Rasp Mine

Zinc – Lead – Silver Project

Project Approval No. 07-0018

Modification Report (MOD6)

Kintore Pit TSF3

August 2021

Broken Hill Operations Pty Ltd

BROKEN HILL

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EXECUTIVE SUMMARY

Broken Hill Operations Pty Ltd (BHOP), a wholly owned subsidiary of CBH Resources Limited, owns and operates the Rasp Mine (the Mine), located centrally within the City of Broken Hill on Consolidated Mine Lease 7 (CML7). The Mine produces zinc and lead concentrates which it dispatches via rail to Port Pirie in South Australia and Newcastle in New South Wales.

BHOP is seeking to modify the Rasp Mine Project Approval, PA 07_0018 (PA), Modification 6 (MOD6), pursuant to Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to allow for the co-placement of tailings with excess waste rock from underground mining into Kintore Pit as Tailings Storage Facility 3 (TSF3) critical to the continuation of mining operation.

The current tailings storage facility (Blackwood Pit (TSF2)) will reach maximum filling capacity in September 2022 and mining will cease at that time if no additional tailings storage facility can be established.

This proposed modification would require the relocation of the underground mine entry from the base of Kintore Pit and the introduction of harvested tailings from TSF2 as dried tailings to be co-placed with waste rock into TSF3. A number of minor modifications to the PA also form part of the modification and these are summarised below.

Mining has been undertaken within CML7 since 1885. The existing operations at the Mine include underground mining operations, a processing plant producing zinc and lead concentrates, a rail siding for concentrate dispatch and other associated infrastructure. These operations are undertaken in accordance with Project Approval PA07_0018 (PA) granted from the then Minister for Planning on 31 January 2011, under Part3A of the EP&A Act and transitioned to a State Significant Development (SSD-814).

The purpose of this Modification Report (MR) is to provide information to support the modification application. It includes an overview of the proposed MOD6, its location and setting within the environment, an environmental impacts review and risk assessment and addresses the identified potential key issues with an explanation of their management and control. Results from consultation with regulators and the community are also provided. Alternatives to and benefits of MOD6 are also outlined.

Summary of Proposed Modification

Summary of proposed MOD6:

- establish Kintore Pit as TSF3 for naturally dried tailings to be co-placed with excess waste rock from underground development;
- relocate the mine portal and access decline with associated infrastructure to a boxcut;
- utilise TSF2 for harvesting naturally dried (solar and air) tailings for transfer to TSF3;
- conduct periodical crushing of non-ore material in Kintore Pit Tipple and/or BHP Pit;
- utilise waste rock (containing on average <0.5% lead(Pb)) for rehabilitation capping; and
- administrative amendments for site noise criteria and annual environmental reporting.

These activities would be undertaken on already disturbed land and no vegetation would be removed or impacted.

Works would include:

Kintore Pit TSF3

- Preparation works including filling of mining access drives beneath the Pit, installation of an engineered plug to seal underground workings, installation of a seepage collection system at the base of the Pit, relocation of 260,000 t of material from the Waste Rock Tipple to the base of the Pit to act as a bridging layer upon which the tailings will be deposited, water management infrastructure and other minor works.

Relocation of Mine Access

- Excavation of a boxcut, mainly via earthworks with some surface blasting at the lower levels (30 m), to gain access to competent rock from which a new portal and decline would be installed. This would require relocating up to 490,000 t of excavated material to Little Kintore Pit and BHP Pit (all material has been deemed to be >0.5%Pb and would be stored in-pit).
- Establishment of a new mine portal (with some surface blasting required) and installation of appropriate ground control.
- Installation of a new decline (400 m) to join current underground mine workings, relocating up to 40,000 t to in-pit storage (as deemed >0.5%Pb). The decline would primarily be installed from underground however some blasting from the surface would be necessary for gaining access.

Tailings Harvesting in Blackwood Pit TSF2

- Preparation works including earthworks to construct bunding for tailings holding cells and an access way for trucks.
- Fresh tailings would continue to be placed into TSF2 into cells alternating between fresh, dried and harvested tailings. Thin layers of tailings (up to 1m) would be harvested once the material is sufficiently dry (average 10% moisture) using an excavator and dozer, and transported by truck to TSF3.

Periodic Crushing of Non-Ore Material

- No preparation works are required, it is proposed to contract a mobile crusher to operate two to three times per year for up to a week at a time providing crushed material for underground roadways, and some surface activities such as gravel capping and site bunding (tested and confirmed <0.5%Pb).

Rehabilitation Capping of Free Areas

- Excess waste rock from underground development would be taken to Kintore Pit and / or BHP Pit tested and sorted into stockpiles of <0.5%Pb which would be used for rehabilitation capping of Free Areas (non-active mining areas within CML7) on a progressive basis, and material >0.5%Pb would be co-placed with tailings in TSF3 or BHP Pit.

Administrative Amendments

- Noise criteria to be updated to align with recent attended noise monitoring and the NSW EPA *Noise Policy for Industry* (2017).
- Annual environmental reporting periods to be aligned (Annual Review and annual Environment Management Report).

Predictions for the life of TSF2, following installation of the embankments, is now September 2022. Mining would cease at that time if no other tailings storage facility is available.

Summary of Potential Key Risks

Several risk assessment workshops were conducted by independent consultants with the BHOP team, at various stages of the project's concept design to identify key risks and mitigation measures. Risks were considered for both construction activities and future operations. In addition BHOP sought feedback from regulators to identify matters considered relevant for assessment.

The following provides a summary of the key risks together and the results of assessments undertaken including identified primary mitigation measures.

Noise

Nosie would be generated during construction activities primarily from earth moving equipment excavating the boxcut, the transport of waste materials and the preparation works for Kintore Pit (for tailings and waste rock placement) and Blackwood Pit (for tailings harvesting). During operations the primary additional noise source would be from the tailings harvesting activities and the transport of harvested tailings to TSF3. There would also be a reduction in noise from the reduced ore haulage route from the new portal to the ROM Pad.

EMM Consulting Pty Limited (EMM) were engaged to complete a noise impact assessment, *Rasp Mine Modification 6 (MOD6) Kintore Pit TSF3 Noise Impact Assessment,* May 2021 (**Appendix E1**) which considered the proposed construction works and future operations, identifying potential impacts on the surrounding community and providing construction and operation management and mitigation measures. In completing its assessment EMM referenced the PA, the Environment Protection Licence (EPL) 12559, as well as various NSW EPA guidelines. Some out-of-hours (OOH) construction activities would also be undertaken.

EMM made the following conclusions:

- The assessment demonstrated that BHOP can achieve contemporary target levels in accordance with the NSW EPA *Noise Policy for Industry*, 2017 (NPfI), the Project Approval and the Environment Protection License (both updated), during future operations and activities associated with MOD6 construction.
- Construction noise levels from proposed worst-case construction works during standard hours and day OOH on Saturday are predicted to satisfy the PA 65 dB $L_{Aeq,day}$ noise limit at all assessment locations.
- For the *Interim Construction Noise Guideline*, 2009 (ICNG) derived noise management level (NMLs), noise levels during standard hours are predicted to exceed (by up to 3 dB) the relevant NML during stage 1 of the boxcut construction (Scenario 1) at assessment location A13. During day OOH on Saturday, noise levels are predicted to exceed (by up to 8 dB) the relevant NMLs during stage 1 and/or stage 2 of the boxcut construction (Scenarios 1 and 2) at assessment locations A1, A2, A3, A13 and A14.
- Construction noise levels from worst-case construction works proposed during evening and night OOH on any day of the week, noise levels are predicted to satisfy the ICNG NMLs at all assessment locations during 2 m/s wind. During the unlikely worst-case night-time temperature inversion (stability category F) and 2 m/s wind speed, construction noise levels are predicted to be negligibly (up to 2 dB) above the relevant NMLs at assessment locations A1, A2, A10, A13 and A14.
- Future operational $L_{Aeq,15min}$ noise levels, following the completion of the MOD6 construction works, are predicted to satisfy the adopted project noise trigger levels (PNTLs) at all assessment locations during 2 m/s wind for the day, evening and night periods.
- Operational noise levels during the unlikely worst-case night-time temperature inversion (stability category F) and 2 m/s wind speed, are predicted to be negligibly above the relevant adopted PNTLs at assessment locations A13 and A14. However, no material increase is predicted between existing and future site noise levels at assessment locations A13 and A14.
- Therefore, no additional noise impacts from future MOD6 operations are predicted to affect surrounding residential receivers as a result of proposed future MOD6 operations.
- Predicted maximum noise level events from the proposed MOD6 operations are not predicted to cause sleep disturbance impact at any of the residential assessment locations during worst-case night-time meteorological conditions for construction works within TSF3 and future operations.

In addition to the existing site noise management and mitigation measures, the following specific noise management strategies would be implemented for MOD6:

- Limited construction works on Sundays (only within Kintore Pit) and no works on Public Holidays;
- Utilising OOH for Saturday mornings and afternoons, which reduces the overall duration of construction by more than five months;
- All construction works (external to Kintore Pit) would be undertaken during daytime hours only;

- Noise bunding for the new Tails Harvesting Haul Road would be installed around the west side of the boxcut where the road connects to the existing Mine Haul Road;
- Harvested tailings transfer to Kintore Pit would occur during daytime hours only, and
- Updating of the Noise Monitoring & Management Plan (BHO-PLN-ENV-009).

Air Quality

Dust would be generated during construction activities primarily from earth moving equipment excavating the boxcut, the transport of waste materials and the preparation works for Kintore Pit (for tailings and waste rock placement) and Blackwood Pit (for tailings harvesting). During operations the primary source of dust emissions would be from the transport of harvested tailings to Kintore Pit. There would also be a reduction in dust from the reduced ore haulage route from the new portal to the ROM Pad. Dust would contain Pb and this was also assessed.

ERM Australia Pacific Pty Ltd (ERM Sydney) was commissioned by BHOP to complete an air quality impact assessment, *R*asp Mine, *Broke Hill – Modification 6 Air Quality Assessment*, May 2021 (**Appendix C1**) for the proposed modification. This assessment included a review and characterisation of the existing environment, updated air emissions inventory, atmospheric modelling for a large range of parameters – Total Suspended Particulates (TSP), Particulate Matter less than 10 microns and 2.5 microns (PM_{10} and $PM_{2.5}$), deposited dust and Pb. Analysis of the assessment results were compared against air quality criteria and previously approved air quality levels for construction (MOD4) and operations (Preferred Project Report (PPR)), a comparison with business as usual operations (BAU) was also included together with a cumulative assessment with the neighbouring mining operations.

In summary ERM Sydney concluded:

- For the MOD6 construction scenario, there is anticipated to be a net increase in lead (Pb) concentrations / deposition rates across the sensitive receptors when compared with MOD4 for a short duration of 6 months, after which time, emissions are expected to decrease. This is due to the volume of material being handled.
- All air quality metrics are predicted to be below their respective NSW EPA criteria for the MOD6 Construction Scenario.
- A net reduction in Pb concentrations / deposition rates is predicted for the MOD6 operational scenario when compared with the PPR scenario and the BAU Scenario.
- All air quality metrics are predicted to be below their respective NSW EPA criteria for the MOD6 Operational Scenario.
- As the MOD6 operational scenario is considered to be a reasonable worst-case future year scenario, ERM Sydney concluded that all future operational years are anticipated to result in a net reduction in off-site air quality impacts (including Pb) when compared with current operations.
- The results for all three scenarios demonstrated compliance with all the NSW EPA impact assessment criteria for all air quality parameters assessed.
- Cumulative impacts from the proposed Broken Hill North Mine Recommencement Project have been assessed for the short term and long term air quality metrics. The results demonstrate no exceedance of the NSW impact assessment criteria at any of the co-located receptors assessed.

Various mitigation measures have been identified to reduce dust emissions which include the sealing of the new ore haul road and the use of larger trucks for tailings haulage (from TSF2 to TSF3) to reduce truck movements. The sprinkler system around the permitter of TSF2 would be upgraded to accommodate the change to tailings harvesting operations.

Community Health

The primary health risk for the community is from the generation of Pb bearing dust emitted from the site and its potential impact on blood lead levels, particularly young children.

SLR Consulting Australia Pty Ltd was engaged by BHOP to undertake a Human Health Risk Assessment (HHRA) for MOD6, *Human Health Risk Assessment for Rasp Mine, Modification 6* (HHRA Report) (**Appendix D1**) The HHRA used air quality modelling results from the air quality assessment completed by ERM for MOD6 (**Appendix C1**).

SLR made the following conclusions:

- Predicted incremental increases in soil Pb potentially arising from approximate 12-month MOD6 construction phase were small and insignificant (0.005-0.43% of existing soil Pb).
- MOD6 operations were not expected to change absolute geometric mean blood Pb in children living in Broken Hill.
- Blood Pb concentrations in children living in Broken Hill were not anticipated to be affected by activities associated with MOD6.
- The risk of exceeding health-based toxicity reference values for other metals as a result of MOD6 construction or operations was very low.

Mitigation measures for air quality also reduce Pb dust.

Blasting Vibration, Overpressure & Flyrock

The excavation of the boxcut and installation of the portal would require some surface blasting with potential impacts for blasting vibration, overpressure and flyrock.

Prism Mining Pty Ltd (Prism) was commissioned by BHOP to complete an assessment for potential vibration, overpressure and flyrock impacts resulting from blasting activities for the boxcut, portal and decline, *Blasting Impact Assessment for the Proposed Boxcut and Portal/Decline at Rasp Mine (MOD6)*, March 2021 (Blasting Report) (**Appendix F1).** Prism also provided the preliminary blasting parameters required to meet vibration limits for surface blasting with the aim of minimising potential impacts to the local community.

Golder provided recommendations for blasting limits together with other relevant information in relation to blasting vibration near the Rasp Mine tailings storage facilities, *Rasp Mine – Potential Impact of Blasting on Tailing Storage Facility*, 4 October 2019 (Appendix K in the Golder Report, **Appendix B**).

Preliminary blasting parameters were modelled against achieving the blasting limits in the PA and Environment Protection License as well as the ground vibration limit imposed by Dams Safety NSW for TSF2 (a Declared Dam). The preliminary blasting parameters were adjusted to ensure all limits could be met and these are the blasting parameters to be used at the commencement of surface blasting works to validate the model results.

Appropriate factors of safety, based on the maximum expected flyrock range, were used to identify a controlled blast clearance area for flyrock management within the Lease. A 300 m clearance zone was identified.

Prism demonstrated how blasting within the proposed boxcut and portal / decline for MOD6 activities can be carried out in compliance with appropriate standards for ground vibration, overpressure and flyrock.

The following mitigation measures would be undertaken for MOD6 blasting activities in addition to any relevant existing measures:

- As recommended by Prism, an appropriately qualified project supervisor would be engaged to establish a blast management plan and oversee the process of surface blasting.
- Mine blasting vibration data, as blasting is undertaken, would be used to confirm modelling results and identify peak ground vibration and overpressure trends.
- A conservative starting point of 35 kg would be used for blasting near (approximately 100 m) TSF1 to validate the modelling results and ensure blasting limits are not exceeded.
- Conservative stem heights would be used, as per blast design, to achieve required overpressure levels.

- There would be no free-face blasting.
- A flyrock clearance zone of at least 300 m would be installed prior to each blast with evacuations of the Café, Miners Memorial and Cameron Pipe Band Hall and closing of Federation Way and Holten Drive during blasting.
- Establish a trigger warning (70% of target) for blasts within 100 m of TSF1 and TSF2.
- Identity conditions surrounding the portal and assess in regards to blasting methods once known.
- BHOP would conduct a more detailed risk assessment for potential impacts to site infrastructure prior to blasting (crusher).
- Consultation with relevant neighbours, including Crown Lands and the BHCC, notifications would be conducted prior to blasting events.

A Surface Blasting Management Plan would be formulated during detailed design to address these measures.

Kintore Pit – Slope Stability

During the risk assessment two potential risks were identified for pit-wall slope stability within Kintore Pit. These were related to the historic tailings slope located in the north wall of the Pit and the waste rock stockpile located to the south-west of the Pit.

BHOP engaged GCE to undertake an assessment with particular reference to the impact of wet tailings abutting these structures - Kintore Open Pit: Slope Stability Analysis of Existing In-Pit Waste Rock Dump, During Tailings Placement, August 2019 (**Appendix G3**) and Kintore open Pit: Stability Analysis of Pit Slope Comprising Historic Tailings, Letter Report, August 2019 (**Appendix G4)**.

The slope stability analyses conducted by GCE highlights the potential for slope scale instability of the historic tailings slope forming the north wall of the Kintore Pit under certain hydrogeological conditions. Circular failure or composite failure with a major circular component was considered by GCE as the most likely potential failure mechanism.

The progressive placement of fresh tailings against the existing historic tailings slope is expected to increase the stability of the slope.

The assessment of the slope of the waste rock stockpile located in Kintore Pit indicates that the waste rock slope may experience shallow sloughing of the near surface materials and that the placement of engineered fill against the toe would improve the stability of the slope. The slope stability analyses conducted by GCE indicates that current, free draining, waste rock dump slope has a FoS for overall slope scale stability of greater than 1.3.

The modelling highlights the potential for shallow, circular style failure (sloughing) in all cases. This may materialise as minor rilling, which is typical of waste rock slopes.

Works have been proposed by Golder to support the slopes during tailings and waste rock placement and safety bunds have been included in the conceptual placement design to mitigate these risks.

Liquefaction and Inrush

The potential for liquefaction of tailings deposited into TSF3 and associated historic pathways into the Mine was identified as a key risk. In addition the potential for liquefaction of tailings contained in TSF1 and TSF2 from blasting vibration with the development of the new portal and decline was also considered.

BHOP engaged Golder to provide an assessment of the liquefaction potential for these facilities, Golder Report (**Appendix B1**) in Section 5.3 for TSF3 and Section 7.1.6 for TSF2, and the assessment for TSF1 in the *Letter Report - Liquefaction Assessment of Tailings – Rasp Mine TSF1*, April 2020 (**Appendix M**).

The analysis by Golder concluded that:

- TSF1 at depth indicates near saturation conditions. The conditions of the upper part of the tailings do not support conditions of static liquefaction, whereas the conditions of bottom zone of the tailings may support potential static liquefaction. TSF1 data for all the CPTu's analysed indicate a FoS above 1. This indicates that for TSF1 the tailings are not expected to liquefy under seismic conditions. There are no known connections between the decline and TSF1 and no mining extends beneath TSF1. This has removed the risk of inrush and inundation from beneath this facility.
- TSF2 tailings studies indicate that saturation conditions typically occurred in the tailings mass below 25 m from the surface and based on the results the lower portion of the tailings are likely to be marginally at risk for static liquefaction. The top layer of the tailings is dilative and over consolidated and are not likely to be at risk of saturation. TSF2 data for all the CPTu analysed indicate a FoS that is close to or just below unity for a significant portion of the tailings. This indicates that the tailings may liquefy under a seismic event. There are no active mine workings beneath or in the vicinity of TSF2 as estimated using original survey mining plans. Underground mining activities for the decline development would be undertaken over 100 m to the west of TSF2 and as such no risk of inrush and inundation has been identified for this facility.

Ground vibration limits have been recommended to prevent triggering any liquefaction event for TSF1 and TSF2 and Prism have identified the required blasting parameters to meet these limits.

- The deposition strategy for tailings in TSF3 has been designed to provide unsaturated tailings conditions given the use of partially dried compacted tailings, underlying drainage layer, and the removal of stormwater. In summary the following measures have been included in the design features for Kintore Pit to minimise any potential for an inrush and inundation risk:
  - Moisture content of tailings would be tested and confirmed prior to harvesting and deposition into Kintore Pit.
  - Tailings to be compacted to method specification to achieve the required void ratio or compaction state to prevent liquefaction.
  - Timely removal of stormwater from within TSF3.
  - Extensive drainage system would collect and direct seepage within Kintore Pit through the installed Decline Plug to be managed by the underground mine water management system.
  - MLD and portal drive to the Decline Plug would be backfilled with waste rock.
  - The Decline Plug to be installed at the intersection of the two drives and designed for a full hydraulic load.
  - Cone penetration would be conducted every 10 m to 15 m of tailings placement to identify its condition for saturation and thus potential for liquefaction with additional plugs to be installed if required.
  - Waste rock buttresses to be installed at known voids in the walls of Kintore Pit to prevent water ingress.

Waste Rock Geochemical Characterisation

The long term potential impacts for the use of waste rock as a capping medium for progressive rehabilitation was considered by BHOP who engaged ERM Australia Pty Ltd (ERM Perth) to undertake a waste rock characterisation and geochemical risk assessment for the waste rock, *Long Term Geochemical Degradation Assessment for Waste Rock – MOD6 Waste Rock Management Rasp Mine*, March 2021 (**Appendix H**).

In summary ERM Perth concluded that:

- The review of the waste rock characterisation results against the bedrock aquifer baseline water quality indicates that potential metalliferous drainage from the waste rock tested should have limited, if any, material impact on the existing water quality of the basement rock aquifer and although some samples showed potential acid forming results, a site inspection concluded that there was no evidence of acid drainage on the Mine site from almost 140 years of continuous mining.

- The risk assessment undertaken by ERM Perth concluded that for the waste rock placement domains potential complete Source – Pathway – Receptor (SPR) the linkages were limited to on-site receptors, site personnel. These were related to use of dewatering water and surface water onsite. Risk rankings for these potentially complete SPR linkages were considered to be low.

BHOP will continue to test the waste rock for its Pb content to identify and approve material <0.5%Pb for use as capping material. The method for the placement of capping was considered to reduce wind across the surface and retain rainfall.

Water – Raw Water Usage & Water Quality

Raw water consumption is not expected to be impacted by the proposed changes outlined in MOD6 as no additional usage or savings are likely from the changes. Raw water consumption on site has increased from start up in 2012 peaking in 2018 and then stabilising. Increased demand has occurred due to the installation and operation of the concrete batching plant, surface exploration drilling and the installation of an additional truck wash at the maintenance workshop wash bay. Raw water consumption has also increased due to problematic ores which require a higher proportion of raw water (vs process water) in the Mill.

BHOP considered the potential for seepage from tailings placement in Kintore Pit to impact groundwater quality and engaged Golder to conduct an assessment of this risk. Golder expected that there would be no or negligible seepage from dried tailings placed into Kintore Pit, as the material is partially saturated during placement, would be compacted to a high density and there is no free water expected on the tailings during operation.

Golder conducted a comparison of the water quality of the collected groundwater at Shaft 7 with the water quality of the tailings filtrate from the current tailings stream into TSF2, both measured over the same period from 2018 to 2019. Golder concluded that there would be negligible impact of tailings water on groundwater with perhaps some dilution of analytes. The potential impact on groundwater quality of the small volume of water calculated to report to the bottom of Kintore Pit was expected by Golder to result in at least equal or better quality than the current water quality.

In addition ERM Perth conducted a review of potential receptors of groundwater for their risk assessment and identified that all water supply bores and the bore registered for "other" use are located to the north of the Mine, with the closest located approximately 1.6 km to the north of the Mine and the Globe Vauxhall Shear, which presents a hydraulic barrier between the Mine site and groundwater bores located to the north. ERM Perth found that there are no bores located where they could be impacted by mine groundwater.

The closest potential aquatic groundwater dependent ecosystem (GDE) was identified by ERM and was located approximately 2.2 km to the north-east of the northern most point of the Mine site boundary. This potential GDE is the feature known as Imperial Lakes at Broken Hill and was not found to be impacted by groundwater quality at the Rasp Mine.

On advice from Golder the Rasp Mine Site Water Management Plan would be updated to address a number of areas where MOD6 works will impact current management of stormwater these include the area of the boxcut including the underground mine services area and Tails Harvesting Haul Road, Kintore and Little Kintore Pits, Blackwood Pit for tailing harvesting activities and the Free Areas.

Other matters which were assessed as part of this MR include:

- Traffic Interactions - off-site construction traffic would be minimal and not discernible from normal traffic movements. Internal road networks have been designed to provide safe movement of vehicle traffic and minimise interactions of heavy and light vehicles.

- Heritage - There are no heritage items located in the vicinity of the proposed boxcut or Kintore Pit. The current protection measures in place for heritage items within BHP Pit would continue to protect these items with the MOD6 proposed operations.
- Visual Amenity - MOD6 is consistent with current mine use and no material changes would be visible to the City of Broken Hill from the changes in surface landform to create the boxcut or for the final height of tailings for Kintore Pit.

The Project is substantially the same development as that described in the original Environment Assessment for the PA as the proposed modification would not change the primary purpose of the original development, being an underground mine with associated surface infrastructure, including ore processing and waste management activities. The modified project would not change the approved rate of ore extraction and would continue to use existing processing and waste management infrastructure. The modification includes the construction of a boxcut to access mine workings, however this would be a replacement portal for the existing portal located within Kintore Pit. Waste rock and tailings at the site would continue to be handled and stored at approved locations, with the addition of storage in Kintore Pit.

The proposed modifications would be located on land previously disturbed by historic mining operations and are substantially the same as the Project under the consent originally granted. Proposed changes to surface structures and landform are consistent with the current mining landscape of CML7.

Benefits of the project

The proposed modification would:

- Permit mining at the Rasp Mine to continue post 2022 with additional storage of tailings.
- Significantly reduce the surface distance of hauling ore from underground to the ROM Pad thereby reducing impacts from noise and dust.
- Ensure continued employment of 186 full-time employees, 32 full-time contractors and indirectly over 200 casual contractors that provide specialist services when required.
- Engagement of approximately 20 contractors during construction and an additional 6 full time employees for operations.
- Allow the resource to be fully utilised.
- Allow the Mine to continue to contribute royalties and payroll tax to the State of NSW.
- Allow BHOP to continue to support the economic growth of Broken Hill.

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1. INTRODUCTION

This Section provides a background to the Rasp Mine Project details of the proponent, summarises the modification application and its need, and outlines the key issues for assessment.

1.1. Overview

Broken Hill Operations Pty Ltd (BHOP) is seeking to modify the Rasp Mine Project Approval, PA 07_0018 (PA), Modification 6 (MOD6), pursuant to Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to allow for the co-placement of tailings with excess waste rock from underground mining into Kintore Pit as Tailings Storage Facility 3 (TSF3) critical to the continuation of mining operation.

The current tailings storage facility (Blackwood Pit (TSF2)) will reach filling capacity in September 2022 and mining will cease at that time if no additional tailings storage facility can be established. This proposed modification would require the relocation of the underground mine entry from the base of Kintore Pit and the introduction of harvested tailings from TSF2 and transferred to TSF3. A number of minor modifications to the PA also form part of the modification and these are summarised below.

The location of the site is shown in **Figure 1-1** and the site layout in **Figure 1-2**. Changes to the surface landform would include:

- an excavated boxcut, required for the new mine access;
- new road to enable tailings haulage, predominantly contained within the boxcut;
- full filling-in of two pits, Kintore Pit with tailings and waste rock, and Little Kintore Pit with waste material from the boxcut;
- partial filling-in of BHP Pit with waste material from the boxcut, and
- rehabilitation capping to Free Areas.

All of the activities for MOD6 will be undertaken on previously disturbed land and there is no requirement to remove or impact any vegetation.

This Modification Report has been prepared by BHOP with specialist input.

1.2. Applicant

Broken Hill Operations Pty Ltd is the proponent for the Project and owns and operates the Rasp Mine. BHOP is a wholly owned subsidiary of CBH Resources Limited. Proponent details are listed in **Table 1-1**.

Table 1-1 Proponent Details

Project	Details
Address	130 Eyre Street, Broken Hill, New South Wales, Australia
	PO Box 5037, Broken Hill, New South Wales, Australia
Registered Office	Level 10, 99 Mount Street, North Sydney, NSW 2060
	PO Box 1967, North Sydney, NSW 2059, Australia
ABN	58 054 920 893
Web Site	https://www.cbhresources.com.au/operations/rasp-mine/

1.3. Background

The Rasp Mine (the Mine) is a zinc, lead and silver mine located in the City of Broken Hill, in the far west of New South Wales (**Figure 1-1**). The Rasp Mine consists of Consolidated Mine Lease 7 (CML7) and Mining Purpose Leases 183, 184, 185 and 186. These leases occupy a central region of the historic

Broken Hill Line of Lode orebody and incorporate the original mine areas that commenced operations in the 1880s and include a substantial amount of mining infrastructure from various mining phases. BHOP purchased the Rasp Mine from Normandy Mining Investments in March 2001 and commenced works at the site in 2007 with the installation of an exploration decline. Underground mining re-commenced at the site in 2011 and ore processing recommenced in 2012.

The Mine produces zinc and lead concentrates which are dispatched via rail to Port Pirie in South Australia and Newcastle in New South Wales. **Figure 1-2** depicts the existing operations at the Mine which include the following components:

- current and historic underground mine workings;
- four open-cut pits, one used to access the underground mine workings (Kintore Pit), one used for tailings deposition (Blackwood Pit), one used for ancillary mining activities (BHP Pit), and one not currently used (Little Kintore Pit);
- a processing plant;
- concentrate rail load out area, and
- ancillary mine infrastructure, including water management, workshops, offices and other facilities.

The Mine site also includes historic mine buildings and structures from previous mining, including original buildings and structures from the beginnings of the original BHP operations and other significant mining operations, some of which date from the 1890s. These are listed as heritage items on the Broken Hill City Council Local Environment Plan 2013 (LEP). The site also comprises historic waste rock and tailings emplacements, and extensive non-active mining areas (Free Areas).

These operations are undertaken in accordance with Project Approval 07_0018 (as modified) (PA) granted by the then Minister for Planning on 31 January 2011, under Part 3A of the EP&A Act. With the repeal of Part 3A of the EP&A Act and the transitional arrangements under Section 75W, the Project has been transitioned to a State Significant Development (SSD-814).

Figure 1-1 Locality Map

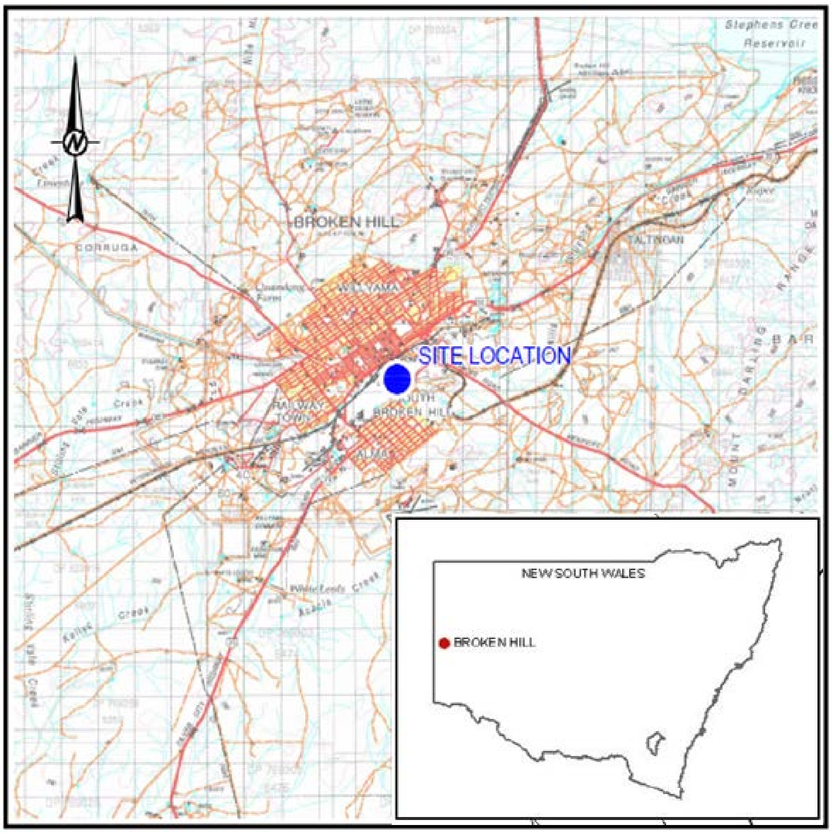
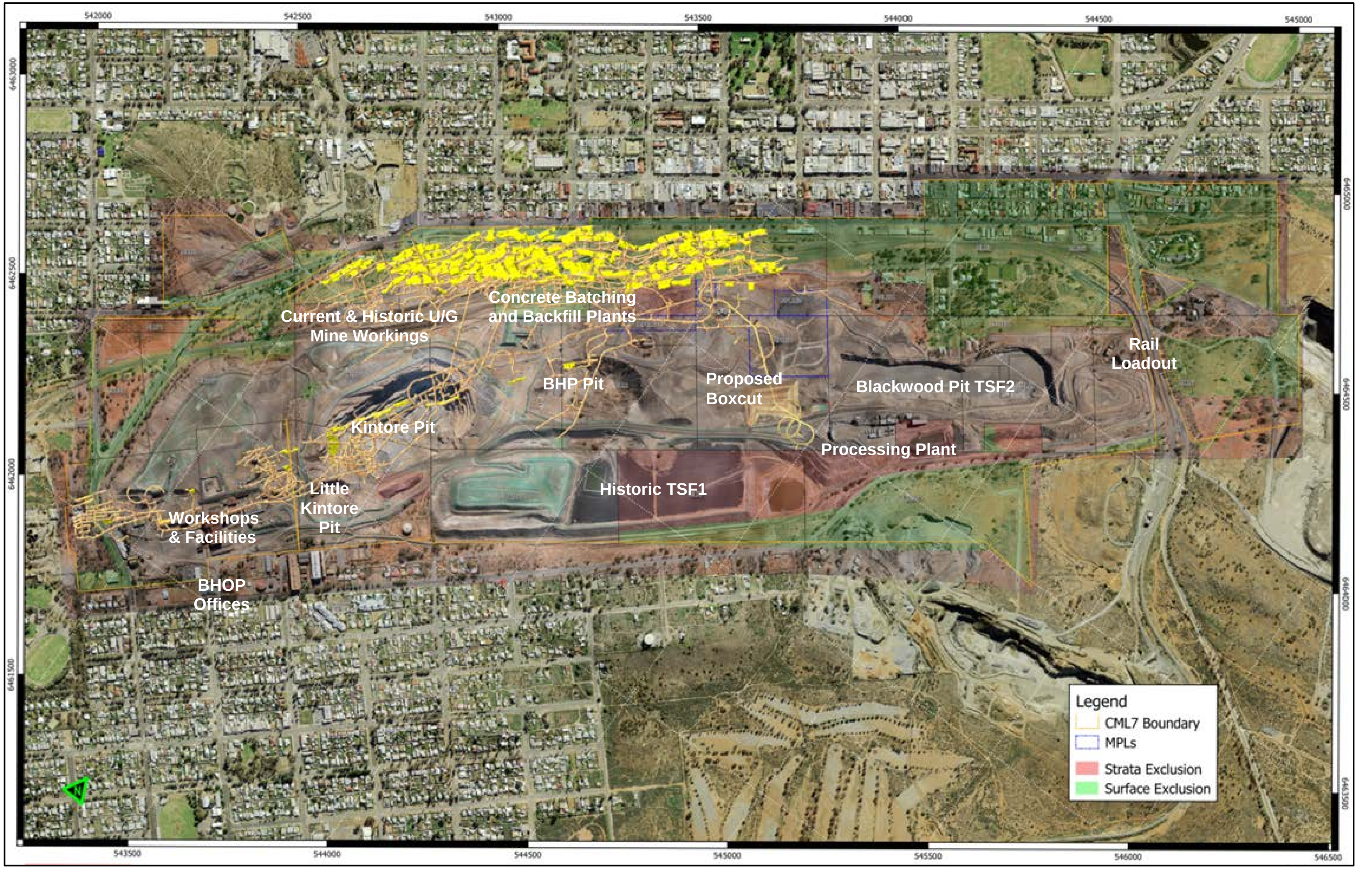


Figure 1-2 Rasp Mine - Site Layout



The PA allows BHOP to:

- mine 8,450,000 t of ore (750,000 tpa) until 31 December 2026;
- transport the ore to the surface in haul trucks;
- process the ore using crushing, milling and flotation;
- transport ore concentrate in covered containers to the site rail siding and transport of concentrate in covered rail wagons to a smelter and/or port facility;
- deposit tailings into Blackwood Pit (TSF2) and historic tailings storage facility (TSF1) (not currently used), and use of tailings as back fill for underground mining voids (this has yet to be implemented);
- undertake works for surface water management;
- undertake other ancillary activities, and
- rehabilitate the site.

Item 3BA(6) in Schedule 1 to the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, requires that the development, as proposed to be modified, would be substantially the same development as the development authorised by the last modification under the former section 75W of the EP&A Act. For the Rasp Mine Project the development, as proposed to be modified, must be substantially the same development as that authorised by MOD7 on 29 July 2019.

The proposed modification would not change the primary purpose of the original development, being an underground mine with associated surface infrastructure, including ore processing and waste management activities. The modified project would not change the approved rate of ore extraction and would continue to use existing processing and waste management infrastructure. The modification includes the construction of a boxcut to access mine workings, however this would be a replacement portal for the existing portal located within Kintore Pit. Waste rock and tailings at the site would continue to be handled and stored at approved locations, with the addition of storage in Kintore Pit.

The proposed modifications would be located on land previously disturbed by historic mining operations and are substantially the same as the Project under the consent originally granted. Proposed changes to surface structures and landform are consistent with the current mining landscape of CML7.

1.4. Summary of Proposed Modification

The following sections summarise the proposed MOD6 works.

1.4.1. Kintore Pit TSF3

Preparation of Kintore Pit as a co-placement facility for tailings and waste rock including filling of mine access drives beneath the Pit, installation of a Decline Plug to seal underground workings, installation of a seepage collection and monitoring system, relocation of up to 260,000 t of material from the Kintore Pit stockpile to the base of the Pit and other minor works.

1.4.2. Relocation of Underground Mine Access

Excavation of a boxcut to gain access to competent rock with batters designed for long term stability. This would require relocating up to 490,000 t of excavated material from the boxcut to Little Kintore Pit and BHP Pit (all material deemed to be >0.5% lead (Pb) stored permanently in-pit and capped).

Excavation and installation of a new mine portal requiring some surface blasting (at the lower levels of the excavation) and appropriate ground support. This would also require the installation of a new Mine Ore Haul Road taking ore from the new portal to the Run of Mine (ROM) Pad and reducing the current haulage distance by approximately 1720 m (from 2050 m to 325 m). Haulage of underground waste rock to surface would continue to utilise the current Mine Haul Road.

Installation of a new decline (approximately 400 m from surface) to connect to current underground mine workings, requiring the transfer of up to 40,000 t of waste rock. The majority of this decline would be developed from underground with waste rock placed in underground voids, some material would be placed in BHP Pit once portal access is available.

1.4.3. Tailings Harvesting In Blackwood Pit TSF2

Preparation works including earthworks to construct bunding for tailings holding cells and access tracks for trucks. Construction of the Tails Harvesting Haul Road to separate haulage of mine ore and tailings transfer trucks.

Fresh tailings would continue to be placed into TSF2 with cells alternating between fresh and dried tailings. Thin layers of tailings (up to 1.0m) would be harvested once the material is sufficiently dry (10% moisture) using an excavator and dozer (loader), and transported by truck to TSF3.

1.4.4. Periodic Crushing of Non-Ore Material

Crushed material is required primarily for underground roadways and some surface activities such as gravel capping and site bunding. No preparation works are required. A contracted mobile crusher would operate two to three times per year for up to a week at a time in either Kintore or BHP Pits. Prior to crushing, selected waste rock would be tested and confirmed as containing <0.5%Pb.

1.4.5. Rehabilitation Capping of Free Areas

Excess waste rock from underground development would be taken to Kintore Pit Tipple and/or BHP Pit where it would be tested and sorted into stockpiles of material <0.5%Pb.

This material would be used for rehabilitation capping of Free Areas (non-active mining areas within CML7) on a progressive basis, and material >0.5%Pb would be co-placed with tailings in TSF3.

1.4.6. Administrative Amendments

Update site noise criteria to align with recent attended noise monitoring and the NSW EPA *Noise Policy for Industry* (2017).

To eliminate duplication of report generation BHOP seeks to align the annual environmental reporting periods for the Annual Review and the Annual Environment Management Report.

1.5. Requirement for the Proposed Modification

Predictions for the life of TSF2, following installation of the embankments, is now September 2022 (as at July 2021). The extended life of the facility is due to improved tailings settling rates and reduction in mine production rates under the new mine plan (July 2020) representing a low volume high grade strategy.

The Rasp Mine would cease all operations in September 2022, or when Blackwood Pit TSF2 is filled, if no other tailings storage facility is available.

The use of Kintore Pit as TSF3 would provide tailings storage capacity in excess of 13 years.

1.6. Reasons for the Proposed Modification

1.6.1. Tailings Storage

At current tailings deposition rates, following the installation of TSF2 embankments, TSF2 would reach fill capacity in September 2022. In MOD4 it was identified that under current volumes storage capacity within TSF2 would cease in mid-2021. Actual experience has indicated that the tailings is settling with a higher density, increasing the maximum volume for deposition and this, together with new survey data and updated Mine Plan (July 2020), the life of the facility has been extended to 2022.

In the original Environment Assessment (EA) for the Project it was planned for tailings to be placed in both an above ground tailings storage facility and underground, via the Backfill Plant, to fill mining voids. The tailings waste stream from ore processing was approved to be deposited in the historic tailings facility (TSF1) and in the disused Blackwood Pit (TSF2). BHOP chose to deposit tailings in TSF2 and not use

TSF1 due to its greater capacity of 3.1 Mt, TSF1 (970,000 t) and lower construction and operating costs. The lower capacity and costs associated with reinstating TSF1 make it an uneconomical option compared with Kintore Pit for tailings storage.

In the EA BHOP underestimated the amount of mine development that was required to access the Main Lode and Western Mineralisation ore bodies. The need to undertake more underground mining development has impacted the amount of waste generated. In the EA it was predicted that approximately 250,000 t of waste rock would be produced each year for a production rate of 750,000 t of ore. Actual total waste rock produced has averaged 417,000 t per year since commencement of operations peaking in 2015 and 2018 with around 452,000 t. BHOP has chosen to place the additional waste rock underground to fill voids and stopes, as it is more economic to dispose of waste rock underground where possible rather than transporting waste to the surface. Thus there has been no void space underground for the backfill of tailings. **Table 1-2** summarises tailings and waste rock placement as predicted in the original EA (at a production rate of 750,000 t) and what has actually been placed since commencement of operations.

Table 1-2 Summary of Proposed (EA) and Actual Placement of Waste Rock and Tailings

Year (to 30 June)	EA Tailings in Underground backfill per year (t)	EA Tailings deposited in TSF1 (t)	EA Tailings deposited in TSF2 (t)	EA Waste Rock U/G (t)	Actual Tailings in TSF2 (t)	Actual waste rock placed underground (t)	Actual waste rock stored Kintore Pit (t)	Actual Total waste rock (t)
2012	97,969	273,281	0	250,000	322,111	47,527	150,000[1]	197,527
2013	195,938	195,138	0	250,000	574,833	230,607	150,000[1]	380,607
2014	195,938	195,138	0	250,000	486,749	223,473	163,304	386,777
2015	216,563	216,563	0	250,000	499,598	223,611	228,942	452,553
2016	247,500	88,281	159,219	250,000	555,837	265,369	96,888	362,257
2017	278,438	0	278,438	250,000	622,161	215,897	76,578	292,475
2018	309,375	0	309,375	250,000	644,828	330,577	121,864	452,441
2019	309,375	0	309,375	250,000	588,407	242,626	28,841	401,811[2]
2020	309,375	0	309,375	250,000	469,048	88362	115,870	409,875[2]
TOTALS	**2,160,471**	**968,401**	**1,365,782**	**2,250,000**	**4,763,572**	**1,868,049**	**1,391,859**	**3,336,328**

Note[1]: Estimated

Note[2]: Total waste rock to surface includes material to BHP Pit. 2019 – 159,185t with 28,841t placed in Kintore Pit and 130,344t placed in BHP Pit due to safety issues and use of Kintore Pit Tipple. 2020 – 321,513t with 115,870 placed in Kintore Pit and 205,643t placed in BHP Pit.

A review was conducted by Golder Associates Pty Ltd (Golder) of potential locations for tailings storage off-site and around the vicinity of the Mine (within 10 km); a summary of this Report is provided in **Section** 4. Following these investigations BHOP determined to use Kintore Pit as TSF3, which would necessitate the relocation of the Mine access with the establishment of a new portal and decline.

1.6.2. Relocation of Mine Access

The current underground mine access portal and decline are located at the base of Kintore Pit. An alternative mine access is required if Kintore Pit is used as a tailings and waste rock emplacement. An investigation was undertaken by the Mine of various potential new mine entry locations across the mining Lease that would meet operational constraints including a requirement to be close to the current haul road and ROM (Run of Mine) Pad, and current and future mining areas. **Section 4.3** provides a summary and discussion of these locations.

1.6.3. Tailings Harvesting

Studies have shown that in establishing TSF3 in Kintore Pit, tailings would need to be further dewatered from the current 35% moisture content achieved by the milling processes. This is required to reduce its potential for liquefaction and any subsequent inrush / inundation risk to underground mining operations (Golder Report **Appendix B1**). BHOP propose to utilise the natural solar and air drying process offered within Blackwood Pit TSF2 to enable the harvesting of thin layers (up to 1.0 m) of dried tailings prior to stockpiling and transferring to Kintore Pit. This would allow continued fresh tailings to be deposited into this facility which would be naturally dried and removed by excavation, resulting in cyclical rotation of depositing, drying, harvesting and transferring of tailings to TSF3. This provides a more economical option than the construction and operation of a Filter Plant to dewater the tailings ($15M) (as previously planned for MOD6) and lowers the risk of the tailings moisture content exceeding its critical point as the tailings must be sufficiently dry and trafficable for mobile equipment to access and remove the tailings.

1.6.4. Waste Rock Placement

Waste rock would continue to be generated from underground mining and development activities in excess of suitable storage capacity in underground voids and would require permanent storage. BHOP has opted to co-place this waste rock with the tailings in TSF3 and use material confirmed to be <0.5% Pb for rehabilitation capping.

1.6.5. Crushing of Non-Ore Material

Crushing of non-ore material is currently undertaken in Kintore Pit (EA) and BHP Pit (MOD7) and BHOP propose to continue these activities using a mobile crusher to produce material primarily for underground road base and for surface bunding and other purposes as required. The alternative is to buy-in aggregate type material at considerable cost.

1.6.6. Rehabilitation Capping

BHOP proposes to commence progressive rehabilitation of surface areas which currently contain elevated Pb levels (7,000 mg/kg to 31,000 mg/kg) by capping some of these areas using excess waste rock from underground development which has been tested and confirmed to contain <0.5% Pb. This would result in minimising lead-bearing dust being taken up by wind and deposited off site.

1.6.7. Administrative Amendments

Requests for administrative changes are also included in this MR to:

- Update noise criteria for operations as a result of additional noise monitoring identified during completion of noise modelling for MOD6 and to align with the NSW EPA *Noise Policy for Industry (2017)*.
- Align reporting requirements for the annual Environment Management Report (EMR) required by the mining Lease and Schedule 4 Condition 3 of the PA requirements for an Annual Review (AR). These reports although similar have different time periods requiring two separate reports to be written and submitted within months of each other. Aligning these reports would streamline their formulation by BHOP and review by the regulator, removing duplication.

1.7. Benefits of the Proposed Modification

The proposed modification would:

- permit mining at the Rasp Mine to continue post 2022 with additional storage of tailings;
- significantly reduce the surface distance of hauling ore from underground to the ROM Pad thereby reducing impacts from noise and dust;
- ensure continued employment of 186 full-time employees, 32 full-time contractors and indirectly over 200 casual contractors that provide specialist services when required;

- engage approximately 20 contractors during construction and an additional 6 full time employees for operations;
- allow the resource to be fully utilised, and
- allow BHOP to continue to support the economic sustainability of Broken Hill.

1.8. Key Areas of Consideration for the Modification Report

Formal Environment Assessment Requirements were not issued for MOD6. BHOP distributed a Project Brief to regulators outlining the proposed modifications and potential risks for their review and comment, and to seek any additional key issues to be addressed in the modification application. MOD6 works continued to be developed and this Project Brief was updated on several occasions, July 2018, February 2019 and September 2020. The Department of Planning Industry and Environment (DPIE) consulted with various government agencies, collated their responses and provided specific advice on the key areas of consideration for assessment, which are summarised in **Table 1-3.** A copy of this correspondence together with the Project Brief (September 2020) are provided in **Appendix A1** and **Appendix A3** respectively.

Table 1-3 Summary of DPIE Collation of Key Issues for the Environment Assessment

Issues Identified	Response in MR
MINE PLAN	
• Include a strong justification and consideration of alternatives, in relation to all aspects of the proposed modification, including the:	
- need to use Kintore Pit as a new tailings facility storage (TSF3) and co-disposal of excess waste rock from underground with tailings in Kintore Pit and reasons why the approved TSF1 and TSF2 are not the preferred options for tailings storage;	Sections 1.6.1.
- proposed design of the TSF3 embankments, retaining wall, water leakage/permeability and safety issues;	Section 3.4.1
- proposed design of the tailings dewatering system and infrastructure;	Section 3.5 and 4.2
- proposed design for relocation of the current mine portal, access decline and the new boxcut;	Section 3.6 and 4.3
- proposed design and location of future excess waste rock emplacement areas in consideration of potential lead content and management of higher lead generating exposed areas on the site; and	Section 3.4, 3.8 and 4.4
- proposed hours, timeframe and sequence of proposed works.	Section 3.2 and 3.3
• Include a detailed revised materials balance accounting for the storage of tailings and waste rock for the life of the mine; including consideration of the current waste rock volumes in the pit and justification for future mine waste rock volumes.	Section 3.3 and 4.4
AIR QUALITY	
• Include a detailed air quality impact assessment and description of on-site dust mitigation and management measures that would be used to prevent exceedances of the air quality criteria, accounting for the cumulative impacts from both Rasp and Perilya Mine operations.	Section 8.2
• The measures proposed and presented in the Modification Report must be developed in consultation with the EPA.	Section 6, Table 6-1 and Table 6-2
NOISE and VIBRATION	
• Include a detailed noise and vibration impact assessment and description of management measures that would be used to prevent exceedances of noise and vibration criteria in accordance with the EPA's *Noise Policy for Industry* and *Interim Construction Noise Guideline*, accounting for the cumulative impacts from both Rasp and Perilya Mine operations.	Section 8.1 and 8.4
• The measures proposed and presented in the Modification Report must be developed in consultation with the EPA.	Section 6, Table 6-1 and Table 6-2
HEALTH	
• Include a human health risk assessment, in accordance with the *Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards* (enHealth, 2012).	Section 8.3

Issues Identified	Response in MR
• Include an update of the current activities being implemented to minimise the existing impact of lead exposure in the community, as per Conditions 12, 13 and 14 of Schedule 3 of the current approval. • The Modification Report must demonstrate that the proposed modification would not increase the potential for lead exposure or increase blood lead levels in the community.	Section 8.3.5 Section 8.3.3 and 8.3.4
WATER • Include detailed assessment and measures to prevent water seepage, permeability and safety risks. • Include details of changes to the surface management system and identification of the modifications required to the mine soil and water management plan (if applicable). • Include details of raw water supply and use, including existing raw water consumption and proposed consumption associated with the modification. Provide details about the improvements in water use and consumption that have reduced raw water usage to date.	Sections 3.4.3, 3.4.4.2, 3.4.4.4 and 8.6 and 8.7 Section 3.4.4.2, 3.4.4.4, 3.4.3.6, 3.5.4.3 and 3.6.9 and 8.7 Section 8.7.1 and 8.7.4
REHABILITATION • Include details of the revised rehabilitation strategy, proposed final landform and post-closure maintenance, specifically in relation to the proposed modification, and any requirements of the Broken Hill Rehabilitation Steering Committee. • The measures proposed and presented in the Modification Report must be developed in consultation with the Department's Division of Resources and Geoscience and the Resources Regulator.	Section 3.8 and 3.10 Section 6, Table 6-1 and Table 6-2
GENERAL • Ensure that project scheduling is clearly defined in the Modification Report, providing scheduling details of proposed construction activities and materials movement. • The Modification Report for the proposed modification must account for all the potential cumulative impacts, including from the Perilya Mine operations and if construction activities are expected to overlap with the other proposed activities. • Adequate justification would be required to justify the level of assessment undertaken for minor environmental impacts. • Identify any proposed changes to the Environment Protection Licence requirements. • Evidence of consultation with the local community as well as the relevant agencies about the proposed modification must be provided and documented in the Modification Report. • As the Modification Report is a standalone document, rather than state that impacts were assessed in the original Environmental Impact Assessment (EIS) and reference this document, sufficient detail from the original project EIS must be included in the Modification Report to describe overall project impacts.	Section 3.3, 3.4.3.7, 3.5.1.4, 3.5.1.5 and 3.6.10 Sections 8.2.3 Not applicable Section 5.4 and Table 5-1 Section 6 Addressed throughout the document and in relevant consultant reports.

In addition matters were raised during consultation with government agencies and the community, these are summarised in **Section 6 Table 6-1** (government agencies) and **Table 6-2** (community).

This Modification Report (MR) generally follows the requirements set out in the DPIE *State Significant guidelines – preparing a modification report,* July 2021 and the relevant requirements outlined in the *Environment Planning and Assessment* Regulation 2000 as listed in **Table 1-4**.

Table 1-4 EIS Content Requirements

Requirement	MR Reference
Summary of the report.	Executive Summary
Objectives of the Project.	Section 1
Analysis of any feasible alternatives to the Project, including the consequences of not carrying out the Project.	Section 4
Description of the Project.	Section 3

Requirement	MR Reference
Description of the environment likely to be affected by the Project.	Section 2
The likely impacts on the environment of the Project.	Sections 7 & 8
Description of the measures proposed to mitigate any adverse effects of the Project on the environment.	Section 8 & 9
A list of any approvals that must be obtained under any other Act or law before the Project may lawfully be carried out.	Section 5.4
Compilation (in a single section of the EIS) of the measures proposed to mitigate any adverse effects of the Project on the environment.	Section 9
The reasons justifying the carrying out of the develop activity or infrastructure in the manner proposed, having regards to the biophysical, economic and social considerations, including the principles of ecologically sustainable development (ESD).	Section 1.6 and Section 10

1.9. Project Consultants

The MR was prepared by BHOP with specialist input as listed in **Table 1-5**.

Table 1-5 List of Project Consultants and Works Undertaken

Organisation	Area of works undertaken
Golder Associates Pty Ltd	Design of tailings harvesting, tailings liquefaction assessments, seepage assessment and design of collection systems, stormwater management, water quality assessment, tailings compaction and critical state testing, u/g plug(s) design and location, waste rock deposition and capping, seismic assessment, monitoring. • *Rasp Mine – Tailing and Waste Rock Management for MOD6*, June 2021 (**Appendix B1**). This Report includes the following appendices: o *Kintore Pit Tailing Storage Facility – Critical State Testing*, August 2018 o *Kintore Pit Preliminary Mine Plug Design*, 13 August 2020 o *Liquefaction Assessment of Tailing – Rasp Mine Blackwood Pit Tailing Storage Facility*, 31 March 2020 o *Slope/W Outputs for Intermediate Embankment Stability Assessment,* February 2021 o *Rasp Mine – Potential Impact of Blasting on Tailing Storage Facility*, 4 October 2019 • *Liquefaction Assessment of Tailings - Rasp MineTSF1*, April 2020 (**Appendix B2**)
Environment Resources Management Australia Pacific Pty Ltd (Sydney)	Air quality and greenhouse gases assessment, prediction modelling and impact assessment, dust suppression management, monitoring. • *Rasp Mine Broken Hill Modification 6* – Air Quality Assessment, 26 May 2021 (**Appendix C1**) • *MOD6 Air Quality Assessment Addendum*, Letter Correspondence J Barnett, R Francis & D Roddis, 7 May 2021 (**Appendix C2**)
SLR Consulting Australia Pty Ltd	Human health risk assessment, prediction modelling and impact assessment. • *Human Health Risk Assessment for Rasp Mine*, Modification 6, SLR Consulting Australia Pty Ltd, December 2020 (**Appendix D1**) • *HHRA for Rasp Mine MOD6 Addendum*, Letter Correspondence T Hagen, 24 May 2021 (**Appendix D2**)
ToxConsult Pty Ltd	Peer review of the Human Health Risk Assessment by Dr R Drew (refer HHRA Report **Appendix D1**)
EMM Consulting Pty Ltd (Newcastle)	Noise, prediction modelling and impact assessment, update of site noise levels, recommendations for changes to EPL. • *Rasp Mine Modification 6 – Kintore Pit TSF3 – Noise Impact Assessment,* May 2021 (**Appendix E1**) • *Addendum to MOD6 Noise Impact Assessment – TSF2 tailing harvesting haul road update*, Letter Correspondence T Villierme, 7 May 2021 (**Appendix E2**)
Prism Mining Pty Ltd	Blasting vibration and overpressure prediction modelling and impact assessment, recommended blasting parameters, TSF2 blasting assessment. • *Blasting Impact Assessment for the Proposed Boxcut and Portal/Decline at Rasp Mine (MOD6*), 1 March 2021 (**Appendix F1**) • *Blast Vibration Assessment at TSF2,* Letter Report, March 2021 (**Appendix F2**)

Organisation	Area of works undertaken
Ground Control Engineering Pty Ltd	Geotechnical assessment and concept design of the boxcut, geotechnical assessment of the drives below Kintore Pit and stability analysis for the waste tipple and old tailings slope. • *Geotechnical Assessment of the Rasp Mine Box Cut*, Letter Report C Tucker, July 2021 (**Appendix G1**) • *Geotechnical Assessment of the MLD Drive Below the Kintore Pit*, Letter Report C Tucker, July 2021 (**Appendix G2**) • *Kintore Open Pit – Slope Stability Analysis of Existing In-Pit Waste Rock Dump, during Tailing Placement*, Letter Report C Byrne & C Tucker, August 2019 (**Appendix G3**) • *Kintore Open Pit – Slope Stability Analysis of Pit Slope Comprising Historic Tailing*, Letter Report C Byrne & C Tucker, August 2019 (**Appendix G4**)
Environment Resources Management (Perth) Pty Ltd	Long term geochemical degradation assessment for waste rock. • *Long Term Geochemical Degradation Assessment for Waste Rock – MOD6 Waste Rock Management Rasp Mine*, 16 March 2021 (**Appendix H**)
Mine Earth	Review and assessment of alternatives for rehabilitation capping. • *Rasp Mine – Dust Management Options Assessment*, July 2021 (**Appendix I)**

1.10. Document Purpose and Structure

The MR has been prepared to support the Modification Application which would be lodged with the DPIE for determination by the Minister for Planning (or delegate). A detailed description of the activities proposed in the Modification Application is provided in **Section** 3 with potential risks and mitigation measures addressed in **Sections** 7 and 8.

The Modification sought is otherwise consistent with the BHOP original 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.

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

- **Section 1** provides a background to the Rasp Mine Project details of the proponent, summarises the modification application and its need, and outlines the key issues for assessment.
- **Section 2** discusses the location of the Mine and its neighbours, details ownership of the land, lists current development consent and authorisations, and summarises the physical setting of the Mine including the surrounding land users and environment.
- **Section 3** describes the various components of the Modification, including required preparatory works, construction and operation, and proposed closure concept.
- **Section 4** outlines the alternatives considered for storing tailings and strategies for tailings deposition. It also discusses locations considered for the new portal.
- **Section 5** details the regulatory framework relevant to the Modification.
- **Section 6** summarises the stakeholder engagement undertaken and any issues raised during that process.
- **Section 7** describes the environmental risk assessment process and summarises the key potential environmental issues for the proposed Modification.
- **Section 8** provides a discussion of the potential impacts identified in relation to the Modification and the management and mitigation measures to be implemented by BHOP.
- **Section 9** summarises the mitigation measures to be implemented as a result of the Modification.
- **Section 10** outlines the conclusion and provides a justification for the Modification as sought.

- **Section 11** provides a list of acronyms used in this MR

2. STRATEGIC CONTEXT

This Section discusses the location of the Mine and its neighbours, details ownership of the land, lists current development consent and authorisations, and summarises the physical setting of the Mine including the surrounding land users and environment.

2.1. Mine Location

The Mine is located in far west New South Wales and lies centrally within the City of Broken Hill, **Figure 1-1**. It is surrounded by transport infrastructure, areas of commercial and industrial development and some residential housing.

The Mine is bounded by Eyre Street and Holten Drive to the south and east, Perilya's Broken Hill North Mine to the east and South Mine to the west, and the commercial centre of Broken Hill to the north. Mawsons Concrete and Quarry Pty Ltd (Mawsons) lies opposite the Mine on Holten Drive. The Mine site 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 of the Mine and lies on the main Sydney – Perth railway line. Residential and commercial areas surround the Mine with pasture land to the southeast, **Figure 1-2**.

The land within CML7 has several surface exclusion zones, which contain rail lines and stock yards to the north, Perilya employee housing to the north east, the Southern Cross Care Broken Hill Hall (former Italo International (Bocce) Club) and the Silver City Removals (previous lawn bowling club) to the south west and other commercial and residential properties.

2.2. Land Ownership

The majority of the land on which the CML7 and MPLs are located is designated as "WILLYAMA COMMON Reserve 2421" (refer to **Figure 1-2**). The 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. All activities associated with this Modification would be located on CML7 and within Willyama Common.

2.3. Land Zoning

The majority of the Mine, including the areas proposed for MOD6 works are 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.

2.4. Current Mine Plan

The Rasp Mine has revised (July 2020) its mine production plan for the period 2020 to 2026 implementing a new mine production strategy based on lower volumes and higher grades. Yearly production rates are now planned with a maximum capacity of 500,000 t of ore, 146,000 t of waste rock to surface from underground mining and development, 480,000 t of tailings harvesting transferred to Kintore Pit and 440,000 t of freshly deposited tailings into TSF2 (BHOP Mine Plan 2020 to 2026). The lower production rate has extended the predicted life of TSF2 to September 2022. The higher rate for tailings removal from TSF2 (compared to deposition) and transfer to TSF3 allows for some buffer capacity in TSF2 for periods of adverse weather conditions.

The current mine plan has a mine life of between 3 to 5 years (with known and anticipated ore resources) however this can be extended with continued success of current and future CML7 exploration. With the approval of Kintore Pit tailings storage facility this mine life can extend to up to 13 years.

The Life of Mine (LoM) post 2026 would continue to mine the Western Mineralisation across CML7, develop the Centenary Mineralisation and extend the Main Lode to all mining blocks within CML7. A modification application would be submitted to extend mining operations past 2026 and to include mining areas that are not within the current PA.

2.5. Current Consents, Authorisations and Licences

2.5.1. Current Consents

Table 2-1 lists the consents held by BHOP for the Rasp Mine Project.

Table 2-1 Development Consents

Approval	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 Environmental Effects (SEE).
DA 101/2007	26 April 2007	Work completed	Undertake temporary mining in the Kintore Pit, supported by a SEE.
DA 264/2009	19 Jan 2010	Work completed	For ancillary surface mining activities including crushing, stockpiling and transport of ore, supported by a SEE.
PA 07_0018 (Part 3A)	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 Environmental Assessment (EA).
PA 07_0018 MOD 1	16 March 2012	31 Dec 2026	Relocation of ventilation shaft.
PA 07_0018 MOD 2	29 August 2014	31 Dec 2026	Allow 24 hour crusher operation.
PA 07_0018 MOD3	17 March 2015	31 Dec 2026	Extension of underground mining to include all of Block 7 and the Zinc Lodes.
PA 07_0018 MOD4	4 Sept 2017	31 Dec 2026	To allow the installation of a Concrete Batching Plant and construction of embankments, spillway and a retaining wall for Blackwood Pit TSF2.
PA 07_0018 MOD5	2 Nov 2018	31 Dec 2026	Installation of cement silo at the Backfill Plant, extension to current warehouse and adjustment to air quality monitoring
PA 07_0018 MOD7	29 Jul 2019	Duration of TSF2 Embankment Works	Permits crushing of waste rock in BHP Pit for TSF2 embankment construction.
MOP 06/6463	1 July 2021	30 Sept 2021	Current approved (July 2021) Mining Operations Plan for the Rasp Mine.
PA 07_0018 MOD8	14 Apr 2021	31 Dec 2026	Permits sublease (20x250m) on Perilya ML1249

2.5.2. Leases

Table 2-2 presents the mineral authorities held by BHOP for the 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 which also includes various Western Land Leases and properties owned by BHOP.

This Modification applies to CML7 and would have no impact on any of the MPL 183, 185 and 186. It is proposed to use part of MPL 184 for tailings harvesting vehicle services and parking.

Table 2-2 Mineral Authorities and Leases

Mineral Authority / Lease	Grant Date	Last Renewed	Renewal Date	Purpose
CML7	8 Oct 1987	17 Apr 2007	31 Dec 2026	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 tailings, development of roads
MPL 183	4 Feb 1981	24 Apr 2007	31 Dec 2026	Dumping of ore and mine residues, treatment of tailings
MPL 184	4 Feb 1981	24 Apr 2007	31 Dec 2026	Dumping of ore and mine residues, treatment of tailings
MPL 185	4 Feb 1981	24 Apr 2007	31 Dec 2026	Dumping of ore and mine residues, treatment of tailings
MPL 186	4 Feb 1981	24 Apr 2007	31 Dec 2026	Dumping of ore and mine residues, treatment of tailings
WLL 2547	15 Jan 1913	14 Jun 1973	In perpetuity	Storage and erection of machinery.
WLL 2638	13 May 1914	14 Jun 1973	In perpetuity	Storage purposes.
WLL 2639	13 May 1914	14 Jun 1973	In perpetuity	Storage purposes.
WLL 2649	8 Jul 1914	14 Jun 1973	In perpetuity	Storage and erection of machinery.
WLL 2650	8 Jul 1914	14 Jun 1973	In perpetuity	Storage and erection of machinery.
WLL 3183	1 Jan 1925	14 Jun 1973	In perpetuity	Storage and erection of machinery.

2.5.3. Licence / Permits

Table 2-3 presents the licences held by BHOP in relation to the Mine. The only licence / permit that may require amendment due to MOD6 activities would be the Environment Protection License 12559.

Table 2-3 Licences / Permits 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 Explosives	Work Cover	24 Oct 2022	Store and Manufacture
Refrigerant	Refrigerant Trading Council	22 March 2022	Use of refrigerant
Water extraction 85WA752823	DPI-Water	29 Mar 2027	To extract 370 ML for use on site or to send to Perilya Broken Hill Operations Pty Ltd.
Radiation	EPA	26 Jul 2022	Sell and/or possess radiation apparatus. Sell and/or possess radioactive or items containing radioactive substances.
TSF2 Embankment Design	Dams Safety Committee	9 Sept 2017 (No renewal required)	DSC endorsement of Blackwood Pit TSF2 extension design for embankments and retaining wall, works conform to DSC requirements.
Blackwood Notification Area	Dams Safety Committee	Until Revoked	Gazetted (9 August 2019) the Blackwood Notification Area, prohibiting mining in the area without approval.
Mining within Blackwood Notification Area	Resources Regulator Safety	30 Jun 2025	Chief Inspector approved the application to mine in the Blackwood Notification Area for MOD6 notification area which had been endorsed by the Dams Safety Committee 30 Oct 2019.

2.6. Community Health Contributions

The current PA Schedule 3 Condition 12 requires BHOP to make a reasonable contribution to public blood lead monitoring and public education.

12. During the implementation of the project, the Proponent shall make a reasonable contribution towards the cost of:
(a) public health monitoring, particularly in relation to child blood lead levels; and
(b) public education campaigns about the health risks associated with lead,
to the satisfaction of the Secretary.

And Schedule 3 Condition 13 of the PA provides for the development and implementation of a Lead Management Plan that details, among other things, the proposed commitment.

(c) outline the proposed commitment towards the cost of:

- *public health monitoring, particularly in relation to child blood lead levels, and tracking of this data;*
- *over time; and*
- *public education campaigns about the health risks associated with lead, including lead hygiene, lead and children, tank water lead risks and soil lead contamination risks.*

The BHOP Community Lead Management Plan (CLMP) outlines the arrangements for the contribution and that a reasonable contribution would be up to $50,000 pa. It was developed in consultation with the Broken Hill Lead Reference Group (BHLRG) which at the time of consultation consisted of Broken Hill City Council (who chair the meeting) - NSW Department of Health Broken Hill University Department of Rural Health (UDRH) and Far West Local Health District (FWLHD) - Environment Protection Authority - Broken Hill Environmental Lead Program - Department of Resources & Energy - Appointed members of the public - Local mining companies.

BHOP is a member of the BHLRG and provides a representative at each scheduled meeting.

The process requires a request for funding, with proposal details meeting the PA conditions as listed above, be submitted to BHOP by August each year so that it can be incorporated into the budgeting process. **Table 2-4** lists the submissions received by BHOP and payments made to end of 2020.

Table 2-4 Summary of Submissions and Contributions 2012 to 2020

Year	Submission Received	Contribution
2012	Not received	-
2013	Received in March for a Public Health Monitoring and a community Education Campaign	$25,000 was made
2014	Not received	-
2015	Not received	-
2016	Received July for a Lead Screening Project including establishment of a new database and electronic medical records system.	$50,000 was made
2017	Received in March for lead testing, education and cleaning of private residences.	Provided $50,000 which was later refunded due to the proposed program not passed by their ethics committee.
2018	Received in December 2018 a belated request was submitted on the 28th December applying for any underspent funding to contribute towards a Television Commercial promoting blood lead monitoring clinics and case management.	Unfortunately due to the lateness of the application and closing of the budget period it was not able to be supported.
2019	Not received	-

Year	Submission Received	Contribution
2020	Not received	-

BHOP is committed to supporting local efforts to educate the public in lead health management practices and initiatives and provides active support to the Child and Family Health Centre to promote its success. In October of each year Broken Hill holds *Lead Week* – a campaign which focuses on raising awareness and education about lead impacts on health and the community. As a part of this campaign a *Day in the Park* event is held and BHOP provides the Child and Family Health Centre with a gazebo to shelter their display and bags for children that include a bottle of water, a piece of fruit, a fruit or vegetable seedling, and information pamphlets provided by the Leadsmart group.

2.7. Existing Environment

2.7.1. Climate

The Patton Street Automatic Weather Station (AWS) was the nearest Bureau of Meteorology (BoM) weather station to the Mine; it is located approximately 250 m south of the Mine. This AWS closed in 2015. Average climate data recorded at the AWS is summarised in **Table 2-5**.

