasonable minimum daytime and night-time L_{A90} values (taking into account the variation in noise levels over the quietest daytime and night-time periods and the variation from day to day over the monitoring period). The results are provided in Table 14.13.

Table 14.13: Measured Noise Levels at Location LT3

Weekday / Weekend	Period	L_{Aeq} (dB)	Minimum L_{A90} (dB)
Weekday	Daytime	47	Daytime 36 dB(A) Night-time 30 dB(A)
Weekday	Evening	42	
Weekday	Night-time	37	
Weekend	Daytime	50	
Weekend	Evening	43	
Weekend	Night-time	38	

14.4.24 The noise climate at LT3 was dominated by distant road traffic.

14.4.25 Following the noise survey, the results were supplied to Plymouth City Council Public Protection Service. In a subsequent telephone conversation followed up by email [14], the following were agreed:

- The prevailing minimum daytime and night-time free field background L_{A90} noise levels at the monitoring locations.

- A preliminary target Rating Level of 5 dB(A) above minimum background noise level for daytime and night-time periods at surrounding sensitive receptors.

14.4.26 The minimum background noise levels, taken from the measured data at Locations LT1, LT2 and LT3, were adjusted using the short term measurements at ST1, ST2 and ST3 to provide representative minimum background noise levels at surrounding sensitive receptors for employment in the operational noise assessment. These are provided in Table 14.14.

Table 14.14: Minimum Background Noise Levels for Employment in Assessment

Measurement Location	Details	Minimum Background Noise Level (dB L_{A90})	
		Daytime	Night-time
LT1	Representative of properties on Savage Gardens and on Wolseley Road and Hamoaze Avenue	41	34
LT2	Representative of properties on Talbot Gardens	41	31
LT3	Garden of 38 Moor Lane. Representative of properties in this area.	36	30

14.5 Incorporated Mitigation

Construction

14.5.1 It is expected that the contractor will follow Best Practicable Means to minimise the noise impact upon the local community. Best Practicable Means will include the following:

- All construction plant and equipment should comply with EU noise emission limits.
- Proper use of plant with respect to minimising noise emissions and regular maintenance. All vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good efficient working order.
- Selection of inherently quiet plant where appropriate. All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use and all ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers.
- Machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum.
- Plant and equipment such as flat bed lorries, skips and chutes should be lined with noise attenuating materials. Materials should be handled with care and be placed, not dropped. Materials should be delivered during normal working hours.
- All ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimum noise disturbance, i.e. furthest from receptors or behind close boarded noise barriers. If necessary, acoustic enclosures should be provided and/or acoustic shielding.

- Construction contractors should be obliged to adhere to the codes of practice for construction working and piling given in BS 5228 and the guidance given therein minimising noise emissions from the site.
- Reference should be made to the Building Research Establishment, BRE 'Pollution Control' guidelines, Parts 1-5 [15].

Operation

14.5.2 The plant has been designed to minimise operational noise levels as far as is practicable, including

- Selection of low noise plant items. For example, the ACCs employ large diameter, low speed fans to provide the lowest possible noise emission for this type of equipment
- Selection of wall and roof cladding constructions to minimise noise breakout from the plant buildings. High performance multi-layered cladding systems have been chosen for each part of the facility to provide the necessary reduction in breakout noise resulting from the calculated internal noise levels.
- Selection of acoustic attenuated ventilation openings to minimise noise breakout from the plant buildings. High performance attenuated vents have been chosen for each part of the facility to provide the necessary reduction in breakout noise resulting from the calculated internal noise levels.

14.5.3 The chosen plant items and plant layout have been chosen to result in one of the quietest facilities of its type in the UK.

14.5.4 In addition, preliminary calculations indicated the significant noise contribution of HGV traffic entering and leaving the site. A 3-metre high acoustic barrier, expected to be a close-boarded fence, has been specified to the HGV route to mitigate this noise source. The final extent of this barrier will be decided during the detailed design.

14.6 Impact Assessment

Construction Noise

14.6.1 Noise levels resulting from construction activities have been predicted at five selected receptors. These receptors have been chosen as being representative of the closest noise sensitive properties in different directions from the development site. The selected receptors are:

- C1: 25-36 Talbot Gardens;
- C2: 1-12 Talbot Gardens;
- C3: 13-18 Savage Road;
- C4: 471 Wolseley Road; and
- C5: 21 Hamoaze Avenue.

14.6.2 The receptor locations are shown in Figure 14.1.

14.6.3 The following major activities have been assumed during the construction of the proposed facility:

- site clearance;
- earthworks;
- excavation and foundations;
- piling;
- slab construction;
- steelwork construction;
- services and fitting; and
- access road construction.

14.6.4 Distances from the closest approach of the construction works to each selected receptor are given in Appendix 14.3, Table A14.3.1.

14.6.5 The assumed plant to be used during each construction activity and their 'on-times' (the percentage of time that an item of plant is operational per day or hour or other relevant time period) are given in Appendix 14.3, Table A14.3.2. Sound power levels for plant items have been sourced from BS 5228-1.

14.6.6 Construction noise levels have been calculated for a 10 hour working day, a worst-case 3 hour period and a worst-case 5 minute period. For all calculations it has been assumed that construction works are being carried out at the closest approach to each receptor and there is direct line of sight between the works and the receptor. The detailed results of the calculations are given in Appendix 14.3, Tables A14.3.3 to A14.3.5.

