GROUNDWORK plus

CORAKI QUARRY
BLAST MANAGEMENT PLAN

Prepared for:
Quarry Solutions Pty Ltd

Date:
November 2017

Reference:
1837.610.005v3

Document Control

Project/ Report Details

Document Title:	Coraki Quarry Blast Management Plan
Principal Author:	Clayton Hill
Client:	Quarry Solutions Pty Ltd
Ref. No.	1837.610.005v3

Document Status

Issue	Description	Date	Author	Reviewer
1	Blast Management Plan	September 2016	C. Hill	J. Lawler
2	Updated to support and manage Principal Hazard of Explosives	March 2017	C. Hill	J. Rowe
3	Update following DP&E comments	November 2017	C. Hill	J. Rowe

Distribution Record

Recipient	
Quarry Solutions Pty Ltd	1E

Groundwork Plus ABN: 13 609 422 791

Queensland
6 Mayneview Street, Milton Qld 4064
PO Box 1779, Milton BC, Qld 4064
P: +61 7 3871 0411
F: +61 7 3367 3317

South Australia
2/1 First Street, Nuriootpa SA 5355
PO Box 854, Nuriootpa SA 5355
P: +61 8 8562 4158

E: info@groundwork.com.au

Table of Contents

Table of Contents

TABLES

DIAGRAMS

FIGURES

Table of Contents

ATTACHMENTS

1. Introduction

Quarry Solutions Pty Ltd (a wholly owned subsidiary company of SEE Civil Pty Ltd) have engaged Groundwork Plus to develop a Blast Management Plan (BMP) for their new Coraki Quarry (the 'Site'), to be compliant with Australian Standard AS2187.2 Explosives Storage, Transport and Use – Part 2 Use of Explosives (AS2187.2) and NSW Planning & Environment Development Consent (SSD 7036).

This BMP has been developed to reduce the potential for safety breaches and/or incidents, and to minimise environmental impacts that may result from the drilling and blasting activities that are to be undertaken at the Coraki Quarry operation. The BMP forms part of the Site's Environmental Management System (EMS) and as such should be read in conjunction with the EMS and associated management plans.

The site is located immediately adjacent to an existing hard-rock quarry (Petersons Quarry) at Seelems Road and Petersons Quarry Road, Coraki, New South Wales (NSW). The site is located approximately 2.5km to the north-west of Coraki, on the Far North Coast of NSW, on property described as comprising Lot 401 DP633427, Lots 402 and 403 DP 802985, Lot 408 DP 1166287, Lot A DP397946, Lot A DP389418, Lot 3 DP701197, Lot 2 DP954593, Lot 1 DP954592, Lot 1 DP310756 and Lot 1 DP1165893.

Whilst operating in conjunction with the pre-existing Petersons Quarry (owned by Richmond Valley Council, and currently operated under lease by Quarry Solutions), and sharing some supporting infrastructure, the Coraki Quarry operations are approved and conditioned under a separate planning consent. The new quarry is to be developed and operated primarily for the supply of construction materials required for the Pacific Highway upgrade works. The planning consent is valid for a maximum of seven (7) years, to 30 June 2023.

The Coraki Quarry development is therefore designated as a project, and is classified as a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011.

The resource is generally described as comprising a basalt flow of varying thickness, typically from 12-20m. The proposed extraction area represents a mafic magma extrusion overlying sandstone. The basalt rock is considered to be homogenous with faint flow lineations expressed by constituent plagioclase laths which compose the rock's ground mass. Exhibiting some degrees of near surface weathering, the body of the rock is highly competent with columnar jointing and overlying agglomeritic basalt grading sharply to the superficial lithosols and residual soils observed at the surface.

The resource has been defined by investigative drilling, and rock samples have been collected, analysed and classified as being suitable for the production of high quality construction materials (aggregates and crushed rock).

This BMP is prepared and submitted (to the Office of Environment and Heritage) in accordance with Environmental Performance Condition 11 (refer to Schedule 3 of the Development Consent), which states:

11. The Applicant must prepare a Blast Management Plan for the development to the satisfaction of the Secretary. This plan must:
    (a) be submitted to the Secretary for approval within 6 months of the date of this consent, or prior to the commencement of blasting, whichever is earlier, unless otherwise agreed by the Secretary;
    (b) describe the measures that would be implemented to ensure compliance with the blast criteria and operating conditions of this consent;
    (c) include measures to manage flyrock;
    (d) include a monitoring program for evaluating and reporting on compliance with the blasting criteria in this consent;
    (e) include community notification procedures for the blasting schedule; and
    (f) include a protocol for investigating and responding to complaints.

    The Applicant must implement the approved management plan as approved from time to time by the Secretary.

2. Performance Criteria

The main objectives in the development and implementation of the BMP are to:

- Ensure that drill and blast activities conducted on the site minimise any risk of injury to any site employee or contractor.
- Protect the neighbouring properties and general public. Environmental Performance Condition 10 of Development Consent SSD 7036, Schedule 3 states:

  During blasting operations, the Applicant must:

  a) implement best practice management to:
    - protect the safety of people and livestock in the areas surrounding blasting operations;
    - protect public or private infrastructure/property in the surrounding area from damage from blasting operations;
    - minimise the dust and fume emissions of blasting.
- Ensure that all environmental impacts of drilling and blasting activities inclusive of the following are kept to within industry standards and compliance parameters, refer to Table 1 – Airblast Overpressure and Ground Vibration Limits below.

Table 1 – Airblast Overpressure and Ground Vibration Limits

Receiver	Airblast Overpressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance
Any residence on privately-owned land	120	10	0%
	115	5	5% of the total number of blasts over a period of 12 months

Note: Table 1: Airblast Overpressure and Ground Vibration Limits are taken from Development Consent SSD 7036, Schedule 3, Environmental Performance Condition 8 (Table 4).

- Ensure there are no flyrock events that have the potential to cause a safety incident or accident on the Site, or to inflict damage to any machinery and/or plant, either on the site or the adjacent properties.
- Minimise any impacts that drill and blasting operations may have on the local community.
- Ensure the integrity of any house or structure is not compromised by drill and blast operations throughout the period of operation of the Site.

Blasting is permitted only between the hours of 9:00am and 3:00pm Monday to Friday. Blasting is not permitted on Saturdays, Sundays or public holidays. (Refer Development Consent SSD 7036 Schedule 3, Condition 1 (Noise) Table 1). Additionally, the frequency of blasting events has been conditioned to not more than two (2) blasts per calendar month (excluding additional blasting required in the event of a misfire, or to ensure the safety of workers on the site or other persons). Reference is made to Development Consent SSD 7036, Schedule 3, Environmental Performance Condition 9. Other operating conditions applicable to blasting at the site are noted under Development Consent SSD 7036, Schedule 3, Environmental Performance Condition 10.

Operational noise from the site is conditioned under Development Consent SSD 7036, Schedule 3, Environmental Performance Condition 4, as follows:

Noise Impact Assessment Criteria

4. The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 3 at any residence on privately-owned land.

Table 3: Noise criteria dB(A)

Receiver	dB(A) ($L_{Aeq\ (15\ min)}$	dB(A) ($L_{Aeq\ (15\ min)}$	dB(A) ($L_{Aeq\ (15\ min)}$
All privately-owned residences	35	35	35

Note: Receiver locations are shown on the figure in Appendix 3.

Noise generated by the development is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy. Appendix 4 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria. However, the noise criteria in Table 3 do not apply if the Applicant has an agreement with the relevant landowner to exceed the noise criteria, and the Applicant has advised the EPA and the Secretary in writing of the terms of this agreement.

The requirements for noise compliance are noted herewith in respect of the drilling activities to be conducted and equipment to be employed for such activities.

Operational dust from the site is conditioned under Development Consent SSD 7036, Schedule 3, Environmental Performance Condition 12, as follows:

Air Quality Impact Assessment Criteria

12. The Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not cause exceedances of the criteria in Table 5 at any residence on privately-owned land.

Table 5. Air quality criteria

Pollutant	Averaging Period	Criterion	
Particulate matter < 10µm (PM_{10})	Annual	[a,d] 30µg/m^3	
Particulate matter < 10µm (PM_{10})	24 hour	[b] 50 µg/m^3	
Total suspended particulates (TSP)	Annual	[a,d] 90µg/m^3	
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a,d] 4 g/m^2/month

Notes for Table 5:
a. Cumulative impact (ie increase in concentrations due to the development plus background concentrations due to all other sources).
b. Incremental impact (ie incremental increase in concentrations due to the development with zero allowable exceedances of the criteria over the life of the development).
c. Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
d. Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, or any other activity agreed to by the Secretary.
e. "Reasonable and feasible avoidance and mitigation measures" includes, but is not limited to, the operational requirements in conditions 14 and 15 to develop and implement an air quality management system that ensures operational responses to the risks of exceedance of the criteria.

The requirements for air quality compliance are noted herewith in respect of the blasting activities to be conducted and mitigation strategies to be employed for such activities.

3. Safety

Quarry Solutions are committed to the safety of its employees and any contractors that enter the Site. To ensure safe and efficient blasting on the Site, a number of blasting procedures have been developed to assist shotfirers, quarry management, contractors and employees understand the potential dangers associated with blasting. The following safety requirements will be met as part of the BMP:

3.1 Site Requirements

- All personnel that enter site must be signed in.
- All personnel will be inducted as per the site protocol.
- All personnel shall have the appropriate Personal Protective Equipment (PPE) as mandated under the Site rules, and/or may be required for the particular task to be performed.
- All company / site policies and procedures are to be adhered to whilst on the Quarry Solutions site.
- All incidents and/or accidents are to be noted and followed up immediately by Quarry Solutions management.

3.2 Responsibilities

All personnel that undertake work in a designated drill and blast area must be sufficiently trained in the relevant area of expertise, inclusive of the following:

3.2.1 Quarry Manager

- The Quarry Manager has overall responsibility for ensuring safety procedures and protocols are being adhered to on the site, including the BMP.
- It is the role of the Quarry Manager to ensure that the driller and blasting crews have the appropriate training and qualifications applicable to their tasks and area of work, so as to not expose themselves or other contractors and/or employees to unacceptable risk. A copy of security clearances and licences are to be kept for all persons involved in the handling and use of explosives onsite. An audit of security clearances and licences is to be undertaken as part of the Site Explosives and Blasting Risk Assessment refer Attachment 3 – Site Explosives and Blasting Risk Assessment.
- Provide resources to assist drill and blast personnel to operate in a safe manner.
- Review and sign-off on the design, drilling and firing of any blast to be undertaken on site.

3.2.2 Driller

- The driller is to be experienced with drilling operations / equipment, and have a sound knowledge of working at an extractive operation (hard rock quarry).
- The driller is to correctly interpret and drill the shot plan accurately. If he/she has any concerns regarding the shot plan, the matter is to be raised and discussed with the Quarry Manager and shotfirer.
- The driller is to undertake necessary risk assessments prior to the start of work, consistent with the site's procedures. This may include the installation of edge marking / protection systems prior to the commencement of drilling.
- The driller is to drill the specified diameter hole/s to the correct depth and angle, as per the drilling plan, including any specified sub-drill.
- The driller is to record all required hole data onto the Drillers Report, inclusive of cavities that are present, clays or any other data that will assist the shotfirer when designing the initiation plan and loading the shot.

3.2.3 Shotfirer

- Undertake risk assessments prior to profiling and/or surveying the face of a blast.
- Undertake an assessment to evaluate the predicted ground vibration and airblast overpressure, from the firing of a blast, prior to designing the drilling and initiation plan, to ensure compliance with the Development Consent Conditions, AS2187.2. The historic airblast overpressure and ground vibration monitoring results will assist in assessing predicted measurements from the blasting activity.
- Provide a Drilling Plan, initiation design, vibration and airblast overpressure estimations, MIC, total explosive estimations and any other relevant data to the Quarry Manager.

- Prepare a drill plan that highlights drill depth, angle, location, diameter and azimuth.
- Maintain security of the site whilst any Mobile Mixing Unit (MMU) is on site.
- Supervise all personnel whilst on-bench loading of the shot.
- Supervise the MMU operator in manoeuvring the truck onto the bench.
- Implement procedures for blasting.
- Ensure all records inclusive of the following are maintained and kept on site:
  - Drilling Plan inclusive of drill angle, depth, location, diameter and azimuth
  - Loading Plan
  - Maximum Instantaneous Charge (MIC) used in design and preparation of the blast
  - Drilling log
  - Loading plan inclusive of kilograms loaded into each hole
  - Date of blast
  - Time of blast
  - Burden and Spacing designed
  - Blast Identification or number
  - Explosives used and quantities
  - Environmental reports including vibration and air over pressure readings
  - Community feedback if any
  - Number of holes drilled and fired
  - Number of holes deleted (if any) from the original drilling plan
  - Reconciliation of Initiating and Heavy Explosives used (Detonators and Primers)
  - Tonnes of rock blasted
  - Copy of initiation pattern
  - Bench Height
  - Density of the rock
  - Actual MIC
  - Environmental and/or weather readings (if any)
  - Blast holes checked prior to loading for deviation on the front row and record if any water is present in the blasthole
  - Check the face of the blast to assess any variances or anomalies in geology (e.g. cracks, voids, undercuts, etc) that constitute a zone of weakness that may necessitate a hole/s to be deck charged to minimise the chance of energy displacement through the zone of weakness, which may add to the airblast overpressure reading or contribute to a potential fly rock incident
  - Ensure that trained sentry guards are in place with 2–way radio communication with shotfirer when preparing the site for blasting.

3.3 Emergency Procedure

In the event of an emergency please refer to Coraki Quarry Emergency Procedure, included as Attachment 1 – Emergency Procedures.

3.3.1 Explosives Incidents

Incidents related to loss, theft, suspicious activity that threatens security, or serious incidents involving explosives or explosive precursors at mines must be reported under the Explosives Regulation 2013.

A licence holder under the Explosives Act 2003 must immediately notify NSW Mine Safety of the loss, theft—including attempted theft or any suspicious activity that threatens security—of explosives or explosive precursors at a mine. Notification must also be made to other relevant authorities, including NSW Police and SafeWork NSW.

A licence holder under the Explosives Act 2003 must notify NSW Mine Safety of any serious incident involving the handling of any explosives or explosive precursors at a mine. Notification is not required for a serious incident involving explosives or explosive precursors the incident has been notified under the Work Health and Safety (Mines and Petroleum Sites) Act 2013.

In addition to the Site's Emergency Procedure, if theft, attempted theft, loss, suspicious activity that threatens security or a serious incident involving explosives or explosive precursors occurs onsite, the Quarry Manager or delegate must take the following action:

- notify NSW Mine Safety immediately by calling 1300 814 609 (24 hours a day, 7 days a week)
- provide further details to NSW Mine Safety using the notification form http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health/notifications/incident-or-injury
- preserve the area within a 4-metre radius of where the serious incident occurred
- not use, interfere or disturb the place(s) affected by the serious incident for a period of 36 hours after NSW Mine Safety has been notified.

However, the above requirements do not prevent any action:

- to help or remove a trapped or injured person, or to remove a body
- to avoid injury to a person
- to avoid damage to property
- for the purpose of any police investigation
- in accordance with a direction or permission of an inspector.

Other authorities must also be contacted

- SafeWork NSW – Ph: 13 10 50
- Police – Ph: 000 (Triple Zero)

3.4 Lightning

Lightning can pose a significant risk when loading and firing a shot, especially if the lead-in line and/or surface and downhole detonators are exposed. Due to the potential high risk of lightning affecting a blasting event, a Lightning Procedure has been developed and can be viewed in Attachment 2 – Thunderstorm and Lightning Safe Work Procedure.

