Rasp Mine

Zinc – Lead – Silver Project

Project Approval No. 07-0018

Environmental Assessment

Modification 3
Mining Extension

November 2014

Broken Hill Operations Pty Ltd
BROKEN HILL

ABN 58 054 920 893

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ENVIRONMENTAL ASSESSMENT STATEMENT

SUBMISSION OF ENVIRONMENTAL ASSESSMENT (EA)
This EA is prepared under section 75W of the *Environmental Planning and Assessment Act 1979*

MODIFICATION EA PREPARED BY

Name:	*Gwendalynn Wilson*
Qualifications:	*B Com Grad Dip OHM*
Address:	*Level 4, 100 Mount Street* *North Sydney* *NSW 2060*

PROJECT APPROVAL MOD3

Applicant Name:	*Broken Hill Operations Pty Ltd*
Applicant Address:	*Eyre Street PO Box 5073* *Broken Hill Broken Hill* *NSW 2880 NSW 2880*

Proposed modification: *Approval is sought to modify the Rasp Mine Project Approval 07_0018 to extend mining of Main Lode Pillars to the southwest to include Block 7 and to include mining of the Zinc Lodes both located within Consolidated Mine Lease 7.*

ENVIRONMENTAL ASSESSMENT *An EA for this Modification is attached.*

CERTIFICATION

I certify that the contents of this EA have been prepared and to the best of my knowledge:

- *It is in accordance with Section 75W of the Environmental Planning and Assessment Act 1979;*
- *Contains all available information that is relevant to the environmental assessment of the activities to which this Modification EA relates; and*
- *The information contained in this Modification EA is neither false or misleading.*

Signature 

Name: *Gwendalynn Wilson*
Group Manager – Safety Health Environment Community
CBH Resources Ltd

Date: *November 2014*

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EXECUTIVE SUMMARY

OVERVIEW

Mining has been undertaken in the CML7 area since 1887. The existing Rasp Mine Project is owned and operated by Broken Hill Operations Pty Ltd (BHOP) and involves underground mining operations, a processing plant producing zinc and lead concentrate and a rail siding for concentrate dispatch. The Rasp Mine received approval from the then Minister for Planning on 31 January 2011 under Part3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (PA07_0018). The Rasp Mine is located on Consolidated Mine Lease 7 (CML7).

Pursuant to section 75W of the EP&A Act BHOP is seeking to modify its Project Approval to extend underground mining to the southwest of CML7.

MODIFICATION DESCRIPTION

BHOP proposes to extend its underground mining workings to the southwest of CML7 to include Block 7. Block 7 contains mining resources in the form of Main Lode Pillars, as currently mined in Blocks 8 to 12, and a high grade pod of ore called the Zinc Lodes. The Zinc Lodes extends beneath South Road to the border of CML7 with the adjacent mine owned and operated by Perilya Broken Hill Operations Pty Ltd (Perilya). The existing known ore resource within Block 7 includes the Zinc Lodes with an orebody of approximately 266,000 tonnes (t) and the Main Lode Pillars with an orebody of approximately 50,000 t. These orebodies will be mined over a period of approximately 2 to 3 years.

The areas included for the proposed mining extension were intended to be mined and were included in the resource model as part of the Rasp Mine reserves. However at the time of the Project Approval application, a geotechnical study for the area had not been completed. It was therefore decided to allow the application to proceed and request a modification to the Project Approval prior to mining in these areas.

This Modification is also seeking approval to mine additional resource within Block 7. The volume of this additional resource will be defined following further exploration drilling operations. The existing known and proposed resource within Block 7 will be mined at the already approved extraction rate of 750,000 t per annum.

The Modification is required because material from the Main Lode Pillars within the approved mining area cannot be successfully mined due to their oxidation, inaccessibility or inability to process. In September 2013 BHOP were forced to reduce mine production making 49 employees redundant and operating the processing plant on a campaign basis restricting operating days per month.

Without approval of the Modification the Rasp Mine cannot rely on the remaining resource within the Western Mineralisation alone to be economically viable. The Modification will provide better utilisation of the resource and will also provide an opportunity for future exploration drilling in this area which may expand the resource. The Modification will improve the financial position of the Mine in the current market downturn securing its future. If the Modification is not approved there is a high risk that the Mine will close.

The in-situ value of this existing known resource (based on a conservative recovery of 200,000 t) at today's commodity prices is approximately $100 million. The Modification secures the employment of the current Rasp Mine workforce of 150 full time employees and will require an additional 35 employees.

The Modification does not include any significant surface activities or additional land disturbance to that already approved. The Modification will not result in an extension to the mine life, changes to the extraction rates, mining methods, processing operations or transportation arrangements.

The following table provides a summary existing approved and proposed modified project.

Summary Comparison Table

Component	Approved Rasp Mine	Modified Rasp Mine
Mine Life	15 years (includes construction and closure) from 2011 to 2026.	No change
Tenement Status	CML7 – Incorporates the Rasp Mine.	No change
Mining Methods	Underground mining using various methods including long hole, benching, modified Avoca, room and pillar or uphole retreat. Within Western and Centenary Mineralisation and Blocks 8 to 12.	No change Extension of mining into Block 7.
Mining Rate and Total Production	750 000 tonnes per annum (tpa) ore. Total production over life of Project: Approximately 8,450,000 t	No change
Waste Rock Disposal	Underground: Backfill Surface: Inert material to be used for road repair and bunding and rehabilitation at closure	No change
Underground Ventilation	2 x 450 kW primary fans located 160 m below ground and exhausting centrally within CML7, Point 1.	Additional 4 x 110 kW fans located 90 m (Shaft 5) and 160 m (Shaft 6) below ground and exhausting centrally within CML7 at Shaft 6.
Processing Methods	Crushing, grinding, flotation, thickening and filtration at on-site processing facilities.	No change
Processing Rates	250 tonnes per hour (tph) ph in crushing plant and 93.8 tph in grinding plant.	No change
Concentrate Production	Lead: 44,000 tpa (concentrate 73% lead (Pb) and 985 g/t silver (Ag) Zinc: 87,000 tpa (concentrate 50% zinc (Zn))	No change
Tailings Disposal	Fine and coarse tailings disposal to TSF2 Blackwood Pit Coarse tailings disposal as underground stope back fill.	No change
Services	Extensions to existing substations, water lines and phone lines. New 22kV overhead powerlines to be constructed.	No change
Water supply / Extraction	Potable / treated water 9 ML/pa Raw untreated water 139 ML/pa Reclaimed / recycled water 300 ML/pa	No change Increased water recycling has resulted in no additional

	Extraction up to 390 ML per annum.	requirement in the water supply. As mining is above the current water level there is no requirement for additional water extraction.
External Roads	No changes to external road network.	No change.
Employment Numbers	Full Production: 150	Increase by 35 to 185.
Hours of Operation	Underground Operations: 7 days per week, 24 hours per day Shunting 7 days per week, 7am to 6pm. Activities not listed above – 7 days per week, 24 hours per day.	No change
Disturbance Footprint	CML7 consists of 342.66 Ha Current land disturbance due to Rasp Mine activities is 28.4 Ha	No change

REGULATORY FRAMEWORK

The Rasp Mine was declared a Major Project under the State Environment Planning Policy (SEPP) (Major Development) 2005 and was approved in January 2011 by the then NSW Minister for Planning under Part 3A of the EP&A Act. Following appeal of Part 3A of the EP&A Act, the approved project is classified as a 'transitional Part 3A Project', under Schedule 6A of the Act. This modification is therefore to be considered under Section 75W of the EP&A Act, despite its repeal in 2011.

EXISTING ENVIRONMENT

The Rasp Mine is located centrally within the City of Broken Hill and is surrounded by transport infrastructure, areas of commercial and industrial development and some residential housing. The Rasp Mine is bounded by Eyre Street and Holten Drive to the south and east, Perilya's North Mine to the northeast and Perilya's Southern Operations to the southwest, and the commercial centre of Broken Hill to the northwest. It is dissected by two major State roads South Road (Silver City Highway SH22) to the southwest and Menindee Road (MR66) to the northeast. The Broken Hill railway station is located directly to the north and west of the mine and lies on the main Sydney – Perth railway line. Residential and commercial areas surround the mine with pasture land to the south east. The Italio International (Bocce) Club and Broken Hill Bowling Club which are intermittently used are located to the southwest.

IMPACTS, MANAGEMENT AND MITIGATION

The proposed Modification has the potential to result in additional impacts to subsidence, vibration, noise, air quality and heritage to those already approved. BHOP has engaged specialists consultants to provide assessments of potential impacts and advise on recommended measures to control any risks.

The following provides a summary of their findings.

Subsidence

Specialist consultant Ground Control Engineering Pty Ltd was engaged to undertake a geotechnical assessment for the Modification concluded that the proposed mining designs pose little risk to surface infrastructure. Good rock mass conditions are expected during mining. All development headings and wide span areas designed for underground infrastructure will be reinforced according to industry

standards. Hangingwall and stope crown exposures will be cablebolted according to the dimensions of the exposure and local conditions identified during development mining. Recommendations for specific ground support designs have been made by the geotechnical engineer and incorporated into the BHOP Underground Ground Control Management Plan. A 60 m pillar beneath the road will provide adequate protection of this facility and early discussions with Perilya have not identified any issues in relation to their operations which would prohibit the proposed extended mining. In the 1990s Perilya mined the part of the Zinc Lode orebody which extended into their mining lease. Risk reviews are planned with personnel from each mine to identify operational issues and required control measures.

Vibration

Ground vibration at the Rasp Mine is quite variable and influenced by geological structures. However, specialist consultants Prism Mining Pty Ltd have confirmed that the current criteria for vibration as outlined in the Project Approval can be met with a high level of control in the drill and blast methods applied. It is proposed to apply vibration constraints on a 'block by block' basis taking into account sensitive locations, the mapping of geological structures and the blast design parameters to achieve vibration limits.

The potential impacts on infrastructure including road, power lines and water pipework, were assessed by Barnson Pty Ltd who concluded that proper mine operation will not cause any damage to the road reserve infrastructure. BHOP will implement recommendations which include installation of signage to provide information for pedestrians and motorists in the area and implementing measures where high peak particle velocity levels are predicted near the road.

Vibration monitors will also be located at two points to assess potential impacts for residences and at one point to assess potential impacts to the road and surface infrastructure.

Noise

A noise assessment was completed by EGMA|Mitchell McLennan for ventilation fans proposed to be used at Shaft 5 for intake air (2 fans installed 90 m underground) and at Shaft 6 for exhaust air (2 fans installed 160 m underground). The assessment identified that the noise limits as outlined in the current Project Approval would be complied with and that the ventilation fans would not contribute to existing operational noise levels at off-site assessment locations.

Air quality

An air quality assessment was undertaken by Pacific Environment Limited to assess the potential air quality impacts associated with the ventilation exhaust at Shaft 6. The assessment used a comparison with the ventilation shaft proposed in the original EA and the proposed exhaust air at Shaft 6, which is located 50 m to the west. The assessment concluded that the additional ventilation system will not result in any additional adverse (or measureable) impacts to residents surrounding the Mine and will meet Environment Protection Licence 12559 (EPL) criteria.

Heritage

The proposed Modification will not impact on heritage structures within CML7. However a potential risk was identified in relation to Number 4 Headframe which already shows signs of movement. Specific mitigation measures have already been designed to reinforce this wooden structure in consultation with the Broken Hill City Council (BHCC). Engineers have advised that no changes to these works are required due to the Modification.

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Appendix C Letter Report – *Rasp Mine Zinc Lodes Project Approval Variation Noise Assessment,* EGMA|Mitchell McLennan, October 2014

Appendix D – Letter Report – Proposed Upcast Ventilation Shaft 6 - Air Quality Aspects, Pacific Environment Limited, October 2014

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Appendix F – Consolidated Mining Lease 7, Mining Lease Conditions 2004

Appendix G – BHOP Rasp Mine Extension Risk Analysis – Surface / Environmental Aspects SPSolutions October 2014

Appendix H – Letter to Ms Gwen Wilson – MP07_0018: Pre DA Enquiry; Proposed extension to Rasp Mine; 130 Eyre Street, Broken Hill, 24 September 2014

Appendix I – Preliminary Paper – Zinc Lodes Project Approval Variation, Rasp Mine, Broken Hill Operations Pty Ltd, September 2014

Appendix J – Community Consultation – Letter Drop, October 2014

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1.0 BACKGROUND

This section provides an introduction to the Environmental Assessment, details of the proponent and summarises the report structure.

1.1 Introduction

Broken Hill Operations Pty Ltd (BHOP) (a wholly owned subsidiary of CBH Resources Limited (CBH)), purchased the Rasp Mine from Normandy Mining Investments in 2001 (Normandy). The Rasp Mine occupies a central region of the historic Broken Hill Line of Lode orebody and incorporates the original mine areas that commenced operations in the 1880s this includes a substantial amount of mining infrastructure from various mining phases.

Mining has been undertaken in the CML7 area since 1887 by a number of companies including Broken Hill Pty Ltd (BHP), Broken Hill South and Minerals Mining and Metallurgy Ltd (MMM). Operations have been both open pit and underground, with the most recent being the MMM Kintore Pit. Mining ceased in the Kintore Pit in 1991 when Normandy Mining Investments commenced implementation of a rehabilitation plan.

The Rasp Mine is located centrally within the City of Broken Hill (**Figure 1.1**) and is surrounded by transport infrastructure, areas of commercial and industrial development and some residential housing. The Rasp Mine is bounded by Eyre Street and Holten Drive to the south and east, Perilya's North Mine to the northeast and Perilya's Southern Operations to the southwest, and the commercial centre of Broken Hill to the northwest.

The Mine site is dissected by two major State roads, including South Road (Silver City Highway SH22) to the southwest and Menindee Road (MR66) to the northeast. These roads form part of the existing road train and B-double routes through Broken Hill. The Broken Hill railway station is located directly to the north and west of the mine and lies on the main Sydney – Perth railway line.

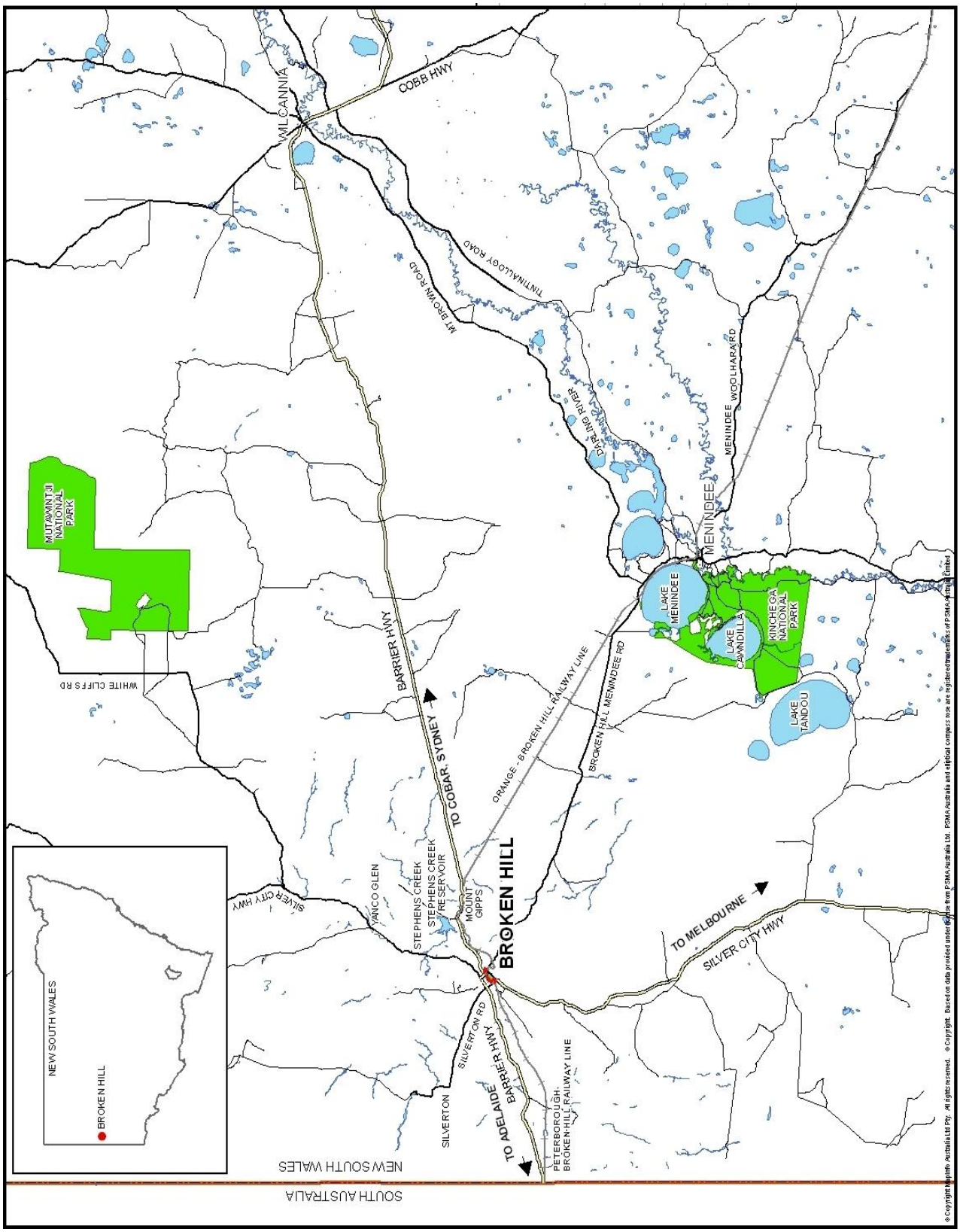
Residential and commercial areas surround the mine with pasture land to the south east. Recreational activities Italio International (Bocce) Club and Broken Hill Bowling Club, which are only intermittently occupied, are located to the southwest. The Blue Metal Quarry lies to the east of the processing plant. An aerial view of the Rasp Mine is provided in **Photograph 1.1**.

The Rasp Mine was declared a Major Project under the State Environment Planning Policy (SEPP) (Major Development) 2005 (now repealed) and required the approval of the then NSW Minister for Planning under Part 3A of the EP&A Act. Approval was granted on 31 January 2011 for underground mining, the construction and operation of a processing plant to produce lead and zinc concentrates and a rail siding for concentrate dispatch. The approval has subsequently been modified on two occasions to accommodate the relocation of the main ventilation shaft and to allow crushing of ore to occur at any time.

BHOP is now seeking approval from the Minister of Planning for a minor modification to PA 07_0018 under Section 75W of the EP&A Act to extend underground mining to Block 7 (including the Zinc Lodes) located to the southwest of CML7, refer **Photograph 1.2.**

The Modification does not involve any significant changes to surface infrastructure or activities or requires any additional land disturbance to that already approved.

Figure 1.1 Locality Map



Legend

Rasp Mine/CML 7 Boundary

Source

Mapinfo Australia Pty Ltd by ERM

Photograph 1.1 Aerial View of the Rasp Mine

Legend

- Rasp Mine/CML 7 Boundary
- Project Area

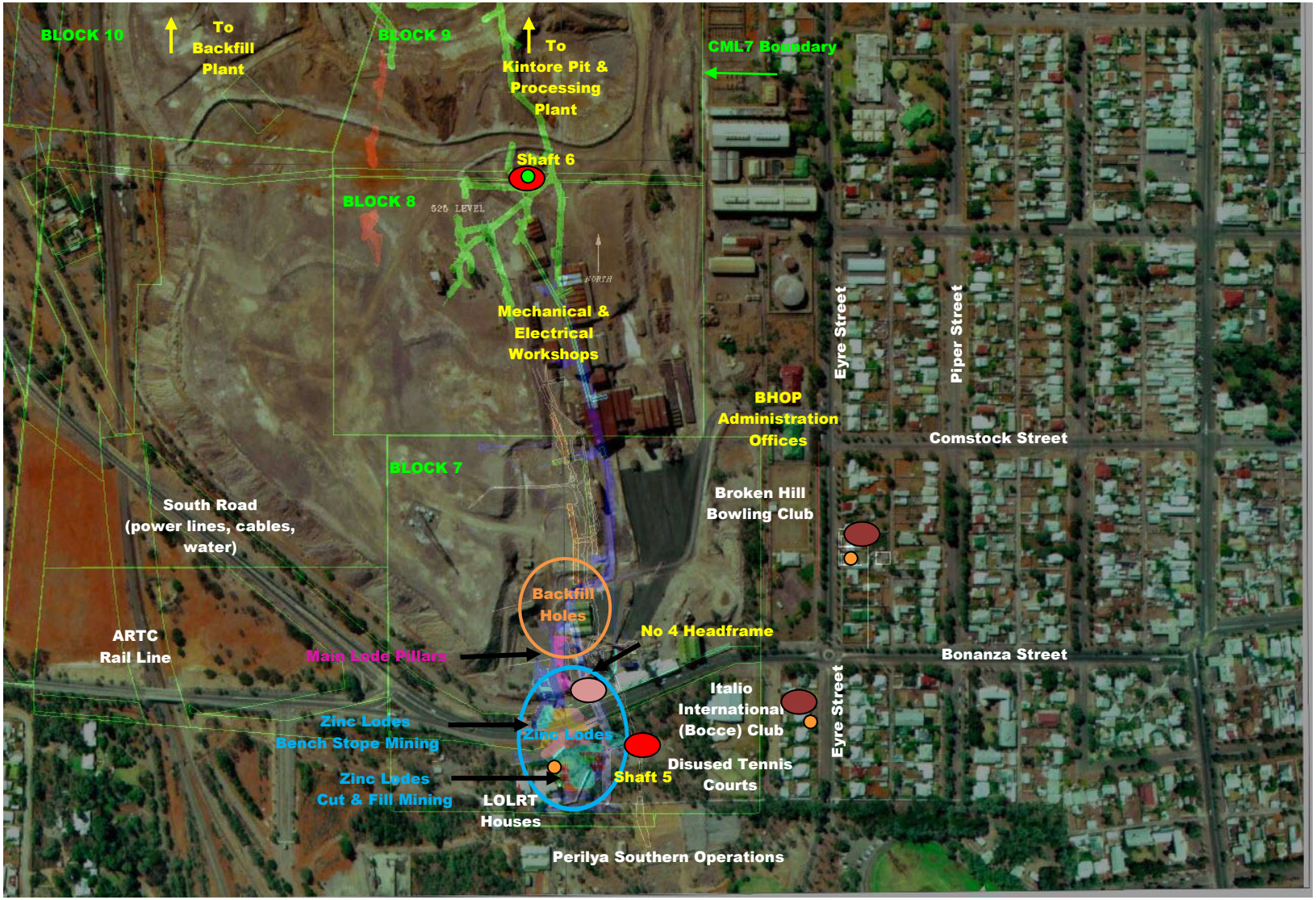
Broken Hill Operations Pty Ltd

Date: 24/09/07

Source: Aerial Dept of Lands by ERM

Scale: Not to scale

Photograph 1.2 Proposed Modification Extended Mining Area and Surrounds



1.2 Reason for Modification

The Modification is required because material from the Main Lode Pillars within the approved mining area cannot be successfully mined due to their oxidation, inaccessibility or inability to process. In September 2013 BHOP were forced to reduce mine production making 49 employees redundant and operating the processing plant on a campaign basis restricting days of operation per month.

The Modification will allow the recovery of up to approximately an additional 316,000 t of high grade zinc / lead ore from the Line of Lode orebody. It will also provide an opportunity for further exploration drilling in this area which may expand the resource maximising ore extraction from this orebody.

Without approval of the Modification the Rasp Mine cannot rely on the remaining resource within the Western Mineralisation alone to be economically viable. The Modification will provide better utilisation of the resource and will also provide an opportunity for future exploration drilling in this area which may expand the resource. The Modification will improve the financial position of the Mine in the current market downturn securing its future. If the Modification is not approved there is a high risk that the Mine will close.

The mining of the high grade Zinc Lodes is vital to ensure the viability of the Rasp Mine. Mining at a conservative rate will provide a significant head grade increase to the operation and enable the mine to operate profitably. The mining of the Zinc Lodes will allow Rasp to return to an annual production level of 600,000 tpa after production was cut to the current level of 450,000 tonnes/year in September 2013. This will translate into an additional 35 jobs plus significant flow-on effects in the City of Broken Hill with respect to service industries and spending. The in-situ value of this existing known resource at today's commodity prices is approximately $100 million. BHOP has used a conservative estimate of 200,000 t when calculating value to account for losses from dilution and / or sterilization of the orebody from the proposed control measures, for example, the 60 m crown pillar and 5 m bridge pillars.

