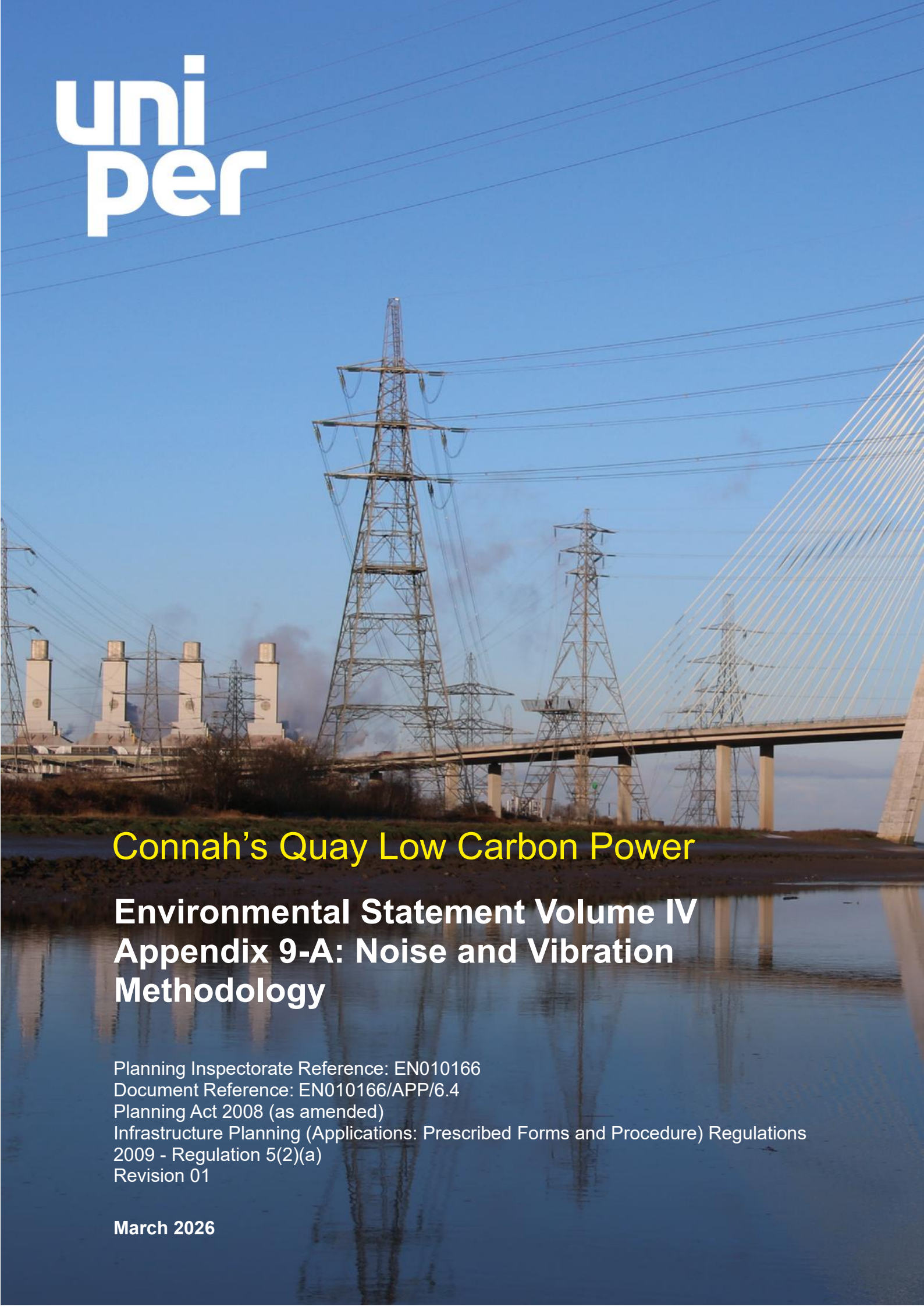

Connah's Quay Low Carbon Power

Environmental Statement Volume IV Appendix 9-A: Noise and Vibration Methodology

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1. Noise and Vibration Methodology

1.1 Assessment Methodology and Significance Criteria

Study Area

1.1.1 The extent of the study area has been defined to include the closest receptors/ communities in each direction from the Main Development Area, Construction & Indicative Enhancement Area (C&IEA), and Proposed Connection Corridors, and those that may be affected by changes in road traffic flows during the construction phase of the Proposed Development as described below:

- construction noise: the construction noise assessment study area is typically 300 m (based on BS 5228-1 guidance (Ref 1)) from the Construction and Operation Area, however the construction noise study area has been extended up to 1 km from the Main Development Area and a further 300 m from the Proposed CO_2 Connection Corridor and C&IEA that extend beyond the 1 km study area of the Main Development Area;
- construction vibration: receptors within 100 m (based on BS 5228-2 guidance (Ref 2) from the closest construction activity with the potential to generate vibration;
- construction traffic: based on traffic links in the transport model (as discussed in **Chapter 10: Traffic and Transport** (**EN010166/APP/6.2.10**); and
- operational noise: study area for operational noise is defined at a distance of 1 km from the Main Development Area. This distance is based on professional judgement and AECOM's previous experience of combined cycle has turbine (CCGT) and carbon capture plant (CCP) projects.