If an electrical storm is approaching during loading, the site must be evacuated to the clearance distances outlined in Section 3.5.4 of this document and the blast guards established until the Shotfirer give the all clear for the weather event passing.

3.5 Exclusion Zone

It is important to understand safe exclusion zones when undertaking the blasting task to ensure safety to all plant, equipment, employees and contractors of the site. Exclusion zones within a quarry operation are developed as rock ejection (flyrock) is a possibility when the initiation of a blast is conducted. The chemical reaction of the explosives together with the geology of the rock can alter from blast to blast. The three (3) main sources of potential flyrock are highlighted below.

3.5.1 Cratering

Cratering occurs when the burden above the explosive column has either been weakened through previous blast occurrences, or there is weak / fractured geology. Subgrade damage can be caused previous blasting, and/or excessive subgrade drilling. Due to the above, energy (in the form of rapidly expanding gasses) from the explosives used has the potential to escape through the top of the blasthole causing flyrock to be ejected in a vertical or near vertical motion into the atmosphere. This occurrence will also potentially escalate the airblast monitor readings. To minimise cratering it is important to use a competent stemming material (aggregate) to lock in the explosives and use all of the chemical energy to fragment the rock.

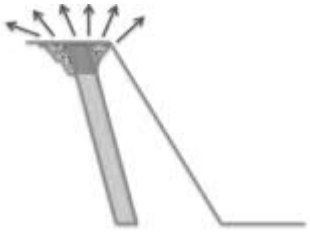


Diagram 1 – Cratering

3.5.2 Rifling

Rifling occurs when there is insufficient or poor quality stemming used in the drillhole on top of the explosive column, or if there is insufficient burden available to confine the chemical energy generated from the explosive. To minimise the chance of rifling occurring, the use of competent stemming (aggregate) is important, together with ensuring adherence to the intended hole charge weight and design stemming depth for the blasthole.

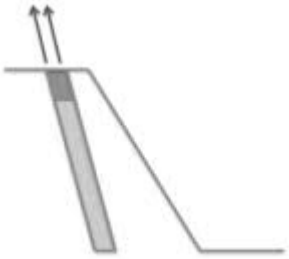


Diagram 2 – Rifling

3.5.3 Face Bursting

Face burst is encountered either when insufficient burden parameters are in place, or when the explosive energy encounters a zone of weakness (fault or crack) in the geology of the rockmass. It is important to visually recheck the face prior to loading to ensure there is no apparent cracking or displacement of the rock burden in front of a blasthole that has occurred since face survey and/or drilling. If any such anomaly is noticed, it is recommended to review the blast design, and reduce the charge weights at the affected holes. Boretracking the front row holes for all blasts is recommended to confirm the hole positioning and angle is within design tolerance, and the burden is sufficient to minimise the potential of face burst occurring.

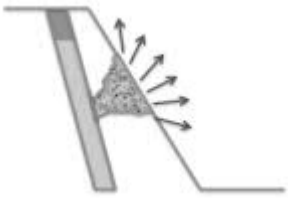


Diagram 3 – Face Bursting

3.5.4 Safe Clearance Distances and Sentry Blast Guarding

Safe clearance distances are calculated based on a site-by-site and blast-by-blast evaluation. Blast It Global undertook a flyrock assessment within the Coraki Quarry Proposed Blast Parameters Evaluation report dated 10 September 2015, included in the Environmental Impact Statement. This flyrock assessment was based on the Scaled Depth of Burial (SDoB) method which indicated that the proposed Factor of Safety (FOS) of 4.0 should be applied. This FOS was based on proposed design data. Since commencing operations, including within the exiting Petersons Quarry, Quarry Solutions have been collecting data from blasting activities including charge weights, face burdens, explosive types, ground conditions and stemming heights which will inform a future site specific assessment and review of the proposed Blast Exclusion Zone (BEZ).

Blast It Global modelled a worst case scenario using the equations documented in the "Flyrock Assessment" section of the Coraki Quarry Proposed Blast Parameters Evaluation report dated 10 September 2015. A flyrock constant (K) of 27 was used in all calculations to maximise the factor of safety in the absence of any site data. Where the SDoB is greater than 1.3 the "Maximum Horizontal Distance Crater" value was not used. Calculated worse case flyrock projection distances from the Blast It Global report are provided below:

Table 6: Calculated worse case flyrock projection distances (Blast It Global)

Hole Diameter (mm)	89	102
Bench Height (m)	12	12
Face Burden (m)	2.8	3.2
Burden (m)	2.6	3.0
Spacing (m)	3.0	3.4
Stemming (m)	2.3	2.5
Subdrill (m)	0.5	0.7
Insert Deck Length (m)	0	0
Explosive Density (g/cm3)	1.05	1.05
Charge Weight (kg)	67	88
Max Horizontal Distance Face Burst (m)	76	89
Max Horizontal Distance Cratering (m)	104	119
Max Horizontal Distance Stem Ejection (m)	52	60
SDoB	1.5	1.44

To determine the blast exclusion zone (BEZ), Blast It Global recommended a factor of safety be applied to the values in Table 6 of the report. A minimum factor of safety of 4.0 is recommended for the human clearance distance, which will form the BEZ distance. Figure 2 – Blast Area and Exclusion Zones shows the recommended BEZ equating to 334m. The BEZ distance is dependent on the blast parameters that are being used. If charge weights, face burdens, explosive types, ground conditions or stemming heights change significantly, the BEZ distance should be adjusted to suit. The factor of safety is only a recommended minimum. It is suggested that a risk assessment be conducted, using experienced blasting and quarrying personnel, prior to assigning a site specific factor of safety.

Developing benches with faces orientated away from infrastructure, neighbouring properties, public infrastructure and open space can significantly reduce the risk associated with flyrock. Quarry Solutions have well established systems and procedures to calculate, monitor and evaluate blasting plans and procedures to ensure no flyrock events occur.

3.6 Blast Fume Management

Blast fumes are the gases generated throughout the chemical reaction following initiation of explosives. Some of the gases are potentially toxic and some of the gases are non-toxic. Those gases that can be of risk to health are:

- Oxides of Nitrogen (NO_X)
- Nitrogen Oxide (NO_2)
- Nitric Oxide (NO).

Nitrogen Oxide is the plume sometimes seen following a blast, and is generally a red / orange colour. Generation of this gas can usually be attributed to incorrect sensitising of the explosive ("over gassing"), or having an excess of diesel in the mix of ANFO or ANFO/Emulsion products. The main risk to health is that of lung inflammation or (pulmonary oedema) which can take effect several hours after the blasting event.

Other health effects may include:

- Dizziness
- Headache
- Eye, nose and throat irritation
- Shortness of breath
- Wheezing or exacerbation of asthma.

To reduce the potential for ill effects, it is important to abide by all blast safety procedures. Procedures indicate that a mandatory five (5) minutes wait-time is to apply from the time of initiation before the shotfirer is to enter the blast zone to inspect for misfires. This five (5) minute period is to be adhered to for nonel and electronic initiation blasts taking place. Adhering to this procedure will dramatically reduce any risk of operators being affected by blast fumes associated with blasting.

3.7 Relevant Legislation

The relevant legislation that is to be adhered to at all times whilst drill and blast practises are undertaken on the Quarry Solutions Coraki Quarry site includes:

- Explosives Act 2003 No. 39 (NSW)
- Explosive Regulation 2013 (NSW)
- Work Health and Safety (Mines and Petroleum Sites) Act 2013 No. 54 (NSW)
- Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (NSW).

3.8 Bench and Crest Protection

It is important that only authorised personnel have access to the bench being prepared for blasting. Some key processes and procedures that are to be implemented include:

- Signage and physical barriers are to be in place
- Maintain 2m exclusion zone from the crest line
- Never turn back to the crest whilst loading a shot
- Only diesel fuelled vehicles are to be permitted on the bench where a shot is being prepared and loaded.

3.8.1 Appropriate Signage

Appropriate signage signifying that an exposed face or unprotected edge is present must be highlighted so that all staff and contractors are aware of the potential for danger. A physical bund / barrier is to be erected to separate the bench about to be loaded from all other quarry equipment and personnel. This may come by way of bunting or by placing a bund (earth or quarry product) to restrict vehicles and/or personnel having access to the bench.

3.8.2 2 metre Exclusion Zone from Crest

Before the drilling of blastholes commences, a 2m exclusion zone is to be marked out from the crest line of the bench and a physical barrier installed on this 2m exclusion line, which should remain in place until after the shot is loaded. The physical barrier consists of steel posts placed 500mm into the bench with two (2) steel wire ropes with sheathing installed at the top and middle of the posts to provide for a physical barrier with structural capability to the 2m exclusion zone.

This minimises the risk of drill and blast personnel having an incident or accident involving falling from height. Production benches are to be typically 10-18m at Coraki Quarry, and a fall from this height could be fatal. No personnel are authorised to access the 2m exclusion area unless approval is provided by the Quarry Manager and appropriate risk assessment and controls are put into place.

3.8.3 Training of Operators

The shotfirer and Quarry Manager will ensure that all contractors and employees are aware of, and understand, the work-plan and procedures for blasting on the nominated days. Pre-start and pre-blast (“toolbox”) talks on the day are recommended to communicate the specifics of the work-plan, and thereby eliminate potential for confusion, and the risk of a procedural error occurring.

4. Development Consent Conditions

The following Conditions form part of the Development Consent (SSD 7036) for the Coraki Quarry site, as issued by NSW Dept. Planning and Environment on 18/04/2016. The objectives of the Conditions are to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the development.

Blasting is permitted only between the hours of 9:00am and 3:00pm Monday to Friday. Blasting is not permitted on Saturdays, Sundays or public holidays. (Ref SSD 7036 Schedule 3, Condition 1 (Noise) Table 1).

BLASTING

Blasting Criteria

8. The Applicant must ensure that blasting associated with the development does not cause any exceedance of the criteria in Table 4.

   Table 4: Blasting criteria

Receiver	Airblast Overpressure (dB(Lin Peak))	Ground Vibration (mm/s)	Allowable Exceedance
Any residence on privately-owned land	120	10	0%
	115	5	5% of the total number of blasts over a period of 12 months

   However, these criteria do not apply if the Applicant has a written agreement with the relevant owner to exceed the limits in Table 4, and the Applicant has advised the Department in writing of the terms of this agreement.

Blasting Frequency

9. The Applicant may carry out a maximum of 2 blasts per calendar month, unless with the prior approval of the Secretary or unless an additional blast is required following a blast misfire. This condition does not apply to blasts required to ensure the safety of workers on site or other persons. Note: For the purposes of this condition a blast refers to a single blast event, which may involve a number of individual blasts fired in quick succession in a discrete area of the quarry.

Operating Conditions

10. During blasting operations, the Applicant must:

    (a) implement best practice management to:
    - protect the safety of people and livestock in the areas surrounding blasting operations;
    - protect public or private infrastructure/property in the surrounding area from damage from blasting operations;
    - minimise the dust and fume emissions of blasting;

    (b) operate a suitable system to enable the local community to get up-to-date information on the proposed blasting schedule for the development;

    (c) obtain agreement with any private land owner affected by blast exclusion zones that are required to manage flyrock; and

    (d) carry out regular monitoring to determine whether the development is complying with the relevant conditions of this consent, to the satisfaction of the Secretary.

Blast Management Plan

11. The Applicant must prepare a Blast Management Plan for the development to the satisfaction of the Secretary. This plan must:

    (a) be submitted to the Secretary for approval within 6 months of the date of this consent, or prior to the commencement of blasting, whichever is earlier, unless otherwise agreed by the Secretary;

    (b) describe the measures that would be implemented to ensure compliance with the blast criteria and operating conditions of this consent;

    (c) include measures to manage flyrock;

    (d) include a monitoring program for evaluating and reporting on compliance with the blasting criteria in this consent;

    (e) include community notification procedures for the blasting schedule; and

    (f) include a protocol for investigating and responding to complaints.

    The Applicant must implement the approved management plan as approved from time to time by the Secretary.

Operational noise from the site is conditioned under Development Consent SSD 7036, Schedule 3, Environmental Performance Condition 4, as follows:

NOISE

Noise Impact Assessment Criteria

4. The Applicant must ensure that the noise generated by the development does not exceed the criteria in Table 3 at any residence on privately-owned land.

    Table 3: Noise criteria dB(A)

Receiver	Day dB(A) ($L_{Aeq\ (15\ min)}$)	Evening dB(A) ($L_{Aeq\ (15\ min)}$)	Night dB(A) ($L_{Aeq\ (15\ min)}$)
All privately-owned residences	35	35	35

Note: Receiver locations are shown on the figure in Appendix 3.

Noise generated by the development is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy. Appendix 4 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, the noise criteria in Table 3 do not apply if the Applicant has an agreement with the relevant landowner to exceed the noise criteria, and the Applicant has advised the EPA and the Secretary in writing of the terms of this agreement.

5. Adjacent Infrastructure and Neighbours

The development of Coraki Quarry will closely interface with the pre-existing developments associated with Petersons Quarry. The new pit area will integrate with the existing Petersons pit. Shared site infrastructure will include:

- Site access road (Petersons Quarry Road)
- Internal roads / working tracks
- Weighbridge
- Offices / amenities
- Workshop, refuelling, servicing facilities
- Processing plant
- Overhead Power Lines.

The Blast Exclusion Zone (BEZ) and access control points will take into account these existing facilities. The BEZ will be determined for each blast by the shotfirer and implemented by the Quarry Manager and documented in the Shot Plan. The proposed (minimum) BEZ will include establishment of sentry guards at the Petersons Quarry Road entrance to the site and also at the internal quarry access road from the weighbridge to the pit. Additional sentry points will be established depending on the location, size and timing of the blast by the shotfirer as part of the Shot Plan. In the course of development and integration of the Coraki Quarry pit workings, amendments to the generic BEZ may be required from time to time and/or on a case-by-case basis. In particular amendment will be required in the event of the access by Seelems Road being activated.

Neighbouring residences, and an adjoining industrial zone, are the identified potential sensitive receptors. Residences R1 to R9 have been identified under the impacts evaluation conducted for the Environmental Impact Statement (EIS). The Development Consent requires Quarry Solutions to provide the local community with up-to-date information on the quarry blasting activities and blast schedule.

Of the nine (9) neighbouring residences, three (3) were identified as being the most likely sensitive receptors:

- 140 Newmans Road, Coraki (Lot 4 DP6339), residential dwelling, 335m from the closest extraction limit
- 200 Lagoon Road, Coraki (Lot 12 DP6339), residential dwelling, 595m from the closest extraction limit
- 95 Spring Hill Road, Coraki (Lot 12 DP714770), residential dwelling, 820m from the closest extraction limit.

If any of the nine (9) neighbouring residences are located within the BEZ, landowner agreements will be obtained prior to blasting occurring. These residences, R1 to R9 will be notified by the Quarry Manager of upcoming blasts and blasting schedule in accordance with each landowner agreement. These neighbouring residents will be provided with a telephone number to contact the Quarry Manager should concerns arise as a result of blasting activities. Subject to landowner agreement, routine blast compliance monitoring will be undertaken at the closest residence.

Sensitive structures must also be considered when undertaking drill and blast activities. The Overhead Power Lines (OHL) to the north east of the pit development must be considered and a risk assessment completed prior to blasting activities in this area refer Attachment 3 – Site Explosives and Blasting Risk Assessment and Attachment 4 – Blast Specific Risk Assessment Form.

