



Low Level Waste Repository: Site Optimisation and Closure Works **Environmental Statement**

Appendix D: Noise Assessment
June 2011






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Revision Schedule

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1 Introduction

1.1.1 This Appendix provides an assessment of the noise impacts associated with the proposed optimisation and closure works at the LLWR site (the Scheme) as detailed in Volume I of the ES. The associated Figure is included in the rear of this volume of the ES.

1.1.1 In particular the following aspects are assessed:

- noise impact of the construction of five vaults to dispose of LLW;
- noise impact of the capping and cut off wall construction; and
- noise impact of construction traffic on public roads.

Associated figures are included in Volume III of the ES.

1.1.2 Vibration impacts are not an issue usually associated with this type of development. Significant levels of vibration are not usually associated with mobile plant, fixed plant and haul routes. No blasting is to be employed on site. In addition, due to the relatively large distances between the plant and the nearest residential receptors, it is considered that vibration will be imperceptible at receptor locations. Therefore vibration impacts have been scoped out of this assessment.

1.1.3 Current activities at the LLW Repository comprise the movement of ISO containerised LLW by train, low loader and forklift, delivery of cement and materials for the grouting facility and general site maintenance. The operational activities generate little off site noise and as such this assessment will focus on the construction impacts.

1.1.4 A noise assessment has been undertaken with regard to available data from historical baseline monitoring at the nearest noise sensitive receptors. Predictions of the resulting noise levels for a range of construction phases has been undertaken in accordance with BS5228, Code of practice for noise and vibration control on construction and open sites [i].

1.1.5 This report includes the following elements:

- assessment methodology and criteria;
- overview of historical baseline noise monitoring at the nearest noise sensitive receptors;
- discussion of the predicted noise levels at the nearest receptors;
- comparison of predicted noise levels with guidance and criteria; and
- conclusions.

1.1.6 The various phases of construction and capping are detailed in Section 3.2. The programme indicates that works will be undertaken until 2080. Since the majority of activities occur at the closest approach to the nearest receptors in the earlier years (Phase 1), this is the focus of the assessment. Also assessed are Phase 2 and scenarios in Phases 3 and 7 where certain aspects of the works are at the closest approach to neighbouring receptors. This therefore represents the worst case noise levels that would arise during the proposed works.

1.1.7 A brief summary of noise theory and terms used within this report are provided in Annex A.

2 Site Description and Proposed Works

2.1 Overview

2.1.1 A full description of the site and proposed works is detailed in Section 3, in Volume I of the Environmental Statement (ES).

2.2 Working Hours

Construction Hours

2.2.1 Construction hours are 0730 to 1800 Monday to Friday and 0800 to 1300 on Saturdays with no workings on Sundays or Public / Bank Holidays.

Operational Hours

2.2.2 It is proposed that the currently permitted operational working hours for LLW disposal will continue for the operation of future vaults.

2.3 Closest Noise Sensitive Receptors

2.3.1 The area around the Site is rural in nature and hence the number of residential receptors in proximity is relatively low.

2.3.2 The nearest residential receptors and the corresponding distances from the consented area are:

- R1 – Properties on Summer View, 50 m;
- R2 – The Stubble, 60 m;
- R3 – Drigg Moorside Farm, 250 m; and
- R4 – Sandy Acre, 400 m.

2.3.3 An operational coal yard is located adjacent to the northern boundary of the site. This will be assessed as Receptor 5 (R5), however, the noise limit will be higher than for the residential locations as this receptor is not considered to be as noise sensitive.

2.3.4 The receptor locations are illustrated in Figure 9.1.

2.4 Site Operations

2.4.1 The main noise generating activities at the Site can be summarised as mobile plant associated with the following activities:

- Installing final cap perimeter drainage;
- Screening preparation works;
- Installing cut off wall;
- Installing secant pile wall;
- Placing profile fill over vaults and trenches;
- Placing cap over vaults and trenches;

- Excavating and constructing vaults; and
- Loading / unloading train.

2.4.2 In addition, during the construction period, the former PCM containing magazines will be demolished as part of a separate development.

2.5 HGV and Rail Movements

2.5.1 All construction and capping materials will be delivered to the Site by train. Plant, bentonite, cement, and small van deliveries will be delivered to the Site by road. There will be no additional proposed train movements as a result of the development.

2.5.2 It is estimated that there will be a total of up to ten deliveries per week required throughout the periods of Vault construction and five deliveries per week for capping (Appendix B).

2.5.3 Access to the Site by road is via the entrance off the B5344. The positioning of the proposed on Site haul routes are illustrated in Figure 3.7, Volume I of the ES.

3 Assessment Methodology and Criteria

3.1 Legislative Context

- 3.1.1 Construction noise impacts are not covered directly by legislation. However, the Control of Pollution Act (CoPA) 1974 [ii] and Part III of the Environmental Protection Act (EPA,1990) [iii] contain sections which can be applied to construction noise.
- 3.1.2 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.
- 3.1.3 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.