In addition as part of general expenditure, BHOP has planned a $70M capital and cash expenditure in the next 12 months, which will be repeated in future years, benefiting the local community of Broken Hill and industry in New South Wales.

This extended mining would be mined within the approved Rasp Mine mine life using the existing surface infrastructure and would not result in any further land disturbance. Therefore the Modification is a natural extension to the existing Rasp Mine Project.

1.3 Document Purpose

This Environmental Assessment (EA) has been prepared to support the Application which will be lodged with the Department of Planning and Environment (DP&E) for determination by the Minister for Planning (or delegate). A description of the activities proposed in the Modification is provided in **Section 3**.

The Modification sought is otherwise consistent with the BHOP EA and Preferred Project Report (PPR) and PA 07_0018 (as Modified). The schedule of land to which this EA applies is also consistent with the BHOP EA, PPR and PA 07_0018.

1.4 Document Structure

The Executive Summary provides a brief overview of the Project and the major outcomes of this EA. A description of each section of this EA is detailed in below.

- **Section 2** provides detail on the existing approved operations at BHOP;

- **Section 3** includes a description of the various components of the Modification;
- **Section 4** discusses the regulatory framework relevant to the Modification;
- **Section 5** summarises the stakeholder engagement undertaken and any issues raised during that process;
- **Section 6** describes the environmental risk assessment process and summarises the key potential environmental issues for the proposed Modification.
- **Section 7** outlines impacts identified in relation to the Modification and provides management and mitigation measures to be implemented by BHOP;
- **Section 8** lists management commitments to be implemented as a result of the Modification;
- **Section 9** provides a justification for the Modification as sought;
- **Section 10** provides a list of abbreviations and acronyms used in this EA; and
- **Section 11** provides a list of documents referenced in this EA.

2.0 EXISTING OPERATIONS & ENVIRONMENT

This section provides detail on the existing approved operations at BHOP including land tenure, consents and licences, operations, environment management, environmental monitoring and details of the Environment Protection Licence.

2.1 Project Approval

2.1.1 Environment Assessment and Preferred Project Report

Environmental Assessment

The *Environmental Assessment* (EA) (BHOP, July 2010) supported the original Project application and described the following elements of the Project:

- Mining of 8,450,000 t of ore until 31 December 2026;
- Construction and/or extension of associated infrastructure, plant and equipment, including upgrade of internal roads and construction of an on-site noise abatement barrier;
- Transport of ore to the surface in haul trucks;
- Ore processing using crushing, milling and flotation;
- Tailings management, to be deposited into Blackwood Pit (TSF2), and used as back fill for underground mining voids (this has yet to be implemented);
- Works for surface water management; and
- Construction of a rail siding and transport of concentrate in covered rail wagons to a smelter and/or port.

Preferred Project Report

BHOP subsequently amended the layout and design of the Project in order to further minimise environmental impacts and streamline operations. A PPR was submitted in September 2010 outlining the proposed changes to the Project and the subsequent reductions in environmental impacts. Updated environment assessments for air quality, noise and vibration, and storm water management were also submitted as part of the PPR.

These amendments involved:

- Modifying the Project Area to include the new rail load-out area at the north-eastern end of the site;
- Locating the processing plant to the north-eastern end of the lease (away from densely populated residential areas);
- Removing secondary and tertiary crushers and screens from the crushing circuit; and
- Loading concentrate into containers on trucks and transporting them to a newly constructed rail siding located at the north-eastern end of the lease.

2.1.2 Approved Project

On 31 January 2011 the Project Approval (07_0018) for the Rasp Mine Project was granted under Part 3A of the EP&A Act. The key features of the Rasp Mine are provided in **Table 2.1**.

Table 2.1 Key Features of the Rasp Mine

Item	Description
Mine life	15 years to 31 December 2026
Tenement status	CML7 – Incorporates the Rasp Mine.

Item	Description
Mining methodology	Underground mining using various methods including long hole, benching, modified Avoca, room and pillar or uphole retreat.
Mining Area	Western Mineralisation, Centenary Mineralisation, Main Lode Pillars (Blocks 8 to 12)
Mining rate and total production	750 000 tpa ore. Total production over life of Project: Approximately 8,450,000 t
Waste rock disposal	Underground: Backfill Surface: Inert material to be used for road repair and bunding and rehabilitation at closure
Processing methodology	Crushing, grinding, flotation, thickening and filtration at on-site processing facilities.
Processing rates	250 tph in crushing plant and 93.8 tph in grinding plant.
Concentrate production	Lead: 44,000 tpa (concentrate 73% Pb and 985 g/t Ag) Zinc: 87,000 tpa (concentrate 50% Zn)
Tailings disposal	Tailings disposal to TSF2 Blackwood Pit and to be used as backfill in underground stopes. Backfill Plant (constructed and to be commissioned in 2015/16),
Services	Extensions to existing substations, water lines and phone lines. 22kV overhead powerlines.

2.1.3 Project Approval Modifications

There have been two modifications to the Project Approval and these are outlined in **Table 2.2**.

Table 2.2 Rasp Project Approval Modifications

Modification	Purpose	Date Approved
MOD1	Relocation of the ventilation shaft and installation of the ventilation fans underground.	16 March 2012
MOD2	Allow crusher to be operated at any time (24 hours per day 7 days per week).	29 August 2014

2.2 Current Infrastructure

BHOP is serviced by surface facilities including administration offices, washhouse and change rooms, electrical and maintenance workshops, laboratory, stores facilities, core work and storage, crusher plant, processing plant and rail siding facilities. The site also includes historic mining buildings and structures across CML7 left behind from previous mining, including BHP Pty Ltd. These are listed as heritage items on the BHCC Local Environment Plan 2013 (LEP) and some of which date from the 1890s.

2.3 Current Consents, Authorisations and Licences

2.3.1 Consents

Table 2.3 presents the consents held by BHOP.

Table 2.3 Development Consents

Approval Number	Date Issued	Duration	Purpose
DA 125/2001	5 Sept 2002	Work completed	Surface drilling on CML7 in surface exclusion zone (near rail), supported by a Statement of Environment Effects (SEE).
MOP 06/6463	26 Oct 2006	31 Aug 2008	Construct exploration decline, conduct drilling and obtain bulk sample, supported by a Review of Environmental Factors (REF).
DA 101/2007	26 April 2007	Work completed	Undertake temporary mining in the Kintore Pit, supported by a SEE.
MOP Amendment 06/6436	5 May 2008	31 Oct 2008	Extend the exploration decline.
MOP 06/6463	1 Sept 2009	31 Dec 2010 Extended to 31 March 2011	For underground mining and stockpiling 120,000 tpa, supported by a REF.
DA 264/2009	19 Jan 2010	2 Feb 2011	For ancillary surface mining activities including crushing, stockpiling and transport of ore, supported by a SEE.
Part 3A Application 07_0018	31 Jan 2011	31 Dec 2026	Mining production of 750,000 tpa from Western Mineralisation, Centenary Mineralisation and Main Lode Pillars. Construction and operation of a minerals processing plant and rail loadout facility. Supported by an EA.
MOP 06/6483	1 April 2011	31 Mar 2014 Extended to 31 Oct 2014	Mining production of 750,000 tpa from Western Mineralisation, Centenary Mineralisation and Main Lode Pillars. Construction and operation of a minerals processing plant and rail loadout facility. Supported by an EA prepared for DP&I Part 3A Project Approval.
Part 3A Project Approval 07_0018 Modification	16 March 2012	31 Dec 2026	Relocation of ventilation shaft.
MOP 06/6463	30 March 2012	31Mar 2014	Relocation of ventilation shaft.
MOP 06/6463	March 2014	30 Jun 2014	Extension of Mining Operations Plan (MOP) requested and granted.
Part 3A Project Approval 07_0018 Modification	Feb 2014	29 Aug 2014	Allow 24 hour crusher operation.

2.3.2 Leases

Table 2.4 presents the mineral authorities held by BHOP in the vicinity of the Rasp Mine. For the purposes of this document, the area covered by CML7 and MPLs 183, 184, 185 and 186 within the surface area rights of BHOP, is referred to as the Rasp Mine.

Table 2.4 Mineral Authorities

Mineral Authority	Grant Date	Last Renewed	Renewal Date	Holder	Purpose
CML7	8 Oct 1987	17 Jan 2007	31 Dec 2026	BHOP	As per Schedule 2 of the Lease Open cutting, shaft sinking, stoping, tunnelling, building of dams, extraction and obtaining minerals, generation of electricity, erecting dwellings, storage of fuels, dumping of ore, treatment and dumping of tailing, development of roads (**Appendix F**)
MPL 183	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
MPL 184	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
MPL 185	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
MPL 186	4 Feb 1981	24 Apr 2007	31 Dec 2026	BHOP	Dumping of ore and mine residues, treatment of tailing
EL 5818	8 Mar 2001	7 Mar 2009	7 Mar 2015	BHOP	Surface disturbing works such as drilling and soil sampling

This Modification applies only to CML7 and will have no impact on any of the other MPLs or EL.

2.3.3 Licences

Table 2.5 presents the licences held by BHOP in relation to the Rasp Mine.

Table 2.5 Licences Held

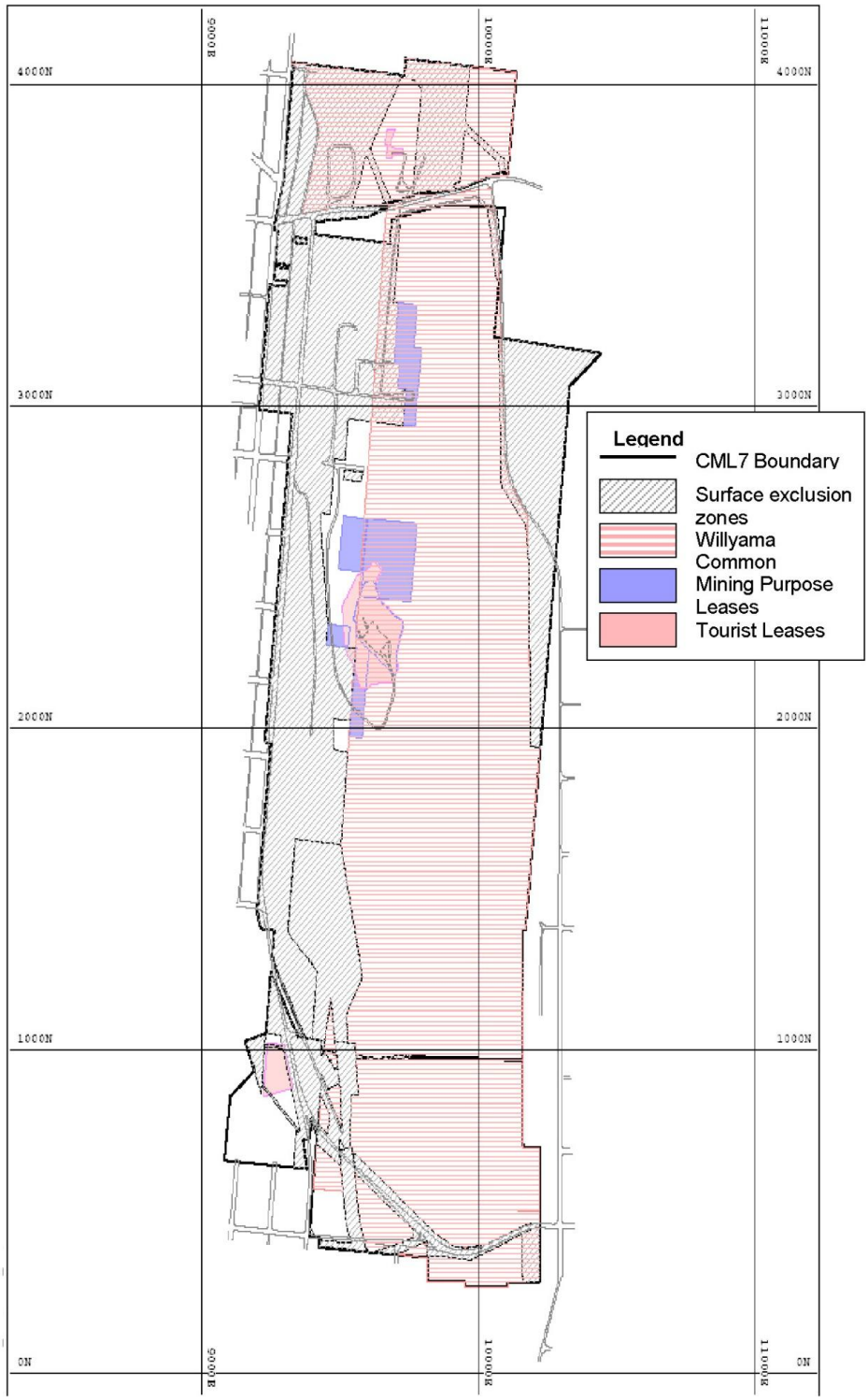
Licence / Permit	Issued By	Date of Expiry/ Renewal	Purpose
EPL 12559	EPA	Upon surrender, suspension or revocation.	Authorises the carrying out of scheduled activities: Crushing , grinding or separating >500,000 – 2,000,000T processed. Mining for minerals >500,000 – 2,000,000T produced.
Dangerous Goods and Explosives Notification	Work Cover	23 Feb 2017 24 Oct 2017 23 April 2015	Store Manufacture Notification
Water extraction 85WA752823	NOW	29 March 2017	To extract 390 ML for use on site or to send to Perilya Broken Hill Operations Pty Ltd.
Radiation	EPA	Sept 2014[1]	Sell and/or possess radiation apparatus. Sell and/or possess radioactive or items containing radioactive substances.

Note 1: BHOP have been advised by the EPA that renewal notices for radiation licences will not be available until the end of November and that an extension to the end of November has been provided.

2.4 Land Ownership for the Rasp Mine

The majority of the land on which the CML7 and MPLs are located is designated as "WILLYAMA COMMON Reserve 2421"(**Figure 2.1)**. This lease was originally gazetted on 4th September 1886. Only a small portion of the lease area is freehold and this land is identified in Certificate of Title 4635/757298. The land within CML7 upon which BHOP has surface rights is leased from the Crown through a series of Mining and Western Land Leases, with the exception of one freehold block (Block 10) located towards the centre of CML7.

Figure 2.1 Consolidated Mining Lease 7



2.5 Environment Management System

BHOP operates under an Environment Management System (EMS) designed to assist BHOP to:

- Effectively manage its environmental issues;
- Ensure compliance with regulatory requirements;
- Continually improve its environmental performance; and
- Address the expectations of stakeholders.

In accordance with PA 0018_2007, BHOP implements the following management plans to control potential environment impacts:

- This Environment Management Strategy (EMS);
- An Air Quality Management Plan (AQMP), including air quality monitoring;
- A Community Lead Management Plan (CLMP);
- A Noise and Blasting Management Plan (NBMP), including noise and blasting monitoring;
- A Site Water Management Plan (SWMP), including surface and ground water monitoring;
- A Traffic Management Plan (TMP);
- A Waste Management Plan (WMP); and
- Rasp Rehabilitation and Environmental Management Plan / Mine Closure Plan (MCP)
- Conservation Management Plan (CMP), in preparation and expected to be completed by mid 2015 (BHOP Letter to DP&E (Kane Winwood), July 2014).

The overall objectives for environmental management are outlined in the Environment Policy. **Table 2.6** provides a summary of objectives for a number of key environmental areas.

Table 2.6 Environment Objectives

Issue	Goal	Objectives
Air	To maintain current air quality standards.	To comply with air quality criteria as listed in the Project Approval and EP Licence, as verified by monitoring. To implement air quality control measures as outlined in the Air Quality Management Plan. To receive minimal community complaints, which are addressed promptly and satisfactorily, and reported as required. To report and address any non-compliances.
Lead	To have no adverse impact on blood lead levels of the community.	To assist the community in raising awareness about managing lead in the environment. To use measures to minimise dust emissions. To support community blood lead level monitoring programs.
Noise	To maintain an acceptable noise amenity for surrounding neighbours.	To use measures to minimise noise emissions. To monitor and meet noise emission criteria and EP Licence conditions. To promptly address any complaints relating to noise from the general public and report as required. To report and address any non-compliances.
Water	To prevent pollution and contamination to surrounding lands.	To use measures to prevent water discharge. To reduce the risk of oil or chemical contamination of surface / groundwater. To reduce sediment runoff.

Issue	Goal	Objectives
Emergency response	To quickly and effectively minimise adverse impacts to the environment associated with an emergency situation.	To provide training and equipment to enable a quick and effective response to environmental emergencies including spillages.
Heritage	To retain the maximum possible value of cultural mining heritage located on CML7.	To prevent demolition wherever possible of listed heritage buildings and structures. To adaptively reuse heritage buildings where possible. To conserve heritage buildings and structures where possible.

A key component of the EMS is the continued implementation of the existing comprehensive environment monitoring program, refer **Table 2.7.** Environmental monitoring includes a comprehensive air quality, noise, blasting, water quality and meteorological programs to effectively monitor the environmental performance of BHOP operations. The monitoring programs have been developed in consultation with the relevant government agencies and in accordance with BHOP's Environment Protection Licence and conditions of the Project Approval.

Table 2.7 Summary of BHOP Environmental Monitoring

Category	Parameter	Program
Air Quality	TSP	3 HVAS
	PM10	2 HVAS, 2 TEOM
	Dust Deposition	7 depositional dust gauges
	Lead	2 HVAS, 7 depositional dust gauges
	Gases and dust testing	2 locations
Water Quality	Surface water	8 locations
	Groundwater	16 locations
Noise Monitoring	Attended noise monitoring	14 locations
Blast Monitoring	Fixed blast vibration and overpressure monitors	3 locations
Meteorological monitoring	Weather station	1 location

2.6 Environment Protection Licence

BHOP also carry out their activities under Environment Protection Licence 12559 (updated September 2014) (EPL). The Licence provides for crushing, grinding or separating to 2Mt and mining to a maximum of 2Mt.

The following provides a summary of EPL conditions:

- Undertake monitoring for dust, surface and ground water at listed locations for listed parameters and meet listed criteria.
- Prevent pollution of waters in compliance with section 120 of the *Protection of the Environment Operations Act 1997.*
- Not to take waste from outside the premises or allow waste generated at the premises to be disposed at the premises except as permitted by the EPL.
- Only allow shunting of wagons to occur between 7.00am and 6.00pm on any day.
- Undertake production rock blasting only between 6.45am and 7.15pm on any day.

- Undertake construction activities only between 7 am and 7 pm on any day.
- Meet noise criteria as listed.
- Meet blasting and overpressure criteria as listed.
- Not to cause any offensive odour from the premises.
- Carry out activities in a competent manner.
- Accommodate the stormwater runoff generated in a 100 (24 hour) ARI event.
- Line water storage ponds – Plant Event Pond, Overflow Event Pond, Backfill Plant Sediment Pond and Mine Settle Ponds.
- Maintain and operate plant and equipment in a proper and efficient manner
- Prevent dust emission from the premises.
- Cover the loads of any ore trucks entering or leaving the premises.
- Immediately suppress any visible dust emissions from the TSF by water or chemical suppressant.
- Only crushing extracted material in the crusher enclosure and operate the enclosure under negative pressure at all times when in operation and minimise any fugitive emissions.
- Include dust management practices in the air Quality Management Plan that effectively minimise dust emissions.
- Maintain water storage ponds to ensure sedimentation does not reduce capacity by more than 10% of the design capacity.
- Undertake weather monitoring at the listed location for listed parameters.
- Maintain monitoring records for 4 years and provide to an EPA officer upon request.
- Record pollution complaints and maintain these records for 4 years and provide to an EPA officer upon request.
- Establish and maintain a complaints line for the public, providing notification of the number and its purpose.
- Provide (and retain) an annual return to the EPA including a summary of monitoring results, statement of compliance and any public complaints made during the period.
- Notify the EPA of incidents causing or threatening to cause environmental harm (131 555) and provide written reports as required.
- Keep a copy of the EPL on the premises and make available to an EPA officer and/or employee on request.

The EPL includes several Pollution Reduction Programs due to historic and current mining activities. A list including current status of items is provided in **Appendix L** and where relevant are referenced in the body of this EA.

3.0 MODIFICATION REQUESTED

This section includes a description of the various components of the Modification including the location of the extended mining, mining resource, mining methods, backfill process and surface infrastructure.

3.1 Background

BHOP seeks to modify its Project Approval 07_0018 for the Rasp Mine in Broken Hill to extend its underground mining to the south-western boundary of CML7 to include both the known and potential resources within Block 7 which includes the mining of Main Lode Pillars and the Zinc Lodes, a pod of high grade ore, refer **Figure 3.1**. The current Project Approval (07_0018 January 2011) permits underground mining of the Western Mineralisation, the Centenary Mineralisation (to the south/western lease boundary) and the Main Lode Pillars (from Blocks 8 to 12), refer **Figure 3.2**.

The areas included for the proposed mining extension were intended to be mined and were included in the resource model as part of the Rasp Mine reserves. However at the time of the Project Approval application, a geotechnical study for the area had not been completed. It was therefore decided to allow the application to proceed and request a modification to the Project Approval prior to mining in these areas.

There will be no addition to life of mine mined tonnages or ore processed as the proposed mining will replace material from Main Lode Pillars which cannot be mined successfully due to its oxidation, inaccessibility or inability to process. Therefore there will be no requirements for additional equipment to extract or process ore from these areas and no impact on tailings produced for life of mine.

There will be no additional land disturbance as a result of the proposed extended mining.

3.2 Known Targeted Resource

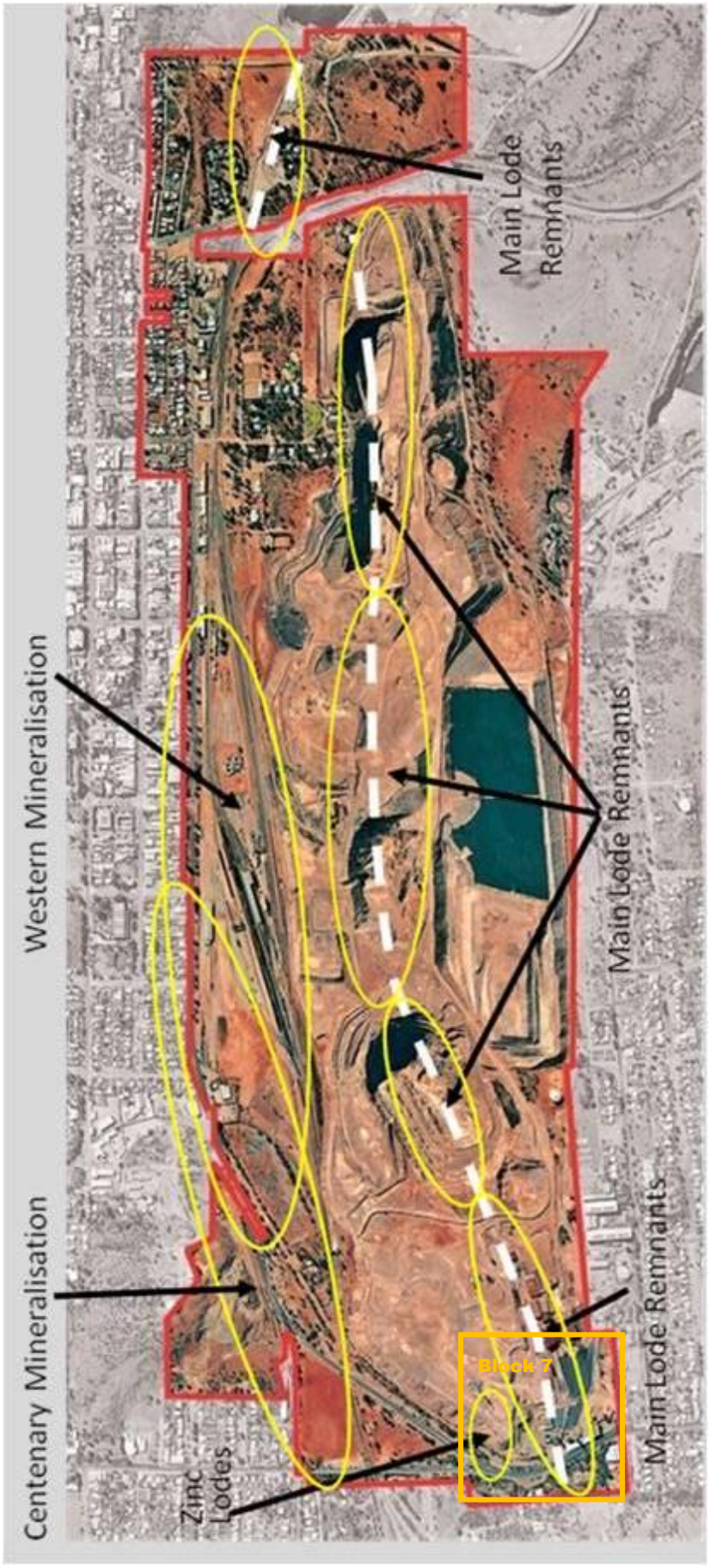
The Zinc Lodes located in Block 7 represent an updated resource (from the 2009 resource presented in the original EA) (refer **Table 3.1)** of 266,000 t at a grade of 11.6% zinc, 6.8% lead and 88 g/t silver. The in-situ value of this ore at today's commodity prices is approximately $80 million (based on recovery of 200,000 t providing a conservative estimate and allowing for dilution and sterilization of ore due to porposed control measures, for example, 60 m crown pillar and 5 m bridge pillars).