1.1.2 The Noise Sensitive Receiver (NSRs) included in the noise and vibration assessments are shown in **Figure 9-1: Noise Sensitive Receptors** (**EN010166/APP/6.3**). The study area extents seek to identify all likely significant effects as a result of the Proposed Development. It is considered that if noise and vibration levels are suitably controlled at the nearest and most exposed receptors identified, then noise and vibration levels would be suitably controlled at other sensitive receptors in the surrounding area.

Sources of Information/ Data

1.1.3 The following sources of information have been reviewed and have informed the assessment:

- baseline sound monitoring survey data (see **Appendix 9-B: Baseline Sound Level Survey** (**EN010166/APP/6.4**));
- the proposed plant as listed in **Appendix 9-C: Construction Noise Effects and Assumptions** (**EN010166/APP/6.4**);
- construction plant and equipment from similar construction projects;
- connection corridor construction plant noise data and indicative activities;
- construction noise data referenced from BS 5228-1 (Ref 1);
- indicative concept layout plans for the Main Development Area as shown in **Indicative Design - Site Layout** (**EN010166/APP/7.9**);
- items of plant including sound power level data for the Main Development Area. Where data are not currently available, noise source data from similar projects have been used;
- Annual Average Weekday Traffic (AAWT) flow data;
- Ordnance Survey (OS) mapping of the Proposed Development and surrounding area; and
- topographical data (LIDAR data) and aerial photography.

Determining Baseline Conditions and Noise Sensitive Receptors

Noise Monitoring Locations and Protocol

1.1.4 The location of potential NSRs in proximity to the Proposed Development has been considered when assessing the effects associated with noise and vibration levels from the construction, operational (including maintenance) and decommissioning phases of the Proposed Development. The NSRs have been identified using aerial photography and confirmed during the site visit.

1.1.5 NSRs include but are not limited to residential properties, education facilities, places of worship, health buildings / care homes, and libraries. The sensitivity of receptors is discussed later in **Table 11**. Potential noise impacts upon ecological receptors are assessed in **Chapter 11: Terrestrial and Aquatic Ecology** (**EN010166/APP/6.2.11**) and **Chapter 12: Marine Ecology** (**EN010166/APP/6.2.12**) and potential noise impacts on heritage receptors are assessed in **Chapter 17: Terrestrial Heritage** (**EN010166/APP/6.2.17**) using the levels/contours provided as a result of this assessment.

1.1.6 Adopting a 'worst-case scenario' approach, key NSR locations considered to be representative of the nearest and likely most sensitive existing receptors to the Proposed Development have been identified and selected. All residential receptors are of high sensitivity. The educational receptors of Connah's Quay High School and Coleg Cambria are also classed as high

sensitivity. These receptors are shown on **Figure 9-1: Noise Sensitive Receptors** (**EN010166/APP/6.3**) and distances to the Order limits are shown in **Table 1.**

Table 1: Key Representative Noise Sensitive Receptors

Receptor ID	Name	Receptor Type	Construction Assessment	Operational Assessment	Distance to Order limits (m)	Distance To Main Development Area (m)	Distance to Construction & Indicative Enhancement Area** (m)	Distance To Proposed CO_2 Connection Compound (m)	Distance To Proposed CO_2 Connection Corridor (m)	Distance To Water Connection Corridor (m)	Distance To Electrical Connection Corridor (m)
R1	Waen Isa Farm	Residential	✓		277	1787	1850	307	277	N/A	N/A
R2	Coed-Onn Farm	Residential	✓		91	1361	1429	356	91	N/A	N/A
R3	Little Leadbrook Farm	Residential	✓		109	1165	1217	338	191	N/A	N/A
R4	Leadbrook Hall Barn / Islyn, Leadbrook	Residential	✓	✓	61	745	791	768	595	N/A	N/A
R5	Leadbrook Drive Properties (south)	Residential	✓	✓	93	672	742	872	649	N/A	N/A
R6	Leadbrook Drive Properties (north)	Residential	✓	✓	146	663	741	1019	782	N/A	N/A
R7	Ffordd Pedrog Properties	Residential	✓	✓	191	856	937	889	636	N/A	N/A
R8	Llys Cadfan Properties	Residential	✓	✓	55	823	890	1048	787	N/A	N/A
R9	Ffordd Tudno / Llys Collen Properties	Residential	✓	✓	65	946	1011	1048	770	N/A	N/A
R10	377-387 Chester Road	Residential	✓	✓	16	771	827	1174	915	N/A	N/A
R11	Hyfield, Chester Road	Residential	✓	✓	13	666	728	1148	905	N/A	N/A
R12	397-417 Chester Road	Residential	✓	✓	12	687	744	1185	938	N/A	N/A
R13	Ladies Masonic Lodge, Chester Road	Recreational	✓	✓	11	721	778	1178	926	N/A	N/A
R14	337-369 Chester Road	Residential	✓	✓	23	884	939	1163	890	N/A	N/A

