COFFS HARBOUR BYPASS

Blast Management Strategy

CHBPW-FGJV-NWW-EN-STG-000001- Revision D - Coffs Harbour Bypass

FERROVIAL GAMUDA JOINT VENTURE

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Endorsed by	Duncan Thomson	Environmental Representative	21/04/2023

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A	March 2023	Draft for suitably qualified and experienced person review	
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D	June 2023	Update in response to DPE review	

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TABLES

GLOSSARY/ABBREVIATIONS

Abbreviation	Expanded Text
AA	The Acoustics Advisor for the CSSI approved by the Planning Secretary
AS	Australian Standard
BMS	Blast Management Strategy
BS	British Standard
CCS	Community Communications Strategy
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise and Vibration Management Plan
Council	Coffs Harbour City Council
CSSI	Critical State Significant Infrastructure
dB(A)	Decibels using the A-weighted scale which is accepted as being representative of the frequency response of the human ear.
DPE	Department of Planning and Environment, NSW (previously DPIE)
DPE, EESG	Department of Planning, Industry and Environment, Environment, Energy and Science Group
DPIE	Department of Planning, Industry and Environment, NSW (now DPE)
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPA	NSW Environment Protection Authority
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
EPL	Environment Protection Licence
ER	Environmental Representative
EWMS	Environmental work method statement
FGJV	Ferrovial Gamuda Joint Venture
Hz	Hertz - unit of frequency. The number of hertz equals the number of cycles per second.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
MCoA	NSW Minister's Conditions of Approval
MIC	Maximum Instantaneous Charge (maximum explosive weight per delay)
NATA	National Association of Testing Authorities
NCA	Noise Catchment Area
NML	Noise Management Level
NSW	New South Wales
NVMP	Noise and Vibration Management Plan
OOHW	Out of Hours works
PPV	Peak Particle Velocity - is the highest velocity of a particle (such as part of a building structure) as it vibrates. Most sound level meters measure root mean squared (RMS) values; it is common to approximate the PPV based on an RMS measurement. PPV is commonly used as a vibration criterion, and is often interpreted as a PPV based on the Lmax or Lmax,spec index.
Project Area	The area required to facilitate the construction of the Project (i.e. construction footprint)
The Project	Coffs Harbour Bypass
REMMs	Revised Environmental Management Measures
Sensitive receiver	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), childcare centres, passive recreation areas (including outdoor grounds used for teaching), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces), and others as identified by the Planning Secretary.
Shotfirer	a statutorily appointed Shotfirer who will hold a NSW Blasting Explosives User License, as per Part 3 of the Explosives Act 2003
TfNSW	Transport for NSW
VDV	Vibration Dose Value

1 INTRODUCTION

1.1 BACKGROUND

This Blast Management Strategy (BMS) forms part of the Construction Environmental Management Plan (CEMP) for the Coffs Harbour Bypass (the Project).

This BMS has been prepared to address the requirements of the Minister's Conditions of Approval (MCoA), the mitigation and management measures listed in the Coffs Harbour Bypass Environmental Impact Statement (EIS), the Submissions Report, Amendment Report and all applicable legislation.

The project includes a 14-kilometre bypass of Coffs Harbour, including a 12-kilometre new build from south of England's Road to Korora Hill in the north and a two-kilometre upgrade of the existing highway between Korora Hill and Sapphire. The project would provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill.

1.2 PURPOSE

Condition E61 of the MCoAs stipulates that a *"Blast Management Strategy must be prepared in accordance with relevant guidelines and in consultation with the EPA, in order to ensure that all blasting and associated activities are carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive receivers land user(s)*".

This Blast Management Strategy (BMS) is an appendix (Appendix D4) to the Noise and Vibration Management Plan (NVMP). The purpose of the BMS is to satisfy the MCoAs and provide a high-level overview of the approach to be adopted for the safe and efficient execution of controlled blasting on the Project.

1.3 OBJECTIVES

The key objective of the BMS is to minimise potential controlled blasting impacts to the local community and the built environment.

This BMS includes:

a) sequencing and review of trial controlled blasting to inform controlled blasting design;
b) regularity of controlled blasting;
c) intensity of controlled blasting;
d) periods of relief; and
e) controlled blasting program.

2 ENVIRONMENTAL REQUIREMENTS

2.1 MINISTERS CONDITIONS OF APPROVAL

The MCoA relevant to the requirements of this BMS are listed in Table 1 below. A cross reference is also included to indicate where the condition is addressed in this BMS or other project management documents.

TABLE 1 MINISTER'S CONDITION OF APPROVAL RELEVANT TO THIS BMS

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>E54</td><td>Blasting
Blasting associated with the CSSI must only be undertaken during the following hours:
(a) 9:00am to 5:00pm, Monday to Friday, inclusive;
(b) 9:00am to 1:00pm on Saturday;
(c) at no time on Sunday or public holidays; and
(d) 7:00am to 6:00pm, Mondays to Fridays, inclusive, for work required for the Roberts Hill, Shephards Lane and Gatelys Road tunnels.
Blasting may be undertaken outside the above hours where:
(a) no sensitive receivers would be impacted by blasting; or
(b) an agreement has been made with potentially affected receivers.
This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.</td><td>Section 3.4</td></tr>
<tr><td>E55</td><td>Airblast overpressure generated by the blasting associated with the CSSI must not exceed the criteria specified in Table 10 when measured at the most affected residence.
<table>
<tr><th>Receiver</th><th>Type of Blasting Operations</th><th>Airblast Overpressure Limit</th></tr>
<tr><td rowspan="2">Sensitive site</td><td rowspan="2">Blasting operations lasting more than 12 months or more than 20 blasts</td><td>115 dBL for 95% of blasts per year</td></tr>
<tr><td>120 dBL maximum limit</td></tr>
<tr><td rowspan="2">Sensitive Site</td><td rowspan="2">Blasting operations lasting less than 12 months or less than 20 blasts in total</td><td>120 dBL for 95% of blasts per year</td></tr>
<tr><td>125 dBL maximum limit</td></tr>
<tr><td>Occupied non-sensitive sites, such as factories and commercial premises</td><td>All blasting</td><td>125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect thee equipment operation</td></tr>
</table>
Source – Table J5.4 – AS 2187.2 – 2006
Note: A sensitive site includes houses and low-rise residential buildings, theatres, schools and other similar buildings occupied by people.</td><td>Section 3.6</td></tr>
</table>

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>E56</td><td>
Ground vibration generated by blasting associated with the CSSI must not exceed the criteria specified in Table 11 and Table 12 when measured at the most affected residence or other sensitive receiver.
Table 11: Ground vibration limits for human comfort and structures
<table>
<tr><th>Receiver</th><th>Type of Blasting Operations</th><th>Peak component particle velocity (mm/s)</th></tr>
<tr><td>Sensitive site</td><td rowspan="2">Blasting operations lasting more than 12 months or more than 20 blasts</td><td>5 mm/s for 95% of blasts per year</td></tr>
<tr><td>10 mm/s maximum limit</td></tr>
<tr><td>Sensitive Site</td><td>Blasting operations lasting less than 12 months or less than 20 blasts in total</td><td>10 mm/s maximum limit</td></tr>
<tr><td>Occupied non-sensitive sites, such as factories and commercial premises</td><td>All Blasting</td><td>25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer’s specifications or levels that can be shown to adversely affect the equipment operation</td></tr>
</table>
Source – Table J4.5(A) – AS 2187.2 – 2006
Note: A sensitive site includes houses and low-rise residential buildings, theatres, schools and other similar buildings occupied by people.

Table 12: Ground vibration limits for control of damage to structures
<table>
<tr><th>Receiver</th><th>Type of Blasting Operations</th><th colspan="2">Peak component particle velocity (mm/s)</th></tr>
<tr><td>Other structures or architectural elements that include masonry, plaster and plasterboard in their construction 1</td><td>All Blasting</td><td>15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.</td><td>20 mm/s 15 Hz and above</td></tr>
<tr><td>Reinforced or framed structures. Industrial and heavy commercial buildings 2</td><td>All Blasting</td><td>50 mm/s at 4 Hz and above</td><td></td></tr>
<tr><td>Unreinforced or light framed structure. Residential or light commercial type building 2</td><td>All Blasting</td><td>15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz</td><td>20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above</td></tr>
<tr><td>Unoccupied structures of reinforced concrete or steel construction</td><td>All Blasting</td><td colspan="2">100 mm/s maximum, where agreed with the structure owner.</td></tr>
<tr><td>Infrastructure service structures, such as pipelines, powerlines, cables and reservoirs.</td><td>All Blasting</td><td colspan="2">Limits to be determined by structural design methodology in consultation with the infrastructure service provider.</td></tr>
</table>
Table 12: Ground vibration limits for control of damage to structures (cont.)
Source: Table J4.5(B) – AS 2187.2 – 2006 and Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2)
</td><td>Section 3.6</td></tr>
</table>

MCoA No.	Condition Requirements	Document Reference
E57	The blasting criteria specified in the Tables in Conditions E55 and E56 may be exceeded where the Proponent has obtained the written agreement of the landowner and occupier to increase the relevant criteria. In obtaining the agreement, the Proponent must make available to the landowner and occupier: (a) details of the proposed blasting program and justification for the proposed increase in blasting criteria including alternatives considered (where relevant); (b) an assessment of the environmental impacts of the increased blasting criteria on the surrounding environment and most affected residences or other sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures; and (c) details of the blast management, mitigation and monitoring procedures to be implemented.	Section 5.3
E58	The Proponent must provide a copy of the landowner and occupier written agreement to the Planning Secretary and the EPA, including details of the consultation undertaken (with clear identification of proposed blast limits and potential property impacts), before commencing blasting at the higher limits. Unless otherwise agreed by the Planning Secretary, the following exclusions apply: (a) the landowner and occupier may terminate at any time an agreement made with the Proponent to increase the blasting criteria, should concerns made by the landowner and occupier about the blasting criteria be unresolved. Where an agreement is terminated, the Proponent must not exceed the criteria specified in the tables in **Conditions E55 and E56** for future blasting that affects the property; and (b) the blasting limit agreed to under any agreement must not exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL.	Section 5.3
E59	**Blast Management Strategy** A Blast Management Strategy must be prepared and must include: (a) sequencing and review of trial blasting to inform blasting; (b) regularity of blasting; (c) intensity of blasting; (d) periods of relief; and (e) blasting program.	Whole document
E60	The **Blast Management Strategy** must be endorsed by a suitably qualified and experienced person.	Section 7.3 & Appendix 2
E61	The **Blast Management Strategy** must be prepared in accordance with relevant guidelines and in consultation with the EPA, in order to ensure that all blasting and associated activities are carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive receivers.	Section 7.1
E62	The **Blast Management Strategy** must be submitted to the Planning Secretary for information no later than one month before the commencement of blasting. The Strategy as submitted to the Planning Secretary, must be implemented for all blasting activities.	Section 7.1

2.2 REVISED ENVIRONMENTAL MANAGEMENT MEASURES

Relevant Revised Environmental Management Measures (REMMs) derived from Chapter 6 of the CHB Submissions Report are listed in Table 2 below. This includes reference to required outcomes, the timing of when the commitment applies, relevant documents or sections of the environmental assessment influencing the outcome and implementation.

TABLE 2 REVISED ENVIRONMENTAL MANAGEMENT MEASURES RELEVANT TO THIS BMS

REMM Ref #	Outcome	Commitment	Timing	Document Reference
NV03	Construction and vibration impacts	Building condition surveys will be undertaken for buildings and other structures within the following distances from the main vibration generating activities: • Blasting operations – within 500 m • Pile driving – within 250 m • Excavating by hammering or ripping – within 100 m • Vibrating compaction > 7 tonne plant – within 50 m • Vibrating compaction < 7 tonne plant – within 25 m • Demolition of structures – within 50 m. A copy of the building condition survey report will be provided to the property owner.	Prior to construction	Section 5.1
NV10	Blasting	A Blast Management Strategy will be prepared as part of the Noise and Vibration Management Plan. The strategy will aim to demonstrate that all blasting and associated activities will be carried out in a manner that will not generate unacceptable noise and vibration impacts or pose a significant risk impact to residences and sensitive receivers. The Blast Management Strategy will address: • Details of blasting to be performed, including location, method and justification of the need to blast • Identification of any potentially affected noise and vibration sensitive sites and structures • Establishment of appropriate criteria for blast overpressure and ground vibration levels at each category of noise sensitive site • Details of the storage and handling arrangements for explosive materials and the proposed transport of those materials to the construction site • Identification of hazardous situations that may arise from the storage and handling of explosives, the blasting process and recovery of the blast site after detonation of the explosives Determination of potential noise and vibration and risk impacts from blasting and appropriate best management practices • Community consultation procedures.	During construction	Whole document

2.3 LICENSING REQUIREMENTS

The Project currently holds an Environmental Protection Licence (EPL) (Licence #21766) which includes conditions relating to controlled blasting and are listed in Table 3. A cross reference is also included to indicate where the condition is addressed in this BMS.

TABLE 3 EPL CONDITIONS RELEVANT TO THIS BMS

EPL Ref#	Condition	Document Reference
L5.1	When blasting operations occur at the premises, the airblast overpressure level must not exceed limits in condition E55 of the Minister of Planning's Conditions of Approval.	Section 3.6
L5.2	When blasting operations occur at the premises the ground vibration peak particle velocity must not exceed limits in condition E56 of the Minister of Planning's Conditions of Approval.	Section 3.6

EPL Ref#	Condition	Document Reference
L5.3	To determine compliance with condition(s) L5.1 and L5.2: a) Airblast overpressure and ground vibration levels must be measured and electronically recorded for all blasts carried out in or on the premises at location(s) representative of the most effected Noise Sensitive Receiver(s) that is not owned by the licensee or subject to a private agreement with the licensee; b) Instrumentation used to measure the airblast overpressure and ground vibration levels must meet the requirements of Australian Standard AS 2187.2-2006: Explosives—Storage and use Part 2: Use of explosives; and c) Error margins associated with any monitoring equipment used to measure airblast overpressure and ground vibration levels are not to be taken into account in determining whether or not the limit has been exceeded.	Sections 3.8 and **Error! Reference source not found.**
L6.6	Unless otherwise specified by another condition of this license, blasting operations at the premises may only take place between the operating hours in the table below: Day / Time Monday to Friday / 9:00am to 5:00pm Saturday / 9:00am to 1:00pm Sunday or Public Holidays / NIL *Note: Where compelling safety reasons exist, the EPA may permit a blast to occur outside the above hours. A prior written request for approval of any such blast must be made to the EPA and be supported with justification to the satisfaction of the EPA.*	Section 3.4 For the avoidance of doubt, written request for EPA approval to blast outside the hours specified in L6.6 is only required where a compelling safety reason exits. EPA approval is not required for out of hours blasting undertaken where no sensitive receivers would be impacted, or an agreement has been made.
L6.8	Exemptions to standard constructions hours for tunnelling and blasting, and associated works, are to be in line with Minister of Planning's Conditions of Approval.	Noted. Controlled blasting within the tunnels and portals at Roberts Hill, Shephards Lane and Gatelys Road will be undertaken within the extended hours of 7:00am to 6:00pm, Mondays to Fridays permitted under CoA E54(d).

2.4 BLASTING EXPLOSIVES USER LICENCE

Each controlled blast will be executed by a statutorily appointed Shotfirer who will hold a NSW Blasting Explosives User License, as per Part 3 of the *Explosives Act 2003*.

2.5 APPLICAPLE LEGISLATION, GUIDELINES, CODES AND STANDARDS

Controlled blasting will be undertaken in accordance with the relevant legislation, guidelines, codes and standards including:

- *NSW Explosives Act, 2003;*
- *NSW Explosives Regulation, 2013;*
- the General explosive licence and security clearance conditions under the NSW explosives act and regulation;
- Australian Explosives Code;
- ANZEC Guidelines for Blasting Pressure and Ground Vibration and
- AS2187: Explosives – storage transport and use.
-

A Notification of Blasting Activity will be lodged no less than seven working days before the intended blast date with SafeWork NSW by the holder of a blasting explosives user licence. The notification will be valid for a single event, or for a maximum of three months where there are multiple blasts at the same work location. Any subsequent changes to the notified details shall be provided to SafeWork NSW by email prior to the controlled blasting activity (note: the licence holder must retain evidence of the date/time the notification or variation was submitted via e-mail date stamp).

2.6 SECURITY CLEARANCE

Any persons, who will perform any work with explosives without being under the direct supervision of a Shotfirer, will require a security clearance under the NSW Explosives Regulation, previously named Unsupervised Handling of Explosives License.