It has also been determined that Block 7 contains 50,000 t of Main Lode known resource at a grade of 7% zinc, 8% lead and 150 g/t silver. The in-situ value of these reserves is approximately $20 million (it is considered that 50,000 is representative of what ore can be extracted).

There will be some partial sterilization of the orebody, particularly in regards to the upper areas of the Zinc Lodes, due to BHOP's conservative approach to mining this area. This approach results in some minable ore being left behind in the 60 m crown pillar and in the 5 m bridge pillars used in the bench stoping. Sterilisation of ore may also occur through stope failure. Hangingwall or crown failures have the potential to sterilise ore in the vicinity of the failure and mine designs will be directed at reducing this risk.

These two areas, Main Lode Pillars and Zinc Lodes, represent high grade ore essential for the viability of the Rasp Mine operations. Current grades from the Western Mineralisation are to be supplemented with higher grades reserves such as these to ensure viability and maximise recovery of underground resources.

Figure 3.1 Rasp Mine Resources Areas



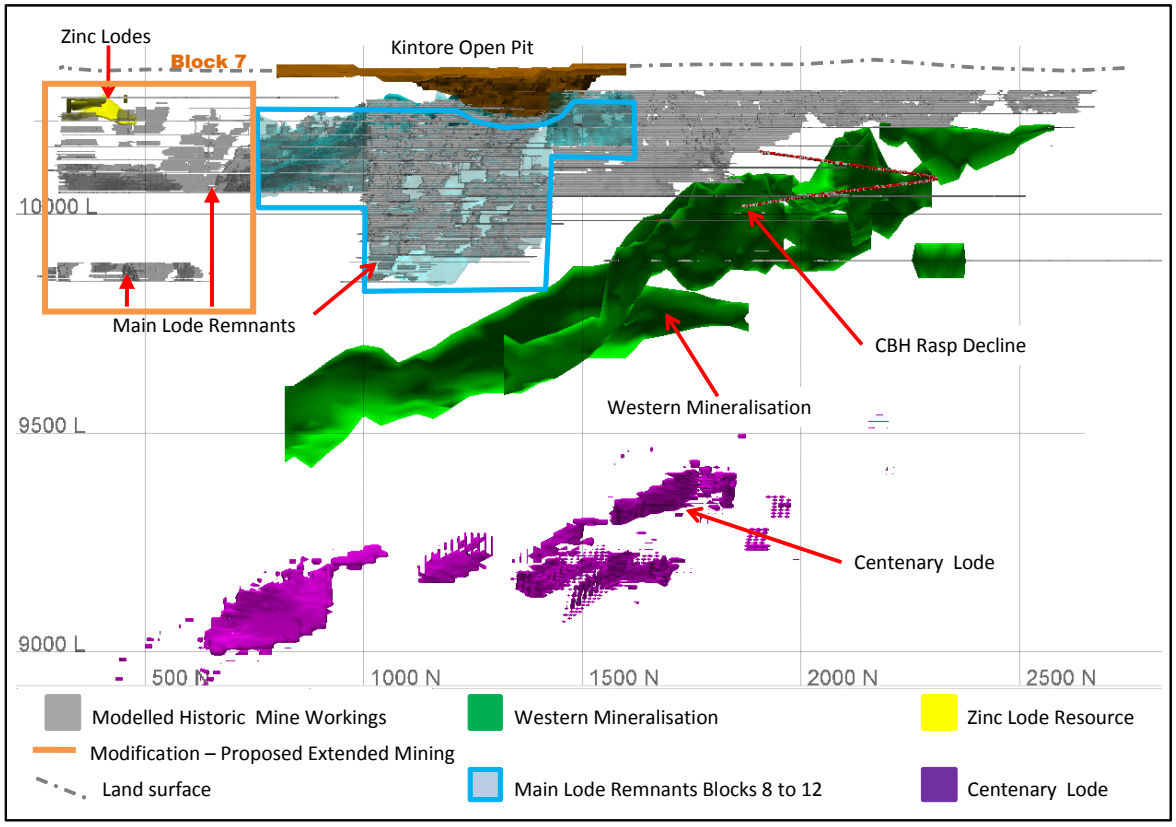
3.3 Potential Resource Development

BHOP will continue its underground exploration drilling program to identify opportunities to extend the resource to maximise ore extraction from the Line of Lode orebody. This exploration will be concentrated on the north west portion of Block 7 and is limited to the south east of Block 7 by the Eastern Shear Zone. This potential orebody is concentrated further from sensitive residential receivers that the known resource mining areas.

Table 3.1 Known ore Resource as at 30 June Block 7

	Category	'000 t	Zn%	Pb%	Ag g/t
Main Lode Pillars	Probable	50	7.0	8.0	150
Zinc Lode	Probable	260	11.6	6.8	83

Figure 3.2 Rasp Mine Resource Areas - Looking West



3.3.1 Block 7 – Main Lode Pillars

Block 7 Main Lode is an extension of the old Main Lode orebody (comprising 2 and 3 Lens material). The Rasp Mine currently has Project Approval to extract left-over pillars from historic mining in Blocks 8 to 12 and seeks to continue this mining into Block 7.

The Main Lode was the primary focus of mining operations on CML7 between 1884 and 1991 and BHOP will extend its focus on the remaining material left in Block 7. These pillars are dispersed throughout old

timber stoping areas that were originally uneconomic to mine but with bulk mining methods can now be economically recovered.

3.3.2 Block 7 - Zinc Lodes

The Zinc Lodes are along a strike extension of the B and C Lodes that were mined on the Perilya Southern Operations Lease to the south west. The geology of the B and C lodes has been well documented in Broken Hill over a long period. On CML7 the B Lode material is concentrated in an area of fold interference and the C Lode material is concentrated in “dropper” structures which are axial planar to the B Lode folds. This is typical of B and C lodes throughout the field.

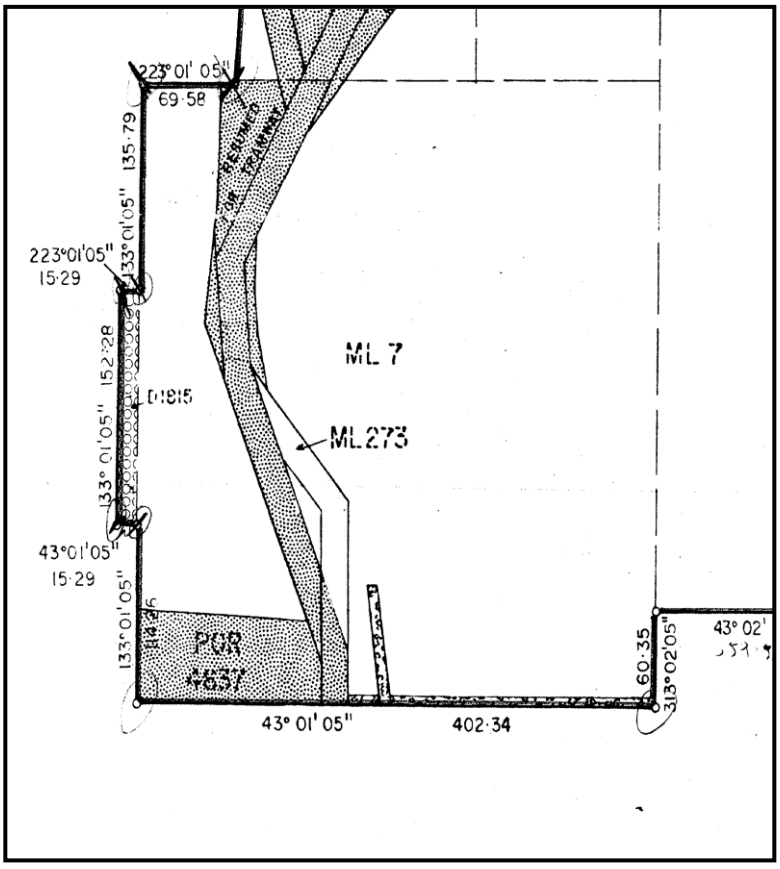
The whole rock geochemistry within the Zinc Lodes is consistent with other areas of B and C lode within CML7. Details of whole rock geochemistry of the Zn-lodes can be found in *Zinc Lodes, CML7, Broken Hill, NSW, Report on Drilling Programme November 2002*. Additionally, re-assaying of drilled core in ore intervals has produced results similar to those originally reported.

3.4 Description of Proposed Mining Areas

The extended mining areas are located in the southwest corner of CML 7 (**Appendix F**), granted in 1987. CML7 consists of a number of mineral leases dating back to 1886 including mining purposes leases from 1973. Mining Lease 7 or Block 7 is located in the southwest corner of CML7 and contains surface exclusions for transport and other facilities to a depth of 15.24 m (indicated by small dots in **Figure 3.3**).

The area also includes a strata inclusion (indicated by the small circles in **Figure 3.3**) embracing the stratum between the depths of 420.62 m and 664.46 m from the surface. This area will not be affected by the extended mining.

Figure 3.3 Block 7 CML7



3.5 Surface Infrastructure and Nearby Land Uses

3.5.1 Surface Infrastructure

There are a number of structures and buildings within Block 7.

Historic underground mine workings run throughout the area with expressions to surface at Shaft 4 (now sealed), Shaft 5, located northwest of the Italio International (Bocce) Club and Shaft 7 which is currently used for water extraction. In addition there are a number of heritage items, including Nos 4 and 7 Headframes, and old mine offices.

South Road (Silver City Highway), which is one of two main roads carrying traffic from the north and south of Broken Hill, also dissects Block 7, **Photograph 3.1**.

The proposed mining extension area also includes powerlines, underground communication cables and raw water service pipes. Roads and other surface infrastructure are depicted on **Photograph 1.2, Section 1**.

Australian Rail and Track Corporation (ARTC) rail line is located to the north west of the proposed mining extension. Potential ground failure from mining induced subsidence was assessed in the original EA by Coffey Mining Pty Ltd. As the proposed mining is located at a greater distance from the rail line it is not discussed in this EA. The Coffey Mining, Subsidence Study, can be found in Volume 2 as Annexure E of the original EA.

Photograph 3.1 South Road (Silver City Highway)

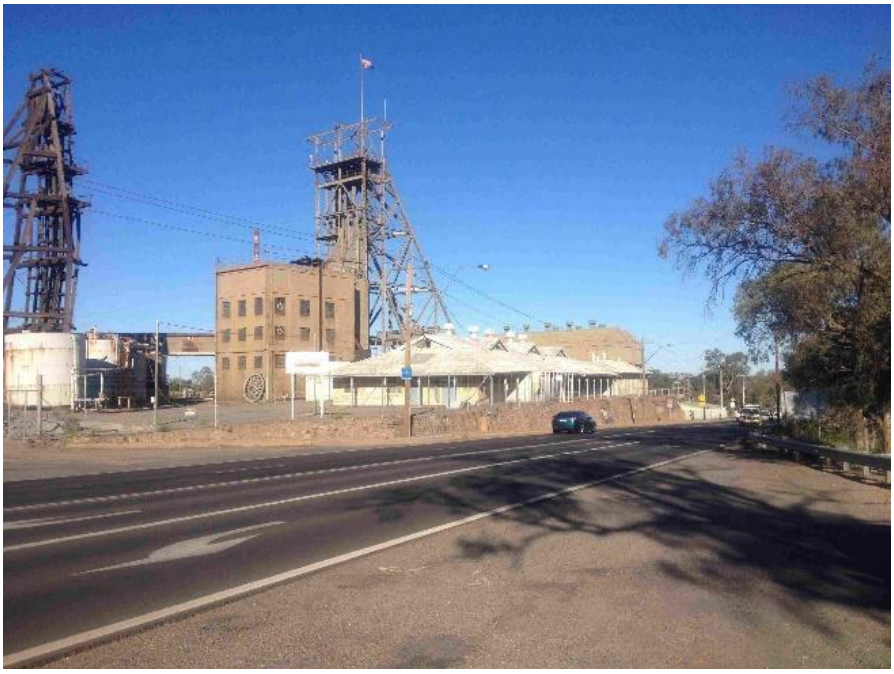


Table 3.2 provides the minimum direct distances from mining activity (blasting) to relevant surface infrastructure items.

3.5.2 Land Users

The area in and surrounding Block 7 has a number of land users. As referred above motorists and pedestrians use South Road and the road reserve, recreational facilities are located adjacent to Block 7 and include the Broken Hill Bowling Club, the Italio International (Bocce) Club and disused tennis courts.

Perilya's Southern Operations is located adjacent and to the west and residential properties are located along Eyre Street and beyond to South Broken Hill. **Table 3.2** provides the minimum direct distances from mining activity (blasting) to these land users. The following provides a description of these land users.

Perilya's Power and Water Corridor

Perilya runs power and water from its South Mine to its North Mine located at the opposite end of CML7. A surface exclusion zone runs the length of CML7 containing these facilities, an overhead power line and water pipework.

Perilya's Southern Operations

Perilya operate a number of mining facilities in Broken Hill, their Southern Operations is located to the west of CML7 and Block 7. As at 30 June 2012 it had a mine life of 10 years and produces approximately 130,000 t of combined zinc and lead concentrate per year. In the 1990s the Southern Operations mined the Zinc Lodes that extended into their lease area.

Broken Hill Bowling Club

The Broken Hill Bowling Club is located adjacent to CML7 (Block 7) and was originally owned and operated by the old South Mine for their employees, **Photograph 3.2**. It is now operated by a volunteer group. The group has around 20 members and they meet twice a week on Wednesdays and Saturdays between 1.30 pm and 4.30 pm.

Facilities consist of two bowling greens and a club house.

Photograph 3.2 Broken Hill Bowling Club

Italio International (Bocce) Club

The Italio International (Bocce) Club is located on a surface exclusion area of CML7, **Photograph 3.3**. It was first established in 1960 as a social gathering point for Italians who had migrated to Broken Hill post the Second World War. Membership waned in the 1970s and then ceased. The present Club commenced in March 1992 with membership varying between 40 and 50 persons. The Club meets on the third Wednesday of each month and Bocce is played every Sunday between 3.00pm and 8pm.

Facilities consist of a large structure with an indoor bocce play area. The building is also occasionally rented as a venue for other social activities.

Photograph 3.3 Italio International (Bocce) Club

Unused Tennis Courts

There are two unused tennis courts located to the west of the Italio International Club. It is not known when they were last used.

Line of Lode Reserve Trust houses (one derelict and one tenanted)

There are two isolated residential houses located on South Road opposite the Rasp Mine gates and old mine offices. These houses are located on CML7 and were once owned by the relevant mining company holding the Lease. Normandy as part of its mine closure and rehabilitation program gifted these houses, along with a number of other properties and movable historic items, to the then Line of Lode Association (LOLA). LOLA went into receivership and the buildings were taken over by the then LPMA now Department of Trade & Investment Crown Lands who established the LOLRT to manage these properties. The houses are shown in **Photograph 3.4** the house on the right is tenanted.

Photograph 3.4 Line of Lode Trust Houses

Table 3.2 Direct Mining Distance to Surface Infrastructure and Land Users

Mining Area	Item	Shortest direct distance from underground mining (m)	Within CML7
Block 7	Mining infrastructure, consisting of workshops, storage areas, core working area and water pumping station.	100	Yes
	Heritage structures (as listed on the BHCC LEP, there are no State heritage listed items), including headframes (numbers 4 and 7), winder houses, mullock storage, tanks, offices and ancillary buildings.	60	Yes
	Broken Hill Bowling Club.	311	No
	Residential houses (10) in Eyre Street (from Comstock St to South Rd).	340	No
	Residential houses (10) in Piper Street (rear of Eyre St) (from Comstock St to South Rd).	378	No
	Services such as power lines and pylons, communication cables and water pipes.	150 to 200	Yes
Zinc Lodes	Heritage structures (as listed on the BHCC LEP, there are no State heritage listed items), including headframes (numbers 4 and 7), winder houses, offices and ancillary buildings.	80	Yes
	South Road (Silver City Highway SH22).	60	No, surface exclusion 15.24 m.
	Services such as power lines and pylons, communication cables, sewerage and water pipes.	60	Yes
	Recreational services - the Italio International (Bocce) Club and unused tennis courts.	191	No, surface exclusion 15.24 m.
	Line of Lode Reserve Trust houses (2, 1 tenanted).	78	Yes
	Residential houses (14) in Eyre St and Eyre St west (150m).	281	No
	Perilya Southern Operations decline.	40	No

3.6 Mining Methods

Underground mining will continue to be accessed by the existing portal located in the northern end of Kintore Pit, **Photograph 3.5**.

A variety of mining methods will be utilized appropriate to the ground conditions and location of each of the mining areas. These may include; benching, cut and fill or room and pillar and up-hole retreat. Up-hole retreat will predominantly be used in the Main Lode Pillars within Block 7 as currently utilized in Blocks 8 to 12. Benching and cut and fill methods will be used within the Zinc Lodes.

Drill and blast will be the primary method used to break the ore into a size range which is less than 800 mm. The current Technical Blast Management Plan will be updated to accommodate requirements for mining in Block 7 Main Lode Pillars and the Zinc Lodes.

Photograph 3.5 Current Rasp Mine Workings

Mining of the Main Lode Pillars will predominately occur at depths greater than 200 m below surface while some mining may occur at depths of less than 100 m below surface depending on the location of the ore. The Zinc Lodes are located approximately 45 m from surface. However, a crown pillar will be left in place extending from the mining area to the surface, so that no mining will take place closer to the surface than 60 m.

Consistent with current operations, drives will be developed from the decline and lead to production areas where stopes will be developed using conventional drill and blast methods. Ore and waste will be excavated using load haul dump (LHD) equipment and transported to loading points where mine trucks will transport ore to the ROM Pad via the northwest haul road, consistent with current approved operations. Waste will be stored in Kintore Pit and / or used as underground back fill. In some areas this fill will be supplemented by hydraulic fill from the Backfill Plant.

The initial geotechnical review indicates that there are no significant geotechnical structures, shear zones or dolerite in the area. Structural defect data and geotechnical data will continue to be collected and interpreted as mining through the Zinc Lodes progresses. This will allow validation of design parameters and timely input to the mine detailed design process.

3.6.1 Mining Development

Development headings (declines, levels, tunnels, etc) will be constructed consistent with current operations (provisionally 5.0 m wide x 5.5 m high) and will be reinforced with various combinations of rock bolts, cable dowels, mesh and shotcrete to provide for the safety of personnel. The current Ground Control Management Plan will be updated to reflect these requirements. Development mining is predominantly 95 m below surface.

Development into areas will follow a comprehensive diamond drill program where additional core will be extracted and inspected completing a structural picture or model for the mining district. This process will identify any structures / dykes that will determine blasting and detailed mining designs.

Blasting for development mining utilizes 45 mm diameter blast holes. The number of blast holes and the maximum instantaneous charge (MIC) will be determined for each blast based on its location and the location and potential impact on sensitive receivers.

Ongoing testing of representative samples of the rock mass will be undertaken to characterize the engineering properties and validate drill hole orientation.

3.6.2 Mining Block 7 – Main Lode Pillars

The Project Approval Modification also seeks approval to allow the continuation of mining of the Main Lode Pillars (MLP) to extend into Block 7. The Main Lode Pillar resource has a large tonnage of high value ore remaining across CML7. Mining of MLP is currently undertaken in Blocks 8 to 12 where small up-hole retreat stopes have been mined by BHOP, recovering remnant blocks left after 125 years of mining.

This ore has generally been left behind in vertical pillars. These pillars are generally narrow blocks of ore between 2 to 5 m in width and approximately 10 to 15 m vertically high.

The method of recovering vertical pillars involves the development of a drive in the base of the pillar from which the up-hole blast holes can be drilled and the blasted ore recovered. The development is generally 5 x 5 m and requires additional ground support, in particular all development within a vertical pillar is shotcreted. The blast holes are typically 45 mm and / or 76 mm diameter and are drilled on a ring spacing of 1.5 m. Generally firings are kept quite small in the pillars with only 2 - 3 rings of blast holes being fired at any time. Decking will be used to minimise the MIC and peak particle velocity (PPV) and will be determined for each blast based on its location and the location and potential impact on sensitive receivers.

It is proposed to extend the currently approved area to the southwest to include Block 7 and continue extracting small remnant pillars (stope sizes between 1,000 and 10,000 tonnes), by a combination of development and small retreat up-hole stopes. These blocks in comparison to the Western Mineralisation and Zinc Lodes are very small in nature, blasting is comparable to development firings and the Pillars are surrounded by sand filled voids.

A summary of the stope geometry for the Main Lode Pillars in Block 7 is provided in **Table 3.3**.

Table 3.3 Stope Geometry for Main Lode Pillars

Parameter	Pillar
Strike Length	5m to 15m
Cross Strike Width	Typically 2m to 5m
Height Level	10 m to 15 m
Depth Below Surface	From 100m to 500m but the majority of pillars lie at depths greater than 200m
Blast Hole Size	Typically 45mm to 76mm diameter

3.6.3 Mining Zinc Lodes

The Zinc Lodes extend across the mining lease boundary to the Perilya operations and were successfully mined by Perilya in the 1990's. A discussion for the potential for interaction with the Perilya Southern Operations can be found in **Section 7.2.3** in this EA.

Given its location and proximity to the surface, the high grade Zinc Lode orebody will be mined in a much more conservative fashion to how mining is undertaken throughout the rest of CML7. The Western Mineralisation is currently mined by sub-level long-hole stoping, with stope heights averaging between 25 to 30 m in vertical height, strike lengths generally unrestricted and 89 mm diameter blast holes used in blasting designs.

To provide a significant factor of safety and remove the risk of any surface subsidence the Zinc Lodes will be mined with a combination of "cut and fill" in the 'flatter' areas of the orebody and "half height bench stopes" in the steeper sections. The shape of the Zinc Lodes rises to a high point about 5 to 7 m in width and 60 m from surface, and then flattens to a depth of about 80 to 85 m and extending to about 100 m from surface, refer **Figures 3.4** and **3.5.**

Figure 3.4 Zinc Lode Orebody

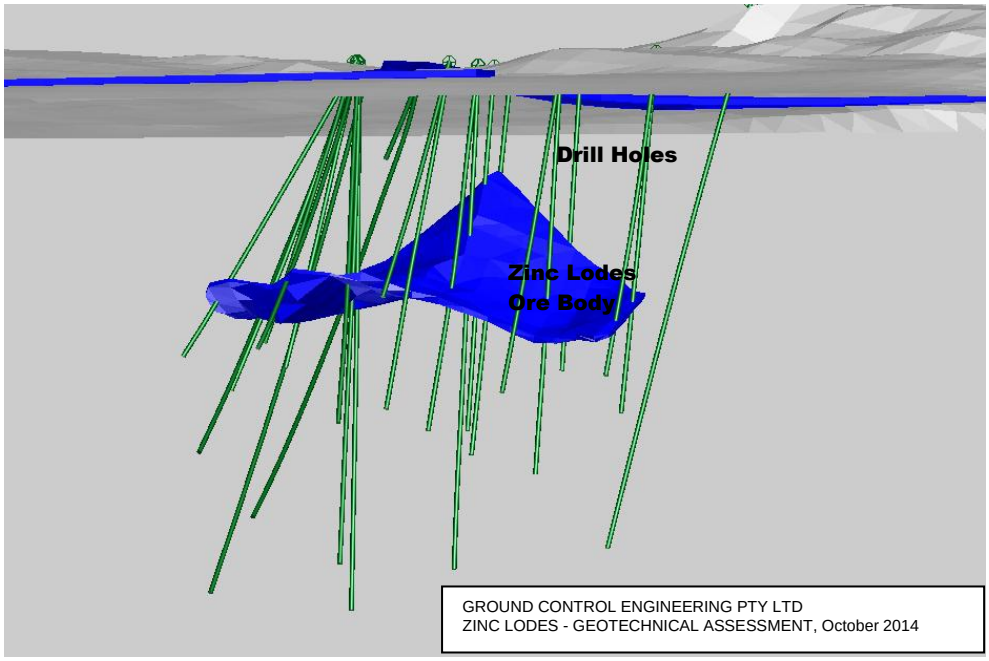


Table 3.4 Stope Geometry for Zinc Lodes

Parameter	Cut & Fill	Bench Stoping
Strike Length	5m	10m to 15m
Cross Strike Width	50m	5m to 12m
Height Level	5m	10m to 12m
Depth below Surface	80m to 100m	60m to 80m
Blast Hole Size	45mm	76mm

Cut and fill mining

The flatter sections of the orebody will be mined using cut and fill methods. This method allows very good control of ground conditions by limiting the exposure of unsupported stope surfaces. Fill will be introduced immediately following completion of each cut and fill stope section. Primarily fill will consist of waste rock however this will be topped up where required with hydraulic fill.

