8.0 NOISE & VIBRATION

8.1 Introduction

This Environmental Impact Assessment Report (EIAR) has been prepared to accompany a planning application to be made under S.37L of the Planning and Development Act, 2000 as amended for the continuation of extraction at an existing quarry at Windmillhill, Rathcoole, Co. Dublin.

This chapter of the EIAR assesses the likely impacts of noise and vibration from Behan's Quarry ('the quarry') on the environment during the extraction (and restoration) activities at the Application Site.

The primary source of noise from the development will include traffic, blasting, screening, and crushing of extracted materials, vehicle movements, intermittent noises, reversing alarms, and general plant and machinery.

The primary source of vibration associated with the proposed activity is blasting from the excavation of rock. Blasting results in ground borne vibrations and air-overpressure impacts. It is acknowledged that humans are particularly sensitive to vibration stimuli and that any perception of vibration may lead to concern.

8.1.1 Project Background and Overview

The application for further development of the quarry is to be made concurrent with an application for substitute consent for the quarry that is accompanied by an rEIAR.

The lands the subject of this EIAR extend to 46.14 ha. that reflect historic operational site information including the extractable area declared under S.261 quarry registration in 2005. The EIA project boundary is generally bounded by the N7 to the north and the local Windmillhill Road to the south. The eastern and western EIA project boundaries are demarcated by the Windmillhill townland boundary that consist of field boundaries and the entrance to a dwelling called 'Four Winds' that is within the ownership of the planning applicant to the east; and the former local Steelstown Road to the west.

At the centre of the EIAR project boundary is an existing quarry that covers an area of approximately 28.8 ha. with an average working depth of 173 mAOD. The existing quarry is roughly rectangular in shape with an east – west axis parallel to the N7/M7 and local Windmillhill Road. The existing quarry has a centrally located administration and processing plant area over approximately 3.06 ha.

The further quarrying development proposed involves a lateral northward extension of the current quarry void over approximately 4.1 ha (over a total of 5.16 ha. to accommodate screening berms) west and east of an existing dwelling also in the applicant's ownership and a deepening of the western and eastern side of the laterally extended void to a final working depth of 150 mAOD. The further development proposed is for quarrying only and is over an area of approximately 26.87 ha. The material extracted will be processed at the existing central processing area and the existing quarry access will be utilised.

It is anticipated that extraction of the remaining reserve will occur over 10 to 15 years, depending on market conditions with a further 2 to 5 years for restoration that will remediate the quarry void to agricultural /amenity use and remove the quarry processing plant.

8.1.2 Scope of Assessment

The scope of this assessment has included the following:

- Identification of the study area and sensitive receptors;
- Analysis of noise and vibration survey data;
- Derivation of applicable noise criteria;
- Prediction of operational phase noise and vibration impacts;

- Evaluation of noise and vibration impacts against criteria; and
- Specification of appropriate mitigation, if required.

8.1.2.1 Effects scoped out – HGV Contribution to Road Traffic Noise

DMRB provides scoping criteria for the evaluation of operational noise from a road. With reference to the DMRB scoping criteria provided in Section 8.2.2.5, the contribution of HGVs to traffic noise does not meet 'reasonable stakeholder expectation' for an operational noise assessment. Operational phase changes in traffic noise levels have therefore been scoped out of this assessment.

8.1.3 Site Location and Setting

The quarry is situated approximately 1 km south-west of Rathcoole and 10 km east of Naas. The N7 national road which connects Dublin with Naas passes in an east-west direction just off the quarry.

Vehicular access to the quarry is from the N7 via a 170 m access track that provides access to the quarry and surrounding lands. The quarry is surrounded by agricultural fields and there are other industrial sites 200 m to the east. The area immediately around the quarry is sparsely populated, with a small number of houses to the south of the quarry, to the north west and to the north on the other side of the N7 roadway. A series of third-class roads run around the lands, serving a number of dwellings and farms.

8.1.4 Study Area, and NVSRs

The study area considered in this assessment comprises a buffer approximately 600 m beyond the quarry redline boundary. This area includes the receptors anticipated to be impacted by quarry operations. The closest receptors are located approximately 200 m south of the quarry boundary.

Representative Noise and Vibration Sensitive Receptors (NVSRs) considered within this assessment are shown in Figure 8.1 and are listed in Table 8.1.

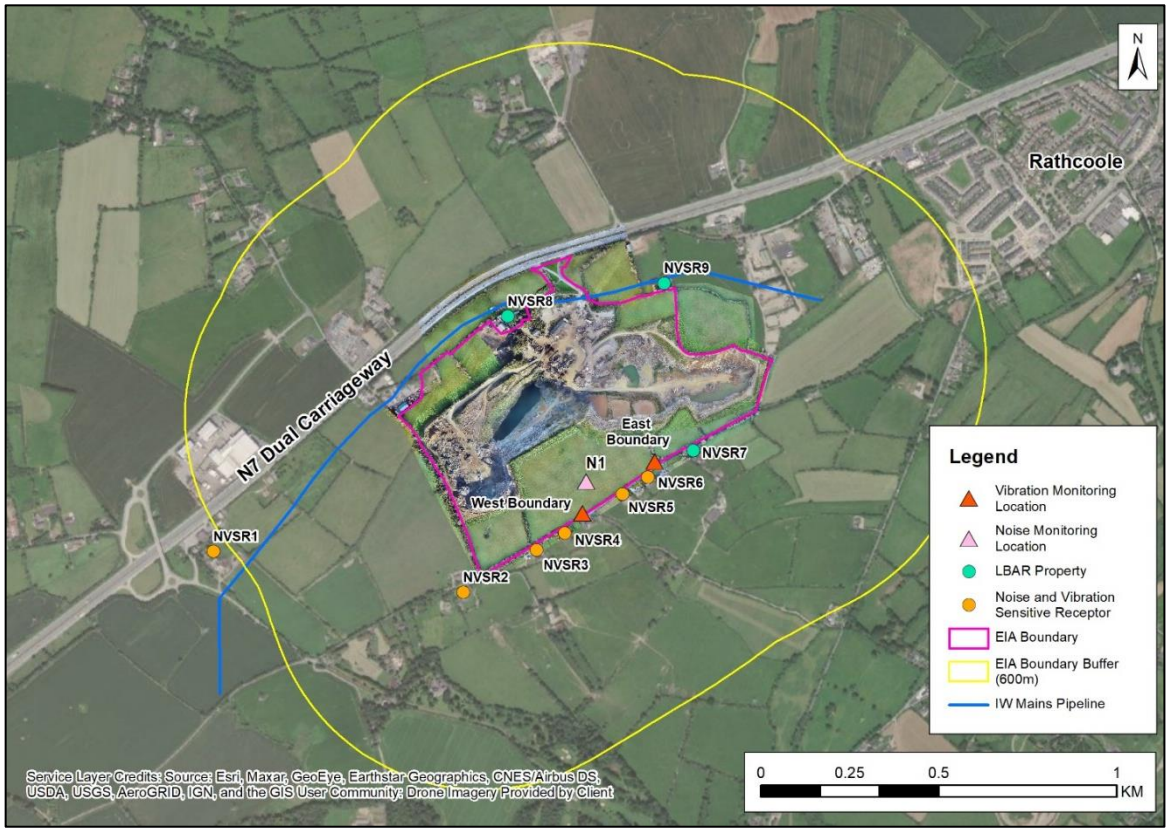

Figure 8.1: Noise and vibration monitoring locations and noise and vibration sensitive receptors.

Table 8.1: Identified representative NVSRs

Item	Representative of	X	Y
NVSR1	Property to the west of the quarry.	698868	725304
NVSR2	Property to the south of the quarry.	699570	725189
NVSR3	Property to the south of the quarry.	699776	725309
NVSR4	Property to the south of the quarry.	699855	725355
NVSR5	Property to the south of the quarry.	700018	725465
NVSR6	Property to the south of the quarry.	700088	725513
NVSR7	Applicant owned property to the south of the quarry.	700217	725588
NVSR8	Applicant owned property to the north of the quarry	700134	726057
NVSR9	Applicant owned property to the east of the quarry	699696	725965

Residential properties were also identified to the north of the quarry, on the far side of the N7 roadway. Observations of the noise environment at these potential NVSRs confirmed that road traffic noise from the N7 was of such prominence that noise from quarry operations would not be audible. These potential NVSRs were therefore scoped out of this assessment. Similarly, residential properties were identified approximately 600 m east of the quarry, however noise from quarry operations was inaudible here against the residual road traffic noise.

An Irish Water (IW) pipeline lies 40 m to the north of the quarry and is potentially vulnerable to proposed blasting activities. This is considered a representative Vibration Sensitive Receptor (VSR) within this assessment. The extent of the IW pipeline is shown in Figure 8.1.

This assessment therefore focuses on potential noise and vibration impacts at the closest NVSRs in the quietest environments, where such impacts would be greatest. Noise and vibration impacts associated with quarry activities at more distant NVSRs in noisier environments have been assumed to be lesser.

8.1.5 About the Author

This noise assessment has been prepared by Gregor Massie MSc BEng AMIOA. Gregor is a corporate member of the UK Institute of Acoustics (IoA) and has more than 3 years' experience in environmental noise assessment. He has completed the IoA postgraduate diploma in Acoustics and Noise Control, and also the Certificate of Competence in Environmental Noise Measurement.

This section of the EIAR has been reviewed by Simon Waddell BSc. (Hons) MIOA. Simon is Principal Consultant at ITPEnergised and has over 10 years of experience in environmental acoustics. Simon has completed the Institute of Acoustics' (IOA) Diploma in Acoustics and Noise Control, and also holds the Certificate of Competence in Environmental Noise Measurement.

ITPEnergised have considerable experience in the assessment of noise impacts and have compiled EIA studies ranging from quarries, mines, retail development, housing developments and wind farms.

8.2 Legislation, Policy and Guidance

8.2.1 Relevant Legislation

Legislative references considered specifically for the assessment of noise and vibration from quarrying activities and relevant statutory instruments in a planning context include:

- Directive 2014/52/EU of the European Parliament and of the Council (amending Directive 2011/92/EU);
- European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018, S.I. 296 of 2018; and
- Planning and Development Regulations 2001 (as amended).

8.2.1.1 EU Directive 2002/49/EC

The Directive provides a basis for developing and completing the Community measures concerning noise emitted by the major sources, in particular; road and rail vehicles and infrastructure, aircraft, outdoor and industrial equipment and mobile machinery. The Directive applies to environmental noise in which humans are exposed, in particular built-up areas, in public parks or quiet areas in an agglomeration, in quiet areas in open country, near schools, hospitals and other noise-sensitive buildings and areas.

"Environmental noise" is defined within the Directive as "*unwanted or harmful outdoor sound created by human activities, including noise emitted by means of road traffic, and from site of industrial activity…*"

Member states (of the EU) are required to implement the Directive, by making and approving noise maps and action plans for agglomerations, major roads, major railways, and major airports.

Noise indices specified by the Directive include L_{den} and L_{night}, however, supplementary noise indicators are permitted where these are used to express relevant limit values in Member State legislation.

8.2.2 Relevant Guidance

This assessment has been made with guidance from the 'Guidelines on the information to be contained in environmental impact assessment reports', published in 'draft' by the Environmental Protection Agency (EPA) in August 2017. Guidance related specifically to noise and vibration has been identified below.

8.2.2.1 NG4: Guidance Note for Noise: Licence Applications, Surveys and Assessment in Relation to Scheduled Activities

With regards to noise, the most recent Irish guidance document in relation to noise was published in 2016 by the EPA, Office of Environmental Enforcement (OEE), entitled 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)'.

NG4 sets methods for addressing noise from operations that fall under IPPC and Waste Licensing functions of the Environmental Protection Agency Office of Environmental Enforcement (OEE). NG4 provides detailed consideration of a range of noise related issues including basic background to noise issues, various noise assessment criteria and procedures, noise reduction measures, Best Available Techniques (BAT) and the detailed requirements for noise surveys. NG4 identifies typical limit values for noise from licensed sites as: Daytime (07:00 to 19:00) – 55dB $L_{Ar,\,T}$; Evening (19:00 to 23:00) – 50dB $L_{Ar,T}$; and, Night-time (23:00 to 07:00) – 45dB $L_{Aeq,\,T}$.

NG4 identifies the following guidance as potentially appropriate for assessing noise, subject to the use of the methodology being considered and justified by a competent person:

- BS 4142: 2014: Methods for rating and assessing industrial and commercial sound – evaluation of industrial and commercial noise sources at residential properties;

- BS 8233: 2014 Guidance on sound insulation and noise reduction for buildings – outline guidance on noise matters and deals specifically with noise within buildings; and
- BS 5228-1: 2009 + A1: 2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise – outline guidance on prediction and control of noise from construction and open sites.