Advice may need to be sought from the energy infrastructure provider as to acceptable levels of vibration and monitoring may be required to confirm compliance. As the approved pit does not extend into the area where the OHL is present, management of blasting impacts is anticipated to be achievable.

6. Quarrying Method

The frequency, size and scale of blasting will be dependent on the demand to supply materials to the Pacific Highway upgrade project, and taking into consideration the progressive development of the quarry pit workings. As a general practice however, the intention is for the Site to undertake larger and less frequent blasts to reduce the impact on surrounding residences as opposed to smaller more frequent blasts. The size of the blast is not necessarily linked to the resultant ground vibration when appropriate design and timings are applied and therefore, there is benefit in increasing the size of each blast to reduce blasting frequency.

Blasting will be compliant with the regulatory guidelines in relation to airblast overpressure and ground vibration limits. Therefore Shot Plans are to be developed using the following criteria:

- Blasthole diameter ranging from 76mm – 102mm (but typically either 89mm). This will be dependent on the area of the pit being worked, along with the potential MIC to be used to comply with regulatory limits in regard to vibration and airblast overpressure.
- A nominal maximum blasthole length of up to 12 to 15m - this will be dependent on the quarry development plan and topography of the area that is to be quarried.
- Burden and spacing designs to be in line with industry standards - taking into account rock type/quality, and type of explosives to be used.
- MIC used will be dependent on evaluation of the distance from the blast to the nearest sensitive receptor, whilst meeting regulatory limits.
- A powder factor will be adopted to ensure that fragmentation is achieved to enable the safe and efficient loading of the rockpile onto haul trucks. Whilst fragmentation enhances crusher throughput it is also important to manage maximum lump size so that operator and machinery safety is maintained at all times.
- Where practicable, blasts and benches will be orientated away from sensitive receptors to reduce airblast overpressure impacts.

The requirement under the development approval states that no more than two (2) blasts can be fired within a calendar month (Ref SSD 7036 Schedule 3, Condition 9 (Blasting Frequency)), with a maximum extractive rate of 1,000,000 tonnes in any calendar year (Ref SSD 7036 Schedule 2, Condition 8 (Limits on Consent)).

The quarrying method is that of a conventional open cut hard-rock quarry. The general process steps are:

- Definition of the area to be worked
- Clearing of vegetation (if applicable), in accordance with regulatory conditions
- Pre-stripping of top soil (generally stockpiled on site and retained for future rehabilitation)
- Stripping of overburden/weathered rock (typically using bulldozer/excavator/haul truck)
- Preparation of quarry benches (typically involving development blasting) and establishing working roads (haul road)
- Production drill and blast
- Loading and hauling of raw feed (from quarry pit to processing plant)
- Processing (crushing and screening)
- Stockpiling and testing
- Sales load-out and despatch.

7. Drilling and Blasting Impacts

Blast firing is permitted between 9.00am – 3.00pm Monday to Friday, with no blasting activities to occur on Saturdays, Sundays or on public holidays (Ref SSD 7036 Schedule 2, Condition 1 (Noise) Table 1). Blasting outside of these hours can only be for emergency reasons or if/when a safety issue is present.

Drilling hours of operation are to align with the conditions in the Development Consent, which are specified as:

- 7.00am – 6.00pm Monday to Friday
- 8.00am – 1.00pm Saturday.

Is should be noted that the Development Consent does provide for extended operating hours, requiring written agreement with the residents (R1-R9). (Ref SSD 7036 Schedule 2, Condition 1 (Noise) Table 2).

No production activities are permitted on Sunday's or on public holidays, however maintenance activities are allowed at any time, provided no audible noise is evident at any private residence.

To understand, predict and manage the potential impacts of blasting from Coraki Quarry, a review of recent previous blasting events at Petersons Quarry, in conjunction with a prediction analysis, has been undertaken.

7.1 Blast Monitoring Data

Data has been obtained for three (3) blasts that were fired at Petersons Quarry between January and April 2016, and the vibration and airblast readings that were recorded from monitoring are summarised below in Table 2 – Blast Monitor Readings:

Table 2 – Blast Monitor Readings

Blast Date / Ref No.	Monitor Location #	Distance from blast (m)	Ground Vibration (mm/s)	Airblast (dBL)	MIC (kg)
19/02/2016 QS-PQ-008	1 (Quarry W/bridge)	500	2.052	119.2	135
	2 (Residence R2)	850	No Register	No Register	135
	3 (Residence R3)	1000	No Register	No Register	135
26/04/2016 QS-PQ-009	1 (Quarry W/bridge)	500	1.988	111.5	160
	2 (Residence R2)	850	No Register	No Register	160
	3 (Residence R3)	1000	No Register	No Register	160
28/04/2016 QS-PQ-010	1 (Quarry W/bridge)	500	1.900	111.5	160
	2 (Residence R2)	850	No Record	No Record	160
	3 (Residence R3)	1000	No Record	No Record	160

The blasthole diameter for all blasts was 89mm. The monitors were installed by Ron Southon P/L (Drill and Blast Contractor) for all blasts. The geophone trigger level was set to 0.51mm/s. Where 'No Register' is recorded in Table 2 – Blast Monitor Readings, this means that the vibration of the blast was less than 0.51mm/s and/or airblast was lower than the set trigger level.

7.2 Blast Vibration

Along with the historical monitoring data and the prediction modelling of future ground vibration and airblast overpressure, blast design and monitoring data will continue to be captured to develop a comprehensive dataset that can be used to determine and refine the site constants used for design of future blasts. The primary factors known to influence the level of ground vibration from blasting include:

- the weight of explosive per delay (and hence the MIC).
- the distance between the blastholes and the point of measurement.
- the local geological conditions and the influence of geology and topography on vibration attenuation.

7.2.1 Ground Vibration Calculation

Consistent with the recommendations of the Australian Standard, the common form of the vibration equation to predict the amplitude of ground vibration from blasting at any distance from a blast hole and is given as:

$$PPV = K\left(\frac{d}{\sqrt{w}}\right)^{-\beta}$$

Where: d is the distance between the blastholes and the point of measurement;
w is the maximum instantaneous charge weight per delay;
K and β are site specific constants.

K and β are site constants that can be determined from historical blasting data for a site. However where constants are not known, or haven't been derived, it is standard practice to use K = 1140 and β = 1.6, referenced from the Australian Standard AS2187.2-2006 Appendix J for a 50% compliance calculation. Suitably qualified persons with engineering or equivalent qualifications and experience in quarry drill and blast should be engaged to calculate ground vibration predictions.

7.2.2 Ground Vibration Prediction Calculation

Using the Australian Standard K and β constants, a prediction calculation was undertaken by a blasting specialist in the blasting impacts technical report provided with the EIS.

Based on the identified minimum distance to the closest residence, blast vibration prediction was calculated assuming a single blast hole firing scenario, which would require the blast to be limited to three rows in depth. If vibration predictions are less than 50% of the 5mm/s compliance value, then the number of blast holes firing in the 8ms time interval can be increased. The results of the vibration prediction equation are shown in Table 3 – Predicted blast vibration for proposed blast parameters (ex Blast It Global EIS Report).

Table 3 – Predicted blast vibration for proposed blast parameters (ex Blast It Global EIS Report)

Blast Scenario	Distance (m)	Hole Dia, (mm)	No Decks	Bench Height (m)	K	B	MIC (kg)	PPV (mm-s1)	Blast 1 K Value	PPV (mms-1) Using Blast 1 K
12m_89mm	335	89	1	12	1140	1.6	67	3.00	743	1.96
6m_89mm	335	89	1	6	1140	1.6	28	1.49	743	0.97
12m_102mm	335	102	1	12	1140	1.6	88	3.74	743	2.44
6m_102mm	335	102	1	6	1140	1.6	36	1.83	743	1.19

The predicted vibration levels are higher than those indicated by the monitoring data, so the site constants adopted (for the EIS report) can therefore be considered to be conservative. With further data to be collected as future blasts are undertaken, a regression analysis will be used to determine a K factor that will be appropriate for the site, and can therefore be used in predicting ground vibration with greater certainty:

- Site geology – The site is essentially a basalt flow deposit, with underlying sandstone
- Any potential interburden or ash layers that alter the rock strength / density
- Any geological structures, faults or zones of weakness.

With these facts in mind, it is essential for the site to further grow a historic database of shot monitoring analysis to gain an increased understanding of the site geology and how the energy from blasting is dispersed and affects ground vibration parameters. It is essential whilst building this vibration model to work towards the upper limits associated with the AS2187.2 Appendix J so as to limit the risk to the nearest sensitive receptors of the site.

Continual monitoring and analysis of the site ground vibration experienced at the site from blasting operations will optimise and allow the site to gain an increased knowledge of blast vibration parameters to be adopted throughout the life of the operation.

7.3 Airblast Overpressure

Along with the historical monitoring data and the prediction modelling of future ground vibration and airblast overpressure, blast design and monitoring data will continue to be captured to develop a comprehensive dataset that can be used to determine and refine the site constants used for design of future blasts. The primary key factors that influence airblast overpressure are:

- Bench height
- Stemming length and type
- Explosive density
- Weather e.g. cloud cover, temperature, wind speed and direction
- Face orientation
- Burden and spacing of blast holes
- Broken ground and cavities.

7.3.1 Airblast Overpressure Calculation

The calculation for airblast overpressure prediction is stated within Australian Standard AS2187.2 as:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

Where: P = pressure in kilopascals
Q = explosives charge mass, in kilograms
R = distance from charge, in metres
Ka = site constant
a = site exponent

Ka and a are both constants relative to the site however in the absence of a known constant, it is standard practice to use Ka in the range of 10 to 100 and a = -1.45.

The predicted airblast overpressure was calculated in the blasting impacts technical report for the EIS, adopting the proposed set of blast parameters, documented in Table 3 – Predicted blast vibration for proposed blast parameters (ex Blast It Global EIS Report). This equation does not take into account atmospheric conditions on the day, topography of the landscape between the blast and the sensitive receiver or specialised design techniques used to reduce airblast overpressure. Table 4 – Predicted airblast for proposed blast parameters (ex Blast It Global EIS Report) displays the results for the airblast overpressure modelling.

Table 4 – Predicted airblast for proposed blast parameters (ex Blast It Global EIS Report)

Blast Scenario	Distance (m)	Hole Dia, (mm)	No Decks	Bench Height (m)	MIC (kg)	Airblast Overpressure (dBL)	Blast 1 Calibration Estimation
12m_89mm	335	89	1	12	67	119	116
6m_89mm	335	89	1	6	28	116	115
12m_102mm	335	102	1	12	88	120	119
6m_102mm	335	102	1	6	36	117	116

Many factors described above can impact the resultant level of airblast experienced, which includes many environmental factors outside of the control of the quarry operations. As such, predicting airblast overpressure with high levels of accuracy can be problematic. General industry practice is to adopt best practice guidelines, together with site experience, to assist in ensuring compliance. Australian Standard 2187.2 Appendix J provides further guidance on the common factors that affect airblast overpressure and which should be considered when implementing measures to ensure compliance. Section 9.2 of the BMP outlines further control measures which may be taken with respect to airblast overpressure and mitigating disturbance and risk.

As was experienced with the Blast Vibration Prediction (Section 7.2.2) versus actual monitoring data, there is variation between predicted airblast overpressure (in the EIS report) and actual measurements in dBL. The Airblast Overpressure prediction is therefore also conservative, as the recorded levels are taken from within the site, at a distance greater than that used in the prediction modelling. The monitoring at the residences did not trigger, further reinforcing why it is important to once again build an historic blasting database that indicates what parameters are being used inclusive of the following:

- Maximum Instantaneous Charge (MIC)
- Face height
- Face burden (design and actual)
- Are any front row blastholes deck charged.

The database will act as a tool to further optimise blasting design, and create site awareness of environmental parameters to be used to comply with the site Development Consent. The designated shotfirer can refer to the database, and in time this historic knowledge will supercede the Australian Standard 2187.2 prediction evaluation models.

It is also important that the site Quarry Manager and designated shotfirer understand that other factors that need to be considered when designing and firing a shot that can affect airblast overpressure can include:

- Temperature (in particular if there is an inversion)
- Cloud cover (low depression systems)
- Wind (direction and intensity)
- Geology (fractures in the face or resource).

Continual monitoring and analysis of the site airblast overpressure experienced from blasting operations will inform and allow the site management to gain an increased knowledge of airblast overpressure parameters to be considered throughout the blast design process.

7.4 Flyrock

7.4.1 Flyrock Calculation

Flyrock poses the greatest risk when blasting close to structures, and in particular to overhead transmission power lines and offices. It is the phenomenon that is most likely to cause damage or injury.

Australian Standard 2187.2-2006 Appendix E highlights considerations for blast design to minimise the generation of flyrock. AS2187.2-2006 Appendix E (E2.1) – Contributing Factors, outlines the key contributing factors that must be considered when addressing controls to minimise the effects of flyrock and developing a safe and productive BEZ.

To assist in controlling flyrock, the amount of additional stemming will be calculated and refined during the design process. The below equation will be used to determine stemming lengths that are sufficient to prevent a significant flyrock event.

$$SD = D/W^{0.333}$$

Where:

SD = Scaled Distance ($m/kg^{0.333}$)
W = Charge weight (kg)
D = Stemming length (m)

Diagram 4 below shows the expected surface expression that results from the corresponding SD value. All designs must be designed with an SD value above 1.4 $m/kg^{0.333}$.

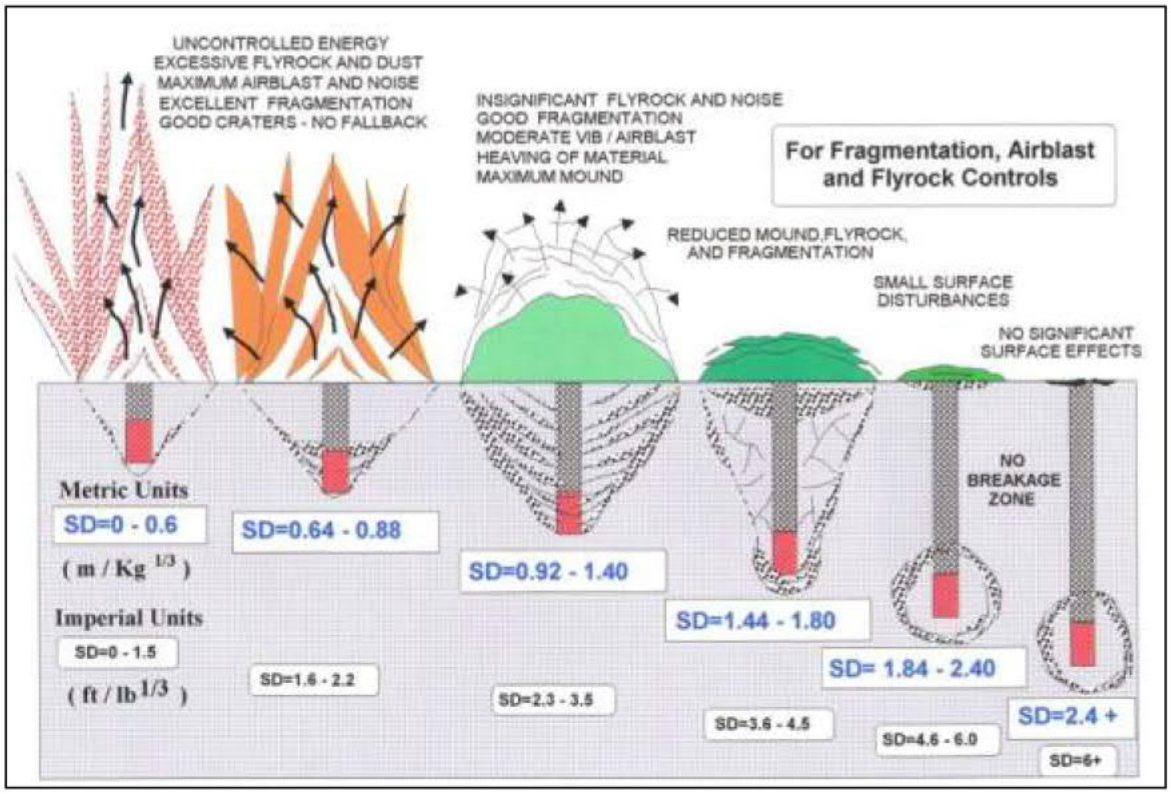


Diagram 4 – Significance of Scaled Depth of Burial (Chiappetta)

Three main equations (below) are used, developed by Richards and Moore (2004) to determine flyrock generation and safe exclusion distances. These equations were also used by Blast It Global in determining the BEZ in the EIS.

$$\text{Face burst}: L_{\max} = \frac{k^2}{g}\frac{\sqrt{m}^{2.6}}{B}$$

$$\text{Cratering}: L_{\max} = \frac{k^2}{g}\frac{\sqrt{m}^{2.6}}{l_s}$$

$$\text{Rifling}: L_{\max} = \frac{k^2}{g}\frac{\sqrt{m}^{2.6}}{l_s}\sin 2\theta_0$$

where, θ = drill hole angle, $L_{\max}$ = maximum throw (m), m = charge mass/m (kg/m); B = burden, l_s = stemming Height (m), and g = gravitational constant.

