



RedBull® POWDER COMPANY



DRILLING AND BLASTING VIBRATION ASSESSMENT

CLEVEDON QUARRY – PROPOSED EXPANSION

STEVENSON AGGREGATES LIMITED

15 OCTOBER 2026





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1 Executive Summary

Introduction	RedBull Powder Company (RPC) was engaged by Stevenson Aggregates Ltd (SAL) to carry out an assessment of the vibration effects associated with blasting for the proposed expanded quarry extents to accompany SAL resource consent application for the proposed quarry expansion.
Current Operations	SAL operate Clevedon Quarry (the site) for aggregate extraction, processing and supply, located at 546 McNicol Road, Clevedon. Blasting is required for aggregate extraction. Conditions for blasting are outlined in Conditions 38-43 of the resource consent (granted 2018). Key blast vibration condition: Blast vibration must not exceed the limits set out in German Standard DIN 4150-3 1999: Structural Vibration - Part 3.
Surrounding Land	The site is mostly surrounded by plantation forestry, bush and farmland with few residential properties. 600 McNicol Road is the nearest residential property, located approximately 315m southwest from the proposed expansion boundary. A police and emergency services radiocommunication tower is located approximately 45m east of the expansion boundary (AUP Designation 5728).
Summary of Proposed Expansion	The proposed quarry expansion will comprise five indicative stages over an approximate 50-year period with each comprising a 10-year design. The expansion design comprises 15 metre bench heights. SAL proposes to adopt the relevant vibration and blasting conditions from the 2018 consent unchanged as conditions of this new consent.
Site Blasting History	RPC has been the blasting contractor for several years. All RPC fired blasts compliant.
Seed Hole Blasting	Suitable testing area identified. Three holes were drilled into the rock mass at quarry benches RL160 & RL170. 89 and 102mm hole diameters used.
Charges Fired	Pumped bulk emulsion was used in all three holes. Charge weights of 100-129 kg were fired. Holes initiated using electronic detonators.
Vibration Monitoring	Five seismographs were set up at surveyed locations. Three at nearfield locations within the quarry and two at offsite compliance locations. The nearfield seismographs recorded blast vibration for each of the seed holes fired. Blasting did not trigger the seismographs at offsite locations.
Recorded Vibration	Monitoring data was used to determine vibration attenuation calculations for the site using USBM empirical relationships. A power trendline was developed using scaled distance. The scaled distance relationship allows PPV predictions to be made for varying charge masses and distances in line with expected production blasting parameters. Industry best practice is to use the 95% confidence interval to estimate the maximum expected vibration level.
Expected Vibration	The vast majority of the site is expected to be suitable for unrestricted production blasting. 600 McNicol Road is predicted at 2.0mm/sec PPV at the boundary of the quarry expansion (DIN4150 compliant). As the quarry expansion incrementally approaches the police and emergency services radiocommunication tower (Stage 5, years 40-50), vibration management may need to be implemented to maintain compliance. A 35kg MIC at the boundary predicts 19.4 mm/sec PPV (DIN4150, Line 1 compliant).
Vibration Management Techniques	May include reduced charge weight and Maximum Instantaneous Charges through deck-loading or reduced bench heights. Waveform and arrival time modelling with monitoring as feedback loop may allow blasting at higher MIC than predicted. Update model with additional seed holes (nominally when monitoring results approach 75% of consent limit).
Conclusions	Overall, the assessment concludes that blasting associated with the proposed quarry expansion can be undertaken in a manner that complies with the relevant DIN4150 vibration criteria, consent conditions and AUP standards, subject to implementation of the recommended management and monitoring measures.
Recommendations	To manage the effects of vibration, a Blast Management Plan should be reviewed, updated and implemented by the blasting contractor once the proposal for quarry expansion has been approved. Blasting contractor to develop a vibration model and to target vibration results 75% of consented limits.

2 Introduction

Stevenson Aggregates Ltd (SAL) operates Clevedon Quarry (the site) for aggregate extraction, processing and supply. The site is located at 546 McNicol Road, Clevedon, Auckland. RedBull Powder Company Ltd (RPC) are familiar with the site and have provided drilling and blasting services at Clevedon Quarry from circa 2017 to 2021 and has been the current blasting contractor since 2024.

Land surrounding the site mostly comprises plantation forestry, pockets of native bush and farmland. There are few dwellings nearby, with the closest being 600 McNicol Road, located approximately 315 m southwest of the expansion boundary. A police and emergency services radiocommunication tower (AUP Designation 5728) is located approximately 45 m east of the of the expansion boundary. A location plan is presented in Figure 1.

As part of SAL's proposed expansion of the Clevedon Quarry, RPC has been engaged to provide an assessment of the vibration effects associated with blasting for the proposed expanded quarry extent.

The purpose of this report is to support SAL's resource consent application under the Fast-track Approvals Act 2024. This report details the assessment undertaken and provides recommendations for managing blasting generated vibration effects from the proposed quarry expansion.

Blasting will be required in the quarry expansion to allow rock extraction. Based on RPC's experience at the site, there will be areas within the quarry expansion that will not require blasting. These will be in areas where the material is freely diggable. Generally speaking, this is more likely to be in the upper benches, for example within overburden and weathered rock mass areas. This means blasting may be offset from the pit design boundary in places. Where extraction transitions from free-dig to blasting will be decided by SAL as the quarry expands, and will likely be based on rock mass hardness, geological interpretation, volume, production rates and machinery employed. Determination of the extent of blasting is outside the scope of this report.

3 Blasting Vibration Assessment Process

To determine the expected vibration levels from blasting, a series of individual holes are drilled into the rock mass, loaded with explosive charges (as per regular production blasting drilling and loading techniques) and fired individually to generate a vibration waveform from each hole.

The vibration waveforms (and corresponding peak particle velocity (PPV, recorded in mm/s)) are recorded on seismographs at nearfield locations on site and at the nearest compliance locations offsite.

Scaled distance values are then calculated for each hole fired and each PPV measurement (based on the charge size and seismograph location/distance from the charge fired) allowing a power law to be established through United States Bureau of Mines (USBM) empirical calculations and relationships that demonstrate the rate at which vibration attenuates/reduces with distance from the source (the charges being fired).

This attenuation relationship then allows an assessment of the likely effects at receivers at different distances and can be considered as part of a resource consent application and used to define appropriate vibration limits for blasting activity on site.

4 Summary of Expansion Proposal

The existing Clevedon Quarry is located entirely within 546 McNicol Road, Clevedon. It sits within a wider area owned by SAL, encompassing approximately 544.32 hectares (ha), referred to in this application as the

'SAL landholdings'. Existing land types/uses within the SAL landholdings include quarrying, plantation forestry (recently harvested and replanted), and pockets of native vegetation.

Currently, Clevedon Quarry extracts approximately 200,000 - 300,000 tonnes of aggregate annually. SAL holds an existing consent (granted in 2018) allowing expansion of the current pit to enable the extraction of approximately 60 million tonnes (MT) of aggregate and overburden over 35 years, across six stages, at an annual extraction rate of around 3 MT per year[1].

To continue to provide a reliable local supply of aggregate, SAL proposes to progressively expand the existing quarry at 546 McNicol Road south-eastward within the SAL landholdings. The total proposed expansion area/Life of Quarry footprint (LoQ) is approximately 74 ha (excluding approximately 4.6 ha overburden disposal area), and approximately RL 20 m.

The proposed quarry expansion will comprise five indicative stages over an approximate 50-year period with each comprising a 10-year design. The expansion design comprises 15 metre bench heights. The proposed pit plan is shown in Figure 1.



Figure 1 - Proposed Clevedon Quarry Expansion (magenta) with identified nearest surrounding features (yellow)

Under the Auckland Unitary Plan – Operative in Part (AUP), the proposed expansion is located primarily within the Special Purpose Quarry Zone (SPQZ), which comprises approximately 59 ha (around 80%), with the remaining approximately 15 ha (around 20%) situated within the Rural Production Zone (RPZ). The

[1] [2018] NZEnvC 96

northeastern portion of the proposed pit will extend slightly into a Significant Ecological Area Overlay (SEA) (SEA_T_5588) in year 20 (Stage 2) and then predominantly after Year 40 (Stage 4).

5 Assessment Framework and Compliance Criteria

The Auckland Unitary Plan (AUP) provides rules for vibration and blasting limits, as set out in Chapters E25 Noise and Vibration and H28 Special Purpose – Quarry Zones. These are provided in sections E25.6.31 and H28.6.2.2 of the AUP and summarised as follows:

1) Noise created from the use of explosives must not exceed a peak overall sound pressure of 128dB Lzpeak.
2) The measurement of blast noise (air blast) and ground vibration from blasting must be measured at the notional boundary of a dwelling that existed at 1 January 2001.
3) Vibration generated by blasting shall be measured within a building in accordance with Appendix J of Part 2 of Australian Standard AS 2187 2006.
4) All blasting is restricted to: (d) 9am-5pm, Monday to Saturday; (e) an average of two occasions per day over a calendar fortnight; and (f) except where necessary because of safety reasons.
5) Blasting activities must be controlled to ensure any resulting ground vibration does not exceed the limits set out in German standard DIN 41503 1999: Structural vibration – Part 3 Effects of vibration on structures when measured on the foundation in the horizontal axis on the highest floor of an affected building.
6) A siren must be used prior to blasting to alert people in the vicinity.

AUP, E25.6.31:

1) The noise created by the use of explosives for any blasting activity measured at the boundary of the site on which the explosives are used must not exceed a peak sound pressure of 120 dB (Lzpeak).

SAL is seeking a new standalone resource consent to authorise the construction and operation of the proposed Clevedon Quarry expansion, as well as a variation to the existing 2018 Environment Court consent, to reduce its scope and extent so that it functions as a standalone Front of House consent.

The current consented conditions for blasting activity carried out within the site are outlined in Conditions 38 to 43 of the resource consent granted in 2018[2]. These conditions are:

38) Noise created from the use of explosives must not exceed a peak overall sound pressure of 120db l_{zpeak}.

39) The measurement of blast noise (air blast) from blasting must be undertaken at the notional boundary of a dwelling that existed at the date of commencement of this consent (for the purposes of this consent, the closest dwelling that existed at the date of commencement of this consent outside the Special Purpose - Quarry Zone is 600 McNicol Road, approximately 480m away.)

40) Vibration generated by blasting shall be measured within a building in accordance with Appendix J of Part 2 of Australian Standard AS 2187 2006.

41) Except where necessary because of safety reasons, all blasting is restricted to:

    (a) 9am - 5pm, Monday to Saturday; and
    (b) an average of two occasions per day over a calendar fortnight.

42) Blasting activities must be controlled to ensure any resulting ground vibration does not exceed the limits set out in German Standard DIN 4150-3 1999: Structural Vibration - Part 3 Effects of Vibration

[2] Resource consent was granted by the Environment Court on 25th June 2018 and referenced as [2018] NZEnvC 96 (Council reference BUN60302442).

on Structures when measured on the foundation in the horizontal axis on the highest floor of an affected building.

43) A siren must be used prior to blasting to alert people in the vicinity.

Vibration limits are in accordance with German Standard DIN 4150-3 1999: Structural Vibration - Part 3 Effects of Vibration on Structures (DIN4150), which specifies a method of evaluating the effects of vibration on structures designed primarily for static loading. This standard gives guideline values which, when complied with, will not result in damage that will have an adverse effect on the structure's serviceability.

Table 1, taken from DIN4150, provides guideline values for vibration limits at varying frequencies applicable with the different structure types when measured at the foundation, with vibration limits at horizontal plane of the highest floor at all frequencies. Figure 2 displays the DIN4150 table values of the guideline values.

Table 1: Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

Line	Type of structure	Guideline values for velocity, v_i, in mm/s			
		Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all frequencies
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz *)	
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8

*) At frequencies above 100 Hz, the values given in this column may be used as minimum values.

Table 1 - DIN4150 Table 1

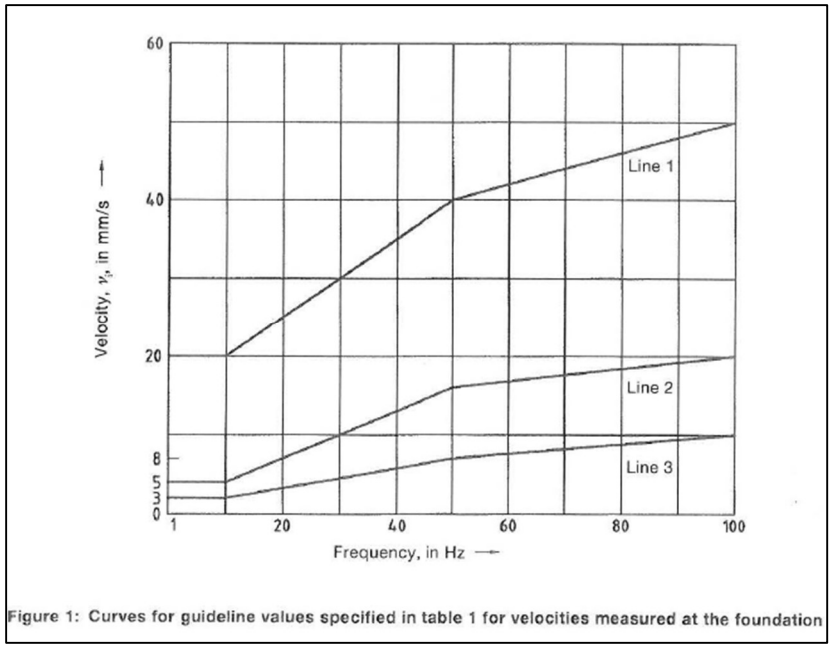


Figure 1: Curves for guideline values specified in table 1 for velocities measured at the foundation

Figure 2 - Curves for guideline values specified in DIN4150

Land surrounding the site mostly comprises plantation forestry, pockets of native bush and farmland. Offsite nearby receivers have been identified (Figure 1) and are presented in Table 2, alongside the applicable DIN4150 Line. Note 546 McNicol Road, though owned by SAL, has been classified as an offsite receiver for the purposes of this report because it has a residential building near the northern boundary.

