Chapter 9:

NOISE & VIBRATION

Table of Contents

List of Figures

List of Tables

9 NOISE & VIBRATION

9.1 Introduction

Greentrack Consultants were commissioned by Murray Stone to assess the potential noise impacts of development at an existing quarry site located at Drumbeagh, Mountcharles 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 Pleanála.

9.2 Statement of Authority

This Chapter of the rEIAR has been prepared by Colin Farrell of Greentrack Consultants Ltd. Colin is a geochemist with Greentrack. Colin holds a BSc. Geochemistry from Reading University and MSc Applied Environmental Science from Queens University Belfast. He also holds a Certificate of Competence in Environmental Noise Measurement awarded by the Institute of Acoustics and Certificate in Arboriculture issued by the Royal Forestry Society. Colin has over 10 years' experience working with Greentrack in dealing with Environmental Impact assessment, Site Remediation works, Quarry assessments, Flood Risk assessment, hydrological and hydrogeological reports.

9.3 Site Location and Setting

The development consists of a quarry located on a 3.45-hectare site in the rural townland of Drumbeagh. The site is located immediately north of the N56 between the villages of Mountcharles and Inver. The site is approximately 2.5 km west of Mountcharles, 3 km east of Inver and 1.7 km south of the villages of Frosses. The site is accessed off a local slip road immediately off the N56. The access road also serves the quarry owner and one other local resident. The site is surrounded by a mixture of poor-quality agricultural land, improved agricultural grassland and one-off rural houses and farmsteads. There are also peatlands and isolated forestry blocks in the surrounding area. The subject site location is outlined in Figure 9.1 below.

Figure 9.1: Location of Subject site

CYAL50381113 © Ordnance Survey Ireland/Government of Ireland

As described in Chapter 3, *Project Description,* the existing working quarry consists of an extraction area where rock is extracted and a small processing area where rock is guillotined and cut.

9.3.1 Description of Site Activity

The site area is 3.45 hectares and is irregular in shape runs generally uphill from southwest to northeast with the lowest point at c. 54 mOD in the central western part of the site and the highest point in the east on top of the screening berms at c. 73 mOD. The quarry contains a central access road leading to the main quarry deck where stockpiles of product are stored on pallets and tonne bags awaiting collection. This central area is also used to park vehicles and to access the working quarry faces.

9.3.1.1 Overburden and berm construction

Overburden removed from areas of extraction have been used to create screening berms along the eastern and northwestern boundaries of the site. These berms have largely re-vegetated and provide screening for quarrying activities.

9.3.1.2 Extraction of Material

Extraction of the product is by mechanical means using a ripping claw on an excavator. Occasionally boulders have to be broken down further using an impact breaker mounted on an excavator down into smaller more manageable pieces. In the distant past, the applicant states that occasionally blasting occurred on site to win rock. The practice was discontinued after it was seen to induce unwanted fracture patterns into the rock lessening its value as cut-stone product. No blasting is planned for the site.

9.3.1.3 Sequence of extraction

There are a number of lithologies present in the quarry. The dominant rocks are brown sandstone and a blue sandstone. Historically these have been extracted from west to east within the site. Current extraction areas are in the central eastern part of the site.

9.3.1.4 Processing of material

Won rock is then transported using excavator bucket or telehandler to the guillotine area. Rock is then guillotined by hand and stacked on pallets ready for collection. Some rock pieces are cut with a circular saw to size and then stacked on pallets ready for collection.

9.3.1.5 Products

The main products produced are cut stone and dimension stone. Most of the product is used for facing houses with some product used for garden features, and ornamental features. Stone not ustilised for cut stone is used to level out previous extraction areas.
Historically, the lower value stone was used as aggregate. In the 1960's aggregate was used as fill for the construction of the nearby N56 national route.

9.3.1.6 Stockpiling of materials

Cut stone and dimension stone are stored on site either on pallets or in tonne bags awaiting collection from the customer.

9.3.1.7 Transport to Market

Ther are no delivery lorries associated with the quarry activity as customers usually collect the product directly from the site. On average, there is one lorry pick-up (rigid or articulated) from site. Product is loaded onto the lorry using the on-site telehandler. There are also occasional smaller loads collected from the site by customers. These are usually done in smaller pick-up 3.5 T lorries or using vans and trailers. On average there is one of these smaller collections per week.

9.3.1.8 Fuel and Chemical Storage

Fuels and lubricants are stored in a bunded area within the applicant's workshop offsite.
All re-fueling operations are carried out with strict adherence to pollution prevention protocols.

9.3.1.9 Surface and Groundwater Management

Protection of the wider surface water environment is achieved on site is settlement ponds. The main settlement pond is in the central southern portion of the site which captures runoff from the main extraction area. Another smaller linear settlement pond is located on the northeastern boundary and captures runoff in the immediate area. The settlement ponds discharge to separate tributaries of the Eany Water River which discharges to the sea at Inver Bay approximately 3 km southwest of the subject site.
The guillotining and cutting area is serviced by a sump which collects all runoff. Water is recycled from this sump and sludge periodically emptied and used to supplement the screening berms.

9.3.1.10 Working hours and employment

Normal quarrying operations are confined to the hours of 8.00 am to 5.00 pm, Monday to Friday. The quarry is shut on Saturdays, Sundays and Public Holidays. The applicant provides employment for approximately 2-3 people directly.

9.3.1.11 Utilities and services

There is no electricity supply or mains water supply to the site. There is no telecommunications connection to the site.

9.3.1.12 Facilities

There is no weighbridge on site. Canteen, toilet and welfare facilities are provided at the applicant home approximately 130 m west of the quarry entrance.

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].

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

[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.

[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

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 5 km from any national primary route. The application site is adjacent to the national N56 route so the area would not be considered as a 'Quiet Area'.
The times of operation have been between 0800 hours and 1700 hours Monday to Friday. The quarry is shut on Saturdays, Sundays and Public Holidays. The quarry currently provides employment for approximately 2-3 persons.

<u>9.5.2 Construction</u>

<u>Relevant Guidance</u>

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	70dB LAeq, (1h) and LAmax 80dB
07:00 – 19:00hrs	*60dB LAeq, (1h) and LAmax 65dB*
19:00 – 22:00hrs	
Saturday	65dB LAeq,1h and LAmax75dB
08:00 – 16:30hrs	
Sunday and Bank Holidays	*60dB LAeq,1h and LAmax 65dB*
08:00 – 16:00hrs	

*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:

[2] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*

- 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 Chapter 3, *Project Description*, 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 rock 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 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, drainage infrastructure and construction of processing area.