The above equations include a site constant “K”, which requires calibration to site conditions in order to improve the accuracy of the factor of safety calculation, and in some cases, improve productivity by ensuring good energy confinement. This can be achieved by measuring actual blast parameters and recording the maximum fly rock projection distance from each blast on site, thus ensuring specificity to the site’s drill and blast parameters and geology. In this case the absence of any site data dictates that a value of 27 should be used for “K” in order to maximise the factor of safety. Industry standard K values are from 13 in soft rock, to 27 in hard rocks such as granite.

8. Explosive Products

The following products are both currently used on the site (Petersons Quarry) as well as being proposed to be used on the Coraki Quarry site. The current supplier's products have been used for reference purposes within this BMP, albeit in future other and/or multiple suppliers may be engaged, and alternative products may be used in the blasting activities. It is recommended that the BMP is updated on a regular basis to highlight any changes in products used.

A copy of all of the current products used (at Petersons Quarry) and proposed for use at Coraki Quarry, and their respective Material Safety Data Sheets (MSDS) are kept on site for reference as are a copy of the of the product Technical Data Sheets.

8.1 Initiation Methods

Initiation methods proposed at Coraki Quarry will include the following:

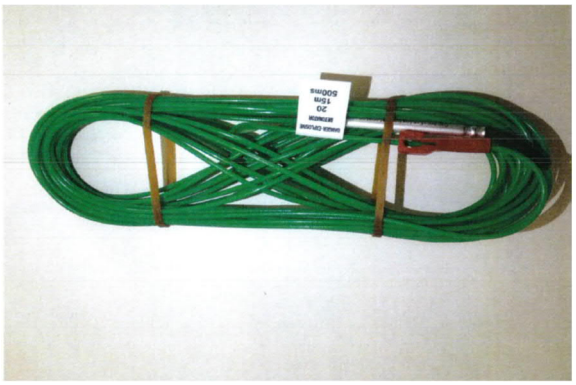
8.1.1 Non Electric (Nonel) Downhole Detonators

Nonel in-hole detonators are used to initiate the primer or booster that is located at the bottom of a single blasthole, the primer or booster then in turn initiates the bulk explosive which then releases energy and fragments the rock. Nonel detonators have standard initiating times assigned to the detonator such as 400ms (millisecond), 425ms etc.

Maxnel® MS

Description:

Maxnel® MS consist of a high energy detonator, a T-connector and a length of shock tube. The connectors make the connection with detonating cord more easily. On the tag is relay time
Maxnel® MS are in hole detonator to initiate packaged explosive. Maxnel® MS are suitable to be used in blasting operations of underground and surface mining, quarry and construction projects where no explosion hazard of marsh gas and mine



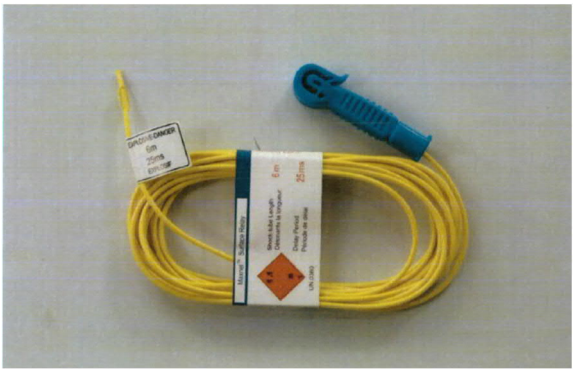
8.1.2 Non Electric (Nonel) Surface Connecting Detonators

Nonel surface connecting detonators are used to link one blast hole to another via the means of a millisecond delay. Like the downhole detonators they are set millisecond delays such as 17ms, 25ms, 42ms, 65ms and 100ms etc.

Maxnel® Surface Delays

Description

MAXNEL® Surface Delays consist of a low energy surface detonator, a C-connector and a length of shock tube. The low energy detonator is characterized by moderate initiating power and no damage to the blasting network after initiation. The connectors make the blasting network building more easily and initiating more reliable.
MAXNEL® Surface Delays are used in conjunction with MAXNEL® MS and MAXNEL® LP to form the flexible blasting network, providing the



8.1.3 Electronic Detonators

Electronic initiation systems have a computer chip located in the head of the detonator, this way more accurate and sophisticated timing delays can be programmed to ensure single hole initiation and therefore to limit the amount of explosive that is being detonated at any one time (Maximum Instantaneous Charge, or MIC).

8.1.4 Primers

Primers are used to initiate the bulk explosive and are initiated via a detonator (either Nonel or electronic).

Maxprime® Booster

Description

Maxprime® Booster are made of a high explosive composition cast into a cylindrical cardboard or plastic shell. Maxprime® Booster can be initiated by detonators or detonating cord to provide reliable initiation of pumped, augered and packaged explosives.

8.1.5 Detonating Cord

Detonating Cord can be used in applications such as pre-split blasting or smooth wall blasting in conjunction with packaged bulk explosives. Detonating cord does not have an assigned delay and is initiated using a Nonel detonator.

8.1.6 Lead in Line

Lead in line or 10P Cordtex is used in the initiation process, a plunger which is loaded with a shotgun shell is stomped on by the shotfirers foot that then sends a shock through the lead in line that is lined with a fine explosive, this lead in line is hooked into a downhole lead in the blast hole and initiates the blast.

8.2 Bulk Explosives

8.2.1 ANFO

ANFO (Ammonium Nitrate / Fuel Oil) is used as a bulk explosive, and generally transported to site as/when needed. Loading into the blasthole is done via an auger from the delivery truck (Mobile Mixing Unit or MMU), with the quantity delivered being metered (by weight). It is a product that will dissipate and degrade if comes into contact with water or significant moisture. Generally, ANFO is made up of 94% of Ammonium Nitrate and 6% Fuel/Oil (diesel).

8.2.2 Emulsion

Emulsion is a waterproof bulk explosive that is generally transported to site as/when needed. Metering and delivery of the product from the MMU to the blasthole is via pump and hose, with calibrated metering (by weight or volume) to confirm quantity delivered hole-by-hole.

WALA
Gassed Blend Series
Hard Rock Blasting Solution

Description

WALA Hard Rock are series of bulk explosive blends specifically formulated for Hard Rock blasting application based on **NanoBlok®** technology. WALA is chemically sensitised and thickened to achieve maximum water resistance. WALA may be used as a pumpable product or poured into the blast hole via augers.

8.2.3 Packaged Products

Packaged products inclusive of buster plugs and presplit product may be used on site. Plugs are used when there is a minimal amount of water in the blast hole as the product is waterproof and can be used to "plug" the water based area of the hole, then ANFO may be loaded on top. Presplit is a technique used to efficiently and safely pre blast a final wall to assist with vibration control and stability of crest lines, due to the smooth finish it leaves on the wall post blast.

9. Environmental Mitigation Measures

Control and mitigation measures will be designed into each and every blast to minimise the effect of the following impacts:

- Ground Vibration
- Airblast Overpressure (Air Blast)
- Flyrock
- Dust
- Blast Fume.

9.1 Vibration

Ground vibration generally radiates out from the blast area, and apart from distance, the rate of attenuation may also be influenced by geology and other factors. The more pronounced levels of vibration typically are directed the opposite way to which the blast is fired. Typical mitigation measures to manage and minimise vibration include:

- Designing the blast with the appropriate amount of burden. If too much burden is required to be blasted the explosive will not be able to release energy to the free face, and the blast energy and majority of the vibration will be directed behind the shot.
- Confirming the actual drilled length (depth) of each blasthole, and adjusting the depth (by backfilling) to conform with the design sub-drill depth.
- Design the blast with an initiation timing sequence that allows the rockmass to move, for instance if the front row of a blast is very slowly initiated then the rest of the blast is initiated quickly it may “choke” the blast with excessive vibration occurring as a result.
- Ensure the actual loaded charge weights conform with design, this will optimise the blast and ensure a MIC in excess of design is not initiated.
- Ensure the MMU metering is calibrated, so that it is not giving a false reading as to the amount of explosive being delivered down each blasthole.

9.2 Airblast

Airblast is a term applied to the pressure pulses in the air (often not audible) which are generated by blasts and the transfer of energy through the atmosphere. There are many factors that need to be taken into consideration to reduce airblast, they include:

- Ensure all relevant areas associated with blast activities have been properly analysed to determine scale of blasting required.
- Ensure that the blastholes are drilled to the correct positioning, angle and azimuth - as per the drilling plan which should include bore tracking of the front row of holes at a minimum.
- Ensure only exact quantity of designed explosives are loaded into each hole. This is to be measured by the MMU operator, and calibration of the weight / density of explosive (both ANFO and emulsions) are to take place prior to loading the first blasthole.
- All blasts are to have airblast overpressure monitors in place at specified locations to record and confirm that disturbance levels experienced are at or below design, and within regulatory limits.
- All blasts designed with a minimum uncharged collar length (stemming depth).
- The angle of the face adjacent to the front row blastholes, or any other exposed vertical face, are assessed using face profiling and bore tracking to confirm that the distance or burden to the free face is sufficient to eliminate face bursting and the resulting high overpressure levels.
- Minimum face burdens dimensions are to be as follows:

Hole Dia. (mm)	Minimum Face Burden (m) ANFO	Minimum Face Burden (m) HANFO (1.1)	Minimum Face Burden (m) Emulsion (1.1)
89	2.4	2.8	2.8
102	2.7	3.2	3.2

- Appropriately sized, shaped and type of stemming material is used.

- Checking the face prior to loading the shot. If any (new) voids or cracks are visible it may be necessary to deck charge through this area to limit the amount of energy being displaced throughout blasting process.

9.3 Flyrock and Exclusion Zones

Flyrock is the term used when rock is ejected into the air in an uncontrolled manner, typically due to the explosive energy released being too high for the rockmass to be blasted.

Flyrock may eject from the face, or from the bench surface in a vertical / near vertical direction (which can include behind the blast – please refer to mechanisms described under Section 3.5 of this BMP) endangering personnel and machinery on / near the quarry site. Mitigation measures to ensure the potential for flyrock is minimised include:

- Ensuring a minimum uncharged collar length equal to that recommended in the Australian Standard AS2187.2 applied to all blastholes
- Ensuring all blasts are face profiled, surveyed and the front row of holes bore tracked to ensure air blast overpressure compliance, combined with the ability to control face burst that can cause flyrock
- Ensuring that all design criteria are measured, documented and adhered to
- Ensuring that drill holes are drilled to the correct angle and azimuth as per the drilling plan
- Ensuring that face burdens are sufficient enough to eliminate flyrock
- Using appropriate stemming material. Recommended stemming material includes:
  - Up to and including 102mm dia. blastholes - use 10mm crushed aggregate.

For each blast, the BEZ is to be determined by the shotfirer in the Shot Plan and confirmed and agreed with the Quarry Manager. Sentry guard points are to be located outside of the BEZ.

9.4 Dust

Dust and particulate matter resultant of drilling and blasting activities has the potential to create nuisance and occupational health impacts to both workers and the surrounding environment. Activities related to blasting which have the potential to cause an impact include:

- Bench preparation
- Drilling
- Blasting
- Muckpile (blasted material) extraction.

Strategies and mitigation measures which may be employed for the management of dust and particulate emissions related to blasting activities include but are not limited to:

- Dampening down the bench prior to clearing and preparation activities
- Ensuring the rock drill has an appropriate dust extraction system with collector fitted to the rig and/or watering system via water sprays
- Blasting during favourable weather conditions
- Dampening down of the shot and muckpile.

9.5 Blast Fume Management

Blast fumes are the gases generated throughout the chemical reaction following initiation of explosives. Some of the gases are potentially toxic and some of the gases are non-toxic. Those gases that can be of risk to health are:

- Oxides of Nitrogen (NO_X)
- Nitrogen Oxide (NO_2)
- Nitric Oxide (NO).

Nitrogen Oxide is the plume sometimes seen following a blast, and is generally a red / orange colour. Generation of this gas can usually be attributed to incorrect sensitising of the explosive ("over gassing"), or having an excess of diesel in the mix of ANFO or ANFO/Emulsion products. The main risk to health is that of lung inflammation or (pulmonary oedema) which can take effect several hours after the blasting event.

Other health effects may include:

- Dizziness
- Headache
- Eye, nose and throat irritation
- Shortness of breath
- Wheezing or exacerbation of asthma.

To reduce the potential for ill effects, it is important to abide by all blast safety procedures. Procedures indicate that a mandatory five (5) minutes wait-time is to apply from the time of initiation before the shotfirer is to enter the blast zone to inspect for misfires. This five (5) minute period is to be adhered to for nonel and electronic initiation blasts taking place. Blasting should also be undertaken during favourable weather conditions and not during period of high wind. Adhering to this procedure will dramatically reduce any risk of operators being affected by blast fumes associated with blasting.

10. Blasting Activities

10.1 Pre-Blast Activities

Prior to undertaking drilling and blasting activities at Coraki Quarry, the following actions will be completed:

- Planned blasting area selected after discussions with the Quarry Manager and/or supervisor as per the quarry development plan.
- Notification issued to the drill and blast contractor of the requirement to prepare and design the blast pattern.
- Preliminary review assessing the expected maximum explosive quantities for control of ground vibration and airblast overpressure.
- Risk assessment completed for the site annually or following changes to drill and blast practices refer Attachment 3 – Site Explosives and Blasting Risk Assessment.
- Blast specific risk assessment (refer Attachment 4 – Blast Specific Risk Assessment Form) prior to the shot mark-out to ensure the potential outcomes and risk are assessed, and considered to be within acceptable ranges.

10.2 Preparation of Drilling Area

The area where blasting will be undertaken will be prepared to a condition to enable accurate survey and drilling. Areas for drilling will be determined in advance of the drilling and delineated by a 2m spray paint line around the blast area.

