10. NOISE AND VIBRATION

10.1 Introduction

10.1.1 Overview

This chapter assesses potential noise impacts associated with the Proposed Development and sets out agreed mitigation proposals. Noise emissions may be divided into the following categories:

- Construction Phase noise levels at surrounding receptors.
- Operational Phase noise levels at surrounding receptors.

The construction Phase will involve the opening of a new site entrance and initial preparatory works in the Phase 1 area. Operational Phase emissions will arise from extraction and processing of aggregates sourced within the site.

Construction operations will not involve any activities which generate groundborne vibration. Similarly, operational activities are not expected to give rise to groundborne vibration. Sand and gravel quarries are not typically associated with vibration. Blasting is not proposed. Vibration was therefore scoped out at the outset and is not assessed further.

10.1.2 Brief Overview Of The Proposed Development

The applicant proposes to extract sand and gravel on a greenfield plot located 7 km south of Dunmore village. Extraction will be carried out over three Phases worked westwards into the site from local road L2232. The site is shown in Figure 10-1.

At the working face, an excavator will be used to load an articulated dump truck, which will then transfer the aggregate to a washing and screening plant. It is expected that up to six loads per hour will be transported to the plant from the extraction face, equivalent to 12 dump truck movements. Throughout the 10 year life-time of the project, the processing plant will be retained in its initial installation zone at the southeast corner of the site. The plant will include a modular crusher and water recycling equipment.

The proposed area will be excavated in one bench with an average excavation depth of 3 m. Overburden stripped ahead of the working face at intervals will be stored in a perimeter berm in order to provide acoustic and visual screening. Overburden stripping and berm construction will require use of an excavator and an articulated dump truck. Each overburden removal event is likely to last up to one week, and is expected to occur no more than once per year. Site reinstatement at the end of the project will constitute a reversal of overburden stripping.

Processed aggregates will be exported by HGV via the adjacent L2232. The number of HGV loads exported will average 15 per day.

Map Legend

EIAR Study Area

N

Drawing Title: Site Location

Project Title: Lomaunaghbaun Quarry

Drawn By	Checked By
TM	OC
Project No.	Drawing No.
211034	Figure 10-1
Scale	Date
1:30,000	2023-12-19

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10.1.3 Methodology

This chapter describes the Proposed Development and the existing baseline environment, identifies, describes and assesses the noise effects of the Proposed Development; and proposes mitigation and monitoring measures where appropriate. This is achieved through the following:

- Relevant noise criteria are identified.
- Noise sensitive receptors in the local area are identified.
- A baseline noise survey is described.
- Noise sources associated with the Proposed Development are identified.
- Noise levels at offsite receptors are predicted.
- Potential noise impacts are assessed by reference to identified criteria.
- Cumulative impacts are also assessed.
- Noise mitigation requirements are determined.

10.1.4 Relevant Guidance

The following documents were consulted during the preparation of this chapter:

- *International Standard ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation* (1996).
- *Guidelines on community noise* (World Health Organisation, 1999).
- *Quarries and ancillary activities: Guidelines for planning authorities* (Department Of The Environment, Heritage & Local Government, 2004).
- *Environmental management guidelines: Environmental management in the extractive industry (non-scheduled minerals)* (Environmental Protection Agency, 2006).
- *Design manual for roads and bridges* (UK Highways Agency, 2011).
- *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (Institute of Acoustics, 2013).
- *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (2014).
- *International Standard ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise, Part 2: Determination of environmental noise levels* (2017).
- *British Standard BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound* (2019).
- *Guidelines on the information to be contained in environmental impact assessment reports* (Environmental Protection Agency, 2022).

10.1.5 Competence Of Assessor

The noise chapter was prepared by Damian Brosnan of Damian Brosnan Acoustics who has over 20 years' experience in scoping and carrying out such impact assessments. His qualifications are as follows:

- BSc (Honours) 1993 (University College Cork).
- Diploma in Acoustics & Noise Control 2009 (Institute of Acoustics).
- MSc (Distinction) in Applied Acoustics 2015 (University of Derby).
- Member of Institute of Acoustics (MIOA) & secretary of Irish branch.
- Founder member of Association of Acoustic Consultants of Ireland (AACI).
- Member of Engineers Ireland (MIEI).
- 1996-2001: Noise Officer with Cork County Council.
- 2001-2014: Partner with DixonBrosnan Environmental Consultants, specialising in EIA.
- 2015-2023: Principal at Damian Brosnan Acoustics.
- 2023–: Project Director, Acoustics at MKO.

10.2 Guidance And Criteria

10.2.1 World Health Organisation

There are no national mandatory noise criteria specified with respect to quarries or sand and gravel pits. Several guidance documents of relevance have been issued by various authorities, as discussed below. As the Proposed Development will operate only during daytime hours, this assessment refers solely to daytime criteria.

Most environmental noise guidance documents issued across Europe ultimately derive limits from guidance issued by the World Health Organisation (WHO). The WHO document *Guidelines on community noise* (1999) sets out guideline values considered necessary to protect communities from environmental noise. With respect to residential settings, the document notes that an outdoor $L_{Aeq\ 16\ h}$ level of 55 dB is an indicator of serious annoyance during daytime and evening hours. The 55 dB criterion was first suggested by the WHO in their 1980 document *Environmental health criteria 12*.

Since 1980, the 55 dB criterion has become the de facto daytime limit applied by most Irish regulatory authorities to commercial and industrial operators. Although the WHO criterion applies to daytime periods of 16 hours, authorities typically specify shorter periods. A period of one hour has become conventional practice with respect to quarries. Compliance with a one hour criterion, timed to coincide with the loudest onsite activity, will guarantee compliance with an $L_{Aeq\ 16\ h}$ criterion.

10.2.2 Department Of The Environment Heritage And Local Government And Environmental Protection Agency

The WHO criterion most likely informed the 55 dB $L_{Aeq\ 1\ h}$ limit recommended by the then Department of the Environment, Heritage & Local Government (DEHLG) in their 2004 document *Quarries and ancillary activities: Guidelines for planning authorities*. The document sets out guidance for local authorities in the assessment of quarry planning applications. Although initially issued to provide guidance with respect to the 2005-2007 quarry registration process as set out in S.261 of the Planning & Development Act 2000, the DEHLG document remains valid and in force. The document draws on guidance presented in EPA report MS-2000-M1, subsequently published in 2006, and titled *Environmental management guidelines: Environmental management in the extractive industry (non-scheduled minerals)*.

In addition to the 55 dB $L_{Aeq\ 1\ h}$ criterion, the DEHLG guidance and the related EPA document recommend that audible tonal and impulsive components be minimised. The criterion is typically applied at offsite noise sensitive locations, defined by the EPA as:

> *'Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires absence of noise at nuisance levels.'*

From the foregoing, a 55 dB daytime $L_{Aeq\ 1\ h}$ limit is considered the most suitable noise criterion with respect to the Proposed Development, applicable externally at offsite receptors during daytime working hours. This criterion applies to all noise emissions arising within the Proposed Development site.

The DEHLG document notes that:

> *'In general, it can be expected that complaints will result where the noise from quarrying and associated activities are between 5 to 10 dB above the background noise levels.'*

This clause is most likely informed by guidance presented in *British Standard BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound* (2019), which, although not directly

applicable to quarrying, has been used to form the basis of many noise recommendations relating to various sectors. BS 4142:2014 notes that adverse impacts may occur where the specific noise level (the $L_{Aeq\ T}$ level due to the source in question) is 'around +10 dB' higher than the background $L_{AF90\ T}$ level, with a difference of 5 dB suggesting an adverse impact. It is important to note that the BS 4142 scale of impact is also influenced by context. In this regard, context relates to the historic prevalence of sand and gravel extraction in the local area.

10.2.3 Institute Of Environmental Management And Environmental Protection Agency

Guidelines for environmental noise impact assessment (Institute Of Environmental Management & Assessment, 2014) (IEMA) sets out guidance on impacts by comparison with ambient levels. Table 10-1 sets out a scale adapted from IEMA and EPA guidance, with the latter drawn from *Guidelines on the information to be contained in environmental impact assessment reports* (EPA, 2022). The table is considered relevant to total ambient $L_{Aeq\ 1\ h}$ levels i.e. predicted levels may be compared to existing $L_{Aeq\ 1\ h}$ levels.

Table 10-1 Assessment of impact by reference to increase over existing noise levels

Change	Impact	Effect
<2 dB	Imperceptible	Capable of measurement, but without significant consequences
2-4 dB	Not significant	Causes noticeable changes to soundscape, but without significant consequences
4-6 dB	Slight	Causes noticeable changes to soundscape without affecting its sensitivities
6-10 dB	Moderate	Alters soundscape in manner consistent with existing and emerging baseline trends
10-15 dB	Significant	Alters soundscape due to source character, magnitude, duration or intensity
15-20 dB	Very significant	Significantly alters soundscape due to source character, magnitude, duration or intensity
>20 dB	Profound	Obliterates soundscape

10.2.4 BS 5228

British Standard BS 5228-1:2009+A1:2014 Code Of Practice For Noise And Vibration Control On Construction And Open Sites – Part 1: Noise (2014) sets out a procedure which may be used to determine the impacts of construction noise at surrounding receptors. This is considered relevant to the proposed initial construction works required to enable the development. The procedure involves setting threshold values based on ambient $L_{Aeq\ T}$ levels. The standard recommends that, during the construction Phase, total noise levels including construction emissions should not exceed these levels. On the basis of guidance given in the standard, a limit of 65 dB is considered appropriate, applicable at receptors, and over a one hour period. This applies to temporary construction works occurring over a period of several weeks at the start of the project.

10.2.5 DMRB

Local offsite receptors are currently subject to existing traffic noise levels on the surrounding road network. The Proposed Development will increase traffic volumes locally, with a consequent increase in traffic noise levels. The *design manual for roads and bridges* (UK Highway Agency, 2011) notes that the resulting noise impact is linked to the magnitude of the noise increase. Table 10-2 sets out the DMRB guidance. Included in the table are impact categories listed by the EPA in their 2022 EIAR guidelines document.

Table 10-2 DMRB assessment guidance

Increase	Subjective reaction	DMRB impact	EPA impact
0 dB	None	No change	Neutral
0-3 dB	Imperceptible	Negligible	Imperceptible to Not Significant
3-5 dB	Perceptible	Minor	Not Significant to Slight

Increase	Subjective reaction	DMRB impact	EPA impact
5-10 dB	Up to a doubling of loudness	Moderate	Slight to Moderate
>10 dB	Doubling of loudness or greater	Major	Significant to Profound

10.3 Receiving Environment

10.3.1 Receptors

The Proposed Development site lies 7 km south-southeast of Dunmore village, and 9 km northeast of Tuam. The site is accessed directly from the L2232 which forms the eastern boundary of the site. The remaining boundaries adjoin grazing land. The 6.2 ha site is approximately rectangular in shape, and consists of several small field currently used for grazing. The topography within the site rises gently westwards. The topography across the surrounding area is rolling. Local land use consists chiefly of agricultural grazing and aggregate extraction.

The extensive sand and gravel deposits in this area have resulted in the development of a number of sand and gravel pits in recent decades. The nearest pit, on a site to the immediate east, is now closed, and the site has been returned to agriculture. Several active and closed pits lie to the southwest of the site. The nearest of these, at 750 m, represents the chief active pit in the local area.

The nearest dwelling to the Proposed Development site is a house 190 m northeast, adjacent to the now-restored pit opposite the site. The dwelling is accessed from the L2232. The dwelling is in the ownership of the applicant, and is not a noise sensitive receptor.

A number of other dwellings lie along the L2232. The nearest occupied dwellings here are 520 m to the north, and 410 m to the south-southeast. A dwelling 270 m to the southeast is derelict.

To the south of the site, a local road runs east-west. This road provides access to the active sand and gravel pit to the southwest of the site. There are also several dwellings located along this road, the closest of which lies 470 m south of the site. A grouping of three dwellings lies 480-650 m southwest of the site.

North of the Proposed Development site, a local road serves a number of dwellings. The nearest of these is 800 m directly north of the proposed pit. The road continues northwest and west of the site, and dwellings here lie beyond audible range.