Structure Location (nearby receiver)	Applicable DIN4150 Line
546 McNicol Road (dwelling or building of similar design or occupancy)	Line 2
600 McNicol Road (dwelling or building of similar design or occupancy)	Line 2
439 Otau Mountain Road (dwelling or building of similar design or occupancy)	Line 2
Police and emergency radiocommunications tower east of site (industrial buildings, or similar design)	Line 1

Table 2 Structure and applicable DIN4150 Line

Where vibration and air overpressure are measured, it is done so at ground level to represent a foundation at a notional boundary. This is industry standard and is a practical solution for obtaining access on private property.

Monitoring reports are issued to SAL by RPC following blasting. Monitoring reports record the peak air overpressure and PPV recorded at each monitored location.

Definitions:

Term	Abbreviation	Definition
Charge Weight / Charge Mass	-	The weight/mass of bulk explosives in a single explosive column
Confidence interval	-	A range of values, calculated from sample data, that is likely to contain the true population value. 95% of the calculated intervals would be expected to be included.
Maximum Instantaneous Charge	MIC	Mass of explosives (kg) detonated within any 8 millisecond time period
Millisecond	ms	1/1000th of a second
Peak Particle Velocity	PPV	Maximum velocity at which the ground or structural particles move during a vibration event, measured in mm per second
Scaled distance	-	Relationship between blast vibration and distance (distance divided by the square root of the charge mass)
Vibration attenuation	-	Reduction in vibration intensity as waves travel through a material or medium
Charge Weight / Charge Mass	-	The weight/mass of bulk explosives in a single explosive column
Shotfirer	SF	Designated person licensed and authorized to use explosives
Measure While Drilling	MWD	Drill data collected by sensors on the drill that can be used to determine indicative rock hardness

6 Site Blasting Vibration History

From 2017 to about 2019, blasting was generally more focused on the lower benches of the quarry. Then from about 2024 onwards, blasting was generally focused further east in the upper benches of the quarry, further from the front gate and McNicol Road properties.

A review of available blast monitoring results since 2017 was carried out. Monitoring was carried out at the quarry's front gate, 530, 546 and 600 McNicol Road, to ensure compliance with the consent condition and AUP standards.

6.1 Vibration – Previous Blasting Records

Monitoring results demonstrate compliance with the DIN 4150-3:1999 vibration criteria specified in the AUP and consent conditions. All blast vibration monitoring results were well within the consented and AUP limits, and no exceedances were identified. The maximum PPV recorded was 1.40 mm/s, and the average of the maximum recorded PPVs was 0.84 mm/s. Most of the results are recorded as No Trigger. A No Trigger is recorded when the vibration of the blast is less than the seismograph's minimum trigger level, typically 0.50 mm/s.

6.1 Air Overpressure – Previous Blasting Records

Monitoring results demonstrate compliance with the consented and AUP limits for air overpressure (air blast), and no exceedances were identified. The maximum air overpressure recorded was 114.2 dBL, and the average of the maximum recorded air overpressure was 108.4 dBL. Most of the results are recorded as No Trigger. A No Trigger is recorded when the air overpressure of the blast is less than the seismograph's minimum trigger level, typically 115.0 dBL. Results below the seismograph's minimum trigger level are recorded when the seismograph is triggered by vibration.

6.2 Summary

Because of the typically low levels of vibration and air overpressure levels recorded historically, relative to the consented and AUP limits, RPC has considered the site as low risk for blasting-generated vibration and air over pressure. This means that blast design parameters have focused on meeting quarry production and fragmentation requirements, with limited specific vibration mitigation measures required due to the low risk of exceeding consented limits.

This means that historical blasting records are of limited use for modelling potential blasting vibration effects as the quarry expands closer to neighbouring properties. However, blast monitoring records demonstrate air overpressure and vibration levels have historically been well within consented and AUP limits.

As the quarry footprint expands and the distance from blasting areas and neighbouring residential properties reduces in places, vibration levels from blasting are expected to increase incrementally. This is expected to enable the proactive and incremental management of blasting vibration to maintain compliance with the AUP standards and consent conditions.

7 Vibration Assessment

7.1 Introduction

RPC completed seed hole blasting at Clevedon Quarry on Monday 18th March 2025.

A Sandvik DP1100i drill rig was used to drill three blast holes. Individual holes were loaded with varying charge masses comprising bulk emulsion and fired using electronic initiation, with sufficient delays between holes to ensure accurate monitoring results of individual holes could be obtained.

Seismographs were set up prior to blasting at surveyed points within the quarry (nearfield) and at offsite locations. The purpose of the monitoring array was to record blast vibration from each of the individual seed holes fired in order to assess scaled distance and vibration attenuation.

7.2 Testing Location

Following a review of the proposed quarry expansion area and design, a site walkover was carried out by RPC to evaluate the current and expansion quarry areas for practicality to carry out seed hole drilling and blasting.

RPC considered Stages 2 to 5 impractical to carry out seed holes for several reasons. These included access, slope gradient and depth to rock.

Within the existing quarry, consideration was given to the current quarry model position, quarry operations (load and haul, crushing etc), rock accessibility and geotechnical considerations such as bench height and bench width requirements pre and post blasting. To be representative, it is important the charges used for assessing vibration are contained within the rock mass and not soil or overburden material.

Quarry benches at RL160 and RL170 were identified as most suitable for seed hole blasting, and three seed holes were marked out as shown in Figure 2. The drill plan is presented in Appendix 1.

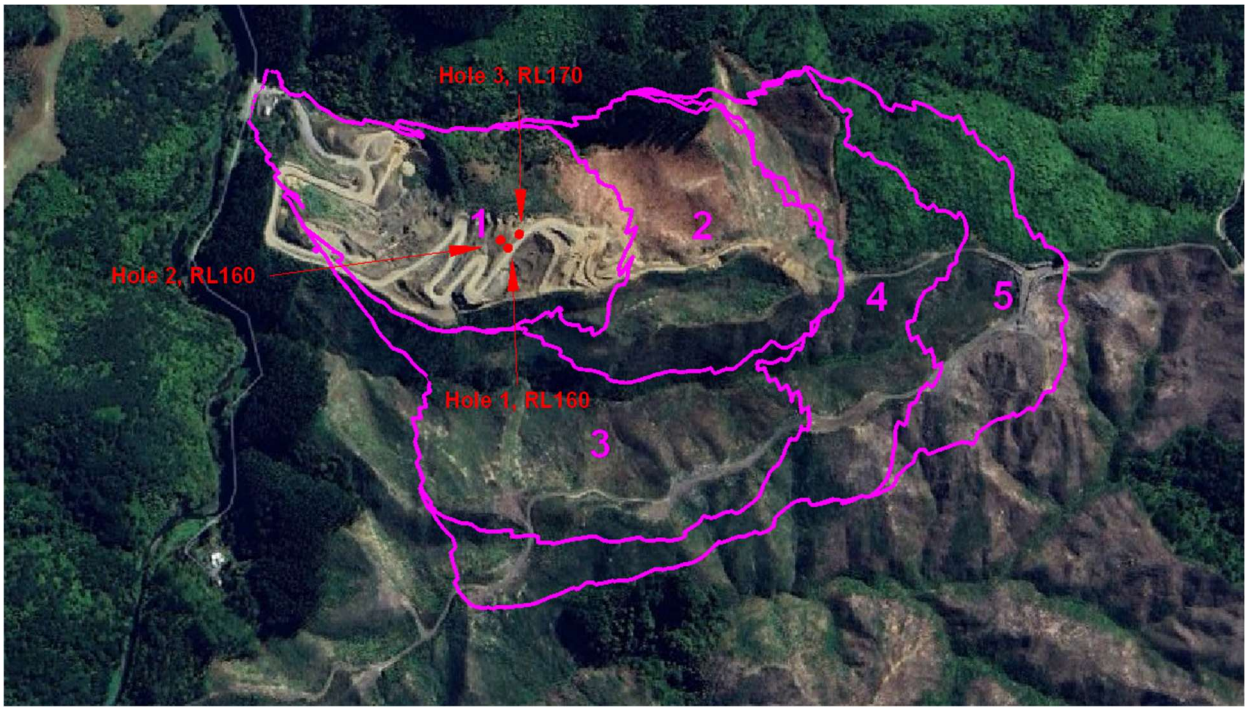


Figure 3 - Seed hole locations

7.3 Charges Fired

Three seed holes were fired. Holes 1 and 3 were 89 mm diameter, and hole 2 was 102mm diameter. Each hole was primed with electronic detonators and cast boosters and loaded with RedStar Bulk Emulsion. Maximum Instantaneous Charge (MIC) Weights ranged from 100 to 129kg. The holes were initiated individually, with delays of between 1,000 and 19,000 ms.

A summary of the holes fired is presented in Appendix 2.

8 Blast Vibration and Air Overpressure Monitoring

Five seismographs were set up prior to blasting to record blast vibration and air overpressure in accordance with RedBull's Standard Operating Procedure. A location plan of the seismographs is presented in Figure 4.

Three seismographs were set up at practical nearfield locations within the quarry site (RL177, RL191 & RL200) to assess scaled distance and vibration attenuation. An additional two seismographs were set up at

offsite locations (530 & 600 McNicol Road) to assess blast vibration and air overpressure levels at nearby residential properties and to satisfy consent condition 39 (600 McNicol Road).

The seismograph's geophone was securely clamped to a steel plate, which was secured to a concrete block recessed into the ground, at all the monitoring locations except for 600 McNicol Road. The geophone for the seismograph at 600 McNicol Road was ground spiked into the ground, because there was no access (locked gates) to the usual monitoring block located on private property.

Geophones were set to a minimum trigger level of 0.50 mm/s and microphones set to 115 dBL to avoid data loss due to non-blast related triggers.



Figure 4 - Seismograph monitoring locations (nearfield and offsite) in cyan

The maximum PPV recorded was at Near Field Monitor 1, RL177. This was the seismograph closest to the seed holes (and it recorded 16.10 mm/sec, 67.3m from the 100kg charge in hole 3. All vibration results are included in a summary table as Appendix 2.

The maximum air overpressure recorded by a seismograph was 122.6 dBL. This was recorded at Near Field Monitor 1, RL177 and was the closest seismograph to the seed holes (67 m from hole 3). All air overpressure results are included in a summary table as Appendix 2.

9 Recorded Air Overpressure

Air overpressure from blasting did not exceed the seismograph's minimum trigger level of 115 dBL at the off-site compliance locations (530 and 600 McNicol Road) and were reported as No Trigger.

Air overpressure was recorded by the Near Field monitors and results ranged from 109.8 dBL at 120.7 m distance to 122.6 dBL at 67.3 m distance. All air overpressure results are included in a summary table as Appendix 2.

One air overpressure result of 122.6 dBL exceeded the consented limit of 120 dBL but remained below the AUP limit. The result was recorded by a Near Field monitor located on site, 67.3 m from the blast (Appendix 2). This monitoring location is not specified in either the consent or AUP and, therefore, the result does not represent a breach of the consent condition. Strategies to minimise air overpressure levels are presented in Section 15.

10 Recorded Vibration

Vibration caused by blasting did not exceed the seismograph's minimum trigger level of 0.50 mm/sec at the off-site compliance locations (530 and 600 McNicol Road) and were reported as No Trigger.

Each seed hole fired triggered the three nearfield monitors set up on the upper quarry benches, recording nine data points.

Each data point represents the distance to the charge and the maximum recorded PPV.

Recorded vibration results were in the range of 2.6mm/s at 148.9m to 16.1mm/s at 67.3m. The seismographs also recorded the frequency of the vibration, which was in the range of 8.1 to 32Hz.

All vibration results are presented in Appendix 2.

All nine data points recorded at the nearfield seismographs have been used to determine the site's vibration attenuation relationship.

From the vibration data presented in Appendix 1, vibration attenuation calculations have been made using United States Bureau of Mines (USBM) empirical calculations and relationships. The scaled distance (distance / square root of the charge mass) is plotted against the PPV on a Log scale and a power trendline determined. A screenshot of the raw data and calculations spreadsheet is attached (Appendix 3).

The scaled distance relationship allows PPV predictions to be made for varying charge masses and distances in line with expected production blasting parameters. On Figure 5 below, the data trendline represents the average peak vibration expected for a given scaled distance. Industry best practice indicates that maximum vibration should be predicted using a 95% confidence interval, which is shown as the red line on the graph below and used in vibration predictions in the following section. Note that the gradient and y-intercept of the scaled distance graph gives the K and n rock constants for site that are used in the USBM Scaled Distance calculations below.