8.2.2.2 British Standard BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites, Parts 1 and 2.

BS5228 (BSI, 2014) provides a procedure for the estimation of construction noise and vibration levels and for the assessment of the significance of the predicted effects at the nearest sensitive receptors. Annex D of the Standard includes measured typical noise levels for a range of construction plant and activities.

Part 1 of the Standard provides several methods for the evaluation of the significance of construction noise effects. The ABC method considers significance by comparison to the measured baseline $L_{Aeq,T}$ noise level, rounded to the nearest 5 dB. Three categories of threshold values are provided; A, B and C, in increasing 5 dB bands, for the periods “daytime and Saturdays”, “evenings and weekends” and “night time”. Where the measured baseline exceeds the highest category (C), a 3 dB increase over baseline is considered significant. The evaluation periods are defined as follows:

- Daytime: 07:00 – 19:00 on weekdays and 07:00 – 13:00 on Saturdays;
- Evenings and weekends: 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays; and
- Night-time: 23:00 - 07:00 (all days).

Part 2 of the Standard provides threshold levels at which vibration may be perceptible to people, through to becoming intolerable and frequency-weighted thresholds at which vibration may cause cosmetic damage to structures.

The thresholds are dependent on frequency and the type of building, however, in the worst-case, residential, or light commercial structures may see the onset of damage at 15 mm/s PPV at 4 Hz, increasing to 20 mm/s PPV at 15 Hz and above.

8.2.2.3 BS7445-1:2003 Description and Measurement of Environmental Noise. Guide to Quantities and Procedures.

BS7445 provides guidance on appropriate environmental noise monitoring, including specification of equipment and appropriate calibration intervals, suitable weather conditions and observations to note regarding the nature of the noise environment.

Other guidance reviewed as part of the assessment process includes:

- The EPA’s Environmental Management Guidelines: Environmental Management in the Extractive Industry (Non Scheduled Minerals; April 2006);
- As well as the EPA’s NG4 guidance, noise monitoring at the quarry is based on procedures outlined in ISO 1996: Description, Measurement and Assessment of Environmental Noise, and BS4142:2014 Method for Rating and Assessing Industrial and Commercial Sound;
- Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment, 2014;
- The EPA is in the process of updating the existing guidance documents relating to EIAs and the preparation of EIARs. ‘Guidelines on the information to be contained in environmental impact assessment reports’,

published in 'draft' by the EPA in August 2017, and 'Advice notes for preparing Environmental Impact Statements', (Draft, 2015);

- BS 6472:1992 - The Evaluation of Human Exposure to vibration in buildings;
- BS 7385-1:1990 - Evaluation and measurement for vibrations in buildings;
- Department of the Environment, Heritage and Local Government – Quarries and Ancillary Activities: Guidelines for Planning Authorities, 2004;
- Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (2006) Environmental Protection Agency. This guidance outlines primary sources of noise associated with quarrying and offers guidance in relation to the correct approach to be followed in respect of assessment and mitigation. Recommended noise limit values are 55dB $L_{Aeq,1hr}$ and 45dB $L_{Aeq,15min}$ for daytime and night-time respectively; and
- Environmental Code (2005) Irish Concrete Federation. EPA guidelines in relation to blasting activities outlining the methodology and limits to be used for vibration measurement.

8.2.2.4 BS7385:, Evaluation and measurement for vibration in buildings, Part1 1990 Guide for measurement of vibrations and evaluation of their effects on buildings and Part 2 1993 Guide to damage levels arising from ground borne vibration

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above.

BS7385 also provides further context with regards to air overpressure:

"Windows are generally the weakest parts of a structure exposed to air overpressure. Research by the United States Bureau of Mines has shown that a poorly mounted window that is pre-stressed can crack at around 150 dB(lin), with most windows cracking at around 170 dB(lin). Structural damage would not be expected at air overpressure levels below 180 dB(lin).

8.2.2.5 Design Manual for Roads and Bridges (DMRB)

DMRB provides standards and advice regarding the assessment, design, and operation of roads in the UK and sets out screening criteria, by which percentage changes in traffic flow can be related to a predicted change in road traffic noise and vibration. The guidance also provides significance criteria, by which the percentage of people adversely affected by traffic noise can be related to the total noise or vibration level due to road traffic, or the increase over an existing level.

DMRB provides a method for predicting the Basic Noise Level (BNL), a measure of the source noise level of a road. The BNL is a function of the composition, flow and speed of traffic and the quality of the road surface. Changes in the BNL, arising from changes in traffic flow, may be used as a means of determining the significance of operational noise effects.

The following scoping criteria are provided for the evaluation of operational noise from a road:

1) is the project likely to cause a change in the BNL of 1dB $L_{A10,18hr}$ in the do-minimum opening year (DMOY) compared to the do-something opening year (DSOY)?
2) is the project likely to cause a change in the BNL of 3dB $L_{A10,18hr}$ in the do-something future year (DSFY) compared to the DMOY?
3) does the project involve the construction of new road links within 600m of noise sensitive receptors? and

4) would there be a reasonable stakeholder expectation that an assessment would be undertaken?

With regard to a 'reasonable stakeholder expectation' for an operational noise assessment, DMRB notes an example where works involve changes to infrastructure but are not expected to give rise to significant environmental effect, such as smart motorway projects.

Where the response to any of the above scoping questions is 'yes' the scoping assessment shall make a recommendation on the scope of further assessment.

8.2.3 Other Guidance

Other guidance reviewed as part of the assessment process includes:

- Department of the Environment, Heritage and Local Government (DEHLG) – Quarries and Ancillary Activities: Guidelines for Planning Authorities, 2004;
- Design Manual for Roads and Bridges (DMRB);
- BS 6472:1992 - The Evaluation of Human Exposure to vibration in buildings;
- Department of the Environment, Heritage and Local Government – Quarries and Ancillary Activities: Guidelines for Planning Authorities, 2004; and
- Environmental Code (2005) Irish Concrete Federation (ICF). EPA guidelines in relation to blasting activities outlining the methodology and limits to be used for vibration measurement.

8.2.4 Relevant Planning Objectives and Plans

8.2.4.1 South Dublin County Development Plan 2016-2022

The quarry is located within the administrative area of South Dublin County Council (SDCC) and is subject to the objectives and policies contained within the South Dublin County Development Plan 2016-2022.

In their County Development Plan SDCC identifies that mineral extraction and the aggregate industry is an important economic sector that provides raw materials for the construction industry. SDCC also acknowledges that the processes involved in extraction can give rise to long-term environmental effects and significantly alter landscape character. These effects require important consideration when identifying the suitability of areas for extraction.

Under the SDCC policies for Economic Development and Tourism, 'Policy 10 Mineral Extraction' specifies:

> *'It is the policy of the Council to support the sustainable extraction of aggregate resources at suitable locations within the County subject to appropriate environmental safeguards.'*

Specific objectives in this policy which are relevant to the quarry include:

- **ET10 Objective 1:** To facilitate mineral extraction in suitable locations subject to the protection of amenity and environmental quality; and
- **ET10 Objective 3:** To ensure the satisfactory reinstatement and/or re-use of disused quarries and extraction facilities, where active use has ceased.

SDCC acknowledges that factors such as air pollution, water pollution, nuisance noise and vibrations can negatively affect human health, the environment and residential amenity.

Chapter 7 of the SDCC County Development Plan 2016 - 2022 provides policies and objectives related to 'Infrastructure and Environmental Quality'. In this chapter relevant policies which are related to the development and bio-physical factors (air, noise and water) which could affect human health include:

Policy 2 Surface Water and Groundwater:

'It is the policy of the Council to manage surface water and to protect and enhance ground and surface water quality to meet the requirements of the EU Water Framework Directive.'

Policy 7 Environmental Quality:

'It is the policy of the Council to have regard to European Union, National and Regional policy relating to air quality, light pollution and noise pollution and to seek to take appropriate steps to reduce the effects of air, noise and light pollution on environmental quality and residential amenity.'

8.3 Assessment Methodology and Significance Criteria

8.3.1 Noise Impact Assessment

8.3.1.1 Receptor Sensitivity

This assessment considers that human receptors, including residential dwellings, have a high sensitivity to noise. Commercial and industrial receptors, comprising buildings and businesses, are considered to have a low sensitivity to noise and have been scoped out of further assessment. The assumed sensitivity of identified representative existing and proposed NVSRs are provided in Table 8.2

Table 8.2: Assumed sensitivity of representative NVSRs

Receptor	Type of receptor	Sensitivity
NVSR1– NVSR9 existing dwellings (eNVSRs)	Human / residential	High

8.3.1.2 Impact Magnitude Criteria

Appropriate criteria have been adopted for the derivation of impact magnitude and are provided in Table 8.3. The criteria have been adapted from DMRB. DMRB provides useful criteria for evaluation of noise during the construction phase of developments, including the typical subjective reaction of affected populations, which is relevant to this assessment.

Table 8.3: Impact Magnitude Criteria

Exceedance of threshold value OR change in noise level, $dBL_{Aeq,T}$	Subjective reaction	Impact Magnitude
≥5	Clearly perceptible	High adverse
≥3, <5	Perceptible	Medium adverse
>0, <3	Barely perceptible	Low adverse
≤0	Inaudible	No change / none

The Proposed Development will introduce additional anthropogenic noise sources to the study area during both the construction and occupation phases, therefore all impacts are assumed to be adverse. The criteria in Table 8.2 and Table 8.3 have been used to determine the significance of noise effects for receptors of different sensitivities, as shown in Table 8.4.

Table 8.4: Assumed Sensitivity of Representative NVSRs

Magnitude	Level of significance, relative to sensitivity of receptor		
	Low	Medium	High
High	Moderate	Moderate/Large	Large
Medium	Slight	Moderate	Moderate
Low	Neutral	Slight	Slight
No change / none	Neutral	Neutral	Neutral

All residential NVSRs are considered to be of 'high' sensitivity to noise and vibration.

This assessment considers that effects of moderate and large significance are significant, and that effects of neutral and slight significance are not significant.

8.3.1.3 Target Noise Levels

Noise criteria have been adopted from appropriate guidance, as provided in Section 8.2. The adopted criteria are provided below.

The quarry's existing permitted noise limits (SDCC Reg. Ref.: SDQU05A/4, Condition 4) are:

a) *'Free-field noise levels attributable to the operation of the entire quarry complex, when measured at the nearest noise sensitive receptor, shall not exceed 55 dB (A) (60 minute L_{Aeq}) during permitted operating hours, and shall not exceed 45 dB(A) (15 minute L_{Aeq}) at any other time.*

b) *Monthly monitoring shall be carried out.*

c) *No audible or impulsive noise shall be permitted outside permitted operating hours.*

d) *Notwithstanding (a) above, where any temporary quarry activity is expected to exceed the noise limits above, this shall be notified in advance to the planning authority, and to residents on the vicinity, indicating the for such activity, and its likely duration. No such exceedance of noise limits shall occur without the prior agreement of the planning authority.*

e) *A noise survey and assessment programme shall be undertaken every six months to assess the impact of noise emissions arising from the operation of the entire quarry complex. The scope and methodology of this survey and assessment programme shall be submitted to the planning authority for its written agreement within three months of the date of this decision. The results obtained from the assessment programme shall be submitted within two weeks of completion for the written agreement of the planning authority. The operator shall carry out any amendments to the programme required by the planning authority following this six-monthly review.'*

The quarry's existing permitted hours of operation (SDCC Reg. Ref.: SDQU05A/4, Condition 3) are:

> *'Quarrying operations, other than blasting, shall be carried out only between 05:00 and 21:00 hours on Monday to Friday inclusive and between 05:00 and 14:00 hour on Saturday. No such activity shall take place outside these hours or on Sundays or public holidays.'*

Excavation and mobile processing of material is carried out between 08:00 - 20:00, Monday to Friday and between 08:00 - 14:00 on Saturdays.

Outside the hours of 08:00 – 20:00 the activities are limited to loading and moving trucks.

It is proposed that these hours and limits are maintained for the proposed continuation of extraction and processing at the quarry and this assessment has been undertaken on this basis.

8.3.1.4 Noise Limits Provided in Guidance

The applicable guidance which dictates noise thresholds is the EPA's '*Environmental Management in the Extractive Industry (Non-Scheduled Minerals)'* (2006). As noted previously, the recommended noise limit values for the Proposed Development are 55 dB $L_{Aeq,1hr}$ and 45 dB $L_{Aeq,15min}$ for daytime and night-time, respectively. The guidance then specifies the daytime and night-time periods as between 08:00 and 20:00, and 20:00 and 08:00, respectively.