Table 2-5 Summary of Climate Data – Broken Hill Patton AWS (1891 – 2015)

Parameter	Period	Measurement	Month
Maximum mean temperature (C^o)	Annual	24.3	
	Highest Monthly	32.8	January
	Lowest Monthly	15.2	July
Minimum mean temperature (C^o)	Annual	12.0	
	Highest Monthly	18.5	January
	Lowest Monthly	5.4	July
Mean rainfall (mm)	Annual	259.8	
	Highest Monthly	25.8	February
	Lowest Monthly	17.8	April
Mean number of rain days	Annual	34.6	
	Highest Monthly	3.5	July
	Lowest Monthly	2.1	April
Mean 9am wind speed (km/h)	Annual	12.7	
	Highest Monthly	15.3	November
	Lowest Monthly	9.3	May
Evaporation rates (mm)	Annual	2356	
	Highest Monthly	390.5	January
	Lowest Monthly	74.4	July

Annual average rainfall is provided in **Figure 2-1** for the years 1986 to 2020. Data for the years 1986 to 2015 has been taken from the Patton Street AWS and data for the years 2016 to 2020 has been taken from the Broken Hill Airport AWS. Noted events for the Rasp Mine are highlighted with the opening of the portal at the base of Kintore Pit for the exploration drive in 2007, the commencement of underground mining operations in late 2011 and the commencement of processing operations in April 2012. The construction works for the processing plant were commenced in April 2011 and completed in April 2012; the construction works for TSF2 embankments were completed - Stage 1 June to December 2019 and Stage 2 July 2020 to April 2021.

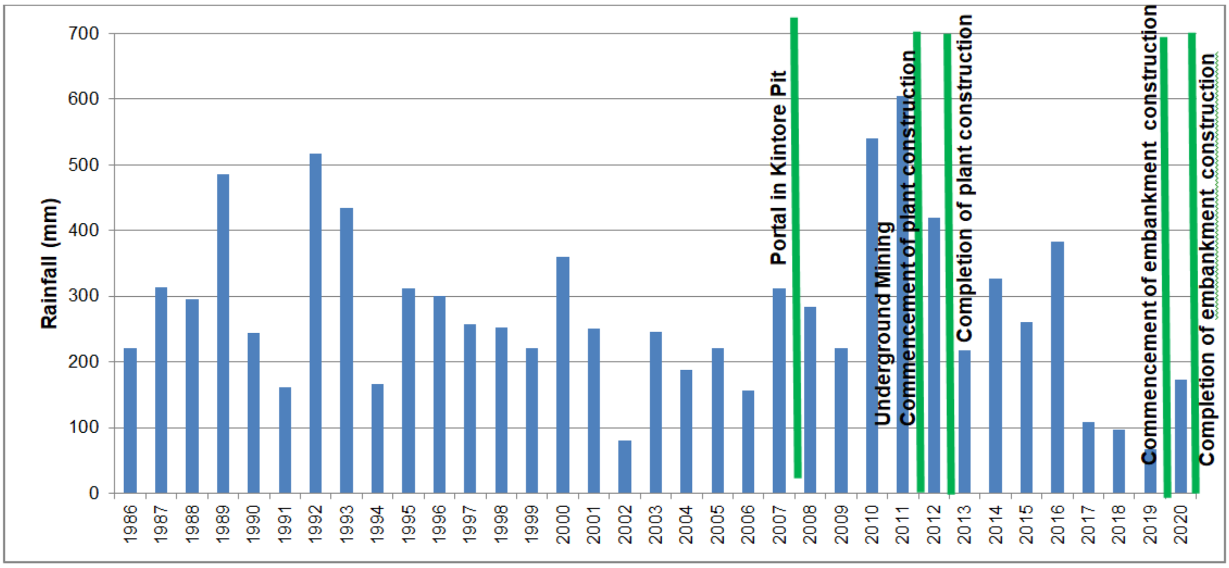
Broken Hill experienced a severe drought in the years 2017 to 2020 recording well below average annual rainfall (259 mm) with 108.6 mm in 2017, 96.4 mm in 2018, 68 mm in 2019 and 174 in 2020. Note 2019 experienced the lowest rainfall on record (records from 1889).

Wind speed and direction information is available from long term average data collected at the BoM Broken Hill Airport AWS, located approximately 3.5 km south of the site.

On an annual basis, winds are predominantly from the south, with smaller contributions from the southwest. On average, November is the month of highest wind flow and May is the month of lowest wind flow. Calm conditions are evident approximately 1% of the time. A review of wind-rose information concludes:

- during summer and autumn, predominant winds are from the south, with smaller contributions from the south east;
- during winter, predominant winds are from the north and west, with smaller contributions from the south, and
- during spring, predominant winds are from the south, with smaller contributions from the south west.

Figure 2-1 Annual Average Rainfall Data 1986 to 2020



2.7.2. Air Quality

The regional area of Broken Hill is subject to winds and dust storms which impact local air quality sources. Other sources for emissions to air include motor vehicles, domestic and commercial heating, agriculture and industry including local mines. BHOP have an extensive system for air quality monitoring, listed in **Table 2-6**. **Figure 2-2** to **Figure 2-5** provide air quality data recorded by the BHOP air quality BHOP quality monitoring units since their installation. For reference BHOP commenced the exploration decline in Kintore Pit in 2007, underground mining and stockpiling in late 2011 and processing and despatching of ore in 2012. The Broken Hill region has experienced severe drought conditions, over the past few years, which have impacted these results.

Table 2-6 BHOP Environmental Monitoring

Category	Parameter	Program
Air Quality	TSP	3 HVAS
	PM10	2 HVAS, 2 TEOM
	Dust Deposition	7 depositional dust gauges

Category	Parameter	Program
	Lead	2 HVAS, 7 depositional dust gauges
	Gases and dust testing	2 ventilation outlets, 1 baghouse
Water Quality	Surface water	8 locations
	Groundwater	16 locations
Noise Monitoring	Attended noise monitoring	14 locations
Blast Monitoring	Fixed blast vibration and overpressure monitors	5 locations (2 roving monitors)
Meteorological monitoring	Weather station	1 location

Figure 2-2 TEOM1 & TEOM2 PM_{10} Annual Rolling Average Results for the Period 2013 to 2020

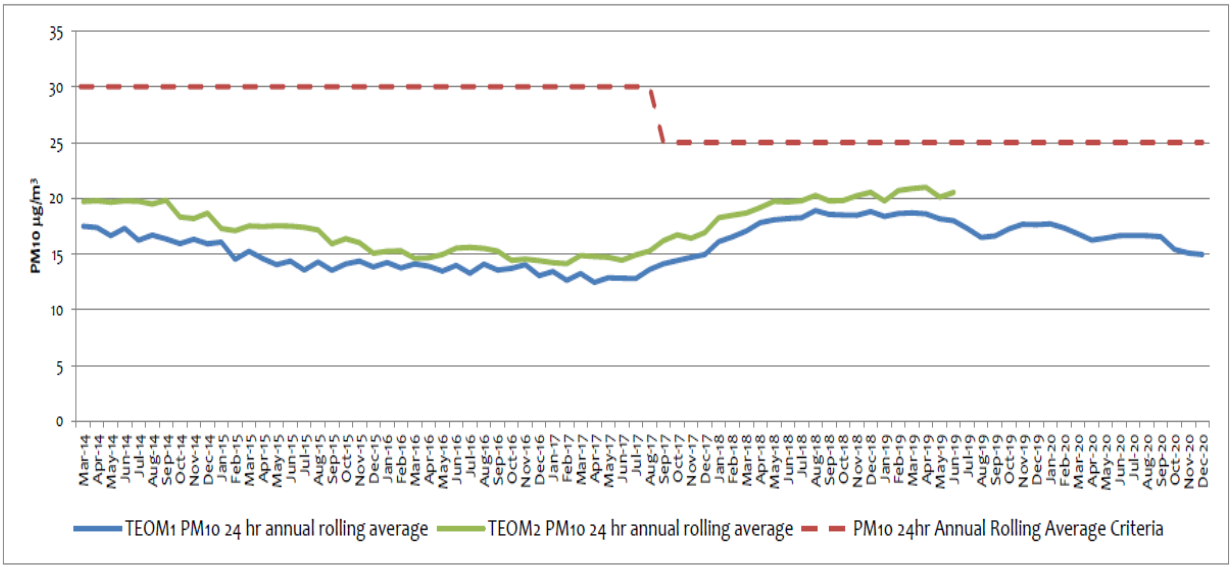


Figure 2-3 HVAS TSP and TSP-Lead Results for the Period 2008 to 2020

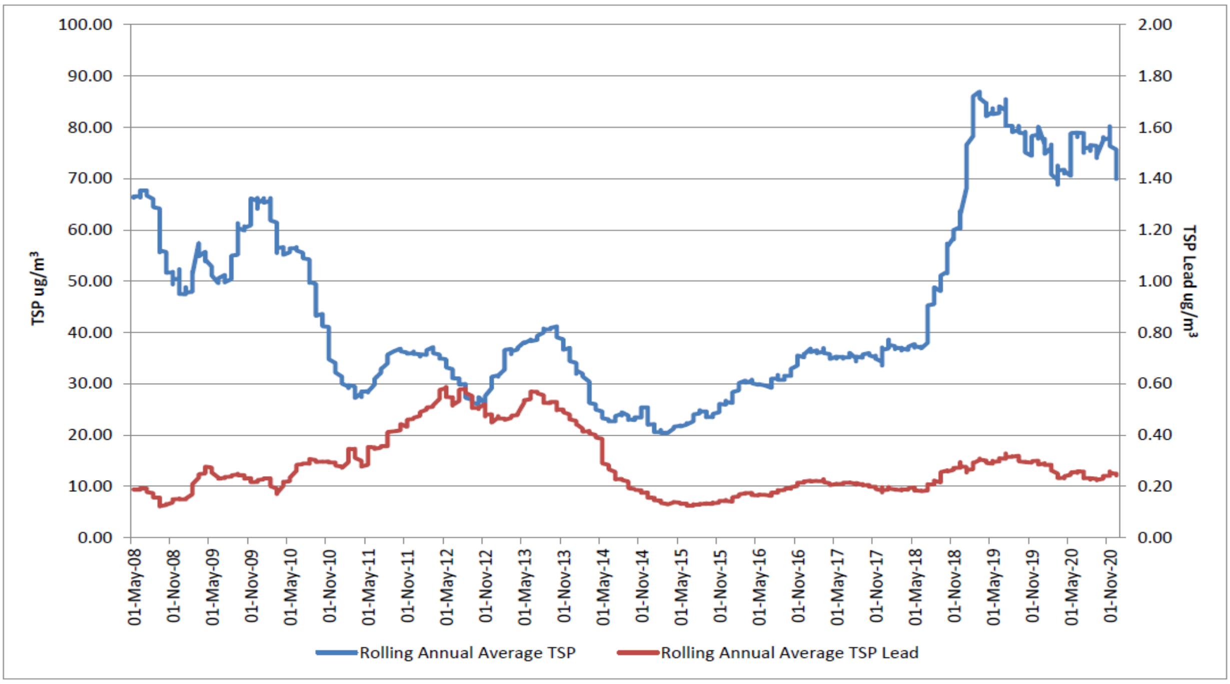


Figure 2-4 Total Deposited Dust 2007 – 2020

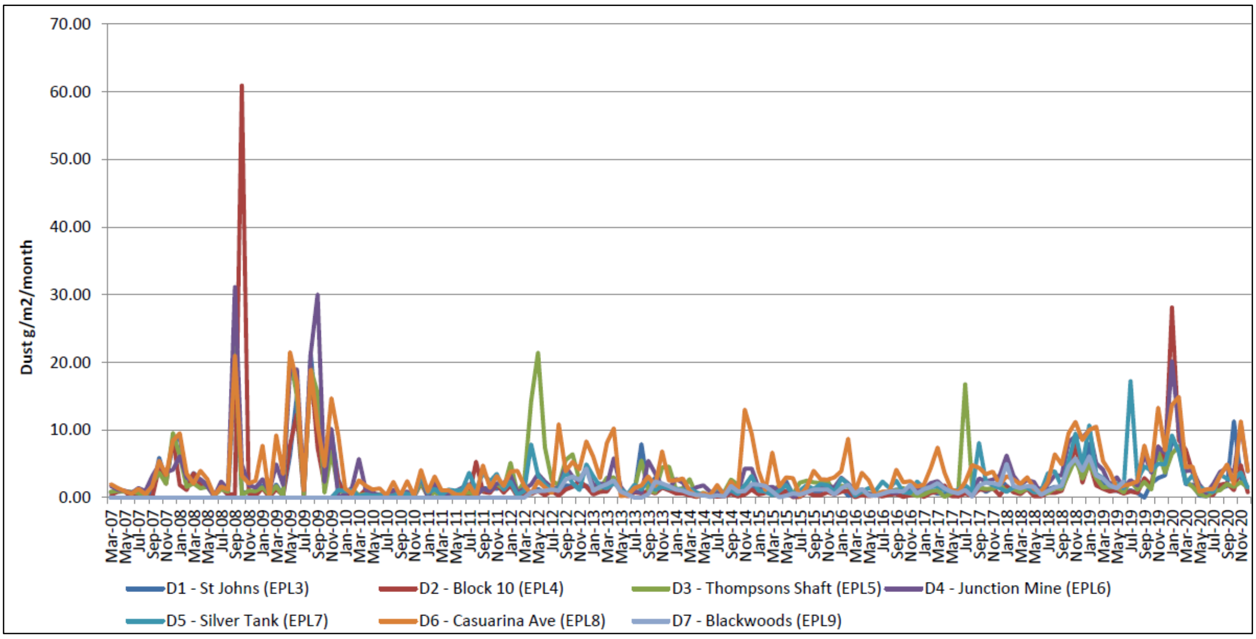
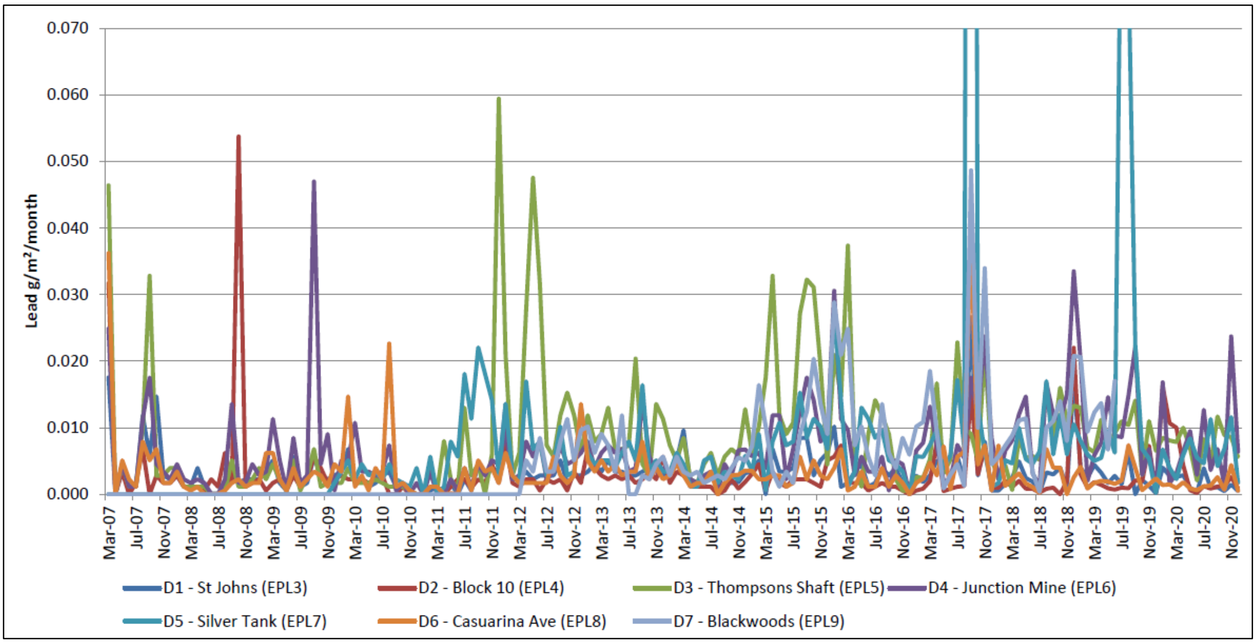


Figure 2-5 Total Deposited Lead 2007 to 2020



2.7.3. Topography and Drainage

The far west region of NSW is characterised by rolling downs and lowlands. The Barrier Range lies to the north, west and south-west of Broken Hill. Elevations generally range from approximately 180 m AHD 30 km west of Broken Hill to 300 m AHD within Broken Hill to 472 m AHD at Mount Robe, 33 km north-west of Broken Hill (Broken Hill City Council, 2000).

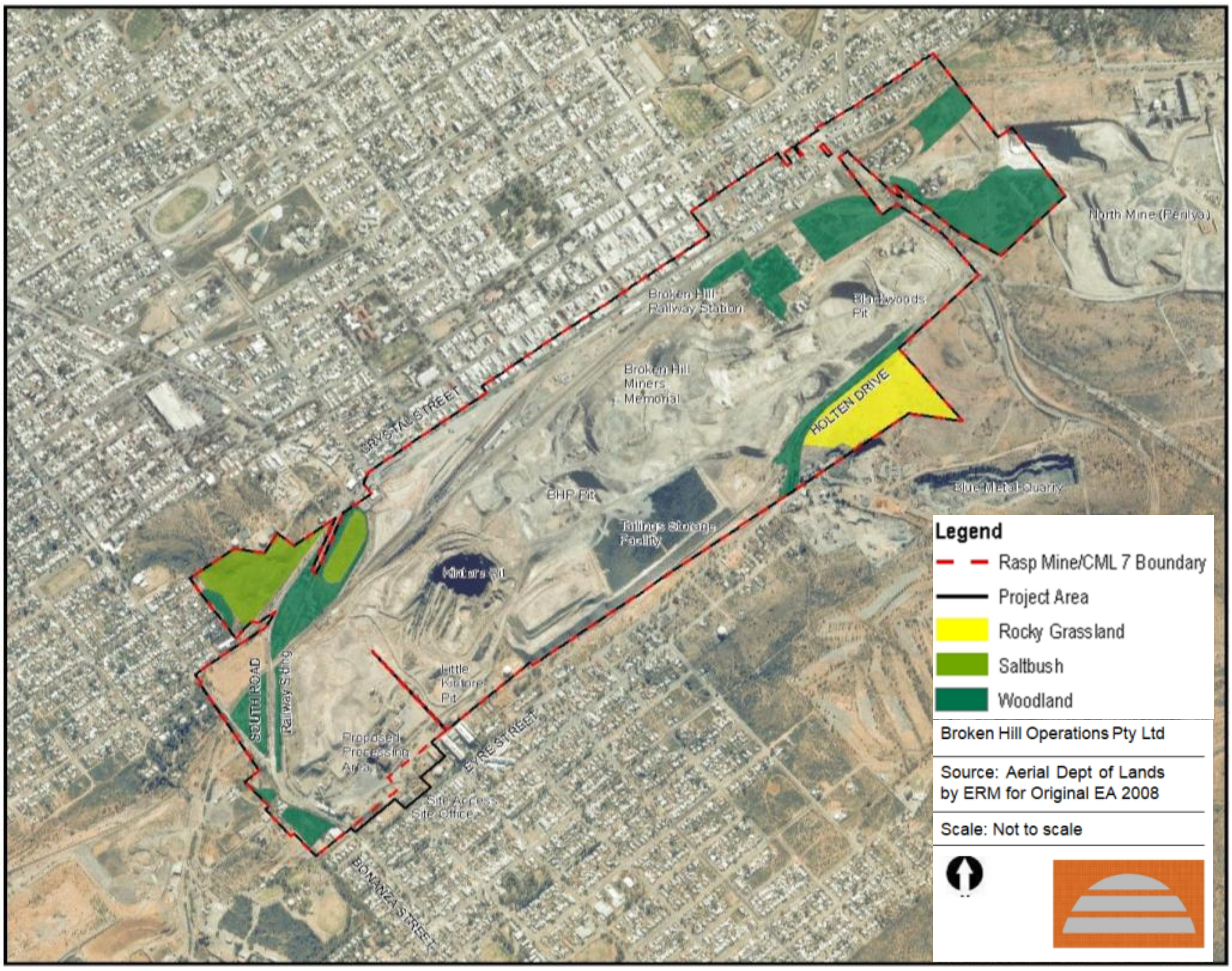
CML7 lies centrally within the Line of Lode which divides the City and its surrounds into North and South Broken Hill. To the north of the City, the land consists generally of steep, rugged hills and hill slopes. The remaining area consists of low hills, foot slopes and low calcareous rises.

The Rasp Mine and the City of Broken Hill are located within the catchment of the Stephens Creek Reservoir. West of Broken Hill, all runoff drains to Lake Frome, in South Australia. Three main creeks run within 30 km of the City; Umberumberka Creek to the northwest, Stephens Creek to the east and southeast and Yancowinna Creek to the northeast. The closest major water course is the Darling River approximately 100 km to the south east. The Rasp Mine is not subject to flooding from external water courses. There are no natural water courses on the Mine site. The Mine site rises approximately 45 m above the City with the historic waste rock stockpile adjacent South Road and the café carpark located centrally, the highest points (356RL).

2.7.4. Description of Site Flora and fauna

The Rasp Mine is surrounded by urban commercial and industrial areas there is little native vegetation cover and ground cover is sparse, as shown in **Figure 2-6**. The site has been mined for almost 140 years leaving the site highly disturbed with a number of heritage buildings and structures. The majority of the site is covered with historic waste rock or tailings material, with little of the original topsoil and fragmented remnants of native vegetation communities remaining. There are some individual trees, including introduced species such as figs (*Ficus* sp.) oleander, wild tobacco and pepper trees, which are mostly found adjacent to buildings and infrastructure and on waste dumps. Native vegetation is restricted to small isolated patches of woodland, saltbush and rocky grassland at the site perimeters and along roadside verges*.* Vegetation along roadside verges also comprises planted Western Australian eucalyptus. These communities are outside the proposed Project footprint.

Figure 2-6 Vegetation in and Surrounding the Rasp Mine



The woodland communities occur at the south-western (west of the railway line) and north-eastern extents of the Rasp Mine. These communities are sparsely vegetated with canopy vegetation of Eucalypts (*Eucalyptus* spp.) and a shrub and groundcover layer of Mulga (*Acacia aneura*), Old Man

Saltbush (*Atriplex nummularia*), Bluebush (*Maireana* spp.), Copperburr (*Bassia* spp.) and Wiregrass (*Aristida* spp.). Saltbush communities within the Rasp Mine are almost mono-specific stands of Old Man Saltbush and Bluebush species to the north of South Road, in the north-western corner of the mine lease. Several areas on rocky foot-slopes contain grasses such as wiregrass and Barley Grass (*Hordeum leporinum*), with scattered mulga and old man saltbush. This community occurs south of Holten Drive, and outside of the Project Area.

These communities would not be removed or disturbed during the proposed Project activities.

The small isolated woodland patches have little value as fauna habitat. Previous ecological studies identified that there was very little foraging, nesting or roosting habitat for fauna at the site, though the existing mine buildings provide some potential roosting habitat for bats. The mine shafts were considered to be unsuitable roosting habitat for bats as their steel capped roofs provide limited or no access and up-draught of airflow containing highly sulphurous fumes was noted at some shafts (Greg Richards and Associates Pty Ltd, 2001). There are a few openings from historic underground workings within Kintore Pit however there is no current access to undertake any assessment for their potential as fauna habitat. During mining operations there have not been any sightings of fauna entering or leaving these areas or within the Pit.

No notable alterations to habitat at the site have occurred. For these reasons, the area of the Rasp Mine is considered to be of low habitat value for native flora and fauna.

The areas of vegetation around the perimeter of the site would not be affected by any of the proposed MOD6 activities.

Progressive rehabilitation with the establishment of an olive grove has been undertaken over an area previously used as a water storage dam. This is located adjacent to South Road and one of the old man saltbush communities. The Broken Hill Gourmet Products Co-Operative Limited has undertaken the establishment, harvesting and maintenance of the olive grove. None of the proposed Project activities would impact this area.

2.7.5. Heritage

The City of Broken Hill was granted National Heritage status on the 20 January 2015 primarily for its role in mining and mineral processing in Australia.

Mining and related activities have been carried out in Broken Hill and in the area of the Rasp Mine since the 1880s. A substantial amount of the mining infrastructure from various mining phases is retained *in situ.* This remnant mining infrastructure is predominately located along the Line of Lode which extends to the north-east and south-west of the Rasp Mine.

There are number of heritage items located on the Mine site which are listed on the City of Broken Hill Local Environment Plan (2013). None of these items would be impacted by the proposed MOD6 works. The continued protection of heritage items located in BHP Pit together with their description is provided in **Section 8.10.**

The extensive land disturbance resulting from more than a century of intense mining, processing and surface work is clearly evident and no trace of undisturbed land was observed during the studies undertaken by ERM for the original EA. The land use field surveys conducted by ERM which involved on-site consultation with local indigenous groups, did not identify any indigenous archaeology at the Mine site.

3. DESCRIPTION OF MODIFICATIONS

This Section describes the various components of the Modification, including required preparatory works, construction and operation and proposed closure concept.

3.1. Proposed Changes to the Project

The current Project Approval permits underground mining of the Western Mineralisation, the Centenary Mineralisation and Main Lode from Blocks 7 to 12 until 31 December 2026 extracting up to 750,000 tonnes of ore per annum and 8,450,000 tonnes of ore over the life of the Project. It also permits the processing of ore and the dispatch of concentrate products from the Mine by rail. There are a number of auxiliary facilities with the Project footprint including maintenance workshops, inventory, chemical and explosives storages, backfill and concrete batching plants and a rail siding.

Table 3-1 provides a summary of existing approved project components compared to the proposed modifications. **Appendix N** provides a comparative table for all modification to the PA.

Table 3-1 Comparison of Existing Approval and Proposed MOD6

Component	Approved Rasp Mine	Proposed MOD6
Mine Life	15 years (includes construction and closure) from 2011 to 2026.	No change, however operations will cease in 2022 without approval for additional capacity for tailings storage. Current PA expires 31 December 2026. A new modification application is planned to be submitted in 2021 and would seek to extend mining within CML7 post 2026 and provide a new Life of Mine Plan.
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 Main Lodes Blocks 7 to 12.	No change to mining methods.
Mine Access	Access to underground mining is via a portal and decline located in the base of Kintore Pit.	MOD6 proposes a new access portal and decline to the underground mine, to be located within a boxcut.
Mining Rate and Total Production	750,000 tpa ore. Total production over life of Project: Approximately 8,450,000 t	MOD6 is based on a mine plan to the end of 2026 with 500,000tpa ore, 146,000tpa of waste (to surface) and 480,000 tpa of tailings harvested and transferred to TSF3.
Waste Rock Disposal	Underground: Backfill. Surface: Material (<0.5% Pb) to be used for road repair and bunding and rehabilitation at closure	MOD6 proposes that excess waste rock from U/G mining be: - co-placed with tailings in TSF3, - used for rehabilitation capping where testing confirms average is <0.5%Pb, and - permanently stored in Little Kintore Pit and BHP Pit (all material from construction of the boxcut and new decline development from surface).
Underground Ventilation	2 x 450 kW primary ventilation fans located 160 m below ground and exhausting centrally within CML7.	No change
Processing Methods	Crushing, grinding, flotation, thickening and filtration at on-site processing facilities.	No change
Processing Rates	250 tph in crushing plant and 93.8 tph in grinding plant.	No change
Concentrate Production	Lead: 44,000 tpa (concentrate 73% Pb and 985 g/t Ag)	No change due to MOD6. Concentrate production rates decreased in July 2020 with

Component	Approved Rasp Mine	Proposed MOD6
	Zinc: 87,000 tpa (concentrate 50% Zn)	new mine strategy, now Lead = 25,000t and Zinc = 55,000t (based on 500,000tpa).
Tailings Disposal	Course stream returned to mine void and finer stream to be directed to tailings storage facilities.	MOD6 proposes to: - establish a tailings storage facility at Kintore Pit as TSF3 with an approximate 14 year life, and - utilise the surface of TSF2 to naturally dry tailings which would be harvested and transferred to TSF3.
Facilities	Other associated facilities such as Backfill Plant including a cement silo, Concrete Batching Plant, Rail Loadout, Warehouse, core preparation and inventory storage and workshops.	Periodic surface crushing to continue in Kintore Pit (EA) and BHP Pit (MOD7) for road base, surface capping within mine active areas and bunding requirements, up to 20 Ktpa.
Services	Extensions to existing substations, water lines and phone lines. New 22kV overhead power lines to be constructed.	MOD6 proposes to relocate services currently within Kintore Pit that support the underground mining to an area adjacent the proposed boxcut. This would include portable buildings used for underground equipment, crib and substation.
Water Supply / Extraction	Potable / treated water 9 ML/a Raw untreated water 139 ML/a Reclaimed / recycled water 300 ML/a Extraction up to 370 ML/a.	Potable / treated water 10 ML/a Raw untreated water 324 ML/a Reclaim / recycled water 525 ML/a Extraction – no change
External Roads	No changes to external road network.	No change.
Employment Numbers	Current numbers are: Employees: 186[1] Contractors: 32	MOD6 proposes increases in personnel: During construction: Employees – 0 Contractors – 20 For operations: Employees – 6 Contractors – 0
Hours of Operation	Underground Operations: 7 days per week, 24 hours per day Shunting 7 days per week, 7am to 6pm (not conducted). Construction hours 7am to 6pm Mon-Fri and 8am to 1pm Sat, no construction work on Sundays or Public holidays. Activities not listed above – 7 days per week, 24 hours per day.	No change to operating hours for current activities. MOD6 proposes to campaign harvest tailings from TSF2 over a roster basis which would occur on day shift (7am to 7pm) on any day. MOD6 proposes to construct the boxcut – 7am to 6pm Monday to Saturday with no works on Sundays or public holidays.
Disturbance Footprint	CML7 consists of 342.66 ha Current land disturbance due to Rasp Mine activities is 28.4 Ha	Proposed land disturbance in MOD6 activities is 40.2 Ha, increasing land disturbance (from Rasp Mine activities) to 70 Ha.

Note 1: New employee and contractor numbers reflect Rasp Mine restructure in July 2020.

3.2. Proposed Construction and Operations Schedule to 2026

Table 3-2 provides an outline of the proposed construction and operational schedule for MOD6 (assumes all approvals (PA, EPL and MOP) would be approved by end April 2022).

3.3. Proposed Hours for Construction and Current Hours of Operation

3.3.1. Proposed Construction Hours

Table 3-3 outlines the proposed construction hours. MOD6 construction works will generally be undertaken during standard construction hours. However to decrease the duration of some excavation works BHOP proposes to undertake some of these works out of construction hours (OOH), as outlined in

Table 3-2 Indicative MOD6 Schedule

	2022												2023												2024	2025	2026[1]
CONSTRUCTION	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**			
Decline Development (U/G)																											
Stage 1 of Boxcut																											
Stage 2 of Boxcut																											
Stage 3 of Boxcut and road excavations outside of boxcut																											
Portal and decline (surface)																											
Tag board area prep-works, underground services																											
Capping of LKPit, BHP Pit																											
Plug, portal adit drive K Pit																											
Seepage/Shaping Layer in K Pit																											
Bridging layer in K Pit and stormwater diversions																											
Preparation works for tailings harvesting and concrete exit ramp.																											
OPERATIONS																											
Planned Production – Mining of Ore (500,000t)																											
Planned Production – Waste to Surface (146,000)																											
Planned Production – Tailings Deposited in TSF2 (480,000t)																											
Tailings Harvesting (TSF2) and Transfer to TSF3																											
Rehabilitation Capping (16,000t)[2]																											

Note 1 = The PA expires 31 December 2026, a new modification (MOD10) will be submitted for approval prior to this date to allow mining to continue.
Note 2 = No recapping is planned as part of rehabilitation activities in this year due to construction activities

the *Interim Construction Noise Guidelines, Department of Environment*, Climate Change and Water, 2011. This would include:

- Boxcut excavation works to be conducted OOH on Saturdays from 7am to 8am and 1pm to 6 pm (additional 6 hours per week). Reducing the duration of boxcut construction works from 26 weeks to 22 weeks.
- Kintore Pit preparation works to be conducted OOH each day 7 days per week from midnight to 7am and 6 pm to midnight Monday to Friday, midnight to 8am and 1pm to midnight Saturdays and all day Sundays (additional 108 hours per week). Reducing the duration of preparation works in Kintore Pit from 33 weeks to 12 weeks.

This would require a modification to PA Schedule Condition 15 Table 6.1 for construction hours.

This OOH timetable has been included in the noise impact assessment discussed in **Section 8.1**, in particular the reasons for including the boxcut development and Tails Harvesting Haul Road to be treated as construction activities is included at **Section 8.1.2.1**.

Table 3-3 Proposed Construction Hours and Activities

Construction works	Proposed Hours	Activities
Boxcut	7am to 6pm Monday to Saturday No Sundays No Public Holidays	Excavation of U/G mining services area, trucking excavated waste material to Little Kintore Pit
		Stage 1 – excavation to first bench (10 m depth) and trucking of waste material to Little Kintore Pit
		Stage 2 – excavation to second bench (20 m depth) and trucking waste material to Little Kintore Pit and BHP Pit
		Stage 3 – excavation to base of boxcut, portal and first part of decline (30 m depth), surface blasting and trucking of waste material to Little Kintore Pit and BHP Pit
New decline (surface activities only)	7am to 6pm Monday to Saturday No Sundays No Public Holidays	Blasting and trucking from boxcut to BHP Pit
New decline (U/G activities only)	24 hours a day 7 days per week as per all current underground operations	All underground works, blasting and trucking of waste to underground voids
TSF3 preparation works[1]	24 hours a day 7 days per week	Decline plug
		Shaping layer with seepage collection
		Bridging layer
TSF2 tailings harvest preparation works[2]	7am to 6pm Monday to Saturday No Sundays No Public Holidays	Bunding for bays separation, installation of supernatant and water management features

Notes: 1. Would start after completion of the boxcut construction and access is gained through the new portal.
2. These works would overlap with the TSF3 preparation works.

3.3.2. Current Hours of Operation

There would be no change to the current hours of operation as detailed in **Table 3-4**. Tailings harvesting would be undertaken on a campaign basis with all activities occurring during daytime only. Waste rock transfer from underground to Kintore Pit would continue to be undertaken at any time, 24 hours per day 7 days per week. **Table 3-4** outlines proposed operational hours. Note all underground activities would occur as per current mine hours 24 hours per day 7 days per week.

Table 3-4 Proposed Operational Hours

Operational Works	Proposed Hours	Activities
Ore transfer	24 hours a day 7 days per week as per current PA conditions	Trucking of ore from (surface) new portal to ROM Pad
Waste rock transfer to surface	24 hours a day 7 days per week as per current PA conditions	Trucking of waste rock (surface) from new portal to Kintore Pit or BHP Pit
Tailings / waste rock handling	Anytime between 7am to 7pm on any day	Handling and compacting within in TSF3
Tailings harvesting	Anytime between 7am to 7pm on any day	Harvesting works in TSF2 and trucking of tailings to TSF3
Capping and rehabilitation (surface activities)	Anytime between 7am to 7pm on any day	Trucking of waste rock to Free Areas

All other activities would be undertaken at the site in accordance with the PA.

3.4. Kintore Pit – Tailings Storage Facility 3

BHOP engaged Golder to undertake an investigation of both on-site and off-site opportunities for tailings storage, *Rasp Mine – Tailing Storage Facility Options Assessment*, Golder September 2017, **Appendix J**. Golder identified several off-site potential locations all requiring land acquisition and extensive earthworks, and assessed the only suitable on-site location - Kintore Pit, the only pit of sufficient size to provide reasonable capacity. The placement of tailings into Kintore Pit was the preferred option as there would be no increase to the disturbance footprint, less impact to public and private land owners with the installation of pipe-works and access tracks, and it was the most cost-effective option. In addition filling Kintore Pit also provides a safer option at mine closure with the filling and removal of an open void. A summary analysis of these alternative options is provided in **Section 4.1**.

3.4.1. Kintore Pit Location and Description

Kintore Pit (the Pit) is a large open pit mined in the 1970s and ceased operation in 1991. It is located at the western half of the Mine site (**Figure 1-2**). It is currently used to access underground mining operations via a mine portal and decline at its northern base, and for storage of excess waste rock on the Kintore Pit Tipple located in the south of the Pit.

The Pit is approximately 100 m deep (RL210 to RL310) on the southern perimeter and approximately 480 m (north to south) by 360 m (east to west) (**Figure 3-1**). The footprint of the Pit is approximately 0.5 ha (4,800 m^2) at the base to approximately 2 ha at RL250 and 17 ha at the surface (RL320).

Excess waste rock used to fill underground voids is stored in the Pit when there are no underground voids available. On average 173,982 t per year has been stored in-Pit since BHOP commenced mining in 2011 (to the end of 2020, 1,391,859 t) (**Table 1-2**). This material would be left within the Pit with some material used to form a foundation for the co-placed tailings and following testing, utilised for rehabilitation capping. The current access ramp within the Pit would remain to provide access to the active co-placement area and would be covered as the tailings level rises.

The portal and decline are located at the base of Kintore Pit into the toe of the western batter slope. The current portal has a nominal width of 5 m and a height from the floor to the crown arch of 5.5 m. Ground support installed at the portal and into the decline comprises nine 2.4 m long 20 mm and 46 mm diameter rock bolts at 1.5 m intervals covered by 50 mm (minimum) thickness of 40 MPa fibrecrete. The lower slopes of the western batter above and around the decline portal are also supported by a combination of resin bolts, split sets, cable bolts and fibre reinforced shotcrete.

Underground mine operational areas are currently accessed by drives (commenced in 2007 with the installation of the exploration decline) leading off the decline. The Main Lode Drive (MLD) is located close to the floor of the Pit, with a maximum vertical separation of 15 m between the floor of the Pit and the MLD. Historic mine plans show that shallow mine workings partially underlie the Pit base, and in places also overlap the drives. Crown pillars separating the Pit floor from the old workings were removed either during open pit mining or by previous underground remnant mining. Access to these drives would be removed by filling the MLD directly beneath the Pit prior to the commencement of tailings and waste rock co-placement.

A plan of the decline and access drives is presented in **Figure 3-2** and shows the decline branching at about 160 m from the portal with one drive continuing to the northern mine workings and one turning back under the Pit floor and connecting to the southern mine workings (Block 7).

Figure 3-1 Kintore Pit

The Pit side walls have been formed as a series of batters with generally small benches and have an average sidewall slope of about 40°. Pit excavations have exposed old tailings on the north-east wall of the Pit and two collapsed old mine workings can be observed in the north eastern Pit sidewall, one partially filled with old tailings. Timber supports from historic mining are also visible.

There is limited information on the old mine workings which are beneath and around the Pit some are known to be filled and some still open (shown as tan shading in **Figure 3-2**).

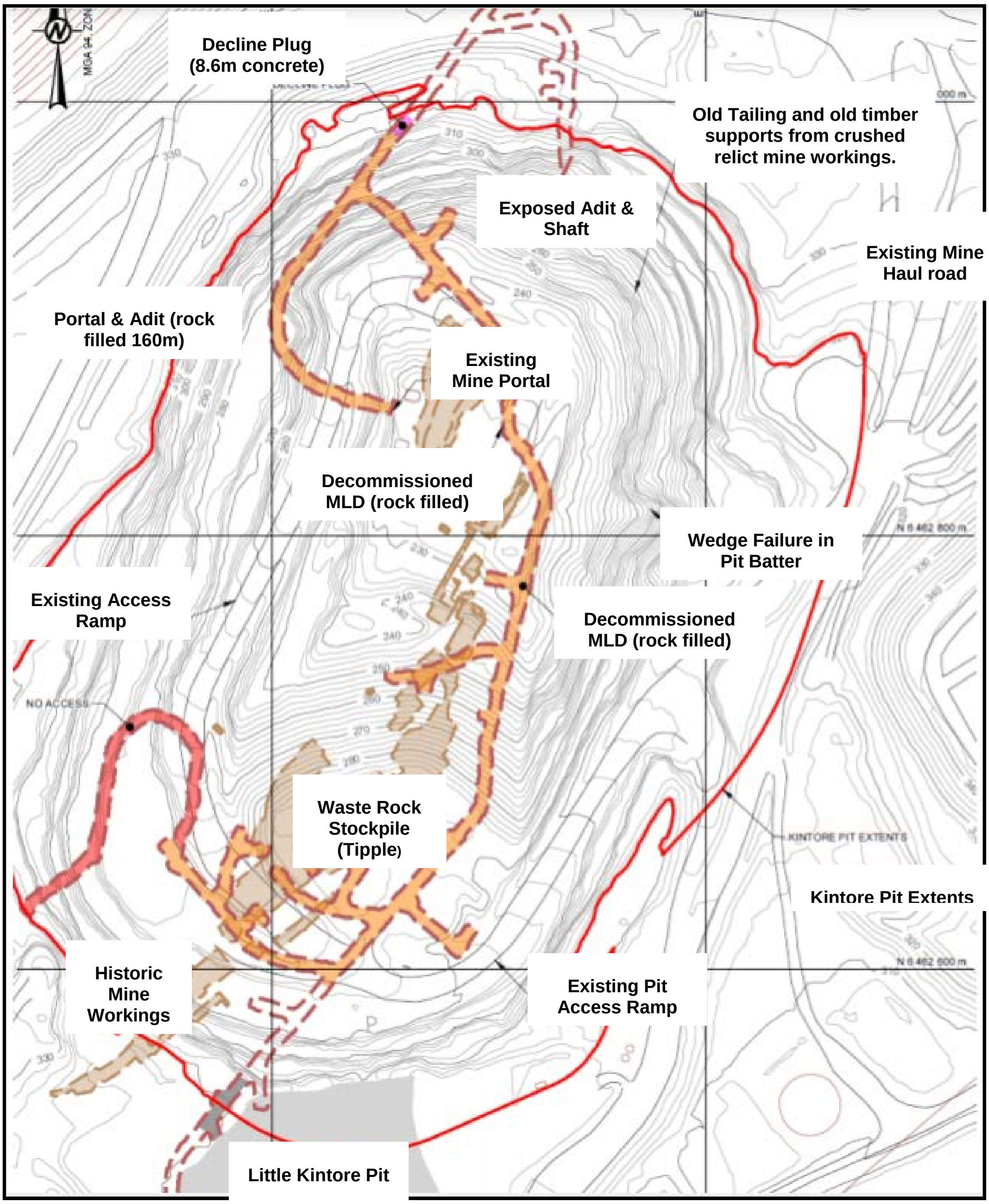
A slope wedge failure occurred in the eastern batter of the Pit where the intersection of discontinuity planes in the rock slope have day-lighted in the batter slope. Failure of the wedge occurred in 2014 following a period of heavy rain.

The Pit floor and underground workings are highly porous; water that enters the Pit drains through the old workings into the underground mine and is removed by the Mine dewatering system.

There is no requirement for vegetation to be removed, there are no heritage items located in the vicinity and there would be no new land disturbance in the proposed use of the Pit as TSF3. There are no known fauna (eg bats) living in the old adits and shafts visible within the Pit. As part of operations, voids would be inspected and an assessment of habitats conducted as they become safely accessible within the Pit, refer **Section 2.7.4**.

The use of the Pit as a tailings storage facility requires closing the current underground mine access portal and decline. This would require managing old workings and recent mine workings beneath and around the Pit, to ensure tailings is contained within the Pit and address the risk of inrush to the underground workings.

Figure 3-2 Kintore Pit General Layout



The storage capacity of the Pit has been estimated by Golder to be 4.3 Mm^3. At current production rates this provides a life for the facility of approximately 13.5 years with a further 1 to 2 years if filled to a dome shaped surface. The life of the facility can be further extended by raising the embankment; however BHOP has not planned to include these embankments in the current modification, if these were to proceed a new modification application would be submitted.

Several risk assessment workshops were held to identify and address risks associated with the use of Kintore Pit as a tailings storage facility, including the potential for inrush to underground workings. Tailings is currently dewatered to approximately 65% solids and 35% moisture and it was concluded that the tailings would need to be dewatered further prior to deposition within the Pit to maintain safety and achieve sufficient compaction rates. Several options were considered on how best to undertake this dewatering including the equipment required, its location and tailings moisture content. These options are discussed in **Section 4.2**.

BHOP determined that the safest and most efficient option was to dry the tailings prior to placement in TSF3. This would reduce the potential for the tailings to become saturated and enable the optimum moisture level to achieve compaction. Compacting the tailings would maintain tailings particle spacing below the critical void ratio while providing the highest filling capacity.

BHOP investigated methods for both filtering and naturally drying the tailings with the naturally drying method, by solar and air, selected as the preferred option. It is proposed to dry the tailings on the surface of TSF2 to a moisture content that allows the tailings to be trafficable for excavation and haulage to Kintore Pit where it would be spread and compacted as it is co-placed with excess waste rock from underground mining and development.

BHOP also engaged Golder to undertake a number of studies for the safe placement of tailings and waste rock within TSF3 and to design the method for their placement into the Pit. This included:

- Tailings properties, including classification, critical state testing, compaction testing, liquefaction.
- Capacity and life of the facility.
- Design requirements for mine plugs.
- Required Pit preparation works including a seepage system, and safety recommendations for any exposed old works and historic tailings slope.
- Waste rock placement.
- Stormwater management.
- Monitoring requirements.

Their findings and recommendations form the basis for the use of the Pit as a tailings storage facility and are detailed in **Appendix B1** *Rasp Mine - Tailing and Waste Rock Management for* MOD 6, Golder Associates Pty Ltd, June 2021 (Golder Report).

3.4.2. Tailings and Waste Rock Properties

It is proposed to place dried full stream tailings, stored as engineered fill, with excess waste rock from underground mining and development in Kintore Pit as TSF3.

3.4.2.1. Tailings Properties

Golder conducted various tests (summarised in **Section 5** of **Appendix B1**) of tailings sampled as full stream tailings taken from the cyclone feed to inform their design for tailings placement in the Pit with the following findings:

- Soil classification testing in accordance with the Australian soil classification system classified tailings as non-plastic silt with a liquid limit of 22% and a fines content of 45%.
- Compaction testing found that the optimum water content for compaction was 10.0%.
- Critical state testing results indicated that the slope of the critical state line is consistent to a stress of approximately 600 kPa,

- Critical state testing also concluded that full stream tailings compacted to 95% standard dry density is unlikely to be contractive and hence not liquefiable up to a confining pressure of approximately 1000 kPa (equal to a thickness of compacted tailings of 53 m).
- Critical friction angle inferred from the CID and CIU triaxial testing is typical of silt tailings varying between 34^o and 39^o.
- CIU triaxial testing indicated the peak and residual consolidated undrained shear strength ratios was 0.21 and 0.12, respectively (at Ψ of approximately +0.7).

3.4.2.2. Waste Rock Properties

Pacific Environment Ltd (PEL) completed an investigation of the classification of waste rock for PA 07_0018 Modification 4 (MOD4) (*Rasp Mine – Waste Rock Classification*, March 2017, Appendix K of MOD4). PEL identified the waste rock as belonging to the stratigraphic group for the Broken Hill Line of Lode, representing the Broken Hill Group which lies between the Sundown Group and the Thackaringa Group. The ore body being positioned in the rock units Hores Gneiss (Unit 4.7) with minor lead-zinc mineralisation in the Parnell Formation (Unit 4.4). Other rock units within the Broken Hill Group positioned at the Mine include 4.3 Unit, 4.5 Unit and the 4.6 Unit. The bulk of the waste rock is composed of Garnet Pelite (GPE) and Psammopelite (PM), then Garnet Spotted Psammopelite (SPM) with very minor quantities of Dolerite (DOL) and Garnet Quartzite (GQ) present. All of these rock types are described as hard and competent units with the exception of Garnet Pelite (GPE) 1 and 2, which is noted as a softer rock type that has been more susceptible to accommodating shearing. Conversely, DOL1 and DOL2 are rated as extremely hard rock with very high uniaxial compressive strength (UCS).

PEL's investigations also determined that the moisture content of the waste rock is approximately 3% and its permeability 3×10^{-6}.

Studies have also been undertaken to determine the characterisation of the waste rock including an investigation and analysis of its geochemical properties. The results of these studies are summarised in **Section 3.8** and discussed in **Section 8.9**.

3.4.3. Kintore Pit Preparation Works

Investigations undertaken by Golder identified a number of features that needed to be considered in the design of the Pit as a tailings and waste rock storage facility. These included:

- Open cut excavations of the Pit that have exposed tailings within an old storage facility in the northern batter of the Pit.
- Old timber supports from crushed relict mine workings.
- Adits and shafts to old workings that are present in the walls of the Pit.
- Historic mine records which show old mine workings below the Pit floor have minimum rock cover thickness to the old workings of approximately 15 m.
- Crown pillars separating the Pit floor from the old workings had been removed either during open pit mining or by previous underground remnant mining.
- A slope wedge failure had occurred in the eastern batter of the Pit.

Design requirements for the Pit to ensure the safety of mine personnel working underground were also informed by a liquid pathways analysis conducted by BHOP Technical Services personnel (**Appendix K** *Technical Report – Identification of Potential Inrush and Inundations Pathways from Present and Future TSF Facilities into Rasp Mine Underground Workings (with a focus on Kintore Pit Proposed TSF3*), Rasp Mine Technical Services Team, April 2020) (BHOP Technical Report).

There are a number of works required within the Pit as preparation for tailings/waste rock co-placement. These include filling of drives beneath the Pit, installation of an engineered portal plug, shaping the Pit floor to allow for the installation of a seepage collection system and installing a bridging layer to form a base for the tailings.

3.4.3.1. Filling of Drives

It is proposed that drives directly beneath the Pit would be filled with waste rock material prior to tailings deposition (as shown in tan in **Figure 3-2**). The (MLD) would be filled along the full length of the drive directly beneath the Pit; this would provide passive support and restrict access to the immediate area underneath TSF3 footprint. The MLD would be filled directly from underground sources (76,780 t). The drive from the portal to the Western Mineralisation Decline (WMD) and MLD intersection would be backfilled to support the void and reduce the risk of stress relief effects potentially resulting in sudden rock mass movements once the tailings load is applied to the blast affected pit slope rock formation. This drive would be filled from the surface using waste rock material from the Kintore Pit Tipple (9,680 t).

3.4.3.2. Portal Plug

BHOP conducted an investigation into the various pathways where liquid material (stormwater and tailings water) could flow from TSF3 towards underground mine workings, BHOP Technical Report, **Appendix K.** The BHOP Technical Report details the potential pathways for ingress into the Rasp Mine's underground workings were the tailings to liquefy, and identifies the locations required to effectively isolate these pathways from current or currently proposed active mine workings. This is through the installation of underground mine plug/engineered barriers and establishment of inrush control zones. This Report was used to inform Golder and GCE in their design considerations.

Six locations were identified in the Report as potentially requiring engineered barriers; these are listed with their location in **Table 3-5** and shown in **Figure 3-3**.

Table 3-5 Location of the Underground Mine Barriers

	Mine Plug	Easting[1] (m)	Northing[1] (m)	Reduced Level (m)
1	Portal Plug no longer required due to filling of drives	1365	9727	10226
2	Decline Plug - WMD and MLD Intersection	1148	9962	10212
3	Dickenson's Shaft Western Min Decline below SP3	1149	9903	10 145*
4	1000 ft Level East of Park-bay	2052	9612	10 046*
5	Block 11 Access Incline east of ladder-way intersection	1698	9451	9944
6	1480 South (Access Drive West of intersection with airway)	1514	9600	9900

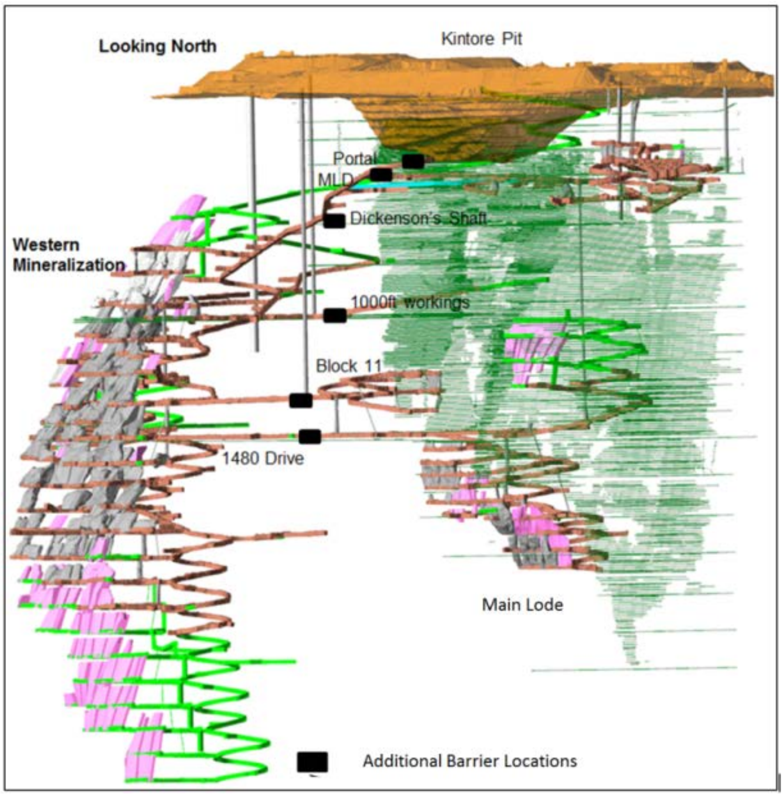
Note 1 - Easting and Northing is relative to local Mine Grid.

Ground Control Engineering Pty Ltd (GCE) were contracted to undertake a geotechnical assessment of the drives below the Pit and identified the geotechnical conditions at the locations for the barriers (Geotechnical Assessment of the MLD/Zinc Lodes Drive Below Kintore Pit, GCE, July 2021, **Appendix G2**). Golder was engaged to provide designs for the barriers (*Kintore Pit: Preliminary Drive Plug Design Rasp Project Broken Hill*, Golder Associates Pty Ltd, August 2020, appended to the Golder Report **Appendix B1**.

Golder reviewed the locations for the barriers and determined that due to the filling of the portal / adit drive and the MLD with waste rock the Portal Plug would not be required and that a plug seal could be located at the MLD and WMD intersection. This is now referred to as the Decline Plug. This Decline Plug would be installed prior to waste rock or tailings placement in TSF3. The installation of the remaining barriers would be dependent on the in-situ geotechnical properties of the engineered fill placed during TSF3 operation. The proposed locations and elevations for barriers are summarised in **Table 3-5**.

The Decline Plug and all proposed barriers have been designed for hydrostatic pressure of the full potential depth of tailings plus water hammer effects, resulting in a conservative design. However it is expected that the compacted dried tailings and waste rock placed as engineered fill, would result in unsaturated conditions. The design also assumes that the tailings liquefies and loses strength, resulting in heavy liquid/fluid tailings loading on the barrier. This conservative approach was considered by Golder as appropriate given the potential consequence if the tailings placement does not achieve unsaturated conditions. It is only if the tailings become saturated as identified through the CTPu testing would any additional barriers be required to be installed.

Figure 3-3 Indicative Location of Underground Mine Barriers



The Decline Plug has been designed for the future surcharge mass of the tailings in the Pit. It comprises a concrete bulkhead and waste rock, notched into the existing rock and located in the mine workings where the rock conditions have not been stress-relieved by the historical mining.

The Decline Plug location and photographs of the drive are presented in **Figure 3-4** and **Figure 3-5** respectively. The Decline Plug would be located approximately 160 m from the current portal entrance, at a depth of approximately 120 m (vertically from the Pit crest) and is designed to be 8.6 m in length.

The Decline Plug would be formed using upstream and downstream bulkheads to close off the drives and facilitate placement of the plug concrete. The Decline Plug and, any other future required plugs, would be constructed using concrete of at least 25 MPa compressive strength, any existing ducts, pipes, cables etc in the area of the plug would be decommissioned and the service relocated away from the plug area. All the plugs would be pressure grouted.

Depending on the condition of any fibrecrete lining at the location for the barrier it may be necessary to remove some or all of the fibrecrete and to expose any existing rock bolt heads, install additional rock bolts as per plug design, before the mass concrete is placed. If the fibrecrete is removed any loose or spalled rock would also be removed to leave a competent rock surface.

All plugs would include a permanent drainage outlet through the plug with a high-pressure valve on the downstream end that can be closed in an emergency. Golder has recommended that these valves remain open under normal operating conditions.

The Decline Plug drain pipe would extend from the plug through the portal adit drive and join to the drainage layer on the base of the Pit. The outlet pipe would be covered with rock fill and aggregate to protect the pipe in the adit drive from the Pit to the plug.

The drainage outlet through the Decline Plug would be high strength steel pipe suitably corrosion protected and designed for the maximum hydraulic pressure, so it remains operational during and after any liquefaction event. The drainage outlet and isolation valve would be situated at a location that is safely accessible downstream of the plug.

Construction materials and quantity estimates for the Decline Plug construction are outlined in **Table 3-6.**

Figure 3-4 Location of the Decline Plug

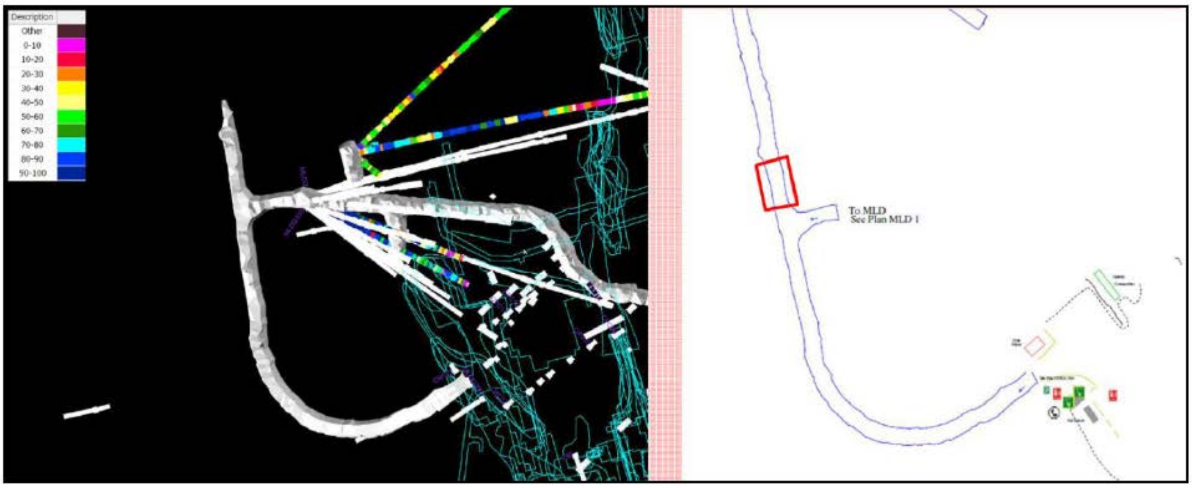
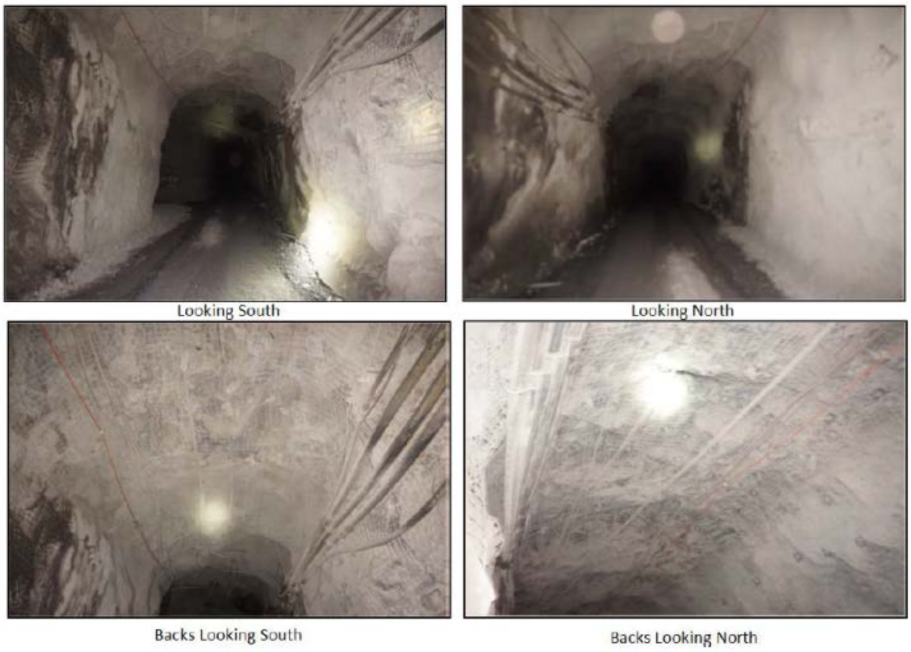


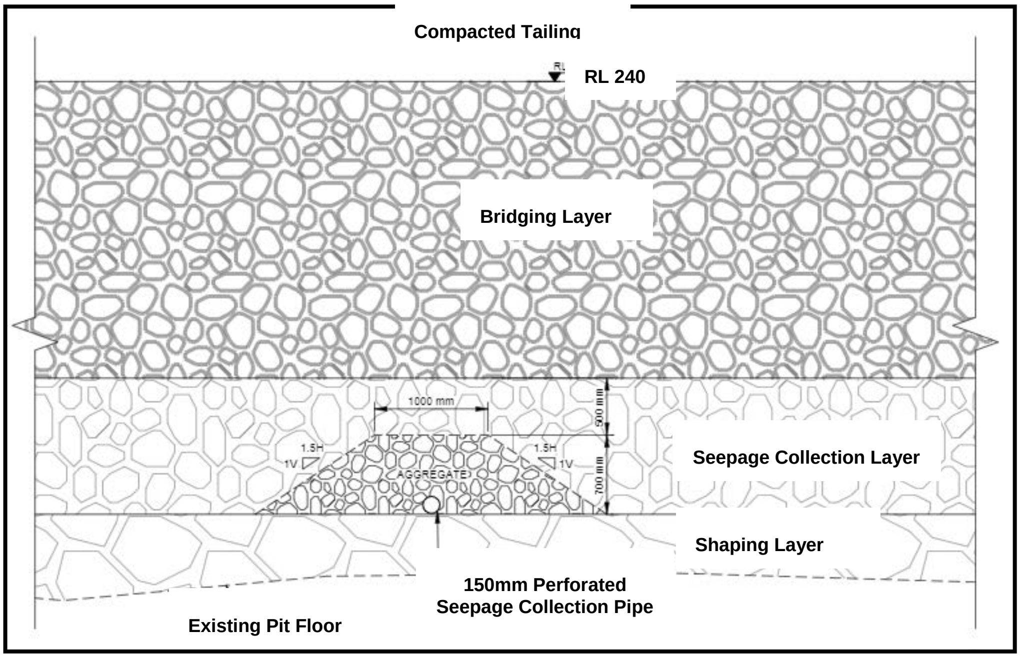
Figure 3-5 Photographs of the Decline Plug location



3.4.3.3. Shaping Layer

A layer of waste rock would be placed over the base of the Pit using a dozer to spread and shape the floor which would be nominally compacted and graded towards the portal. This shaping layer would be up to 600 mm in depth, depending on the topography, and would provide a base for the installation of a seepage collection network. The rock layer would be sourced from within the Pit (current waste rock stockpile – Kintore Pit Tipple) and would include up to approximately 4,000 t. Dump trucks and a front end loader (FEL) would also be used. Base layers for pit preparation works are shown in **Figure 3-6**.

Figure 3-6 Indicative Design Layers for the Base of TSF3



3.4.3.4. Seepage Collection Layer

A series of seepage collection pipes would be installed over the shaping layer and covered with a mound of drainage aggregate. Pipe lines of perforated 100 mm to 200 mm pipes would be installed in a fan shape to a solid pipe network feeding into the outlet pipe installed in the portal adit drive and Decline Plug, **Figure 3-7**. This pipe network would collect and convey seepage water to the Mine's water management system. The seepage outlet pipe (solid walled) would be placed on the floor of the existing adit drive and be covered with a mound (700 mm) of crushed rock fill to protect the pipe from potential damage. The outlet pipe would also include a gate valve located on the mine side of the Decline Plug.

The drainage aggregate would be free draining and would be crushed to nominally 20 mm in size with limited fines. This material (approximately 3,410 t) would be sourced from off-site suppliers. A 20 t compactor would be used to compact the aggregate layer. Dump trucks, a FEL and a dozer (D8) would be used.

3.4.3.5. Bridging Layer

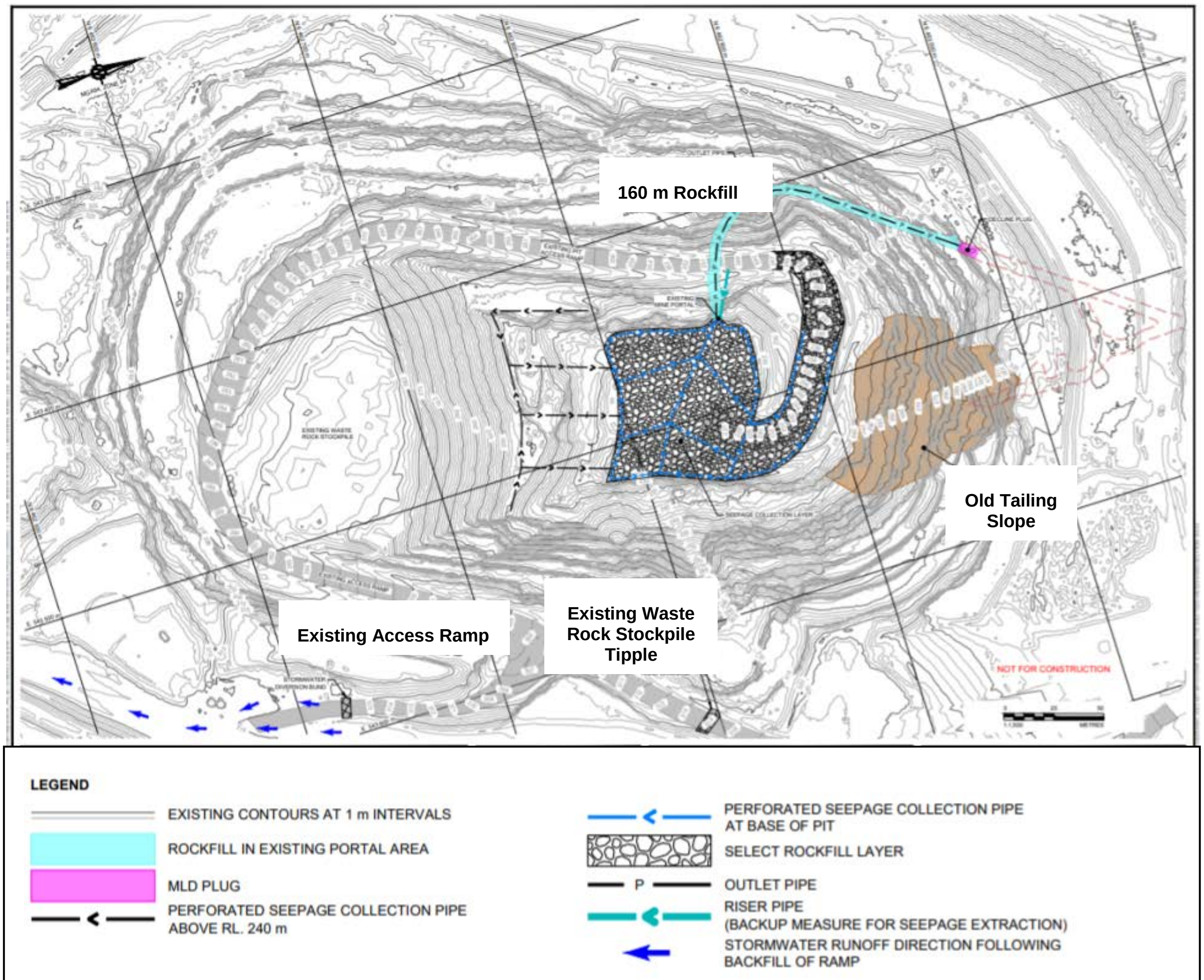
A bridging layer of rock fill, nominally up to 10 m in depth, would be placed over the drainage aggregate layer and floor of the Pit and the adit entrance area to stabilise the base. The bridging layer is shown in **Figure 3-6**. The rock fill would be sourced from the Kintore Pit Tipple (approximately 241,000 t) filling to an elevation of RL240. Dump trucks and a FEL would be used to transfer the material from the Tipple to the base of the Pit and material would be placed using a dozer (D8), an excavator may also be used. This would reduce the current height of the waste stockpile by 10m to 20 m.

A final layer of non-woven separation geotextile cover would be placed over the rock fill layer and extend nominally 2 m up the sides of the waste rock surround to limit the potential migration of fines from the tailings into the bridging layer and subsequent seepage collection layer to maintain its integrity.

3.4.3.6. Stormwater Management Diversion Works

Stormwater management works to prevent rainfall runoff from flowing into adjacent areas to Kintore Pit were undertaken during Pit preparation works for the current decline and portal access. To further reduce rainfall ingress into the Pit it is proposed to install two stormwater diversion measures across the current Mine Haul Road and access road into the Pit. Approximately 220 t of waste rock would be used to construct these bunds which would be completed in less than 2 days using a grader, compactor and truck for placement, grading and compaction of the mounds.

Figure 3-7 Indicative Seepage and Drainage Layer



Referenced from Figure 2 in Appendix A of the Golder Report (**Appendix B1**)

3.4.3.7. Summary of Proposed Kintore Pit Preparation Material and Equipment Movements

Pit preparation activities together with vehicle movements and equipment are summarised in **Table 3-6**.