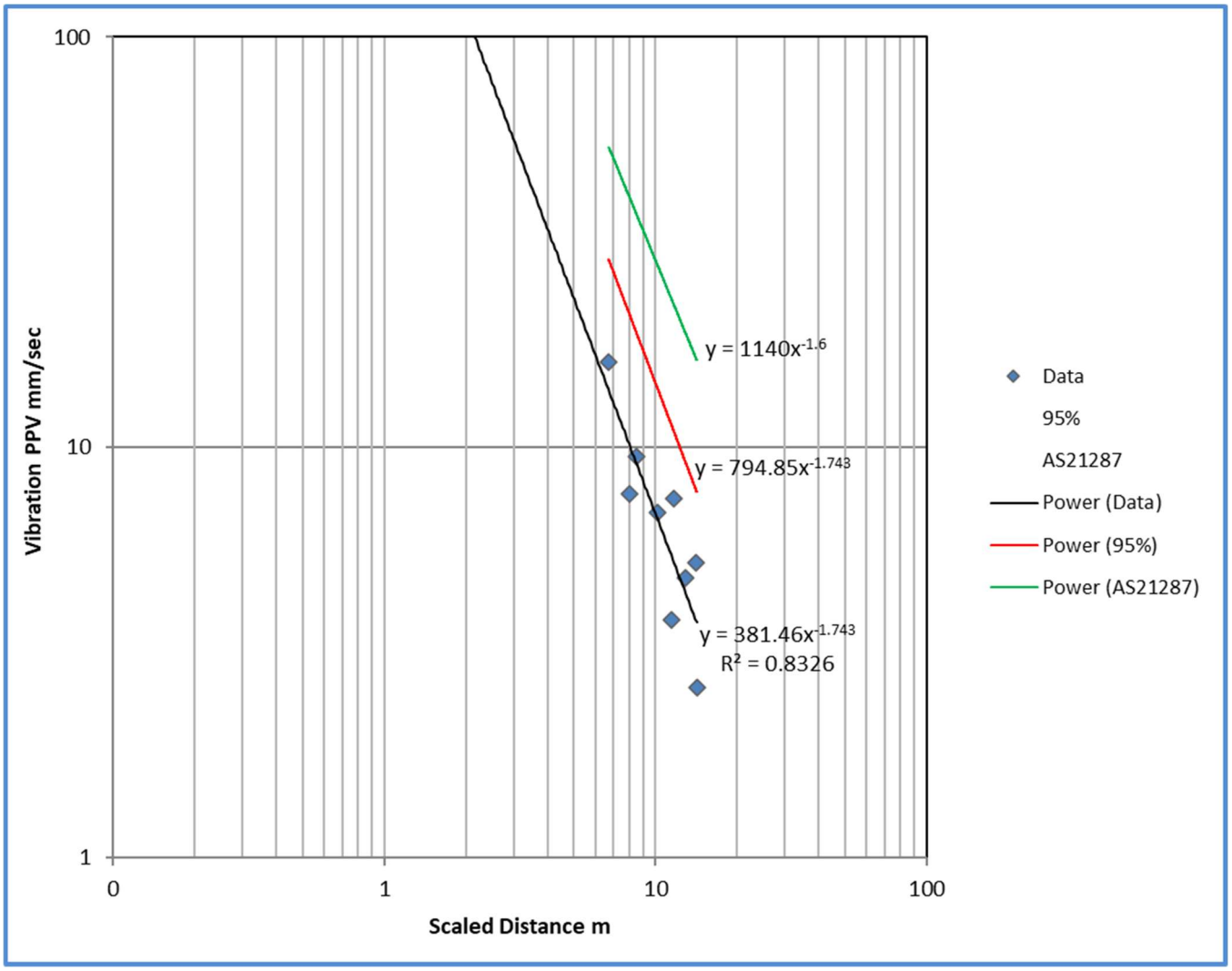


Figure 5 Clevedon Quarry PPV - Scaled Distance Relationship plotted

11 Defining Charge Weights

To assess vibration at different distances, estimated production blasting charge weights need to be established.

The charge weights adopted for the seed holes fired are representative of what is expected for near or fully charged holes in the proposed expansion and have been based on nominal blast parameters that are in general accordance with current drill and blast practices carried out at Clevedon Quarry, which include;

- 15 m bench heights for the proposed expansion
- 89 and 102 mm diameter holes
- Bulk emulsion with appropriate product density
- Load rates (kg/m) appropriate for the product and hole diameter
- Stemming for adequate charge confinement

This results in charge weights of approximately 108 kg for an 89 mm hole and 128 kg for a 102 mm hole. If vibration must be managed to maintain compliance to consent conditions and AUP, reducing charge weight is an effective method that can be used to reduce blast vibration at a receiver. There are several suitable ways this could be achieved in the proposed expansion if required, for example;

- Reducing hole diameters to reduce loading rates and MIC
- Reduced bench heights (for example two 7.5 m bench heights instead of one 15 m bench height)
- Deck loading (two or more explosive decks within one hole separated with stemming and fired separately)
- Control of MIC to ensure design charge weights are used

All options have pros and cons (both commercially and operationally) and a detailed assessment between the site and blasting contractor is needed where vibration management to maintain compliance is required.

Additional methods such as initiation/timing and waveform modelling could also be implemented. This is discussed in section 12.

12 Expected Vibration

Table 3 presents expected vibration based on the testing data and nominal charge parameters for a 15 m, production bench at 50 m and 100 m increments.

K	381	381	381	381	381	381	381	381	
n	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	
Distance to closest blasthole, D	50	100	150	200	300	400	500	600	m
Max charge per hole	1	1	1	1	1	1	1	1	kg
Max number of simultaneous blastholes	1	1	1	1	1	1	1	1	
Max Instantaneous Charge, MIC (W)	108	108	108	108	108	108	108	108	kg
Predicted Peak Particle Velocity, PPV	24.8	7.4	3.7	2.2	1.1	0.7	0.5	0.3	mm/s

Table 3 USBM Scaled Distance Vibration Predictions for 108 kg charge mass

Table 4 presents predictions for the same charge weights and distances as Table 3 but based on 95% confidence interval parameters generated from the site data.

K	795	795	795	795	795	795	795	795	
n	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	
Distance to closest blasthole, D	50	100	150	200	300	400	500	600	m
Max charge per hole	1	1	1	1	1	1	1	1	kg
Max number of simultaneous blastholes	1	1	1	1	1	1	1	1	
Max Instantaneous Charge, MIC (W)	108	108	108	108	108	108	108	108	kg
Predicted Peak Particle Velocity, PPV	51.7	15.5	7.6	4.6	2.3	1.4	0.9	0.7	mm/s

Table 4 USBM Scaled Distance 95% Confidence Interval Vibration Predictions

Table 5 presents predictions based on 95% confidence interval for limiting maximum instantaneous charge weights to 35 kg. This represents a nominal scenario for blasting near the radiocommunication tower.

K	795	795	795	795	795	795	795	795	
n	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	
Distance to closest blasthole, D	50	60	70	80	90	100	110	120	m
Max charge per hole	1	1	1	1	1	1	1	1	kg
Max number of simultaneous blastholes	1	1	1	1	1	1	1	1	
Max Instantaneous Charge, MIC (W)	35	35	35	35	35	35	35	35	kg
Predicted Peak Particle Velocity, PPV	19.4	14.1	10.8	8.6	7.0	5.8	4.9	4.2	mm/s

Table 5 USBM Scaled Distance Vibration Predictions for reduced 35 kg charge mass (nominal vibration management scenario for the tower)

Note that as discussed in section 13.2 below, the above may be conservative as it is derived empirically and cannot account for waveform superposition peak PPV reductions that may be achieved with modern blasting techniques, which may allow higher charge masses to be used at lesser distances than presented in Table 4. Other Vibration Management Techniques

There are varying levels of blasting vibration mitigation and management available, starting with general blast design considerations, then charge weight and basic blast initiation management, then where required, detailed modelling including a feedback loop allowing accurate predictions for vibration management.

If either predicted or measured PPV values exceed 75% of any consented limits, then blast design and parameters should be reviewed and additional vibration management and mitigation controls considered to maintain compliance with the relevant consent conditions and AUP standards.

13 General Blast Design Guidance

Blast planning and design significantly affects vibration. Charge size, charge confinement, blast geometry (hole depth, hole diameter, drill pattern) and pattern geometry all have an effect. For example, a fully confined "sump" blast (the first blast in lowering a floor level to allow the next bench to be established) where holes only have upwards relief will generally record higher PPV than a less confined, well designed bench blast (having a free face and allowing the rock to move aids in reducing vibration by providing relief).

The direction a blast is fired will also affect vibration. Generally, firing away from a receiver will give lower vibration than a blast fired towards a receiver.

13.1 Empirical

The USBM empirical calculations and (scaled distance) attenuation relationship assessment presented is a well-accepted approach to assessing blasting vibration purely from a charge weight perspective to give an indication of expected vibration levels and implications for proposed blasting projects.

The main limitation of the empirical approach is that it is modelling a single hole firing only which is not necessarily representative of well managed firing of multiple hole production blasts (50-100 holes typical for quarry blasting). The initiation sequence ("timing" or delay) of how the holes are fired can significantly affect vibration generated, as well as other blast design parameters like powder factor and the number of rows being initiated. This is discussed in the next section.

13.2 Waveform and Arrival Time Modelling

Each individual hole in a blast generates a vibration waveform assumed to be similar to those of representative seed holes fired in a similar location to any given blast. Waveforms have a series of peaks and troughs within a frequency range. Modern blast modelling software packages allow the modelling of these individual waveforms and how they interact, targeting overlapping peaks with troughs to reduce the amplitude of a vibration waveform for a given charge mass.

This technique is successfully used regularly to allow full depth bench production blasting to continue to reduce distances compared with those predicted using the empirical technique, however it can be difficult to model at this stage in the process. This is discussed to note that no fixed rules should be imposed around charge masses derived from empirical analysis. Instead, a robust feedback loop process is required from a suitably experienced/qualified team to manage blast vibration as a quarry expands.

The key is to model, measure, and continue to develop the model to maintain compliance over the longer term, and to ensure blasting does not become overly conservative too early as the quarry expands (with the associated operational and commercial implications of shifting to reducing charge weights). This will include

a requirement for more regular seed hole monitoring during production blasting as the quarry expands to ensure models remain accurate. A concept process is contained in the Blast Management Plan.

14 Assessment Results

14.1 Overview of Predicted Effects

Based on the results presented in Table 4, the majority of the blasting in the quarry expansion is expected to comply with DIN4150 when using standard blasting parameters for 15m bench heights and general charge parameters when based on the scaled distance relationship and 95% confidence interval. The assessment indicates that vibration effects at the identified residential receivers can be appropriately managed to maintain compliance with DIN4150 and the relevant consent conditions.

Based on a review of historical monitoring records and Near Field monitoring of seed hole firing, air overpressure levels generated by blasting are expected to comply with consented and AUP limits when measured at the notional boundary of the nearest residential properties (600 & 546 McNicol Road and 439 Otau Mountain Road). We note that one near field monitoring result was 122.6 dBL, measured 67.3 m distance from the fired hole. This was a fully charged hole with 100kg charge mass and the distance was significantly less than the distance from the proposed expansion boundary to the nearest residential property (600 McNicol Road).

14.2 Predicted Vibration Effects at Offsite Receiver

Vibration at the nearest identified residential properties (600 & 546 McNicol Road and 439 Otau Mountain Road) is predicted to comply with the consented limits, AUP and DIN4150, Line 2 if 15m bench heights are blasted to the proposed quarry expansion boundary.

Vibration predicted at the radiocommunication tower may require some form of vibration management to be implemented when or if blasting approaches approximately 100m from the tower (refer to charge weight contour map in figure 6). This is expected to occur during Stage 5 of the expansion (years 40 to 50). This can be managed through the Blast Management Plan or, if appropriate, specific consent conditions, with controls and monitoring implemented before blasting approaches this distance. Based on the information available, reducing the MIC to 35kg will decrease vibration to a level that is compliant with DIN4150, Line 1. This could be achieved through reduced bench heights or drilling small hole diameters. It should be noted that waveform modelling will likely achieve lower vibration results than currently predicted, which will be developed incrementally. This is because the modelling can optimise the interactions of individual vibration waveform peaks and troughs to reduce the amplitude of a vibration waveform. The development of the site model as more data is collected can also reduce vibration results from current predictions.

Vibration frequency cannot be accurately determined using empirical calculations, however, blast vibration recorded by seismographs is typically at the lower end of the frequencies specified in DIN4150. As discussed in AS2187.2-2006 Appendix J, higher frequencies typically attenuate rapidly, so receivers located closer to the source of the vibration frequencies will present greater recordings than at locations further from the source. This aligns with taking a more conservative approach by working to the PPV limit at the lower end of frequencies specified in DIN4150 (i.e. with DIN4150, the maximum allowable PPV increases with frequency for each Line) as well as having distance between receiver and source. The frequencies recorded from the seed holes RPC fired ranged from 8.1 to 32.0 Hz, and the mean was 13.6 Hz.

Vibration at the tower is predicted to require vibration management to comply with DIN4150 Line 1. Mitigation measures may include reduced maximum instantaneous charge (MIC), deck loading, reduced hole diameters, reduced bench heights, and waveform modelling.