2.7 RELEVANT DOCUMENTS

The following guidelines and industry documents are relevant to this document:

- *Explosives Act 2003*
- *Explosives Regulations 2013*
- Code of Practice – WorkCover - Tunnels Under Construction - 2006
- Code of Practice – AEISG - Mobile Processing Units - 4th Edition, September 2018
- Code of Practice – Control of Major Hazard Facilities - October 2002
- Australian Code for The Transport of Explosives by Road and Rail - 3rd Edition
- Australian Standard 2187.1-1998 Explosives — Storage, transport and use, Part 1: Storage
- Australian Standard 2187.2-2006 Explosives — Storage and use, Part 2: Use of explosives
- RMS Specification R44 – Earthworks (Cl. 4.5; Cl. 4.7 Blasting and ANNEXURE R44/A6 Blasting)
- RMS Specification G36 – Environmental Protection
- WorkCover Licensing Requirements
- German DIN 4150: Part 3 – 2016 Effects of Vibration on Structure (DIN, 2016)
- Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990).

FGJV are currently undertaking a review of other specifications and industry research related to controlled blasting in close proximity to elements of the Project asset such a tunnel support structures (i.e. shotcrete and bolts) and bridge abutments. This review will be used to inform element-specific vibration limits should the criteria contained in Section 3.6 be considered unsuitable.

3 SCOPE OF CONTROLLED BLASTING

3.1 JUSTIFICATION OF NEED TO BLAST

Geotechnical investigations along the Project alignment have identified areas of high strength moderately weathered to fresh rock material. These areas are considered too hard to efficiently and productively remove using typical mechanical excavation techniques.

With mechanical excavation techniques, including rock hammering and ripping, excavation would take approximately five times longer than with controlled blasting. This increase in duration would also expose sensitive receivers to longer periods of noise and vibration impacts. Rock hammering is also considered a highly noise intensive and annoying activity, and often results in community complaints. Therefore, blasting in areas of hard rock would reduce rock hammering and its associated noise impacts. Controlled blasting is therefore the most efficient and less impactful excavation method in areas of hard rock and critical for the on-time completion of the Project works.

Due to the design size of the tunnels and geology, controlled blasting was also determined as the most feasible excavation method for tunnel excavation over mechanical excavation with roadheaders and/or rock hammering.

3.2 LOCATION, SCOPE AND PROGRAM OF BLASTING

Ferrovial Gamuda Joint Venture (FGJV) propose to undertake controlled blasting in areas of hard rock material where conventional excavations methods would not be efficient. Controlled blasting is proposed for the heading, bench or cross passages in Gatelys Road Tunnel, Shepherds Lane Tunnel and Roberts Hill Tunnel, and in various open cuttings along the CHB alignment.

Proposed locations of controlled blasting are provided in Table 4 and shown in Appendix 3. These locations will be subject to detailed design and further geotechnical investigations

Controlled blasting shall be undertaken with bulk emulsion and/or packaged explosive types, depending on factors such as, but not limited to, blast size, blasting frequency and logistical implications.

It is envisaged that controlled blasting may occur up to four times per day in tunnels (i.e. two blasts per tunnel drive) and two times per day in cuttings. This will be subject to final construction methodology and schedule requirements.

TABLE 4 PROPOSED CONTROLLED BLAST LOCATIONS

Cut / Tunnel	From Chainage	To Chainage	Estimated Blast Volume (m3)	Estimated Number of Blasts	Estimated Timing
2	10,289	10,596	59,495	6	Jul-23 to Oct-23, Mar-25 to Apr-25
3	11,460	11,567	5,496	1	Aug-23 to Sep-23
4	12,900	13,417	184,220	12	Sept-23 to Apr-24
5A	13,570	13,631	28,538	3	Aug-23 to Sep-23
Roberts Hill	13,620	13,860	32,127	97	Dec-24 to Jun-25
5B	13,795	14,171	243,289	16	Dec-23 to May-24
6	14,215	14,423	82,610	8	Jun-24 to Jul-24
8	15,366	15,487	27,667	3	May-24 to Jun-24
9	15,565	15,816	89,595	9	Aug-24 to Sep-24
10	15,995	16,154	37,175	4	Jun-24 to Sep-24
11	16,345	16,462	36,532	4	Oct-24 to Nov-24
12	16,776	16,871	41,691	4	Mar-24 to May-24
13A	16,937	16,995	38,513	4	Nov-23 to Dec-23
Shepherds Lane	17,010	17,340	62,980	170	Aug-24 to Mar-25
13B	17,310	17,344	7,599	1	Nov-23, May-24

Cut / Tunnel	From Chainage	To Chainage	Estimated Blast Volume (m3)	Estimated Number of Blasts	Estimated Timing
14	17,484	17,524	2,050	1	Jun-24
15A	18,825	18,891	3,976	1	Aug-23 to Sep-23
Gatleys Road	18,920	19,360	69,914	231	Nov-23 to Nov-24
15B	19,285	19,353	24,574	2	Jul-23 to Aug-23
16	20,232	20,632	476,442	32	Sep-23 to May-24
18	21,225	21,350	35,882	4	Oct-23 to Nov-23, Aug-25
19	21440	21,573	5,937	1	Nov-23 to Dec-23
20	23,227	23,378	4,741	1	Jan-24 to Feb-24
TOTAL			**1,601,043**	**615**	

Notes:

(1) Blast locations may change following finalisation of detailed design and further geotechnical investigations. Some cuttings with a smaller quantity of high strength rock will be excavated using conventional methods if possible. They have been included in this BMS for completeness and to ensure proper planning is undertaken should blasting be required.

(2) Quantities above may change subject to ground conditions encountered on site.

3.3 POTENTIALLY-AFFECTED SENSITIVE RECEIVERS

Sections 5.4.1 and 5.4.2 of the Updated Noise and Vibration Impact Assessment (Arup, 2020) (Amendment Report) identify sensitive receivers along the alignment and groups them into 'Noise Catchment Areas' (NCAs). In the context of controlled blasting, potentially affected sensitive receivers are those located above or immediately adjacent to the alignment. This includes receivers in the following NCAs:

- NCA 2-NCA 7, NCA 10-NCA 21, NCA23 and NCA 28.

Pursuant to Sections 5.4.1 and 5.4.2 of the Amendment Report, potential overpressure and ground vibration impacts from controlled blasting shall be managed through site and blast-specific assessments. These assessments will be based on the closest receivers to the location of each blast. Further detail on the assessment process is outlined in Section 3.7 and Section 3.8.

3.4 BLASTING TIMING & REGULARITY

Pursuant to CoA E54, it is envisaged that controlled blasting may be undertaken daily during the permitted hours of:

(a) 9:00am to 5:00pm, Monday to Friday, inclusive;

(b) 9:00am to 1:00pm, Saturday; and

(c) at no time on Sunday or on a public holiday; or

(d) 7:00am to 6:00pm, Mondays to Fridays, inclusive, for work required for the Roberts Hill, Shephards Lane and Gatelys Road tunnels.

Controlled blasting may be undertaken outside the above hours where:

(a) no sensitive receivers would be impacted by controlled blasting; or

(b) an agreement has been made with potentially affected receivers.

Overall, controlled blasting across for the Project is anticipated to start about August 2023 and will continue until June 2025.

Tunnels

An indicative program for blasting within the tunnels is provided in Table 4. It is envisaged that controlled blasting may occur up to four times per day, in the eventual case of blasting headings and bench concurrently. This will be very unlikely to happen in the same tunnel, however, may occur in two tunnel locations. This will be subject to final construction methodology and schedule requirements

Open Cuttings

In open cuttings, it is envisaged that blasting may occur up to two times per week in any single location. An indicative program for blasting within the open cuttings is provided in Table 4.

3.5 BLAST DESIGN

Tunnels

In general, the scale of controlled blasts within the tunnel will be led by the requirement to comply with vibration and airblast overpressure criteria at the adjacent infrastructure around the tunnel. The blast design is therefore based upon:

- A small blasthole diameter, most likely less than 64mm, drilled using mechanical equipment;
- A blasthole length of up to 5 metres although shorter blastholes will be required where control over the explosive weight is required;
- A nominal blasthole pattern with a spacing between blastholes of around 1 metre depending upon rock strengths, blasthole diameter and allowable explosive quantity; and
- Single or multiple explosive charges may be utilised per blasthole, which may be independently sequenced if required to achieve vibration compliance.

Blast patterns for the tunnelling works will be based on the allowable explosive charge weight per delay identified from modelling results to ensure compliance with vibration criteria at the nearest sensitive receivers. As blasting approaches closer to sensitive receivers, charge weights may need to be reduced and may require shortening of blastholes, effectively reducing the length of the advance (or depth) that each blast achieves. Conversely, where blasting occurs further from a sensitive receiver as a result of the depth of the tunnel or a greater horizontal separation distance, and larger explosive weights per blasthole can be used, the blast pattern may be expanded, and/or blasthole length increased.

Open Cuttings

Controlled blast management and mitigation practices for open cuttings have been developed by FGJV to minimise the impact of blast fumes, dust, odour, fly rock, ground vibration and airblast overpressure. The procedures aim to minimise the impacts to human safety, property and public infrastructure.

A number of blast management controls are incorporated into the open cutting blast design process. These include:

- Limiting blast Maximum Instantaneous Charge (MIC) via bench height control or application of deck charges;
- Implementing a delay detonation system to minimise hole interaction;
- Use of appropriate stemming length and stemming quality to ensure maximum confinement of the explosives;
- Orientation of the blast face away from sensitive receivers; and
- Monitoring weather conditions and adjusting activities where possible

3.6 INTENSITY OF BLASTING

The intensity of blasting may be described in terms of the environmental impacts of blast vibration and air overpressure. Blast assessments and modelling will be undertaken for each blast area to predict the intensity of vibration and airblast overpressure and will be reviewed against the applicable criteria detailed in

Section 3.6.1. Comparison against these criteria will enable FGJV to identify areas where written agreements with affected receivers would be required to enable to efficient blast designs.

Preliminary assessments of vibrations intensity have been undertaken for the three tunnels and Cut 16, which is the largest open cutting to be blasted, as summarised below. These assessments would be further refined during the blast design and assessment process and updated to include airblast overpressure predictions. Refer to Section 3.7 for further detail on the blast assessment process.

Tunnels

Preliminary estimates of vibration intensity for the three tunnels based on 51mm diameter holes, 2m/3m charge height, k = 2660 and beta = -1.6 have modelled the following at:

- Roberts Hill: Peak ground vibration of 5mm/s at the nearest residential receiver on Buchanans Rd which is located approximately 107m from the blast area
- Shephards Lane: Peak ground vibration between 2-5 mm/s at the nearest residential receiver on Shephards Lane which is located approximately 192m from the blast area
- Gatelys Road: Peak ground vibration of 5mm/s at the nearest residential receiver on Gatleys Road which is located approximately 117m from the blast area

Based on this preliminary assessment, written agreements are not anticipated to be required for tunnel blasting.

Open Cuttings

Preliminary estimates of vibration intensity for Cut 16 based on an MIC 35.75kg, 89mm diameter holes, 5m charge height, k = 1140 and beta = -1.6 have modelled the following:

- Peak ground vibration of 5.1mm/s at the nearest residential receiver on Bruxner Park Road which is located approximately 175m from the blast area
- Peak ground vibration of 22.3mm/s at the nearest structure (Fire Station at Mackays Road) which is located approximately 70m from the blast area
- Airblast is predicted to be 123 dBL at the nearest sensitive receiver to Cut 16 (175m) based on the formula included in Section 3.7 below.

Based on this preliminary assessment, written agreements would be required from these receivers to enable an efficient blast design and productive blast program at Cut 16. Refer to Section 5.3 for further detail on the process for obtaining written agreements.

3.6.1 APPLICABLE BLAST CRITERIA

Pursuant to CoA E55, airblast overpressure generated by the controlled blasting associated with the CSSI must not exceed the following criteria (unless written agreement is obtained in accordance with MCoA E57 and E58):

Receiver	Type of Blasting Operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year 120 dBL maximum limit
Sensitive Site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year 125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Source – Table J5.4 – AS 2187.2 – 2006

Pursuant to CoA E56, ground vibration generated by controlled blasting associated with the CSSI must not exceed the following criteria for human comfort and structures (unless written agreement is obtained in accordance with MCoA E57 and E58):

Receiver	Type of Blasting Operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year 10 mm/s maximum limit
Sensitive Site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All Blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Source – Table J4.5(A) – AS 2187.2 – 2006

Compliance against the above overpressure and vibration limits applicable to sensitive sites for blasting operations lasting more than 12 months or more than 20 blasts will also meet the human comfort exposure limits contained in the *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZEC,1990).

Pursuant to CoA E56, ground vibration generated by controlled blasting associated with the CSSI must not exceed the following criteria for control of damage to structures:

Receiver	Type of Blasting Operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction 1	All Blasting	15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings 2	All Blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building 2	All Blasting	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied structures of reinforced concrete or steel construction	All Blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, powerlines, cables and reservoirs.	All Blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source: Table J4.5(B) – AS 2187.2 – 2006 and Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2)

As detailed in Section 2.7, FGJV is currently reviewing specifications and research available within the industry to determine whether vibration criteria that differs from the tables above are required for controlled blasting in the vicinity of Project asset elements such as tunnel support structures (i.e. shotcrete and bolts) and bridge abutments.

3.7 BLAST MODELLING OF EXPLOSIVE QUANTITIES

Initial blast designs will adopt a conservative approach to build confidence in the vibration and airblast models and embed safe and efficient blast practices. In accordance with AS 2187, this modelled approach will be based on the following equations:

Vibration (V) Formula:

$$V = 1140\left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

Airblast Formula:

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

where

P = pressure, in kilopascals

Q = explosives charge mass, in kilograms

R = distance from charge, in metres

K_a = site constant

a = site exponent

The data from the trial blasts as well as each subsequent controlled blast shall be fed back into the vibration and airblast equations above to ensure ongoing refinement. Controlled blast design is therefore an iterative process whereby vibration contour drawings and airblast predictions will be updated where necessary and used by the team to ensure that the correct notifications and property condition surveys have been put in place.

Blast patterns will also be modified and designed according to the MIC and the criteria that must be achieved. The measured vibration and airblast results after each blast will be analysed and adjustments to subsequent designs will be determined accordingly.

3.8 CONTINGENCIES AND TRIAL BLASTING

The implementation of controlled blasting will adopt a conservative approach. An initial, small-scale trial blast will be designed using conservative estimates of vibration prediction constants and be undertaken within a representative geological area along the alignment. The trial blast will not provide any detail on fragmentation or diggability, but rather information on the vibration attenuation over distance. These relationships are integral in determining the scale of blasting (i.e. advance rate per day) that can be used.

If the trial blast indicates that the modelling has underestimated the level of vibration and/or airblast overpressure, several mitigation measures may be adopted, including:

- limiting the quantity of explosive by further reducing the length of the blasthole or the length of the explosive column;
- reducing the blasthole diameter; and
- use of alternative explosive types.

To ensure the trial blast complies with the applicable criteria (refer to Section 3.6), airblast levels will be predicted by the specialist blast consultants as part of the blast design.

Open Cuttings

A trial blast will be completed at the first cutting to be blasted on the Project.

The open cutting trial blast MIC will be determined by limiting the vibration and airblast at the nearest receiver to less than 5mm/s and 115dBl when calculated using a conservative site constant k = 1850 and ka = 10 with site exponents fixed at a = -1.45 and B = -1.6.

The exact MIC value for the trial blast will be determined when the location of the trial blast is confirmed on site as it will depend on both the actual distance to the nearest receiver, aspect and the depth of rock to the next bench down once the overburden is removed.

Should significantly different geology be encountered in a new location, FGJV will assess the need for another trial blast and undertake one if required.

Tunnels

The blasting trials are anticipated to consist of three trial blasts at each portal, consisting of approx. 1kg, 3kg and 7kg of MIC, respectively. These MIC volumes are estimates only and are anticipated to change during the trials depending on the result of preceding trial blasts. Should there be sufficient baseline data available from the portal blasting to determine a robust and appropriate k-value, tunnel-specific trial blasts may not be required.

The vibration intensity associated with the trial blast MIC quantities have been designed to comply with the limits detailed in Section 3.6.1. This modelled compliance is shown in the preliminary blast assessment for Gatleys Tunnel in Figure 1 as the predicted surface vibration contours are associated with MIC equal to and/or greater than those proposed for the trial blast.