3.2 Minerals Policy Statement 2

- 3.2.1 Minerals Policy Statement 2 (MPS 2) [iv] gives guidance to planners on how to measure and assess noise from quarries and similar activities. MPS 2 supersedes Mineral Planning Guidance 11: The control of noise at surface mineral workings (MPG 11)[v]. Paragraph 9 of MPG 11 states that waste disposal operations may share many common features with surface mineral workings, and as such MPS 2 is relevant to vault construction and capping. MPG 11 was used as the basis of the previous assessment for Vault 9 construction. BS 4142 [vi] is also used for assessing industrial noise sources, however, this relates fixed sources. As such MPS 2 is considered more appropriate in this case where the locations of noise sources will vary.
- 3.2.2 MPS 2 [vii] Annex 2: Noise, states that planning conditions should be used to apply absolute controls on noise emissions with limits normally being set at particular noise sensitive properties. It is recommended to aim to establish noise limits at the noise sensitive properties that do not exceed the background level by more than 10 dB(A).
- 3.2.3 MPS 2 also recognises, however, that these prescribed levels will in many circumstances be difficult to achieve without imposing unreasonable burdens on the mineral operator. It goes on to state:
- 'In such cases, the limit set should be as near that level as practicable during normal working hours (0700-1900) and should not exceed 55dB(A) $L_{Aeq, 1hr}$ (free field). Evening (1900-2200) limits should not exceed background level by more than 10dB(A) and night time limits should not exceed 42 dB (A) $L_{Aeq, 1hr}$ free field at noise sensitive dwellings'*
- 3.2.4 However, it is accepted within MPS 2 that all operators will have some particularly noisy short-term activities that cannot meet the limits set for normal operations. An example includes the construction of new permanent landforms.
- 3.2.5 As a result, and where these activities can bring a longer-term environmental benefit, increased temporary daytime limits are suggested of up to 70 dB $L_{Aeq, 1h}$ (free field) for up to 8 weeks in a year.
- 3.2.6 Therefore, with reference to this assessment, a temporary daytime noise level of 70 dB $L_{Aeq, 1h}$ is considered acceptable for activities such as vegetation clearance and landscape filling and

capping. With regard to general construction activities an acceptable daytime noise limit of 55 dB $L_{Aeq,1h}$ is considered appropriate.

3.2.7 No evening or night-time operations are proposed.

3.2.8 MPS 2 states that the noise level must be determined at the receptor location using the noise-prediction technique in Part 1 of BS5228: 1997 (superseded in 2009) [i].

3.3 Baseline Noise Monitoring

3.3.1 Noise monitoring at the nearest neighbouring receptors has been carried out by others on a number of occasions including for the Environmental Statement for the PCM retrieval project [viii] and the higher stacking of ISO freight containers for Vault 8 [ix].

3.3.2 It is understood that the noise monitoring procedures adopted conformed to BS 7445:1991 'Description and Measurement of Environmental Noise' [x]. It has been assumed that all measurements were made 'free-field' (no vertical reflective surfaces within 3 metres of the microphone) and at a height of approximately 1.5m above the ground.

3.3.3 It has been assumed that the monitoring equipment was traceably calibrated and that measurements were carried out by a competent person.

3.4 Assessment of Noise from the Vault Construction and Capping Works

3.4.1 The construction and capping works are anticipated to proceed from 2013 and to be finalised in 2080.

3.4.2 The following phases are proposed:

- Phase 1 – site preparation (2013 to 2015), including northern and eastern cap shoulders and profile filling of northern part of trenches;
- Phase 2 – construct part of western cap shoulder, cap Vault 8 and northern part of trenches , construct Vaults 9A and 10 and profile fill central part of trenches (2018 to 2022);
- Phase 3 – construct part of western cap shoulder, cap Vault 9/9A and adjacent trenches , construct Vault 11 and profile fill south of trenches (2023 to 2026);
- Phase 4 – construct part of western cap shoulder, cap Vault 10 and adjacent trenches and construct Vault 12 (2027 to 2029);
- Phase 5 – construct part of western cap shoulder, cap Vault 11 and adjacent trenches , construct Vault 13 and complete profile filling of trenches (2031 to 2033);
- Phase 6 – cap Vault 12 and adjacent trenches (2035 to 2036);
- Phase 7 –construct southern shoulder to trenches, cap Vault 13 and remainder of trenches and construct Vault 14 (2050 to 2055); and
- Phase 8 – cap Vault 14 and construct southern shoulder to vaults. (2078 to 2079).

3.4.3 The assessment methodologies for construction noise have been applied to Phases of the development where works occur at the closest approach to the neighbouring receptors. These are considered to be during phases 1, 2, 3a and 7c.