14.6.7 Appendix 14.3, Tables A14.3.6 to A14.3.10 present the assessments for each receptor location for the 10 hour working day. The significance of construction noise levels above the limit value is taken from Table 14.2.

14.6.8 Appendix 14.3, Tables A14.3.11 to A14.3.15 present the assessments for each receptor location for the worst-case 3 hour period. The significance of construction noise levels above the limit value is taken from Table 14.2.

14.6.9 Appendix 14.3, Tables A14.3.16 to A14.3.20 present the assessments for each receptor location for the worst-case 5 minute period. The significance of construction noise levels above the limit value is taken from Table 14.2.

14.6.10 Table 14.15 shows the results for receptor C1: 25-36 Talbot Gardens. It can be seen that there are significant effects for a number of site activities for both the 10 hour working day and the worst-case 3 hour period, due to the closeness of the receptor.

14.6.11 However, these are worst-case noise levels, with construction activities being carried out at the closest approach. For the major part of the site clearance, earthworks, excavations and foundations and building construction works, noise levels will be significantly less than these. The period of time for which there will be construction noise effects of High significance will be a small proportion of the total construction time.

14.6.12 The worst-case 5 minute noise limit is not exceeded.

Table 14.15: Construction Noise Assessment – Receptor C1

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
$L_{Aeq,10h}$ dB								
Predicted Noise Level $L_{Aeq,10h}$ dB	78	79	77	68	74	76	72	74
Level Above Acceptable L_{Aeq} dB	+8	+9	+7	-2	+4	+6	+2	+4
Significance of Effect	High	High	High	None	Med	High	Low	Med
$L_{Aeq,3h}$ dB								
Predicted Noise Level $L_{Aeq,3h}$ dB	80	80	78	69	75	77	74	75
Level Above Acceptable L_{Aeq} dB	+6	+6	+4	-5	+1	+3	0	+1
Significance of Effect	High	High	Med	None	Neg	Low	None	Neg
$L_{Aeq,5min}$ dB								
Predicted Noise Level $L_{Aeq,5min}$ dB	84	80	79	69	76	79	77	75
Level Above Acceptable L_{Aeq} dB	-2	-6	-7	-17	-10	-7	-9	-11
Significance of Effect	None	None	None	None	None	None	None	None

14.6.13 Table 14.16 shows the results for receptor C2: 1-12 Talbot Gardens. This receptor is in the same area as C1 and there are significant effects for site clearance, earthworks, excavations and foundations and piling for the 10 hour working day. There are significant effects, assessed as low, for site clearance, earthworks and excavations and foundations for the 3 hour period.

14.6.14 As for receptor C1, these are worst-case noise levels, with construction activities being carried out at the closest approach. For the major part of the works, noise levels will be significantly less than these.

14.6.15 The worst-case 3 hour and 5 minute limits are not exceeded.

Table 14.16: Construction Noise Assessment – Receptor C2

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
$L_{Aeq,10h}$ dB								
Predicted Noise Level $L_{Aeq,10h}$ dB	75	76	76	72	70	71	68	70
Level Above Acceptable L_{Aeq} dB	+5	+6	+6	+2	0	+1	-2	0
Significance of Effect	Med	High	High	Low	None	Neg	None	None
$L_{Aeq,3h}$ dB								
Predicted Noise Level $L_{Aeq,3h}$ dB	77	77	77	73	71	73	70	71
Level Above Acceptable L_{Aeq} dB	+3	+3	+3	-1	-3	-1	-4	-3
Significance of Effect	Low	Low	Low	None	None	None	None	None
$L_{Aeq,5min}$ dB								
Predicted Noise Level $L_{Aeq,5min}$ dB	81	78	77	73	72	75	73	71
Level Above Acceptable L_{Aeq} dB	-5	-8	-9	-13	-14	-11	-13	-15
Significance of Effect	None	None	None	None	None	None	None	None

14.6.16 Table 14.17 shows the results for receptor C3: 13-18 Savage Road. There are no significant effects for the 10 hour working day, the worst-case 3 hour period or the worst-case 5 minute period.

Table 14.17: Construction Noise Assessment – Receptor C3

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
$L_{Aeq,10h}$ dB								
Predicted Noise Level $L_{Aeq,10h}$ dB	69	71	68	67	64	66	63	65
Level Above Acceptable L_{Aeq} dB	-6	-4	-7	-8	-11	-9	-12	-10
Significance of Effect	None	None	None	None	None	None	None	None
$L_{Aeq,3h}$ dB								
Predicted Noise Level $L_{Aeq,3h}$ dB	71	72	69	68	65	67	65	65
Level Above Acceptable L_{Aeq} dB	-8	-7	-10	-11	-14	-12	-14	-14
Significance of Effect	None	None	None	None	None	None	None	None
$L_{Aeq,5min}$ dB								
Predicted Noise Level $L_{Aeq,5min}$ dB	74	72	70	68	66	69	68	66
Level Above Acceptable L_{Aeq} dB	-17	-19	-21	-23	-25	-22	-23	-25
Significance of Effect	None	None	None	None	None	None	None	None

14.6.17 Table 14.18 shows the results for receptor C4: 471 Wolseley Road. There are no significant effects for the 10 hour working day, the worst-case 3 hour period or the worst-case 5 minute period.