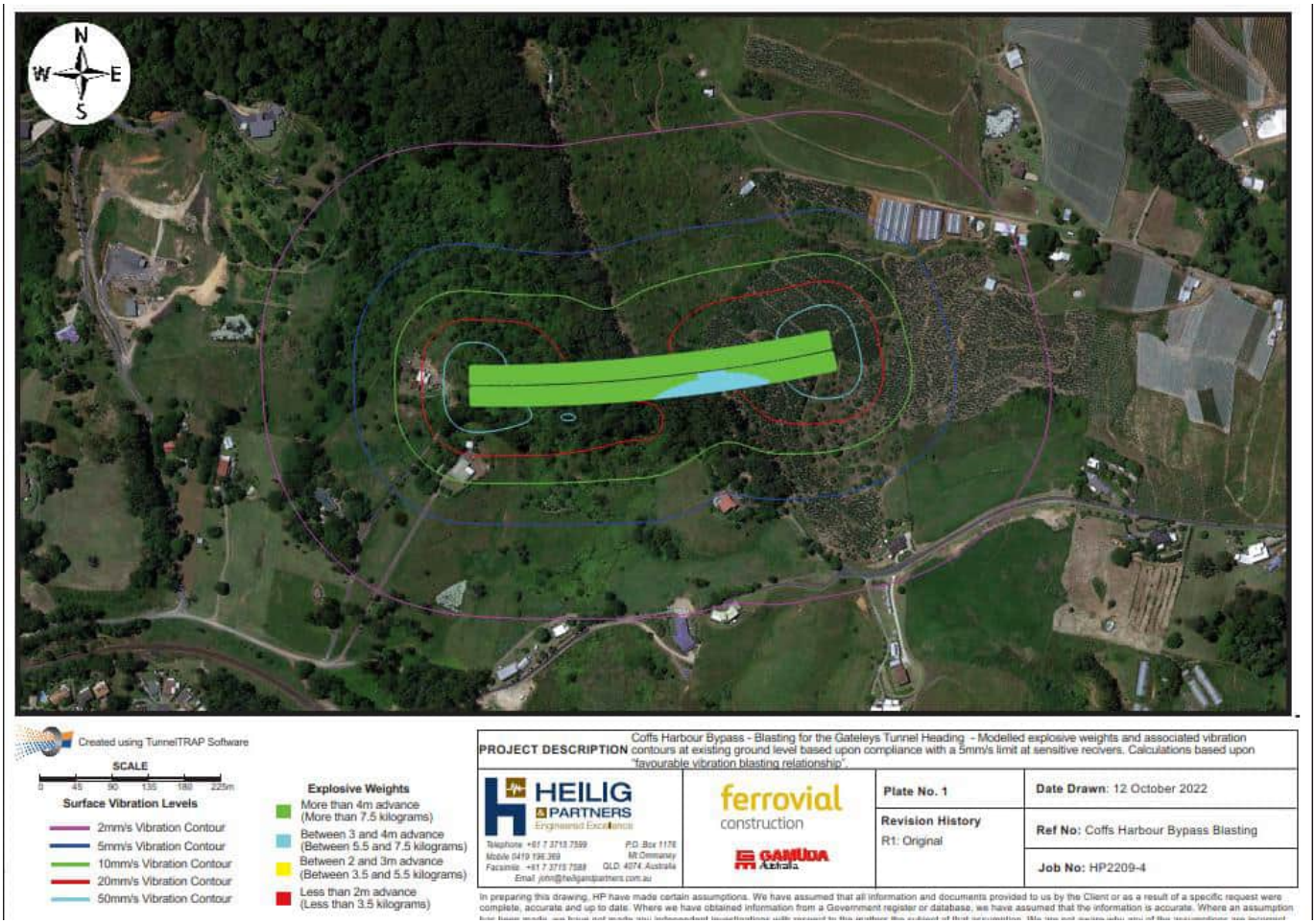

FIGURE 1 PRELIMINARY MIC AND VIBRATION INTENSITY FOR GATLEYS TUNNEL

The vibration monitoring results from the trial blast will then be used to back-calculate the Project-specific k value to be used for the baseline design of subsequent production blasts across the whole alignment. The Project-specific k value will also be continually validated with vibration monitoring results throughout blasting operations to ensure it remains appropriate in the numerous blast locations along the alignment.

The air blast model will be modified by fixing the site exponent a at -1.45 and back-calculating the site constant Ka, which will provide a different site constant value for confined tunnel blasts vs open cuttings.

3.8.1 TRIAL BLAST MONITORING

Vibration monitoring will be undertaken during the trial blast to assess the quantity of MIC against attenuation of vibration over distance within the subject geology. External geophones (transducers) will monitor ground vibration (Peak Particle Velocities - PPV) in three directions (transverse, vertical and longitudinal particle velocities) and report the level in mm/s. The recording duration will be set to exceed the duration of the blast to ensure that the entire event is captured.

Airblast overpressure monitoring will also be undertaken in accordance with As 2187.2-2006 Appendix J, including using a microphone orientated towards the trial blast location, with a frequency range of at lkeast 2Hz to 250Hz with the results expressed in decibels Linear (dBL). The absolute maximum pressure level will be recorded for the full duration of the blast event.

Monitoring locations will be identified prior to the trial blast as being fit for use (AS 2187) by the blasting consultant, and approval received from the property owners as required. At least five monitoring locations will be selected and will generally include:

- The nearest five residential properties generally a property towards the north, south, east and west of each blast zone, or as otherwise determined by the expert blasting consultant;
- Any heritage item at risk of damage, that is within 50 metres of each blast zone (this refers to heritage listed buildings/infrastructure or other items, and not Heritage Conservation Areas);
- Commercial properties that contain potentially sensitive equipment, such as electronic or scientific apparatus or other equipment with tight tolerances for vibration impacts;
- As otherwise required under the Project EPL

Where property owner approval is not obtained, alternative locations may need to be utilised in appropriate public areas.

Trial blast data will be reviewed by the expert blast consultant for analysis, to identify a relationship between MIC and vibration impacts. Airblast data will also be reviewed against the applicable criteria (refer to Section 3.6), as well as predicted levels. Should monitored levels be found to differ from predicted levels, the prediction formula will be updated to ensure it remains appropriate for subsequent controlled blasting.

Further detail on controlled blast monitoring is provided in Section 6.

4 CONTROLLED BLAST MANAGEMENT

4.1 PRE-BLAST ACTIVITIES

Prior to undertaking drilling and blasting, the following actions will be completed:

- Provide reasonable notice of intended blasting and the anticipated impacts on the nearby properties, occupants of these premises, authorities and any affected public utilities owners;
- Submit blasting notification to Safework NSW detailing the proposed blasting activities for the intended period of blasting;
- A condition survey report of adjacent infrastructure, including an assessment of any increased susceptibility of the infrastructure to vibration related effects;
- A broad scale visual assessment of surrounding areas of interest/concern to ensure no external hazards are present and/or precluding blasting from occurring; and
- Preliminary review assessing the expected maximum explosive quantities for control of vibration.

4.1.1 BLAST NOTIFICATION

A blast notification form will be completed prior to undertaking blasting activities and submitted to the following regulators and government agencies on a weekly basis:

- Safework NSW
- NSW Police
- Rural Fire Service
- Fire and Rescue NSW
- State Emergency Service
- City of Coffs Harbour
- EPA.

4.1.2 PREPARATION OF DRILLING AREA

The area where blasting will be undertaken will be prepared to a condition to enable accurate drilling to achieve both the alignment and grade requirements.

4.1.3 DESIGN AND LAYOUT OF BLASTHOLES

Drilling of blastholes will be completed using well maintained, hydraulic drill equipment. Key considerations include:

- The Shotfirer and/or blasting engineer will establish a drilling pattern, including blasthole lengths, and record the information on a blast pattern design worksheet;
- The type and quantity of explosive which will be loaded into the blastholes will be identified and clearly marked on the plan;
- The total quantity of explosive for each blast will be calculated and reconciled against the designed quantity;
- The nearest distance to the closest property, or other sensitive receiver or infrastructure, will be used to calculate the expected level of vibration;
- Appropriate burden cover for drill angles in will be accommodated in blast design
- Blast face to be directed away from receiver if possible

- Ensure stemming material is suitable and placed in accordance with the standard
- Ensure charge depth is suitable; and
- Reasonable and feasible noise and vibration mitigation measures contained in the Construction Noise and Vibration Management Plan (CNVMP)

4.1.4 TUNNEL WALL CONTROL

Protection of the walls of the tunnels may be improved by adjusting the explosive loading practices around the perimeter of the excavation, including the use of a reduced hole spacing and/or adjusted explosive loading. The perimeter drill holes will be accurately set up in terms of their alignment to minimise drilling error over depth.

4.1.5 BLASTHOLE DRILLING

Blasthole drilling will only be completed once the area has been cleared to establish a reasonable platform to ensure that blastholes can be accurately drilled, both in terms of their inclination as well as the depth. Careful placement of drill holes to ensure the tunnel and cut batter presplit profile is achieved is critical to the design.

4.1.6 TRANSPORT AND STORAGE OF EXPLOSIVES

Transport and storage requirements for blasting activities will be managed by the drill and blast contractor in accordance with the NSW Explosives Act 2003 and the NSW Explosives Regulation 2013.

It is anticipated that explosives for controlled blasting of open cuttings will be stored off site under the appropriate authority license and delivered to site as required with no explosive will be stored on site. The quantity of explosive and detonators required for each blast will be transported daily from the magazines in approved/licenced vehicles. Any unused explosive will be returned to the offsite magazine at the completion of loading.

For controlled blasting for the tunnels, FGJV are investigating opportunities to establish an on-site magazine to store explosives. An Explosive Storage Licence under the NSW Explosives Regulation 2013 would be obtained from SafeWork NSW prior to on-site storage with a Nominated Authorised Person from FGJV appointed. Any explosive storage will comply with relevant legislation and guidelines including:

- AS 2187 Explosives – Storage, transport and use
- AS 4326 The storage and handling of oxidizing agents
- Australian Explosive Industry And Safety Group Inc. Code of practice. Storage and handling of UN3375.

4.1.7 PRIMING AND LOADING OF THE BLASTHOLE

The following key issues will be included as part of the blasthole priming and loading methods:

- Prior to loading a blasthole, the Shotfirer will confirm the depth of the blasthole is consistent with the depth indicated on the blasting plan;
- Where blastholes are loaded with packaged product, the diameter, length and number of cartridges will be recorded;
- Where the blastholes are loaded with bulk emulsion, the quantity of explosive will be carefully controlled and monitored to be consistent with the designed quantities;
- Any overloaded blastholes shall be remediated as directed by the Shotfirer and may include removal of the excess explosive, or implementation of additional burden/cover;
- The maximum quantity of explosive loaded into any blasthole will be reported on the blast loading plan; and
- 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 and confirmed as acceptable prior to initiating the blast.

4.1.8 METEOROLOGICAL ASSESSMENT

Meteorological conditions are monitored by an FGJV Senior Project Engineer and the blast controller prior to all blasts (in the days leading up to and the day of blasting). Actual conditions on site are reviewed the morning of the blast by the blast controller to determine if the blast should go ahead. Conditions assessed include:

- Wind speed
- Wind direction
- Forecast rainfall
- Rainfall for previous days leading up to the blast

Where unfavourable weather conditions are observed that could affect the safety of the blast, the decision will be made to postpone the blast. Safety of the blast may refer to Airblast risks, fumes and safe access.

4.1.9 CLEARANCE PROCEDURES

Safety of personnel within work areas will be achieved through documented clearance procedures. Procedures will be completed for any controlled blasting that may be required.

Prior to blasting, all personnel will be evacuated to a safe working area. Blast safety procedures will be developed and implemented. Safe working areas will be determined by the Shotfirer in consultation with other relevant site personnel in accordance with risk management procedures. These areas will contain a permanent source of fresh air and maintain positive means of egress in the event of an emergency. These locations are to be risk assessed individually and comply with WorkCover NSW Work Health and Safety requirements.

Personnel evacuation and clearance will be controlled by FGJV under the direction of the Shotfirer. An electronic monitoring system which can be monitored from a safe working area will be the primary means of personnel accountability. All FGJV personnel, sub-contractors and visitors will use an electronic system as part of the site-specific induction for personnel entering the relevant area of works.

Blast sentries/guards will be positioned at strategic locations as determined by the Shotfirer in consultation with other relevant site personnel. A final clearance shall be conducted prior to initiation. Upon confirmation to the Shotfirer and senior supervisors that all personnel are evacuated from the clearance area, the direction to commence firing procedures will be given. Initiation of the blast will be conducted by the Shotfirer only when they are satisfied that it is safe to do so. The Shotfirer will have full discretion to terminate the blast sequence at any time if they determine it is unsafe to proceed.

Following the blast, blast fumes will be given appropriate time to clear. This complies with the NSW “Tunnels Under Construction Code of Practice 2006” air quality and ventilation systems guidelines. When it is determined safe, the Shotfirer will inspect the blast location and confirm complete detonation. Upon confirmation that the area is safe to enter the ‘All Clear’ will be given by the Shotfirer and personnel allowed to re-enter.

In accordance with the blast safety procedures, the Shotfirer will ensure relevant controls are implemented to neutralise and make safe the blast area and ensure geotechnical risks are managed before allowing personnel entry.

4.2 INITIATION

Blasting, including the loading and sequencing of blastholes will be completed in accordance with all applicable NSW legislation. Key issues include:

- The Shotfirer/Blasting Engineer will determine the initiation sequence;
- Preference shall be given to the use of electronic detonators to ensure maximum control over vibration levels; and

- A blast initiation plan shall be documented for each blast and assessed for likely compliance with imposed vibration criteria.

4.3 FIRING

Firing of the blast will be under the control of the Shotfirer. The following key issues will be confirmed:

- The community team have informed the potentially affected persons of the intent to blast;
- The area will be inspected to ensure all personnel are a safe distance from the blasting activities; and
- Put in place all control points to block access to the tunnel or cuttings, including internal access other than ramps, at a safe distance from the blast area. The safe distance will be determined through standard risk assessment procedures.

4.4 MISFIRES

Should a misfire (failure of an explosive to detonate) occur, an investigation into the root cause will be conducted including a review of the loading and firing process, review of the blast design and initiation sequence, and analysis of the performance of the initiation system. Following a blast, the re-entry process is as follows:

- After the blast is fired and the tunnel area has been adequately ventilated, the Shotfirer will visually inspect the entire shot for evidence of misfires.
- If found, the Shotfirer will notify FGJV immediately along with the blast guards; and
- The Shotfirer will decide the safe and appropriate method of action.

If a misfire (unexploded explosive) is detected during excavation:

- Stay well clear;
- Warn all personnel in the area;
- The Project Area supervisor will notify the Shotfirer immediately; and
- A detailed and safe excavation plan will be formulated and implemented.

4.5 FLYROCK

All blasts shall be designed with due consideration for the likelihood of, and tolerance for, flyrock.

Blasting in the underground environment is often highly energetic and may generate significant flyrock. The need to control this flyrock will vary on the location of blasting within the tunnel and whether there are sensitive services or equipment in the vicinity that may be damaged. Flyrock control in the tunnel environment may be achieved through the use of stemming and/or blast mats or other barricades.

Conversely, blasting portals or ramps that are open to the surface require complete control over flyrock. Surface blasts shall be designed to minimise flyrock using a number of methodologies including, but not limited to:

- Increased stem heights based on Scaled Depth of Burial Calculations; and
- Importation of ‘false burden’ where required to provide additional blast cover.

4.6 FUMES

Blast fumes may result from non-ideal detonation of explosives due to a number of factors, including presence of ground water and lack of confinement. Fumes are typically visible as reddish or orange clouds, can be odorous and can pose a health risk if exposure occurs. Gases produced during blasting usually disperse rapidly and pose no acute health risk.

Prevention of fume due to groundwater is a function of using the appropriate explosive type for the ground conditions and this shall be assessed collaboratively by the blasting contractor and/or a specialist blasting consultant. Fumes due to lack of confinement are generally a result of soft ground conditions which is not expected to be the case on this Project.

Should fumes occur, potential impacts on surrounding receivers will be minimised through the establishment and maintenance of blast exclusions areas until fumes have cleared. Standard exclusion zones are expected to be adequate to allow blast fume to clear should it occur, but if required the shotfirer's siren and UHF radio will be used with the assistance of blast guards to expand the exclusion zone in order to keep people clear of blast fume. Where prevailing weather conditions indicate a plume of blast fumes are likely to approach a nearby sensitive receiver, the receiver will be evacuated to ensure the exclusion zone is maintained.

For controlled blasting within the tunnels, gas monitors will be utilised in areas where gases have the potential to accumulate to ensure levels are safe before personnel re-enter work areas.

Any potentially exposed persons will be taken for immediate medical assessment and communicated to medical staff that they have been potentially exposed to respiration of NOx.

Blast fume events that meet the requirements of condition A39 will be reported accordingly.

4.7 DUST

Dust in the underground environment will be managed through adequate ventilation in conjunction with re-entry procedures that are predicated on effective air monitoring.