Initially, cut and fill mining will be used over four separate 5 m lifts, with a continuous mining and filling operation (**Figure 3.5**). Filling of mined voids will be completed using waste rock and the crown above the mined lifts will be supported by the extensive use of cable bolts (8 m) designed and approved by an external geotechnical engineer, refer **Figure 3.6** for designed pattern.

Cut and fill mining involves smaller blasting in a similar vein to “development firings”. A development firing consists of approximately 40 holes drilled horizontally into the face with 45 mm diameter holes. The smaller diameter holes require much less explosive reducing blasting vibrations. Firing of “cuts” (a 3.5 m horizontal blast) can be further controlled with respect to blast vibrations by sequencing of the blast to ensure the MIC is minimised.

Bench Stoping

Conventional downhole benching is proposed for the more steeply dipping sections of the Zinc Lode orebody. The mining sequence will incorporate a fill cycle where each stope is filled immediately after extraction is complete to limit potential hangingwall instability. Open voids in the mining block will be limited to one stope at any one time.

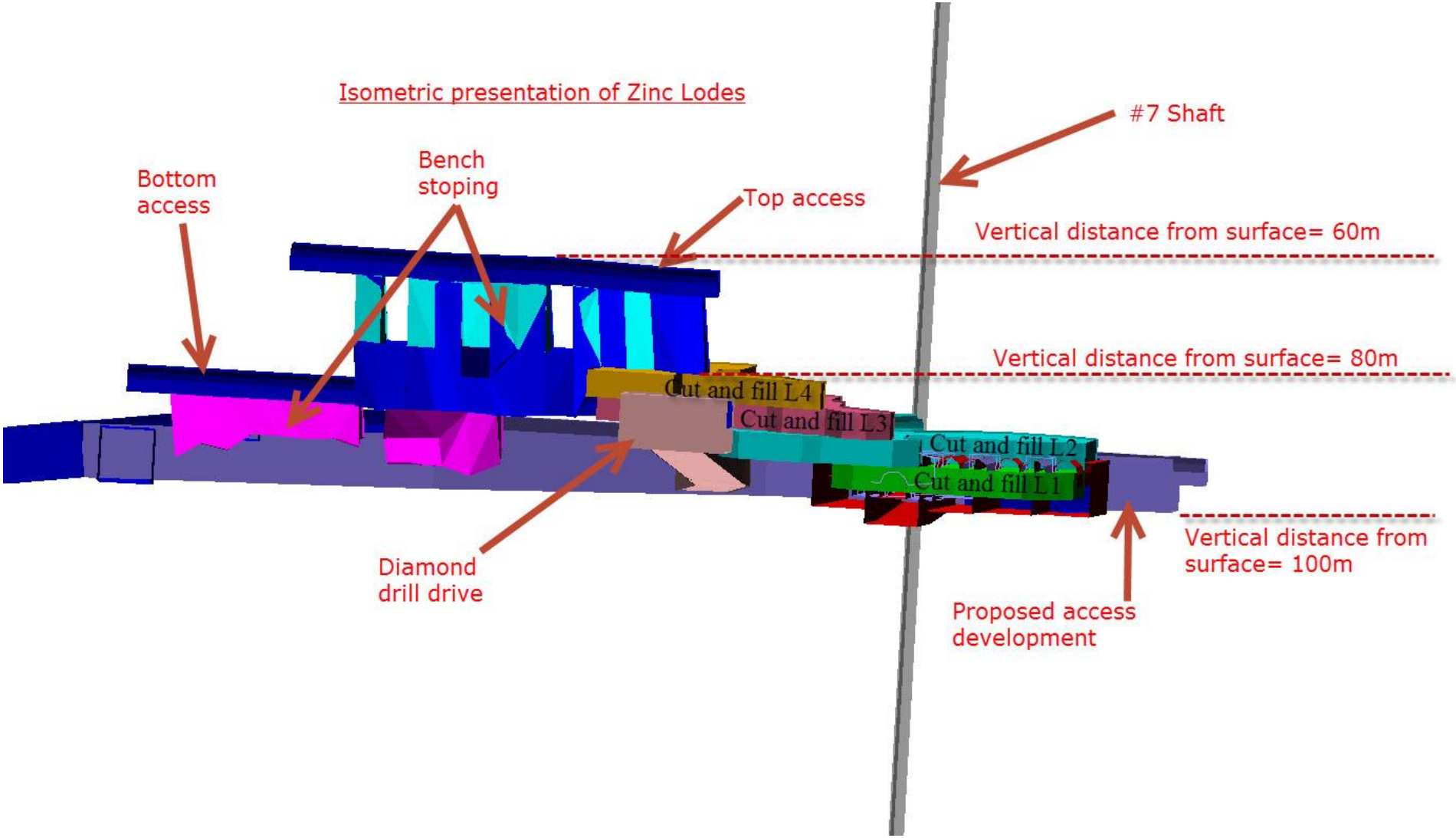
Half height (10 – 12 m) bench stopes will be mined in the northern section of the Lode, with small diameter (76 mm) blast holes to control vibration from blasting. Stopes will be mined one at a time and then filled before the next bench is taken with a combination of waste rock and hydraulically placed fill. This mining sequence will be used to limit strike length openings (stope spans).

Waste rock will come from current and previous development whilst the hydraulic fill will be piped from the current Backfill Plant.

A comprehensive ground support regime will be installed in both the crown of those benches and on the hanging wall to remove any risk of significant uncontrolled over break. This will include:

- A fully ground supported crown pillar left above the mining shapes (designed and approved by external geotechnical engineers).

Figure 3.5 Mining Sections - Zinc Lodes



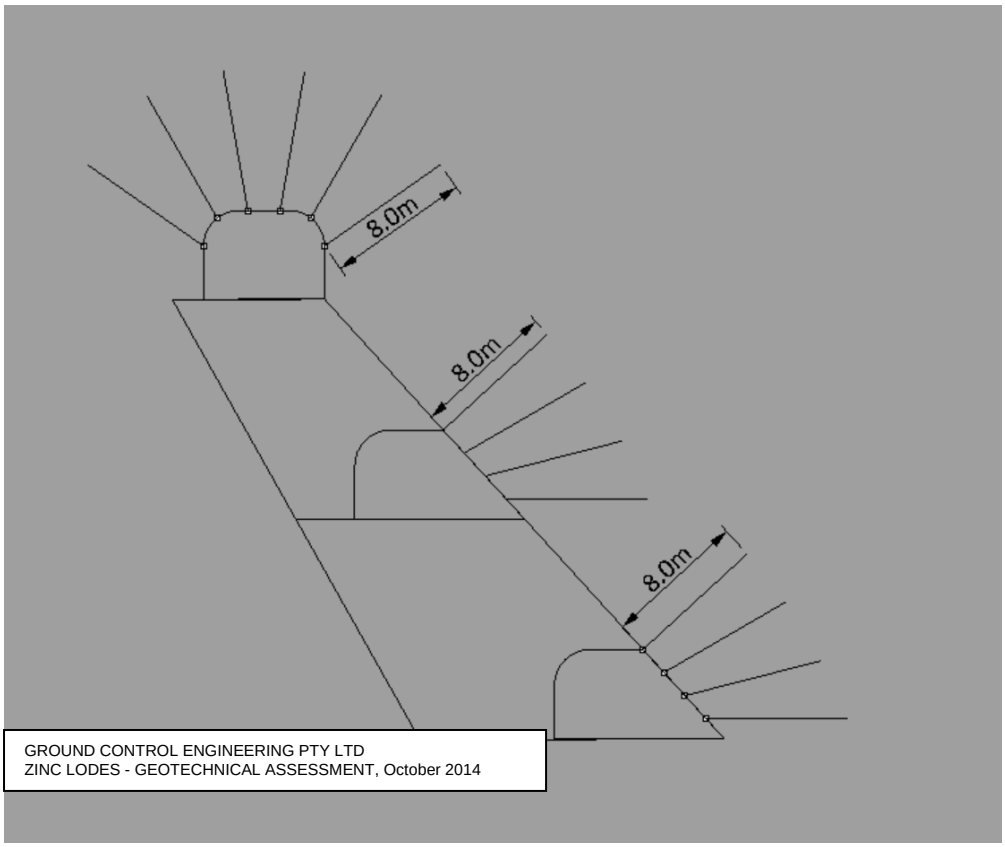
- The installation of grouted 8-10 m cable bolts, (as designed by competent external geotechnical experts, refer **Figure 3.6** for placement).
- A hanging wall development drive (refer, **Figure 3.6**) which effectively splits the benches vertically in two providing the support regime required to limit potential over break and providing a much more conservative mining shape.
- Decking of blasts which controls the MIC generated by each blast (decking splits the blast into a number of separate shots thereby reducing the MIC.
- Rib pillars (5 m) will be left between bench stopes to further enhance stability and limit the risk of uncontrolled over break.

In addition as a minimum, a 60 m vertical crown will be left between the mined area and the surface. In some areas this will be as much as 80m. Directly above any mining that takes place will be a heavily ground supported crown pillar as per external geotechnical advice and design. In the development phase and before mining commences there will be (through additional diamond drilling and structural assessment of the development drive) further validation of geotechnical design parameters to ensure structural stability in the region. Any unusual structures (should they be present) such as dolerite dykes would then be factored into blast designs to meet vibration and overpressure criteria.

Blast vibrations will be monitored and continuously assessed as discussed in **Sections 3.8** and **7.2**.

A complete mining/filling strategy will be in place (prior to mining commencing) to extract each bench that incorporates appropriate infrastructure to fill each bench after the completion of extraction.

Figure 3.6 Plan for Cable Bolt Placement



3.7 Backfill Material and Process

The construction and operation of a backfill plant has been approved as part of the original EA. Approval for emplacement of deslimed tailings in underground voids has been approved under the existing Project Approval. The Backfill Plant has been constructed however, due to an excess of waste rock, sufficient for current backfill requirements, the commissioning of the Backfill Plant has yet to occur.

In accordance with existing approved methods, stope voids will be back filled with a combination of materials including waste rock and deslimed tailings from the Backfill Plant. This will minimise rock stress build-up and stabilise the void during and after mining. It will also maximise ore recovery.

The process of placement of deslimed tailings (hydraulic backfill) will involve construction of purpose built underground bulkheads or barricades (containment walls) which are capable of withstanding the loads imposed by the fill material. The fill will be delivered, either via a fill hole or fill line, in short bursts – the duration of which is stipulated by the size of the void and its drainage characteristics. Water drainage pipes or matting will be placed into the stope and water decant holes will be drilled into the void to assess dewatering. In accordance with existing approved methods this water will be mixed with current mine dewatering water and recycled. Waste rock may also be tipped into the stope from the top of the sill drive.

Hydraulic fill will be piped from the Backfill Plant, pipework will be located in trenches for containment of unexpected spillage. Surface holes for the placement of backfill will be installed within CML7 to the east of South Road. Up to 5 holes (125 to 200 mm) may be required. Backfill holes will be installed using a drill rig with the operation occurring only on day shift. BHOP proposes to manage the filling process by:

- Constructing purpose built underground containment structures that meet design standards which take into account the need for drainage and loadings imposed by blasting, earthquakes and the material itself;
- Ensuring that the containment structures and filling processes are routinely inspected and monitored;
- Placing where possible fill in advance of mining activities – for example voids from old mining operations are filled before mining moves into the area;
- Restricting blasting in close proximity to the structures during back fill placement; and
- Development and implementation of procedures for inrush management.

The location for the installation of backfill holes is indicated in **Photograph 1.2, Section 1**. This location has been previously disturbed and therefore no vegetation clearing is required.

3.8 Blasting Management

The proposed mining areas and blasting operations are closer to nearby infrastructure and residences than previous blasting undertaken in the Western Mineralisation with a higher level of associated risk. BHOP will manage this risk by updating its blasting plans and preparation, charging and blast control, data collection, vibration assessment and review.

Drill and blast designs shall take into account previous blasting results in terms of peak particle velocity (PPV) and distances to sensitive receivers to limit blast sizes and provide correct blasting parameters. Designs will consider the key criteria charge mass, timing sequence and hole location, with more perimeter holes particularly in narrow areas. Drill design plans will be approved by mining engineers and management. Drilling methods will provide accurate drilling of blast holes and drilling equipment and drill consumables will be matched to control drill hole accuracy and achieve targeted limits.

All down holes will be prepped and inspected to verify location, voids and other issues prior to charging to the approved charge plans and low density explosives will be used where applicable and where suited to conditions.

Drill and blast designs will also be optimised from the results of each firing and any potential effects from structures, dykes or shears identified during drilling. The design will be changed and adapted to suit the conditions and minimise vibration. Progressive development into the area closer to the points of interest (from development to cut and fill then finally bench stoping) will enable the data collected throughout these phases to be utilised to direct subsequent blasting and control vibration.

As development mining progresses towards the south west of the lease to access the Zinc Lodes, blasting vibrations will be monitored using a roving blast monitor that will be positioned between the advancing development face and residences located on Eyre Street. Each development blast that exceeds 3.0 mm/s PPV will be reviewed and changes made to the development blast timing to reduce the MIC. This process will allow blasting techniques to be refined and optimised for minimal impact before mining commences in the Zinc Lodes. Prior to the mining face reaching the Zinc Lodes, development mining will move from the north to the south of historical workings. These old workings will act as a barrier absorbing some of the blasting vibration between the Zinc Lodes mining and residential housing located on Eyre Street.

Blasting will be monitored via three vibration monitoring locations, one located along each section of Eyre Street to monitor PPV levels at these sensitive receptors and one located near the Rasp Mine South Road gates to monitor PPV levels in relation to the road and associated infrastructure and to assess trigger levels for pedestrians using South Road.

The initial blasts (first 6 months) will be primarily for development with cut-and-fill / room-and-pillar mining commencing towards the end of this period. This mining is conducted using 45 mm blast holes

This will allow further refinement of blasting techniques prior to the commencement of half-height bench stoping which is not expected to occur until 7 months later.

The blasting review and optimisation process conducted will be performed by the BHOP Technical Services Department and will follow the following steps which are a part of the BHOP Technical Blasting Management Plan:

1. Blast fired
2. Complete blast analysis which involves downloading blasting data from the monitors and comparing the actual PPV to the initial calculated/predicted PPV for the specific blast.
3. If there is a variation in the actual recorded PPV and the calculated/predicted PPV prior to the blast then the K factor (ground transmission constant) is back calculated to match the actual PPV.
4. The new back calculated K factor is then used to calculate the predicted PPV for the next blast in that area. This will then show where modifications to the blast design are required to reduce the MIC.

The first half-height bench stope is scheduled for late December 2015. The following controls have been put in place for the bench stoping to minimise PPV:

- A reduction from the current Western Mineralisation blast hole size from 89 mm to 76 mm diameter.
- A reduction from the current Western Mineralisation stope size from 30 m to 12.5 m spacing between levels. This will significantly reduce the MIC as blast holes are halved in length.
- A further reduction in stope size to 10 m spans when mining beneath South Road.
- Deck charging will be employed where required.

- Electronic detonators will be used in all bench stopes allowing precise initiation of each blast.

In addition to these controls steps 1 - 4 will be followed after every blast in accordance with the BHOP Technical Blasting Management Plan.

Training of personnel in the standards and procedures required for establishing, installing and taking results for vibration monitoring stations and roving monitoring units (including location and protection to prevent interference) will also be undertaken to assist in the management of the blasting program. Shrouding effects from filled stopes, voids and workings will be assessed and used to shield vibration transmissions to sensitive receptors where found.

BHOP will continue to engage appropriately qualified and experienced consultants and formalise the review/audit process for the vibration analysis and Technical Blast Management Plan.

Timings of blast firings will be consistent with current Project Approval requirements with all production rock blasting from cut and fill or half bench stoping will only occur between 6:45 am and 7:15 pm on any day. The majority of the smaller development blasts will also occur during this period however there may be a requirement for some independent firings.

There will be a requirement for 2 development and 2 cut and fill / room and pillar firings per day. From approximately December 2015 the cut and fill mining will be completed and there will be a requirement for 4 firings per week for the bench stoping. During the months of mining the half height bench stopes, development firings will reduce.

Blasting details shall be placed on the BHOP web site and signage will be installed along the road way to inform pedestrians and motorists of blasting times. BHOP maintains a 24 hour, 7 day a week community and employee information telephone line that can be used to enquire about firing times.

BHOP will organize a notification system for identified community stakeholders who will be notified of blasting times via email or texts to their mobile telephones.

3.9 Water Management

The proposed extended mining will occur at depths of up to 500 m for the Block 7 Main Lode Pillars and 100 m Zinc Lodes. This mining is well above the current water table level which is maintained between 540m to 560 m to ensure the safety of personnel working underground at both the Rasp Mine and the adjacent Perilya Southern Operations.

No additional mine dewatering will be required from that originally approved as these mining activities replace mining activities that would have occurred elsewhere in the mine and no additional mining will occur.

Operational water will be supplied and recycled through our current underground reticulation and pumping system. Settlement water from backfill will be recycled with the operational water and used underground.

The installation of the (up to) five 125 mm to 200 mm holes used to place the hydraulic fill underground will not impact the current surface water management arrangements outlined in the current Site Water Management Plan.

3.10 Waste Management

There is no significant change to waste management or their impacts from that originally approved. Waste will be managed in accordance with the BHOP Waste Management Plan.

Testing of rock geology from core samples has indicated that same geochemistry consistent with previous testing results. Waste rock will be managed using the same methods as currently approved, being used as backfill for underground voids storing in Kintore Pit until voids become available. Surface usage will also be consistent with the waste rock once tested being used for noise bunding, roads and rehabilitation works to suppress dust.

There is no change to tailings emplacement or management from the original EA and PPR.

3.11 Ventilation

Mine ventilation will be managed with intake air entering the mine workings at Shaft 5 and exhausting at Shaft 6, refer **Photograph 1.2 Section 1**. Ventilation will require the use of up to four new ventilation fans typically 110 kW, operating at 1500 rpm and with a diameter of 1400 mm. Two ventilation fans (secondary) will be required to be installed 90 m underground and approximately 20 m along a horizontal drive to draw surface air down to the proposed south-west areas. Brick walls will be installed to control airflow and will act as a noise barrier minimising noise propagating from the fans or other mining activities. Shaft 5 is located at the south-west boundary of the site.

Two additional ventilation fans (primary) would be required to be installed in parallel approximately 160 m underground below Shaft 6. These primary ventilation fans would be used to exhaust air through Shaft 6. Shaft 6 is situated in a more central part of the site near current mine workshops and is located approximately 650 m north-east of Shaft 5.

Both Shaft 5 and Shaft 6 are existing shafts and there will be no requirement for surface works as installation of fans and all associated ventilation activities will occur underground.

The approved (MOD1) primary ventilation exhaust system will continue to operate centrally and to the north west of the Mine site.

3.12 Mobile Equipment

There will be no additions to the current mobile fleet.

3.13 Traffic

There will be no additional road traffic required than that proposed in the original EA and Project Approval.

3.14 Mine Personnel

The Rasp Mine currently employs 150 full time personnel. A reduction in personnel numbers occurred in September 2013 when mining plans were restructured to account for the loss of a crown pillar and the oxidation of another which reduced available ore.

The extended underground mining will increase employment numbers by approximately 35 personnel.

3.15 Rehabilitation Strategy

The Rasp Mine rehabilitation strategy would remain unchanged for the Modification.

The existing / approved rehabilitation principles and objectives for the Rasp Mine are to return the Rasp Mine to suitable commercial and / or educational uses preserving the heritage value of the site and heritage buildings as agreed with regulators, the community and the Mine.

The following mine specific rehabilitation objectives have been developed in response to regulatory and community requirements and identified risks. These objectives are consistent with those listed in the current Project Approval, Schedule 3 Conditions 34 and 35.

- Conserve heritage items, as agreed, and make them accessible;
- Undertake closure stormwater management initiatives to minimise erosion and restrict the potential for off-site pollution;
- Provide final landforms that are safe, stable, non polluting and sympathetic to the mining heritage of Broken Hill;
- Install covers which enhance landform stability, minimise dust generation and adequately contain potentially hazardous material within the landform;
- Seal and/ or treat 'free areas' of the site and other potential sources of wind-blown dust to prevent the emission of dust following closure;
- Install barriers to restrict access to potentially hazardous locations (i.e. decline, shafts or open cut pits), and
- Meet the expectations and preferences, where possible, of the local community for post-mining land use for tourism.

The location of the placement for the backfill drill holes is in an area which is already disturbed. Consistent with the conditions for surface exploration outlined in CML7 and the DRE guidelines, BHOP will rehabilitate the backfill drill holes.

There is no other surface activities and there will be no changes from the approved volumes of production materials such as ore, waste, concentrates or tailings.

4.0 REGULATORY FRAMEWORK

This section discusses the regulatory framework relevant under which the Rasp Mine is approved to operate relevant to the Modification.

4.1 Commonwealth Legislation - Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The purpose of the Commonwealth Legislation - Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) is to ensure that actions likely to cause an impact on a matter of National Environmental Significance (NES) undergo a rigorous assessment and approval process. Under the EPBC Act, an action includes a project, undertaking, development or activity. An action that "*has, will have or is likely to have a significant impact on a matter of National Environmental Significance (NES)*" may not be undertaken without prior approval from the Commonwealth Minister for the Environment, as provided under Part 9 of the EPBC Act.

Consistent with the original Project Approval the proposed Modification is not considered a '*controlled action'* and is unlikely to impact matter of NES as listed in the EPBC Act and will not impact water resources. Therefore it does not require referral to the Commonwealth Department of Environment.

4.2 Environment Planning and Assessment Act 1979

The Rasp Mine was declared a Major Project under the State Environment Planning Policy (SEPP) (Major Development) 2005 (now repealed) and was approved in January 2011 by the then NSW Minister for Planning under Part 3A of the EP&A Act.

The Project is subject to the transitional requirements as outlined in Clause 12 of Schedule 6A of the EP&A Act which applies to facilitate modifications of approvals with the repeal of Part 3A of the EP&A Act.

This application is made under section 75W of the Act.

Section 75W of the EP&A Act provides for the modification of planning approvals issued under Part 3A of the EP&A Act as follows:

> *"(2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.*
>
> *(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*
>
> *(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification."*

4.3 Other Applicable Legislation

The existing approvals relevant to the Project are described in **Section 2**.

Existing approvals, licences and/or authorities under various other pieces of NSW State legislation will continue to apply to the proposed Modification operations. **Table 4.1** lists the key relevant pieces of NSW State legislation and indicates the implications, if any, for the Project.

Table 4.1 Relevant NSW State Legislation

NSW State Legislative Act	Project Implications to Approvals, Licences and/or Authorities
Protection of the Environment Operations Act 1997 (POEO Act)	The proposed Modification will continue to operate under the approved limits within EPL 12559. BHOP will apply for a variation to the EPL to include the new ventilation exhaust at Shaft 6 and additional vibration monitors and their locations, and any other requirements of the EPA.
Mining Act 1992	CML7 permits the extraction of zinc and lead (among others) ore within the Project Area. The proposed mining extension lies within this area with a surface exclusion of 15.24 m along a transport corridor and in the location of recreational facilities. Therefore there is no need for any amendments to authorities under this Act. Environmental protection and rehabilitation are also regulated under this Act by conditions of mining leases, including requirements for the submission of a MOP. The current MOP will require modification to include the activities outlined in the Modification. CML7 contains no requirement for an Extraction Plan and DRE has confirmed it is not required (email 30 October 2014).
Roads Act 1993	RMS advised that Section 138 of the *Roads Act 1993* may apply to this modification. 138 Works and structures (1) A person must not: (a) erect a structure or carry out a work in, on or over a public road, or (b) dig up or disturb the surface of a public road, or (c) remove or interfere with a structure, work or tree on a public road, or (d) pump water into a public road from any land adjoining the road, or (e) connect a road (whether public or private) to a classified road, otherwise than with the consent of the appropriate roads authority. (2) A consent may not be given with respect to a classified road except with the concurrence of the RTA (now RMS). However as South Road and the road reserve will not be impacted it does not apply. Council and RMS have been consulted and will receive a copy of this Modification for their comment.
Water Management Act 2000	The location of the area for mining extension is above the current water table. No additional water licences under the *Water Management Act 2000* are required for the Modification. Therefore water resources will not be affected by this Modification.
Mine Health & Safety Act 2004	BHOP will implement its Safety Management Plan in the area of the Modification and will utilise standards, plans and procedures in accordance with the *Work Health & Safety Act 2011*.
Heritage Act, 1977	There is one State Heritage listed item within CML7, the BHP office Chimney located to the north-east of CML7 and 2,574 m from the extended mining zone. This item will not be affected by the Modification.
Threatened Species and Conservation Act 1995	Not relevant to this Modification.
National Park and Wildlife Act 1974	Not relevant to this Modification.
Aboriginal Lands Rights Act 1983	Not relevant to this Modification.