Local dwellings are shown in Figure 10-2. There are six habitable dwellings within 500 m of the site, with two more dwellings located just outside the 500 m offset. All receptors in the surrounding area consist of dwellings. No other receptors such as creches, schools, care centres or nursing homes have been identified in proximity to the site. The nearest settlements are Dunmore village and Tuam town.

Map Legend

- Noise Sensitive Receptors
- EIAR Study Area

Drawing no.
Noise Sensitive Receptors

Project Title
Lomaunaghbaun Quarry

Drawn By	Checked by
EK	TM
PProject No. 211034	Drawing No. Figure 10-2
Scale 1:7000	Date 2023-12-20

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10.3.2 Baseline Noise Survey

Baseline noise levels in the vicinity of the Proposed Development site were measured Wednesday July 6th 2022. Monitoring was carried out at four stations representing surrounding receptors. The stations are described in Table 10-3 and shown in Figure 10-3 and Plates 10-1 to 10-4. Survey methodology, equipment specifications and weather conditions are listed in Table 10-4.

Table 10-3 Baseline noise survey stations

Station	NGR	Location	Reason for selection
N1	552440 756470	SE corner of Proposed Development site	To represent dwellings alongside L2232
N2	552600 755982	Roadside gate on road S of site, 60 m from L2232	To represent dwelling 460 m S of site
N3	551600 755797	Roadside gate on road S of site, 750 m SE of development site boundary	To represent cluster of dwellings on road S of site
N4	551180 756940	Field adjacent to road NW of site, 920 m NW of development site boundary	To represent dwellings alongside road N and NW of site

Map Legend

- Baseline Noise Stations
- EIAR Study Area

Drawing no.
Baseline Noise Stations

Project Title
Lomaunaghbaun Quarry

Drawn By	Checked by
EK	TM
PProject No. 211034	Drawing No. Figure 10-3
Scale 1:7000	Date 2023-12-20

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Plate 10-1 N1, looking northeast towards nearest dwelling (in applicant's ownership)

Plate 10-2 N2, looking west towards dwelling

Plate 10-3 N3, looking southwest towards distant dwelling

Plate 10-4 N4, looking northeast towards distant dwelling

Table 10-4 Baseline survey details

Factor	Details
Wind	W 0-4 m/s
Rain	0 mm
Temperature	15 °C rising to 17 °C
Cloud cover	100 %
N1	NTi XL2, Serial A2A-15392-E0, Verification 13/05/21, Field calibration 06/07/22 09:22
N2	NTi XL2, Serial A2A-14337-E0, Verification 13/05/21, Field calibration 06/07/22 11:09
N3	NTi XL2, Serial A2A-17932-E0, Verification 17/02/22, Field calibration 06/07/22 09:02
N4	NTi XL2, Serial A2A-15429-E0, Verification 16/02/22, Field calibration 06/07/22 08:37
Calibrator	Type: Bruel & Kjaer Type 4231, Serial: 3017723, Verification 16/02/22
Operator	Damian Brosnan

Measured noise levels are listed in Table 10-5. $L_{Aeq\ 1\ s}$ profiles are shown in Figures 10-4 to 10-7. There were no activities at the Proposed Development site during the survey. The soundscape at all four stations was influenced by bird song/calls, sheep bleating, lightly rustling trees, and local traffic. Traffic was more frequent at N1 and N2. Noise emissions from an existing sand and gravel pit to the southwest of the Proposed Development site were continuously audible at N3 to 1700 h. These emissions were faintly audible at intervals at N2 and N4.

Table 10-5 Measured noise levels 06/07/22

Time	N1		N2		N3		N4	
	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$	$L_{Aeq\ 1\ h}$	$L_{AF90\ 1\ h}$
0900-1000	-	-	-	-	51	38	47	36
1000-1100	47	35	-	-	48	40	45	38
1100-1200	46	36	-	-	50	42	47	41
1200-1300	44	33	-	-	49	40	46	40
1300-1400	47	37	-	-	47	40	47	40
1400-1500	49	36	59	38	50	41	45	38
1500-1600	47	31	50	34	47	39	44	36
1600-1700	46	33	54	35	47	38	46	38
1700-1800	47	33	52	31	42	29	46	35

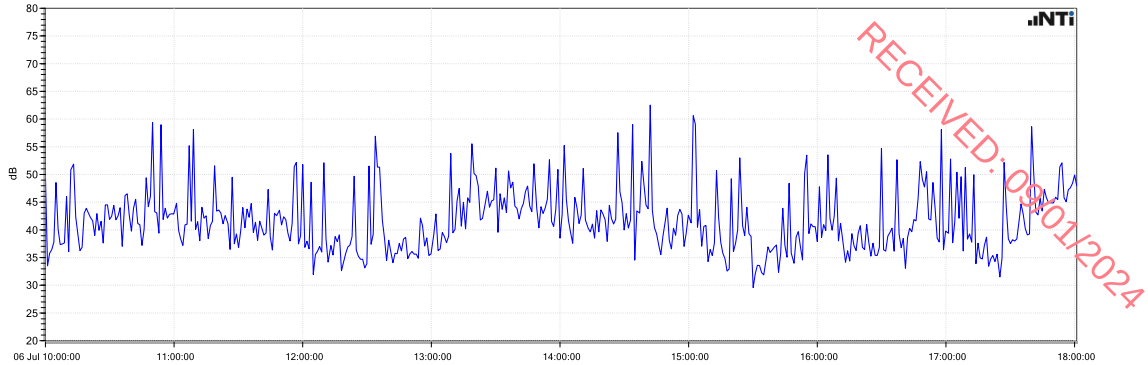

Figure 10-4 $L_{Aeq\ 1\ s}$ profile at N1

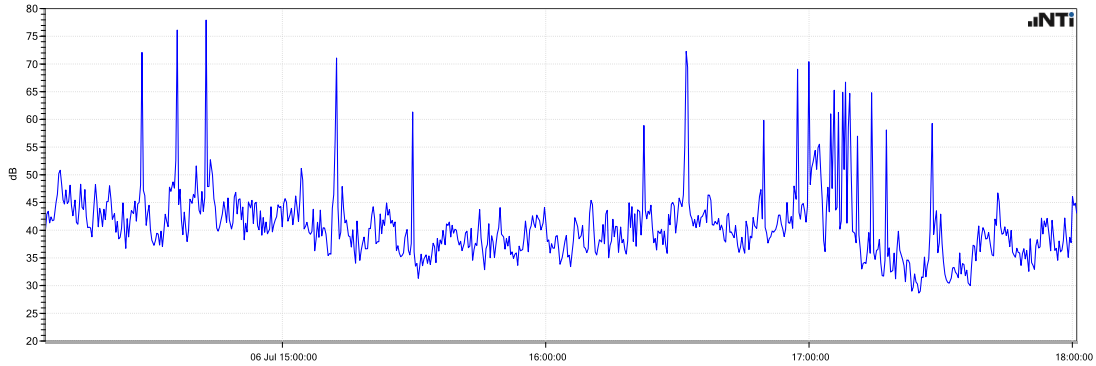

Figure 10-5 $L_{Aeq\ 1\ s}$ profile at N2

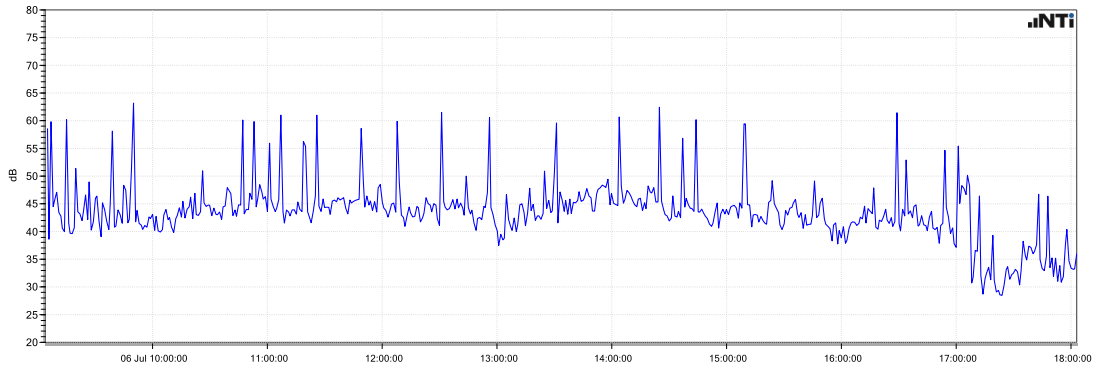

Figure 10-6 $L_{Aeq\ 1\ s}$ profile at N3

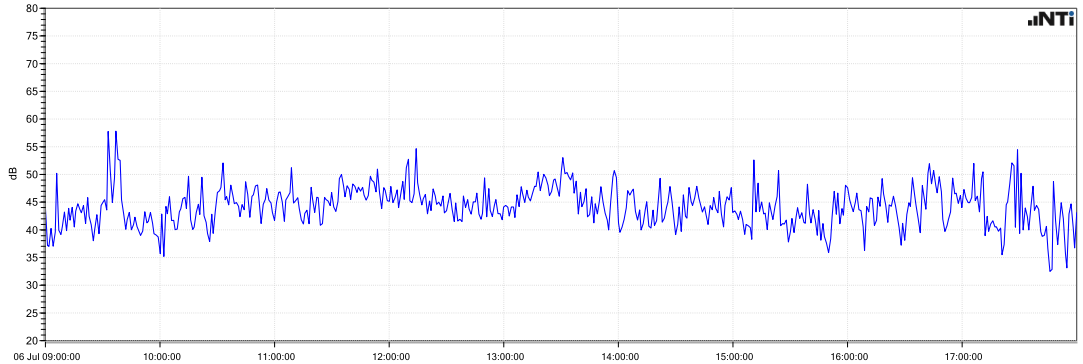

Figure 10-7 $L_{Aeq\ 1\ s}$ profile at N4

The following conclusions may be drawn from Table 10-5:

- $L_{Aeq\ 1\ h}$ levels were reasonably similar at N1 and N4, ranging from 44 to 49 dB. Levels were higher at N3, due to audible emissions from the nearby sand and gravel pit.
- The highest $L_{Aeq\ 1\ h}$ levels were seen at N2, where traffic movements arose through the nearby junction at intervals, including sporadic truck movements.
- $L_{AF90\ 1\ h}$ levels were 31-37 dB at N1, and were reasonably similar at N2. Levels were marginally higher at N4, possibly due to a light breeze evident here.
- The highest $L_{AF90\ 1\ h}$ levels were seen at N3, due to continuous washing plant emissions audible until 1700 h.
- Overall, noise levels are typical of a quiet rural area influenced by local traffic and distant quarry operations.

10.3.3 Future Trends

No major changes in the local soundscape are expected into the future. The replacement of the national car fleet with electric vehicles is unlikely to reduce traffic noise levels significantly, as traffic noise in the local area is dominated by tyre rolling noise rather than engine noise emissions.

Given the historic sand and gravel extraction across the local area, it is expected that quarrying activity will continue into the future across one or more sites, with each pit gradually returned to agriculture following exhaustion.

10.4 Potential Noise Impacts

10.4.1 Do Nothing Scenario

Should the Proposed Development not proceed, no changes in the local soundscape are expected. The site is likely to remain in agricultural use. Noise impacts in this scenario will be neutral.

10.4.2 Construction Phase impacts

Construction works required to enable the Proposed Development will consist of the following:

- A new entrance will be opened on the L2232 boundary.
- Overburden will be removed over the eastern half of the Phase 1 area (see Figure 10-8 and Planning Drawings attached in Appendix 4-1), and will be stored in a perimeter berm around the eastern and southern side of the Phase 1 area.
- Aggregates in the eastern half of the Phase 1 area will be excavated to a depth of approximately 6 m, and transported to the Phase 2 area where they will be temporarily stockpiled.
- The aggregate processing plant will be installed near the southeast corner.
- Ancillary infrastructure including the washwater recycling system, staff portacabin and wastewater holding tank will also be installed adjacent to the plant.
- A borehole will be drilled to supply water to the plant and portacabin.

These works will be undertaken at the start of Phase 1. The chief plant required during the construction phase will be up to two tracked excavators and up to two 6x6 dump truck used for entrance works, overburden removal, berm construction, aggregate extraction and stockpiling. Expected noise emissions from these are presented in Table 10-6, taken from BS 5228:2009.