Receptor ID	Name	Receptor Type	Construction Assessment	Operational Assessment	Distance to Order limits (m)	Distance To Main Development Area (m)	Distance to Construction & Indicative Enhancement Area** (m)	Distance To Proposed CO_2 Connection Compound (m)	Distance To Proposed CO_2 Connection Corridor (m)	Distance To Water Connection Corridor (m)	Distance To Electrical Connection Corridor (m)
R15	Burneshead / Mossgiel / 421 Chester Road	Residential	✓	✓	42	152	230	N/A	1183	N/A	N/A
R16	Paper Mill Lane / Old Paper Mill Lane Properties	Residential	✓	✓	254	366	409	1147	958	N/A	N/A
R17	Paper Mill Lane Properties (south)	Residential	✓	✓	535	632	638	1210	1095	N/A	N/A
R18	Oakenholt Farm	Residential	✓	✓	365	415	421	N/A	N/A	N/A	N/A
R19	Glantraeth Farm	Residential	✓	✓	53	53	59	N/A	N/A	1093	1174
R20	Rockliffe Lane Properties	Residential	✓	✓	65	178	302	N/A	N/A	905	931
R21	Kelsterton Road Properties (west)	Residential	✓	✓	36	53	188	N/A	N/A	836	902
R22	Wenlo / The Sheiling, Kelsterton Road	Residential	✓	✓	76	76	167	N/A	N/A	736	782
R23	Cae Coch Cottages, Kelsterton Road	Residential	✓	✓	33	33	126	N/A	N/A	587	614
R24	Kelsterton Farm	Residential	✓	✓	197	197	355	N/A	N/A	598	453
R25	The Coach House / Kelsterton Hall	Residential	✓	✓	109	109	503	N/A	N/A	459	254
R26	Perenna Court Properties	Residential	✓	✓	204	204	535	N/A	N/A	556	351
R27	Coleg Cambria	Educational	✓	✓	249	410	501	N/A	N/A	651	410

Receptor ID	Name	Receptor Type	Construction Assessment	Operational Assessment	Distance to Order limits (m)	Distance To Main Development Area (m)	Distance to Construction & Indicative Enhancement Area** (m)	Distance To Proposed CO_2 Connection Compound (m)	Distance To Proposed CO_2 Connection Corridor (m)	Distance To Water Connection Corridor (m)	Distance To Electrical Connection Corridor (m)
R28	Kelsterton Lodge / 85-105 Kelsterton Road	Residential	✓	✓	169	193	612	N/A	N/A	483	274
R29	66-102 Kelsterton Road	Residential	✓	✓	135	231	519	N/A	N/A	435	209
R30	36-64 Kelsterton Road	Residential	✓	✓	91	398	349	N/A	N/A	513	248
R31	2-34 Kelsterton Road	Residential	✓	✓	106	614	143	N/A	N/A	669	369
R32	Connah's Quay High School	Educational	✓	✓	328	689	460	N/A	N/A	889	628
R33	Bank Road, Connah's Quay	Residential	✓		44	1182	44	N/A	N/A	1101	806

*N/A outside the study area limits

1.1.7 In order to define baseline sound conditions at selected NSRs, ambient sound measurements have been undertaken at representative residential and non-residential locations consisting of long-term and short-term measurements as well as long-term measurements at locations representative of ecological receptors. The monitoring locations in **Table 2** are shown on **Figure 9-1: Noise Sensitive Receptors** (**EN010166/APP/6.3**).

1.1.8 A description of ecological receptors in the vicinity of the Construction and Operation Area is available in **Chapter 11: Terrestrial and Aquatic Ecology** (**EN010166/APP/6.2.11**) and **Chapter 12: Marine Ecology** (**EN010166/APP/6.2.12**). Baseline data have been collected at locations Ecology 1 to Ecology 4 based on the sensitive ecological receptors as defined in the chapters above and have been used in the assessments in those chapters to define effects on ecological receptors.

Table 2: Monitoring Locations

Monitoring Location[1]	Address	Details	Date/Time of Measurements
Ecology 1	Adjacent to the River Dee and Connah's Quay Power Station	Unattended sound measurement	11/04/2024 11:22 to 23/04/2024 10:58
Ecology 2	Adjacent to the River Dee and Connah's Quay Power Station	Unattended sound measurement / weather station location	11/04/2024 11:00 to 22/04/2024 06:31
Ecology 3	Adjacent to the River Dee and Connah's Quay Power Station	Unattended sound measurement	11/04/2024 10:15 to 23/04/2024 11:30
Ecology 4	Adjacent to the River Dee and Connah's Quay Power Station	Unattended sound measurement	11/04/2024 09:45 to 23/04/2024 12:00
LT1	Adjacent to the edge of Coleg Cambria campus	Unattended sound measurement / weather station location	30/04/2024 14:35 to 08/05/2024 11:06
LT2	Local residents garden along Rockcliffe Lane near R21	Unattended sound measurement / weather station location	23/04/2024 16:00 to 30/04/2024 11:15

[1] ST3 is in place of LT7 and Ecology 1to 4 replaces LT10- as detailed in Appendix 9-B