Dust from potential blasting in a surface environment will be managed through ensuring adequate stemming length is provided.

4.8 RECORD KEEPING

Accurate records of each blast shall be kept and include the following details as a minimum:

a) Date, identification number and time of blast;

b) Location, number and diameter of blast holes loaded;

c) Depth of each drill hole loaded;

d) Inclination of drill holes;

e) Types and amounts of explosives used;

f) Maximum instantaneous charge;

g) Initiation Plan; and

h) Ground vibration at monitoring locations.

The Shotfirer shall maintain responsibility for ensuring that all information is recorded as the blast is loaded.

4.9 RECONCILIATIONS AND REPORTING

Prior to firing each blast, the following documents will be compiled:

- A pre-blast sheet confirming that the expected level of vibration at each of the nearest sensitive receivers complies with the vibration limits;
- A completed drilling sheet prepared by the Shotfirer showing the measured depth of each blasthole. The sheet will identify and clearly mark any "anomalous" blastholes;
- A blast loading plan showing the depth of each blasthole, quantity of explosive in each blasthole and the stemming length.
- A blast initiation plan showing the firing sequence.

- 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 actions are in accordance with the specifications listed in the Australian Standards AS2187.2 document.

Procedures will be developed and implemented to address accounting and reporting issues associated with the loss or theft of explosives.

Following the completion of a blast, monitoring results will be collated and reviewed against pre-blast predictions and applicable criteria to inform subsequent the blast designs. Further detail on this continual improvement process is provided in Section 6.5.

5 ENVIRONMENTAL MANAGEMENT & COMMUNITY NOTIFICATION

5.1 PROPERTY CONDITION SURVEYS

The objective of a condition survey report is to document the pre-existing condition of the infrastructure prior to the commencement of any construction. The condition surveys therefore establish the benchmark of the condition of the property for later reference should any claim of damage be made. All condition surveys shall be prepared to meet these objectives.

Pursuant to MCoA E71 and REMM NV03, condition surveys of buildings, structures and utilities within 500 meters of blasting operations will be undertaken by an appropriately qualified independent professional. The results of the surveys must be documented in a Condition Survey Report for each item surveyed. Copies of Condition Survey Reports must be provided to the owners of the items surveyed prior to the work commencing.

5.2 COMMUNITY CONSULTATION AND NOTIFICATION

A Community Communications Strategy (CCS) has been prepared in accordance with MCoA B3 to provide an approach to stakeholder, community communications and engagement. The CCS has been approved by DPE prior to the commencement of works, for implementation in accordance with MCoA B4. All community consultation, notification and complaints management associated with blasting will be undertaken in accordance with the CCS.

In line with the process outlined in the CCS, residents and businesses within the relevant offset zones for tunnelling/blasting activities shall be notified before tunnelling/blasting is to occur near that property. Notification will include the likely times, dates and duration of blasting activity near the property.

Nearby residents and businesses will be consulted/informed about controlled blasting by:

- meeting with nearby residents and businesses to provide information about blasting and process for each blast;
- meetings to occur before blasting starts and then ongoing during construction, as required and requested by residents and businesses;
- obtain written agreement from residents and business (based on vibration limit predications) for increased blasting limits in accordance with the EPL/MCoA; and
- notify residents, businesses and motorists of each controlled blasting.

A Community and Stakeholder Engagement (CSE) Action Plan will also be implemented, with a focus on the inception period of the controlled blasting program.

5.3 WRITTEN AGREEMENTS

Pursuant to MCoA E57, the blasting criteria specified in the Tables in Conditions E55 and E56 may be exceeded where the Proponent has obtained the written agreement of the landowner and occupier to increase the relevant criteria. In obtaining the agreement, the Proponent must make available to the landowner and occupier:

a) details of the proposed blasting program and justification for the proposed increase in blasting criteria including alternatives considered (where relevant);

b) an assessment of the environmental impacts of the increased blasting criteria on the surrounding environment and most affected residences or other sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures; and

c) details of the blast management, mitigation and monitoring procedures to be implemented.

Pursuant to MCoA E58, the Proponent must provide a copy of the landowner and occupier written agreement to the Planning Secretary and the EPA, including details of the consultation undertaken (with clear identification of proposed blast limits and potential property impacts), before commencing blasting at the higher limits. Unless otherwise agreed by the Planning Secretary, the following exclusions apply:

a) the landowner and occupier may terminate at any time an agreement made with the Proponent to increase the blasting criteria, should concerns made by the landowner and occupier about the blasting criteria be unresolved. Where an agreement is terminated, the Proponent must not exceed the criteria specified in the tables in Conditions E55 and E56 for future blasting that affects the property; and

b) the blasting limit agreed to under any agreement must not exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL.

5.4 RESPITE

MCoA E54 provides limitations on times of the day and days of the week that blasting events may take place. It is envisaged that the limited blasting windows will provide sufficient mitigation of the impacts of blasting without the need to provide further respite periods. This however will be assessed on an ongoing basis as construction works proceed in light of any complaints received from the local community.

6 MONITORING, REVIEW AND REPORTING

For every controlled blast, vibration and airblast monitoring shall be carried out in accordance with the guidelines provided in Australian Standard AS 2187.2-2006 (Appendix J). Section J3 of the standard provides guidelines for how to measure vibration and airblast overpressure caused by blasting, with Section J3.2 and J3.3 providing more specific guidance on standard equipment and techniques used for monitoring respectively.

All monitoring will be undertaken by competent personnel and in accordance with AS AS2187 recommendations. Personnel may include the blast contractor, an acoustic consultant or an FGJV Environmental Officer suitability trained and experienced in undertaking blast monitoring. Evidence of qualifications and/or training will be retained by FGJV for auditing and compliance purposes.

Monitoring instruments will be calibrated in accordance with manufacturers specifications and relevant Australian Standards. Records of monitoring equipment calibration will be maintained by FGJV throughout delivery of the Project.

6.1 MEASUREMENT OF GROUND VIBRATION

Vibration from blasting is measured as Peak Particle Velocity (PPV), expressed in millimetres per second (mm/s), and monitoring is to be carried out in all three axes (vertical, longitudinal and transverse). This arrangement enables a rapid assessment of vibrations in a coordinate system applicable to most man-made structures. The frequency range of the measurement equipment will be between 2 Hz and 250 Hz, as this will contain the expected frequency of vibration.

Monitoring shall be carried out on the property foundations near the point of concern as the preferred choice. Where there is a rigid surface available, monitors will be adhered or mechanically bonded (i.e. bolted) to achieve effective coupling between the monitor and ground. Where the surface is soil, fixed embedded mounts (i.e. concrete blocks) will be utilised especially in areas where repeated blasts are required. Where this is not possible and only a few blasts are required in an area, soil spikes will be used noting that these can result in more conservative vibration results.

6.2 MEASUREMENT OF AIRBLAST

Airblast overpressure monitoring will be undertaken in accordance with As 2187.2-2006 Appendix J, including using a microphone orientated towards the trial blast location, with a frequency range of at least 2Hz to 250Hz with the results expressed in decibels Linear (dBL). The absolute maximum pressure level will be recorded for the full duration of the blast event. Where required, the microphones will be located adjacent to the vibration monitors, orientated towards the blasting location.

Measurement of airblast will be taken at an appropriate location that is exposed to the direction of blasting and at least 4 m from any noise-affected building or structure or within the boundary of a noise sensitive place, at a position between 1.2 m and 1.5 m above the ground. Windshields must attached to all microphones.

It is anticipated that in some instances for controlled blasting within the tunnels, airblast overpressure will no longer be a key impact given blasting will be underground away from the tunnel portal. In these instances, only vibration from blasting would be measured.

6.3 MONITORING LOCATIONS

Monitoring locations will be identified prior to each blast, as part of the blast design. Once the blast quantities and location are determined, a review of surface receivers will be undertaken, with each location determined as being fit for use (AS 2187) and approval obtained from property owners as required.

The number of monitoring locations will be assessed per blast location and depend on the number and location of sensitive receivers and/or structures susceptible to potential impacts given their close proximity to the blast area.

Generally, a vibration and airblast monitor will be installed at the nearest receiver and up to three additional monitoring locations. Locations will generally be near the perimeter of the sensitive receiver (building) at the point closest to the detonation. However, monitoring locations may be altered where property owner permission cannot be obtained.

6.4 MONITORING RECORDS

Monitoring records will be completed to record details like:

- Date and time of measurements
- Name of person undertaking the measurements
- Type and model number of instrumentation
- Time of day, length of measurement and measurement time intervals
- Monitoring location (including a sketched map of area)
- Measurement location details and number of measurements at each location

6.5 REVIEW AND VALIDATION

Blast monitoring data as well as the blast design and quantities of MIC used will continually reviewed by the expert blast consultant after each blast for analysis and used to inform future controlled blast designs.

Monitored vibration and airblast levels, distances between blasts and the monitoring points and explosive weights will be entered into a database, regressed and reviewed to provide an updated explosive weight to ensure the applicable criteria are met. In this manner, each blast is designed and continually verified using the recorded results of previous blasting activities.

6.6 REPORTING

Reporting required under the EPL conditions (e.g. monitoring results will be placed on the project web page etc) will be complied with.

Monitoring results will be analysed against the applicable criteria described in Section 3.6. Where results are found to be above criteria, an initial investigation will be undertaken to confirm the monitored levels are not being impacted by other sources or equipment issues. On confirmation that exceedances are attributed to the Project's blasting operations, these results will be analysed to refine future blast designs predictions to ensure compliance.

Exceedances of the set criteria will be reported in accordance with the CEMP, EPL and Pollution Incident Response Management Plan as relevant.

7 TRAINING, DOCUMENT REVIEW AND APPROVAL

7.1 TRAINING

All personnel responsible for controlled blasting will be tool boxed on the requirements of the Blast Management Strategy prior to the first blast. Refresher toolboxes will be completed as required throughout the delivery of the construction program as required (change in personnel/change in location etc).
A detailed planning session will be held by responsible personnel prior to each blast to ensure the requirements of the BMS are implemented, including selection of monitoring locations

7.2 CONSULTATION

This BMS has been developed in consultation with FGJV Environmental Managers, Construction Managers, the Environment and Sustainability Manager and finally the Project Director.

External consultation for this BMS was undertaken with EPA as required under MCoA E61. Pursuant to MCoA A5, evidence of this consultation is provided in Appendix 1.

Pursuant to MCoA E62, this BMS shall be submitted to the Planning Secretary for information no later than one month before the commencement of blasting. The Strategy as submitted to the Planning Secretary, must be implemented for all blasting activities.

The FGJV Environment and Sustainability Manager will be the authorised contact person for communications with the relevant stakeholders i.e. TfNSW, DPE and the EPA on environmental matters. Liaison will include reporting on the ongoing environmental performance and key environmental matters on the Project to these stakeholders.

7.3 DOCUMENT REVIEW

This Blast Management Strategy will be reviewed annually or as a result of a change in scope outside that described within the current version, incident and/or non-compliance that requires a review of the document.

7.4 ENDORSEMENT

In accordance with MCoA E60, this BMS has been endorsed by a suitably qualified and experienced person. This endorsement is provided in Appendix 2.

In accordance with MCoA A30(d) the Project Acoustic Advisor (AA) shall review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Planning Secretary (if required to be submitted to the Planning Secretary) or before implementation (if not required to be submitted to the Planning Secretary).

APPENDICES

APPENDIX 1 STAKEHOLDER CONSULTATION AND COMMENTS TRACKING REGISTER

BLAST MANAGEMENT STRATEGY

External Consultation Summary Table

In accordance with MCoA E51, the Blast Management Strategy (BMS) must be prepared in consultation with the NSW EPA. The outcomes of this consultation in accordance with Condition A5 have been summarised in this attachment. One comment was provided by the EPA and is detailed below in Table 1.

TABLE 5 EPA CONSULTATION SUMMARY REVISION B

Item	Date Document Provided	Date Comments Received	Comment	FGJV Response
1	23/03/2023	27/03/2023	We understand the plan has been made to the Australian Standard AS2187 however, please also aim to remain within the ANZEC Guidelines for Blasting Pressure and Ground Vibration (https://www.nepc.gov.au/sites/default/files/2022-09/anzec-gl-technical-basis-guidelines-minimise-annoyance-due-blasting-overpressure-and-ground.pdf) where possible.	Limits for Blasting Pressure and Ground Vibration contained in the CoA are generally consistent with the limits contained in the *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZEC,1990). For the avoidance of doubt, Section 2.7 and 3.5 have been updated to reference the ANZEC Guideline.

Please find attached:

- Attachment A: Evidence of submission and comments receipt by email
- Attachment B: Environmental Representative and Acoustic Advisor endorsement letters
- Attachment C: Cumulative Consultation Comments Register

ATTACHMENT A

Corliss, Hari

From: john hutchison <john@hutchisonweller.com>
Sent: Tuesday, 2 May 2023 6:10 PM
To: Corliss, Hari; Burke, Anna; Duncan Thomson
Subject: RE: CHB - Blast Management Strategy - Condition E59

That's fine Hari. I support the amended equation.
My only comment is my usual formula is Lp = 20LOG(P/Po)
All good, yours works too – just ignore me.
I will prepare an endorsement.
Can you send the final doc to me for reference?
Thanks
John

hutchison weller

John Hutchison | Environmental Engineer
p: 02 8969 6071 **m**: 0407 801 144 www.hutchisonweller.com
Level 1 / 357 Military Road, Mosman NSW

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Tuesday, May 2, 2023 5:40 PM
To: john hutchison <john@hutchisonweller.com>; Burke, Anna <aburke@CHBteam.com.au>; Duncan Thomson <duncan@geolink.net.au>
Subject: RE: CHB - Blast Management Strategy - Condition E59
Importance: High

Hi John,

On review – the original formula proposed was suitable (accurately predicted Airblast in dBL.) however didn't align with the constants in the standard.

I’ve updated the document to include the below formula – which makes sense now. This formula is from the standard and just needs conversion to dBL. via:

dBL.) =10*LOG10((P*1000/0.00002)^2)

Does this address your concern?

3.7 BLAST MODELLING OF EXPLOSIVE QUANTITIES

Initial blast designs will adopt a conservative approach to build confidence in the vibration and airblast models and embed safe and efficient blast practices. In accordance with AS 2187, this modelled approach will be based on the following equations:

Vibration (V) Formula:

$$V = 1140\left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

Airblast Formula:

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

where

P = pressure, in kilopascals

Q = explosives charge mass, in kilograms

R = distance from charge, in metres

K_a = site constant

a = site exponent

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

From: john hutchison <john@hutchisonweller.com>
Sent: Tuesday, 2 May 2023 12:03 PM
To: Corliss, Hari <hcorliss@CHBteam.com.au>; Burke, Anna <aburke@CHBteam.com.au>; Duncan Thomson <duncan@geolink.net.au>
Subject: RE: CHB - Blast Management Strategy - Condition E59

Hi Hari
Very close. I think there was one last change that confused me (easy to do).

Section 3.6 updated to include:
The airblast model will be modified by fixing the site exponent a at -1.45 and back-calculating the site constant Ka, which will provide a different site constant value for confined tunnel blasts vs open cuttings.

I can't see those exponents in the formula:

Airblast Formula: $A = 164.2 - 24(Log_{10}R - 0.33Log_{10}Q)$

Where:

V = ground vibration as peak particle velocity in mm/s
R = distance between charge and point of measurement in metres
Q = effective charge mass per delay or maximum instantaneous charge in kilograms
A = peak airblast level in dBLinear

hutchison weller

John Hutchison | Environmental Engineer
p: 02 8969 6071 **m**: 0407 801 144 www.hutchisonweller.com

Level 1 / 357 Military Road, Mosman NSW

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Saturday, April 29, 2023 8:15 AM
To: john hutchison <john@hutchisonweller.com>; Burke, Anna <aburke@CHBteam.com.au>; Duncan Thomson <duncan@geolink.net.au>
Subject: RE: CHB - Blast Management Strategy - Condition E59

Hi John,

Please see attached updated BMS (TC) and response sheet.

I trust this addresses your concerns and we can move forward with endorsement. If we need to chat over any specific details lets try do it early in the week, as we are getting very close from a program perspective.

Have a nice weekend.