4.4 SEPP - Mining, Petroleum Production and Extractive Industries

The State Environment Protection Policy (Mining, Petroleum Production and Extractive Industries) 2007 (Mining SEPP) aims to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of NSW. Part 3 of the Mining SEPP

stipulates matters for consideration by the consent authority before determining an application for consent in respect of development for the purposes of mining. Specifically, Clauses 12 to 17 (inclusive) requires consideration to be given to the significance of the resource, the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

The information presented in this EA addresses each of the matters for consideration prescribed in the abovementioned clauses. Emphasis has been placed on anticipation and prevention of potential environmental and social impacts, with various mitigation measures, management strategies, and monitoring activities proposed to minimise adverse impacts.

Under Clauses 12 and 14 the consent authority is required to consider the compatibility of the Project with other nearby land uses and impacts on significant water resources, threatened species and greenhouse emissions.

Existing and approved land uses in the vicinity of the Modification consist of:

- Current mining operations of BHOP and the adjacent Perilya Southern Operations ;
- Motor vehicle and pedestrian traffic over South Road or the Silver City Highway and road reserves along Eyre Street;
- Recreational facilities including the Italio International (Bocce) Club, Broken Hill Bowling Club, unused tennis courts; and
- Residential houses.

The Modification will not change these existing uses and can operate without impacting these users. However, further consideration will be given to the tenant living on South Road in a property owned by Crown Lands, to assess safety concerns. A formal agreement with the tenant as already discussed and agreed with the tenant will be entered into which will consider future options in regards to communication and notification, remaining in the property and potential relocation, as discussed at **Section 7.2**. A structural assessment of the property will also be undertaken in relation to the predicted vibration levels for this area.

The Modification optimises mining of the Line of Lode orebody within the Rasp Mine providing additional financial benefits and employment for Broken Hill.

In addition this Modification will not impact:

- Significant water resources as there will be no requirement for additional water supply or extraction and the extended mining will occur above current the water table;
- Threatened species as there are no known threatened species in the area; and
- There will be no measurable change in greenhouse gas emissions from the original Project Approval as the production from extended mining replaces current planned production and there is no increase in production rates.

The Rasp Mine would implement a range of measures to avoid or minimise potential impacts of the Modification with existing and future land uses in the area. This would be achieved through implementation of the existing Rasp Mine Environment Management Strategy amended in line with this EA and implementation of measures listed in Sections 6, 7 and 8 of this EA.

4.5 Local Council Environment Planning Instruments

4.5.1 Broken Hill Local Environment Plan 2013

The majority of the Rasp Mine, including the area proposed for the extended mining lies within Special Purpose Zone 1 (SP1) Special Activities – Mining (BHCC Local Environment Plan (LEP), 2013). A section of this area from South Road to the boundary of Perilya's mining lease is zoned R1 General Residential. Mines are prohibited on land zoned R1.

Sub-clause 7(1)(a) of the Mining SEPP states that development for the purpose of underground mining may be carried out on any land with development consent. In relation to any inconsistency between the Mining SEPP and an LEP, sub-clause 5(3) provides that the Mining SEPP prevails to the extent of the inconsistency. Therefore mining is permissible in this location with development consent.

Section 5.10 outlines requirements for heritage conservation. BHOP have identified a number of cultural heritage items within the proposed mining area and has considered potential impacts from the extended mining on these heritage items (refer Section 6). There are no indigenous items in the proposed area.

4.5.2 Broken Hill Control Plan No 11 Management of Lead Contamination

Development Control Plan (DCP) 11 provides guidelines for the management of issues relating to lead contamination. As there are no changes to surface activities there will be no impacts additional to the original project EA and Project Approval.

4.6 Summary of Required Approvals

The following approvals will be sought for the Modification:

- Modification to the Project Approval 07_0018 by the Department of Planning & Environment for the extended mining.
- Variation to the Environment Protection Licence 12559 (EPL) for the additional ventilation exhaust from the Environment Protection Authority.
- Modification to the Mining Operations Plan from the Department of Trades and Industry, Division of Resources and Energy for mining activities undertaken on CML7.

4.7 List of BHOP Documents Required to be Amended by this Modification

4.7.1 Environment Plans Required Under the Current Project Approval

- Environment Management Strategy
- Environment Noise & Blasting Management Plan
- Environment Blasting Monitoring Protocol (and procedures)
- Air Quality Management Plan
- Air Quality Monitoring Protocol

4.7.2 Mining Plans

- Technical Blasting Management Plan
- Underground Ground Control Management Plan

5.0 STAKEHOLDER ENGAGEMENT

This section summarises the stakeholder engagement undertaken and any issues raised during that process, this includes consultation with government agencies, owners of potential impact infrastructure, the adjacent mine, local business, local residents and the community.

5.1 Government Agencies

BHOP consults with relevant government agencies on a regular basis in relation to the approved Rasp Mine. Additional consultation with key agencies has been undertaken as part of this assessment process. A document summarising the proposed Modification including potential impacts was provided to the agencies prior to meetings to review and discuss any issues, refer Preliminary Paper – Zinc Lodes Project Approval Variation, Rasp Mine, Broken Hill Operations Pty Ltd, September 2014, **Appendix I**.

A summary of this consultation in regards to the proposed Modification is outlined in **Table 5.1**.

Table 5.1 Summary of Consultation with Agencies

Government Agency	Issues Identified	Response in EA (Sections and Appendices)
Trades & Investment, Division of Resources and Energy (DRE) Meeting held – 4 Sept 2014	Requirement for Mining Operations Plan to be amended once DP&E approval received.	
	- Resource must be JORC compliant	3.2
	- Resource sterilization issues	3.2
	- Consistent geochemistry	3.2.2
	- Subsidence	6.3, 7.1, 8.1, Appendix A
	- Potential impacts with the adjacent Perilya Mine	3.5, 5.3, 6.1, 7.3.2, 8.2
	- Underground water assessment for post mining	Water not affected by this Modification. No change from original EA.
	- Life of mine tailings strategy	No change No change, 3.14
	- Rehabilitation and decommissioning activities	No change, 3.14
	- Post mining land use	
Roads and Maritime Services (RMS) Meeting held – 5 Sept 2014 Letter from RMS listing items to be considered in EA, **Appendix H**. Teleconference – 21 October 2014	Need for meeting S138 Roads Act, concurrent consent required from RMS.	4.3
	- Completion of risk assessment to address subsidence and vibration in all phases - development, operations and decommissioning	6.2, Appendix G
	- Subsidence, requires geotechnical assessment	7.1, Appendix A
	- Differential settlement (usually issue in relation to coal mines)	7.3.2, Appendix A
	- RMS will require Deed of Agreement	8.2
	- Traffic study if road traffic to be affected	No change
Broken Hill City Council Meeting held – 5 Sept 2014	- Traffic movements on roads	No change
	- Heritage impacts	6.3, 7.6, 8.5
Department of Planning & Environment Meeting – 16 Sept 2014	- Section to be included in EA on general environmental management	2.5
	- Status of PRP items in EPL	Appendix L

	- Noise & dust from ventilation	6.3, 7.4, Appendix D, 7.5, Appendix C, 8.3, 8.4
Environment Protection Authority Meeting held – 16 Sept 2014 Meeting held – 14 October 2014	The major issues to address vibration and noise also to address: - Other infrastructure that may be impacted in the area - Blast modeling - Blast monitoring - Updating Blast Management Plan for Zinc Lodes	7.3, Appendix B, 8.2, 7.5, Appendix C, 8.4 7.3.2, Appendix E, 8.1 7.3, Appendix B, 8.2 7.3, 8.2 8.2
Trades & Investment, Crown Lands Meeting held – 17 Sept 2014	Old mine managers houses on South Road, one is tenanted and BHOP will need to address arrangements for tenant.	8.2
Essential Water and Essential Energy Telephone and email contacts: 20 to 23 October 2014	Possible impacts of major mine firings on aging water infrastructure.	7.3.2, Appendix E, 8.1

5.2 Infrastructure Owners

Telephone discussions were conducted with representatives of Essential Water and Essential Energy in October 2014 and a copy of the Preliminary Paper – Zinc Lodes Project Approval Variation was provided with further clarification of the proposed Modification. No significant issues were raised, however, consideration was given to potential impacts on aging water infrastructure from blasting.

5.3 Perilya Broken Hill Operations Pty Ltd

Discussions outlining the proposed Modification and in particular its relation to the close proximity of mining lease boundaries were held between senior management of the Perilya Southern Operations and the Rasp Mine. A meeting was then held with technical personnel from each mine on the 23 September 2014 at Perilya offices to outline the proximity of workings both current and historic, including any identified voids, interactions between the mines in relation to blasting activities, impacts on ventilation, geotechnical structures in the area and any known history of bad ground conditions and knowledge and experience from Perilya's previous mining in the area.

It was agreed that technical personnel would continue to work closely together to identify any potential issues and measures to prevent incidents between the two mines occurring. To this end it was also agreed to hold a risk assessment specific to both mines activities in the area.

5.4 Community Consultation

There has been considerable consultation with local residents and community members, **Table 5.2** provides a summary of issues identified and where they are addressed in this EA.

BHOP provided a Letter Drop to local residents to outline the proposed Modification and what changes they might experience, Appendix J.

BHOP made direct representations to the tenant located in the LOLRT property located on CML7 and the issues around the effects of blasting. It was agreed a Letter of Arrangement will be agreed prior to the commencement of mining in the area.

Consultation was also undertaken with local business including the Italio International (Bocce) Club and the Bowling Club directly adjacent to the proposed mining area.

In addition BHOP organized a public information briefing at its Rasp Mine offices to outline the proposed Modification, the potential environmental impacts that have been identified and the findings from specialist reports, refer **Appendix K** for presentation. There was also an opportunity for residents to ask questions and seek clarification on any aspects of the proposed Modification. This public briefing was held on the 23 October 2014 and was advertised in the local newspaper. Nine people attended the meeting including representatives from the media.

There has been media interest in the proposed Modification and in particular what it might mean for the ongoing economic future of Broken Hill. There has been a number of local media interviews for radio (ABC and 2BH) and an article in the local newspaper – Barrier Daily Truth, which have been supportive of the Modification.

Table 5.2 Summary of Consultation with Residents and Local Businesses

Government Agency	Issues Identified	Response in EA
Residents Public meeting held – 23 October 2014	A number of questions were raised regarding: - Timing of firings - Vibration - Vibration criteria - Size of blasts - Noise - Ventilation	 3.7 7.3, Appendix B, 8.2 7.3, Appendix B 7.3, Appendix B 7.5, Appendix C, 8.4 7.4, Appendix D, 8.3
Italio International (Bocce) Club Meeting 29 October 2014	An overview of the proposed Modification was provided. Vibration predictions also provided. No issues were raised and offered support for the Modification.	No issues
Broken Hill Bowling Club Meeting 29 October 2014	An overview of the proposed Modification was provided. Main issue raised was in relation to building damage from blasting vibration. Vibration predictions were also provided.	7.3, Appendix B, 8.2

6.0 ENVIRONMENTAL ASSESSMENT

This Section describes the environmental risk assessment process and summarises the key potential environmental issues for the proposed Modification.

6.1 Preliminary Environmental Review

A preliminary review was undertaken internally by BHOP to identify the potential environmental impacts that could result from the proposed Modification. A summary of these was included in documentation distributed to government agencies for consultation. This has now been updated with development of the proposed Modification.

Table 6.1 provides a summary of the results of this review identifying the key environment issues relevant to the proposed Modification.

Table 6.1 Preliminary Review of Environment Issues

Environmental Issue	Relevance – Preliminary Review	Key Issue	Relevance – Including Agency Feedback	Key Issue
Noise, general mining	All mining works including fans will be conducted/positioned underground. As the material to be mined replaces other mining material that has been found to be uneconomic to mine there will be no change in tonnes mined.	No	Noise from mining equipment has been identified by local residents as a potential issue.	Yes
Noise, ventilation fan	It is currently proposed to use a sealed shaft (Shaft 5) to exhaust air from underground workings, although this has yet to be determined. This would require the removal of the seal and placing a fan at an appropriate location within and along the shaft underground. It is expected that the system will require a small fan (less than currently installed for Western Min). The closest facilities to the shaft are the tennis courts (unused) located 50 m to the south and the Italio International (Bocce) Club located 75 m also to the south. Beyond these facilities are 7 residential housing located 140 m to 165 m from the Shaft. Depending on the location and size of the fan noise may have an impact.	Yes	It is now proposed to use Shaft 5 as intake air and to exhaust air via shaft 6 which lies centrally within CML7 near the Mechanical Workshop. It is proposed to install up to up to four fans, two to be installed 90 m underground at Shaft 5 and 160 m underground at Shaft 6.	Yes
Vibration	Mining will be undertaken up to 65 metres from surface and will proceed beneath South Road (Silver City Highway SH 22) and 2 houses owned by the Line of Lode Reserve Trust (located on CML7). There is also some residential housing and the Italian Club located in the area within (surface measure) 71 m and the other approximately 100-150 m of the proposed mining operations. Extending mining to the southwest boundary brings the Rasp Mine mining activities closer to the workings of the Perilya's Southern Operations.	Yes	A crown pillar will be left at surface to a depth of 60 m.	Yes
Subsidence	Mining will be undertaken within 65 metres	Yes	A crown pillar will be left at	Yes

	below South Road (Silver City Highway SH 22).		surface to a depth of 60 m.	
Air Quality, general	All mining works will be conducted underground as the material to be mined replaces other mining material that has been found to be uneconomic to mine there will be no change in tonnes mined and therefore no additional ore haulage or processing requirements or other dust generating activities.	No	No change.	No
Air Quality, air extraction from mining	It is proposed to use the existing shaft (Shaft 5) to vent air from underground workings. This would require the removal of the seal and placing a fan at an appropriate location along the shaft. The closest facilities to the shaft are the unused tennis courts located 50 m to the south and the Italio International (Bocce) Club located 75 m also to the south. Beyond these facilities are 7 residential houses located 140 m to 165 m from the shaft.	Yes	It is now proposed to use Shaft 6 located centrally within CML7 to vent exhaust air.	Yes
Community Health	As there will be no additional ore mined or processed there will be no additional impacts to community health.	No	No change.	No
Water Resources	No impact as proposed mining is well above the current water table. Water is currently pumped from underground to lower water table levels to permit mining to occur. Water extraction is also required to allow safe operations at the adjacent mine – Perilya Southern Operations.	No	No change.	No
Heritage	The BHCC Local environment Plan lists a number of heritage items located in the area adjacent to South Road. These include the No 7 and No 4 Headframes. Engineering reports indicate that the No 4 Headframe requires stabilisation. This work is scheduled for Quarter 4 2014.	Yes	Stabilisation works now planned for Quarter 1 2015. **Refer Section 7.5** for a discussion of these works.	Yes
Ecology	Past mining has left the Rasp Mine and Project Area highly modified and disturbed. The original landform has been significantly altered, the majority of native vegetation has been removed and soils have been degraded and covered with waste rock.	No	No change.	No
Visual Amenity	There will be no change to surface activities, structures or buildings.	No	No change.	No
Traffic & Transport	There will be no change to surface activities, traffic or haulage movements for ore or concentrates.	No	No change.	No
Waste Management	Non mining waste will be managed in line with the current BHOP Waste Management Plan. Waste rock will be used to fill underground voids, may be stored in Kintore Pit and / used, if tested as suitable, as noise/safety bunding material or road base.	No	No change.	No
Rehabilitation	There will be no additional surface	No	No change.	No

	disturbance or stockpiling of ore or waste (concentrates are not stockpiled but placed into containers directly from the filtration process).			

Mitigation measures identified as a result of this preliminary review included:

- Installation of 60 m crown pillar to be left beneath the road.
- Relocation of exhaust air to Shaft 6.
- Barrier walls to be installed at ventilation fan installation in Shaft 5.
- All ventilation fans to be located underground.

6.2 Risk Review Process

BHOP engaged SP Solutions Pty Ltd, an independent company specializing in risk assessment and risk management programs in the mining industry, to conduct a risk review of the proposed Modification. This review is located at **Appendix G**, Rasp Mine Extension, Risk Analysis – Surface Environmental Aspects, October 2014.

The purpose of the risk review was:

> *"To conduct a risk analysis of the mine extension to identify threats/hazards during the life cycle of the project that may impact on the surface; clarify the risk potential and identify preventative controls, reactive controls and recommendations for consideration."*

The scope of the risk review included the life cycle of the Modification, development, operation and decommissioning, the linkages to current mining activities where concurrent mining activities could impact and in particular, given its location, the potential risks associated with mining of the Zinc Lodes.

A team of professionals was chosen to participate in the risk review to provide an appropriate mix of skills and experience to identify the potential scenarios / issues and the controls to be applied. **Table 6.2** details the team members and their relevant qualifications and experience. Participants were required to provide input into the process and challenge the adequacy of the controls for example, procedures, training and equipment. The key focus was to identify hazards (underlying threats / causes) and the measures to control these hazards.

Table 6.2 Risk Review Team Members

Name	Organization / Role	Experience & Qualifications
Rob Williamson	BHOP / General Manager	16 years, B Eng First Class Mine Manager Certificate
Costa Papadopoulos	BHOP / HSE Manager	25 years
Callum Kerr	Intergrated Auditing Resources/ Consulting Senior Mining Engineer	10 years, B Eng B Sc (Geo)
Mike Humphreys	Prism Mining Pty Ltd, Consulting Vibration Specialist	25 years, B Sc PHD Mining Engineering
Gwen Wilson	CBH / Group Manager - SHEC	30 years. BCom Grad Dip Occ Hazard Management

Name	Organization / Role	Experience & Qualifications
Visko Sulicich	CBH / Chief Operations Officer	35 years, B Eng Mining Mine Manager Certificate
Brett Anderson	BHOP / Mining Manager	25 years, B Eng Mining Mine Manager Certificate
Leanne Waddell	BHOP / Technical Services Superintendent	17 years, Grad Dip Mining
Patrick Evers	BHOP / Mining Superintendent	38 years, Underground mining supervision
Cameron Tucker	Ground Control Engineering Pty Ltd / Consulting Geotechnical Engineer	14 years, B Eng Geotechnical
Richard Noonan	Barnson Pty Ltd / Consulting Civil Engineer	22 years, B Eng MIE Aust CP Eng
Peter Reardon	SP Solutions / Risk Review Facilitator	40 years, B Eng Min (Hon) Grad Dip Management Registered First Class Mine Manager

The risk review was undertaken over two days on the 9th and 10th of October 2014. It involved a brainstorming session where the following issues were identified:

- Causes or threats;
- Escalators (or causes which may impact on controls);
- Control measures, either existing or potential improvements;
- Incidents / outcomes (end result of incidents), and
- General background information

The brainstorming list was then reviewed so as to ensure that all aspects and issues had been included to build the risk model. A threat analysis was then conducted by the participants which focused on the causes or hazards, preventive controls, reactive or mitigation controls and recommendations or actions to improve the effectiveness of the current controls or fill significant gaps.

Risk rankings were conducted for the most serious potential risks using the BHOP risk assessment tools, refer **Figures 6.3** to **6.5**.

Table 6.3 Likelihood & Definitions

Likelihood	Definition
Almost Certain	Is expected to occur almost every time the task is completed. Occurs once per week.
Likely	Is likely to occur on a regular basis. Occurs once per month.
Possible	Would expect this to occur every now and then. Occurs once per year.
Unlikely	Would not expect this to occur too often. Occurs once every five years.
Rare	Not likely to occur unless under exceptional circumstances.

Table 6.4 Risk Ranking Matrix

Likelihood	Consequence				
	Minor	**Moderate**	**Significant**	**Major**	**Catastrophic**
Almost Certain	11	16	20	23	25
Likely	7	12	17	21	24
Possible	4	8	13	18	22
Unlikely	2	5	9	14	19
Rare	1	3	6	10	15
(Tick Low, Medium or High)	1-5 Low Risk		6-17 Medium		18-25 High Risk

Table 6.5 Severity Consequence Table

	Safety	Environment	Community/Reputation	Operations
Catastrophic	• Fatality • Permanent disability • Serious injury, loss of limb • Prosecution or litigation	• Fatality of a person • Devastation to large area of land • Severely health effects or death or severe impact to protected flora and fauna or their habitat • Prosecution or litigation	• Community complaint impacts State/National level • Destruction of cultural items of significance • Complaint causes cessation of operations > 1 week	• Downtime of critical equipment > 1 week • Potential loss / property damage > $200,000
Major	• Lost time injury • Disabling injury > 4 days • Serious breach of safety regulations (breach of Golden Rules)	• Recorded health effect to people • Impact on protected fauna, flora • Emission/discharge exceeding legal guideline and requires government reporting • Loss of containment of substance (on site) >200L	• Community complaint impacts State level • Permanent damage to cultural items of significance • Prosecution/Litigation • Complaint causes cessation of operations < 1 week	• Downtime of critical equipment > 1 shift < 1 week • Potential loss / property damage > $50,000 < $200,000
Significant	• Requires government reporting • Medical treatment eg stitches, etc	• Any loss of containment off site to private or State property, road, waterway, etc • Loss of containment of substance (on site) 50 – 200L • Requires government reporting	• Community complaint impacts Council level • Damage to items of significance • Community relations affects ability to obtain environmental licence/approval	• Production loss > 4 hours < 12 hours • Potential loss / property damage > $10,000 < $50,000 • Theft on site requires police involvement
Moderate	• First aid treatment	• Loss of containment of substance (on site) 20 – 50L • Non-compliance with internal environmental target • Concern by local community re environmental matter	• Local complaint resolved and has future impact • Minor infringement of cultural heritage	• Production loss > 1 hour < 4 hours • Potential loss / property damage > $2,000 < $10,000
Minor	• Reported injury, no first aid required	• Loss of containment of substance (on site) <20L.	• Local complaint resolved	• Production loss < 1 hour • Potential loss / property damage < $2,000 • Theft on site no police involvement

Shaded areas are serious potential incidents (SPIs).

6.3 Key Potential Environmental Issues

The key environmental issues were identified during the risk review and consultation and are summarized in **Table 6-3** and addressed in Section 7 of this EA. Where relevant the key potential environment issues are also addressed in the various appendices to the EA.