Table 3-6 Summary of Pit Preparation Materials, Equipment and Vehicle Movements

	Equipment	Material / Activity	Duration	Return Trips For Activity	Return Trips Per Day	Return Trips per Hour	Duration of Return Trip (mins)
Fill MLD	2 x 55t mine trucks	76,780t waste rock sourced from underground	During normal operations 20 hours per day, 7	1,396	-	-	-

	Equipment	Material / Activity	Duration	Return Trips For Activity	Return Trips Per Day	Return Trips per Hour	Duration of Return Trip (mins)
			days per week				
Decline Plug	3 x Agi trucks	210 m^3 concrete (5.5 m^3 per truck) from gate to KP Portal (1,700 m)	13 hours over 1 day	38	38	3	30
	1 x 30t excavator	Outlet pipe (solid walls) 220Lm Laying pipework	10 hours per day over 3 days	-	-	-	-
Portal Adit & Drive	3 x 43t dump trucks 1 x dozer (D8) 1 x 45t excavator	9,680t (4,400 m^3) waste rock from KP Tipple to Portal (547 m)	20 hours over 1 day	225	225	12	12.8
Shaping Layer	1 x crusher 1 x dozer (D8) 1 x 30t excavator 1 x FEL 1 20t compactor 3 x 43t dump trucks	Based on 400 t per hour <500mm Day time operation	10 hours over 1 day	-	-	-	-
		8,800 t select waste rock from KP Tipple to 600 mm KP Tipple to base of KP (547 m)	20 hours over 1 day	205	205	12	12.8
Seepage Layer and Works	3 x 43t dump trucks 1 x 45t excavator	1,200t waste rock from KP Tipple	7 hours over 1 day	28	28	12	12.8
Drainage Pipes	1 x 30t excavator	Drainage pipe (perforated walls) 650Lm Laying pipework	10 hours per day over 5 days	-	-	-	-
Drainage Aggregate	1 x 24t rigid body tip truck 1 x excavator	3,410t crushed offsite 20 mm	7 days @ 10 hours per day	142	20	2	30
	1 x dozer D8	Used in base of Pit to spread material	Day shift only With above	-	-	-	-
	1 x 20 t compactor	Used in base of Pit to compact material	Day shift only With above	-	-	-	-
Bridging Layer	4 x 43t dump trucks	241,000 t waste rock from KP Tipple to base of KP (547 m) Placed to 240 RL	2.5 weeks @ 7 days per week 20 hours per day	5,605	320	16	12.8
	1 x 45t excavator	Loading waste rock into trucks	With above	-	-	-	-
	1 x dozer D8	Used in base of Pit to spread material	With above	-	-	-	-
Geotextile Filter	1 x truck	Delivery, sourced from off site	-	-	-	-	-

	Equipment	Material / Activity	Duration	Return Trips For Activity	Return Trips Per Day	Return Trips per Hour	Duration of Return Trip (mins)
	1 x FEL	Used in base of Pit to place geotextile (9,600 m^2)	Day shift only 10 hours per day over 5 days	-	-	-	-
Stormwater Diversion	1 x 43 t	110 t waste rock from KP Tipple to top of ramp	1 hour over 1 day	3	3	3	12.8
	1 x 30t excavator	Loading waste rock into trucks	With above	-	-	-	-
Dust management	1 x 35,000L water truck	Used in all areas within the Pit	During all dust generating activities operating 20 hours per day	-	-	-	-

3.4.3.8. Kintore Pit Preparation Timetable

Table 3-7 provides an indicative timeframe for preparation works within Kintore Pit. Note some activities are completed concurrently.

Table 3-7 Preliminary Construction Timeframe for Pit Preparation Works

Item	Weeks
Filling of MLD (to be completed as part of normal operations for placing waste rock into U/G voids)	10 weeks
Installation of Decline Plug	2 weeks
Filling of portal adit drive	2 week
Installation of shaping layer and associated works	4 weeks
Installation of seepage collection layer and associated works	4 weeks
Installation of bridging layer and associated works, including stormwater management diversions	4 weeks

3.4.4. Operation of TSF3

3.4.4.1. Tailings and Waste Rock Placement TSF3

The dried full stream tailings would be sourced by harvesting from TSF2 and deposited as engineered tailings fill in the central part of TSF3. This fill would be transported from TSF2 and co-placed with waste rock, placement at the end of year one is shown in **Figure 3-8**.

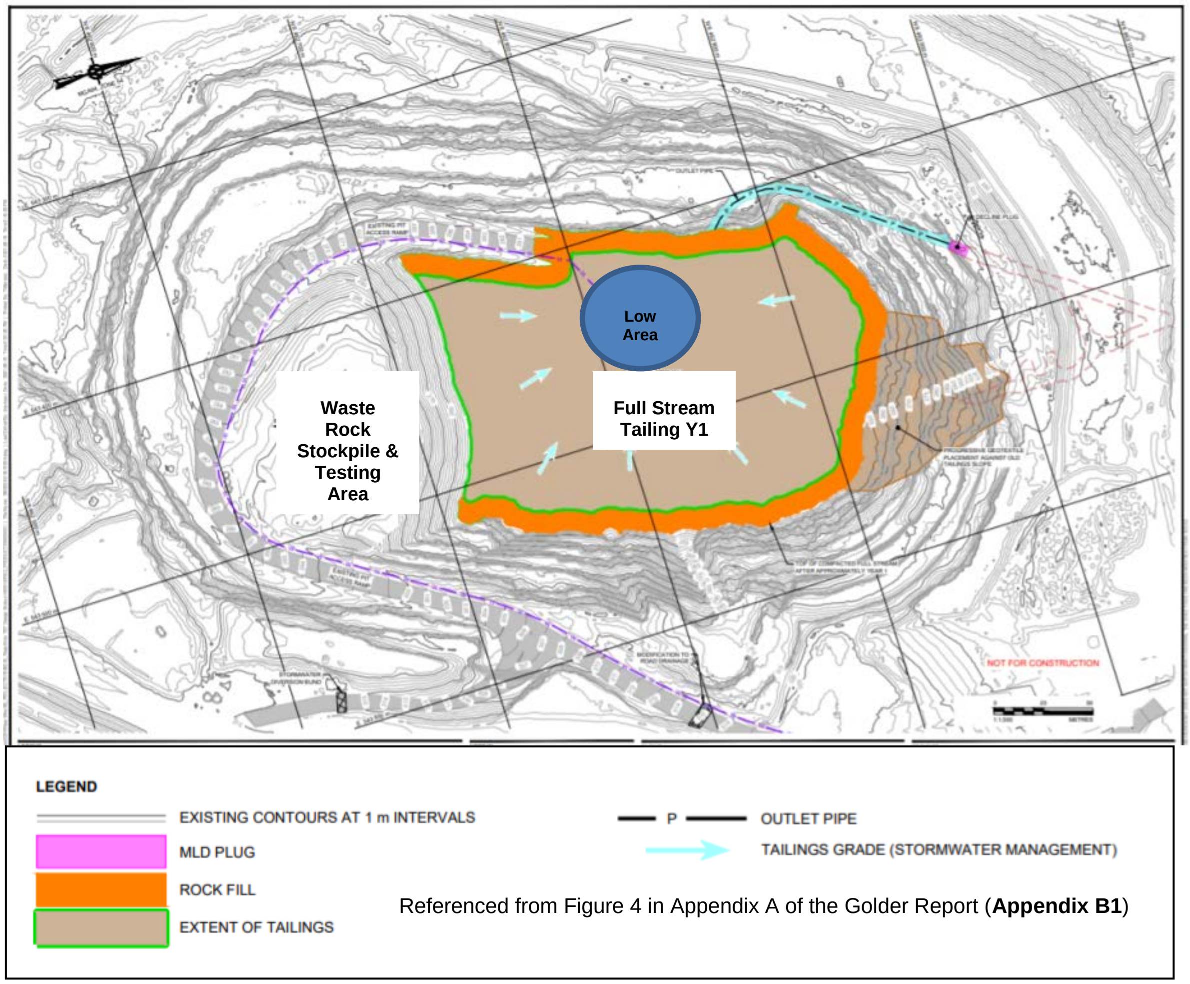
The harvesting fleet would be scheduled to load, haul and place the dried tailings into the bottom of the Pit over a period of a maximum 10 hours per day, during day shift only. It is expected that spreading and compaction of a days' delivery of harvested tailings would take a few hours per day. Depending on operation constraints and equipment availability and scheduling, this may be progressively spread and compacted, or carried out in campaigns spaced a few days apart.

The dried tailings would be placed in near horizontal layers of a nominal 250 mm thickness across the entire area and be compacted with a roller. The layer thickness and roller mass would be determined as part of the commissioning stage of tailings placement process based on a trial pad, to develop the most effective placement method to achieve a dry density ratio of at least 95% Standard compaction effort in accordance with ASTM D1556 (Golder has advised that the density requirements are related to stability of the tailings mass which is important during operation and closure and to achieve a void ratio that minimises liquefaction).

BHOP has selected a larger truck to transfer tailings to reduce the number of truck cycles and thus dust generated from this activity. It is proposed to use 60 t with a 55 t payload which would require approximately 8,720 truck cycles per year to transfer 480,000 t of tailings. It is expected that the average transfer rate between TSF2 and TSF3 would be approximately 170 tonnes per hour, which is approximately 3.1 trucks per hour. Higher transfer rates may occur during peak periods.

Waste rock would be transferred from underground to either Kintore Pit or BHP Pit. Prior to transfer to the surface waste rock would be classed into categories with no / low lead content, and assumed high lead content.

Figure 3-8 Indicative TSF3 Placement Strategy



Referenced from Figure 4 in Appendix A of the Golder Report (**Appendix B1**)

The expected no / low lead material would be selected and placed on the Kintore Pit Tipple for testing and use in rehabilitation capping, the assumed high lead material would be directly taken and placed within and around the perimeter of TSF3. The waste rock would be placed in near horizontal layers, and the top shaped to direct rainfall runoff onto the tailings where it would be removed via pumping and / or evaporation. The waste rock filling plan would be updated at least annually to suit the progress of the tailings filling plan and the stormwater management infrastructure. The waste rock would be placed to an elevation nominally 0.5 m above the tailings level. Remote operated equipment may be used to help enable this material to be placed safely.

The surface area of the bridging layer at the base of TSF3 (top of bridging layer and shaping layer at approximately RL 240 m AHD) presented in the concept design is approximately 14,600 m^2. The volume of compacted tailings at the full tailings production rate of 480,000 tpa is equal to approximately 21,277 m^3/month. This volume is related to the compaction target dry density of 1.88 t/m^3. It is expected to deposit a maximum of 130,000 tpa of waste rock into TSF3 which equates to approximately 59,000 m^3 per annum. **Table 3-8** summarises truck numbers over an operational year. A further 16,000 t of waste rock would be taken to Kintore Pit Tipple and tested for its lead and sulphur content, once confirmed it is<0.5%Pb and <0.2% sulphur it would be stockpiled for use as rehabilitation capping material.

Table 3-8 Summary of Operations - Vehicle Movements and Equipment

	Equipment	Material / Activity	Duration	Return Trips For Activity	Return Trips Per Day	Return Trips per Hour	Duration of Return Trip
Equipment use within TSF3	Roller Excavator Dozer	Compacting tailings and/or waste rock Loading trucks on KP Tipple Earthworks for waste rock placement, if required	During normal operations 10 hours per day, during day shift only	-	-	-	-
Tailings	2 x 60t Moxy trucks (55t payload)	Transferring 480,000t harvested tailings from TSF2 to TSF3 (2,283m)	During normal operations 10 hours per day, during day shift only	8727	31	3.1	48
Waste Rock	Sandvik TH663 haul trucks with ejector tray (55t payload)	Transferring 146,000t waste rock from underground operations to KP (1,823m) (may also go to BHP Pit)	24 hours per day 7 days per week	2,654	7.3	0.3	47.4

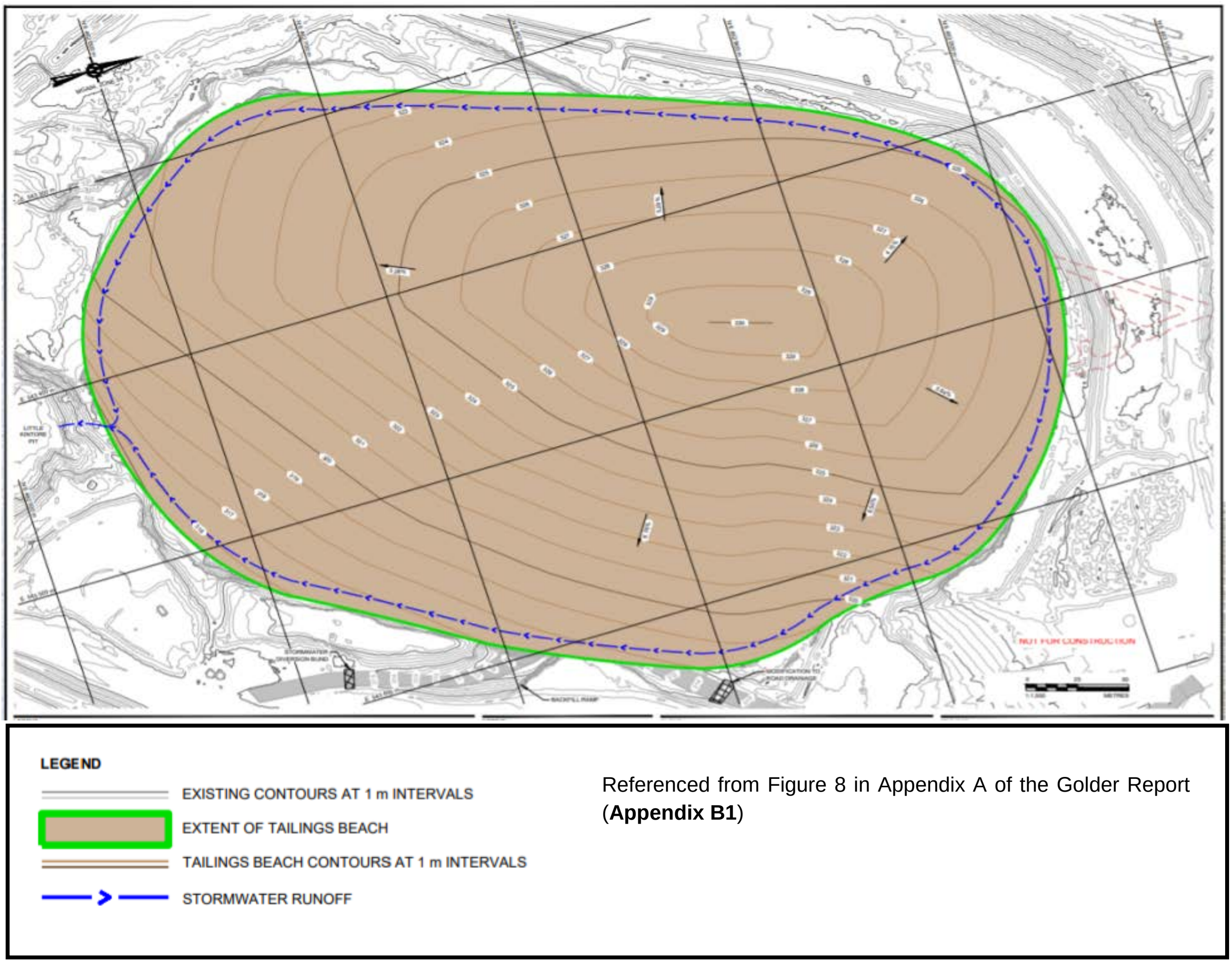
The rate of rise based on a tailings production rate of 480,000 tpa and 130,000 tpa of waste rock is summarised in **Table 3-9**. The rate of rise accounts for material from the surface of the bridging layer upwards.

Table 3-9 TSF3 Preliminary Filling Schedule (all elevations and volumes are approximate)

Year	Approximate filling elevation (RL)	Cumulative Volume of Tailings Produced (m^3)	Cumulative Volume of Waste Rock Produced (m^3)	Combined Total of Tailings and Waste Rock Produced (m^3)
1	255	255,319	59,091	314,410
2	265	510,638	118,182	628,820
3	275	765,957	177,273	943,230
4	280	1,021,277	236,364	1,257,640
5	285	1,276,596	295,455	1,572,050
6	290	1,531,915	354,545	1,886,460
7	295	1,787,234	413,636	2,200,870
8	300	2,042,553	472,727	2,515,280
9	304	2,297,872	531,818	2,829,691
10	308	2,553,191	590,909	3,144,101
11	312	2,808,511	650,000	3,458,511
12	316	3,063,830	709,091	3,772,921
13	~ 320	3,319,149	768,182	4,087,331

The full capacity of the TSF3 is approximately 4,305,000 m^3. There would be approximately 217,689 m^3 of capacity remaining after 13 years of operation which would take the life of the facility to almost 14 years. A further 1 to 2 years would be available from mounding the tailings depending on the achieved tailings density in the Pit and the extent of completed consolidation to the 330RL, as shown in **Figure 3-9** (plan view) and **Figure 3-10** (cross-section view).

Figure 3-9 Final Level of Tailings/Waste Rock Placement



Referenced from Figure 8 in Appendix A of the Golder Report (**Appendix B1**)

3.4.4.2. Management of In-Pit Old Mine Workings and Tailings Slope

As recommended by Golder (**Appendix B1**) measures would be undertaken during operations to address some old mine workings visible in the eastern wall and northern slope of the Pit where residual crushed timbers are visible and the old exposed tailings slope located in the northern batter. These measures would be addressed in the Operations and Maintenance Plan for TSF3 to be completed during detailed design.

Old Mine Workings

Additional measures have been designed to protect underground workings from any ingress of liquefied tailings that may enter the mine from existing voids or known pathways in the Pit walls. Measures would be taken to reduce the size and / or porosity of any opening by forming a buttress of waster rock around the opening.

Once the tailings reach a level where an opening is encountered and it is safe to do so, the area would be inspected to identify any fauna habitats, particularly bats (using an appropriate detection device (such as an Anabat Detector). If bats were detected the area would be covered when the bats have exited and the buttress installed. The NSW DPIE would be notified. Note, no bats have been seen in or around the Pit since operations commenced in 2007. This is a precautionary measure only.

Following inspection and approval to install the buttress, the area would be filled with large boulders and covered with compacted waste rock (buttress) that extends 10 m beyond the top and sides of the opening and extended 10 m from the pit slope. A layer of non-woven separation geotextile would be placed on the outside face of the waste rock buttress and be covered with another layer of waste rock to hold it in place. The geotextile is to be placed on the bottom, front, sides and top of the buttress to fully envelope the buttress and intercept potential liquefied tailings flow paths into the buttress. Based on engineering advice and considering the actual size of the opening, a biaxial geogrid (or other reinforcing material) may be placed across the opening and extending nominal 5 m either side of the opening edge and be covered with the waste rock buttress if considered necessary.

Old Tailings Slope

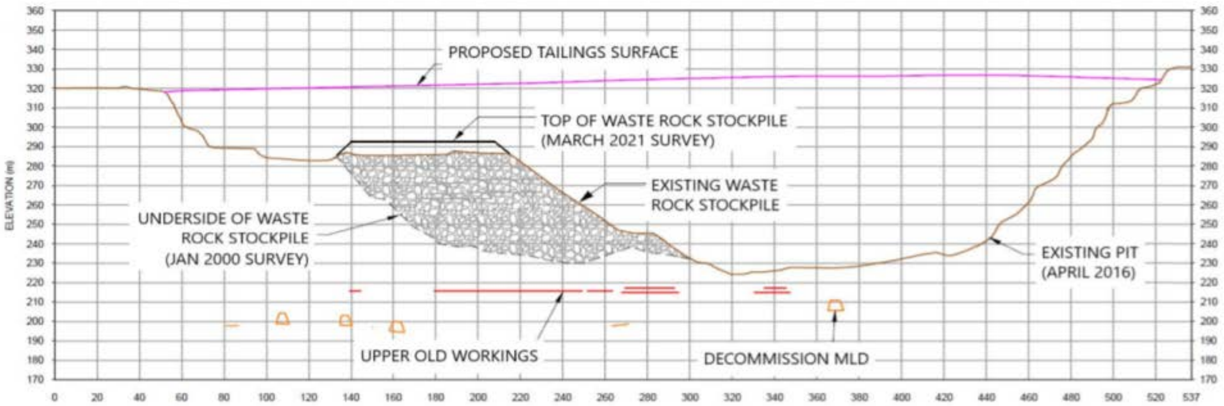
GCE (**Appendix G4**) and Golder (**Appendix B1**) considered the stability of the historic tailings slope and indicated that the slope appears to be cemented with a factor of safety greater than 1.0 when dry.

A detailed risk assessment would be undertaken during detailed design for the historic tailings slope to identify safe methods for tailings deposition. A slope stability assessment undertaken by GCE (and discussed in **Section 8.5**) shows the potential for slope scale instability of the historic tailings slope under certain hydrogeological conditions. The existing surface of the tailings has been observed to have crusted over providing rainfall erosion resistance of the tailings slope. The historic tailings slope would be supported progressively by the placement of waste rock against its surface (with a safety bund installed along the base of the slope for protection of personnel which would be progressively re-established as the surface of the fresh tailings rises). In addition as filling progresses, and depending on the outcome of the risk assessment, the surface of the historic tailings may be selectively protected by a layer of geotextile (or alternative product) prior to the placement of waste rock.

3.4.4.3. Seepage and Surface Stormwater Management

The moisture content of the tailings and waste rock, as placed, is low and with the high evaporation rates in Broken Hill seepage from these sources is expected to be minimal. Some seepage may occur from stormwater penetrating through the waste rock, both the perimeter placement and the current stockpile until the stockpile is covered with tailings.

Figure 3-10 North-South Section through Kintore Pit TSF3



As tailings is deposited into TSF3 the surface of the tailings would be shaped to form a depression or a number of low lying areas to enable the rainfall runoff to be collected. This would provide for timely removal of any surface water.

The tailings would be partially saturated when transported into the Pit where it would be compacted, hence its permeability is expected to be very low (Golder Report **Appendix B1**) resulting in very low and slow infiltration into the tailings from any stormwater stored on the surface. Minor volumes of collected rainfall runoff would be either evaporated on the compacted tailings surface or pumped out of the Pit to maximise the drying area of the tailings surface for trafficability and compaction purposes. The design provided by Golder is to restrict rainfall collected on the tailings surface and remove water from the low areas within seven days of rainfall events.

Rainfall from the surrounding waste rock placed around the perimeter of the Pit would also be directed to these low lying areas and managed via evaporation and/or pumping and removal.

TSF3 would be designed to manage rainfall events up to 1:10 ARI and a strategy to detain and remove runoff from a 1:100 ARI event, via evaporation and removal by pumping. Removal of collected rainwater would be by pumping or water truck and taken to the water storage pond (S22) adjacent to Mt Hebbard, where it would be redirected to the processing plant or underground. The low areas/depression within the tailings surface would be maintained during the ongoing tailings deposition works. It is estimated that a 24 hour 1% AEP event would result in up to approximately 9.8 ML of rainfall runoff accumulated on the tailings surface, assuming 80% total runoff coefficient. Some runoff is expected to infiltrate via the waste rock layer at the perimeter of the Pit.

It is expected that seepage over time would reduce from current seepage rates as less rainfall can penetrate through the tailings and stored rainfall would be removed via pumping and surface evaporation.

3.4.4.4. Underground Water Management

Water is used underground for service facilities and drilling operations. There is also a requirement to dewater the mine to ensure the water table remains at a safe level (570 m to 590 m below surface) for both the Rasp Mine and the adjacent Perilya South Operations.

Mine water used underground is a combination of process water that is supplied underground via a gravity feed water reticulation system (four 22,500 L surface and 2 14,000 L water tanks) and natural groundwater.

Water used and entering the Mine working areas is collected in a series of dedicated underground sumps located in close proximity to the active mine workings, currently there are approximately 23 sumps with a nominal capacity of approximately 70 m^3 (May 2021) per sump. From these sumps mine water is transferred to either one of the two current mine dewatering systems via:

- A piping system of three dedicated and permanent 150 mm poly pipes with an average flow rate of 14.2 L/s or 51 m^3/hr, and / or
- Pumping infrastructure, currently 8 mono pumps with a nominal capacity of 14 m^3 per pump (May 2021).

The two dewatering systems used at the Rasp Mine are the Primary Dewatering Network (PDN) extraction via a dedicated rising main to the surface (150 mm poly pipe outside diameter (OD) with a flow rate of approximately 28 L/s) and the Shaft 7 vertical water storage facility suspended in line pump (Schlumberger 23 stage ESP, with a flow rate of approximately 20 L/s).

The PDN is made of three dedicated pump stations (Pump Station 1, 2 and 3) that are configured in-series to transfer water out of the mine via the dedicated rising main. These pump stations have been strategically placed vertically through the mine to support the current and future mining activities and the required pumping capacity at these locations. A settling pond is located at each of the three pump stations with a total storage capacity of approximately 1,000 m^3.

The Shaft 7 vertical water storage facility has a total capacity of approximately 2,500 m^3 (water depth of 170m) and a working capacity of approximately 2,000 m^3 (115 m depth). Shaft 7 is an historic shaft located to the south west of the Lease and utilises an inline pump suspended in the shaft with a dedicated discharge pipe (150 mm pipe OD) to the surface.

The Shaft 7 vertical dam facility provides spare pumping capacity from the underground workings that may be used if and when the PDN is inoperable for a period of time (planned and/or unplanned). Water is transferred to Shaft 7 via a dedicated unused underground drive located on the 1480 ft level approximately 450 m below the surface. It has a water holding capacity of approximately 2,700 m^3 (assuming nominal depth of 1.0 m). This pumping system is periodically used to dewater the Mine as required providing redundant mine dewater capacity.

The daily pumping capacity (nameplate) from both the PDN and Shaft 7 is approximately 4.1 ML per day. Average daily pumping is approximately 1.8 ML providing sufficient spare capacity to absorb any additional water generated from tailings seepage within TSF3.

The tailings have a low permeability and it is not expected that there would be any significant seepage through the tailings to underground. Some seepage may occur from stormwater which finds its way through the placed waste rock at the Pit's perimeter. An extensive seepage system would be installed in the base of the Pit and seepage would be directed through the newly filled portal adit drive and the Decline Plug, joining other water sources underground where it would be collected and transferred through the underground water management system. A seepage water monitoring system would be installed at the Decline Plug which would be inspected on a daily basis to identify any changes in water flows.

Therefore it is anticipated that any seepage that may report to the underground working from the placement of dried tailings into TSF3 would be captured in the existing underground water management network and underground sumps and pumped to the surface for use in the processing plant or returned underground.

3.5. Tailings Harvesting TSF2

Tailings from the plant are currently placed as thickened slurry (65% solids) into Blackwood Pit as TSF2, a Declared Dam (Blackwoods) by Dams Safety NSW. Blackwood Pit is located centrally and to the north-east of CML7, the processing plant lies adjacent and to its south, historic waste rock storage areas lie to the east and west with Proprietary Square (Perilya CML4 property) to the north (**Figure 1-2**).

The tailings surface elevation is approaching the final maximum design elevation and BHOP plans to develop the nearby Kintore Pit TSF3 for ongoing storage of dried, compacted tailings co-placed with mine waste rock. BHOP plan to continue utilising Blackwood Pit for ongoing wet tailings deposition as well as operating as an ongoing tailings drying and tailings harvesting area.

Under this approach slurried tailings would continue to be deposited into TSF2 at a proposed maximum rate of 440,000 tonnes per annum (tpa). Harvesting capacity would be up to 480,000 tpa to allow sufficient buffer and catch-up capability. The tailings harvesting and deposition rate may vary over time depending on processing plant production, mining operations and variable weather conditions.

BHOP engaged Golder (TSF2 Design Engineer and Certifier), to design a conceptual layout for tailings harvesting and propose a tailings harvesting strategy. This concept design is included as part of the Golder Report in **Appendix B1**. It is noted that TSF2 would be operated as an active tailings storage facility and would need to continue to conform to the requirements of Dams Safety NSW. Hence the freeboard, spillway, water management and monitoring requirements for TSF2 remain unchanged from current operations.

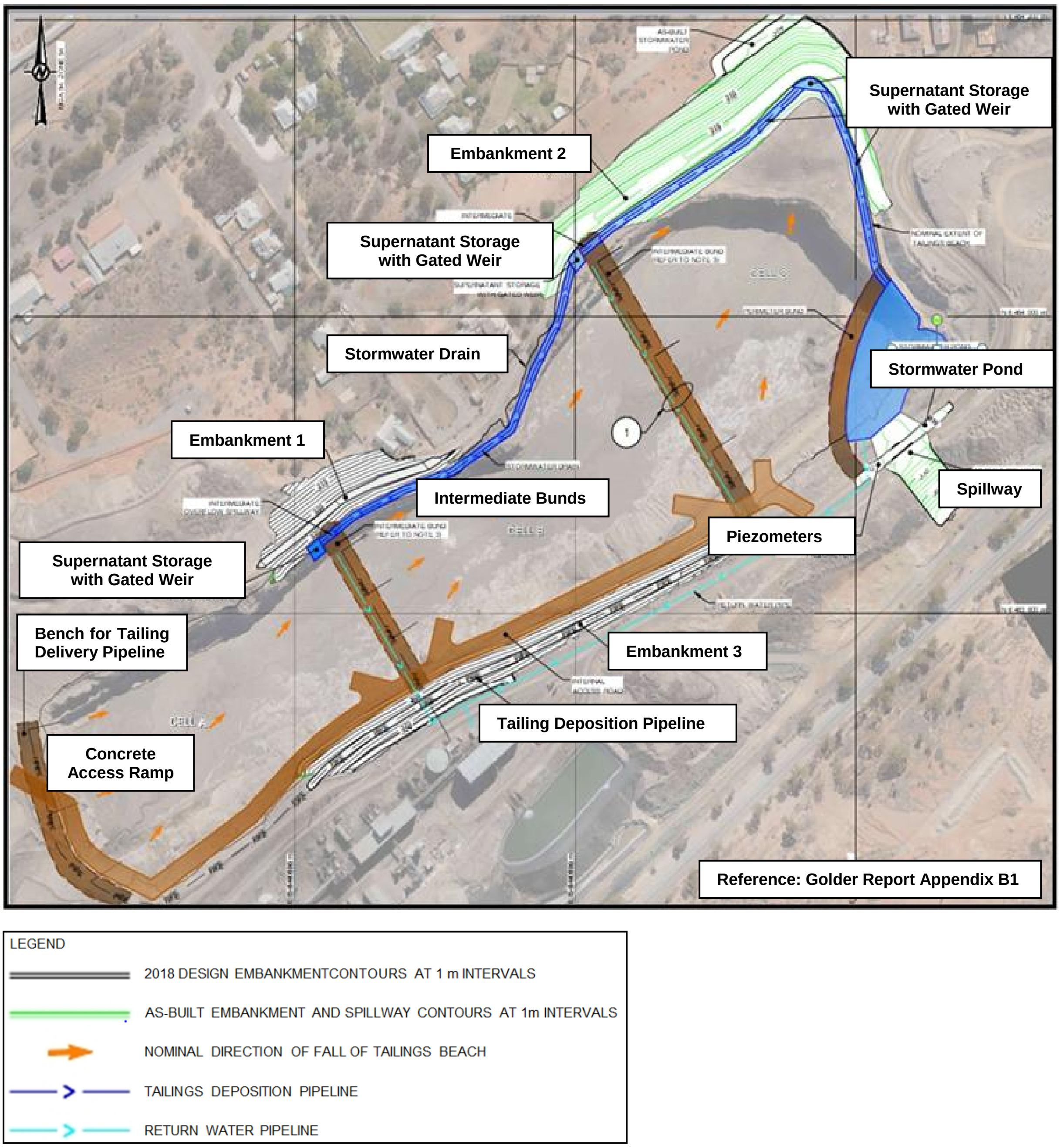
Golder has provided a concept layout design for TSF2 which includes allowance for collection of supernatant liquid, stormwater management and internal access roads. This layout is based on:

- Providing capacity for stormwater storage to manage stormwater runoff.
- Tailings supernatant liquid being detained in each cell for progressive removal during filling operations.

- Providing a minimum 10 m width access road corridor for one way traffic (allowing for a trafficable width of approximately 5 m).
- Incorporating intermediate bunds (between cells) of up to approximately 15 m wide footprint to allow for tailings harvesting to be undertaken to a maximum thickness of approximately 1.5 m.

The conceptual layout provided by Golder for tailings harvesting included three almost equally sized cells installed within Blackwood Pit each with approximately a 3 Ha available drying area, as shown in **Figure 3-11**. It is proposed to deposit the tailings in thin layers into the cells or drying bays to enable the tailings to dry or 'dewater' to a point where the tailings can be excavated, loaded and transferred to TFS3 for placement and compaction.

Figure 3-11 Golder Tailings Harvesting Concept Layout for Blackwood Pit TSF2



3.5.1. Tailings Harvesting Preparation Works

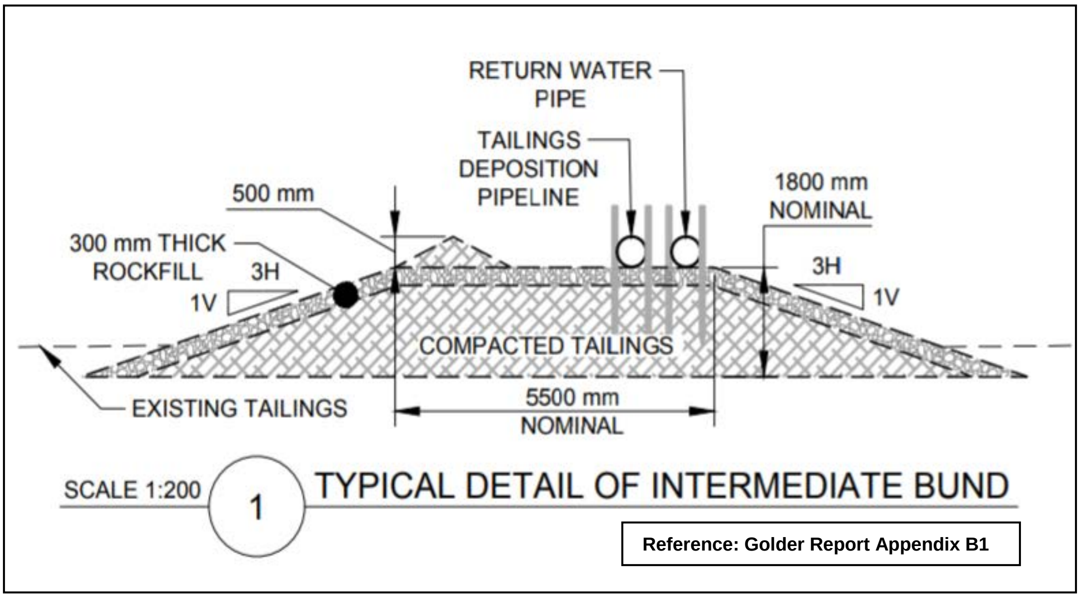
The development of TSF2 as a drying area for tailings would require preparation works to be completed prior to harvesting. These pre-harvesting works would be undertaken at the same time as the preparation works in Kintore Pit, together with works to complete the Tails Harvesting Haul Road.

The following sections describe the preparation works to be undertaken for tailings harvesting to commence operation.

3.5.1.1. Intermediate Bunds

The intermediate bunds between the three cells would be constructed with a crest elevation nominally 300 mm above the final tailings surface level for TSF2 and with an overall height of 1.8 m, **Figure 3-12**. These intermediate bunds are proposed to be formed with a nominal crest width of at least 5.5 m to allow for the installation of safety bunds on either side enabling them to be safely trafficked by light vehicles. Tailings delivery pipelines may be buried within these safety bunds. The intermediate bunds are intended to be formed using excavated tailings with nominal 3H:1V embankment batters, external faces and crest would be covered with a layer of waste rock. The waste rock layer is intended to act as both an erosion protection layer and marker layer to help avoid inadvertent excavation of the bunds during tailings harvesting activities. The bunds would be engineered structures and the crest elevation would be lower than the adjacent perimeter embankment or pit rim of TSF2 maintaining the required freeboard.

Figure 3-12 Conceptual Design for Intermediate Bunds



3.5.1.2. Supernatant Management Network

Supernatant from the deposited tailings would be managed by incorporating a gated weir into the western end of each of the intermediate bunds. These weirs would be designed to enable them to be progressively raised and lowered on a nominal daily basis during tailings deposition to suit the deposited tailings surface level in the upstream bay. This would enable the supernatant liquor to be decanted from the tailings surface to a sump formed adjacent to the bunds. Supernatant collected in the sumps would either be decanted or extracted by periodic pumping during deposition and returned to the processing plant. If required the sump may be lined to limit water infiltration into the adjacent tailings.

The western end of each cell would include a geotextile lined rock fill mound designed to be overtopped in the event of intense rainfall events. The mound would be incorporated with the gated weir to form intermediate overflow spillways for each cell. The return water pipe from the sump to the processing plant would be incorporated within the safety bund.

3.5.1.3. Stormwater Management System

It is proposed to construct a stormwater pond, designed to store rainfall runoff from a 24 hour 10% annual exceedance probability (AEP) event, on the tailings surface adjacent to the existing TSF2 spillway. This pond would be formed by excavating tailings to form a depression which would be lined to limit stormwater infiltration into the underlying tailings. Stormwater collected in this pond would be extracted by pumping with the water returned to the processing plant for use in operations. The stormwater pond would include access for the required pumping equipment.

An open channel drain would be installed to convey runoff from each of the cells to the stormwater pond. This drain would be sized for the 10% AEP event and may be lined (where required) to limit infiltration to underlying tailings. This channel drain would run along the northern perimeter of the cells.

Intermediate overflow ‘spillways’ would also be constructed from the supernatant sumps in each cell which would discharge to the open channel drain that in turn discharge to the stormwater pond. This is designed to enable stormwater runoff from each cell to be conveyed directly to the stormwater pond to limit disruption to drying and harvesting operations.

The intermediate overflow spillways would be formed at the west end of the intermediate bunds with the overflow formed with waste rock to limit risk of erosion. The intermediate overflow spillways would be designed to convey flows for a 1% AEP event.

To maintain the ability of the TSF2 to retain a 1 in 10,000 AEP storm event (approximately 48,000 m^3) without spillway discharge as required by Dams Safety NSW, the existing TSF2 spillway would remain as constructed and would allow discharge flows when the detention capacity of TSF2 is exceeded (as per its design intent and requirements of Dams Safety NSW).

3.5.1.4. Construction Materials

The preparation works for tailings harvesting would be constructed utilising the following materials:

- Tailings excavated from Blackwood Pit would be used to form intermediate bunds and as fill for internal road embankment construction.
- Rock fill sourced from the waste rock stockpile located within Kintore Pit. Rock fill would comprise rock particles typically less than 500 mm in size and would be used as an erosion protection measure and as a marker layer to help prevent inadvertent over excavation of the bunds.
- Crushed and/or select rock fill with particles typically less than 70 mm for the wearing course and surfacing of internal pit roads.
- Pipes to enable deposition of tailings within each of the three cells. It is expected pipes for this application may be available onsite. If this is not the case they would be required to be manufactured off-site and transported to site.
- Return water pipes. It is expected pipes for this application may be available onsite.

3.5.1.5. Construction Quantities

Quantity estimates for materials expected to be used in the construction preparation works for tailings harvesting are as follows (approximate quantities):

- 25,000 t of dried tailings excavated from Blackwood Pit for use in construction of intermediate bunds and internal pit roads. Tailings would be won from excavation of the stormwater pond, drains and sumps required to be formed as part of pre-harvesting works.
- 5,000 t of waste rock excavated from the Kintore Pit stockpile and processed / crushed for use in construction of intermediate bund protection layer, internal pit road wearing course and drain lining system.
- 3,000 m^2 of liner material for drain and pond construction (imported to site).
- 1,000 m of tailings delivery pipeline (and spigots) installed on the intermediate bunds and along southern pit perimeter.

- 1,000 m of return water pipeline to return collected supernatant water to the processing plant.
- 30 m^3 of concrete for construction of weir gates (precast or cast in situ).
- 10 m^3 of concrete for construction of pump platforms for extraction of collected liquid from stormwater pond.

3.5.1.6. Mobile Equipment Requirements

The proposed equipment types and the estimated number of vehicle movements required for the tailings harvesting preparation works are presented in **Table 3-10**.

Table 3-10 Mobile Equipment for Preparation Works

Mobile Equipment	Nominal Capacity	Material	Number of Movements / Operating period[1]
Off road haul truck	40 t	25,000 t	Movement of tailings within TSF2, short haul distances, operating continuously, estimated at 625 return trips)
Off road haul truck	40 t	5,000 t	Movement of crushed rock fill from Kintore Pit stockpile to TSF2 (125 return trips in total)
Excavator	45 t		Continuous during tailings excavation and rock fill transport
Bulldozer	200 kW		Continuous during tailings and rock fill transport
Concrete truck	6 m^3	40 m^3	10 (loaded and unloaded), during gated weir construction
Water cart	30,000 L	N/A	As required during rock fill and tailings transport
Roller compactor	15 t	16,000 m^3	During intermediate bund
Motor grader	100 kW	16,000 m^3	During intermediate bund
Pipe delivery truck	N/A	2,000 m	10 to 20 depending on truck size
Liner Material Delivery Truck	N/A	3,000 m^3	2 to 6 depending on truck size and liner material

Note: 1. One truck movement corresponds to travel from a loading point to an unloading area or vice versa. A return trip therefore constitutes two truck movements.

3.5.1.7. Blackwood Pit TSF2 Tailings Harvesting Preparation Timetable

Table 3-11 provides an indicative timeframe for preparation works within Blackwood Pit which are expected to take approximately 18 weeks to complete.

Table 3-11 Preliminary Construction Timeframe Harvesting Preparation Works

Item	Weeks
Construction of intermediate cell bund walls and overflow spillways	4 weeks[1]
Construction of internal pit roads and benches for pipeline corridors	4 weeks[1]
Installation of stormwater drains, supernatant storage sumps, gated weirs and stormwater pond	4 weeks
Installation of return water pump stations and pipes	3 weeks
Installation of tailings delivery pipes and deposition spigots	2 weeks
Modification of sprinkler system to suite harvesting setup	1 weeks

Note: 1. Some of these works would be completed for the installation of the sprinkler system (MOD4).

3.5.1.8. Tails Harvesting Haul Road Extension

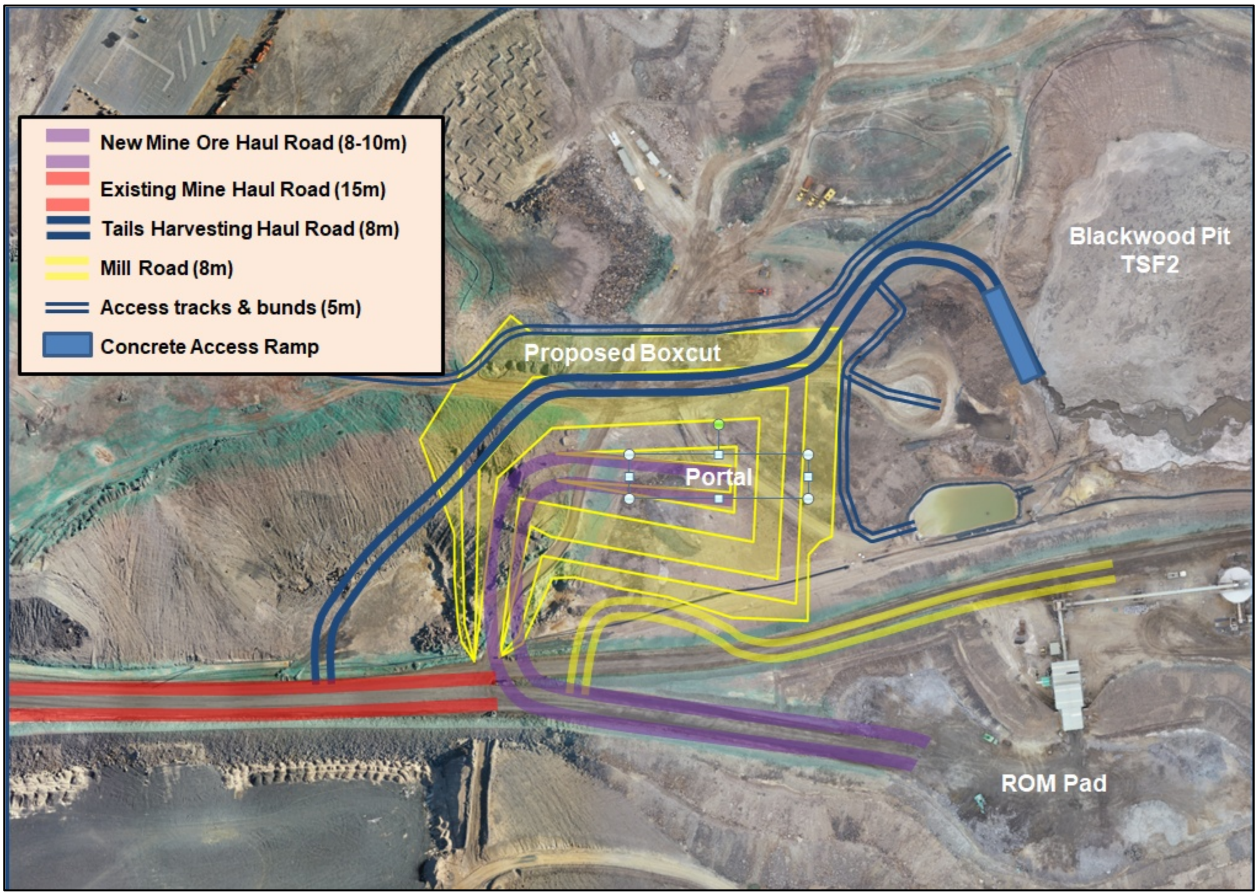
A new road would be constructed to allow the transfer of tailings from TSF2 to TSF3 (Tails Harvesting Haul Road) exiting the southern side of TSF2 and running along the north-east bench of the proposed box cut until joining the existing Mine Haul Road to the south of the new portal location, **Figure 3-13** . This road would be sealed.

The proposed location of the junction of the new Tails Harvesting Haul Road to the existing Mine Haul Road is intended to limit interaction between mine ore haulage and tailings haulage vehicles. This haul road would be an extension to the existing haul road network primarily for use by haul trucks transporting harvested tailings between TSF2 and TSF3. Traffic management along this new section of haul road would follow the existing BHOP Principal Hazard Management Plan (PHMP) for Roads and Vehicles (BHO-PLN-SAF-004). The road would operate as a single lane for vehicle traffic with right of way given to trucks hauling tailings. Travel would be in one direction at a time.

BHOP recognises vehicle interaction as a principal hazard and as such the detailed design of this road would be subject to a robust process adopting required standards and guidelines throughout the design, construction and operation of this infrastructure. As part of the process of detailed design, the specifications for the road would be developed through a formal risk assessment process to provide for the following; width, curvature, grade, intersections, visibility, pavement shape, construction materials, safety berms, barriers, guideposts and signs. Traffic flow and characteristics of mine vehicles are also considered factors in the road design.

The proposed Tails Harvesting Haul Road would intersect the existing Mine Haul Road at 90^{o} at a point where there is sufficient visibility. The road would enter the boxcut at a horizontal level (at 335RL) with the grade increasing to 3 - 5% as it runs through the boxcut intermediate bench. As the road exits the boxcut at the northwest corner the gradient would be approximately 10% at which point it then enters the southern end of TSF2 via a concrete access ramp into Blackwood Pit.

Figure 3-13 Proposed Tails Harvesting Haul Road and TSF2 Access Ramp



In addition noise abatement bunding would be installed around the west side of the boxcut where the road connects to the existing Mine Haul Road. This would require approximately 5,500 t of waste rock which would be sourced from the Kintore Pit stockpile and would be tested to ensure the content is <0.5%Pb.

The construction of the new road would utilise the heavy mobile plant used for boxcut construction such as excavators, articulated dump trucks, bulldozer, grader and water truck. Additional equipment for road pavement construction would include rollers, concrete trucks and an asphalt tanker. Approximately 70,000 t would be excavated to construct the road and this material would be placed in-pit into Little Kintore Pit for permanent storage. Crushed waste rock which has been tested and contains <0.5%Pb would also be used (2,640 t) together with concrete (240 t) and asphalt (99 t) for sealing. It is expected the road works would take two weeks with the bulk of the works occurring with the boxcut excavation.

The internal roads within TSF2 would be constructed using compacted tailings excavated from TSF2 for the bulk formation and crushed waste rock for surfacing.

In addition minor works would be undertaken to re-align the Mill Road with the new Mine Ore Haul Road by creating a 90^{o} intersection and improving intersection visibility.

3.5.2. Considerations Related to the Design

3.5.2.1. Tailings Drying Trials – Blackwood Pit

BHOP completed multiple tailings drying trials on tailings within TSF2 between June 2020 and January 2021. Initial sampling and testing of tailings in July 2020 was undertaken with the aim to assess tailings drying times. Results showed tailings had already reached steady state moisture content from the commencement of measurement. Further testing commenced in September 2020 placing tailings slurry in 200 mm deep buckets which were able to be moved as necessary to avoid effects from runoff and pooling water. In response to the results of these trials another round of drying trials was undertaken between 30 November 2020 and 6 January 2021. Monitoring of these trials included measuring moisture content of placed tailings in-situ to depths of up to approximately 500 mm. A report prepared by BHOP summarising the results of these trials is included in Appendix F of the Golder Report (**Appendix B1**).

Golder’s assessment of the results of the drying trials is presented in the following subsections.

<u>September 2020 – October 2020 trials</u>

The results of the September/October trials and associated monitoring undertaken by BHOP indicate:

- All sample locations except the sample location on the tailings surface at the north east corner of TSF2 reached gravimetric moisture content approximately equal to or below Standard Optimum Moisture Content (SOMC) of approximately 11% within approximately 14 days.
- Tailings harvesting is proposed to be undertaken when the tailings is approaching the SOMC to enable effective compaction of the dried tailings. The ‘mill side’ sampling locations near the deposition location reached a moisture content of less than 11% within 7 days. Based on the information provided it is understood samples were recovered from a depth of less than approximately 200 mm below tailings surface level.
- The sample location at the north east corner location of TSF2 was recorded to have ‘*pooled water approaching the sample point*’ on days 10 to 12 and *‘pooled water at (or over) the sampling point’* on days 13 to 17 before the sampling location was moved to be away from the pooled water. The pooled water was supernatant water runoff from the upslope tailings beach. The presence of pooled water at the sample location is expected to have influenced the moisture content of the recovered samples.
- Rainfall events appear to influence the moisture content of the samples with increases in sample moisture contents recorded after rainfall events. For example, on 19 September 2020 a total of 29 mm of rainfall was recorded and moisture content measurements undertaken on 21 September 2020 (which was the first measurement undertaken after this rain event) indicated moisture content increases of up to approximately 10% compared with measurements undertaken on 18 September 2020. The moisture content at the sample locations returned to that approximately equal or below that recorded on 18 September 2020 by 28 September 2020, 10 days later.

During the 33 day trial period a total of 34 mm of rainfall was recorded onsite by the Mine weather station. The onsite recorded average rainfall over the monitoring period equated to 1.03 mm/day which was greater than the mean rainfall for the same period in a typical year of approximately 0.7 mm/day (taken from historic data recorded at Patton Street AWS). It is noted that evaporation is not recorded onsite or available from the Patton Street AWS and daily records are not available for other BoM stations in Broken Hill for the trial period. The BoM records from the Stephens Creek Reservoir AWS (approximately 15 km from the site) indicate:

- Mean evaporation for September is approximately 5.8 mm/day
- The lowest monthly period for evaporation is June when mean evaporation is approximately 2.4 mm/day
- Mean daily evaporation over 12 month is approximately 7.2 mm/day.

<u>November 2020 – January 2021 Trials</u>

The results of the November-January monitoring period were designed to investigate the drying rate of a tailings layer of up to 500 mm thick. The results of the trial indicate:

The majority of the trial period was conducted in December 2020 which experienced wetter and cooler than typical conditions for that time of year. Weather conditions recorded in December 2020 at the Mine indicated an average maximum daily temperature of 30.3˚C compared to the mean 32.2˚C with rainfall of 21.8 mm, higher than the average December rainfall of 18.3 mm and higher than the average for all months in the year of 18.9 mm. These trends are consistent with data reported by BoM for the Broken Hill Airport weather station. BoM records from the Stephens Creek Reservoir weather indicate mean daily evaporation for December is 11.6 mm which is:

- Approximately 5 times greater than that for June, and
- Approximately 1.6 times greater than the mean annual daily evaporation rate.

The trial comprised depositing to the full 500 mm thickness layer of slurried tailings in one operation. The average moisture content of deposited tailings, to a depth of approximately 400 mm below surface level in the trial area, reached approximately equal to SOMC within a period of approximately 1 week of deposition. This was considered the most representative by BHOP (In-Situ-4). The average moisture content of deposited tailings to a depth of 400 mm at an alternate trial location (Mill Pit), considered less representative by BHOP, reached moisture content approximately equal to SOMC within a period of approximately 19 days.

In summary the moisture content of the tailings at a depth of between approximately 400 mm and 500 mm:

- Reached moisture content approximately equal to SOMC after approximately 30 days at the Mill Pit trial location.
- Reached a moisture content of approximately 16% (5% wetter than SOMC) at the completion of the trial (after 24 days) at the In-Situ-4 trial location.

<u>Trailing Testing Summary</u>

Golder concluded, based on the information provided, it is expected that:

- A deposited thin layer (of nominal 200 mm to 300 mm thickness) of tailings would typically be able to dry to a moisture content approaching or below SOMC within a period of approximately 14 days. During summer periods this period may reduce to approximately 7 days.
- During summer months drying and harvesting may be able to be undertaken in increased layer thickness of up to approximately 500 mm based on the proposed production schedule and favourable weather conditions.
- The timeframe for tailings drying during winter period is expected to be slower than that indicated by the trials. It is expected that during cooler months operations would be restricted to suit

deposition in thinner layers. Based on the available information and our experiences we expect drying in layer thicknesses of average 250 mm may be achievable during winter based on the proposed schedule.

- Significant rainfall events are expected to result in increased moisture content in the deposited tailings and are expected to increase the drying timeframe. The available information indicates this may be an additional approximately 7 to 10 days from that experienced without significant rainfall events.
- Drying to increased depths is expected to be able to be achievable if:
  - Mechanical processes (such as ploughing or ripping during harvesting activities) are employed during the drying period, and/or
  - The tailings surface is ‘shaved’ multiple times during harvesting rather than waiting for the full depth to dry.

It is intended that following the initial 20 days drying a layer of approximately 220mm would be removed over the first 7 days and then a further 220mm layer removed over the next 7 days.

Based on this it is expected that the entire available surface area of the TSF2 is required to be made available for tailings harvesting to enable the Mine to achieve production rates equal to or approaching the 480,000 t annual harvesting target. During periods where drying conditions are favourable (dry summer periods) it may be possible to use some of the available surface area on TSF2 for storage of stockpiled harvested tailings to provide operational flexibility in the event of operational unfavourable conditions.

Similarly it is expected that during favourable conditions it may be possible to excavate tailings at a greater rate than deposition to provide ‘backup’ storage capacity at TSF2 enabling operations to continue in the event that tailings placement within TSF3 cannot be achieved for short periods.

However, it is considered likely that varying the tailings harvesting rate throughout the year may be required in response to encountered weather conditions. To help with planning around operations and to better understand the tailings drying behaviour, Golder recommended that the deposited tailings be regularly assessed for moisture content over the deposited thickness at a number of locations within each drying bay.

3.5.2.2. Tailings Surface Trafficability During Harvesting

TSF2 embankments 1 and 3 were partially constructed on compacted tailings fill platforms on the existing tailings beach, sourced from within the beach as shown in **Figure 3-14**. The construction method adopted to source tailings from the surface for the compacted fill platforms, as shown in **Figure 3-15**, was similar to that proposed for the tailings harvesting process.

Based on the experience during the recent construction activities associated with Embankments 1 and 3 the tailings surface becomes trafficable for tracked vehicles within approximately two to three days after tailings deposition has ceased, provided decant or rainfall runoff is promptly removed from the beach. Trafficability for light-wheeled and wide-wheel heavy equipment was found to be possible within approximately one week after tailings deposition had ceased.

Golder considered the on-going stability of TSF2 with the proposed harvesting process of the tailings and for the future closure shape of TSF2. The closure assessment considered a waste rock layer to be placed over the final tailings surface. The loading of the future waste rock layer for closure is higher than the loading for the proposed harvesting process of tailings, so the loading conditions assessed in the following sections are for a more onerous waste rock layer loading. The detailed assessment and testing results are presented in Appendix G of the Golder Report (**Appendix B1**).

Figure 3-14 Compacted Fill Platforms Constructed on Existing Tailings Beach at Embankment 1

Figure 3-15 Harvesting of Tailings for Fill Platforms During Embankment Construction

3.5.2.3. Stability of Blackwood Pit TSF2

Static Liquefaction

Golder assessed the risk of liquefaction of tailings in the TSF2 storage facility by analysing data collected from a cone penetration test (CPTu) program completed on the existing tailings on 7 and 8 February 2020 (discussed in **Section 8.6.3.1**). The investigation was carried out in three locations on the tailings surface. Two of the locations are near where Embankments 1 and 3 are constructed.

The Golder Report (**Appendix B1**) presents the results of the CPTu analyses and the associated slope stability assessment relative to the embankments along the sides of the Pit and the final waste rock rehabilitation profile over the surface of the tailings storage facility.

Based on these results the tailings in TSF2 was not likely to result in static liquefaction for the shallower or lower depth of tailings. The results suggest that the tailings would have a stable surface under mobile vehicle loads.

Stability of Perimeter Embankments

TSF2 includes three embankments over parts of the Pit perimeter. Embankment 2 has been constructed on weathered rock or engineered rock fill foundations. Embankments 1 and 3 are constructed partly over the tailings beach.

The upper 5 m thick layer of tailings is dilative and over-consolidated. The foundation pressure under the proposed embankments and proposed harvesting cell bunds is estimated to be less than the over consolidation pressure of the upper layer of the tailings, so it is assessed that the tailings would remain dilative when loaded by the proposed embankment.

The minimum target factors of safety values as per the ANCOLD guidelines for the consequence category of the TSF2 are:

- Static conditions (drained and undrained conditions) = 1.5
- Post liquefied conditions = 1.1

For all of the above slope stability analyses the post liquefied strength analysis is the critical case and the reported factors of safety relate to the post liquefied condition. The results of the slope stability analyses indicate the target factors of safety are met, as shown in (**Table 3-12**). The Golder assessment shows that the tailings storage facility is expected to meet contemporary slope stability targets, both for static and post-liquefied conditions of the tailings, on the basis that the tailings beach is operated to continue promoting desiccated tailings, supernatant water and stormwater is removed in a timely manner.

Table 3-12 Slope Stability Results for future filled tailings behind embankments

Location	Factor of Safety
Embankment 1	1.9
extending into liquefied tailings	3.4
Embankment 2	2.1
with phreatic surface	1.8
Embankment 3	< 1.5 without modification
with as installed buttress	2.1
Waste Rock Slope	2.0

Stability of Intermediate Bunds

Two intermediate bunds would separate the three containment cells at the TSF2. Analysis of intermediate bund stability was undertaken by Golder for the case where saturated tailings are filled to maximum capacity of 1.5 m height to one side of the bund, and dry tailings fully excavated to base level at the opposite side of the bund. This simulates a critical scenario where maximum lateral force is experienced at one side of the bund (full-height saturated tailings) with no resisting lateral force at the opposite side of the bund (fully excavated case).

Golder analysis of the bund under the described geometry and material parameters yields a minimum factor of safety (FoS) of approximately 1.5, with potential failure being a shallow slip through the downstream slope extending into the existing tailings layer. Results of this analysis suggest that the proposed bunding design meets conventional targets for engineered earthworks structures with the saturated tailings, vehicle and seismic loads.

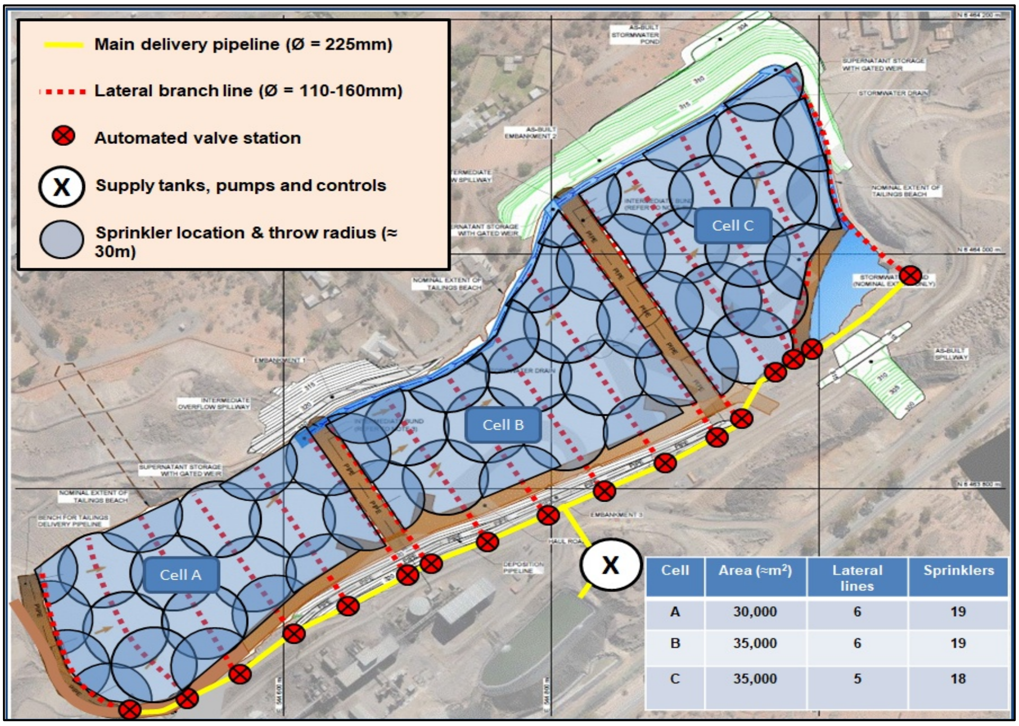
3.5.3. Dust Suppression

BHOP proposes to employ a combination of the approved automated sprinkler system (currently under construction) and water cart application with the addition of a chemical dust suppressant during tailings harvesting preparation works and harvesting operations at TSF2, if required.

The primary (passive) management for dust mitigation is the deposition of wet tailings slurry which provides a spread of water over the tailings surface to suppress dust generation. This is the management strategy under current operating conditions.

The second (active) level of dust management for TSF2 consists of the installation of a water spray system at TSF2 with water applied through a network of sprinkler heads. The proposed activation for the sprinkler system within the cell configuration is presented in **Figure 3-16**. Meteorological forecasting would be used to predict conditions for the coming day(s) to determine when an elevated risk of dust emissions may occur (based on wind speed, direction, rainfall and atmospheric stability). BHOP currently monitors PM10 concentrations and wind speed/direction continuously. Inputs from these sources would enable an automatic response that would activate when certain triggers (PM10 concentration level, wind speed and direction) are applied.

Figure 3-16 TSF2 Sprinkler Concept Design – Harvesting Setup



Cell	Area (≈m²)	Lateral lines	Sprinklers
A	30,000	6	19
B	35,000	6	19
C	35,000	5	18

The spray system would apply water over the tailings surface from a number of strategically located water sprays. The sprays would be located around the inside toe of the embankments and pit wall and across the surface of the tailings beach. When the dividing cell walls are constructed sprays would also be installed along these walls. A storage tank with a capacity of 0.5 ML would be fed from the existing Process Water Pond located adjacent to the processing plant and would have an automatic top-up system. The sprinkler system would draw water from the tank and the automated control system would allow activation of a number of sprinklers as required (up to 4 on each branch supply line).

An additional level for dust control during the proposed tailings harvesting operations of TSF2 is the application of a chemical dust suppressant through the water spray system. This chemical agent can be added to the water to extend the control of dust through wind entrainment. This would be useful to manage the harvesting operations between deposition, drying and harvesting cycles, particularly if there are longer delays or breaks in tailings deposition or where the application of water is not desirable.

3.5.4. Tailings Harvesting Operations

3.5.4.1. Tailings Deposition

The operational requirements for current tailings deposition and management for TSF2 are outlined in the BHOP TSF2 Operations Maintenance and Surveillance Manual (BHO-MAN-MET-029) (BHOP TSF2 Manual) which would be updated in line with MOD6 activities. The BHOP TSF2 Manual has been formulated to meet the requirements of the Dams Safety NSW as TSF2 is a Declared Dam under the *Dams Safety Act 2015*.

The tailings harvesting process would be managed within the Metallurgy Department as part of the Tailings Section and on a day to day basis operators would report to the day Shift Mill Supervisor.

The concept deposition and harvesting strategy for MOD6 requires tailings deposition to be undertaken within cells cycling through each cell in-turn, covering the three production stages (deposition, drying, harvesting) over a 6 week operating cycle to align with the current 8 day on / 6 day off milling campaign.

Tailings would be deposited alternatively between the cells with tailings beaching generally towards the north and north-west. Supernatant water pooling would be toward the north end with any excess water directed via gravity flow, to the northeast end of TSF2 where a stormwater pond would be formed in the tailings beach adjacent to the spillway to detain runoff from the three cells.

Water detained in the stormwater pond would be kept to a minimum by pumping the water for reuse, in accordance with the current BHOP TSF2 Manual.

Fresh tailings (as a slurry) would continue to be deposited into TSF2 and allowed to dry naturally (solar and air). Once sufficiently dried the tailings would be harvested and then transferred to TSF3.

The tailings would be deposited in the cell in one thickness over the 8 day mill roster, and left to dry for two subsequent mill roster cycles. This results in approximately 20 days of drying time after the completion of the deposition in a cell, before the proposed 14 days of harvesting. However depending on weather conditions it is expected harvesting of the surface layer could be performed earlier than this 20 day mark, to increase the drying rate of tailings at greater depth. It is noted that drying would continue over the harvesting period. Drying over the harvesting period is considered an additional buffer for achieving the target moisture content for placement of the tailings in TSF3.

The tailings slurry would be deposited from the eastern and southern sides of the cells to form a sloping tailings beach towards the supernatant water collection sumps in each cell. These sumps would be pumped out as needed to minimise the amount of water ponding on the tailings, and maximise the drying opportunity for the tailings.

Experience has shown that a tailings sump storing water would wet-up adjacent tailings, so it is proposed that the sumps would include a tarpaulin liner to reduce wetting effects of adjacent tailings. These tarpaulins may be removed during tailings harvesting and reinstalled in the formed sump prior to fresh tailings deposition, or permanent sumps formed with waste rock protection around the perimeter. This would be determined during detailed design.

Survey of beach slopes undertaking during construction of TSF2 embankments, typically indicates a beach angle of approximately two percent over 300 m from the tailings discharge point.

The current perimeter embankment crests and existing tailings surface grade downwards from south west to north east. It is intended that the drying cells are operated generally in a similar way to the current tailings deposition orientation, with deposited tailings grading downwards to the north, and deposition occurring generally from the southern end of each cell. This approach enables the currently constructed perimeter embankments to be utilised as part of the tailings drying system.

Experience and the field drying trials indicate that the tailings quickly dries to a moisture content between 20% to 25% and then progressively desiccates to a moisture content approaching approximately 10% to 11%. The moisture content of the drying tailings over the initial 10 to 14 days after deposition is expected to vary between approximately 5% to 10% over the layer thickness. The variation of moisture content with depth reduces significantly after this period when desiccation and unsaturated conditions develops over the depth of the tailings layer.

Adopting a target layer thickness, after the initial drying of 300 mm to 500 mm, enables approximately 12,700 to 21,200 t of tailings to be placed in a 3 Ha cell (respectively). The layer is expected to further reduce in thickness as the final desiccation drying occurs.

BHOP proposes an annual maximum tailings production rate of 440,000 t and an annual harvesting rate of 480,000 tpa. The 480,000 tpa annual tailings harvesting rate equates to an average layer thickness of approximately 440 mm based on the proposed tailings harvesting schedule, as presented in **Table 3-13**.

Table 3-13 Proposed Continuous Tailings Harvesting Schedule

Week	Day	Cell A			Cell B			Cell C		
		Dep.	Dry	Harv.	Dep.	Dry	Harv.	Dep.	Dry	Harv.
Week 1	1			1	1				7	
	2			2	2				8	
	3			3	3				9	
	4			4	4				10	
	5			5	5				11	
	6			6	6				12	
	7			7	7				13	
Week 2	8			8	8				14	
	9			9		1			15	
	10			10		2			16	
	11			11		3			17	
	12			12		4			18	
	13			13		5			19	
	14			14		6			20	
Week 3	15	1				7				1
	16	2				8				2
	17	3				9				3
	18	4				10				4
	19	5				11				5
	20	6				12				6
	21	7				13				7
Week 4	22	8				14				8
	23		1			15				9
	24		2			16				10

	25		3			17				11
	26		4			18				12
	27		5			19				13
	28		6			20				14
Week 5	29		7				1	1		
	30		8				2	2		
	31		9				3	3		
	32		10				4	4		
	33		11				5	5		
	34		12				6	6		
	35		13				7	7		
Week 6	36		14				8	8		
	37		15				9		1	
	38		16				10		2	
	39		17				11		3	
	40		18				12		4	
	41		19				13		5	
	42		20				14		6	

Legend: Tailings is deposited Tailings is harvested Tailings is drying

3.5.4.2. Tailings Harvesting

The tailings harvesting operation proposed would utilise mobile plant such as a bulldozer to shave off the layers of tailings with a FEL used to pick up the pushed up tailings and load into 60 t haul trucks. Trucks would be loaded to 55 t to prevent spillage. As discussed in **Section 3.5.2.1** the sampling program has confirmed that the tailings is sufficiently dry to support mobile equipment traffic within 5 days. However to ensure safety of personnel and that the tailings has reached optimum drying level (SOMC), sample testing would be undertaken to confirm moisture content prior to mobile equipment entering the tailings surface area. The method of sampling and testing would be confirmed during detailed design.

When loading from windrow stockpiles a FEL or excavator may be employed for haul truck loading. Haul trucks would access TSF2 via the Tails Harvesting Haul Road and then proceed down the concrete access ramp onto the internal access road on the south eastern side of the TSF2 along which the designated loading area would be located.

Loaded trucks would leave via the internal access road, up the concrete access ramp and proceed along the Tails Harvesting Haul Road to the intersection with the existing Mine Haul Road. Trucks would then proceed along this road to Kintore Pit TSF3 for unloading via the existing pit access ramp. This road is shared with mine trucks hauling waste rock to Kintore Pit.

3.5.4.3. Stormwater Management on the Tailings Surface

A 24 hour 1% AEP (approximately 1 in 100 years) event is estimated to generate approximately 18,000 m^3 of rainfall runoff and would result in partial inundation of Cell C drying and harvesting area temporarily disrupting operations in this cell. Depending on the beach angle of deposited tailings it is expected that approximately 15% to 30% of the Cell C harvesting area may be impacted by inundation resulting from stored runoff from a 1% AEP storm event.

TSF2 is designed to retain the 1 in 10,000 AEP storm event (approximately 48,000 m^3) without spillway discharge as endorsed and approved by Dams Safety NSW. In the event of a storm event of this magnitude the majority of the Cell C harvesting area would be inundated and accordingly disruption to drying and harvesting operations would occur.

The storm water pond excavated next to the emergency spillway, to retain rainfall runoff, would include a pump platform to enable extraction of water from the area to be reused in the processing plant. The inspection and maintenance requirements for stormwater and return water (supernatant liquor) management structures associated with TSF2 and the harvesting areas would be included in a revision of the BHOP TSF2 Manual).

3.5.4.4. Supernatant Management

Supernatant from the deposited tailings would be managed by incorporating a gated weir into the western end of each of the intermediate bunds. These weirs would be designed to enable them to be progressively raised and lowered on a nominal daily basis during tailings deposition to suit the deposited tailings surface level in the upstream cell and to enable supernatant liquor to be decanted from the tailings surface to a sump formed adjacent to the intermediate bunds. Supernatant collected in the sumps would either be decanted or extracted by pumping daily during deposition and retuned toe the processing plant.