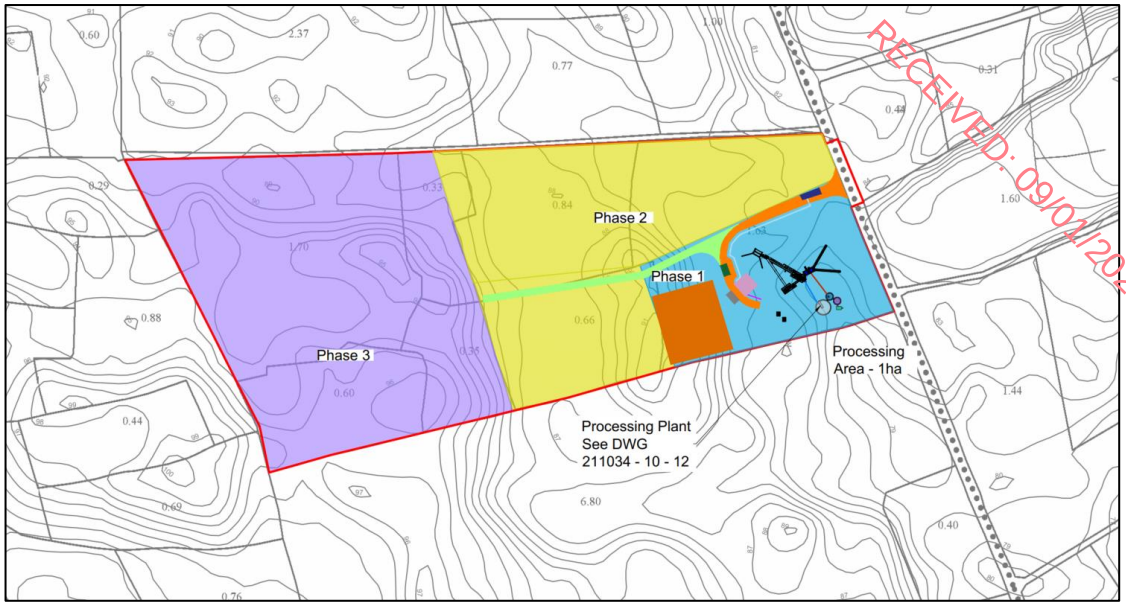

Figure 10-8 Proposed phasing

Table 10-6 Construction Phase plant sound pressure levels (dB) at 10 m, from BS 5228:2009 (band levels Z-weighted)

Plant	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	$L_{Aeq\ T}$
Excavator	82	87	82	77	72	70	66	59	80
Dump truck	87	85	83	81	78	74	71	66	83

Noise levels arising at receptors as a result of operation of the above plant during the construction phase were calculated using DGMR iNoise v.2023 software. The following input parameters were applied:

- Algorithm: *International Standard ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation* (1996).
- Ground conditions: Soft, vegetated.
- Source data taken from Table 10-6. 31.5 Hz data (not supplied in BS 5228) assumed to be same as 63 Hz levels.
- Receiver height: 4 m.
- Atmospheric conditions: 10 °C, 70 % RH.
- Modelled scenario: An excavator operating continuously at existing ground level near the southeast corner, with a second excavator near the northeast corner, and continuous dump truck movements between both zones.

Predicted $L_{Aeq\ 1\ h}$ levels are shown in Figure 10-9, and presented in Table 10-7. The highest $L_{Aeq\ 1\ h}$ level received at any receptor during the construction phase will be 41 dB, arising at a dwelling 410 m southeast of the site. Levels will be lower at all other dwellings, and below 40 dB. In all cases, received $L_{Aeq\ 1\ h}$ levels will be considerably lower than the 65 dB criterion relevant to construction works.

A comparison with baseline noise levels presented in Table 10-5 indicates that noise emissions arising during the construction phase may be slightly audible at the nearest dwellings on the L2232. On this basis, noise impacts at these dwellings will be slight adverse and temporary. At more distant dwellings, impacts will be imperceptible.

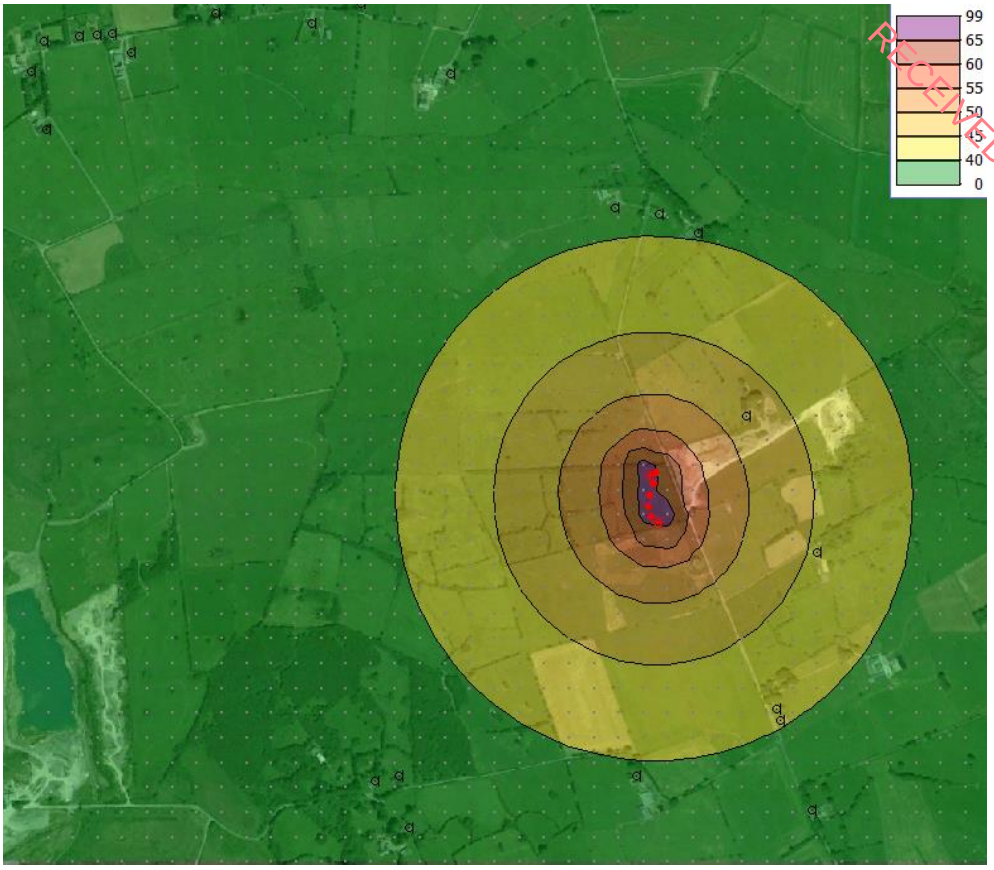

Figure 10-9 Predicted $L_{Aeq\ 1\ h}$ contours during construction phase

Table 10-7 Predicted $L_{Aeq\ 1\ h}$ levels (dB) at the nearest receptors during the construction phase. Receptors are shown in Figure 10-2. Noise levels at all other receptors will be lower.

Receptor	$L_{Aeq\ 1\ h}$
R1 to R12	28-33
R13 to R16	39-40
R17 & R18	40-41
R22	39
R23 to R25	36-36

10.4.3 Operational Phase Noise Levels

The proposed phasing is shown in Figure 10-8 above. In Phase 1, aggregates previously stockpiled in the Phase 2 area during the initial construction works will be transferred to the processing plant at the southeast corner. Once the stockpile has been cleared, extraction will continue into the remainder of the Phase 1 area, to the west of the processing plant. Extraction here will be worked westwards into the incline.

Following completion of the Phase 1 area, extraction will move north into the Phase 2 area. The Phase 2 area will be initially worked northwards along the eastern side of the Phase 2 area, before turning west to excavate the remainder of Phase 2. Phase 3 will see the remaining deposit worked out to the boundary.

Extraction will be carried out across one bench. Face heights will decrease gradually throughout the lifetime of the project. At the working face, an excavator will be used to load an articulated dump truck, which will transfer the aggregate to the processing plant.

The processing plant will operate continuously throughout the working day, outside of break periods. A front end loader will be used to manage stockpiles of processed aggregates and to load HGVs for

export. The number of HGV loads exported will average 15 per day. During peak periods, the number of loads may rise to three per hour, equivalent to six movements.

Overburden stripped ahead of the working face at intervals will be stored in a perimeter berm which will be gradually extended alongside each Phase. Overburden stripping and berm construction will require plant similar to that used in aggregate extraction. Each overburden removal event is likely to last up to one week, and is expected to occur no more than once per year. Site reinstatement at the end of the project will constitute a reversal of overburden stripping.

Table 10-8 lists mobile plant noise data, taken from BS 5228:2009. Noise emissions data relating to the processing plant (including washing, screening and crushing units) are listed in Table 10-9, measured 18th May 2021 by Damian Brosnan Acoustics at a similar facility operated by the applicant.

Table 10-8 Mobile plant sound pressure levels (dB) at 10 m, from BS 5228:2009 (band levels Z-weighted)

Plant	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	$L_{Aeq\ T}$
Excavator	82	87	82	77	72	70	66	59	80
Dump truck	87	85	83	81	78	74	71	66	83
Loader	77	83	91	75	75	72	65	59	83
HGV	73	78	78	78	74	73	68	66	80

Table 10-9 Processing plant sound pressure levels (dB) at 10 m (band levels Z-weighted)

31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	$L_{Aeq\ T}$
86	77	71	68	69	70	71	70	66	77

Noise levels arising at receptors during the operational phases were calculated using DGMR iNoise v.2023 software. The following input parameters were applied:

- Algorithm: *International Standard ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation* (1996).
- Ground conditions: Soft, vegetated outside quarry. Compacted ground within quarry.
- Source data taken from Tables 10-8 and 10-9. 31.5 Hz data (not supplied in BS 5228) assumed to be same as 63 Hz levels.
- Receiver height: 4 m.
- Atmospheric conditions: 10 °C, 70 % relative humidity.
- Modelled scenario 1: Extraction in Phase 1 west (scenario 'Phase 1').
- Modelled scenario 2: Extraction in Phase 2 east, with overburden removal also underway (scenario 'Phase 2+overburden removal').
- Modelled scenario 3: Extraction in Phase 2 east, following overburden removal (scenario 'Phase 2').
- Modelled scenario 4: Extraction in Phase 3 centre, with overburden removal also underway (scenario 'Phase 3+overburden removal').
- Modelled scenario 5: Extraction in Phase 3 centre, following overburden removal (scenario 'Phase 3').
- Processing plant operating continuously during all five scenarios.
- Extraction involving excavator and 6x6 dump truck in all five scenarios.
- Overburden removal involving second excavator and second 6x6 dump truck.
- Export underway in all five scenarios, involving a front end loader, and a maximum hourly average of three HGV loads.

Predicted $L_{Aeq\ 1\ h}$ levels are shown in Figures 10-10 to 10-14, and presented in Table 10-10.