Monitoring Location[1]	Address	Details	Date/Time of Measurements
LT3	Next to the reservoir near Paper Mill Lane at the rear of the residences	Unattended sound measurement	30/04/2024 15:25 to 08/05/2024 14:30
LT4	In the field along Leadbrook Drive by R6	Unattended sound measurement	30/04/2024 19:50 to 08/06/2024 11:56
LT5	In residents garden at 109 York Road	Unattended sound measurement	23/04/2024 16:45 to 30/04/2024 11:47
LT6	Opposite side of railway tracks to Dee View Road	Unattended sound measurement	11/04/2024 12:30 to 23/04/2024 16:05
LT8	South of the National Grid Electricity Transmission 400 kV substation adjacent to the trainline at the opposite side of the tracks to R30 and R31	Unattended sound measurement	11/04/2024 13:00 to 17/04/2024 14:30
LT9	Alongside the A548, opposite Leadbrook Drive	Unattended sound measurement	23/04/2024 14:33 to 30/04/2024 10:48
LT11	Adjacent to Leadbrook Drive and R4	Unattended sound measurement	23/04/2024 17:50 to 30/04/2024 10:04
ST1	On the Llwyn Onn road that leads to R1	Attended daytime sound measurement	24/04/2024 10:45 to 24/04/2024 11:45
ST2	North of holiday home 'Ewe Two' adjacent to Little Leadbrook Farm	Attended daytime sound measurement	11/04/2024 15:17 to 11/04/2024 16:17
ST3	Golftyn Lane	Attended daytime and nighttime sound measurement	24/04/2024 12:00 to 24/04/2024 13:00 23/04/2024 23:43 to 24/04/2024 00:28

1.1.9 All measurements were made between approximately 1.2 and 1.5 m above ground level, and in accordance with the requirements of British Standard BS 7445 (Ref 3). All sound level meters were positioned at least 3.5 m from any reflecting surface, other than the ground (i.e. free-field). Details of ongoing activities and typical noise sources in the area were recorded during visits to the monitoring locations to set up and collect the measurement equipment.

1.1.10 Details of the instrumentation used at each location during the surveys are included in **Appendix 9-B: Baseline Sound Level Survey** (**EN010166/APP/6.4**).

1.1.11 All sound level meters (SLMs) used were Class 1 precision instruments. Each has been programmed to log a range of sound indicators including $L_{Aeq,T}$, $L_{A90,T}$, $L_{A10,T}$ and L_{AFmax}, in 15-minute contiguous intervals.

1.1.12 The calibration levels were checked prior to and following all measurements. No significant drift, more than 0.2 dB occurred.

Meteorological Conditions

1.1.13 A weather station was set up to monitor meteorological conditions during measurements. Measurement periods during which the weather was recorded as not suitable for environmental sound measurements (i.e. when wind speeds >5 m/s and during precipitation or wet conditions) have been removed during analysis of the measured data based on the guidance in BS 7445 (Ref 3). The results of the sound monitoring are presented in Section 9.4 of **Chapter 9: Noise and Vibration** (**EN010166/APP/6.2.9**).

Impact Assessment Methodology

Assessment of Construction Noise Effects

1.1.14 As a construction Contractor is yet to be appointed, site-specific details regarding the construction activities, programme and numbers and types of construction plant are not yet confirmed. Nevertheless, indicative construction noise predictions have been undertaken using the calculation methods set out in BS 5228-1:2009+A1:2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' (Ref 1). Predictions have taken account of the expected construction programme and methods of working, based on current understanding at this stage in the design of the Proposed Development, and knowledge from other similar projects.

1.1.15 The calculation method provided in BS 5228 (Ref 1) takes account of factors including the number and types of equipment operating, their associated sound power levels (*L*w), their modes of operation (% on-times within the working period), the distance to NSRs, and the effects of intervening ground cover or barrier/ topographical screening. Construction activities away from the Main Development Area and C&IEA (including the construction of the Connection Corridors) have been assessed separately from the construction assessment for the Main Development Area and C&IEA because the types of plant and activities (as listed in **Appendix 9-C: Construction Noise Information** (**EN010166/APP/6.4**)) are likely to be different and construction would extend over a greater area. Construction noise effects from activities away from the Main Development Area and C&IEA have been assessed

based on the same significance criteria described in this section as for construction noise from activities within the Main Development Area and C&IEA.

ABC Method

1.1.16 The ABC method (detailed in BS 5228-1 Section E.3.2 (Ref 1)) sets construction noise thresholds for NSRs for different time periods (e.g. day, evening, night and weekends) based on the corresponding existing ambient noise levels. For each appropriate period, the existing ambient noise level is determined and rounded to the nearest 5 dB and the appropriate threshold value is then derived. The predicted construction noise level is then compared with this construction noise threshold value. The construction noise thresholds are derived from **Table 3.**

Table 3: Construction Noise Thresholds at Residential Receptors

Assessment category and threshold value period	Threshold Value $L_{Aeq,T}$ dB – Free-field		
	Category A (a)	Category B (b)	Category C (c)
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (d)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the **table** (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3: Applies to residential receptors only.

(a) Category A: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

(b) Category B: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

(c) Category C: Threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

(d) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays, 07:00 – 23:00 Sundays.