The planned blasting area, including the free-face, will be surveyed using laser profiling equipment to ensure the burden distance between the front row blasthole/s and the free face is adequate to control the level of airblast overpressure and manage the potential for generation of flyrock. The profiling will typically be completed by the drill and blast contractor, and the results supplied to Quarry Solutions site management as part of the blast planning and reporting process.

10.3 Design and Layout of Blastholes

Drilling of blastholes will be completed using mechanical drilling equipment (drilling rig), supplied and operated by appropriately trained and qualified contractors. Key issues and considerations include:

- The driller must follow the designed drilling pattern, including blast hole depths, and record the information on a blast pattern design log / worksheet.
- The blasthole burden and spacing will be measured as accurately as possible.
- The drill log data will be examined for any irregularities and where appropriate, incorporated into the blast design.
- The quantity of explosive which is to be loaded into each blast hole will be identified and clearly marked on the blast loading plan.
- The total quantity of explosive used will be measured and reconciled against the designed quantity.

The distance to the nearest neighbouring property / residence, or other identified sensitive receptor, will be assessed to confirm that the expected level of airblast overpressure and ground vibration will be compliant with regulatory limits.

10.4 Blasthole Drilling

The driller must operate the machine (drilling rig) in a safe and efficient manner, and in accordance with the manufacturer's recommendations and operating procedures. The equipment deployed at Coraki Quarry shall conform to the environmental noise limits specified in the Development Consent.

Machine operating parameters and settings should be such that blasthole accuracy (deviation) can be adequately controlled to ensure compliance with the drill plan.

Prior to commencement of the pattern drilling, a series of short "stab" holes will be drilled across the front of the blast area to permit barricading to provide a safe working area.

On the completion of drilling each blasthole, or group of blastholes, the driller will measure and confirm the depth of the hole/s and, if within tolerance, plug the collar of the hole. Variation in the depth, redrilled holes or other amendments will be marked on the drilling log sheet. The as-drilled inclination of the front row of blastholes will be measured (using "boretracking" procedures) to ensure the drilling meets specified accuracy. Any holes that may have been over-drilled (i.e. are too deep), will be backfilled in accordance with the design sub-drill. Blastholes outside of tolerance will be redrilled, or excluded from loading.

10.5 Transport and Storage of Explosives

Transport and storage of explosives for all blasting activities will be defined by the contractor's procedures and in accordance with the (NSW) Explosives Act 2003 No. 39, and Regulation 2013. The quantity of explosive and detonators will be transported on the day of the blast from the contractor's magazines in approved vehicles. Any unused explosive will be immediately returned to the magazine at the completion of loading. The blasting contractor will be responsible for all explosive transport and storage requirements.

10.6 Priming and Loading the Blast

Priming and loading of blastholes will be completed by the blast contractor. The following key issues and considerations will be included as part of the priming and loading methods:

- Prior to priming a blasthole, the shot firer will confirm the depth of the blasthole is consistent with the depth indicated on the blasting plan depth. The measured depth will be recorded on the blasthole loading plan
- If a short hole is encountered, the shot firer will ensure the depth is adequate to eliminate the possibility of flyrock, or otherwise the blasthole will either not be loaded, or the design adjusted accordingly
- Quantity of explosive loaded into each blasthole, or deck, will be reported on the blast loading plan
- The total quantity of explosive loaded into the blast will be reconciled against the quantity indicated on the submitted blast plan. Where the quantities differ, a comment for the variation will be included on the blast loading plan. Any significant variations are to be reported to the Quarry Manager prior to final blast tie-up.

10.7 Stemming of Blastholes

The stemming of blastholes is a critical and important task, and is to be administered methodically and accurately. The bridging of stemming in a blasthole may result in stemming material ejecting, airblast overpressure, flyrock or poor fragmentation. In addition:

- The stemming material will consist of a graded crushed aggregate with a nominal sizing approx. 10mm
- The stemming length (depth) will be measured and written onto the blast loading sheet
- Recommended stemming lengths are 2.3m for 89mm diameter blast holes and 2.5m for 102mm diameter blast holes.
- All blastholes will be stemmed before the surface tie-up of the initiation system commences.

10.8 Surface Tie Up

The surface tie-up of the initiation system will be completed in accordance with the proposed blast plan. Key issues and considerations include:

- The shotfirer and blast crew will implement the planned tie-up
- The blast pattern provided to Quarry Solutions will indicate the proposed tie up sequence, clearly identifying the different delay elements that will be used. This will be used to assist in determining that the maximum instantaneous charge (MIC) will comply with design, and in accordance with the permitted maximum vibration level at the nearest potentially sensitive receiver.
- The implemented timing sequence and actual quantity of explosive (MIC) will be clearly identified on the loading plan.

10.9 Community Notification

In accordance with Condition L5.3 of the EPL Residents 1 to 9 are to be provided with 24hours notice of when blasting is to be undertaken, unless otherwise agreed to in writing by the resident. The form of the notice is dependent upon the requirements of the resident and may include telephone, email or text message. A sign at the front of the quarry will also display the date and time of the proposed blast in addition to any other requested methods by residents 1 to

9. Quarry Solutions, through the Quarry Manager or other designated responsible officer, will respond to all issues of concern and complaints promptly and efficiently, and relay any necessary information through to the appropriate persons and/or regulatory authority.

10.10 Firing

Firing of the blast will be under the control of the shotfirer in conjunction with the nominated Quarry Solutions representative. The blast pattern will be initiated in accordance with the contractor's safety procedures, and the site specific Quarry Solutions Coraki Quarry procedures. The following key issues will be addressed:

- Quarry Manager will complete the blast checklist refer Attachment 5 – Managers Blast Checklist.
- Prior to firing, the shotfirer will confirm with the Quarry Manager or their representative of the intent to blast
- Weather is confirmed as being suitable for blasting and will not increase the risk of dust or fume migration or air over pressure impacts from inversions
- The area will be cleared and checked to ensure all personnel are a safe distance from the blasting activities
- Control (sentry) points to restrict access to the blast site will be placed, including internal access to the blast area from within the site
- Prior to the blast, a siren of sufficient loudness will be sounded to alert all adjacent personnel of the immediate intention to blast
- Following the blast, and after the specified period to allow for any fume dispersal, the shotfirer is to inspect the blast prior to instructing the sounding of the "all clear" siren.

10.11 Misfires

Should there be a fault in the firing sequence (typically caused by a cut-off severing the leads to the detonators, either on-surface or in-hole) during the blast, procedures compliant with the Explosives Act 2003 No. 39 and Regulation 2013 will be followed. The following checks for misfires will be implemented immediately following all blasts:

- After the blast is fired, the shotfirer will visually inspect entire shot for evidence of misfires.
- If found, the shotfirer will notify the Quarry Manager immediately along with the blast sentry guards
- The post-blast "all-clear" signal will NOT be sounded.
- The shotfirer and the Quarry Manager will decide if it is safe to re-fire the remaining part/s of the shot.
- The same method of initiation will be used.
- If the shot is unable to be fired safely, all blast guards are to await radio instructions as to the intended plan of action.

If a misfire (unexploded explosive or initiation product) is subsequently detected during excavation:

- Personnel will be instructed to stay well clear of the area.
- All personnel in the quarry will be informed.
- A means of controlling access to the area will be put into place.
- A detailed and safe excavation plan will be formulated and implemented.
- The Inspector of Mines will be notified (as per the regulatory requirements).

10.12 Disposal of Explosives

It is not intended to dispose of any explosives onsite. In the event there is a requirement for explosives to be disposed of onsite, the blasting contractor is to provide a methodology and accounting procedures for disposal to the Quarry Manager.

10.13 Sleeping of Shots

Sleeping of shots is not considered an appropriate practice onsite unless extenuating circumstances prevent the loading and subsequent firing of explosives.

Sleep time is defined as the time between charging and firing the shot. The sleep time of an explosive is important because explosive can often deteriorate under unfavourable conditions. Conditions such as heat, cold, humidity and water cause the explosive to deteriorate possibly causing failure of the explosives. Product deterioration may result in

a charge, or part of a charge, failing to explode or misfiring. Best practice is for explosives to be charged and fired at the earliest practicable time.

In the event a shot is 'slept' onsite the following should be undertaken:

- Charging areas shall be clearly marked by appropriate warning signs.
- BEZ is to be established.
- If damp blastholes are required to sleep, an explosive with some water resistant properties is required.
- Where charged holes are to be left to sleep over night suitable warning signs and lighting is to be utilised.
- All loaded holes are to be stemmed to prevent theft or loss.
- Shots shall only be slept for a maximum time period that complies with the manufacturer's bulk explosive technical data sheet.
- Approaching machinery and person needs to be able to clearly identify the charge area.
- If further warning is required an overnight guard can be utilised to direct persons and mobile equipment around the shot area.
- Any hole that is not loaded shall have the detonator and primer removed, separated and returned to the magazine storage facility or secured vehicle with appropriate security provided.
- If a blast is cancelled and slept overnight, all surface detonators or surface initiators shall be removed from the down hole detonators and returned to the magazine storage facility or secured vehicle with appropriate security provided.

10.14 Reconciliations and Reporting

Prior to firing each blast, the following worksheets and documents will be completed and made available to Quarry Solutions:

- An assessment of the expected level of airblast overpressure and ground vibration at each of the nearest sensitive receiver/s complies with the regulatory limits.
- A completed drilling sheet prepared by the driller or shotfirer, showing the measured depth of each blasthole. The sheet will identify and clearly mark any "short" blastholes.
- A blast loading plan showing the depth of each blasthole, quantity of explosive in each blasthole and the uncharged stemming length. The initiation sequence will also be shown. Reconciled explosive quantities used versus the designed quantity will also be shown and any variations accounted for.
- A signed blast summary sheet showing that each of these forms been received and no variations between the intended and implemented design exist. These requirements are in accordance with the specifications listed in the Australian Standard AS2187.2 document.

11. Monitoring of Blasting Activities

Monitoring of various aspects is required in relation to blasting activities on the Site. Table 5 – Monitoring Requirements Summary provides an overview of the environmental indicators relevant to blasting to be measured and the relevant EPL, DC and section within each of the Management Plans that govern the environmental monitoring requirements. Figure 1 – Environmental Monitoring Locations identifies the location of relevant monitoring points required under the EPL, DC and management plans.

Table 5 – Monitoring Requirements Summary

Aspect	DC Condition (Specific to Monitoring Requirements)	EPL Condition (Specific to Monitoring Requirements)	Associated Management Plan
Noise	Schedule 3, Condition 7	Condition L4 Condition M1 Condition M2 Condition M9.1	Appendix B – Noise Management Plan
Blasting	Schedule 3, Condition 10 (d)	Condition L5 Condition M1 Condition M2 Condition M8	Appendix C – Blast Management Plan
Air	Schedule 3, Condition 14 (b and d)	As required	Appendix D – Air Quality Management Plan

The airblast and ground vibration monitoring system will consist of a series of individual monitors (minimum of 2) which will be positioned at specified locations around the quarry, and covering the nearest of the potentially sensitive receptors adjacent to the site. Each vibration monitor will have four recording channels. An external geophone (transducer) will monitor ground vibration in three directions (transverse, vertical and longitudinal particle velocities) and report the resultant peak particle velocity (PPV) in mm/s. An external microphone will measure the level of overpressure, reporting the data in units of dBL. The monitors will be configured with a vibration threshold trigger to record blast events which exceed a minimum value, typically around 0.5mm/s. The recording duration will be set to exceed the duration of the blast.

Monitoring locations for blasting will be identified prior to each blast. In the event that additional monitoring sites are required, these will be confirmed by the Quarry Manager. Blast monitoring will be undertaken in accordance with AS 2187.2.

Monitoring must be undertaken by a suitably qualified person in accordance with AS2187.2, and include:

a. peak particle velocity (mm/s)
b. air blast overpressure level (dB linear peak)
c. location of the blasting within the site
d. atmospheric conditions including temperature, relative humidity, wind speed and direction
e. affects due to extraneous factors
f. location, date and time of measurements.

For comparative purposes, it is recommended that two (2) monitoring sites (located at the closest residences where permission can be granted) be monitored at the same location for every blast, so as to provide a baseline data set.

Ground vibration and airblast overpressure monitoring will be controlled / completed by the contractor (or other designated specialist). The contractor / monitoring specialist will provide the necessary equipment and personnel and/or procedures to deploy, record and forward the measured blast data, and undertake any necessary subsequent analyses and distribution to Quarry Solutions. Blast monitoring data will be made available after each blast for analysis, review and record keeping.

This data will be provided to EPA and/or other relevant regulatory authorities upon request, and records will be kept for a period of five (5) years.

Each blast conducted onsite should also be video recorded to provide information about the shot and to assist in reviewing blast performance. An electronic copy of each video is to be retained by the Site on the network drive for recall when required.

Flyrock distances are also to be calculated either through review of video recordings or measured onsite following each blast. A record of flyrock distances and particle size is to be maintained onsite for use in establishing a site specific K factor and calculation of an updated BEZ.

Blast videos will also be reviewed in relation to identification of blast fume and whether the fume (if generated) travels beyond the boundary of the site.

Results of monitoring relating to blasting and required by the EPL are published on Quarry Solutions website www.quarrysolutions.com.au in accordance with the EPA's reporting requirements for publishing of pollution data. This data is to be maintained and made available to the public.

A community engagement and complaints procedure has been developed by Quarry Solutions and forms part of the Environmental Management Strategy. Neighbouring residents will be provided with a telephone number to contact the Quarry Manager should concerns arise as a result of blasting activities.

12. References

Development Consent (Coraki Quarry) SSD 7036
NSW Dept. of Planning and Environment

Chiappetta F., (2010), Combining Electronic Detonators with Stem Charges and Air Decks,
Drill and Blast 2010 Conference, Brisbane Australia

Richards A, Moore A (2004), Flyrock control – by chance or design
3th Annual Conference on Explosives and Blasting Techniques.