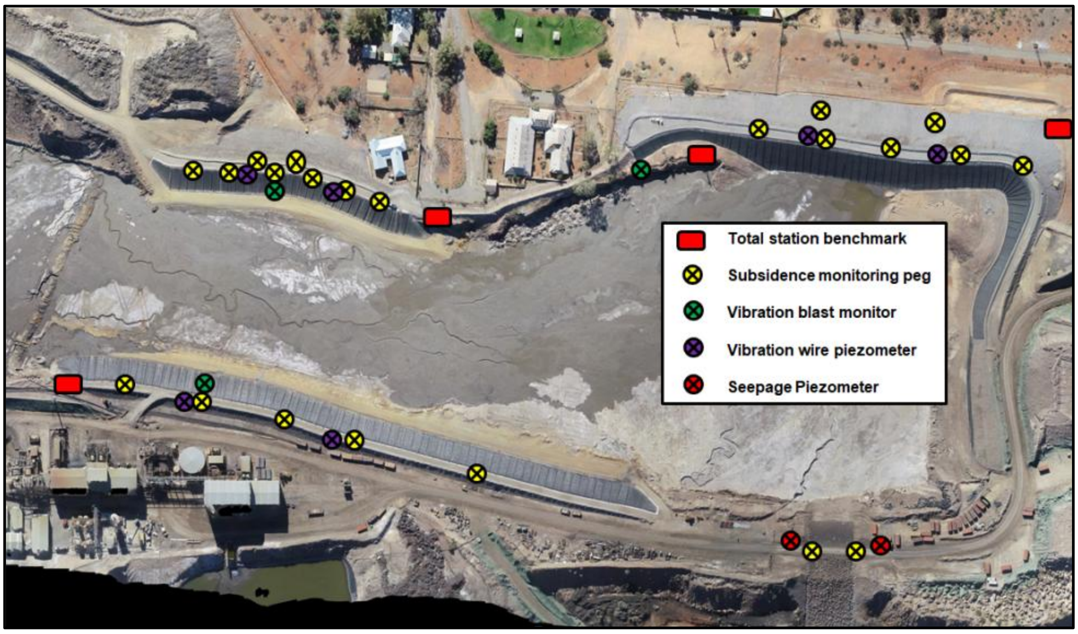
3.5.4.5. TSF2 Monitoring

In addition to the Dams Safety NSW requirements for general inspections and monitoring of tailings storage facilities, BHOP is also required to meet specific conditions, including inspections and monitoring, related to the approval to mine within an area of a Declared Dam. Blackwood Pit TSF2 is a declared dam by Dams Safety NSW (approval and conditions in **Appendix M**). Daily, weekly, monthly and annual inspections would continue to be undertaken as outlined in the BHOP TSF2 Manual.

There are currently a total of six vibrating wire piezometers (VWPs) which measure pore water pressure within the three embankments located at TSF2. Data is collected from these VWPs on a monthly basis in accordance with procedures as outlined in the Manual.

As part of the preparation works, two piezometers would be installed, to approximately 20 m depth or bedrock, on each side of the TSF2 spillway chute close to the crest, as recommended by Golder. These would be used to monitor for any seepage from the stormwater collection pond located adjacent to the spillway and inside the Pit (TSF2). This would provide data to inform slope stability assessments and seepage review in this area. The locations of the piezometers together with other monitoring units are indicated in **Figure 3-17**.

Figure 3-17 TSF2 Monitoring Network



3.6. New Underground Mine Access (Portal and Decline)

3.6.1. Location and Description

Underground mine workings are currently accessed via a portal located in the base of Kintore Pit which would no longer be available when Kintore Pit is used to co-deposit tailings and waste rock. It is proposed to access underground mine workings via a new portal to be located adjacent to the current Mine Haul Road north of TSF1, **Figure 1-2** and **Figure 3-18** with new road configurations are shown in **Figure 3-19**. This would require the excavation of a boxcut to reach the required depth to enable a new portal and decline to be developed through competent rock connecting to current underground workings (approximately 488,000 t would be excavated to create the boxcut).

A number of alternative locations for the boxcut were considered (**Section 4.3**) BHOP selected the location proposed location for the boxcut based on the following operational factors:

- proximity to the current Run of Mine Pad (ROM) and Mine Haul Road;
- access (depth) to competent rock, and
- proximity to current and future underground mining areas.

The selected area for the boxcut is an historical mining area dissected with some minor access tracks; it consists mainly of fill material from BHP Pit and Blackwood Pit excavations with small amounts of slag and tailings. The area is not used for current mining activities, however, it has been significantly impacted by historic mining and is currently devoid of any vegetation and provides no habitat for native fauna.

Figure 3-18 Indicative Location for New U/G Mine Access and Decline

There are two historic shafts located within the boxcut area. These are the Darling Shaft located to the west and the Wilson Shaft located to the east (shown in **Section 3.6.3 Figure 3-21**). They are not visible from surface and it is believed they were filled after abandonment. Probe drilling would detect their location prior to excavation works.

The proposed Tails Harvesting Haul Road would also be incorporated into the footprint of the boxcut and would traverse the upper bench of the proposed footprint (approximately 27,000 t would be excavated from the boxcut to accommodate this road). This section of the road would be installed as part of the 'free-dig' during Stage 1 of the boxcut using the same equipment and within the construction schedule for this stage. A services and parking area for tailings harvesting would be located to the north east adjacent to the Tails Harvesting Haul Road. This road would be sealed to minimise dust. Refer **Section 3.4** for further information regarding tailings harvesting and related preparation works.

In addition the current underground mining services required for on-going operations would be relocated from the base of Kintore Pit to an area adjacent and southwest of the boxcut (shown in **Figure 3-34**).

These are discussed at **Section 3.6.8** and include:

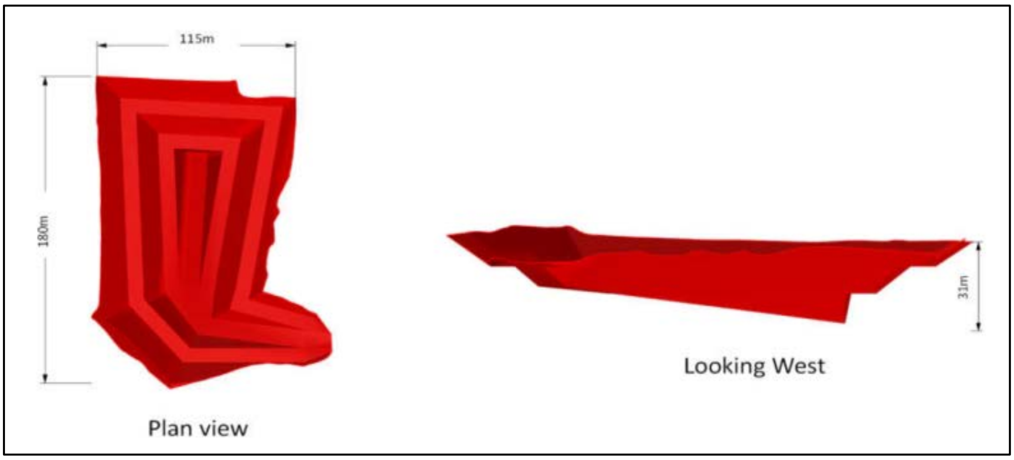
- compressor station and air lines into underground;
- transformer and power into underground;
- communications into underground;
- water supply storage tanks and water pipelines into underground;
- stormwater management sump and pumps in boxcut, and
- other underground mining services such as tag board, storage for emergency equipment, designated surface firing facility to initiate underground firings and vehicle parking.

Figure 3-19 Proposed Location for Boxcut with Current and Proposed Road Configurations

3.6.2. Conceptual Design for Boxcut

BHOP engaged Ground Control Engineering Pty Ltd (GCE) to design the boxcut and portal, *Geotechnical Assessment of the Rasp Mine Boxcut*, July 2021 (**Appendix G1**). **Figure 3-20** provides an outline for the conceptual design shape of the proposed boxcut. This conceptual design provides stable slopes for mine life and has been optimised from the Project Brief with lower slope angles, wider benches and a reduced depth. The new Mine Ore Haul Road would be realigned to meet the access ramp from the boxcut and ore trucks exiting the boxcut would cross the current Mine Haul Road and travel direct to the ROM Pad. (This entry point is horizontal and located at RL335.)

Figure 3-20 Proposed Conceptual Boxcut Design



The dimensions and slope angles for the proposed boxcut are provided in **Table 3-14** for boxcut dimensions, and **Table 3-15** for bench/slope configurations. Slopes have been designed to meet a factor of safety of 1.5.

Table 3-14 Boxcut Design Dimensions

Dimension	Unit	Measure
Length	m	180
Width	m	115
Depth	m	31
Excavated volume	m^3	191,000
Extracted tonnage	t	488,760

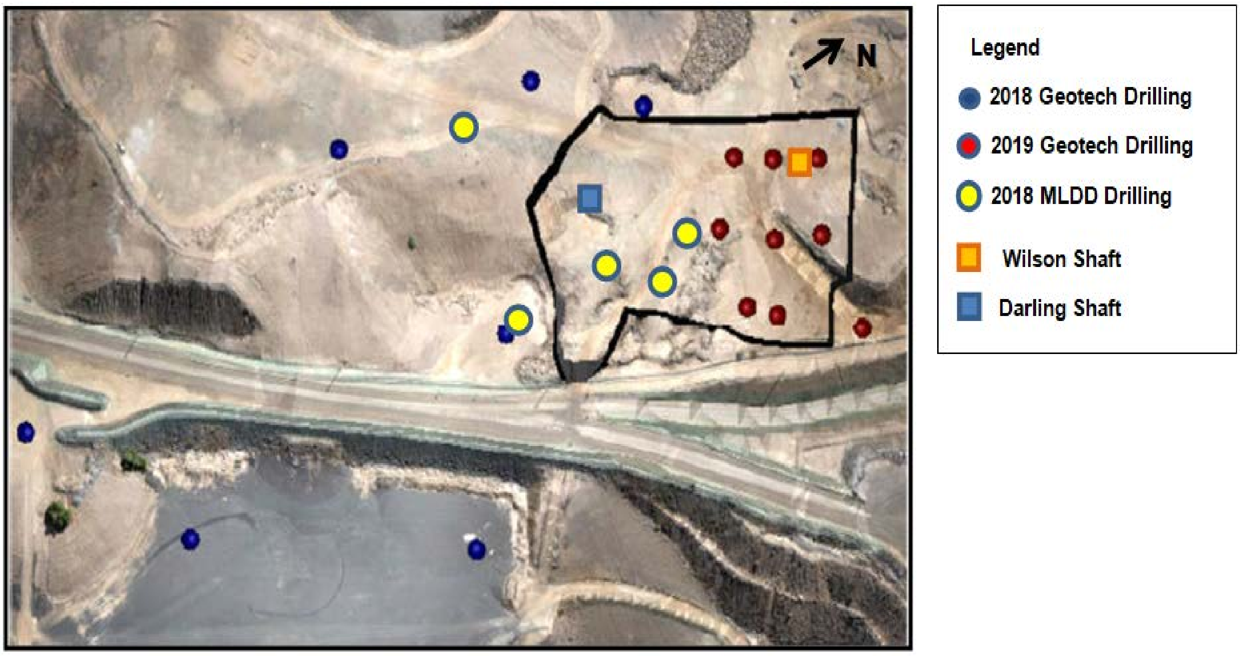
Table 3-15 Proposed Slope/Bench Configurations

Geotechnical Unit	Maximum Batter Angle	Maximum Batter Height	Bench Width	Overall Slope Angle in Material	Maximum Slope Height
Fill	35°	10 m	8 m	29°	18 m
Fill/Weathered	40°	10 m	10 m	NA	10 m
Weathered	54°	11 m	10 m	34°	16.5 m

3.6.3. Excavated Materials Properties

GCE completed geotechnical investigations of the area of the boxcut as a basis for their design. Two drilling campaigns were undertaken; the first campaign in 2018 within the original boxcut footprint and the second campaign in 2019 within the current proposed boxcut footprint. **Figure 3-21** provides the locations for the holes drilled during these campaigns. The geotechnical assessment undertaken by GCE was to identify the base of the historic fill material within the boxcut area and to characterise the weathering profile of the rock below. There were seven holes were drilled in 2018 with a further 9 holes in 2019 ranging in depth from 36.0 m to 53.6 m.

Figure 3-21 Boxcut Investigation Drill Holes



The materials within the proposed area of the boxcut were identified as:

- Mixed Rock Fill – brown or grey poorly consolidated rock fill, variably weathered with a mixture of rock fragments (>5 mm and <1 m), fines and some foreign materials such as metal and timber. Typically metasediments (pelite, psammite, etc).
- Clean Rock Fill – grey, poorly consolidated rock fill, variably weathered with fragments of mixed size rock (<5 mm and > 1 m) and some finer material between the rock fragments. Typically pelite, psammite and pegmatite.
- Basement Rock – brown-grey, highly to moderately weathered, weak fractured rock typical of the Broken Hill area, psammite, pelite and minor pegmatite. It is distinguishable from fill material by the lack of fines material.
- Slag Fill – brown or grey, poorly consolidated rock fill with fragments of rock and slag ranging in size from <0.5 m to <0.5 m.
- Old Tailings Fill – dark brown fine grained unconsolidated or loosely consolidated with occasional rock or slag fragments.

The identified material to be excavated was deposited primarily as waste rock and backfill from previous mining, development of BHP and Blackwood Pits, with a small amount of old tailings and slag material.

The largest portion of the fill material is Mixed Fill which was found in all drill holes. This domain was interpreted by the BHOP geology team as a broad and flat area with Clean Rock Fill above and below. Most of the Old Tailings and Slag Fill were found to be outside the current boxcut footprint with a small amount of Old Tailings Fill located near surface at the southwest corner of the proposed boxcut.

The geotechnical logging of the holes formed the basis of the empirical analysis that was used in the determination of the boxcut and portal batters and initial decline ground support as outlined by GCE**.**

GCE divided the rock mass within the boxcut area into four geotechnical units based on material type, degree of weathering, strength and fracture intensity. These units are described in **Table 3-16**.

Table 3-16 Boxcut Location Materials – Geotechnical Units

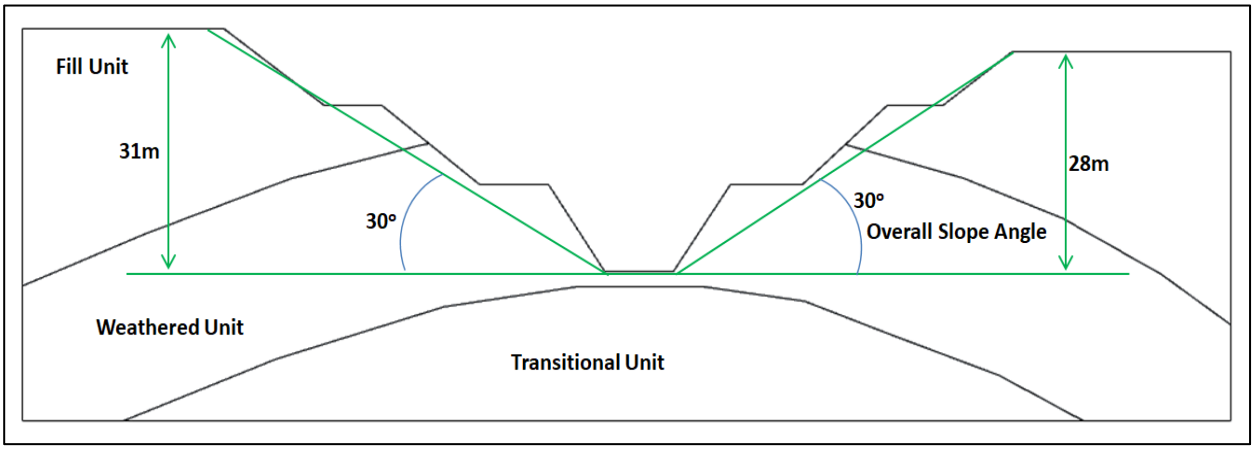
Unit Type	Description
Fill Unit	Is material deposited from previous mining, the strength of this material is defined by its compaction, drainage characteristics and angle of repose. Assumed to be homogenous.
Weathered Unit	Is characterised by material affected by ground water and oxidation, it has very low to low strength, and is classified as extremely weathered to highly weathered.
Transition Unit	Is classified as moderately weathered to slightly weathered.
Fresh Rock Unit	Natural primary unweathered rock.

The installation of the proposed new underground access portal requires excavation of a boxcut to reach competent rock material for development of an underground decline. **Table 3-17** outlines the location of the project activities within these units and **Figure 3-22** estimates their location within the proposed boxcut design.

Table 3-17 Location of Geotechnical Units in Boxcut

	Geotechnical Units
Boxcut	Upper slopes to be excavated predominantly in the Fill Unit and the lower batter slopes excavated in the Weathered Unit.
Portal	Portal batter is expected to be excavated in Weathered and Transitional Units and ground conditions are expected to be very poor to poor.
Decline	The Decline is expected to commence within the Weathered Unit with ground conditions expected to be poor, improving as it progresses into Fresh Rock Unit.

Figure 3-22 Slide Model Configuration for Permanent Slopes



Given the extent of poor ground conditions and anticipated variability within the area of the boxcut GCE recommended that the final portal design and initial decline support design be finalised once the new portal batter is established and ground conditions can be confirmed.

The 2018 drilling program provided samples from the boxcut suitable for chemical analysis. Three of the 7 drill holes were within the proposed boxcut design (MLDD 3965, 3967 and 3968) and two others were located close to the designed boxcut footprint (MLDD3963 and 3966). These holes were drilled vertically to a depth of between 9 m and 61 m with 10 samples taken down each hole where possible (some holes collapsed and/or partially collapsed due to the nature of the material). Samples were successfully recovered from all geotechnical units. Results of the sample analysis are summarised in **Table 3-18**.

Table 3-18 Laboratory Analysis Results for Boxcut Material (mg/kg)

	NEPM Guidelines			**Drill Hole Identification MMDD**				
	HIL A (Residential)	**HIL C** (Recreational)	**HIL D** (Commercial)	**3963**	**3965**	**3966**	**3967**	**3968**
Arsenic	100	100	100	123	7 - 918	34	139	<5 - 161
Barium	ND	ND	ND	40	50 - 100	80	120	50 - 130
Berylium	60	60	60	<1	1	<1	<1	<1 - 2
Boron	4,500	4,500	4,500	<50	<50	<50	<50	<50
Cadmium	20	20	20	125	<1 - 126	2	7	<1 - 4
Chromium	100	100	100	25	16 - 29	21	20	22 - 26
Cobalt	100	100	100	10	11933	16	13	10 - 21
Copper	6,000	6,000	6,000	54	29 - 308	141	198	53 - 796
Lead	300	300	300	776	24 - 19300	3600	8870	16 - 25800
Manganese	3,800	3,800	3,800	481	161 - 4450	4830	11100	149 - 20700
Mercury	10	13	180	<0.1	<0.1 - 1.2	<0.1	0.1	<0.1 - 1.4
Nickel	400	1,200	6,000	23	21 - 44	13	8	9 - 32
Selenium	200	700	10,000	<5	<5	<5	<5	<5
Vanadium	ND	ND	ND	28	13 - 23	17	18	24 - 30
Zinc	7,400	30,000	400,000	2250	2700 - 8740	1020	696	445 - 901

An analysis of the material within the boxcut has indicated that the overall average Pb content is 0.64%Pb, peaking at 2.58%Pb. Therefore, all of the material excavated from the boxcut would be placed in-pit and transferred to Little Kintore Pit (422,760 t) and BHP Pit (66,000 t). This would result in containment of all waste fill material generated through excavation of the boxcut and portal.

Little Kintore Pit is a small historic open pit approximately 140 m by 130 m and 17 m deep. An old shaft within the Pit would be capped prior to placement of waste material. The area proposed for waste material placement in BHP Pit lies to the north where the Pit is deeper. This proposed infill area is approximately 80 m (w) by 80 m (l) and 14 m deep.

The material in Little Kintore Pit and BHP Pit would be capped with waste rock from underground to be sourced from Kintore or BHP Pits and tested to contain <0.5%Pb as a final and permanent capping.

3.6.4. Boxcut Construction

The boxcut would be constructed through a combination of free-dig excavations and drill-and-blast-and-dig excavations. It would be undertaken in stages utilising one 65 t excavator, up to six 43 t dump trucks, three 40,000 L water carts, two dozers (D9) and one grader (12M). Trucks would be under-filled (to approximately a 40 t payload) to minimise spillage and dust exposure.

Initial excavation in the boxcut would utilise the excavator and a fleet of up to six dump trucks. As the excavation advances and the area of working floor reduces the number of dump trucks would decrease to a minimum of 3 during the final stages of excavation. A dozer would work alongside the excavator to stockpile the boxcut material prior to loading. Water carts would be utilised throughout the loading and dumping activities to control any dust generated from these working faces. A grader would be used to maintain the haul roads and boxcut floor to provide a trafficable surface for the dump trucks. A conceptual three staged approach to construction of the boxcut is provided in **Figure 3-23**. **Table 3-19** outlines the equipment to be used for each stage of construction together with the volumes of material to be excavated and scheduled timing for these works. **Table 3-20** summarises the truck movements for the activity both within the proposed boxcut and associated mine access underground pre-works.

Figure 3-23 Conceptual Staged Construction of the Boxcut

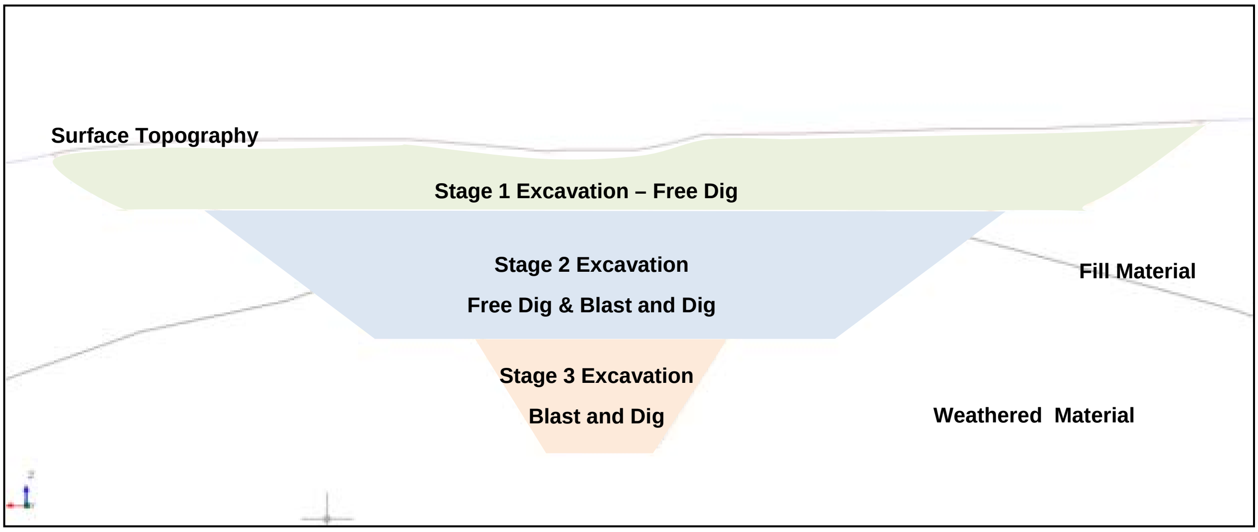


Table 3-19 Equipment Assumptions for Boxcut Construction

Stage	Volume (t)	Equipment
Stage 1 Excavation (Free dig) (duration = 11 weeks)	276,760	1 x 65t excavator 6 x 43t dump trucks 2 x 40,000L water carts 1 x Caterpillar D9 Dozers 1 x Caterpillar 12M Grader
Stage 2 Excavation (Free dig and drilling and blast) (duration = 4 weeks)	167,180	1 x 65t excavator 6 x 43t dump trucks 3 x 40,000L water carts 2 x Caterpillar D9 Dozers 1 x Caterpillar 12M Grader
Stage 3 Excavation Drill, blast and dig (duration = 2 weeks)	17,820	1 x 65t excavator 3 x 43t dump trucks 3 x 40,000L water carts 2 x Caterpillar D9 Dozers 1 x Caterpillar 12M Grader

Table 3-20 Boxcut Construction Summary of Truck Movements

	Truck	Boxcut material	Source & Destination	Return Trips	Duration (days)	Return Trips Day	Return Trips Hour	Duration of Return Trip (min)
Boxcut Excavation	6 x 43t Dump Trucks (40t payload)	Stage 1: 303,760t	Boxcut to Little Kintore Pit: 1,751m	7,594	67	113	12	36
	6 x 43t Dump Trucks (40t payload)	Stage 2: 167,180t	79,000t Boxcut to Little Kintore Pit: 1,751m	1,975	21	94	10	36
			66,000t Boxcut to BHP Pit: 717m	1,650	8	207	22	16

	Truck	Boxcut material	Source & Destination	Return Trips	Duration (days)	Return Trips Day	Return Trips Hour	Duration of Return Trip (min)
			22,180t Boxcut to Kintore Pit: 1,276m	555	3.4	163	17	21
	3 x 43t Dump Trucks (40t payload.)	Stage 3: 17,820t	Boxcut to Kintore Pit: 1,276m	446	5.4	83	9	21
Decline	1 x 60t Mine Haul Truck (55t payload)	Waste rock from surface development	10,000t Boxcut[1] to BHP Pit: 717m	182	54	4	0.35	16
Tag Board Area & Parking	2 x 43t Dump Trucks (40t payload)	Excavation	1,500t to BHP Pit: 717m	38	0.5	75	8	21
	4 x 43t Dump Trucks (40t payload)	Capping - <0.5%Pb	1,100 From BHP Pit 717m	28	0.2	138	15	21
Progressive Rehabilitation	2 x 43t Dump Trucks (40t payload)	Capping - <0.5%Pb	20,000t BHP Pit to Little Kintore Pit:	500	9.6	52	6	36

Note 1 – The majority of the new Decline would be developed from underground with excavated waste rock placed in underground voids a nominal 10,000t has been included that may be transferred to Kintore Pit Tipple.

The new decline (400 m with 40,000 t excavated to intersect current underground workings) would primarily be developed from underground as this would minimise the need for surface blasting resulting in less disruption to the local community from potential road closures and the closure of the Café and Miners Memorial. The development underground would be undertaken during normal mining hours, 24 hours per day 7 days per week, consistent with current blasting activities. A nominal 10,000 t has been proposed to be developed from surface and proposed construction hours would apply. Surface blasting and transfer of material would only occur during day time hours within the proposed construction schedule of 7 am to 6 pm six days per week. There would be no construction activities on Sundays or public holidays.

Capping and sealing of roads occurs in Stage 3, these are discussed in **Section 3.6** with tonnages and truck movements presented in **Table 3-20** above.

3.6.5. Conceptual Blasting Strategy

It is anticipated that drilling and blasting of the Weathered Unit would be required once the base of the Fill Unit material is reached. Prism Mining Pty Ltd was engaged to evaluate the blasting methodology for the final stage of the boxcut and establishment of the new portal. A precise volume of material requiring blasting would not be able to be determined until the 'base of fill material' horizon is reached and the ability to continue free-digging assessed. However, it is assumed that approximately 42,000 m^3 of the excavation would require blasting in order to continue excavation.

It is proposed that blasting would be divided into three areas as the excavation advances toward the northern end of the boxcut, as shown in **Figure 3-24** and **Figure 3-25**. **Figure 3-24** also provides an indication of the depths to the crest for each blast area. Vibration and overpressure modelling would be conducted for each blast to minimise any potential impacts on surrounding areas. It is proposed that a blasting cycle is conducted over a single day (drilling, charging and firing) and that the resulting environmental adjustments (using the results from the blast vibration and overpressure parameters) can be modified and incorporated into the subsequent blast. A conceptual blasting strategy is detailed for each blast area, specialist surface drill and blast design engineering services would be engaged to develop a detailed strategy and design.

Figure 3-24 Long Section Showing Depth to Pit Crest

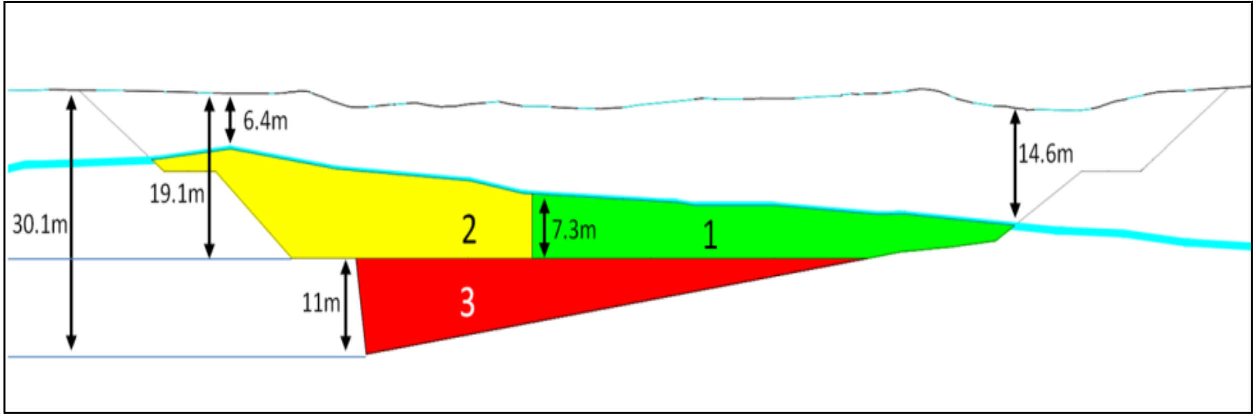
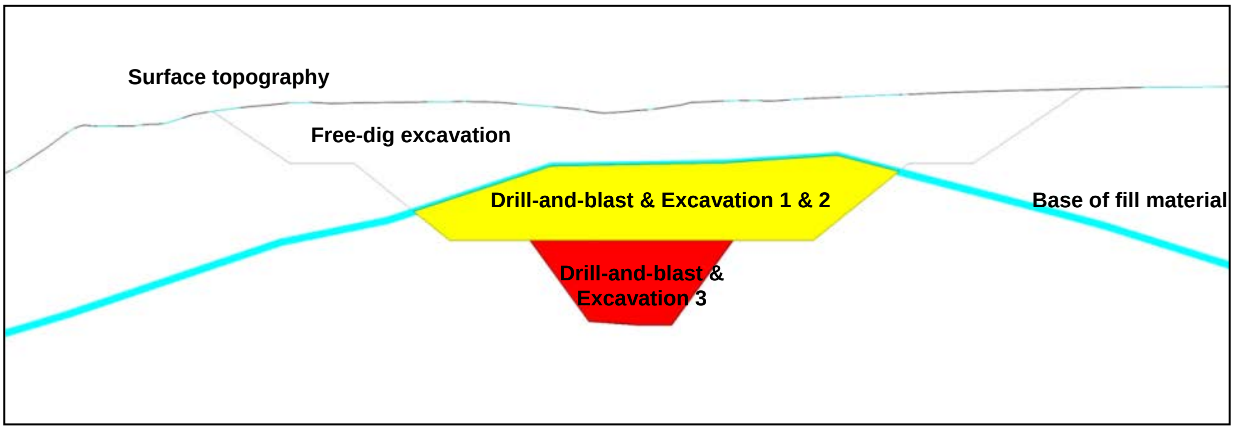


Figure 3-25 Cross Section Looking South from Portal Entrance



All blasting would be conducted using ammonium nitrate emulsion (or equivalent) and electronic detonators. Electronic detonators allow delays between blast holes to be assigned at any delay up to 30 seconds in one millisecond increments. This allows greater blast control by having the ability to reduce maximum instantaneous charge, (by programming the blast such that a minimum number of holes initiate simultaneously) providing precise modelling of vibration and overpressure. Installed blast monitors would provide information that, used in conjunction with the data derived from the programming of detonators mentioned previously, would enable control of vibration and overpressure.

In order to manage fly rock, choke blasting techniques would be implemented to manage free faces together with appropriate sized stemming material. In the event pre-splitting is required to establish batter faces blast matting would also be employed to manage flyrock (due to the confined nature of pre-split blasts).

3.6.5.1. Blast 1 Area

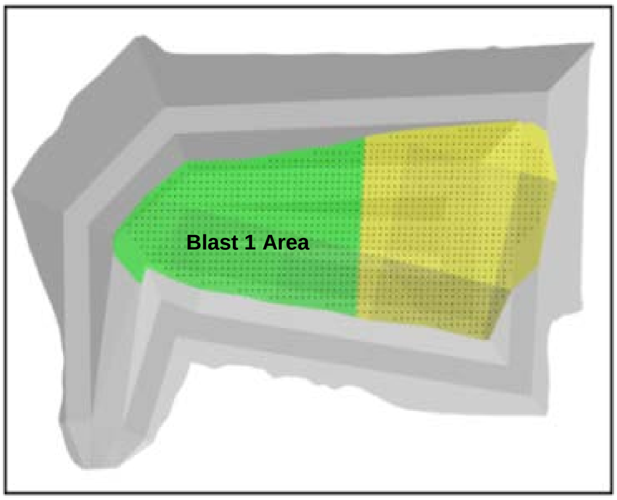
Blasting to the lower catch bench horizon at the southern end of the boxcut excavation would create a dig horizon level with the floor of the lower bench. Variable length drill holes would be required due to the irregular geometry of the weathered material however the bottom horizon would be horizontal. **Table 3-21** lists the details and parameters for the Blast 1 Area and **Figure 3-26** depicts the area within the boxcut. **Figure 3-24** provides a long section showing the depth to the crest.

Table 3-21 Blast 1 Details

Detail	Parameter
Volume of material blasted	13,419m^3
Maximum depth of material blasted	7.3m

Detail	Parameter
Blast hole diameter	89mm
Burden	2.0m
Spacing	2.0m
Total drill metres	6,000m
Approximate total explosives used	28,000kg
Maximum instantaneous charge weight	43kg
Depth below pit crest (min)	14.6m
Depth below pit crest (max)	19.1m

Figure 3-26 Blast 1 Boxcut Plan View



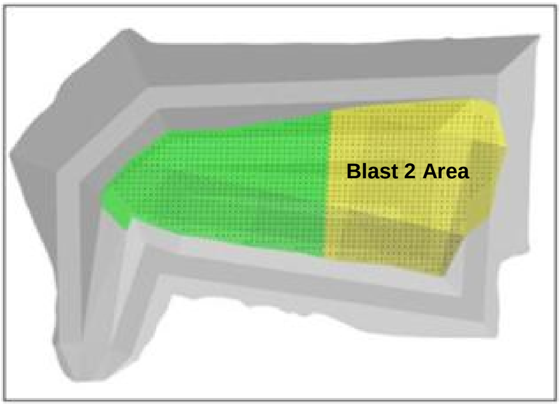
3.6.5.2. Blast 2 Area

Similar to the Blast 1 Area, the Blast 2 Area would establish a flat horizon on the lower catch bench of the boxcut excavation. **Table 3-22** lists the details and parameters for the Blast 2 Area and **Figure 3-27** depicts the area within the boxcut. **Figure 3-24** provides a long section showing the depth to the Pit crest.

Table 3-22 Blast 2 Details

Detail	Parameter
Volume of material blasted	22,209m^3
Maximum depth of material blasted	7.3m
Blasthole diameter	89mm
Burden	2.0m
Spacing	2.0m
Total drill metres	5,300
Approximate total explosives used	24,800kg
Maximum instantaneous charge weight	43kg
Depth below pit crest (min)	14.6m
Depth below pit crest (max)	19.1m

Figure 3-27 Blast 2 Boxcut Plan View



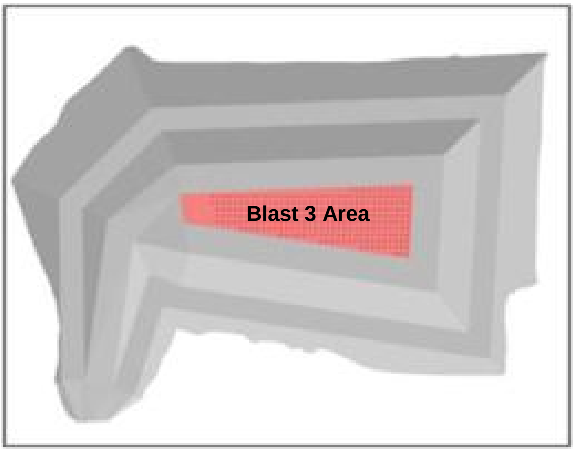
3.6.5.3. Blast 3 Area

A third blast area would be required to establish the bottom floor horizon and portal face. Indicative sub-drilling of approximately 0.5 to 1 m into the floor may be required to enable effective excavation to the correct RL and to establish a road surface. Pre-splitting may be implemented in order to establish the correct batter of the 70° portal face and lower batters to the floor. **Table 3-23** lists the details and parameters for the Blast 3 Area within the boxcut. **Figure 3-28** depicts the area within the boxcut. **Figure 3-24** provides a long section showing the depth to the crest.

Table 3-23 Blast 3 Details

Detail	Parameter
Volume of material blasted	6,620m^3
Maximum depth of material blasted	11.0m
Blast hole diameter	89mm
Burden	2.0m
Spacing	2.0m
Total drill metres	1,508m
Approximate total explosives used	9,300kg
Maximum instantaneous charge weight	68kg
Depth below pit crest (min)	19.1m
Depth below pit crest (max)	30.1m

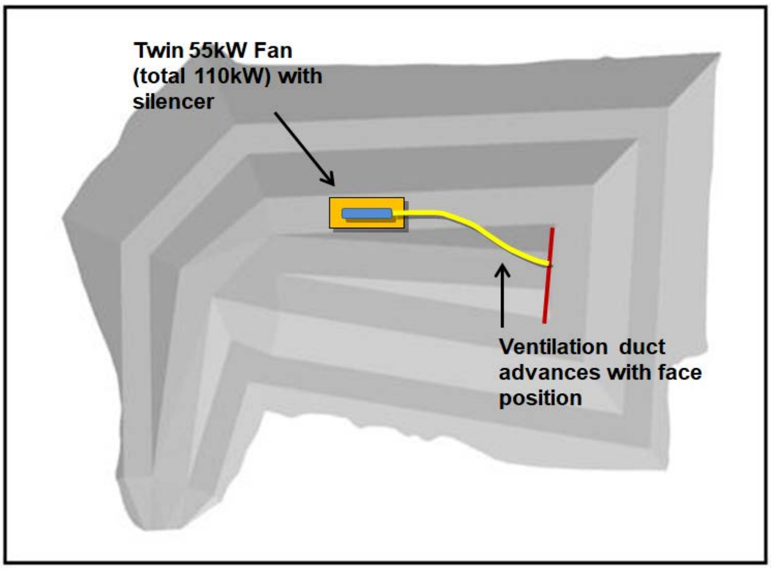
Figure 3-28 Blast 3 Boxcut Plan View



3.6.6. Ventilation

In order to maintain safe atmospheric conditions once the decline begins development, temporary ventilation ducting would be installed from a 1000V electrical fan mounted on a 20 ft container located on the lower bench of the boxcut excavation, **Figure 3-29**. The fan would be installed upon completion of the boxcut excavation works and would be required to be in operation at all times when personnel are actively working within the decline (after approximately 10 to 15 m decline development). Once the decline has been completed the temporary ventilation ducting and fan would be removed as underground mine ventilation would be used.

Figure 3-29 Ventilation Fan Location



The proposed ventilation fan would be equivalent to a Clemcorp CC1254Mk3 Twin stage Axial Fan. These fans are fitted standard with a silencing system to reduce noise when in operation. The fan specifications include speed – 1495 rpm, 2 stages, peak pressure – 4.0 kPa, maximum volume – 34 m^3/sec, fixed pitch and the motor size is 55 kW x 2.

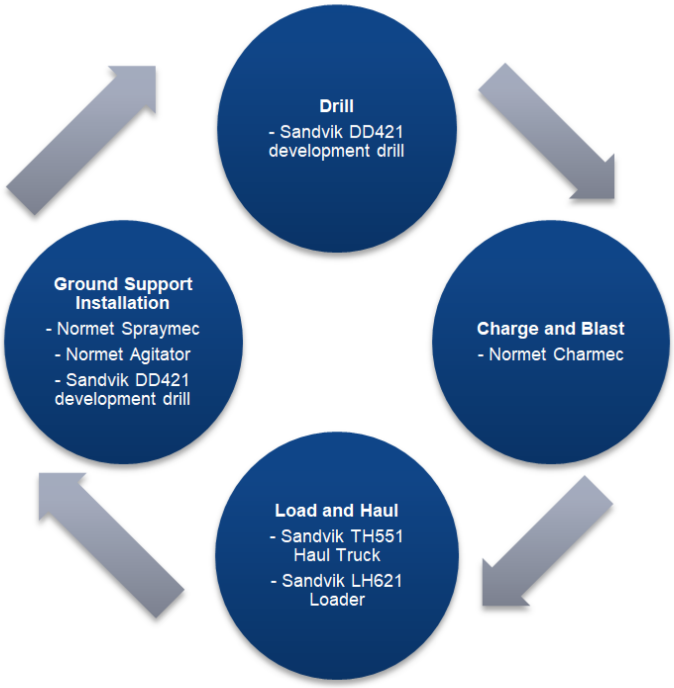
3.6.7. Proposed Portal and Decline Development

The new decline would be developed from the proposed portal and extend 400 m underground to meet mine workings as shown previously in **Figure 3-18**, the majority of these works would be completed from underground until the portal is established.

Development would occur via conventional underground mining methods to drill, blast and install ground support as the excavation advances. **Figure 3-30** outlines the typical lateral development cycle and equipment utilised for each part of the cycle. The development cycle can be completed in 24 hours or less depending on the wait time for blasting. The geometry of the decline excavation would align with current mine design standards to facilitate safe access of equipment as per **Figure 3-31**.

To limit impacts to surrounding areas the decline would be developed from two directions; approximately 150 m construction below the portal from the surface and 250 m upwards from underground workings (the amount of works from underground would be governed by the establishment of the portal). The surface works would be conducted using proposed construction hours (6 days per week) and the development from underground would continue by working normal mine shifts (24 hours per day, 7 days per week). It is expected that the decline would be completed over a period of 4 to 5 months.

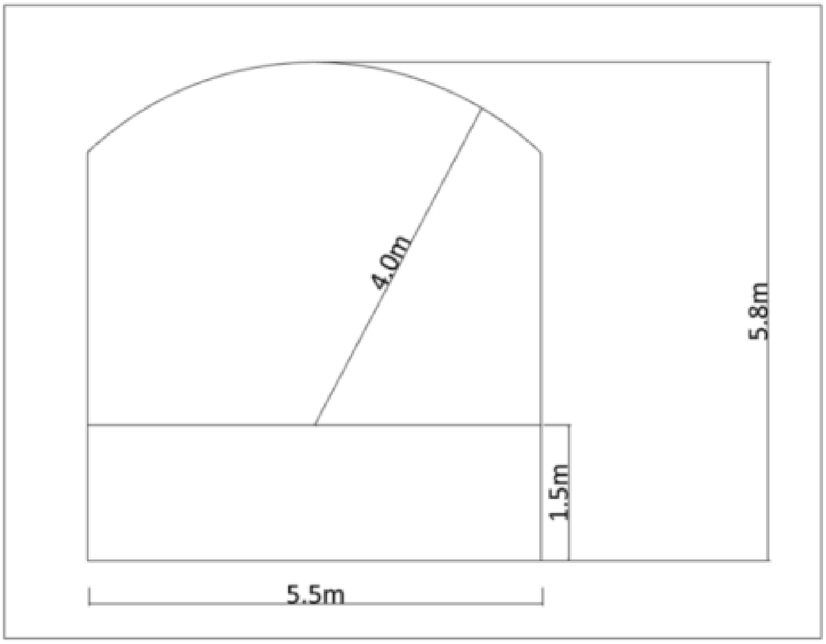
Figure 3-30 Underground Lateral Development Cycle



Equipment used during the portal and decline development would include:

- 1 x LH517 U/G Loader 15 t capacity
- 1 x TH663 Haul Truck 55 t
- 1 x DD421 development drill
- 1 x Normet Charmac charge vehicle
- 1 x Cat 930 IT Carrier
- 1 x Normet Agitator
- 1 x Normet Spraymac

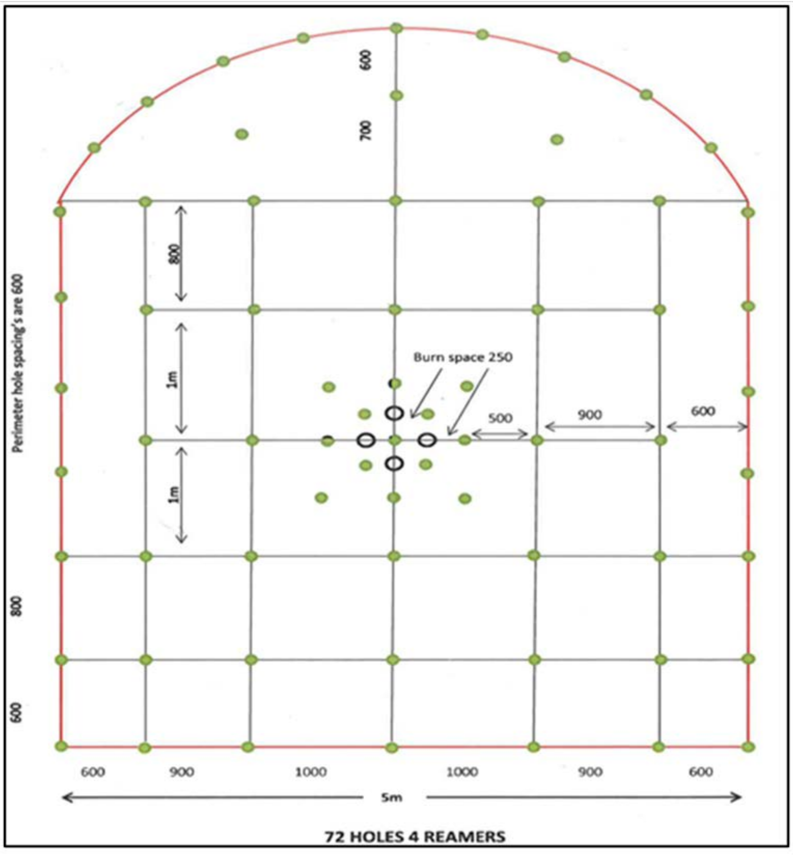
Figure 3-31 Decline Development Geometry



3.6.7.1. Drilling

Drilling is proposed to be completed with a single Sandvik DD421 development drill, drilling blast holes to a maximum of 4.5 m depth per blast (shorter blast holes may be required in the initial stages dependent on ground conditions encountered). This drill uses diesel for transportation and once drilling is commenced it uses 1000V power to continue operation. Approximately 72 mm x 45 mm blast holes would be drilled in the face to ensure a clean excavation, however this can vary dependent on geometry and ground conditions. **Figure 3-32** provides an example of a drill pattern for this size of development drive.

Figure 3-32 Example Lateral Development Drill Plan



3.6.7.2. Charging and Blasting

Upon completion of the drilling cycle, blast holes would be charged with explosives in order to advance the decline face. It is proposed to utilise the current explosives products available to the operation due to their proven reliability and availability. An ammonium nitrate emulsion would most likely be used as the bulk product, cast boosters as primers, and either nonelectric (nonel) or electronic detonators to initiate the charged face.

Indicatively each blast hole would contain approximately 5.0 kg of ammonium nitrate emulsion, one detonator and one primer. Blast timing may vary between blasts to maximise effectiveness parameters (including fragmentation, linear advance, profile result and to manage misfire mitigation) with the ultimate aim of minimising vibration and overpressure. Blasting methods would be designed by a mining specialist to minimise potential impact from vibration and overpressure, particularly in relation to the portal development from surface blasting. It is proposed where possible to develop the decline from underground to minimise surface impacts. Flyrock may present a risk for the initial (approximately) 20 m of development into the portal face and would be assessed, appropriate clearance zones would be required to manage this risk. Once the decline advances beyond 20m into the face the likelihood of flyrock is largely mitigated.

3.6.7.3. Load and Haul

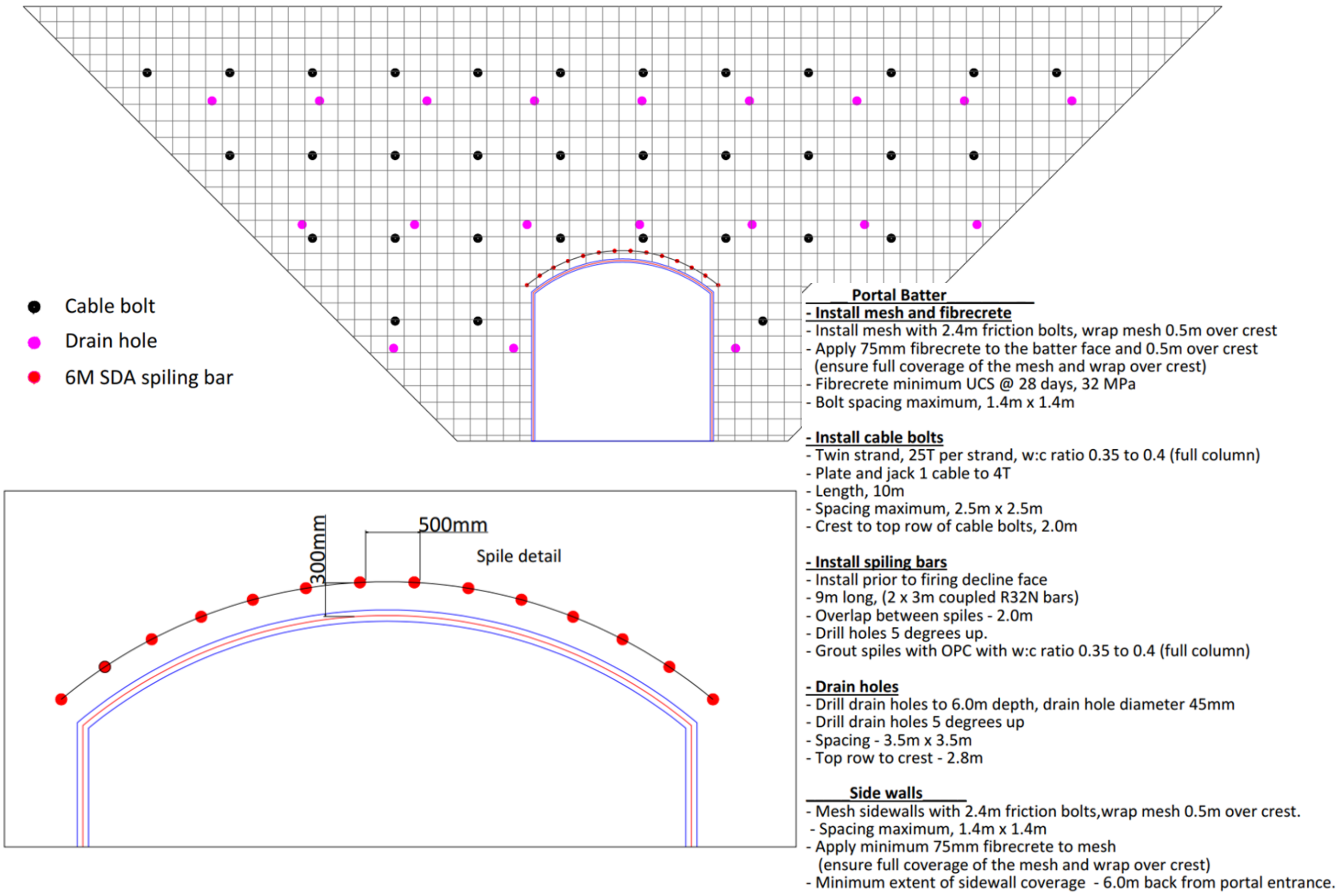
Loading and hauling operations would be conducted to remove material from the face in order to access the freshly blasted excavation. It is proposed that this would be conducted using one Sandvik LH517 or equivalent loader and one Sandvik TH551 (43t) or equivalent dump truck.

The total waste from this new section of decline is estimated at 40,000 t. This material is expected to have similar properties, including lead levels, to mine waste rock and would be transferred by truck to BHP Pit when working from the surface for testing and use for progressive rehabilitation. Material tested and found to be >0.5%Pb would be retained in BHP Pit and capped or returned underground. Waste material from underground development would be placed in underground mine voids.

3.6.7.4. Ground support Installation

Ground support is required to be installed as each blast advances the decline. This would consist of shotcrete and rock bolts as a minimum support regime. Shotcreting activities would be conducted using a Normet Agitator and Spraymec (or equivalent), and all rock bolting would be completed using the same development drill used in the drilling cycle. Rock bolting requires drilling approximately 2.4 m into the rock surface to allow installation of the bolts. A conceptual ground support design was provided by GCE and is shown in **Figure 3-33**.

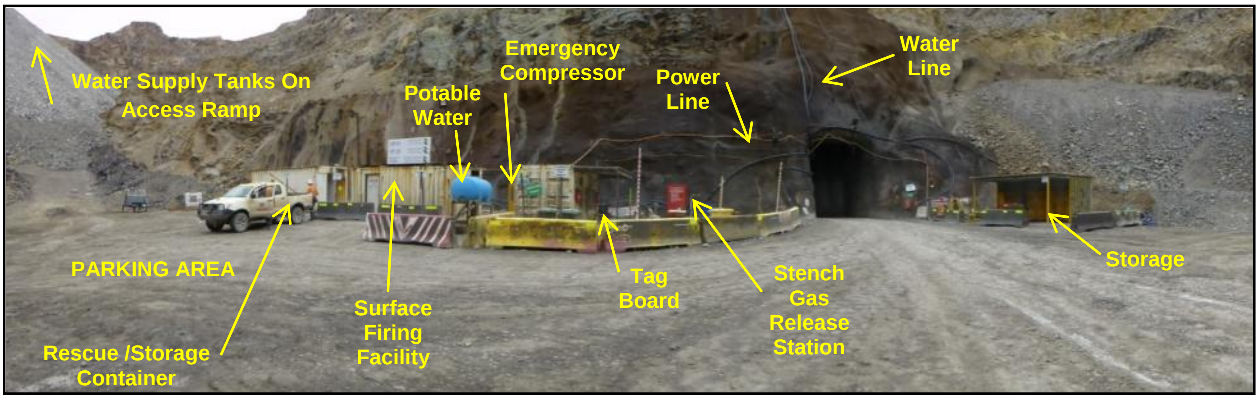
Figure 3-33 Conceptual Ground Support Design



3.6.8. Underground Mining Services

Underground mining services would be relocated from Kintore Pit (**Figure 3-34** shows current arrangements) to an area adjacent and southwest of the boxcut. **Figure 3-20** provides an indicative layout for the boxcut area which would be optimised and confirmed during detailed design. It is proposed that the area would require minor earthworks (approximately 1,500 t of free-dig material) which would be completed concurrently with the boxcut excavation works. The S37 stormwater pond lies within this area and would remain with any overflow directed to the S41 stormwater pond.

Figure 3-34 Underground Mining Services Located in Kintore Pit

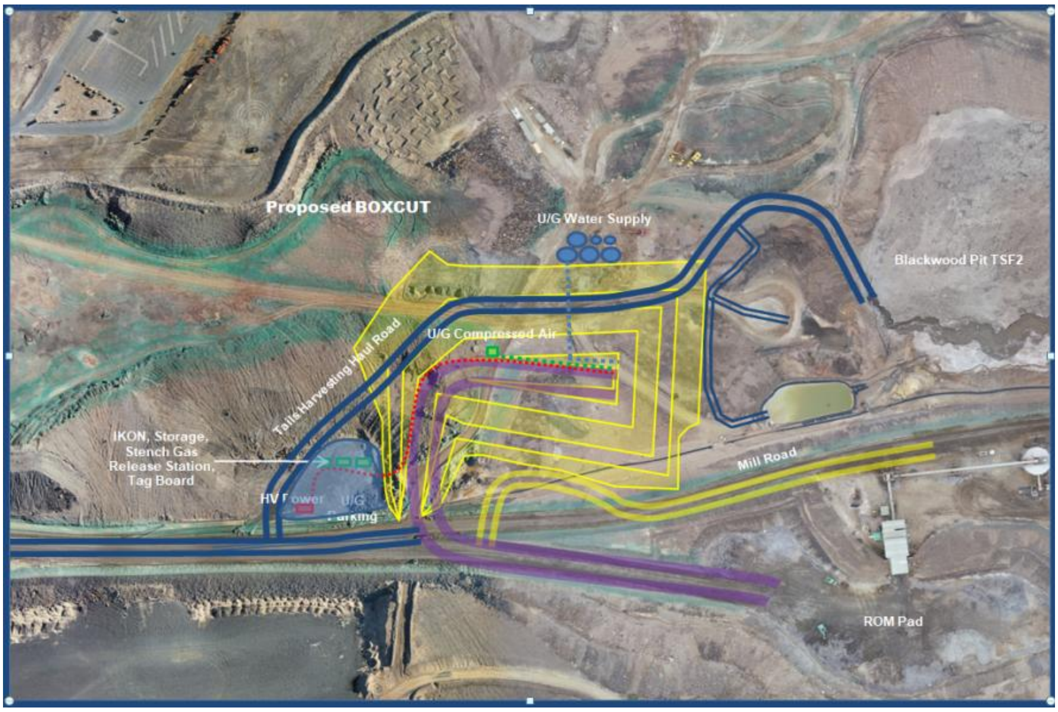


The underground mining services area would contain a simple crib room (20 ft container) for haul truck drivers, substation and switching gear, tag board, parking area for both heavy and light vehicles and communications infrastructure.

It is anticipated that the area would be largely inactive aside from shift change (twice daily) and cribbing periods. The tag board would be used by personnel entering and leaving the underground. Drivers would enter the services area, turn off their equipment, place or collect their underground tag from the tag board and return, taking approximately 5 minutes. This would occur twice daily over a 30 minute period at the beginning and end of each shift (6.45am to 7.15am and 6.45pm to 7.15pm) and would include: 6 haul trucks, 10 light vehicles, and one each of a loader, drill ancillary equipment and grader. This would also occur spasmodically over the day (and night) as personnel enter and leave the underground.

In operation there would be no change to the number and type of haul trucks currently used to transport ore to the ROM Pad. The haulage distance to the ROM Pad would reduce from approximately 2050 m to 326 m.

Figure 3-35 Indicative Boxcut Layout



A compressor using low capacity diesel or electric power would be used in the initial decline development and post breakthrough to current underground mining areas. The compressor would then remain for emergency use only when it would be used to supplement the existing air distribution network fed underground through a dedicated borehole to Stockpile 3.

A transformer would be used from the existing high voltage power line to feed power underground during the decline development. This transformer would also power the designated surface firing facility.

Water would be fed underground from a similar header tank arrangement as currently operating at Kintore Pit where water tanks are located along the access ramp and gravity-feed water into the underground workings. Water would be piped to the water storage tanks located to the northwest of the boxcut from a branch off the existing Mill Plant water supply feed. The feed line would run around the south side of the boxcut from a take-off located along the existing Mine Haul Road to underground workings.

A sump would be installed to collect rainwater runoff from some areas of the boxcut and reduce the amount of stormwater reporting to the S37 stormwater pond and the underground decline. Prior to break through with existing / planned underground workings the water would be pumped to existing surface catchment areas (S37 and S41). Once there is connectivity with the underground workings any excess water would report to underground and be managed through the underground water management system. The location of the sump has been conceptually placed on the lower bench; however, the actual location would be determined during detailed design. Diversion drains for excess stormwater runoff would direct any water overflow from S37 to the drainage lines running along the existing Mine Haul and Mill Roads to the S41 stormwater pond.

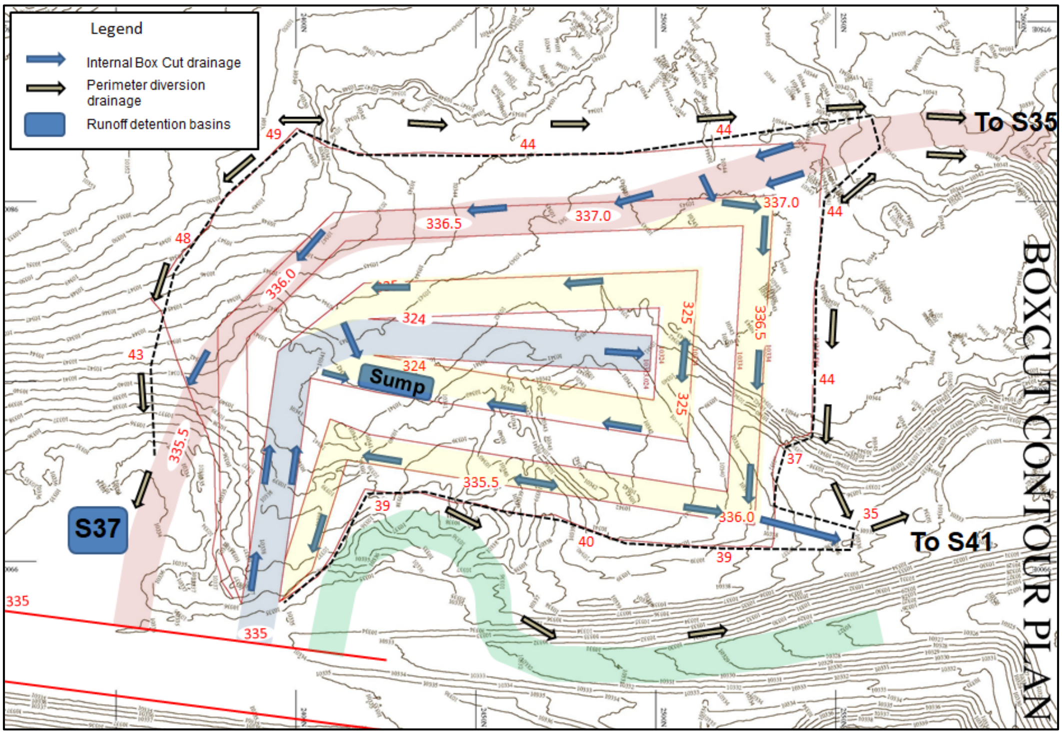
3.6.9. Surface Water Management within Boxcut

Management of stormwater runoff within the boxcut would be defined during detailed design and the BHOP Site Water Management Plan (BHO-PLN-ENV-004) (BHOP SWMP) would be updated to accommodate these changes.

The proposed concept design has included several measures to limit the volume of stormwater that enters the boxcut. These are shown in **Figure 3-36** and include:

- Diversion drains would be constructed around the perimeter of the boxcut. These drains would be designed to report to S35, S37 or S41 storage ponds as outlined in the BHOP SWMP.
- A drainage channel would be installed along the Tails Harvesting Haul Road with runoff directed to S37.
- A small diversion bund would be installed on the Tails Harvesting Haul Road at its northern entry / exit point and on the Mine Ore Haul Road as it exits the boxcut.
- Drains would be installed on the upper bench diverting any rainfall runoff to S37 or S41.
- Installation of a sump to collect and remove (by pumped extraction) any stormwater that is not able to be diverted. This sump has been indicatively placed on the lower bench however its actual position will be identified during detailed design.

Figure 3-36 Indicative Stormwater Management for Boxcut



3.6.10. Boxcut, Portal and Decline Construction Timetable

Table 3-24 provides an indicative timeframe for construction of the boxcut, portal, decline and associated works.

Table 3-24 Indicative Construction Timeframe Boxcut, Portal, Decline and Associated Works

Item	Weeks
Decline development from underground (30 m)	16 weeks
Excavation of boxcut (Stages 1, 2 and 3)	17 weeks
Portal and decline development from surface (10 m)	4 weeks
Capping of Little Kintore Pit, BHP Pit and roads	4 weeks
Underground services and stormwater diversion drains	4 weeks

3.7. Crushing of Non-Ore Material

The Mine requires crushed material primarily to provide an operational base for mine trucks on underground roadways; some material is also required for surface activities such as noise bunding, other bunding and gravel capping. Currently this material is obtained from leasing a mobile crushing and undertaking crushing in Kintore Pit. BHOP has approval to also crush material for the TSF2 embankment works in BHP Pit. BHOP proposes to continue these crushing activities with the option of using either pit location.

The recovery of waste rock material and the sorting, crushing and screening activities would only occur as part of a campaign crushing program (likely 2 to 3 times per year for 1 week per campaign) and up to 20,000 t. Crushing activities would be limited to Monday to Friday – 7.00am to 6pm, Saturdays – 8am to 1pm with no work on Sunday or public holidays.

A description of Kintore Pit and its location is provided in **Section 3.4**. It is proposed to use the top of the Kintore Pit Tipple (waste rock stockpile) for crushing activities whilst this area continues to be available during the first 6 years of the TSF3 operation. The top of the Tipple, once material is removed for the bridging layer, is approximately 280 RL and 30 m from the Kintore Pit rim. BHP Pit may also be used for crushing activities during this time as required. All crushing activities would be undertaken using a mobile crusher in BHP Pit when the Kintore Pit Tipple area is no longer available.

BHP Pit is located centrally within the Mine, **Figure 1-2**. It is surrounded by mining works with Delprats Shaft and mine infrastructure to the north and the processing plant and TSF2 to the north east. Kintore Pit and the Mine infrastructure lay to the west of BHP Pit. Mount Hebbard (a historic tailings storage facility), rises 20 m above BHP Pit to its south with the historic tailings facility TSF1 is also located to the south. The current Mine Haul Road lies between BHP Pit and TSF1. A 4 m earthen noise bund has been installed along the Mine Haul Road adjacent to TSF1 and extends to the ROM Pad. The explosives store is located on the western side of the Pit and approximately 125 m to the west of the proposed crushing activities.

The closest residential location to the north or south is approximately 500 m.

The overall dimensions of the BHP Pit are 347 m at its longest point and 198 m at its widest point, the proposed working area of the BHP Pit floor is 15 m below surface and is approximately 60 m by 50 m. A deeper section lies to the north east end of BHP Pit and is 100 m x 90 m and 29 m deep. This area would be filled with material from the boxcut excavation and made level with the current pit floor. The crushing works would be located in this area. **Figure 3-37** shows crushing works being undertaken in BHP Pit for the embankment works and this would also be the proposed location for future crushing activities.

There is no vegetation in this area and there would be no impact to flora or fauna. The closest heritage items, as listed in the BHCC LEP, are located approximately 30 m to 40 m from the proposed activities, are fenced for their protection, and would not be affected. These items have not been impacted by the conduct of other activities within the Pit including the placement and storage of waste rock in the Pit. Protection of these items is discussed in **Section 8.10**.

There is no requirement for site preparation for the crushing of non-ore material, as the surface would be flat and stable.

Figure 3-37 Mobile Crusher in BHP Pit

The process for crushing would utilise the current practice whereby deposited waste rock from underground is initially moisture conditioned in-situ with a water canon attached to the water truck, reclaimed using appropriate mobile equipment (front end loader or excavator) and then stockpiled. Moisture of the feed stockpiles is maintained by the use of a water truck equipped with sprays and high pressure water cannon. After the material is sufficiently moist, depending on the particle size, it is further processed through a mobile crusher to reduce the particle size down to the required fraction likely but not limited to sub-50 mm for usage as road base material underground. The mobile crusher includes the installation of water sprays within the conveyor cover.

The sizing of the waste rock material (prior to crushing) is anticipated to be sub-500 mm (given that the majority of fine waste is sourced from underground development firings) and hence the requirement of secondary breakage (use of mobile rock breaker) is not required.

All waste rock would be tested for its lead content as per current procedures (Surface Placemen of Material Testing Procedure BHO-PRO-ENV-036) and material >0.5% Pb would not be used. Three stockpiles would be created: Stockpile 1 for untested material, Stockpile 2 for material that has been tested at <0.5% lead and is suitable for surface use, and Stockpile 3 for material tested and is >0.5% lead, this material may be used for underground road base or placed in TSF3.

Material suitable for use would be water conditioned then loaded into a truck using an excavator and transported to the required location and unloaded.

3.8. Progressive Rehabilitation

Schedule 3 Condition 34 of the PA requires progressive rehabilitation to be undertaken at the Mine site. The Mine has a number of Free Areas as depicted in Appendix 4 of the PA and shown in **Figure 3-38**, these are areas where no current active mining activities are conducted. These areas have not been disturbed by Rasp Mine activities but are a legacy from historic mining at the site. However these areas contribute to airborne Pb bearing dust emissions from wind entrainment and taken offsite. The updated emissions inventory as modelled by ERM Sydney shows that the source of dust from the Free Areas is approximately 14% of total TSP while they account for 22% of total Pb (TSP) dust emissions from the site. BHOP propose, to meet its PA obligations, to progressively rehabilitate these areas with waste rock capping.

Figure 3-38 Aerial Depicting the Free Areas (shaded in white)

These areas contain historic storage of mixed materials (waste rock, tailings, slag, other) some with high Pb levels. Surface materials were reviewed by Toxikos Pty Ltd in their Human Health Risk Assessment during the original EA and were found to range from 7,000 mg/kg to 31,000 mg/kg lead with bioaccessibility ranging from 3.7% to 14.6%, **Figure 3-39**.

3.8.1. Capping Options Assessment

BHOP engaged Mine Earth Pty Ltd (Mine Earth) to assess options for capping materials, including vegetation, to minimise wind entrainment of Pb bearing dust from the Mine site, *Rasp Mine – Dust Management Options Assessment,* June 2021 (**Appendix I**). The scope of this study was to:

- Examine previous revegetation programs undertaken at the Mine to gain an understanding of their success or failure.
- Identify the likely areas at the Mine where dust generation is most probable.
- Review existing information detailings the predicted contributions to lead levels to the surrounding areas adjacent to the Mine.
- Identify any opportunities for the use of vegetation to achieve acceptable dust management outcomes (especially in areas where significant dust generation is less likely) over time and under drought conditions.
- Analysis of the visual amenity aspects of the various approaches, consistent with possible end land use scenarios.
- Provide a discussion into potential barriers to success of revegetation (e.g. costs, maintenance, characteristics of available materials etc).

The study considered dust generated from a number of sources from the Mine site including exposed Free Areas, uncapped hard stand areas not currently used for mining activities, unsealed roads, laydown areas used for equipment storage and parking, ROM pad, TSF2 and the proposed TSF3. Mine Earth concluded that the majority of dust that could be taken up by wind was generated from the Free Areas.

Figure 3-39 Soil Lead Concentrations and Bioaccessibility for Soil Sample Composites

Mine Earth completed an options assessment using a multi-criteria analysis (MCA) to evaluate the dust management options available for the Mine with the aim to identify and rank dust management options for closure. The criteria was weighted and included: Effectives of the cover, its ease in construction, whether the method had been proven elsewhere, cost, likely acceptance by stakeholders, visual amenity, company reputation and its endurance as a post closure walk-away solution were considered in the analysis. The results of the MCA are provided in **Table 3-25** and indicated that covering areas with waste rock is likely to be the most effective closure option for controlling dust. Other options which could also be considered in particular areas of the site also included:

- Stabilising mining areas with an impervious cover, concrete or slag type materials, particularly around heritage sites.
- Installing bunds or other wind breaks to reduce wind velocity across the surface, and
- Re-profiling or contouring areas to create depressions with the aim of reducing dusting potential and encouraging resource accumulation and natural vegetation.