1.1.17 Based upon the BS 5228 ABC method (Ref 1), the criterion adopted in this assessment for the determination of potentially significant effects is the exceedance of the $L_{Aeq,T}$ threshold level for the category appropriate to the ambient noise level at each NSR. Other project-specific factors, such as the number of NSRs affected and the duration and character of the impact are also considered when determining if there is a potentially significant effect.

1.1.18 Based on the above, the magnitude of construction noise on NSRs is classified in accordance with the criteria in **Table 4**. These are based on professional judgement and precedent from other EIAs.

Table 4: Magnitude of Construction Noise Impacts for Residential Noise Sensitive Receptors

Magnitude of Impact	L_{Aeq}, T dB (façade)
High	Exceedance of ABC Threshold Value by ≥+5 dB
Medium	Exceedance of ABC Threshold Value by up to +5 dB
Low	Equal to or below the ABC Threshold Value by up to -5 dB
Very low	Below the ABC Threshold Value by ≥-5 dB

Assessment of Daytime Construction and Operational Traffic on the Public Highway

1.1.19 The Proposed Development would affect traffic flows on existing roads in the area within and surrounding the Order limits during construction – refer to **Chapter 10: Traffic and Transportation** (**EN010166/APP/6.2.10**). This assessment focuses on the impacts at existing NSRs located alongside the existing local road network.

1.1.20 Construction traffic noise has been assessed by considering the increase in traffic flows during the construction works, following the guidance of CRTN (Ref 4) and DMRB LA 111 – Noise and Vibration (Ref 5).

1.1.21 18-hour (06:00 – 24:00) Annual Average Weekday Traffic (AAWT) data have been obtained for the year 2034 'with' and 'without' construction traffic during the peak construction period. Basic Noise Level (BNL) calculations have been undertaken to predict the change in noise level between the 'with' and 'without' scenarios.

1.1.22 Where potential adverse impacts have been predicted, further, more detailed assessment has been undertaken for NSRs on Kelsterton Road, using CadnaA noise modelling software to model the without and with construction traffic scenarios. The predicted road traffic noise levels at the receptors include contributions from the roads included in the noise model.

1.1.23 The criteria for the assessment of traffic noise changes arising from construction works have been taken from **Table 3.17** of DMRB LA 111 – Noise and Vibration and are provided in **Table 5**. The magnitude descriptors in parentheses are provided to align with the descriptors used in this assessment.

Table 5: Construction Traffic Noise Criteria

Magnitude Of Impact	Change In Traffic Noise Level $L_{A10,18hr}$ dB
Major (High)	≥ 5
Moderate (Medium)	≥3 to <5
Minor (Low)	≥1 to <3
Negligible (Very low)	<1

1.1.24 An increase in road traffic flows of 25% (where the traffic speed and composition remain consistent) equates to an approximate increase in road traffic noise of 1 dB L_A. A doubling of traffic flow would be required for an approximate increase in 3 dB L_A.

1.1.25 It is generally accepted that changes in noise levels of 1 dB L_A or less are imperceptible, and changes of 1 to 3 dB L_A are not widely perceptible. Consequently, at the selected road traffic noise receptors the magnitude of the predicted change in noise levels uses the scale shown in **Table 5** with respect to construction traffic. The criteria are based on the current guidance on short-term changes in traffic noise levels in DMRB LA 111 – Noise and Vibration.

Assessment of Construction Vibration Effects

Impacts on Humans

1.1.26 Vibration due to construction activities has the potential to result in adverse effects at nearby NSRs. The transmission of ground-borne vibration is highly dependent on the nature of the intervening ground between the source and receptor and the activities being undertaken. BS 5228-2:2009+A1:2014 'Code of Practice for Noise and Vibration Control on Construction and Open Sites - Vibration' (Ref 2) provides data on measured levels of vibration for various construction works, with particular emphasis on piling. Impacts are considered for both damage to buildings and annoyance to occupiers.

1.1.27 **Table 6** details Peak Particle Velocity (PPV) vibration levels and provides a semantic scale for the description of demolition and construction vibration effects on human receptors, based on guidance contained in BS 5228-2 (Ref 2).

Table 6: Construction Vibration Threshold at Residential Dwellings

Peak Particle Velocity (PPV) Level (mm/s)	Description	Magnitude Of Impact
>= 10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	High
1.0 to < 10	It is likely that vibration of this level in residential environments would cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Medium
0.3 to < 1.0	Vibration might be just perceptible in residential environments.	Low
0.14 to < 0.3	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.	Very low

1.1.28 For residential receptors and other sensitive receptors, a PPV of 0.3 mm/s is the point at which construction vibration is likely to become perceptible. A PPV of 1.0 mm/s, is the level at which construction vibration can be tolerated with prior warning.

1.1.29 At receptors where there is an initial medium or high impact based on the predicted vibration level, further consideration of whether an effect is Significant is undertaken using professional judgement, taking account of the duration and frequency of the effect, as well as the time of day/evening/night that the effect would be experienced.

Impacts on Buildings

1.1.30 In addition to human annoyance, building structures may be damaged by high levels of vibration. The levels of vibration that may cause building damage are far more than those that may cause annoyance. Consequently, if vibration levels are controlled to those relating to annoyance (i.e. 1.0 mm/s), then it is highly unlikely that buildings would be damaged by construction vibration levels.