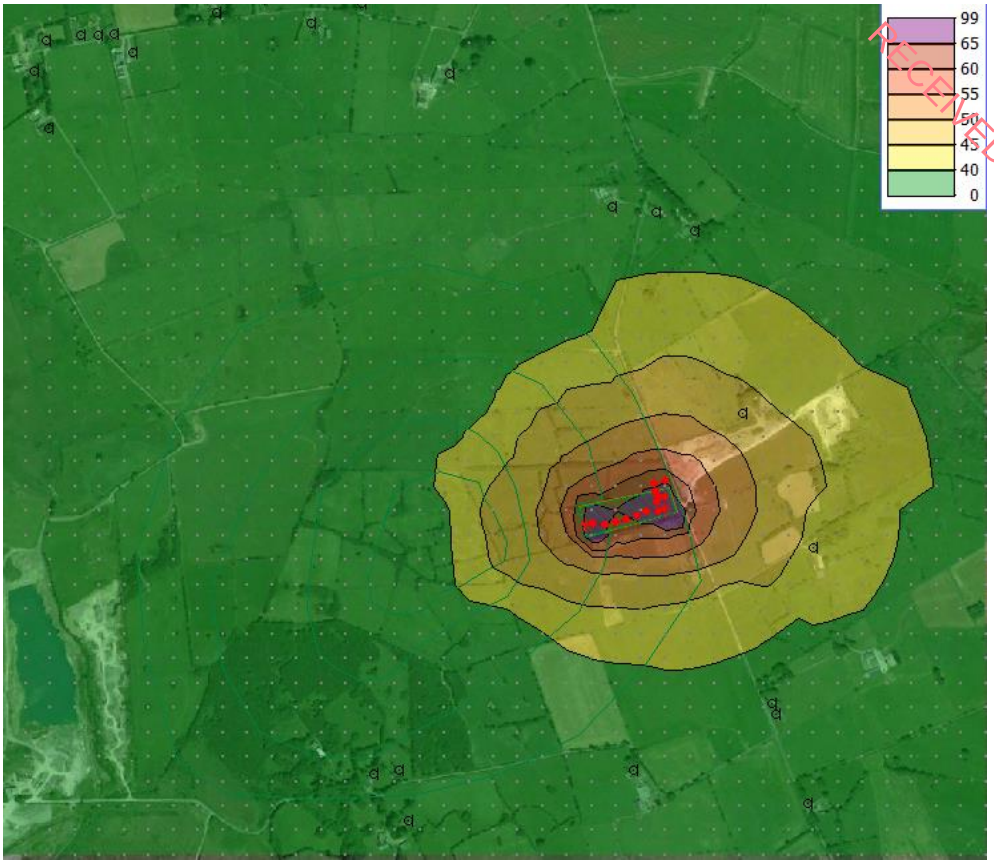

Figure 10-10 Predicted $L_{Aeq\ 1\ h}$ levels – Phase 1

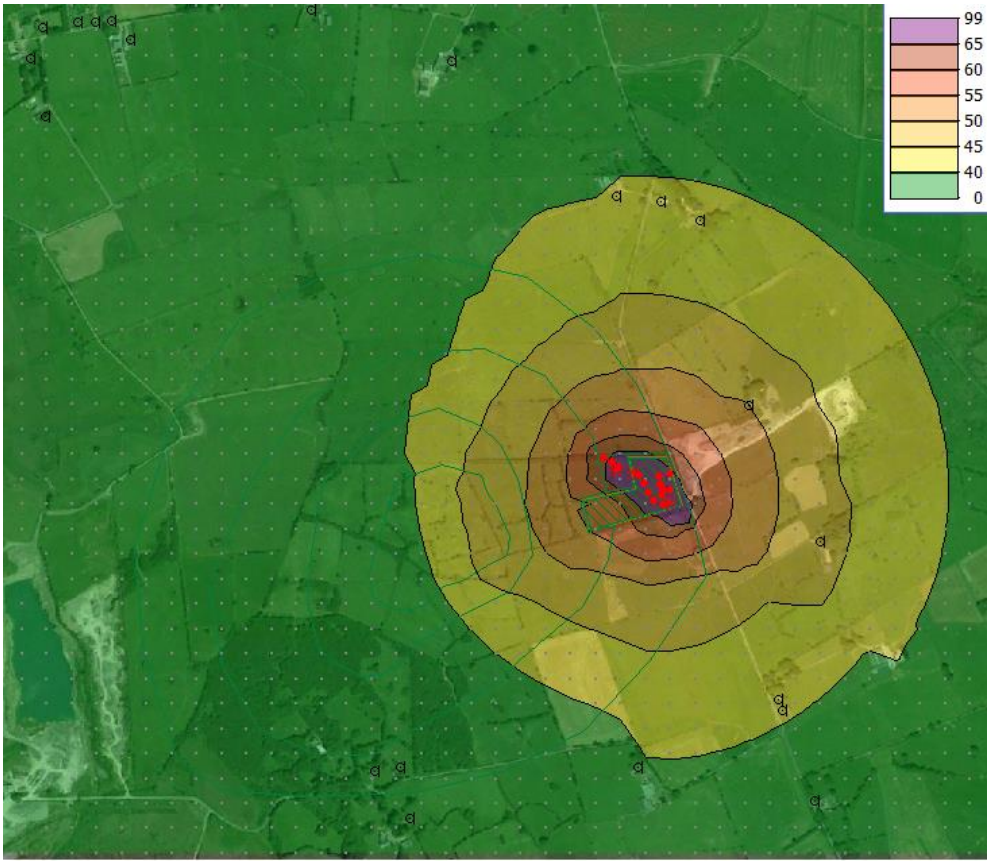

Figure 10-11 Predicted $L_{Aeq\ 1\ h}$ levels – Phase 2+overburden removal

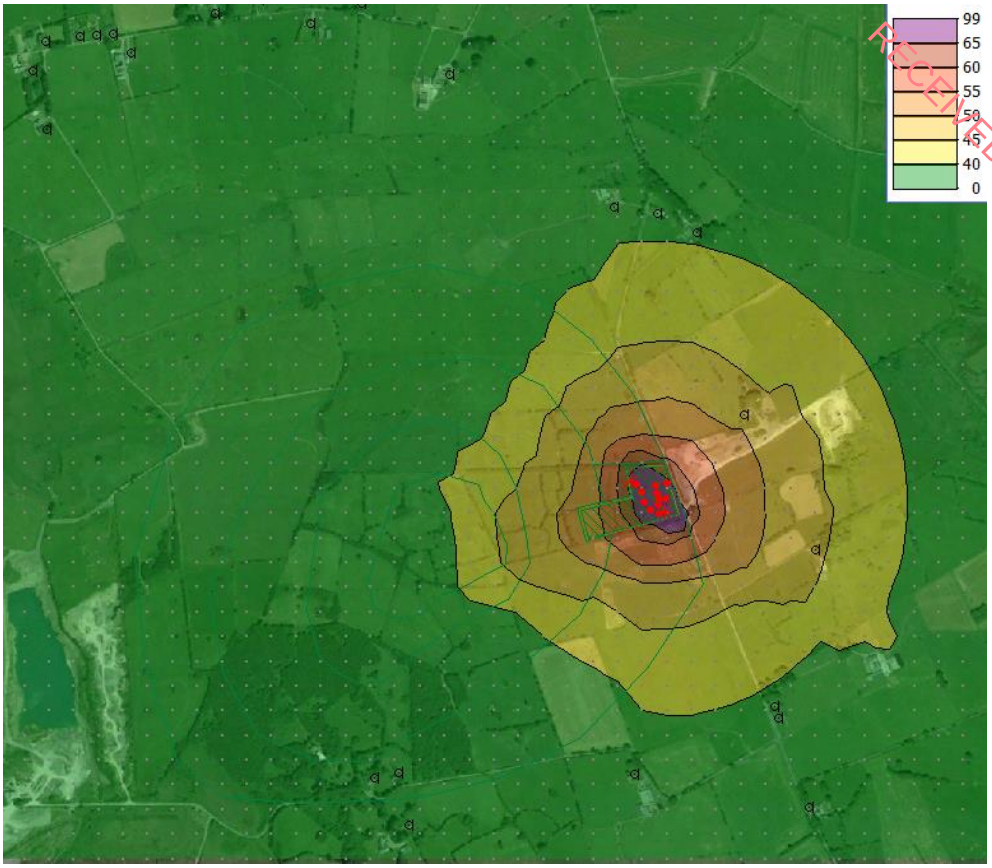

Figure 10-12 Predicted $L_{Aeq\ 1\ h}$ levels – Phase 2

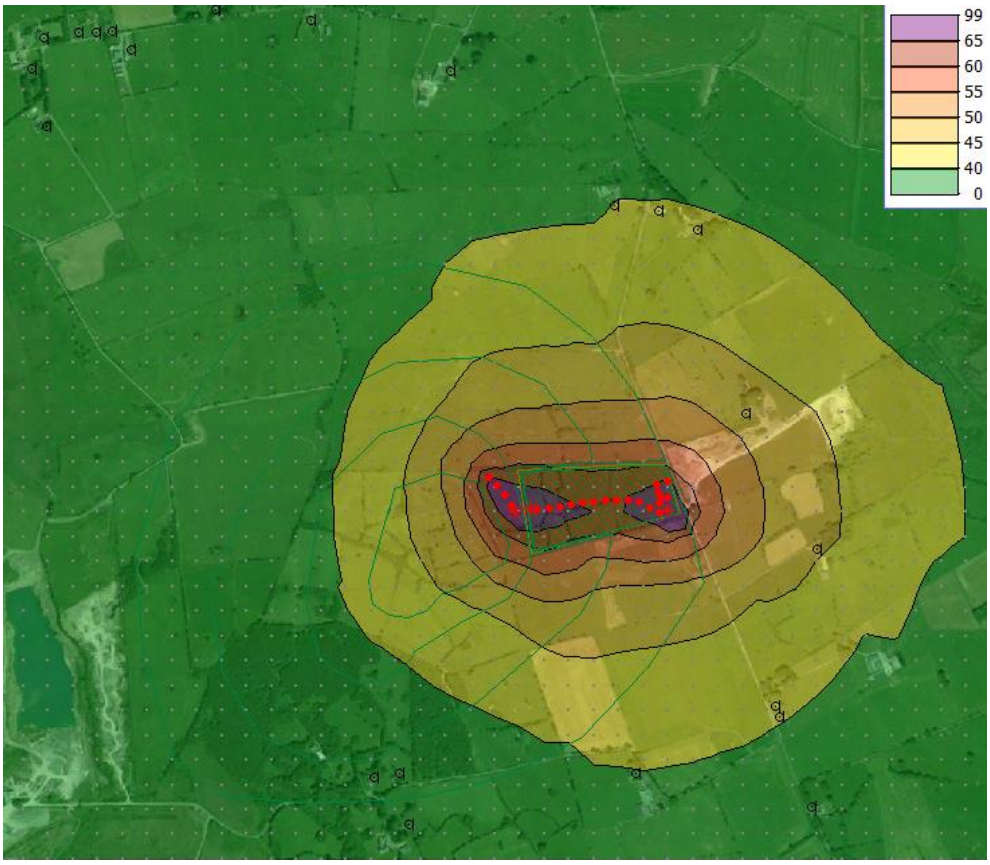

Figure 10-13 Predicted $L_{Aeq\ 1\ h}$ levels – Phase 3+overburden removal

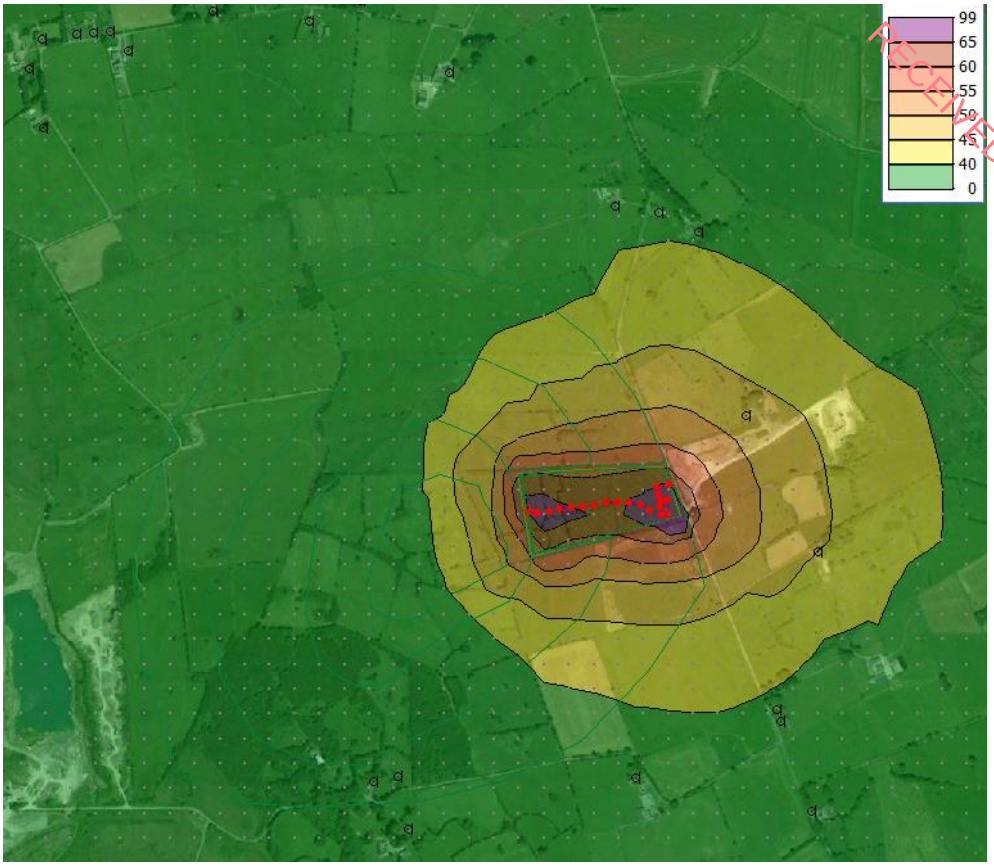

Figure 10-14 Predicted $L_{Aeq\ 1\ h}$ levels – Phase 3

Table 10-10 Predicted $L_{Aeq\ 1\ h}$ levels (dB) at the nearest receptors during operational phases