Table 14.18: Construction Noise Assessment – Receptor C4

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
$L_{Aeq,10h}$ dB								
Predicted Noise Level $L_{Aeq,10h}$ dB	67	69	66	65	62	63	60	63
Level Above Acceptable L_{Aeq} dB	-3	-1	-4	-5	-8	-7	-10	-3
Significance of Effect	None	None	None	None	None	None	None	None
$L_{Aeq,3h}$ dB								
Predicted Noise Level $L_{Aeq,3h}$ dB	69	70	67	65	63	65	62	63
Level Above Acceptable L_{Aeq} dB	-5	-4	-7	-9	-11	-9	-12	-11
Significance of Effect	None	None	None	None	None	None	None	None
$L_{Aeq,5min}$ dB								
Predicted Noise Level $L_{Aeq,5min}$ dB	71	70	68	66	64	67	65	64
Level Above Acceptable L_{Aeq} dB	-15	-16	-18	-20	-22	-19	-21	-22
Significance of Effect	None	None	None	None	None	None	None	None

14.6.18 Table 14.19 shows the results for receptor C5: 21 Hamoaze Avenue. There are no significant effects for the 10 hour working day, the worst-case 3 hour period or the worst-case 5 minute period.

Table 14.19: Construction Noise Assessment – Receptor C5

Construction Activity	Site Clearance	Earthworks	Excavations and Foundations	Piling	Slab Construction	Steelwork Construction	Services and Finishing	Access Roads/ Car parking
$L_{Aeq,10h}$ dB								
Predicted Noise Level $L_{Aeq,10h}$ dB	67	69	63	62	59	61	58	63
Level Above Acceptable L_{Aeq} dB	-3	-1	-7	-8	-11	-9	-12	-7
Significance of Effect	None	None	None	None	None	None	None	None
$L_{Aeq,3h}$ dB								
Predicted Noise Level $L_{Aeq,3h}$ dB	69	70	64	63	60	63	60	64
Level Above Acceptable L_{Aeq} dB	-5	-4	-10	-11	-14	-11	-14	-10
Significance of Effect	None	None	None	None	None	None	None	None
$L_{Aeq,5min}$ dB								
Predicted Noise Level $L_{Aeq,5min}$ dB	72	71	65	63	61	65	63	64
Level Above Acceptable L_{Aeq} dB	-14	-15	-21	-23	-25	-21	-23	-22
Significance of Effect	None	None	None	None	None	None	None	None

14.6.19 Apart from residential properties on Talbot Gardens (receptors C1 and C2) it is predicted that the noise limits for the 10 hour working day, the worst-case 3 hour period and the worst-case 5 minute period will not be exceeded at surrounding residential receptors.

14.6.20 Where the 10 hour and 3 hour noise limits are exceeded at Talbot Gardens, this will be for a relatively short period of time, only when construction works are in close proximity to these properties. For the major part of the construction works, noise levels will be below the noise limits.

14.6.21 If practical, the provision of noise barriers, close in to construction works, when working close to Talbot Gardens, would reduce noise levels by approximately 5 dB(A), resulting in low or negligible significance for the majority of these works. The practicality and effectiveness of these will be dependent on the nature and duration of the particular works, and the allowable proximity

of the barrier to the works (the barrier will need to be close to the works to provide any potential attenuation to the higher floors of properties on Talbot Gardens).

14.6.22 Overall, the significance of construction noise effects is assessed as negligible / low.

Off Site Electrical Cable Works and Steam Pipeline Works

14.6.23 As part of the construction works, the following works will also be carried out:

- Provision of electricity cable from the site to the North Intake Substation and construction of a new switchroom building.
- Provision of new steam pipework to connect into the existing system and replacement of some existing pipework.

14.6.24 The majority of these works will be carried out within HMNB Devonport and Devonport Dockyard, where there are no receptors of high sensitivity.

14.6.25 There are residential properties on Saltash Road, close to the works to connect into the North Intake Substation. Temporary significant noise effects could result from works in this area, although the duration of the works is expected to be relatively short. Adherence to the mitigation procedures outlined in paragraph 14.5.1 will reduce noise effects to a minimum.

Construction Vibration

14.6.26 All piling during construction works will be rotary bored piling. Ground borne vibration levels have been calculated at the receptor locations for piling works at the closest approach, employing measured source data from BS5228-2. The estimated ppv values are shown in Table 14.20.

Table 14.20: Predicted Construction Vibration Levels

Receptor	ppv (mms^{-1})
C1	< 0.1
C2	< 0.2
C3	< 0.1
C4	< 0.1
C5	< 0.1

14.6.27 With reference to the criterion values in Table 14.3, the predicted vibration levels are unlikely to be perceptible at surrounding residential receptors. The significance of ground borne vibration with respect to nuisance is assessed as negligible.

14.6.28 With reference to the criterion values in Table 14.4, the predicted vibration levels are well below the levels at which cosmetic damage to buildings might occur. The significance of ground borne vibration with respect to building damage is assessed as negligible.

Construction Traffic on Public Roads

14.6.29 The results of the construction traffic assessment have been employed to calculate the increases in noise levels to receptors along the construction traffic route. It is understood that construction traffic will mostly access and egress the site via Weston Mill Drive to the A38.

14.6.30 The number of vehicles per day will vary throughout the construction period. The worst-case has been considered, assuming 150 HGV movements per day (75 in / 75 out) and 308 car movements per day (154 in / 154 out).

14.6.31 The effects of the additional traffic during construction are presented in Appendix 14.3, Table A14.3.21, which shows the baseline traffic flows, the "with construction traffic" flows and the change in Basic Noise Level for each of the road links on the construction traffic route (Basic Noise Level is the calculated road traffic noise level at a reference distance of 10 metres from the edge of the carriageway). The results are summarised in Table 14.21 below.