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

From: john hutchison <john@hutchisonweller.com>
Sent: Wednesday, 26 April 2023 4:44 PM
To: Burke, Anna <aburke@CHBteam.com.au>; Duncan Thomson <duncan@geolink.net.au>

Cc: Corliss, Hari <hcorliss@CHBteam.com.au>
Subject: RE: CHB - Blast Management Strategy - Condition E59

CAUTION: External email. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Anna
A couple of questions around the additional content. Happy to discuss if I'm not clear.
Thanks
John

hutchison weller

John Hutchison | Environmental Engineer
p: 02 8969 6071 **m**: 0407 801 144 www.hutchisonweller.com
Level 1 / 357 Military Road, Mosman NSW

From: Burke, Anna <aburke@CHBteam.com.au>
Sent: Thursday, April 20, 2023 10:56 AM
To: Duncan Thomson <duncan@geolink.net.au>; john hutchison <john@hutchisonweller.com>
Cc: Corliss, Hari <hcorliss@CHBteam.com.au>
Subject: RE: CHB - Blast Management Strategy - Condition E59

Hi Duncan and John,

Thanks for your time this morning! Please see attached revised Blast Management Strategy (edits in TC) and comments review sheet.

Once you're both happy all your comments have been closed out, could you please issue a letter of endorsement. Then we will provide to John Heilig for re-endorsement prior to lodging with DPE.

Thanks,

Anna Burke
Environmental Advisor - Coffs Harbour Bypass
Ferrovial Gamuda JV
COFFS HARBOUR BYPASS team

182 North Boambee Road, North Boambee Valley, NSW, 2450
+61 411 200 529
aburke@CHBteam.com.au

From: Duncan Thomson <duncan@geolink.net.au>
Sent: Wednesday, 29 March 2023 1:54 PM
To: Corliss, Hari <hcorliss@CHBteam.com.au>
Cc: Scott.LAWRENCE@transport.nsw.gov.au; Burke, Anna <aburke@CHBteam.com.au>; john@hutchisonweller.com; Mick.browne@transport.nsw.gov.au
Subject: RE: CHB - Blast Management Strategy - Condition E59

Hi Hari, see attached for comments on the Blast Management Strategy.

Thanks

Duncan Thomson
Director / Environmental Engineer

GeoLINK
P 02 6687 7666 | **M** 0419 237 075

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Thursday, March 23, 2023 4:54 PM
To: john@hutchisonweller.com; Duncan Thomson <duncan@geolink.net.au>; Mick.browne@transport.nsw.gov.au
Cc: Scott.LAWRENCE@transport.nsw.gov.au; Burke, Anna <aburke@CHBteam.com.au>
Subject: CHB - Blast Management Strategy - Condition E59

Hi John/Duncan/Mick,

Please see the link below for the Blast Management Strategy (BMS) prepared for the Coffs Harbour Bypass Project as required by MCoA E59.

https://www.dropbox.com/scl/fo/hfzz8p6ujup1iul9j3h3w/h?dl=0&rlkey=ze2q1atxlu41axt9t2qmc13y1

Appendix 2 of the BMS is the endorsement by a suitably qualified and experienced person required under MCoA E60.

MCoA E61 requires the Blast Management Strategy to be prepared in consultation with the EPA. EPA has been issued this document for review today.

Please review the BMS and provide comment/endorsement if the document is suitable for the intent. Although the conditions E59-E62 do not specifically call out ER/AA endorsement the independent engagement conditions indicate this is required.

Attached is a comments review sheet for any comments to be provided.

A response by COB 29th March would be greatly appreciated, any issues please let me know.

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

Corliss, Hari

From: James Tucker <james.tucker@epa.nsw.gov.au>
Sent: Wednesday, 26 April 2023 7:33 AM
To: Corliss, Hari
Cc: Burke, Anna; Scott King; Ben Lewin
Subject: RE: CHB - Blast Management Strategy

Hi Hari,

Yes our comment have been address.

Thanks

James Tucker
Operations Officer
NSW Environment Protection Authority
Ph: (02) 6659 8294 M: 0499 488 109
james.tucker@epa.nsw.gov.au www.epa.nsw.gov.au @EPA_NSW
Report pollution and environmental incidents 131 555 (NSW only) or (02) 9995 5555

I acknowledge and respect the Traditional Custodians of the land on which I work and live – Gumbainggir.

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Monday, 24 April 2023 3:05 PM
To: James Tucker <james.tucker@epa.nsw.gov.au>

Cc: Burke, Anna <aburke@CHBteam.com.au>; Scott King <Scott.King@epa.nsw.gov.au>; Ben Lewin <Benjamin.Lewin@epa.nsw.gov.au>
Subject: RE: CHB - Blast Management Strategy

Hi James,

Please see attached updated BMS, Rev C in TC.

We have addressed your comment per table 5 snipped below.

Item	Date Document Provided	Date Comments Received	Comment	FGJV Response
1	23/03/2023	27/03/2023	We understand the plan has been made to the Australian Standard AS2187 however, please also aim to remain within the ANZEC Guidelines for Blasting Pressure and Ground Vibration (https://www.nepc.gov.au/sites/default/files/2022-09/anzec-gl-technical-basis-guidelines-minimise-annoyance-due-blasting-overpressure-and-ground.pdf) where possible.	Limits for Blasting Pressure and Ground Vibration contained in the CoA are generally consistent with the limits contained in the *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZEC,1990). For the avoidance of doubt, Section 2.7 and 3.5 have been updated to reference the ANZEC Guideline.

Can EPA please confirm the comment has been addressed?

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

Consider the environment. Please don't print this e-mail unless really necessary.

From: James Tucker <james.tucker@epa.nsw.gov.au>
Sent: Monday, 27 March 2023 10:31 AM
To: Corliss, Hari <hcorliss@CHBteam.com.au>
Cc: Burke, Anna <aburke@CHBteam.com.au>; Scott King <Scott.King@epa.nsw.gov.au>; Ben Lewin <Benjamin.Lewin@epa.nsw.gov.au>
Subject: RE: CHB - Blast Management Strategy

Morning Hari,

The NSW EPA has reviewed the Blast Management Strategy and has only the following comment;

We understand the plan has been made to the Australian Standard AS2187 however, please also aim to remain within the ANZEC Guidelines for Blasting Pressure and Ground Vibration (https://www.nepc.gov.au/sites/default/files/2022-09/anzec-gl-technical-basis-guidelines-minimise-annoyance-due-blasting-overpressure-and-ground.pdf) where possible.

Any questions let me know.

Thank you

James Tucker
Operations Officer
NSW Environment Protection Authority
Ph: (02) 6659 8294 M: 0499 488 109

james.tucker@epa.nsw.gov.au www.epa.nsw.gov.au @EPA_NSW
Report pollution and environmental incidents 131 555 (NSW only) or (02) 9995 5555

I acknowledge and respect the Traditional Custodians of the land on which I work and live – Gumbainggir.

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Thursday, 23 March 2023 4:47 PM
To: James Tucker <james.tucker@epa.nsw.gov.au>
Cc: Burke, Anna <aburke@CHBteam.com.au>
Subject: CHB - Blast Management Strategy

Hi James,

Hope you are well this afternoon.

Please see the link below for the Blast Management Strategy (BMS) prepared for the Coffs Harbour Bypass Project as required by MCoA E59.

https://www.dropbox.com/scl/fo/hfzz8p6ujup1iul9j3h3w/h?dl=0&rlkey=ze2q1atxlu41axt9t2qmc13y1

Appendix 2 of the BMS is the endorsement by a suitably qualified and experienced person required under MCoA E60.

MCoA E61 requires the Blast Management Strategy to be prepared in consultation with the EPA. Can EPA please review and provide feedback as required?

Attached is a comments review sheet for any comments to be provided.

A response by COB 29th March would be greatly appreciated, any issues please let me know.

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

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Any views expressed in this email are those of the individual sender except where the sender expressly and with authority states them to be the views of the Environment Protection Authority.

PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS EMAIL

Corliss, Hari

From: Duncan Thomson <duncan@geolink.net.au>
Sent: Friday, 21 April 2023 2:10 PM
To: Burke, Anna
Cc: Corliss, Hari; john hutchison
Subject: RE: CHB - Blast Management Strategy - Condition E59
Attachments: 3992-1045 ltr to FGJV re ER endorsement of BMS.pdf

Hi Anna, thanks for the clear explanation of the BMS updates in yesterday's meeting. The updated version of the BMS is OK from my perspective and my comments have been addressed.

See attached for an endorsement letter.

Have a good weekend!

Thanks
Duncan

Duncan Thomson
Director / Environmental Engineer

GeoLINK
P 02 6687 7666 | **M** 0419 237 075

From: Burke, Anna <aburke@CHBteam.com.au>
Sent: Thursday, April 20, 2023 10:56 AM
To: Duncan Thomson <duncan@geolink.net.au>; 'john hutchison' <john@hutchisonweller.com>
Cc: Corliss, Hari <hcorliss@CHBteam.com.au>
Subject: RE: CHB - Blast Management Strategy - Condition E59

Hi Duncan and John,

Thanks for your time this morning! Please see attached revised Blast Management Strategy (edits in TC) and comments review sheet.

Once you're both happy all your comments have been closed out, could you please issue a letter of endorsement. Then we will provide to John Heilig for re-endorsement prior to lodging with DPE.

Thanks,

Anna Burke
Environmental Advisor - Coffs Harbour Bypass
Ferrovial Gamuda JV

182 North Boambee Road, North Boambee Valley, NSW, 2450
+61 411 200 529
aburke@CHBteam.com.au

From: Duncan Thomson <duncan@geolink.net.au>
Sent: Wednesday, 29 March 2023 1:54 PM
To: Corliss, Hari <hcorliss@CHBteam.com.au>
Cc: Scott.LAWRENCE@transport.nsw.gov.au; Burke, Anna <aburke@CHBteam.com.au>; john@hutchisonweller.com; Mick.browne@transport.nsw.gov.au
Subject: RE: CHB - Blast Management Strategy - Condition E59

Hi Hari, see attached for comments on the Blast Management Strategy.

Thanks

Duncan Thomson
Director / Environmental Engineer

GeoLINK
P 02 6687 7666 | **M** 0419 237 075

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Thursday, March 23, 2023 4:54 PM
To: john@hutchisonweller.com; Duncan Thomson <duncan@geolink.net.au>; Mick.browne@transport.nsw.gov.au
Cc: Scott.LAWRENCE@transport.nsw.gov.au; Burke, Anna <aburke@CHBteam.com.au>
Subject: CHB - Blast Management Strategy - Condition E59

Hi John/Duncan/Mick,

Please see the link below for the Blast Management Strategy (BMS) prepared for the Coffs Harbour Bypass Project as required by MCoA E59.

https://www.dropbox.com/scl/fo/hfzz8p6ujup1iul9j3h3w/h?dl=0&rlkey=ze2q1atxlu41axt9t2qmc13y1

Appendix 2 of the BMS is the endorsement by a suitably qualified and experienced person required under MCoA E60.

MCoA E61 requires the Blast Management Strategy to be prepared in consultation with the EPA. EPA has been issued this document for review today.

Please review the BMS and provide comment/endorsement if the document is suitable for the intent. Although the conditions E59-E62 do not specifically call out ER/AA endorsement the independent engagement conditions indicate this is required.

Attached is a comments review sheet for any comments to be provided.

A response by COB 29th March would be greatly appreciated, any issues please let me know.

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

Corliss, Hari

From: John Heilig <john@heiligandpartners.com.au>
Sent: Monday, 1 May 2023 9:12 AM
To: Corliss, Hari
Cc: Burke, Anna
Subject: RE: Blast Management Strategy Endorsement
Attachments: BMS Coffs Harbour Endorsement April .pdf

Many thanks for your message.

As requested, I have reviewed the document and attached the appropriate response.

Any questions most welcome.

Kindest regards,

HEILIG & PARTNERS Engineered Excellence

John Heilig
Principal: Heilig & Partners Pty Ltd

Phone: +61 7 3715 7599
Mobile: +61 419 196 369
Email: john@heiligandpartners.com.au

91 Burdekin Drive
Sinnamon Park QLD 4073

PO Box 1176
Mount Ommaney QLD 4074

www.heiligandpartners.com.au

REGISTERED NER Engineers Australia
BOARD OF PROFESSIONAL ENGINEERS OF QUEENSLAND

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Saturday, April 29, 2023 8:17 AM
To: John Heilig <john@heiligandpartners.com.au>
Cc: Burke, Anna <aburke@CHBteam.com.au>
Subject: RE: Blast Management Strategy Endorsement

Hi John,

Please see attached updated BMS for CHB for your endorsement.

We have been through two rounds of comments with the AA, I've attached the record of consultation with the AA and ER also – for information.

Please review and provide an updated endorsement as soon as you can please.

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

COFFS HARBOUR BYPASS team

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

Consider the environment. Please don't print this e-mail unless really necessary.

From: John Heilig <john@heiligandpartners.com.au>
Sent: Thursday, 23 March 2023 3:39 PM
To: Burke, Anna <aburke@CHBteam.com.au>
Cc: Gutierrez Bahillo, Eduardo <egutierrez@CHBteam.com.au>; Corliss, Hari <hcorliss@CHBteam.com.au>; Shaarani, Salehudin <sshaarani@CHBteam.com.au>
Subject: RE: Blast Management Strategy Endorsement

Hi Anna,

Thanks for the comments on the report. Apologies that it caused further work for your team. I have attached a letter of endorsement. Let me know of any questions.

Any comments welcome.

Kindest regards,

HEILIG & PARTNERS Engineered Excellence

John Heilig
Principal: Heilig & Partners Pty Ltd
Phone: +61 7 3715 7599
Mobile: +61 419 196 369
Email: john@heiligandpartners.com.au

91 Burdekin Drive
Sinnamon Park QLD 4073

PO Box 1176
Mount Ommaney QLD 4074

www.heiligandpartners.com.au

REGISTERED NER Engineers Australia
BOARD OF PROFESSIONAL ENGINEERS OF QUEENSLAND

From: Burke, Anna <aburke@CHBteam.com.au>
Sent: Thursday, March 23, 2023 10:53 AM
To: John Heilig <john@heiligandpartners.com.au>
Cc: Gutierrez Bahillo, Eduardo <egutierrez@CHBteam.com.au>; Corliss, Hari <hcorliss@CHBteam.com.au>; Shaarani, Salehudin <sshaarani@CHBteam.com.au>
Subject: RE: Blast Management Strategy Endorsement

Hi John,

Thanks for your time on the phone today! Please see attached revised Blast Management Strategy & comments sheet addressing your feedback.

As discussed, we have left our single small-scale production trial blast approach as is, as this will be continually validated with monitoring data as we move to new locations. Where the geology is found to be significantly different we would assess the need for and undertake another trial if required.

Once you are happy we have addressed your comments, could you please issue a simple endorsement letter confirming the BMS addresses the requirements of the Conditions of Approval and our blast management framework is appropriate.

Thanks,

Anna Burke
Environmental Advisor - Coffs Harbour Bypass
Ferrovial Gamuda JV
COFFS HARBOUR BYPASS team

28 Isles Drive Boambee Valley
+61 411 200 529
aburke@CHBteam.com.au

From: John Heilig <john@heiligandpartners.com.au>
Sent: Monday, 20 March 2023 10:39 AM
To: Corliss, Hari <hcorliss@CHBteam.com.au>; Shaarani, Salehudin <sshaarani@CHBteam.com.au>
Cc: Gutierrez Bahillo, Eduardo <egutierrez@CHBteam.com.au>; Burke, Anna <aburke@CHBteam.com.au>
Subject: RE: Blast Management Strategy Endorsement

Hi Hari and Co,

I have attached a letter discussing the BMS that has been provided for endorsement. I have put my comments together in this response as well as transferring to the comments' spreadsheet.

I welcome any questions or comments.

As always, the accountants have asked if you can provide the necessary information for the end of month invoicing./ If this will occur through the previous contract, and there are sufficient monies available on it, please let me know.

Please let me know of any changes to the letter that may be required for the endorsement

Kindest regards,

HEILIG & PARTNERS Engineered Excellence

John Heilig
Principal: Heilig & Partners Pty Ltd
Phone: +61 7 3715 7599
Mobile: +61 419 196 369
Email: john@heiligandpartners.com.au

91 Burdekin Drive
Sinnamon Park QLD 4073

PO Box 1176
Mount Ommaney QLD 4074

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REGISTERED NER Engineers Australia
BOARD OF PROFESSIONAL ENGINEERS OF QUEENSLAND

From: Corliss, Hari <hcorliss@CHBteam.com.au>
Sent: Tuesday, March 14, 2023 11:46 AM
To: Shaarani, Salehudin <sshaarani@CHBteam.com.au>; John Heilig <john@heiligandpartners.com.au>
Cc: Gutierrez Bahillo, Eduardo <egutierrez@CHBteam.com.au>; Burke, Anna <aburke@CHBteam.com.au>
Subject: RE: Blast Management Strategy Endorsement

Thanks Hud,

Documents are in the drop box folder:

https://www.dropbox.com/s/c4x9m5bz344q5zz/FGJV%20CHB%20BMS%20Rev%20A.pdf?dl=0

John – FYI the relevant Planning Conditions, requiring endorsement by a suitably qualified and experienced person.