Mine Earth also considered revegetation options and found that there are a number of factors that are likely to impact the success of any revegetation activities at the Mine including:

- Climate – in particular, drought conditions and high evaporation rates.
- Lack of growth medium.
- Dominance of weeds.
- Excessive grazing by goats.
- Excessive dust generation which impacts plant growth and wind erosion which can remove seed from the soil surface.

Table 3-25 MCA of Post Closure Dust Management Options

	Options (Items highlighted in green were considered by Mine Earth to be the most effective solutions.)	Effectiveness	Ease to construct	Proven method	Cost - capex	Cost - opex	Acceptance	Visual amenity	Reputation	Enduring	Weighted average score	Gaps / issues / comments
	Weighting	5	3	5	3	3	5	3	3	5		
1	Cover mining areas with waste rock	5	5	5	3	5	4	2	4	5	4.3	Determine stakeholder acceptance/availability of waste rock/quality of waste rock/cost. Develop a design concept for the waste rock cover.
2a	Stabilise mining areas with an impervious cover (e.g. concrete) to bind contaminants and fine particles	5	4	5	1	3	3	1	3	3	3.3	Expensive but could be used in targeted areas
2b	Stabilise mining areas with an impervious cover (e.g. slag) to bind contaminants and fine particles	5	4	5	1	4	3	1	3	3	3.4	Expensive but could be used in targeted areas
3	Install bunds or other wind breaks to reduce wind velocity	3	4	3	4	3	3	2	3	3	3.1	
4	Revegetate exposed areas	2	1	3	2	2	4	4	3	2	2.6	Revegetation is likely to be unsuccessful in the long-term
5	Re-profile areas to reduce susceptibility to dusting	2	3	3	2	3	3	3	3	2	2.6	Define options to establish depressions to encourage moisture/resource accumulation
6	Spray chemical dust suppressants	4	3	4	2	2	2	2	3	1	2.6	Not sustainable long term once operator leaves the site
7	Install water sprays in mining areas	3	2	4	2	2	2	2	2	1	2.3	Ongoing water source required so not sustainable
8	Company to purchase affected properties downstream of the areas likely to dust	1	2	2	2	3	2	2	2	2	1.9	Not likely to be acceptable by stakeholders
9	Use street sweeper/water truck on town roads	2	3	3	2	2	1	2	1	1	1.9	Not likely to be acceptable by stakeholders
10	Monitor dust levels	1	4	1	4	2	1	2	1	1	1.7	Not acceptable by stakeholders
11	Leave as is/ do nothing	1	5	1	5	1	1	1	1	1	1.7	Not acceptable by stakeholders

Mine Earth concluded that due to these barriers including drought conditions, lack of growth medium, the occurrence of weeds and grazing impacts, revegetation is unlikely to be successful without considerable intervention. Intervention strategies including irrigation and import of growth medium are expensive and are unlikely to achieve viable long term revegetation outcomes.

Waste rock has been used successfully on the site to reduce wind entrainment of dust into the air. During site rehabilitation works undertaken by Normandy in the 1990's under the guidance of the then DMR and EPA, waste rock was placed over some areas of the site to reduce dust, primarily layered over slopes and roads. This has now been in place for well over 25 years and recent testing showed that waste rock had a high level of control when used for dust management, refer discussion below. Waste rock was also used by BHOP to cover areas disturbed during earthworks repairing the western top end of Kintore Pit. Visual assessment of the waste rock surface shows good consolidation of the rock material with very little fines present on the surface as they have been washed through the course material leaving a rock armoured surface.

Mine Earth states that waste rock is routinely used as an effective dust control measure in mine site rehabilitation at mines in Australia and around the world, especially on tailings storage facilities. Their recommendation to use waste rock capping as the preferred dust suppressant was based on the following factors:

- The rock type varies, however all rock types identified were competent and mostly hard, with good resistance to weathering.
- The waste rock comprises only approximately 1% fines capable of producing dust.
- Pb concentrations averaged 2,371.5 mg/kg (0.24%) and were taken from crushed samples (and therefore conservative as there is only 1% of fines capable of producing dust). This is approximately four times the NEPM health investigation level (HIL-C) criterion (600 mg/kg) but significantly below surface dust averages (15,640 mg/kg, or 1.56%).
- Bioaccessibility was very low (7.3% on average). This is much lower (6.8 times) than the 50% bioavailability assumed for the calculation of HIL's. This would suggest that results, if adjusted for bioaccessibility, would meet HIL-C criteria.
- Air quality modelling conducted at the Mine site has assumed lead concentrations of 0.5% (5,000 mg/kg), which is above the average identified in the waste rock on site (0.24%) and therefore the waste rock is likely to meet NSW EPA impact assessment criteria for air quality parameters assessed and is unlikely to impact further upon surface soil lead concentrations within local communities.

Mine Earth concluded that the results supported the use of waste rock for dust suppression for the TSF and Free Areas, and is considered unlikely to cause an unacceptable risk to human health based upon the final proposed land use as a tourist/recreational site (BHOP, 2017) and that the recommendations by PEL should be adopted for its use, providing:

- Waste rock be tested prior to placement to ensure median level of lead concentration does not exceed 0.5%.
- Dust suppression water spraying is carried out during capping material (waste rock) placement to ensure finer particles are washed between the larger rocks.

BHOP propose to commence progressive rehabilitation of these Free Areas with the aim to minimise dust generation.

Since the commencement of mining operations BHOP has placed approximately 1.4 Mt (to the end of 2020 refer **Table 1-2**) of waste rock from underground workings into Kintore Pit. Some of this waste rock would be used to form the bridging layer and other preparatory works in TSF3 (260,000 t) which would decrease the height of the in-pit stockpile by approximately 10 m. This area, Kintore Pit Tipple, is proposed to be used for periodic mobile crushing until the area is covered over with tailings. During this time, approximately 6 years, the area would also be available for testing the contents of the fresh waste rock transferred from underground (also utilising BHP Pit) and it is proposed to select and use material with <0.5%Pb as capping, allowing areas of the site to be progressively rehabilitated with the prime aim of reducing the potential for wind entrainment of Pb bearing dust.

In addition it is proposed that the waste rock stored in the stockpile would also be tested and where suitable separated for future rehabilitation capping. Material >0.5%Pb would be transferred to TSF3 and placed around the perimeter of the Pit walls.

This would significantly decrease the lead content of surface material open to wind entrainment of dust that can be deposited off site.

This waste rock is a valuable resource that needs to be used before it is lost and covered with tailings material. There is sufficient waste rock available within Kintore Pit to accommodate rehabilitation capping within the current PA period and it is proposed to stockpile waste rock (<0.5% Pb) on surface for future capping requirements. This would be assessed in a future modification with the extension of underground mining within CML7 and the PA period.

3.8.2. Waste Rock Characteristics

A waste rock study was undertaken in 2017 by Pacific Environment Ltd (PEL) for MOD4, *Rasp Mine - Waste Rock Classification, March 2017 (***Appendix L**) and an assessment of potential long term impacts of surface placed waste rock was undertaken by Environment Resource Management Australia Pty Ltd (ERM Perth), *Long Term Geochemical Degradation Assessment for Waste Rock – MOD6 Waste Rock Management Rasp Mine,* 16 March 2021 (**Appendix H**). The information in the following sections has been used by the consultants to inform their assessments.

Golder were also commissioned to provide a concept design for the waste rock placement over surface areas and this is discussed in the Section 10 of the Golder Report (**Appendix B1**), including dust control and surface water management which would be addressed in an updated BHOP SWMP.

The current active waste rock stockpile, located within Kintore Pit, is composed of material obtained from the creation of the portal and decline which commenced in 2007 with further mining development material placed in the stockpile when there were no available voids underground. As the decline and mining development was developed outside of the orebody the vast majority of the stockpile is either very low grade ore or material with little to no Pb or zinc content. All of this waste rock was derived from within the site and is therefore comprised of natural material to this region.

3.8.2.1. Waste Rock Lithology

As identified by BHOP Technical Services staff the bulk of the waste rock is composed of Garnet Pelite (GPE) and Psammopelite (PM), then Garnet Spotted Psammopelite (SPM) with very minor quantities of dolerite (DOL) and Garnet Quartzite (GQ) present. All of these rock types are described as hard and competent units with the exception of GPE 1 and 2, which are noted as a softer rock type that has been more susceptible to accommodating shearing. Conversely, DOL1 and 2 is rated as extremely hard rock with very high uniaxial compressive strength (UCS). A detailed description of the rock types is outlined in the PEL Report.

3.8.2.2. Particle Size and Moisture Content

The waste rock composition was analysed for particle size and moisture content, and these results are presented in **Table 3-26**. PEL found that the moisture content of all samples was very low ranging from 1.6% to 3.4%. Moisture content has a significant effect on rock strength, lower moisture contents are typically linked to increased rock strength which would impact how much weathering of the rock may occur over time.

PEL also found that the waste rock samples showed a consistent trend with a low proportion of small particle sizes. Laboratory reports showed that 4 of the 5 samples had 1% of the sample passing a 75 µm sieve; while one sample had 2% passing the 75 µm sieve. Significant volumes of dust are unlikely to be generated from particle sizes greater than 75 µm.

Table 3-26 Size and Moisture Characterization

Sample ID	Moisture Content	Sieve sizes - Percentage Passing				
		75 mm	53 mm	19 mm	2.36 mm	75 µm (silt and clay)
1	3.1%	100%	52%	23%	8%	**2%**
2	1.6%	68%	49%	14%	3%	**1%**
3	3.1%	85%	47%	15%	5%	**1%**
4	3.4%	70%	47%	16%	5%	**1%**
5	3.4%	71%	49%	11%	3%	**1%**

Note - Results in **bold** represent particle sizes that are potentially ‘dust producing’

Furthermore PEL found that the greatest percentage of any sample passing a 2.36 mm sieve was only 8%, with 2.36 mm considered to be the geotechnical cut-off point for fine grained soils. Silt is classed as particles of less than 75 µm, but greater than 2 µm; particles of less than 2 µm are classed as clay.

The average silt content of the five samples was 1.2%, which may include some proportion of clay particles and may be dust generating; therefore the rock comprises only approximately 1% fines capable of producing dust.

PEL also commented that “*importantly, it is also noted that the proportion of small or fine grained material in the waste rock pile is likely strongly influenced by the method of mining (blasting) rather than being reflective of the rock’s natural degradation and erosion (which will be slow).”*

The efficiency of waste rock on the reduction of dust emissions caused by wind erosion was investigated in 2016 as supporting information to BHOP’s application for PA MOD4, Appendix I Air Impact Assessment, Pacific Environment Limited, March 2017. In this assessment Controlled Air Burst Chamber (CABC) testing was used to simulate the effect of windy conditions on surface treatments to determine a control efficiency rate. Results indicated that the waste rock trial on site provided a control efficiency of 99.7%. This is compared to a control efficiency of 96.6% on “Uncontrolled Free Areas - Crusted”, such as the surface of the high Free Areas, and 90% on “Unsealed Areas - Crusted”, which would simulate the worst-case for these areas. These results are presented in **Table 3-27**.

Table 3-27 Wind Erosion Control Efficiencies

Erosion Surface	Control Measure	Efficiency
Tailings (dry, disturbed) – Base Case	N/A	N/A
Tailings (dry, crusted)	Crusting	99.7%
Tailings (wet)	Maintenance of moisture content	100.0%
Waste rock	Covering with waste rock	99.7%
Uncontrolled free area (dry, disturbed) – Base Case	N/A	N/A
Uncontrolled free area (dry, crusted)	Crusting	96.6
Uncontrolled free area (5 month old RST Total Ground Control)	Dust suppressant (aged)	98.9
Unsealed area (dry, disturbed) – Base Case	N/A	N/A
Unsealed area (dry, crusted)	Crusting	90.0
Unsealed area (fresh dust suppressant).	Dust suppressant (fresh)	99.2

3.8.2.3. Metals Content

It is known that the waste rock comprises a number of different rock types, in varying quantities**.** The waste rock samples were crushed prior to metals analysis was undertaken in order to homogenise the sample and eliminate or reduce the possibility that sampling of the finer material, that may constitute a particular rock type, may bias analytical results. Samples were taken in August and September 2016.

The analytical results have been summarised in **Table 3-28** and the National Environment Protection Measure (NEPM) Health Investigation Level (HIL) guidelines are provided for comparison. PEL concluded that the "Recreational' guidelines would be the most relevant given potential future land use.

The concentrations of all metals analysed, with the exception of Pb, are within the NEPM HIL-C (recreational) and HIL-D (industrial/commercial) guideline criteria. Four of the six samples exceed the NEPM HIL-C (recreational) criteria for Pb in soil, and two of the samples (samples 3 and 5) exceed HIL-D (industrial/commercial) Pb criteria. The mean Pb concentration of all six samples was 2,371.5 mg/kg exceeding the NEPM HIL-C guideline value of 600 mg/kg and the HIL-D guideline value of 1,500 mg/kg.

Table 3-28 Summary of Laboratory Analysis Results, Moisture and Heavy Metals

Analyte	NEPM Guidelines			Sample ID (results in mg/kg)					
	HIL A (Residential)	**HIL C** (Recreational)	**HIL D** (Commercial)	**Initial** (Composite)	**1**	**2**	**3**	**4**	**5**
Arsenic	100	300	3,000	13	9	241	34	26	75
Barium	ND	ND	ND	40	30	30	30	30	20
Beryllium	60	90	500	<1	<1	<1	<1	<1	<1
Boron	4,500	20,000	300,000	<50	<50	<50	<50	<50	<50
Cadmium	20	90	900	6	<1	5	57	4	17
Chromium	100	300	3,600	17	22	13	10	20	17
Cobalt	100	300	4,000	8	9	16	14	10	11
Copper	6,000	17,000	240,000	93	15	55	240	45	141
Lead	300	600	1,500	543	57	905	9010	684	3030
Manganese	3,800	19,000	60,000	78	91	258	405	174	188
Nickel	400	1,200	6,000	12	18	18	12	19	18
Selenium	200	700	10,000	<5	<5	<5	<5	<5	<5
Vanadium	ND	ND	ND	15	22	18	14	28	22
Zinc	7,400	30,000	400,000	1780	222	1420	21500	973	4060
Mercury	10	13	180	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Moisture Content (%)	-	-	-	1.3	3.1	1.6	3.1	3.4	3.4

During the original Human Health Risk Assessment completed by Dr Roger Drew, Toxikos 2010, sampling was undertaken from various areas across the Mine and tested for Pb content and its bioaccessibility. It was found that Pb content alone did not determine how much was taken up into the human body and that the older more weathered material had the highest bioaccessibility, **Table 3-29**.

Table 3-29 Bioaccessibility of Lead in Surface Soils – Rasp Mine

Sampling Point	Lead Concentration (mg/g)	Lead Concentration (mg/kg)	Lead Concentration (%)	Bioaccessibility (Bac) (%)
1	31	31,000	3.1	**14.6**
2	8.8	8,800	0.88	**3.6**
3	7.1	7,100	0.71	**8.5**
4	11.8	11,800	1.18	**6.1**

Sampling Point	Lead Concentration (mg/g)	Lead Concentration (mg/kg)	Lead Concentration (%)	Bioaccessibility (Bac) (%)
5	18.7	18,700	1.87	**3.7**

These results are well above the Pb levels found in waste rock sampling from the Kintore Pit Tipple with the exception of one sample (9,010 mg/kg) with the next closest result, 3,030 mg/kg.

Figure 3-40 shows a summary of results of Pb in waste rock from the Kintore Pit Tipple and the bund wall installed as noise mitigation for the Concrete Batching Plant. The results were obtained in the field using an XRF unit and maintaining a conservative approach by adopting the data at the highest end of the error margin. The volume of wast rock material used was approximately 16,000 t. The number of readings taken was 1788 of which 1116 or 62.4 percent did not detect any Pb, 93.3 percent (1669) of readings detected Pb levels below 0.5%.

In addition over 40,000 t of waste rock material was used, primarily from the Kintore Pit stockpile, in the construction of the embankments for TSF2. This material was tested via sampling and laboratory analysis with 436 samples assayed. **Figure 3-41** shows a summary of the assayed results with 85.6% of samples below 0.5% Pb. The average Pb content of all assayed samples was 0.277% lead content comparable to the 0.237% identified by PEL.

Figure 3-40 Waste Rock XRF Readings for Concrete Batching Plant

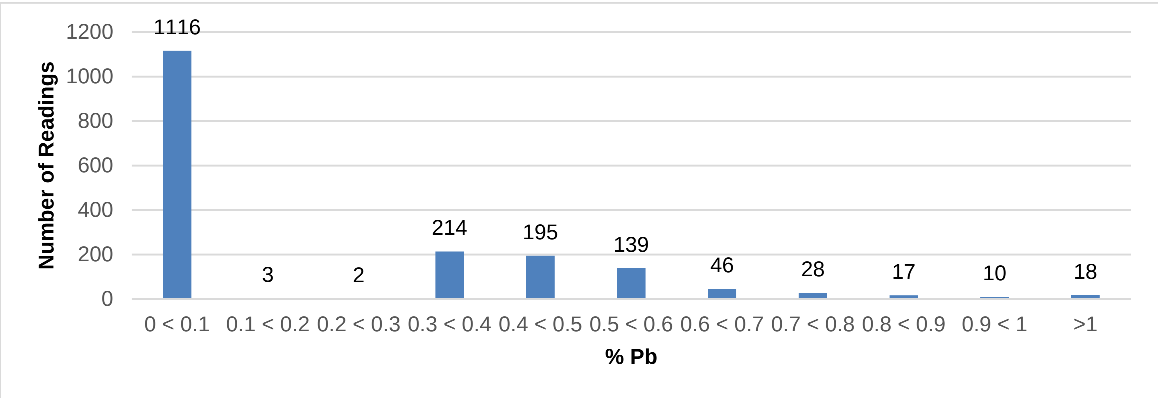
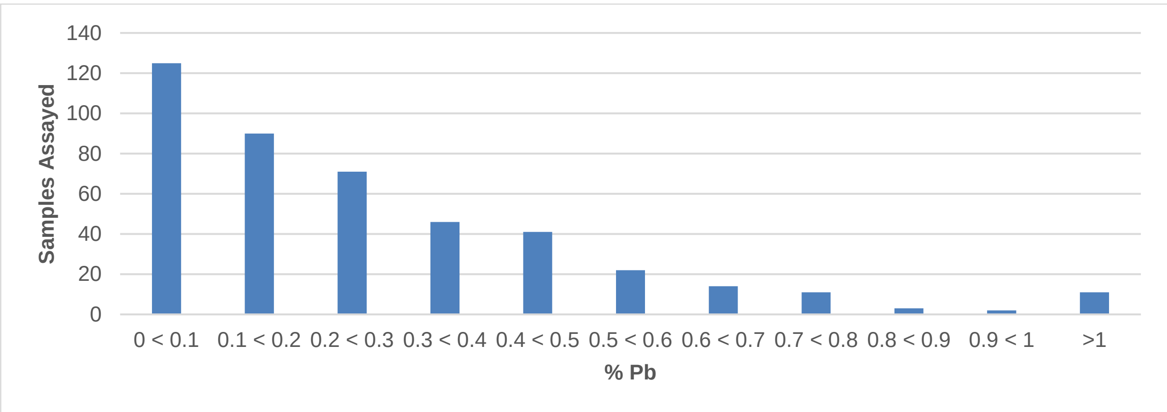


Figure 3-41 Waste Rock Sampling for TSF2 Embankments



This confirms that the majority of the waste rock contains little to no Pb and is well below the 0.5% Pb identified as the criteria for surface placement.

3.8.2.4. Geochemical Analysis

BHOP engaged ERM to undertake a long term assessment of the use of waste rock for surface capping (ERM Perth **Appendix H**). ERM Perth engaged Mine Waste Management Pty Ltd to undertake geochemical analysis of the waste rock material which informed their risk assessment. ERM Perth made the following conclusions:

Potential for acidic drainage:

- The majority of samples tested were classified as non-acid forming (NAF) (76%) with low sulphur (S) (<0.3%) and low to moderate acid neutralising capacity (ANC), only 3 of the 50 samples showed moderate to high sulphur (0.42% to 1.14%).
- Two psammopelite samples (4% of samples) were classified as potentially acid forming (PAF) and 10 samples (20%) as uncertain (UC). All PAF and UC samples were <0.2% sulphur.
- Mineralogy testing demonstrated that the samples mostly consist of quartz and very slow to slow reacting silicates. Some chlorite was present in most samples, a mineral with immediate reactivity. Garnets were identified in all samples, which can provide fast reacting silicate buffering. No carbonate minerals were identified.
- All rock type groupings, including the psammopelite rock type, had average net potential ratio (NPR) values ≥2. The NPR ratio is the ratio of acid neutralisation capacity (ANC) over maximum potential acidity (MPA), with a ratio above 2 indicating that the material is NAF.

ERM Perth concluded that while a small subset of samples have been identified as PAF, the central tendency in the data (and specifically the average NPR ratio ≥2 for all rock types) indicate that the material is expected to be largely NAF. This aligns with site observations by ERM Perth during their site inspection, which indicates that acidic drainage has not been identified at the site (where mining commenced in the 1880s).

Potential for metalliferous drainage:

- Elemental enrichment, based on the total elemental data for the samples and using the geochemical abundance index (GAI), identified a number of elements enriched more than 12 times the average crustal abundance.
- The majority of these where identified for psammopelite samples and elements enriched at this level included silver (Ag), arsenic (As), bismuth (Bi), cadmium (Cd), Molybdenum **(**Mo), Pb, antimony (Sb) and Zn.
- Analysis of a deionised (DI) water leach at a solid to liquid ratio of 1:2 and of the NAG test liquor for the samples indicate the potential for metalliferous drainage when the metal content of the leachate is compared to conservative freshwater aquatic ecology guidelines (specifically the freshwater aquatic guidelines for slightly to moderately disturbed aquatic ecosystems - ANZECC & ARMCANC, 2000).
- Metals leaching at concentrations above the conservative aquatic guidelines for both the DI leachate and NAG liquor included (but were not limited to) aluminium (Al), chromium (Cr), copper (Cu) and Pb. It should be noted that the NAG liquor data presents a conservative estimation for drainage quality in the long term, with NAG testing entailings aggressive oxidation of a pulverised rock sample.
- While the majority of samples have been classified as non-acid generating, the DI leachate and the NAG testing indicate that the majority of material sampled has potential to generate metalliferous drainage.
- All median leaching values (for both DI leach and NAG liquor) are well below the baseline values at the Rasp Mine, with the exception of iron (Fe) for the NAG liquor data, all 90th percentile values are also below the baseline values, **Table 3-30**.

Table 3-30 Summary of Metalliferous Drainage Data Compared to Groundwater Baseline Data

Grouping	Ec (µS/cm2)	SO4 (mg/L)	Cd (mg/L)	Pb (mg/L)	Mn (mg/L)	Zn (mg/L)	Fe (mg/L)
Groundwater Baseline	13,900	9,660	6.32	2.25	907	3,330	1.57
DI Leach - Median	320	37.5	0.0001	0.0015	0.009	0.005	0.1115
DI Leach – 90th Percentile	689	37.5	0.0001	0.0015	0.009	0.005	0.115

Grouping	Ec (µS/cm2)	SO4 (mg/L)	Cd (mg/L)	Pb (mg/L)	Mn (mg/L)	Zn (mg/L)	Fe (mg/L)
DI Leach - Maximum	1,900	432	0.0003	0.02	0.415	0.028	1.57
NAF Liquor - Median	210	45	0.0015	0.001	0.12	0.005	0.05
NAF Liquor – 90th Percentile	277	78	0.035	0.53	0.45	2.88	4.23
NAF Liquor - Maximum	709	312	0.31	5.93	1.02	87.5	33

ERM Perth concluded that given these results potential metalliferous drainage from the waste rock should have limited if any material impact on the existing water quality of the basement rock aquifer.

ERM Perth also conducted a detailed risk assessment based using a source-pathway-receptor (SPR) evaluation process for surface water runoff and concluded:

> *The risk assessment for the mine placement domains indicates that potentially complete SPR linkages are limited to on-site receptors. These are related to use of dewatering water and surface water onsite. Risk rankings for these potentially complete SPR linkages were considered to be low*

3.8.3. Description of Waste Rock Placement

A number of locations, Free Areas, have been identified for progressive rehabilitation using waste rock as a surface capping material. Golder was engaged to provide a design concept for the capping of these Free Areas to identify the method for waste rock placement and to provide an assessment for stormwater management. Current mine trucks would be used to transport the waste rock material from underground to either Kintore Pit or BHP Pit for testing. Material tested to be <0.5%Pb would be used as capping for progressive rehabilitation. Material tested and found to be >0.5%Pb would be transferred to TSF3 and placed around the perimeter of the Pit walls. Transport of waste rock from underground to either pit, would occur 24 hours a day 7 days a week, whenever the mine is operating. Transport of material for rehabilitation would only occur during the daytime 7 days a week.

An area within the Free Areas was identified by Golder to illustrate how material placement would occur. The area on top of Mt Hebbard was chosen as it was located centrally and to the south of the site, and is in close proximity to residents and Eyre Street, so this represented a worst case scenario.

Mt Hebbard is an historic tailings storage facility with active deposition concluding in the 1980s; it is located in an elevated area of the Mine site, standing approximately 18 m above the existing Mine Haul Road. The top of Mt Hebbard is a rough 'L' plateau-shape with the widest point 130 m and its longest point 300 m, approximately 88,000 t would be used to cap this historic facility.

Residential housing located along the north of Eyre Street are directly adjacent to the Mine with the closest residential properties located approximately 50 m from Mt Hebbard. The dominant wind directions are to the south of the Mine and South Broken Hill has been classified as the most affected area by Pb contamination in Broken Hill (Toxikos). The assessment undertaken by Toxikos found Mt Hebbard to have the second highest Pb concentrations of surface soils (18.7 mgPb/g) and a bioaccessibility 3.7%.

Revegetation had been attempted in this area and was not successful. The primary reason for this failure was the cessation of irrigation. This was further exacerbated by prolonged drought conditions continuing for over 10 years accompanied by high evaporation rates. (Average evaporation rates in Broken Hill are approximately 10 times the average rainfall.)

The waste rock is proposed to be paddock dumped over the existing surface area to provide an undulating terrain that would help resist wind effects and provide small depressions for water collection to promote natural vegetation growth. The proposed paddock dumping approach is to comprise 40 t (payload) trucks dumping loads adjacent to one another to cover the surface. No spreading or compaction of the dumped loads is proposed in order to minimise dust emissions from material handling and encourage vegetation growth in depressions. Golder found that a minimum fill depth of 700 mm is achieved if the truck loads are dumped within 4 m of one another (centre to centre spacing, in a triangular grid) and dumped loads overlap by approximately 1 m. Fines would be watered-in to minimise dust in the initial stages of the rehabilitation development, a method of dust minimisation recommended by PEL. The addition of chemical dust suppressant may be used in the early stages of development.

Golder concluded that a paddock dump placement of this nature would result in a surface with numerous tightly spaced mounds with depressions between the mounds. During rainfall events any rainfall would gravitate towards these depressions. It is estimated based on 1 in 100 ARI rainfall and assuming initial infiltration losses of 15 mm and a continuing loss of 2 mm/hr that standing water contained in the depressions resulting from a 1 in 100 ARI rainfall event would be less than 400 mm depth. Accordingly, runoff from a 1 in 100 ARI rainfall event would be wholly contained within the depressions formed by the paddock dumping mounds. The standing water contained within these depressions would infiltrate the placement area or evaporate. Accordingly, runoff from rain events would be contained on the surface of the placement area consistent with the BHOP SWMP.

Alternatively a different capping method may be used depending on the availability of sufficient waste rock with the aim of installing an undulating surface to interrupt wind patterns and provide pockets for water collection to encourage vegetation growth.

Selection criteria for progressive rehabilitation capping would consider:

- the results of lead in soil and bioaccessibility undertaken during the HHRA;
- the potential for wind-blown dust to be generated;
- the proximity and potential for the wind to deposit lead bearing dust to affected areas off-site;
- the visual aesthetic value of the area, and
- the current use for the area.

3.9. Administrative

3.9.1. Noise

BHOP requests that the conditions in the PA pertaining to noise be updated to align with recent attended noise monitoring and the NSW EPA NPfI. PA Schedule 3 Condition 17 provides a list (Table 7) of noise limits for noise generated by the project that must not be exceeded.

Current operational noise limits are based on project specific noise levels adopted in the noise impact assessment completed for the site in 2007. The project specific noise levels adopted in the 2007 noise impact assessment were derived based on measured or assumed minima rating background level (RBL) +5 dB for all assessment locations (residential), in accordance with the EPA's INP (now superseded by the NPfI).

A review of the RBLs (Rating Background Levels) at assessment locations identified that the RBLs previously adopted for assessment location A7 (ie NPfI minimum threshold values) in previous noise impact assessments were low compared to what is expected in that area of the community. Furthermore, an analysis of annual attended noise monitoring assessments completed by EMM for the site between 2017 and 2021 identified that background noise levels at this location may have increased since the background noise monitoring was originally completed for the site in 2007. The current site noise limits are based on the INP's minimum 30 dB night period rating background level (RBL). Hence, to verify the current background noise environment at A7 ambient noise monitoring was completed at A7. Both unattended and short-term attended noise surveys were conducted based and were based on the requirements as outlined in the NPfI. Monitoring results indicated that the RBL for this location should be 40 dB which is consistent with other sensitive receptor locations in this area (R8 = 43 dB and R9 = 41 dB. A discussion of this monitoring is included in the EMM Report Section 3.2 and results in EMM **Appendix D1**.

In addition EMM recommended that the RBLs for a number of locations be updated in accordance with the NPfI (minimum RBL was 30 dB now 35 dB) and reflected in the noise limits specified in the Environment Protection Licence and the PA.

The current noise limits are shown in **Table 3-31** together with the updated RBLs under the NPfI and the proposed noise limits.

Table 3-31 Rasp Mine Project Noise Limits

Assessment location[1]	PA Noise Limits (Old RBL + 5dB)			Adopted RBL[2], dB			Proposed Noise Limits (RBL + 5 dB), $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night	Day[5]	Evening[5]	Night[5]
A1	38	37	35	35[3]	32	30	40	37	35
A2	38	37	35	35[3]	32	30	40	37	35
A3	44	41	39	39	36	34	44	41	39
A4	44	41	39	39	36	34	44	41	39
A5	44	41	39	39	36	34	44	41	39
A6	48	41	39	43	36	34	48	41	39
A7	35	35	35	40[4]	37[4]	31[4]	45	42	36
A8	48	39	39	43	34	34	48	39	39
A9	46	39	39	41	34	34	46	39	39
A10	42	41	35	37	36	30	42	41	35
A11	46	39	39	41	34	34	46	39	39
A12	46	39	39	41	34	34	46	39	39
A13	38	35	35	35[3]	30	30	40	35	35
A14	35	35	35	35[3]	30	30	40	35	35

Notes:
1. Residential assessment locations only.
2. Referenced from EMM report *Rasp Mine Modification 4 – Concrete batching plant and TSF2 (Blackwood Pit) extension – Noise impact assessment* (2017) unless noted otherwise.
3. Based on the NPfI minimum day period RBL of 35 dB.
4. Determined from most recent ambient noise monitoring completed in June 2019.
5. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: remaining periods.

3.9.2. Reporting Requirement

BHOP requests that the annual environmental reporting periods be aligned to eliminate duplication of report generation.

Currently BHOP is required to produce and submit two reports to the DPIE – (1) The Annual Environment Management Report (AEMR) required by the mining lease and due 31 March for the period 1 January to 31 December, and (2) the Annual Review (AR) required under Schedule 4 Condition 3 of the PA required by 30 June each year for the preceding financial year.

These reports although similar have different time periods requiring two separate reports to be written and submitted within months of each other. Aligning these reports would streamline their formulation by BHOP and review by the regulator, removing unnecessary duplication. As all internal business reports are completed for a calendar year, BHOP requests that the date for the AR be changed to align with the AEMR and become due by 31 March each year for the preceding calendar year.

3.10. Mine Closure and Rehabilitation – MOD6 Works

This section outlines the Mine closure strategy for MOD6 works. It is consistent with the existing principles and objectives for the Rasp Mine to return the site 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 providing a stable and safe environment.

The aims for rehabilitation and closure are outlined in Schedule 3 Condition 35 of the PA are to:

- retain and/or manage heritage items, as agreed by relevant regulatory authorities;
- manage stormwater to minimise erosion and restrict the potential for off-site pollution;
- provide final landforms that are safe, stable and sympathetic to the mining heritage of Broken Hill;
- minimise the generation of dust and adequately contain potentially hazardous materials within the landform; and
- install barriers to restrict access to potentially hazardous locations (eg decline, shafts or open cut pits);

In addition Schedule 3 Condition 34 of the PA requires progressive rehabilitation to be undertaken at the site as soon as practicable following disturbance. BHOP plans to commence rehabilitation of historically disturbed areas and seeks approval for the proposed waste rock capping method as part of this MOD6.

Guidance from the Resources Regulator following the Department of Premier & Cabinet Broken Hill Post Mining Interagency meeting held in Broken Hill on 13 and 14 August 2019 is still forthcoming. During this meeting there was acknowledgement that paddock dumping of waste rock on Free Areas may be a suitable method of capping for these areas and BHOP has now confirmed this with further waste rock and capping studies. In addition to the waste rock characterisation study completed by PEL in 2017 and provided with MOD4, BHOP has commissioned two further studies:

- A capping options analysis was completed by Mine Earth which also included a multi-criteria analysis and risk assessment. The report is included at **Appendix I** and is discussed in **Section 3.8.1**.
- An assessment of the long term impact of waste rock as a capping medium, including a geochemical investigation, was undertaken by ERM Perth. The report is included at **Appendix H** and discussed in Section **3.8.2**.

The following outlines the proposed progressive rehabilitation for the Free Areas and outlines the closure concept for each of the areas impacted by MOD6 works.

3.10.1. Progressive Rehabilitation for Free Areas Using Waste Rock Capping

BHOP proposes to commence progressive rehabilitation of the Free Areas as identified at Appendix 4 of the PA and shown in the previous **Figure 3-38.** The prime aim in the rehabilitation of these areas is to reduce as far as is reasonably possible, the level of Pb bearing dust that may be entrained from these areas via wind take-up and displaced off-site. The updated emissions inventory as modelled by ERM Sydney shows that the source of dust from these areas is approximately 14% of total TSP while the Free Areas account for 22% of total Pb (TSP) dust emissions from the site.

Sampling results from the HHRA (**Appendix D1**) indicate that the range of Pb in soils within the Free Areas is 20 to 25 times the Pb content of soils in Broken Hill and that the maximum bioaccessibility of Pb within the soils in the Free Areas is higher, **Table 3-32**. The emission of dust from these areas is currently managed with the application of chemical dust suppressant which is not sustainable post mine closure.

Table 3-32 Lead in Soils and their Bioaccessibility

	Urban Areas BH		Free Areas	
	Average	Range	Average	Range
Pb mg/kg	490	104 - 1150	7,527	2155 - 29700
BAc%	42	28 - 50	37	10 – 54

BHOP propose a permanent capping for rehabilitation of these areas using waste rock that has been tested and is <0.5%Pb. The use of waste rock for rehabilitation has been supported by various studies commissioned by BHOP including the PEL Waste rock characterisation work conducted in 2016/17, the ERM geochemical analysis conducted in 2020/21 and the Mine Earth capping options analysis completed in 2021, (refer **Section 3.8** for discussion).

In summary these studies concluded:

- The rock type varies - all rock types identified were competent and mostly hard, with good resistance to weathering.
- The rock comprises of only approximately 1% fines capable of producing dust.
- Lead concentrations averaged 2,371.5 mg/kg (0.24%) and were taken from crushed samples (and therefore conservative as there is only 1% of fines capable of producing dust).
- Bioaccessibility was very low (7.3% on average). This is much lower (6.8 times) than the 50% bioavailability assumed for the calculation of HIL's. This would suggest that results, if adjusted for bioaccessibility, would meet HIL-C criteria.
- Air quality modelling conducted by ERM Sydney show that Pb (TSP) criterion is met.
- Other metals analysed, with the exception of lead, were within the NEPM HIL-C (recreational) and HIL-D (industrial/commercial) guideline criteria.
- The Controlled Air Burst Chamber testing conducted by PEL (2017) found that waste rock had the highest efficiency (with the exception of wet tailings) in controlling dust at 99.7%.
- Geochemical analysis found majority of samples were NAF with only 2 samples (from 50) PAF.
- Mineralogy testing demonstrated that the samples mostly consist of quartz and very slow to slow reacting silicates. Some chlorite was present in most samples, a mineral with immediate reactivity. Garnets were identified in all samples, which can provide fast reacting silicate buffering. No carbonate minerals were identified.
- ERM Perth concluded that while a few samples were identified as PAF, the central tendency in the data (and specifically the average NPR ratio ≥2 for all rock types) indicate that the material is expected to be largely NAF.
- ERM Perth confirmed with site inspection NO acid drainage evident on the site from almost 140 years of mining activity.
- ERM Perth confirmed some potential for metalliferous drainage (to land – Ag, As, Bi, Cd, Mo & Pb) (to water – Al, Cu, Cr & Pb). Land surfaces around the site and the orebody are above ANCCEC guidelines for soils. There are no water courses running through the site and rainfall from a 1:100 rainfall event is retained on site and would continue to be contained post closure.

Mine Earth concluded that:

"Results supported the use of waste rock for dust suppression for the TSF and Free Areas, and is considered unlikely to cause an unacceptable risk to human health based upon the final proposed land use as a tourist/recreational site (BHOP, 2017) and that the recommendations by PEL should be adopted for its use, providing:

- *Waste rock be tested prior to placement to ensure median level of lead concentration does not exceed 0.5%, and*
- *Dust suppression water spraying is carried out during capping material (waste rock) placement to ensure finer particles are washed between the larger rocks."*

Waste rock is available at the Mine site with 1.2 Mt stored in Kintore Pit and with further waste rock generated each year from underground mining and development. The waste rock has less adverse effects than the historic mine residues currently covering Free Areas of the site and its use would reduce Pb bearing dust leaving the site.

3.10.1.1. Waste Rock Capping Method

Golder provided a method for waste rock capping ensuring a safe, stable process with limited dust generation, designed to continue to capture rainfall events (1:100), Golder Report (**Appendix B1** Section 10). The following summarises their outcomes:

- The waste rock would be loaded into trucks and paddock-dumped (or other method) over the selected Free Area to provide an undulating surface that would help resist wind effects and provide small depressions for water collection to promote natural vegetation growth. Dumping would follow the current surface terrain where possible.
- Trucks would dump loads adjacent to one another to cover the surface area.

- No spreading or compaction of the dumped loads is proposed in order to minimise dust emissions from material handling and encourage vegetation growth in depressions.
- Fines would be watered-in to minimise dust in the initial stages of the rehabilitation development, as recommended by PEL.
- The addition of chemical dust suppressant may be used in the early stages of development.
- During rainfall events any rainfall would gravitate towards the depressions between the mounds.
- Runoff from a 1 in 100 ARI rainfall event was calculated (by Golder) to be wholly contained within the depressions formed by the paddock dumping mounds.

Alternatively a different capping method may be used depending on the availability of waste rock with the aim of installing an undulating surface to interrupt wind patterns and provide pockets for water collection to encourage vegetation growth.

Selection criteria for progressive rehabilitation capping would consider:

- the results of Pb in soil and bioaccessibility undertaken during the HHRA;
- the potential for wind-blown dust to be generated;
- the proximity and potential for the wind to deposit Pb bearing dust to affected areas off-site;
- the visual aesthetic value of the area, and
- the current use for the area.

3.10.2. Landform - MOD6 Works Areas

The final landform for the Mine site would be informed by advice and consultation from the inter-government group (Line of Lode Interagency Panel). In the absence of this advice BHOP has developed a closure strategy for each of the areas impacted by MOD6 works as provided in the following section. Proposed final landforms are consistent with current mining landforms at the site and with Schedule 3 Condition 35 (d) being “sympathetic to the mining heritage of Broken Hill”.

3.10.2.1. Kintore Pit TSF3

BHOP have considered two closure scenarios for TSF3: Scenario 1 where the Mine ceases operation prior to completely filling Kintore Pit with tailings and waste rock, and Scenario 2 where Kintore Pit is filled to maximum capacity.

Scenario 1

Were there to be an intermediate closure of the Mine prior to completing the filling of TSF3 an open void would be evident from the surface of the placed tailings to the Pit rim. It is proposed that this void would remain and the top of the tailings would be covered with a layer of waste rock material that has been tested and is <0.5%Pb. The tailings would be compacted during placement so it is expected to be trafficable for construction equipment when filling ceases. Waste rock would be placed by paddock dumping (or alternative method) with the aim to minimise dust. Water trucks would be used to control any dust that may be generated during the placement of the waste rock. In addition the Pit would be made safe with the installation of a safety bund installed around its perimeter to block entry. It is expected that approximately 260,000 t of waste rock would be required.

Rainfall runoff would continue to fall onto the area of Kintore Pit and would either be evaporated or seep through to underground.

Scenario 2

It is estimated that as part of MOD6 operations TSF3 would be filled to the natural surface level, an elevation of approximately RL 330 (when domed). As the tailings surface reaches the crest of the Pit the depression formed by the southern branch of the access ramp would be filled in to promote surface runoff from the tailings mound towards the stormwater pond to be located near Little Kintore Pit. The waste rock perimeter layers around the circumference of the Pit may be stopped at approximately 10 m below the pit rim, or lower if operational considerations and geotechnical assessments of the as placed compacted tailings confirm it is not needed for tailings liquefaction risk management. Tailings would be filled and compacted against the Pit edge and would result in the perimeter waste rock layer being capped to surface water infiltration once the facility is filled and closed. **Figure 8-34** provides a conceptual design for closure of Kintore Pit.

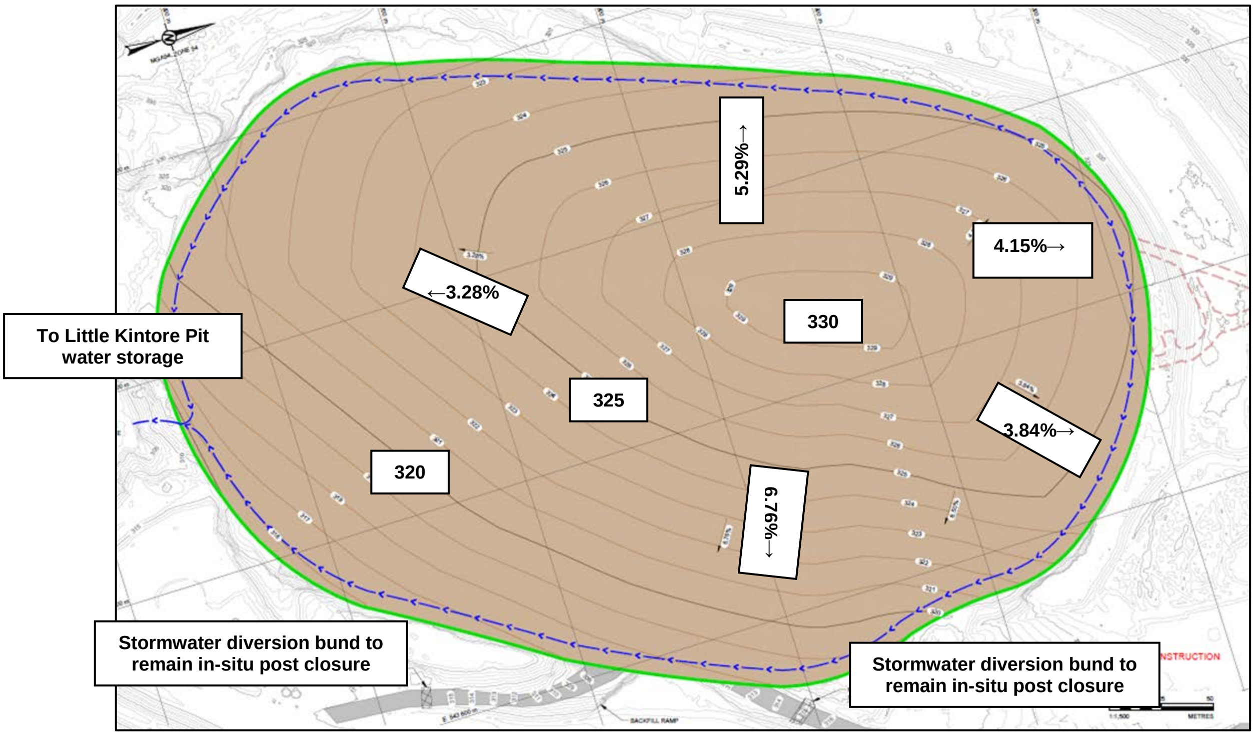
The final surface of the tailings is proposed to be covered with a layer of waste rock to protect the tailings from erosion by wind or rainfall runoff. The tailings would be compacted during placement so is expected to be trafficable for construction equipment when filling ceases. The final surface would be shaped as a shallow dome to allow rainfall to shed to the sides of the Pit and either seep to groundwater or be directed to Kittle Kintore Pit stormwater detention basin.

The surface is expected to be relatively stable with minimal settlement or deformation occurring during and after placement of the cover layer. It is expected that the final thickness of cover over the tailings may be between approximately 500 mm and 700 mm. The final waste rock layer would be placed by paddock dumping or alternative, with the aim to minimise dust and to protect underlying tailings from erosion by wind or rainfall runoff. Water trucks would be used to control any dust that may be generated during the placement of the waste rock.

The edge of the final surface would be shaped to direct rainfall runoff towards the south. A stormwater detention pond would be located to the west side of the infilled Little Kintore Pit and may extend partially onto the edge of the Pit mound.

Progressive rehabilitation of the final filled mass surface would be undertaken in line with the site's final landform requirements and closure strategy. The shallow dome shaped surface would be consistent with the surrounding mine landforms and would not be noticeable from the City of Broken Hill (refer discussion in **Section 8.11**).

Figure 3-42 Conceptual Closure Landform for Kintore Pit



3.10.2.2. Little Kintore Pit

Little Kintore Pit is a small historic open pit approximately 140 m by 130 m and 17 m deep. BHOP proposes to fill Little Kintore Pit with waste material removed from the boxcut excavation and to cap its surface with selected waste rock (<0.5%Pb) which would be shaped to develop the required stormwater detention pond. Water trucks would be used to control any dust that may be generated during the placement of the waste rock. Water would remain on the surface of Little Kintore Pit and within the stormwater detention pond which would retain rainfall runoff for a 1:100 rainfall event. Rainwater would be evaporated or allowed to seep to groundwater.

Capping of Little Kintore Pit is planned and scheduled as part of the construction works for the boxcut. Approximately 20,000 t would be used for capping.

3.10.2.3. Boxcut & Portal

The area surrounding the boxcut and portal would be made safe and stable. An engineered plug would be installed in the portal to prevent entry. Any infrastructure located within the boxcut would be removed and placed in underground voids prior to the portal plug installation.

The slopes of the boxcut have been design as permanent slopes. It is proposed to leave the boxcut as a small open pit and a safety bund would be installed around its perimeter preventing access.

Rainwater that falls within the boxcut would pool and either be evaporated or seep to groundwater.

The area used for underground mining services adjacent to the boxcut would be inspected and capping replaced as required. All infrastructure would be removed and either taken off-site or placed in underground voids.

The surface water pond (S37) would remain as part of post closure surface water management.

3.10.2.4. Blackwood Pit TSF2

The closure concept for TSF2 is consistent with that proposed in MOD4 with the primary objective with the to provide a safe stable structure that prevents or minimises the potential for Pb bearing dust, to be emitted from the site.

During the final stages of mining production tailings would cease to be harvested and would be used to fill the cells within TSF2 that were used for harvesting activities leaving the surface with an approximately 1% slope, from west to east. Depending on conditions and scheduling chemical suppressant may be used to minimise any dust while the tailings dries and become trafficable. Water collection and water spray infrastructure would be buried within the facility or removed and placed in underground voids.

Once all the cells have been filled it is proposed to cover the tailings with a layer of waste rock to provide a permanent seal to the surface and protect the tailings from erosion by wind or rainfall runoff. The waste rock would be tested and material with an average of <0.5% Pb would be utilised as capping material. Similarly to the capping of Mt Hebbard and other Free Areas, the waste rock is proposed to be paddock dumped over the existing surface.

The proposed paddock dumping would comprise haul trucks dumping loads adjacent to one another to cover the surface of the tailings. No spreading or compaction of the dumped loads is proposed in order to minimise dust and encourage vegetation growth in depressions. Water trucks would be used to control any dust that may be generated during the placement of the waste rock.

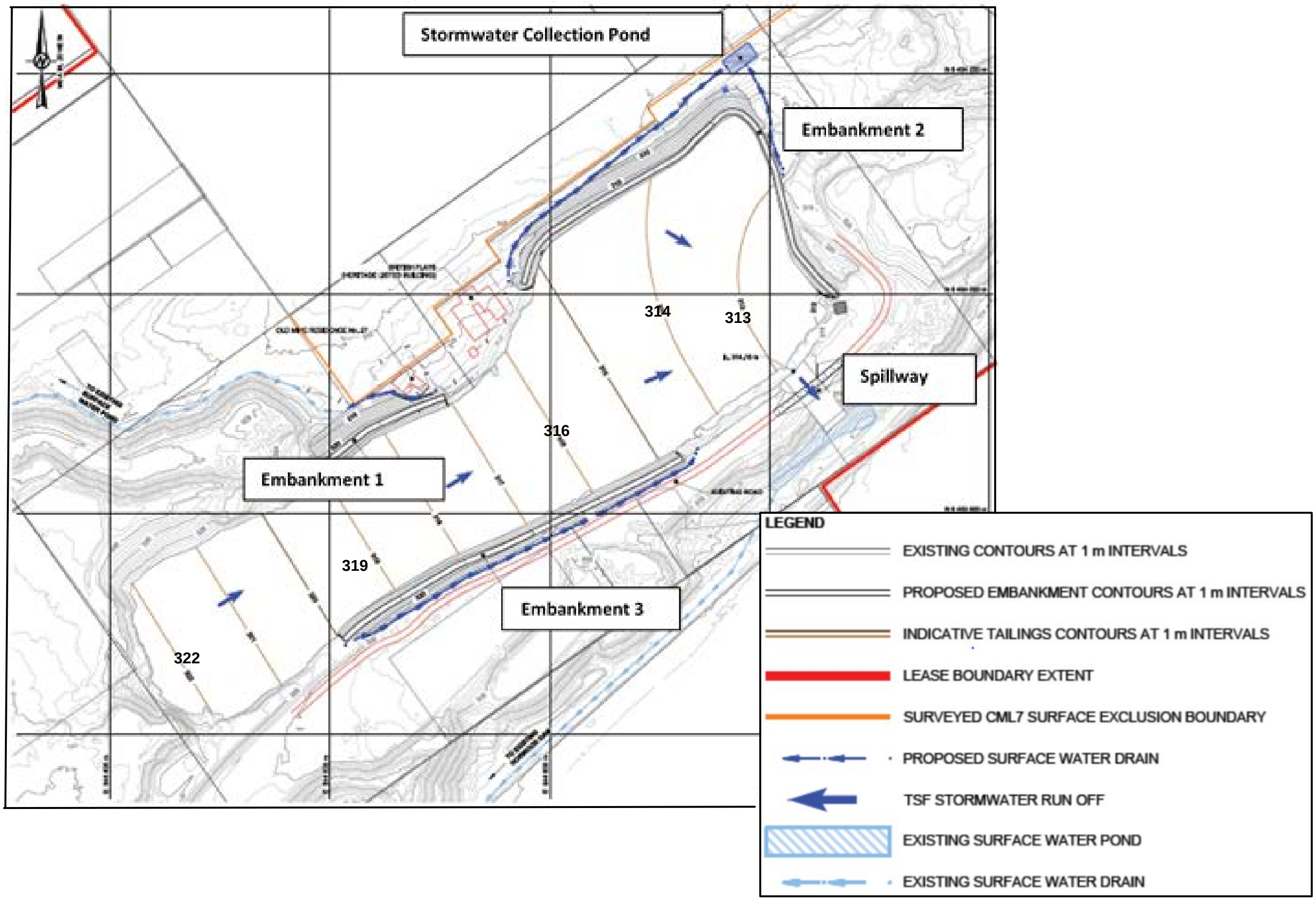
The capping layer would be constructed over the entire tailings surface and be integrated into the in-situ rock on the Pit rim and the surface of the embankments. The embankments are designed with 2.5H:1V downstream slopes which are appropriate for closure and long term stability. Wind and rain erosion of the embankments is expected to be minimal. No further rehabilitation of the downstream embankment slopes is envisaged (as these have already been capped with waste rock).

The surface of TSF2 is expected to be relatively stable with minimal settlement or deformation occurring during and after the placement of the capping layer. The surface would slope down from a high point in the south-west (322RL) to its lowest point in the east (312RL) at the location of the stormwater pond and spillway. A freeboard for rainfall runoff would be retained at the spillway. **Figure 3-43** provides a conceptual design for the final surface for TSF2.

Once the facility is closed and has been de-registered as a Declared Dam by Dams Safety NSW, the stormwater pond located inside the facility would be partially filled to reduce rainfall retention from a 1:10,000 year event to a 1:100 year event. Any over flow from a 1:100 year event would flow over the spillway and directed to Horwood Dam.

The paddock dump placement would result in a surface with numerous tightly spaced mounds with depressions between the mounds. During rainfall events rain would gravitate towards these depressions which would hold sufficient rainfall to retain a 1 in 100 ARI 24 hour event. The standing water contained within these depressions would infiltrate the placement area or evaporate. Golder estimated, based on 1 in 100 ARI rainfall, assuming initial infiltration losses of 15 mm and a continuing loss of 2 mm/hr, that standing water contained in the depressions resulting from a 1 in 100 ARI rainfall event would be less than 400 mm depth. Accordingly, runoff from a 1:100 year 72 hour rainfall event would be wholly contained within the depressions formed by the paddock dumping mounds. A surface slope would be maintained directing stormwater towards the spillway, with runoff in excess of 1 in 100 year events discharging through the spillway which would be left in-situ for this purpose.

Figure 3-43 Concept Closure Landform for Blackwood Pit



The stormwater pond to the north and adjacent to the facility would be removed and rainwater runoff from the slope of Embankment 2 allowed to flow offsite. The majority of the surface stormwater runoff in this area would be from the embankment slope which has been capped with waste rock that has a low Pb content (average <0.5% Pb).

Seepage flow rate from the collection system within the embankments would be monitored periodically. When the seepage rate has stopped the sumps may be decommissioned and removed. Removed sumps and any other removed materials would be disposed as part of the mine rehabilitation procedure to underground voids or other tailings storage facility.

3.10.3. Rehabilitation Management Plan

In accordance with the Mining Amendment (Standard Conditions of Mining Leases—Rehabilitation) Regulation 2021 under the Mining Act 1992 (Rehabilitation Regulation) BHOP will submit a Rehabilitation Management Plan (RMP) prior to 2 July 2022. BHOP will review the current risk assessment profile for rehabilitation of the Mine site and update its RMP pursuant to Schedule 8A, Part 2 Condition 10:

(a) *a description of how the holder proposes to manage all aspects of the rehabilitation of the mining area,*

(b) *a description of the steps and actions the holder proposes to take to comply with the conditions of the mining lease that relate to rehabilitation,*

(c) *a summary of rehabilitation risk assessments conducted by the holder,*

(d) *the risk control measures identified in the rehabilitation risk assessments,*

(e) *the rehabilitation outcome documents for the mining lease,*

(f) *a statement of the performance outcomes for the matters addressed by the rehabilitation outcome documents and the ways in which those outcomes are to be measured and monitored.*

A Progressive Rehabilitation Schedule will be developed which will outline a framework and timetable for rehabilitation treatment of the Free Areas and address Condition 34A and 35 of the PA. This will include details of the rehabilitation medium (waste rock <0.5%Pb), volumes required and source, once the capping medium has been agreed with the relevant government agencies. A spatial plan of the landform proposed for the capping of the Free Areas will also be included. Details for any opportunities for revegetation of areas favourable to vegetation growth will also be considered in the RMP and provided in the Progressive Rehabilitation Schedule.

The BHOP Rehabilitation Strategy and Rehabilitation Management Plan have been postponed awaiting guidance on closure objectives for the whole Line of Lode from the Minister for Cabinet - Interagency Panel on the Line of Lode. BHOP understands that this panel is currently being reorganised to provide this guidance. The BHOP Rehabilitation Strategy and Rehabilitation Management Plan would be finalised for MOD6 and will be submitted following MOD6 approval.

4. ALTERNATIVES CONSIDERED

This Section outlines the alternatives considered for storing tailings and strategies for tailings deposition. It also discusses locations considered for the new portal.

4.1. Tailings Storage

Blackwood Pit TSF2 would reach capacity and be filled by September 2022 and as advised by the NSW Dam Safety Committee that:

> *"The DSC has given endorsement to the proposed structure and the mining proposed but has advised that there should be no more raises to this dam as it is bad practice to construct tailings dams in built up areas. Future tailings should either be sent to a mining void or piped to a tailings facility away from the population…"*

BHOP engaged Golder to investigate off-site tailings storage potential within a 10 km area of the Mine, *Tailings Storage Options Assessment*, Golder Associates Pty Ltd, September 2017 (**Appendix J**). The assessment was undertaken in two stages (assuming 750 Ktpa), Stage 1 considered sites with the potential for a capacity of 21 Mdt (million dry tonnes) and 30 years life (Sites 1 to 9) and Stage 2 considered sites with the potential for a capacity of 7 Mdt and a life of 10 years (Sites 8, 10 and 11).

In addition BHOP requested that an assessment of Kintore Pit for potential tailings storage also be included in the assessment. This was the result of a site review of possible tailings storage within the current mine Lease. Other pits on site were not considered as their capacity was insufficient (even collectively) to make them economically viable. Consideration was also given to utilising TSF1, however, it was considered to have insufficient capacity (4.1Mt) for this stage of the operation. **Table 4-1** lists the options and the results of their assessment and **Figure 4-1** provides a map with their location.

Sites were initially identified from topographical maps and then confirmed or dismissed due to their suitability following a site inspection. Cost assessments were conducted for the final three sites (Sites 8, 10 and 11) and Kintore Pit.

Table 4-1 Options for Tailings Storage

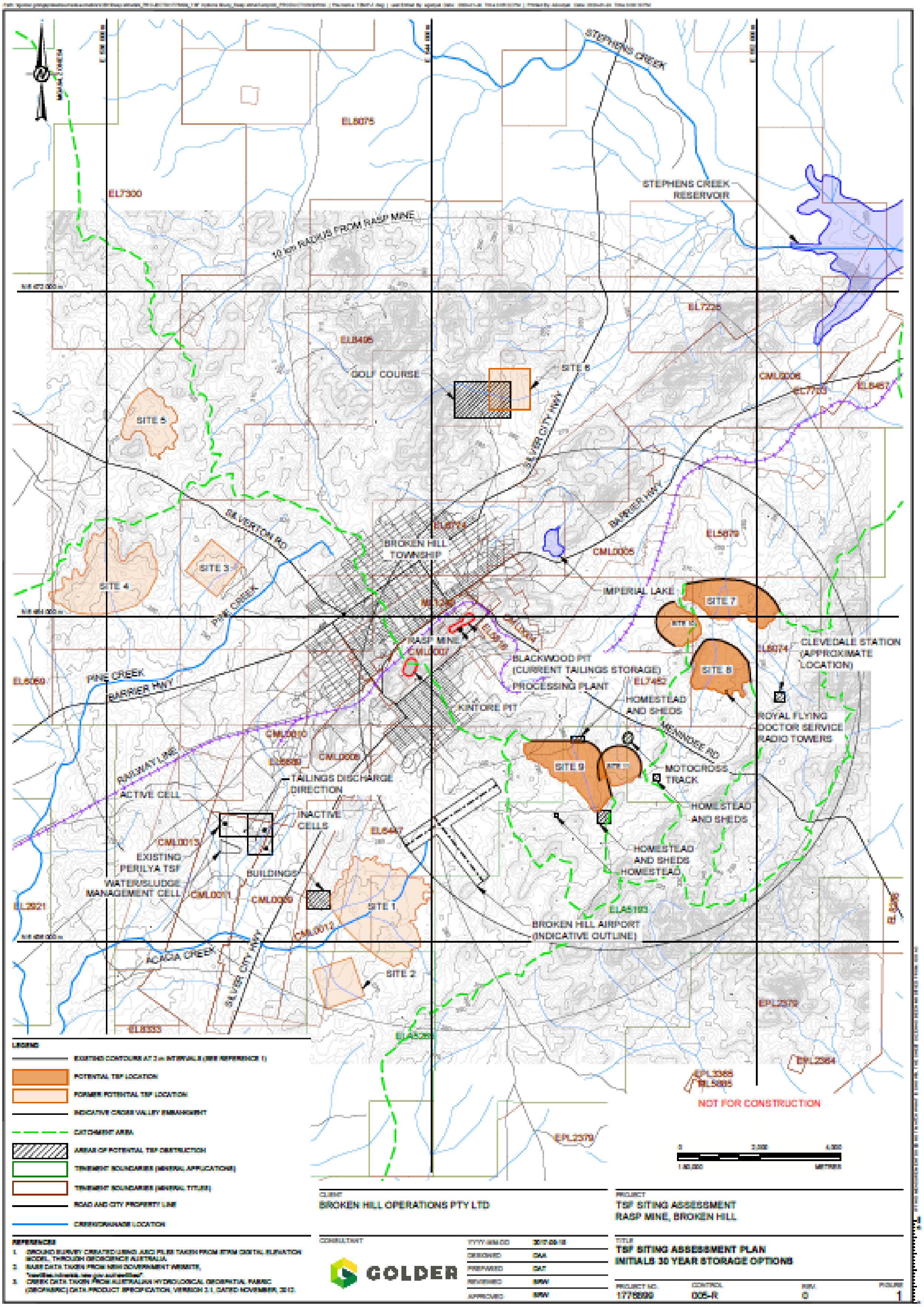
Opt	Location	Comment	Assessment
1	South of Broken Hill township, to the east of Silver City Highway and to the southwest of the airport, in a valley formed by Acacia Creek and within the Pine Creek catchment.	On inspection this was found to be a well-developed operating farm with extensive man made wetlands and a number of dwellings.	On inspection found not suitable for further assessment due to the extent of development, high value farm.
2	South of Broken Hill township to the east of Silver City Highway, southwest of Site 1, located within a small valley formed by a tributary to Acacia Creek.	On inspection this was found to be a well-developed operating farm with extensive man made wetlands and a number of dwellings.	On inspection found not suitable for further assessment due to the extent of development, high value farm.
3	West of Broken Hill township between Silverton Road and the Barrier Highway, located within a small valley formed by a tributary to Pine Creek.	Access to the site was not possible due to fencing. Tailings delivery return water pipeline distance around the township would be approximately 12 km.	On inspection found not suitable for further assessment due to long distance from the mine and associated high costs for pipeline installation and on-going operational pumping.
4	West of Broken Hill township between Silverton Road and the Barrier Highway, located within a small valley formed by a tributary to Pine Creek to the west of Site 3.	Tailings / delivery return water pipeline distance around the township would be approximately 14 km.	On inspection found not suitable for further assessment due to long distance from the mine.
5	Northwest of Broken Hill township and to the north of Silverton Road, located within a small valley that drains to the northwest.	Tailings / delivery return water pipeline distance around the township would be approximately 13 km.	On inspection found not suitable for further assessment due to long distance from the mine.
6	North-northeast of the Broken Hill township to the west of Silver City Highway in a broad valley formed by a tributary to Stephens Creek.	Site is located south of CML7 in the area of the Broken Hill Golf Course.	On inspection found not suitable for further assessment due to the extent of current site development.

Opt	Location	Comment	Assessment
7	East of both the Broken Hill township in a valley formed by a tributary to Stephens Creek Reservoir. Located 7 km from the Rasp Mine and to the north of Site 8. 177 Ha for 30 year case.	Pipework length approximately 10.4 k. Close proximity to the mine (7 km) and is located within the Stephens Creek catchment (3.2% of total) and partially lies within the property of a local farm station which may restrict the size of the facility. Drainage catchment 1637 Ha.	Not suitable due to land acquisition required.
8	East of both the Broken Hill township and the railway line and to the north of Menindee Road in a valley formed by a tributary to Stephens Creek Reservoir. Located 6.5 km from the Rasp Mine and covers 80 Ha for 10 year case (and 148 Ha for 30 year case).	Pipework length approximately 9.5 km. Drainage catchment is 1024 Ha which would require storage and located within the Stephens Creek catchment (2.0% of total) and partially lies within the property of a local farm station which may restrict the size of the facility. A watercourse within the footprint that drains to Stephens Creek Reservoir would require diversion. Dam break risk high.	Not suitable due to cost $71M plus land acquisition.
9	Southeast of the Broken Hill township and south of the railway line and Menindee Road in a valley formed by a tributary to Stephens Creek Reservoir. 201 Ha for 30 year case.	Close proximity to the mine (4 km). Drainage catchment 824 Ha. Two homesteads and recreational facilities (motorcycle/cart track) are located within the footprint. Located within Stephens Creek catchment (0.1% of total).	Not suitable for further assessment.
10	East of the Broken Hill township and south of the railway line and immediately to the west of Site 8. Located 5 km from the Rasp Mine and 82 Ha.	Pipework length approximately 9.5 km. Drainage catchment 110 Ha which would require water storage. Located in Stephens Creek catchment (0.1% of total). Dam break risk high.	Not suitable due to cost $61M plus land acquisition.
11	Southeast of the Broken Hill township, south of the railway line and directly east of the airport. Located 5 km from the Rasp Mine and 79 Ha.	Drainage catchment is 100 Ha and lies within the Stephens Creek catchment (0.1% of total). Dam break risk high.	Not suitable due to cost $57M plus land acquisition.
12	Kintore Pit located centrally and to the west within CML7.	Decline portal at the base of the Pit to be closed with appropriate measures. Closing methods to be considered for the base and batters of the Pit to limit uncontrolled seepage from deposited tailings. Consideration to be given to removal of waste rock located in the southern area and a potential embankment near the Pit rim to maximise tailings storage potential. As in-pit placement not classified as a dam by Dam Safety NSW (only triggers if embankments installed).	Most cost efficient ($6.7M) and preferred option.

In conclusion Kintore Pit was selected as the preferred option due to:

- Most cost effective for storage capacity with both construction and operating costs considerably less than other options.
- Remained with CML7 within close proximity to the processing plant and was within the activities listed on the Lease.
- Less complex to operate with no offsite transfer pipework.
- Did not increase the Rasp Mine environmental footprint hence no additional land disturbance required.
- No land acquisitions or access arrangements were required.
- Allowed an open pit mine void to be filled.
- Allowed the ability to manage dust more efficiently.

Figure 4-1 TSF Location of Options



4.2. Method for Dewatering Tailings

Following the determination to store future tailings in Kintore Pit, BHOP engaged Golder to provide a storage and deposition concept for the Pit as a tailings storage facility, *Thickened Tailings Options Report*, April 2018. Based on a preliminary review of risks with respect to underground workings beneath and near the Pit, it was considered necessary to minimise the water content in the tailings and improve the strength gain of the tailings, compared to conventional tailings deposition techniques. Two options were considered to meet these objectives:

- deposition of thickened tailings via pipeline, similar to the strategy used for TSF2, and
- placement of filtered tailings, requiring installation of a filter plant and associated delivery system to the TSF3.

Paste tailings would also meet those objectives but was discounted due to high capital costs and high on-going operational costs of such plant.

Placement of filter tailings in the Pit would provide the significant advantage of reducing the volume of water entering the Pit, thereby reducing risks associated with seepage and/or tailings in-rush to underground workings.

Following a site risk assessment and review it was decided to further investigate the option of filtration and compaction of tailings to minimise the chance of water infiltration or tailings liquefaction.

GR Engineering Services Ltd were commissioned to investigate three dewatering options as part of a scoping study, *Rasp Tailings Disposal Scoping Study*, August 2018. The options investigated included:

- cycloning and screening;
- vacuum filtration, and
- pressure filtration.

Golder were commissioned to conduct critical state testing of mine tailings samples and determined that to achieve optimal moisture content for compaction the tailings needed to be dewatered to a moisture content of around 10%. Of the three options investigated by GR Engineering it was found that pressure filtration was the only process that was able to achieve the correct moisture content. This method also had the highest operating and capital expense.

While considering options available and the risks associated with filtration of the tailings, it was suggested that in-situ drying and harvesting could be an option. The climatic conditions in Broken Hill are suited to air and solar drying as there is relatively low rainfall and high evaporation rates. On further investigation Golder concluded that the method would be marginal at the then proposed annual rate of production of 630,000 t of tailings.

To sustain the viability of the Rasp Mine operation a new mining strategy was adopted in July 2020 based on lower tonnes and higher grade ore. This led to a reconsideration of the option of natural drying of tailings with a maximum annual harvesting rate of 480,000 t and at a maximum annual ore production of 500,000 t this rate allows an additional buffer of approximately 40,000 t surplus harvesting capacity.

Concurrent to this MOD4 embankment works, including construction on the tailings surface, CPT testing and surface moisture sampling, testing and field trials were conducted to determine the tailings stability and dryness. These investigations and trials suggested that the tailings surface would be sufficiently dry and stable to allow both construction and harvesting to occur.

Golder then used this information, together with additional field trials results of the CPT testing, to further evaluate the use of air and solar drying and the harvesting for relocation and compaction of tailings within Kintore Pit, (**Appendix B1**).

Tailings drying options are summarised in **Table 4-2**.

Table 4-2 Options for Tailings Deposition

Deposition Method	Advantages	Disadvantages	Outcome
Thickened tailings	Known method currently used at site.	High moisture content (35%)	Not selected due to the high moisture content.
Paste tailings	Some of the required plant already at site.	High operational costs.	Not selected due to the high operational costs.
Filtered tailings:			
- Cycloning		Couldn't achieve required moisture content.	Not selected due to the high moisture content.
- Vacuum filtration		Couldn't achieve required moisture content.	Not selected due to the high moisture content.
- Pressure filtration	Achieved required moisture content (10%).	High capital costs ($15 to $20M). High operating costs.	Not selected due to high capital cost.
Natural dried tailings (air and solar)	Right climate conditions suited to process. Lowest capital outlay. Field trials show the dried tailings can be trafficable and achieve the required moisture content.	Marginal at production rate of 630,000 t.	**Preferred option. Selected due to low cost to achieve correct moisture content.**

4.3. Portal Location

Underground mine workings are currently accessed via a portal located in the base of Kintore Pit which would no longer be available when Kintore Pit is used to co-place tailings and waste rock. BHOP site mining personnel and consulting geotechnical engineer (GCE) undertook a review of potential sites within the surface rights area of CML7 to identify a suitable location for a new portal and decline for underground mining access. Potential sites identified included and are shown in **Figure 4-2**:

- BHP Pit
- Blackwood Pit
- Adjacent to Holten Drive
- Little Kintore Pit
- Adjacent to (Historic) TSF1

Sites were considered based on the following operational considerations:

- proximity to the current Run of Mine Pad (ROM) and Haul Road;
- difficulty of access to competent rock;
- proximity to future underground mining areas, and
- potential community impacts

Figure 4-2 Potential Locations for New Portal

4.3.1. Boxcut Location Option 1 – BHP Pit

A location in the northern wall of BHP Pit was investigated.