Table 6.6 **Key Potential Environment Issues**

Potential Key Environmental Issues				**EA Reference**
	C	P	R	
Ground Failure / Subsidence affecting surface This is particularly relevant to the Zinc Lodes where mining will be conducted closer to the surface and where damage could occur to South Road and local infrastructure such as power lines and underground communication cables and water pipes. - Surface infrastructure damage instigated by possible large scale stope failure in the benching stoping section of the orebody. - Structurally controlled failures from hangingwall and crown resulting in smaller stope spans than predicted by the empirical stability analysis. - Sterilisation of ore through stope failure. Hangingwall or crown failures have the potential to sterilise ore in the vicinity of the failure. - Failure of pillars due to presence of unfavourable defects in the pillar. - Variability in geotechnical parameters used in the stope analysis. There are inherent risks in extrapolating drill hole point data to generalised rock mass conditions across domains. Whilst the host rock mass and the mineralised lenses could be described as close to homogeneous, there are localised variations in rock mass conditions. Assumptions are also made with regards to the presence of the critical defect set within the rock masses forming the stope walls. - Vibrations from blasting at adjacent mine workings (Rasp Mine and Perilya) result in safety issues and / or damage to mining infrastructure.	Catastrophic	Rare	Medium - 15	8.1 7.1 7.3.2 7.1, Appendix A 7.1, Appendix A Appendix A 3.2 Appendix A 7.1, Appendix A 7.3.2, 8.2
Ground Failure / Differential settlement affecting surface This is particularly relevant to the Zinc Lodes where mining will be conducted closer to the surface and where damage could occur to South Road and local infrastructure such as power lines and underground communication cables and water pipes. - Damage to infrastructure eg cracks or small movements in road, or pipework.	Catastrophic	Rare	Medium - 15	8.1 7.3.2, Appendix A 7.3.2, Appendix E
Vibrations and Overpressure affecting surface, from blasting. - Damage to properties. - Community complaints. - Failure to meet vibration criteria.	Catastrophic	Unlikely	Medium - 14	8.2 7.3.2, Appendix E 7.2, Appendix B
Air Quality, exhaust ventilation - Public exposure to increased airborne contaminants. - Community complaints. - Failure to meet air quality criteria.	Minor	Rare	Low-1	8.3 7.4, Appendix D 7.4, Appendix D 7.4, Appendix D

Noise, from ventilation fans and mining equipment - Public exposure to increased noise, particularly at night from underground mining activities. - Community complaints. - Failure to meet noise critieria.	Moderate	Unlikely	Low - 5	8.4 7.5, Appendix C 7.5, Appendix C 7.5, Appendix D
Heritage, Number 4 Headframe - Collapse of headframe. - Damage to surrounding buildings and structures. - Injury to personnel.	Minor	Rare	Low-1	8.5 7.6 7.6 7.6

Mitigation measures identified as a result of this risk review included:

- Conduct ongoing testing of representative samples of the rock mass to characterize the engineering properties, including validation of drill hole orientation.
- Develop and refine structural model as more data is obtained.
- Collect and interpret structural defect data and geotechnical data as mining progresses towards the Zinc Lodes allowing validation of blast design parameters.
- Formal the analysis regarding the 60 m crown pillar.
- Design 5 m bridge pillars to be installed for bench stoping.
- Increase size and quality of the geotechnical database for the Zinc Lodes by collecting geotechnical information from future resource drilling programs.
- Update TARP to include Zinc Lodes.
- Develop a comprehensive program to monitor stope stability and potential surface subsidence (implemented before and during the extraction of the Zinc Lodes).
- Conservative ground control management, including cable bolting.
- Limiting span width in bench mining beneath the road to 10 m.
- Implement a mining sequence whereby open voids are limited to one at any time and that stopes are immediately filled when completed.
- Establish vibration trigger level for the road.
- Formalise the review/audit process for the vibration analysis and blast management plan.
- Conduct addition training for key personnel including assessment of vibration results, waveform, etc.
- Review the drilling equipment and drill consumables combination to optimize the control of the drillhole accuracy.
- Consider shrouding effects from filled stopes, voids and workings that assist to shield vibration transmission, including orientation of shear zones.
- Establish agreed PPV at which point pedestrians and vehicle traffic may be warned and / or temporarily stopped and develop procedure.
- Review and upgrade signage and fencing at Shaft 5 as required.

The majority of activities to be conducted under the proposed Modification will be undertaken underground. The only surface activity involves drill holes for placement of hydraulic fill underground. These are to be installed on an already disturbed area in the vicinity of current mining activities approved under the current Project Approval.

There will be no specific construction activities associated with the proposed Modification and there will be no change to the following areas, already approved, as a result of the proposed Modification:

- No additional items in the mobile fleet;

- No additional on or off-site traffic movements;
- No extension of the footprint, and / or
- No additional land disturbance

Therefore there will be no material alteration to the current Rasp Mine Project Approval in relation to:

- Land resources, rehabilitation and final landform;
- Waste rock management and geochemistry;
- Tailings management and geochemistry;
- Flora or fauna;
- Groundwater resources or extraction;
- Surface water resources, and /or
- Road or rail traffic.

7.0 ENVIRONMENTAL ASSESSMENT

This section outlines impacts identified in relation to the Modification and provides management and mitigation measures to be implemented by BHOP.

7.1 Ground Failure

7.1.1 Impact Assessment - Subsidence

Mining induced subsidence is a term which describes the phenomena in which large scale earth vertical movements occur as a direct result of mining activities below surface. It is commonly associated with underground long-wall coal mining operations and rarely with underground hard rock operations. In hard rock, subsidence can occur either deliberately (eg block caving) or as an unplanned event (eg stope collapse).

Ground Control Engineering Pty Ltd (GCE) was engaged to assess the potential for subsidence at surface, particularly in relation to mining of the Zinc Lodes which lay closer to the surface than the Main Lode Pillars, *Zinc Lodes Geotechnical Assessment*, Ground Control Engineering Pty Ltd, October 2014, **Appendix A**.

The Silver City Highway or South Road that links the southern residential areas of Broken Hill to the greater city area is located directly above the Zinc Lodes. The study by GCE was to provide a geotechnical understanding of the rock mass and stope stability above and within the Zinc Lodes and to provide recommendations for mining methods to maintain the stability of the area. Consideration was to be given to all aspects of the mining life cycle from access development, operational mining and decommissioning.

The scope of the work for GCE also included:

- Geotechnical data collection and validation of exploration core from 2002 -2004 program;
- Geotechnical characterisation including data processing and rock mass characterisation, geotechnical domaining and classification of rock mass description by domain;
- Assessment of expected rock mass conditions, geotechnical properties and design parameters for each geotechnical domain. This incorporates discontinuity data and intact rock properties. The impact of major structure and zones of weakness on development and stoping will be assessed;
- Assessment of key geotechnical risks for the Zinc Lodes;
- Assessment of stable stope spans using empirical design methods for all stope walls (hanging wall, footwall, crown and end walls);
- Stability assessment of the crown pillar between the Zinc Lode bench stopes and the ground surface using empirical and numerical modelling methods;
- Recommendations for stope sequencing based on the expected ground conditions and the selected mining method, and
- Reporting of findings and recommendations.

The geotechnical risks identified by GCE and addressed in their assessment included:

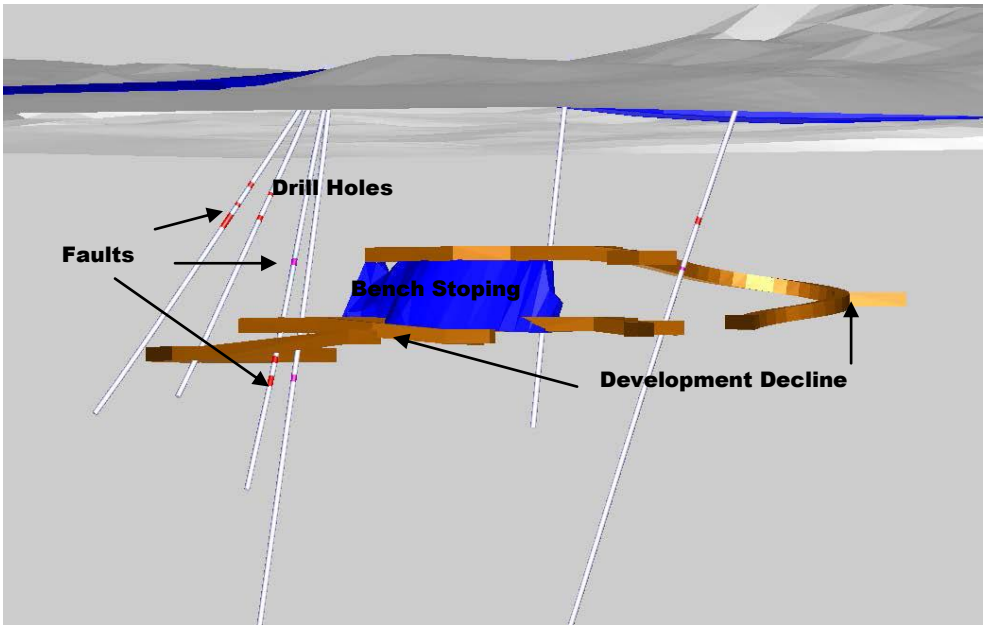
- Surface infrastructure damage instigated by possible large scale stope failure in the benching stoping section of the orebody;
- Structurally controlled failures from hangingwall and crown resulting in smaller stope spans than predicted by the empirical stability analysis;
- Sterilisation of ore through stope failure. Hangingwall or crown failures have the potential to sterilise ore in the vicinity of the failure;
- Failure of pillars due to presence of unfavourable defects in the pillar; and
- Variability in geotechnical parameters used in the stope analysis.

The geotechnical assessment completed by GCE is based on core logging data from twenty-two previously drilled geological exploration holes. A total of 2856.2 m of core was logged. A selection of samples for intact rock properties testing was also undertaken.

Faults and Shear Zones

GCE used logging data to identify the width and physical characteristics of the shear and fault zones. Of the 25 such zones identified by GCE, only 8 were considered significant and these were not located in the hanging wall or crown of the downhole bench stopes and are therefore not expected to have an impact on the stability of the stopes or development access drives, refer **Figure 7.1**. GCE recommends further geotechnical analysis as part of the mining plan to confirm these results.

Figure 7.1 Location of Identified Significant Fault or Shear Zones



Rock Mass Conditions

Testing was undertaken on samples of the core for rock strength. These tests indicate that the samples are generally within the strong category (R4), refer Tables 3 and 4 of the Report, **Appendix A.** These results correlate to the field assessments undertaken during the logging process.

The quality of the rock mass is measured using the Tunneling Quality Index (Q) used to analyse rock mass and determine support requirements in tunneling. GCE using this method to classify rock mass for the Zinc Lodes determined that the ground conditions for development and stoping are expected to be fair to good with localized intersections of poor zones.

These results were then used by GCE in their review of mining methods for the Zinc Lodes. In regards to bench stope mining GCE recommend that a mining sequence that will limit the number of open voids in the mining block to one stope at any one time. GCE considered that the flatter sections of the orebody that will be mined using cut and fill methods supports this mining method as it allows very good control of ground conditions by limiting the exposure of unsupported stope surfaces and recommend that fill is introduced immediately following the completion of each cut and fill stope section.

Stope Stability

A stope stability assessment was conducted by GCE using the Modified Stability Graph method. This involved the determination of the Modified Stability Number N' which was then compared to a database of stope stability performance to derive a Hydraulic Radius (HR) (the area of stope surface divided by the perimeter of the face). This allows the determination of the stable unsupported HR, **Figure 7.2.**

Figure 7.2 Stability Graph Method Chart showing Database of Unsupported Open Stopes

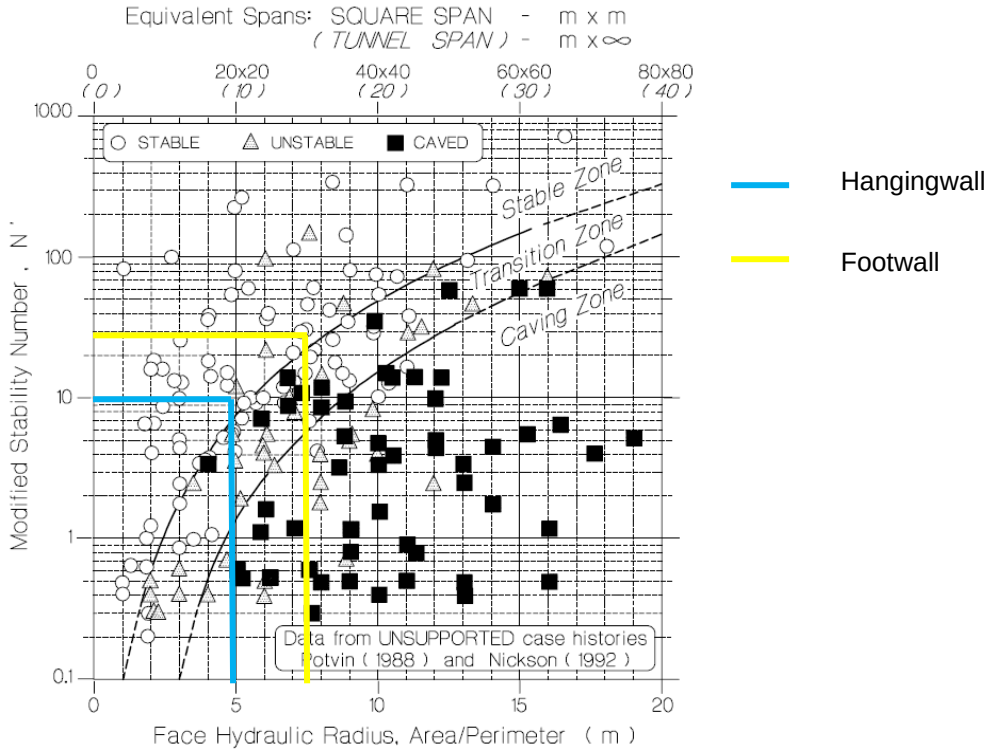


Table 7.1 presents the maximum unsupported strike spans for 20 m level intervals for weighted mean rock mass conditions for the hangingwall and footwall. Due to the very narrow nature of the mineralised zone, the stope crowns and end walls are not considered critical to the overall spans. The hangingwall is considered the most critical and limiting surface for stope stability. The main influence on hangingwall stability is the adverse influence of defects oriented sub parallel to the hangingwall surface.

Table 7.1 Unsupported Stope Stability Results

	Depth	Modified Stability Numbers					Hydraulic Radius	Wall Dimension
Stope Wall	**RL (m)**	**Q'**	**A**	**B**	**C**	**N'**	**Unsupported Stable Zone**	**Max Strike Span (m)**
Hanging Wall	10239	9.8	1.0	0.4	2.7	10.0	5.0	15.5
Foot Wall	10239	26.0	1.0	0.2	5.0	26.0	7.5	>40

The GCE analysis indicates that unsupported hangingwall spans, with cable bolt support, are predicted to be stable at 15 m. The empirical database indicates that with the addition of mid-span cable support in the hangingwall, the maximum span can be increased to a maximum strike span of 34 m. Further evaluation of ground conditions from development mining is required to evaluate the efficiency of cable bolts to increase the span.

The critical stability factor in the cut and fill stopes is the crown stability. Using weighted mean Q' values, the calculated stable HR = 9.8 m. This indicates that the planned 20 m high spans will be stable.

The stability of the crown pillar between the ground surface and the production stopes was assessed using the empirical method - 'Scaled Crown Span'. This method is applied by comparing the scaled crown pillar span to the critical span value for the controlling rock mass. When the scaled crown pillar span is less than the critical span, the crown pillar would be considered stable.

GCE determined the resulting Scaled Crown Span to be 2.4 m and the calculated Critical Span to be in the range of 5.9 m to 12.8 m, therefore the empirical crown pillar assessment indicates that the crown between the planned longhole stope and the ground surface will remain stable during extraction.

BHOP is cognisant of the requirement for ongoing stability of South Road and surrounding infrastructure and plans to mine this area conservatively limiting spans under the road to 10 m. This represents a highly conservative approach which is well below the recommendations. However, BHOP wishes to ensure negligible impact to the road and any surface infrastructure.

7.1.2 Impact Assessment - Differential Settlement

Differential settlement is usually associated with underground coal mining and the use of longwall mining methods where large unfilled voids remain in-situ post mining. It can lead to surface cracking, slope instability and erosion. Given the location of infrastructure, particularly South Road above the bench stope mining, BHOP requested GCE to assess the area for the potential for settlement, refer scope of work listed at Section 7.1 and *Zinc Lodes Geotechnical Assessment*, Ground Control Engineering Pty Ltd, October 2014, **Appendix A**.

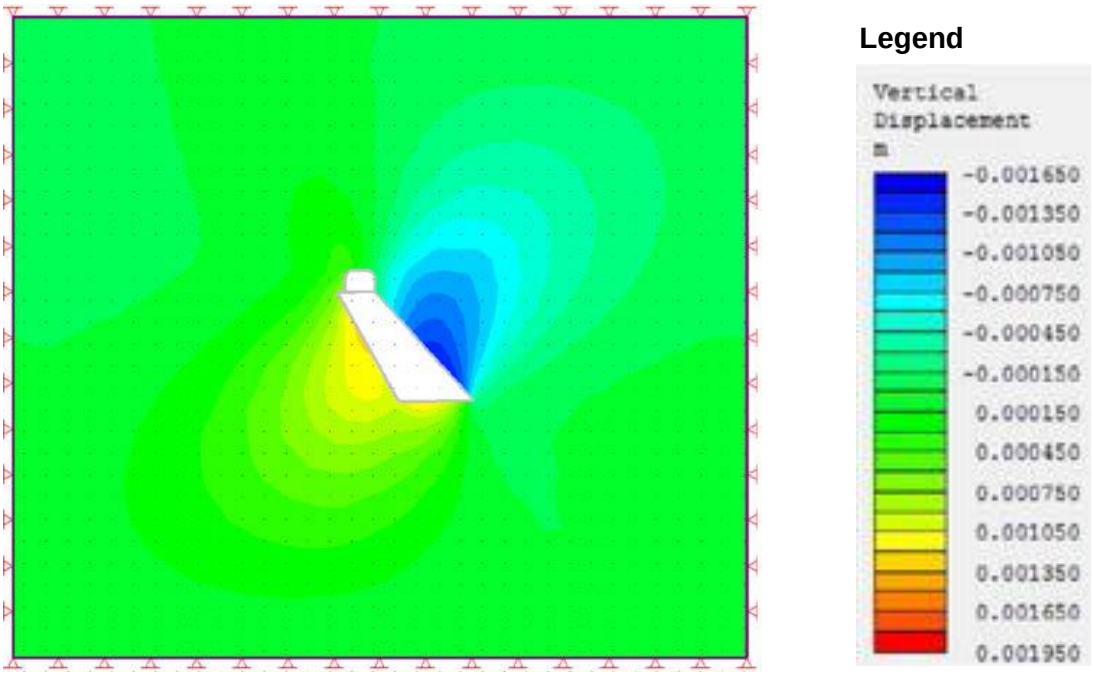
The stability of the crown pillar between the ground surface and the Zinc Lodes bench stoping area was undertaken utilising numerical modelling techniques. A simple, 2 dimensional, non-linear numerical model of the Zinc Lodes mining geometry was created using the Rocscience program, Phase2. The purpose of the numerical modelling assessment was to gain an overall appreciation of the potential interaction between the Zinc Lodes mining operation and surface infrastructure. The main area of interest is the potential for vertical displacement or settlement within the crown pillar following stope extraction.

The model assumed a homogenous rock mass with strength properties derived from the recent testing program undertaken using rock samples taken from the previous Zinc Lodes resource drilling program. Backfill was not introduced into the model following stope for simplicity and the strength properties of backfill are insufficient to prevent displacement in the stope walls following extraction. The function of backfill is to provide passive support, preventing hangingwall failure which may lead to large scale stope overbreak.

The maximum magnitude of vertical displacement predicted by the model occurs as expected after extraction is complete, where the model shows vertical displacement of 1.5 mm at the hangingwall interface of the lower lift of the bench stopes. The modelling predicts no vertical displacement at the ground surface following complete extraction, **Figure 7.3**.

Based on the results of the model, interaction between the Zinc Lodes production areas and the surface is not expected.

Figure 7.3 Numerical Model Results - Vertical Displacement (m), complete Model Geometry - Complete Extraction



7.1.3 Impact Assessment – Surface Infrastructure

A section of the Zinc Lodes orebody lies directly under the Silver City Highway (South Road). This area also contains power cables supported on timber poles (Essential Energy), underground communication cables (Telstra) and water supply pipework in the form of two Ductile iron water mains (Essential Water). Footpaths for pedestrians are also located on the road reserve.

BHOP engaged Barnson, consulting engineers to provide an assessment of the potential impacts to surface infrastructure associated with potential subsidence during and after mining, refer Letter Report – Barnson Pty Ltd, October 2014, **Appendix E**.

Barnsons concluded that:

> *"With the findings of the mine geotechnical assessment, the potential for surface infrastructure disturbance from mine subsidence should be limited to acceptable levels and thus no effect to the surface from subsidence should occur during mining operation or after mine life."*

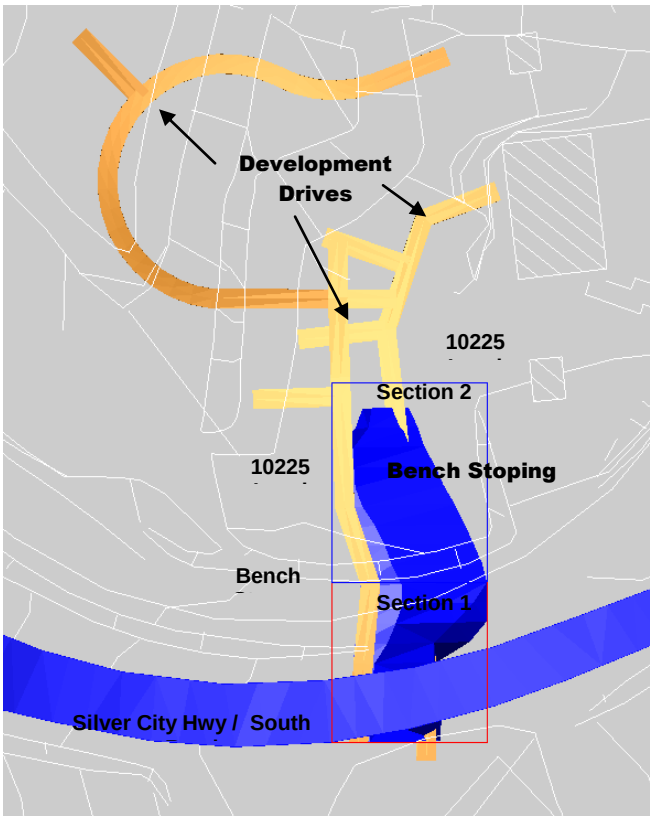
7.1.4 Mitigation Measures, Management and Monitoring

As recommended by specialists, BHOP will implement the following mitigation, management and monitoring measures to ensure negligible ground failure associated with the Modification:

- Maintain a 60 m crown pillar above the bench stoping mining area beneath the road.
- Maintain 10 m spans in bench stoping under South Road.
- Maintain 5 m bridge pillars in bench stoping.
- Cablebolt hangingwall and stope crown exposures according to the dimensions of the exposure and local conditions during development mining. Specific ground support designs have been prepared, Ground control Management Plan – BHO-PLN-MIN-001.

- Incorporate a mining sequence within mine plans that will limit the number of open voids in the mining block to one stope at any one time.
- Backfill stopes and voids with either waste rock and / or hydraulic fill immediately following the completion of each stope section.
- Incorporate ongoing collection and review of geological and geotechnical conditions and stope performance data which will validate the design parameters and provide timely input into the mine design process.
- Develop a program to monitor stope stability and potential surface subsidence. The program will be implemented both before and during the extraction of the Zinc Lodes.
- Install monitoring instruments in the 10250 level, in the crown pillar and on the 10225 level in the hangingwall prior to the commencement of extraction of the lower lift bench stopes which will be used to confirm the understanding of the rockmass response to mining and assess changes in the behaviour of the rockmass allowing design engineers to adjust mining dimensions and mining schedules if required.
- Increase the size and quality of the geotechnical database for the Zinc Lodes by collecting geotechnical information from future resource drilling programs.
- Collect and analyse structural information by conducting routine detailed geotechnical mapping to identify structures and to characterise the geotechnical environment during development mining and resource definition drilling and incorporate this information into the final stope designs and production sequence.

Figure 7.4 Spatial Relationship Between Zinc Lodes Benching Section and Surface Infrastructure (Plan View)



- **Figure 7.4** Section 1 (northing 365 m to northing 415 m) is located below surface infrastructure. Mine design in Section 1 will incorporate small, 10 metre hangingwall strike length stopes to increase hangingwall stability,.

- **Figure 7.4** Section 2 (northing 415 m to 452 m). Mine design will incorporate 15 metre hangingwall strike length stopes as recommended by the stope stability assessment,.

To prevent large scale stope wall failure, although identified as a low risk, the following requirements will be incorporated into mine designs and ground control methods:

- Data collection and detailed characterisation of ground conditions in the hangingwall and crown of the ore lens.
- Sufficient and ongoing testing of representative samples of the rock mass to characterise the engineering properties.
- Stope production spans do not exceed stable dimensions.
- Conduct ongoing monitoring and back analysis of the performance of stope spans.
- Record stope performance data and apply to stope design.
- Complete a strategy to extract each stope that incorporates appropriate infrastructure to fill each stope after the completion of extraction.
- Complete ground support designs to control stope overbreak.
- Implement ground control strategies, such as the cable bolting designs indicated in Figure 3.6, to protect the crown between surface infrastructure and the planned downhole benching stoping block.