Table 14.21: Changes in Noise Levels on Public Roads Due to Construction Traffic

Road Link	Basic Noise Level (dB $L_{A10,18h}$)		Change (dB $L_{A10,18h}$)
	2011 Baseline	2011 With Construction	
Link between Site Roundabout and Wolseley Rd / Weston Mill Drive junction	63.6	64.6	1.0
Weston Mill Drive east of Wolseley Rd junction	69.5	69.8	0.3
Weston Mill Drive east of Ferndale Road	69.6	69.9	0.3
Weston Mill Drive west of A38	69.6	69.9	0.3
A38 westbound on-slip - one way flows	65.5	66.0	0.5
A38 westbound off-slip - one way flows	64.3	64.9	0.6
A38 Eastbound on-slip - one way flows	65.4	65.9	0.5
A38 Eastbound off-slip - one way flows	65.2	65.7	0.5
A38 westbound (west of Weston Mill Drive) - one way flows	76.3	76.4	0.2
A38 westbound (east of Weston Mill Drive) - one way flows	76.0	76.2	0.2
A38 eastbound (west of Weston Mill Drive) - one way flows	76.2	76.4	0.2
A38 eastbound (east of Weston Mill Drive) - one way flows	76.3	76.4	0.2

14.6.32 Apart from the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive, the increases in noise level are all below 1 dB(A), the significance of which is assessed as negligible with reference to Table 14.5.

14.6.33 The increase on the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive is 1 dB(A). However, there are no sensitive residential receptors adjacent to this link. The nearest residential properties front on to Wolseley Road and Weston Mill Drive and

the noise climate at these properties is dominated by road traffic on these two links. Weston Mill Community Primary School is located on the eastern side of the Wolseley Road / Weston Mill Drive junction, but again the existing noise climate here is dominated by road traffic noise. Hence, the resultant increases in noise levels due to construction traffic will be less than 1 dB(A) and the significance of these noise increases is assessed as negligible.

Operational Noise

14.6.34 The operational noise model, consisting of a detailed three dimensional representation of the proposed facility and the surroundings, has been employed to calculate noise levels at surrounding sensitive receptors due to noise breakout from the facility buildings, noise emission from external plant and noise emission from HGVs on site (between the junction with the dockyard North Access Road and the facility buildings).

14.6.35 The model employs the calculation methodology provided in ISO 9613-2, which is the standard methodology for the calculation of noise levels from industrial sources within the UK and most of Europe. The methodology takes account of the following;-

- Noise breakout from the facility buildings
- Noise from external fixed plant (e.g. ACCs, transformer, recoolers, stack)
- Attenuation of noise with distance
- The frequency spectrum of the noise from each source
- The ground topography between the facility and surrounding receptors, enabling corrections to be made for shielding and ground absorption (these corrections will take account of the unusual topography of this particular site, with the receptors located above the level of the facility)

14.6.36 A summary of the input data to the model is provided in Appendix 14.4.

14.6.37 Two periods have been considered:

- the daytime period (when HGVs will be accessing and leaving the site); and
- the night-time period (no HGV traffic).

14.6.38 For each period, free-field L_{Aeq} noise levels have been calculated at all floors of surrounding buildings (free-field levels have been calculated, rather than facade levels, for direct comparison with the prevailing background noise levels).

14.6.39 For the daytime period, one situation has been considered:

- a worst-case weekday hour, with the maximum number of HGV arrivals and departures (23 in / 23 out).

14.6.40 During weekends, the total number of daily HGV movements on and off site will be less than during the week. The daytime noise impact for weekend periods will thus be less than reported here for the weekday.

14.6.41 For the night-time period, two situations have been considered (since night-time noise from the EfW CHP facility is steady, a 1 hour period can be employed in place of the 5 minute period specified in BS 4142):

- a usual night-time hour, with no workshop activity; and
- an unusual night-time hour, with workshop activity (the workshop will be operational during the night-time period on very few occasions throughout the year).

14.6.42 Maintenance staff will only normally be employed during the day time, not at night. There will, for example, be standby items of equipment (e.g. pumps) which can be brought into operation in the event of equipment breakdown. Repair work can then be carried out during the daytime.

14.6.43 For the daytime period, a +5 dB(A) correction has been applied to derive the Rating Level, to account for the irregularities in the noise from the facility due to HGV operations.

14.6.44 It is proposed that no +5 dB(A) correction need be applied for the night-time period to derive the Rating Level, since there is no HGV traffic and the emitted noise is steady and broadband (measurements on a similar facility in Mannheim, Germany have demonstrated the non-tonal nature of the emitted noise). See Appendix 14.5 for further details, which provides measured noise levels for this comparable plant in Germany. However, for comparison, results are presented with and without the +5 dB(A) correction.

14.6.45 Figure 14.2 shows a plan of the site and surrounding area, with the receptor locations shown.

14.6.46 Table 14.22 presents the results for the worst-case weekday hour. The levels shown are the maximum for each receptor (usually the top floor).