1.1.31 The criteria used in this assessment relate to the potential for cosmetic damage, not structural damage. The principal concern is generally transient vibration, for example due to piling.

1.1.32 BS 7385-2: 1993 'Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Groundborne Vibration' (Ref 12) provides guidance on vibration levels likely to result in cosmetic damage and is referenced in BS 5228-2: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Vibration' (Ref 2). Guide values for transient vibration, above which cosmetic damage could occur, are given in **Table 7.**

Table 7: Transient Vibration Guide Values for Cosmetic Damage

Type Of Building	Peak Component Particle Velocity (PPV) 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 mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s 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.

1.1.33 BS 7385-2:1993 (Ref 12) states that the probability of building damage tends to be zero for transient vibration levels less than 12.5 mm/s PPV. For continuous vibration, such as from vibratory rollers, the threshold is around half this value.

1.1.34 It is also noted that these values refer to the likelihood of cosmetic damage. ISO 4866:2010 'Mechanical vibration and shock - Vibration of fixed structures' (Ref 6) defines three different categories of building damage:

- cosmetic – formation of hairline cracks in plaster or drywall surfaces and in mortar joints of brick/concrete block constructions;
- minor – formation of large cracks or loosening and falling of plaster or drywall surfaces or cracks through brick/block; and
- major – damage to structural elements, cracks in support columns, loosening of joints, splaying of masonry cracks.

1.1.35 BS 7385-2:1993 (Ref 12) defines that minor damage occurs at a vibration level twice that of cosmetic damage and major damage occurs at a vibration twice that of minor damage. Therefore, this guidance can be used to define the magnitude of impact identified in **Table 8** for both transient and continuous vibration.

Table 8: Magnitude of Impact – Construction Vibration Building Damage

Magnitude Of Impact	Damage Risk	Continuous Vibration Level PPV (mm/s)		Transient Vibration Level PPV (mm/s)	
		Unreinforced Or Light Framed Structures	Reinforced Or Framed Structures	Unreinforced Or Light Framed Structures	Reinforced Or Framed Structures
High	Major	≥30	≥100	≥60	≥200
Medium	Minor	15 to <30	50 to <100	30 to <60	100 to <200
Low	Cosmetic	6 to <15	25 to <50	12 to <30	50 to <100
Very low	Negligible	<6	<25	<12	<50

1.1.36 The proposed construction plant list as stated in **Appendix 9-C: Construction Noise Effects and Assumptions** (**EN010166/APP/6.4**) has been reviewed to identify which plant and/or activities have the potential to cause adverse vibration impacts at sensitive receptors. Indicative vibration levels have been predicted using the guidance in BS 5228-2: 2009+A1:2014.

Assessment of Sound from Site Operations

1.1.37 A noise propagation model has been developed using the noise modelling software CadnaA to assess the 'indicative' operational layout for the Proposed Development. CadnaA implements the sound prediction method ISO 9613-2: 2024 'Attenuation of Sound during Propagation Outdoors' (Ref 7), which has been employed to calculate sound levels at surrounding NSRs due to sound breakout from the proposed buildings and plant at the Proposed Development.

1.1.38 The relevant UK standard for the prediction of sound pressure levels outdoors has been updated. BS ISO 9613-2:2024 (Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors (Ref 7)) was published in January 2024. The previous version of the standard (ISO 9613-2:1996 (Ref 8) was withdrawn at the same time. Unlike the previous version, the current version is adopted as a British Standard. The current version of the standard is therefore the appropriate UK methodology for the prediction of sound pressure levels outdoors (except where more appropriate specific methods. Although there was some time between the publication of the new version, and its implementation in commercial environmental noise modelling software, it is now implemented in the most commonly used packages. At the time of the PEIR the noise modelling software implemented the 1996 version. For the operational noise model considered in the ES, the 2024 version of ISO 9613-2 has been implemented.

1.1.39 The new version of the standard contains changes which predominantly relate to decreasing uncertainty with software implementation, in particular where low barriers and/or large source-to-receiver distances are present. Under these circumstances, the new version of the standard can result in higher predicted sound levels compared with the previous version for certain

sound source types). The assessment presented herein therefore uses the current version of the standard.

1.1.40 The noise model consists of a three-dimensional representation of the indicative layout of the Proposed Development and its surroundings. Indicative sound level data for the key sound emitting plant/buildings within the Proposed Development have been used. Details of the proposed plant and assumptions can be found in **Appendix 9-D: Operational Sound Information** (**EN010166/APP/6.4**).

1.1.41 Significant topographical details and buildings that may influence the transmission of operational sound to NSRs are included in the noise model. A digital terrain model created using ground elevation spot height data has been used to position buildings and other sound sources at the correct height. The model assumes that the prevailing wind direction is always from source to receiver, which is likely to overestimate sound levels associated with the Proposed Development.

BS 4142 Assessment

1.1.42 Based upon the predicted sound levels from the noise model, an assessment of potential impacts at nearby NSRs has been undertaken using the guidance in BS 4142: 2014 'Methods for Rating and Assessing Industrial and Commercial Sound' (Ref 9).