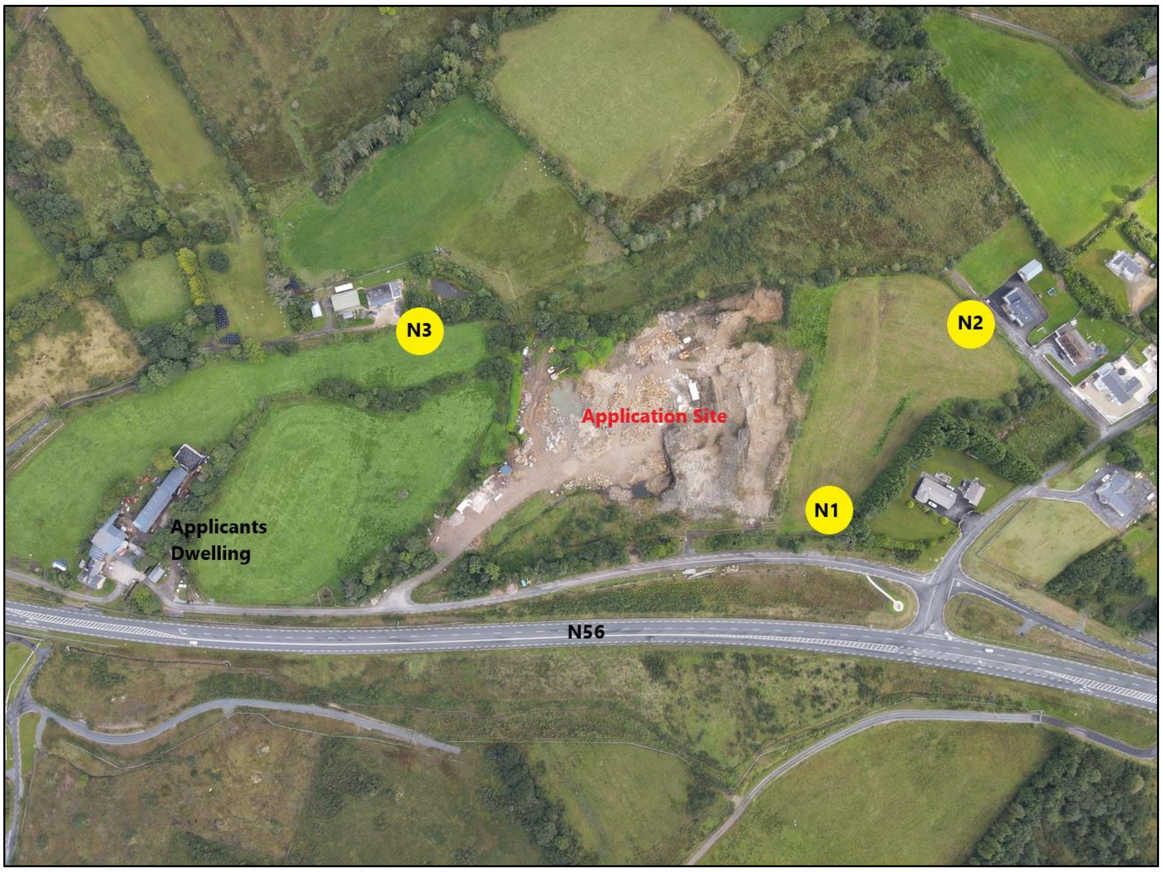
The initial phase of development will have included all overburden removal, placement of all site infrastructure and development of settlement ponds and access routes. Operational noise will include extraction and processing activities, loading of product and transport of product. Currently most of this activity takes place on the quarry floor and in the processing area to the west of the site. The topography of the quarry setting provides significant acoustic screening / barrier effects which is provided by the height differential between the quarry floor and receptors and the screening berms and mature trees in the south and western boundaries.

9.6.2 Noise Measurement

A noise survey was conducted by Greentrack 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 Murray Stone, Drumbeagh, Mountcharles, Co. Donegal 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.

Three noise sensitive locations were chosen surrounding the quarry and a brief attended noise survey was carried out at each location. During the noise survey the operator was asked to perform the noisiest operations so that a worst-case scenario can be considered. The noisiest operation was extraction activities with a ripping claw attached to an excavator extracting rock mechanically which generally took place about once a month. When the extraction activity was taking place processing of rock by sawing and by guillotine was taking place simultaneously. It was unusual to have both operations occurring simultaneously but was done to facilitate a worst-case scenario. The location of the noise sensitive locations is shown below in Figure 9.3. The full report of the noise survey is presented in Appendix 9.1.

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	$L_{Aeq,\ 15\ min}$ dBA	$L_{A10,\ 15\ min}$ dBA	$L_{A90,\ 15\ min}$ dBA
N1	55 m	49.2	52.1	52.1
N2	115 m	56.6	50.9	50.9
N3	80 m	61.1	39.6	39.6

9.6.3 Noise measurement assessment

As can be seen from Table 9.2 above, all the L_{A90} values were below the 55 dBA threshold. The L_{A90} 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} values are also below the 55 dBA threshold for N1 but above for N2 and N3. The contribution of traffic noise from the N56 will have contributed most of the noise.