Offsite Receiver Location	DIN4150 Classification	Distance at closest point (m)	Blasting Scenario	Predicted Ground Vibration (mm/sec)
600 McNicol Road	Line 2	323	Full 15m bench production blasting	2.0
546 McNicol Road	Line 2	460	Full 15m bench production blasting	1.1
439 Otau Mountain Road	Line 2	450	Full 15m bench production blasting	1.1
Police and emergency radiocommunications tower	Line 1	55	Full 15m bench production blasting	43.8
			Reduced MIC (nominal)	19.4

Table 6 Predicted vibration at offsite locations

We note that the expected vibration may be conservative as it is derived empirically and cannot account for waveform superposition peak PPV reductions that may be achieved with modern blasting techniques.

A charge weight contour map (indicative only) is presented in Figure 6. The purpose of this figure is to show approximate vibration contours (5.0, 2.5 and 1.0 mm/sec PPV) using a 95% confidence interval for a 108 kg charge weight (full 15 bench production blast scenario) for blasting undertaken at the boundary of the quarry expansion (magenta) using site attenuation data. The area in orange shows the approximate extent of area that will require vibration management to achieve compliance to DIN4150 Line 1 at the tower. As discussed in section 2, blasting may not be required to the full extents of the proposed pit shell if the material is free-diggable.

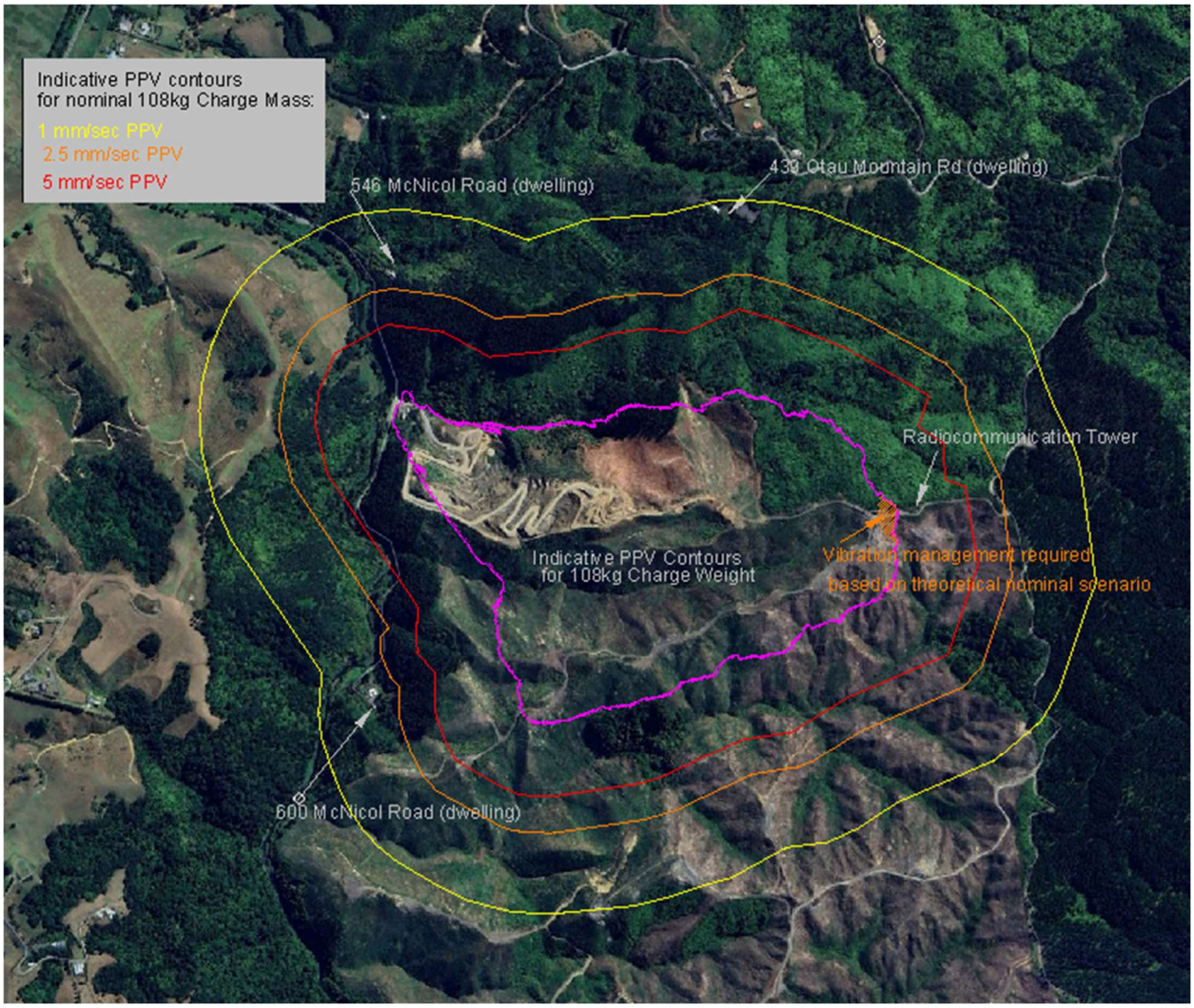


Figure 6 – Indicative PPV contours for nominal 15m bench (108kg charge mass) – contours approximate only based on blasting at the boundary

14.3 Human Comfort Assessment

The level of ground vibration that causes human discomfort is generally considered less than the level that could potentially cause damage to structures, this is discussed in AS2187.2-2006 Appendix J.

For sensitive sites such as dwellings, AS2187 suggests the following ground vibration limits for human comfort could be followed; maximum PPV of 5mm/sec for 95% of blasts per year and 10mm/sec maximum, unless an agreement is reached with the occupier. For non-sensitive sites, AS2187 suggests a maximum of 25mm/sec maximum PPV. These are frequency independent values. With consideration to the distances of the nearest offsite receivers, it is likely that the frequencies of vibration measured will be at the lower end, which is also the lower end of the maximum PPV limit when using DIN4150.

RPC considers it likely that adherence to DIN4150 complies with the recommendations of AS2187 with regards to blast vibration's potential impact on human comfort. The vibration predicted at the nearest sensitive offsite receiver (600 McNicol Road) is predicted to comply with the limits suggested by AS2187 for human comfort.

Predicted vibration at the nearest offsite receivers is presented in Table 6.

14.4 Assessment Summary

Overall, the assessment indicates that blasting associated with the proposed quarry expansion can be undertaken in a manner that achieves compliance with DIN4150 and the relevant consent conditions, subject to the implementation of appropriate vibration management, monitoring, and adaptive blast design measures.

15 Effects and Mitigation Assessment

The levels at which vibration or air overpressure from blasting are perceptible by people have been proven to be much lower than levels that could cause damage to structures, and air blast is generally the cause of more complaints than ground vibration. This is discussed further in AS2187. There is no fixed level at which complaints occur, as this depends on individual perception and sensitivity and varies person to person.

Air overpressure is controlled by good blasting practices, such as explosives confinement (for example, face burdens and stemming) presented in the Blast Management Plan. Electronic detonators will be used for blasting at Clevedon Quarry. These do not have surface delays, which eliminates the noise associated with use of non-electric (nonel) detonators. The use of electronic detonators also provides greater timing accuracy and flexibility compared to non-el detonators, which assists in minimising blast vibration effects.

A limited list of variables that have an influence on air overpressure as stated in AS2187, is presented in Table 7, alongside RPC control measures that are currently in place. There are factors that influence air overpressure levels that are outside the full control of the blasting contractor. These are primarily general surface conditions, wind and weather conditions. The intention is to provide an indicative overview, rather than an exhaustive list. The mitigation measures identified in Table 7 are intended to minimise the potential for adverse air over pressure effects and support compliance with the relevant consent conditions and AUP standards.

Air Overpressure Variable (AS2187)	**RPC Control**
Optimizing blast design	- Pattern selection based on SF assessment - Review of previous blasts (design, execution including Measure-While-Drilling, and compliance to consent)
Combination of appropriate delays	- Electronic timing for all shots (programmable detonators) allows flexible and millisecond accurate timing combinations
Using survey methods, as appropriate, to ensure burden is accurate	- RPC carries out drone survey or face profiling of blasts at Clevedon Quarry to accurately assess burdens and to adapt loading - GPS drilling to assess - Hole deviation measurement (if required by RPC Blast Risk Guidelines) to determine true as-drilled position in relation to burden
Ensuring stemming type and length is adequate	- SF assessment and RPC Blast Risk Guidelines - Stem heights based off industry standards - Stemming material checked before blasting to ensure suitability (i.e. Grade 2/3 chip) - Hole stemming procedure - SF checks all holes are stemmed prior to firing
Eliminating use of Nonel initiation therefore exposed surface delays	- Not applicable using electronic detonators
Varying the direction of initiation.	- SF assessment at blast planning stage - Review of previous blasting effects

Air Overpressure Variable (AS2187)	RPC Control
Taking particular care where the face is already broken or where it is strongly jointed, sheared, or faulted (geological conditions)	- SF face assessment at mark out and before loading - Measure-While-Drilling data reviewed - Drill logs reviewed - Drone survey assessment - Loading plan
Orientating faces where possible so that they do not face directly towards residences	- Review of previous blast effects - Short-term quarry planning allows flexibility - Blast planning and RPC Blast Risk Guidelines
Weather and wind conditions	- Stemming procedure - Record weather conditions at time of firing - Explosives confinement
General condition	- RPC bench preparation standard met prior to mark out

Table 7 Variables affecting air overpressure levels (AS2187) with RPC mitigation measures

Ground vibration or air overpressure at levels near the limits in the consent would be noticeable by a person. AS2187 provides limits to vibration and air overpressure for human comfort. These are presented in Table 8 for sensitive sites (such as a residential buildings) for operations lasting >12 months or >20 blasts.

Type	Measure
Vibration	5mm/sec for 95% of blasts per year, 10mm/sec maximum unless a higher limit is agreed with the occupier
Air overpressure (Table J4.5(A))	115 dBL for 95% of blasts per year, 120 dBL maximum unless a higher limit is agreed with the occupier

Table 8 Recommended vibration and air overpressure limits for human comfort (AS2187)

The limits of vibration and air overpressure for the quarry expansion are consistent with the current consent conditions, as well as the AUP and are therefore considered appropriate for managing potential adverse effects at nearby sensitive receivers . For context, AS2187 Table J5.4(B) specifies 133 dBL as the maximum air overpressure limit for damage control in structures that comprise masonry, plaster and plasterboard in their construction.

Blasting may have a startle effect on some people. This can be minimised through the utilisation of fixed blast windows and using an audible siren to alert people in the local area that blasting is about to take place. Additionally, community liaison is another measure that can be used to manage this effect. As presented in the BMP, firing times within the consented firing windows should be nominated and agreed between RPC and SAL Quarry Manager. This should allow consistency with firing times. These measures are intended to minimise potential safety and amenity effects associated with blasting activities.

It is recommended blasts are designed targeting a maximum PPV of 75% of the consented limit, to allow a buffer for any inaccuracies in modelling going forward. Where predicted or measured values exceed the 75% of limit target there should be a process requiring formal review of the blast design and parameters, including charge.

16 Monitoring, Reporting and Adaptive Management Plan

A Blast Management Plan (BMP) is already in effect for Clevedon Quarry and is attached to this report (Appendix 4). RPC will continue to work to it and carry out periodic reviews to ensure that it remains fit for purpose. The BMP outlines how RPC will blast in a safe and efficient manner and in compliance with regulatory requirements and the current consent conditions and AUP standards.

Pre-blast notifications will be carried out using the procedure in the BMP (Appendix E), which comprises audible sirens, radio calls, exclusion zones and blast guards (including training).

RPC proposes to continue monitoring all blasts at the existing installed monitoring positions at 530 & 600 McNicol Road. Compliance reporting of monitoring events to SAL to be targeted within two business days following the blast, or within 24 hours of receiving a complaint.

Blast monitoring positions can be reviewed and adapted if required and will be considered on a case-by-case basis. For example, if there is feedback with regards to potential blast effects at an offsite receiver, RPC could carry out monitoring at an additional location on a temporary basis (nominally three blasts) to quantify the effects of blasting, before considering further action. This adaptive monitoring approach will assist in verifying predicted effects and responding to community concerns where required.

Blasts will be recorded for video review. Videos will be stored by RPC and made available to SAL upon request.

Event reports will be shared to the Clevedon Quarry Manager (including other SAL staff as requested) and stored using an accessible online cloud-based platform, such as SharePoint.

RPC will maintain a Blast Data Spreadsheet, this will summarise blast parameters for individual blasts and will provide a tool for identifying trends.

Updates to the site's vibration model will be triggered where predicted or measured PPV values exceed 75% of the consented vibration limit. Blasting parameters and vibration management measures will then be considered. This allows incremental adjustment, while allowing a buffer between predicted/measured PPV and consented limits. The approach also means that blast vibration and air overpressure will be more in line with levels associated with human comfort, as discussed in AS2187. A framework for managing vibration and air overpressure is presented in the BMP. RPC considers that firing more seed holes and updating the site model will not be necessary in the short to medium term but will likely occur when blasting is approaching the expansion boundary near offsite receivers such as the tower (medium to long term). This means an incremental and adaptive management approach is considered by RPC as suitable for the quarry expansion.

Complaints arising from blasting are treated sensitively and in a manner that recognises the potential for blasting to have effects on the environment and offsite receivers. Upon receipt of a complaint, RPC will investigate the nature of the complaint and will carry out a review of the complaint and blast records to establish the cause and impacts. Any actions required will be carried out and tracked through RPC's health and safety system.