1.1.43 A key aspect of the BS 4142 (Ref 9) assessment procedure is a comparison between the *background sound level* in the vicinity of residential locations and the *rating level* of the sound source under consideration. The relevant parameters in this instance are as follows:

- *background sound level* – $L_{A90,T}$ – defined in the Standard as the "A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels";
- *specific sound level* – L_s ($L_{Aeq,Tr}$) – defined as the "equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr"; and
- *rating level* – $L_{Ar,Tr}$ – defined as the "specific sound level plus any adjustment made for the characteristic features of the sound."

1.1.44 BS 4142 (Ref 9) allows for corrections to be applied based upon the presence or expected presence of the following:

- tonality: up to 6 dB penalty;
- impulsivity: up to 9 dB penalty (this can be summed with tonality penalty); and
- other sound characteristics (neither tonal nor impulsive but still distinctive): 3 dB penalty.

1.1.45 Once any adjustments have been made, the *rating level* and the *background sound level* are compared. The standard states that:

- "*typically, the greater the difference, the greater the magnitude of impact.*

- *a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending upon the context.*
- *a difference of around +5 dB is likely to be an indication of an adverse impact, depending upon the context.*
- *the lower the rating level is to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon the context."*

1.1.46 Importantly, as suggested above, BS 4142:2014 (Ref 9) requires that the *rating level* of the sound source under assessment be considered in the context of the environment when defining the overall significance of the impact. As stated in BS 4142 ((Ref 9) the following can be taken into consideration for the context:

- the absolute level of sound;
- the character and level of the residual sound compared to the character and level of the specific;
- the sensitivity of the receptor and whether dwellings or other premises used for residential purposes would already incorporate design measures that secure good internal and/or outdoor acoustic conditions; and
- the existing sound environment and character and historical sound levels.

1.1.47 BS 4142:2014 (Ref 9) suggests that a one-hour assessment period is considered during the day and a 15-minute assessment period at night.

1.1.48 **Table 9** illustrates the adopted magnitude of impact scale used in this assessment based upon the numerical level difference. Although the consideration of context (including the absolute level of the sound under consideration) can vary the overall classification of effects.

Table 9: Magnitude of Impact for Industrial Sound

Magnitude Of Impact	*Rating Level – Background Sound Level* (dB)
High	>=14
Medium/ High	12 to 13
Medium	9 to 11
Low/Medium	7 to 8
Low	4 to 6
Very low/Low	2 to 3
Very Low	<= 1

ISEP Guidelines for Environmental Noise Impact Assessment

1.1.49 The Institute of Sustainability and Environmental Professionals (ISEP) (formerly the Institute of Environmental Management Assessment (IEMA[2])) 'Guidelines for Environmental Noise Impact Assessment' (Ref 10) have been used to undertake a assessment of the impact of changes in ambient sound level at NSRs due to Proposed Development operation. On the impact of noise level changes, paragraph 2.7 of the guidelines state *"For broad band sounds which are very similar in all but magnitude, a change or difference in noise level of 1 dB is just perceptible under laboratory conditions, 3 dB is perceptible under most normal conditions, and a 10 dB increase generally appears to be twice as loud. These broad principles may not apply where the change in noise level is due to the introduction of a noise with different frequency and/or temporal characteristics compared to sounds making up the existing noise climate. In which case, changes of less than 1 dB may be perceptible under some circumstances."* The ISEP Guidelines provide criteria for magnitude of impacts due to noise level changes from a project, as shown in **Table 10**, and these have been used within this preliminary assessment in respect of predicted changes in ambient sound levels. This guidance has been used to help with the context as required by BS 4142 assessment.

Table 10: Categorising the Magnitude of the Noise Change

Magnitude Of Impact	Noise Change, (dB)
No Change (Very Low)	0
Low	0.1 to 2.9
Medium	3 to 4.9
High	>5

Assessment of Operational Vibration

1.1.50 The type of equipment proposed is unlikely to pass significant levels of vibration into the ground. Taking this into account, together with the distances between the proposed indicative location of the equipment and residential NSRs, it is not anticipated that vibration levels would be significant and would not exceed the thresholds described in **Table 6.** Therefore, further assessment of operational vibration is scoped out of this assessment.

1.1.51 No significant sources of vibration are associated with the operation of the Connection Corridors therefore further assessment of operational vibration for these sources has been scoped out.

Non-residential Receptors

1.1.52 The approach to the setting of noise thresholds for non-residential receptors differs from that adopted for residential receptors.

1.1.53 Design guides for good internal conditions in non-residential receptors are set based on indoor levels. The only non-residential receptors in this assessment are educational facilities (R27 and R32 identified in **Table 1**).

[2] The Institute of Environmental Management Assessment (IEMA) has changed its name to the Institute of Sustainability and Environmental Professionals (ISEP)

Design criterion from Building Bulletin 93 (Ref 11) specifies an internal noise level 35 dB $L_{Aeq,T}$ in classrooms. Assuming that education facilities may have doors or windows open at some points during the year, the maximum external noise level (assuming 15 dB attenuation for a façade containing a partially open door or window as assumed by the WHO) before the design criterion would be exceeded would be 50 dB $L_{Aeq,30mins}$.