Coraki Quarry, Proposed Blast Parameters Evaluation
Drew Martin, Blast It Global Pty Ltd (10 September 2015)

Australian Standard AS2187.2-2006 Explosives – Storage and use – Use of explosives

Safe and Efficient Blasting in Quarries (2008)
Orica Limited

Institute of Quarrying Australia (IQA)
Blue Book (2011) chapter 26 explosives management

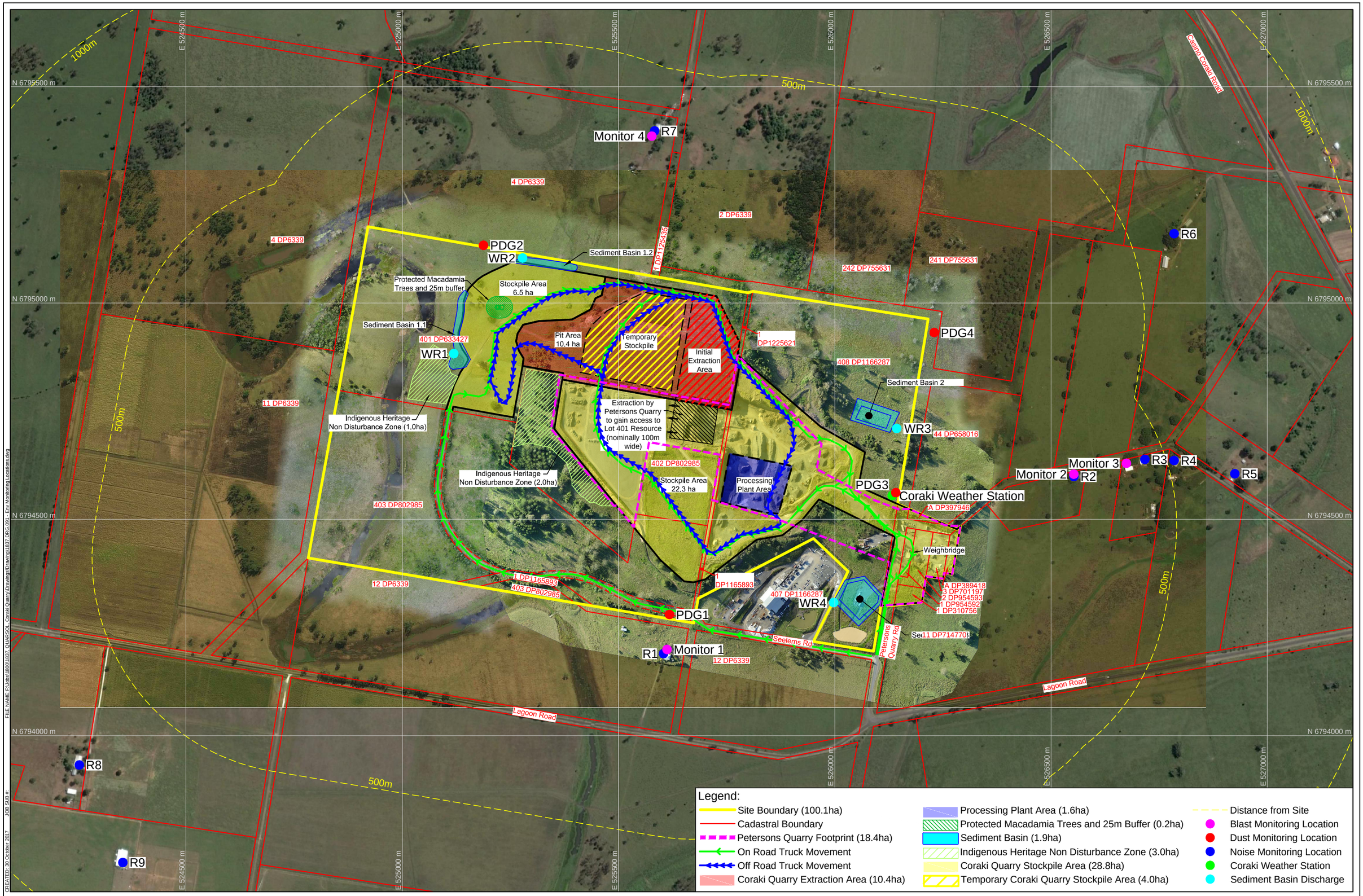
Explosives Act 2003 No. 39 (NSW)

Explosive Regulation 2013 (NSW)

Safe Distances When Using Explosives (2011)
Worksafe Victoria

Blast Fumes and You
NSW Government, Health

figures



Legend:

- Site Boundary (100.1ha)
- Cadastral Boundary
- Petersons Quarry Footprint (18.4ha)
- On Road Truck Movement
- Off Road Truck Movement
- Coraki Quarry Extraction Area (10.4ha)
- Processing Plant Area (1.6ha)
- Protected Macadamia Trees and 25m Buffer (0.2ha)
- Sediment Basin (1.9ha)
- Indigenous Heritage Non Disturbance Zone (3.0ha)
- Coraki Quarry Stockpile Area (28.8ha)
- Temporary Coraki Quarry Stockpile Area (4.0ha)
- Distance from Site
- Blast Monitoring Location
- Dust Monitoring Location
- Noise Monitoring Location
- Coraki Weather Station
- Sediment Basin Discharge

REV	DESCRIPTION	DATE	BY
3	Updated topographic data and aerial survey	31/10/16	LT
4	Extraction Area Amended	10/03/17	JS
5	Extraction Area & Stockpile Area Amended	11/05/17	JS

Data Sources:
Photography: UAV Survey 2016-05-05; Google. Image date: 2014-12-18
Topography: UAV Survey 2016-05-05
Cadastre:
Ecosystem:
Other:

Area of New Disturbance Associated with Coraki Quarry:

Coraki Quarry Extraction Area (Including Temporary Coraki Quarry Stockpile Area) (9.9ha)
Coraki Quarry Stockpile Area Outside of the Petersons Quarry Footprint (7.7ha + 6.5ha on Lot 401 = 14.2ha)
Sediment Basin (1.9ha)

PROJECT: Coraki Quarry

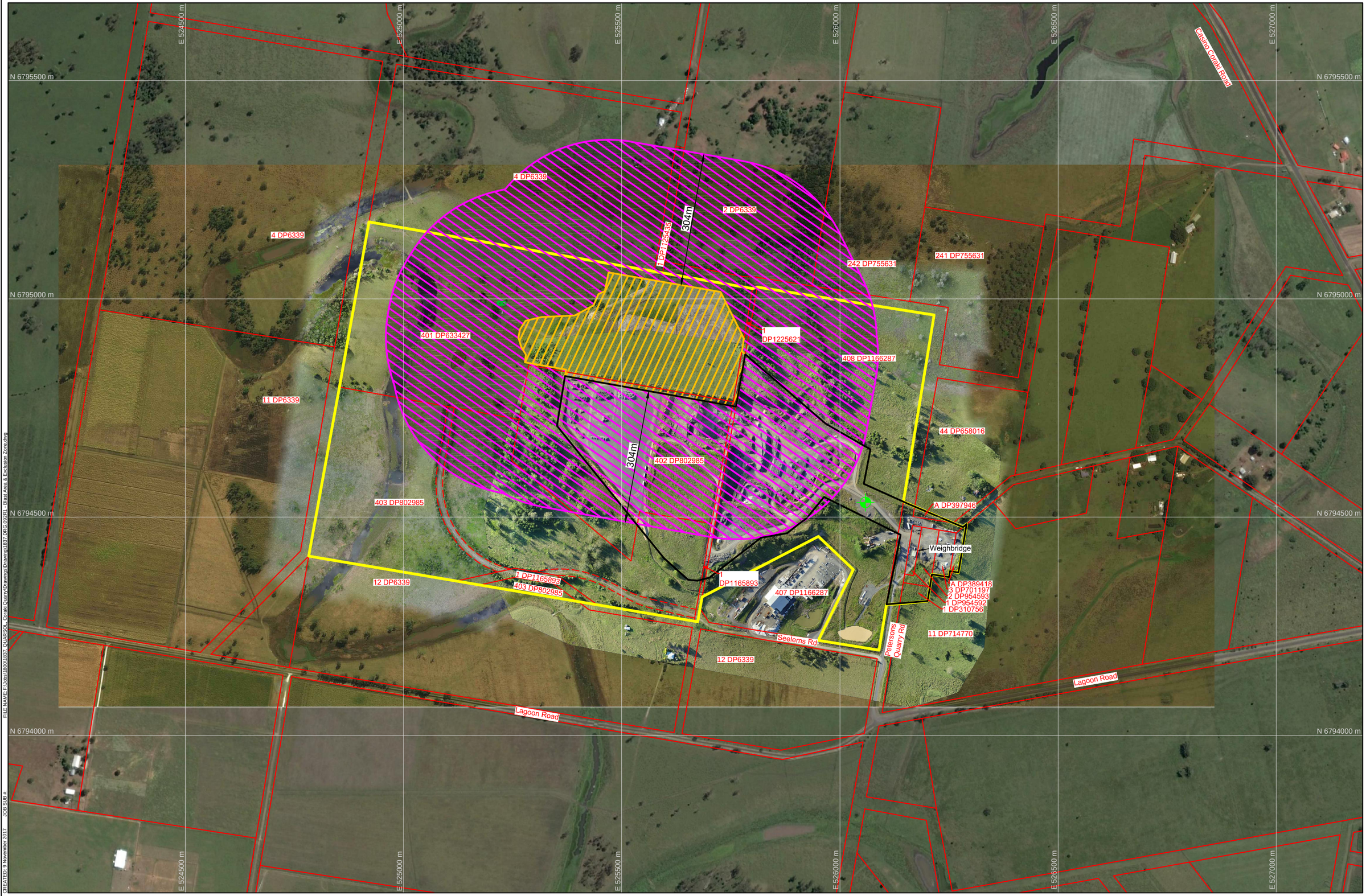
CLIENT: Quarry Solutions Pty Ltd

TITLE: Figure 1 - Environmental Monitoring Locations

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:8,000 When Printed On A3 (0 – 160)
DRAWING NUMBER: 1837.DRG.091A
REVISION:
DATE: 30 October 2017
DRAWN: JS
PRINTED: 30 October 2017
CHECKED: JL
DATUM: HORIZONTAL / VERTICAL / ZONE: MGA / AHD / 56

FILE NAME: P:\Jobs\1800s\1837_QUARSOL - Coraki Quarry\Drawings\Drawings\1837.DRG.091 - Env Monitoring Locations.dwg
JOB SUB #:
CREATED: 30 October 2017



CREATED: 9 November 2017 JOB SUB #: FILE NAME: P:\Jobs\1800s\1837_QUARSOL - Coraki Quarry\Drawings\Drawings\1837.DRG.092R1 - Blast Area & Exclusion Zone.dwg

REV	DESCRIPTION	DATE	BY
1	Exclusion Zone Amended	09-11-17	JS

Data Sources:
Photography: UAV Survey 2016-05-05; Google. Image date: 2014-12-18
Topography: UAV Survey 2016-05-05
Cadastre:
Ecosystem:
Other:

Legend:
- Site Boundary
- Cadastral Boundary
- Exclusion Zone
- Current Active Blast Area
- Blast Guard Location

PROJECT: Coraki Quarry

CLIENT: Quarry Solutions Pty Ltd

TITLE: Figure 2 - Blast Area & Exclusion Zones

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:8,000 When Printed On A3 (0 – 160)
DRAWING NUMBER: 1837.DRG.092
REVISION: 1
DATE: 9 November 2017 DRAWN: JS
PRINTED: 9 November 2017 CHECKED: JL
DATUM: HORIZONTAL / VERTICAL / ZONE: MGA / AHD / 56

attachments

Attachment 1

Emergency Procedures

SEE Civil Pty Ltd ABN - 88 115 963 427
24a Ozone St Chinderah NSW 2487 – Ph. 0266 712 300

OPERATIONAL PROCEDURES Level 3

08

Emergency & Incident Preparedness & Response

SEE Civil Pty Ltd ABN - 88 115 963 427
24a Ozone St Chinderah NSW 2487 – Ph. 0266 712 300

1. Purpose and Scope

To identify and inform personnel onsite of reasonably foreseeable potential emergency situations, incidents and accidents that may cause harm to humans and / or the environment and to detail procedures for preventing and mitigating associated impacts. This includes classification procedures that may occur at the workplace regarding emergency & incident preparedness & response plans, notification of accidents, injuries, incidents and first aid requirements and ensuring investigation, reporting, documenting and review, as per WHS legislation and SEE Civil Pty Ltd IMS requirements.

2. Definitions

Incident/Accident:

An unplanned and unfortunate event that results in damage or injury which may threaten the health and safety of persons, the integrity of property, including product or degradation of the environment

Emergency:

An unexpected and sudden event that must be dealt with urgently, that requires cessation of operational activities and involvement of external emergency services.

Competent Person; Refer to 3.1.1 below

3. Procedure

3.1 Emergency and Incident Preparedness and Response Plans

SEE Civil Pty Ltd requires a *08-A1-03 Site Specific Emergency and Incident Preparedness and Response Plan* be prepared for each site that informs relevant persons of required actions in the event of incidents or emergency situations. The Plan is required to be displayed at the site, presented to all inductees at site inductions and signed off by inductees when they have understood the requirements.

All other personnel, including subcontractors and their workers will be inducted in to the Plan where site risks and controls will be identified and communicated. All inductees are required to sign-off on the last page of the Plan to verify the induction and that the relevant information was presented.

SEE Civil Pty Ltd ABN - 88 115 963 427
24a Ozone St Chinderah NSW 2487 – Ph. 0266 712 300

3. Procedure

3.1 Emergency and Incident Preparedness and Response Plans – continued

The EIPR Plan will be prepared for site specific potential emergencies and incidents that have been identified by a risk assessment of identified hazards as required by the Safety Management Plan 06-A1-00 section 2 Risk Management. IMS document *06-A1-07 Risk Assessment Form* contains the risk assessment of the identified hazards and the controls required for preparation of 08-A1-03. The EIPR plan must be site specific but as an example it may contain any of the following:

- Fire, including bushfires
- Gas leak
- Explosion (e.g. fuel or gas)
- Oil and other chemical spill
- Other industrial accidents
- Flood & landslips
- Extreme fugitive dust
- Building collapse
- Trench or embankment collapse
- Storm events (e.g. high winds)
- Bomb threats
- Electrical emergency (e.g. live power lines)
- Moving plant, rollover or collision
- Injuries or medical emergencies

The EIPR Plan 08-A1-03 must be site specific and include the relevant risks identified on *06-A1-07 Risk Assessment Form* and also contain the following information:

- List identified emergency situations
- Emergency drill requirements
- Emergency equipment required
- Emergency equipment checks & test
- Critical incident worker assistance
- Individual critical incident procedures
- Communication requirements
- Emergency personnel training
- Emergency equipment locations
- First Aid requirements
- Emergency contact numbers
- Emergency contact names/responsibilities

3. Procedure

3.1 Emergency and Incident Preparedness and Response Plans – continued

An Emergency and Incident Preparedness and Response Plan shall be prepared for each project undertaken. This will be included in the Project Management Plan and will include the requirement for emergency drills including evacuation drills where work is performed predominately within a built environment.

On open area sites without a built environment, emergency drills will focus on rescue or worker down type scenario instead of evacuation drills. The scenario for each emergency drill will be varied to suit the type of incidents that have occurred previously and will be decided by consultation between the Supervisor and HSE Manager. The following are examples of possible emergency drills-

a. Evacuation
b. Shock / fainting
c. Snake bite
d. Electrocution
e. Plant rollover
f. Trench collapse
g. Bleeding
h. Other items identified from incident records

SEE Civil Pty Ltd will ensure emergency drills are carried out on a regular basis, as per the requirements of the Project Management Plan, on site, at quarries, in the workshop and also at head office.

The purpose and objectives of emergency drills include the following:

- To identify any weaknesses in the emergency strategy
- To evaluate the effectiveness of the drill and establish corrective actions as required
- To test procedures following changes in work methods or work type
- To familiarise new workers with procedures
- To identify weaknesses in communications or equipment availability
- To verify the suitability of emergency personnel
- To identify training requirements for emergency and other personnel
- To identify positive and negative reactions of personnel with designated responsibilities

3. Procedure

3.1 Emergency and Incident Preparedness and Response Plans – continued

The Fire Warden, Production Manager or Supervisor responsible for co-ordinating the emergency drill will ensure records of outcomes relating to the objectives will be maintained using *08-B1-03 Investigation of Workplace Incident Form* which will be forwarded to the HSE Manager for action as though it was an actual incident being investigated. The effectiveness of Company procedures and subsequent drill will be identified on *08-B1-03 Investigation of Workplace Incident Form* under section 9. The drill is also required to be noted in the *12-B1-07 Daily Site Report.*

Generally the frequency for emergency drills at workshop / head office and quarries is each 6 months. On civil construction sites the frequency is one drill within the first two weeks from start and every third month thereafter or as per risk assessment findings.
It must be noted however due to the specific requirements of some civil construction site that the frequency of emergency drills should be determined based on the risks present at the site. Use Section 2.2.2 of the WHS Plan *06-A1-00* to determine the frequency of drills as per the hazards and risks identified on the Site specific *06-A1-00 WHS Plan.*

The emergency drills should involve site evacuation at the Chinderah Workshop and office complex or other built environments such as major quarry operations. Civil projects generally would not require an evacuation procedure however the individual project would be assessed for this requirement.