17 Conclusion

Blasting has been completed for several years at SAL Clevedon Quarry. Available vibration and air overpressure monitoring records demonstrate that previous blasting has been compliant with the relevant consent conditions and AUP, with no instances of exceedances occurring.

To date the site has had a low requirement for blasting vibration management due to a low risk of exceeding consented limits based on the blasting parameters, distances to the nearest offsite receivers and typical measured PPV values.

The seed hole testing completed on Monday 18th March 2026 generated sufficient data to determine a USBM scaled distance relationship that indicates blasting vibration will be manageable to comply with DIN4150 for the majority of the quarry expansion. A robust blasting vibration management process should be defined and followed. A framework for sure process located in section 4.5 of the BMP. This report

identifies potential vibration management and mitigation measures that may be implemented as quarrying activities progress closer to sensitive receivers. Full 15m bench height production blasting with unrestricted parameters may eventually generate vibration that exceeds the DIN4150 standard near the eastern boundary (refer to Figure 6). This is anticipated to affect the radiocommunications tower. Charge mass management, detailed blast modelling and vibration monitoring may be required to maintain compliance with DIN4150, likely achieved through a combination of deck loading, reduced hole diameters or reduced bench heights. The incremental nature of the quarry expansion will allow the blasting contractor opportunity to manage vibration in a manner that is compliant with the DIN4150 Standard.

A staged approach is recommended for vibration management where this report is used for planning purposes and identifying nominal distances where vibration management efforts may need to increase, and actual changes to blasting parameters are considered where predicted or measured PPV values exceed 75% of the consented vibration limit.

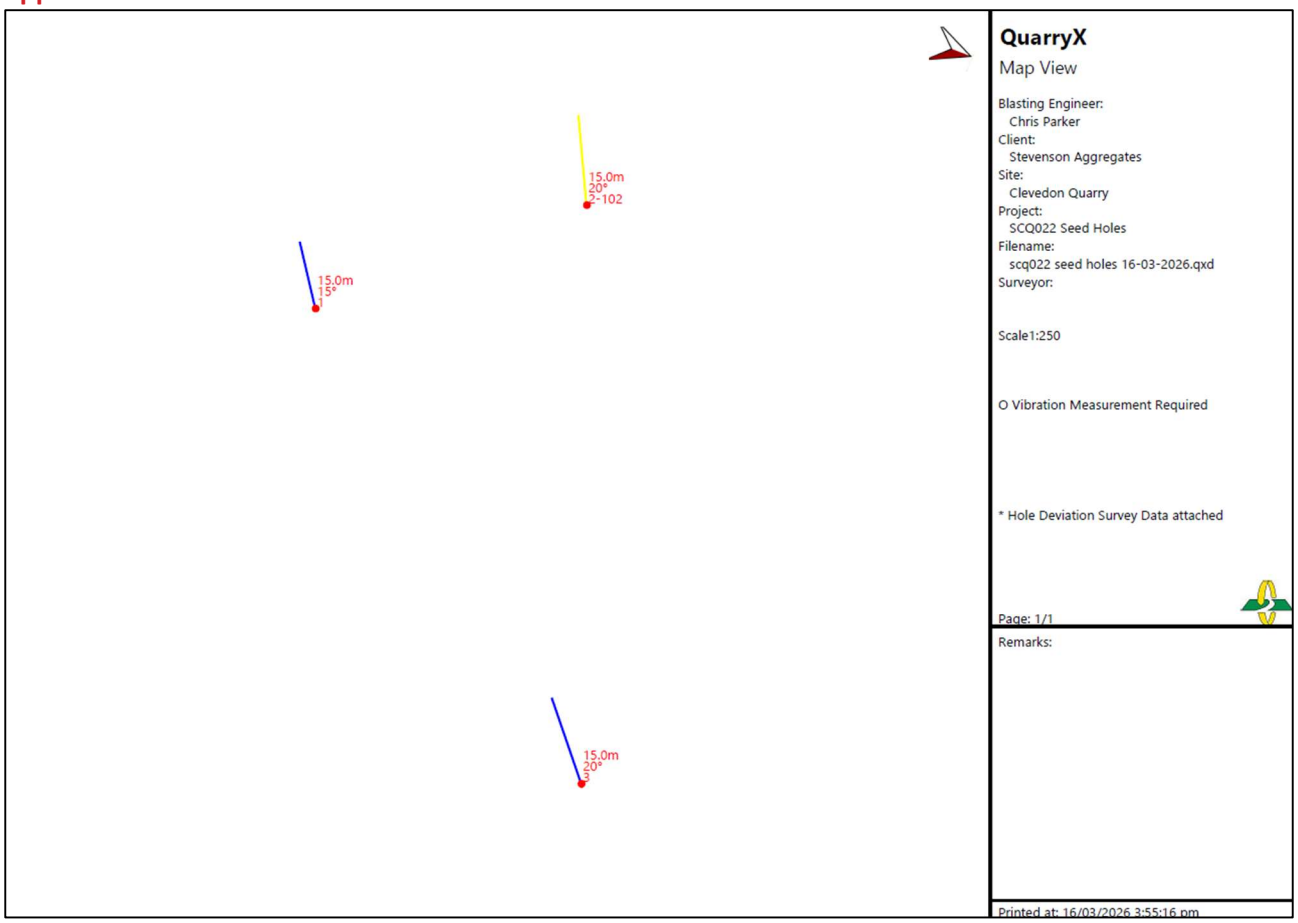
A Blast Management Plan is already in place for the current operation, prepared by the RPC. This should be reviewed and updated by the Blasting Contractor once the resource consent has been issued for the proposed expansion, to manage the effects of vibration and air overpressure associated with blasting activities.

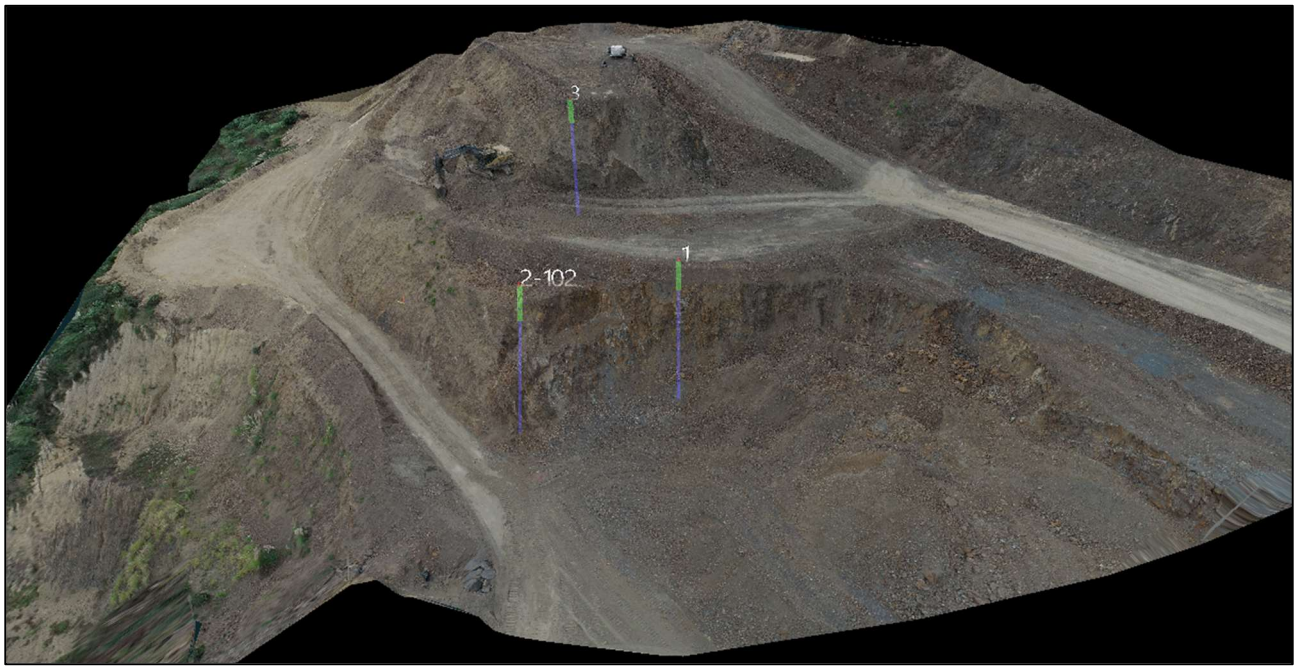
18 Disclaimer

It is noted that as the blasting contractor RPC cannot be deemed fully impartial when assessing blasting vibration and recommending management practices/considerations for vibration limits. An independent review of this assessment and recommendations is recommended and can likely be completed by the independent noise and vibration consultancy engaged for other aspects of the wider application.

19 Appendices

Appendix 1 - Seed Hole Drill Plan





Appendix 2 - Vibration Results Raw Data

		Near Field Monitors									Offsite Monitors					
		1) RL177			2) RL191			3) RL200			4) 530 McNicol Road			5) 600 McNicol Road		
Hole #	MIC (kg)	PPV (mm/s)	Air Overpressure (dBL)	Distance from Hole (m)	PPV (mm/s)	Air Overpressure (dBL)	Distance from Hole (m)	PPV (mm/s)	Air Overpressure (dBL)	Distance from Hole (m)	PPV (mm/s)	Air Overpressure (dBL)	Distance from Hole (m)	PPV (mm/s)	Air Overpressure (dBL)	Distance from Hole (m)
1	110	7.71	113.8	84.55	3.79	112.4	120.74	2.60	109.8	148.93	NT	NT	868.53	NT	NT	655.11
2	129	9.48	118.5	96.31	7.49	118.3	132.20	5.23	115.4	160.37	NT	NT	852.01	NT	NT	655.27
3	100	16.10	122.6	67.31	6.95	118.9	101.60	4.82	116.4	129.37	NT	NT	864.81	NT	NT	687.16

Figure 7 Vibration Results from seed hole blasting at Clevedon Quarry March 2026

Note “NT” represents ‘No Trigger’, where the vibration or air overpressure at that location did not exceed the seismograph’s minimum trigger levels of 0.50mm/s or 115dB.

Appendix 3 - Scaled Distance Relationship Calculation Raw Data

Site Coefficents	50%	95%
K	381	795
B	-1.74	-1.74
Standard Error	0.16	

Prediction - 95%		
MIC	Distance	PPV
108	490	0.96

Shot Name	PPV / mm/s	Distance to Shot (m)	MIC	SD	Log PPV	Log SD	AS2187	Log 95%	95%
1 - 110kg - RL177	7.71	84.55135148	110	8.06	0.89	0.91	40.42	1.32	20.93
1 - 110kg - RL191	3.79	120.73616	110	11.51	0.58	1.06	22.86	1.05	11.25
1 - 110kg - RL200	2.6	148.9251902	110	14.20	0.41	1.15	16.34	0.89	7.80
2 - 129kg - RL177	9.48	96.30899333	129	8.48	0.98	0.93	37.28	1.28	19.16
2 - 129kg - RL191	7.49	132.1965329	129	11.64	0.87	1.07	22.46	1.04	11.04
2 - 129kg - RL200	5.23	160.3669196	129	14.12	0.72	1.15	16.49	0.90	7.88
3 - 100kg - RL177	16.1	67.31074221	100	6.73	1.21	0.83	53.95	1.46	28.66
3 - 100kg - RL191	6.95	101.6009574	100	10.16	0.84	1.01	27.92	1.15	13.98
3 - 100kg - RL200	4.82	129.3744707	100	12.94	0.68	1.11	18.96	0.96	9.18

Figure 8 Scaled Distance Relationship Calculation Raw Data

Appendix 4 – Blast Management Plan for Clevedon Quarry

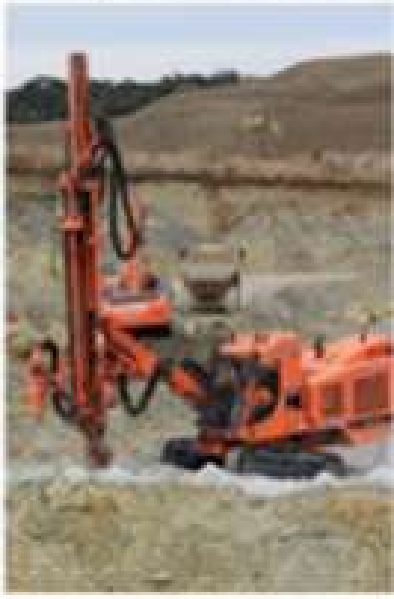






Drilling and Blasting Management Plan

Clevedon Quarry



Stevenson Aggregates Ltd
17 April 2026



BLAST MANAGEMENT PLAN

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1 Overview

Stevenson Aggregates Ltd (SAL) operates Clevedon Quarry, which is located approximately 5km southeast of the Clevedon Township in the Auckland region. Blasting is carried out for aggregate extraction for processing and material supplies offsite. Blasting requires careful design and significant controls. The Blast Management Plan shows how RedBull Powder Company (RPC) blasts are carried out in a safe and efficient manner and in compliance with regulatory requirements.