The benefits of this location were:

- Requirements for excavating a full boxcut would be less with the portal reaching competent rock more quickly.
- It was adjacent to the current Haul Road and close to the ROM Pad reducing haulage distance.
- Being located within a pit would minimise any potential impacts to the community.

The geotechnical assessment discounted this location due to the very poor ground condition encountered. This location was also considered unsuitable as the access point via the southern wall would require the demolition of heritage items - I308 Stone Retaining Wall and I305 Building Foundation and compromise I306 Four Concrete Pillars. Although the origin of these items is unknown they are likely to be remnants from the BHP era and are estimated to be from between 1890 and 1900.

Also the close proximity of the Explosive Storage Facility eliminated this as a preferred site.

Conclusion of the investigation – Not Suitable

4.3.2. Boxcut Location Option 2 – Blackwood Pit TSF2

A location in the western wall of Blackwood Pit TSF2 was investigated.

The benefits of this location was its proximity to the ROM Pad and future underground mining areas reducing the haulage distance for mine trucks travelling underground and on the surface along the existing Mine Haul Road. Although not located low into Blackwood Pit TSF2 the current rock formation in this corner of the Pit would provide some protection from noise for the community.

The major disadvantage of this location was the requirement to have a tailings storage facility (current and future). This would have reduced the capacity of the current TSF2 and also compromised the ability for dried tailings harvesting.

Conclusion of the investigation – Not Suitable

4.3.3. Boxcut Location Option 3 – Adjacent Holten Drive

A location at the base of the hill along Holton Drive (opposite Mawsons Quarry).was investigated.

The benefits of this location was the proximity to future underground mining areas and, as entry could occur direct from the current service road, less excavation material would be required. The site was also located away from residential areas. The haulage distance was reduced and its isolation from neighbours would ensure protection from noise at the portal.

A major problem with this location was identified with truck haulage. There was insufficient space between Blackwood Pit TSF2 and the processing plant for safe haulage operation of mine trucks as appropriate separation distances could not be achieved. A review of the use of the service road for truck haulage, running adjacent to Holten Drive and around Horwood Dam, revealed unacceptable noise impacts from truck movements that would be required to climb a steep ramp to the Haul Road and ROM Pad when fully loaded. There was limited ability to construct noise bunds on this ramp (required elevation gain is ~20 m vertically from current road to ROM Pad access level). The haulage distance for waste rock to Kintore Pit was also prohibitive given the extended travel required.

Conclusion of the investigation – Not Suitable

4.3.4. Boxcut Location 4 – Little Kintore Pit

Little Kintore Pit, located to the south west of Kintore Pit and adjacent the main site access road (sealed) was investigated.

The benefits of this location was the installation of a portal entry in the base of a pit, requiring little excavation works and subsequently less potential noise and dust impacts both in construction and operation.

The major disadvantages of this location was the distance to existing and future mine development and the ROM Pad. The additional haulage distance to the ROM Pad was 0.5 km and with over 10,000 truck movements annually this would have required an additional 5,000 km of travel (each way) increasing operational costs for diesel, maintenance costs due to additional wear and tear on the mine fleet, increased turnaround time for ore to ROM and further potential impacts from noise and dust.

Conclusion of the investigation – Not Suitable

4.3.5. Boxcut Location Option 5 – Haul Road opposite Historic TSF1

A location along the Haul Road opposite the historic TSF1 was investigated.

This location is presented in the MOD6 Project Brief and the design has been streamlined on several occasions including:

- Rotating the boxcut which provided better access and gained entry to competent rock earlier.
- Repositioning the boxcut 100 m towards Blackwood Pit which allowed a redesign reducing the footprint. This had the added benefit of moving away from infill material that had undesirable geotechnical conditions and higher Pb content.

The benefits of this location was:

- Its proximity to the ROM Pad.
- It provides better access for future underground mining locations.
- Is adjacent to the current Haul Road.

The haulage distance for mine ore trucks has reduced from 2.0 km to 0.5 km (one way) which significantly reduces potential impacts from noise and dust generation. The design changes have reduced the size of the boxcut and the required material to be extracted which has halved from 1.1 M t in the original Project Brief (2018) to current estimates of 489,000 t.

This location was selected as it was centrally located to the current surface infrastructure and existing and planned underground development. The boxcut volume required to be excavated was significantly less than other alternatives and could be managed within existing storage locations (eg Little Kintore Pit and BHP Pit). Geotechnical properties for the boxcut excavation were more favourable with shallow bedrock and suitable overburden properties for acceptable batter angles.

Conclusion of the investigation – <u>Preferred and selected location</u>

4.4. Excess Waste Rock Storage

The Rasp Mine would produce approximately 730,000 t of waste rock until 2026 (when current PA expires) that is unable to be accommodated in underground voids (146,000 tpa). In the Project Brief BHOP had identified that all waste rock would be stockpiled on surface and covered with waste rock containing low (<0.5%) lead content.

BHOP considered two further options for the placement and permanent storage of waste rock (1) Capping of surface or Free Areas within CML7 as rehabilitation capping; and (2) Kintore Pit co-placement with tailings. A study was commissioned by Mine Earth to assess different dust management options that could be applied at mine closure, (**Appendix I**). A discussion of their report is in **Section 3.8.** Mine Earth concluded that the most effective capping option was the waste rock as it was proven to reduce dust, it was availability on site, the surface was stable and it was cost effective.

Following consideration of the need to undertake progressive rehabilitation BHOP determined that both of these options would be utilised based on the characteristics of the waste rock material.

Waste rock would be taken to Kintore Pit or BHP Pit and tested for its Pb content. As recommended by ERM (Perth) material with >0.5% Pb content would be placed in-pit together with tailings.

The waste rock material that has been tested and confirmed to have an average of <0.5% Pb would be used as capping and placed over surface areas that have been identified as Free Areas as progressive rehabilitation for these historically disturbed areas.

Off-site storage was also considered but due to the Pb content of the waste rock it was difficult to identify a suitable site and transporting waste material off-site was cost prohibitive.

5. STATUTORY CONTEXT

This Section details the regulatory framework relevant to the Modification.

5.1. Commonwealth Legislation – Environmental Protection

5.1.1. Environmental Protection and Biodiversity Conservation

5.1.1.1. Controlled Actions

The proposed Modification is not considered a *controlled action* under the *Environmental Protection and Biodiversity Conservation Act 1991* (EPBC Act) as it is consistent with the original Project Approval, it does not impact Matters of National Environmental Significance as listed in the EPBC Act and would not impact water resources. A number of heritage items are located in BHP Pit and are protected from current operational activities undertaken in this area. This is discussed in **Section 8.10**, demonstrating that there are no material changes to these works and current protection measures would continue to be employed.

Therefore the proposed Modification does not require referral to the Commonwealth.

5.1.1.2. Heritage

Pursuant to Section 324JJ of the EPBC Act, the entire city area of Broken Hill was listed on the National Heritage List (ID 105861) in January 2015 and is protected under the Act, primarily for the geological significance of the ore body, its mining history and technical achievements.

BHOP does not consider a referral to the Commonwealth for environmental assessment is required for this Modification as no heritage items would be impacted and the activities associated with the Modification are consistent with mining processes.

5.2. NSW Legislation

5.2.1. Environmental Planning and Assessment Act 1979

The Project was declared a Major Project under the SEPP *Major Development 2005* (now repealed) and was approved in January 2011 by the then NSW Minister for the Department of Planning under Part 3A of the EP&A Act. With the repeal of Part 3A of the Act and the transitional arrangements under Section 75W, the Project has been transitioned to a State significant development (SSD-814).

5.2.2. Section 4.55(2) Modification

This Modification application is made under Section 4.55(2) of the EP&A Act which provides for the modification of consents. The DPIE confirmed that the proposed activities can be characterised as a modification to the existing approval and can be assessed and determined under Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (correspondence October 2020, **Appendix A3**).

Item 3BA(6) in Schedule 1 to the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017*, requires that the development, as proposed to be modified, would be substantially the same development as the development authorised by the last modification under the former section 75W of the EP&A Act. For the Rasp Mine Project the development, as proposed to be modified, must be substantially the same development as that authorised by MOD7 on 29 July 2019.

BHOP considers that the approval as modified by MOD6 would be substantially the same development as was approved under MOD7, as the proposed modification would not change the primary purpose of the original development:

- The Mine would continue to operate as an underground mine with associated surface infrastructure, including ore processing and waste management activities.
- The modified project would not change the approved rate of ore extraction and would continue to use existing processing and waste management infrastructure.

- The modification includes the construction of a boxcut to access mine workings, however this would be a replacement portal for the existing portal located within Kintore Pit.
- Waste rock and tailings at the site would continue to be handled and stored at approved locations, with the addition of storage in Kintore Pit.

5.2.3. Other NSW Legislation

The existing approvals, licences and authorities relevant to the Project are described in **Section 2.5**. Existing approvals, licences and/or authorities under various other pieces of NSW State legislation would continue to apply to the proposed Modification operations. **Table 5-1** lists the key relevant pieces of NSW State legislation and indicates the implications, if any, for the Modification and Project as a whole.

Table 5-1 Relevant NSW State Legislation

NSW State Legislative Act	Project Implications to Approvals, Licences and/or Authorities
Dams Safety Act 2015	• Blackwood Pit TSF2 is a Declared Dam and appropriate notifications have been provided to Dams Safety, NSW. The Operation, Maintenance and Surveillance Manual would be updated to accommodate MOD6 requirements. • The then Dams Safety Committee determined that the land around and including Blackwood Pit is a notification (Blackwood Notification Area) gazetted 9 August 2019. • Approval to undertake mining within the Blackwood Notification Area was obtained for MOD6 activities – endorsed by DCS 30 October 2019 and approved by the Chief Inspector 7 November 2019. The TSF2 Operation, Maintenance and Surveillance Manual would be updated to accommodate MOD6 requirements.
Heritage Act, 1977	The heritage items within BHP Pit would continue to be protected and would not be affected by this Modification, refer discussion **Section 8.10**
Mining Act 1992	CML7 permits the extraction of zinc and lead (among others) ore within the Project Area, the Modification does not result in any changes to mining or processing methods. 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 Mining Operations Plan (MOP). The current MOP would require a minor amendment to include the activities outlined in the Modification.
Protection of the Environment Operations Act 1997 (POEO Act)	The proposed Modification would continue to operate under the approved limits and scheduled activities within the current EPL 12559. A variation would be required to the EPL to amend the site noise criteria, consideration would also be given to any requirements to amend air quality monitoring.
Biodiversity Conservation Act 2016	Subsequent to a review of the MOD6 Project Brief (September 2020) DPIE - Biodiversity and Conservation Division considered that the proposed MOD6 development was consistent with Section 7.17(c) of the BC Act and that a full BDAR is unlikely to be necessary for MOD6 as: • MOD6 development is within the mine footprint in the Willyama Common area; • Fauna use of old adits and shafts is unlikely due to difficult access; and • MOD6 development is in a disturbed area and avoids native vegetation. However, the MR should clearly demonstrate that no native vegetation would be removed and that impacts on threatened species habitat would be avoided or would be unlikely. **Section 1.1** and **Section 2.7.4**
Water Management Act 2000	No additional water licences under the *Water Management Act 2000* are required for the Modification. Water resources would not be affected by this Modification.
Work Health & Safety (Mines & Petroleum) Act 2013 *And* *Work Health and Safety Act 2011*	For this Modification BHOP would utilise its current standards, plans and procedures in accordance with WHS laws and would update relevant principal hazard management plans in accordance with the *Work Health and Safety (Mines and Petroleum Act) 2013 (WHS M&P Act)*: - Inundation Inrush - Roads and Other Vehicle Operating Areas - Ground or Strata Failure - Blackwood Tailings Storage Facility (TSF2) In addition three applications for High Risk Activity Notifications would be made for the: - Establishment of a tailings storage facility (TSF3) (Schedule 3, Part 7 Section35) - Development of new mine entry (new portal) (Schedule 3, Part 2, Section4) - Alternation of a tailings storage facility (tailings harvesting) (Schedule 3, Part 7 Section 35)

5.2.4. 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 MR addresses each of the matters for consideration prescribed in the abovementioned clauses, as applicable.

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 mine;
- railway and rail yards;
- Perilya mining residential village and recreational facilities;
- unoccupied heritage structures;
- commercial properties; and
- residential housing.

The Modification would not change these existing uses and can operate without impacting these users.

The Modification optimises the economic viability of the Rasp Mine and with the capacity of Kintore Pit TSF3 allows mining to continue beyond 2022 to 2035 (subject to DPIE approval) providing on-going financial benefits and employment for Broken Hill.

In addition this Modification would not increase the EA assessed impact (as approved) for:

- noise amenity, refer **Section 8.1**;
- dust levels in Broken Hill, refer **Section 8.2**;
- community blood lead levels, refer **Section 8.3**;
- significant water resources as there would be no additional requirements to water supply or extraction, **Section 8.7**;
- threatened species, as there are no known threatened species in the area (the potential for microbats in old adits is discussed in **Section 2.7.4**); and
- greenhouse gas emissions refer **Section 8.2.4**.

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 MR and implementation of measures listed in **Sections** 8 and 9.

5.3. Local Council Environment Planning Instruments

5.3.1. Broken Hill Local Environment Plan 2013

The majority of the Mine, including the area proposed for MOD6 activities, are within Special Purpose Zone 1 (SP1) Special Activities – Mining [BHCC Local Environment Plan (LEP), 2013, version 17 April 2020] and therefore mining is permissible with consent.

5.3.2. Broken Hill Control Plan No 2016

Section 6.2 Lead Contamination

The Development Control Plan (DCP) Section 6.2 provides guidelines for the management of issues relating to lead contamination. There are no changes to lead contamination anticipated with this Modification. A Human Health Risk Assessment was completed for MOD6 and results are discussed at **Section 8.3**.

Section 8.4 Development in the Mining Zone

The DCP Section 8.4 provides guidelines for the management of issues for the protection of heritage items relating to historic mining activities. MOD6 activities would not impact any heritage items. Protection of heritage is discussed at **Section 8.10.**

5.4. Summary of Required Approvals

The following approvals would be sought for MOD6:

- Modification to the Project Approval 07_0018 by the Minister for Planning and Public Spaces (or delegate) for all listed MOD6 activities including administrative changes as outlined at **Section** 3 as required by the EP&A Act.
- Variation to the Environment Protection Licence 12559 (EPL) by the EPA for updated noise limits (Condition L4.2) (refer discussion at **Section 3.9**) and any additional monitoring requirements as required by the POEO Act.
- Modification to the Mining Operations Plan by the Resources Regulator for any new activities to be undertaken within CML7 and any changes to rehabilitation requirements to be included/adjusted in the Rehabilitation Cost Estimate as required by the Mining Act.
- HRA for the establishment of a tailings storage facility (TSF3) (Schedule 3, Part 7 Section 35 of the WHS M&P Act).
- HRA for the development of new mine entry (new portal) (Schedule 3, Part 2, Section 4 of the WHS M&P Act).
- HRA for the alternation of a tailings storage facility (tailings harvesting) (Schedule 3, Part 7 Section 35 of the WHS M&P Act).

5.5. List of BHOP Documents Required to be Developed/Updated

The following BHOP site documents would be formulated or amended in line with MOD6 requirements:

- Environment Management Strategy (BHO- ENV-SYS-001) (existing)
- Air Quality Monitoring Program and Management (BHO-PLN-ENV-010) (existing)
- Community Lead Management Plan (BHO-ENV-PLN-008) (existing)
- Noise Monitoring Management Plan (BHO- PLN-ENV-009) (existing)
- Technical Blasting Management Plan (BHO-PLN-MIN-002) (existing
- Site Water Management Plan (BHO- PLN-ENV-004) (existing)
- TSF2 Operations Maintenance and Surveillance Manual (BHO-MAN-MET-029) (existing)
- Blackwood Tailings Storage Facility (TSF2) (BHO-PLN-MET-003) (existing)
- PHMP for Inundation and Inrush (BHO-PLN-MIN-005)
- PHMP for Roads and Other Vehicle Operating Areas (BHO-PLN-SAF-004)
- PHMP Ground and Strata Failure (BHO-PLN-MIN-014)
- Waste Rock Management Plan (new)
- Surface Blasting Management Plan (new)
- Operations and Management Manual – TSF3 (new)
- Construction Environment Management Plan for MOD6 (new)
- Rehabilitation Strategy (new)
- Rehabilitation Management Plan (new)

6. ENGAGEMENT

This Section summarises the stakeholder engagement undertaken and any issues raised during that process.

6.1. Government Agencies Consultation

Preliminary meetings and discussions have been held with regulators to identify any significant issues to be addressed in the environment assessment for MOD6. These included Department of Planning, Industry and Environment (DPIE), Resources Regulator (RR), the Broken Hill City Council (BHCC), the Environment Protection Authority (EPA), NSW Health, Dams Safety NSW and Natural Resources Access Regulator (formerly known as NSW Water Group). Requirements suggested by these regulators at various meetings are summarised in **Table 6-1**. This consultation was conducted when BHOP proposed to store excess waste rock in surface stockpiles.

Table 6-1 Summary of Agency Key Issues for the Environment Assessment

Government Agency (NSW)	Issues Identified	Response in MR
Broken Hill City Council 25 June 2018 BHCC Offices – meeting 11 September 2020 – Site visit and operation overview 13 October 2020 Correspondence 1 March 2021 - Site visit and operation overview 10 March 2021 BHCC Offices meeting 15 March 2021 side visit 23 July 2021 site visit	The BHCC does not have any initial concerns with the proposed project however dust and noise should be controlled and heritage structures avoided. There is no issue with visual amenity as it was considered an already disturbed mine site. Further correspondence specified the following to be addressed: • Noise – particularly works around the portal and decline and new boxcut, vehicle movements, and waste rock placement, • Dust – particularly during construction phase; and truck movements associated with transporting waste rock and waste materials; • Impact on heritage items on the mining lease – based on the information provided, it appears that no heritage items would be directly impacted by the works/operation changes. Consideration needs to be given to ensure that heritage items located in and near BHP Pit would not be impacted by the placement of waste rock. • Community health – consideration to be given to lead dust/contamination, and impact on community blood lead levels; • Rehabilitation – consideration should be given to rehabilitation of the boxcut and portal (at time of mine closure).	**Section 8.1** Appendix **E1** and **E2** **Section 8.2** Appendix **C1** and **C2** **Section 8.10** **Section 8.3** Appendix **D1** and **D2** **Section 3.10**
EPA 27 June 2018 EPA offices - meeting 18 June 2019 Site Inspection 16 October 2020 Correspondence: 11 March 2021 Site visit	• Provide a description of waste rock to be transported to stockpiles including, particle size and metals content. • Human health risk assessment and in particular an assessment of potential impact on children's blood lead levels and describe air quality control measures used to ensure there is no net increase in blood lead levels. • Air quality assessment. • Noise assessment. • Provide groundwater assessment following tailings placement in Kintore Pit. • Provide seepage analysis for Kintore Pit. • Clarify and justify construction hours and describe the process to provide breaks from noise and activities for local residents. • Assessment of vibration and overpressure from new portal and decline development. • Provide summary of community consultation with local residents particularly in regards to noise and working hours. • Provide details in rehabilitation plan of methods to ensure minimum dust emissions from the site.	**Section 3.4.2.2, 3.8.2** and Appendix **L** **Section 8.3** Appendix **D1** and **D2** **Section 8.2** Appendix **C1** and **C2** **Section 8.1** Appendix **E1** and **E2** **Section 8.7.2**, **3.4.4** and Appendix **B1** **Sections 3.4.4.2**, **8.7.3** and Appendix **B1** **Section 3.3** **Section 8.4** and Appendix **F1** **Table 6-2** **Sections 3.8** and **8.2.5**
DPIE 28 June 2018 DPIE offices - meeting	• Project to follow the assessment pathway for a State Significant Development with MOD3 as the baseline. DPE to provide further information, include summary of assessment pathway in EIS. • Clarify and justify why waste rock stockpile capacities exceed requirement.	**Section 5.2.2** and Appendix **A3** No longer relevant

Government Agency (NSW)	Issues Identified	Response in MR
	• Consult with Resource Regulator re safety issues for underground mine workers.	(**Section 4.4**) **Section 6.1**
	• Seepage analysis for Kintore Pit.	**Section 3.4.4.2** and Appendix **B1**
	• Groundwater quality assessment for Kintore Pit.	**Section 8.7.2.2** and Appendix **B1**
	• Air quality assessment.	**Section 8.2** and Appendix C1 and C2
	• Human Health Risk Assessment, indicating impact to children's blood lead levels.	**Section 8.3** and Appendix **D1** and **D2**
	• Describe the dewatering/filtering system for tailings and its location.	**Section 3.5** and Appendix **B1**
	• Provide a summary of BHOP contributions to Health NSW.	**Section 2.6**
	• Provide an assessment of blasting vibration and over pressure at portal and decline.	**Section 8.4**, Appendix **F1**
	• Provide assessment of the requirement for controlled actions under the EPBC Act, in relation to Broken Hill status on the National Heritage List (BH).	**Section 5.1.1.1**
	• Provide an assessment for fauna (bats) habitat in old shafts / adits within Kintore Pit.	**Sections 2.7.4**, **3.4.4.1**
	• Provide an assessment of any visual impacts from the modification.	**Section 8.11**
Resource Regulator - Environment 29 June 2018 RR offices - meeting 18 June 2019 Site inspection 12 September 2019 Site inspection 11May 2021 Zoom meeting 25 May 2021 Site visit	• Provide stability analysis of TSF1 (from collapse beneath) and TSF2 (from batter/embankment failure) for safe storage of waste rock.	**Section 3.4.4.1** and **3.10.1.1**
	• Provide details for stormwater management on stockpiles.	**Section 8.7.4**
	• Provide information on the geochemical characteristics of the boxcut material, variation within the material, and waste rock generally, this includes all relevant metals. Also its homogeneity.	**Section 3.6.3**
	• Provide details of potential impact of tailings on ground water.	**Section 8.7.2.2**
	• Provide an assessment of slumping of tailings in Kintore Pit at closure (also Blackwoods).	**Sections 3.10.2.1** and **3.10.2.4**
	• Justify the use of waste rock armouring against other dust mitigation measures.	**Section 3.8.1.**
	• Provide details of water management including seepage management, water expression through the pit walls and excess water from dewatering tailings.	**Section 3.4** and Appendix **B1**
	• Provide seepage analysis for Kintore Pit and detail methods to eliminate/minimise seepage.	**Section 3.4.4.2** and Appendix **B1**
	• Provide a noise assessment with modelling particularly in relation to the development of the boxcut.	**Section 8.1** and Appendix **B1** and **B2**
	• Provide details for heritage within BHP Pit and how it would be protected.	**Section 8.10**
	• Outline how noise and dust would be managed and any impacts to visual amenity.	**Sections 8.1, 8.2** and **8.11**, and Appendices **C1**, **C2**, **E1** and **E2**
	• Provide details of the design of the boxcut and entry point to Haul Road, e.g. final height of exit from boxcut to the ROM.	**Section 3.5.1.8** and **8.8**
	• Provide assessment of potential liquefaction of Blackwood Pit tailings and the required stand-off distance for new underground workings.	**Section 8.6**
	• Show sizing of materials – waste rock and from boxcut and if fines show how they would be removed prior to covering 'Free Areas'.	**Table 3-26** and **Section 3.8.3**
	• Provide details for monitoring – air, water, slumping or subsidence (post closure).	**Sections 8.2.5.3**, **8.7.2.2** and **3.10**
	• Provide any details of waste generation e.g. fines from dewatering and how they would be treated.	Not longer relevant (**Section 3.5**)
	• Provide an assessment of long term geochemical degradation i.e. 100 to 500 years of waste rock used on surface coverings.	Sections **3.8.2.4** and **8.9**, Appendix **H**
	• Provide assessment of alternatives for rehabilitation (for dust suppression).	**Section 3.8.1** and **Table 3-25**, Appendix **I**
	• Explain what the final landform would be.	**Section 3.10.2**

Government Agency (NSW)	Issues Identified	Response in MR
Resource Regulator – Mine Safety 12 September 2019 Site inspection 7 February 2020 Site visit/meeting 13 October 2020 Site meeting 22 February 2021 Site inspection 16 June 2021 Zoom meeting	• Trafficability on tailings – confirm how this would be managed • Detail how supervision of the tailings winning team would be managed • Assessment of machinery influence on the embankment integrity (eg vibration) • Assessment of machinery influence on the tailings mass as a whole (eg vibration) • Work method (or proposed controls) to ensure tail harvesting doesn't compromise the certified structure. • Details of how water would be managed in Kintore Pit during placement (temporary management of surface water). • Provide an assessment of the need for an engineered plug at the current portal. • Describe water management underground including its removal. • A HRA would be required for the three activities – New mine entry (portal development), establishment of a new tailings storage facility (TSF3)l and alteration of a tailings storage facility (tailings harvesting) to show that the hazards are understood and have suitable controls.	**Section 3.5.2.2** and Appendix **B1** **Section 3.5.4**. **Section 3.5.2.3** **Section 3.5.2.3** **Sections 3.5.2** and **3.5.2.3** **Sections 3.4.3.6**, **3.4.3.4** and **3.4.4.2** **Section 3.4.3.1** and Appendix **B1** **Section 3.4.4.4** **Table 5-1**
Health 2 October 2020 Correspondence	• Require the Human Health Risk Assessment to be written and/or peer reviewed by a toxicologist. • Update the current Air Quality Management Plan to the satisfaction of the EPA.	**Section 8.3** **Section 8.2.5.2**
Crown Lands 23 September 2020 Correspondence 18 June 2021 Site meeting	• No further issues required to be addressed to those identified in the Project Brief.	
Heritage 30 September 2020 Correspondence	• It is recommended that the modification report contain information identifying the heritage within the MOD6 project area and how it would be protected from any impacts from the proposed works.	**Section 8.10**
Natural Resources Access Regulator (NRAR) Correspondence	• No feedback provided.	-
Biodiversity and Conservation 9 October 2020 Correspondence	• The EIS should clearly demonstrate that no native vegetation would be removed and that impacts on threatened species habitat would be avoided or would be unlikely. • The EIS should address any issues in relation to microbats and provide details about the timing and methods (e.g. acoustic monitoring) to be used for the proposed assessments for bat habitat in the old adits and shafts as they become safely accessible, and also during the life of the mine. • The Project Brief indicates that the modification is within the mine footprint in the Willyama Common area and that fauna use of old adits and shafts is unlikely due to difficult access. As the development is in a disturbed area and avoids native vegetation, DPIE - Biodiversity & Conservation Division considers that the proposed modification is consistent with section 7.17(c) of the BC Act and that a full BDAR is unlikely to be necessary for the modification.	**Section 1.1** **Section 2.7.4** and **Section 3.4.4.2**
Dams Safety, NSW 23 May 2018 DS offices	• Assess blasting vibration meets prescribed dam requirements. • Assess any potential for impacts to the stability of the embankments.	**Section 8.4.3**, **8.4.4.1 8.6.3.6** **Section 3.5.2.3**

In addition to the consultation with regulators as detailed in **Table 6-1** BHOP intended to hold a meeting for regulators outlining proposed MOD6 activities with presentations by consultants who had undertaken the major environmental impact studies. Due to the NSW Department of Health directives for COVID-19 this was not possible. Presentation sessions, via a Zoom were arranged. The purpose of these sessions was to provide an understanding of the aspects for the MOD6 Project and provide the opportunity for regulators to seek any clarification direct from the consultants who have undertaken the various design and assessment studies for MOD6. Participants were also invited to attend at the Rasp Mine if they were able and COVID-19 restrictions permitted.

In addition copies of all consultant reports were provided by computer link prior to the presentation sessions.

The details and agenda for these sessions are provided in **Table 6-2**.

Table 6-2 Summary Details for Specialist Consultant Presentations

Meeting Details	Agenda	Presenters	Attendees
AIR & HEALTH 26 July 2021 2.00pm to 4.30pm	MOD6 overview - would provide a description of the current operations and the changes proposed including construction works and operations and how MOD6 impacts on current closure options with a focus on dust generation and mitigation activities. A fly-over of the site would enable those who are unfamiliar with the site to gain an understanding of the location of activities and the positioning of the Rasp Mine within the City of Broken Hill.	*Giorgio Dall'Armi, General Manager, BHOP*	DPIE NSW Health – Broken Hill NSW Health – Sydney BHCC
	Air Quality Assessment -, would provide a summary of the air quality risk assessment including the methodology applied, modelling assumptions and results with comparisons to the Preferred Project Report, MOD4 (construction) and current operations.	*Damon Roddis, Zephyr Environmental Pty Ltd* (formerly ERM Australia Ltd)	
	Human Health Risk Assessment –, would provide a summary of the human health risk assessment including the methodology applied, modelling assumptions and results with comparisons to the Preferred Project Report, MOD4 (construction) and current operations	*Tarah Hagen, SLR Consulting Australia Pty Ltd*	
BLACKWOOD PIT TSF2 28 July 2021 10.30am to 12.30pm	MOD6 overview – as above	*Giorgio Dall'Armi, General Manager, BHOP*	DPIE Dams Safety NSW Resources Regulator
	TSF2 –would provide an overview of the potential risks identified for TSF2 in relation to blasting and tailings harvesting and explain the tailings harvesting design – vibration, liquefaction TSF2 only, seepage, stability of embankments, traffic vibration on TSF2 surface.	Fred Gassner, Golder Associates Ltd,	
	Vibration and blasting –would provide an overview of vibration and blasting issues related to TSF2 (a Declared Dam).	Mike Humphreys, Prism Mining Pty Ltd,	
	Geotechnical –, would provide an overview of the boxcut design and summaries of other reports for MLD and slopes (tailings and waste rock) within Kintore Pit.	Cameron Tucker, Ground Control Engineering Pty Ltd	
GENERAL 2 August 2021 10.00am to 4.00pm	MOD6 overview – as above	*Giorgio Dall'Armi, General Manager, BHOP*	DPIE Resources Regulator – Environment BHCC NSW Water Crown Lands
	Air Quality Assessment – as above.	*Damon Roddis, Zephyr Environmental Pty Ltd* (formerly ERM Australia Ltd),	
	Noise Impact Assessment - would provide a summary of the noise risk assessment including the methodology applied, modelling assumptions and results and comparisons to the Preferred Project Report, MOD4 (construction) and current operations. In addition Najah would discuss the changes in criteria recommended in accordance with the NSW EPA Noise for Industry.	*Najah Ishac, EMM Consulting Pty Ltd*,	
	Vibration and blasting –would provide an overview of vibration and blasting issues including flyrock management, and potential impacts to neighbours	*Mike Humphreys*, Prism Mining Pty Ltd,	

Meeting Details	Agenda	Presenters	Attendees
	and TSF2 (a Declared Dam).		
	TSF2 and TSF3 Design and management of potential risks -, would provide a discussion of the tailings harvesting – design and operation, the characteristics of Kintore Pit and preparation works to enable safe deposition/placement of tailings and waste rock (plug design, seepage collection system) addressing issues such as liquefaction (TSF1 & 2) and inrush. Summary of issues re TSF2. Fred would also provide an overview of water and stormwater management.	*Fred Gassner, Golder Associates Pty Ltd*	
	MOD6 summary of Mine Closure and proposed rehabilitation activities.	*Joel Sulicich, HSE and Training Manager BHOP*	

In summary the following points were made during the presentations:

- Tonnage for on-going production rates – the current mine plan to 2026 is provided in **Section 2.4.**
- Noise assessment of construction works for mines as operations – BHOP considers these works are required to facilitate to facilitate the commencement of operational mining activities and therefore should be treated as construction works, discussion is provided in **Section 8.1.2.1**.
- Emission inventories need to be provided – these are provided in **Appendix C1**.
- Cumulative impacts need to be included in the air quality assessment – these are provided discussed in **Section 8.2.3** and in **Appendix C1**.
- MR needs to outline air quality management measures for construction activities – these are discussed in **Section 8.2.5**.
- A rehabilitation plan scheduling progressive rehabilitation of Free Areas needs to be addressed – the intention of BHOP is to obtain agreement as part of MOD6 to use waste rock that has been tested and is <0.5%Pb as a capping material for Free Areas. A progressive rehabilitation schedule can then be provided. This is discussed in **Section 3.10.3**.
- TSF2 on-going management needs to have geotechnical input – The Technical Services department (generally the Geotechnical Engineer) is involved in the monthly inspection of TSF2 and in the monthly TSF2 review meetings. This approach is expected to remain for MOD6.
- Selection of preliminary blasting parameters and in particular K factors – preliminary blasting parameters are discussed in **Section 8.4.2.1** and were identified using generic guidelines (Blast Dynamics and Dyno Nobel) and informed by blasting experience at the site. It was acknowledged that there was little information about development blasting, particularly in the boxcut area, and recommendations were made to management the progression of these blasts.
- The number of surface blasts likely, the likely damage to structures and the notice period for surface blasting activities – the number of surface Blasts is discussed in **Section 8.4.1,** blasting damage criteria in **Section 8.4.3** and notices discussed in **Section 8.4.4.3** in relation to flyrock clearance zones.
- Are there faults, dykes or dolerite areas identified with boxcut blasting activities – a description of the blasting area including materials is discussed at **Section 8.4.1**.
- Surface water management for Kintore Pit rim and runoff – stormwater management for Kintore Pit is discussed in **Section 3.4.3.5**, **3.4.4.3** and **3.10.2.1**.
- Closure plans for Blackwood Pit TSF2 – a conceptual closure plan for TSF2 is discussed in **Section 3.10.2.4**.
- What is the status for the interagency panel for the Line of Lode – was established and last met at site in August 2019, advised by Resources Regulator that attempts are being made to reorganise this group.

6.2. Community Consultation

Due to the Department of Health NSW directions in relation COVID 19, a public meeting was not able to be held with local residents and community members in Broken Hill. An alternative consultation program to promote community consultation and obtain feedback was adopted by BHOP including:

- BHOP attendance at the Broken Hill Lead Reference Group with a presentation summarising MOD6 proposed works (Report as Tabled at the meeting) held 20 March 2021.
- A media interview was held on the 13 August 2021 with the Rasp Mine - General Manager and the local ABC outlining proposed MOD6 changes and answering questions about the Project.

  The topics discussed during the interview included:

  - recent changes in production to achieve sustainability and longevity of the Project;
  - details of the proposed changes in MOD6 including their justification. MOD6 changes provided included the new boxcut, Kintore Pit to be used for tailing and waste rock placement, tailing harvesting to be undertaken in Blackwood Pit and waste rock tested and less than 0.5%Pb to be used for rehabilitation.
  - updates on the submission of the proposal and consultation activities carried out with government agencies;
  - expected construction timeframes and modification to proposed construction hours to include Saturday afternoons which would reduce construction times;
  - overall benefits of the Project (extension of operations, continuation of storage of tailings on site and maintaining existing workforce); and
  - the future process to obtain approval for MOD6 including public exhibition of the proposal.

- An article was placed in the local newspaper (Daily Barrier Truth) outlining details for MOD6 and providing contact details for further information. This was published on 14 August 2021.

To date no comments have been received.

7. RISK IDENTIFICATION & ASSESSMENT

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

7.1. Risk Review

In April 2018, HMS Consultants Australia Pty Ltd (HMS) was engaged by BHOP to facilitate a risk assessment on the proposed conversion of Kintore Pit to a tailings storage facility. The objective of this preliminary risk review was to assist in determining a safe and suitable option for converting the Kintore Pit into a storage facility for tailings. This was attended by relevant BHOP management and consultants covering the fields of metallurgy, tailings storage design, mining engineering, geotechnical engineering, environment and safety.

Further risk reviews were conducted by SP Solutions Pty Ltd In January and September 2020. Participation by key personnel provided an appropriate mix of skills and experience to identify the potential scenarios / issues related to each of the areas of the Project and the controls to be applied. **Table 7-1** provides a list of participants to these risk review sessions.

In addition BHOP conducted consultation meetings with regulators to identify their requirements for the development of the Project and where risks were identified during these sessions they have been incorporated into Site's the risk management process.

Table 7-1 List of Participants for Risk Assessments

Name	Organisation / Role	Experience
Andrew McCallum	CBH Group Metallurgist	Metallurgy, 20 years
Eamonn Dare	BHOP Technical Services Superintendent	Mining, 28 years
David Matthews	BHOP Geotechnical Engineer	Geotechnical,11 years
Ben Taylor	BHOP Mine Manager	Registered Mine Manager, Mining, 12 years
Devon Roberts	BHOP Senior Environmental Advisor	Environment, 15 years
Carlos Vanegas	BHOP Metallurgy Manager	Metallurgy, 14 years
Fred Gassner	Golder Associates Principal Consultant	Geotechnical, tailings facility specialist, 35 years
Cameron Tucker	Ground Control Engineering Principal Consultant	Geotechnical, 20 years
Gwen Wilson	CBH SHEC Group Manager	Environment, 35 years
Giorgio Dall'Armi	BHOP General Manager	Mining, 20 years
Bruce Dudgeon	BHOP Project Manager	Construction, 25 years
Joel Sulicich	BHOP HSET Manager	Safety, 15 years
Peter Reardon	SP Solutions, Director Facilitator	Mining and construction, over 30 in risk management processes

A review of the risks was then undertaken to identify the matters relevant to MOD6 construction and operation activities and the key issues for assessment. **Table 7-2** (construction) and **Table 7-3** (operations) provide a summary of the relevant matters identified with the key issues to be addressed in the MR determined. Where a key issue has been identified a reference to the section in the MR where the item is discussed has been included in the Table. Relevant Matters have been provided for both construction and operations for each of the areas relevant to MOD6.

Table 7-2 Relevant Matters and Key Issues - Construction

Issue	Relevance	Key Issue
KINTORE PIT TSF3		
Noise	Noise would be generated by: - closing the portal and installing plugs/barriers as required. Not considered a key issue as this work would be undertaken at the bottom of the Pit (210 m deep) or underground, however has been included in cumulative noise assessment. - transport of cement for concrete plug(s). Not considered a key issue as cement trucks already enter the mine 24 hours/day for shotcrete, consistent with current practice. However truck movements have been included in cumulative noise assessment. - relocation of waste rock from the Kintore Pit Tipple to the base of Kintore Pit to occur 24 hours per day.	No No Yes
Dust	Dust would be generated by: - cement trucks to construct portal plug, not considered a key issue as there would be no increase in truck movements given haul trucks would cease from this location. - Kintore Pit preparation works with the relocation of waste rock material from the Kintore Pit Tipple to the base of Kintore Pit, earthworks in the floor of the Pit.	No Yes
Community Health	The preparatory works required would include earthworks and the relocation of waste rock within the Pit which would be dust generating and have been included in air modelling used for the Human Health Risk Assessment.	Yes
Traffic & Transport	There would be some increased traffic on public roads due to delivery of supplies and equipment but these would not be discernible from current deliveries.	No
Water	Additional water would be used for: - cement to construct portal plug, not considered significant as recycled water is proposed to be use - dust suppression, not considered significant as recycled water is proposed to be use	No No
Heritage	No heritage items are located in the proposed Project locations.	No
Land Disturbance	No vegetation to be removed, no additional land disturbance would be required.	No
NEW MINE ENTRANCE		
Noise	Noise would be generated by: - earthworks using bulldozer and excavator to construct boxcut - truck movements to remove waste rock	Yes Yes
Vibration and Overpressure	Vibration and overpressure would be generated by: - blasting to construct the portal and decline	Yes
Flyrock	Flyrock may be generated during surface blasting for the portal opening.	Yes
Inrush	From liquefaction from tailings stored in TSF1 and / or TSF2, requires safe standoff distance.	Yes
Dust	Dust would be generated by: - earthworks using bulldozer and excavator to construct boxcut - blasting activities for portal and decline - truck movements to remove waste material	Yes Yes Yes
Community Health	It has been assumed that the excavated waste material to be removed for the boxcut excavation works contains >0.5%Pb and works have been included in air and health assessments.	Yes
Traffic & Transport	There would be some increased traffic on public roads due to delivery of supplies and equipment, it is not expected that these would be discernible from current deliveries. Traffic on internal roads potentially increases the interaction of heavy/heavy and heavy/light vehicles. Dust and noise risks from the change to internal traffic are addressed above.	No Yes
Water	Additional water would be used for: - cement to shotcrete sides of portal and decline not considered significant as recycled water is proposed to be used	No

Issue	Relevance	Key Issue
	- dust suppression, not considered significant as recycled water is proposed to be use	No
Heritage	No heritage items are located in the proposed project locations.	No
Land Disturbance	No vegetation to be removed, no additional land disturbance would be required.	No
TAILINGS HARVESTING BLACKWOOD PIT TSF2		
Noise	Noise would be primarily generated by earthworks using a bulldozer and excavator to form dividing bunds between tailings drying cells and some other works. Some of this work would be completed as part of the sprinkler system for MOD 4. The remaining works were considered minor and not a key issue however, dust was included in the construction scenario for noise modelling.	No
Dust	Dust would be primarily be generated by earthworks to form dividing bund between tailings drying cells and some truck movements. Some of this work would be completed as part of the sprinkler system for MOD 4. The remaining works were considered minor and not a key issue however, dust was included in the construction scenario for air quality modelling.	No
Community Health	Tailings contains very low Pb levels - <0.2%. The primary works include the handing of tailings to form the cell dividing bunds, as the tailings is low in Pb these works were not considered a key issue however, dust was included in the construction scenario for air quality modelling which formed the basis for the HHRA.	No
Water	Water would be used for dust suppression, however, as it is proposed to use recycled water this is not considered a key issue.	No
Traffic & Transport	There would be minor temporary increases to off-site traffic from concrete and aggregate deliveries, however it is not expected these would by discernible from current traffic and is not considered a key issue.	No
Land Disturbance	Activities would be undertaken on already disturbed land.	No

Table 7-3 Relevant Matters and Key Issues - Operations

Issue	Relevance	Key Issue
KINTORE PIT TAILINGS STORAGE FACILITY		
Inrush	Inrush could occur from: - seepage from stormwater in pit, saturated tailings, rapid rise of tailings - liquefaction of saturated tailings from seismic event, mine blasting, subsidence of old workings, Pit wall failure - water migration along major fault lines, unknown connection from underground workings to TSF - seepage or perched water table accumulation	Yes Yes Yes Yes
Ground Failure	Ground failure could occur from: • Pit wall failure • Fault zones and geological structures • Stress change during filling • Failure of ground support in current drives • Failure of Pit floor	Yes Yes Yes Yes Yes
Noise	Noise would be generated by: - earthmoving equipment spreading and compacting the tailings, only as tailings reaches closer to the surface - trucking of excess waste rock from underground mining - stockpiling waste rock and loading into trucks for rehabilitation capping	Yes Yes Yes
Dust	Dust may be generated by: - earthmoving equipment spreading and compacting the tailings and waste rock, primarily as the tailings rises and reaches closer to the surface - trucking of excess waste rock from underground mining - stockpiling waste rock and loading into trucks for rehabilitation capping	Yes Yes
Community Health	Dust, which may contain lead, may be generated from tailings and waste rock primarily as the surface of the material rises closer to the surface.	Yes

Issue	Relevance	Key Issue
Water	Water may collect in a depression or series of depressions within the Pit, particularly with rainfall events (this would be used for dust suppression within the Pit or recycled to the Mill as current practice). Tailings may impact groundwater water quality.	No Yes
Traffic & Transport	Transfer of harvested tailings from TSF2 to TSF3 would be undertaken by trucks.	Yes
Waste Management	There are no wastes generated from tailings deposition.	No
Land Disturbance	Activities would be undertaken on already disturbed land.	No
Rehabilitation	Rehabilitation of the filled Kintore Pit would need to be considered.	Yes
NEW MINE ENTRANCE		
Noise	Although the Mine Ore Haul Road would be shortened a new section of road would be used exiting from the boxcut to the Mine Ore Haul Road. Waste rock would be transferred from underground via the new portal to the Kintore Pit Tipple for testing and TSF3 for permanent placement. Vehicle movements for changeover would now be conducted in the Laydown Area adjacent the boxcut and not on Kintore Pit floor.	Yes Yes Yes
Dust	Although the Mine Ore Haul Road would be shortened a new section of road would be used exiting from of the boxcut to the Mine Ore Haul Road which would require the air modelling to be updated. Waste rock would be transferred from underground via the new portal to the Kintore Pit Tipple for testing and TSF3 for permanent placement. Vehicle movements for changeover would now be conducted in the Laydown Area adjacent the boxcut and not on Kintore Pit floor.	Yes Yes Yes
Surface Water	There would be no additional water used, management of rainwater runoff and collection around the boxcut and portal would be addressed in the Site Water Management Plan.	Yes
Community Health	Although the Mine Ore Haul Road would be shortened a new section of road would be used exiting from of the boxcut to the Mine Ore Haul Road which would require the air and health modelling to be updated.	Yes
Traffic & Transport	The surface Mine Ore Haul Road taking ore to the ROM Pad would be shortened and would be sealed ex-boxcut, not considered a key issue.	No
Waste Management	No additional waste generated.	No
TAILINGS HARVESTING		
Noise	Noise would be generated by: • Dozer, truck, excavator harvesting the tailings within TSF2 • Trucks transporting tailings from TSF2 to TSF3	 Yes Yes
Dust	Dust would be generated by: • Dozer, truck, excavator harvesting the tailings within TSF2 • Wind take up of dust within TSF2 • Trucks transporting tailings from TSF2 to TSF3	 Yes Yes Yes
Community Health	Generated dust within TSF2 contains some Pb (Pb in tailings is <0.2%) however potential for Pb bearing dust has been included in air modelling used for the Human Health Risk Assessment.	Yes
Surface Water	Water may collect in a sump within TSF2, particularly with rainfall events (this would be used for dust suppression within TSF2 or recycled to the Mill as current practice). Overflow of embankments from major stormwater event.	Yes
Traffic & Transport	There would be no changes to off-site traffic or transport. Tailings harvesting requires internal transport of tailings from TSF2 to TSF3 which would add to the current traffic on the Mine Ore Haul Road, including increased interaction between trucks and light vehicles.	Yes
Waste Management	There are no wastes generated from tailings deposition.	No
Land Disturbance	Activities would be undertaken on already disturbed land.	No
Rehabilitation	Rehabilitation of Blackwood Pit would need to be considered for mine closure.	Yes

7.1.1. Risk Assessment Process

The risk review is part of BHOP Mine Safety Management Systems and is based on the following:

1) Framework detailed in ISO 31000:2018 *Principles and Generic Guidelines on Risk Management,* Standards Australia.
2) MDG1010 Guide for Risk Management (NSW Resource Regulator); and
3) Aligned to meet requirements for risk management as outlined in the BHOP Risk Management Procedure BHO-PRO-SAF-002.

The key steps of the overall process included:

- data collection and analysis – this included a photo study of the area under review;
- a team based threat analysis where a series of diagrams were developed as primary input into developing the Risk Treatment Plan (hazards, preventative and mitigating controls, recommendations for improvement).
- applying the BHOP risk matrices for assessment and risk ranking.

The tools used for the BHOP risk assessment process are outlined in **Table 7-4** Severity Consequence Table, **Table 7-5** Likelihood Definitions and **Table 7-6** Risk Ranking Matrix.

All key issues identified have gone through a risk assessment process and their risk rankings are summarised in **Table 7-7** together with the section within the MR where they are addressed. Where the rakings varied for each activity the highest risk ranking is shown. The results of the assessments are discussed in **Section** 8.

Table 7-4 Rasp Mine Severity Consequence Table

CONSEQUENCE CATEGORIES					
Impact	**Minor**	**Moderate**	**Significant**	**Major**	**Catastrophic**
People	No Injury/ report only	First Aid Injury	Medically Treated Injury or Illness (MTI) or Restricted Work Injury or Illness (RWI).	Lost Time Injury or Illness (LTI)	Fatality/ Fatalities
Environment	Spill of substance on site 5 - 20 litres	Spill of substance on site 21 - 200 litres	Offsite release of substance that exceeds license criteria. Spill of substance on site greater than 200 litres.	Offsite release impacting residents, flora, or fauna. Major damage to heritage item	Death of or severe impact to protected flora or fauna. Severe impact on community members. Destruction of Heritage item
Property	Damage or loss $0 - $5,000	Damage or loss $5,000 - $20,000	Damage or loss $20,000 - $200,000	Damage or loss $200,000 - $1,000,000	Damage or loss greater than $1,000,000
Business	Production loss 30 minutes - 2 hours.	Production loss of 2 - 12 hours.	Production loss of 12 hours - 1 week.	Production loss of 1 week - 1 month.	Production loss greater than 1 month.
Community Reputation	Single complaint. No impact to operations.	Single complaint with regulator involvement or some impact to operations.	Community complaints, Local council level/media exposure.	Community complaints with Regulator involvement. Prosecution State government level/media exposure.	Community complaints with Regulator involvement. Prosecution/litigation National level exposure

Table 7-5 Rasp Mine Likelihood Definitions

Likelihood	Likelihood description	Frequency guide
Almost Certain	Event will occur if controls are not implemented or there is a critical control failure.	Weekly
Likely	The event will probably occur if controls are not implemented or there is a critical control failure.	Monthly
Possible	The event may occur, would require multiple control failures.	Yearly
Unlikely	The event could occur, would require multiple control failures, and could only result in the specific consequence.	Once every 5+ years
Rare	The event is practically impossible or may only occur in exceptional circumstances. Requires a combination of circumstances and multiple system and control failures.	Once every 10+ years

Table 7-6 Rasp Mine Risk Ranking Matrix

Likelihood	Consequence				
	1- Minor	2 - Moderate	3 - Significant	4 - Major	5 - Catastrophic
A - Almost Certain	Medium 11	High 16	Extreme 20	Extreme 23	Extreme 25
B - Likely	Medium 7	Medium 12	High 17	Extreme 21	Extreme 24
C - Possible	Low 4	Medium 8	Medium 13	High 18	Extreme 22
D - Unlikely	Low 2	Low 5	Medium 9	High 14	Extreme 19
E - Rare	Low 1	Low 3	Low 6	Medium 10	High 15

Table 7-7 Key Potential Issues for MOD6

Potential Key Issue	Risk Ranking	MR Reference
CONSTRUCTION – Kintore Pit, Boxcut, Little Kintore Pit, BHP Pit, Blackwood Pit, Tails Harvesting Haul Road other minor road works		
Noise from earthworks and on-site road traffic trucking.	Medium - 12	Section 8.1
Dust from earthworks, on-site road traffic, surface blasting in the boxcut for the portal and decline and tailings excavation and movement in Blackwood Pit.	Medium - 17	Section 8.2
Impacts to community health from dust and in particular lead bearing dust from excavation and transfer of boxcut waste material, earthworks and trucking.	High - 18	Section 8.3
Vibration and overpressure from surface blasting in the boxcut and underground decline development.	High - 18	Section 8.4
Flyrock impacts from surface blasting in boxcut.	High - 18	Section 8.4
Liquefaction impacts to TSF1, TSF2 and TSF3.	High - 15	Section 8.6
OPERATIONS – MOD6 future operations placement in of materials in Kintore Pit, tailings harvesting, crushing and rehabilitation capping		
Noise from tailings deposition and compaction (only as tailings reaches closer to the surface), trucking of materials (waste rock and harvested tailings) and rehabilitation capping activities.	High - 18	Section 8.1
Air Quality from spreading and compacting tailings (primarily as tailings reaches surface), trucking of materials (harvested tailings and waste rock) and rehabilitation capping activities.	Medium - 14	Section 8.2
Community health - dust, which may contain lead, may be generated from tailings and waste rock primarily as the surface of the material rises closer to the surface.	High - 18	Section 8.3

Potential Key Issue	Risk Ranking	MR Reference
Liquefaction and Inrush to underground workings from seepage, liquefaction, seismic event, mine blasting, failure of historic tailings wall slope. Overflow of TSF2 embankments from major stormwater event.	High - 15	Section 8.6
Slope Stability - Ground failure in Kintore Pit from pit wall failure, fault zones and geological structures, stress change during filling, failure of ground support in current drives, failure of Pit floor.	High - 18	Section 8.5
Water impacts to raw water usage volume, groundwater quality and surface water management.	Medium - 8	Section 8.7
Traffic impacts from interactions of internal vehicle movements (heavy and light vehicles) and mobile equipment working on tailings material in TSF2.	High - 18	Section 8.8
Heritage impacts from works, periodic crushing and waste rock placement (>0.5%Pb), in BHP Pit.	Low - 5	Section 8.10
Visual Amenity impacts from excavation of boxcut and final land profile for Kintore Pit.	Low - 2	Section 8.11

8. ASSESSMENT OF IMPACTS - DISCUSSION

This Section provides a discussion of the potential impacts identified in relation to the Modification and the management and mitigation measures to be implemented by BHOP.

8.1. Noise

EMM Consulting Pty Limited (EMM) were engaged to complete a noise impact assessment, *Rasp Mine Modification 6 (MOD6) Kintore Pit TSF3 Noise Impact Assessment,* May 2021 (EMM Report) (**Appendix E1**) which considered the proposed construction works and future operations, identifying potential impacts on the surrounding community and providing construction and operational management and mitigation measures. In completing the assessment EMM referenced the PA and the Environment Protection Licence (EPL) 12559, as well as the following noise guidelines:

- NSW EPA, *Industrial Noise Policy*, 2000;
- NSW EPA, *Noise Policy for Industry*, 2017;
- NSW EPA, *Implementation and transitional arrangements for the Noise Policy for Industry* (2017), 2017;
- NSW DECC, *Interim Construction Noise Guideline*, 2009;
- NSW DECCW, *Road Noise Policy*, 2011; and
- BHOP Noise Monitoring & Management Plan (BHO-PLN-ENV-009) (NMMP), June 2019.

EMM made the following conclusions:

- The assessment demonstrated that BHOP can achieve contemporary target level in accordance with the NPfI, the PA and the EPL (both updated), during future operations and activities associated with MOD6 construction.
- Construction noise levels from proposed worst-case construction works during standard hours and day out-of-hours (OOH) on Saturday are predicted to satisfy the PA 65 dB $L_{Aeq,day}$ noise limit at all assessment locations.
- For the *Interim Construction Noise Guideline*, 2009 (ICNG) derived noise management level (NMLs), noise levels during standard hours are predicted to exceed (by up to 3 dB) the relevant NML during stage 1 of the boxcut construction (Scenario 1) at assessment location A13. During day OOH on Saturday, noise levels are predicted to exceed (by up to 8 dB) the relevant NMLs during stage 1 and/or stage 2 of the boxcut construction (Scenarios 1 and 2) at assessment locations A1, A2, A3, A13 and A14.
- Construction noise levels from worst-case construction works proposed during evening and night OOH on any day of the week, noise levels are predicted to satisfy the ICNG NMLs at all assessment locations during 2 m/s wind. During the unlikely worst-case night-time temperature inversion (stability category F) and 2 m/s wind speed, construction noise levels are predicted to be negligibly (up to 2 dB) above the relevant NMLs at assessment locations A1, A2, A10, A13 and A14.
- Future operational $L_{Aeq,15min}$ noise levels, following the completion of the MOD6 construction works, are predicted to satisfy the adopted project noise trigger levels (PNTLs) at all assessment locations during 2 m/s wind for the day, evening and night periods.
- Operational noise levels during the unlikely worst-case night-time temperature inversion (stability category F) and 2 m/s wind speed, are predicted to be negligibly above the relevant adopted PNTLs at assessment locations A13 and A14. However, no material increase is predicted between existing and future site noise levels at assessment locations A13 and A14. Therefore, no additional noise impacts from future MOD6 operations are predicted at surrounding residential receivers as a result of proposed future MOD6 operations.
- Predicted maximum noise level events from the proposed MOD6 activities are not predicted to cause sleep disturbance impact at any of the residential assessment locations during worst-case night-time meteorological conditions for construction works within TSF3 and for future operations.

8.1.1. Assessment Locations

Representative assessment locations, consistent with all previous noise modelling at the Mine, are listed in **Table 8-1** and shown on **Figure 8-1**.

Table 8-1 Assessment Locations

Assessment Location ID	Location	Coordinates (MGA56)	
		Easting	Northing
A1	Piper St North	544110	6462598
A2	Piper St Central	543763	6462312
A3	Eyre St North	543555	6462322
A4	Eyre St Central	543324	6462003
A5	Eyre St South	543140	6461859
A6	Bonanza and Gypsum Streets	542833	6462000
A7	Carbon St	542604	6462718
A8	South Rd	542923	6462744
A9	Crystal St	542926	6463052
A10	Garnet and Blende Streets	543158	6463633
A11	Crystal St	544210	6464144
A12	Crystal St	544761	6464527
A13	Eyre St North	544592	6463059
A14	Piper St North	544532	6462860

8.1.2. Noise Criteria

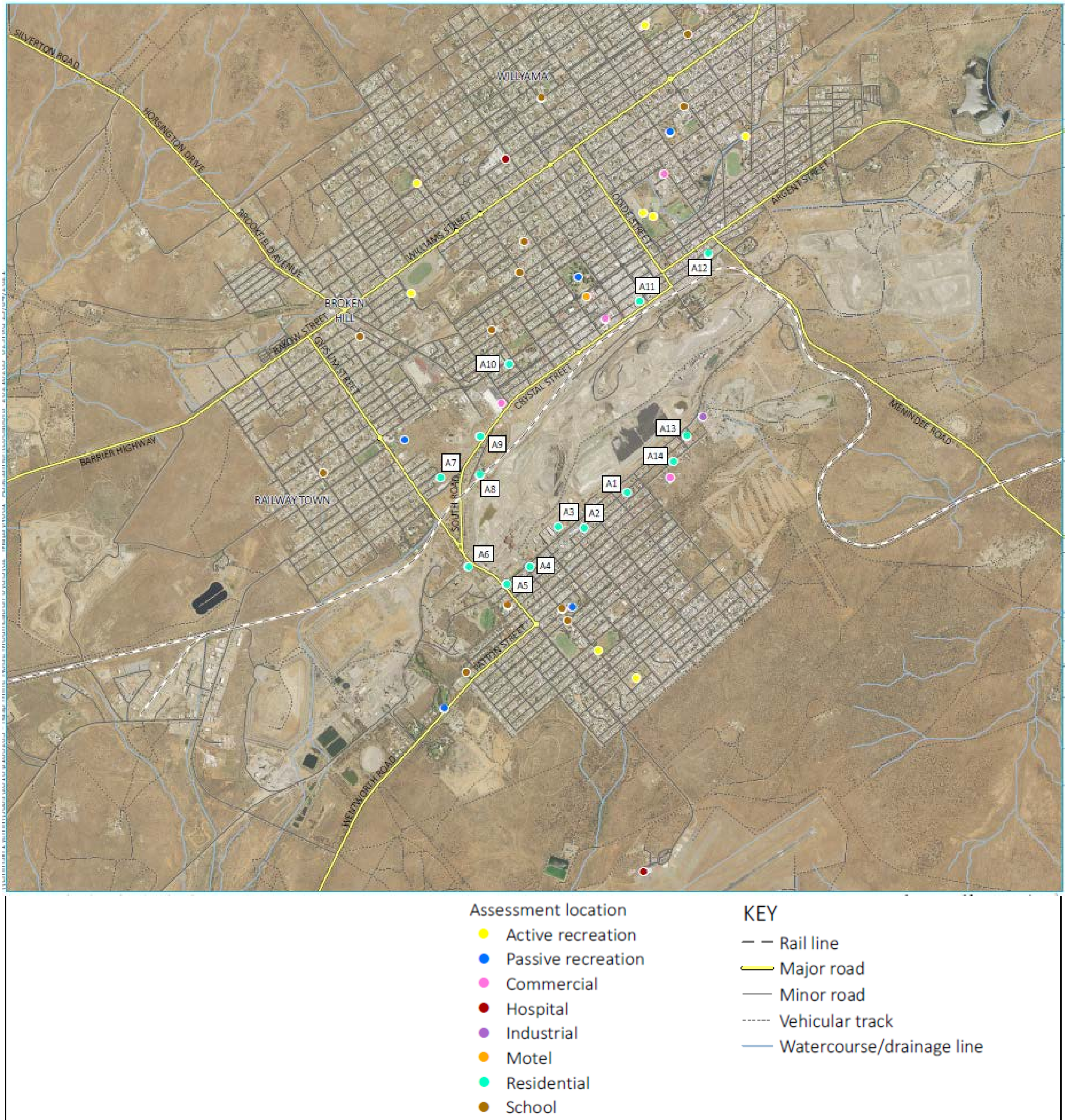
Current noise limits / criteria are listed in Condition L4 of the EPL and Schedule 3 Condition 17 of the PA. These noise limits were founded on project specific noise levels which were derived based on measured or assumed minima rating background level (RBL) +5 dB for all assessment locations (residential), in accordance with the then EPA's *Industrial Noise Policy* (2000) (INP).

The INP has been superseded by the NPfI and in accordance with the EPA's *Implementation and transitional arrangements for the Noise Policy for Industry (2017)*, the EMM assessment adopted the NPfI approach and hence assessment requirements for operational noise and modelling methodologies. EMM recommended updating the original RBLs in accordance with the methodology outlined in the NPfI. These updated limits were adopted for this assessment.

In addition, during routine noise monitoring EMM identified that the RBL for assessment location A7 was relatively low compared to what was expected in that area of the community and that background noise levels may have increased at that location. EMM conducted unattended and short term operator attended noise surveys at this location; detailed results are discussed in Section 3.2 of the EMM Report. EMM recommended changes to the RBL and noise limits at location A7. These changes were also adopted by EMM for their assessment.

EMM recommended that BHOP seek to change the noise criteria in its EPL and PA. BHOP has accepted this recommendation and has requested this change to the PA in this MR (**Section 3.9.1**). BHOP would also make a variation application to the NSW EPA to change its EPL12559 to align with these recommendations.

Figure 8-1 Assessment Locations



EMM Report Figure 2.2 **Appendix E1**

Table 8-2 lists the original RBLs on which the current noise criteria outlined in the PA and EPL are based, together with the existing noise criteria as outlined in the PA and EPL. The updated RBLs are shown (as per NPfI and monitored results for A7) together with the recommended noise criteria which was adopted by EMM for their MOD6 assessment. The daytime RBLs for A1, A2, A13 and A14 were updated by EMM to align with the NPfI minimum RBL for the day period of 35 dB. The RBLs for A7 were updated by EMM based on their ambient noise monitoring completed in June 2019.

Table 8-2 Original RBLs and PA / EPL Operational Noise Criteria

Location	Original RBLs dB(A)			Current PA/EPL Noise Criteria $L_{Aeq,15min}$, dB			Updated RBLs dB(A)			Adopted PA/EPL Noise Limits for Mod 6 Assessment $L_{Aeq,15min}$, dB		
	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
A1	33	32	30[4]	38	37	35	35[5]	32	30	40	37	35
A2	33	32	30[4]	38	37	35	35[5]	32	30	40	37	35
A3	39	36	34	44	41	39	39	36	34	44	41	39
A4	39	36	34	44	41	39	39	36	34	44	41	39
A5	39	36	34	44	41	39	39	36	34	44	41	39
A6	43	36	34	48	41	35	43	36	34	48	41	39
A7	30[4]	30[4]	30[4]	35	35	36	40[6]	37[6]	31[6]	45	42	36
A8	43	34	34	48	39	39	43	34	34	48	39	39
A9	41	34	34	46	39	39	41	34	34	46	39	39
A10	37	36	30	42	41	35	37	36	30	42	41	35
A11	41	34	34	46	39	39	41	34	34	46	39	39
A12	41	34	34	46	39	39	41	34	34	46	39	39
A13	33	30[4]	30[4]	38	35	35	35[4]	30	30	40	35	35
A14	30[4]	30[4]	30[4]	35	35	35	35[4]	30	30	40	35	35

Notes: 1. Day period: Monday to Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
2. Evening period: Monday to Saturday: 6 pm to 10 pm, on Sundays and public holidays: 6 pm to 10 pm.
3. Night period: Monday to Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.
4. The EPA's minima RBL adopted based on policy as at 2007, where measurements indicate levels at or below minima.
5. Based on the NPfI minimum day period RBL of 35 dB.
6. Amended in line with noise monitoring conducted by EMM June 2019.

8.1.2.1. MOD6 Construction Noise Assessment Criteria

The assessment of noise from construction works was completed using the quantitative DECC's *Interim Construction Noise Guideline* (ICNG) (2009). BHOP is aware that consideration is being given by the EPA to replace this guideline with a new *Construction Noise Guideline* currently in draft and open for comment. BHOP considers that under this new guideline the nature of the boxcut construction works and the fact that it is being installed to facilitate mining, means it is not a mining activity of itself and hence should be treated as construction and attract construction noise targets for daytime only works. BHOP would also consider the installation of the new Tails Harvesting Haul Road to be in this category as it is a once only activity to facility mining using equipment dedicated for this purpose whereas once the road is completed it would become an operational input to noise monitoring for tailing haulage.

The ICNG recommends standard hours for normal construction work which are Monday to Friday from 7 am to 6 pm, Saturdays from 8 am to 1 pm, and no work on Sundays or public holidays. The majority of the proposed construction works would be completed during the ICNG standard hours. Proposed construction hours are listed in **Table 8-3**.

The majority of the proposed construction works would be completed during the ICNG's standard hours between 7 am and 6 pm Monday to Friday, 8 am to 1 pm on Saturdays. Proposed construction works would also occur outside the ICNG's recommended standard hours, during out-of-hours (OOH).

The construction of the boxcut, new decline surface trucking (prior to breakthrough to underground) and TSF2 tailings harvest preparation works are proposed to be completed between 7 am and 6 pm Monday to Saturday (excluding Sundays and public holidays). This is one hour (7 am to 8 am) and five hours (1 pm to

6 pm) of OOH construction work on Saturdays and would remain within the daylight hours. The TSF3 preparation works are proposed to occur 24 hours a day 7 days a week, with related activities occurring within Kintore Pit.

Where noise levels from construction works are predicted above the noise affected level during standard hours and/or out-of-hours (OOH), EMM recommend all feasible and reasonable noise management and mitigation measures should be implemented.

Table 8-3 Proposed Construction Hours

Construction works	Construction hours		
	Standard hours Mon to Fri 7 am – 6 pm Sat 8 am – 1 pm	Day OOH Sat 7 am – 8 am Sat 1 pm – 6 pm	24 hours seven days a week
Boxcut	Yes	Yes	No
New decline surface trucking[1]	Yes	Yes	No
TSF2 harvesting preparation works	Yes	Yes	No
TSF3 preparation works[2]	Yes	Yes	Yes

Notes: 1. After completion of the boxcut and access is gained through the new portal.
2. Restricted within Kintore Pit.

EMM applied construction NMLs for all residential assessment locations based on the updated RBLs. In addition the existing PA (Condition 17B(c)) noise limit of 65 dB $L_{Aeq,day}$ for approved construction noise at the site was also adopted for all MOD6 construction activities proposed to occur during the day period.

Table 8-4 lists the updated RBLs together with the NMLs recommended by EMM for site construction activities and the PA construction limit. For the current assessment these conditions are adopted for the daytime construction works. EMM compared modelled noise data with this listed criteria for MOD6 construction.

Table 8-4 Site Specific Construction NMLs and PA Day Noise Limit for Residential Locations

Assessment Location	Updated RBLs[1] dB(A)			Construction NMLs $L_{Aeq,15min}$, dB				PA Construction Limit[2] $L_{Aeq,day}$, dB
	Day	Evening	Night	Standard hours (RBL+10)	Day OOH (RBL+5)	Evening OOH (RBL+5)	Night OOH (RBL+5)	Day
A1	35[3]	32	30	45	40	37	35	65
A2	35[3]	32	30	45	40	37	35	65
A3	39	36	34	49	44	41	39	65
A4	39	36	34	49	44	41	39	65
A5	39	36	34	49	44	41	39	65
A6	43	36	34	53	48	41	39	65
A7	40[4]	37[4]	31[4]	50	45	42	36	65
A8	43	34	34	53	48	39	39	65
A9	41	34	34	51	46	39	39	65
A10	37	36	30	47	42	41	35	65
A11	41	34	34	51	46	39	39	65
A12	41	34	34	51	46	39	39	65
A13	35[3]	30	30	45	40	35	35	65
A14	35[3]	30	30	45	40	35	35	65

Notes: 1. Referenced from EMM report Rasp Mine Modification 4 – Concrete batching plant and TSF2 (Blackwood Pit) extension – Noise impact assessment (2017) unless noted otherwise.
2. Existing PA noise limit for construction activities approved at the site (MOD4, MOD5 and MOD7) has also been adopted for all MOD6 construction activities proposed to occur during the day period.
3. Based on the NPfI minimum day period RBL of 35 dB, in accordance with the ICNG.
4. Determined from the ambient noise monitoring completed in June 2019
5. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Morning shoulder: 6 am to 7 am Monday to Saturday, 6 am to 8 am Sundays and public holidays; Night: remaining periods.

8.1.2.2. Operational Noise Assessment Criteria

EMM based the operational noise criteria on the Rasp Mine Project specific noise levels, adopted in the noise impact assessment completed for the site in 2007 (RBL +5 dB). for all assessment locations (residential) updated in accordance with the EPA's NPfI and new monitoring data for noise Assessment Location A7.

EMM compared modelled noise data with this listed criteria for MOD6 operations.

The NPfI's PNTL is the lower of the calculated intrusiveness or amenity noise level. The adopted PNTLs are largely unchanged from the existing limits stated in the PA and the Rasp Mine EPL. The only changes are for the less sensitive daytime period due to NSW EPA policy changes and assessment location A7 (based on ambient noise monitoring and updated RBL).

The intrusiveness noise levels require that LAeq,15min noise levels from the site during the relevant operational periods do not exceed the RBL by more than 5 dB. The daytime RBLs for A1, A2, A13 and A14 have been updated to align with the NPfI minimum RBL for the day period (ie 35 dB) and for A7 based on ambient noise monitoring completed in June 2019. The intrusiveness noise levels determine for the site are based on the updated RBLs, for residential assessment locations.

EMM compared modelled noise data with these PNTLs for operations, as shown in **Table 8-5**.