Table 14.22: Operational Noise Levels – Worst Case Weekday Hour

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1\ hour}$)	Rating Level (dB $L_{Ar,,1\ hour}$)	Minimum Background Noise Level (dB(A))	Rating Level minus Background Noise Level (dB(A))
R1	38	43	41	2
R2	40	45	41	4
R3	40	45	41	4
R4	37	42	41	1
R5	35	40	41	-1
R6	38	43	41	2
R7	37	42	41	1
R8	33	38	41	-3
R9	31	36	41	-5
R10	36	41	41	0
R11	33	38	41	-3
R12	35	40	41	-1
R13	33	38	41	-3
R14	33	38	41	-3
R15	35	40	41	-1
R16	38	43	41	2
R17	39	44	41	3
R18	39	44	41	3
R19	37	42	41	1
R20	38	43	41	2
R21	41	46	41	5
R22	40	45	41	4
R23	41	46	47 *	-1

* Short term measurement of daytime background noise levels at R23 on 11/3/11.
Minimum measured $L_{A90,5\ mins}$ = 47 dB(A)

14.6.47 Inspection of the results in Table 14.22 shows that the estimated Rating Level is a maximum of 5 dB(A) above the prevailing minimum background noise level. In support of the calculated noise levels in Table 14.22, Figure 14.3 shows calculated operational daytime noise level contours at a height of 1.5 metres above ground across the site and surrounding area.

14.6.48 Table 14.23 presents the results for a usual night-time hour (i.e no workshop activity). The levels shown are the maximum for each receptor (usually the top floor). The numbers in brackets show the results with the +5 dB(A) correction to derive the Rating Level.

Table 14.23: Operational Noise Levels – Usual Night-time Hour (no workshop activity)

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1\ hour}$)	Rating Level (dB $L_{Ar,1\ hour}$)	Minimum Background Noise Level (dB(A))	Rating Level minus Background Noise Level (dB(A))
R1	37	37 (42)	34	3 (8)
R2	39	39 (44)	34	5 (10)
R3	39	39 (44)	34	5 (10)
R4	37	37 (42)	34	3 (8)
R5	33	33 (38)	34	-1 (4)
R6	37	37 (42)	34	3 (8)
R7	36	36 (41)	34	2 (7)
R8	32	32 (37)	34	-2 (3)
R9	29	29 (34)	31	-2 (3)
R10	35	35 (40)	31	4 (9)
R11	32	32 (37)	31	1 (6)
R12	32	32 (37)	31	1 (6)
R13	29	29 (34)	31	-2 (3)
R14	30	30 (35)	31	-1 (4)
R15	30	30 (35)	31	-1 (4)
R16	30	30 (35)	31	-1 (4)
R17	27	27 (35)	31	-4 (1)
R18	25	25 (30)	31	-6 (-1)
R19	24	24 (29)	31	-7 (-2)
R20	36	36 (41)	34	2 (7)
R21	39	39 (44)	34	5 (10)
R22	35	35 (40)	34	1 (6)
R23	27	27 (32)	34	-7 (-2)

14.6.49 Inspection of the results in Table 14.23 shows that the estimated Rating Level is a maximum of 5 dB(A) above the prevailing minimum background noise level, assuming no +5 dB(A) correction to the Rating Level.

14.6.50 With the +5 dB(A) correction, there are 12 receptor locations where the estimated Rating Level is greater than 5 dB(A) above the prevailing minimum background noise level. In support of the calculated noise levels in Table 14.23, Figure 14.4 shows calculated operational night-time noise level contours at a height of 1.5 metres above ground across the site and surrounding area.

14.6.51 Table 14.24 presents the results for an unusual night-time hour, with activity in the workshop. As stated previously, this will be a very rare occurrence. The levels shown are the maximum for each receptor (usually the top floor). The numbers in brackets show the results with the +5 dB(A) correction to derive the Rating Level.

14.6.52 Inspection of the results in Table 14.24 shows that the estimated Rating Level is a maximum of 5 dB(A) above the prevailing minimum background noise level, assuming no +5 dB(A) correction to the Rating Level.

14.6.53 With the +5 dB(A) correction, there are 12 receptor locations where the estimated Rating Level is greater than 5 dB(A) above the prevailing minimum background noise level. It is noted that the target noise level is not exceeded at receptors R15, R16, R17, R18 and R19, which are the closest receptors to the workshop.

14.6.54 In support of the calculated noise levels in Table 14.24, Figure 14.5 shows calculated operational night-time noise level contours (with workshop activity) at a height of 1.5 metres above ground across the site and surrounding area.

14.6.55 It is concluded that, for daytime and night-time operation of the plant, the Rating Level at all receptors will be no more than 5 dB(A) above the minimum background noise level, if, as discussed above and supported by the information in Appendix 14.5, the +5 dB(A) correction to the night-time Rating Level is not applied.

Table 14.24: Operational Noise Levels – Unusual Night-time Hour (with workshop activity)

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1\ hour}$)	Rating Level (dB $L_{Ar,1\ hour}$)	Minimum Background Noise Level (dB(A))	Rating Level minus Background Noise Level (dB(A))
R1	37	37 (42)	34	3 (8)
R2	39	39 (44)	34	5 (10)
R3	39	39 (44)	34	5 (10)
R4	37	37 (42)	34	3 (8)
R5	33	33 (38)	34	-1 (4)
R6	37	37 (42)	34	3 (8)
R7	36	36 (41)	34	2 (7)
R8	32	32 (37)	34	-2 (3)
R9	29	29 (34)	31	-2 (3)
R10	35	35 (40)	31	4 (9)
R11	32	32 (37)	31	1 (6)
R12	32	32 (37)	31	1 (6)
R13	29	29 (34)	31	-2 (3)
R14	30	30 (35)	31	-1 (4)
R15	30	30 (35)	31	-1 (4)
R16	31	31 (36)	31	0 (5)
R17	31	31 (36)	31	0 (5)
R18	28	28 (33)	31	-3 (2)
R19	25	25 (30)	31	-6 (-1)
R20	36	36 (41)	34	2 (7)
R21	39	39 (44)	34	5 (10)
R22	35	35 (40)	34	1 (6)
R23	27	27 (32)	34	-7 (-2)