1.1 Plan Preparation

In preparing this Plan, we have included and considered the following information:

1.1.1 Clevedon Quarry Consents for Blasting (25/10/2018)
1.1.2 AS2187.2 Standard, Explosive – Storage, Transport and use (1998)
1.1.3 Health and Safety as Work Act (HSWA) 2015
1.1.4 Health and Safety at Work (Mining Operations and Quarrying Operations) Regulations 2016
1.1.5 Health and Safety at Work (Hazardous Substances) Regulations 2017
1.1.6 NZS 5433 Transport of Dangerous Goods on Land

1.2 Key points

The key points in this blast management plan are:

1.2.1 Safe and efficient blasting.
1.2.2 Minimising noise and vibration from drilling and blasting activities to ensure compliance to consented limits.
1.2.3 Efficient feedback systems to ensure blasting continues to meet Clevedon Quarry blast expectations.
1.2.4 Process and procedures established to minimise disruption to quarry operation.

1.3 Scope of works

1.3.1 The works covered in this Plan include the provision of supervision, shotfirer labour, explosive materials, and drilling plant and associated equipment necessary for blasting Greywacke. The blasted rock is to be processed with mobile Plant & Fixed plant. Blasting will be carried out in accordance with the Resource Consent, HSWA regulations and as per the pit design plans or Quarry Manager's instruction for the site.
1.3.2 The following is excluded from the scope of works:

1.3.2.1 Blast guards and general liaison (training is provided).
1.3.2.2 Load out and removal of excavated material from the site.
1.3.2.3 Community and client liaison.
1.3.2.4 Blast site prep for safe and efficient quarry blasting.
1.3.2.5 Survey and set out of quarry extents and final levels.

2 Responsibilities

2.1 Shotfirer

Designated RPC Shotfirer (nominally Harvey Bowley 027 237 6893) – Shall be responsible for:

2.1.1.1 All transportation and handling of explosives in accordance with the HSWA 2015 Quarry and Mining Regulations and HSWA Hazardous Substance Regulations 2017.
2.1.1.2 Decision whether to call off blasting if inclement weather poses a threat to site safety (HSWA Act).
2.1.1.3 Ensuring benches are acceptable as per the bench preparation standard.
2.1.1.4 Blast mark out, drilling depths and hole diameters. Submitting a blast plan to the driller for drilling accuracy – Coordination with Technical Services.
2.1.1.5 Dipping all holes to ensure correct depth and ensuring correct diameter.
2.1.1.6 Ensuring that all loading and stemming of the blast is done so in line with site parameters and blast design.
2.1.1.7 Activation of blasting sirens to alert site of imminent blasting activities and sounding all clear.
2.1.1.8 Communication with blast guards (and blast controller if in place) at firing time.
2.1.1.9 Ensuring all blast guards understand and implement the radio communication procedures and know their allocated blast guard positions.
2.1.1.10 Ensuring that the blast area/exclusion zone is clear at the time of blasting.
2.1.1.11 Firing of the blast.
2.1.1.12 Checking to confirm there are no misfires and give all clear and stand down of blast guards.
2.1.1.13 Completion of blast logs and compilation of DG declarations.
2.1.1.14 Reporting to Kyle Lang, Regional Manager (North).

2.2 Regional Manager (North)

Kyle Lang (027 529 9943) – Shall be responsible for:

2.2.1.1 Blasting results.
2.2.1.2 General coordination of the work and ensuring resources are available to carry out the works.
2.2.1.3 The overall safety of blasting practices carried out onsite.
2.2.1.4 Ensuring that the site procedures, protocols, and compliance requirements are followed.
2.2.1.5 Organisation of blast guards for misfired or sleeping shots if required for any reason.
2.2.1.6 Reporting to Operations Manager, Tristen Bradley.

2.3 Operations Manager

Tristen Bradley – (027 444 5675) Shall be responsible for:

2.3.1.1 Senior Management responsibility for the compliance, safety, and operation of the work.

2.4 General Manager

Kurt Hine (027 210 8440) – Shall be responsible for:

2.4.1.1 Executive Management responsibility for the compliance, safety, and operation of the project.

3 Pre-Blasting Activities

3.1 Requirements:

3.1.1 The following must be completed and/or obtained before any blasting activities begin onsite:

3.1.1.1 Commercial Agreement in place between Stevenson and RedBull.
3.1.1.2 Safety information compiled and approved by Stevenson.
3.1.1.3 Blast firing procedures and blast guard procedures established.
3.1.1.4 Site inductions and H&S safety requirements completed.

3.2 Site requirements:

3.2.1 Clearing of overburden and general bench preparation and access by Stevenson in accordance with the bench preparation standard.
3.2.2 Survey set out (targets and locations provided to RedBull) for resection and hole collar positions for blasting.
3.2.3 Site radio frequency for blast communication provided.

4 Drill and Blast Methodology

RedBull promotes safe and efficient Drill & Blast operations. We strive to meet our quarries blasting expectations and remain innovative Industry Leaders. We have the technology to Face profile, Drone survey, GPS Drill, Boretrak drilled holes and use Electronic Initiation systems. This allows us to offer a complete Quarry Drill and Blast service that is safe and efficient. A brief flow diagram is included in Appendix C illustrating this.

4.1 Drill and Blast Risk Management

The implementation of drilling and blasting procedural and safety controls is required. These must be specific to the issues and risks faced at each Quarry and assessed on a shot-by-shot basis.

We have identified the following controls are necessary for the proposed drilling and blasting at Clevedon Quarry:

4.1.1.1 Quarry and adjacent areas, where required, must be carefully managed, including traffic management requirements and the exclusion of quarry personnel during firing times.
4.1.1.2 Ensuring bench preparation standards are met.
4.1.1.3 Blasts to be designed to meet approved quarry plan, bench heights and spill benches.

4.1.1.4 Affected neighbours are to be informed of site drilling and blasting activities by Stevenson.

4.1.1.5 All explosives will be stored off-site and brought on site day of blast using a RedBull Shotfirer's utility vehicle.

4.1.1.6 All blasts marked out, loaded, and fired by trained and qualified personnel.

4.1.1.7 Controls (such as profiling and boretracking) will be implemented for each stage of the drill and blast process as determined using RPC's Blast Risk Guidelines.

4.1.1.8 All blast designs will be aimed at minimising effects to the neighbours to site and be compliant with environmental requirements.

4.1.1.9 Blast Guards are to be placed around the site during firing to ensure that the site is clear and secure.

4.1.1.10 RedBull will monitor the environmental effects of ground vibration and air overpressure, at a minimum of two locations for each blast. Blasting compliance reports will be supplied to Stevenson.

4.1.1.11 Blast windows will be constrained by the hours defined in the relevant resource consent (condition 41):

4.1.1.11.1 Monday to Saturday (inclusive): 9.00 am to 5.00 pm (except where necessary for safety reasons)

4.1.1.11.2 Blasting restricted to an average of two occasions per day over a calendar fortnight.

4.1.1.11.3 The preferred blasting time is during site smoko breaks, Monday to Friday.

4.1.1.11.4 The firing time must be agreed between Quarry Manager and RPC Shotfirer on or before the day of blasting.

4.1.1.12 RedBull Drilling and Blasting Standard Operating Procedures (SOP) will be followed. SOPs attached as Appendix A. Controls will not be limited to the above and will be reviewed on an ongoing basis.

4.2 Health and Safety

4.2.1 Health and Safety will be managed in through the RedBull electronic safety management system, Lucidity, and accordance with the RedBull Health and Safety Management Plan, Safe Standard Operating Procedures (SOPs) along with Health and Safety at Work Act 2015, Quarrying regulations and the Stevenson operational Health and Safety System. All RedBull personnel working on this site will be inducted as per Stevenson safety requirements, both procedural and PPE. They will be required to comply with all aspects of the site-specific safety requirements.

4.2.2 RedBull carry out regular Toolbox meetings, Take-5's, Task specific Authority Forms, and complete incident/near miss reports whilst on site. Toolboxes and Task specific Authority Forms can be submitted monthly whilst incident/near misses will be notified immediately when safe and reports will be submitted within 24 hours of any events that occur onsite.

4.2.3 RedBull's shotfirer will be in sole control of each blast and will have full authority over all safety aspects of the blast. RedBull's blasting procedures will be followed and job specific safety exclusion zones have been established and will be modified as required.

4.3 Job Hazard Assessment

4.3.1 Before any work is carried out, RedBull's site personnel will complete relevant task authorities and carry out a Take-5 to assess if the job can be completed under RPC SOPs or whether a task specific JHA will need to be completed. All personnel working onsite are to sign on to the authority for the task undertaken.

4.3.2 The site hazard board is to be updated with any hazards that apply to all site personnel by Stevenson. Take-5 individual risk assessments are to be completed by all RPC personnel that are working on site.

4.4 Site Access/Induction

4.4.1 All access to site by RedBull will be done as required by Stevenson and through designated site access points and induction requirements. RedBull will aim to minimise traffic movements in the pit and bring the practical minimum of vehicles to site daily. The Clevedon Quarry Traffic Management Plan will be followed by RedBull vehicles as briefed in the prestart meeting.

4.5 Blast Optimisation (Noise, Vibration, Fragmentation)

4.5.1 Blasting will be carried out once overburden and/or shot rock has been removed and a level bench has been prepared and is available for drilling works. Free faces are to be exposed for optimum blasting results. If significant changes to blast design are proposed, vibration mitigation may need to be implemented. This is completed in stages: *theoretical vibration levels* and *signature holes* to determine initial blasting parameters suitable for the site; using this information *trial blasts* will be designed and once these are successfully completed, *production blasts* will commence. The individual processes are outlined below. These steps will be used as required and some steps may be removed as deemed necessary for the level of vibration control required onsite.

4.5.2 **Theoretical Vibration Levels** may be calculated if required using Scaled Distance Analysis Empirical formula and nominal constants for rock blasting.

4.5.3 **Signature Hole Analysis**: Single holes may be fired, and the vibration signature analysed for different charge masses if vibration becomes an issue. From this, appropriate Maximum Instantaneous Charge (MIC's) and blast timings can be identified for trial and production blasting.

4.5.4 **Initial production blasting:** A series of trial blasts will be carried out using:

4.5.5 **Proceed with production blasting and monitor continually:** Regularly revert to blast design procedure and whenever vibration exceeds target.

Vibration management can take place through the production blasting phase when either predicted or measured vibration levels exceed 75% of consented limits. This allows blasting to continue, while still at levels that are within consented limits.

Charge size, charge confinement, blast geometry (hole depth, hole diameter, drill pattern) and pattern geometry all have an effect on vibration. A staged approach to vibration management could comprise general blast planning and design considerations, charge weight, basic blast initiation management and then detailed vibration modelling with feedback loop. Vibration would be managed and implemented by the RPC Shotfirer and Technical Services team. Blast vibration monitoring allows trends to be identified early,

which allows strategies to be considered and implemented while production blasting is ongoing. Some examples of different strategies available are presented below.

General blast design considerations may comprise blasting benches that have a free-face prepared, and planning undertaken to ensure there is an optimal blast geometry, direction of firing available and drill pattern selected.

4.6 Blasting Authority

4.6.1 RedBull utilize a blasting authority to cover all aspects of the blasting process. This starts at mark out and continues through drilling, loading, and firing. RedBull will use this to control the blasting process onsite.

4.7 Design

4.7.1 Mark out will be completed by the RedBull shotfirer and once the Quarry Manager has been consulted and Pit Shell reviewed. Blast design and timing plans will be generated from the mark out and shot plan information.
4.7.2 This will be adjusted following drilling if any changes arise. Specific load plans will be determined following drilling once drill log data is available.
4.7.3 Blast design is adjusted based on shotfirer assessments with feedback from the site as to how the material has processed.

4.8 Personnel

4.8.1 All Shotfirers onsite to hold all relevant New Zealand blasting qualifications and licences (Certified Handler (CH) and Controlled Substance Licence (CSL). These are to be provided to Stevenson.
4.8.2 All drillers, MPU operators and other personnel onsite are to hold relevant driver licences and dangerous goods handling qualifications. Any personnel onsite not holding CH and CSL are to be under the direct supervision of the Shotfirer.

4.9 Proposed Blast Windows:

4.9.1 Monday to Saturday (inclusive): 9.00 am to 5.00 pm – note Resource Consent allows blasting on Saturday.
4.9.2 Preferred blasting time is during site smoko breaks, firing time to be agreed between Quarry Manager and RPC Shotfirer on or before the day of blasting.
4.9.3 All blasts are targeted to be loaded and prepared for firing for the agreed time.
4.9.4 Blasting is restricted to an average of two occasions per day over a calendar fortnight.

4.10 Drilling

4.10.1 The shotfirer will provide a shot plan to the driller detailing number of blast holes depths, hole angles and diameters and any other relevant information.

4.10.2 Drilling is to be completed in accordance with RedBull's Drilling SOPs, drilling rigs and operators.

4.10.3 All holes are to be logged using RedBull's drill logs and these logs given to the shotfirer prior to blasting.

4.10.4 The driller is to communicate with the shotfirer regarding drilling progress and any difficulties faced and any areas where holes may not be able to be drilled as per the design.

4.11 Production Blasting

4.11.1 Once the blast design and drilling processes outlined above has been completed and the appropriate parameters for the site determined, production blasting will commence. Blasting noise and vibration will be managed in accordance with the Blast Management Plan to ensure compliance and meet reporting requirements.

4.11.2 Blasting is proposed to be carried out to meet the production demands of the Quarry. All blast liaison is to be carried out between the RedBull Regional Manager and the Clevedon Quarry Manager. Quarry blasting methods and best practice will be utilized for all blasting onsite.