The Fire Warden / Storeman will co-ordinate at the workshop / head office, the Production Manager at quarries and Supervisors on civil sites. Personnel co-ordinating practise drills will have appropriate competencies and experience and meet SEE Civil training requirements relevant to the position in which they are employed as per SEE Civil IMS roles and responsibilities.

3. Procedure

3.1 Emergency and Incident Preparedness and Response Plans – continued

This will ensure the Company's Emergency Preparedness Plans are tested and amended as required. SEE Civil Pty Ltd will also maintain emergency equipment necessary for effective and safe response including but not limited to the following:

- First aid kits, major trauma kits and first aid instructions.
- Personnel protective equipment
- Spill kits
- Absorbent booms
- Pumps
- Fire extinguishers
- Rescue equipment
- UHF radios
- Trained personnel to Senior First Aid level

An "Assessment of Emergency Equipment Required at This Site" form is included in *08-A1-03 Site Specific Emergency and Incident Preparedness and Response Plan*. The assessment of emergency equipment required and subsequent completion of the above form must be completed by a competent person prior to the work commencing.

The proximity to doctors, hospitals or emergency services will be considered when determining the level of emergency equipment required at each site. Due to increased travel times remote sites may be required to be equipped with additional emergency equipment for injuries, heat stroke (refer *06-A1-10 Heat Stress Procedures)*, snake or insect bites etc.

The location, maintenance and use of emergency preparedness plans, instructions and response equipment shall be included during site induction training.

3. Procedure

3.1 Emergency and Incident Preparedness and Response Plans – continued

3.1.1 Competent Person

The competent person will hold qualifications or consult with another person holding relevant competencies applicable to the work processes they are required to carry out as follows:

- 3 years experience in a civil construction Supervisory role; and
- 3 years technical experience in work procedures and type of plant and equipment that will be used on the project; and
- Trained in Civil Construction Cert 3 or Surface Extractive Industries Cert 3

- ✓ Competent Person required to decide on first aid equipment will also hold a current Senior First Aid certificate and have access to and develop plans in compliance with *First aid code of practice 3834*, available on L Drive - Standards

- ✓ Competent Person required to decide on confined space rescue equipment, if required on site, will also hold a current Confined Space Entry and Rescue Training certificate

- ✓ Personnel engaged in the development, validation and implementation of an emergency plan will have access to and develop plans in compliance with relevant standards. i.e. AS 3745, Planning for Emergencies in Facilities, and other references, available on 'L' Drive - Standards

- ✓ Personnel engaged in the selection, application, location and distribution of portable fire extinguishers will have access to and develop plans in compliance with relevant standards.
  i.e. AS 2444, Portable Fire Extinguishers and fire blankets – selection & Location, available on 'L' Drive – Standards

- ✓ Investigation of Reportable Incidents (as determined by Legislation) will be by a competent person with the above relevant competencies and training in incident investigation. Ie. Workplace Health & Safety Officer, Diploma in OHS, Certificate IV Civil Construction or other CERT IV courses that include Incident Investigation.

The 'Competent Person' prior to commencing work on any document must have ensured the Company has copies of all current qualifications to meet the requirements of the above criteria. Copies of these competencies will be maintained in the HR Department in each employee's confidential employment folder. Where more technically qualified expertise is required to develop emergency procedures or perform incident investigation the HSE Manager will liaise with SEE Civil Management and obtain the required services.

3. Procedure

3.2 Notifiable Accidents, Injuries and Incidents

Accidents are treated in the same manner as emergencies, although they may not necessitate the request of external emergencies services. For further information please refer *08-A1-02 Incident Flowchart* this chart must be displayed onsite in prominent places as advised in the PMP. All accidents, injuries and incidents on site (as per requirements of the relevant Work Health and Safety Acts & Regulations) must be reported, recorded and investigated accordingly. Accidents, incidents and injuries will be recorded onto *08-B1-02 Incident Notification Form* with a copy forwarded within 24 hours to the HSE Manager. Accidents, incidents and injuries will also be entered into *08-C1-04 Site Incident Register* and maintained onsite until the end of the project.

Site management will notify SEE Civil Pty Ltd head office of any incident that results in death, or an injury that requires substantial medical treatment – i.e. urgent medical attention, hospitalisation or treatment for a serious injury. Head office will then notify the relevant authorities.

Relevant authorities must also be notified by SEE Civil Pty Ltd HSE Manager of incidents that expose a person to an immediate risk to health & safety. These include incidents related to plant, excavations, building collapses, fires & explosions and dangerous goods spills and leaks.

For all incidents or accidents the relevant authorities will be advised within the required legal time limits by SEE Civil Pty Ltd HSE Manager using the Authorities online website template or by phone if an urgent response is required.

Site management will inform the HSE Manager of all major incident occurrences within 24 hours. Should the incident result in a death, urgent medical attention, hospitalisation or treatment for a serious injury the site of the incident must not be disturbed (unless safety-related action is necessary) until a health & safety inspector becomes involved.

3. Procedure

3.3 Accident and Incident Procedures

Whenever there is an accident or incident (including equipment damage or failure), the following procedures must be adhered to (also refer to *08-A1-02 Incident Flowchart)*:

1. Ascertain exactly where the accident or incident has occurred onsite
2. Determine whether any person has been injured, render assistance and inform Site Management.
3. Determine if emergency services are required. If required inform them of the nature and exact place of the accident, the number of people injured, your name and your location
4. Inform the employer of the injured worker or the owner of any damaged equipment
5. Advise immediately the next of kin or contact person of the injured worker regarding the accident.
6. Ensure emergency services have been notified as requested
7. At the accident scene following a fatality, serious bodily injury or dangerous occurrence, the area should be isolated and not interfered with until the relevant Government Workplace Health and Safety Department, Police, and the Principal Contractors representative has investigated the occurrence.
8. Interference with the scene is only permissible to relieve suffering of a person or to prevent further damage to persons or property.
9. If a fatality occurs the relevant WHS Authority, SEE Civil General Manager and Police must be notified immediately by the quickest means of communication
10. Ensure that no media obtains access to the site and that no statements are made concerning the accident. Refer all enquiries to the Principal Contractors Head Office

3.3.1 Incident Reporting

1. As per requirements of the relevant WHS Acts all injuries must be recorded
2. Any injury that requires the injured person to be admitted as an inpatient to hospital must be reported to SEE Head Office and HSE Manager within 1 hour.
   Also record details on *08-B1-02 Incident Notification Form* and forward to HSE Manager within 24 hours. Obtain a copy of all medical reports relating to the injury and report to Payroll and HR.
3. Reports to authorities will be on official forms only & completed by the HSE Manager

3.3.2 Incident Investigation

1. It is a requirement under the relevant Work Health and Safety Act that an investigation is carried out on all notifiable accidents and incidents. A competent person will obtain photographs and statements from any witness or any parties involved and include with the investigation report.
2. After stopping work and securing the area, initiate the recording of the incident ensuring the following:

- Commencement of the investigation is to begin promptly, this must be carried out by a suitably competent person who has experience & knowledge required to assess the situation; keeping it objective, factual and free from any attempt to assign blame, use *08-B1-03 Investigation of Workplace Incident Form*
- SEE Civil Pty Ltd requires that the competent person has experience and training as required in *Section 3.1.1 Competent Person*
- Observe, take photographs and sketches of the accident scene. The reporting methodology is determined by the requirements of 08-B1-03 Investigation of Workplace Incident form.
- Take statements from witnesses, other members of the injured persons' work team and people involved in the accident; if seriously injured or hospitalised, use discretion
- Determine all factors which may have contributed to the accident
- Recommend appropriate preventative & control measures as per *08-B1-03 Investigation of Workplace Incident Form* indicates
- Submit report to the HSE Manager who will review Company processes, procedures, work instructions and / or SWMS to ensure preventative and control measures are adequate to ensure the health and safety of all persons onsite
- The HSE Manager will prepare a detailed report for Management & relevant Authorities.

3. Procedure

3.3 Accident and Incident Procedures - continued

3. Where a near miss is considered to be serious because it has the potential to cause an injury, major property damage or environmental contamination the near miss shall be recorded, investigated and reported to the SEE Civil Pty Ltd HSE Manager

3.3.3 Trauma Response & Counselling

The emotional condition of all concerned in a critical incident is of the utmost importance. A critical incident is any situation faced by an individual or group that evokes a strong emotional and / or physical reaction, which has the potential to impede function-ability either at the time of the event or into the future. It must be remembered a critical incident can indirectly impact on co-workers, family members, support personnel and observers. Management will ensure observation of all involved and if they should recognise behaviour out of character SEE Civil Pty Ltd will ensure they seek external specifically trained professional assistance as required.

Contact numbers for professional service providers will be available from SEE Civil
Return to Work Co-Ordinator / HR Manager Peta Newton 0266 712 300

.

Critical incidents may include the following:	
❖ *Sudden, violent deaths*	❖ *A rescue operation fails*
❖ *Colleague dies or is seriously injured at work*	❖ *Witnessing or discovering suicide victims*
❖ *Life threatening situations of staff*	❖ *The death of a child in tragic circumstances*
❖ *Large numbers of causalities*	❖ *Staff are exposed to horrifying circumstances concerning causalities*
❖ *A major disaster has occurred*	

3.3.4 Review

The HSE Manager will review all aspects resulting from a critical incident, including-

- Reporting procedure adequacy and compliance
- Roles taken by workers during coordination and implementation of response actions
- Effectiveness of incident response procedures.
- Assistance provided to any injured workers including rehabilitation
- Assistance provided for trauma counselling and effectiveness
- Review of incident causal factors against SWMS, COP's, Legislative requirements to determine compliance and changes required to prevent a re-occurrence
- SEE Civil Board Report and other reports to relevant authorities were completed.

.

The HSE Manager will ensure a summary of incident review details are entered on *08-B1-03 Incident Investigation Form item 9 Evaluation* prior to incident close out.

The HSE Manager will as required also ensure follow up actions by the use of *16-B1-01 System Improvement Report*, *16-B1-05 Non-conformance Report*, Toolbox Talk or other relevant actions required to record, inform, train and monitor procedures to ensure no reoccurrence of the incident.

The corrective action process, targets, completion dates and assignment of responsibility for implementing & reviewing the effectiveness of corrective actions will be determined to ensure compliance with *16-A1-01 System Improvement & Non-conformance Procedures.*

SEE Civil Pty Ltd ABN - 88 115 963 427
24a Ozone St Chinderah NSW 2487 – Ph. 0266 712 300

3. Procedure

3.4 First Aid Requirements

A risk assessment will be carried out as per requirements of the *First Aid Code of Practise* on each site to determine the level of appropriate first aid equipment, facilities and first aid personnel.
The Initial Risk assessment to determine the requirements of First Aid are identified during the completion of 06-B1-07 Risk Assessment Form within the Site Specific 06-A1-00 WHS Project Plan.
The provision of first aid is not a control measure which prevents or minimises work injury or work caused illness, but is a control measure to deal with injury or illness that has already occurred.

The following five steps can be used to decide on and provide appropriate first aid:

1. Identify the hazards that may cause injury or illness.
2. Assess the risk, type and extent of work injuries and work caused illnesses that may occur.
3. Decide on appropriate first aid equipment, facilities, services (including trained personnel) which can best address the injuries or illnesses likely to occur and which are suitable taking into account the size, layout and location of a workplace.
4. Implement the chosen first aid equipment, facilities and services to effectively manage the injuries and illnesses.
5. Monitor and review first aid equipment, facilities and services to ensure they continue to meet requirements.

Each site must have at least 1 fully stocked dust-proof First Aid box or kit that is generally kept in the Site Office, foreman's vehicle and certain items of plant. These locations will be nominated during site inductions.
The Safety Officer or other nominated person will ensure that an adequate number of First Aid Kits are provided and that they are checked regularly and kept fully stocked. All Supervisors vehicles will contain first aid kits. The HR officer will record kit details and locations on *08-C1-03 Register of Kit Location.* For all enquiries regarding first aid kits contact the HR Department, this includes cleaning and maintenance, restocking and replacement should your kit have been stolen or destroyed.

3. Procedure

3.4 First Aid Requirements - continued

In the case of minor injury, the First Aider will apply treatment as necessary and record details of the injury and treatment rendered on *08-B1-01 First Aid Record Form*. These forms will be filed onsite.

To ensure that the first aid kit is correctly stocked the risk analysis for stock items and quantities will be reviewed and adjusted for each project as required. The first aid stock items and quantities will be recorded in *08-C1-02 First Aid Kit Contents Register*

In the case of a major injury that requires treatment by a doctor or hospitalisation the First Aider will:

- Ensure that the Site Supervisor / Project or Production Manager immediately informs Emergency services
- Take charge of the situation until Emergency Services arrive
- Administer first aid as appropriate
- Keep reassuring the patient
- Not move the injured patient unnecessarily unless he/she is in imminent danger, under the guidance of medical personnel (i.e. Doctor, ambulance officer via mobile phone etc.)

3.5 Review of Drills / Incidents / Accidents / Investigations

An incident / accident review shall be compiled each month by the HSE Manager for all projects to monitor and review common types and total number of incidents / accidents. This data will be reviewed and analysed to determine common trends and find appropriate methods of preventing their recurrence which may include re-evaluation of work practices (i.e. changes to SWMS etc.)

An analysis of incident / accident data will be presented for Management Review.

Investigations using *08-B1-03 Investigation of Workplace Incident Form* once completed are returned to the HSE Manager for review.

As required the HSE Manager will prepare reports after reviewing the emergency drill responses as completed and by onsite management on *08-B1-03.* These reviews will establish the suitability of the emergency scenarios carried out onsite and may result in a change to the EIP&R Plan.

3.6 Maintenance of Emergency Equipment & Personnel Safety

The Project Manager will nominate the Supervisor and / or Safety Officer to ensure the following items are addressed concerning emergency equipment & personnel safety using *06-B1-01 Safety & Environmental Checklist*:

- Emergency preparedness plans will be developed and displayed in site offices & lunch rooms
- Emergency exits must be kept clear of obstructions, with all signs inspected and maintained regularly
- Emergency equipment will be inspected and maintained as per specifications
- Fire extinguishers must be inspected and certified each 6 months
- A designated assembly point will be determined, there may be a number of assembly points depending on the project site conditions
- Designated travel paths to assembly points will be kept clear of obstacles
- Emergency alarms / sirens will be installed and maintained at head office, workshop and quarries
- Due to the size and noise produced at project sites, alarms / sirens may not be the best solution for alerting employees of emergencies, two-way radios or mobile phones are often the best means of communication

3.7 Emergency Preparedness Training

Employees that act as emergency personnel (i.e. fire wardens) will be trained as per procedures outlined in *09-A1-01 Competence, Awareness & Training.* They will receive regular practice in emergency procedures appropriate to their emergency response responsibilities.

4. RESPONSIBILITIES & ACCOUNTABILITIES

4.1 Operations Manager

- Is responsible for ensuring that Emergency & Incident Preparedness & Response Plans have been developed and are understood for all SEE Civil Pty Ltd activities.
- Is accountable to the General Manager by ensuring monthly reporting occurs.