- 3.4.4 A scheme of works, covering the final decommissioning, removal and demolition of the plutonium containing materials (PCM) retrieval facilities and magazines, is also due to be undertaken between 2019 and 2020. These works do not form part of the works which this Environmental Statement supports. However, these works are considered as part of the cumulative assessment for this Proposed Development.
- 3.4.5 Construction noise levels have been predicted using information on the activities and plant likely to be required to complete the works. Noise predictions have been undertaken using SoundPLAN (v7.0) noise modelling software, which implements the standard UK prediction methodology for demolition and construction sites outlined in BS 5228 'Code of practice for noise and vibration control on construction and open sites'. The noise model incorporates the topography of the ground and the existing buildings surrounding the works, further details are provided in Annex B.
- 3.4.6 Noise level predictions have been undertaken for construction HGVs on the Site haul road using the haul route methodology given in BS 5228.
- 3.4.7 The noise predictions have been undertaken for a number of defined noise sensitive receptors surrounding the site as detailed in Section 9.2 of this Appendix.
- 3.4.8 Sound power levels for the various items of plant on the site have been sourced from the previous Environmental Statement for Vault 9 disposal [xi]. Details of plant modelled in each phase and the corresponding sound power data are given in Annex B, Tables B1 and B2 respectively.

3.5 Construction Road Traffic Noise

- 3.5.1 The proposed development will result in additional traffic on the surrounding road network throughout the construction phases.
- 3.5.2 The Design Manual for Roads and Bridges [xii] (DMRB) states that a change in 18-hour traffic flows of less than +25/-20% results in a change in traffic noise levels of less than 1 dB $L_{A10,18h}$, and this is considered to be a negligible change.
- 3.5.3 The magnitude of the change in road traffic noise on the B5344 due to the proposed development has been calculated using the methodology given in Calculation of Road Traffic Noise (CRTN) [xiii].
- 3.5.4 It is generally accepted that changes in road traffic noise levels of 1 dB(A) or less are imperceptible, and changes of 1 to 3 dB(A) are not widely perceptible. An increase of 10 dB(A) is generally perceived as a doubling in loudness. Consequently, significance criteria have been based on the predicted changes in noise level and the sensitivity of the receptor, as shown in Table 3.1. The criteria have been developed by URS Scott Wilson based on a range of current guidance. Residential properties are considered to be of high sensitivity.

Table 3.1: **Significance Criteria for Road Traffic Noise**

Magnitude of Change in Noise Level (dB)	Sensitivity of Receptor		
	Low	Medium	High
Negligible (< 1)	Negligible	Negligible	Negligible
Slight (1 < 3)	Low	Low	Low
Moderate (3 < 5)	Low	Moderate	Moderate
Substantial (5 < 10)	Moderate	Moderate	Substantial
Severe (> 10)	Moderate	Substantial	Severe

4 Baseline Noise Data

4.1.1 To aid the noise assessment for the construction phases of the development, the results of previously available noise monitoring data have been considered. The noise monitoring locations relevant to this assessment are provided in Figure 9.1. A summary of the baseline noise data is given in Table 4.1.

Table 4.1: Measured Existing Noise Levels at the Nearest Receptors

Receptors	Period	Date/Time	L _{Aeq} (dB)	L _{A90} (dB)
R1 Summer View ¹	Day	26 to 27 July 2005, 07:00 to 09:00	50	34
R2 The Stubble ²	Day	4 February 2000, 0942-1549	51	47
R3 Drigg Moorside	Day	-	-	-
R4 Sandy Acre ²	Day	4 February 2000, 0942-1549	52	47
R5 Coal Yard	Day	-	-	-

¹BNG, 2005 [ix], ²BNFL, 2000 [viii]

Note: No data was available for R3 and R5, however, these receptors are assessed within this Appendix.

5 Assessment of Effects

5.1 Construction Noise – Site Plant

5.1.1 The following receptor locations have been used in the construction noise assessments.

- Receptor R1: Summer View;
- Receptor R2: The Stubble;
- Receptor R3: Sandy Acre;
- Receptor R4: Drigg Moorside; and
- Receptor R5: Coal Yard.

5.1.2 Details of plant used in each phase for the noise modelling and the plant details are given in Annex B, Tables B1 and B2 respectively.

5.1.3 Assessment predictions were based on 100% plant on-time, with all plant operating at the closest approach to the receptor. This can therefore be considered as a worst-case assessment.

5.1.4 Construction noise levels for each of the key construction phases are given in Table 5.1.

5.1.5 The construction works are assessed against the MPS 2 daytime noise limit of 55 dB $L_{Aeq,1hr}$ or 70 dB $L_{Aeq,1hr}$ if the works are of short-term duration (up to 8 weeks in a year).

5.1.6 Table 5.1 shows that for a number of Phases there are predicted noise levels above the 55 dB $L_{Aeq,1hr}$ limit and the 70 dB $L_{Aeq,1hr}$ for some Phase 1 works.

5.1.7 Examination of the contribution of the noise sources at the receptors for Phase 1 works shows that activities associated with vegetation clearance are dominant, resulting in the exceedance of the 70 dB $L_{Aeq,1hr}$ limit at some receptors; these include stripping vegetation on the north and east shoulders and preparing stockpile areas C and D. The 70 dB $L_{Aeq,1h}$ limit applies for vegetation clearance since they are temporary works of short duration.