Blasting Management Strategy

E59 A **Blast Management Strategy** must be prepared and must include:

(a) sequencing and review of trial blasting to inform blasting;
(b) regularity of blasting;
(c) intensity of blasting;
(d) periods of relief; and
(e) blasting program.

E60 The **Blast Management Strategy** must be endorsed by a suitably qualified and experienced person.

If you could provide comments in the attached sheet it would be greatly appreciated.

Also please advise when you anticipate this review could be completed by, ideally mid to end of next week would be great.

Cheers

Hari Corliss
Environment and Sustainability Manager – Coffs Harbour Bypass

Ferrovial Gamuda JV

Level 15, 141 Walker St, North Sydney, NSW 2060
+61 419 124 227

hcorliss@chbteam.com.au

From: Shaarani, Salehudin <sshaarani@CHBteam.com.au>
Sent: Tuesday, 14 March 2023 12:10 PM
To: John Heilig <john@heiligandpartners.com.au>; Corliss, Hari <hcorliss@CHBteam.com.au>
Cc: Gutierrez Bahillo, Eduardo <egutierrez@CHBteam.com.au>
Subject: Blast Management Strategy Endorsement

Dear John,

I am reaching out to see if you would be able to assist us with a review of our Blast Management Strategy for the Coffs Harbour Bypass Project. As an expert in the field, your input would be greatly appreciated. We may require Heilig and Partners' endorsement after the review. Would you be willing to provide this if necessary?

In providing more details with regards to the BMS, Hari Corliss CHB Environmental and Sustainability Manager which I have cc-ied in this email would provide you with the details. With that I hope you would be able to provide the number of hours expected to review and provide us with a quotation for payment process.

For reference, I have attached our draft in this for an overview.

Hari,
I tried to give John the whole file, but it the file is too big I think because of too many photo files. (Appendix 3 is 300mb+). If there is a link that we can share and working for external that we can use? I can get Nerea to give access.

Many thanks in advance.

Rgds,
Hud

ATTACHMENT B ER & AA ENDORSEMENT LETTERS

21 April 2023
Ref No: 3992-1045

Ferrovial Gamuda Joint Venture
by email: hcorliss@CHBteam.com.au

Attention: Hari Corliss

Dear Hari

Coffs Harbour Bypass – Blast Management Strategy: ER Endorsement

In my capacity as Environmental Representative, I have reviewed the following document and endorse it as being appropriate:

- Blast Management Strategy: Revision C – Coffs Harbour Bypass (Revision C, April 2023, prepared by Ferrovial Gamuda Joint Venture)

Yours sincerely

GeoLINK

Duncan Thomson
Environmental Representative

PO Box 119
Lennox Head
NSW 2478
Bundjalung Nation
02 6687 7666

PO Box 1446
Coffs Harbour
NSW 2450
Gumbaynggir Country
02 6651 7666

PO Box 1267
Armidale
NSW 2350
Nganyaywana Country
02 6772 0454

PO Box 229
Lismore
NSW 2480
Bundjalung Nation
02 6621 6677

hutchison weller

Hari Corliss
Coffs Harbour Bypass Project Team
Ferrovial Gamuda Joint Venture

3 May 2023 21001-LT-ED-04-0

Dear Hari

Coffs Harbour Bypass
Blast Management Strategy

The Acoustic Advisor, in consultation with the Environmental Representative, has reviewed the *Coffs Harbour Bypass Blasting Management Strategy, Revision C (BMS),* prepared by Ferrovial Gamuda Joint Venture (FGJV) and dated 2 May 2023.

I am satisfied the BMS meets the requirements of Project Condition of Approval (CoA) E59, with adequate detail on sequencing and review of trial blasting, regularity of blasting, intensity of blasting, periods of relief and a blasting program.

In accordance with CoA E61, the BMS has been prepared in accordance with relevant guidelines, which should ensure blasting is carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive receivers.

In accordance with Condition of Approval E60, I have sighted an endorsement of the BMS by a suitably qualified and experienced person, John Heilig.

The BMS has been prepared in consultation with relevant government agencies.

As required by Condition of Approval A30(d), I endorse the BMS as being consistent with the terms of the Infrastructure Approval (SSI 7666).

Kind Regards

John Hutchison
Acoustic Advisor
Coffs Harbour Bypass

Hutchison Weller Pty Ltd
ABN 34 603 174 518

13/357 Military Road
Mosman NSW 2088

Phone: 02 8969 6071
Email: info@hutchisonweller.com

www.hutchisonweller.com

ATTACHMENT C CUMULATIVE CONSULTATION COMMENTS REGISTER

Document No	CHBPW-FGJV-NWW-EN-STG-000001
Document Name	Blast Management Strategy

Item	Date of review	Revision No.	Raised By	Company	Doc. (e.g., Section, Table)	Compliance Ref - If applicable (REMM, CoA, Deed)	Comment (Please include one comment per item)	Category	FGJV Response	Closed-Out (Y, N)	FGJV Response	Closed Out (Y/N)	FGJV Response	Closed Out (Y/N)
1	20/03/2023	A	J Heilig	Heilig & Partners	General		There are few minor textural matters such as Section and Table references that return "Source not found" and these should be updated prior to the final report. In addition, a footer or header should be included with the report that includes page numbers so that reference to the Table of Contents can achieved		Updated.	yes				
2	20/03/2023	A	J Heilig	Heilig & Partners	Section 3.7		Reference to a small-scale trial blast being completed in each new area should be presented in both the open cuttings and tunnels section.		No change proposed to FGJV trial blast approach as there will be a signifcant amount of vibration monitoring data that is continually feed into the blast design to inform MIC and compliance against relevant criteria. Additional wording added to reference where geology is found to be signficantly different, FGJV will assess the need for another trial blast and undertake as required.	yes				
3	20/03/2023	A	J Heilig	Heilig & Partners	Section 3.7		For the open cuttings, the option of the trial blast involving a series of single holes, rather than a small-scale production blast, could also be proposed. The single holes could be deep with large uncharged collar lengths to prevent stemming ejection and other possible issues associated with flyrock and airblast overpressure. It should be noted that the objective of a trial blast is to assess vibration rather than provide any comment on fragmentation and/or diggability		No change proposed to FGJV trial blast approach to be a small-scale production blat. Wording added to detail purpose of trial blast to assess vibration as opposed to fragmentation/diggability.	yes				
4	20/03/2023	A	J Heilig	Heilig & Partners	Section 3.7		An additional Section 3.7.1 (Monitoring) should be included to address the vibration monitoring approach for the trial blast and confirm that the trail blast will be monitored at multiple locations (ideally not less than 5) and these data will be regressed to establish the site-specific vibration/distance/explosive weight relationship		Updated to include section on trial blast monitoring approach.	yes				
5	20/03/2023	A	J Heilig	Heilig & Partners			For completeness, any additional blasting specifications should also be included in the Blast Management Strategy. These might include aspects such as requirements for blasting near shotcrete, grouted cable bolts, bridge abutments. Given these could potentially affect the scale of blasting that may be undertaken, they should be noted, along with any vibration constraints that relate to the specification.		Additional TfNSW specifications referenced in Section 2.7. Wording also included to detail FGJV's approach to sourcing specifications and determining vibration criteria to ensure blasting does not impact on tunnel support works (i.e. shotcrete) behind the blast excavation zone.	yes				
Revision A (23/03/23)														
1	29/03/2023	B	ER	GeoLINK	Section 2.3		Now that the EPL has been issued, suggest update this section.		Updated to reference EPL Licence and conditions.	Y				
2	29/03/2023	B	ER	GeoLINK	Appendix 3		While the maps in Appendix 3 are clear with high resolution aerial photos, there is no way to cross reference with the locations listed in Table 3. Please provide 'cut/tunnel' labels and/or chainages on the maps.		Maps updated with labels detailing cut numbers and tunnel names.	Y				
3	29/03/2023	B	ER	GeoLINK	Sections 3.1 & 3.3	MCoA E59(b)	The document states that blasting may occur up to 4 times per day in tunnels and 2 times per day in cuttings, and that blasting will start about Sept 2023 and continue for approx. 24 months. More detail should be provided. E.g. Is this regularity the same at all blasting locations? Will the stated blasting rates be continuous or intermittent throughout the 24 months? What is the duration of blasting at different locations? This is related to comment #5 below regarding the lack of a blasting program.		Indicative number of blasts and program included in Section 3.2 (Table 4).	Y				
4	29/03/2023	B	ER	GeoLINK	Section 3.5	MCoA E59(c)	This section simply states the blasting limits from the approval. Calculations or modelling should be undertaken to predict/estimate the blasting impacts/intensity that will be generated from the proposed blasting methodology and locations.		Updated to include preliminary vibration assessments for the tunnel and Cut 16 (largest open cutting).	Y				
5	29/03/2023	B	ER	GeoLINK		MCoA E59(e)	The document does not include a blasting program.		Refer to response to comment #3.	Y				
6	29/03/2023	B	ER	GeoLINK		REMM NV10	REMM NV10 requires the document to include justification of the need to blast. At present, there is a single sentence at the beginning of Section 3.1. Suggest that this could be separated out into a stand-alone Section 3.1 'Justification of Need to Blast', with some additional comments around why it is better to blast in some locations and the benefits to residents in terms of reduced time exposed to rock hammering etc.		Standalone Section 3.1 added on blasting justification.	Y				
7	29/03/2023	B	ER	GeoLINK	Section 5.5		This section describes how the monitoring will be undertaken, but it is not clear when monitoring will be undertaken. Is this covered elsewhere (e.g. noise and vibration monitoring program)? If yes, please cross-reference the relevant section of the other document that covers monitoring associated with blasting.		Monitoring approach pulled out into Section 6 'Monitoring and Review' and wording updated to make clear monitoring will be undertaken for every blast.	Y				
8	28/03/2023	B	AA	Hutchison Weller	2.3		Please add the EPL conditions and if conflict arises with the CoA, specify which take precedence. For example, the hours of blasting vary between the two documents, requiring approval from the EPA for blasts outside standard hours.		Relevant blasting conditions from EPL included in Section 2.3. Additional wording including in Table 3 detailing that the CoA takes precedence over the EPL when it comes to blasting OOH (not for safety reasons) and extended hours for tunnel blasting.	Y				
9	28/03/2023	B	AA	Hutchison Weller	3.2		Missing reference last sentence		Referencing fixed.	Y				
10	28/03/2023	B	AA	Hutchison Weller	3.3		Are there any locations you believe you will be able to blast where there would be no affected receivers?		No change proposed. This level of detail is not relevant to this overarching management strategy and not required by the CoA or REMMs. This will be confirmed by during detailed blast design by the Project's specialist Blast Consultant.	Y				

11	28/03/2023	B	AA	Hutchison Weller	3.5	E59	The intensity of blasting is addressed in the document by restating the limits. For me this is not the intent of the condition and reads more like a simple trial blast strategy instead of the project's blast management plan. I would expect to see preliminary estimations of intensity at the nearest receivers. A graph showing the expected airblast and vibration over distance would be suitable with a table/mapping of which residents fall within the max dB and PPV ranges. The procedure describes an iterative process with contours being updated. need to provide these contours initially.		Refer to response to comment #4. Given this document is a management strategy, the purpose is to provide an overarching management framework (i.e. process to assess blast impacts) rather than provide specific detail on predictions and affected receivers. This will be provided as part of the blast assessment/modelling during works.	AA - 27042023 -Airblast has been included in this rev but no indication of airblast intensity for those sites you targeted. What were the MICs used and will the MICs used in the calcs also be ok for airblast requirements?	Section 3.6 updated to include predicted Airblast intensity and MIC used to inform this. As below: *Open Cuttings* *Preliminary estimates of vibration intensity for Cut 16 based on an MIC 35.75kg, 89mm diameter holes, 5m charge height, k = 1140 and beta = -1.6 have modelled the following:* *•Peak ground vibration of 5.1mm/s at the nearest residential receiver on Bruxner Park Road which is located approximately 175m from the blast area* *•Peak ground vibration of 22.3mm/s at the nearest structure (Fire Station at Mackays Road) which is located approximately 70m from the blast area* *•Airblast is predicted to be 123 dBL at the nearest sensitive receiver to Cut 16 (175m) based on the formula included in Section 3.7 below.* *Based on this preliminary assessment, written agreements would be required from these receivers to enable an efficient blast design and productive blast program at Cut 16. Refer to Section 5.3 for further detail on the process for obtaining written agreements.*	Closed. I note there is no discussion of what the proposed criteria and justification might be for obtaining written agreement as per E57. If time is critical, we can push that into the agreement information 'package' unless you'd like to cover it off in this document.		
12	28/03/2023	B	AA	Hutchison Weller	3.5		You describe the frequency of blasting (4 x per day in tunnels and 2 x per week in cuttings. Please described the estimated number of blasts in each location and the likely duration of blasting so residents have some idea of how long this will continue. 24 months total is not a fine enough resolution.		Refer to response to comment #3.	Y				
13	28/03/2023	B	AA	Hutchison Weller	3.5		The trial blast program mentions 1 - 7 kg MIC. What does this look like from an initial estimate of intensity. Who will it affect?		Section updated to detail vibration intensity of the Trial Blast will comply with applicable criteria and be similar to/less than the preliminary model for Gatleys Road tunnel (included as figure).	AA - 27042023 -What MIC is initially planned for the open cutting trial site - same as for portals? The preliminary vibration is right at the limit for Cut 16. Should you go a little more conservative? And also, the MIC selected to achieve the vibration limits, will it be ok for airblast as well?	Section 3.8 updated to include the following: *The open cutting trial blast MIC will be determined by limiting the vibration and airblast at the nearest receiver to less than 5mm/s and 115dBl when calculated using a conservative site constant k = 1850 and ka = 10 with site exponents fixed at α = -1.45 and ß = -1.6.* *The exact MIC value for the trial blast will be determined when the location of the trial blast is confirmed on site as it will depend on both the actual distance to the nearest receiver, aspect and the depth of rock to the next bench down once the overburden is removed.*	OK, closed		
14	28/03/2023	B	AA	Hutchison Weller	3.6		The plan requires a model to be prepared and refined once the trial blast is done so the plan should outline the form of the model. What equations are to be used? And what initial site exponents/constants? The report mentions the average/95th percentile k values. This applies to vibration. What about air blast? What are the assumptions for selecting K factors i.e. what type of rock is expected? Which a and b exponents will you be using initially? How does the trial measurement affect the K or a/b exponents?		Section 3.6 and 3.7 updated to include blast equations. Initial k and beta values for the trial blasts included in Section 3.8.	AA - 27042023 -for open cuttings trial, k will be back calculated - does this assume the alpha or beta value is correct and fixed? How will the airblast model be modified? No discussion around this.	The beta value of -1.6 is considered appropriate for blast vibration modelling, leaving only k to be back-calculated. This method has been found to be sufficiently accurate for predicting ground vibrations caused by blasting. Section 3.6 updated to include: *The airblast model will be modified by fixing the site exponent a at -1.45 and back-calculating the site constant Ka, which will provide a different site constant value for confined tunnel blasts vs open cuttings.*	This response is a little confusing. Which exponents are we talking about? (Airblast formula pasted in next cell) Did you mean vibration?	Formula from AS included and email nsent to AA 02052023 explaining methodology	Yes - email from AA 02/05/2023
15	28/03/2023	B	AA	Hutchison Weller	3.7		No mention of airblast monitoring. Will you do this to verify the model? This may rattle windows and concern the public more than vibration.		Section 3.8 updated to include Airblast predictions and monitoring.	AA - 27042023 -Need to make sure the montitor for airblast has a microphone suitable for the low frequency - refer to standard for requirements of frequency range, resolution etc (i.e. 2Hz to 250Hz). Also first mention of Noisecheck. Describe how this will be used as part of the strategy	Reference to Noise Check has been removed and changed to reference prediction formulas, we are investigating the use of NoiseCheck however this is not finalised. Its use would still comply with the BMS if/when it is used. S 3.8.3 updated: *Airblast overpressure monitoring will also be undertaken in accordance with As 2187.2-2006 Appendix J, including using a microphone orientated towards the trial blast location, with a frequency range of at lkeast 2Hz to 250Hz with the results expressed in decibels Linear (dBL). The absolute maximum pressure level will be recorded for the full duration of the blast event.*	Closed.		
16	28/03/2023	B	AA	Hutchison Weller	3.4 / 4.1.3		Some discussion on management of noise and vibration in addition to simple MIC and drill patterns. Eg. What affect will the direction of the cutting face have on airblast levels? How will weather conditions be taken into account for airblast predictions?		Section 3.5 updated to include reference to noise and vibration blast management controls. Section 4.1.3 updated to include the implementation of noise mitigation measures during drilling works.	AA - 27042023 -The equations used in the model don't have any variables to address stemming length, overburden, orientation and weather. It is basically MIC and distance. So how will the model be shown to be accurate if these blast controls are varied to increase or lower the vibration?	The variables mentioned will be managed in accordance with AS21.87.2-2006. This management will be consistent with the significance of sinfluence on overpressure or ground vibration in Table J6.1 of the AS. For example: **Ensure appropriate burden cover for drill angles in blast design** **Direct face away from receiver if possible** **Ensure stemming material is suitable and placed in accordance with the standard** **Ensure charge depth is suitable** Monitoring weather conditions and adjusting activities where possible (already included) The items in bold above have been included in Section 4.1.3.	Closed. I note the equations provided in the standard are for preliminary assessment and information obtained through the trials will take precedence once the data is available.		
17	28/03/2023	B	AA	Hutchison Weller	4.9		Add a section to close out the pre-blast predictions with the monitoring results.		High-level wording added in Section 4.9 on blast review and validation process. Section 5.6 added detailing our approach to validating pre-blast predictions with monitoring data and then feeding this back into subsequent blasts.	Y				
18	28/03/2023	B	AA	Hutchison Weller	5.1		I am not sure which buildings are shown in the EIS to be at risk of vibration. The blasting assessment provides a guide of MIC for each NCA. No buildings are identified. Therefore you will need a way to identify the at-risk properties. Previous examples are selecting buildings outside low-risk classification (with a 6mm/s guideline value nominated)		Section updated in line with REMM NV03 requirement to complete condition surveys for all properties within 500m of the blast operations. REMM also added to Section 2.2. (Table 2).	Y				
19	28/03/2023	B	AA	Hutchison Weller	5.5		Provide details of how the instruments will be installed/mounted and how many locations / where the locations would be.		Monitoring approach pulled out into Section 6 'Monitoring and Review' and updated to include instrument installation/mounting and selection of monitoring locations.	Y				
20	28/03/2023	B	AA	Hutchison Weller	5.5		Specifically, who meets the requirements of being suitably trained and experienced in undertaking blast monitoring? Will you provide a schedule of "approved" personnel?		Monitoring approach pulled out into Section 6 'Monitoring and Review' and updated to include detail on who will undertake blast monitoring. FGJV are not proposing to provide a schedule of approved personnel, however records will be retained to demonstrate compliance during audits of the CNVMP and BMS.	Y				