Table 8-5 Project Intrusiveness Noise Levels

Assessment Location	Project Intrusiveness Noise Level $L_{Aeq,15min}$, dB			Amenity Noise Levels[1] $L_{Aeq,15min}$, dB			Adopted PNTLs[2] for MOD 6 $L_{Aeq,15min}$, dB		
	Day	Evening	Night	Day	Evening	Night	Day[5]	Evening[5]	Night[5]
A1	40	37	35	53	43	38	40	37	35
A2	40	37	35	53	43	38	40	37	35
A3	44	41	39	58	48	43	44	41	39
A4	44	41	39	58	48	43	44	41	39
A5	44	41	39	58	48	43	44	41	39
A6	48	41	39	58	48	43	48	41	39
A7	45	42	36	53	43	38	45	42	36
A8	48	39	39	58	48	43	48	39	39
A9	46	39	39	58	48	43	46	39	39
A10	42	41	35	53	43	38	42	41	35
A11	46	39	39	58	48	43	46	39	39
A12	46	39	39	58	48	43	46	39	39
A13	38	35	35	53	43	38	40	35	35
A14	35	35	35	53	43	38	40	35	35

Notes: 1. Project amenity $L_{Aeq,15min}$ noise level is the project amenity noise level $L_{Aeq,period}$ +3 dB in accordance with the NPfI.
2. Adopted PNTLs are the lower of the calculated intrusiveness or amenity noise levels.
3. External level based on an external to internal noise reduction of 10 dB in accordance with the NPfI.

4. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: remaining periods.

8.1.2.3. Sleep Disturbance Criteria

A maximum noise level event assessment was undertaken for all residential assessment locations based on the following night-time screening criteria as per the NPfI:

- $L_{Aeq,15min}$ 40 dB or the prevailing RBL plus 5 dB (whichever is the greater); and/or
- L_{Amax} 52 dB or the prevailing RBL plus 15 dB (whichever is the greater).

8.1.3. Methodology

EMM completed quantitative modelling of construction and operational noise using the DGMR iNoise noise prediction software. This software applies the EPA accepted ISO 9613 approach and calculates total noise levels at assessment locations from the concurrent operation of multiple noise sources.

Three-dimensional digitised ground contours of the site and surrounding land were incorporated to model topographic effects. Equipment was modelled at locations and heights representative of proposed construction activities and future operations.

Winds and temperature inversions were not identified applicable to the project area in accordance with the NPfI. As a conservative approach however, this assessment has adopted the meteorological conditions within the international standard ISO 9613-2:1996 ‘Acoustics – Attenuation of sound during propagation outdoors’. As per Section 1 of ISO 9613:

> *The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.*
>
> *These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.*

Further, this assessment has adopted stability category F temperature inversion with 2 m/s wind speed (source-to-receiver) for the most critical night period and hence is considered worst-case.

8.1.3.1. Construction

The construction noise modelling was based on the locations of the works, the list of activities, the list of plant and equipment items and approximate schedule for MOD6 as outlined in the EMM Report. To determine the worst-case noise from the proposed construction activities, construction noise levels predicted for each activity were added to noise levels from existing site operations. Noise from existing site operations was modelled and validated based on site noise contributions determined during recent attended compliance monitoring completed in 2018 and 2019 also by EMM.

Each construction scenario was carefully reviewed to identify constructions works that would result in worst-case noise levels at offsite locations. Worst-case construction scenarios were modelled for all relevant ICNG assessment periods.

Seven scenarios were modelled which included:

- Scenario 1 - Boxcut construction stage one.
- Scenario 2 - Boxcut construction stage two.
- Scenario 3 - Boxcut construction stage three.
- Scenario 4 - New decline development.
- Scenario 5 - TSF3 preparation works.
- Scenario 6 - TSF2 harvesting preparation works and TSF3 preparation works (bridging layer only).
- Scenario 7 - TSF3 preparation works evening/night time.

Modelled construction activities, associated noise sources and sound power levels for the relevant scenarios are based on on-site measurement data or otherwise have been supplemented using EMM's database of equipment used for similar projects. The positions of sources represent typical worst-case noise conditions.

8.1.3.2. Operations

The future MOD6 operational noise modelling was based on information which included a detailed description of the proposed harvesting and tailings/waste rock storage operations, future haul routes (new portal to ROM pad), mobile crusher/screen location and progressive rehabilitation locations.

Modelled operational noise sources for proposed future operations (including existing noise sources) and associated sound power levels were based on on-site measurements or otherwise have been supplemented using EMM's database of plant and equipment used for similar projects.

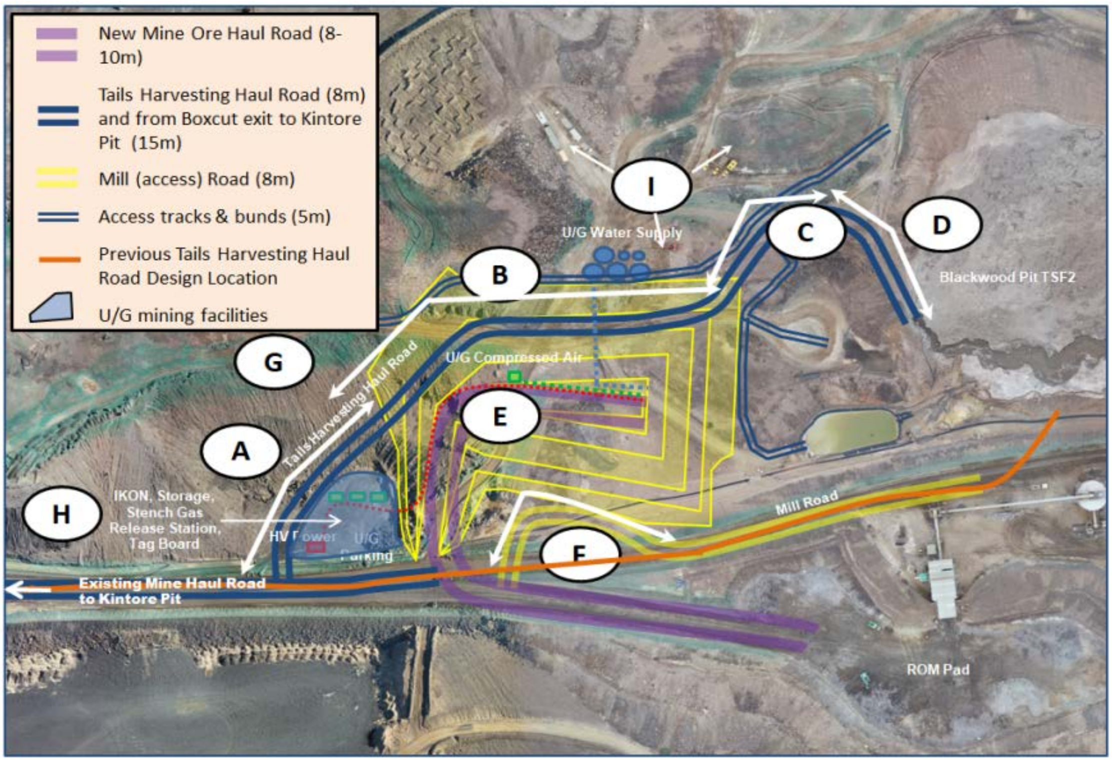
8.1.3.3. Addendum Assessment – Tails Harvesting Haul Road

Following a risk review of traffic flow and management BHOP re-aligned the Tails Harvesting Haul Road. This re-alignment was required to improve safety interactions for heavy vehicles removing the need for mine ore haul trucks and tailings harvesting haul trucks to intersect, **Figure 8-2**. To accommodate this change EMM completed a review of the results for the MOD6 noise assessment taking into account this new road alignment with updated results included as an addendum to their Report, *Letter Report – Addendum to MOD6 noise impact assessment – TSF2 tailings harvesting haul road update*, May 2021 (**Appendix E2**).

Quantitative modelling was completed for construction and operational noise using DGMR iNoise prediction software. Following the review of the construction changes, new construction activities were identified:

- earthworks and road capping for new haul road – A, B and C;
- road capping and pavement (concrete) for new haul road – D;
- boxcut ramp to portal road capping – E;
- mill access road intersection re-alignment and road capping – area F;
- light vehicle access road capping – G;
- boxcut parking area road capping – H; and
- hardstand and heavy vehicle parking area road capping – I.

Figure 8-2 Re-alignment of Tails Harvesting Haul Road



From these activities the following worst case scenarios were identified and modelled:

- Scenario 1A - Earthworks for new haul road in area A, during stage 2 of boxcut construction;
- Scenario 2A - Pavement (concrete) for new haul road in area D, during new decline surface works;
- Scenario 3A - Mill access road intersection re-alignment in area F, during stage 1 of the boxcut construction, and
- Scenario 4A - Mill access road intersection re-alignment in area F, during stage 2 of the boxcut construction.

To assess the worst-case noise from the new haul road construction, noise levels predicted for each construction activity were added to noise levels from existing site operations. The overarching approach was to model worst-case construction activities together with existing site operations as relevant and was consistent with the approach adopted in the initial EMM Noise Impact Assessment.

8.1.4. Impact Assessment Results

8.1.4.1. MOD6 Construction

Site noise levels for each worst-case construction scenario (including on-going approved operations) were predicted during noise-enhancing weather conditions for the relevant ICNG assessment periods. **Table 8-6** presents the noise results with a comparison to the ICNG NMLs and the PA construction criteria, adjusted in accordance with the NPfI to 68 dB $L_{Aeq,15min}$ (equivalent to the amenity 65 dB $L_{Aeq,day}$ noise level). Noise levels predicted to be above day OOH NMLs are indicated in bold and noise levels predicted above the standard hours NMLs are indicated by grey shading.

Table 8-6 Predicted Noise Levels Day Period - Construction

Assessment Location	Predicted Worst-Case Construction noise levels, $L_{Aeq,15min}$, dB Standard hours/day OOH Saturday (Wind[2])						ICNG NMLs, $L_{Aeq,15min}$, dB		PA Limit[1], $L_{Aeq,15min}$, dB
	Scenario 1[3]	Scenario 2[4]	Scenario 3[5]	Scenario 4[6]	Scenario 5[7]	Scenario 6[8]	Standard hours	Day OOH Saturday	Standard hours/day OOH
A1	**42**	**41**	36	<35	<35	<35	45	40	68
A2	**43**	**44**	37	35	37	36	45	40	68
A3	44	**45**	40	39	40	39	49	44	68
A4	43	43	43	42	42	42	49	44	68
A5	37	37	35	<35	<35	<35	49	44	68
A6	<35	<35	<35	<35	<35	<35	53	48	68
A7	35	<35	<35	<35	<35	<35	50	45	68
A8	35	<35	<35	<35	<35	<35	53	48	68
A9	38	36	35	<35	<35	<35	51	46	68
A10	38	36	<35	<35	<35	<35	47	42	68
A11	42	35	<35	<35	<35	36	51	46	68
A12	41	39	38	37	37	40	51	46	68
A13	**48**	39	37	35	35	36	45	40	68
A14	**45**	**43**	38	35	36	36	45	40	68

Notes: 1. The amenity 68 dB $L_{Aeq,15min}$ noise level is equivalent to the amenity 65 dB $L_{Aeq,day}$ noise level as per the NPfI.
2. Downwind conditions in accordance with ISO 9613 algorithm (Sections 5 and 8 of ISO 9613-2:1996).
3. Scenario 1 – Boxcut construction Stage 1.

4. Scenario 2 – Boxcut construction Stage 2.
5. Scenario 3 – Boxcut construction Stage 3.
6. Scenario 4 – New decline development surface trucking.
7. Scenario 5 – TSF3 preparation works.
8. Scenario 6 – TSF2 harvesting preparation works and TSF3 preparation works (bridging layer only)

Modelling predictions satisfy the adopted 65 dB L_{Aeq}, day noise limit in the PA at all assessment locations. Noise levels from proposed construction and existing operations (combined) were also assessed against the ICNG NMLs for standard hours and day OOH on Saturday. Noise levels during standard hours are predicted to exceed (by up to 3 dB) the relevant NML during stage 1 of the boxcut construction (Scenario 1) at assessment location A13. During day OOH on Saturday, noise levels are predicted to exceed the relevant NMLs during stage 1 and/or stage 2 of the boxcut construction (Scenarios 1 and 2) by up to 2 dB at A1 and A3, by up to 4 dB at A2, by up to 5 dB at A14 and by up to 8 dB at A13.

EMM commented that a 1 to 2 dB change in noise levels in the environment is generally not perceptible by the human ear and therefore noise impacts from future operations are considered unlikely to affect residents at these locations.

Predicted site noise levels during TSF3 preparation works for the ICNG evening and night OOH periods during noise-enhancing weather conditions are presented in **Table 8-7** (levels also include on-going approved operations). Noise levels predicted to be above the NMLs are in bold.

Table 8-7 Predicted Noise Levels - Evening and Night - Construction

Assessment Location	Predicted Worst-Case Construction Noise Levels $L_{Aeq,15min}$, dB		ICNG NMLs $L_{Aeq,15min}$, dB	
	Eve/Night OOH Wind[1]	Night OOH Wind + Inv.[2]	Eve OOH	Night OOH
	TSF3 preparation works (Scenario 7)[3]			
A1	<35	**36**	37	35
A2	<35	**37**	37	35
A3	36	39	41	39
A4	<35	36	41	39
A5	<35	<35	41	39
A6	<35	<35	41	39
A7	<35	<35	35	36
A8	<35	35	39	39
A9	<35	36	39	39
A10	<35	**36**	41	35
A11	<35	35	39	39
A12	37	39	39	39
A13	<35	**37**	35	35
A14	<35	**37**	35	35

Notes: 1. Downwind conditions in accordance with ISO 9613 algorithm (Sections 5 and 8 of ISO 9613-2:1996).
2. Stability category F temperature inversion with 2m/s source to receiver wind
3. Within Kintore Pit

For evening and night OOH TSF3 preparation works, modelling results show that noise levels from proposed construction and existing operations (combined) during 2 m/s wind are predicted to satisfy the ICNG NMLs at all assessment locations. During the unlikely worst-case night-time temperature inversion conditions (stability category F) and 2 m/s wind, construction noise levels from proposed construction and existing operations (combined) are predicted to be negligibly (up to 2 dB) above the relevant ICNG NMLs at assessment locations A1, A2, A10, A13 and A14.

8.1.4.2. MOD6 Operations

Future operational noise levels (following the completion of MOD6 construction works) have been predicted based on noise-enhancing weather conditions and assessed against adopted PNTLs, as shown in **Table 8-8**. Furthermore, future operational noise levels have been compared to noise levels from existing site operations (pre-MOD6 activities). Exceedences are highlighted in bold.

Table 8-8 Predicted Future Operational Noise Levels

Assessment Location	Adopted PNTLs, $L_{Aeq,15min}$, dB			Future noise levels $L_{Aeq,15min}$, dB			Future exceedance $L_{Aeq,15min}$, dB			
	Day	Evening /Night	Night	Day	Evening /Night	Night	Day	Evening	Night	Night
				Wind[2]	Wind[1]	Wind + Inv.[2]	Wind[1]	Wind[1]	Wind[1]	Wind + Inv.[2]
A1	40	37	35	<40	<37	<35	Nil	Nil	Nil	Nil
A2	40	37	35	40	<37	<35	Nil	Nil	Nil	Nil
A3	44	41	39	44	<41	<39	Nil	Nil	Nil	Nil
A4	44	41	39	<44	<41	<39	Nil	Nil	Nil	Nil
A5	44	41	39	<44	<41	<39	Nil	Nil	Nil	Nil
A6	48	41	39	<48	<41	<39	Nil	Nil	Nil	Nil
A7	45	42	36	<45	<42	<36	Nil	Nil	Nil	Nil
A8	48	39	39	<48	<39	<39	Nil	Nil	Nil	Nil
A9	46	39	39	<46	<39	<39	Nil	Nil	Nil	Nil
A10	42	41	35	<42	<41	<35	Nil	Nil	Nil	Nil
A11	46	39	39	<46	<39	<39	Nil	Nil	Nil	Nil
A12	46	39	39	<46	<39	39	Nil	Nil	Nil	Nil
A13	40	35	35	40	35	**37**	Nil	Nil	Nil	**2**
A14	40	35	35	<40	<35	**36**	Nil	Nil	Nil	**1**

Notes: 1. Downwind conditions in accordance with ISO 9613 algorithm (Sections 5 and 8 of ISO 9613-2:1996).
2. Stability category F temperature inversion with 2 m/s source-to-receiver wind.

EMM modelling results showed that site noise levels for future operations during 2 m/s wind were predicted to satisfy the adopted PNTLs at all assessment locations for the day, evening and night periods.

During the unlikely worst-case night-time temperature inversion conditions (stability category F) and wind speed of 2 m/s, site noise levels for future operations were predicted to be negligibly above the adopted PNTLs at assessment location A13 (by 2 dB) and A14 (by 1 dB).

Noise management and mitigation measures to be implemented are described in **Section 8.1.4**.

8.1.4.3. Addendum Assessment – Construction and Operations

During construction standard hours and day OOH on Saturday, modelling results show that noise levels from the new haul road construction (combined with existing operations) were predicted to satisfy the adopted 65 dB $L_{Aeq,(day)}$ noise limit as per the PA at all assessment locations.

Noise levels from the new haul road construction (and existing operations) were also compared to ICNG NMLs for standard hours and day OOH on Saturday. Results for the predicted noise for the new haul road construction are presented in **Table 8-9**. Noise levels predicted to be above the day OOH NMLs are indicated in bold and noise levels predicted to be above the standard hours NMLs are indicated by bold font and grey shading.

The predicted results during earthworks for the re-alignment of the Tails Harvesting Haul Road are summarised for each scenario (areas are shown in **Figure 8-2**):

- Scenario 1A Area A (less than half day duration), were predicted to exceed the relevant NMLs during standard hours at assessment locations A13 and A14 by 2 dB, and day OOH on Saturday at assessment locations A1 by 3dB, A13 and A14 by 7dB.
- Scenario 2A (less than one day of activities per week over a four week period) activities were predicted to satisfy relevant NMLs at all assessment locations.
- Scenario 3A (half a day duration), activities were predicted to exceed relevant NMLs during standard hours at locations A14 by 1 dB and A13 by 3 dB and day OOH on Saturday at assessment locations A1 by 3 dB, A3 by 2 dB, A2 by 4 dB, A14 by 6 dB and A13 by 8 dB.
- Scenario 4A (half a day in duration) exceeds the relevant NMLs during day OOH on Saturday at locations A1 by 2 dB, A3 and A13 by 3 dB, A2 by 5 dB and A14 by 4 dB.

Table 8-9 Predicted Noise Levels (including ongoing operations) New Tailings Harvesting Haul Road

Assessment location	Predicted New Haul Road construction noise levels[1] $L_{Aeq,15min}$, dB Standard hours/day OOH Saturday ISO 9613[2]				ICNG NMLs $L_{Aeq,15min}$, dB		PA Limit[7], $L_{Aeq,15min}$, dB
	Scenario 1A[3]	Scenario 2A[4]	Scenario 3A[5]	Scenario 4A[6]	Standard hours	Day OOH Saturday	Standard hours/day OOH
A1	**43**	<35	**43**	**42**	45	40	68
A2	40	36	**44**	**45**	45	40	68
A3	42	40	**46**	**47**	49	44	68
A4	43	43	44	44	49	44	68
A5	36	<35	38	37	49	44	68
A6	<35	<35	36	35	53	48	68
A7	<35	<35	36	35	50	45	68
A8	<35	<35	36	35	53	48	68
A9	<35	<35	39	37	51	46	68
A10	35	<35	38	36	47	42	68
A11	36	<35	42	36	51	46	68
A12	40	37	41	39	51	46	68
A13	**47**	35	**48**	**43**	45	40	68
A14	**47**	35	**46**	**44**	45	40	68

Notes:
1. Combined with noise levels from existing site operations.
2. Downwind conditions in accordance with ISO 9613 algorithm (Sections 5 and 8 of ISO 9613-2:1996).
3. Scenario 1A – Earthworks for new haul road in area A, during stage 2 of the boxcut construction
4. Scenario 2A – Pavement (concrete) for new haul road in area D, during the new decline surface works (surface trucking)
5. Scenario 3A – Mill access road intersection re alignment in area F, during stage 1 of the boxcut construction
6. Scenario 4A – Mill access road intersection re alignment in area F, during stage 2 of the boxcut construction
7. A 65 dB $_{LAeq,day}$ noise level is equivalent to a 68 dB $L_{Aeq,15min}$ noise levels as per the NPfI
8. ICNG standard hours: 7 am to 6 pm Monday to Friday and 8 am to 1 pm on Saturdays. ICNG day OOH: 7 am to 8 am and 1 pm to 6 pm on Saturdays

EMM considered that when comparing these results with the results from the initial noise risk assessment boxcut construction or new decline surface works, there was no significant (>2 dB) increase in construction noise levels predicted for most assessment locations.

EMM emphasised that modelled construction works represent worst case scenarios for each relevant assessment period and activities, therefore noise levels from construction works would be for most of the times lower than the predicted levels.

Noise management and mitigation measures to be implemented during construction would be outlined in the Construction Environment Management Plan.

8.1.4.4. Sleep Disturbance

Maximum noise levels from future night operations with the potential to cause sleep disturbance at nearby residences were assessed by EMM in accordance with the NPfI. This included maximum night-time noise levels from proposed MOD6 night-time construction works (ie TSF3 preparation works).

Maximum $L_{Aeq,15min}$ noise levels represent worst-case noise levels predicted based on TSF3 preparation works and future night operations including the Concrete Batching Plant (CBP), primary crusher, processing plant, haul truck movements (eg new portal to ROM pad) and other mobile plant (eg watercart, concrete agitator truck etc) movements.

Night operations considered for the assessment of maximum L_{Amax} noise levels included events from the proposed TSF3 preparation works and existing site operations such as the CBP FEL loading aggregate in the CBP hopper or the FEL loading material in the primary crusher at the ROM pad.

Maximum noise level events from proposed future night operations would be consistent with those from existing site operations given that they would remain unchanged. Notwithstanding, worst-case predicted maximum L_{Amax} noise levels were assessed against contemporized sleep disturbance screening criteria in accordance with the NPfI.

EMM noise modelling results for maximum L_{Aeq} and L_{Amax} noise levels were predicted to satisfy the NPfI screening criteria for sleep disturbance at all residential assessment locations during noise-enhancing meteorological conditions. Therefore, EMM concluded that it is unlikely that proposed future night operations would cause sleep disturbance at any residential receivers.

8.1.5. Mitigation Measures and Monitoring

8.1.5.1. Existing Mitigation Measures

BHOP currently uses the following best management practices and these would continue to be used during the proposed activities to minimise site noise offsite which include the following:

To ensure that site noise levels achieve the limits at offsite locations BHOP currently implement the following noise mitigation measures which were included in the EMM modelling for the noise impact assessment:

- the primary crusher has been located behind the ROM pad to minimise noise to nearest residences;
- filling of the ROM bin prior to night shift to minimise the use of the FEL at the ROM pad during the night period;
- cladding and insulation has been installed on the primary crusher;
- conveyors and transfer stations prior to the grinding circuit have been covered;
- construction of 6 m high noise bunds surrounding the CBP area;
- CBP batching and slumping processes enclosed within a building;
- construction of noise bunding along the southern side of the haul road and the southern side of the ROM pad Mine Haul Road;
- use of broadband audible / ‘squawker’ reverse alarms on vehicles used on site;
- modification of the processing plant filtration shed's piping system;
- installation of two overlapping bunds at the northern side of the rail wagon stockpile area to shield Crystal Street residences, and

- installed bunding along the existing Mine Haul Road.

The BHOP NMMP provides noise monitoring and management procedures, which include, but are not limited to:

- undertaking compliance noise monitoring at all assessment locations and ensure that site noise satisfy the limits outlined in the PA, completed in accordance with all relevant Australian Standards, policies and guidelines;
- plant is properly maintained and serviced in accordance with original equipment manufacturer requirements to ensure rated noise emission levels are not exceeded;
- noise awareness information provided in employee and contractor inductions;
- taking relevant actions to investigate and determine feasible and reasonable mitigation measures if site noise has been identified to exceed the relevant limits;
- monitoring results are reported to the Environmental Manager and kept on file for a minimum of 4 years;
- providing adequate and timely response to community noise complaints;
- reviewing data and determine management actions to improve noise emissions from site over time;
- ensuring actions are taken to prevent noise exceedances as per conditions in the PA, and
- making noise reports available to EPA as required.

8.1.5.2. MOD6 Mitigation Measures

In addition to the existing management and mitigation measures, the following specific noise management strategies would be implemented for MOD6:

- limited construction works on Sundays (only within Kintore Pit) and no works on Public Holidays;
- all construction works (external to Kintore Pit) would be undertaken during daytime hours only;
- noise bunding for the new Tails Harvesting Haul Road would be installed around the west side of the boxcut where the road connects to the existing Mine Haul Road.
- harvested tailings transfer to Kintore Pit would occur during daytime hours only.
- update of the Noise Monitoring & Management Plan (BHO-PLN-ENV-009).

Prior to construction activities BHOP would prepare a Construction Environment Management Plan, which would identify all reasonable and feasible measures to minimise noise during construction. The application of the standard construction noise management measures that were used for the construction works on-site during the MOD4 TSF2 embankment works would be reviewed and implemented as appropriate. This would include, as recommended by EMM, noise monitoring, operational strategies, source noise control strategies, noise barrier controls, and community consultation would continue to be implemented for the duration of the proposed MOD6 construction works.

8.1.5.3. Monitoring

It is proposed to continue to conduct noise monitoring in accordance with the existing BHOP Noise Monitoring Program, which requires annual attended monitoring at each receptor.

BHOP would also conduct random noise testing during the construction period and review noise generation activities, as required.

8.2. Air Quality

ERM Australia Pacific Pty Ltd (ERM Sydney) was commissioned by BHOP to complete an air quality impact assessment, *R*asp Mine, *Broke Hill – Modification 6 Air Quality Assessment*, May 2021 (AQA Report) (**Appendix C1**) for the proposed modification. This assessment included a review and characterisation of the existing environment, updated air emissions inventory including estimations and atmospheric modelling for a large range of parameters – Total Suspended Particulates (TSP), Particulate Matter less than 10 microns and 2.5 microns (PM_{10} and $PM_{2.5}$), deposited dust and Pb. Analysis of the assessment results were compared against air quality criteria and previously approved air quality levels for construction (MOD4) and operations (PPR), a comparison with usual operations was also included.

In summary ERM Sydney concluded:

- All air quality metrics are predicted to be below their respective NSW EPA criteria for the MOD6 Construction Scenario.
- For the MOD6 construction scenario, there is anticipated to be a net increase in Pb concentrations / deposition rates across the sensitive receptors when compared with MOD4 (current PA for construction activities) for a short duration of 6 months , after which time, emissions are expected to decrease.
- A net reduction in Pb concentrations / deposition rates is predicted for the MOD6 operational scenario when compared with the PPR scenario and the Business as Usual (BAU) Scenario.
- All air quality metrics are predicted to be below their respective NSW EPA criteria for the MOD6 Operational Scenario.
- As the MOD6 operational scenario is considered to be a reasonable worst-case future year scenario, ERM Sydney concluded that all future operational years are anticipated to result in a net reduction in off-site air quality impacts (including lead) when compared with current operations. This is primarily due to the shorter travelling distance for ore transport from the new portal to the ROM pad and the reduction in ore production rates.
- The results for all three scenarios demonstrated compliance with all the NSW EPA impact assessment criteria for all air quality parameters assessed.
- Cumulative impacts from the proposed Broken Hill North Mine Recommencement Project have been assessed for the short term and long term air quality metrics. The results demonstrate no exceedance of the NSW impact assessment criteria at any of the co-located receptors assessed.

8.2.1. Scenarios Modelled

ERM considered three scenarios for its assessment:

- Business as Usual (BAU): This scenario presents a representative operational year under the existing situation and consists of 100% of operations from the Kintore Pit portal. Emissions from this scenario were compared against the latest approved emissions for operations (PPR) and the MOD6 Operational Scenario.
  The annual material throughputs applied to the BAU Scenario were assumed to be:
    - 720 Ktpa of ore
    - 650 Ktpa of tailings (all transferred to Blackwood Pit via a piping system)
    - 190 Ktpa of waste rock (transported from underground mining to surface)

- MOD6 Construction Scenario: This scenario consists of the construction period for the boxcut and installation of the new mine portal, preparation works in Kintore Pit and Blackwood Pit, and progressive rehabilitation (with material sourced from both BHP Pit to Kintore Pit) and is compared against the latest predicted impacts for construction as approved in MOD4. The results from the assessment of this Scenario were presented as ‘mine increments’ inclusive of both construction activities and associated ore handling and concentrate production.
- MOD6 Operational Scenario: This scenario considered a reasonable worst-case future operational year based on the greatest travel distances for waste rock capping projected for that year with 100% of operation from the new mine portal, tailings harvesting and transfer from TSF2 to TSF3 and progressive rehabilitation. The MOD6 Operational Scenario was compared to the PPR and BAU Scenario.

  The annual material throughputs applied to the BAU Scenario were assumed to be:
    - 500 Ktpa of ore
    - 480 Ktpa of tailings (all transferred to Blackwood Pit via a piping system)
    - 146 Ktpa of waste rock (transported from underground mining to surface)

- 18 Ktpa of waste rock to be used as rehabilitation capping to Mount Hebbard (as example area)

In its comparison assessment of construction results ERM Sydney used the results for MOD4 as updated in the *Rasp Mine MOD4 Response to Submissions Report*, BHOP, June 2017. To derive the MOD4 'whole of mine' results the construction increment (taken from the tables in the MOD4 Report) have been added to the result of a model representing the baseline year 2016 increment. The results for the MOD4 – increment and 'whole of mine' increment are presented in Appendix C of the AQA Report

8.2.2. Existing Environment

ERM Sydney used existing meteorological information and dispersion modelling from previous studies for MOD4 in their assessment (to enable effective comparisons), with datasets obtained from Broken Hill Airport. In addition, input for local air quality has been obtained from monitoring conducted at the Mine from:

- three High Volume Air Samplers (HVAS) measuring TSP, PM_{10} and Pb concentrations at one location on site, PM_{10} HVAS at TSF2, and one location offsite measuring TSP and PM_{10};
- two Tapered Element Oscillating Microbalances (TEOMs) measuring PM_{10} at one location on site, and one offsite; and
- seven Dust Deposition Gauges (DDGs) measuring dust deposition and percent deposited Pb at seven locations; three on site, two on surface exclusion areas within the mining lease, and two offsite.

To provide a more accurate understanding of the air quality background conditions, the current operations of the Mine were modelled using known quantities of materials handled and haul truck movements. This approach was consistent with previous air quality impact assessment studies conducted for the Mine. Therefore background air quality was estimated referencing the ambient air quality monitoring data for 2016, minus the Mine's contribution for the same year.

The background annual lead deposition rates adopted for this assessment are 0 g/m^2/year. This is due to the over predictions by the modelling whereby mine-only activities account for more than the observed lead deposition rates across a year, as indicated by air monitoring results. Therefore adopting a background 0 g/m^2/year is considered a conservative approach.

Estimates adopted for the assessment of potential Pb emissions for non-road sources were based on the percentage lead composition of different material substrates on site, the following were applied:

- Tailings = 0.3% Pb
- Waste rock = 0.5% Pb
- Free Areas = 1.4% Pb
- Active mined areas = 1.9% Pb

For unpaved road sources results from sampling undertaken by BHOP in 2019 were applied, these are shown in **Table 8-10**.

Table 8-10 Unpaved Roads Percentage Pb Breakdown

Unpaved road segment	Material	%Pb
Central laydown area road	Unpaved Road A	0.5%
Road north of Kintore Pit	Unpaved Road B	0.8%
Kintore Pit haul road	Unpaved Road C	0.5%
Road to top of Mt Hebbard	Unpaved Road D	1.3%
Road into BHP Pit	Unpaved Road F	1.9%
Road within processing plant	Unpaved Road G	1.1%
Road to lookout over Blackwood Pit	Unpaved Road H	1.4%

ERM Sydney have included a list for the updated mine emissions inventory with estimates for the activities outlined for each scenario in Appendix A of the AQA Report.

Existing control measures have been taking into consideration for the air quality impact assessment; control measures included within MOD4 assessment apply for the current MOD6 assessment. These are summarised below:

- wind erosion post-TSF2 closure – for the MOD4 phase of the Mine, once TSF2 was scheduled to close, it would be capped with waste rock. From field testing of this method, a control efficiency of 99% was deemed appropriate; and
- dust suppression on haul roads – a control efficiency of 80% was adopted for PM emissions on unpaved haul roads due to the application of a chemical suppressant.

Additional control measures were applied for the MOD6 assessment these included:

- use of larger haul trucks for the future tailings harvesting operations transferring tailings from TSF2 to TSF3 (50 t trucks to be used with fewer road trips); and
- sealing of the new Mine Ore Haul Road (road from the portal to the ROM Pad).

8.2.3. Ambient Air Quality Criteria

The *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) (NSW EPA, 2017) specifies air quality assessment criteria relevant for assessing impacts from air pollution and was referenced by ERM Sydney for the assessment. These criteria are consistent with the *National Environment Protection Measure for Ambient Air Quality* (referred to as the Ambient Air-NEPM) (NEPC, 1998a), and the air quality criteria as listed in conditions for Project Approval 07_0018.

Table 8-11 provides a summary of the air quality criteria for pollutants relevant to the impact assessment. With the exception of deposited dust, the criteria are applied to the cumulative impacts due to the proposed modification and other existing sources.

Table 8-11 NSW EPA Air Quality Impact Assessment Criteria

Pollutant	Standard	Averaging Period
TSP	90µg/m^3	Annual
PM_{10}	25µg/m^3	Annual
	50µg/m^3	24-Hour
$PM_{2.5}$	8µg/m^3	Annual
	25µg/m^3	24-Hour
Pb (TSP fraction)	0.5µg/m^3	Annual
Deposited Dust	2g/m^2/month (incremental) 4g/m^2/month (cumulative)	Annual

Background values for these parameters are provided in the AQA Report.

8.2.4. Methodology

For consistency with the original environmental assessment (EA), historical modelling and previous assessments (Pacific Environment 2011; 2013; 2015a; 2015b, 2016, 2017a), the current assessment has used the US-EPA regulatory model, AERMOD.

AERMOD was selected as a suitable dispersion model due to the source types, location of nearest receptors and nature of local topography. AERMOD is the United States Environmental Protection Agency's (US EPA) recommended steady-state plume dispersion model for regulatory purposes. The AERMOD model was developed, and is supported by the US EPA and is now the model of choice for nearfield (less than 50 km from an emission source) applications in the US (US EPA, 2017).

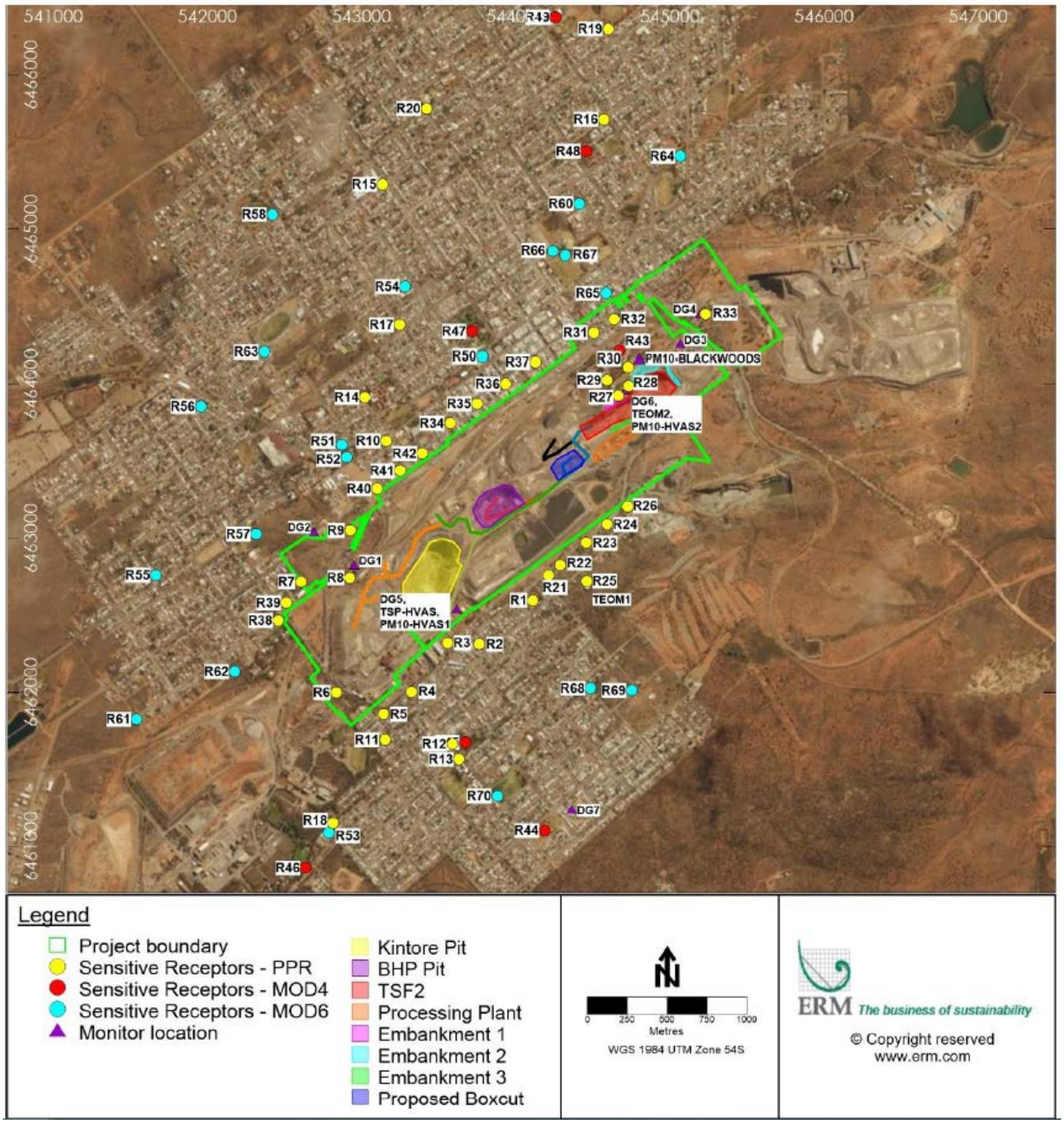
Emission rates of TSP, PM_{10} and $PM_{2.5}$ have been calculated using emission factors developed by the US EPA and routinely applied in NSW. Modelling was completed using the particle size specific inventories and was assumed to emit and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mass of the particle size range.

To reflect the day to day variability in the construction activities for MOD6 Construction Scenario and the batch nature of the tailings harvesting activities during the MOD6 Operational Scenario, ERM Sydney developed a daily worst case emissions scenario for PM_{10} and $PM_{2.5}$ and assessed accordingly. This approach was not applied to the BAU Scenario as operations are assumed to be broadly consistent throughout the year.

8.2.5. Sensitive Receptors

ERM Sydney used a total of 70 sensitive receptors for the MOD6 assessment. The same 42 sensitive receptors were used from the original study (from Environ 2010a) as well as 7 receptors that were added as part of the MOD4 Air Quality Assessment. An additional 21 receptors were included for the MOD6 assessment at the request of the toxicologist conducting the Human Health Risk Assessment. The locations of all sensitive receptors are shown in **Figure 8-3**; a description of each sensitive receptor was included in the AQA Report (Appendix F).

Figure 8-3 Site Location and Sensitive Receptors



8.2.6. Impact Assessment Results Summary

Modelling was undertaken by ERM Sydney to determine incremental mine-related concentrations and deposition rates occurring due to operation of the Mine, combined with the construction of the new portal. Model results are expressed as the maximum predicted concentration for each averaging period at the sensitive receptor over a twelve month period. ERM Sydney has provided a complete list of tabulated results for each of the Scenarios – BAU, MO6 Operational, MOD6 construction, PPR and MOD4 in Appendix B of the AQA Report.

MOD6 construction scenario is compared against the approved MOD4 results for Receptor 1 (R1) to Receptor 70 (R70). MOD6 operations scenario is compared against the BAU (R1 to R70) and PPR scenarios (R1 to R42).

8.2.6.1. MOD6 Construction Scenario Modelling Results Summary

Dispersion modelling undertaken by ERM Sydney indicates that all air quality metrics were predicted to be below their respective NSW EPA criteria for the MOD6 Construction Scenario. However, there is a net increase anticipated in Pb concentration deposition rates when considering all sensitive receptors and comparing with MOD4 mine increment (current Project Approval for construction activities). The major earthworks and dust generating activities for construction proposed by MOD6 are expected to be completed over a period of approximately six months duration and modelling indicates that the associated impacts would reduce upon completion of this phase.

ERM Sydney provided a comparison of the maximum predicted concentrations at sensitive receptor locations under comparable construction scenarios completed for the Mine, this included MOD4 and MOD6 Construction Scenarios with a comparison against NSW EPA impact assessment criteria. A summary of these results is presented in **Table 8-12**.

Table 8-12 Maximum Predicted Concentrations at Sensitive Receptors – Construction Scenario

Metric	Maximum predicted concentrations at sensitive receptors			NSW EPA impact assessment criteria	Units
	MOD4 increment	MOD6 construction increment	MOD6 construction cumulative		
Annual average lead concentration	0.019	0.023	0.240	0.500	μg/m^3
Annual average lead deposition	0.050	0.060	0.060	N/A	g/m^2/ annum
Annual average TSP concentration	1.1	1.3	36.6	90	μg/m^3
Annual average PM_{10} concentration	0.7	0.9	13.5	25	μg/m^3
Maximum 24-hour average PM_{10} concentration	7.7	14.2	46.6	50	μg/m^3
Annual average $PM_{2.5}$ concentration	0.2	0.3	5.5	8	μg/m^3
Maximum 24-hour average $PM_{2.5}$ concentration	1.7	4.0	19.0	25	μg/m^3
Annual average dust deposition	0.3	0.5	3.4	2 (increment) 4 (cumulative)	g/m^2/ month

8.2.6.2. MOD6 Operational Scenario Modelling Results Summary

ERM Sydney has predicted net reductions in lead concentrations / deposition rates when compared with the PPR as well as the BAU for the MOD6 operational scenario. In addition, all air quality metrics were predicted to be below their respective NSW EPA criteria for the MOD6 operational scenario.

Table 8-13 presents a comparison of the maximum predicted concentrations at sensitive receptor locations under comparable operational scenarios for the Mine. This includes the PPR, BAU and MOD6 operational scenarios and its comparison against NSW EPA impact assessment criteria.

The results for all three scenarios demonstrated compliance with all the NSW EPA impact assessment criteria for all air quality metrics assessed.

Table 8-13 Maximum Predicted Concentrations at Sensitive Receptors - Operational Scenarios

Metric	Maximum predicted concentration at sensitive receptors					NSW EPA impact assessment criteria	Units
	PPR increment	BAU increment	BAU cumulative	MOD6 operation increment	MOD6 operation cumulative		
Annual average lead concentration	0.036	0.026	0.243	0.024	0.241	0.500	μg/m^3
Annual average lead deposition	0.200	0.069	0.069	0.067	0.067	N/A	g/m^2/ annum
Annual average TSP concentration	2.9	1.5	36.9	1.8	37.0	90	μg/m^3
Annual average PM_{10} concentration	1.0	1.0	13.6	1.0	13.6	25	μg/m^3
Maximum 24-hour average PM_{10} concentration	10.5	6.6	46.7	6.4	46.9	50	μg/m^3
Annual average $PM_{2.5}$ concentration	0.3	0.3	5.6	0.3	5.5	8	μg/m^3
Maximum 24-hour average $PM_{2.5}$ concentration	2.3	2.2	18.9	1.9	18.9	25	μg/m^3
Annual average dust deposition	0.5	0.3	3.4	0.3	3.6	2 (increment) 4 (cumulative)	g/m^2/ month

8.2.6.3. Annual Average Pb (as TSP) Concentration

ERM Sydney compared the MOD6 construction scenario to the approved MOD4 predictions. The MOD6 operational scenario is compared against the BAU scenario and the PPR.

The modelling found that at all receptors and for all scenarios, the cumulative annual average Pb concentrations were predicted to be well below the NSW EPA impact assessment criterion of 0.5 μg/m^3, with results ranging from 0.2248 μg/m^3 to 0.2396 μg/m^3 for the MOD6 construction scenario, and 0.2247 μg/m^3 to 0.2412 μg/m^3 for the MOD6 operational scenario.

The incremental concentrations for Pb ranged from 0.0005μg/m^3 – 0.0227μg/m^3 for the MOD6 construction scenario, and 0.0005 – 0.0242 μg/m^3 for the MOD6 operational scenario. The annual average Pb monitored data for the modelled year of 2016 was 0.23 μg/m^3.

MOD6 construction scenario compared to the MOD4 modelling results shows a net increase in annual average Pb concentrations. The maximum increase at any one receptor is anticipated to be 0.08 μg/m^3 and it is noted by ERM Sydney that the MOD6 construction scenario would only occur within a single 12 month period.

ERM Sydney predicted a net decrease in annual average Pb across all comparable receptors for the MOD6 operational scenario and PPR for receptors R1 to R42. The results also predicted a decrease in annual average Pb concentrations at all sensitive receptor locations for the MOD6 operational scenario versus BAU scenario for receptors R1 to R70.

Figure 8-4 shows the annual average Pb concentration comparison between MOD6 and MOD4 construction scenarios and **Figure 8-5** shows the annual average Pb concentration for operation scenarios.

Figure 8-4 Annual Average Pb Concentrations (as TSP) - MOD6 Construction Scenario

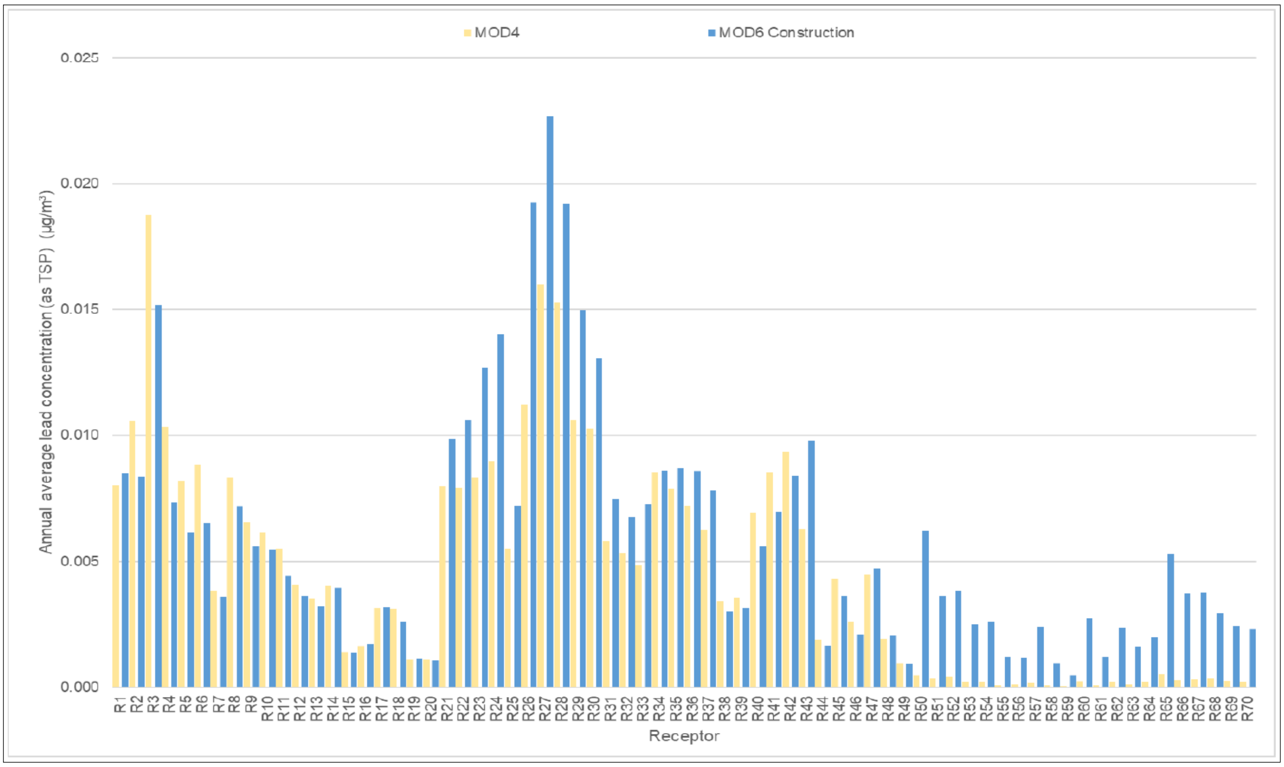
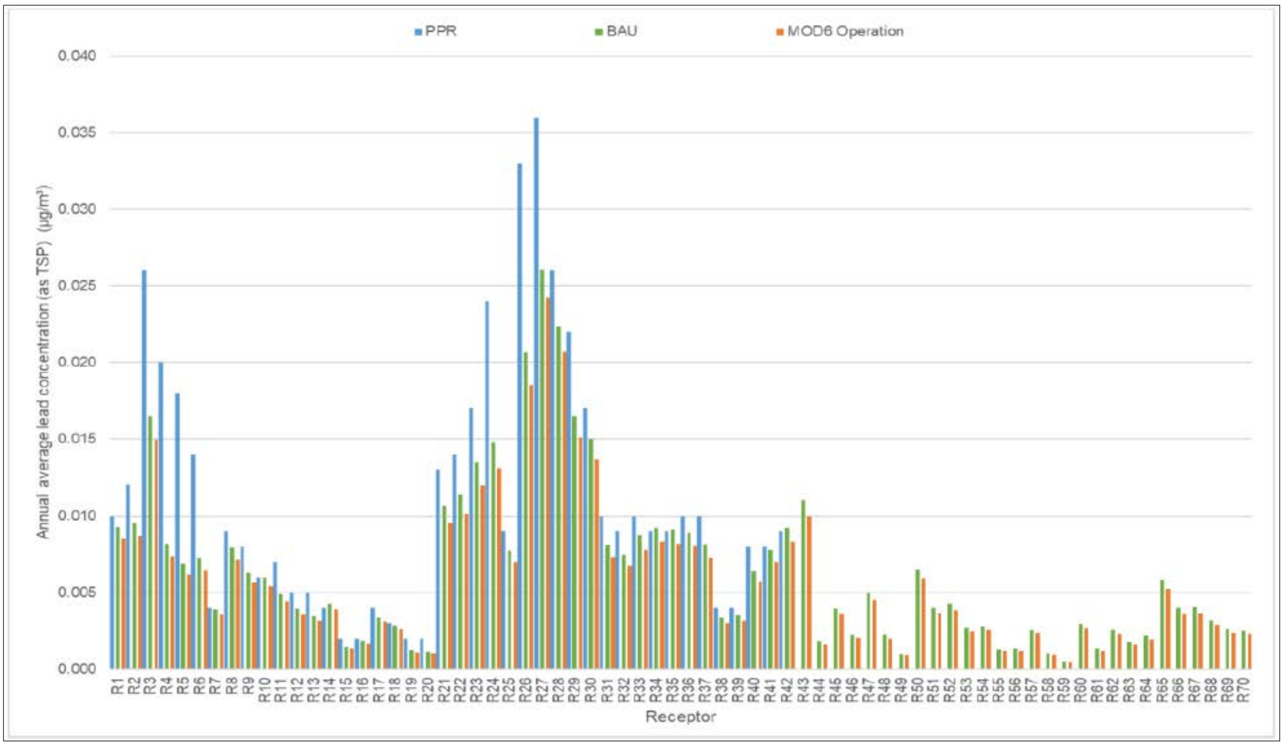


Figure 8-5 Annual Average Pb Concentration (as TSP) – Operational Scenarios

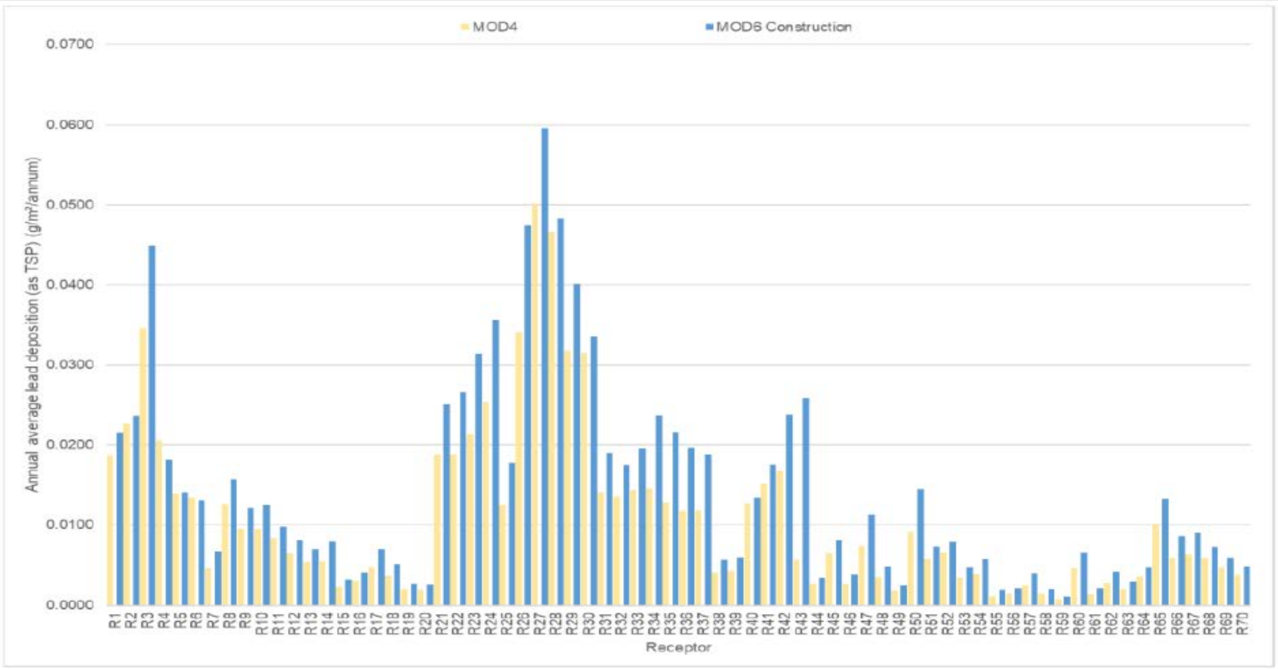


8.2.6.4. Annual Average Pb Deposition

ERM Sydney concluded from its modelling that in both construction and operational scenarios, any increase in Pb deposition is predominantly contained within the site boundary and is reflective of the location of site activities changing between scenarios.

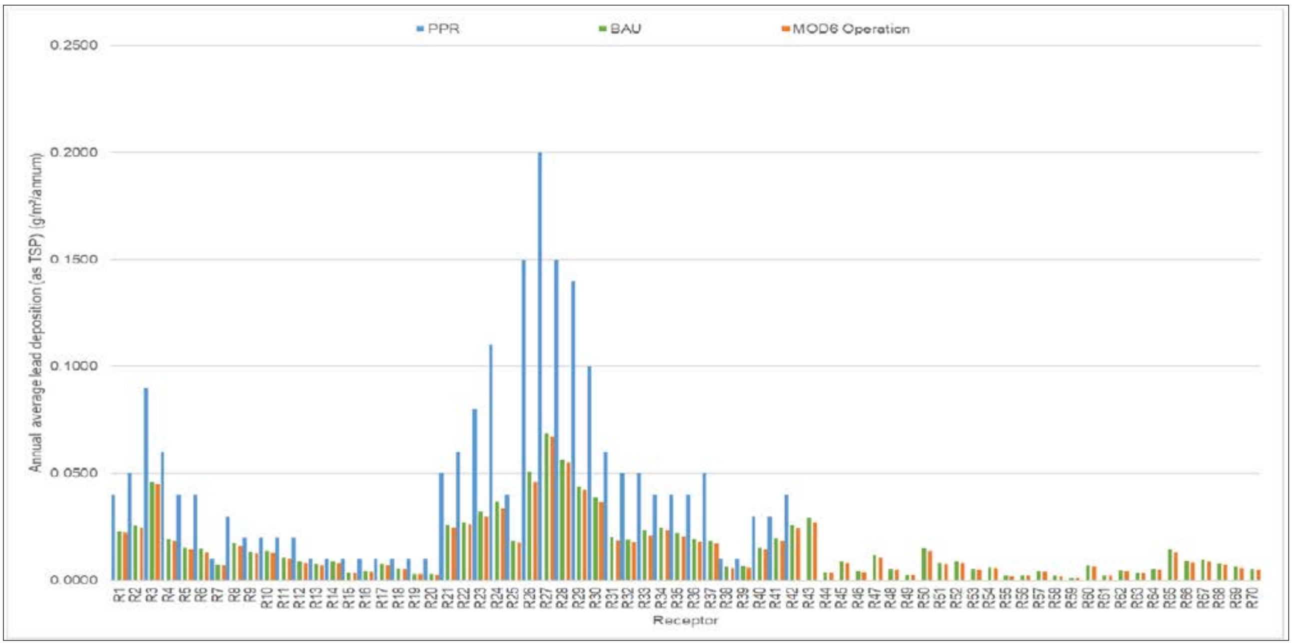
Modelling results for MOD6 construction annual average Pb deposition (as total particulate) in comparison with MOD4 construction results, increased. This increase ranged from 0.0003 g/m^2/annum to a maximum of 0.0203 g/m^2/annum at R43. Increases during construction scenarios were a result of more site activities occurring during MOD6 construction compared with MOD4 activities, albeit for a short duration. **Figure 8-6** shows the annual average lead deposition comparison between MOD6 and MOD4 construction.

Figure 8-6 Annual Average Pb Deposition (as total particulate) – Construction Scenarios



ERM Sydney has predicted a net decrease in annual average lead deposition across all receptors for the MOD6 operational scenario compared with the PPR and the BAU scenario. Modelling results predicted a decrease with the PPR varying between 0.0019 g/m^2/annum at R14 to up to 0.1328 g/m^2/annum at R27. Predictions also indicated a decrease for the BAU scenario ranging from 0.0001 g/m^2/annum at R59 to 0.0046 g/m^2/annum at R26. **Figure 8-7** shows the annual average Pb deposition comparison for operational scenarios.

Figure 8-7 Annual Average Pb Deposition (as total particulate) – Operational Scenarios



8.2.6.5. Annual Average TSP

Modelling results indicated that at all receptors, and for both construction and operational scenarios, the cumulative annual average TSP concentrations were predicted to be well below the NSW EPA impact assessment criterion of 90 µg/m^3, with predicted cumulative concentrations ranging between 35.7 µg/m^3 to 36.6 µg/m^3 for the MOD6 construction scenario, and 35.7 µg/m^3 to 36.9 µg/m^3 for the MOD6 operational scenario. The incremental contribution ranged from 0.0 – 1.3 µg/m^3 for the MOD6 construction scenario, and 0.0 – 1.8 µg/m^3 for the MOD6 operational scenario. The top 5 impacted receptors are shown in **Table 8-14.**

Table 8-14 Top five Impacted Receptors for Annual Average TSP – All Modelled Scenarios

Construction (µg/m^3)			Operation (µg/m^3)			
Receptor	**MOD4**	**MOD6**	**Receptor**	**PPR**	**BAU**	**MOD6**
R27	0.9458	1.3177	R27	2.9000	1.5176	1.7633
R3	0.7510	1.1459	R28	2.3000	1.4941	1.4945
R28	1.0626	1.1365	R3	2.1000	1.3667	1.1396
R26	0.4746	0.9961	R29	2.2000	0.9305	0.9934
R29	0.5238	0.8926	R30	1.7000	0.9991	0.9164

Figure 8-8 shows the annual average TSP concentrations for MOD6 construction scenario and MOD4 updated assessment and **Figure 8-9** shows the comparison for operation scenarios.

Figure 8-8 Annual Average TSP - Construction Scenario

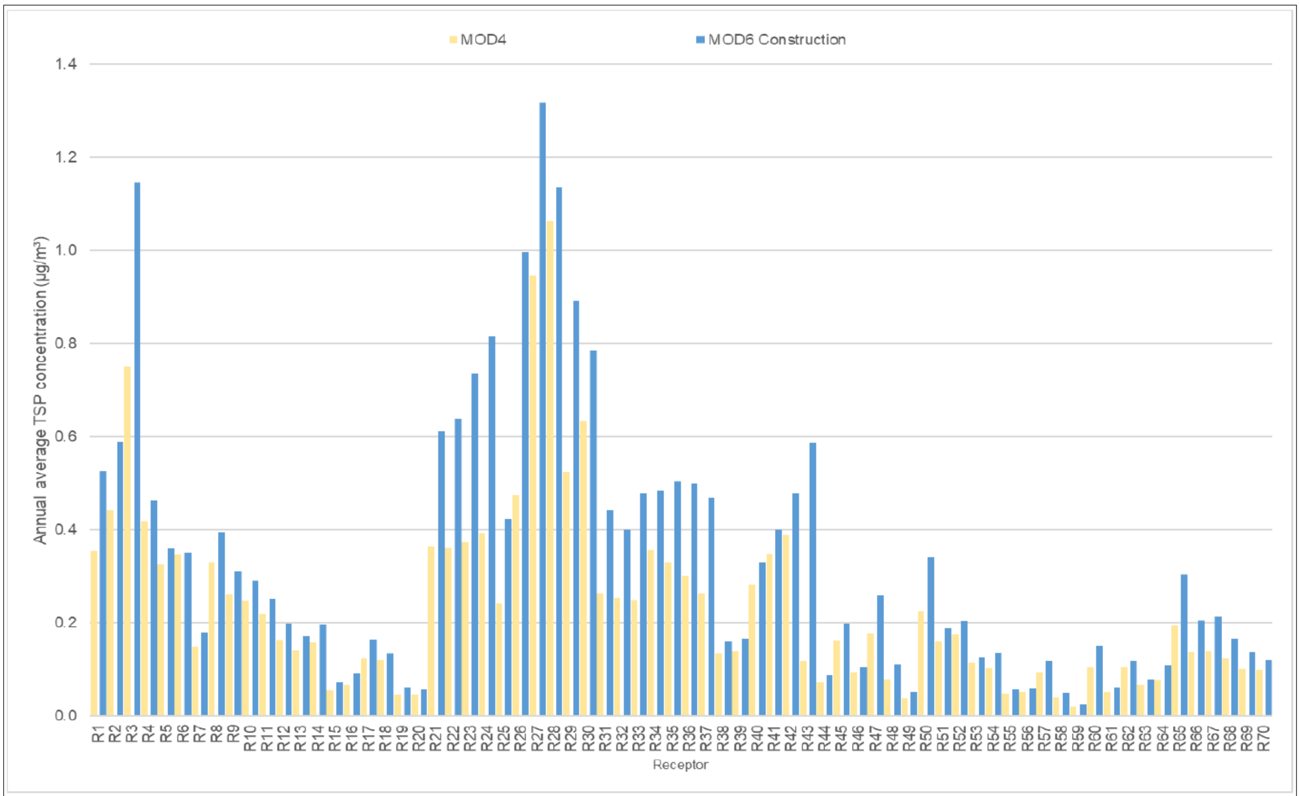
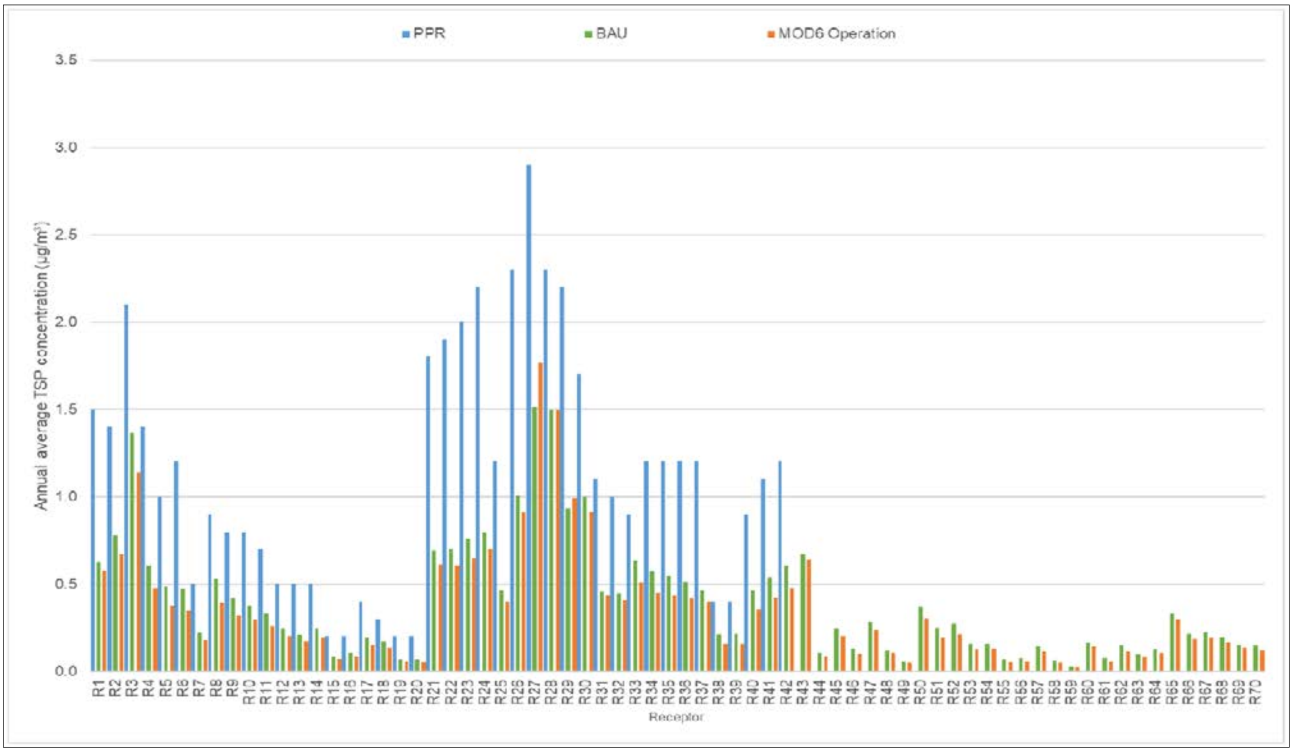


Figure 8-9 Annual Average TSP - Operational Scenarios



8.2.6.6. Annual and Maximum 24-hour Average PM_{10}

Annual Average PM_{10}

Modelling results for all receptors and all MOD6 construction and operational scenarios, predicted cumulative annual average PM_{10} concentrations to be well below the NSW EPA impact assessment criterion of 25 µg/m^3 with cumulative concentrations ranging from 12.8 to 13.5 µg/m^3 for the MOD6 construction scenario and 12.8 to 13.6 µg/m^3 for the MOD6 operational scenario.

The incremental concentrations ranged from 0.0 to 0.9 µg/m^3 for MOD6 construction scenario and 0.0 to 1.0 µg/m^3 for the MOD6 operational scenario. The top 5 impacted receptors are shown in **Table 8-15**.

Table 8-15 Top Five Impacted Receptors for Annual Average PM10 – All Modelled Scenarios

Construction (µg/m^3)			Operation (µg/m^3)			
Receptor	**MOD4**	**MOD6**	**Receptor**	**PPR**	**BAU**	**MOD6**
R27	0.6583	0.8857	R27	1.0000	1.0421	1.0271
R3	0.5425	0.7870	R28	0.8000	0.9952	0.9032
R28	0.650	0.786	R3	0.8000	0.8014	0.6381
R26	0.3826	0.6322	R29	0.7000	0.6664	0.6019
R29	0.415	0.609	R30	0.6000	0.6833	0.5639

Figure 8-10 and **Figure 8-11** show the annual average PM_{10} concentrations for construction and operation scenarios respectively.