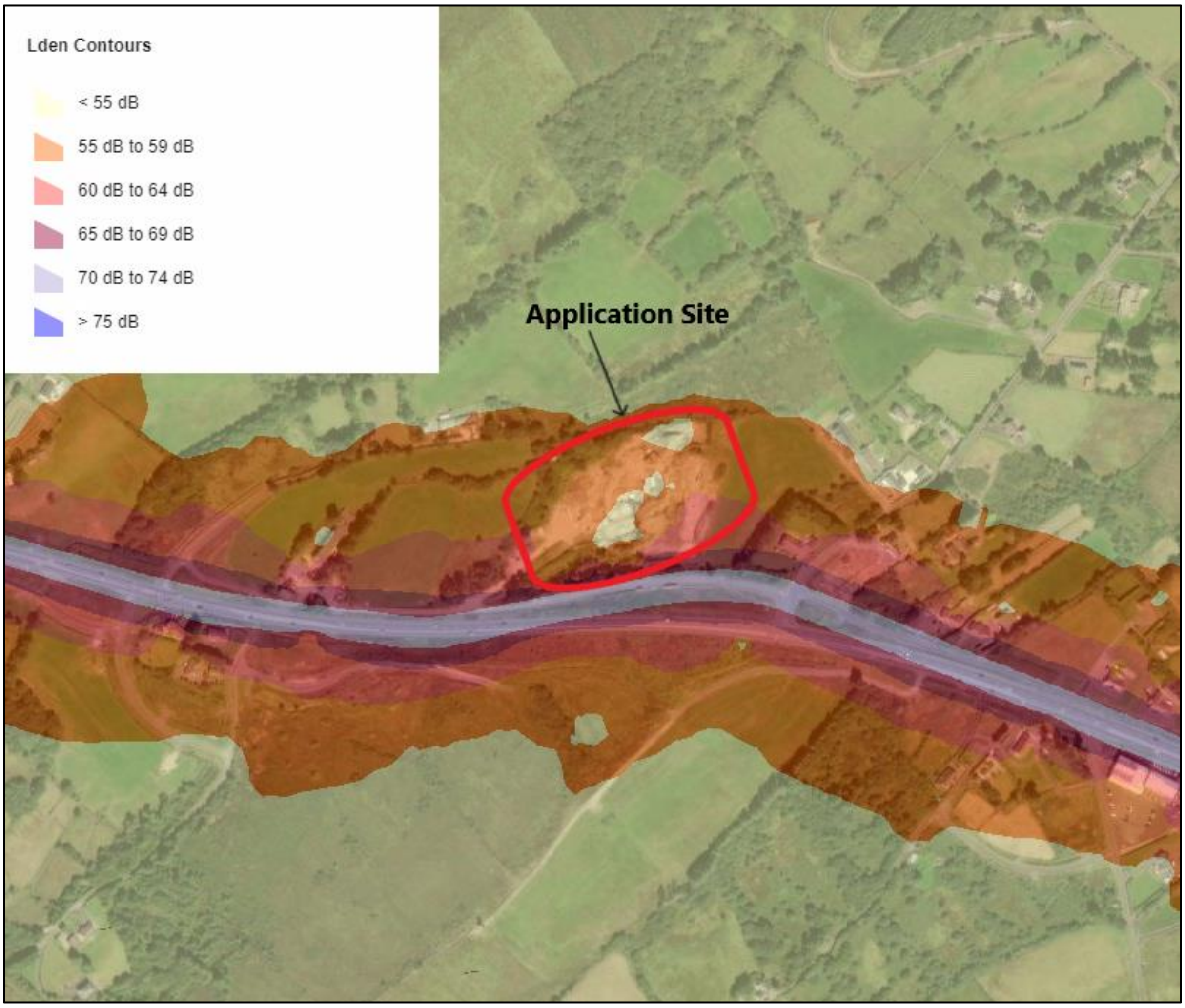
The acoustic screening provided by the screening berms has helped ensure that the contribution from quarry activities to LAeq values for all receptors have been minimal.

9.6.4 Ambient Traffic Noise

A draft Noise Action Plan 2018 – 2023 has been produced by Donegal County Council for the third round of noise action planning under the Environmental Noise Regulations 2006 (S.I 140 of 2006). For the purposes of the Directive and Regulations, environmental noise is unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic and noise in agglomerations over a specified size.

As part of the production of the action plan, noise mapping bodies made strategic noise maps in December 2017 for major road which are defined as those > 3 million vehicles per annum. The N56 running immediately south of the site falls into this category and has been mapped. An extract from the interactive map produced by Donegal County Council is presented below in Figure 9.4.

Figure 9.4: Noise mapping along the N56



(Extract from Donegal draft Noise Action Plan 2018 – 2023)

As can be seen from Figure 4.8 above, part of the site closest to the N56 lies in the 60-64 dB zone and the remainder of the site lies in the 55-59 dB zone.

9.6.5 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 is reported to have occurred one every year from 2004 until c. 2007 and approximately once every 5 years prior to 2004, so this scenario was not very common, but it is considered.

The only other noise source not taken into consideration is the periodic requirement for shot holes to be drilled for the purposes of blasting. 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
N1	90	3	63	61.2
N2	145	3	63	59.2
N3	140	3	63	59.3

Table 9.4 below shows the predicted cumulative noise impacts for each of the Noise Sensitive Locations. In the case of N3, 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} dBA (Table 9.3)	Measured noise levels with ongoing extraction and processing L_{eq} dBA (Table 9.2)	Cumulative Impact $L_{eq,\ 1\text{-hour}}$ dBA
N1	61.2	49.2	61.5
N2	59.2	56.6	61.1
N3	59.3	61.1	63.3

9.6.6 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. This was an unlikely scenario.

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. 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 are very close to the L_{den} contours for traffic noise from the N56 (Figure 9.4).

The 61.5 dB prediction for N1 is within the 60-64 dB L_{den} corridor. The predictions for N2 and N3 are with the 55-59 L_{den} corridor.

It is worth noting that these predictions are mad without any reference to acoustic screening and that the measured noise levels at each receptor have a considerable contribution from passing traffic (Appendix 9.1).

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 (saw cutting and guillotining) generally has been located in the quarry floor area thereby giving maximum barrier attenuation effect
- All mobile plant on site has 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.

9.8 Road Traffic Noise Impacts

There are no delivery lorries associated with the quarry activity as customers usually collect the product directly from the site. On average, there is one lorry pick-up (rigid or articulated) from site. Product is loaded onto the lorry using the on-site telehandler. There are also occasional smaller loads collected from the site by customers. These are usually done in smaller pick-up 3.5 T lorries or using vans and trailers. On average there is one of these smaller collections per week. In total, in a worst-case scenario, there may be 2 two HGV movements and two 3.5T truck movements in a day, allied to potentially staff four car movements which would be a total of eight vehicle movements. There is an average of approximately 5 vehicle movements connected to the site per working day.

The application site contribution to the traffic flow in the general area is minimal. 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. Considering an historic temporary increase in HGV traffic from the site, there is not likely to have been a large enough increase in HGV activity to make any significant effect to traffic noise or vibration. Peak production traffic movements 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 & process rock is not granted substitute consent then local construction end users will be forced to source quarry product from further afield. This will result in reduced noise impacts in the vicinity of the site, but increased noise and vibration impacts elsewhere.

9.10 Noise Monitoring

It is proposed to carry out noise monitoring at three locations annually (N1, N2 & N3). If compliance is met at these three 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).

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[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

9.13.1 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 (saw cutting and guillotining) must be located in the quarry floor area thereby giving maximum barrier attenuation effect
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).

9.15 Blast Vibration

9.15.1 Introduction

This section of the Remedial Environmental Impact Assessment Report (rEIAR) was prepared to assess the vibration impacts from the operation of the existing 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, *Project Description*, of the rEIAR.