21	28/03/2023	B	AA	Hutchison Weller	5.5		Monitoring frequency and duration - every blast, every site? EPL requirement.		Refer to response to comment #7.	Y				
22	27/04/2023	C	AA	Hutchison Weller			Reporting - blast monitoring reports to be included in 6 monthly monitoring report.		Vibration and Airblast monitoring associated with blasting are not included in the approved Noise and Vibration Monitoring Program, and as such will not be subject to 6 monthly reporting. The Project is required to publish this data on a monthly basis as required by the POEO Act for holders of Environment Protection Licences.	Yes		Closed		

APPENDIX 2 ENDORSEMENT OF BMS BY QUALIFIED PERSON

HEILIG & PARTNERS
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Sinnamon Park. QLD. 4073. Australia
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Telephone +61 7 3715 7599
Facsimile +61 7 3715 7588

Email group@heiligandpartners.com.au
www.heiligandpartners.com.au

datatrap
vibration management software

Monday, May 01, 2023

Ref:jhh:BMS Coffs Harbour Endorsement April

Ms. Anna Burke
Coffs Harbour Bypass Team
28 Isles Drive
Boambee Valley, NSW 2450

RE: Endorsement of Coffs Harbour Blast Management Strategy (BMS) including April adjustments

Dear Anna,

Further to the Blast Management Strategy (BMS) that has been prepared for the Coffs Harbour Bypass project, I have reviewed this document with respect to its accuracy, appropriateness for the project and its ability to act as a working document to inform and guide management to deliver a safe solution with respect to blast outcomes.

The revised version of the BMS dated April 2023 has addressed matters raised by the reviewers that primarily relate the prediction of the blast impacts, including the design of the trial blast and how this will inform subsequent blasting. I confirm that the responses are consistent with best practices and in my view adequately address the matters raised by the reviewers. I note that these have been transferred into the BMS where necessary.

It is my professional view that the BMS has met the key requirements of a document that illustrates the potential impacts associated with blasting, how these will be assessed, the controls that might be necessary to mitigate the effects to acceptable levels as specified in the Conditions of Approval and a monitoring approach to quantify confirm compliance with the above.

The BMS addresses the requirements of the Conditions of Approval and Coffs Harbour Bypass blast management framework appropriately.

As always, you are most welcome to contact me at your convenience to discuss in further detail any of the issues raised in this letter.