Receptor	Phase 1	Phase 2+overburden removal	Phase 2	Phase 3+overburden removal	Phase 3
R1 to R12	26-32	28-35	25-32	29-35	27-33
R13 to R16	37-38	41	39-40	40-41	39
R17 & R18	37	40-41	39	40-41	39
R22	35	39	37	40	38
R23 to R25	31-32	34	31-32	36-37	32-33

Modelling indicates that:

- During Phase 1, $L_{Aeq\ 1\ h}$ levels received at receptors will be 37-38 dB at the nearest dwellings on the L2232. Levels will be lower at more distant dwellings.
- At the start of Phase 2, overburden stripping will temporarily increase $L_{Aeq\ 1\ h}$ levels to 40-41 dB at the L2232 dwellings. The level at the dwelling to the south will be 39 dB, and will be less at more distant dwellings.
- Following the completion of overburden stripping, Phase 2 operational noise levels will decrease by 1-3 dB, resulting in $L_{Aeq\ 1\ h}$ levels of 39-40 dB at the L2232 dwellings, and lower at other dwellings.
- Overburden stripping at the start of Phase 3 will temporarily increase $L_{Aeq\ 1\ h}$ levels to 40-41 dB at the L2232 dwellings, as well as the dwelling to the south. Levels at other dwellings will be 37 dB or less.
- Once Phase 3 overburden stripping is complete, operational $L_{Aeq\ 1\ h}$ levels will again reduce by 1-4 dB. Levels at L2232 dwellings will be 39 dB, and lower at other dwellings.

Source data taken from BS 5228-1:2009+A1:2014 suggest that emissions will not be tonal. Noise surveys undertaken at other sand and gravel quarries confirm that emissions are unlikely to be tonal. Impulsive emissions are also unlikely to arise.

10.4.4 Operational Phase Noise Impacts

Noise impacts at receptors may be assessed using the IEMA scheme set out in Table 10-1 above, adapted with reference to EPA impact criteria. The assessment is presented in Tables 10-11 to 10-15. Baseline $L_{Aeq\ 1\ h}$ levels are taken from Table 10-5, averaged and assigned to the nearest receptors. Receptor numbers are shown in Figure 10-2. Noise impacts will be imperceptible at all receptors throughout the project. Noise levels and impacts will be lower at all receptors located further from the site than those included in the tables.

Table 10-11 Assessment of impacts in light of IEMA and EPA guidance – Phase 1 (dB)

Receptor	Predicted	Baseline	Combined	Increase	Impact
R1 to R12	26-32	46	46	0	Imperceptible
R13 to R16	37-38	47	47	0	Imperceptible
R17 & R18	37	47	47	0	Imperceptible
R22	35	54	54	0	Imperceptible
R23 to R25	31-32	48	48	0	Imperceptible

Table 10-12 Assessment of impacts in light of IEMA and EPA guidance – Phase 2+overburden removal (dB)

Receptor	Predicted	Baseline	Combined	Increase	Impact
R1 to R12	28-35	46	46	0	Imperceptible
R13 to R16	41	47	48	1	Imperceptible
R17 & R18	40-41	47	48	1	Imperceptible
R22	39	54	54	0	Imperceptible
R23 to R25	34	48	48	0	Imperceptible

Table 10-13 Assessment of impacts in light of IEMA and EPA guidance – Phase 2 (dB)

Receptor	Predicted	Baseline	Combined	Increase	Impact
R1 to R12	25-32	46	46	0	Imperceptible
R13 to R16	39-40	47	48	1	Imperceptible
R17 & R18	39	47	48	1	Imperceptible
R22	37	54	54	0	Imperceptible
R23 to R25	31-32	48	48	0	Imperceptible

Table 10-14 Assessment of impacts in light of IEMA and EPA guidance – Phase 3+overburden removal (dB)

Receptor	Predicted	Baseline	Combined	Increase	Impact
R1 to R12	29-35	46	46	0	Imperceptible
R13 to R16	40-41	47	48	1	Imperceptible
R17 & R18	40-41	47	48	1	Imperceptible
R22	40	54	54	0	Imperceptible
R23 to R25	36-37	48	48	0	Imperceptible

Table 10-15 Assessment of impacts in light of IEMA and EPA guidance – Phase 3 (dB)

Receptor	Predicted	Baseline	Combined	Increase	Impact
R1 to R12	27-33	46	46	0	Imperceptible
R13 to R16	39	47	48	1	Imperceptible
R17 & R18	39	47	48	1	Imperceptible
R22	38	54	54	0	Imperceptible
R23 to R25	32-33	48	48	0	Imperceptible

Noise impacts may also be assessed with reference to the following DEHLG clause:

> *'In general, it can be expected that complaints will result where the noise from quarrying and associated activities are between 5 to 10 dB above the background noise levels.'*

This assessment is presented in Tables 10-16 to 10-20. Background $L_{AF90\ T}$ levels are taken from Table 10-5. Receptors are shown in Figure 10-2.

Table 10-16 Assessment of impacts in light of DEHLG background clause – Phase 1 (dB)

Receptor	Predicted	Baseline	Difference
R1 to R12	26-32	38	<0
R13 to R16	37-38	34	3-4
R17 & R18	37	34	3
R22	35	35	0
R23 to R25	31-32	39	<0

Table 10-17 Assessment of impacts in light of DEHLG background clause – Phase 2+overburden removal (dB)

Receptor	Predicted	Baseline	Difference
R1 to R12	28-35	38	<0
R13 to R16	41	34	7
R17 & R18	40-41	34	6-7
R22	39	35	4
R23 to R25	34	39	<0

Table 10-18 Assessment of impacts in light of DEHLG background clause – Phase 2 (dB)

Receptor	Predicted	Baseline	Difference
R1 to R12	25-32	38	<0
R13 to R16	39-40	34	5-6
R17 & R18	39	34	5
R22	37	35	2
R23 to R25	31-32	39	<0

Table 10-19 Assessment of impacts in light of DEHLG background clause – Phase 3+overburden removal (dB)

Receptor	Predicted	Baseline	Difference
R1 to R12	29-35	38	<0
R13 to R16	40-41	34	6-7
R17 & R18	40-41	34	6-7
R22	40	35	5
R23 to R25	36-37	39	<0

Table 10-20 Assessment of impacts in light of DEHLG background clause – Phase 3 (dB)

Receptor	Predicted	Baseline	Difference
R1 to R12	27-33	38	<0
R13 to R16	39	34	5
R17 & R18	39	34	5
R22	38	35	3
R23 to R25	32-33	39	<0

The following conclusions may be drawn here:

- At dwellings to the northwest and southwest, no differences will arise between predicted and baseline noise levels.
- At the dwelling to the south of the proposed pit, the difference will be 0 dB during Phase 1, increasing to 2 dB during Phase 2 and 3 dB during Phase 3. When overburden stripping is underway, differences will increase to 4-5 dB.
- At the nearest dwellings on the L2232, the difference will be 3-4 dB during Phase 1, increasing to 5-6 dB during Phases 2 and 3. Differences will temporarily increase to 6-7 dB when overburden stripping is in progress.

As noted above, the DEHLG background clause is most likely drawn from BS 4142:2014. The latter advises that context should be taken into account when drawing conclusions using this assessment method. Given the historic prevalence of sand and gravel extraction in the surrounding area, including a historically worked pit to the immediate east of the Proposed Development site, it is considered that the identified differences are indicative of a slight adverse impact at dwellings along the L2232 during Phases 2 and 3 of the project.

10.4.5 Operational Phase Traffic Noise Impacts

The number of HGV loads exported will average 15 per day. During peak periods, the number of HGV loads may rise to three per hour, equivalent to six movements. All HGVs will access the site using the L2232. $L_{Aeq\ 1\ h}$ levels at dwellings adjacent to the L2232 resulting from these movements may be calculated using:

$$L_{Aeq\ 1\ h} = L_{AE} + 10\log N - 10\log T$$

where the L_{AE} describes the sound exposure level during a typical truck pass, N is the number of passes, and T is the time interval. A passing HGV will typically generate a sound exposure level of 80 dB at 10 m, the typical separation distance to local roadside dwellings. On this basis, $L_{Aeq\ 1\ h}$ levels associated with up to six movements per hour will be 52 dB. This intensity of activity is unlikely to occur regularly. On most days, the number of HGV movements per hour is expected to average two, resulting in an $L_{Aeq\ 1\ h}$ level of 48 dB at dwellings. It follows that $L_{Aeq\ 1\ h}$ levels associated with HGV movements on the L2232 will be lower than the 55 dB daytime criterion during typical operations and during periods of peak activity.

DMRB guidance notes that traffic noise impacts may be assessed with reference to baseline traffic volumes. The traffic assessment included in this EIAR notes that existing HGV movements on the L2232 total 32 per day. The Proposed Development will generate 30 daily movements, resulting in an increase to 62 total HGV movements per day. This increase equates to a daily L_{day} increase of marginally less than 3 dB. With reference to the DMRB scheme presented in Table 10-2, the resulting impact at roadside receptors will be imperceptible to not significant.

10.4.6 Cumulative Noise Impacts

10.4.6.1 Projects Of Potential Consequence

Potential cumulative noise impacts may arise at receptors which receive noise emissions from the Proposed Development as well as emissions from other existing or Proposed Developments. Potential noise sources identified in the surrounding area consist of the following:

- An existing sand and gravel quarry 750 m southwest of the Proposed Development site.
- The proposed Clonberne Wind Farm, located to the east. Based on publicly available information on the Clonberne Wind Farm website, it is estimated that the nearest turbine will lie approximately 1400 m from the site.

- A proposed borrow pit required for the wind farm construction Phase will be located immediately east of the proposed quarry, on the opposite side of the L2232. Potential

cumulative impacts may arise during the wind farm construction Phase due to borrow pit operations over a 1-2 year period.
- HGV traffic associated with the wind farm borrow pit.

10.4.6.2 Existing Sand And Gravel Quarry To Southwest

With respect to the existing sand and gravel pit to the southwest, the most vulnerable receptors are three dwellings located 470-540 m southeast of the pit, and 470-550 m southwest of the Proposed Development. $L_{AF90\ 1\ h}$ levels measured at baseline station N3 while operations were underway at the existing pit to the west were 38-42 dB (average 40 dB). These levels are reasonably representative of continuous washing plant operations at the pit. Based on this, the impact of cumulative emissions is assessed in Table 10-21.

Table 10-21 Assessment of cumulative impacts in light of IEMA and EPA guidance (dB)

Scenario	Existing pit $L_{Aeq\ 1\ h}$	Predicted $L_{Aeq\ 1\ h}$	Cumulative	Increase	Impact
Phase 1	40	31-32	41	1	Imperceptible
Phase 2+overburden removal	40	34	41	1	Imperceptible
Phase 2	40	31-32	41	1	Imperceptible
Phase 3+overburden removal	40	36-37	41	1	Imperceptible
Phase 3	40	32-33	41	1	Imperceptible

From the table, it is concluded that the Proposed Development will give rise to a minimal increase in noise levels at these dwellings, resulting in an imperceptible impact. It is also evident that cumulative noise levels will be influenced almost entirely by emissions from the existing pit to the southwest, with minimal contribution from the Proposed Development.

10.4.6.3 Clonberne Wind Farm Borrow Pit

The Clonberne Wind Farm website (www.clonbernewindfarm.com) includes mapping relevant to the wind farm proposal. The maps show a proposed borrow pit on a site to the immediate east of the proposed Lomaunaghbaun quarry, on the opposite side of the L2232. Proposed borrow pit operation details are not available on the wind farm website, and, for the purposes of the cumulative assessment, it is necessary to apply certain assumptions as follows:

- The borrow pit will be in use for 1-2 years during the wind farm construction Phase.
- The borrow pit will be worked eastwards into the site, away from the L2232.
- At the borrow pit, stone will be extracted through a combination of blasting, ripping and rock breaking.
- Extracted rock will be crushed and screened using mobile processing plant which will follow the working face.
- While active, the borrow pit will be worked akin to a regular stone quarry, with operations underway throughout the working day.

Table 10-22 lists noise data associated with plant likely to be used at the borrow pit, taken from BS 5228:2009.

Table 10-22 Mobile plant sound pressure levels (dB) at 10 m, from BS 5228:2009 (band levels Z-weighted)

Plant	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	$L_{Aeq\ T}$
Drill rig	86	92	85	88	84	83	78	77	90
Excavator	90	85	79	80	78	75	70	62	83
Loader	91	81	73	71	71	72	62	59	77
Crusher	91	91	88	87	85	83	78	68	90

Screener	93	86	79	78	75	71	69	62	81
Breaker	91	89	85	89	87	87	84	80	93
HGV	73	78	78	78	74	73	68	66	80

The noise model described above was rerun with borrow pit operations included. All six scenarios originally modelled (construction phase followed by five operational phases) were rerun, with the following borrow pit plant added:

- Crushing and screening underway on the borrow pit floor, 80 m from the L2232.
- Breaking underway close to the base of the working face.
- A tracked excavator at the working face, loading the crusher.
- A front end loader on the pit floor, loading an 8x4 HGV, with a second HGV manoeuvring.
- A drill rig operating ahead of the working face.

Predicted $L_{Aeq\ 1\ h}$ levels are shown in Figures 10-15 to 10-20, and presented in Table 10-23. Modelling indicates that $L_{Aeq\ 1\ h}$ levels at all times will remain lower than the 55 dB criterion recommended by the DEHLG. In all cases, cumulative noise levels will be dominated by wind farm borrow pit operations, with a negligible contribution from Lomaunaghbaun Quarry works. On this basis, it is concluded that the quarry contribution to cumulative impacts will be slight negative.

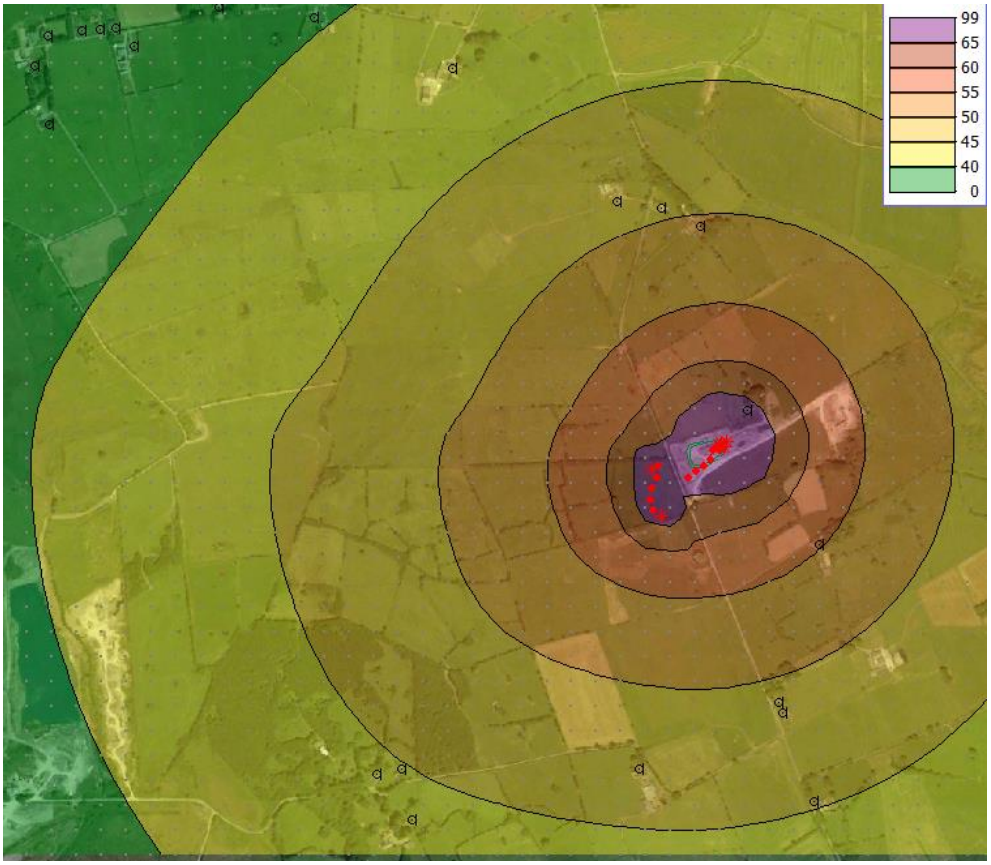

Figure 10-15 Predicted $L_{Aeq\ 1\ h}$ levels – Lomaunaghbaun Quarry construction phase and Clonberne Wind Farm borrow pit operations

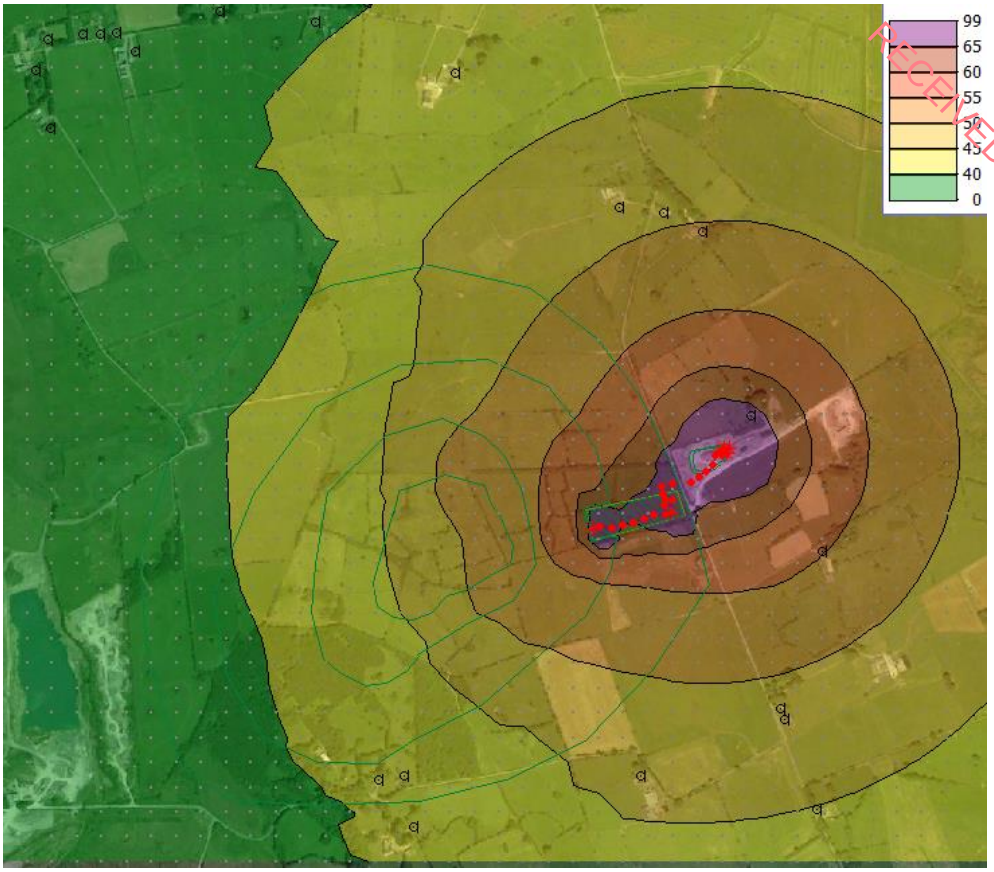

Figure 10-16 Predicted $L_{Aeq\ 1\ h}$ levels – Lomaunaghbaun Quarry Phase 1 and Clonberne Wind Farm borrow pit operations

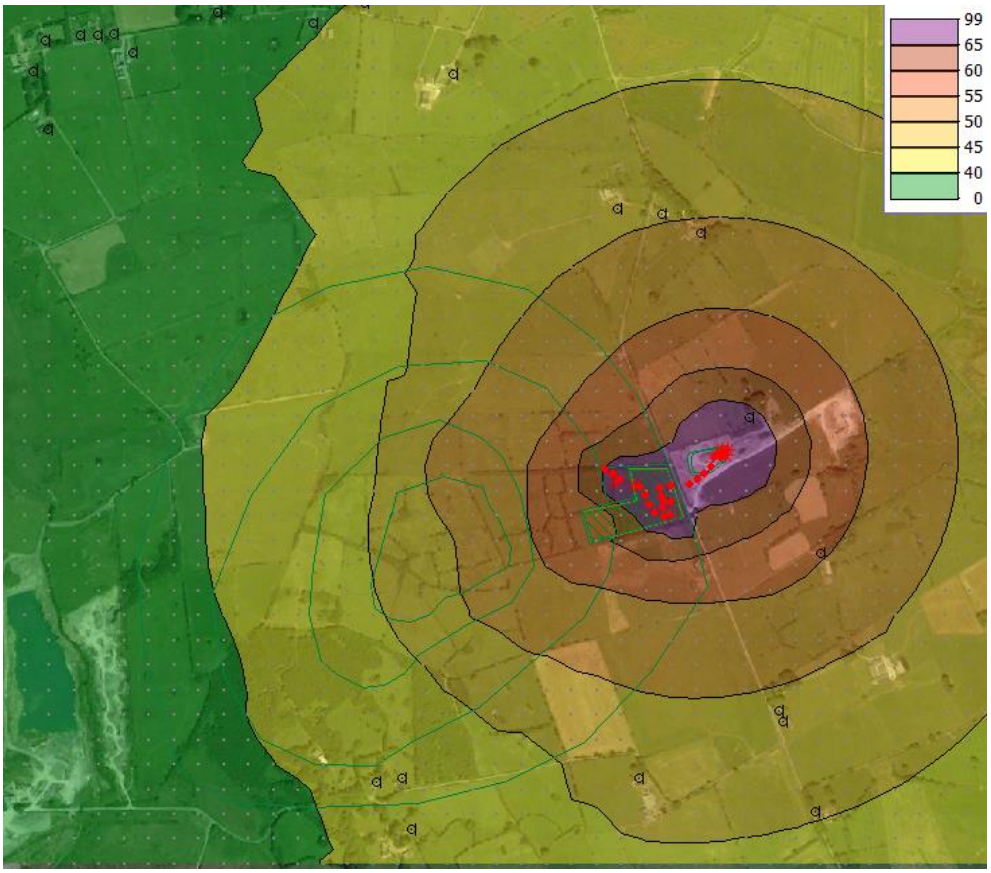

Figure 10-17 Predicted $L_{Aeq\ 1\ h}$ levels – Lomaunaghbaun Quarry Phase 2+overburden removal and Clonberne Wind Farm borrow pit operations

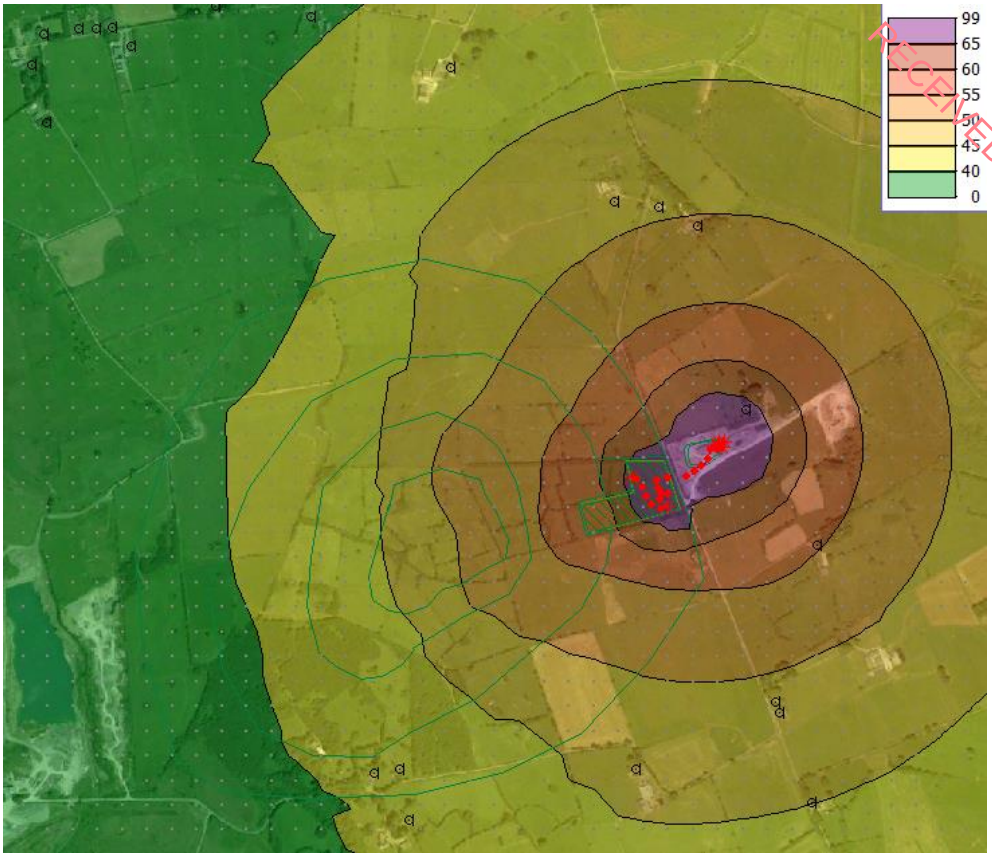

Figure 10-18 Predicted $L_{Aeq\ 1\ h}$ levels – Lomaunaghbaun Quarry Phase 2 and Clonberne Wind Farm borrow pit operations

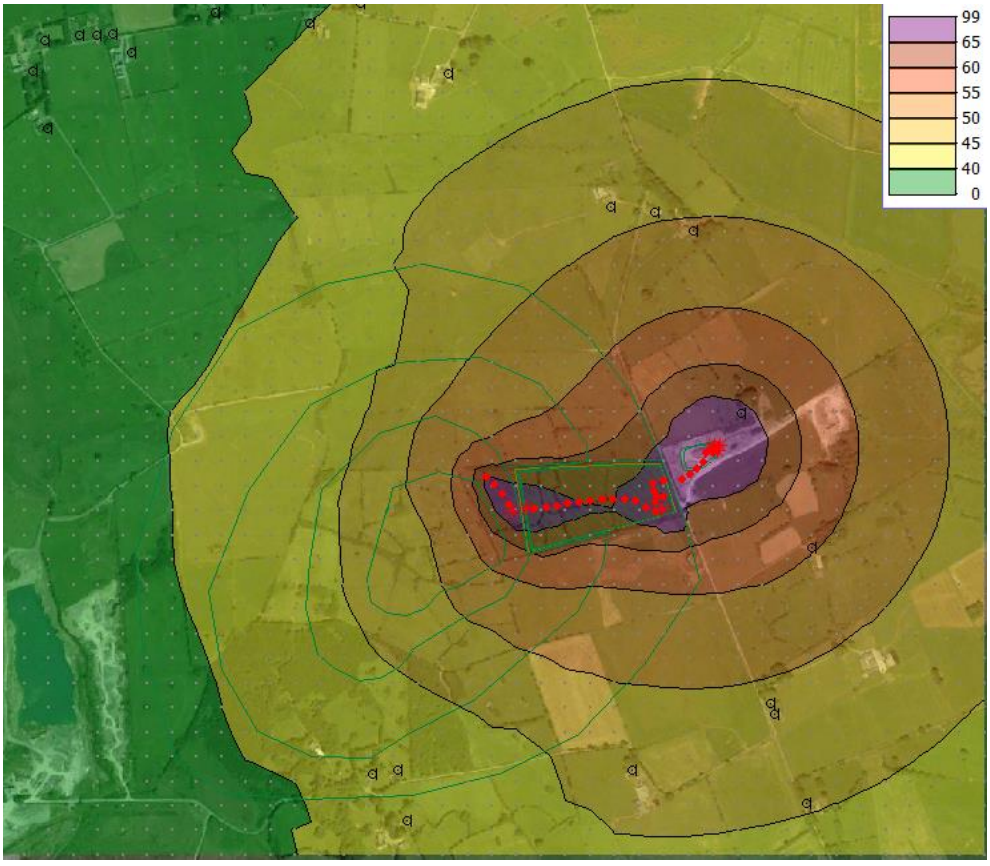

Figure 10-19 Predicted $L_{Aeq\ 1\ h}$ levels – Lomaunaghbaun Quarry Phase 3+overburden removal and Clonberne Wind Farm borrow pit operations

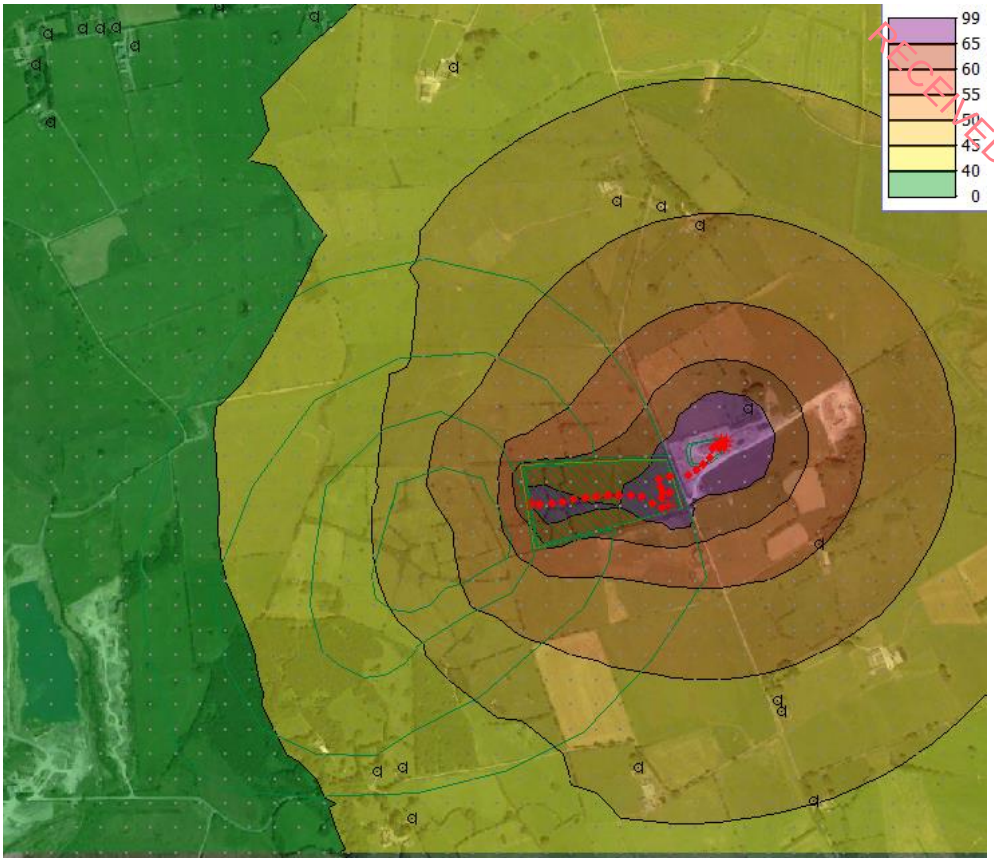

Figure 10-20 Predicted $L_{Aeq\ 1\ h}$ levels – Lomaunaghbaun Quarry Phase 3 and Clonberne Wind Farm borrow pit operations

Table 10-23 Predicted $L_{Aeq\ 1\ h}$ levels (dB) at the nearest receptors during Lomaunaghbaun Phases and borrow pit operations. Overburden removal refers to overburden removal and stockpiling at the Lomaunaghbaun quarry.

Receptor	Construction	Phase 1	Phase 2+overburden removal	Phase 2	Phase 3+overburden removal	Phase 3
R1 to R12	38-42	34-42	34-43	34-42	34-43	34-42
R13 to R16	49-51	48-50	49-51	49-51	49-51	49-51
R17 & R18	48-49	48-49	48-49	48-49	48-49	48-49
R22	47	46	47	47	47	47
R23 to R25	44-45	41-42	41-42	41-42	42-43	41-42

Cumulative impacts will not arise in relation to blasting undertaken at the borrow pit. Each blast will give rise to a noise signal less than 2 seconds in duration, with likely blast intervals of 1-2 blasts per month. Given that the proposed Lomaunaghbaun quarry will not give rise to groundborne vibration, no cumulative vibration impacts will arise.

10.4.6.4 Clonberne Wind Farm Borrow Pit HGV Traffic

Based on mapping available on the wind farm website, HGVs travelling between the borrow pit and the wind farm entrance are likely to use a 600 m segment of the L2232. Two dwellings located along this segment will be exposed to borrow pit HGV traffic noise, as well as noise from HGVs accessing the Lomaunaghbaun Quarry, in addition to HGV traffic using the road at present. The dwellings are numbered 17 and 18 in Figure 10-2.

The Clonberne Wind Farm website does not indicate how many HGV movements per hour will arise between the borrow pit and the wind farm entrance. A likely scenario is that up to 60 HGV loads will be transferred from the borrow pit to the wind farm daily over a period of up to 24 months, equating to 6 HGV loads each hour (12 movements) Up to six movements may arise per hour in relation to the

proposed Lomaunaghbaun Quarry as a worst case scenario. The number of movements in total may thus approach 18 per hour during busy periods.

Using the calculation methodology set out in Section 10.4.5, the $L_{Aeq\ 1\ h}$ level received at the two dwellings adjacent to the L2232 will be 57 dB. This will marginally exceed the 55 dB daytime DEHLG in relation to quarry noise. However, impacts will be offset by the following:

- The 55 dB DEHLG recommendation relates to onsite noise emissions, and is not entirely relevant to emissions arising from public road usage.
- The majority contribution to cumulative traffic noise will be provided by borrow pit traffic. Traffic noise associated with the Lomaunaghbaun Quarry will result in a minimal contribution to cumulative noise levels due to the low proportion of quarry traffic.
- Given that borrow pit operations will constitute a temporary construction phase activity, borrow pit traffic noise will most likely be subject to higher limits such as the 65 dB criterion recommended in BS 5228:2009.
- The 18 movements per hour applied here is an entirely worst case scenario. On most days, the number of truck movements associated with Lomaunaghbaun Quarry is unlikely to exceed two per hour, resulting in a combined cumulative $L_{Aeq\ 1\ h}$ level of 55 dB.
- The segment of road in question is short, at 600 m, with only two dwellings located along this route.
- Baseline traffic noise data indicates that this segment of road is currently subject to 32 daily HGV movements. The cumulative increase due to Lomaunaghbaun Quarry and Clonberne Wind Farm borrow pit operations will be 150 movements per day (30 movements due to the quarry, and 120 due to the borrow pit). This increase will result in an L_{day} increase of 8 dB. Based on the scheme set out in Table 10.2, this will result in a moderate adverse impact at both receptors along the route.

On this basis, cumulative traffic noise impacts at dwellings 17 and 18 in Figure 10-2 are likely to be moderate negative and short-term.

10.4.6.5 Clonberne Wind Farm Turbines

Following commissioning of the wind farm, a number of local receptors may be subject to noise emissions from the turbines as well as emissions from Lomaunaghbaun Quarry. The wind farm website states that 11 turbines are proposed. Turbine coordinates are not presented on the website. However, the following coordinates were estimated using maps included on the website.