Another more recent Irish guidance document in relation to noise was published in 2016 by the EPA and OEE, although applicable to EPA licenced facilities, the NG4 guidance identifies typical limit values for noise from such sites as: Daytime (07:00 to 19:00) – 55 dB $L_{Ar,T}$; Evening (19:00 to 23:00) – 50 dB $L_{Ar,T}$; and Night-time (23:00 to 07:00) – 45 dB $L_{Aeq,T}$.

8.3.1.5 Method of Baseline Characterisation

Baseline noise measurements were undertaken over two days, in November 2020 and February 2021. Monitoring was undertaken at monitoring position N1, which is representative of the closest NVSRs to the quarry, for a duration of 1 hour. Multiple 1/3 octave measurements were also undertaken at 10 m from various plant and equipment operating in the quarry. The monitoring location is shown in Figure 8.1.

Monitoring was undertaken in accordance with BS7445 guidance, using a Norsonic Nor-140 Class I sound level meter (SLM). The SLM was mounted on a tripod at a height of 1.2 – 1.5m above ground level. The SLM was field calibration tested at the start and end of each measurement, with no significant drift noted. The SLM and calibrator were within their laboratory calibration period. SLM calibration certificates are presented in Appendix 8.1.

Weather conditions during the survey were in accordance with the requirements of BS7445, with no rain and wind speeds below 5 m/s throughout. The temperature was generally within the range 5 – 11^{o}C.

The following noise indices were recorded:

- $L_{Aeq,T}$ – the equivalent continuous level is the constant noise level that would result in the same sound energy over a given period and is used to represent varying noise levels over a time, T, as a single number. Typically referred to as the 'ambient' noise level.
- $L_{A90,T}$ – the 'background' or 90th percentile noise level, i.e. the noise level that is exceeded for 90 percent of a time, T. Representative of the quieter moments experienced at a location, this index is unaffected by short-duration noisy events.
- $L_{A10,T}$ – the 10th percentile noise level, i.e. the noise level that is exceeded for 10 percent of a time, T. Typically used to characterise road traffic noise.
- $L_{Amax,T}$ – the maximum noise level recorded over a time, T.

A 1-minute averaging period (T) was selected for measurements to provide sufficient data resolution to characterise the noise environment. Details of observations made during monitoring are provided in Appendix 8.2.

8.3.1.6 Method of Prediction

A 3D model of the quarry was constructed within noise prediction software CadnaA and noise levels were predicted at the representative NVSRs. The software enables prediction of noise levels under atmospheric conditions using the method provided in BS5228.

Measurements were undertaken of various items of plant during the recent baseline survey to characterise their noise emissions. All measurements of plant were undertaken at a distance of 10 m from the source. Appropriate source noise terms from BS5288 were applied to plant which could not be measured during the survey. Table 8.5 presents the noise sources and applied sound power data included in the noise model.

Table 8.5: Source Noise Terms

Item	Resultant sound power level, dBA	Data source	Modelling method
Excavator	110.4	BS_5228_2009_C1_12	Point Source
Excavator - Rock Breaking	121.0	BS_5228_2009_C9_11	Point Source
Screens	110.3	Measured data	Point Source
Loader	103.5	BS_5228_2009_C6_34	Point Source
Drill Rig	119.0	BS_5228_2009_C9_3	Point Source
Crushers	115.5	Measured data	Point Source
Generator	88.1	BS_5228_2009_C4_77	Point Source
Asphalt Plant	98.6	Measured data	Point Source
Dump Truck	105.1	BS_5228_2009_C6_25	Moving point source
Road HGV	101.4	BS_5228_2009_C11_4	Moving point source

The quarry operates during the following hours:

- The quarrying occurs 05:00 - 21:00 Monday to Friday, and 05:00 - 14:00 on Saturdays, with no working on Sundays or Bank Holidays;
- Excavation and mobile processing of material is carried out between 08:00 - 20:00, Monday to Friday and between 08:00 - 14:00 on Saturdays; and
- Outside the hours of 08:00 – 20:00 the activities are limited to loading and HGV movements.

Based on the above timing of activities, two scenarios have been modelled to noise impacts and impacts from proposed operations:

- Scenario 1 – excavation and mobile processing of material; and
- Scenario 2 – loading and moving trucks.

In line with the operational hours of different activities, Scenario 1 has been evaluated against the daytime target level, and Scenario 2 has been evaluated against the night-time target level.

8.3.1.6.1 Scenario 1 – excavation and mobile processing of material

The predicted inputs for this scenario include the activities of the below fixed and mobile equipment. Items of equipment have been located within the designated areas shown in Figure 8.2 so that they are at the closest working location to the NVSRs.

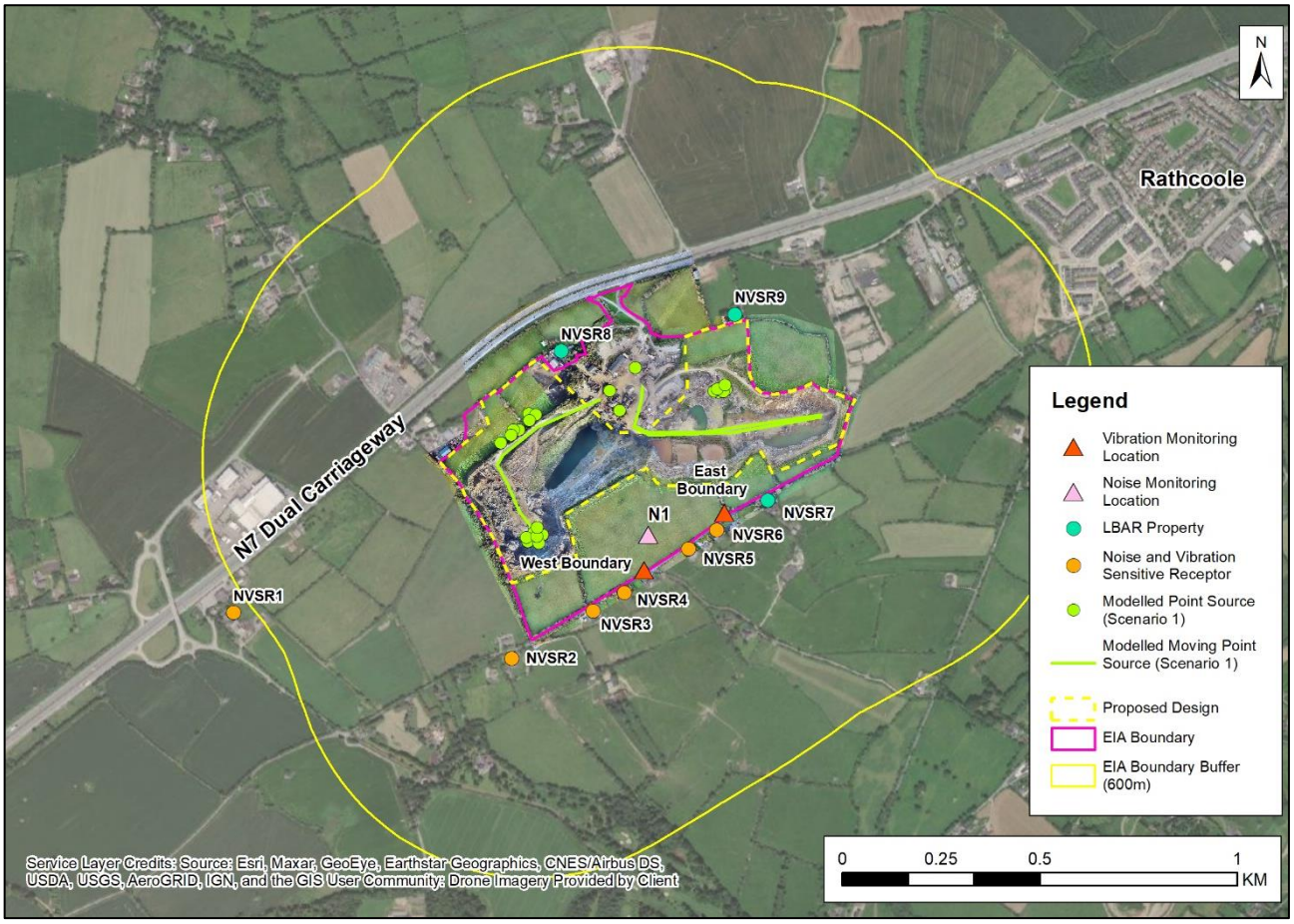

Figure 8.2: Scenario 1 inputs and layout.

Details of operations modelled in Scenario 1 are presented below:

South-west area of pit

- Jaw crusher;
- Cone Crusher;
- Screen;
- Excavator (ca. 50t) feeding first jaw crusher;
- Excavator (ca. 50t) rock breaking;
- Screen; and
- Loader loading road trucks.

Proposed north-west extension area

- Jaw crusher;
- Cone Crusher;
- Screen;
- Excavator (ca. 50t) feeding first jaw crusher;

- Excavator (ca. 50t) rock breaking;
- Screen; and
- Loader loading road trucks.

Proposed north-east extension area

- Jaw crusher;
- Cone Crusher;
- Screen;
- Excavator (ca. 50t) feeding first jaw crusher;
- Excavator (ca. 50t) rock breaking;
- Screen;
- Loader loading road trucks; and
- Road HGV Trucks 4 per hour, 33 % going to and from south-west pit area, 33 % going to and from north-west extension area and 33 % going to and from north-east extension area.

Plant Area

- Screening Plant;
- Asphalt Plant;
- Screening and Washing Plant;
- Water Recycling Unit;
- Loader working with stockpiles and loading; and
- JCB telehandler operating (reduced time)

8.3.1.6.2 Scenario 2 - loading and HGV movements

Scenario 2 includes for the loading and movement of HGVs in the quarry during the night-time period. The locations of the equipment are shown in Figure 8.3.

Details of operations modelled in Scenario 2 are presented below:

- Dump Trucks – Three dumpers moving from north and south work areas to plant area (4 loads per hour);
- Road HGV Trucks 4 per hour, 33 % going to and from south-west pit area, 33 % going to and from north-west extension area and 33 % going to and from north-east extension area; and
- 3 x excavator loading haul trucks and HGVs.

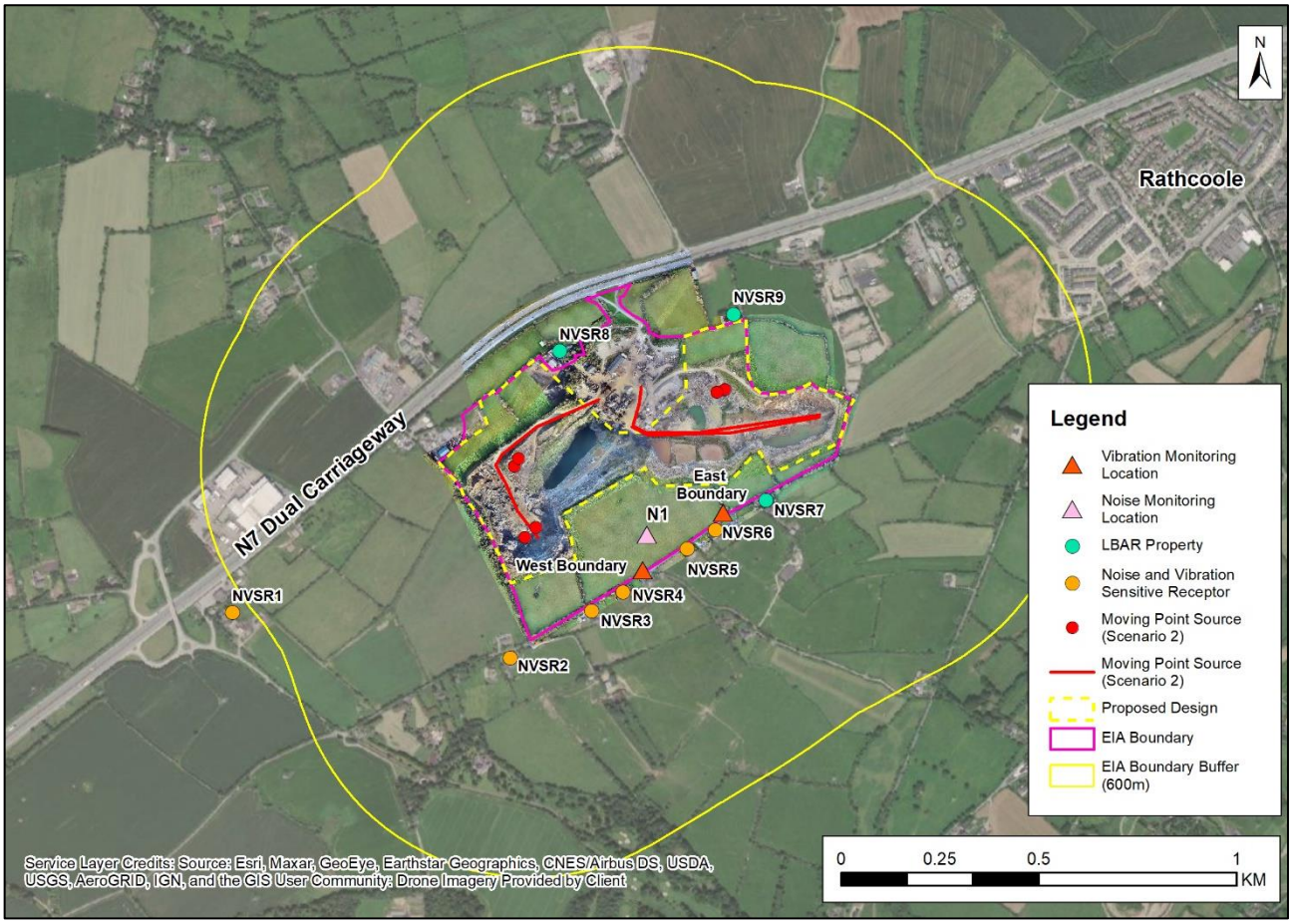

Figure 8.3: Scenarios 2 inputs and layout.