Baling Operations

14.6.56 During periods of plant shutdown, waste will be shredded, baled and stored in order to avoid diverting waste away from the EfW CHP to landfill. During these shutdown periods, the following will apply:

Daytime

- Normal waste delivery HGV traffic
- Elevated noise levels in bale store and bunker (see Table A14.4.2 in Appendix 14.4)
- Maintenance works ongoing in boiler house and turbine hall
- Transformer operating on part load
- Workshop operational (internal reverberant level = 85 dB(A))

Night-time

- Elevated noise levels in bale store and bunker
- Maintenance works ongoing in boiler house and turbine hall
- Transformer operating on part load
- Workshop operational (internal reverberant level = 80 dB(A))

14.6.57 For daytime and night-time, free-field L_{Aeq} noise levels have been calculated at all floors of surrounding buildings (free-field levels have been calculated, rather than facade levels, for direct comparison with the prevailing background noise levels).

14.6.58 Table 14.25 presents the results for the worst-case daytime hour. The levels shown are the maximum for each receptor (usually the top floor). A +5 dB(A) penalty has been applied to account for the character of the noise.

14.6.59 Noise levels during baling operations are generally well below those for standard plant operation. Where this is not the case, noise levels are dominated by factors other than the baling operations:

- Receptors R15 to R19 are dominated by noise from the adjacent workshop, which is operational during standard plant operation and during plant shutdown.
- Receptors R22 and R23 are dominated by noise from HGV traffic, which will be present during standard plant operation and during shutdown.

14.6.60 Examination of Table 14.25 shows that the estimated Rating Level is a maximum of 3 dB(A) above the prevailing minimum background noise level.

Table 14.25: Baling Operations – Worst Case Daytime Hour

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1\ hour}$)	Rating Level (dB $L_{Ar,,1\ hour}$)	Minimum Background Noise Level (dB(A))	Rating Level minus Background Noise Level (dB(A))
R1	30	35	41	-6
R2	31	36	41	-5
R3	30	35	41	-6
R4	28	33	41	-8
R5	30	35	41	-6
R6	29	34	41	-7
R7	29	34	41	-7
R8	27	32	41	-9
R9	26	31	41	-10
R10	31	36	41	-5
R11	28	33	41	-8
R12	32	37	41	-4
R13	31	36	41	-5
R14	31	36	41	-5
R15	34	39	41	-2
R16	37	42	41	1
R17	39	44	41	3
R18	39	44	41	3
R19	37	42	41	1
R20	29	34	41	-7
R21	34	39	41	-2
R22	38	43	41	2
R23	41	46	47 *	-1

14.6.61 Table 14.26 presents the results for the worst-case night-time hour. The levels shown are the maximum for each receptor (usually the top floor). A +5 dB(A) penalty has been applied to account for the character of the noise.

14.6.62 Noise levels during baling operations are generally well below those for standard plant operation. Where this is not the case, noise levels are dominated by factors other than the baling operations:

- Receptors R15 to R19 are dominated by noise from the adjacent workshop, which is operational during plant shutdown.

14.6.63 Examination of Table 14.26 shows that the estimated Rating Level is a maximum of 4 dB(A) above the prevailing minimum background noise level.

Table 14.26: Baling Operations – Worst Case Night-time Hour

Receptor	Calculated Free-Field Noise Level (dB $L_{Aeq,1\ hour}$)	Rating Level (dB $L_{Ar,1\ hour}$)	Minimum Background Noise Level (dB(A))	Rating Level minus Background Noise Level (dB(A))
R1	17	22	34	-12
R2	17	22	34	-12
R3	19	24	34	-10
R4	19	24	34	-10
R5	22	27	34	-7
R6	23	28	34	-6
R7	23	28	34	-6
R8	20	25	34	-9
R9	17	22	31	-9
R10	25	30	31	-1
R11	22	27	31	-4
R12	24	29	31	-2
R13	22	27	31	-4
R14	21	26	31	-5
R15	27	32	31	1
R16	28	33	31	2
R17	30	35	31	4
R18	27	32	31	1
R19	24	29	31	-2
R20	16	21	34	-13
R21	19	24	34	-10
R22	21	26	34	-8
R23	21	26	34	-8

14.6.64 It is concluded that, for daytime and night-time baling and maintenance operations, noise levels to surrounding sensitive receptors will be acceptable. Baling activities will not be carried out during the normal operation of the plant.

Operational Vibration

14.6.65 There are no sources of significant ground borne vibration in the complement of plant items. All internal plant items such as turbines, generators, compressors etc. will be suitably mounted to minimise the transfer of vibration energy to the building structure.

14.6.66 Taking this into account, and the distances from the plant to surrounding sensitive receptors, the significance of operational vibration is assessed as negligible.

Operational Traffic on Public Roads

14.6.67 The results of the operational traffic assessment have been employed to calculate the increases in noise levels to receptors along affected routes. These affected routes include the North Access Road to the dockyard.

14.6.68 The effects of the additional traffic resulting from the development are presented in Appendix 14.4, Tables A14.4.4 and A14.4.5, which show the baseline traffic flows, the "with development traffic" flows and the change in Basic Noise Level for each of the road links (Basic Noise Level is the calculated road traffic noise level at a reference distance of 10 metres from the edge of the carriageway). Residential properties along some of these road links are closer than 10 metres to the roadside. However, the change in noise level resulting from increased traffic due to the EfW facility will be the same as the change in Basic Noise Level.