5.1.8 The highest predicted noise level outside of Phase 1 is 58 dB(A) which occurs at R2 during capping in Phase 7c.

5.1.9 Since Receptor R5, the coal yard, is not a residential receptor, it is considered that the 70 dB $L_{Aeq,1hr}$ limit is applicable and predicted levels do not exceed 58 dB.

Table 5.1: Maximum Unmitigated Predicted Noise Levels during Key Project Phases at the Chosen Receptors (Ground Floor) Allowing for Distance Attenuation Only

Phase	Key Activities	Noise Level at Receptor $L_{Aeq,1hr}$ (dB) (Free-field)				
		R1	R2	R3	R4	R5
1	1a(1) Strip existing vegetation from north and east shoulders; and Prepare stockpile areas C and D.	76	74	62	61	58
	1a(2) Install cap perimeter drain; Import materials / plant for cut off wall; Divert Drigg stream along west; and Prepare stockpile areas C and D.	54	71	60	52	51
	1a(3) Install cut off wall to north and west Vault 8; Import cap materials; Divert Drigg stream along west; and Prepare stockpile areas C and D.	56	71	69	57	54
	1b(1) Place profiling fill; Divert Drigg stream along west; and Prepare stockpile areas C and D.	57	71	69	57	56
	1b(2) Place cap material; Vegetate north and east shoulders; and Divert Drigg stream along west.	59	51	45	46	45
2	2a(1) Install cut off wall V9; Install secant wall V8; and Import placement fill.	44	43	42	36	39
	2a(2) Excavate and construct V9; and Place profiling fill.	48	47	42	42	41
	2b(1) Excavate and construct V10; and Place profiling fill.	44	47	43	36	40
	2c Place cap materials V8 and adjacent trenches.	55	43	38	44	48
3	3a Excavate and construct V11; and Place profiling fill.	40	55	44	37	35
7	7c Place cap materials to south of trenches.	34	58	43	38	31

Construction noise levels which exceed the MPS 2 daytime noise limit of 55 dB $L_{Aeq,1hr}$ are highlighted in bold in Table 5.1.

5.2 Construction Noise – Vehicle Movements

- 5.2.1 Table B3 presents the number of vehicles anticipated per week during construction for each Phase of works. HGV movements on off-site roads are associated with importing plant and materials. Construction workers will use the access road, however, a park and ride minibus scheme will be encouraged.
- 5.2.2 The B5344 currently has an estimated 24-hour AADT of 1400 vehicles for the B5344, 3% of which are HGVs. As a worst case assessment, an additional 18 HGVs are associated with Phases 2 to 5. An additional 60 light vehicles per day are associated with construction workers.
- 5.2.3 The increase in noise level from this construction traffic is 0.7 dB(A). An increase in noise level to adjacent receptors of 1 dB(A) or below is assessed as being of negligible significance. Therefore, it is concluded that the significance of construction traffic on public roads is negligible.

5.3 Construction Noise – Rail Movements

- 5.3.1 Currently one delivery is made to the site each day to import materials and it is proposed that no additional train movements are required for the proposed development. Therefore, based on this assumption, there will be no increase in noise from rail movements and it is therefore concluded that the significance of rail movements is negligible.

6 Supplementary Assessments

6.1 Introduction

6.1.1 The noise implications of disposal of waste in Vaults 9A to 14 and high stacking (up to 9 containers high) in Vaults 8, 9 and all future vaults are discussed in the two following sub-sections.

6.2 Disposal of Waste in Vaults 9A to 14

6.2.1 The disposal of waste in Vaults 9A to 14 will involve the same types and numbers of plant and equipment as currently utilised for the existing operations at the site. Therefore, no significant increases in noise levels are anticipated and these operations can be regarded as of negligible significance.

6.3 High Stacking in Vaults 8, 9 and all Future Vaults

6.2.2 The disposal of waste in Vaults 9A to 14 with high stacking will involve the same types and numbers of plant equipment as currently utilised for the existing operations at the site. There will be negligible increase in noise level as stack height increases since although the plant will be operated at higher level this will be screened by the final cap on the trenches and the shoulder landform. Therefore, no significant increases in noise level are anticipated and this operation can be regarded as of negligible significance.

7 Cumulative Impacts

7.1 Introduction

8.1.1 Demolition works are to be undertaken at the PCM retrieval facilities and magazines, commencing in 2019. These demolition works are not part of the planning permission which this assessment supports. Therefore the effects of these demolition works are considered in this cumulative effects section.

8.1.2 In 2019, the vault construction work (Vaults 9A and 10) assessed in Section 5 will be on-going, when the above demolition works are undertaken.

8.1.3 This section considers the potential cumulative impacts from both sets of works in relation to noise generation from plant.

7.2 Plant Noise

8.2.1 Construction noise levels for the cumulative effect of magazine demolition with Vault 9 construction and associated activities are provided in Table 7.1.