4.11.3 Charge masses will be controlled in accordance with the specific blast design.

4.11.4 All blasts will be stemmed with high quality stemming material to mitigate air blast and stemming ejection.

4.11.5 Blasts are to be fired using remote firing devices or cable.

4.11.6 RedBull's Blasting SOPs for blasting are to be followed for all blasting activities. These will be bound and submitted separately to Stevenson but form Appendix A of this document. Copies will be updated as required.

4.11.7 Firing procedures are to follow RedBull's SOP. Notification to neighbours before any blasting works begin is to be carried out by Stevenson. All blasts will be monitored in two locations for vibration and air overpressure.

4.12 Blasting Safety Measures

4.12.1 All blasting will be controlled using a blasting checklist with appropriate hold points.

4.12.2 A Blast Isolation Plan will be prepared for every blast. Safe blasting distances will be calculated using blast parameters (designed or measured burdens and stem heights). A Safety Factor x2 will be applied to the safe blast distance for machinery. A Safety Factor x4 will be applied to the calculated safe blast distance for people. See attached example of a blast isolation plan and calculation in Appendix D.

4.12.3 Check that the weather is conducive to safe blasting; the shot may be cancelled if deemed unsafe by the shotfirer. RedBull shotfirer to notify Stevenson as soon as this decision is made so arrangements can be made to advise adjacent residents.

4.13 Blast Preparation

4.13.1 Pre-Loading

4.13.1.1 All holes dipped and depths recorded, back filled or re drilled if necessary
4.13.1.2 Detonators for top and bottom decks must be identified visually prior to loading.

4.13.2 Loading

4.13.2.1 Design MIC is in accordance with site parameters.
4.13.2.2 Deck lengths and stemming heights checked.
4.13.2.3 Blast timing to be checked and ensure correct.
4.13.2.4 Stemming to be with clean chip, the person who starts stemming a hole is to finish it.
4.13.2.5 Shotfirer to always remain in the blast area, until shot clearance.
4.13.2.6
4.13.2.7 A “no smoking” zone to be established in the blast area and within 10m of any vehicle used to transport explosives to site. (Blast area to be delineated by Blasting sandwich boards or cones) All vehicles carrying explosives to drive directly to the safe parking or blast area, no parking in public car parking.
4.13.2.8
4.13.2.9 Designated blast guards are to have expectations and requirements clearly explained:
4.13.2.10
4.13.2.11 Locations to be defined.
4.13.2.12 Radio channel specified.
4.13.2.13 Radio call procedure made clear and understood by all involved.
4.13.2.14
4.13.2.15 Shotfirer to confirm blast has been loaded as per the approved blast design and to site parameters and monitoring equipment is set up.
4.13.2.16 Blast guards, and Shotfirer to meet 30 minutes prior to blasting.
4.13.2.17 Blast exclusion zone is cleared.
4.13.2.18 15 minutes prior to the blast, blast guards take positions and clearing run completed.
4.13.2.19 Final blast checks and wiring / arming completed.
4.13.2.20 Final warnings are given over the radio, final announcement that blasting is to proceed made and siren is sounded. The blast is then fired.

4.13.3 Following the blast

4.13.3.1 Post blast radio call is made.
4.13.3.2 A visual check of the blast will be carried out and all clear given over radio and sirens sounded.
4.13.3.3 Blast guards can stand down.
4.13.3.4
4.13.3.5 In the event of a misfire RedBull’s misfire SOP is be followed. If a misfire occurs the blast exclusion zone for firing will revert to the blast area. The blast exclusion zone will apply again when the blast is prepared for firing.

4.14 Misfire/Sleeping Shots

4.14.1 RedBull SOP is to be followed if misfires are discovered or suspected (hard digging or blasted faces standing up).

4.14.2 Explosive cartridges or ANFO / Bulk Emulsion may not be initiated due to dislocation or separation, but these are effectively inert unless subject to excessive heat, shock or electrical current. If discovered during excavation, excavation should cease immediately and the area isolated and RedBull contacted to inspect and remove.

4.14.3 If any uninitiated or suspected uninitiated detonators or boosters are found during excavation, excavation is to cease and RedBull be notified immediately. RedBull will have a Shotfirer on site as soon as possible to inspect and make arrangements in line with misfire SOPs.

4.14.4 No blasts are proposed to be slept onsite. In the event of a misfire occurring and a shot is required to be slept overnight RedBull's SOP is to be followed.

4.15 Onsite Emergency

4.15.1 If an emergency should occur, Stevenson's Clevedon site emergency response plan is to be followed. If the emergency occurs while blasting is being carried out emergency services are to remain clear of the blast zone. Emergency services are to only enter the blast area under the supervision and permission of the shotfirer.

4.15.2 If the emergency happens during the firing procedure the blast will be aborted and is only to proceed once the situation has been dealt with.

5 Explosive Products

5.1 Detonators

5.1.1 Electronic are used for all blasting onsite. Electronic detonators are used for increased control over vibration, improved fragmentation, and reduced risk of misfires through electronic checks and verification.

5.2 Bulk Products

5.2.1 RedBull carry out blasting operations with bulk blasting products. RedStar Bulk Emulsion or ANFO will be used for blasting onsite.

5.2.2 Bulk emulsion is to be delivered by RedBull MPUs following RedBull MPU SOPs.

5.3 Storage and Transport

5.3.1 All RedBull explosives are stored in accordance with HSWA Hazardous Substances Regulations 2017 requirements. Magazines are built and maintained in accordance with the AS2187.2 Standard – Explosive Storage, Transport and Use. All explosives will be stored either at the RedBull Kopako Explosive Reserve in Maramarua or in a RedBull designated and certified storage site.

5.3.2 No explosives will be stored onsite. Explosives and blast agents will be brought to site on the day of loading in accordance with HSWA HSR 2017 requirements in a RedBull Ute, MPU or delivery truck.

6 Managing Environmental Impacts

The summary below details the measures and monitoring mechanisms we will undertake to mitigate adverse effects of blasting to the environment and the local community.

Adverse Effect	Mitigating Measures	Monitoring
Ground vibration	• Blast Design using Regression Analysis. • Small trial blasts to test theoretical designs and predicted PPV.	• Minimum of two seismograph readings per blast at appropriate locations. • Review blast design parameters when ground conditions changes or vibration peaks occur.
Air overpressure	• Use of electronic detonators removing surface delays. • Correct stemming • Face profiling to mitigate face burst	• Record air overpressure as required. • Noise consultants to be engaged by client if required.
Dust emission	• Drill rig to be fitted with dust extractor. • Use water while drilling if required.	• Dust monitoring by Main Contractor.
Noise from drilling	• Damping of drill rig noise where possible.	• Noise monitoring by Main Contractor.
Noise from blasting	• Control MIC and ensure critical burden in place to eliminate air blast.	• Noise monitoring by RedBull's seismographs to limits required.
Flyrock	• Use only high-quality stemming material. • Stemming height to be properly controlled. • Face profiling • Boretrack front row holes	• QC on stemming used. • Video blasts to identify flyrock problems before they emerge. • Review profiles.
Public safety	• Public and neighbour communication protocols to be implemented. • Warning sirens pre- and post-blast. • Blasting at regular times. • Drill and Blast activity signage. • Public exclusion to be implemented. • Blast guards to be posted around the site.	• Blasting and Main Contractor Safety Representative.

7 Compliance

7.1 Regulatory Compliance

7.1.1 Blasting is to be carried out in accordance with Resource Consent conditions held by Stevenson for Clevedon Quarry.
7.1.2 Suitable community liaison should be carried out by Stevenson.
7.1.3 All blasting will be conducted in accordance with WorkSafe NZ (notification of quarry blasting by SA), EPA (was ERMA), Resource Consent conditions and relevant local body requirements. A comprehensive Blast Log will be filled out for each blast, indicating blast plan, explosives used, number of holes as a minimum.
7.1.4 Blast monitoring for noise and vibration will be completed for all blasts. RedBull Technical services team will coordinate all compliance and vibration monitoring and reporting of our monitoring data and aim to supply this for a target of 2 working days following blasting.
7.1.5 Safety data sheets will be provided for all explosive products and blast related items brought to site by RPC. A list of SDSs is provided in Appendix F.

7.2 Reporting

7.2.1 A Summary of RedBull's blasting reporting is listed below:

7.2.1.1 Video Recording of all blasts.
7.2.1.2 Minimum of two seismographs monitoring each blast.
7.2.1.3 Vibration compliance reporting to Stevenson and Blasting information spreadsheet.
7.2.1.4 Blast logs and Dangerous Goods Documents completed and submitted to the RedBull office for each blast.

8 Vibration Performance Standards

8.1 Compliance

8.1.1 Compliance in relation to blasting vibration will be considered prior to any blasting onsite. Empirical models will be used to assess potential blast vibration and cross check against actual blast recordings. Using modern blasting techniques and best practice in relation to the loading and firing of blasts all blasting is to be compliant with the consented vibration limit below.
8.1.2 All vibration shall comply with the consent conditions provided:

Condition 40: Vibration generated by blasting shall be measured within a building in accordance with Appendix J or Part 2 of Australian Standard AS2186 2006.

Condition 42: Blasting activities must be controlled to ensure any resulting ground vibration does not exceed the limits set out in German Standard DIN 4150-3 1999: Structural Vibration – Part 3 Effects Of Vibration On Structures when measured on the foundation in the horizontal axis on the highest floor of an affected building.

9 Noise Controls

9.1 Blasting

9.1.1 RedBull's seismographs also record air blast levels which will be retained and reported for all blasts.

9.1.2 All noise (air blast) shall comply with the resource consent conditions provided by Stevensons:

Condition 38: Noise creased from the use of explosives must not exceed a peak overall sound pressure of 120db l_{ZPEAK}.

Condition 39: The measurement of blast noise (air blast) from blasting must be undertaken at the notional boundary of a dwelling that existed at the date of commencement of this consent (for the purposes of this consent outside the Special Purpose – Quarry Zone is 600 McNicol Road, approximately 480m away).

10 Quality Assurance System

10.1 RedBull Quality Assurance System

10.1.1 RedBull is committed to implementing and maintaining a management system that will improve efficiency and productivity and ensure that all services provided meet our customers' requirements and expectations.

10.1.2 We strive toward that goal by continuing to drive improvements in our products and processes that result in zero variation, better quality, reliable delivery, and improved service.

10.1.3 We recognize the need for meticulous auditing, reviewing, reporting and documentation standards which we have implemented throughout our facilities.

10.1.4 We have several mechanisms to improve quality systems, processes, and procedures:

10.1.4.1 We promote a performance standard of 100% compliance.

10.1.4.2 We monitor and measure our performance through a programme of audits to verify conformance and to identify opportunities for improvement.

10.1.4.3 We provide adequate resources to establish, implement, maintain, and continually improve our quality processes.

10.1.4.4 We are focused on continuous improvement to develop and sustain a culture of outstanding service delivery.

10.1.4.5 We carry out frequent reviews of our quality processes.

10.1.4.6 We implement and maintain stringent quality control procedures on all sites including Velocity of Detonation (VOD) measurements of all explosive products, process control sheets during manufacture and drill logs detailing ground conditions for many blasts.

10.1.4.7 We develop and manage site specific firing procedures and comprehensive environmental monitoring for all environmentally sensitive sites.

10.1.4.8 We communicate our Quality Policy to all employees.

10.1.5 Our processes are reviewed continually to ensure their alignment with customer requirements and International Standards.

11 Traffic Management

Traffic management is to be organised by the Clevedon Quarry Manager and briefed at pre blast briefing. Site traffic at blast times is to be controlled by Stevenson Clevedon. Vehicles taken from the Quarry office down to the drill or blast areas are to be minimised so far as is reasonably practicable.

12 References

Legislation	
Health and Safety at Work (Hazardous Substances) Regulations 2017	
HSWA Quarries and Mines Regulations 2016	
Health and Safety at Work Act 2015	
Health and Safety at Work (General Risk and Workplace Management) Regulations 2016	
Health and Safety at Work Regulations 2016	
Standards	
AS2187.2	Standard, Explosive – Storage, transport and use (1998)
NZS 5433	Transport of Dangerous Goods on Land
Policies	
RPC-HS-PY-01-01	Health and Safety Policy
RPC-HS-PY-01-02	Drug and Alcohol Policy
RPC-HS-PY-01-03	Environmental Policy
RPC-HS-PY-01-05	Fitness for Work Policy
RPC-QR-PY-02-01	Quality Policy
Manuals	
RB-HS-MA-001	Health and Safety
RB-QA-MA-001	Quality
Procedures	
Refer to appendix A below.	
Forms	
Refer to appendix B below.	