9.15.2 Description of Activity On-Site

The Substitute Consent site activity included the occasional extraction of underlying rock by blasting. Blasting ceased in 2007. Between 2004 and 2007 approximately one blast per year was carried out. Prior to 2004, the applicant reports that approximately one blast was used every five years. The applicant has been extracting rock using excavators. 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

9.15.3 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

[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

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).

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.

9.15.4 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 9.5 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 9.5: 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 result, 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.

9.15.5 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 points and
- the distance between the receptor points 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.

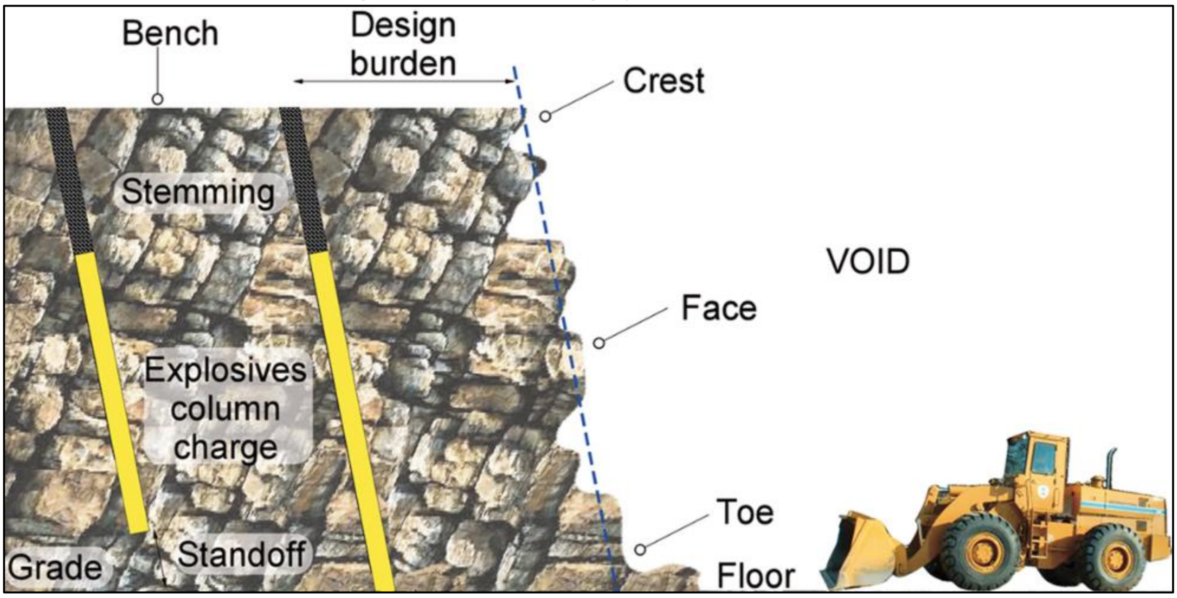
It is important to note that there have been no complaints relating to blasting being carried out at the site which is generally a good indicator of low levels of vibration.

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

Figure 9.4 below details a blast design profile for a quarry which shows a section through the quarry face and drill holes (not to scale).

Figure 9.4: Blast design profile (not to scale)



9.15.6 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

[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

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.

9.15.7 Control 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 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.

9.15.8 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.

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

The applicant states that an experienced and competent blasting contractor was always used by the family for its historical blasts. The following controls were likely to have been in place so that ground vibration, air overpressure and noise was minimised and kept within the regulatory limits.

[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

[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

Specific mitigation 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.
- 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.
- Advance warning notice of blasts were given to in the local environs of the quarry prior to blasting.
- 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.
- The adequate confinement of all charges by means of accurate face survey and the subsequent judicious placement of explosives by certified personnel was maintained.
- 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.
- 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.

9.15.10 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.

9.15.11 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.

9.15.12 Blasting and Vibration Monitoring

Blast vibration monitoring was not carried out. There are no plans to carry out blasting as it has proven detrimental to the quality of the product sought.

9.15.13 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.

9.15.14 Technical Difficulties

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

9.15.15 Conclusion

Vibration levels for the small number of historical blasts carried out as part of the development were never measured. The lack of complaints and infrequent nature of the blasting regime led to the conclusion that blasting is likely to have had a slight negative temporary effect.

9.15.16 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 9.1: Environmental Noise Report

Environmental Consultants

Environmental Noise Survey

Environmental Noise Survey to determine the prevailing noise environment in the area in the vicinity of Murray Stone, Drumbeagh, Mountcharles, Co. Donegal.

Greentrack Environmental Consultants

September 2023

DOCUMENT DETAILS

Client:	Murray Stone
Project Title:	Environmental Noise Survey
Project Number:	23.0708
Document Title:	Environmental Noise Survey, Murray Stone
Completion Date:	12th September 2023
Prepared By:	greentrack