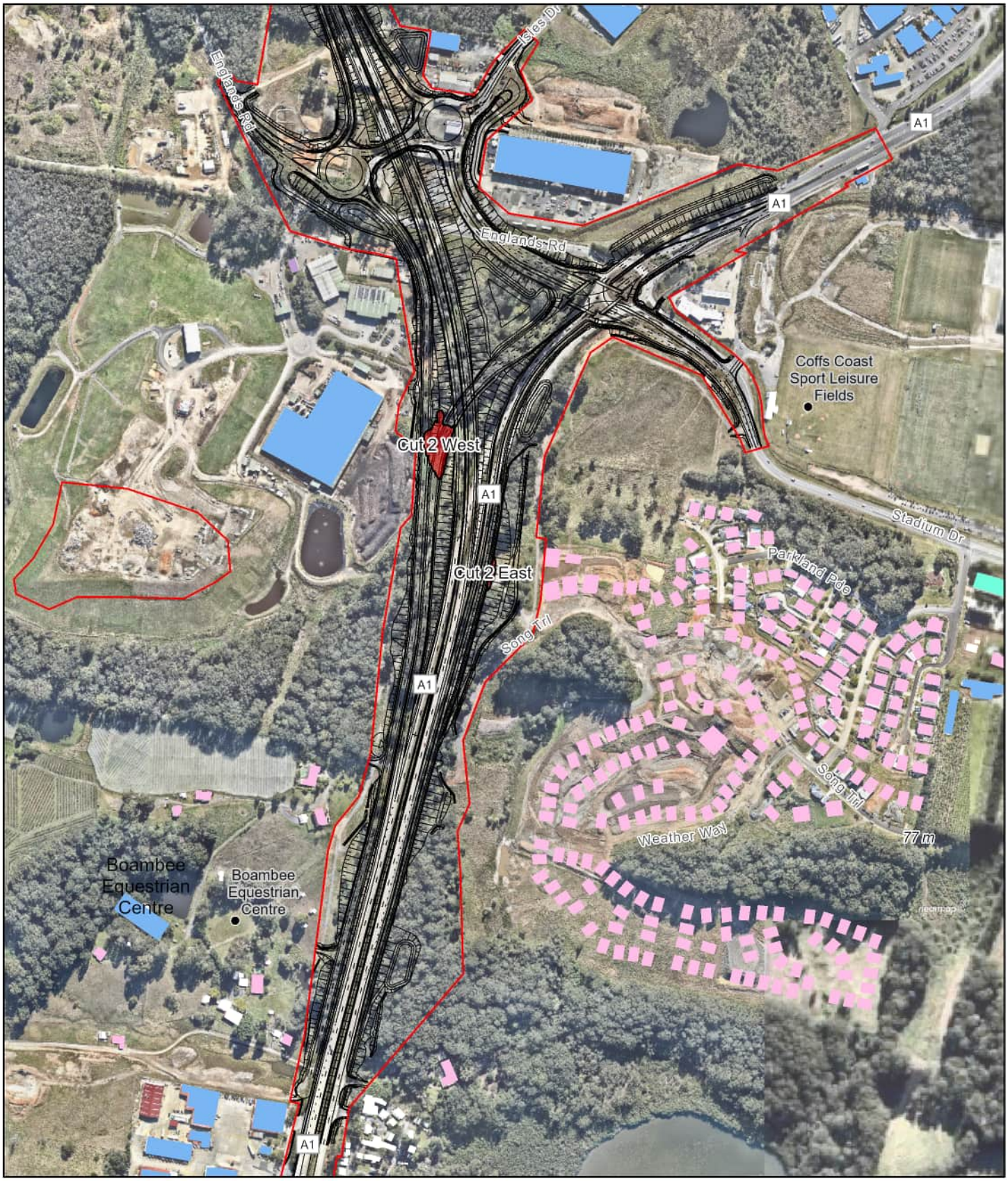
Yours truly,

John Heilig

Dr. John Heilig
Principal - Heilig & Partners Pty Ltd
RPEQ#6304

APPENDIX 3 PROPOSED CONTROLLED BLASTING LOCATIONS

Controlled Blast Locations



1:6,500

0 295 590 1,180 ft

0 90 180 360 m

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Commercial

Hospital

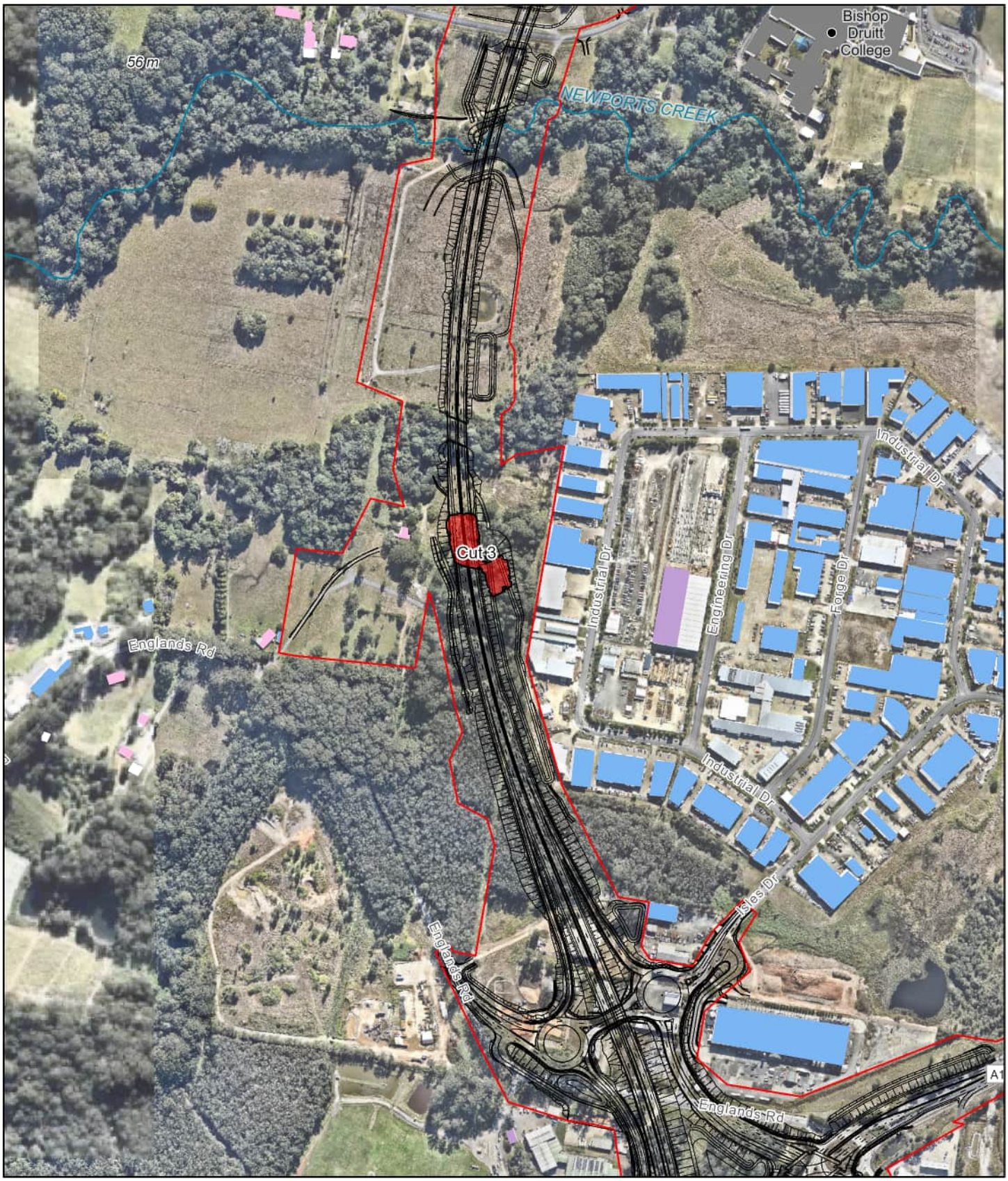
Industrial

Residential

AUX

Proposed Controlled Blast Locations

Controlled Blast Locations



1:6,500

0 295 590 1,180 ft

0 90 180 360 m

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Commercial

Industrial

Place of Worship

Residential

School

AUX

Proposed Controlled Blast Locations

Controlled Blast Locations

1:6,500

0 295 590 1,180 ft

0 90 180 360 m

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Commercial

Hospital

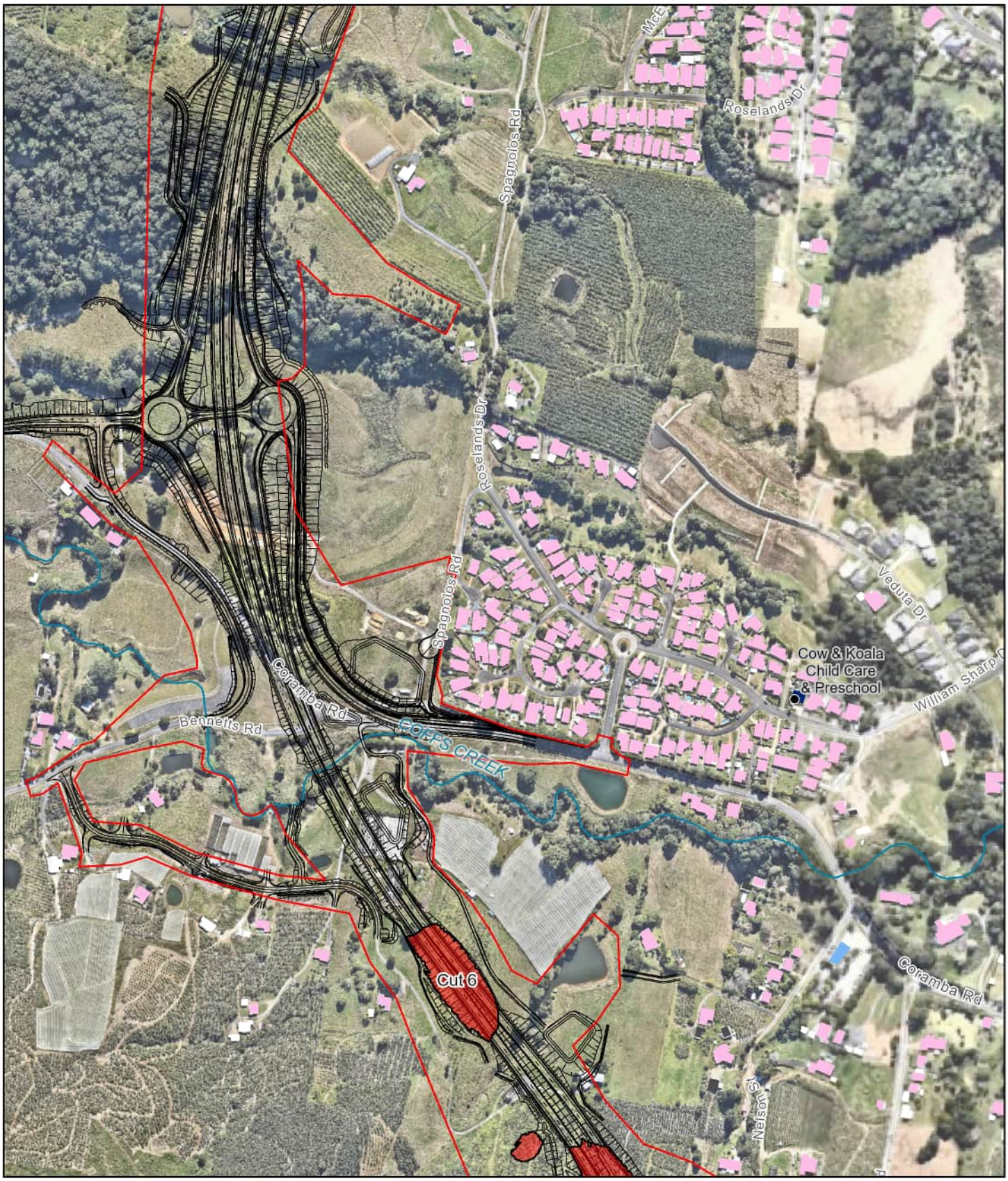
Industrial

Residential

AUX

Proposed Controlled Blast Locations

Controlled Blast Locations



1:6,500

0 295 590 1,180 ft

0 90 180 360 m

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Commercial

Residential

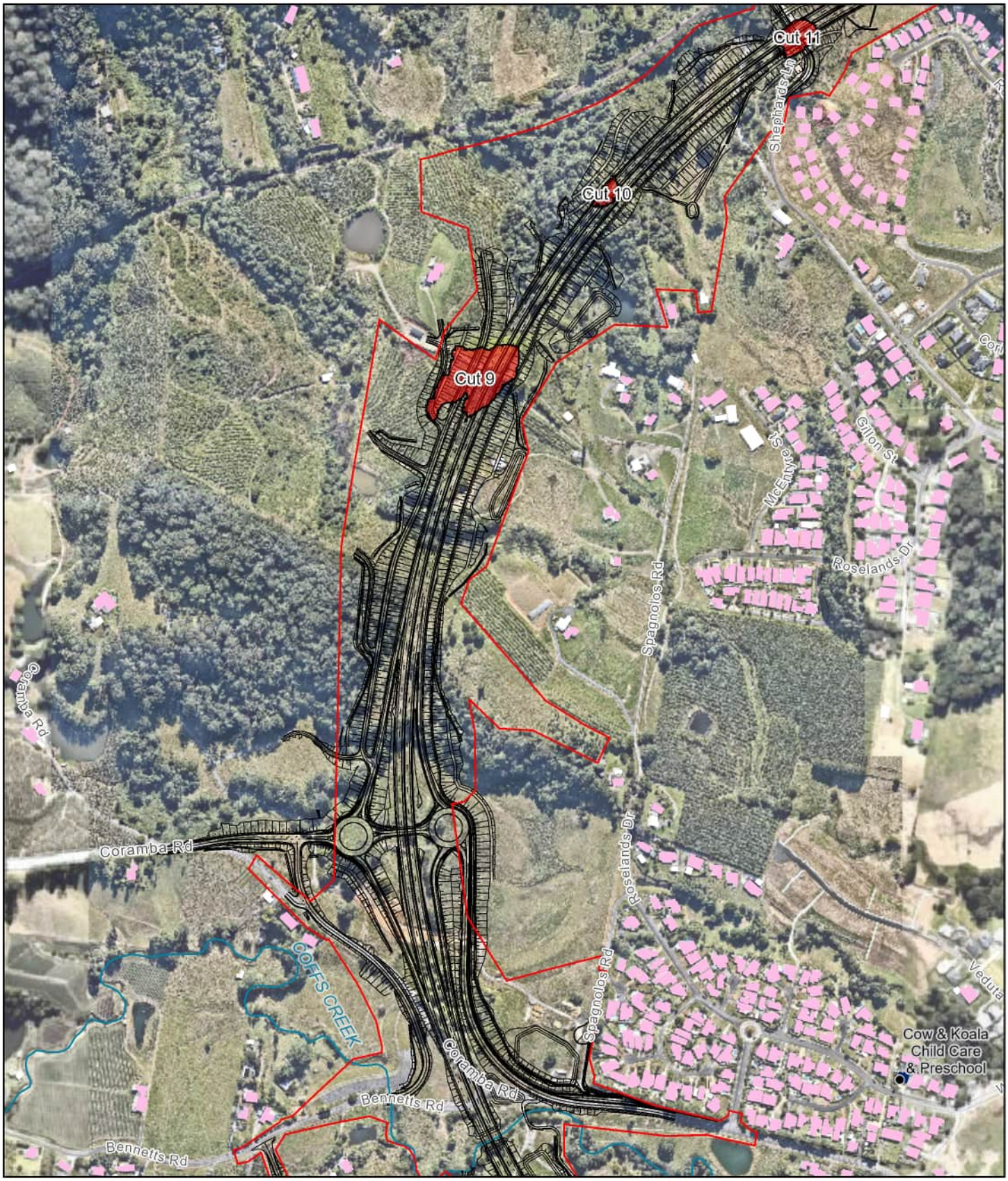
Child Care Facility

SHD

AUX

Proposed Controlled Blast Locations

Controlled Blast Locations



1:7,500

0 345 690 1,380 ft

0 105 210 420 m

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Residential

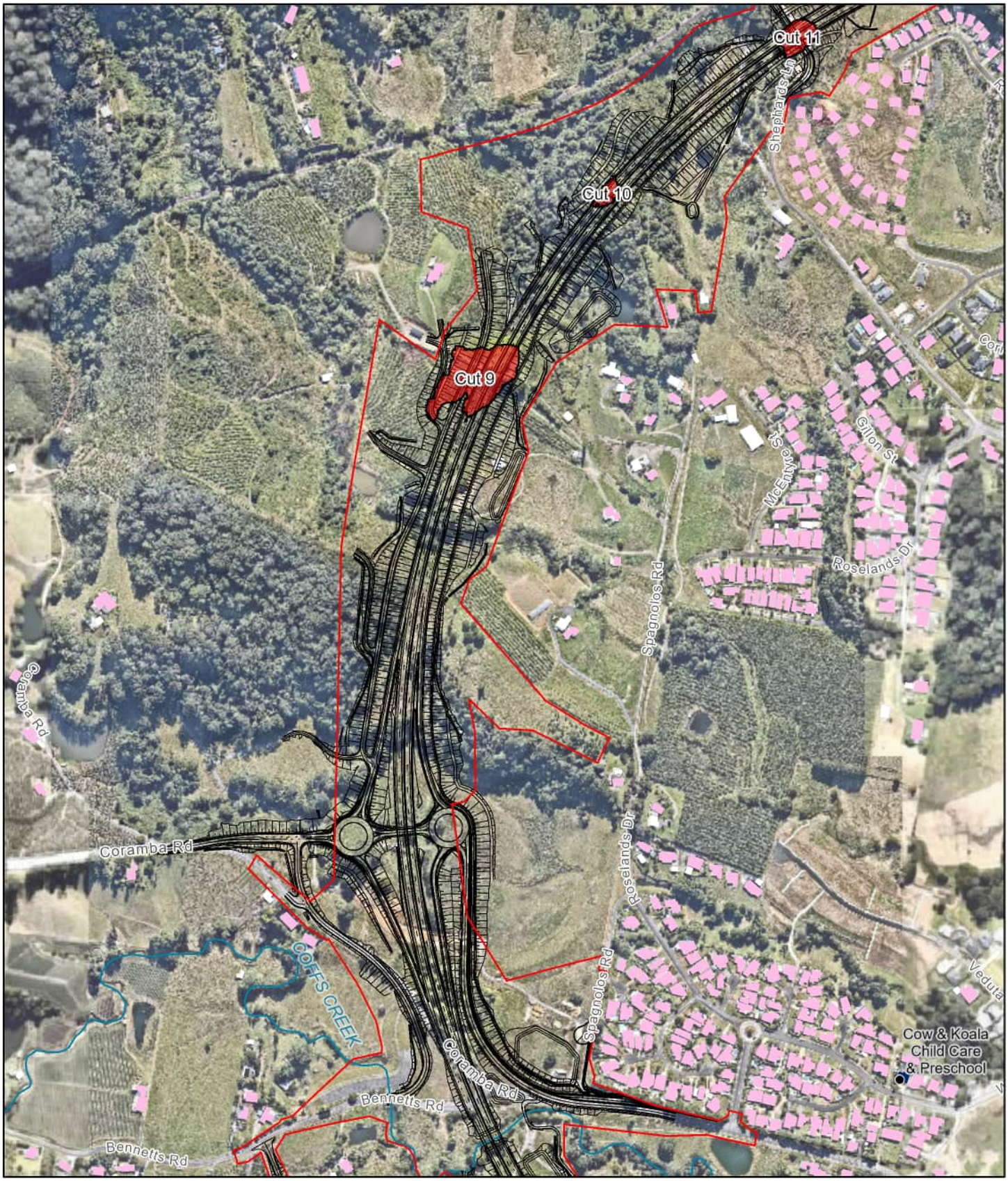
Child Care Facility

SHD

AUX

Proposed Controlled Blast Locations

Controlled Blast Locations



1:7,500

0 345 690 1,380 ft

0 105 210 420 m

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Residential

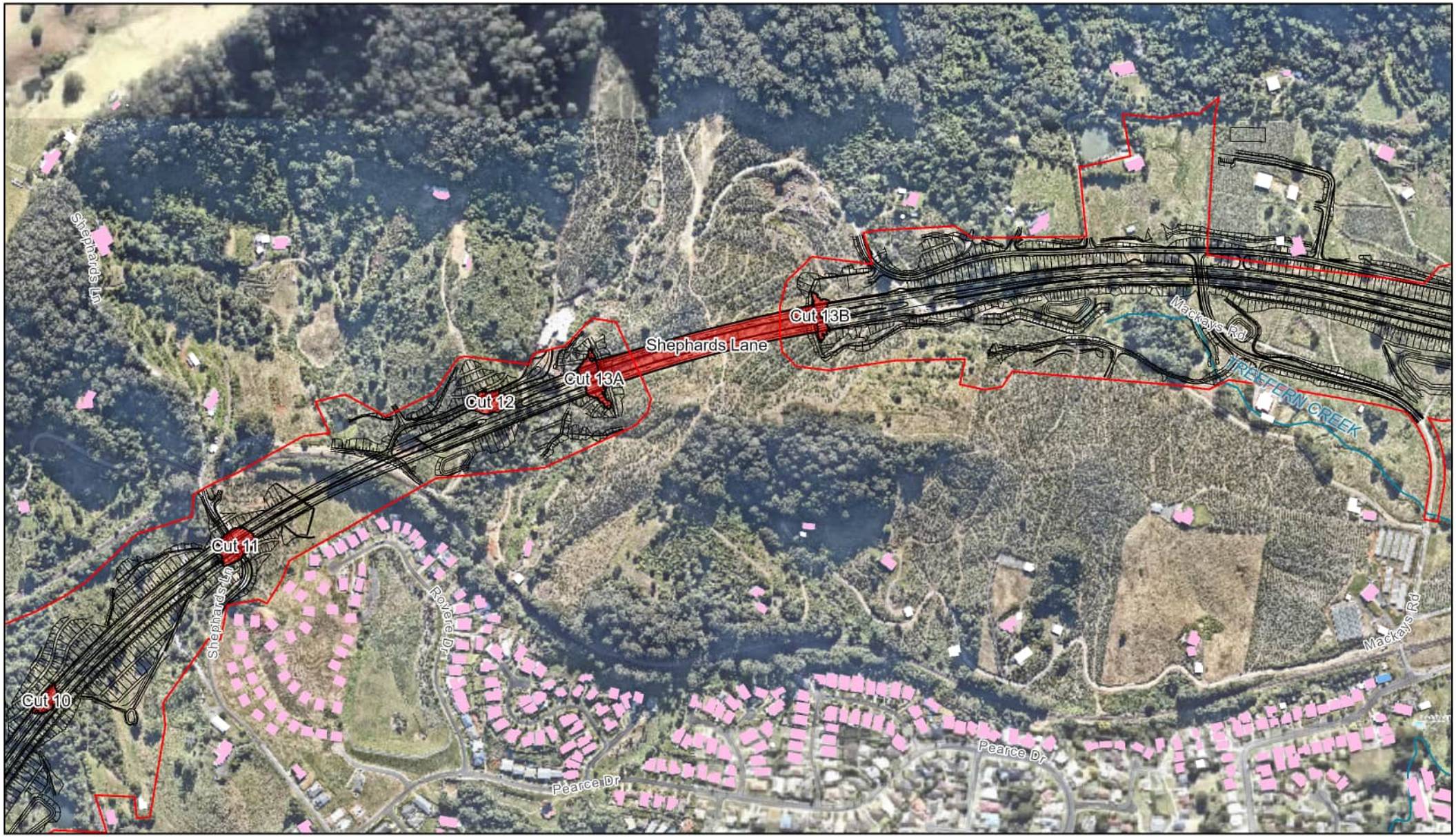
Child Care Facility

SHD

AUX

Proposed Controlled Blast Locations

Controlled Blasting Locations



Proposed Controlled Blast Locations

Approved Construction Boundary – EIS

Sensitive Receivers:

Commercial

Residential

1:7,500

0 345 690 1,380 ft

0 105 210 420 m

Controlled Blasting Locations

Proposed Controlled Blast Locations

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Commercial

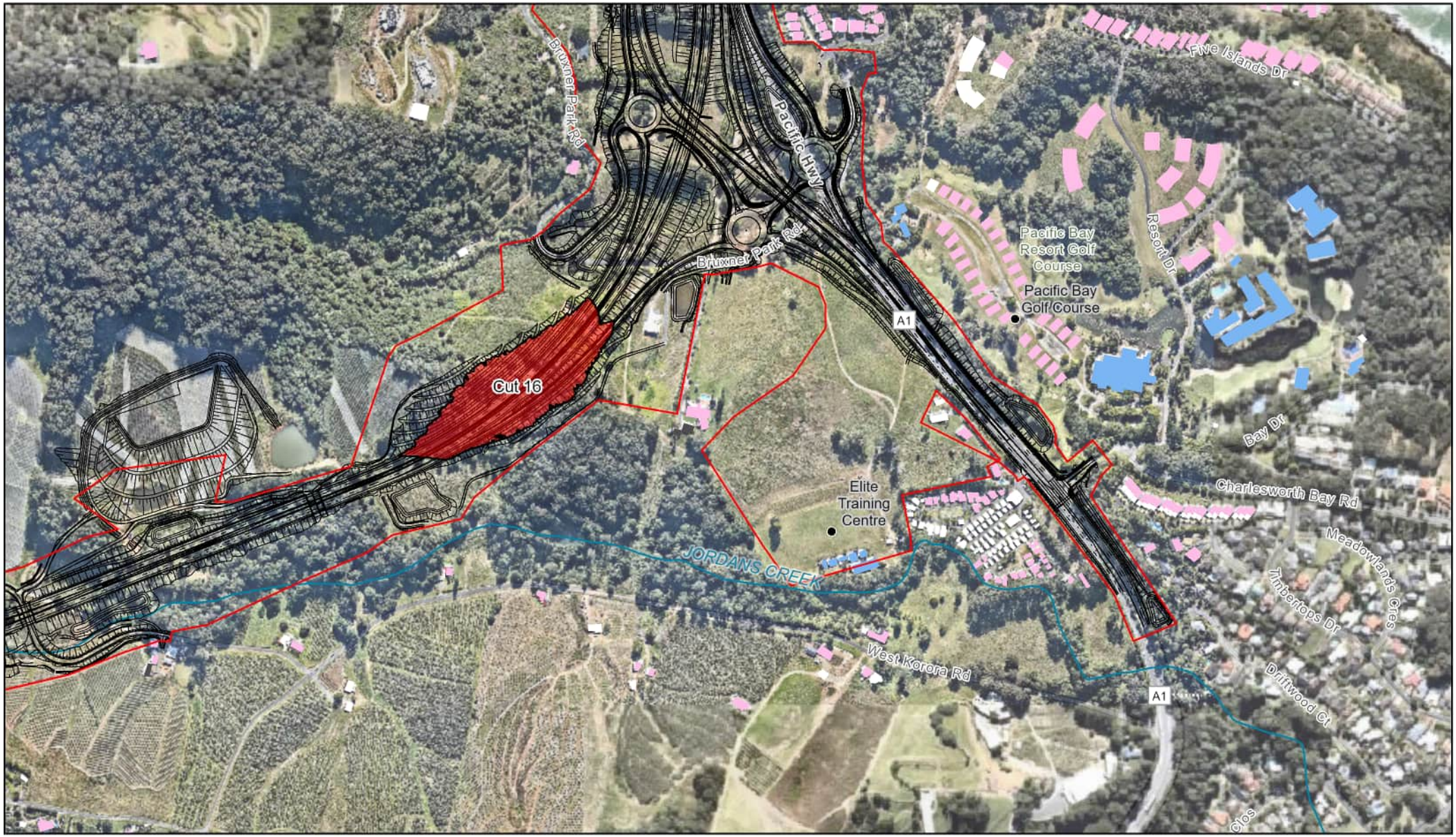
Residential

1:7,500

0 345 690 1,380 ft

0 105 210 420 m

Controlled Blasting Locations



Proposed Controlled Blast Locations

Approved Construction Boundary – EIS

Sensitive receivers

Sensitive Receivers:

Commercial

Residential

1:7,500

0 345 690 1,380 ft

0 105 210 420 m

Controlled Blasting Locations

Proposed Controlled Blast Locations

Approved Construction Boundary – EIS

Sensitive Receivers:

Commercial

Residential

School

1:7,500

0 345 690 1,380 ft

0 105 210 420 m