Table 7.1: Maximum Unmitigated Predicted Noise Levels during Magazine Demolition and Vault Construction

Phase	Key Activities	Noise Level at Receptor $L_{Aeq,1hr}$ (dB) (Free-field)				
		R1	R2	R3	R4	R5
2	2a(1) Demolish magazines; Install cut off wall V9; Install secant wall V8; and Import placement fill.	50	51	54	46	45
	2a(2) Demolish magazines; Excavate and construct V9; and Place profiling fill.	51	52	54	44	46

8.2.2 The highest predicted noise level from the combined works in Phase 2a is 54 dB(A) which occurs at R3. Since the predicted noise levels at all receptors are below the 55 dB threshold given in MPS 2 it is considered that the cumulative effect of magazine demolition with Vault construction and associated activities is negligible.

8 Mitigation Measures

8.1 Construction Noise

7.1.1 Mitigation in the form of a 3m close boarded barrier on the boundary of the site (or similar) in the areas closest to receptors R1 and R2 will be required during Phase 1. This should provide 5 to 10 dB attenuation and with this mitigation in place all predicted levels in Table 5.1 will be below the 70 dB limit for works of short duration. It can be considered that much of the preparatory works in Phase 1 should be assigned this limit for the works which include vegetation clearance and the stream diversion.

7.1.2 It is also expected that the contractor will employ 'best practice' to reduce any potential noise impact upon the nearest receptors. Such measures include:

- all construction plant and equipment should comply with EU noise emission limits;
- machines in intermittent use should be shut down in the intervening periods between work or throttled down to a minimum;
- 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 ancillary plant such as generators, compressors and pumps should be positioned so as to cause minimal noise disturbance. If necessary, localised screens and enclosures should be used to reduce noise from particular noisy, static operations;
- adherence to the codes of practice for construction working given in British Standard BS 5228, and the guidance given therein minimising noise emissions from the site; and
- reference should be made to the Building Research Establishment, BRE 'Pollution Control' guidelines, Parts 1-5 [xiv].

7.1.3 Construction activities will only take place on Monday to Friday, between 0730 and 1800 hours and on Saturdays between 0830 and 1300 hours, with no working on Sundays and public holidays.

8.2 Operational Noise

7.2.1 No operational mitigation measures are likely to be required since available evidence indicates that current site activities generate very little off site noise.

9 Summary

9.1 Construction Noise – Site

9.1.1 Based on the predicted noise levels from plant, with the exception of works associated with vegetation clearance during Phase 1, all works with mitigation in the form of local barriers should be below the 55dB $L_{Aeq,1hr}$ threshold given in MPS2.

9.1.2 Activities associated with vegetation clearance are dominant, resulting in the exceedance of the 70 dB $L_{Aeq,1hr}$ limit at some receptors; these include stripping vegetation on the north and east shoulders and preparing stockpile areas C and D. Therefore, the 70 dB $L_{Aeq,1h}$ limit applies for vegetation clearance during Phase 1 since they are temporary works of short duration.

9.1.3 Adherence to the mitigation procedures given in BS5228 and, where necessary, the employment of local noise barriers to specific items of plant / construction activities, should ensure that the significance of construction noise is negligible / minor at all receptors.

9.2 Construction Noise – Off-Site Road Traffic

9.2.1 The HGV traffic and construction workers vehicles associated with the construction of the development will not have a significant noise impact when assessed in relation to the existing flows on the B5344. It is concluded that the significance of construction traffic on public roads is negligible.

9.3 Construction Noise – Rail Movements

9.3.1 Since no additional train movements are required for the proposed development and the current rail movements do not give rise to adverse noise effects it is considered that the significance of rail movements is negligible.

9.4 Operational Noise

9.4.1 The significance of operational noise effects is rated as negligible, since existing evidence is that baseline noise conditions are acceptable and there are no additional noise generating activities associated with the development.

Disposal of Waste in Vaults 9A to 14

9.5.1 No significant increases in noise level are anticipated and these operations are assessed as of negligible significance.

High Stacking in Vaults 8, 9 and all Future Vaults

9.6.1 No significant increases in noise level are anticipated and this operation is assessed as of negligible significance.

9.5 Cumulative Impacts

9.7.1 Cumulative impacts associated with magazine demolition have been considered. Predicted cumulative noise levels at the nearest receptors are below the 55 dB $L_{Aeq,1hr}$ limit. Therefore, cumulative effects are assessed as negligible.

Annex A: Noise Perception and Terminology

Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure (measured in Pascal's, Pa). Because of this wide range a noise level scale based on logarithms is used in noise measurement called the decibel (dB) scale. Audibility of sound covers a range of approximately 0 to 140 dB.

The human ear system does not respond uniformly to sound across the detectable frequency range and consequently instrumentation used to measure noise is weighted to represent the performance of the ear. This is known as the 'A weighting' and annotated as dB (A). Table A1 lists the sound pressure level in dB (A) for common situations.