14.6.69 The data in Table A14.4.4 include the natural growth in traffic over time from 2011 to 2014. The data in Table A14.4.5 includes the natural growth in traffic over time from 2011 to 2014, plus traffic resulting from two other developments that have the potential to be constructed in future and which have specifically been modelled in an Annex to the Transport Assessment (see ES Appendix 12.1, Annex G) at the request of Plymouth City Council Officers. The results are summarised in Tables 14.27 and 14.28 below. The road links are shown in Figure 14.6, referenced to the Link I.D. numbers in the tables.

Table 14.27: Changes in Noise Levels on Public Roads Due to Operational Traffic

Link I.D.	Road Link	Basic Noise Level (dB $L_{A10,18h}$)		Change (dB $L_{A10,18h}$)
		2014 Do Minimum	2014 Do Something	
1	Link between Site Roundabout and Wolseley Rd / Weston Mill Drive junction	63.7	65.3	1.6
2	Wolseley Rd south of Weston Mill Drive junction	70.2	70.4	0.1
3	Wolseley Rd south of Saltash Rd junction	67.5	67.7	0.2
4	Weston Mill Drive east of Wolseley Rd junction	69.7	70.0	0.3
5	Weston Mill Drive east of Ferndale Road	69.7	70.1	0.3
6	Weston Mill Drive west of A38	69.7	70.0	0.3
7	Saltash Rd	67.5	67.5	0.0
8	Wolseley Rd (north of Weston Mill Drive junction) - one way flows	66.9	66.9	0.0
9	Ferndale Rd	62.2	62.2	0.0
10	Carlton Terrace	60.1	60.2	0.1
11	A38 westbound on-slip - one way flows	65.6	65.7	0.1
12	A38 westbound off-slip - one way flows	64.4	65.0	0.6
13	A38 Eastbound on-slip - one way flows	65.6	66.0	0.4
14	A38 Eastbound off-slip - one way flows	65.3	65.4	0.1
15	A38 westbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
16	A38 westbound (east of Weston Mill Drive) - one way flows	76.1	76.2	0.1
17	A38 eastbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
18	A38 eastbound (east of Weston Mill Drive) - one way flows	76.4	76.5	0.1
19	Wolseley Rd north of Barne Rd junction- two way	60.9	60.9	0.0
20	Barne Rd east of Wolseley Rd junction - two way	65.5	65.5	0.0
21	Barne Rd west of Wolseley Rd junction - two way	63.9	63.9	0.0

Table 14.28: Changes in Noise Levels on Public Roads Due to Operational Traffic (with other potential developments)

Link I.D.	Road Link	Basic Noise Level (dB $L_{A10,18h}$)		Change (dB $L_{A10,18h}$)
		2014 Do Minimum	2014 Do Something	
1	Link between Site Roundabout and Wolseley Rd / Weston Mill Drive junction	63.8	65.3	1.6
2	Wolseley Rd south of Weston Mill Drive junction	70.4	70.5	0.1
3	Wolseley Rd south of Saltash Rd junction	67.7	67.9	0.2
4	Weston Mill Drive east of Wolseley Rd junction	70.0	70.3	0.3
5	Weston Mill Drive east of Ferndale Road	69.9	70.2	0.3
6	Weston Mill Drive west of A38	69.8	70.1	0.3
7	Saltash Rd	67.5	67.5	0.0
8	Wolseley Rd (north of Weston Mill Drive junction) - one way flows	67.3	67.3	0.0
9	Ferndale Rd	64.5	64.5	0.0
10	Carlton Terrace	60.7	60.8	0.1
11	A38 westbound on-slip - one way flows	65.8	65.8	0.0
12	A38 westbound off-slip - one way flows	64.6	65.1	0.5
13	A38 Eastbound on-slip - one way flows	65.7	66.1	0.4
14	A38 Eastbound off-slip - one way flows	65.5	65.5	0.1
15	A38 westbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
16	A38 westbound (east of Weston Mill Drive) - one way flows	76.2	76.2	0.1
17	A38 eastbound (west of Weston Mill Drive) - one way flows	76.4	76.4	0.0
18	A38 eastbound (east of Weston Mill Drive) - one way flows	76.4	76.5	0.1
19	Wolseley Rd north of Barne Rd junction- two way	60.9	60.9	0.0
20	Barne Rd east of Wolseley Rd junction - two way	65.5	65.5	0.0
21	Barne Rd west of Wolseley Rd junction - two way	63.9	63.9	0.0

14.6.70 Apart from the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive, the increases in noise level are all below 1 dB(A), the significance of which is assessed as negligible with reference to Table 14.5.

14.6.71 The increase on the link between the on-site roundabout and the junction of Wolseley Road and Weston Mill Drive is 1.6 dB(A). However, there are no sensitive residential receptors adjacent to this link. The nearest residential properties front on to Wolseley Road and Weston Mill Drive and the noise climate at these properties is dominated by road traffic on these two links. Weston Mill Community Primary School is located on the eastern side of the Wolseley Road / Weston Mill Drive junction, but again the existing noise climate here is dominated by road traffic noise. The resultant increases in noise levels due to operational road traffic will be less than 1 dB(A) and the significance of these noise increases is assessed as negligible. These negligible effects resulting from increased traffic due to the EfW facility are particularly important for properties fronting on to Weston Mill Drive, which has been identified as a site of high noise levels in the Noise Mapping England project.