A robust approach has been applied in both model scenarios; modelling has assumed all mobile plant items operated at the area of the quarry closest to the identified NVSRs. We note that these work practices are very unlikely to occur in close proximity at such a location and this therefore represents a possible 'worst case', actual noise impacts are likely to be lower.

The predicted noise levels assume a receptor height of 4 m above local ground level (representative of a first-floor bedroom window). This is a robust approach, which minimises the attenuation due to ground absorption. Predicted levels at the height of a person standing at ground level (e.g. effective receptor height of 1.5 – 1.8 m) will be lower.

A conservative 100% equipment 'on-time' has been applied in all predictions for all fixed and mobile plant throughout the working day. All equipment and plant has been modelled to run simultaneously. The resultant prediction conservatively overestimates the noise output as all plant is not usually in operation simultaneously for 100% of the day. This assessment therefore considers a 'worst-case' 1 hour period during a working day for each scenario when all on-site plant is in use simultaneously. Actual noise impacts are likely to be lower.

8.3.1.7 Model Settings

A typical air temperature of 10^{o}C and relative humidity of 70% have been assumed within the model. Ground absorption within the quarry has been assumed to be G = 0, representative of hard ground conditions. The ground absorption for the area surrounding the quarry has been modelled as G = 0.5 representative of mixed ground conditions.

Local topography has been included within the model for all scenarios, using detailed contour line data provided by Golder.

8.3.2 Vibration Impact Assessment

The most significant potential source of ground borne vibrations that could be generated by the proposed operations at the quarry is the extraction of rock from the active face. Rock extraction requires the use of a pneumatic rock breaker and blasting techniques.

In order to characterise potential vibration impacts at the closest receptors, monitoring has been undertaken by a blasting contractor during blasting activities at the eastern and western boundaries of the quarry.

Measured vibration levels have been assessed according to *British Standard BS 7385: Evaluation and measurement for vibration in buildings, Part1 1990 Guide for measurement of vibrations and evaluation of their effects on buildings and Part 2 1993 Guide to damage levels arising from ground borne vibration.*

8.3.2.1 Vibration Measurement Parameters

- Ground vibration at sensitive receptors is measured as Peak Particle Velocity (PPV) in mm/s. The PPV is the maximum instantaneous velocity of a particle at a point during a given time interval; and
- Air blast (air overpressure) noise is measured in linear decibels dB(Lin). Air overpressure is energy transmitted from the blast site within the atmosphere in the form of pressure waves and is generally perceived as a loud bang.

8.3.2.2 Evaluation Criteria

Table 1 in BS6472 (reproduced here as Table 8.6) provides magnitudes of vibration that are acceptable with respect to human response for up to three blast vibrations events per day.

Table 8.6 - Maximum satisfactory magnitude of vibration with respect to human response for up to three blast vibration events per day

Place	Time	Satisfactory Magnitude, PPV (mm/s)
Residential	Day – 08:00 to 18:00 Mon-Fri, 08:00 to 13:00 Saturdays Night – 23:00 to 07:00 Other times	6.0 to 12.0 2.0 4.5
Offices	Any time	14.0
Workshops	Any time	14.0

The table recommends magnitudes of vibration below which the probability of adverse comments is low.

8.3.2.3 Vibration and air overpressure limits

Vibration limits from blasting are recommended in DEHLG (now DCCAE), EPA and ICF Environmental Guidelines. The vibration limit from blasting should not exceed a peak particle velocity of 12 mm/s when measured in any three mutually orthogonal planes at a receiver location when blasting occurs at a frequency of once per week or less. Research has found that damage to windows occurs at air overpressure levels of 150 dB(lin) and above. Structural damage would likely only occur at air overpressure levels greater than 180 dB(lin).

The acceptable vibration and air overpressure limits at sensitive receptors in Ireland are 12 mm/s (PPV) and 125 dB(lin) Air Overpressure (AOP) as defined in the EPA management guidelines.

8.3.3 Construction Phase

The construction noise levels associated with the proposed activities of the quarry will be of relatively short term duration which served to minimise the noise impacts at existing NVSRs. Future construction phase works will

consist of stripping the top and subsoils to expose the rock reserve. The construction of the screening banks around the quarry has provided more effective attenuation to noise generated by site activities. Noise levels associated with any future construction phase activities will be controlled in accordance with methods provided in BS5228.

Appropriate construction phase noise limits, which are presented in Table 8.7 (NRA Guidelines, 2004) represent a reasonable compromise between the practical limitations in a construction project, and the need to ensure an acceptable noise level for the nearby residents. In addition to the standard workday criterion of 70 dB(A), the guidelines specify a reduced limit of 65 dB(A) for work on Saturdays, and 60 dB(A) for evening periods, and Sundays and Bank holidays.

Table 8.7 – Construction Phase Noise Limit Values

Days	Times	Ambient level, dBL_{Aeq1hr}	Maximum level, dBL_{Amax}
Monday to Friday	07:00 to 19:00	70	80
Monday to Friday	19:00 to 22:00	60	65
Saturday	08:00 to 16:30	65	75
Sundays and Bank Holidays	08:00 to 16:30	60	65

8.4 Baseline Conditions

8.4.1 Characterisation of Baseline Noise Environment

The noise environment at N1 was dominated by road traffic on the N7 roadway, with a lesser contribution from the current operations at the quarry which were sporadic and only faintly audible. Other lesser contributors to measured noise levels included;

- Very sporadic vehicle movements on the country road running adjacent to the closest NVSRs;
- Wind-induced rustling from vegetation; and
- Bird calls.

The measured noise levels at N1 for the November and February surveys are summarised in Table 8.8.

Table 8.8 – Summary of Measured Baseline Noise Levels

Noise monitoring position ID	Duration of measurement, T	Measured Noise Level			
		Ambient, $dBL_{Aeq,T}$	Maximum, dBL_{Amax}	10^{th} Percentile, $dBL_{A10,T}$	Background, $dBL_{A90,T}$
N1 – November 2020	1 hr	53.5	63.3	56.6	47.9
N1 – February 2021	1 hr	54.4	76.1	55.6	49.1

Measured noise levels are presented in Figure 8.4 (November 2020). Figure 8.4 shows the variation in measured noise levels during a 1-hour measurement at N1 during the day-time period of the November 2020 survey. Noise levels are shown to be increasing gradually at the end of the measurement, in the run up to the rush hour period. All of the noise indices show a maximum variation of approximately 10 dB, indicative of a steady noise environment, consistent with road traffic noise from a busy road (N7). The measured ambient noise level was typically below the 55 dB target noise level throughout the measurement. Operational noise from the quarry was sporadic and only faintly audible at N1.