7.2 Vibrations from Blasting

7.2.1 Vibration Criteria and Safe Limits

Tables 7.2 and **7.3** lists the blast criteria as indicated in the Project Approval. These apply when blasting is measured at the nearest affected residential or other sensitive receiver.

Table 7.2 Airblast Overpressure Criteria

(EPL)	Airblast Overpressure (dB(Lin Peak))	Allowable Exceedance
7 am to 7 pm	115	5% of the total number of blasts over a 12-month period
	120	Never
7 pm to 10 pm	105	Never
10 pm to 7 am	95	Never

Table 7.3 Peak Particle Velocity Criteria

Peak Particle Velocity (mms-1)	Allowable Exceedance
5	5% of the total number of blasts over a 12-month period
10	Never

The Terrock Consulting Engineers report “Effect of Blasting on Infrastructure, ACARP Project No. C14057”, dated 24th September 2008 provides guidance for acceptable peak particle velocity (PPV) limits for surface infrastructure such as roads, electricity poles, water mains and fibre optic cables. The relevant recommended limits as determined in this report are shown in **Table 7.4**, refer Table A of the Terrock Report.

Table 7.4 Recommended 'Safe' Vibration Limits

Item	Recommended PPV Limit (mm/s)	Possible Upper Limit Following Detailed Analysis (mm/s)
Public Roads	100	Block Movement
Power lines – Timber Poles	100	200
Concrete Poles	100[1]	200
Steel Towers	100[1]	200
Fixed Mine Plant and Buildings	100	200
Underground Workings	100	150[2]
Buried Communication cables and Pipelines	100	Block Movement
Heritage Structures	Up to 50[1]	50
Mine Offices, Houses	Up to 50[1]	200

Note: 1 = AS2187.2-2006 2 = Adequate ground support

7.2.2 Vibration Predictions

BHOP engaged Prism Mining Pty Ltd (Prism) to undertake an assessment of vibration impacts for blasting activities in Block 7 and the Zinc Lodes, their report is located at **Appendix B**, Letter Report – Review of Blast Vibration Control at Zinc Lode Rasp Mine, October 2014. In particular Prism were asked to consider:

- Vibration trends with distance and charge mass for recent blasting;
- Estimation of likely impact of proposed blasting at nearby Eyre Street residences; and
- Given the high degree of uncertainty, and the close proximities involved, provide recommendations to assist regarding blasting strategies and minimisation of adverse outcomes.

Prism used recent blasting data from the Western Mineralisation to predict vibration levels and made the following assumptions:

- Development blasting is based on 45 mm diameter holes, with a charge mass around 4 kg per hole and up to 12 holes on the same delay number;
- Production blasting is based on 89 mm or 76 mm diameter holes that could be fully charged or decked with up to three decked charges, and between 12 kg and 62 kg of charge per discrete deck; and

The distance of proposed development and production blasting to nearest residences are indicated in **Figures 7.5** and **7.6** respectively**.**

Figure 7.5 Distance of Development Blasting with Respect to Nearest Locations

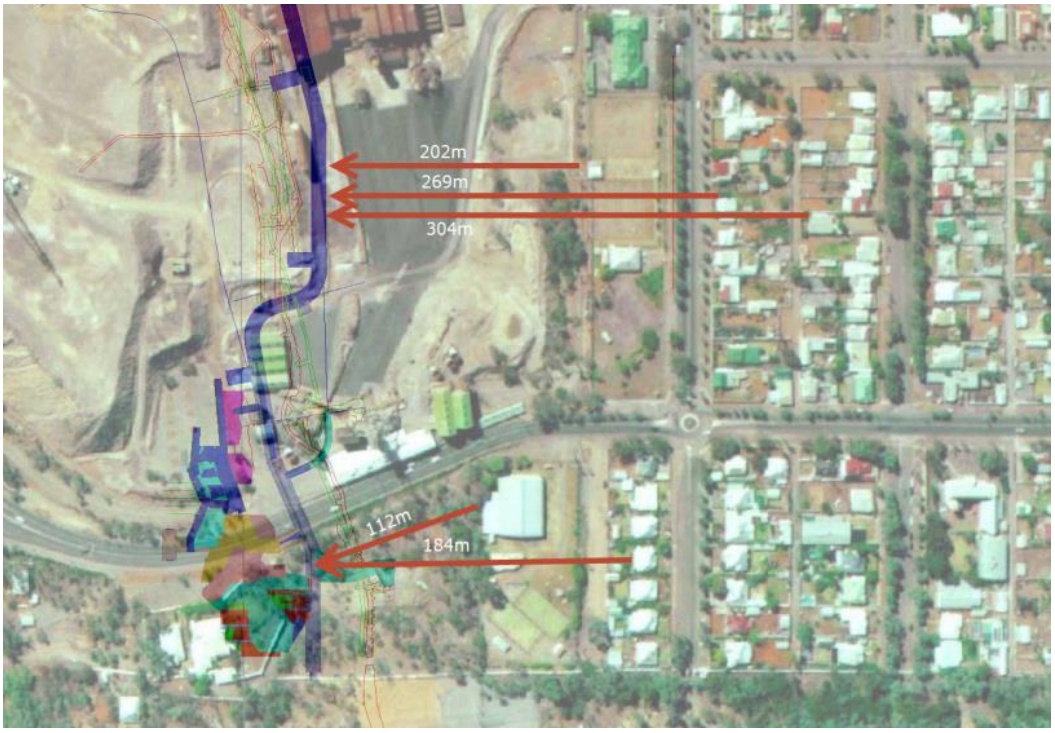
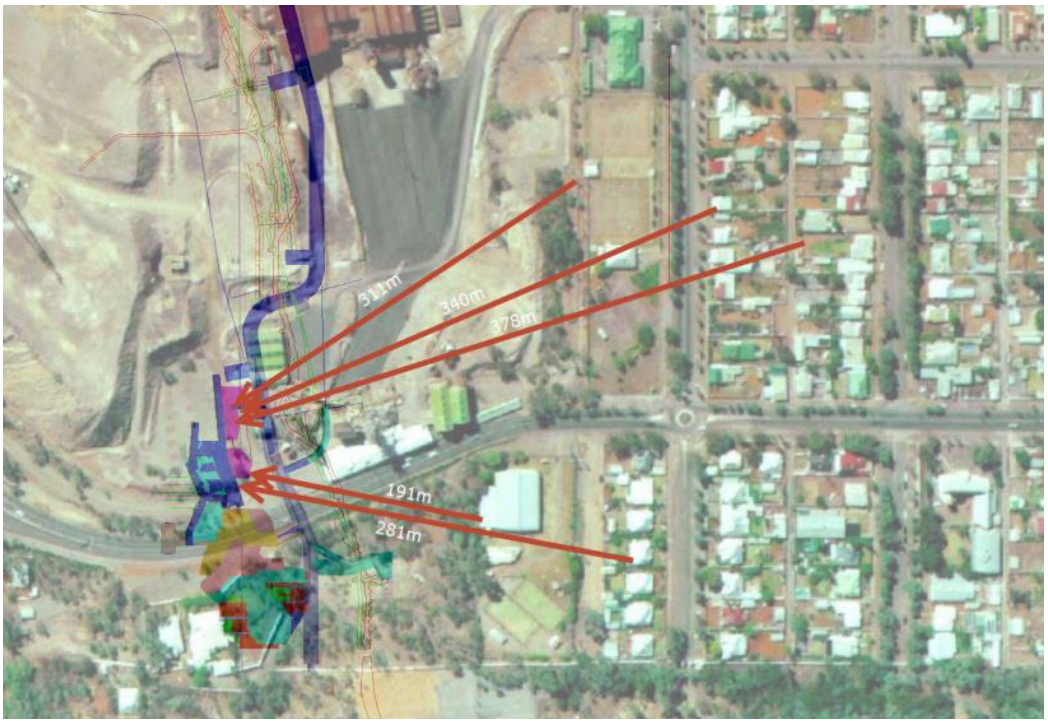


Figure 7.6 Distance of Production Blasting with Respect to Nearest Locations



Based on selected blast parameters and trends in recent data, the potential in peak vibration impact (as measured in peak particle velocity PPV) at nearby locations has been estimated, **Table 7-5** for residences and **Table 7.6** for roads, surface infrastructure, buildings and underground mining.

Table 7.5 Estimated Ranges for Peak Ground Vibration at Residences

Blast Type	Blast Location	Location	Mining Distance (m)	Charge Configuration	Max Charge (kg)	Scaled Distance	Expected Peak Vibration Range (mm/s)		
							500[1]	1500[1]	2500[1]
							-1.6[2]	-1.6[2]	-1.6[2]
Development Blasting (Also used in cut & fill mining for Zinc Lodes) (45 mm diameter blastholes)	Main Lode	Nearest Eyre Street Residence	269	1 hole/delay	4	129.7	0.2	0.6	1.0
			269	6 hole/delay	26	52.9	0.9	2.6	4.4
			269	12 hole/delay	52	37.4	1.5	4.6	7.6
	Zinc Lode	Nearest Eyre Street Residence	184	1 hole/delay	4	88.7	0.4	1.1	1.9
			184	6 hole/delay	26	36.2	1.6	4.8	8.0
			184	12 hole/delay	52	25.6	2.8	8.4	14.0
		South Road Residence[5]	78	1 hole/delay	4	NA	NA	5.4[4]	NA
			78	6 hole/delay	26	NA	NA	22.6[4]	NA
			78	12 hole/delay	52	NA	NA	39.3[4]	NA
Production Benching (76 mm diameter blastholes)	Main Lode	Nearest Eyre Street Residence	340	3 decks/hole	12	98.1	0.3	1.0	1.6
			340	2 decks/hole	31	61.1	0.7	2.1	3.5
			340	FCC[3]/hole	45	50.7	0.9	2.8	4.7
	Zinc Lode	Nearest Eyre Street Residence	281	3 decks/hole	12	81.1	0.4	1.3	2.2
			281	2 decks/hole	31	50.5	0.9	2.8	4.7
			281	FCC[3]/hole	45	41.9	1.3	3.8	6.3
		South Road Residence[5]	78	3 decks/hole	12	NA	NA	11.2[4]	17.6
			78	2 decks/hole	31	NA	NA	23.4[4]	36.6
			78	FCC[3]/hole	45	NA	NA	31.8[4]	49.7
Production Benching (89 mm diameter blastholes)	Main Lode	Nearest Eyre Street Residence	340	3 decks/hole	17	82.5	0.4	1.3	2.1
			340	2 decks/hole	42	52.5	0.9	2.7	4.4
			340	FCC[3]/hole	62	43.2	1.2	3.6	6.0
	Zinc Lode	Nearest Eyre Street Residence	281	3 decks/hole	17	68.2	0.6	1.7	2.9
			281	2 decks/hole	42	43.4	1.2	3.6	6.0
			281	FCC[3]/hole	62	35.7	1.6	4.9	8.2
		South Road Residence [5]	78	3 decks/hole	17	NA	NA	14.5[4]	22.6
			78	2 decks/hole	42	NA	NA	30.1[4]	47.1
			78	FCC[3]/hole	62	NA	NA	40.9[4]	64.0

Notes: 1 = k factor 2 = a, exponent based on best-fit trends of historic data at the Rasp Mine 3 = FCC - Full Column Charge 4 = 1600 k factor 5 = PPV provided by BHOP = PPVs over 5 mm/s criteria

= exceeds recommended PPV 50 mm/s safe limit for mine offices and houses

As indicated in **Table 7.5** and concluded by Prism, blasting can be achieved within criteria at each of the locations provided the following minimium blast limitations apply:

- Development blasting should be limited to no more than 6 holes per delay (and possibly fewer) when blasting at the closest proximity to residential locations.

- Production blasting with 89mm diameter blastholes will require decking, and may not be appropriate at the closest proximity to residential locations.
- Production blasting with 76mm diameter blastholes may require decking, but should be suitable for blasting at the closest proximity to residential locations.
- Subject to actual vibration outcomes as the project advances, and the actual distances from sensitive locations, the use of 89mm diameter blastholes and/or full column production charging may be achievable for some blasts, but should be implemented with care.

BHOP will manage blasts on a case by case basis depending on the location of the mining and the location of sensitive receivers to achieve PPV values within its approved criteria. Examples are given below of how the blasting designs are calculated and then optimised to reduce the maximum PPV at residences. All examples assume a K factor of 2500 mm/s which is a worst case scenario.

Example 1 - Eyre St Residences
BHOP plan to fire a cut-and-fill blast (45 mm diameter holes) in the Zinc Lodes with a maximum of 12 holes per delay. The Technical Services Department then calculate the PPV (refer to table 7.5) which predicts a blast PPV of 14.0 mm/s to the nearest Eyre St residence. Given the PPV is over 5.0 mm/s this will trigger changes to the blasting design to reduce the maximum PPV. For this design the changes would include; reducing the maximum number of holes on a single delay from 12 to 2 holes. The PPV would then be re-calculated at PPV of 3.3 mm/s. The charge plan would be reviewed and signed-off by management.

Example 2 – Eyre St Residences
BHOP plan to fire a half height bench stope blast (76mm diameter holes) in the Zinc Lodes firing one fully charged hole (FCC) per delay. The Technical Services Department then calculate the PPV (refer to table 7.5) which predicts a blast PPV of 6.3 mm/s to the nearest Eyre St residence. Given the PPV is over 5.0mm/s this will trigger changes to the blasting design to reduce the maximum PPV. For this design the changes would include; decking each hole twice and initiating the hole using two delays which will halve the MIC. The PPV would then be re-calculated at a PPV of 4.7 mm/s. The charge plan would be reviewed and signed-off.

The only exception to achieving blasting criteria is the LOLRT house on South Road. The vibration results at this residence are well above acceptable amenity criteria. However, it should be noted that in all but one case they are below safe vibration limits for housing structures. BHOP has consulted with the tenant and is in the process of formalising an agreement to accommodate mining operations and outline communication processes that will be implemented prior to blasting operations in the vicinity of the house. As agreed if the tenant decides that the blasting operations cause vibrations at the premises that are too disruptive, then BHOP will arrange relocation of the tenant during mining in this area. A structural assessment of the property will also be undertaken in relation to the predicted vibration levels for this area. It should be noted that the mining in the vicinity of this house will only be undertaken for a period of up to 12 months.

It is important to note that mining will commence with the smaller development blasts in an area in Block 8 which is located further away from sensitive residential receivers than the proposed mining in Block 7. This will allow ongoing analysis, validation and modification of the blasting methods and allow future planning of blasts to ensure compliance. This approach allows a high degree of confidence in meeting Project Approval criteria.

7.2.3 Infrastructure Assessment (Roads, Power Lines, Water Pipes, Buildings and Adjacent Mine)

A section of the Zinc Lodes orebody lies directly under the Silver City Highway (South Road). This area also contains power cables supported on timber poles (Essential Energy), underground communication cables

(Telstra) and water supply pipework in the form of two Ductile iron water mains (Essential Water). Footpaths for pedestrians are also located on the road reserve.

Based on selected blast parameters and trends in recent data, the potential in peak vibration impact at surface infrastructure locations has been estimated by Prism, **Table 7.6.**

Table 7.6 Estimated Ranges for Peak Ground Vibration at the Road, Buildings and Underground Workings

Blast Type	Blast Location	Location	Mining Distance (m)	Charge Configuration	Max Charge (kg)	Scaled Distance	Expected Peak Vibration Range (mm/s)		
							500[1]	1500[1]	2500[1]
							-1.6[2]	-1.6[2]	-1.6[2]
Development Blasting (Also used in cut & fill mining for Zinc Lodes) (45 mm diameter blastholes)	Main Lode	Bowling Club	202	1 hole/delay	4	97.4	0.3	1.0	1.6
			202	6 hole/delay	26	39.7	1.4	4.2	6.9
			202	12 hole/delay	52	28.1	2.4	7.2	12.0
	Zinc Lode	Italio (Bocce) Club	112	1 hole/delay	4	54.0	0.8	2.5	4.2
			112	6 hole/delay	26	22.0	3.6	10.7	17.8
			112	12 hole/delay	52	15.6	6.2	18.6	30.9
		Perilya Southern Operations[4]	40	1 hole/delay	4	NA	NA	14.1[5]	NA
			40	6 hole/delay	26	NA	NA	59.1[5]	NA
			40	12 hole/delay	52	NA	NA	102.9[5]	NA
		South Road[4]	60	1 hole/delay	4	NA	NA	7.4[5]	NA
			60	6 hole/delay	26	NA	NA	30.9[5]	NA
			60	12 hole/delay	52	NA	NA	53.8[5]	NA
Production Benching (76 mm diameter blastholes)	Main Lode	Bowling Club	311	3 decks/hole	12	89.8	0.4	1.1	1.9
			311	2 decks/hole	31	55.9	0.8	2.4	4.0
			311	FCC[3]/hole	45	46.4	1.1	3.2	5.4
	Zinc Lode	Italio (Bocce) Club	191	3 decks/hole	12	55.1	0.8	2.5	4.1
			191	2 decks/hole	31	34.3	1.7	5.2	8.7
			191	FCC[3]/hole	45	28.5	2.4	7.1	11.8
		Perilya Southern Operations[4]	40	3 decks/hole	12	NA	NA	32.7[5]	51.2
			40	2 decks/hole	31	NA	NA	68.2[5]	106.5.
			40	FCC[3]/hole	45	NA	NA	92.6[5]	144.7
		South Road[4]	60	3 decks/hole	12	NA	NA	17.1[5]	26.7
			60	2 decks/hole	31	NA	NA	35.6[5]	55.7
			60	FCC[3]/hole	45	NA	NA	48.4[5]	75.6
Production Benching (89 mm diameter blastholes)	Main Lode	Bowling Club	311	3 decks/hole	17	75.4	0.5	1.5	2.5
			311	2 decks/hole	42	48.0	1.0	3.1	5.1
			311	FCC[3]/hole	62	39.5	1.4	4.2	7.0
	Zinc Lode	Italio (Bocce) Club	191	3 decks/hole	17	46.3	1.1	3.2	5.4
			191	2 decks/hole	42	29.5	2.2	6.7	11.1
			191	FCC[3]/hole	62	24.3	3.0	9.1	15.2
		Perilya Southern	NA	NA	NA	NA	NA	NA	NA

Blast Type	Blast Location	Location	Mining Distance (m)	Charge Configuration	Max Charge (kg)	Scaled Distance	Expected Peak Vibration Range (mm/s)		
		Operations[4]							
		South Road[4]	60	3 decks/hole	17	NA	NA	22.0[5]	34.4
			60	2 decks/hole	42	NA	NA	45.9[5]	71,7
			60	FCC[3]/hole	62	NA	NA	62.3[5]	97.4

Notes: 1 = k factor 2 = a, exponent based on best-fit trends of historic data at the Rasp Mine 3 = 3 = FCC - Full Column Charge 4 = South Road and Perilya Southern Operations PPV predictions provided by BHOP 5 = 1600 k factor = exceeds recommended PPV 100 mm/s safe limit for roads, buildings and underground mines

BHOP will manage blasts on a case by case basis depending on the location of the mining and the location of sensitive receivers to achieve PPV values within its determined trigger levels for surface infrastructure. Examples are given below of how the blasting designs are calculated and then optimised to reduce the maximum PPV at residences. The provided example assumes a K factor of 2500 mm/s which is a worst case scenario.

Example 3 – South Road Infrastructure

BHOP plan to fire a half height bench stope blast (76mm diameter holes) in the Zinc Lodes firing one fully charged hole (FCC) per delay. The Technical Services Department then calculate the PPV (refer to table 7.5) which predicts a blast PPV of 75.6 mm/s for the South Road infrastructure. The predicted PPV is less than the 100.0 mm/s trigger limit for infrastructure but is over the 65.0 mm/s trigger limit that would require pedestrian access to be blocked during firing of the blast. A determination would then be made to:

a. Either change the blast design to reduce the maximum PPV by decking each hole twice and initiating the hole using two delays which will halve the MIC. The PPV would then be re-calculated at a PPV of 55.7 mm/s. The charge plan would be reviewed and signed-off, or
b. The initial design would be used but the South Road would be blocked to pedestrians while firing occurred.

BHOP engaged Barnson, consulting engineers to provide an assessment of the potential impacts to surface infrastructure associated with these predictions, refer Appendix E Letter Report – Barnson Pty Ltd, October 2014. In preparing this report Barsons used both the geoptechnical assessment conducted by GCE (refer Section 7.1) and the vibration predictions provided by Prism (refer **Tables 7.5 and 7.6**).

Barnson was also engaged to respond to the RMS letter dated 24 September 2014 (refer **Appendix H**) requesting among other things, a geotechnical engineering assessment of the proposed mining extension with an assessment on the road formation, pavement and ancillary structures.

Barsons identified that the road formation at the site varies from flexible pavement on shallow weathered rock cut to flexible road pavement on fill. The road surface is currently asphaltic concrete, which appears to be of recent construction (1-2 years old). The asphalt thickness was not determined, but from side profiles, appears to be 50-100mm thickness, refer **Photographs 7.1.**

Photograph 7.1 South Road Looking East - Zinc Lodes Beneath

Given the predicted vibration levels reported by Prism, Barnsons concluded that careful blast planning will ensure there will be no damage to the road reserve or adjacent infrastructure.

For many structures, damage will only occur close to the blast in the permanent heave/block motion zone and not due to vibration levels themselves. In the elastic zone of ground deformation, very high vibration levels are required to cause strains likely to damage structures such as; buried communication cables, buried steel and plastic pipelines and road pavement (Terrock). **Table 7.4** indicates 'safe' vibration levels for infrastructure. The permanent heave zone in hard rock mines would be very small due to the effect of the overburden stress and higher rock strength. Based on the geotechnical report by Ground Control Engineering, Barnson concludes that the permanent heave zone, often a problem in underground coal mining, will not be an issue at this site.

The review by Barnsons also gave consideration to pedestrians who may be using the road reserve pavement at the time of blasting. It is considered that a PPV above 90 mm/s could cause people difficulties in standing and a PPV of 45 mm/s it is stated that "everyone feels movement". The effect would be less felt in motor vehicles due to the absorption offered by the suspension. Therefore Barnson recommends that for surface vibration expected to be above a PPV of 65 mm/s at the road reserve, pedestrians should be stopped 200 m either side of the centre of the blast, along the road corridor.

BHOP have committed to ensuring that all blast vibration levels remain below Barnsons recommendation of 65 mm/s. It is therefore considered that this additional mitigation measure for pedestrians is not necessary. Irrespective, BHOP will install signage informing pedestrians and motorists of blast times.

In regards to underground workings and heritage structures the Terrock Report recommends an observation approach with a protocol adopted to monitor PPV levels and make sufficient observations to determine if unplanned movement is detected and to reduce PPV limits at the first signs of unacceptable deterioration.

Potential impacts from vibration and blasting activities at each of the adjacent mines (Rasp Mine and Perilya) have been discussed with the respective mine operators both have indicated that it is highly unlikely that the proposed Modification would impact on the existing mine infrastructure or workings. The infrastructure closest to the proposed mining is Perilya's mine decline which is approximately 40 m from the proposed mining. The Terrock Report recommends a PPV limit of 100 mm/s in regards to underground workings.

It should be noted that blasting 40 m away from another main access drive or underground infrastructure such as a sub-station is not uncommon practice. In fact you usually stope from 30 m distance from your own main workings without any of the controls that BHOP plan to put in place to reduce potential vibration impacts to the Perilya Southern Operations underground workings. Generally impacts are minor and may require checking of scaling after the first couple of blasts to remove loose rock, followed up by some minor rehabilitation.

Mitigation Measures, Management and Monitoring

In order to ensure vibration impacts to local residents and infrastructure are minimised and that vibration criteria is met the following measures will be implemented:

- Implement a high level of control regarding data collection, vibration assessment and QA/QC of the blasting process, to be addressed in the Technical Blast Management Plan.
- Review the extent to which geological structures (dolerite dykes and shear zones) could influence vibration outcomes for blasts within the Main Lode and Zinc Lode areas.
- Gather additional data from both the development and production blasts monitored at close distances to validate the estimates made.
- Install vibration monitors at fixed residential locations and include a roving monitor to be used in the event of unexpected results or complaints, refer **Photograph 7.2**.

Photograph 7.2 Proposed Locations for Vibration Monitors

- Maintain a 60 m crown pillar above the bench stoping mining area.
- 5 m bridge pillars in bench stoping.
- Cablebolt hangingwall and stope crown exposures according to the dimensions of the exposure and local conditions during development mining. Specific ground support designs have been prepared, Ground control Management Plan - Zinc Lodes.
- Incorporate a mining sequence within its mine plans that will limit the number of open voids in the mining block to one stope at any one time.