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Table of Contents

List of Figures

List of Photographs

List of Tables

1 INTRODUCTION

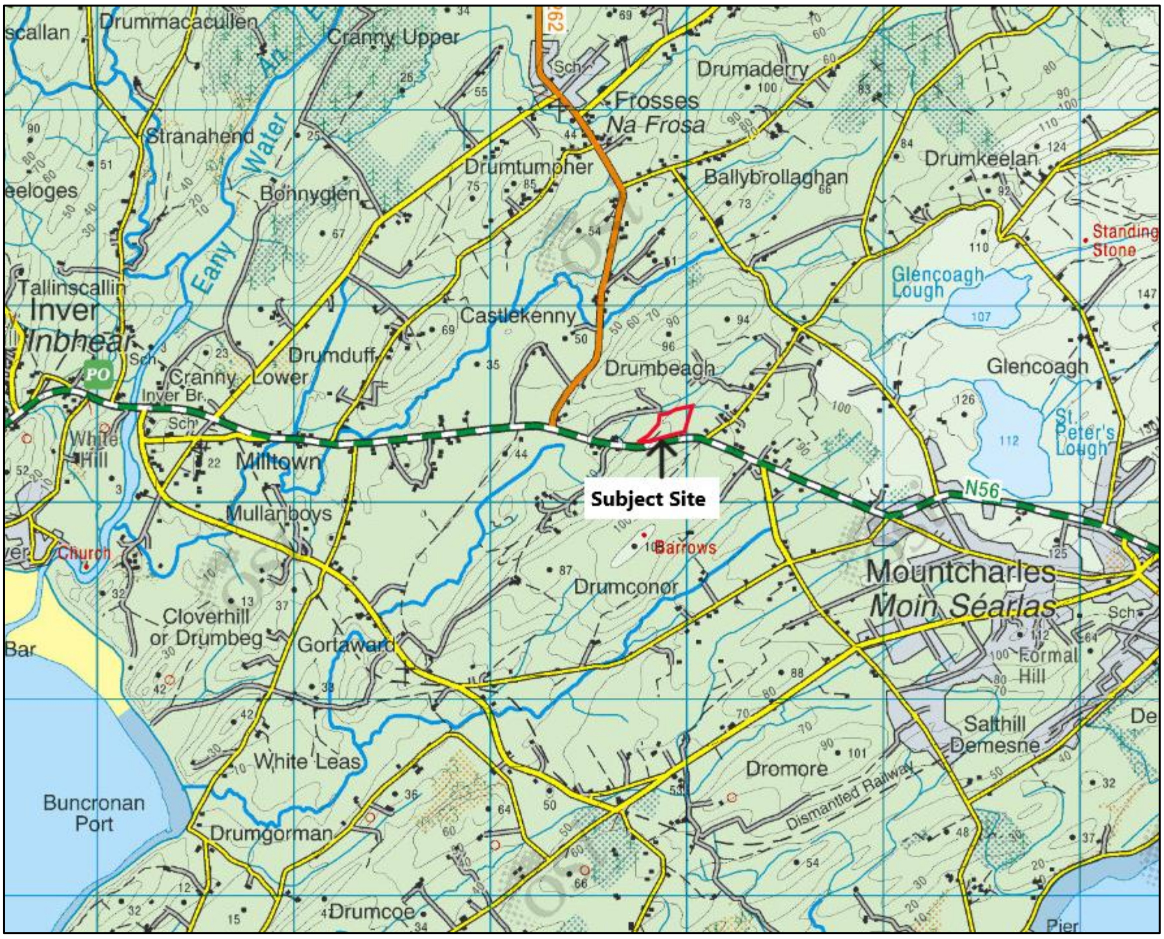
Murray Stone is small well established sandstone supplier in south Donegal. The quarry is currently unauthorised and is attempting to regularise activities with a substitute consent application to An Bord Pleanála. The current enterprise is small scale with mechanical extraction of material from a relatively small quarry face followed by hand cutting of material by guillotine for market. There is the occasional requirement to break larger pieces of stone with a hydraulic impact hammer. A remedial Environmental Impact Assessment Screening Report will accompany the substitute consent application. This environmental noise report is produced to inform the screening report.

2 SITE DESCRIPTION

2.1 Location

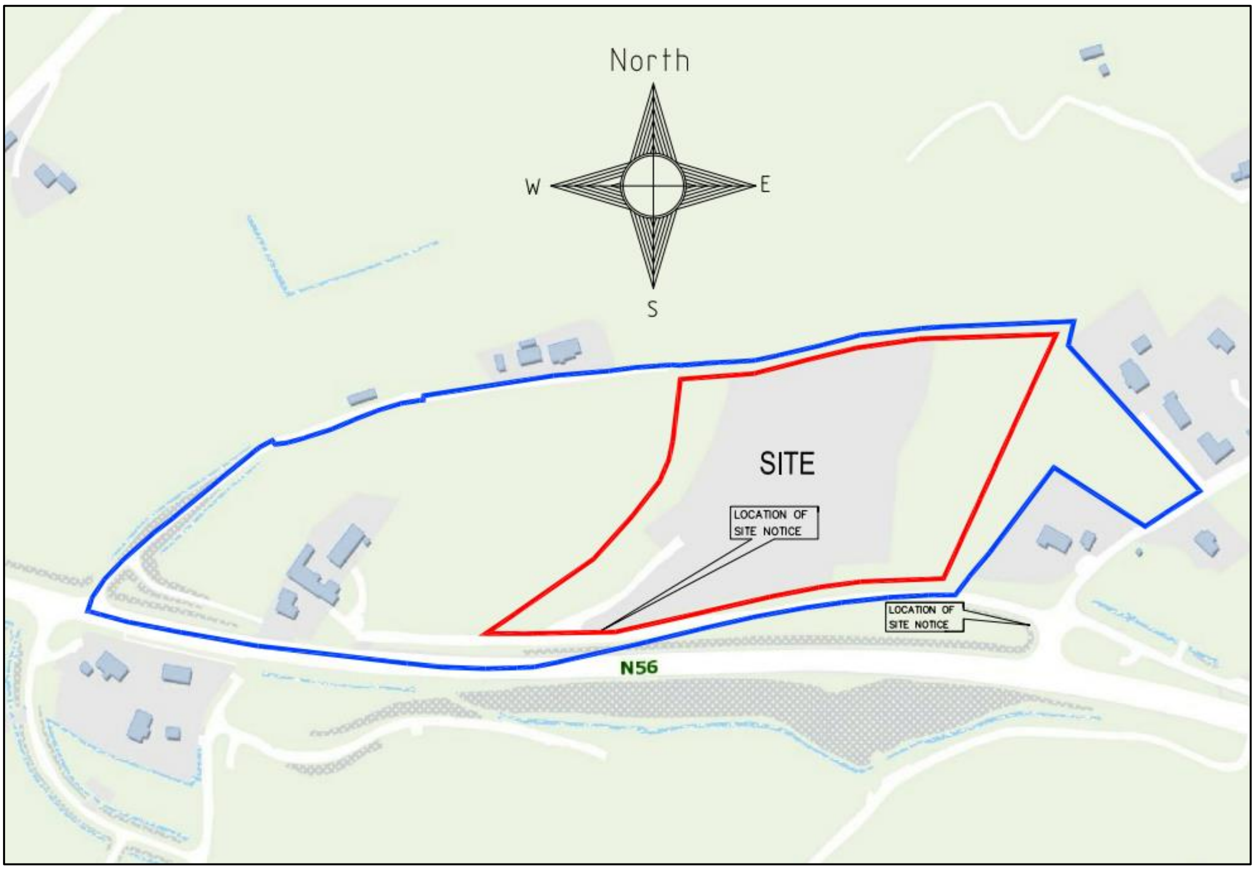
The proposed development is located in the rural townland of Drumbeagh, Mountcharles, Co. Donegal, (Figure 2.1). Access to the site is provided by the local slip road off the N56 which also serves the applicant's home and one other house. The quarry site is part of a larger landholding. Figure 4.1 shows the extent of the site (in red) in relation to the overall landholding (shown in blue).

Figure 2.1 Site location map



CYAL50244901 © Ordnance Survey Ireland/Government of Ireland.

Figure 2.2: Subject Site



(Extract from Drawing provided by McMullin Associates)

The quarry is sited in a rural area with one-off sporadic housing throughout the area. There are 24 dwellings within 500 m of the quarry boundary, one of which is the applicants home. 10 of the dwellings are within 100 m of the N56 national route. The dominant land use in the surrounding area is agriculture and forestry. The quality of the agricultural land would be described as poor and further east of the site there are extensive belts of coniferous forest both in private and state ownership.