13 Appendices

13.1 Appendix A: Standard Operating Procedures

Drilling Procedures	
RPC-DR-PR-06-01	Transporter Operating Procedure
RPC-DR-PR-06-02	Loading and Unloading of Drill Rigs
RPC-DR-PR-06-03	Loading and Unloading of Drill Rods
RPC-DR-PR-06-04	Standard Drilling Operations
RPC-DR-PR-06-05	Drilling Uneven Ground & Tramming Drill Rig
RPC-DR-PR-06-06	Drilling Mechanical Breakdown Procedure
RPC-DR-PR-06-07	Refuelling Procedure
RPC-DR-PR-06-08	Collaring of Holes Procedure
RPC-DR-PR-06-09	Workshop Washdown & Disposal Procedure
RPC-DR-PR-06-10	Drilling Documentation
RPC-DR-PR-06-11	Lock Out / Tag Out Procedure
RPC-DR-PR-06-12	Electric Air Compressor Procedure
RPC-DR-PR-06-13	Grinding and Sharpening Button Drill Bits
RPC-DR-PR-06-14	Grinding Drill Bits using Electric CME 1 & 2 Robot Arm
Technical Services Procedures	
RPC-TS-PR-08-01	Face Profiling Procedure
RPC-TS-PR-08-02	Survey Control Setup Procedure
RPC-TS-PR-08-03	Designing Blasts for GPS Drilling Procedure
RPC-TS-PR-08-04	Configuring GPS for TIM3D Drills Procedure
RPC-TS-PR-08-05	Bore-tracking Procedure
RPC-TS-PR-08-06	AB Line V2
RPC-TS-PR-08-07	Drone Operation
Markout and Blasting Procedures	
RPC-BL-PR-07-01	Mark Out Procedure
RPC-BL-PR-07-02	Handling Explosives Procedure
RPC-BL-PR-07-03	Blast Hole Loading Procedure
RPC-BL-PR-07-04	Blast Hole Stemming Procedure
RPC-BL-PR-07-05	Blast Hook Up Procedure
RPC-BL-PR-07-06	Lightning Procedure
RPC-BL-PR-07-07	Managing Blast Hazards Procedure
RPC-BL-PR-07-08	Vehicles on Blast Pattern Procedure
RPC-BL-PR-07-09	Misfires Procedure
RPC-BL-PR-07-10	Delineation of Blast Patterns Procedure
RPC-BL-PR-07-11	Communication Protocol for Blasting Procedure

RPC-BL-PR-07-12	Construction Blast Firing Procedure
RPC-BL-PR-07-13	General Blasting Procedure
RPC-BL-PR-07-14	Sleeping Blast Pattern Procedures
RPC-BL-PR-07-15	Blast Documentation & Recording Protocol Procedure
RPC-BL-PR-07-16	Vibration Monitoring & Reporting Procedure
RPC-BL-PR-07-17	Electronic Initiation Procedure
RPC-BL-PR-07-18	Run Away Blast Hole Procedure
RPC-BL-PR-07-19	Blast Hole Loading with Packaged Product Procedure
RPC-BL-PR-07-20	Excess Product in Blast Hole Procedure
RPC-BL-PR-07-21	Assembling Primers Procedure
RPC-HS-ST-01-01	RPC Bench Preparation Standard

13.2 Appendix B: Authority to Mark Out, Drill, Load & Fire

Forms	
RPC-DR-FR-06-01	Job Hazard Analysis (JHA) - Drill
RPC-DR-FR-06-02	Authority to Drill V3
RPC-DR-FR-06-03	Pre-Start Transporter Daily Check V3
RPC-DR-FR-06-04	Pre-Start Drill Daily Check Sheet V3
RPC-BL-FR-07-01	Authority to Fire
RPC-BL-FR-07-02	Authority to Load V3
RPC-BL-FR-07-03	Authority to Mark Out V4
RPC-BL-FR-07-04	Authority to Undertake Post Blast Inspection
RPC-HS-FR-01-02	Take-5
RPC-HS-FR-01-06	Toolbox Minutes
RPC-HS-FR-01-07	Pre-Start Minutes
RPC-HS-FR-01-26	Pre-Start (Light Vehicle)

13.3 Appendix C: Blasting Methodology Flow Diagram

Mark out	Discuss with Quarry Manager result wanted and any potential issues with blast site.
	Shotfirer assesses prepared bench in accordance with RPC standard and starts Authority to Mark out.
	Profiles, designs, and Marks out shot. Has Quarry Manager sign off.
	Discusses the blast / risk level and considerations – gains QM approval to proceed.
Drill	Drill arrives onsite, is unloaded in area designated by quarry and in accordance with SOP's.
	Driller is briefed by shotfirer and receives Drill plan.
	Shot is Drilled. Drilling progress is recorded on drill logs and relayed to shotfirer for loading.
	Front row holes are bore tracked for drill deviation and re-drilled if necessary.
Blast	Blast crew arrives onsite and signs in.
	Pre shot briefing carried out and blast crew completes pre blast paperwork. Blast guards identified.
	Blast crew travel to blast site.
	Blast is loaded and fired according to RedBull SOP's and at notified time.
	Blast is checked and all clear is given.
	Shot fragmentation is initially assessed by Quarry Manager.
Feedback	Vibration and air overpressure supplied to Quarry Manager, levels reviewed and adjustments to blast parameters as required.
	Blast video made available to Quarry Manager on request.
	Quarry Manager discusses fragmentation and blast outcomes of previous shot with shotfirer and/or regional manager prior to next mark out.

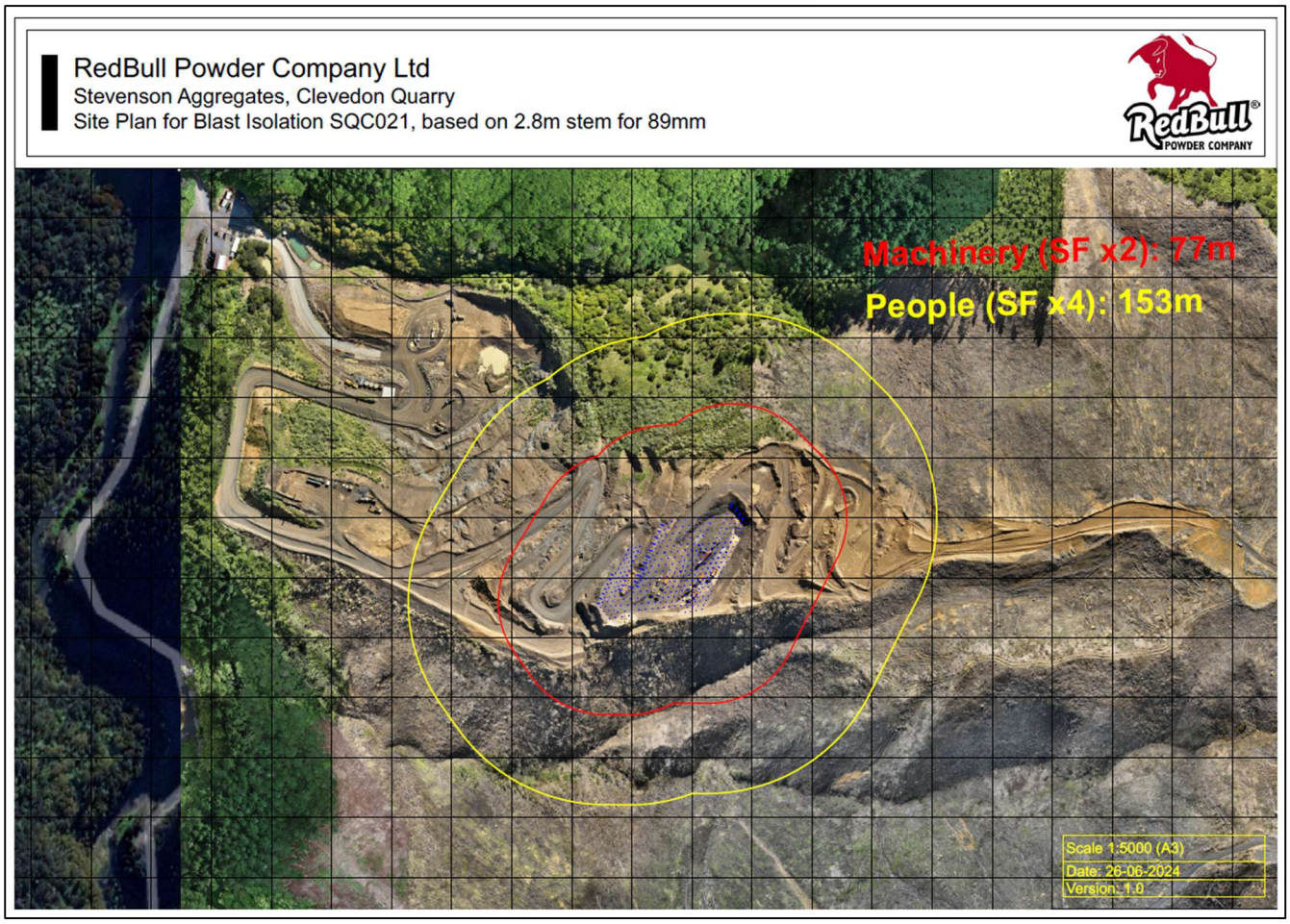
13.4 Appendix D: Safe Blasting Distance

Example - Exclusion Zone Calculation

Hole dia	89
Expl Density	1.2
Drill angle	15
Charge mass/m	7.5
Burden	3.5
Stem Height	2.8
G	9.81
K	20

	Safety 1	Safety 2	Safety 4
Face Burst	21.4	42.8	85.7
Cratering	38.3	76.5	153.0
Rifling	19.1	57.4	76.5

Minimum | Site personnel | Non site personnel



13.4.1 Example of a safe exclusion zone calculated for a Clevedon Blast. Blast location has been inserted from GPS survey data and an accurate Exclusion Zone created. Exclusion zone is calculated from True burden using survey data, stemming height, hole diameter and angle.

13.5 Appendix E: Blast Firing Procedure

RedBull Powder Company Clevedon - Blast Firing Procedure

Day of Blast

1. Confirmation with Site Representative at pre blast meeting (nominally 30 min prior to blast) of blast window and availability of nominated blast guards.

Approximately 15 minutes before blast

2. *Blast Guards* make their way to their position and notify shotfirer over radio once in position. Sweeping run made by blast guards to ensure area is clear on way to position.

Approximately 5 minutes before the blast:

3. *Shotfirer* confirms time of blast. If blast needs to be suspended use clear and concise information. Investigate cause and once resolved start procedure.
4. Warning siren, 5 Short Bursts, sounded by *Shotfirer* over radio.
5. If blast time confirmed as planned, *Shotfirer* contacts *Blast Guards* individually to confirm access points are blocked and secure (refer to radio calls).
6. *Blast Guards* confirm the area is secure.
7. Blast is prepared for firing (Armed).
8. Call over radio requesting radio silence and informing of blast location.

Immediately before blast:

9. 30 Second warning siren, 1 long burst, sounded by *Shotfirer* over radio.
10. 10 seconds prior to firing *Shotfirer* gives message that blast is to be fired over the RT and fires the blast.

After the blast is fired:

11. After checking the blast site, *Shotfirer* gives all clear by contacting *Blast Guards* and sounding all clear (two short sirens bursts over the radio).
12. *Shotfirer* contacts all Blast Guards to stand down.

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Blast Guards to positions.
All radio communication to be carried out on dedicated channel (TBC)

Shotfirer: "5-minute warning sirens being sounded" (5 short, over radio).
Shotfirer: "Blast Guard 1 (Name TBC), are you in position and secure."
Blast Guard 1: "Blast Guard 1 (Name TBC), I am in position, and it is secure."
Repeat as required for additional blast guards.
Note: if at any stage a Blast Guard finds the area is not secure the Shotfirer must be notified immediately.
Call over the RT "Shotfirer stop, there is a breach at position X, the area is no longer secure".
The breach must be investigated and resolved prior to resuming the procedure. Once the area is secure.
Shotfirer: "Attention all personnel, the blast exclusion zone is secure, RedBull is Firing a blast in Clevedon Quarry, please maintain radio Silence until the ALL CLEAR is given."
Shotfirer: "Sounding 30 second sirens." (3 short, over radio).
Shotfirer: "RedBull firing a Blast in Clevedon Pit in 10 seconds."
Blast is Fired.
Shotfirer: "Blast in Clevedon Quarry has been fired, Blast Guards please hold your positions and wait for all clear."
Blast clearance inspection made.
Shotfirer: "Blast in the Clevedon Quarry is ALL CLEAR, sounding all clear sirens." (2 Short, over radio).
Shotfirer: "Blast in the Clevedon Quarry is ALL CLEAR, Blast Guards thank you for your help you can stand down.".

RedBull Powder Company Blast Guard Instructions

Blast Controller:
Shotfirer:
Radio Channel:
Blast Guard Number:
Blast Guard Name:
Location:

Instructions

1. No less than 15 minutes prior to the blast contact shotfirer and confirm location.
2. No less than 5 minutes prior to the blast take your position and advise any site personnel in the area that blasting will take place.
3. Block the access at the warning siren. Do not let anyone into the blast exclusion zone.
   If not secure at any stage
   "*Blast controller, this is blast guard (number and name), blast area has been breached".*
   Blast controller will contact Blast Guard:
   "*Blast Guard (number and name) are you in position and secure".*
   Blast Guard, if secure:
   "*Blast controller, this is blast guard (number and name), I am in position, and it is secure*."
   Note: If blast area breached, Blast controller to identify issue and procedure does not proceed until the area is secure.
4. Maintain your position and keep access blocked until the blast all clear has been given. Acknowledge all clear via radio call in blast Guard order (1,2 ,3 etc).

13.6 Appendix F: Safety Data Sheets

13.6.1 ANFO
13.6.2 RedStar Bulk Emulsion (Gassed in blast hole)
13.6.3 Ammonium Nitrate Emulsion (Matrix in MPU)
13.6.4 Ammonium Nitrate (Prill in MPU)
13.6.5 Gasser 1 – Acetic Acid
13.6.6 Gasser 2 – NOS Oxidiser
13.6.7 Packaged Emulsion
13.6.8 Cast Boosters (without Detonators)
13.6.9 Electronic Detonators

Hard copies or soft copies of all SDSs to be provided on request.