- Backfill stopes and voids with either waste rock and / or hydraulic fill immediately following the completion of each cut and fill stope section.
- Place warning signs approaching the blasting area on South Road to warn motorists and pedestrians of the possibility of blast vibrations being felt while travelling that section of road.
- Install a blast monitor on the mine lease land directly above the proposed mine stopes, as close as possible to the road and monitor vibration against a pre-determined trigger level for example PPV of 100 mm/s as the safe vibration level indicated by ACARP and included at **Table 7.4**.
- Use this monitor to provide an indication of when pedestrians should be stopped, as the blasts get closer to the road reserve, and when surface PPV is expected to be greater than 65mm/s.
- Conduct risk assessments for mining works on each lease with Perilya, determine and implement measures to minimise any impacts.
- Undertake a road condition study both prior to any mining in the vicinity of the road and post mining of the area.
- As a requirement of RMS enter into a Deed of Agreement.
- Consult with the tenant residing in the LOLRT property and formulate an agreement to accommodate mining operations and outline communication processes that will be implemented prior to blasting operations in the vicinity of the house, including processes for relocation if required.
- A structural assessment of the property will also be undertaken in relation to the predicted vibration levels for this area.
- Formulate and implement procedures for notification of blasting, specifying the approximate time and location of the blast to specified neighbouring stakeholders by either phone or email prior to each blast occurring.
- Formulate notification arrangements with the adjacent Perilya Southern Operations for each mine to notify the other prior to blasting events.

7.3 Air Quality, Exhaust Ventilation

7.3.1 Impact Assessment

It is proposed to operate a ventilation system that will bring intake air through Shaft 5. Fans will be installed to draw the air through the Shaft and into the Mine workings with brick walls installed to act as a barricade preventing air escape. Exhaust air will then exit the mine at Shaft 6 located centrally in CML7 near the Mechanical Workshop. Again fans will be installed to draw the air through. Section 3.9 of this EA provides details and a description of the ventilation system. In summary 4 new fans will be installed, 2 at Shaft 5 for intake air and 2 at Shaft 6 to exhaust. Fans will be 110 kW and placed 90 m and 160 m underground.

BHOP engaged environmental consultants Pacific Environment Limited (PEL) to provide an evaluation of the potential air quality impacts associated with the proposed ventilation exhaust system at Shaft 6. Their letter report can be found at **Appendix D**. PEL currently conducts air quality monitoring for the existing Point 1 ventilation exhaust at the Mine.

BHOP is currently required under its Environment Protection Licence 12559 (EPL) to conduct air quality monitoring from its existing ventilation shaft at the Rasp Mine. The EPL specifies the minimum performance in-stack concentration criteria relevant to point source emissions within NSW pursuant to the *Protection of the Environment Operations (Clean Air) Regulation* 2010.

Consistent with the requirements of Condition M2.3 of EPL 12559, BHOP commissioned PEL to monitor emissions from their Point 1 ventilation shaft at quarterly intervals. A summary of the concentrations recorded at this point is presented in **Table 7.7**. The monitoring campaigns show that the in-stack concentrations have not exceeded the EPL limits.

Table 7.7 Current Ventilation Stack Criteria and Monitoring Results

Licence Parameter	Units	Licence limit	2013			2014	
			Q1	Q3	Q4	Q1	Q2
PM concentration	mg/Nm3	20	8.37	7.15	6.58	2.02	6.62
Total heavy metals[a] concentration	mg/Nm3	1	13.69 [c]	0.24	0.47	0.10	0.09
Oxides of Nitrogen (as NO2)[b]	mg/Nm3	350	7.85	6.72	2.44	36.54	2.61
Volatile organic compounds	mg/Nm3	40	4.88	1.15	2.68	1.16	0.04

a Where appropriate results is an average of 2 sample runs
b Total heavy metals are the sum of As, Be, Cd, Co, Cr, Mn, Ni, Pb Sb, Se, Sn, V & Hg. Non detect figures are not included.
c It is understood that this elevated result was considered anomalous and due to a sample contamination issue.

The original air quality assessment for the EA (ENVIRON, 2010) modeled the then proposed ventilation shaft at the Kintore Shaft, located in Little Kintore Pit. This did not proceed due to storm damage to the Shaft however its location is within 75 m of Shaft 6 which is proposed to exhaust air for the current Modification. Project Approval MOD1 March 2012 approved the relocation of the ventilation shaft from Kintore Shaft to the current location to the north-west of CML7.

At such low levels, as measured from Point 1 Ventilation Shaft and predicted for Shaft 6, cumulative air quality at receivers is not considered an issue.

Table 7.9 compares the parameters of the ventilation stacks from (a) the original EA where the exhaust air was to be vented from a Shaft in Little Kintore Pit, (b) the ventilation stack as provided in Project Approval MOD1 and (c) the ventilation system proposed to exhaust air from Shaft 6.

Table 7.8 Comparison of Modelled Stack Parameters with the Proposed Ventilation Shaft 6

Scenario	Kintore Shaft (modeled 2010)	Current Point 1 Vent Shaft (modeled 2011)	Vent Shaft 6 (proposed 2014)
Stack height (m)	0	0	8
Vent cross-sectional area (m2)	30	30	4
Stack diameter (estimated m equivalent)	6.18	6.18	2
Gas volumetric flow (m3/s)	300	400	96
Gas exit velocity (m/s)	10	13	24
Gas exit temperature (K)	293	293	293
Emission Source Type	Horizontal Point	Horizontal Point	Vertical Point
Easting	543350	543618	543304
Northing	6462472	6463202	6462437

Pacific Environment Limited concluded that:

"Due to its location and comparable (or, in the case of volumetric flow, significantly lower) exit parameters, the predicted ground level concentrations from the Kintore Shaft are anticipated to give a conservative indication of the potential impacts from the proposed exhaust ventilation from Shaft 6. Accordingly, predictions of ground level impacts associated with modelling of the Kintore Shaft have been taken as a (conservative) surrogate for modelling emissions from Vent Shaft #6." Letter report – Proposed Upcast Ventilation Shaft 6 - Air Quality Aspects, Pacific Environment Limited, October 2014

Therefore comparing modeling predictions from Kintore Shaft (acting as a surrogate for Shaft 6) and the current Vent Shaft results indicate that the highest predicted concentrations are well below criteria. The highest PM_{10} 24 hour prediction was at R 3 (Eyre Street) 4.1 µg/m^3 compared to criteria of 50 µg/m^3, and annual average PM_{10} the highest predicted value was 0.2 µg/m^3 at R42 (Proprietary Square) compared to a value of 30 µg/m^3. Highest predictions for NO_2 for 1-hour average was 195 µg/m^3 at R2 (Eyre Street) compared to 246 µg/m^3 and for annual average the highest prediction was 2.3 µg/m^3 at R3 compared to 62 µg/m^3 , refer Table 3 of the Letter Report - Proposed Upcast Ventilation Shaft 6 - Air Quality Aspects, Pacific Environment Limited, October 2014.

In addition current monitoring results (refer **Table 7.7** above) have indicated that measured parameters for the current Point 1 Ventilation Exhaust Shaft are well within the EPL criteria. This is a larger system with 2 450 kW fans and higher volumetric air flows than those proposed in the Modification.

Pacific Environment Limited concluded that:

"Given that it is anticipated that the stack and fan system will operate under more favorable conditions from dispersion (lower volumetric flows, potentially vertically oriented, elevated release point), it is not anticipated that this additional ventilation system will not result in any additional adverse (or indeed measureable) impacts at sensitive receptors surrounding the mine."

A comparison of in-stack concentrations from actual sampling and modeling confirm that actual and predicted results will be well below EPL criteria, **Table 7.9**.

Table 7.9 Comparison of In-Stack Concentrations (Modelled and Monitored) Against EPL Criteria

Air quality parameter	In-stack concentration limits (mg/m3)	Kintore Shaft (modelled 2010)	Point 1 Vent Shaft (modelled 2011)	Point 1 Vent Shaft (average of measured) a
Total Solid Particles	20	0.41	0.31	6.15
Nitrogen Oxides (NOx)	350	4.64	3.48	11.23
Type 1 and Type 2 substances in aggregate	1	0.02	0.01	0.23
Volatile organic compounds as n-propane equivalent	40	0.31	0.23	1.98

7.3.2 Mitigation Measures, Management and Monitoring

It is not expected that the Modification will impact air quality however the following will be implemented to manage this issue:

- Conduct monitoring of air exhaust in line with EPL. Refer **Section 2.7.**

7.4 Noise, from Ventilation Fans and Mining Equipment

7.4.1 Impact Assessment

BHOP engaged EGMA|Mitchell McLennan Pty Ltd (EMM), to review potential noise impacts associated with the proposed underground mining extension. This assessment is provided at **Appendix C** - Letter Report – *Rasp Mine Zinc Lodes Project Approval Variation Noise Assessment,* EGMA|Mitchell McLennan Pty Ltd, October 2014.

It was determined that the main noise source was the operation of additional ventilation fans (located underground and venting at the surface) at Shaft 5 (intake air) and at Shaft 6 (exhaust air). This would require the use of 4 ventilation fans to supply air to the new mining areas. The fans would be typically 110 kW each, operate at 1500 rpm with a diameter of 14 mm. Two ventilation fans would be installed approximately 90 m underground below Shaft 5 and approximately 20 m horizontally along a drive to draw surface air down to the proposed south-west mining areas. Installation will take place from underground with no surface activity.

Two additional fans would be installed at Shaft 6 at approximately 160 m underground and be used to extract air through the system and eventually exhaust through the top of the stack.

Sound emissions of the fans were obtained from the supplier and form the basis for the noise modelling.

Schedule 3, Condition 16 of the Project Approval 07_0018 provides noise limits for the Rasp Mine at a number of sensitive receptors. In addition EMM adopted an additional location A5B located in Eyre Street east as this would be more representative of noise from the fans located at Shaft 5.

Noise modelling was carried out for day (calm conditions, no wind or temperature gradient), evening (calm conditions, no wind or temperature gradient) and night (with a temperature inversion (F class)).

The predicted results indicate that the noise emissions from the proposed ventilation fans are relatively low (generally more than 10 dB below existing site noise contributions) and would not influence existing site noise contributions, refer **Table 7.10**. Hence, the noise contribution from the ventilation fans is insignificant by

Table 7.10 Predicted Operational Noise Levels

Assessment location	Address	Assumed existing $L_{eq(15\text{-}min)}$ site contribution, dB(A)			Predicted ventilation fans noise, $L_{eq(15\text{-}min)}$ contribution, dB(A)			Predicted combined $L_{eq(15\text{-}min)}$ site contribution, dB(A)			Predicted change, dB(A)	Criteria, dB(A)		
		Day	Evening	Night	Day	Evening	Night	Day	Evening	Night		Day	Evening	Night
		Calm	Calm	Inversion	Calm	Calm	Inversion	Calm	Calm	Inversion				
A1	Piper St North	38	37	35	11	12	15	38	37	35	0	38	37	35
A2	Piper St Central	38	37	35	17	18	20	38	37	35	0	38	37	35
A3	Eyre St North	44	41	39	24	25	26	44	41	39	0	44	41	39
A4	Eyre St Central	<44	<41	<39	19	20	22	<44	<41	<39	0	44	41	39
A5	Eyre St South	<44	<41	<39	24	24	26	<44	<41	<39	0	44	41	39
A5B	Eyre St South-east	<44	<41	<39	28	28	30	<44	<41	≤39	≤+1	44	41	39
A6	Bonanza & Gypsum Sts	<48	<41	<39	27	27	27	<48	<41	<39	0	48	41	39
A7	Carbon St	35	35	35	7	8	11	35	35	35	0	35	35	35
A8	South Rd	48	39	39	2	2	5	48	39	39	0	48	39	39
A9	Crystal St	46	39	39	6	7	10	46	39	39	0	46	39	39
A10	Garnet & Blende Sts	42	41	35	6	7	10	42	41	35	0	42	41	35
A11	Crystal St	46	39	39	0	0	2	46	39	39	0	46	39	39
A12	Crystal St	46	39	39	0	0	2	46	39	39	0	46	39	39
A13	Eyre St North 2	38	35	35	4	5	8	38	35	35	0	38	35	35
A14	Piper St North	35	35	35	6	7	10	35	35	35	0	35	35	35

comparison with all site noises sources at assessment locations off-site. It should be noted that the noise assessment did not include noise reductions attributed to the installation of the brick barrier.

EMM concluded that:

> *The assessment identified that the ventilation fans would not generally contribute to existing operational noise levels at off-site assessment locations. This assessment demonstrates that the Project Approval noise limits would be satisfied*.

7.4.2 Mitigation Measures, Management and Monitoring

It is not expected that the Modification will impact noise levels however the following will be implemented to manage this issue:

- Fans are to be installed underground to minimise noise levels at surface.
- At Shaft 5 a brick wall will be constructed surrounding the fans and will act as a noise barrier preventing fan and other mining noise from propagating up the Shaft.
- A noise monitoring program will be undertaken post fan and wall installation to verify that predictions are met.

7.5 Heritage, Number 4 Headframe

7.5.1 Impact Assessment

Given the predicted blasting levels and the location of heritage items (as listed on the BHCC LEP 2013) it is not expected that damage will occur to any heritage items in the vicinity of proposed mining operations.

However, No 4 Headframe structure has deteriorated. This structure is located near the south western boundary of CML7 near South Road and is listed under the BHCC LEP as a heritage item (I267 was 180) **Photograph 7.3**. The Headframe is a well recognised structure on the Broken Hill landscape and in recent years has started to deteriorate.

Photograph 7.3 No 4 Headframe

The Headframe was first mentioned historically in 1904, the wooden battens were fitted in 1912/13 when it was decided to fit the shaft with electric winders. It is a timber structure braced diagonally with iron rods and stands 28 m. The stability of the bolted timber structure relies on diagonal steel tension bracing connected to the main legs. The secondary timber members of the Headframe are clamped to the main legs using steel rods, ensuring that the structural integrity of the Headframe is maintained for all load conditions.

The Headframe is surveyed monthly by the BHOP technical services department. It was inspected by a structural engineer in April 2013 and was found to show signs of rotation in a south easterly direction. Due to safety issues an exclusion zone of 33 m around the Headframe was established consisting of signage and barriers and work in the core shed was relocated to outside the old administration buildings near the No 7 Shaft. There have been ongoing discussions with heritage personnel through the BHCC and in August 2014 BHCC agreed to assist in the required repair work to the Headframe with a contribution of $10,000.

7.5.2 Mitigation Measures, Management and Monitoring

To manage potential impacts to heritage items the following will be implemented prior to the commencement of mining:

- Implement a stabilisation project for the No 4 Headframe prior to the commencement of extended mining using slings for cross bracing (similar to steel ties currently in place) and continue current monitoring program.
- Undertake a regular inspection program for heritage items in the area that may be influenced by vibration.

8.0 PROPOSED STATEMENT OF COMMITMENTS

This Section lists management commitments to be implemented as a result of the Modification.

8.1 Ground Failure – Subsidence and Settlement

The following summarises the measures to be used by BHOP to control potential for mining induced subsidence and / or differential settlement:

- Control potential ground failure in the bench stoping area by maintaining a 60 m crown pillar above South Road and utilising 10 m spans as indicated for Section 1 and 15 m spans as indicated for Section 2, and installing 5 m bridge pillars as required;
- Cablebolt the hangingwall and stope crown exposures according to the dimensions of the exposure and local conditions during development mining. Specific ground support designs have been prepared, Ground Control Management Plan – BHO-PLN-MIN-001;
- Incorporate a mining sequence within mine plans that will limit the number of open voids in the mining block to one stope at any one time;
- Backfill stopes and voids with either waste rock and / or hydraulic fill immediately following the completion of each stope section;
- Incorporate ongoing collection and review of geological and geotechnical conditions and stope performance data which will validate the design parameters and provide timely input into the mine design process;
- Develop a program to monitor stope stability and potential surface subsidence. The program will be implemented both before and during the extraction of the Zinc Lodes;
- Increase the size and quality of the geotechnical database for the Zinc Lodes by collecting geotechnical information from future resource drilling programs;
- Collect and analyse structural information by conducting routine detailed geotechnical mapping to identify structures and to characterise the geotechnical environment during development mining and resource definition drilling and incorporate this information into the final stope designs and production sequence;
- Install monitoring instruments in the 10250 level, in the crown pillar and on the 10225 level in the hangingwall prior to the commencement of extraction of the lower lift bench stopes which will be used to confirm the understanding of the rockmass response to mining and assess changes in the behaviour of the rockmass allowing design engineers to adjust mining dimensions and mining schedules if required;
- Section 2 from northing 415m to 452m. Mine design will incorporate 15 metre hangingwall strike length stopes as recommended by the stope stability assessment;
- To prevent large scale stope wall failure, although identified as a low risk, the following requirements will be incorporated into mine designs and ground control methods:
    - Data collection and detailed characterisation of ground conditions in the hangingwall and crown of the ore lens;
    - Sufficient and ongoing testing of representative samples of the rock mass to characterise the engineering properties;
    - Stope production spans do not exceed stable dimensions;
    - Conduct ongoing monitoring and back analysis of the performance of stope spans;
    - Record stope performance data and apply to stope design;
    - Complete a strategy to extract each stope that incorporates appropriate infrastructure to fill each stope after the completion of extraction;
    - Complete ground support designs to control stope overbreak; and

- Implement ground control strategies to protect the crown between surface infrastructure and the planned downhole benching stoping block.

8.2 Vibration

The following summarises the measures to be used by BHOP to minimise potential vibration impacts to local residents and on surface and surrounding infrastructure, and to ensure that blasting criteria is met:

- Implement a high level of control regarding data collection, vibration assessment and QA/QC of the blasting process, to be addressed in the BHOP Technical Blast Management Plan;
- Review the extent to which geological structures (dolerite dykes and shear zones) could influence vibration outcomes for blasts within the Main Lode and Zinc Lode areas;
- Gather additional data from both the development and production blasts monitored at close distances to validate the estimates made;
- Install 3 vibration monitors at fixed residential locations and include a roving monitor to be used in the event of unexpected results or complaints;
- Place warning signs approaching the blasting area on South Road to warn motorists and pedestrians of the possibility of blast vibrations being felt while travelling that section of road;
- Include trigger limits in the BHOP Technical Blast Management Plan and agreed actions for these limits in regards to the condition of South Road (100 mm/s) and stopping of pedestrians (65 mm/s).
- Conduct risk assessments for mining works on each lease with Perilya, determine and implement measures to minimise any impacts;
- Undertake a road condition study both prior to any mining in the vicinity of the road and post mining of the area; and
- As a requirement of RMS BHOP will enter into a Deed of Agreement which outlines the risks and mitigation measures and final void controls, and any other matters appropriate. This Deed will also outline notification requirements for any incidents in relation to the road or road reserve.
- Consult with the tenant residing in the LOLRT property and formulate an agreement to accommodate mining operations and outline communication processes that will be implemented prior to blasting operations in the vicinity of the house, including processes for relocation if required.
- Undertake a structural assessment of the property (LOLRT) in relation to the predicted vibration levels for this area.
- Formulate and implement procedures for notification of blasting, specifying the approximate time and location of the blast to specified neighbouring stakeholders by either phone or email prior to each blast occurring.
- Formulate notification arrangements with the adjacent Perilya Southern Operations for each mine to notify the other prior to blasting events.

8.3 Air Quality

It is not expected that the Modification will impact air qulity levels however the following an air quality monitoring program for the air exhaust at Shaft 6 will be undertaken in line with EPL and to validate predicted air quality results.

8.4 Noise

It is not expected that the Modification will impact noise levels however BHOP will undertake the following:

- Install ventilation fans underground to minimise noise levels at surface;
- Construct a brick wall at Shaft 5 to control air flow and to act as a noise barrier preventing fan and other mining noise from propagating up the shaft; and
- Undertake a noise monitoring program post fan and wall installation to check noise predictions are met.

8.5 Heritage

To manage potential impacts to heritage items the following will be implemented prior to the commencement of production mining:

- Implement a stabilisation project for the No 4Headframe prior to the commencement of extended mining using slings for cross bracing (similar to steel ties currently in place) and continue current monitoring program; and
- Undertake a regular inspection program for heritage items in the area that may be influenced by vibration.

9.0 CONCLUSION

This section provides a justification for the Modification as sought and concluding comments.

The Modification will allow the recovery of approximately an additional 316,000 t of high grade zinc / lead ore from the Line of Lode orebody. It will also provide an opportunity for further exploration drilling in Block 7 which may expand the resource maximising ore extraction from this orebody. Without the Modification the Rasp Mine cannot rely on the remaining resource within the Western Mineralisation alone to be economically viable and by granting the Modification it will provide better utilisation of the resource. The Modification is expected to improve the financial position of the Mine in the current market downturn securing its future.

The mining of the high grade Zinc Lodes is vital to ensure the viability of the Rasp Mine. Mining at a conservative rate will provide a significant head grade increase to the operation and enable the mine to operate profitably. The mining of the Zinc Lodes will allow Rasp to return to an annual production level of 600,000 tpa after production was cut to the current level of 450,000 tonnes/year in September 2013. This will translate into an additional 35 jobs plus significant flow-on effects in the City of Broken Hill with respect to service industries and spending.

In addition BHOP has planned a $70M capital and cash expenditure in the next 12 months benefiting the local community of Broken Hill and industry in New South Wales.

In order to assess the potential environmental impacts of the proposed Modification, a number of environmental studies were completed. These studies concluded that with the appropriate mining and blasting methods utilised there would be no significant impacts to the environment or the community.

This extended mining would be mined within the approved Rasp Mine mine life using the existing surface infrastructure and would not result in any further land disturbance. Therefore the Modification is a natural extension to the existing Rasp Mine Project.

10.0 REFERENCES

TERROCK Consulting Engineers	EFFECT OF BLASTING ON INFRASTRUCTURE - ACARP PROJECT NO C14057, September 2008
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Broken Hill Operations Pty Ltd	Consolidated Mining Lease 7
Department of Planning & Infrastructure	Director General Requirements, March 2009
Department of Planning & Infrastructure	Project Approval Rasp Mine 07_0018 January 2011
EGMA|Mitchell McLennan	Letter Report - *RASP Mine Zinc Lodes Project Approval Variation Noise Assessment,* October 2014
Ground Control Engineering Pty Ltd	Zinc Lodes Geotechnical Assessment, October 2014
Pacific Environment Ltd	Letter Report – Proposed Upcast Ventilation shaft 6 – Air Quality Aspects, October 2011
Prism Mining Pty Ltd	Review of Blast Vibration Control at Zinc Lode Rasp Mine, October 2014
Road Maritime Services	Correspondence – MP07_0018: Pre DA Enquiry; Proposed Extension to Rasp Mine, 24 September 2014
SP Solutions Pty Ltd	Rasp Mine Extension Risk Analysis – Surface / Environmental Aspects, October

11.0 ACRYNOMS

Ag	Silver
AQMP	Air Quality Management Plan
BHCC	Broken Hill City Council
BHOP	Broken Hill Operations Pty Ltd
CBH	CBH Resources Ltd
CLMP	Community Lead Management Plan
CML7	Consolidated Mining Lease 7
CMP	Conservation Management Plan
DCP	Development Control Plan
DP&E	Department of Planning & Environment
DP&I	Department of Planning & Infrastructure
DRE	Department of Trade & Investment, Division of Resources & Energy
EA	Environment Assessment
EL	Exploration Lease
EMS	Environment Management Plan
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environment Protection Licence 12559
g/t	Grams per tonne
JORC	Joint Ore Reserves Committee Code
km	kilometres
LEP	Local Environment Plan 2013
LOLA	Line of Lode Association
LOLRT	Ling of Lode Reserve Trust
m	metres
MCP	Mine Closure Plan
MMM	Minerals Mining & Metallurgy Ltd
MOP	Mining Operations Plan
MPL	Mining Purpose Lease
NBMP	Noise Blasting Management Plan
Normandy	Normandy Mining Investments
NSW	New South Wales
Pb	Lead
Perilya	Perilya Broken Hill Operations Pty Ltd
PM_{10}	Particulate matter with equivalent aerodynamic diameter of 10 micrometres

PPR	Preferred Project Report
PPV	Peak Particle Velocity
REF	Review of Environmental Factors
RMS	Road Maritime Services
RTA	Road Traffic Authority
SEE	Statement of Environment Effects
SEPP	State Environment Planning Policy
SWMP	Site Water Management Plan
t	Tonnes
TARP	Trigger and Action Response Plan
tpa	Tonnes per annum
tph	Tonnes per hour
TMP	Traffic Management Plan
$\mu g/m^3$	microgram/cubic metre
WMP	Waste Management Plan
Zn	Zinc