2.2 Site Description

The development consists of a quarry located on a 3.45-hectare site in the rural townland of Drumbeagh. The site is located immediately north of the N56 between the villages of Mountcharles and Inver.

The quarry features an access track that leads to a levelled are in the central portion of the quarry. Worked and working faces are to the east and a guillotine processing area lies in the west of the quarry.

There is an excavator, telehandler and small tractor in use at the site. Most of the product is transported in tonne bags by customers collecting directly from the site. There are some stockpiles of cut and uncut material on site and a small area of loaded tonne bags ready for shipment. Murray Stone do not deliver product and there are no delivery lorries.
Structures at the quarry include small shelter structures around the guillotine and generator which powers the guillotine and a mobile home which serves as an office located to the east of the central levelled area. There are also several abandoned vehicles and redundant pieces of quarry equipment/plant which are mainly located in the northern part of the quarry.

2.3 Quarrying Operations

There has been a quarry recorded on the site since the mid 1800's. The primary product from the quarry is cut sandstone for decorative cladding or garden stone.

Rock is extracted by mechanical means using an excavator with a ripping claw. Larger boulders are then further broken down into manageable sizes using a hydraulic breaker attachment on the excavator. Manageable pieces are then guillotines cleaving the rock along natural bedding planes into decorative stone. The quarry produces a beige/light brown cut stone and a blue cut stone from the available lithology.

A water management system including settlement ponds ensures runoff from the quarry is treated to a high standard before discharge off site.

3 SCOPE

Greentrack were commissioned to carry out a remedial Environmental Impact Assessment Screening Report to assess if the development requires, or would have required, Environmental Impact Assessment. A noise survey was conducted 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 Murray Stone, Drumbeagh, Mountcharles, Co. Donegal 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 inform the screening report.

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 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.

Following a site inspection where all noise sensitive receptors were considered, three locations were selected as Noise Sensitive Locations (N1, N2 & N3).

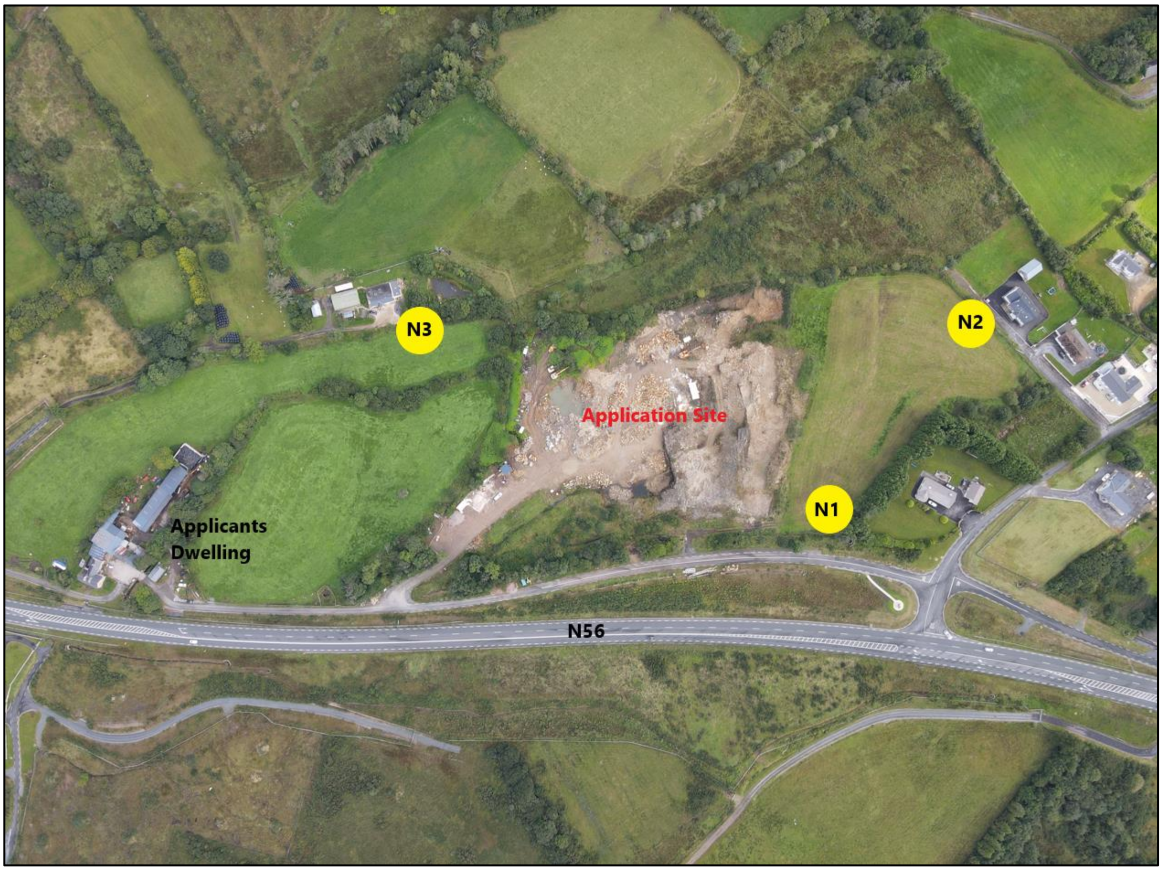
N1 was the most obvious noise sensitive location being situated approximately 55 m east of the southeast corner of the application site. A boundary of mature coniferous trees separates the dwelling from the quarry. Noise measurements were taken east of this acoustic buffer and are therefore likely to be higher than those experienced at the dwelling. N1 is approximately 25 m from the N56 national route.

There are no noise sensitive locations to the south of the N56.

N2 was chosen as a location to the east of the site as representative of the three bungalows in this area. N2 is a dwelling house approximately 115 m east of the quarry boundary.
N3 was selected as the location that best represented receptors located to the northwest of the site. N3 is approximately 80 m from the northwest boundary of the site. A boundary of native trees and hedges separates the dwelling from the quarry. Noise measurements were taken south of this acoustic buffer and are therefore likely to be higher than those experienced at the dwelling.

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

Figure 4.1: Noise Sensitive Locations N1, N2 & N3.



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 N1, N2 & N3 are shown in Photographs 4.1, 4.2 & 4.3.

Photograph 4.1: Survey equipment at N1

Photograph 4.2: Survey equipment at N2

Photograph 4.3: Survey equipment at N3

4.3 Survey Period

Noise measurements were conducted over the course of 24th August 2023 from approximately 10.30 am to 12.30 pm. One 15-minute attended survey was conducted at each location. To create a worst-case scenario for noise impact, the noisiest operation was being undertaken while the surveys were being conducted. The ripping claw was fitted to the excavator and extraction of rock was ongoing.

The guillotine was also in full operation when extraction was occurring. This was an unusual situation for the quarry to have two processes occurring simultaneously. 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 was warm, sunny conditions with scattererd light showers. Wind speed averaged 5 m/s from the WSW and the temperature ranged from 15 °C to 18 °C. Cloud cover was 60%.

5 SURVEY RESULTS

The main measurement parameter was the equivalent continuous A-weighted Sound Pressure level, $L_{Aeq,T}$, over 15 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 – 5.4. The summary report of each 15-minute survey is presented in Appendix 2.

Table 5.1: Summary of the Environmental Noise Survey for N1

Receptor	N1 - dwelling approximately 55m east of southeast quarry corner.				
Period	**Time**	**Measured Noise Level dB**			**Comments**
		L_{Aeq}	L_{AF90}	L_{AFmax}	
Daytime 0700 - 1900 (24.8.23)	10:54 – 11:09	55.6	50.5	70.7	Background noise dominated by N56 traffic, and some quarry activity can be heard. Other noise sources are birdsong and wind noise through the adjacent trees. Contribution from quarry to overall noise levels is estimated around 47-55 dB and general traffic noise from the N56 is estimated around 53-64 dB L_{AFmax} caused by vehicle noise on adjacent N56 road (non-quarry related).

Table 5.2: Summary of the Environmental Noise Survey for N2

Receptor	N2 - dwelling approximately 115 m east of eastern quarry boundary.				
Period	**Time**	**Measured Noise Level dB**			**Comments**
		L_{Aeq}	L_{AF90}	L_{AFmax}	
Daytime 0700 - 1900 (24.8.23)	11:12 – 11:29	52.7	47.4	69.0	Background noise dominated by N56 traffic, and some quarry activity can be heard. Birdsong also makes a small contribution to the overall noise environment. Contribution from quarry to overall noise levels is estimated around 49-55 dB and general traffic noise from the N56 is estimated around 52-61 dB L_{AFmax} caused by vehicle noise on adjacent N56 road (non-quarry related).

Table 5.3: Summary of the Environmental Noise Survey for N3

Receptor	N1 - dwelling approximately 80 m west of the northwestern boundary of the quarry				
Period	**Time**	**Measured Noise Level dB**			**Comments**
		L_{Aeq}	L_{AF90}	L_{AFmax}	
Daytime 0700 - 1900 (24.8.23)	11.44 - 11:59	52.1	46.5	69.3	Background noise dominated by N56 traffic, and some quarry activity is faintly audible. Other noise sources are birdsong and wind noise through the adjacent trees. Contribution from quarry to overall noise levels is estimated around 37-45 dB and general traffic noise from the N56 is estimated around 45-55 dB L_{AFmax} caused by vehicle noise on adjacent N56 road (non-quarry related).

6 GENERAL ASSESSMENT

$L_{eq,15}$ levels for N1 are 55.6 dBA. As expected, activity from the quarry can be heard loudest at this location but the noise levels due to extraction activity at an estimated 47-55 dBA is within recommended levels. The screening berms along the eastern boundary of the quarry are providing some noise attenuation from inside the quarry. Passing traffic along the N56 dominates the noise environment at this location.

Average $L_{eq,15}$ levels for N2 are 52.7 dBA. Quarry activity is estimated to be at 49-55 dBA at this location. Quarry noise has been partially attenuated by the partial screening berms along the eastern boundary of the quarry and the distance from the quarry.

At N3 the average $L_{eq,15}$ levels were observed at 52.1 dBA. Activity within the quarry was faintly audible at an acceptable level 37-45 dBA and traffic noise along the N56 was heard at approximately 45–55 dBA. Noise attenuation was provided by scrub cover along the north-western boundary of the quarry.

Background noise levels, represented by L_{AF90}, are 50.5 dBA, 47.4 dBA, and 46.5 dBA for N1, N2 and N3 respectively. These are all relatively low background noise levels. The highest background noise was recorded at N1 where there was a slight contribution from quarry activity but most of the noise source was traffic from the N56.

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 largely influenced by traffic noise from the nearby N56. There were variable contributions from quarry activity to the noise environments at all noise sensitive locations. 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

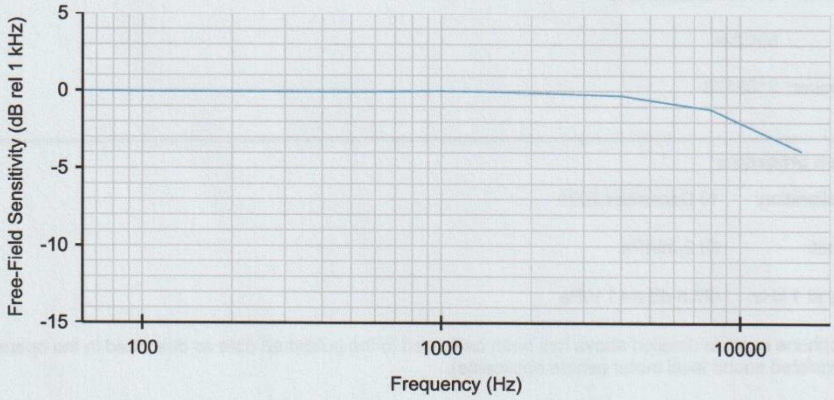
Certificate Number: **167205**

Page 2 of 2

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
Model:	CR:171B
Serial number:	G301928
Class:	1
Firmware version:	5.5.3021

Notes:

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

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

APPENDIX 2: SUMMARY NOISE REPORTS

12/09/2023

Cirrus Research plc

Measurement Summary Report

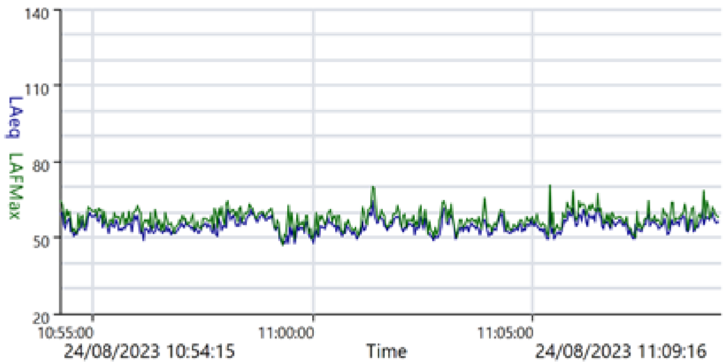
Name	50						
Time	24/08/2023 10:54:15	**Person**		**Place**		**Project**	
Duration	00:15:00	Colin Farrell		NSL1		Murray Stone	
Instrument	G301928, CR:171B						

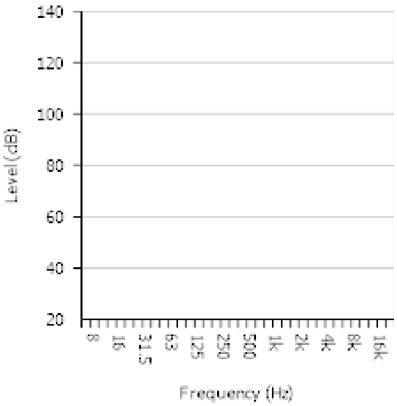
Calibration

Before	24/08/2023 10:19	Offset	-0.24 dB	**After**	24/08/2023 12:04	Offset	0.06 dB

Basic Values	
LAeq	55.6 dB
LAE	85.1 dB
LAFMax	70.7 dB

Statistical Levels (Ln)	
LAF1	61.9 dB
LAF5	59.5 dB
LAF10	58.4 dB
LAF50	54.1 dB
LAF90	50.5 dB
LAF95	49.2 dB
LAF99	47.3 dB





12/09/2023

Cirrus Research plc

Measurement Summary Report

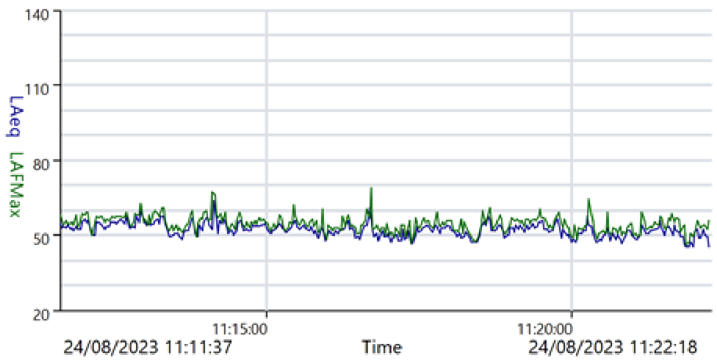
Name	51					
Time	24/08/2023 11:11:37	**Person**		**Place**		**Project**
Duration	00:10:41	Colin Farrell		NSL2		Murray Stone
Instrument	G301928, CR:171B					

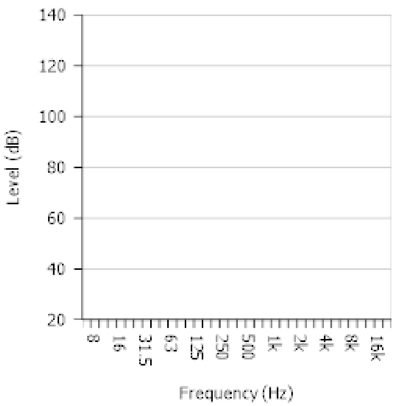
Calibration

Before	24/08/2023 10:19	Offset	-0.24 dB	**After**	24/08/2023 12:04	Offset	0.06 dB

Basic Values	
LAeq	53.0 dB
LAE	81.1 dB
LAFMax	69.0 dB

Statistical Levels (Ln)	
LAF1	59.1 dB
LAF5	56.6 dB
LAF10	55.4 dB
LAF50	51.7 dB
LAF90	47.9 dB
LAF95	46.9 dB
LAF99	44.9 dB





12/09/2023

Cirrus Research plc

Measurement Summary Report

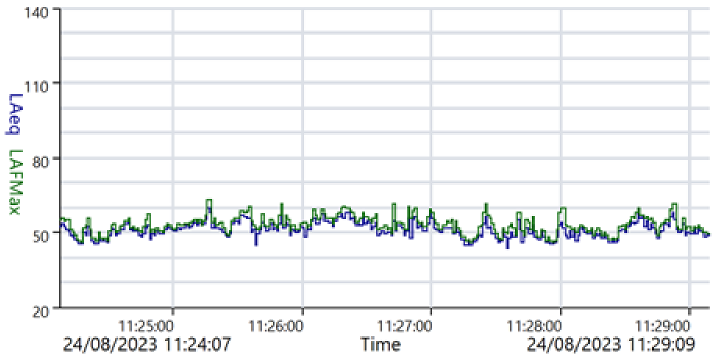
Name	52						
Time	24/08/2023 11:24:07	**Person**		**Place**		**Project**	
Duration	00:05:02	Colin Farrell		NSL2		Murray Stone	
Instrument	G301928, CR:171B						

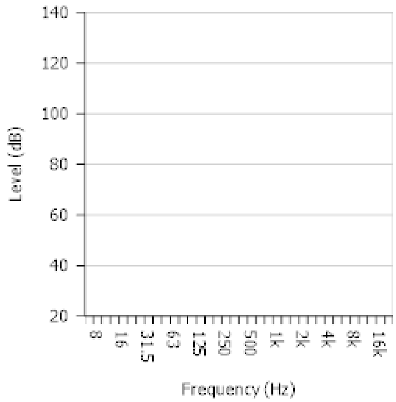
Calibration

Before	24/08/2023 10:19	Offset	-0.24 dB	**After**	24/08/2023 12:04	Offset	0.06 dB

Basic Values	
LAeq	52.1 dB
LAE	76.9 dB
LAFMax	63.1 dB

Statistical Levels (Ln)	
LAF1	58.9 dB
LAF5	56.4 dB
LAF10	55.1 dB
LAF50	50.6 dB
LAF90	46.5 dB
LAF95	45.7 dB
LAF99	44.5 dB





12/09/2023

Cirrus Research plc

Measurement Summary Report

Name	53					
Time	24/08/2023 11:44:32	**Person**		**Place**		**Project**
Duration	00:15:00	Colin Farrell		NSL3		Murray Stone
Instrument	G301928, CR:171B					

Calibration

Before	24/08/2023 10:19	Offset	-0.24 dB	**After**	24/08/2023 12:04	Offset	0.06 dB

Basic Values	
LAeq	53.6 dB
LAE	83.1 dB
LAFMax	69.3 dB

Statistical Levels (Ln)	
LAF1	61.1 dB
LAF5	57.3 dB
LAF10	56.1 dB
LAF50	52.0 dB
LAF90	48.3 dB
LAF95	46.9 dB
LAF99	42.4 dB