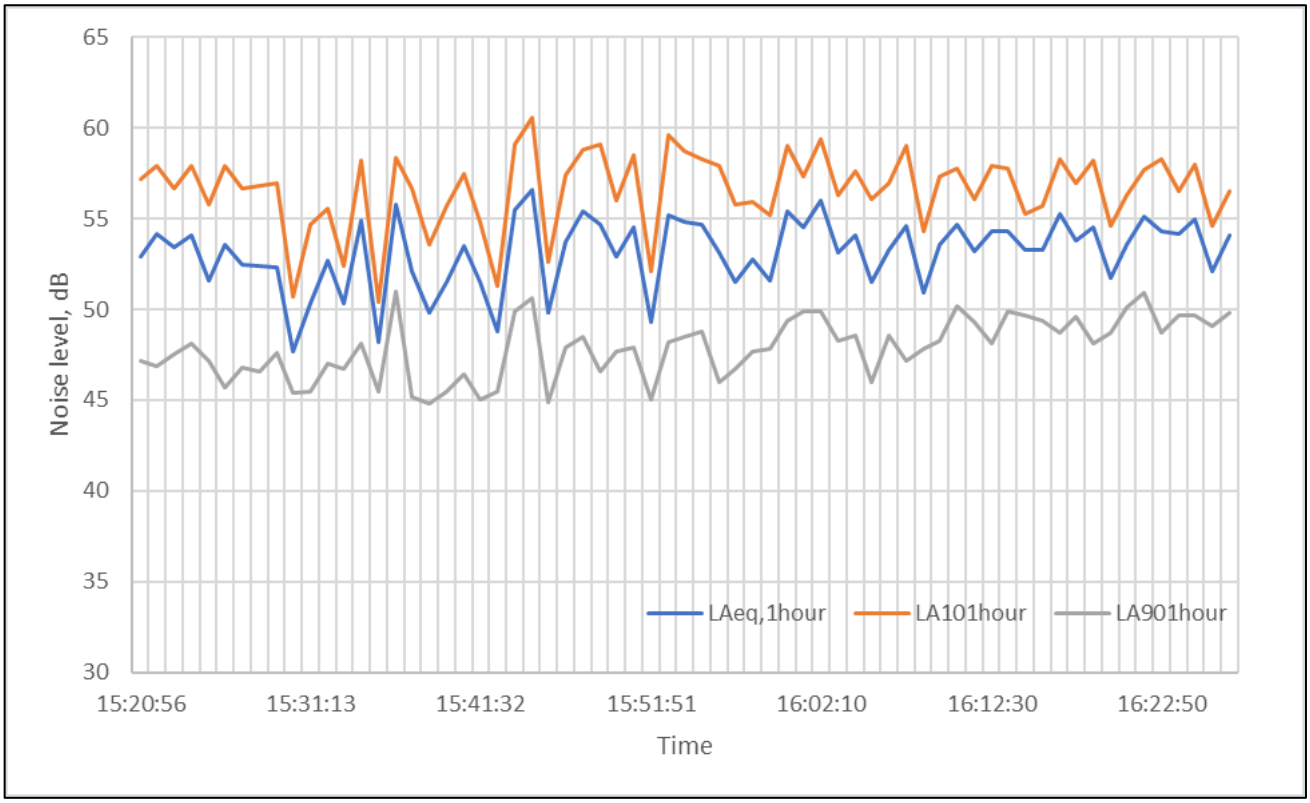

Figure 8.4: Measured Noise Levels – N1 – November 2020

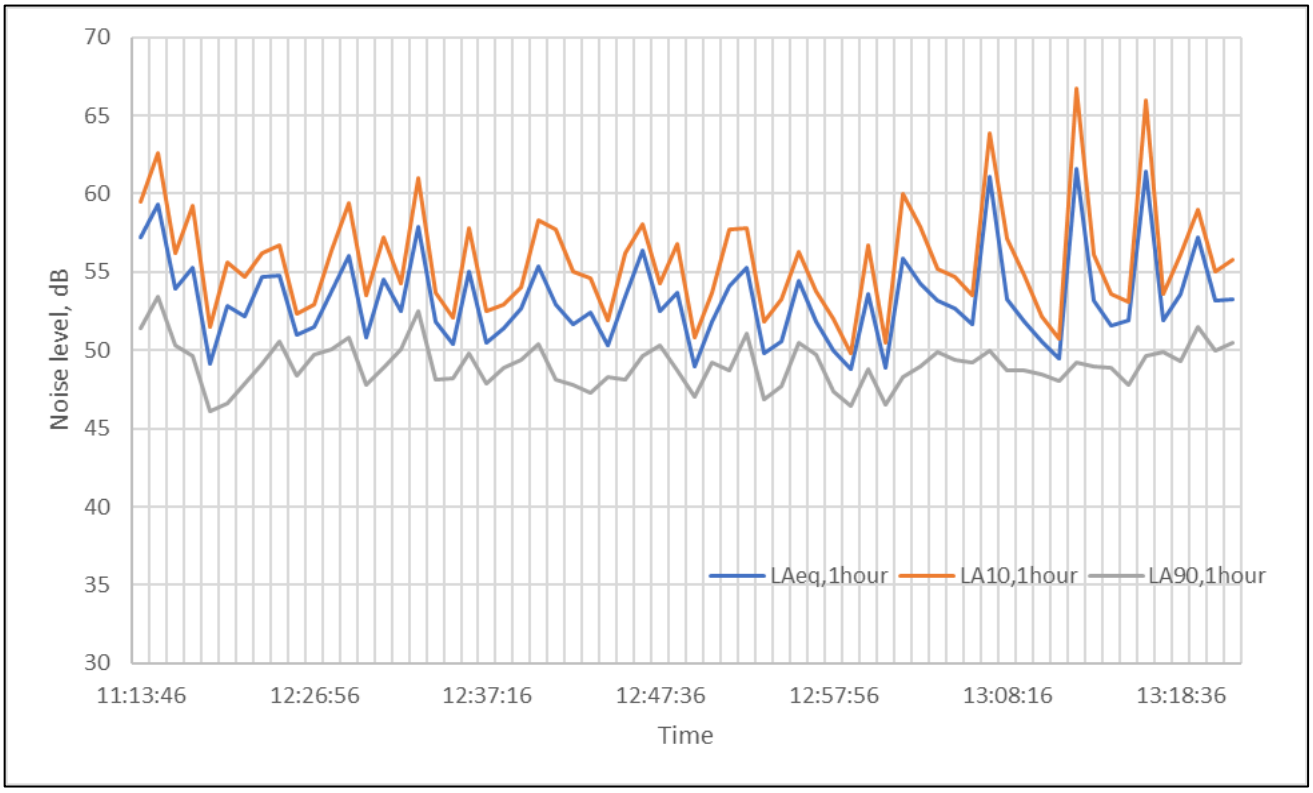

Figure 8.5 shows the variation in measured noise levels during a 1-hour measurement at N1 during the day-time period of the February 2021 survey. The fluctuations in noise levels at the end of the measurement correspond with pulses in the level of road traffic on the N7 roadway. All of the noise indices show a maximum variation of approximately 10 dB, indicative of a steady noise environment, consistent with road traffic noise

from a busy road (N7). The measured ambient noise level was typically below the 55 dB $L_{Aeq1hour}$ target noise level throughout the measurement. Operational noise from the quarry was sporadic and only faintly audible at N1.

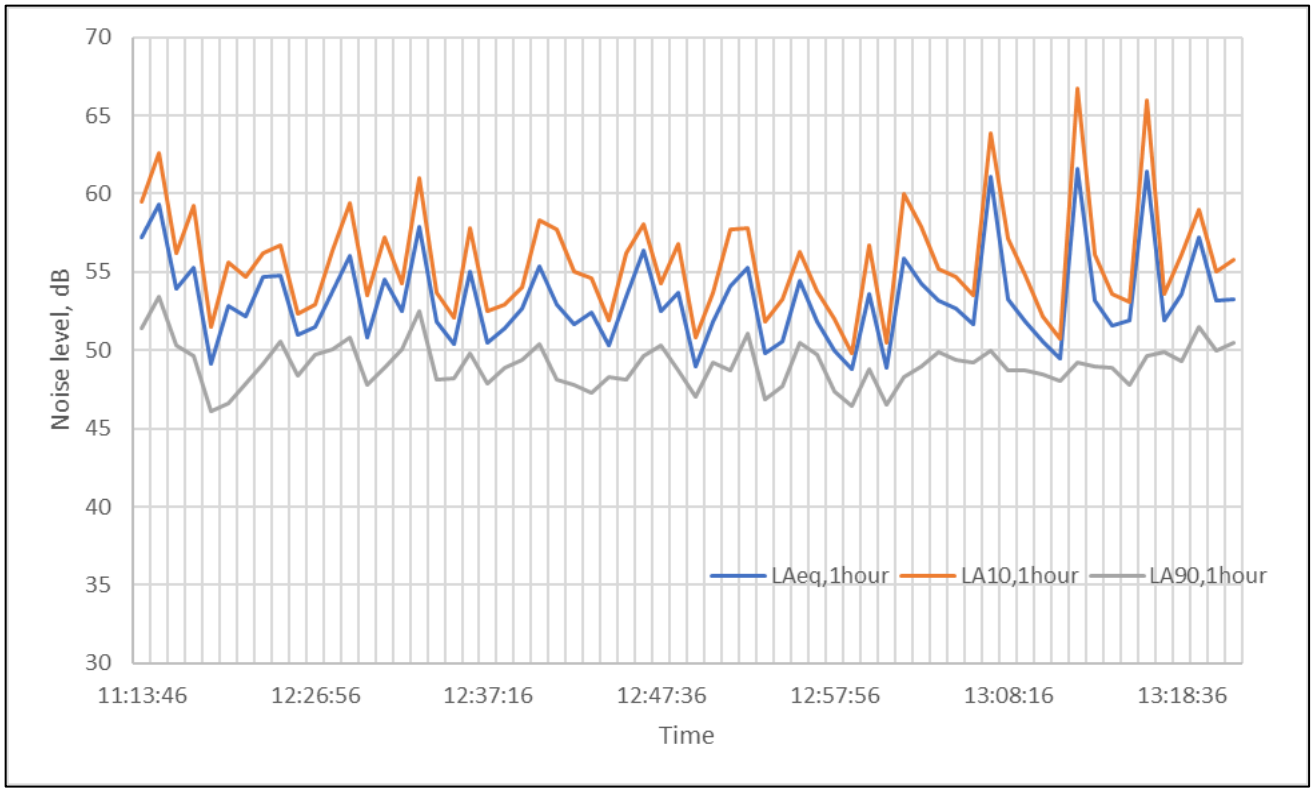

Figure 8.5: Measured Noise Levels – N1 – February 2021

Although there were occasional exceedances in the 55 dB $L_{Aeq1hour}$ target level during both surveys, these were caused by road traffic noise, with quarry operations a lesser contribution to the overall noise environment.

8.4.2 Vibration Monitoring

Human beings are extremely sensitive to vibration, the threshold of perception is typically in the PPV range of 0.14 mm/s to 0.3 mm/s. BS6472-2 sets out vibration levels from blasting activities at which minimal adverse comment is likely to be provoked (Table 8.6). If vibration levels from blasting exceed these values, then the chance of adverse comment increases significantly.

Measurements were undertaken at the eastern and western boundary of the quarry throughout 2019 and 2020. The full results of the vibration monitoring undertaken in 2019 and 2020 are presented in **Appendix 8.3**.

The maximum PPV recorded was 10.6 mm/s, which complies with the vibration limit. The maximum air-overpressure recorded was 124.8 dB(lin) and therefore complies with the air overpressure limit. Measured air-overpressure levels were below the values provided in BS6472 at which damage may be expected to windows.

8.5 Potential Effects

8.5.1 Operational Phase – Noise Impacts

Noise modelling has predicted noise from proposed quarry activities to determine the likely worst-case contribution of proposed quarry operations to the noise environment. The predicted noise levels for Scenario 1 are presented in Table 8.9. The magnitude of impact and significance of effect have been determined with reference to criteria provided in Table 8.3 and Table 8.4 respectively.

Table 8.9 - Evaluation of Predicted worst-case levels for Scenario 1 against daytime target level

Noise Sensitive Receptor	Predicted Noise Level dB(A)	Predicted level minus target level, 55 dB(A) $L_{Aeq,1hour}$	Magnitude of Impact	Significance of effect
NVSR1	48.6	-6.4	No change	Neutral
NVSR2	34.5	-20.5	No change	Neutral
NVSR3	38.7	-16.3	No change	Neutral
NVSR4	38.1	-16.9	No change	Neutral
NVSR5	37.9	-17.1	No change	Neutral
NVSR6	38.7	-16.3	No change	Neutral
NVSR7 – applicant owned property	40.6	-14.4	No change	Neutral
NVSR8 – applicant owned property	54.6	-0.4	No change	Neutral
NVSR9 – applicant owned property	46.2	-8.8	No change	Neutral

Predicted noise levels at all NVSRs are below the daytime target level (55 dB L_{Aeq}) during this conservatively predicted scenario for proposed operations at the quarry. Predicted noise levels are higher at the applicant properties north and east of the quarry (NVSR8 & NVSR9) due to their close proximity to proposed quarry operations. However, for this conservative operational scenario, predicted noise levels at NVSR8 are still 0.4 dB(A) below the target level during the daytime operations.

The predicted noise levels for Scenario 2 are presented in Table 8.10. The magnitude of impact and significance of effect have been determined with reference to criteria provided in Table 8.3 and Table 8.4 respectively.

Table 8.10 - Evaluation of Predicted worst-case levels for Scenario 2 against night-time target level

Noise Sensitive Receptor	Predicted Noise Level dB(A)	Predicted level minus target level, 45 dB(A) $L_{Aeq,15min}$	Magnitude of Impact	Significance of effect
NVSR1	35.3	-9.7	No change	Neutral
NVSR2	25.5	-19.5	No change	Neutral
NVSR3	32.6	-12.4	No change	Neutral
NVSR4	31.0	-14.0	No change	Neutral
NVSR5	30.6	-14.4	No change	Neutral
NVSR6	30.8	-14.2	No change	Neutral
NVSR7 – applicant owned property	32.8	-12.2	No change	Neutral
NVSR8 – applicant owned property	41.6	-3.4	No change	Neutral
NVSR9 - applicant owned property	37.7	-7.3	No change	Neutral

Predicted noise levels at all NVSRs are below the night-time target level (45 dB L_{Aeq}) during this conservatively predicted scenario for proposed operations at the quarry. Predicted noise levels are higher at the applicant properties north and east of the quarry (NVSR8 & NVSR9) due to their close proximity to proposed quarry

operations. However, for this conservative operational scenario, predicted noise levels at NVSR8 are still 3.4 dB(A) below the target level during the night-time operations.

Noise effects for Scenario 1 and Scenario 2 associated with proposed quarry operations during the daytime period and night-time period have been evaluated as being of 'neutral' significance and are therefore 'not significant'.

8.5.2 Comparison of Predicted Noise Levels with Measured Noise Levels at Receptors

A comparison has been made below of the predicted noise levels against the noise levels measured at representative locations during the 2020 and 2021 noise surveys. **Table 8.11** below shows the comparison for the three quarrying scenarios, cells in red signify an exceedance of the daytime baseline noise level.

Table 8.11 - Comparison of Predicted noise levels, Scenario 1 & 2, with measured baseline noise levels

Receptor	Monitoring position	Daytime $L_{Aeq,T}$*	Predicted noise level, dB, $L_{Aeq,1hr}$		Predicted vs Measured noise level, dB	
			Sc.1	Sc.2	Sc.1	Sc.2
NVSR1	N1 – November 2020	53.5	48.6	35.3	-4.9	-18.2
NVSR2	N1 – November 2020	53.5	34.5	25.5	-19.0	-28.0
NVSR3	N1 – November 2020	53.5	38.7	32.6	-14.8	-20.9
NVSR4	N1 – November 2020	53.5	38.1	31.0	-15.4	-22.5
NVSR5	N1 – November 2020	53.5	37.9	30.6	-15.6	-22.9
NVSR6	N1 – November 2020	53.5	38.7	30.8	-14.8	-22.7
NVSR7	N1 – November 2020	53.5	40.6	32.8	-12.9	-20.7
NVSR8	N1 – November 2020	53.5	54.6	41.6	1.1	-11.9
NVSR9	N1 – November 2020	53.5	46.2	37.7	-7.3	-15.8
NVSR1	N1 – February 2021	54.4	48.6	35.3	-5.8	-19.1
NVSR2	N1 – February 2021	54.4	34.5	25.5	-19.9	-28.9
NVSR3	N1 – February 2021	54.4	38.7	32.6	-15.7	-21.8
NVSR4	N1 – February 2021	54.4	38.1	31.0	-16.3	-23.4
NVSR5	N1 – February 2021	54.4	37.9	30.6	-16.5	-23.8
NVSR6	N1 – February 2021	54.4	38.7	30.8	-15.7	-23.6
NVSR7	N1 – February 2021	54.4	40.6	32.8	-13.8	-21.6
NVSR8	N1 – February 2021	54.4	54.6	41.6	0.2	-12.8
NVSR9	N1 – February 2021	54.4	46.2	37.7	-8.2	-16.7

Under Scenario 1 the predicted noise level due to quarrying activities is below the measured noise level at all NVSRs except NVSR8. At NVSR8 the predicted noise level is above the measured baseline ambient level by between 0.2 and 1.1 dB.