Value/ Sensitivity of Receptors

Receptor Sensitivity

1.1.54 Effects are classified based on the magnitude of the impact (as outlined above) for the various potential impacts during construction and operation, and the sensitivity or value of the affected receptor. A scale of receptor sensitivity is presented in **Table 11**.

Table 11: Sensitivity/Value of Receptors

Sensitivity/Value of Resource/ Receptor	Description	Examples Of Receptor Usage
Very high	Receptors where noise or vibration would significantly affect the function of a receptor.	• auditoria/studios; • specialist medical/teaching centres, or laboratories with highly sensitive equipment.
High	Receptors where people or operations are particularly susceptible to noise or vibration.	• residential; • quiet outdoor areas used for recreation; • conference facilities; • schools/educational facilities in the daytime; • hospitals/residential care homes; • places of Worship • libraries;
Medium	Receptors moderately sensitive to noise or vibration where it may cause some distraction or disturbance	• offices; • restaurants/retail; • sports grounds when spectator or noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf).
Low	Receptors where distraction or disturbance of people from noise or vibration is minimal	• residences and other buildings not occupied during working hours; • factories and working environments with existing high noise levels;

Sensitivity/Value of Resource/ Receptor	Description	Examples Of Receptor Usage
		• sports grounds when spectator or noise is a normal part of the event.

Significance of Effects

1.1.55 The following terminology has been used in the preliminary assessment to define noise and vibration effects:

- **adverse** – detrimental or negative effects to an environmental resource or receptor;
- **neutral** – effects to an environmental resource or receptor that are neither adverse nor beneficial; or
- **beneficial** – advantageous or positive effect to an environmental resource or receptor.

1.1.56 The effect resulting from each individual potential impact type above has been classified according to the magnitude of the impact and the sensitivity or value of the affected receptor using the matrix presented in **Table 12**, but where necessary also considering the context of the acoustic environment.

Table 12: Classification of Effects

Sensitivity/Value of Resource/ Receptor	Magnitude Of Impact			
	High	Medium	Low	Very Low
Very high	**Major**	**Major**	**Moderate**	Minor
High	**Major**	**Moderate**	Minor	Negligible
Medium	**Moderate**	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

1.1.57 Where adverse or beneficial effects have been identified, these have been assessed against the following significance scale, derived using the matrix presented in **Table 12**:

- **negligible** – imperceptible effect of no significant consequence;
- **minor** – slight, very short or highly localised effect of no significant consequence;
- **moderate** – limited effect (by extent, duration or magnitude), which may be considered significant; or
- **major** – considerable effect (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability, legislation, policy or standards.

1.1.58 For the purposes of this assessment, Negligible and Minor effects are considered to be Not Significant, whereas Moderate and Major effects are considered to be Significant as indicated in light grey in **Table 12**.

Cumulative Noise and Vibration Effects

1.1.59 An assessment of cumulative effects with other proposed developments that could interact with the effects of this Proposed Development has been carried out based on the short-list of other developments, as detailed in **Chapter 24: Cumulative and Combined Effects** (**EN010166/APP/6.2.24**). **Chapter 24: Cumulative and Combined Effects** (**EN010166/APP/6.2.24**) also assess the in-combination effects of multiple aspects on one receptor.

1.1.60 The assessment of cumulative effects follows the methodology described in Nationally Significant Infrastructure Projects '*Advice Note Seventeen: cumulative effects assessment relevant to nationally significant infrastructure projects*'.

1.1.61 It is important to note that cumulative effects may vary from the effects of the Proposed Development considered in isolation. For example, it is possible for the Proposed Development to have greater effects cumulatively with other planned developments than if it is considered in isolation against the existing baseline.

References

Ref 1. British Standards Institute (BSI) (2014). BS 5228-1:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 1: Noise

Ref 2. British Standards Institute (BSI) (2014). BS 5228-2:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites. Part 2: Vibration

Ref 3. British Standards Institute (BSI). (2003). BS 7445-1 – Description and measurement of environmental noise. Guide to quantities and procedures

Ref 4. Department of Transport (DfT)/ Welsh Office. (1998). Calculation of Road Traffic Noise

Ref 5. Highways England. (2020). Design Manual for Roads and Bridges LA111 Noise and vibration – Version 2

Ref 6. International Organization of Standardization (2010) ISO 4866:2010 'Mechanical vibration and shock - Vibration of fixed structures'

Ref 7. International Organization of Standardization (Part 2: 2024) ISO 9613 – Acoustics – Attenuation of sound during propagation outdoors

Ref 8. International Organization of Standardization (Part 2: 1996) ISO 9613 – Acoustics – Attenuation of sound during propagation outdoors

Ref 9. British Standards Institute (BSI). (2019). BS 4142:2014+A1:2019: 'Methods for rating and assessing industrial and commercial sound'

Ref 10. Institute of Environmental Management and Assessment (IEMA). (2014). Guidelines for Environmental Noise Impact Assessment

Ref 11. Department for Education (1995) Building Bulletin 93 Acoustic Design of Schools: performance standards https://www.gov.uk/government/publications/bb93-acoustic-design-of-schools-performance-standards (Accessed 03 July 2025)

Ref 12. British Standards Institute (1993) BS 7385-2: 1993 'Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration'