Section 9.0: NOISE & VIBRATION

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9.0 NOISE & VIBRATION

9.1 Introduction

Greentrack Consultants were commissioned by Tinneys Quarry Ltd to assess the potential noise impacts of development at an existing quarry site located at Trentamucklagh, St Johnston, Co.Donegal, to inform a remedial Environmental Impact Assessment Report (rEIAR). The rEIAR is required to support an application for substitute consent to An Bord Pleanala.

9.2 Statement of Authority

This section of the rEIAR has been prepared by Colin Farrell of Greentrack Consultants Ltd. Colin has a MSc in Applied Environmental Sciences from QUB and a BSc in Geochemistry from Reading University. Colin has completed many environmental noise surveys and contributed to Environmental Impact Reports produced by Greentrack over the last 15 years.

9.3 Site Location and Setting

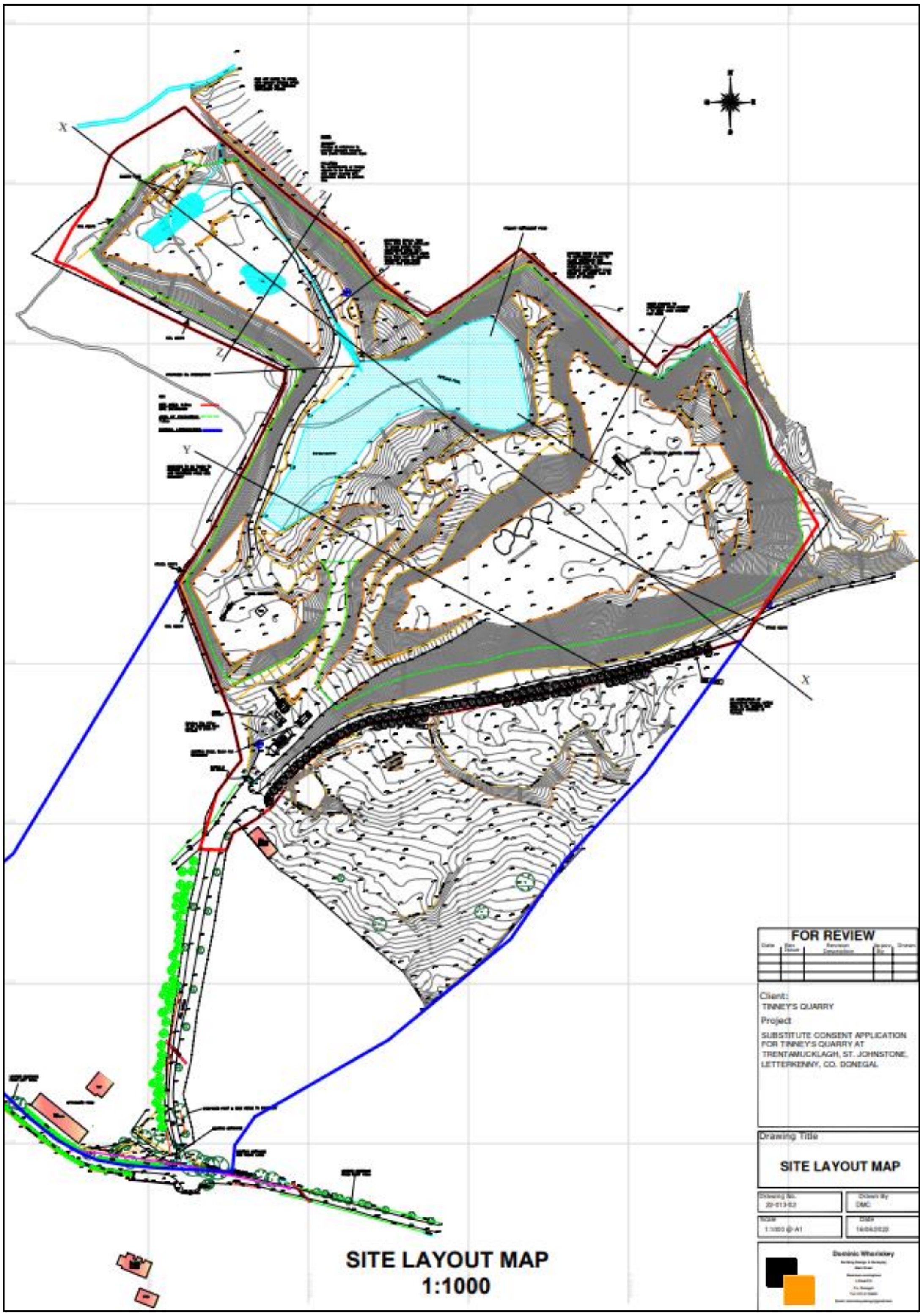
The application site is located approximately 4 km west of the town of St Johnston in east Co. Donegal (Eircode: F93 KC04). The site is located in the townland of Trentamucklagh and is served by the local road, L-5414. Access to the quarry is off this local road via a concrete and hardcore access road.

The site is surrounded by agricultural land on all sides apart from to the east where a quarry face separates the site and a separate quarry operated by a different owner. An extensive area of commercial forestry lies to the north and northwest of the site, flanking the slopes of Dooish Mountain. The subject site location is outlined in Figures 9.1 below and the site layout is detailed in Figure 9.2 below.

Figure 9.1: Location of Subject site

greentrack

Figure 9.2: Site Layout (not to scale)



(supplied by Dominic Whorisky Architects)

9.3.1 Description of Site Activity

Extraction at the site was underway prior to the applicant taking control of the site but was not carried out in a coordinated fashion and the applicant states many distinct quarry pits were on the application site when control was taken of the lands. Extraction was then continued chasing the rock of easiest access and that could be broken out easily. As a result, an ad hoc extraction direction was taken until most areas of the site footprint had been extracted to some degree. Blasting has occurred occasionally at the site with an average of one or two blasts per year required.

The location of processing activities has historically followed extraction and been based on the quarry deck as close as practicable to the extraction areas. Processing has been by mobile crusher/screener.

The quarry operation includes extraction of rock by mechanical means and blasting. Rock won will be loaded by an excavator on the quarry floor into the mobile crusher/screener on the quarry deck. The crushers grind the material into different sizes and shapes with resultant material divided into stockpiles of varying sizes and shapes. A loading shovel will operate in this area for truck loading and managing stockpiles. The loaded processed material is then trucked off site using rigid lorries. The current output of the quarry is approximately 100 tonnes per day which equates to approximately 5 lorry loads per day resulting in a daily total of 10 HGV's movements to and from the site.

9.4 Methodology

To assess the potential noise emissions from the proposed development, the following relevant guidance and legislation were consulted:

- Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (Jan 2016).
- Integrated Pollution Control Licensing – Guidance Note for Noise in Relation to Scheduled Activities, EPA 1995.
- ISO 9613-2, First Edition 1996-12-15. Acoustics-Attenuation of sound during propagation outdoors-Part 2: General method of calculations
- Draft Guidelines for the Treatment of Noise and Vibration in National Road Schemes
- BS5228, 2009 Code of Practice for Noise Control on Construction and Open Sites: Part 1: Noise.
- EPA, 2006, Environmental Management Guidelines-Environmental Management in Extractive Industry (Non Scheduled Minerals).
- EPA, 2003,Environmental Quality Objectives-Noise in Quiet Areas
- HMSO, Welsh Office, 1988. Calculation of Road Traffic Noise

9.4.1 Acoustic Terminology

Sound is simply the pressure oscillations that reach our ears. These are characterised by their amplitude, measured in decibels ("dB"), and their frequency, measured in Hertz ("Hz"). Noise is unwanted or undesirable sound, it does not accumulate in the environment, is transitory, fluctuates, and is normally localised. Environmental noise is normally assessed in terms of A-weighted decibels, dB (A), when the 'A weighted' filter in the measuring device elicits a response which provides a good correlation with the human ear. The criteria for environmental noise control are of annoyance or nuisance rather than damage. In general, a noise level is liable to provoke a complaint whenever its level exceeds by a certain margin, the pre-existing noise level or when it attains an absolute level. A change in noise level of 3 dB (A) is 'barely perceptible'; while an increase in noise level of 10 dB (A) is perceived as a twofold increase in loudness. A noise level in excess of 85 dB (A) gives a significant risk of hearing damage. Construction and industrial noise sources are normally assessed and expressed using equivalent continuous levels, LAeq[1].

[1] L_{Aeq} is defined as being the A-weighted equivalent continuous steady sound level that has the same sound energy as the real fluctuating sound during the sample period and effectively represents a type of average value.

9.5 Relevant Guidance and Legislation

9.5.1 Operation of Quarry

The EPA has produced Environmental Management Guidelines 2006[2]. This document references 'A Guidance Note for Noise in Relation to Scheduled Activities (EPA, 1996[1])'. It deals with the approach to be taken in the measurement and control of noise and provided advice in relation to the setting of emission limits values and compliance monitoring.

In relation to quarry developments and ancillary activities, it recommended that noise from the activities on site shall not exceed the following noise limits at the nearest noise-sensitive receptor:

Daytime	08.00-20.00 hrs	LAeq (1h) = 55dBA
Night-time	20.00-08.00 hrs	LAeq (1h) = 45dBA

95% of all noise levels shall comply with the specified limits values(s). No noise level shall exceed the limit value by more than 2dBA.

The guidelines also recommend that where existing background noise levels are very low, lower noise levels ELV's may be appropriate. It is also appropriate to permit higher ELV's for short term temporary activities such as construction of screening bunds etc. where such activities will result in considerable environmental benefit.

Very low background noise environment is well defined and referenced in the EPA's NG4 (Jan'16). Quiet areas are referenced in NG4 and refer to in Environmental Quality Objectives-Noise in Quiet Areas. To qualify the first stage involves screening and a number of criteria needs to be satisfied, one which involves being more than 15 km from urban areas with a population >15,000 people, or at least 7.5 km from any motorway or dual carriageway. The town of Letterkenny had a population in the 2016 census of 19,274 people and is situated approximately 13 km away from the site. There is a dual carriage way approximately 7 km from the site. The area would not be considered as a 'Quiet Area'.

The times of operation have been between 0800 hours and 1800 hours Monday to Friday and 0800 to 1300 hours on Saturdays with no work on Sundays. The quarry has not operated outside these hours or on Sundays or Public Holidays. The quarry currently provides employment for approximately 4 persons.

9.5.2 Construction

Relevant Guidance

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. However, the National Roads Authority ("NRA") give limit values which are acceptable ("the NRA Guidelines")[2]. Guidance to predict and control noise is also given in BS 5228:2009, *Code of Practice for Noise and Vibration Control on Construction and Open Sites* (two parts) where Part 1 deal with Noise. The NRA guidelines for construction noise which are considered typically acceptable are given in Table 9.1.

Table 9.1: Noise levels that are typically acceptable

Day / Times	Guideline Limits
Monday to Friday 07:00 – 19:00hrs 19:00 – 22:00hrs	70dB LAeq, (1h) and LAmax 80dB *60dB LAeq, (1h) and LAmax 65dB*

[2] 'Environmental Management in the Extractive Industry (Non-Scheduled Minerals),2006
[1] Ref. EPA's Guidance Note For Noise In Relation to Scheduled Activities, 1996
[2] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*

Day / Times	Guideline Limits
Saturday 08:00 – 16:30hrs	65dB LAeq,1h and LAmax75dB
Sunday and Bank Holidays 08:00 – 16:00hrs	*60dB LAeq,1h and LAmax 65dB*

*Construction outside of these times, other than required by an emergency works, will normally require explicit permission from the relevant local authority

Part 1 of BS 5228 provides several example criteria for the assessment of the significance of noise effects from construction activities. Noise levels generated by construction activities are considered significant if:

- The LAeq, period level of construction noise exceeds lower threshold values of 65dB during daytime, 55dB during evenings and weekends or 45dB at night, and;
- The total noise level (pre-construction ambient noise plus construction noise) exceeds the pre-construction noise level by 5dB or more for a period of one month or more.

9.6 Noise Impacts

The development is fully described in Section 3 of this rEIAR which includes construction and operation of the development.

9.6.1 Potential Noise Sources on site

The principal potential noise impact arising from the operation of the quarry in the past is increased noise nuisance. Increased noise levels are likely to have arisen on account of:

- Increased traffic along existing access roads to the site and internally across the applicant's landholding
- Operation of plant within the site for aggregate extraction and processing activities
- Drilling of blast holes and blasting
- Excavations and earthmoving for any preliminary restoration works including construction of screening berms

With respect to the potential for noise impacts, the key objective at the Application Site has been to manage activities in order to ensure that any discernible increase in noise levels have been prevented and the effect of any increase in noise emissions has been minimised.

Construction activity includes removal of overburden to provide berms/screening and storage stockpiles to be used in the restoration of the quarry. Other construction includes settlement ponds, haul roads and weighbridge.

The initial phase of development will have included all overburden removal, placement of all site infrastructure and development of settlement ponds and haul roads.

Operational noise will include extraction and processing activities, loading of product and transport of product. Currently most of this activity takes place on the quarry floor but the centre of these extraction and processing activities has moved around the site with the point of extraction over time.

The topography of the quarry setting provides significant acoustic screening / barrier effects which is provided by the height differential between the quarry floor, the height of the quarry boundary and the lower elevation of most receptors (lower than the quarry floor and significantly lower than the quarry boundary). The topographical setting provides acoustic screening similar to having a hill between the noise source and receptor. The current quarry floor base at 106-107 mOD resulting in effective barrier/screening height from the surrounding quarry faces. In similar topographical settings measurements have indicated that the screening benefit provided ranged between 34 and 38 dBA.

9.6.2 Noise measurement

In order to make an assessment of noise impact, a noise survey was carried out at 5 noise sensitive locations around the quarry site on 16th June 2022. The details of the noise survey carried out are contained in Appendix 9.1. The results of the survey are summarised below.

Five Noise Sensitive locations were chosen, and one 60-minute survey was carried out at each location while the quarry was fully operational. Plant in operation at the time of survey was the mobile crusher/screener, excavator ripping bedrock, excavator loading crusher, loading shovel moving product and loading lorries and lorries transporting product off site. The location of the Noise Sensitive locations is shown below in Figure 9.3.

Figure 9.3: Noise Sensitive Locations

The results of the noise survey are summarised in Table 9.2 below

Table 9.2: Noise Survey Summary

Location	Distance from nearest site boundary	$L_{Aeq,\ 1\text{-hour}}$ dBA	$L_{A10,\ 1\text{-hour}}$ dBA	$L_{A90,\ 1\text{-hour}}$ dBA
NSL1	200 m	49.2	52.1	52.1
NSL2	300 m	56.6	50.9	50.9
NSL3	330 m	61.1	39.6	39.6
NSL4	300 m	43.7	44.7	44.7
NSL5	300 m	43.7	45.9	45.9

9.6.3 Noise measurement assessment

As can be seen from Table 9.2 above, all the $L_{A90,\ 1\text{-hour}}$ values were below the 55 dBA threshold. The $L_{A90,\ 1\text{-hour}}$ values are representative of background noise levels and would include operational noise from the quarry. The noise sources from the application site are acoustically screened very well from most noise sensitive receptors. The $L_{Aeq,\ 1\text{-hour}}$ values are also below the 55 dBA threshold apart from NSL3 (66.1 dBA) and NSL2 (56.6 dBA) where the contribution from passing traffic (non-quarry related) is the reason for these values (see Appendix 9.1)

NSL1 is at approximately 105 mOD which is 23m below the level of the screening berms near the entrance to the quarry.

NSL2 is at approximately 102 mOD which is 21-26m below the level of the eastern boundary of the quarry.

NSL3 is at approximately 140 mOD which is 25m above the nearest quarry boundary. There is a direct line of site from the two houses situated at NSL3 into the northern portion of the quarry. Current workings are on the quarry floor at 107 mOD which is screened from NSL3 by means of a large bedrock promontory at approximately 125-127 mOD. This acoustic screening has helped ensure that the contribution from quarry activities to $L_{Aeq,\ 1\text{-hour}}$ values for this NSL have been compliant with guidance.

Historically the greatest impact to NSL3 is likely to have been extraction and processing in the northern portion of the site. Excavation levels are not particularly deep in this location but may have had a significant noise impact on NSL3. Some basic predictive modelling for historical noise levels at this NSL is given below: The assumptions made are:

Extraction and processing activities at or close to the northern site boundary.
Mechanical extraction by 45 T excavator and processing by mobile crusher/screener – 87 dBA @10m distance (from previous measurements taken on similar sites)
The difference between noise levels at two different locations can be modelled as follows:

$$\mathbf{L}_{p2} - \mathbf{L}_{p1} = 10 \log (R_2 / R_1)^2 - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$

$$\mathbf{L}_{p2} - \mathbf{L}_{p1} = 20 \log (R_2 / R_1) - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$

Where;

L_{p1} = sound pressure level at location 1
L_{p2} = sound pressure level at location 2
R_1 = distance from source to location 1
R_2 = distance from source to location 2, and where
A_{atm} = Attenuation due to air absorption
A_{gr} = Attenuation due to ground absorption
A_{br} = Attenuation provided by a berm/barrier
A_{mis} = Attenuation provided by miscellaneous other effects

Attenuation by miscellaneous effects is assumed as zero in all the predictions. Attenuation by air absorption and ground absorption combined is conservatively assumed as 3dBA. There are some semi-mature trees near to the site boundary but no dedicated screening berm so attenuation by berm/barrier is conservatively assumed to be zero.

Predicted $L_{Aeq,\ 1\text{-hour}}$ at NSL3 for historical activity in the northern part of the site is 53.6 dBA.

NSL4 is at approximately 127 mOD with the nearest quarry screening berms at 136 mOD.

NSL5 is at approximately 123 mOD and the screening berms of the adjacent quarry (not part of this study) are at 125 mOD and 40m distant.

The only other noise source not taken into consideration is the periodic requirement for shot holes to be drilled for the purposes of blasting. This has been required approximately once or twice per year. Values for the noise associated with shot hole drilling is taken from the average over a number of field measurements on various sites and is 63 dBA at 40m distance. These were predicted for each of the Noise Sensitive Locations for the likely blast locations closest to each receptor. The results of the historical predictions are listed in Table 9.3 below. There has been no allowance made for attenuation that may have been in place due to a screening berm.

Table 9.3: Predicted historical noise levels due to shot hole drilling

Location	Distance from location to nearest historic blast face / m	Ground and Air Attenuation / dBA	Source of Noise at 40m / dBA	$L_{eq, 1\text{-hour}}$ / dBA
NSL1	220	3	63	45.2
NSL2	310	3	63	42.2
NSL3	360	3	63	40.9
NSL4	330	3	63	41.7
NSL5	320	3	63	41.9

9.6.4 Predicted historical worst-case scenario

The worst-case scenario is likely to have been extraction & processing occurring at the same time as shot holes were being drilled for a blast. Blasting occurred one or twice yearly, so this scenario was not very common, but it is considered. Table 9.4 below shows the predicted cumulative noise impacts for each of the Noise Sensitive Locations. In the case of NSL3, the predicted noise levels when extraction & processing was closest are used rather than the measured levels from the 2022 noise survey with all equipment operating simultaneously within the quarry void.

Table 9.4: Historical Cumulative noise level predictions

Location	Predicted levels from shot hole drilling $L_{eq, 1\text{-hour}}$ dBA (Table 9.3)	Measured noise levels with ongoing extraction and processing $L_{eq, 1\text{-hour}}$ dBA (Table 9.2)	Cumulative Impact $L_{eq, 1\text{-hour}}$ dBA
NSL1	45.2	49.2	50.7
NSL2	42.2	56.6	56.8
NSL3	40.9	53.6*	53.8
NSL4	41.7	43.7	45.8
NSL5	41.9	43.7	45.9

*Predictive rather than measured

9.6.5 Noise Impact Assessment

The maximum noise levels are predominately based on the contribution made by shot hole drilling close to the boundary in conjunction with extraction and processing activities taking place simultaneously.

Noise levels have been measured at receptor locations when all plant is in operation. By the very nature of quarrying all plant will normally not be in operation at the same time as two days crushing may be sufficient for a weekly demand. Mitigating measures have been implemented where deemed necessary. The predicted noise levels are maximum levels and include the cumulative effects of all activity. The predicted noise levels for all receptors apart from NSL2 are below the levels recommended by the EPA Environmental Management Guidelines for Quarries. It is noted that the measured noise levels at NSL2 have a considerable contribution from passing traffic (Appendix 9.1). The actual and predicted noise levels at NSL2 sourced from activities at the application site are not likely to have exceeded the recommended guidelines.

9.7 Mitigation Measures Implemented

- Acoustic berms of 2.5 to 3m height have been constructed along the extraction boundary of the site where possible.
- The processing plant (crushing and screening) generally has been located in the quarry floor area thereby giving maximum barrier attenuation effect
- All motors and pulleys have been maintained to a high standard with regular maintenance so as to avoid any tonal or impulsive components in the emission.
- All mobile plant on site have well maintained silencers.
- Machinery is throttled down or turned off when not in use.
- A noise buying standard has been in place where any replacement of mobile plant was due, noise characteristics are considered.
- Operating procedures have included training to reduce drop heights for product.

9.8 Road Traffic Noise Impacts

The planned output of the quarry is 100 tonnes per day which results in 5 lorry loads per day resulting in a daily total of 10 HGV movements to and from the site. This equates to a mean flow of 1 HGV's movements/hour. The hourly road traffic flow from 2022 on the L-5414 is 13 vehicles. Over 10 hours this equates to a mean flow of 130 movements. Typically, 2 light vehicles can equate to 1 HGV in noise emission terms.

The recorded traffic flow approximates to a flow of 13 veh /hr. The application site contribution to the traffic flow is approximately one HGV per hour. There is a logarithmic relationship between traffic flow and noise levels and typically doubling the road traffic flow will increase the noise levels by 3dBA. The increase in road traffic from the application site will be negligible at all receptors.

Peak production has been estimated at 20 loads per day which is 40 HGV movements to and from the site. General traffic movements are likely to have been at increased levels during these times in proportion to general increased economic activity. On an hourly basis, this adds 4 HGVs per hour or the equivalent of an extra 8 light vehicles per hour in noise emission terms. Assuming traffic volumes during these times were also increased it may be reasonable to assume that traffic volumes may have almost doubled, therefore the noise levels can have been expected to rise by approximately 3 dBA. Of this 3 dBA, not all of the noise source will be quarry related.

Peak production traffic movements, adding almost 3 dBA to the $L_{Aeq,\ 1\text{-hour}}$ values at Noise Sensitive Locations will not have increased the overall contribution from quarry related activity beyond the 55 dBA threshold.

9.8.1 Ground Vibration from HCV's

The level of ground vibration at 10m from a loaded truck will be below the human threshold at less than PPV of 0.2mm/sec[3]

9.9 Do-nothing Scenario

If the development to extract rock and process aggregate is not granted substitute consent then local construction end users will be forced to source quarry product and aggregate from further afield. This will result in reduced noise impacts in the vicinity of the site but increased noise impacts elsewhere.

[3] Wiss, J. F., and Parmelee, R. A.. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division*", ASCE, Vol 100, No. S74, PP. 773-787

9.10 Noise Monitoring

It is proposed to carry out noise monitoring at five locations annually (NSL1, NSL2, NSL3, NSL4 & NSL5). If compliance is met at these five nearest locations then it will be met at locations further away from the site.

9.11 Residual Impacts

It is not expected that there has been an adverse impact on noise quality in the vicinity of the application site assuming that mitigation measures and best practice has been applied.

9.12 Technical Difficulties

There were no technical difficulties encountered during the study / assessment.

9.13 Conclusion Noise

Noise levels for the development have been measured and predicted to include the cumulative and historical effects of activity. Predictions have been made of maximum hourly noise levels with no allowance made for ground absorption or air attenuation. The measured and predicted noise levels sourced from quarry activity at the application site are well within the levels recommended by the EPA Environmental Management Guidelines-Environmental Management in Extractive Industry (Non-Scheduled Minerals).

9.13.1 Determination of Significance of Impact Pre-Mitigation

Impact	**Receptor**	**Description of Impact (Character / Magnitude / Duration / Probability / Consequences)** Negligible - High	**Existing Environment (Significance / Sensitivity)** Negligible -High	**Significance** Imperceptible - Profound
Operational noise of day-to-day quarrying activity from the site including blasting	Noise sensitive receptors near the site	Low	Medium	Slight
Construction noise from the site	Noise sensitive receptors near the site	Low	Medium	Slight
Increased traffic noise	Noise sensitive receptors near the site	Low-Negligible	Low-Medium	Not significant

9.13.2 Summary of Mitigation Measures

Summary of Mitigation Measures Implemented & Proposed
Acoustic berms of 2.5 to 3m height have been constructed along the extraction boundary of the site where possible.
The processing plant (crushing and screening) must be located in the quarry floor area thereby giving maximum barrier attenuation effect
The screener systems must be in a housing envelope

All motors and pulleys must be maintained to a high standard with regular maintenance so as to avoid any tonal or impulsive components in the emission.
All mobile plant on site must have well maintained silencers.
Machinery must be throttled down or turned off when not in use.
A noise buying standard must be put in place where any replacement of mobile or fixed plant is considered.

9.13.3 Determination of Significance of Impact Following Mitigation

Impact	**Receptor**	**Description of Impact (Character / Magnitude / Duration / Probability / Consequences)** Negligible - High	**Existing Environment (Significance / Sensitivity)** Negligible -High	**Significance** Imperceptible - Profound
Operational noise of day-to-day quarrying activity from the site including blasting	Noise sensitive receptors near the site	Low	Medium	Not significant
Construction noise from the site	Noise sensitive receptors near the site	Low	Medium	Not significant
Increased traffic noise	Noise sensitive receptors near the site	Low-Negligible	Low-Medium	Not significant

9.13.4 Impact Assessment Conclusion

There will be no significant negative impact from noise following the implementation of the recommended mitigation measures.

9.14 References

Department of Communities and Local Government (1993) Minerals Planning Guidance 11 – The Control of Noise at Surface Mineral Workings (MPG-11).

Department of the Environment, Heritage and Local Government (2004) Quarries and Ancillary Activities: Guidelines for Planning Authorities.

DEFRA (2005) Update of Noise Database for Prediction of Noise on Construction and Open Sites.

EPA (2006) Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals).

EPA (2012) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

BS5228 (2009) Code of Practice for Noise Control on Construction and Open Sites. Part 1: Noise.

Safety Health and Welfare at Work (Control of Noise at Work) Regulations 2006 (S.I. No. 371 of 2006).

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Blast Vibration Report

Tinneys Quarry Development

Report Prepared by: Brendan O'Reilly (June 2022)

9.15 BLAST VIBRATION

9.16 Introduction

This section of the Remedial Environmental Impact Assessment Report (rEIAR) was prepared by Brendan O'Reilly of Noise and Vibration Consultants to assess the vibration impacts from the operation of the existing Tinneys quarry. Substitute consent is sought for extraction and processing activities that have been carried out to date. A full description of the development is provided in Chapter 3 of the rEIAR. The application site is located approximately 4 km west of the town of St Johnston in east Co. Donegal in the townland of Trentamucklagh (Eircode: F93 KC04).

9.17 Statement of Authority

This section of the rEIAR has been prepared by Mr. Brendan O'Reilly of Noise and Vibration Consultants Ltd. Mr. O'Reilly has a Master's degree in noise and vibration from Liverpool University and over 35 years' experience in noise and vibration control (and many years' experience in preparation of noise impact statements) and was a member of a number of professional organisations including ISEE. Brendan was a co-author and project partner (as a senior noise consultant) in 'Environmental Quality Objectives Noise in Quiet Areas' administered by the Environmental Protection Agency. Noise & Vibration Consultants have considerable experience in the assessment of noise impact and have compiled EIA studies ranging from quarries, mines, retail development, wastewater treatment plants, housing developments and wind farms. Experience included dealing with all the noise and vibration related issues in Europe's largest Zn/Pb mine where blasting frequently occurred under houses.

9.18 Description of Activity On-Site

The Substitute Consent site activity included the removal of overburden and extraction of underlying rock by blasting. The extraction area is c.10.5 hectares in size and has been developed as a stone quarry. Extraction has taken place over most of the footprint of the site. The highest point of the site is along the southeast boundary where the vegetated berms are at 136 mOD. The boundary between the application site and the quarry to the north is a rocky ridge at approximately 133 mOD. The lowest point of the site is the quarry deck at approximately 106 mOD. A significant promontory remains in the centre of the site at approximately 125-129 mOD. The applicant has been extracting rock using excavators. Blasting process which included prior shot hole drilling has been carried out one to two times per year when a particularly hard piece of lithology was encountered. The layout of the site is given in **Plate 1**.

All blasting at the quarry was undertaken in accordance with all applicable legislation including the Safety, Health and Welfare at Work Act 2005, and the Safety, Health and Welfare at Work (Quarries) Regulations, 2008. There were no blast vibration measurements carried out, however values were predicted at the nearest receptors using an established methodology (refer to Appendix for predicted blast vibration levels). Plate 1 illustrates the location of the two properties where the blast predictions were made, F93 X9X4 and F93 X9X4.

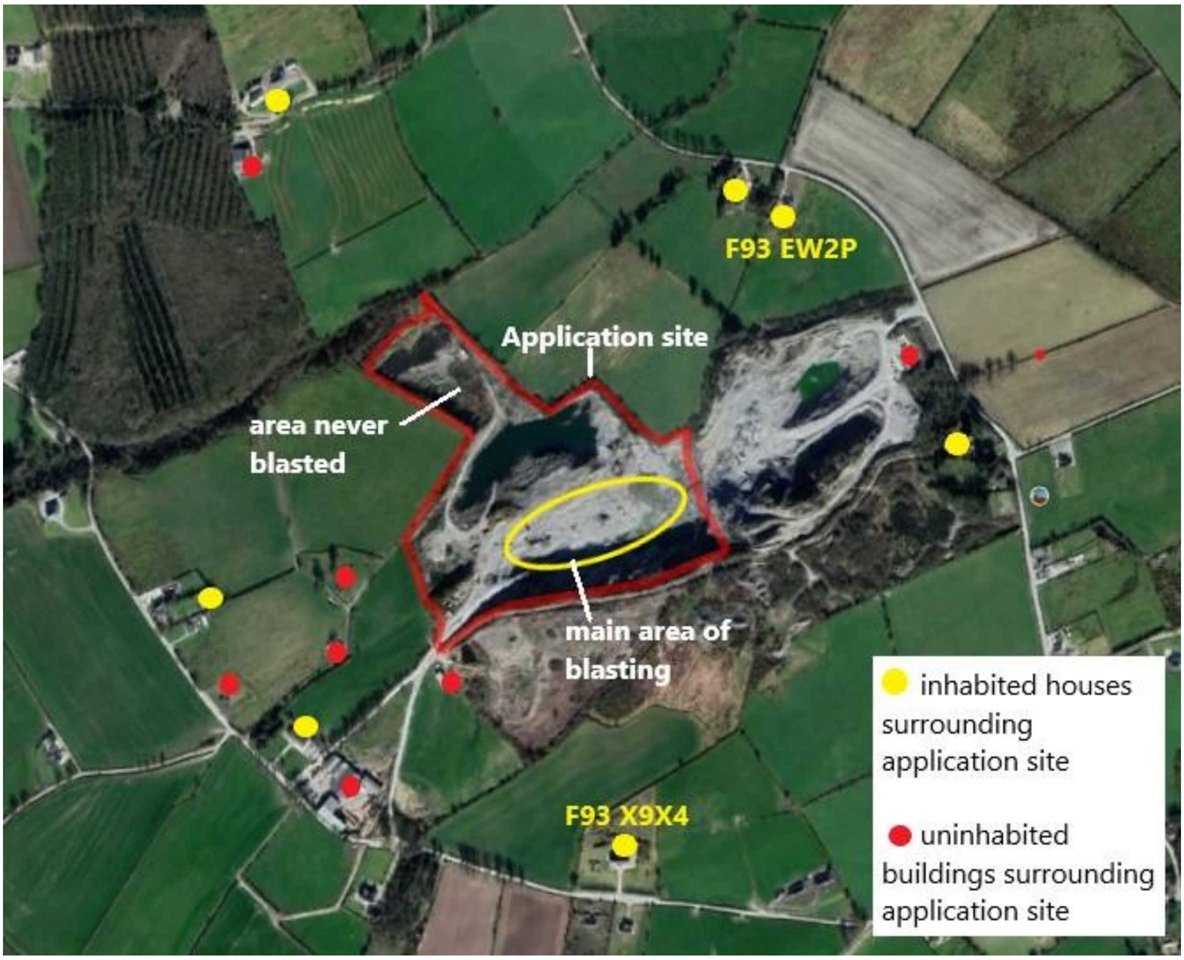

Plate 1 : Layout of Site

9.19 Blast Vibration Criteria, Guidelines/Recommendations/Standards

Ground Vibration

The measurement of peak particle velocity (PPV) is internationally recognised as the best single descriptor to use when assessing potential ground vibration damage to structures/buildings. More recently velocity-frequency control bounds are used as damage control criteria.

There are many different standards and recommendations being used internationally, some like the German DIN 4150[1] that lacks data for its foundation. However, most of these standards and recommendations are derived from the considerable work carried by the U. S Bureau of Mines (USBM). The USBM Report of Investigation 8507[2] gives practical safe criteria for blasts that generate low frequency ground vibrations (<40Hz). These are 19 mm/sec for modern houses and 12.7 mm/sec for older houses. It is normal when measuring PPV that the vibration levels are measured in three orthogonal directions (horizontal longitudinal, vertical, horizontal transverse (often termed x, y, z vector components, or L, V, T).

[1] German Standard, DIN 4150; Part 3: 1986, Vibration in buildings; effects on structures

[2] Siskind, D. E, Stagg, M. S., Kopp, and Dowding, C. H. (1980) '*Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting*' U .S Bureau of Mines RI 8507

There are no Irish standards for ground vibration, however there are limits recommended in the EPA's Guidance Note on Noise in Relation to Scheduled Activities. These limits are also recommended in the Guidelines for Planning Authorities for *Quarries and Ancillary Activities* issues in April 2004 by the Department of the Environment, Heritage and Local Government. The EPA has also published "Environmental Management Guidelines" Environmental Management in the Extractive Industry (Non Schedule Minerals), 2006. For ground vibration the recommended limits is 12mm/s, measured in any of the three mutually orthogonal directions at the receiving location (for vibration with a frequency of less than 40Hz) and normal hours of blasting should be defined with quarry operators providing advance notification of blasting to nearby residents.

For this development the quarry has been operating a ground vibration limit of 12 mm/sec.

Air Overpressure (Air Blasts)

Air blasts are characterised by containing a larger proportion of its energy in the sub-audible spectrum, below 20 Hz. Because the waves associated with air blasts are essentially outside the audible spectrum (below 20 Hz), a separate unit of measure, pressure is reported

The pressure is recorded using an air-blast transducer and the linear device must measure accurately in the structurally critical range of 2 to 20 Hz. Air blast (sound waves) can be reported in two distinct units of measurements, pressure (psi) or decibels (dB), however it is normal to report air-overpressure in dB with a microphone that is Linear down to 2Hz. EPA guidance recommends limit of 128 dB (linear maximum peak value), with a 95% confidence level.

9.20 Ground Vibration

Ground vibration can be defined as regularly repeated movement of a physical object about a fixed point. Ground-borne vibration can be generated by a number of sources, including road and railways, construction activities such as piling, blasting and tunnelling.

Table 1 below details a list of common tasks and the level of vibration they produce. This table was extracted from the Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals) which was published by the EPA in 2006.

Table 1: Typical vibration levels generated by everyday activities

Vibration level	Description of activity
1.0–2.5 mm/s	Walking measured on a wooden floor
2.0–5.0 mm/s	Door slam, measured on a wooden floor
12–35 mm/s	Door slam, measured over doorway
5–50 mm/s	Footstamp, measured on wooden floor
30–70 mm/s	Daily changes in temperature and humidity
120 dB	Constant wind of 5 m/s: Beaufort Scale 3, Gentle Breeze
130 dB	Constant wind of 8 m/s: Beaufort Scale 4, Moderate Breeze

Ground Vibration from Blasting

When an explosive detonates within a borehole it causes the rock in the immediate vicinity to break or distort. Outside this immediate vicinity of the blast site permanent deformation does not occur.

Ground vibration is caused by the imperfect utilisation of the explosive energy released during fragmentation of rock in blasting operations. The energy that is unused in the fragmentation of rock propagates as an elastic disturbance away from the shot area as seismic waves. These waves, which radiate in a complex manner, diminish in strength with distance from the source. The theory relative to this motion is based on an idealised (sinusoidal) vibratory motion. When these waves come into contact with a free face physical motion results, as the energy induces oscillation in the ground surface. Blasting vibration is a surface wave type, which incorporates components of both body and surface motion.

Ground vibration itself is in-audible, however air vibrations (Air overpressure) both audible and sub-audible usually accompany it. The resulting impacts of blasting vibration are often characterised as being impulsive and of short duration, usually less than 1 second. It is difficult for the average lay person to differentiate between the various types of vibrations (ground vibration and air overpressure), humans commonly associate the level of vibration with the 'loudness' of a blast.

9.21 Ground Vibration Control

Ground vibration from blasting at any receptor point is influenced in the main by:

- the maximum instantaneous charge of explosives usually referred to as MIC.
- the medium between blast source and receptor point and.
- the distance between the receptor point and the blast source.

The level of ground vibration control is based on reducing and controlling the weight of explosives detonated per delay. In any given situation large amounts of explosives can be detonated using time delay intervals (greater than 8millie-second) between specific charges within the overall blast. The level of ground vibration is directly related to the maximum charge weight per delay and numerous studies have shown that peak particle velocity (PPV) is directly related to the maximum charge weight per delay. In terms of predicting ground vibration each quarry location is 'site specific'. Typically, a 'scaled distance' regression line can be established using monitored vibration data, MIC and distance, or in this instance a conservative regression line can be used from a known similar site. Continuous vibration monitoring will ensure that blast vibration limits are being complied with and it also allows the development and adjustments to the 'scale distance' regression line for the proposed site. The Tinney quarry has relied on predicted vibration levels based on 'scale distance' regression line. Predicting vibration on a 'scale distance' regression line is best practice when accompanied by monitoring. It is important to note that there have been no complaints relating to blasting being carried out which is generally a good indicator of low levels of vibration.

In practice the distance and medium to a receptor will determine the MIC to be used for a blast. Lowering the MIC can be obtained by a number of means including any combination of the following:

- reducing the shot hole diameter for given bench height
- reducing the bench height, thereby reducing the shot hole
- decking charges-dividing the charge within the shot hole by using a minimum of 1.5m of stemming

Plate 2 below details a blast design profile for a quarry which shows a section through the quarry face and drill holes (not to scale).

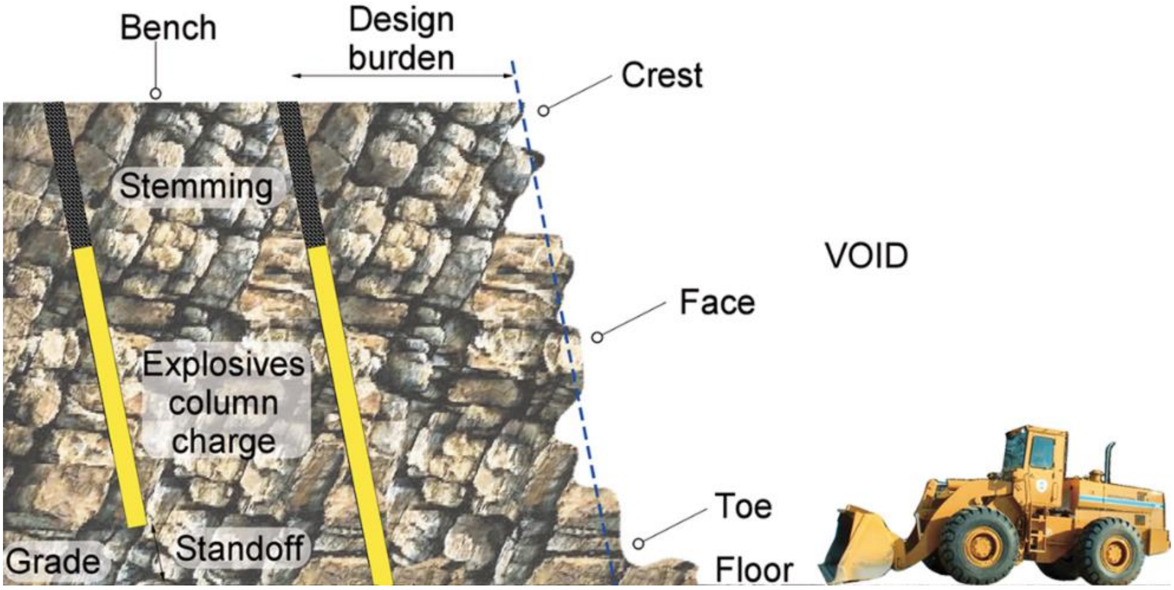

Plate 2: Blast design profile

9.22 Air Blast (Air-Overpressure) Noise

A blast causes a diverging shock-wave front that quickly reduces to the speed of sound, and an air blast is then propagated through the atmosphere as sound waves. Air blast or air overpressure is the term used to describe the low frequency, high energy air vibrations generated by blasting detonation. Air blasts are characterised by containing a larger proportion of its energy in the sub-audible spectrum, below 20 Hz. Because the waves associated with air blasts are essentially outside the audible spectrum (below 20 Hz), a separate unit of measure, pressure is reported.

The pressure is recorded using an air-blast transducer and the linear device must measure accurately in the structurally critical range, 2 to 20 Hz. Air blast (sound waves) can be reported in two distinct units of measurements, pressure (psi) or decibels (dB). It is standard to report in decibels

Sound waves in the form of the sub-audible sound waves (air overpressure/air blast waves), and noise (the audible waves) are sometimes linked inextricable. It is difficult sometimes for humans to differentiate between the characteristics of air blasts and noise.

In general the sub-audible waves are of greatest concern. The sub-audible sound waves, if high enough can excite structures to produce audible rattle inside structures and may, in the extreme, break glass and crack wall coverings. However, there are no known cases of foundation cracks from air blasts at values anywhere near the glass breakage threshold of 140 dB[4]. The cracking of glass (the weakest component of a structure) is likely to be probabilistic in nature. In other words, not all windows will crack at 140 dB.

A wind speed of 9 m/s produces a pressure equal to 133.7 dB (0.014 psi). Although such wind is comparable in amplitude to a strong air-blast, its effects are not as noticeable because of the relatively slow rate of wind change and the corresponding minor or non-existent rattling, compared with the rapid rise time (impulsive) of an air blast transient.

Air blast waves are attenuated over distance in much the same way as sound waves; however, there are some differences due to the lower frequency of the sub-audible air blast waves. Lower frequency waves are attenuated at a lower rate by air absorption over distance than the higher frequency audible waves. Air blasts, being very high pulses of energy in the form of low frequency waves can travel great distances. The effects of temperature inversions are negligible close to a blast, but may exceed 10 dB at 800m or greater. However, lack of focusing at short distances is important, since only at short distances are pressures large enough to produce cracking. The effects of ambient temperature and relative humidity are considered negligible, at less than 1 dB at 1Km[5]. Prediction and control of air blasts can be more difficult than that of ground vibration due to the influences of weather conditions on the air blast propagation.

9.23Control of Air Blasts

The principal factors governing air blasts are:

(a) the type and quantity of explosives

(b) the degree and type of confinement (stemming)

(c) the method of initiation (not-use of exposed detonating Cord etc.)

(d) local geology, topography and distance

(e) atmospheric conditions

Factors (a), (b) and (c) are variables within the control of the quarry operator whereas (d) and (e) are essentially uncontrollable at any particular site. However, by varying the timing of a blast (avoid early morning or late evening), by controlling the degree of confinement and by using non-electric or electronic detonators as the method of initiation (non –use of detonating Cord on surface) the quarry operator, in effect, achieves control over the influence of atmospheric conditions and hence over the blast emissions. It is important to note that atmospheric conditions (including temperature inversions) will have little effects at distances within 300m.

There were no measurements of air overpressure made, however it is proposed to monitor and limit any future quarry blasts to an air overpressure level of 125 dB (Lin peak) with a 95% confidence limit

[4] Siskind, D. E., Crum, S. V., and Plis, N. M. (1993). '*Blast Vibrations and Other Potential Causes of Damage in Homes Near a Large Surface Coal Mine in Indiana'*, USBM, RI 9455

[5] Aimone-Martin, C., and Martin, R. S. (2000). *Effects of Temperature and Humidity on Airblast Sound Pressure Levels*. Journal of the International Society of Explosive Engineers

when measured with instrumentation that has a linear response down to 2 Hz. This proposed limit is well below the safe level of 133.7 dB for air blasts given by Siskind *et al.*, 1980[6] and is also within the limit recommended by the EPA. It is worth noting that there were no complaints made regarding blasting which can be a guide to good blasting practice.

9.24 Flyrock

Flyrock can occur due to incorrect design and poor management of blasting rounds where there is inadequate stemming or inadequate burden (overcharging the holes with explosives). Overcharging can be avoided by following proper management procedures). Considerations for the bench height, bench face profile, face condition, local geology, rock properties, burden and spacing of the drilling pattern and in particular to the first row of boreholes when calculating charge weight per hole will ultimately define the optimum powder and energy factors for a safe and productive blast. The measures taken to control ground vibration and air-overpressure will also control and counteract the possibility of flyrock. There were no breaches relating to flyrock during the development of the quarry.

9.25 Mitigating Impacts for Ground Vibration, Air-Overpressure Noise and Flyrock Control

The following controls were in place so that ground vibration, air overpressure and noise is minimised and kept within the regulatory limits. Specific mitigations measures incorporated are listed as follows;

- Considerable care was taken to conduct the blast only between 12:00 hrs and 16:00 hrs, Monday to Friday. No blasts were conducted on weekends or bank holidays.
- Prior to drilling of any blast, a face profiling or a trigonometric bench height measurement was carried out for all blasts.
- Prior to drilling the blasting pattern, the quarry foreman marked the position of the boreholes and the blast number on the ground as per the agreed blasting plan approved and signed by the Drilling and Blasting Manager.
- A blasting plan was issued by the blaster in charge for agreement to the Drilling and Blasting Manager prior the drilling of any blast.
- Only personnel with appropriated Certification in drilling and blasting was allowed to operate the blasting programs.
- A driller's log was put in place at all times.
- A site-specific scale distance regression for the proposed development site was used.
- Advance warning notice of blasts were given to in the local environs of the quarry prior to blasting.
- The optimum blast ratio was maintained to ensure that the maximum amount of explosive on any one delay, the maximum instantaneous charge (MIC) is optimised so that the ground vibration levels were kept below the regulatory limits.
- Explosive charges were properly and adequately confined by a sufficient amount of quality of stemming by using angular chippings and/or a combination of angular chippings and plug.

[6] Siskind, D. E., Stachura, V.J., Stagg, M. S., and Kopp, J. W. (1980). *Structural Response and Damage Produced by Air Blast from Surface Mining*, USBM, RI 8485

- The adequate confinement of all charges by means of accurate face survey and the subsequent judicious placement of explosives by certified personnel was maintained.
- Overcharging was avoided by considering depth, burden and spacing when calculating charge weight per hole
- There was no exposed detonating cord used in surface.
- The initiation sequence in the blast were set in a way that it progresses away from the nearest sensitive locations or structure to be protected, were practical.
- An adequate powder factor and energy factor was chosen for each blast by considering safety, confinement and productivity.
- Borehole deviation studies was conducted in order to have a better control in potential borehole deviation.
- Only the necessary sub drilling to achieve good breakage was used (Normally 1 to 1.5 m), excessive sub-drilling was avoided at all times.

9.26 Do-nothing Scenario

If the development had not proceeded, there would be no ground vibration or air overpressure impacts and the local community would be required to source their rock material requirements from a more distant source.

9.27 Unplanned Events

No emergencies were encountered during the extraction process such as a fire to plant or equipment. Going forward an emergency response plan will be implemented for the site.

9.28 Blasting and Vibration Monitoring

Blast vibration monitoring was not carried out, however predicted ground vibration levels were made using a 'scaled distance' regression line for each of the nearest receptors with levels predicted given in Appendix.

Where measurements are not being taken that conservative Mic's are used from another similar site.

9.29 Residual Impacts of Development

It is not anticipated that there was an adverse impact on the vibration quality in the vicinity of the application site as no complaints were reported.

9.30 Summary of Significant Effects

The operation of quarry blasting was designed and planned to keep within the predicted levels which were within the normal statutory limits applied.

9.31 Statement of significance

This Section has assessed the significance of the potential effects of quarry blasting during operation and decommissioning. The control measures put in place along with the mitigation measures and only personnel with appropriated Certification in drilling and blasting were 'scaled distance' regression line allowed to operate the blasting programs.

9.32 Technical Difficulties

There were no technical difficulties encountered during the study / assessment based on the predicted levels.

9.33 Glossary of Technical Terms

Peak Particle Velocity (PPV) – the maximum rate of change of particle displacement, measured in millimetres per second (mm/sec).

Frequency (Hz) – the number of cycles per second of vibration usually expressed in Hertz (Hz)

dB – Decibel, a unit of measure on a logarithmic scale used to quantify pressure fluctuations such as those associated with air overpressure (concussion wave)

dB(A) – Decibel measured within an A weighted frequency curve that differentiates between sounds of different frequency in a similar way to the human ear

Maximum Instantaneous Charge Weight – The maximum amount of explosives detonated at any one precise instance in time

Scaled Distance – The blast/receiver separation distance divided by the square root of the maximum instantaneous charge weight

Blast Ratio – The amount of work per unit of explosive measured in tonnes of rock per kilogram of explosives detonated

Delay Interval – The time between successive detonations of detonators

Sequential Detonation – The method of control of time intervals between explosions of individual charges

Stemming – The term given to the inert material, typically stone chippings that is placed into the top of a borehole which has already been filled with explosives. The length of stemming should equal the distance between the hole and its associated free face.

Burden – The distance measured at right angles between a row of holes and the free face, or between rows of holes.

Shot – is a borehole complete with primed charge and stemming

Bench blasting - method of blasting in quarries and opencast sites by means of steps or benches with holes positioned parallel to the bench face.

Flyrock - The projection of material from the blast site to any area beyond the designated danger zone.

Free face - A rock surface bounded by air.

9.34 Vibration Terminology

Particle Velocity (V) - the particle velocity is defined as the rate of change of amplitude or, for sinusoidal motion this may be mathematically expressed as;

$V=2\pi fa$

Where, 'V' represents PPV (mm/sec.), 'f' is the frequency (Hz) and 'a' is the peak particle displacement or amplitude (mm). Particle velocity as the term suggests is the movement of particles within a body or medium.

Vibration is usually measured in three orthogonal directions: the vertical, horizontal transverse and the horizontal longitudinal (often termed the x, y, z vector components). Vibration waves can be divided into P (primary) waves which are compression wave, S (secondary) waves which are shear waves, Rayleigh waves, Love waves, Stonely waves etc. However, in practice it is very difficult (and not very important) to distinguish between these waves. In most cases the vertical component is the *body wave* while the *surface waves* are the longitudinal and transverse waves.

Peak Particle Velocity (PPV)- the peak particle velocity is the maximum peak level of the 3 vectors (x, y, z), often referred as the real-time resultant. As all three vectors have different travel times the PPV of the three vectors will not arrive at the same time at a monitoring location.

Peak Vector Sum (PVS) - the peak vector sum is often referred to as the RPPV (resultant peak particle velocity) and can be mathematically expressed as;

$$PVS = \sqrt{X^2 + Y^2 + Z^2}$$

and this is the pseudo resultant (not the real time resultant). You will usually find that in practice the average difference in the peak vector-particle and the PVS is less than 10% at distances in excess of 200 metres[5].

Zero cross frequency (zc) - zero crossing frequency is the frequency at the peak particle velocity of the recorded wave.

9.35 References

[1] Siskind, D.E., Stagg, M.S., Kopp, J.W. and Dowding C.H., *Structural response and damage produced by ground vibration from surface mine blasting,* United States Bureau of Mines (USBM), Report of Investigations No. RI 8507, 1980. OSMRE –The U.S. Office of Surface Mining (OSM) regulation given by the solid line is a modification of USBM

[2] DIN 4150: Part 3: 1986, *Vibrations in buildings; effects on structures.*

[3] BS 7385: Part 2: 1993 *Evaluation and measurement for vibration in buildings,*

Part 2. Guide to damage levels from ground borne vibration.

[4] Dowding, Charles, H. (1996). *Construction Vibrations*, 610 pages, Prentice Hall.

[5] O'Reilly, B., (2000), Noise and Vibration Monitoring Around an Active Base Metal Mine, M.Phil Thesis, Liverpool University, U.K.

[6] BS 5228-1:2009: Code of Practice for noise and vibration and open sites- Part 1: Noise

Appendix: Predicted blast vibration levels

Ian Tinney Quarry Summary of Blasting

Date	Blast Total (kg)	mic (kg)	Nearest residence	Direction	Distance (m)	Scaled Distance (m/kg$^{1/2}$)	Predicted PPV (mm/s)
25 April 2014	4368	115	F93X9X4	S	368	34.3	4.2
05 February 2015	2604	108	F93X9X4	S	368	35.4	4.0
20 July 2015	3350	120	F93X9X4	S	350	32.0	4.7
14 January 2016	3300	168	F93X9X4	S	340	26.2	6.2
31 May 2017	3920	145	F93X9X4	S	320	26.6	6.1
02 March 2018	3323	97	F93X9X4	S	340	34.5	4.2
07 November 2018	2280	67	F93X9X4	S	340	41.5	3.2
03 April 2019	3526	175	F93EW2P	NE	360	27.2	5.9
05 September 2019	4590	190	F93EW2P	NE	360	26.1	6.3

APPENDIX 9.1: Environmental Noise Report

greentrack
Environmental Consultants

Environmental Noise Report

Environmental Noise Report by Greentrack Consultants commissioned by Tinney's Quarry Ltd to assess the potential noise impacts of development at an existing quarry site located at Trentamucklagh, St Johnston, Co.Donegal, to inform a remedial Environmental Impact Assessment Report (rEIAR).

Greentrack Environmental Consultants

June 2022

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1 INTRODUCTION

Tinney's Quarry Ltd is a well-established quarry enterprise supplying aggregate. An application for substitute consent is to be lodged with AnBord Pleanala. A remedial Environmental Impact Assessment Report (rEIAR) is to accompany the substitute consent application. The purpose of this environmental noise report is to help inform the rEIAR.

2 SITE DESCRIPTION

2.1 Location

The application site is located approximately 4 km west of the town of St Johnston in east Co. Donegal (Eircode: F93 KC04). The site is located in the townland of Trentamucklagh and is served by the local road, L-5414. Access to the quarry is off this local road via a concrete and hardcore access road.

The site is surrounded by agricultural land on all sides apart from to the east where a quarry face separates the site and a separate quarry operated by a different owner. An extensive area of commercial forestry lies to the north and northwest of the site, flanking the slopes of Dooish Mountain.

The red line boundary to which the application refers is shown in the site layout in Figure 2.1 below.

Figure 2.1: Site Layout and Red Line Boundary

(supplied by Dominic Whorisky Architects)

2.2 Site Description

The Application site is c.9.9 Ha in size and broadly rectangular in shape, orientated NW/SE.

On site there is a redundant office and weighbridge at the entrance and one main haul road leading to the working quarry deck. There is a mobile crusher/grader adjacent to the extraction area on the quarry deck and several excavators, and a mobile water pump and loading shovel situated in the main quarry void.

2.3 Quarrying Operations

The main products from the quarry are aggregate of various sizes.

Rock has been historically extracted by a combination of blasting and mechanical means. Blasting has been taking place under licence approximately once or twice a year depending on demand. Extracted rock is crushed to the required size grade in a mobile crusher and then stockpiled ready for transport off site to the end user.

A water management system including settlement ponds ensures runoff from the quarry is treated to a high standard before discharge off site. Quarry discharge is currently monitored under licence from Donegal County Council (LWat67).

3 SCOPE

Greentrack were commissioned to carry out an environmental noise survey by Tinneys Quarry Ltd to assess how activities on site impact on any noise sensitive locations surrounding the site. The environmental noise survey was conducted in the vicinity of Tinneys Quarry Ltd, Trentamucklagh in accordance with the EPA's Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4, EPA 2016) and ISO 1996 (2017) Description Measurement and Assessment of Environmental Noise. Part 2 Determination of Environmental Noise Levels.

The purpose of the survey was to determine the prevailing noise environment in the area and to advise the relevant operational noise criteria.

4 METHODOLOGY

The survey was carried out by Colin Farrell BSc. MSc. of Greentrack Environmental Consultants.

4.1 Noise Sensitive Locations

A site visit was undertaken as part of the baseline environmental noise survey to inform the assessment. The site visit was used to choose appropriate Noise Sensitive Locations (NSL) for the monitoring sites. As specified in the guidance document, facilities that are not located in Industrial Estates and were standalone sites of industry should not use the site boundaries as noise monitoring locations but use relevant Noise Sensitive Locations. The assessment of Noise Sensitive Locations was complicated by the existence of a live working quarry situated immediately adjacent to the east of the application site. Information from the applicant and from site observations was that this adjacent quarry operated similar, if not identical, working hours to the application site. It was therefore very difficult to differentiate noise sources to assess possible contribution from the application site and possible contribution from the adjacent site.

Following a site inspection where all noise sensitive receptors were considered, five locations were selected as Noise Sensitive Locations (NSL1, NSL2, NSL3, NSL4 & NSL 5).

N1 was the most obvious noise sensitive location being situated approximately 200 m southwest of the main quarry entrance. It is sited topographically lower than the quarry. This is expected to provide a degree of acoustic screening. This is the applicants dwelling house.

N2 was chosen as a location to the west of the site. It is close to N1, but the occupants have no connection to the applicant. It is approximately 300 m west of the quarry entrance and topographically lower than the quarry.

N3 was selected as the location that best represented receptors located to the north of the site. N3 is located 330 m north of the northern boundary of the application site. N3 is the only NSL that has a clear line of sight into the quarry.

N4 and N5 were selected as a representation to the east of the quarry. N4 is located approximately 300 m north-east of the nearest site boundary. It is also approximately 180 m from the quarry which is adjacent to the application site. NSL5 is located approximately 300 m from the south-east corner of the application site and 40 m from the adjacent quarry.

The location of each of the Noise Sensitive Locations relative to the quarry boundary are shown on Figure 4.1.

Figure 4.1: Noise Sensitive Locations NSL1, NSL2, NSL3, NSL4 & NSL5

4.2 Survey Equipment

The measurements were made using a Cirrus Optimus + Green CK:177B sound level meter fitted with a 1:1 and 1:3 octave band filter. The instrument was calibrated in situ at 93.7 dB prior to use and the calibration was cross-checked after the measurements using a Cirrus acoustic calibrator. Calibration certificates from the manufacturer are supplied in Appendix 1, and on-site calibration values are supplied with the summary environmental noise reports in Appendix 2.

The sound level meter was orientated towards the closest quarry boundary and mounted on a tripod at 1.5m above ground level. This instrument is a Type 1 instrument in accordance with IEC 651 regulations. The Time Weighting used was Fast and the Frequency Weighting was A-weighted as per IEC 651. 4.3 Survey Implementation.

Photographs of the sound level meter in place in NSL1, NSL2, NSL3, NSL4 &NSL5 are shown in Photographs 4.1, 4.2, 4.3, 4.4 & 4.5 below.

Photograph 4.1: Survey equipment at NSL1

Photograph 4.2: Survey equipment at NSL2

Photograph 4.3: Survey equipment at NSL3

Photograph 4.4: Survey equipment at NSL4

Photograph 4.5: Survey equipment at NSL5

4.3 Survey Period

Noise measurements were conducted over the course of 15th & 16th June 2022. One 60-minute attended survey was conducted at each location. Activity at the quarry was typical during the survey period. Lorries collected loads, product was moved within the quarry and mobile crushing/screening was taking place and extraction of rock by mechanical means was taking place. No evening or night-time surveys were undertaken as the site is not operational during the evening or night-time.

4.4 Conditions

The meteorological condition during the survey period were relatively calm, warm, dry conditions. Wind speed averaged 5 m/s from the south and south-west and the temperature ranged from 16°C to 18°C. Cloud cover was variable from 60 to 100 %.

5 SURVEY RESULTS

The main measurement parameter was the equivalent continuous A-weighted Sound Pressure level, $L_{Aeq,T}$, over 60 minute monitoring periods. A statistical analysis of the measurement results was completed so that the percentile levels, $L_{AN,T}$, for N = 90 % and N = 10 % over the monitoring periods could be assessed. The percentile levels represent the noise level in dBA exceeded for N % of the measurement time.

The results of the survey for each of the noise sensitive locations are summarised in Table 5.1 – 5.5. The summary report of each 60-minute survey is presented in Appendix 2.

Table 5.1: Summary of the Environmental Noise Survey for NSL1

Receptor	**NSL1 - dwelling approximately 200 m south-west of the quarry entrance.**					
Period	**Time**	**Measured Noise Level dB**				**Comments**
		L_{Aeq}	**L_{AF90}**	**L_{AF10}**	**L_{AFmax}**	Background noise dominated by bird calls/chatter (Crows, Magpies, Pigeons & Starlings), agricultural activity, passing traffic and some wind noise through the mature trees nearby. General background noise was audible from Tinney's Quarry at approximately 38-40 dBA. Lorries can be heard on the access road to the quarry at approximately 44 dBA. There was no activity taking place in the adjacent quarry to the application site during this survey period. Lower LA_{eq} value due to set back approximately 50 m from the road. **L_{AFmax}** caused by agricultural activity in the farmyard adjacent to NSL1 (non-quarry related).
Daytime 0700-1900 (16.6.22)	13.58-14.58	49.2	38.0	52.1	70.1	
	Daytime Criteria $L_{Aeq,T}$ (dB)				55	

Table 5.2: Summary of the Environmental Noise Survey for NSL2

Receptor	NSL2 - dwelling approximately 300 m west of the quarry boundary					
Period	Time	Measured Noise Level dB				Comments
		L_{Aeq}	L_{AF90}	L_{AF10}	L_{AFmax}	Background noise dominated by birdsong, breeze through the trees and passing traffic. Quarry activity from the application site is audible at approximately 36-39 dBA. Other noise sources apparent are a barking dog at adjacent property (48 dBA) and some DIY activity (drilling, hammering etc) at a neighbouring property (45 dBA). L_{AFmax} caused by tractor and slurry tanker on nearby county road (quarry related). Two quarry related HGVs passed by the NSL during the survey period.
Daytime 0700-1900 (16.6.22)	12.13-13.13	56.6	37.3	50.9	86.6	
	Daytime Criteria $L_{Aeq,T}$ (dB)				55	

Table 5.3: Summary of the Environmental Noise Survey for NSL3

Receptor	NSL3 - dwelling approximately 330 m north of the quarry boundary					
Period	Time	Measured Noise Level dB				Comments
		L_{Aeq}	L_{AF90}	L_{AF10}	L_{AFmax}	Background noise dominated by birdsong, quarry activity, agricultural activity and passing traffic. Also audible in the background was an excavator rock breaking in the quarry adjacent to the application site. Other smaller contributions to background noise were grass cutting in the distance and occasional wind noise through trees. Application site quarry contribution was estimated at 45 dBA, lorries climbing out of quarry void at 40 dBA, birdsong up to 55 dBA and rock breakers in adjacent quarry 39 dBA. Occasional gusts of wind generated noise up to 50 dBA in the roadside trees. L_{AFmax} caused by tractors on adjacent county road (non-quarry related).
Daytime 0700-1900 (16.6.22)	11.03-12.03	61.1	39.6	56.9	89.5	
	Daytime Criteria $L_{Aeq,T}$ (dB)				55	

Table 5.4: Summary of the Environmental Noise Survey for NSL4

Receptor	NSL4 - dwelling approximately 200 m south-west of the quarry entrance.					
Period	Time	Measured Noise Level dB				Comments
		L_{Aeq}	L_{AF90}	L_{AF10}	L_{AFmax}	Background noise dominated by birdsong, quarry activity and agricultural activity. General background noise was audible from Tinney's Quarry at sporadic intervals at approximately 54 dBA, and rock breaking activity could be heard in the adjacent quarry at approximately 45 dBA. An industrial power-washer in operation on a property to the south-east of the site was also audible. Occasional gusts of wind generated noise up to 50 dBA in the roadside trees. L_{AFmax} caused by vehicle noise on the adjacent county road (non-quarry related).
Daytime 0700-1900 (15.6.22)	13.08-14:08	43.7	34.8	44.7	72.9	
	Daytime Criteria $L_{Aeq,T}$ (dB)				55	

Table 5.5: Summary of the Environmental Noise Survey for NSL5

Receptor	NSL5 - dwelling approximately 300 m west of the quarry boundary					
Period	Time	Measured Noise Level dB				Comments
		L_{Aeq}	L_{AF90}	L_{AF10}	L_{AFmax}	Background noise dominated by birdsong and quarry activity from the quarry adjacent to Tinney's. Two rock breakers were operating simultaneously at a level of approximately 46 dBA at the adjacent quarry. Some feint background noise could be heard from Tinney's Quarry. At this site there is a significant screen of semi-mature and mature trees between the quarries and the receptor. L_{AFmax} caused by vehicle noise on nearby county road (non-quarry related).
Daytime 0700-1900 (15.6.22)	14.12-15.12	43.7	37.6	45.9	64.7	
	Daytime Criteria $L_{Aeq,T}$ (dB)				55	

6 GENERAL ASSESSMENT

A summary of the noise monitoring results is presented in Table 6.1 below.

Table 6.1: Noise monitoring summary

Receptor	$L_{Aeq,\ 1\text{-}hour}$	L_{AF90}	L_{AF10}	L_{AFmax}
NSL1	49.2	38.0	52.1	70.1
NSL2	56.6	37.3	50.9	86.6
NSL3	61.1	39.6	56.9	89.5
NSL4	43.7	34.8	44.7	72.9
NSL5	43.7	37.6	45.9	64.7

$L_{eq,1\text{-}hour}$ levels for NSL1, NSL4 & NSL5 are low and average 45.5 dBA

$L_{eq,1\text{-}hour}$ levels for NSL2 are 56.6 dBA. These levels are more reflective of the passing traffic than the quarry influence. This can be seen in Appendix 2 in the summary noise report with the graph of the time series showing numerous peaks corresponding to passing vehicles.

$L_{eq,1\text{-}hour}$ levels for NSL3 are 61.1 dBA. These levels are more reflective of the passing traffic than quarry activity. As expected, activity from the quarry can be heard loudest at this location but at an estimated 45 dBA is well below recommended levels. The distance and source of noise (within the quarry void) play a large role in attenuating the noise at this location. Passing traffic plays a significant role in the noise environment at this location and several large tractors accounted for the maximum noise levels experienced. No quarry traffic passes this noise sensitive location.

Background noise levels, represented by L_{AF90}, range from 34.8 dBA to 39.6 dBA. These are all relatively low background noise levels. The highest background noise was recorded at NSL3 where there was a slight contribution from quarry activity.

6.1 Tonal Assessment

The methodology of objective identification of the presence of tonal noise is set out in BS 4142: 2014: Annex C (normative): *Objective method for assessing the audibility of tones in sound: One-third octave method.*

'This methodology requires that for a prominent, discrete tone to be identified as present, the time-averaged linear sound pressure level in the one-third-octave band of interest is required to exceed the time-averaged linear sound pressure levels of both adjacent one-third octave bands by some constant level difference. The appropriate level differences vary with frequency. They should be greater than or equal to the following values in both adjacent one-third-octave bands:

15dB in low-frequency one-third-octave bands (25Hz to 125Hz);

8dB in middle-frequency bands (160Hz to 400Hz), and;

5 dB in high-frequency bands (500Hz to 10,000Hz).'

The third octave spectra presented in Appendix 1 were examined for the presence of tonal noise.

It is concluded that there was no audible tonal noise associated with the site during the survey period.

6.2 Impulsive Assessment

Normally an impulsive characteristic, such as thumping, banging or an impact noise, is determined subjectively.

No impulsive noise from the facility was identified during the survey period.

7 CONCLUSIONS

Recorded noise levels at noise sensitive locations were influenced by a number of non-quarry related noise sources such as traffic on the local road network and agricultural activity. The noise climates at the receptors were not adversely impacted by any continuous or dominant noise sources associated with quarrying activities. Where noise was apparent from quarrying activity, it was measured at a level well below typical guideline limit values.

No audible tonal component of noise associated with quarry activities could be identified at any of the noise sensitive locations.

No impulsive noise sources associated with quarry activities could be identified at any of the noise sensitive locations.

Appendix 1: Calibration Certificates

CERTIFICATE OF CALIBRATION

ISSUED BY	**Cirrus Research GmbH**		
DATE OF ISSUE	**10/12/21**	CERTIFICATE NUMBER	**167205**

Cirrus Research GmbH
Arabella Center
Lyoner Strasse 44-48
D-60528 Frankfurt
Germany

Page 1 of 2

Test engineer:
M.Laakel
Electronically signed:

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 213317B

Calibration procedure

Date of calibration: 10 December 2021

Open circuit: 53.2 mV/Pa

Sensitivity at 1 kHz: -25.5 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using a closed cavity applying a known pressure level using the sequential excitation technique in accordance with BS EN 61094-5:2016 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 98.29 kPa

Temperature: 23.4 °C

Humidity: 21.3 %

CERTIFICATE OF CALIBRATION

Certificate Number: **167205**

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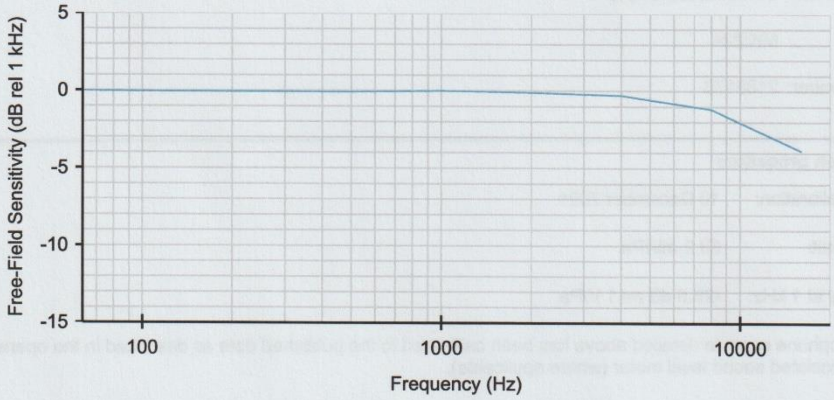
Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)
63	-0.01
125	-0.05
250	-0.06
500	-0.07
1000	0.00
2000	-0.10
4000	-0.28
8000	-1.15
16000	-3.85

Free-Field Frequency Response : Graphical



CERTIFICATE OF CALIBRATION

ISSUED BY **Cirrus Research GmbH**

DATE OF ISSUE **13 December 2021** CERTIFICATE NUMBER **167285**

Cirrus Research GmbH
Arabella Center
Lyoner Strasse 44-48
D-60528 Frankfurt
Germany

Page 1 of 2

Approved signatory
M.Laakel
Electronically signed:

Sound Level Meter : IEC 61672-3:2013

Instrument information

Manufacturer:	Cirrus Research plc	Notes:
Model:	CR:171B	
Serial number:	G301928	
Class:	1	
Firmware version:	5.5.3021	

Test summary

Date of calibration: 13 December 2021

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

CERTIFICATE OF CALIBRATION

Certificate Number: **167285**

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Environmental conditions

The following conditions were recorded at the time of the test:

Before	Pressure: 101.60 kPa	Temperature: 24.4 °C	Humidity: 28.7 %
After	Pressure: 101.60 kPa	Temperature: 24.5 °C	Humidity: 28.3 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	KEYSIGHT	33511B	MY58001553
Attenuator	Cirrus Research	ZE:952	78713
Environmental Monitor	Comet	T7510	21961307

Additional instrument information

Instruction manual:

Reference level range: Single range

Pattern approval: No

Source of pattern approval: -

Preamplifier

Model: MV:200F

Serial number: 10685F

Microphone

Model: MK:224

Serial number: 213317B

Test results summary

Test	Result
Toneburst response	Complies
Electrical noise-floor	Complies
Linearity	Complies
Electrical Frequency weightings	Complies
Frequency and time weightings at 1 kHz	Complies
C-weighted peak	Complies
Overload indication	Complies
High level stability	Complies
Long-term stability	Complies
Acoustic Frequency weightings	Complies

Appendix 2: Summary Noise Reports

Cirrus Research plc

Measurement Summary Report

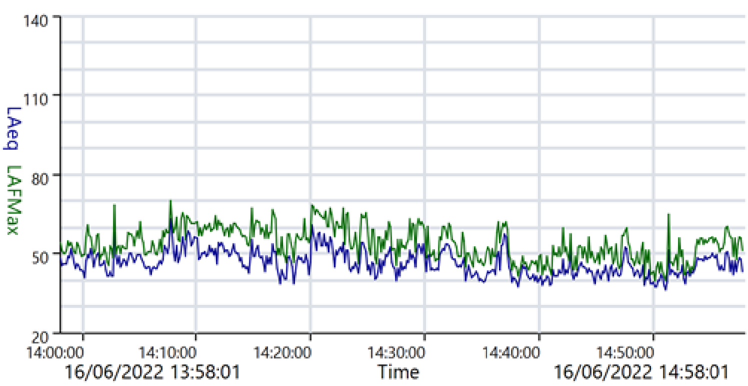
Name	24						
Time	16/06/2022 13:58:01	**Person**		**Place**		**Project**	
Duration	01:00:00	Colin Farrell		NSL1		Tinneys Quarry	
Instrument	G301928, CR:171B						

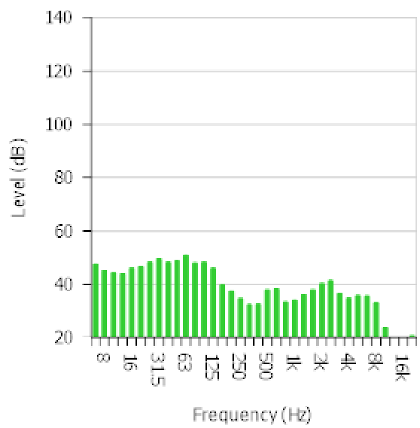
Calibration

Before	16/06/2022 10:59	Offset	-0.23 dB	**After**	16/06/2022 15:01	Offset	0.00 dB

Basic Values	
LAeq	49.2 dB
LAE	84.8 dB
LAFMax	70.1 dB

Statistical Levels (Ln)	
LAF1	60.3 dB
LAF5	54.8 dB
LAF10	52.1 dB
LAF50	43.3 dB
LAF90	38.0 dB
LAF95	36.8 dB
LAF99	34.4 dB





Cirrus Research plc

Measurement Summary Report

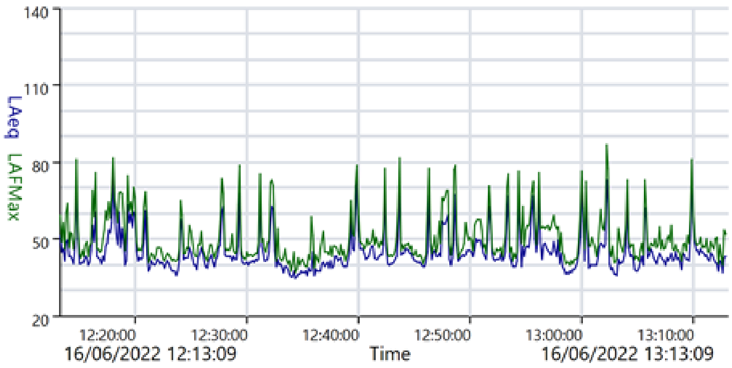
Name	23			
Time	16/06/2022 12:13:09	**Person**	**Place**	**Project**
Duration	01:00:00	Colin Farrell	NSL2	Tinneys Quarry
Instrument	G301928, CR:171B			

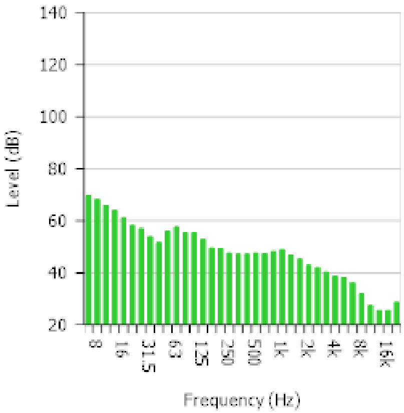
Calibration

Before	16/06/2022 10:59	Offset -0.23 dB	**After**	16/06/2022 15:01	Offset	0.00 dB

Basic Values	
LAeq	56.6 dB
LAE	92.1 dB
LAFMax	86.6 dB

Statistical Levels (Ln)	
LAF1	69.5 dB
LAF5	57.2 dB
LAF10	50.9 dB
LAF50	42.0 dB
LAF90	37.3 dB
LAF95	36.1 dB
LAF99	34.5 dB





Cirrus Research plc

Measurement Summary Report

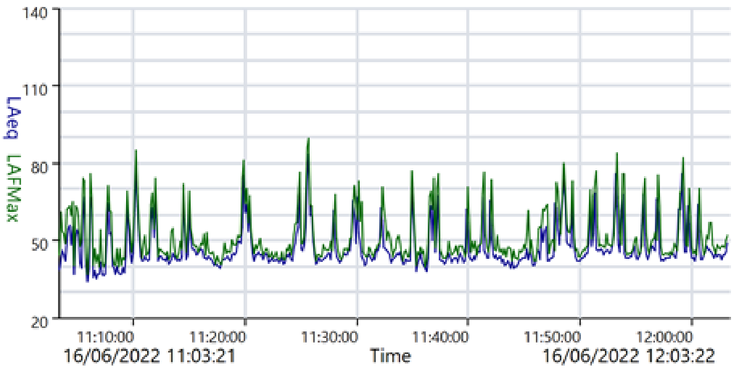
Name	22				
Time	16/06/2022 11:03:21	**Person**	**Place**	**Project**	
Duration	01:00:00	Colin Farrell	NSL3	Tinneys Quarry	
Instrument	G301928, CR:171B				

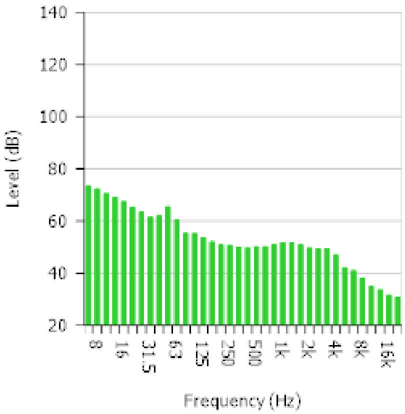
Calibration

Before	16/06/2022 10:59	Offset	-0.23 dB	**After**	16/06/2022 15:01	Offset	0.00 dB

Basic Values	
LAeq	61.1 dB
LAE	96.6 dB
LAFMax	89.5 dB

Statistical Levels (Ln)	
LAF1	72.9 dB
LAF5	62.6 dB
LAF10	56.9 dB
LAF50	43.6 dB
LAF90	39.6 dB
LAF95	37.5 dB
LAF99	34.5 dB





Cirrus Research plc

Measurement Summary Report

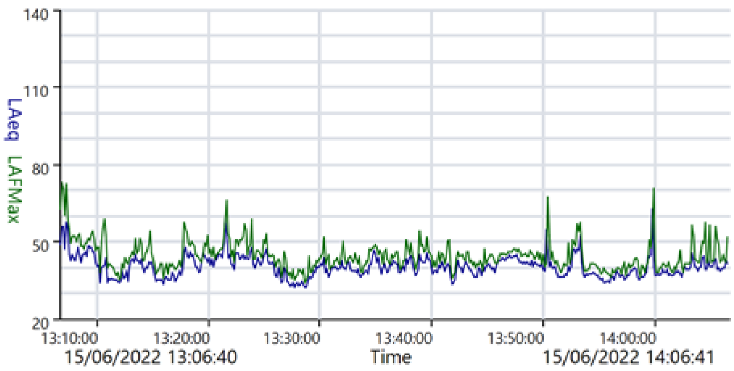
Name	20				
Time	15/06/2022 13:06:40	**Person**	**Place**	**Project**	
Duration	01:00:00	Colin Farrell	NSL4	Tinneys Quarry	
Instrument	G301928, CR:171B				

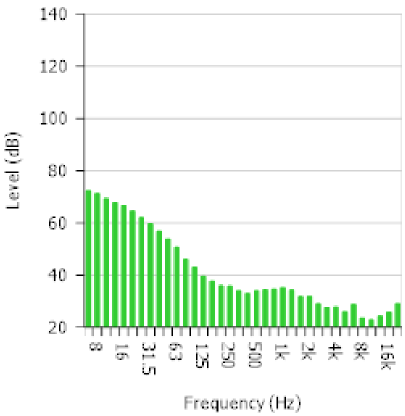
Calibration

Before 15/06/2022 13:06 Offset -0.17 dB **After** 16/06/2022 10:59 Offset -0.23 dB

Basic Values	
LAeq	43.7 dB
LAE	79.3 dB
LAFMax	72.9 dB

Statistical Levels (Ln)	
LAF1	51.0 dB
LAF5	46.3 dB
LAF10	44.7 dB
LAF50	39.2 dB
LAF90	34.8 dB
LAF95	33.7 dB
LAF99	32.0 dB





Cirrus Research plc

Measurement Summary Report

Name	21			
Time	15/06/2022 14:12:45	**Person**	**Place**	**Project**
Duration	01:00:00	Colin Farrell	NSL5	Tinneys Quarry
Instrument	G301928, CR:171B			

Calibration

Before 15/06/2022 13:06 Offset -0.17 dB **After** 16/06/2022 10:59 Offset -0.23 dB

Basic Values	
LAeq	43.7 dB
LAE	79.3 dB
LAFMax	64.7 dB

Statistical Levels (Ln)	
LAF1	50.2 dB
LAF5	47.0 dB
LAF10	45.9 dB
LAF50	42.4 dB
LAF90	37.6 dB
LAF95	36.0 dB
LAF99	33.5 dB