Under Scenario 2 the predicted noise level due to quarrying activities under each scenario is below the measured noise level at all NVSRs.

In context, these increases above baseline levels reference can be made to the fact that a 3 dB(A) difference in noise level is the minimum perceptible by the human ear. Both modelled scenarios also made conservative assumptions (see Section 8.3.1.6) and as such the predicted exceedances are unlikely to occur in practice.

It should be noted that predicted noise levels are within the acceptable limits of the existing planning permission and those prescribed in Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA 2006).

8.5.3 Operational Phase – Vibration Impacts (blasting activities)

A sample of the most recent vibration monitoring data is provided in **Table 8.12**.

Table 8.12 – Sample of Vibration Monitoring Data

Date	Location of Seismograph	Air Overpressure dB(L) 125 dB(L) limit	Peak Particle Velocity (mm/s)		
			X 12 mm/s limit	Y 12 mm/s limit	Z 12 mm/s limit
14/10/2020	East Boundary	105.5	2.3	2.3	3.6
16/10/2020	East Boundary	109.5	1.2	1.0	1.7
16/10/2020	West Boundary	114.8	4.2	3.8	4.6
20/10/2020	East Boundary	105.5	1.9	1.2	2.4
20/10/2020	West Boundary	115.9	5.1	5.3	7.4
27/10/2020	East Boundary	107.5	1.8	1.3	2.3
27/10/2020	West Boundary	110.9	2.8	5.1	3.9
03/11/2020	East Boundary	108.8	2.9	1.8	3.0

In this data sample, there are no exceedances in the vibration limits. With reference to **Table 8.6** the probability of adverse comment due to blasting activities at representative NVSRs for this data sample is low. The full record of vibration monitoring data is provided in **Appendix C**

The maximum PPV recorded during historical vibration monitoring was 10.6 mm/s; 1.4mm/s below the 12 mm/s PPV limit. On average PPV values were 2.9 mm/s (see **Appendix C**). With reference to **Table 8.6** the probability of adverse comment due to blasting activities at representative NVSRs is low.

The maximum air-overpressure value recorded was 124.8 dB(lin); marginally below the 125 dB(lin) limit. The average air-overpressure recorded was 111 dB(lin). Measured air overpressure levels were substantially below the level which would see structural damage to windows occur (150 dB(lin)).

It should be noted that vibration monitoring was undertaken at the eastern and western boundary of the quarry, close to blasting activities. Actual vibration levels at NVSRs will be lower.

8.5.3.1 Irish Water (IW) Pipeline

Controlled blasting is conducted at the quarry as a method of rock extraction. The process of drilling and blasting involves drilling a number of holes into a specific rock face, which are then filled with explosives. The explosives

are detonated in a controlled explosion causing the rock face to shatter and collapse. The resultant rock is then removed and crushed for transport from site.

If this process is not managed properly there is potential for accidents to occur. As well as impacting local residents and their properties an improperly managed blast could damage the IW pipeline located to the north of the quarry.

The previously blasted rock face of the quarry is ca. 160 m from the IW pipeline to the north of the quarry. As the proposed quarry extension progresses northwards the blasting activities will occur nearer to the pipeline, however the closest blasted face will be located ca. 40 m away from the line at its closest point. As noted, the IW 2020 'Code of Practice for Water Infrastructure' dictates that: *'detailed proposals, including work method statements, insurance confirmations and details of work completed of a similar nature must be submitted to IW for its consideration before approval will be issued prior to undertaking work in close proximity to IQ assets. All such works in the vicinity of Water Mains or sewers of 400mm diameter and greater shall be subject to written agreement with Irish Water before construction commences on site.'* The extraction methods and mitigation measures will be agreed in consultation with Irish Water prior to the commencement of extraction activities in the northern sections of the Site. Should further surveys be required then these will also be commissioned in conjunction with the requirements of Irish Water.

To reduce the potential of damage to the IW pipeline numerous mitigation measures are currently employed during blasts; these are identified in Section 8.6.2. These measures include a number of operational controls and also the requirement for blasting contractors to be trained and competent.

The quarry will deploy a vibration monitor at the IW pipeline during all blasting events on the northern face of the quarry. From these monitoring records the blasting contractor can determine the margin of compliance with the vibration limit and if blast parameters require refinement for future blasting events.

With the implementation of these mitigation measures and controls it is considered that vibration effects on the IW pipeline from blasting are 'not significant'.

8.5.3.2 Gas Networks Ireland (GNI) Pipeline

A GNI distribution line lies to the north of the quarry adjacent to the N7 roadway. No blasting works are proposed in the vicinity of the distribution line. GNI were consulted regarding the quarry design and noted their potential concerns if works were occurring in the vicinity of a GNI transmission line (as opposed to the distribution line along the N7). GNI advised that upon their review of the plans for the quarry that the nearest extremity to a GNI transmission pipeline was ca. 1,800 m away. GNI also identified that the quarry 'should not, without prejudice, have an undue impact on the GNI Gas Transmission Pipeline or Wayleave'. Should GNI have any concern at a later stage the Applicant will facilitate the monitoring of blasting at the transmission line and will undertake appropriate mitigation measures in line with GNI recommendations.

8.6 Mitigation

8.6.1 Existing Noise Mitigation

Noise mitigation measures for the proposed operations will be incorporated into the design and operation from the existing quarry operation's management and work practices. Measures to reduce potential noise impacts will include:

- A noise monitoring programme will be maintained at N1 bi-annually. This will determine compliance with threshold noise levels specified in the EPA Guideline Document for Extractive Industries (2006), and the Irish Concrete Federation Environmental Code (2nd Edition, 2005);

- Site activities will only take place during the permitted hours of operation and will be monitored to determine compliance with the conditioned noise limits. There will be no activities on site on Sundays or Public Holidays;
- Perimeter screening berms will be constructed along the boundaries of the proposed extended operational area to reduce noise propagation beyond the quarry boundary;
- All haul roads will be kept clear and maintained in a good state of repair to minimise noise from rattling and bouncing of mobile plant;
- Heavy goods vehicles entering and leaving the quarry will have tailgates securely fastened;
- Plant will be operated in a proper manner with respect to minimising noise emissions, e.g. minimisation of drop heights, no unnecessary revving of engines, plant used intermittently not left idling;
- Plant will be subject to regular maintenance, i.e. all moving parts kept well lubricated, the integrity of silencers and acoustic hoods maintained;
- Internal haul roads will be designed so as to have as low a gradient as possible so as to minimise excessive revving of vehicle engines on-site;
- The use of vehicle horns will be discouraged during the daytime period and is banned during the early morning periods before 10:00;
- Out of hours activity (where permitted by the local authority) will only include the loading of trucks from stockpiles and the operation of the asphalt plant, which are relatively low noise activities. Quarry operations such as blasting, excavation or crushing will not occur outside normal operating hours;
- 10 kmph speed limit on access road;
- All site plant, machinery and vehicles will shut down when not in use;
- All pneumatic rock breakers will be fitted with dampeners;
- Pumps and mechanical static plant will be housed in acoustic enclosures;
- Drop heights for materials will be minimised; and
- Low noise level reverse warning alarms consistent with site safety to be utilised.

8.6.2 Existing Vibration Mitigation

The following blast mitigation procedures will continue to be employed during each blast event at the quarry:

- Blast events will be conducted by an approved blasting contractor in accordance with best practice in this field, and potential impacts associated with the activity will therefore be minimised.
- The use of delayed blasting techniques whereby each blast event takes place in a series of timed small blasts rather than a single large blast will be employed to minimise vibrations in the rock body.
- All shot holes will be drilled to exact specifications by specialist contractors. Any features encountered during drilling such as cavities or soft material will be recorded by the drilling contractor and this information will be subsequently passed on to the shot-firer so that the correct charge will be used. This will ensure safe and efficient blasting of the rock face.

- In addition to implementing the necessary blast specifications, the quarry operator will provide appropriate advance warning of blasts to neighbouring residents, undertake required environmental monitoring and record any complaints arising, as detailed below.

The following blast warnings will continue to be provided by the quarry:

- A warning sign will be posted at the quarry entrance on the day of each blast and will be removed following each blast;
- Residents will be notified of blasting times by means of a phone call or text message prior to the blast taking place;
- The blast operator signals 30 seconds prior to each blast;
- The blast operator signals after each blast under Garda supervision;
- Blasting will occur between 09:00 to 18:00 Monday to Friday. Blasting does not take place on Saturdays;
- Vibration monitoring records will continue to be maintained by the Quarry Manager and will be available for display to local residents that may have been affected by site operations; and
- The quarry manager will maintain a written complaints log in which all complaints made by local residents are detailed. This will ensure that the concerns of local residents who may be affected by site activities are considered during the management of activities at the quarry site.

8.6.3 Proposed additional mitigation measures for future operation

The following additional measures are proposed:

- The noise monitoring programme will be undertaken consistently every six months at the monitoring location N1 for a period of 60 minutes while the quarry is operating normally;
- Vibration blast monitoring will be undertaken during blast activities at the closest NVSRs to blasting locations, and not at the eastern and western boundary of the quarry;
- IW will be notified of blasting times by means of a phone call prior to the blast taking place;
- The quarry operator will engage with IW to agree appropriate vibration limits for its infrastructure and a method and programme of monitoring such that compliance with limits will be established as required;
- Vibration blasting monitoring will record PPV, air overpressure, distance to each blast and maximum instantaneous charge levels (MIC); and
- Monitoring of vibration levels at local residences will be conducted in agreement and with the consent of local residents. The quarry manager will give at least 24-hours' notice to the residents at whose homes vibration monitoring will occur. IW will also be contacted in advance of any blasting activities in close proximity to their pipeline to the north of the quarry.

8.7 Cumulative Effects

During recent monitoring, noise from the quarry was determined to be a lesser contributor to the noise environment, with the ambient noise level typically dominated by the road traffic noise from the N7 roadway. Noise from quarrying and other industrial activities will therefore only be audible and have the potential for cumulative effects within fairly close proximity of the quarry site.

A review of quarrying and other industrial activities nearby has determined that there are no other quarry facilities operating in close proximity to the quarry, and cumulative effects are therefore not anticipated. Industrial

premises are noted to the north-west and east of the quarry, however, these were not noted to be audible at NVSRs during the recent survey.

Potentially cumulative noise effects have therefore been assessed as 'not significant'.

The nearest potentially cumulative site at which blasting is known to occur is approximately 7 km from the quarry. At this range the likelihood of blasting related ground-borne vibration or air-overpressure occurring at NVSRs affected by vibration from the quarry is negligible. Potentially cumulative vibration effects have therefore been assessed as 'not significant'.

8.8 Residual/Likely Significant Noise & Vibration Impacts

8.8.1.1 Noise

No additional mitigation is required for operational noise from the quarry, therefore residual effects remain unchanged, and are therefore not significant.

8.8.1.2 Vibration

Following implementation of the supplementary remedial measures outlined in Section 8.6.3, it is anticipated that vibration caused by blasting will meet the vibration limits at all NVSRs. With reference to **Table 8.6** and Section 8.3.2.2 the probability of adverse comments due to blasting activities at representative NVSRs will be low and vibration effects will therefore be not significant.

8.9 Difficulties Encountered

This assessment has been undertaken during the Covid-19 global pandemic, and as such it is possible that road traffic and commercial activities were at lower levels than before Covid-19 restrictions came into force. As a result, measured baseline noise levels due to road traffic may be lower than would have been expected in the pre-Covid situation. Any reduction in road traffic noise would result in a greater prominence of quarrying noise, thereby resulting in a more conservative assessment.

Observations of road traffic flows on the N7, which is a major transport route in and out of Dublin, indicate that traffic conditions are not noticeably different to pre-pandemic conditions, however, and therefore baseline conditions may be considered appropriately representative.

8.10 Summary and Conclusions

This assessment has considered potential noise and vibration impacts associated with the proposed future operations of the quarry on the amenity of residents at existing nearby properties.

The assessment has comprised a desk study to determine an appropriate study area and identify potentially sensitive receptors, characterisation of the baseline noise environment, prediction of worst-case operational phase noise levels and evaluation against appropriate criteria.

The baseline noise environment was dominated by road traffic noise from the N7, with noise from quarry operations noted to be sporadic and only faintly audible at the closest NVSRs.