4.2 HSE Manager:

- Is responsible to ensure the preparation, compliance, implementation and maintenance of emergency and incident preparedness and response plans and instructions at all locations where SEE Civil Pty Ltd operate.
- Is responsible to conduct investigations and report findings to Management and other concerned parties
- Is accountable to the General Manager to ensure compliance with SEE Civil IMS and Regulatory requirements for all WH&S and Environmental issues.

4.3 Supervisor or Production Manager:

- Is responsible for the implementation and maintenance of emergency and incident preparedness and response plans for all project sites under their control.
- Is accountable to the Operations Manager to maintain WH&S compliance at sites under their control.

4.4 Competent Person:

- Is responsible for the assessment, suitability, location and accessibility of emergency equipment with other competent personnel as required.
- Is responsible for ensuring the EIP&R Plan is displayed and current.
- Is responsible to ensure emergency drills are performed, corrective actions are carried out and records maintained.
- Is accountable to the HSE Manager to ensure compliance with SEE Civil IMS and Regulatory requirements for all WH&S issues at projects under their control.

5. DOCUMENTATION

- *06-A1-10 Heat Stress Procedures*
- *08-A1-03 Emergency & Incident Preparedness & Response Plan – Site Specific*
- *08-A1-04 Emergency & Incident Preparedness & Response Plan – Depot/Workshop*
- *08-A1-05 Emergency & Incident Preparedness & Response Plan – Head Office*
- *08-B1-01 First Aid Record Form*
- *08-B1-02 Incident Notification Form*
- *08-B1-03 Investigation of Workplace Incident Form*
- *08-C1-01 First Aid Kit Injury Register*
- *08-C1-02 First Aid Kit Contents Register*
- *08-C1-03 Register of Kit Location.*

Other Relevant Forms –

- Qld – WorkCover Incident Notification Form
- Qld – Employer Injury Claim Form
- Qld – Employee Application for Compensation
- Qld – Application for Compensation – Fatal Injury
- NSW – WorkCover Incident Notification Form (Online Application)
- NSW – Workers Injury Claim Form
- NSW – WorkCover NSW Medical Certificate
- NSW - Permanent Impairment Claim

Attachment 2

Thunderstorm and Lightning Safe Work Procedure

Petersons quarry - Thunderstorm and Lightning Safe Work Procedure (SWP)

Introduction
Due to the close proximity of the sea and the relatively elevated position of the Petersons quarry when compared with its surrounding landscape, the Quarry is susceptible to lightning strikes during certain weather events.

Aim
The aim of this SWP is to detail the actions that are to be taken when lightning is forecast or when caught outside during a thunderstorm.

Weather Forecast
The Quarry Production Manager is responsible for monitoring local weather conditions in order to gain an advance warning of inclement weather that may include lightning strikes.

30/30 Rule
The 30/30 rule is used to determine the proximity of a thunderstorm to the Quarry area and the conditions required to ensure it is safe to return to work.

30 Seconds: Count the seconds between seeing the lightning flash and hearing the thunder clap. Each second represents about 300 meters. If this time is 30 seconds or less, then the lightning storm is less than 10km away and there is an 80% chance that the next strike will happen within that 10km. In this case seek shelter immediately, preferably in a building, all-metal vehicle or in a low-lying area.

30 Minutes: After seeing the last lightning flash or thunder clap, wait 30 minutes before leaving shelter. More than half of lightning deaths occur after the thunderstorm has passed. Stay in a safe area until you are sure the threat has passed.

Action to be taken in the event of a thunderstorm
When a thunderstorm is forecast and approaching, the Quarry Production Manager is to take the following action:

- Suspend all quarry production activities
- Instruct all workers to park their machines in a fundamentally stable position and meet in the site office
- Whilst the storm is passing stay away from windows, sinks, toilets, water reservoirs, electrical junction/fuses boxes, outlets and appliances. Lightning can flow through these systems and “arc” to a person.
- Unplug appliances if possible and avoid their use
- Use land line telephones ONLY in an emergency
- If an electrical storm is approaching during loading, the site must be evacuated to the clearance distances outlined in Section 3.5.4 of the Blast Management Plan and the blast guards established until the Shotfirer give the all clear for the weather event passing.

Action to be taken if you are caught in a thunderstorm
If you are caught out and find yourself inside a vehicle during lightning, then avoid parking under trees or power lines that may topple over during a storm. Be aware of downed power lines that may be touching your vehicle. You are safe inside your vehicle but you may receive a shock if you step outside. If you are caught outside with no time to reach a safe shelter, then follow these rules:

Petersons quarry - Thunderstorm and Lightning Safe Work Procedure (SWP)

- Do NOT stand underneath a natural lightning rod: tall, isolated trees, towers, power lines, telephone poles etc.
- AVIOD all unsafe shelters: metal objects such as power poles, fences, gates, bleachers, small sheds, partial shelters, electrical equipment, mowing and road machinery.
- AVIOD solitary trees, hilltops, water, open fields, high ground and caves.
- Stay away from wire fences, metal pipes, rails and other metallic paths which could carry lightning towards you.
- If you are in a wooded area, seek shelter in a low area under a thick growth of shorter trees. Crouch down away from tree trunks. In open areas, seek shelter in low places such as a ravine or a valley.
- Get out of and away from open water. Lightning can strike water and travel some distance from its point of contact.
- Get off of and away from items of quarry machinery crushers, screens, etc.
- Ensure all hand tools are put down. Holding something can make you the tallest object and a target for lightning.
- DO NOT stand in puddles even if you are wearing rubber boots.
- If with a group, ensure there are several meters between individuals to avoid lightning jumping from person to person.
- If you feel your skin tingle, your hair stand on end, and/or you hear “crackling noises” a strike may be about to happen. If outdoors, immediately remove metal objects (including baseball cap), and get into the lightning safety crouch.

Lightning Safety Crouch
Crouch down on the balls of your feet with your feet close together. Keep your hands on your knees and lower your head. Some people may prefer to wrap their hands over their ears or cover the back of their neck. Make yourself the smallest target possible and minimize your contact with the ground. DO NOT LIE DOWN ON THE GROUND! side view front view


side view


front view

Remember, if you can hear thunder- you are close enough to be struck by lightning

Petersons quarry - Thunderstorm and Lightning Safe Work Procedure (SWP)

Helping Someone Who Is Struck By Lightning

- Get emergency help as soon as possible.
- People who have been struck by lightning do NOT carry an electrical charge and are safe to handle.
- Apply first aid, immediately.
- Common injuries include: burns, wounds and fractures.
- If numerous people have been struck treat those who are unconscious first, they are at the greater risk of dying.

Responsibilities

The Quarry Production Manager is responsible for ensuring:

- All workers are aware of, understand and comply with the safe work procedure.
- This SWP is to be reviewed annually and amended, if required.
- Any changes that have been made must be communicated to all workers with a copy posted on the Safety Noticeboard.

Workers:

- Read, understand and comply with the requirements of this SWP

Conclusion

Adherence to this SWP will ensure that weather conditions that are likely to result in lightning strike are forecast and in the unlikely event that a person is caught outside will ensure that they remain safe until the weather event has passed.

Attachment 3

Site Explosives and Blasting Risk Assessment

SITE EXPLOSIVES AND BLASTING RISK ASSESSMENT

Mine: _____

To be completed for overall site and reviewed periodically

Team members: _____

Shotfirer Representative: _____

Date: _____

Category		Risk (H / M / L)	Audit Observations - Controls
Legislation			
Competencies	Has a qualified shotfirer been engaged to conduct blasts?		
	Do all persons having unsupervised access to explosives or explosive precursors have a security clearance?		
Licences	If explosives are to be stored will they are stored in licenced premises in accordance with AS2187?		
	Has the risk of theft been considered and a security plan has been drafted (if required)?		
	Is the site allowed to blast pursuant to its development consent?		
Planning			
Notification	Has community consultation taken place with neighbours prior to blasting?		
	Has an exclusion zone been identified?		
	Has an agreed notification process to alert the community, employees & visitors that blasting will take place been developed? (signage, letter drop, verbal, sirens etc.)		
	Has a geological assessment been undertaken to identify potential hazards? (cavities, jointing, faults, weathered material etc.)		

Blasting Hazards			
Flyrock	Do procedures exist to control flyrock to a minimum? (stemming, loading, overcharging,)		
	Do procedures exist to ensure blast designs are 'signed off'?		
	Do controls include laser profiling & bore tracking?		
	Does the exclusion zone consider all possible flyrock scenarios?		
Ground Vibration	Have calculations been completed to model potential vibration levels?		
	Are monitoring devices being installed at agreed locations?		
Noise (overpressure)	Have calculations been performed to model potential noise/overpressure levels?		
	Are monitoring devices being installed at agreed locations?		
Dust and fumes	Are adverse weather conditions considered in the modelling?		
	Is dust and or fume monitoring required at close residences?		
Traffic	Has public and mine traffic been considered in relation to exclusion zones?		
	Has a communication strategy been developed to manage all traffic, clearing of exclusion zones and firing requirements?		
Managing the Blast cycle			
Transport	Are vehicles transporting explosives licenced (if on a public road) or maintained to a similar standard (on a mine site)?		
	Are procedures in place to exclude non-essential personnel from the blast area? (signage, removal of production equipment)		
	Will selected transport routes keep explosives vehicles separated from production equipment as much as possible?		
	The site has considered its response to a fire situation where explosives may be present?		
Loading	Are procedures in place to control the amount of product that is loaded into each hole?		
	Are procedures in place to manage persons working near high wall benches?		
	Are all highwalls protected by a structural barrier or a bund?		
	Is the site going to have to manage wet shots? (ground water and surface water)		

Firing	Are procedures in place to manage the clearing of exclusion zones?		
	Are procedures available to manage 'misfires'?		
	Does the misfire procedure reference AS2187?		
	Are procedures in place to ensure that anything capable of generating a fire is not carried out within 10m of explosives?		
Loss of Explosives	Has the security of the site been considered, particularly with respect to 'sleeping shots'?		
	Has the site got systems in place to identify the loss of explosives and the reporting of the loss to the police and the regulator?		
Documentation			
	Will the site be requiring blast specific risk assessments?		
	Will the site be requiring SWMS to cover all activities relating to blasting?		
	Will the site be requiring a copy of the blast report at the conclusion of the shot?		
	Are there copies of explosive legislation, standards, and codes available for persons to refer to?		
	• Explosives Act 2003		
	• Explosives Regulation 2013		
	• AS 2187 (storage, transport and use of explosives		
	• Australian Explosives Code (transporting explosives)		

Attachment 4

Blast Specific Risk Assessment Form

BLAST SPECIFIC RISK ASSESSMENT FORM

Site: _____ **Date shot commenced:** _____ **Date fired:** _____ **Shot number:** _____

Company performing Drilling: _____ **Name of Driller:** _____

Company performing Blasting: _____ **Nominated shotfirer:** _____

Person supervising Drill and Blast for Quarry: _____

	(To be completed before work commences)	Y/N
Access / layout	Is the access road to the bench adequate? (gradient, edges protected, surface)	
	Is there appropriate distance from the back row of holes to the highwall? (> ½ the face height)	
	Have all highwalls been scaled and confirmed safe?	
	Does everyone have SWMS to cover their work?	
Mark-out	Has the face been inspected from below? (no undercuts, overhangs, back break)	
	Is the shot surface reasonably smooth & clear of trip hazards?	
	Are all edges protected by a structural barrier or a bund?	
	Have communication systems been confirmed with the quarry operator?	

	(To be completed before firing commences)	Y/N
Pre Initiation	Has loading occurred as per the blast design? (No overloading, slumping, lost holes)	
	Has an exclusion zone been established?	
	Is the shotfirer able to fire the shot without any known risks to people or infrastructure?	
Agreed Alterations to Design (both parties sign to accept changes)	**Shotfirer:**	
	Manager:	
Hazards Identified and Implemented Controls (record actions)		
1.		
2.		

Drilling	Can the drill rig drill all holes perpendicular to the face?		3.	
	Can all holes be drilled on gradients within the capabilities of the drill rig?		**SIGN – OFF (all members of blast cycle team to sign off on risk assessment)**	
	Is there an exclusion zone around the boom of the rig?		1.	
	Have all water sources been identified and drawn to the shotfirer's attention?		2.	
Loading	Has the blast area been defined with signage and all non-essential equipment and people removed?		3.	
	Can all holes be loaded without a person having to breach the structural barrier or bund to load?		4.	
	What fall protection devices will be used?		**Confirmation of completed Risk Assessment by Manager**	(signature)

Attachment 5

Managers Blast Checklist

MANAGERS BLAST CHECKLIST

Site: _____ **Date shot commenced:** _____

Date fired: _____ **Shot number:** _____

Company performing Drilling: _____

Name of Driller: _____

Company performing Blasting: _____

Nominated shotfirer: _____

Person supervising Drill and Blast for Quarry: _____

Preparation:	✓or n/a
A copy of the driller's SWMS and / or contractor management plan has been obtained and reviewed	
A copy of the shotfirer's SWMS and /or Contractor Management Plan has been obtained and reviewed	
All persons have been inducted onto site	
A face & bench stability inspection has been conducted to identify any issues	
The blast design has been completed in consultation with the shotfirer and agreed upon	
A blast specific risk assessment has been completed	
Edge protection is in place prior to mark out (fencing with structural capability or bunded)	
Measure from the back row of holes to the face behind to verify that final bench width will be as designed, taking account of back break, edge protection required etc.	
Drilling:	**✓or n/a**
Drilling equipment has been inspected and confirmed 'fit for purpose'	
If the shot is laser profiled, the results have been reviewed and accepted	
If the shot is bore tracked the results have been reviewed and accepted	
A copy of the final drill log has been supplied and reviewed with the shotfirer	
Where a front hole has deviated toward the face, what is the allowable minimum burden before the load plan is modified?	
Is the actual burden along the length of each front hole within the allowable minimum burden?	
Has the driller done a risk assessment prior to drilling to ensure the bench being drilled is safe? i.e. Back break, undercut face below or above the driller, steepness of ground	

Blasting:	"How Notified" (verbal, mail etc.)	Neighbours Names	✓or n/a
All neighbours have been notified as per DA or agreed requirements *(record details)*		1.	
Environmental monitors have been positioned		2.	
Is the blast going to occur between allowable hours		3.	
Weather conditions are confirmed O.K to blast		4.	
Blast camera is in position to record shot		5.	
Sentries have been positioned		6.	
All persons on site have been accounted for and are outside of exclusion zone			
Control handed over to shotfirer	**Monitor Locations**		**✓or n/a**
All audible warning sirens have been sounded prior to blast	1.		
Reconciliation between design and actual explosives used, and powder factor, completed and reviewed with shotfirer.	2.		
Has the Exclusion zone been calculated for the shot and is it appropriate for the blast as charged?	3.		
	4.		
Post Blast Inspection:			**✓or n/a**
No misfires have been identified			
Misfires have been identified, recorded and dealt with in accordance with an approved 'misfire' procedure			
Shotfirer has handed site back to 'mine operator'			
No environmental exceedances identified	**Regulatory Notifications**		**✓or n/a**
Any blast concerns are noted on the blast plan & report			1.
Regulators have been notified of reportable incidents or exceedances *(flyrock, misfire, faulty product, exceedances)*			2.
A copy of the blast plan & record has been provided to the mine / quarry Operator			3.