Table 10-24 Clonberne wind farm turbine coordinates, estimated from website maps

Turbine	Easting	Northing
T01	554970	757600
T02	555680	757300
T03	554340	757300
T04	555070	757080
T05	555560	756790
T06	554470	756800
T07	553840	756700
T08	554000	756170
T09	554330	755820
T10	554860	755740
T11	554830	756300

The wind farm website does not name the candidate turbine model proposed at present. The website states that the proposed turbines will generate approximately 66 MW of electricity, suggesting that 6 MW turbines will be installed. Website photomontages indicate that a turbine with a 150 m rotor

diameter is proposed. The most commonly installed 6 MW turbine with a 150 m diameter is the Vestas V150 6 MW turbine with a hub height of 105 m. Information presented on the Vestas website (www.vestas.com) indicates that the V150 with serrated edge reaches a maximum sound power level (L_{WA}) of 104.9 dB. As with all modern pitch-regulated wind turbines, this maximum is likely to be reached at 8-9 m/s (wind speed at 10 m height standardised). Octave band data are not presented on the website. However, octave band data in relation to the V150 5.6 MW turbine are held on the MKO wind turbine database, and these were adjusted pro rata to match the 104.9 dB total L_{WA} value. The adjusted values are listed in Table 10-25.

Table 10-25 Vestas V150 6 MW sound power values assumed in this assessment (dB, A weighted)

63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	L_{WA}
85.6	93.4	98.2	100.1	98.9	94.8	87.7	77.6	104.9

Wind turbine noise data are typically subject to an uncertainty margin. In the absence of any value provided by Vestas, a +2 dB margin is applied here, as recommended *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (Institute of Acoustics, 2013). An additional correction of -2 dB, to correct to $L_{AF90\ T}$ values, is not applicable here as the cumulative assessment is based on the $L_{Aeq\ T}$ parameter.

For the purposes of the cumulative impact assessment, a 2 km turbine radius is considered relevant, and a 1 km radius to Lomaunaghbaun Quarry i.e. any dwelling within 2 km of the proposed turbines and within 1 km of the proposed quarry is included in the cumulative assessment zone. This rationale for this zone radius is as follows:

- Quarry noise emissions are typically of relevance out to a distance of 500 m. Beyond this distance, quarry noise levels typically fall to or below background levels. Operations may be just about audible in the quietest environments out to a distance of 1 km.
- At a distance of 1 km, wind turbine noise levels typically fall well below applicable limits. In some weather conditions, turbines may become faintly audible beyond 1 km. A radius of 2 km is applied here in order to adopt a worst case scenario.

Mapping presented on the wind farm website indicates that there are 13 dwellings on the western side of the proposed wind farm which will lie within the 2 km turbine radius, and within 1 km of Lomaughaghbaun Quarry. The dwellings are shown in Figure 10-21. Numbers used are those given on the wind farm website. Some of the dwellings are derelict or vacant.

In order to calculate cumulative noise levels arising at dwellings shown in Figure 10-21, the Lomaunaghbaun Quarry noise model was extended to include the 11 turbines. The following assumptions were applied to the wind turbine element:

- Modelling was undertaken using the ISO 9613:1996 algorithm. This assumes that all receptors are simultaneously downwind of the quarry and all wind turbines, thus adopting an entirely worst case scenario.
- Contour correction and barrier correction factors, as described in the Institute of Acoustics *Good practice guide*, are not applicable.
- Turbine octave band data are taken from Table 10-25. The 31.5 Hz value is assumed to the same as the 63 Hz value.
- A turbine hub height of 150 m is assumed.
- Receiver height is 4 m.
- A ground factor G of 0.5 is assumed, as recommended by the *Good practice guide*.

Given that the greatest Lomaunaghbaun Quarry noise emissions will arise during Phase 3+overburden removal (i.e. during the initial weeks of Phase 3 when overburden is being removed ahead of the working face), the model was run in relation to this period in order to adopt a worst case scenario. Thus the model relates to this Phase of the quarry, while all 11 wind turbines will be operating. The model assumes that turbines will be operating at maximum power output i.e. 104.9 dB. The model output is

shown in Figure 10-22. Results relating to the 13 dwellings in the cumulative zone are listed in Table 10-26.

Figure 10-21 Dwellings (white) within 2 km of the proposed Clonberne Wind Farm turbines and 1 km of Lomaunaghbaun Quarry (yellow).

Figure 10-22 Predicted $L_{Aeq\ T}$ levels from proposed Clonberne Wind Farm turbines and Lomaunaghbaun Quarry Phase 3+overburden removal

Table 10-26 Predicted $L_{Aeq\ T}$ levels (dB) from proposed Clonberne Wind Farm and Lonaunaghbaun Quarry Phase 3+overburden removal. Receptor numbers are those assigned on the wind farm website.

Receptor	Lomaunaghbaun Quarry[1]	Clonberne Wind Farm[2]	Combined
1	36 dB	43 dB	44 dB
63	37 dB	38 dB	40 dB
67	37 dB	38 dB	40 dB
68	39 dB	38 dB	41 dB
70	42 dB	38 dB	43 dB
75	42 dB	38 dB	43 dB
80	35 dB	37 dB	39 dB
102	42 dB	36 dB	43 dB
129	42 dB	37 dB	43 dB
143	41 dB	36 dB	42 dB
146	41 dB	36 dB	42 dB
159	42 dB	36 dB	43 dB
218	37 dB	34 dB	39 dB

[1]$L_{Aeq\ T}$ levels due to the quarry alone are 0-2 dB higher here than presented in Table 10-10 due to application of a conservative 0.5 value for G in the cumulative assessment, as recommended by the Instititue of Acoustics in relation to wind turbine noise models. A higher G factor is applied in the original model, based on observed ground conditions in the surrounding area.
[2]Predicted turbine noise levels here are likely to be 2 dB higher than actually occurring, as turbine noise is conventionally assessed using the $L_{AF90\ T}$ parameter, rather than the $L_{Aeq\ T}$ parameter assessed here. $L_{AF90\ T}$ levels have been shown to be approximately 2 dB lower than $L_{Aeq\ T}$ levels at most sites.

At all receptors in the cumulative zone, received $L_{Aeq\ T}$ levels will be considerably lower than the 55 dB criterion recommended by the DEHLG and the WHO. Cumulative noise impacts will be imperceptible.

10.5 Mitigation Measures

Noise levels from the Proposed Development will be lower than the 55 dB criterion, and impacts will be imperceptible at receptors. Stripped overburden will be stored in a perimeter berm throughout the project, extended with each Phase, and this represents the chief mitigation measure. The applicant additionally proposes to apply the following general mitigation measures during the construction and operational phases:

- Plant used onsite will be maintained in accordance with manufacturer specifications. In particular, exhaust silencers will be maintained in a satisfactory condition.
- Communication through plant horns will be prohibited.
- Unnecessary revving of truck engines will be prohibited.
- Site haul roads will be maintained in a satisfactory condition, and free from surface defects that may generate rattles in empty truck bodies.
- Machinery not in active use will be shut down.

10.6 Residual Impacts

10.6.1 Population & Human Health

The assessment of impacts on human health is typically undertaken by reference to WHO guidance as discussed above, which has been revised over the last four decades according as noise and health studies have been published. The WHO currently recommends that a daytime-evening $L_{Aeq\ 16\ h}$ level of 55 dB is an indicator of serious annoyance. Noise levels associated with the Proposed Development will be lower than this criterion. On this basis, it is considered that there will be no adverse noise impact on the local population or on human health.

10.6.2 Overall Residual Impacts

Noise levels at receptors attributable to the Proposed Development will be lower than the identified 55 dB criterion. Using guidance set out by IEMA and the EPA, it is concluded that noise impacts at receptors will be imperceptible. The Proposed Development will be consistent with the local and historic soundscape. Traffic noise impacts will be imperceptible to not significant.

At a cluster of three dwellings in proximity to both the Proposed Development and an existing sand and gavel pit to the southwest, cumulative noise impacts will be imperceptible. In relation to cumulative impacts due to operation of the proposed quarry in tandem with extraction at Clonberne Wind Farm borrow pit, cumulative impacts will be slight negative at the nearest receptors, due almost entirely to borrow pit activity. Cumulative truck noise impact at two dwellings on the L2232 will be moderate negative where these activities occur simultaneously. Cumulative noise impacts will be imperceptible where the proposed wind farm becomes operational during the lifetime of the proposed quarry.
In the context of EPA EIAR assessment guidance, impacts are summarised in Tables 10-27 to 10-32.

Table 10-27 Residual impacts 1

Source	Routine operations
Receptor	Dwellings in audible range
Quality	Neutral
Significance	Imperceptible
Duration	Medium term

Table 10-28 Residual impacts 2

Source	Quarry traffic
Receptor	Dwellings alongside L2232
Quality	Negative
Significance	Imperceptible to not significant
Duration	Medium term

Table 10-29 Residual impacts 3

Source	Cumulative: Lomaunaghbaun Quarry and quarry to SW
Receptor	3 dwellings between both pits
Quality	Neutral
Significance	Imperceptible
Duration	Medium term

Table 10-30 Residual impacts 4

Source	Cumulative: Lomaunaghbaun Quarry and Clonberne wind farm borrow pit
Receptor	Dwellings in audible range
Quality	Negative
Significance	Slight (due almost entirely to borrow pit)
Duration	Short term

Table 10-31 Residual impacts 5

Source	Cumulative: Lomaunaghbaun Quarry traffic and Clonberne wind farm borrow pit traffic
Receptor	2 dwellings alongside L2232
Quality	Negative
Significance	Moderate (due almost entirely to borrow pit traffic)
Duration	Short term

Table 10-32 Residual impacts 6

Source	Cumulative: Lomaunaghbaun Quarry and Clonberne wind farm
Receptor	13 dwellings on W side of wind farm
Quality	Neutral

Significance	Imperceptible (based on WEDG 06 guidance)
Duration	Medium term

10.7 Glossary

Ambient: Total noise environment at a location, including all sounds present.

A-weighting: Weighting or adjustment applied to sound level to approximate non-linear frequency response of human ear. Denoted by suffix A in parameters such as $L_{Aeq\ T}$, $L_{AF10\ T}$, etc.

Background level: A-weighted sound pressure level of residual noise exceeded for 90 % of time interval T. Denoted $L_{AF90\ T}$.

Broadband: Noise which contains roughly equal energy across frequency spectrum. Does not contain tones, and is generally less annoying than tonal noise.

Decibel (dB): Unit of noise measurement scale. Based on logarithmic scale so cannot be simply added or subtracted. 3 dB difference is smallest change perceptible to human ear. 10 dB difference is perceived as doubling or halving of sound level. Examples of decibel levels are as follows: 20 dB: very quiet room; 30-35 dB: night-time rural environment; 55-65 dB: conversation; 80 dB: busy pub; 100 dB: nightclub. Throughout this report noise levels are presented as decibels relative to 20 µPa.

Fast response: 0.125 seconds response time of sound level meter to changing noise levels. Denoted by suffix F in parameters such as $L_{AF10\ T}$, $L_{AF90\ T}$, etc.

Free field: Measurement position removed from acoustically reflective surfaces other than ground.

Frequency: Number of cycles per second of a sound or vibration wave. Low frequency noise may be perceived as hum, while whine represents higher frequency. Range of human hearing approaches 20-20,000 Hertz.

Hertz (Hz): Unit of frequency measurement.

Impulse: Noise which is of short duration, typically less than one second, sound pressure level of which is significantly higher than background.

Interval: Time period T over which noise parameters are measured at position. Denoted by T in $L_{Aeq\ T}$, $L_{AF90\ T}$, etc.

$L_{Aeq\ T}$: Equivalent continuous sound pressure level during interval T, effectively representing average A-weighted noise level of ambient noise environment.

$L_{AF90\ T}$: Sound pressure level exceeded for 90% of interval T, usually used to quantify background noise. May also be used to describe noise level from continuous steady or almost-steady source, particularly where local noise environment fluctuates.

Noise sensitive location: Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires absence of noise at nuisance levels.

Octave band: Frequency spectrum may be divided into octave bands. Upper limit of each octave is twice lower limit.

Specific level: $L_{Aeq\,T}$ level produced by specific noise source under consideration during interval T, measured directly or by estimation or calculation.

Tone: Character of noise caused by dominance of one or more frequencies which may result in increased noise nuisance.

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