Commissioning and Plant Start-Up

14.6.72 Detailed assessments for plant commissioning and plant start-up after shutdowns have not been provided.

14.6.73 During commissioning and plant start-up there may be short term elevated noise levels to surrounding receptors due to plant testing (including exhaust venting systems). These potential short term disturbances will be best handled by close liaison with the surrounding community to provide reassurance and information in advance of any operations. Wherever possible, potentially noisy activities will be carried out during the daytime period only.

14.7 Additional Mitigation

Construction

14.7.1 Where practical, noise barriers, close in to construction works, when working in the vicinity of properties on Talbot Gardens, will be provided. This will provide additional mitigation for the short-term significant construction noise effects at these properties. The practicality and effectiveness of these will be dependent on the nature and duration of the particular works, and the allowable proximity of the barrier to the works (the barrier will need to be close to the works to provide any potential attenuation to the higher floors of properties on Talbot Gardens).

14.7.2 Since it may be perceived by the local community that there could be noise impacts, MVV has undertaken to prepare and work to a noise monitoring protocol and action plan. This will provide a detailed methodology for regular noise monitoring (including frequency of monitoring, monitoring locations, monitoring time periods and parameters to be logged) and a clear set of action to be followed in the event of any agreed noise level criteria being exceeded.

Operation

14.7.3 Since it may be perceived by the local community that there could be noise impacts, MVV has undertaken to prepare and work to a noise monitoring protocol and action plan. This will provide a detailed methodology for regular noise monitoring (including frequency of monitoring,

monitoring locations, monitoring time periods and parameters to be logged) and a clear set of action to be followed in the event of any agreed noise level criteria being exceeded.

14.8 Residual Effects (with Mitigation in Place)

Construction

14.8.1 With the provision of mitigation, as outlined in paragraph 14.7.1 and 14.7.2 above, and adherence to good site practices as outlined in paragraph 14.5.1, residual construction noise effects are assessed as negligible / low.

14.8.2 Construction vibration effects are assessed as negligible.

Operation

14.8.3 Assuming that no +5 dB(A) correction is required to derive the night-time Rating Level (as discussed previously and supported by the data in Appendix 14.5), operational noise levels at surrounding sensitive receptors are at, or below, the target noise levels of 5 dB(A) above minimum background noise level proposed by Plymouth City Council Public Protection Service. Mitigation has been designed into the plant, as detailed in paragraphs 14.5.2 and 14.5.3, to reduce operational noise levels as far as is practicable. Operational noise effects are assessed as negligible / low.

14.8.4 Operational vibration effects are assessed as negligible.

14.8.5 Operational road traffic noise effects are assessed as negligible.

14.9 Conclusion

Construction

14.9.1 The construction noise assessment has shown that, for the major part of the construction works, construction noise levels to surrounding sensitive receptors will be below the proposed limit values.

14.9.2 For some construction activities, when working close to properties on Talbot Gardens, the noise limit values will be exceeded and significant effects will result. Where practicable, noise barriers, close in to construction works, when working in the vicinity of properties on Talbot Gardens, should be provided. This will reduce noise levels by approximately 5 dB(A), resulting in low or negligible significance for the majority of these works. The practicality and effectiveness of these will be dependent on the nature and duration of the particular works, and the allowable proximity of the barrier to the works (the barrier will need to be close to the works to provide any potential attenuation to the higher floors of properties on Talbot Gardens).

14.9.3 Overall, the significance of construction noise effects is assessed as negligible / low.

14.9.4 Taking into account the construction works to be carried out (and, in particular, the location and type of piling works) the significance of construction vibration effects is assessed as negligible.

Operation

14.9.5 With the comprehensive mitigation incorporated in the plant design, optimum plant orientation and location, and the provision of a 3-metre high noise barrier to the on-site HGV route, the significance of operational noise effects is assessed as negligible / low. This conclusion is based on the following:

- The calculated daytime noise levels at surrounding receptors are at or below the target noise levels of 5 dB(A) below minimum background noise level.
- The calculated night-time noise levels at surrounding receptors are at or below the target noise levels of 5 dB(A) below minimum background noise level (with, as discussed previously, no +5 dB(A) correction to derive the Rating Level).

14.9.6 Taking into account the type of plant to be employed, and the distances from the plant to surrounding sensitive receptors, the significance of operational vibration is assessed as negligible.

14.9.7 Operational vibration effects are assessed as negligible.

14.9.8 Operational road traffic noise effects are assessed as negligible.

14.10 References

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2. Control of Pollution Act (1974).
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4. BS 7445: 1991/2003 Description and Measurement of Environmental Noise.
5. BS 5228-1: 2009 Noise and Vibration Control on Construction and Open Sites – Part 1: Noise.
6. City of Plymouth Public Protection Service. Code of Practice: Control of Pollution and Noise from Demolition and Construction Sites.
7. BS 5228-2: 2009 Noise and Vibration Control on Construction and Open Sites – Part 1: Vibration.
8. BS 7385-2: 1993 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground Borne Vibration.
9. ISO 9613-2: Acoustics – Attenuation of Sound Propagation Outdoors – Part 2: General Method of Calculation (1996).
10. Noise Protection Specification (App 0.8.1) Rev 1 - SWDWP Plymouth, MVV Umwelt (2010).
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12. BS4142: 1997 Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.
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14. Email from A Maneylaws to Public Protection Service, 12:41 11/8/10.

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