Table A1: Sound Pressure Levels for a Range of Situations

Typical Noise Levels dB(A)	Example
0	Threshold of hearing
30	Rural area at night, still air
40	Public library Refrigerator humming at 2m
50	Quiet office, no machinery Boiling kettle at 0.5m
60	Normal conversation
70	Telephone ringing at 2m Vacuum cleaner at 3m
80	General factory noise level
100	Pneumatic drill at 5m
120	Discotheque - 1m in front of loudspeaker
140	Threshold of pain

The noise level at a measurement point is rarely steady, even in rural areas, and varies over a range dependent upon the effects of local noise sources. Close to a busy road, the noise level may vary over a range of 5 dB(A), whereas in a suburban area this may increase up to 40 dB(A) and more due to the multitude of noise sources in such areas (cars, dogs, aircraft etc.) and their variable operation. Furthermore, the range of night time noise levels will often be smaller and the levels significantly reduced compared to daytime levels.

The equivalent continuous A-weighted sound pressure level, L_{Aeq} , is the single number that represents the average sound energy measured over that period. The L_{Aeq} is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period.

Human subjects are generally only capable of noticing changes in steady levels of no less than 3 dB(A). It is generally accepted that a change of 10 dB(A) in an overall, steady noise level is perceived to the human ear as a doubling (or halving) of the noise level. (These findings do not necessarily apply to transient or non-steady noise sources such as changes in noise due to changes in road traffic flow, or intermittent noise sources).

The LASmax measurement parameter is the maximum instantaneous sound pressure level attained during the measurement period (30 seconds, 5 minutes etc.), measured on the 'slow' response setting of the sound level meter. Even though sounds appear fairly steady to the human ear they are seldom if ever steady in level. To accommodate this factor, sound level meters (SLMs) are generally provided with at least two meter responses or exponential averaging circuits. Fast meter response has a time constant of 1/8th of a second (125ms) and approximates the integration time of human hearing. The slow time response (time constant = 1 second) is intended to obtain an approximate average value of rapidly fluctuating levels from simple meter readings. This is used during the application of noise exposure categories, during night time periods within PPG24.

Annex B: Noise Modelling Details

Topography

Commercially available 1 m ground contour data for surrounding area.

Topographical surveys of site – Existing, with fill and final capping phases.

Building Heights

Existing and proposed buildings on around the site assumed to be at a height of 6m for 2 storey and 4.5m for 1 storey buildings.

Other Settings

Order of Reflections = 3

BS5228 prediction methodologies.

Receptor height = 1.5 metres

Ground absorption (0= hard, 1 = soft):

- Wider area 0.7.
- On site proposed 0.5.

Plant

100% on-time

Table B1: Plant Associated with Each Phase

Phase	Activity / Plant
1a(1)	A - 1 Brushcutter, 1 chainsaw, 1 polesaw, 1 woodchipper, 1 stumpgrinder, 1 dump truck 6t J - 2 Excavators, 2 dump trucks, 2 Brushcutters, 2 chainsaws, 2 polesaws, 2 woodchippers, 2 stumpgrinders, 2 dump trucks (all split between area C and D).
1a(2)	B - 2x Excavators, 2 x Dump trucks 6t C - 1 HGV haul road I - 2x Excavators 20t, 2x Articulated dump trucks 20t J - 2 Excavators, 2 dump trucks, 2 Brushcutters, 2 chainsaws, 2 polesaws, 2 woodchippers, 2 stumpgrinders, 2 dump trucks (all split between area C and D).
1a(3)	B - 2x Excavators, 2 x Dump trucks 6t D - 2x Excavators, 2x dump trucks I - 2x Excavators, 2x Articulated dump trucks J - 2 Excavators, 2 dump trucks, 2 Brushcutters, 2 chainsaws, 2 polesaws, 2 woodchippers, 2 stumpgrinders, 2 dump trucks (all split between area C and D).
1b(1)	E - 2x Excavators, 2x dump trucks 20t, vibratory roller, 2x bulldozers I - 2x Excavators, 2x Articulated dump trucks J - 2 Excavators, 2 dump trucks, 2 Brushcutters, 2 chainsaws, 2 polesaws, 2 woodchippers, 2 stumpgrinders, 2 dump trucks (all split between area C and D).
1b(2)	G - 2x Excavators, 2x dump trucks 20t, vibratory roller, 2x bulldozers H - Wheeled loader I - 2x Excavators, 2x Articulated dump trucks
2a(1)	K - 2x Excavators with breaker, 2x dump trucks 6t, 2x dump trucks 20t L - 2x Excavators, 2x dump trucks N - Tracked Excavator, Articulated Dump Truck, Mounted auger piling rig, Concrete pump, 2x Concrete mixer truck Q - Train - no additional movements
2a(2)	C - 1 HGV haul road K - 2x Excavators with breaker, 2x dump trucks 6t, 2x dump trucks 20t P - Excavator, dump truck, articulated dump truck, telehandler, vibratory roller 19t, concrete pump, concrete truck, power generator, tractor, road sweeper, dust suppression unit trailer. E - 2x Excavators, 2x dump trucks 20t, vibratory roller, 2x bulldozers
2b	P - Excavator, dump truck, articulated dump truck, telehandler, vibratory roller 19t, concrete pump, concrete truck, power generator, tractor, road sweeper, dust suppression unit trailer. E - 2x Excavators, 2x dump trucks 20t, vibratory roller, 2x bulldozers
2c	R - 2x Excavators 20t, 2x Articulated dump trucks 20t, 2x Bulldozers, vibratory roller
3a	P - Excavator, dump truck, articulated dump truck, telehandler, vibratory roller 19t, concrete pump, concrete truck, power generator, tractor, road sweeper, dust suppression unit trailer. E - 2x Excavators, 2x dump trucks 20t, vibratory roller, 2x bulldozers
7c	R - 2x Excavators 20t, 2x Articulated dump trucks 20t, 2x Bulldozers, vibratory roller