Operational noise from the quarry has been predicted for two operational scenarios; proposed daytime and proposed night-time operations. Night-time operations are limited to loading and HGV movements. All modelled scenarios followed a highly conservative approach to determine the likely 'worst-case' noise levels at NVSRs. Predicted noise levels are well within the daytime and night-time levels recommended by the EPA Environmental Management Guidelines – Environmental Management in Extractive Industry. Predicted noise levels from quarry operations for all modelled scenarios have been found to be 'not significant'.

Vibration monitoring undertaken throughout 2019 and 2020 at the eastern and western boundary of the quarry determined there were no exceedances in the specified vibration limits. The probability of adverse comments due to blasting activities is low, and measured air overpressure levels were substantially lower than the levels which would see structural damage to windows.

Potential noise and vibration impacts will be controlled by continued implementation of mitigation measures at the quarry. Supplementary measures have been proposed to ensure that blasting is monitored appropriately, and potential impacts associated with the IW pipeline are considered. Noise and Vibration impacts due to proposed quarry operations have been determined to be ‘not significant’.

8.11 References

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

BS5288: 2009+A1:2014 Code of practice for noise and vibration control on open sites: Part 1 Noise and Part 2 Vibration.

BS 7385:, Evaluation and measurement for vibration in buildings, Part1 1990 Guide for measurement of vibrations and evaluation of their effects on buildings and Part 2 1993 Guide to damage levels arising from ground borne vibration.

BS7445-1:2003 Description and Measurement of Environmental Noise. Guide to Quantities and Procedures.

ISO 9613-2, First Edition 1996-12-15. Acoustics-Attenuation of sound during propagation outdoors-Part 2: General method of calculations.

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

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

Design Manual for Roads and Bridges (DMRB).

BS 6472:1992 - The Evaluation of Human Exposure to vibration in buildings.

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

Environmental Code (2005) Irish Concrete Federation. EPA guidelines in relation to blasting activities outlining the methodology and limits to be used for vibration measurement.

APPENDIX 8.1

SLM Calibration Certificates

CAMPBELL ASSOCIATES
SOUND & VIBRATION SOLUTIONS

Sonitus House, 5b Chelmsford Road Industrial Estate
Great Dunmow, Essex, CM6 1HD

Sales Tel: 01371 871033 Hire Tel: 01371 871037
Admin Tel: 01371 871030 Fax Tel: 01371 879106
E-Mail: info@campbell-associates.co.uk
Website: www.campbell-associates.co.uk

Technical Report

Customer: Golder Associates (Scotland)

Contact: Kevin McGillycuddy

Order No: To be advised

Comments: Calibrator Requires UKAS Calibration

Technical log No: 20900

Report Date: 28 April 2020

Internal ref: 24705/GOL300A

Service Req'd: Calibration

Equipment ID:- NOR-1251.33002

Service Request:- Requires UKAS Calibration

Report: UKAS calibration complete.

Certificate number: U34661

Accessories supplied: C/W Black Leather case & type 1443 adapter

Important

Please note, our calibration and/or repair process may involve changing several parameters in your equipment. We endeavour to restore the original setting wherever possible, however, we cannot guarantee the equipment has been returned with your original settings. On receipt, please ensure that the settings meet your requirements prior to use.

Technician:

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate number: U34661

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**Norsonic**
Type:	**1251**
Serial no:	**33002**
Customer:	Golder Associates (UK) Ltd
Address:	Attenborough House, Browns Lane Business Park, Stanton on the Wolds, Nottinghamshire. NG12 5BL.
Contact Person:	Kevin McGillycuddy.

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	114.08 dB	0.06 dB	1000.63 Hz	0.00 %	0.35 %
2:	114.07 dB	0.05 dB	1000.63 Hz	0.00 %	0.35 %
3:	114.08 dB	0.06 dB	1000.63 Hz	0.00 %	0.35 %
Result (Average):	**114.08 dB**	**0.06 dB**	**1000.63 Hz**	**0.00 %**	**0.35 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.0005 dB/kPa Temperature: 0.003 dB/°C Relative humidity: 0.000 dB/%RH Load volume : 0.0003 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2020\NOR1251_33002_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	99.841 ± 0.042 kPa	24.2 ± 0.1 °C	33.8 ± 1.0 %RH

Date received for calibration:	24/04/2020
Date of calibration:	28/04/2020
Date of issue:	28/04/2020
Engineer	Michael Tickner
Supervisor	Darren Batten TechIOA

Certificate number: U34661

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to an accredited national physical laboratory within the EU or EFTA.

Comment
Calibrated as received, no adjustments made.

Statement of conformance
As public evidence was available[1], from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

[1] This evidence is held on file at the calibration laboratory.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
www.campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION 0789

Certificate of Calibration and Conformance

Certificate No.: U31392

Test object:	**Sound Level Meter, BS EN IEC 61672-1:2003 Class 1 (Precision)**
Manufacturer:	**Norsonic**
Type:	**140**
Serial no:	**1402742**
Customer:	**Golder Associates**
Address:	**Sirius Building, The Clocktower, Flassches Yard, South Gyle Crescent, Edinburgh. EH12 9LB.**
Contact Person:	**Karen Campbell.**

Method :
Calibration has been performed as set out in CA Technical Procedures TP01 & 02 as appropriate. These are based on the procedures for periodic verification set out in BS EN IEC 61672-3:2006. Results and conformance statement are overleaf and detailed results are in the attached Test Report.

	Producer:	Type:	Serial No:	Certificate number
Microphone	Norsonic	1225	72926	31391
Calibrator*	Norsonic	1251	33002	U31390
Preamplifier	Norsonic	1209	12131	Included

Additional items that also have been submitted for verification

Wind shield	Norsonic	Nor1451
Attenuator	None	
Extension cable	None	

These items have been taken into account wherever appropriate.

	Pressure:	Temperature:	Relative humidity:
Environmental conditions:			
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	102.88 ±0.01kPa	22.9 ±0.2°C	35.2 ±2%RH

Date received : 20/03/2019
Date of calibration: 28/03/2019
Date of issue: 28/03/2019

Engineer

Michael Tickner

Supervisor

Darren Batten TechIOA

Certificate of Calibration and Conformance

UKAS Laboratory Number 0789

Certificate No.: U31392

Conformance

From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to BS EN IEC 61672-1:2002 and similarly that the associated sound calibrator conforms to BS EN IEC 60942.

Statement of conformance

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of BS EN IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available[1], from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with BS EN IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in BS EN IEC 61672-1:2002, and that the sound level meter submitted for testing conforms to the class 1 requirements of BS EN IEC 61672-1:2003.

[1] This evidence is held on file at the calibration laboratory

Measurement Results:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10	Passed
Acoustical signal tests of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed
Electrical signal tests of frequency weightings - IEC 61672-3 Ed.1 #12	Passed

Comment

Correct level with associated calibrator is 113.9dB(A).

Observations

The details of the uncertainty for each measurement is available from the Calibration Laboratory on request and is based on the standard uncertainty multiplied by a coverage factor K=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements. Details on the sources of corrections and their associated uncertainties that relate to this verification are contained the detailed test report accompanying this certificate.

APPENDIX 8.2

Noise Monitoring Data and Notes

Project Title: L Behan Aggregates		**Project Number: 20137776**	
Monitoring Location No.	N1	**Time & Date** (start of measurement):	06/11/2020 15:20
GPS Coordinates:		**Time & Date** (end of measurement):	06/11/2020 16:26
Calibration check (pre-measurement):	114.1 LAeq	**Calibration check** (post-measurement):	
Weather conditions (at commissioning & decommissioning & any evidence of throughout measurement)			
Wind (light/med/strong/km/h):	Light	Temperature (°C):	11°C
Rain:	None	Cloud (% cover):	20%
Ambient Noise Environment			
Dominant noise source(s):	N7 dual Carriageway to the North		
Other audible noise sources: Tonality, frequency of occurrence, description of noise (e.g. drone/whistle/hum/banging)	Local traffic passing on nearby Kilteel Rd.		
	Birdsong, activity in ajdacent dwellings (builders working on a house)		
	Dogs barking to South, aircraft overhead		
	Presumed quarry activity (pop) heard at 15:24.		
	Cow mooing to South.		
SLM file number (s):	#2		
Photographs:			

Project Title: L Behan Aggregates		**Project Number: 20137776**	
Monitoring Location No.	N1	**Time & Date** (start of measurement):	18/02/2021 12:21
GPS Coordinates:		**Time & Date** (end of measurement):	18/02/2021 13:26
Calibration check (pre-measurement):	114.3 LAeq	**Calibration check** (post-measurement):	
Weather conditions (at commissioning & decommissioning & any evidence of throughout measurement)			
Wind (light/med/strong/km/h):	Medium – remained below 5m/s.	Temperature (°C):	5°C
Rain:	Light drizzle after reading	Cloud (% cover):	100%
Ambient Noise Environment			
Dominant noise source(s):	N7 dual Carriageway to the North		
Other audible noise sources: Tonality, frequency of occurrence, description of noise (e.g. drone/whistle/hum/banging)	Excavator breaking rock on site heard at low levels due to North Westerly wind		
	Local traffic passing on nearby Kilteel Rd.		
	Birdsong, rustling hedges from light gusts of wind		
	Dogs barking to South, horse neigh to south		
	Activity in nearby dwellings to the south.		
SLM file number (s):	#2		
Photographs:			

APPENDIX 8.3

Vibration Monitoring Data

Date	Time	Location of Seismograph	Company	Air Overpressure dB(L)	Peak Particle Velocity (mm/sec)		
					Tran	Vert	Long
01/11/2019	09:56	East Boundary	Instantel	112.8	0.571	0.44	0.635
30/01/2019	11:23	East Boundary	Instantel	119.8	1.429	1.095	1.524
30/01/2019	11:23	West Boundary	Instantel	107	0.524	0.508	0.714
07/02/2019	11:51	East Boundary	Instantel	112.8	2.984	1.921	3.365
07/02/2019	11:51	West Boundary	Instantel	115.7	4.921	4.953	7.445
04/03/2019	10:45	East Boundary	Instantel	111.2	1.524	1.111	2.048
04/03/2019	10:44	West Boundary	Instantel	113.8	3.286	3.445	3.969
27/03/2019	11:19	East Boundary	Instantel	114	6.525	2.619	3.429
27/03/2019	11:19	West Boundary	Instantel	101	1.111	1.429	1.111
02/04/2019	11:43	East Boundary	Instantel	116.1	2.762	1.873	2.556
02/04/2019	11:43	West Boundary	Instantel	118.1	4.191	6.223	9.049
10/04/2019	09:21	East Boundary	Instantel	113.8	1.302	0.587	1.302
10/04/2019	11:11	East Boundary	Instantel	117.4	3.397	1.318	1.683
10/04/2019	09:21	West Boundary	Instantel	123.6	3.508	1.619	3.683
18/04/2019	10:38	East Boundary	Instantel	109.2	2.048	2.873	2.127
18/04/2019	10:38	West Boundary	Instantel	114.2	5.842	7.144	7.826
26/04/2019	10:31	East Boundary	Instantel	94	3.286	1.492	3
26/04/2019	10:31	West Boundary	Instantel	104.2	0.524	0.492	0.635
30/04/2019	10:45	East Boundary	Instantel	109.2	2.191	2.302	2.254
30/04/2019	10:45	West Boundary	Instantel	114.8	7.842	5.461	10.62
03/05/2019	09:15	East Boundary	Instantel	114.2	5.667	1.699	4.588
03/05/2019	09:15	West Boundary	Instantel	101	0.857	0.413	0.73
14/05/2019	10:36	East Boundary	Instantel	111.2	2.048	1.254	2
14/05/2019	10:36	West Boundary	Instantel	115	6.223	5.826	7.064
22/05/2019	09:38	East Boundary	Instantel	109.9	1.873	0.825	1.302
22/05/2019	09:38	West Boundary	Instantel	114	3.953	2.619	5.636
28/05/2019	10:58	East Boundary	Instantel	116.3	5.397	2.508	4.635
28/05/2019	10:58	West Boundary	Instantel	104.2	0.841	0.841	1.333
31/05/2019	12:46	East Boundary	Instantel	109.5	1.667	0.952	2
31/05/2019	12:46	West Boundary	Instantel	113.1	5.239	4.381	8.89
07/06/2019	10:07	East Boundary	Instantel	106.5	1.794	1.429	1.413
07/06/2019	10:06	West Boundary	Instantel	109.9	3.588	4.826	6.461
13/06/2019	10:12	East Boundary	Instantel	114.2	4.794	1.937	3.604
13/06/2019	10:12	West Boundary	Instantel	102.8	0.571	0.476	0.635

Date	Time	Location of Seismograph	Company	Air Overpressure dB(L)	Peak Particle Velocity (mm/sec)		
					Tran	Vert	Long
18/06/2019	12:54	East Boundary	Instantel	104.9	2.302	1.857	2.429
18/06/2019	12:54	West Boundary	Instantel	116.4	6.271	6.413	7.668
26/06/2019	10:16	East Boundary	Instantel	107.5	2.318	1.46	2.826
26/06/2019	12:04	East Boundary	Instantel	115.4	4.794	1.968	3.937
26/06/2019	10:16	West Boundary	Instantel	118.5	4.905	7.239	6.683
26/06/2019	12:04	West Boundary	Instantel	108.4	0.921	0.762	1.476
02/07/2019	10:44	East Boundary	Instantel	109.2	2.222	1.397	2.445
02/07/2019	10:43	West Boundary	Instantel	97.5	0.683	0.381	0.619
09/07/2019	12:17	East Boundary	Instantel	116.7	5.318	2.159	4.953
09/07/2019	12:16	West Boundary	Instantel	107.5	1.413	0.984	2.222
16/07/2019	10:48	East Boundary	Instantel	114.4	2.175	0.937	2.048
16/07/2019	10:48	West Boundary	Instantel	115.6	6.652	2.826	4.381
07/08/2019	13:27	East Boundary	Instantel	114.2	8.398	2.921	6.62
07/08/2019	13:27	West Boundary	Instantel	120	4.223	3.302	4.635
20/08/2019	12:00	East Boundary	Instantel	110.6	4.016	1.857	3.731
20/08/2019	11:59	West Boundary	Instantel	102.8	0.825	0.73	0.968
11/09/2019	12:03	East Boundary	Instantel	114.6	5.048	3.159	4.318
11/09/2019	12:04	East Boundary	Instantel	116.4	2.603	0.667	1.635
11/09/2019	12:03	West Boundary	Instantel	105.5	0.984	0.794	1.492
11/09/2019	12:03	West Boundary	Instantel	118.5	5.699	2.222	4.794
13/09/2019	10:12	East Boundary	Instantel	114.2	4.27	1.508	3.159
20/09/2019	12:27	West Boundary	Instantel	106.5	1.048	1	1.572
26/09/2019	11:50	East Boundary	Instantel	108.4	6.334	2.175	2.905
26/09/2019	11:50	West Boundary	Instantel	98.8	0.698	0.651	1.365
02/10/2019	11:20	East Boundary	Instantel	111.8	0.873	0.46	1.254
02/10/2019	11:20	West Boundary	Instantel	119	2.699	1.095	2.191
07/10/2019	14:40	East Boundary	Instantel	114	6.382	2.397	4.572
07/10/2019	14:40	West Boundary	Instantel	102.8	0.857	1.159	1.365
15/10/2019	13:18	East Boundary	Instantel	110.9	6.858	2.746	2.397
15/10/2019	13:17	West Boundary	Instantel	115.2	5.731	4.318	5.62
22/10/2019	12:28	East Boundary	Instantel	113.8	1.302	0.746	1.222
22/10/2019	10:28	West Boundary	Instantel	116.9	3.921	1.73	3.064
25/10/2019	11:55	East Boundary	Instantel	113.8	6.81	3.873	4.35
25/10/2019	11:52	West Boundary	Instantel	104.2	0.794	0.905	0.952

Date	Time	Location of Seismograph	Company	Air Overpressure dB(L)	Peak Particle Velocity (mm/sec)		
					Tran	Vert	Long
01/11/2019	09:56	West Boundary	Instantel	116.6	1.254	0.952	1.095
04/11/2019	11:03	West Boundary	Instantel	103.5	0.413	0.524	0.698
05/11/2019	12:03	East Boundary	Instantel	113.5	5.35	1.81	3.286
05/11/2019	12:03	West Boundary	Instantel	104.9	0.571	0.778	0.667
13/11/2019	10:11	West Boundary	Instantel	100	0.365	0.365	0.667
14/11/2019	11:04	East Boundary	Instantel	112.8	6.382	1.953	4.715
19/11/2019	10:21	East Boundary	Instantel	109.9	0.873	0.492	1.175
19/11/2019	10:21	West Boundary	Instantel	114.6	1.683	1.191	1.968
22/11/2019	12:36	East Boundary	Instantel	114.6	5.731	2.857	3.016
22/11/2019	12:36	West Boundary	Instantel	106	0.794	0.762	0.873
03/12/2019	13:21	East Boundary	Instantel	118.6	3.985	2.318	3.445
03/12/2019	13:20	West Boundary	Instantel	102.8	0.825	0.937	0.714
11/12/2019	12:12	East Boundary	Instantel	115	2.207	1.413	2.556
11/12/2019	12:12	West Boundary	Instantel	114.4	7.604	5.636	6.461
19/12/2019	11:37	East Boundary	Instantel	111.5	5.255	3.175	5.001
07/01/2020	13:34	East Boundary	Instantel	120.9	8.033	2.873	4.81
07/01/2020	13:33	West Boundary	Instantel	118.7	2.492	2.635	5.429
14/01/2020	13:06	East Boundary	Instantel	114.2	1.794	1.445	2.397
14/01/2020	13:06	West Boundary	Instantel	119.2	7.445	3.81	3.477
17/01/2020	12:14	East Boundary	Instantel	113.8	6.636	2.937	6.017
17/01/2020	12:14	West Boundary	Instantel	101.9	1.016	0.841	1
22/01/2020	10:40	East Boundary	Instantel	113.3	0.873	0.587	1.095
22/01/2020	10:40	West Boundary	Instantel	119.8	1.191	1.016	1.079
31/01/2020	11:45	East Boundary	Instantel	108	3.286	1.079	2.889
31/01/2020	07:59	West Boundary	Instantel	No events recorded			
07/02/2020	10:48	East Boundary	Instantel	108.4	2.016	1.095	1.635
07/02/2020	10:47	West Boundary	Instantel	112.8	2.794	2.413	3.048
12/02/2020	12:07	East Boundary	Instantel	114.8	4.588	1.651	3.254
12/02/2020	08:45	West Boundary	Instantel	No events recorded			
12/02/2020	08:45	West Boundary	Instantel	No events recorded			
18/02/2020	09:16	West Boundary	Instantel	No events recorded			
18/02/2020	09:16	West Boundary	Instantel	No events recorded			
20/02/2020	11:48	East Boundary	Instantel	119.3	5.747	1.699	4.286
20/02/2020	11:47	West Boundary	Instantel	111.5	0.889	0.635	1.016

Date	Time	Location of Seismograph	Company	Air Overpressure dB(L)	Peak Particle Velocity (mm/sec)		
					Tran	Vert	Long
25/02/2020	11:46	East Boundary	Instantel	114.2	1.206	1.238	1.953
25/02/2020	11:46	West Boundary	Instantel	117.6	2.667	2.54	3.429
28/02/2020	12:31	East Boundary	Instantel	118.1	4.334	1.476	2.683
05/03/2020	10:08	East Boundary	Instantel	109.9	0.698	0.492	1.032
05/03/2020	10:08	West Boundary	Instantel	111.5	2.159	0.889	1.651
11/03/2020	11:35	East Boundary	Instantel	108.4	3.794	1.699	3.048
11/03/2020	11:34	West Boundary	Instantel	98.8	0.635	0.635	1.143
19/03/2020	10:01	East Boundary	Instantel	112	1.667	1.048	1.746
19/03/2020	10:01	West Boundary	Instantel	124.8	3.683	1.651	4.953
23/03/2020	09:40	East Boundary	Instantel	116.7	2.064	1.397	2.937
23/03/2020	09:40	West Boundary	Instantel	101.9	0.889	0.635	0.889
10/04/2020	11:11	West Boundary	Instantel	108.8	0.619	0.571	0.667
03/06/2020	09:50	West Boundary	Instantel	121.1	2.41	1.78	6.6
11/06/2020	10:29	West Boundary	Instantel	116.6	1.65	0.889	1.9
17/06/2020	10:36	West Boundary	Instantel	88	2.54	2.03	3.05
23/06/2020	10:06	West Boundary	Instantel	114.6	2.03	1.78	2.67
26/06/2020	12:06	East Boundary	Instantel	97.5	1.476	0.952	1.524
26/06/2020	12:06	West Boundary	Instantel	119	3.937	1.778	3.937
03/07/2020	10:32	East Boundary	Instantel	98.8	1.937	0.746	1.159
03/07/2020	10:32	West Boundary	Instantel	121.6	6.477	3.429	5.842
08/07/2020	09:28	East Boundary	Instantel	91.5	0.762	0.683	1.333
08/07/2020	09:28	West Boundary	Instantel	111.8	1.651	1.016	1.905
13/07/2020	09:43	East Boundary	Instantel	103.5	1.524	0.714	1.254
13/07/2020	09:43	West Boundary	Instantel	116.9	1.778	1.397	2.286
16/07/2020	10:16	East Boundary	Instantel	94	1.778	1.079	1.889
16/07/2020	10:15	West Boundary	Instantel	114.2	1.905	1.524	2.667
22/07/2020	10:50	East Boundary	Instantel	113.5	1.508	0.635	0.873
22/07/2020	10:50	West Boundary	Instantel	117.1	1.143	1.27	2.54
28/07/2020	09:25	East Boundary	Instantel	115	1.175	0.714	1.143
28/07/2020	09:24	West Boundary	Instantel	120.1	1.397	1.778	2.286
04/08/2020	12:49	East Boundary	Instantel	111.8	0.556	0.381	0.429
04/08/2020	12:49	West Boundary	Instantel	111.8	0.762	0.508	0.635
10/08/2020	10:30	East Boundary	Instantel	106	1.302	0.46	1.143
10/08/2020	10:30	West Boundary	Instantel	113.3	2.159	1.27	2.413

Date	Time	Location of Seismograph	Company	Air Overpressure dB(L)	Peak Particle Velocity (mm/sec)		
					Tran	Vert	Long
18/08/2020	10:40	East Boundary	Instantel	118.3	2	1.556	2.969
18/08/2020	10:40	West Boundary	Instantel	107	0.635	0.508	0.762
25/08/2020	09:37	East Boundary	Instantel	115.9	1	0.381	0.81
25/08/2020	09:36	West Boundary	Instantel	113.8	1.397	1.143	1.778
02/09/2020	10:57	East Boundary	Instantel	112.8	0.651	0.476	0.698
02/09/2020	10:56	West Boundary	Instantel	112.8	1.143	1.016	1.143
08/09/2020	09:58	East Boundary	Instantel	104.9	2.222	1.603	2.826
08/09/2020	09:58	West Boundary	Instantel	104.2	2.667	2.667	2.286
16/09/2020	09:44	West Boundary	Instantel	103.5	0.762	1.016	0.889
19/09/2020	09:45	East Boundary	Instantel	114.6	2.302	1.46	2.349
20/09/2020	12:27	East Boundary	Instantel	115.4	4.985	2.349	4.985
22/09/2020	09:45	East Boundary	Instantel	109.2	0.81	0.317	0.571
22/09/2020	09:45	West Boundary	Instantel	117.2	1.397	0.762	1.778
29/09/2020	11:30	East Boundary	Instantel	107	3.477	1.603	3.572
29/09/2020	11:30	West Boundary	Instantel	115.2	3.302	3.81	5.334
04/10/2020	11:52	West Boundary	Instantel	108.8	3.683	4.318	5.08
05/10/2020	11:29	East Boundary	Instantel	109.5	1.46	0.794	1.349
05/10/2020	11:20	West Boundary	Instantel	113.3	3.175	3.302	6.477
14/10/2020	11:52	East Boundary	Instantel	105.5	2.3	2.3	3.6
16/10/2020	10:58	East Boundary	Instantel	109.5	1.2	1.0	1.7
16/10/2020	10:58	West Boundary	Instantel	114.8	4.2	3.8	4.6
20/10/2020	10:04	East Boundary	Instantel	105.5	1.9	1.2	2.4
20/10/2020	10:04	West Boundary	Instantel	115.9	5.1	5.3	7.4
27/10/2020	13:10	East Boundary	Instantel	107.5	1.8	1.3	2.3
27/10/2020	13:10	West Boundary	Instantel	110.9	2.8	5.1	3.9
03/11/2020	11:23	East Boundary	Instantel	108.8	2.9	1.8	3.0
03/11/2020	11:23	West Boundary	Instantel	116.6	6.5	6.7	8.3
Maximum Recorded				**124.8**	**8.4**	**7.2**	**10.6**
Average Recorded				**111.3**	**2.8**	**1.9**	**2.9**