Activity Key:

A. Strip existing vegetation from north and east shoulders.	K. Demolish magazines
B. Install cap perimeter trench drain along north, east and west Vault 8	L. Install CoW V9
C. Import materials / plant for cut off wall	M. Import materials / plant for secant pile wall to v10
D. Install cut off wall to north and west Vault 8	N. Install secant wall Vx
E. Place PF	O. Import material for Vault construction
F. Import cap material	P. Excavate and construct Vx
G. Place cap material	Q. Import PF
H. Vegetate north and east shoulders and bolster existing planting to south	R. Place cap materials Vx and adjacent trenches
I. Divert Drigg stream along west	S. Prepare south of site - demolish offices, redirect services etc.
J. Prepare stockpile area D and C i.e. wildlife	T. Install cap perimeter drainage south of T13

Table B2: Plant Noise Data

Plant Item	Activity	Frequency								Sound Power, L _{WA} (dB)	Reference
		63	125	250	500	1k	2k	4k	8k		
Brushcutter (Stihl FS 450)		82	89	99	105	110	110	105	104	115	Manufacturers spec
Chainsaw (Stihl MS 200T or 346 XPG)		77	93	102	105	105	105	109	102	113	Manufacturers spec
Woodchipper (STC 19-28 MT50)		87	94	104	110	115	116	110	109	120	Manufacturers spec
Stump Grinder (STM25-18H)*		87	94	104	110	115	116	110	109	120	Manufacturers spec
Polesaw (STIHL HT 130 &131)		70	86	95	98	98	98	102	95	106	Manufacturers spec
Tracked excavator (40t, 226kW)	ground excavation	105	98	97	97	93	91	88	83	107	Table C2 ref 14
Tracked excavator with backhoe mounted surface breaker (67 kW)	surface breaking	111	105	103	102	106	108	107	106	116	Table C5 ref 1
Wheeled excavator (18t, 90 kW)	excavating	88	84	87	88	86	81	75	69	94	Table C4 ref 10
Telehandler (10t, 60kW)	distributing material	98	92	82	80	77	75	69	60	99	Table C2 ref 35
Dump truck (29t, 306 kW)	empty drive by	113	110	100	102	98	96	90	86	115	Table C2 ref 31
Articulated dump truck (25t, 194 kW)	drive by	107	114	94	96	92	90	84	80	109	Table C4 ref 1
Dozer (20t, 142 kW)	ground excavation	102	99	99	99	99	104	89	80	109	Table C8 ref 17
Vibratory roller (4t, 29 kW)	drive by	101	96	82	81	80	78	75	72	102	Table C2 ref 39
Vibratory roller (12t, 53 kW)	drive by	110	103	97	98	93	95	102	82	112	Table C5 ref 24
Dump truck (5t, 56 kW)	drive by	104	100	86	85	85	85	80	73	106	Table C4 ref 7
Tractor (100kW)	towing equipment drive by	103	95	102	99	102	94	85	79	108	Table C4 ref 74
Road sweeper (70kW)		101	96	90	96	92	88	82	79	104	Table C4 ref 90
Dust suppression unit trailer		100	95	96	102	92	90	82	78	106	Table C4 ref 91
Concrete pump truck mounted		102	97	98	104	94	92	84	80	108	Table C4 ref 29
concrete mixer truck		106	97	89	92	93	101	83	78	108	Table C4 ref 20
Generator	Welding	97	94	89	90	92	88	84	82	101	Table C3 ref 32
Generator	Power for site cabins	89	89	87	80	79	80	76	73	94	Table C4 ref 85
Batching plant (360 ³ m ³ hr ⁻¹)		-	-	-	-	-	-	-	-	108	Table D4 ref 11
Piling rig, rotary		103	111	100	99	97	95	87	80	112	Table C3 ref 14
HGV on haul road		97	102	102	102	98	97	92	90	108	Table C2 ref 34

Note: Table references refer to BS5228:2009

Table B3 Increase in Traffic Associated with the Development (Worst Case)

Phases	HGVs Two Way per Day	LGVs Two Way per Day	Increase in AADT*
Phase 1 (2013 - 2015)	-	-	-
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cap Material for north and east shoulders	-	-	-
Staff Vehicles	-	60	-
Totals	4	60	64
Phase 2 (2018 - 2022)	-	-	-
Import Cap Material for Vault 8 and adjacent trenches	-	-	-
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cement Powder for Secant Pile Wall	2	-	-
Import Profiling Fill	-	-	-
Import Bentonite and Cement Powders for Vault 9a and 10 Construction	8	-	-
Import Bentonite Powder for Capping of Vault 8 and adjacent trenches	4	-	-
Staff Vehicles	-	60	-
Totals	18	60	78
Phase 3 (2023 - 2026)	-	-	-
Import Cap Material for Vault 9 and adjacent trenches	-	-	-
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cement Powder for Secant Pile Wall	2	-	-
Import Profiling Fill	-	-	-
Import Bentonite and Cement Powders for Vault 11 Construction	8	-	-
Import Bentonite Powder for Capping of Vault 9 and adjacent trenches	4	-	-
Staff Vehicles	-	60	-
Totals	18	60	78
Phase 4 (2027 - 2029)	-	-	-
Import Cap Material for Vault 10 and adjacent trenches	-	-	-
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cement Powder for Secant Pile Wall	2	-	-
Import Profiling Fill	-	-	-
Import Bentonite and Cement Powders for Vault 12 Construction	8	-	-
Import Bentonite Powder for Capping of Vault 10 and adjacent trenches	4	-	-
Staff Vehicles	-	60	-
Totals	18	60	78
Phase 5 (2031 - 2033)	-	-	-
Import Cap Material for Vault 11 and adjacent trenches	-	-	-
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cement Powder for Secant Pile Wall	2	-	-
Import Profiling Fill	-	-	-
Import Bentonite and Cement Powders for Vault 13 Construction	8	-	-
Import Bentonite Powder for Capping of Vault 11 and adjacent trenches	4	-	-
Staff Vehicles	-	60	-
Totals	18	60	78
Phase 6 (2035 - 2036)	-	-	-
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cap Material for Vault 12 and adjacent trenches	-	-	-

Phases	HGVs Two Way per Day	LGVs Two Way per Day	Increase in AADT*
Import Profiling Fill	-	-	-
Import Bentonite Powder for Capping of Vault 12 and adjacent trenches	4	-	-
Staff Vehicles	-	60	-
Totals	8	60	68
Phase 7a (2051 - 2052)			
Import Bentonite and Cement Powders for Cut-Off Wall	4	-	-
Import Cement Powder for Secant Pile Wall	2	-	-
Import Bentonite and Cement Powders for Vault 14 Construction	8	-	-
Staff Vehicles	-	60	-
Totals	14	60	74
Phase 7b (2053 - 2054)			
Import Cap Material for Vault 13 and adjacent trenches	-	-	-
Import Profiling Fill	-	-	-
Staff Vehicles	-	60	-
Totals	0	60	60
Phase 7c (2054 - 2055)			
Import Bentonite Powder for Capping of Vault 13 and adjacent trenches	-	-	-
Import Cap Material for remaining trenches	-	-	-
Import Bentonite Powder for Capping of remaining trenches	4	-	-
Staff Vehicles	-	60	-
Totals	8	60	68
Phase 8 (2078 - 2079)			
Import Cap Material for Vault 14	-	-	-
Import Profiling Fill	-	-	-
Import Bentonite Powder for Capping of Vault 14	4	-	-
Staff Vehicles	-	60	-
Totals	4	60	64

* AADT – Annual Average Daily Traffic

References

- i BS5228: 2009 'Code of practice for noise and vibration control on construction and open sites.'
- ii` Control of Pollution Act (CoPA) 1974
- iii The Environmental Protection Act 1990.
- iv Minerals Policy Statement 2 (MPS2), 2005. Controlling and Mitigating the Effects of Minerals Extraction in England. Office of the Deputy Prime Minister
- v Mineral Planning Guidance 11: The control of noise at surface mineral workings. Department of the Environment, Welsh Office. 1993.
- vi BS 4142: 1997. Method for rating industrial noise affecting mixed residential and industrial areas. British Standards Institute.
- vii Minerals Policy Statement 2 (MPS2), 2005. Controlling and Mitigating the Effects of Minerals Extraction in England. Office of the Deputy Prime Minister
- viii BNFL 2000. Drigg PCM retrieval project environmental statement. BNFL, Risley.
- ix BNG 2005. Temporary increase in ISO-freight stacking height Vault 8: Environmental Statement further information. BNG Project Services, Berkley.
- x BS 7445: 1991: Description and measurement of environmental noise. Part 1: Guide to quantities and procedures. British Standards Institute.
- xi Planning application for the construction and operation of Vault 9 for the storage of LLW. British Nuclear Group.
- xii DMRB Design Manual for Roads and Bridges Volume 11 Part 7, 2008, The Department of Transport.
- xiii Department of Transport and the Welsh Office (1988) Calculation of Road Traffic Noise (CRTN).
- xiv Building research Establishment, Controlling particles, vapour and noise pollution from construction sites. Parts 1-5, 2003.