Figure 8-10 Annual Average PM10 - MOD6 Construction Scenario

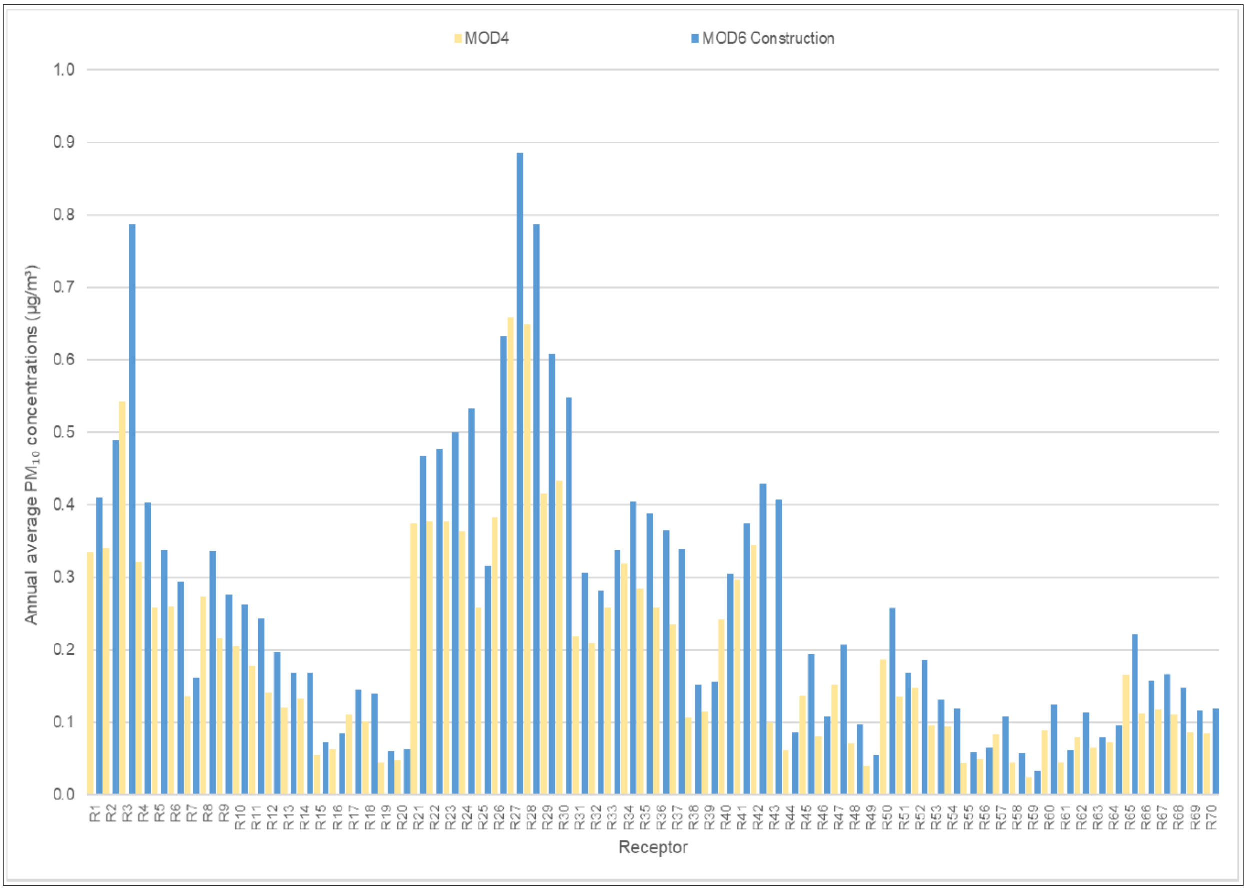
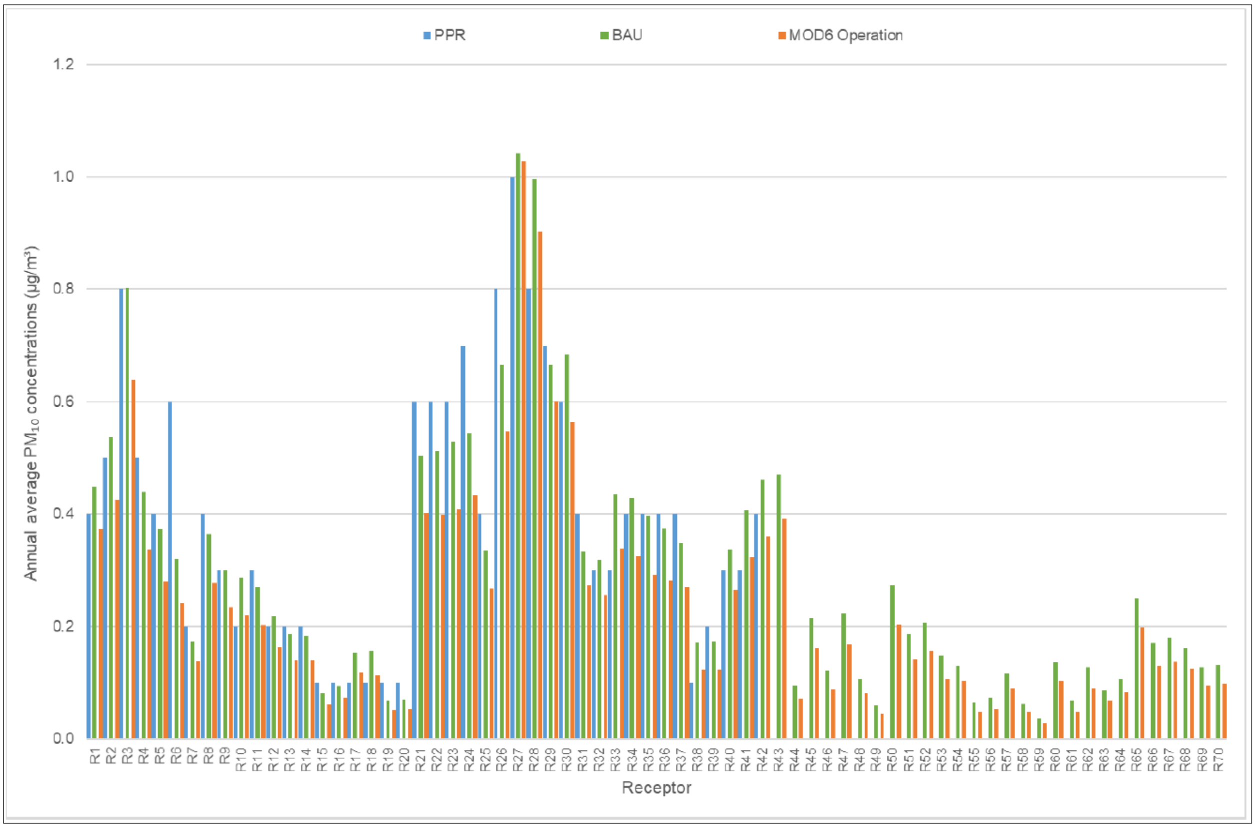


Figure 8-11 Annual Average PM10 - MOD6 Operational Scenarios



24 Hour Maximum PM_{10}

Modelling results for all receptors and for all the MOD6 construction and MOD6 operational scenarios, predicted cumulative 24-hour average PM_{10} concentrations to be below the NSW EPA impact assessment criterion of 50 µg/m^3 with cumulative concentrations ranging from 36.1 to 46.6 µg/m^3 for the MOD6 construction scenario and 36.1 to 46.9 µg/m^3 for the MOD6 operational scenario.

The incremental concentrations ranged from 0.5 to 14.2 µg/m^3 for MOD6 construction scenario and 0.3 to 6.4 µg/m^3 for the MOD6 operational scenario. The top 5 impacted receptors are shown in **Table 8-16**.

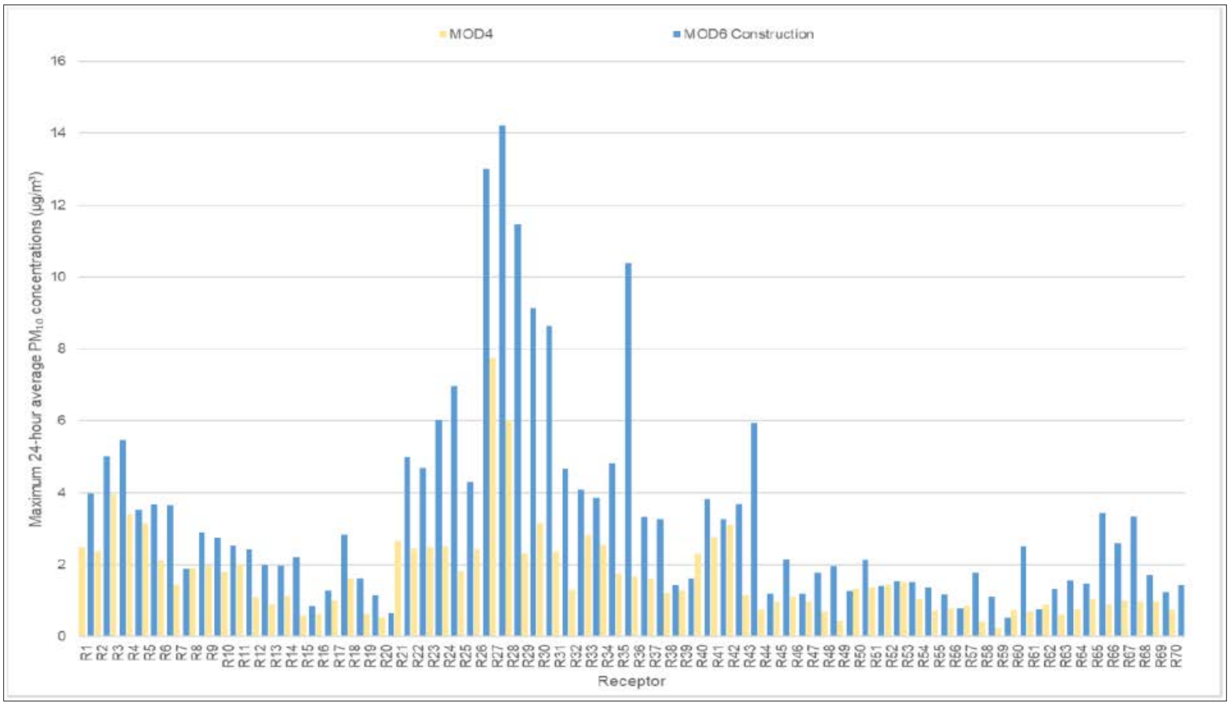
Table 8-16 Top Five Impacted Receptors for 24 Hour Maximum PM10 - All Modelled Scenarios

Construction (µg/m^3)			Operation (µg/m^3)			
Receptor	**MOD4**	**MOD6**	**Receptor**	**PPR**	**BAU**	**MOD6**
R27	7.7474	14.2086	R27	7.4000	6.0472	6.4369
R26	2.4264	13.0068	R28	4.7000	6.6168	6.3830
R28	6.0291	11.4778	R3	5.1000	5.2081	4.6228
R35	1.7486	10.3788	R2	3.1000	5.0692	4.5000
R29	2.3024	9.1361	R29	3.8000	3.7467	4.0163

To determine the 24-hour cumulative concentrations, ERM Sydney adopted a contemporaneous assessment. This assessment combines the monitored background daily 24-hour average PM_{10} concentrations with the predicted project incremental concentration. For each of the scenarios modelled, the maximum 24-hour average prediction at each receptor ranged between 36 µg/m^3 and 47 µg/m^3. Review of the time series data for the receptors indicates that these reported maxima were heavily influenced by the contribution of the background rather than Rasp Mine related increments.

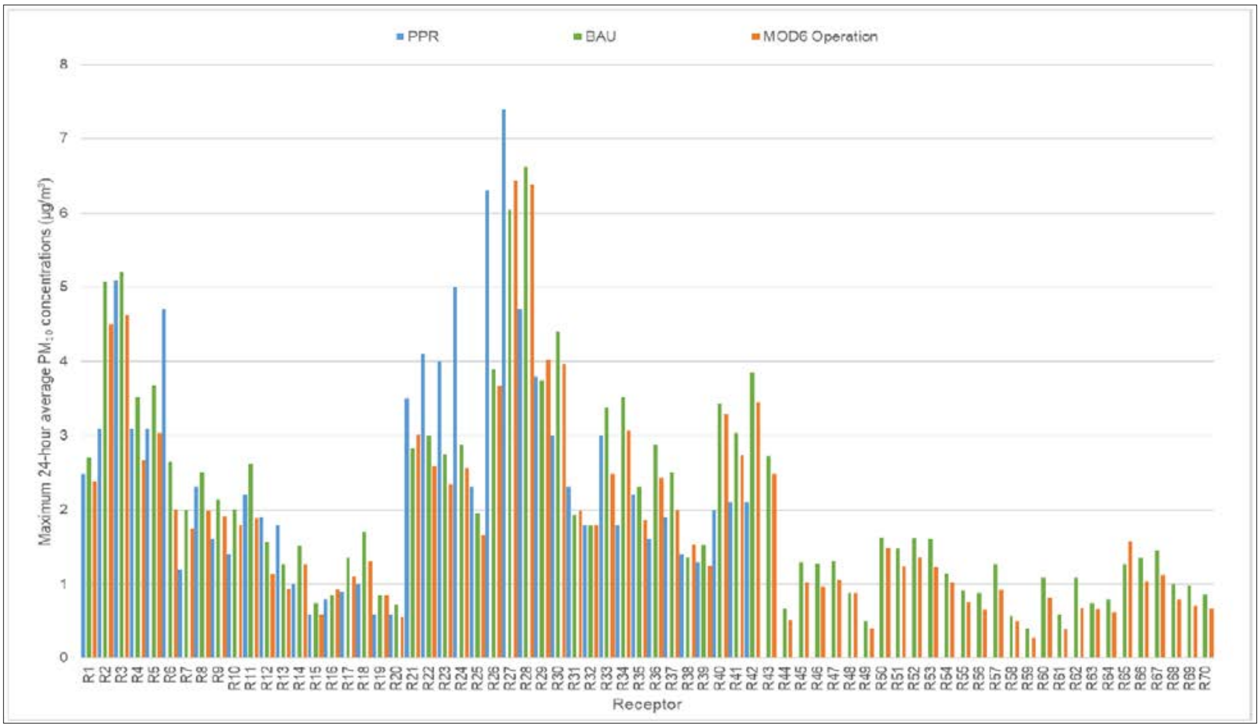
Figure 8-12 and **Figure 8-13** show the maximum 24 hour PM_{10} concentrations for MOD6 construction and operation scenarios respectively.

Figure 8-12 Maximum 24 hour PM10 - MOD6 Construction Scenario



The modelling found that the MOD6 construction scenario had the highest maximum incremental 24-hour average contribution of all the scenarios. This result was recorded at Receptor 27, Proprietary Square, due to its proximity to the boxcut construction works. The maximum 24-hour average increment at R27 is predicted to be 14.2 µg/m^3, approximately 28% of the NSW EPA impact assessment criterion of 50 µg/m^3. The cumulative concentration at this receptor is 46.6 µg/m^3, which is below the NSW EPA impact assessment criterion.

Figure 8-13 Maximum 24 hour PM10 - MOD6 Operational Scenarios



The modelling results indicated that the maximum incremental 24-hour average contribution for the MOD6 operational scenario was also at receptor R27. The maximum 24-hour average increment at R27 is predicted to be 6.4 µg/m^3, approximately 13% of the NSW EPA impact assessment criterion of 50 µg/m^3. The cumulative concentration at this receptor is 46.9 µg/m^3, which is below the NSW EPA impact assessment criterion.

8.2.6.7. Annual and Maximum 24-hour Average $PM_{2.5}$

<u>Annual Average $PM_{2.5}$</u>

At all receptors, and for both the MOD6 Construction and MOD6 Operational Scenarios, ERM Sydney predicted cumulative annual average $PM_{2.5}$ concentrations were below the NSW EPA impact assessment criterion of 8 µg/m^3, with cumulative predictions ranging from 5.3 to 5.5 µg/m^3 for MOD6 construction scenario and 5.3 to 5.5 µg/m^3 for MOD6 operational scenario. The incremental contributions ranged from 0.0111 – 0.3 µg/m^3 for the MOD6 Construction Scenario and 0.0 to 0.3 µg/m^3 for the MOD6 Operational Scenario. The top 5 impacted receptors are shown in **Table 8-17**.

Table 8-17 Top Five Impacted Receptors for Annual Average PM2.5 – All Modelled Scenarios

Construction (µg/m^3)			Operation (µg/m^3)			
Receptor	**MOD4**	**MOD6**	**Receptor**	**PPR**	**BAU**	**MOD6**
R27	0.1735	0.2583	R27	0.2500	0.3104	0.2799
R3	0.1256	0.2413	R28	0.2100	0.3061	0.2488
R26	0.0997	0.2322	R26	0.2000	0.2463	0.2169
R28	0.1806	0.2308	R3	0.2400	0.2079	0.2011
R29	0.1059	0.1853	R29	0.1900	0.2129	0.1833

Figure 8-14 and **Figure 8-15** show the annual average $PM_{2.5}$ concentrations for MOD6 construction and operational scenarios respectively.

Figure 8-14 Annual average PM2.5 - MOD6 Construction Scenario

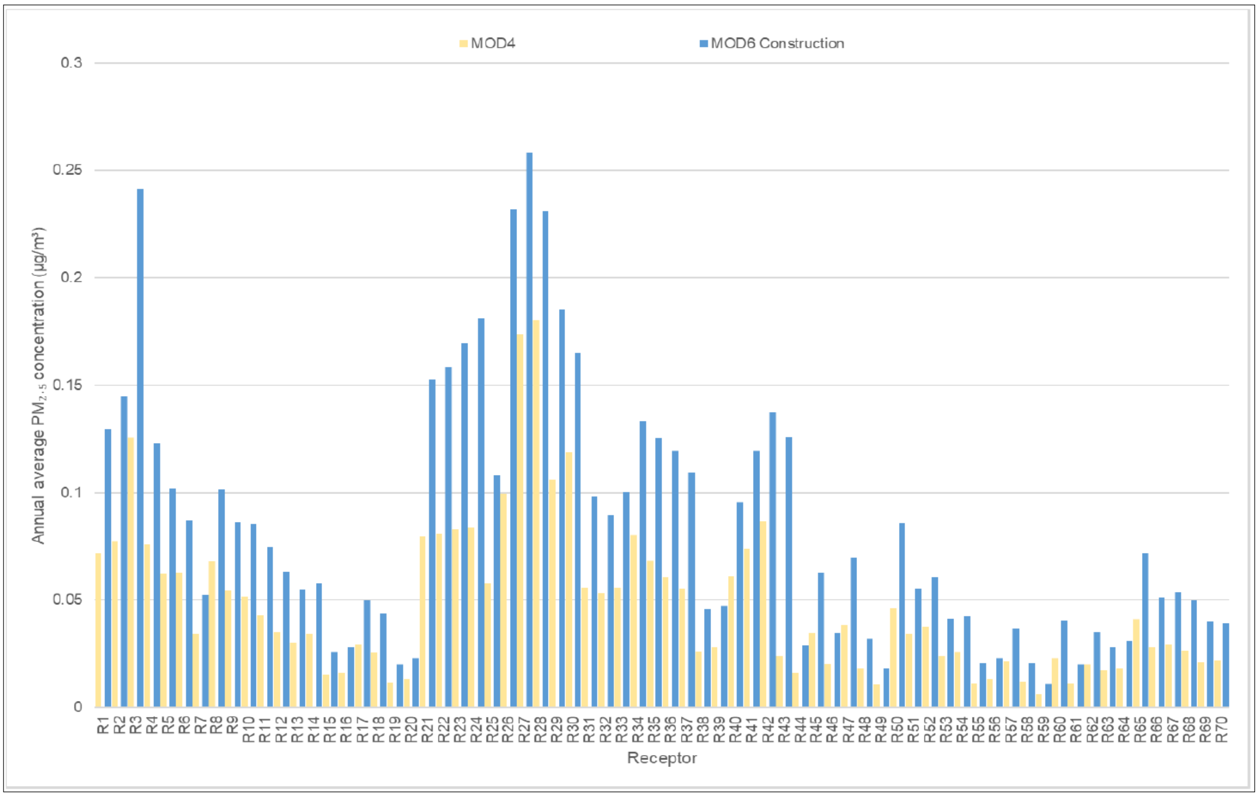
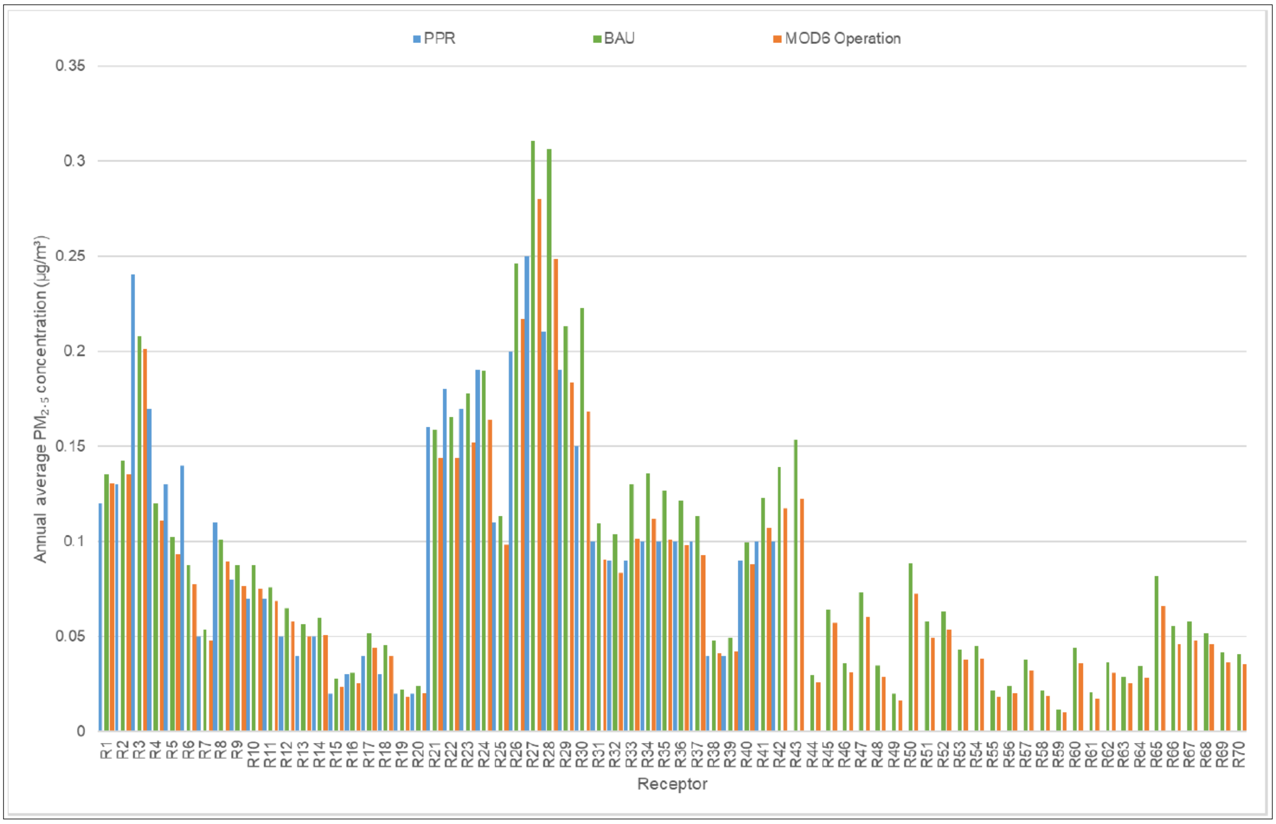


Figure 8-15 Annual Average PM2.5 - MOD6 Operational Scenarios



24 Hour Maximum $PM_{2.5}$

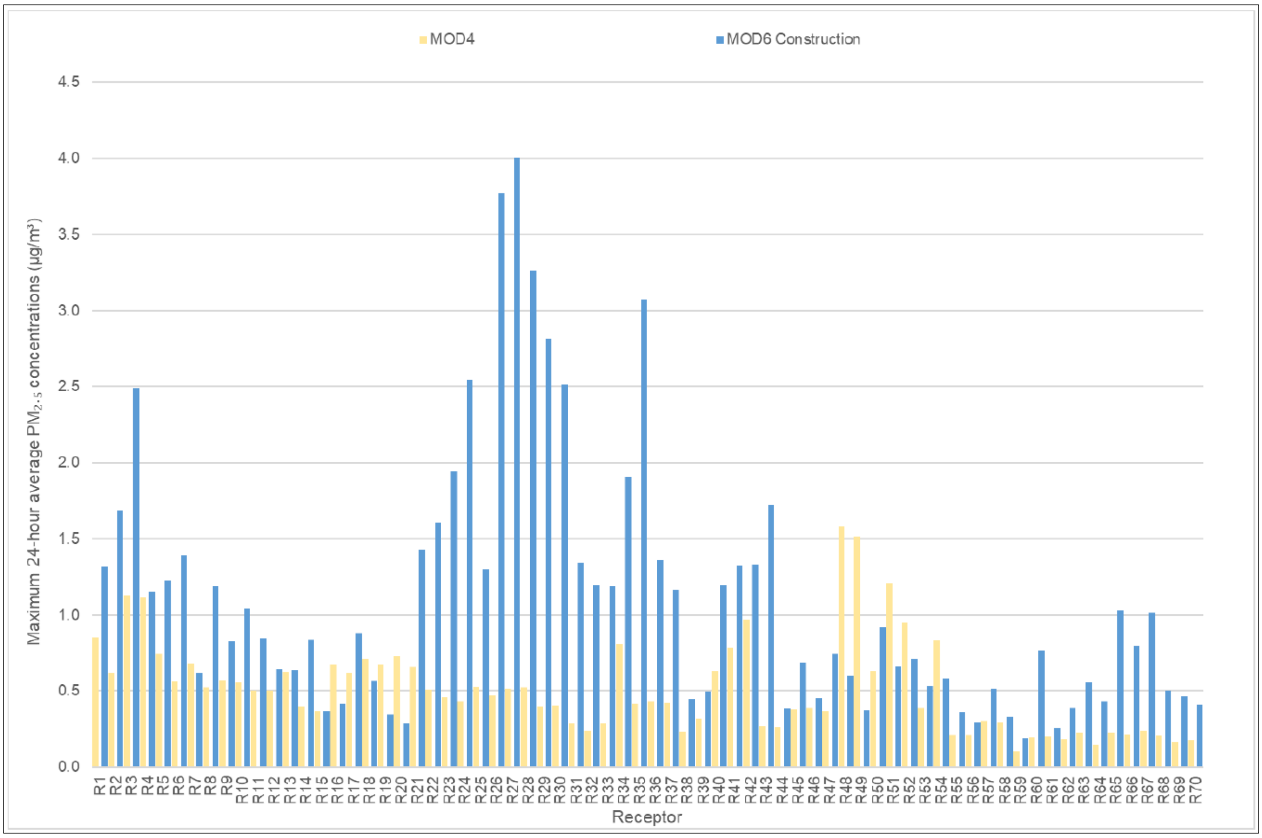
At all receptors, and for both the MOD6 construction and MOD6 operational scenarios, ERM Sydney predicted cumulative 24-hour average $PM_{2.5}$ concentrations were below the NSW impact assessment criterion of 25 µg/m^3, ranging from 14.8 to 19.0 µg/m^3 for the MOD6 construction scenario and 14.8 to 18.9 µg/m^3 for the MOD6 operations scenario. The incremental contributions ranged from 0.2 – 4.0 µg/m^3 for the MOD6 construction scenario, and 0.1 – 1.9 µg/m^3 for the MOD6 operational scenario. The top 5 impacted receptors are shown in **Table 8-18**.

Table 8-18 Top Five Impacted Receptors for 24 Hour Maximum PM2.5 – All Modelled Scenarios

Construction (µg/m^3)			Operation (µg/m^3)			
Receptor	**MOD4**	**MOD6**	**Receptor**	**PPR**	**BAU**	**MOD6**
R27	1.6473	4.0044	R28	1.6000	2.2321	1.944
R26	0.5946	3.7679	R27	2.3000	2.0047	1.7737
R28	1.5429	3.2632	R26	1.8000	1.8022	1.6030
R35	0.4657	3.0729	R3	1.5000	1.4889	1.4767
R29	0.7889	2.8169	R29	1.3000	1.4099	1.3841

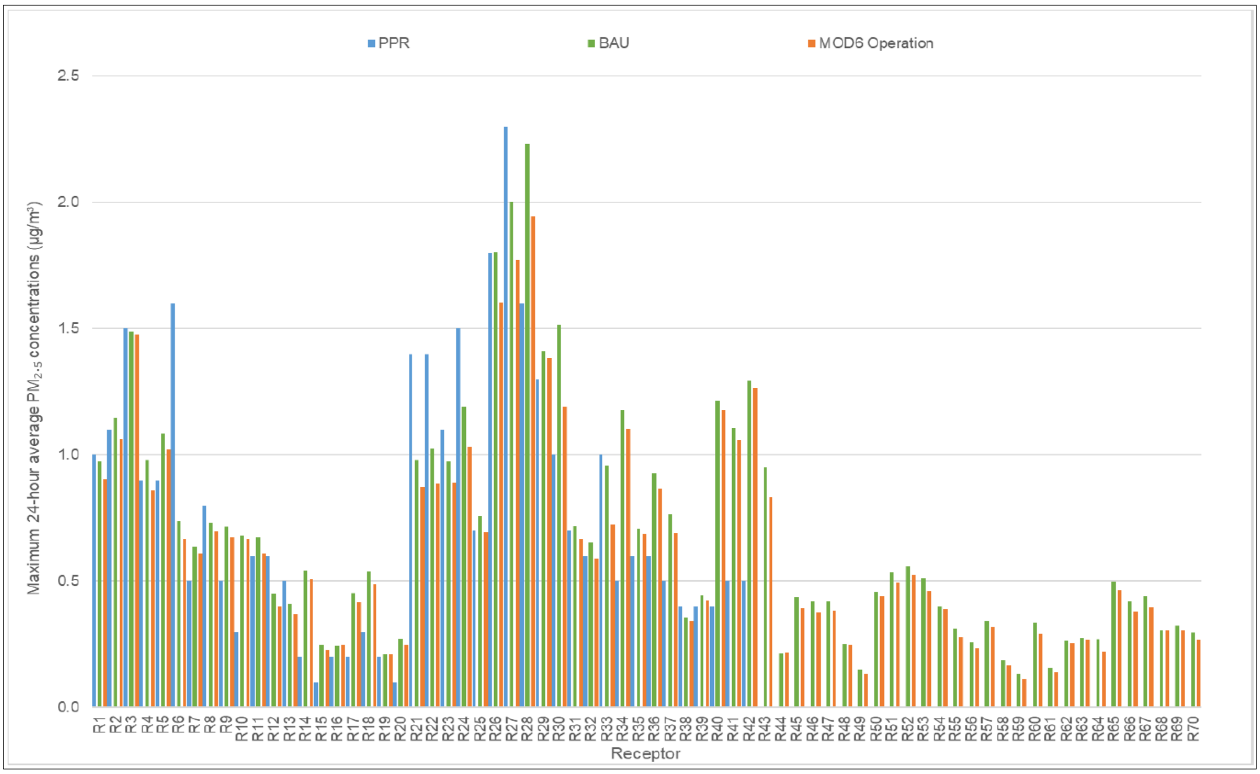
Figure 8-16 and **Figure 8-17** show the annual average $PM_{2.5}$ concentrations for MOD6 construction and MOD6 operational scenarios respectively.

Figure 8-16 Maximum 24 hour PM2.5 - MOD6 Construction Scenario



The receptor that was predicted to experience the maximum incremental 24-hour average $PM_{2.5}$ contribution for the MOD6 construction scenario was R27, due to its proximity to the boxcut construction works. The maximum 24-hour average $PM_{2.5}$ increment at R27 was predicted to be 4.0 µg/m^3 with a cumulative prediction of 18.9 µg/m^3 or 76% of the NSW impact assessment criterion of 25 µg/m^3.

Figure 8-17 Maximum 24 hour PM2.5 - MOD6 Operational Scenarios



The receptor that was predicted to experience the maximum incremental 24-hour average contribution for MOD6 operational scenario was R28. The maximum 24-hour average $PM_{2.5}$ increment at R28 is predicted to be 1.9 µg/m^3 with a cumulative prediction of 18.9 µg/m^3, approximately 76% of the NSW EPA impact assessment criterion of 25 µg/m^3.

For each of the scenarios modelled the maximum 24-hour average $PM_{2.5}$ cumulative predictions varies between 15 µg/m3 and 19 µg/m3 and as with PM_{10}, these reported maxima are heavily influenced by the contribution of dust levels background rather than the Rasp Mine related increments.

8.2.6.8. Monthly Average Deposited Dust

ERM Sydney modelling results indicated that at all receptors and for both the MOD6 construction and MOD6 operational scenarios, the predicted incremental monthly dust deposition rates were below the NSW EPA impact assessment criterion of 2 g/m^2/month. The dust deposition rates ranged between 0.0 and 0.3 g/m^2/month for the MOD6 construction scenario and between 0.0 and 0.4 g/m^2/month for the MOD6 operational scenario.

The top 5 impacted receptors are shown in **Table 8-19**.

Table 8-19 Top Five Impacted Receptors for Incremental Monthly Deposited Dust – All Modelled Scenarios

Construction (g/m^2/month)			Operation (g/m^2/month)			
Receptor	**MOD4**	**MOD6**	**Receptor**	**PPR**	**BAU**	**MOD6**
R27	0.3199	0.2939	R27	0.4700	0.3167	0.4744
R3	0.1970	0.2761	R28	0.3700	0.2939	0.3895
R28	0.3308	0.2455	R3	0.3200	0.2858	0.2804
R26	0.1330	0.2227	R29	0.3400	0.1982	0.2654
R29	0.1597	0.2093	R30	0.2600	0.2028	0.2354

Similarly, at all receptors, for both the MOD6 construction and MOD6 operational scenarios, the predicted cumulative monthly dust deposition levels were below the NSW EPA impact assessment criterion of 4 $g/m^2/month$. The dust deposition levels ranged between 0.3977 and 3.3771 $g/m^2/month$ for the MOD6 construction scenario and 0.3978 and 3.5576 $g/m^2/month$ for the MOD6 operational scenario.

Figure 8-18 and **Figure 8-19** show the monthly average dust deposition levels for MOD6 construction and MOD6 operational scenarios respectively.

Figure 8-18 Monthly Average Dust Deposition Levels - MOD6 Construction Scenario

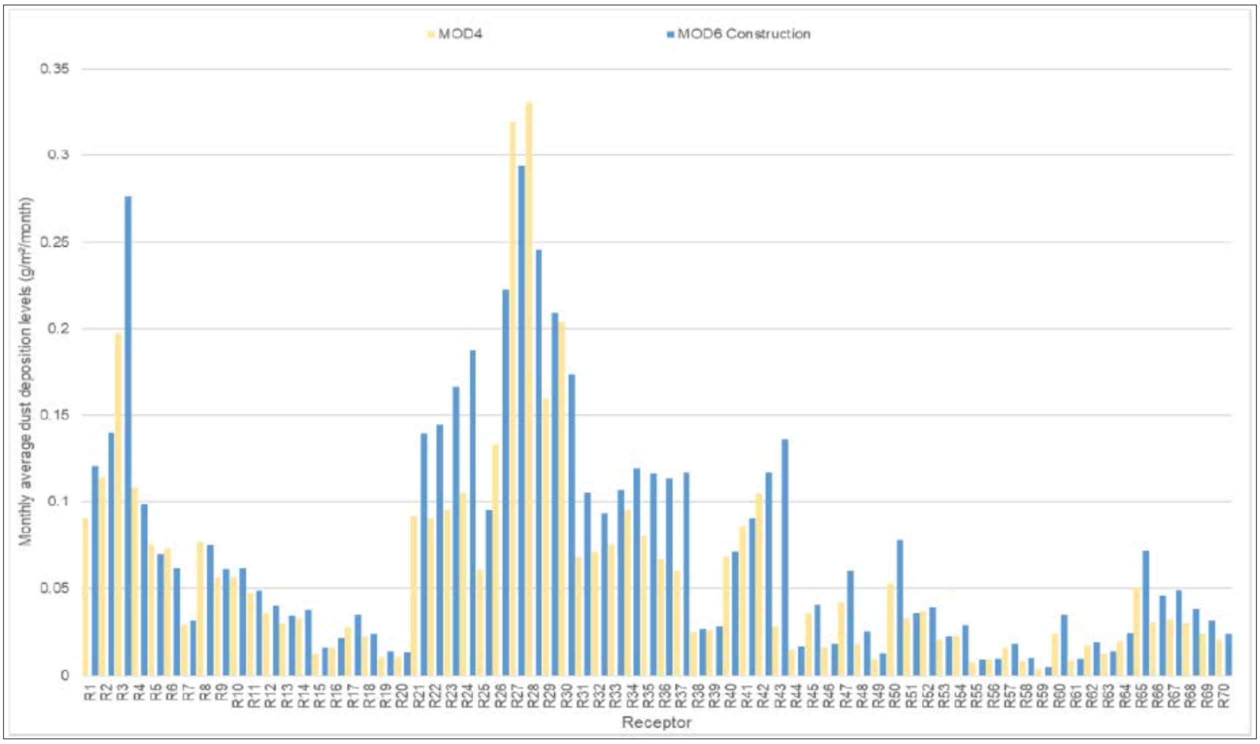
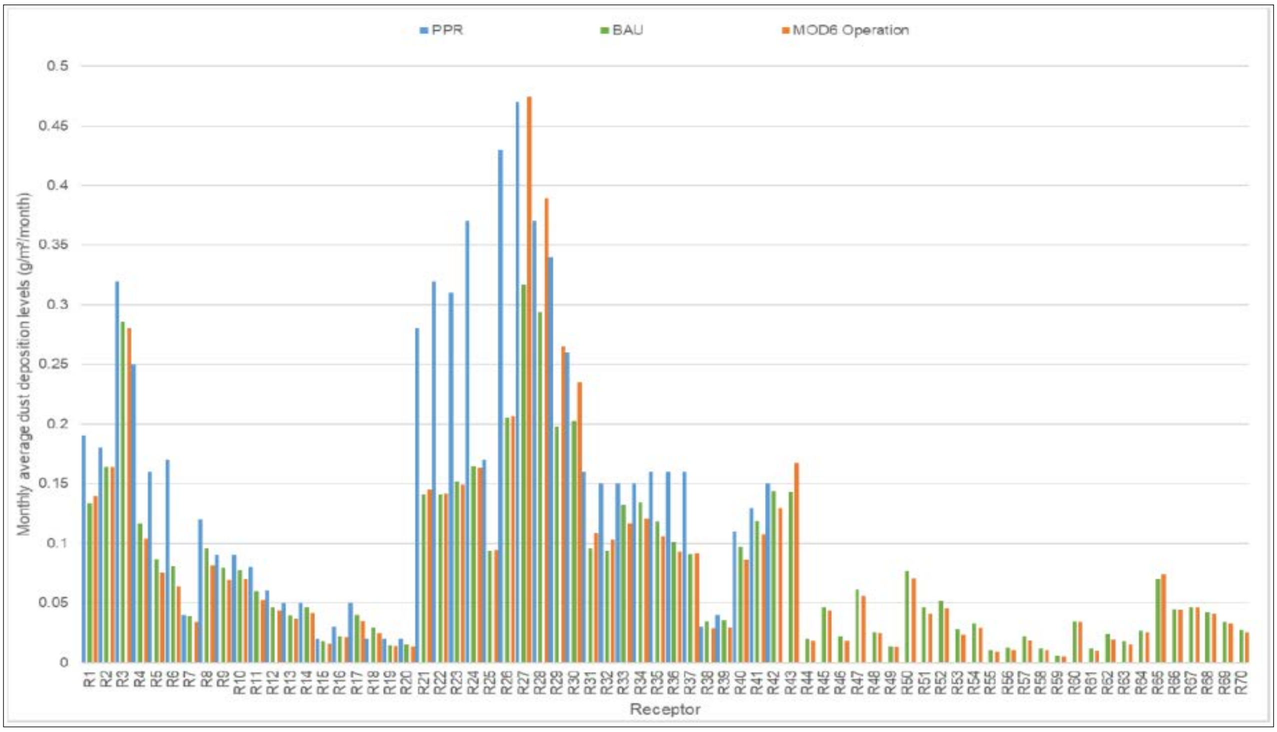


Figure 8-19 Monthly Average Dust Deposition Levels - MOD6 Operational Scenarios



8.2.7. Assessment Addendum

ERM Sydney completed a review of their air quality assessment results to account for minor changes in the project description related to the location and alignment of the Tails Harvesting Haul Road, *Letter Report – MOD6 Air Quality Addendum* **Appendix C2** (Addendum). The new alignment would commence on the western slope of TSF2 entering the northern corner of the boxcut and exiting at its western corner before intersecting the current Mine Ore Haul Road. These changes resulted in additional material movements during construction phase in the vicinity of the proposed box cut as well as a change on the road layout during the operational phase. As a result of the amendment to the initial project brief, it is anticipated that an additional 51,700 t of material movement during construction.

Table 8-20 and **Table 8-21** show a comparison between the initial calculated emissions for construction and operation in MOD6 and the calculations with the amended activities.

Table 8-20 Comparison of Annual Emissions – Construction Scenario

Annual Emissions per Pollutant (kg/year)				
	Lead	**TSP**	**PM_{10}**	**$PM_{2.5}$**
Air Quality Assessment Report	519	44,027	14,006	2,714
Addendum (as Amended)	528	45,190	14,310	2,753
Percentage Change	1.6%	2.6%	2.2%	1.4%

Table 8-21 Comparison Annual Emissions – Operational Scenario

Annual Emissions per Pollutant (kg/year)				
	Lead	**TSP**	**PM_{10}**	**$PM_{2.5}$**
Air Quality Assessment Report	530	48,269	13,487	2,476
Addendum (as Amended)	533	48,413	13,515	2,483
Percentage Change	0.6%	0.3%	0.2%	0.3%

ERM Sydney identified a minor increase in annual emissions across construction and operational scenarios of less than 3% and did not consider this small increase to be material in terms of their initial MOD6 air quality assessment results and its conclusions. In addition, ERM Sydney noted that the proposed changes would lead to a greater separation distance between potential emission sources and off site sensitive receptors.

8.2.8. Cumulative Impacts Associated with the Broken Hill North Mine

ERM Sydney conducted an assessment of the cumulative impacts of MOD6 operations when combined with predictions associated with the Broken Hill North Mine (BHNM). As no data was presented for Pb deposition the cumulative assessment was limited to PM_{10}, $PM_{2.5}$, TSP, dust deposition and Pb concentration. There were eight receptor locations that align for both operations and have been included for assessment, these included R2, R11, R17, R18, R23, R24, R32 and R43. Tabulated results presented by BHNM were limited to one decimal place and therefore some receptor locations were reported as 0.0 µg/m3. ERM Sydney assumed that in those instances where the model prediction was 0.0 µg/m3 that the contribution of BHNM was negligible. In the case of Pb concentrations, results for the BHNM were only received for the most impacted receptors therefore, ERM Sydney has taken a conservative approach and assumed a uniform value of 0.006 µg/m^3 across all receptors.

ERM Sydney found that for all of the air quality metrics assessed the cumulative results that combine emissions from the proposed MOD6, the proposed BHNM Recommencement Project and contributions from other background sources are all below the NSW impact assessment criteria at the nominated receptors. All results are included in Appendix B of the AQA Report; **Table 8-22** presents the cumulative results for annual average TSP, annual average PM_{10}, monthly dust deposition and annual average Pb concentrations.

Table 8-22 Predicted Cumulative Combined Results for MOD6 and BHNM

ID	Construction Year (2021)			Future Operational Year (2026)		
	MOD6 Increment	BHNM Increment	Cumulative (MOD6 + BHNM + background)	MOD6 Increment	BHNM Increment	Cumulative (MOD6 + BHNM + background)
Annual average TSP (µg/m3)						
Criterion	**n/a**	**n/a**	**90**	**n/a**	**n/a**	**90**
R2 (R38)	0.5882	0.0000	35.5395	0.6711	0.0000	35.5395
R11 (R34)	0.2513	0.0000	35.7043	0.2603	0.0000	35.7043
R17 (R28)	0.1647	0.0000	35.7891	0.1569	0.0000	35.7891
R18 (R30)	0.1343	0.0000	35.7892	0.1335	0.0000	35.7892
R23 (R15)	0.7351	0.1000	35.6756	0.6507	0.1000	35.6756
R24 (R14)	0.8148	0.1000	35.6576	0.7014	0.1000	35.6576
R32 (R12)	0.3996	0.1000	35.8129	0.4066	0.1000	35.8129
R43 (R13)	0.5870	0.1000	35.7429	0.6386	0.1000	35.7429
Annual average PM_{10}						
Criterion	**n/a**	**n/a**	**25**	**n/a**	**n/a**	**25**
R2 (R38)	0.4889	0.1	13.2841	0.4254	0.1	13.2206
R11 (R34)	0.1089	0.1	13.1777	0.2025	0.1	13.1368
R17 (R28)	0.1446	0	13.1406	0.1189	0	13.1149
R18 (R30)	0.1393	0.1	13.1441	0.1133	0.1	13.1181
R23 (R15)	0.5003	0.1	13.2474	0.4096	0.1	13.1567
R24 (R14)	0.5322	0.1	13.2929	0.4332	0.1	13.1939
R32 (R12)	0.2818	0.1	13.3043	0.2564	0.1	13.279
R43 (R13)	0.4075	0.1	13.3618	0.391	0.1	13.3453
R2 (R38)	0.4889	0.1	13.2841	0.4254	0.1	13.2206
Monthly dust deposition (g/m2/month)						
	2	**2**	**4**	**2**	**2**	**4**
R2 (R38)	0.1397	0.0000	1.0483	0.1640	0.0000	1.0483
R11 (R34)	0.0489	0.0000	1.0792	0.0526	0.0000	1.0792
R17 (R28)	0.0350	0.0000	0.4124	0.0352	0.0000	0.4124
R18 (R30)	0.0241	0.0000	0.8758	0.0250	0.0000	0.8758
R23 (R15)	0.1662	0.0000	1.0441	0.1489	0.0000	1.0441
R24 (R14)	0.1877	0.0000	1.0435	0.1635	0.0000	1.0435
R32 (R12)	0.0933	0.0000	3.1600	0.1033	0.0000	3.1600
R43 (R13)	0.1360	0.0000	3.1450	0.1673	0.0000	3.1450
Annual average lead concentration (µg/m3)						
	n/a	**n/a**	**0.5**	**n/a**	**n/a**	**0.5**
R2 (R38)	0.008	0.006	0.227	0.009	0.006	0.227
R11 (R34)	0.004	0.006	0.231	0.004	0.006	0.231
R17 (R28)	0.003	0.006	0.233	0.003	0.006	0.233
R18 (R30)	0.003	0.006	0.233	0.003	0.006	0.233
R23 (R15)	0.013	0.006	0.229	0.012	0.006	0.229
R24 (R14)	0.014	0.006	0.228	0.013	0.006	0.228

ID	Construction Year (2021)			Future Operational Year (2026)		
	MOD6 Increment	BHNM Increment	Cumulative (MOD6 + BHNM + background)	MOD6 Increment	BHNM Increment	Cumulative (MOD6 + BHNM + background)
R32 (R12)	0.007	0.006	0.231	0.007	0.006	0.231
R43 (R13)	0.010	0.006	0.230	0.010	0.006	0.230

8.2.9. Greenhouse Gas (GHG) Emissions

ERM Sydney also assessed the potential impacts for greenhouse gas emissions based on annual returns provided to the Federal Clean Energy Regulator under the National Greenhouse and Energy Reporting (NGER) scheme. ERM Sydney estimated annual emissions of GHG (Scope 1 and 2) to be less than 50 ktCO_2-e and concluded that the MOD6 operational scenario is not anticipated to have a material impact upon current GHG emissions compared to the status quo.

8.2.10. Mitigation Measures and Monitoring

8.2.10.1. Existing Mitigation Measures

BHOP has a number of existing measures relating specifically to dust control, these include:

- Free Areas are the primary source of dust from the Mine site and a procedure, Management of Exposed Areas (BHO-PRO-ENV-003) has been developed to manage dust in these areas. This procedure includes requirements for the use of dust chemical suppressants, vehicle restrictions, remediation of areas where fines or silt has built up and remediation of any stabilised exposed area disturbed due to works carried out on site.
- Management of potential dust generating activities on windy days including suspension of works if required (winds exceed 50 kph).
- Waste rock would be sampled and tested for its characteristics and metals content including lead, and a placement system developed.
- Chemical dust suppressant applied to unsealed roads.
- Installation of a water spray system on the Mine Haul Road within Kintore Pit.
- Use of a street sweeper (PM_{10}) on sealed roads with frequency governed by silt load testing.
- Speed restrictions on all roads.
- Hazard reports generated when dust emissions on haul roads are visible.
- Paving, stabilisation or vegetation of shoulders of paved roads.
- Avoid overloading of haul trucks to avoid spillage of material onto roadways.
- Installation of a vehicle wash and a dedicated truck wash to ensure that all vehicles are cleaned before they exit onto public roads, water deluge system designed to wash wheels and undercarriage of cars and trucks.
- Provision for storm water drainage to prevent water erosion onto paved roads.
- Provision for timely clean-up of temporary sources of dust, and rerouting of traffic around spills until they are removed.
- Static wind breaks used to deflect wind on the ROM pad with installed water sprays used when visible dust occurs, chemical dust suppressant also applied when required, BHOP Procedure ROM Pad Area (BHO-PRO-MET-040).
- Management of dust on the surface of TSF2 through the implementation of the BHOP Procedure Tailings Storage Facility Dust Management (BHO-PLN-ENV-010) listing operational requirements.
- All above ground conveyors and transfer points prior to the grinding circuit (SAG and ball mills) are enclosed.
- Conveyors fitted with dust extraction which report to insertable dust collectors.
- Crushed ore bin fitted with insertable dust collector to filter the air discharged during filling.
- Underground mine ventilation exhaust fitted with water sprays automatically triggered prior to and during blasts.

- Ring nozzle water sprays (atomised sprays) installed on the apron feeder hopper to the crushing circuit and negative pressure taking this airflow to the crushing circuit bag-house.
- Loading to the apron feeder is not undertaken during adverse weather conditions (high winds).
- Primary crusher circuit (jaw (primary) crusher) located in a fully enclosed building which operates under negative pressure and vents to a baghouse.
- Visible fugitive emissions from the crusher enclosure are minimised, in the event that sustained (>5 minutes) visible dust is observed to be emitted from the crusher circuit enclosure, crushing ceases until investigated and rectified.
- Enclosed structure over the ROM bin extends five meters out over the front end load feed area to prevent particulate wind entrainment around the top of the ROM bin.
- Concentrate loading is undertaken in an enclosed building (solid roof and side walls) and a lid placed over the container once filled eliminates any dust emissions during transport to the rail load out, and subsequently to port.
- Concentrate containers are washed via a purpose facility prior to transport to the rail load out area.
- High level dust alarms are installed on the Lime Silo including a pressure relief device, lime levels within the silo are monitored and during lime deliveries displaced air is back-vented to the delivery tanker, to minimise emissions.
- Grading of unsealed roads - Grader Operation Training Package (BHO-PKG-MIN-016) includes operating instructions to avoid dust generation.

8.2.10.2. MOD6 Mitigation Measures

BHOP have a number of additional measures used during construction activities including:

- hosing down excavation areas prior to removal of material with a dedicated water cart and/or water sprays;
- applying water during the placement of any rock fill layers (boxcut / roads) during construction;
- water sprays or water truck used to aid dust suppression on any material stockpiles, and
- the use of chemical suppressants on roadways.

Control measures specific to MOD6 construction activities would be identified during detailed design and included in the Construction Environment Management Plan for MOD6.

In addition to the existing management and mitigation measures, the following specific air quality management strategies would be implemented for MOD6 operations:

- use of larger haul trucks for the future tailings harvesting operations transferring tailings from TSF2 to TSF3 (50 t trucks to be used);
- use of a water truck and chemical dust suppressant in TSF3 as required;
- sealing of the new Mine Ore Haul Road from the portal to the ROM pad;
- permanent in-pit storage of material excavated from the boxcut in Little Kintore Pit and BHP Pit;
- adaption of the water spray system designed for TSF2 (approved MOD4) to accommodate the tailings harvesting operations;
- capping of the Free Areas, and
- update of the BHOP Air Quality Management Plan (BHO-PLN-ENV-010).

8.2.10.3. Monitoring

BHOP have an extensive air monitoring network including:

- three High Volume Air Samplers (HVAS) measuring TSP, PM_{10} and Pb concentrations at one location on site, PM_{10} HVAS at TSF2, and one location offsite measuring TSP and PM_{10};
- two Tapered Element Oscillating Microbalances (TEOMs) measuring PM_{10} at one location on site, and one offsite;
- seven Dust Deposition Gauges (DDGs) measuring dust deposition and percent deposited Pb at seven locations; three on site, two on surface exclusion areas within the mining lease, and two offsite;

- the crusher baghouse is monitored through the control software in the processing plant (Citect) and via point source monitoring detailed within the AQMP; and
- stack testing is conducted at the ventilation shaft.

In addition the installation of the adapted water spray system for TSF2 would be based around a programmable logic controller (PLC) which would manage and control the parameters as listed in **Table 8-23**. SMS or email alerts to relevant site personnel can be provided when critical PM concentrations or wind speeds occur.

Table 8-23 TSF2 Water Spray System PLC Operating Parameters

Inputs	• Air quality monitoring units • Meteorological forecasts • Water level sensors in storage tanks and pond • Flow meter installed on supply and distribution lines
Control of	• Transfer and booster pumps • Electric valves which control water to sprinklers • Crusting dosing system
Warnings	• No water flow (e.g. pump failure) • Low water flow (e.g. sprinkler malfunction) • High water flow (e.g. pipeline leak) • No crusting dosing (e.g. supply disruption) • Sensor and/or communications failure

The need for any additional air quality monitoring units or the relocation of existing units would be discussed and agreed with the EPA once detailed design is completed and included in the updated AQMP.

8.3. Community Health

SLR Consulting Australia Pty Ltd was engaged by BHOP to undertake a Human Health Risk Assessment (HHRA) for MOD6, *Human Health Risk Assessment for Rasp Mine, Modification 6* (HHRA Report) (**Appendix D1**) The HHRA used air quality modelling results from the air quality assessment completed by ERM for MOD6 (**Appendix C1**). The assessment was peer reviewed by Dr Roger Drew (toxicologist), PhD, DABT, FACTRA.

A minor modification from the project description in relation to the location and re-alignment of the Tails Harvesting Haul Road, resulted in minor changes in the air quality predictions by ERM Sydney; as outlined by ERM Stdney in an addendum to the AQA Report. The changes resulted in minor annual increases for emissions in Pb, TSP, PM_{10} and $PM_{2.5}$ of less than 3%. It was also noted by ERM Sydney that this proposed change would lead to a greater separation distance between potential emission sources and off site sensitive receptors. Due to the minor overall variations SLR has considered that the conclusions from the HHRA do not change due to this minor project variation, *HHRA for Rasp Mine, Mod6 Addendum* (**Appendix C2).**

SLR made the following conclusions:

- Predicted incremental increases in soil Pb potentially arising from approximate 12-month MOD6 construction phase were small and insignificant (i.e. 0.005-0.43% of existing soil Pb).
- MOD6 operations were not expected to change absolute geometric mean blood Pb in children living in Broken Hill.
- Blood Pb concentrations in children living in Broken Hill were not anticipated to be affected by activities associated with MOD6.
- The risk of exceeding health-based toxicity reference values for other metals as a result of MOD6 construction or operations was very low.

8.3.1. Methodology

The HHRA was conducted in line with established national and international risk assessment frameworks and in particular SLR followed guidance materials by enHealth as outlined in their *Environment Health Risk*

Assessment: Guidelines for assessing human health risks from environmental hazards, (2012a). The following sections summarise the process used by SLR for its assessment.

8.3.1.1. Issue Identification

The purpose of the assessment was to identify any potential for MOD6 activities during both construction and operations to impact exposures of the local community due to altered dust emissions from these activities.

To assess the construction scenario for MOD6 the estimated Pb dust deposition was compared to MOD4 approved construction emissions. Pb soil deposition predicted for MOD6 construction was also compared to existing measured soil Pb.

To assess the potential impacts from MOD6 operations SLR established two operational scenarios to evaluate metal in dust emissions. For each scenario it is assumed that the same emissions would occur for the remainder of the life of mine (up to 2026 project approval period):

- Scenario 1 (S1): current operations, including background.
- Scenario 2 (S2): MOD 6 proposed future operation, including background.

8.3.1.2. Hazard Assessment

SLR identified metals in dust as the chemicals of potential concern with the principle metal of concern as Pb. Pb was assessed against the dose response determined level by the National Health Medical Research Council (NHMRC) as blood concentration and toxicity levels were used for other metals.

8.3.1.3. Exposure Assessment

SLR adapted modelling information for metals in dust emissions to calculate potential metal concentrations in soils and using this, as well as other literature information and metal analytical data from soil/dust sampling at site, to estimate background levels which were then used to assess changes in exposures at particular sensitive receptor locations from MOD6 activities.

For estimates of soil metal concentrations from deposition onto soil, SLR used US EPA standard equations. To better understand existing soil/dust metals concentrations, SLR reviewed existing literature together with a comprehensive sampling program which included urban sample locations within the City of Broken Hill; samples were tested for bioaccessibility of lead, arsenic, chromium, iron, manganese and cadmium.

Bioaccessibility for other metals which were identified as part of the Broken Hill geology such as arsenic, cadmium, chromium, manganese, antimony, barium, beryllium, iron, copper, mercury, nickel, silver and zinc were also assessed. Where no data of bioaccessibility was available SLR conservatively assumed that these metals were fully soluble. Potential impacts from these metals were assessed by determining the risk of exceedances of a chronic toxicity reference value (TRV). For metals with the potential to cause cancer, the risk was determined for cancer risk from inhalation exposure and comparing the results with the acceptable risk recommended by Australian health authorities.

Exposure pathways at receptor locations considered for the assessment included incidental ingestion of soil / dust from outdoor air, inhalation of indoor / outdoor airborne dust and ingestion of vegetables or fruits from home grown gardens. Dermal contact with metals in soil or dust was considered to be negligible, therefore not considered in the assessment. SLR considered that ingestion of tank water containing metal deposited as dust was unlikely to be a major pathway of exposure and was not included in the exposure estimates. This was determined from information regarding reticulated water being supplied by local government authorities and campaigns that have been carried out to educate people about the risks of consuming tank water.

8.3.1.4. Risk Characterisation

To determine potential health impacts of Pb, SLR used a validated model (IEUBK) from the US EPA to predict Pb in blood (BPb) levels. Results from the model provide geometric mean BPb levels by age, a distribution curve of BPb concentrations for a population with specified exposure inputs and the percentage of children of a particular age group with predicted BPb concentrations above a threshold were established.

The risk characterisation was carried out by comparing modelled BPb between the different scenarios, modelled BPb with measured BPb and with the National Health and Medical Research Council (NHMRC) action level of 5µg/dL.

For modelling of BPb input assumptions used by SLR were considered conservative and consequently were more likely to over predict than under predict modelled BPb.

For other metals the lifetime time-weighted average daily intake (TWADI) was calculated in addition to inhalation exposure. Cancer risk was also estimated from inhalation and incidental ingestion. Results from cancer risk were compared with ‘acceptable risk’ for relevant metals, while intakes compared with Tolerable Daily Intakes (TDI) and the Chronic Air Guideline Value (AGV).

8.3.2. Existing Environment

SLR considered the 70 receptor locations for the HHRA as included in the air quality modelling undertaken by ERM, for metal concentrations in airborne dust and deposition to soil. These locations included residences, parks, playground, schools, childcare centres among others. Receptor locations have been identified according to the risk areas or districts as described by Borland et el (2002). In this study an extensive soil sampling program was used to identify the spread of Pb in soil across the City of Broken Hill.

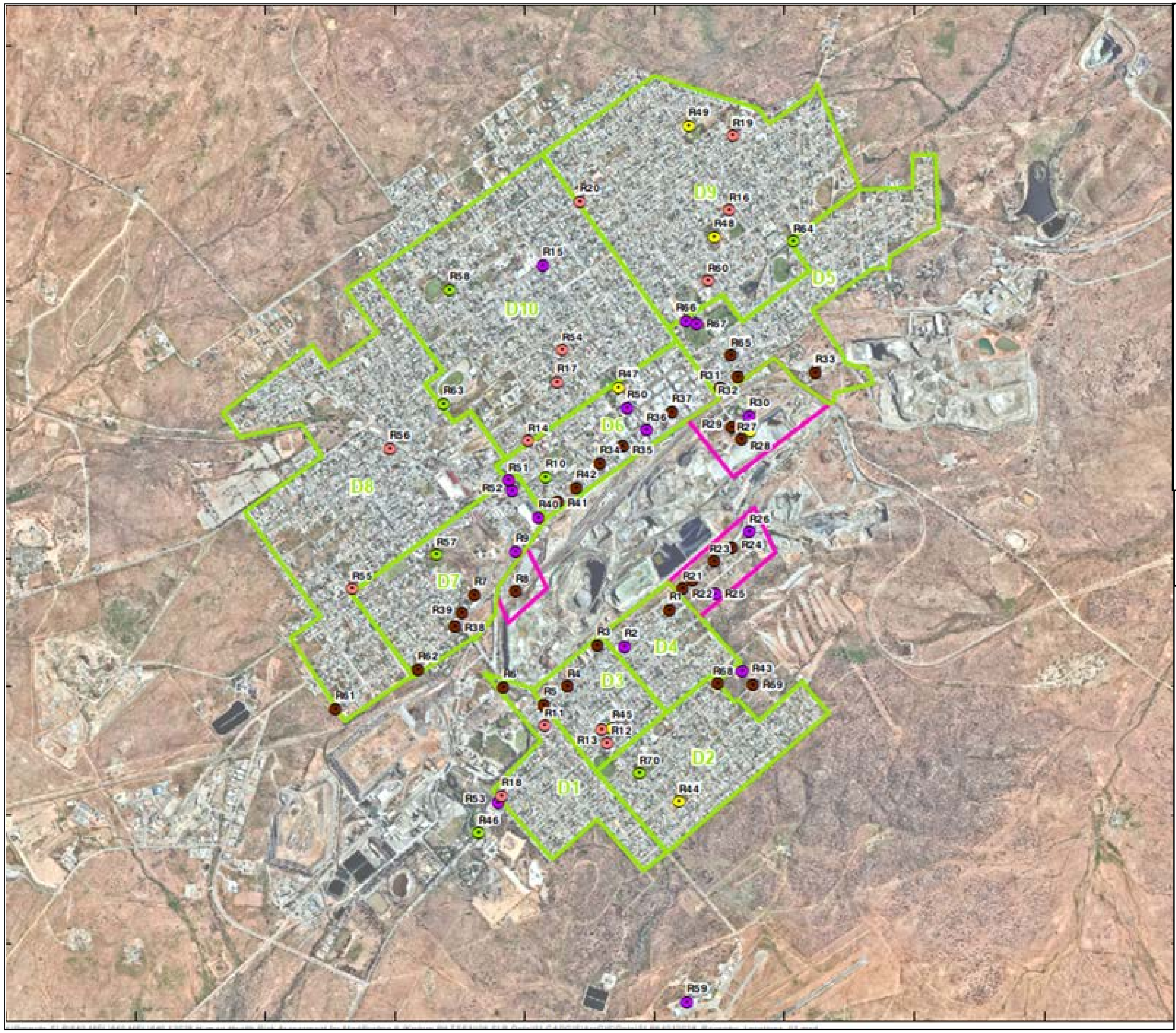
The receptor locations included in the HHRA are described in **Table 8-24** and shown in **Figure 8-20**.

Table 8-24 HHRA Receptor Locations

Boreland District[1]	Receptor	Description	Boreland District[1]	Receptor	Description
D1	R6	Residence	D6	R10	Duke of Cornwall Park
	R11	Alma Bugdli Preschool		R34	Residence
	R18	Rainbow Preschool		R35	Residence
	R46	Zinc Lakes Playground		R36	Nachiapan Surgery
	R53	War Vets Retirement Living		R37	Residence
D2	R43	Bowling Green		R41	Residence
	R44	Duff Street Park Playground		R42	Residence
	R68	Residence		R47	Sturt Park Playground
	R69	Residence		R50	Aruma Lodge
	R70	Lamb Oval	D7	R7	Residence
‘Other’ (close to D2)	R59	Flying Doctors Medical Centre		R9	RSPCA
D3	R3	Residence		R38	Residence
	R4	Residence		R39	Residence
	R5	Residence		R40	Coles Supermarket
	R12	Playtime Preschool		R51	Eureka Shorty O’Neill Retirement Village
	R13	Alma Primary School		R52	Con Crowley Retirement Village
	R45	Patton Park Playground		R57	AJ Keast Park
D4	R1	Residence		R62	Residence
	R2	Southern Cross Care (St Anne’s)	‘Other’ (close to D7)	R8	Residence
‘Other’ (close to D4)	R21	Residence	D8	R55	Railwaytown Public School
	R22	Residence		R56	Burke Ward Public School
	R23	Residence		R61	Residence
	R24	Residence	D9	R16	N. Broken Hill Primary School

Boreland District[1]	Receptor	Description	Boreland District[1]	Receptor	Description
	R25	Essential Water Tank		R19	Willyama High School
	R26	Mawsons Quarry offices		R20	Morgan Street Primary School
D5	R31	Residence		R48	Playground (QE Park)
D5	R32	Residence		R49	Playground
D5	R33	Brownes Shaft Residence		R60	Busy Kids Childcare
D5	R64	Jubilee Oval	D10	R14	Broken Hill High School
D5	R65	Residence	D10	R15	Broken Hill Base Hospital
D5	R66	O'Neill Park Soccer Grounds	D10	R17	Broken Hill Public School
D5	R67	Cricket Grounds	D10	R54	Sacred Heart Parish Primary School
'Other' (close to D5)	R27	Residence	D10	R58	Picton Oval
'Other' (close to D5)	R28	British Flats Playground	D10	R63	Memorial Oval
'Other' (close to D5)	R29	Residence			
'Other' (close to D5)	R30	Perilya Social Club			

Figure 8-20 HHRA Receptor Locations



LEGEND

- Residences
- Schools/Childcare
- Ovals
- Playgrounds
- Other (Hospital, Health Centre, Aged Care Service)
- Defined by Boreland et al. (2002) Boundary
- 'Other' Boundary

*** D = District**

**** R59 is the Flying Doctors Medical Centre at Broken Hill Airport (approx. 1 km from southern edge of D2)**

Reference SLR Report Figure 2-1 Appendix D1

Existing soil / dust concentrations in Broken Hill were informed by existing literature research and by a comprehensive sampling program which included collection of soil / dust samples from the Mine site as well as in urban areas located with the City of Broken Hill. The samples were tested for bioaccessibility of Pb, arsenic (As), chromium (Cr), iron (Fe), manganese (Mn) and cadmium (Cd). For other metals the assessment accounted for potential background exposures by adjusting the respective TRVs. Existing soil metal concentrations at receptor locations used in the HHRA are presented in **Table 8-25**.

Table 8-25 Existing Soil Metal Concentrations at Receptor Locations

District/ Area	HHRA Receptor location	Metals/Metalloid (mg/kg)													
		Pb	As[1]	Cd[1]	Cr[1]	Fe[1]	Mn[1]	Sb	Ba	Be	Cu	Hg	Ni	Ag	Zn
D1	R6, R11, R18, R53	370	7	0.9	23	27500	431	No data available [2]							
	R46	2450													
D2	R43, R68, R69, R70	735	12	1.3	27	28317	409								
	R44	700													
Other (airport) [3]	R59	735	12	1.3	27	28317	409								
D3	R3, R4, R5, R12, R13	370	12	1	24	26550	450								
	R45	700													
D4	R1, R2	370	12	2	19	21700	640								
Other (Close to D4) [3]	R21, R22, R23, R24, R25, R26	370	12	2	19	21700	640								
D5	R31, R32, R33, R64, R65, R66, R67	604	11	4.7	24	26983	573								
D6	R10, R34, R35, R36, R37, R41, R42, R50	1125	35	5	24	31650	1490								
	R47	300													
Other (close to D6) [3]	R27, R28, R29, R30	1125	35	5	24	31650	1490								
D7	R7, R9, R38, R39, R40, R51, R52, R57, R62	1125	35	5	24	31650	1490								
Other (close to D7) [3]	R8	1125	35	5	24	31650	1490								
D8	R55, R56, R61	251	12	1.6	24	27350	390								
D9	R16, R19, R20, R48, R60	275	12	1.6	24	27350	390								
	R49	80													
D10	R14, R15, R17, R54, R58, R63	343	12	1.3	27	28317	409								

Note 1: Total concentrations for metals are averages of all samples collected in a particular district for bioaccessibility. No samples were collected within D6 or D9, so the data from the closest neighbouring district was used.

Note 2: As no data were available for these metals, the existing soil concentration could not be incorporated into the assessment. Nevertheless, the HHRA has accounted for potential background exposure to these metals by adjusting the respective TRVs by an assumed background intake due to metal intake from diet including home-grown produce.

Note 3: Since this location did not fall within a particular district, it has been assumed soil concentrations are similar to the average concentration measured in the nearest (or bordering) district.

8.3.3. Impact Assessment Results - Lead (Pb)

8.3.3.1. Construction

The health risks of the MOD6 construction activities were evaluated in two ways:

- Comparison of incremental air Pb and Pb dust deposition from the MOD6 construction year with the approved incremental air Pb and Pb dust deposition from the MOD4 construction year.
- Determining the relativity of the predicted incremental increase in surface soil Pb due to the MOD6 construction year to existing soil Pb concentrations.

The predicted incremental increases modelled by SLR in soil Pb potentially arising from the approximately 12-month MOD6 construction phase ranged from 0.03 – 2.0 mg/kg which represent only 0.005 – 0.43% of existing soil Pb concentrations. SLR considered these increases to be small and insignificant.

The five receptors with the largest percentage increases in soil Pb relative to existing soil Pb concentrations were R26 (0.43%), R3 (0.4%), R24 (0.32%), R23 (0.28%), and R21 (0.23%) in District 3 or on the southern edge of the mine Lease. At these locations, the IEUBK model predicts very small potential increases in BPb (0.011 – 0.021 µg/dL) for the period that MOD6 construction occurs, noting that these predictions are conservative (due to assumptions regarding bioavailability of Pb in soil / dust, as well as deposition modelling of Pb). Such small changes are within the margin of error of ±2 µg/dL for standard BPb testing (NHMRC 2016) and would not be distinguishable in a Pb monitoring program. Results are shown in **Table 8-26**.

SLR also noted that during the assessment for MOD4 (undertaken by ToxConsult Pty Ltd (ToxConsult)), which included construction activities only (TSF2 embankments and concrete batching plant), it had determined that a human health risk assessment was not required. Toxconsult had concluded that small increases in air Pb over a short period and in soil were unlikely to materially influence existing exposures to Pb. This was consistent with findings by Bowers and Liu (2019) that long-term chronic Pb exposures were more closely associated with human intelligence impacts than short term BPb elevations.

Table 8-26 Predicted Percentage Increase in Existing Soil Pb Concentration as a Result of MOD6 Construction

District	Location No.	Total Incremental Construction Pb deposition (g/m2) (1)	Construction Increment in soil Pb		District	Location No.	Total Incremental Construction Pb deposition (g/m2)(1)	Construction Increment in soil Pb	
			mg/kg	as % of existing soil Pb(3)				mg/kg	as % of existing soil Pb(3)
1	R6	0.013	0.4	0.12	Other (close to D6)	R27	0.06	2	0.18
	R11	0.01	0.3	0.09		R28	0.048	1.6	0.14
	R18	0.005	0.2	0.05		R29	0.04	1.3	0.12
	R46 (2)	0.004	0.1	0.005		R30	0.033	1.1	0.1
	R53 (2)	0.005	0.2	0.04	7	R7	0.007	0.2	0.02
2	R43 (2)	0.026	0.9	0.12		R9	0.012	0.4	0.04
	R44	0.003	0.1	0.02		R38	0.006	0.2	0.02
	R68	0.007	0.2	0.03		R39	0.006	0.2	0.02
	R69 (2)	0.006	0.2	0.03		R40	0.013	0.4	0.04
	R70	0.005	0.2	0.02		R51	0.007	0.2	0.02
	R59 (2)	0.001	0.03	0.005		R52	0.008	0.3	0.02
3	R3	0.045	1.5	0.4		R57	0.004	0.1	0.01
	R4	0.018	0.6	0.16		R62	0.004	0.1	0.01
	R5	0.014	0.5	0.13	Other (close to D7)	R8	0.016	0.5	0.05

District	Location No.	Total Incremental Construction Pb deposition (g/m2) [1]	Construction Increment in soil Pb		District	Location No.	Total Incremental Construction Pb deposition (g/m2)[1]	Construction Increment in soil Pb	
			mg/kg	as % of existing soil Pb[3]				mg/kg	as % of existing soil Pb[3]
	R12	0.008	0.3	0.07	8	R55	0.002	0.1	0.03
	R13	0.007	0.2	0.06		R56	0.002	0.1	0.03
	R45	0.008	0.3	0.07		R61	0.002	0.1	0.03
4	R1	0.022	0.7	0.19	9	R16	0.004	0.1	0.05
	R2	0.024	0.8	0.21		R19	0.003	0.1	0.03
Other (close to D4)	R21	0.025	0.8	0.23		R20	0.003	0.1	0.03
	R22	0.027	0.9	0.24		R48	0.005	0.2	0.06
	R23	0.031	1	0.28		R49	0.002	0.1	0.1
	R24	0.036	1.2	0.32		R60	0.007	0.2	0.08
	R25	0.018	0.6	0.16	10	R14	0.008	0.3	0.08
	R26	0.047	1.6	0.43		R15	0.003	0.1	0.03
5	R31	0.019	0.6	0.1		R17	0.007	0.2	0.07
	R32	0.017	0.6	0.1		R54	0.006	0.2	0.06
	R33	0.02	0.7	0.11		R58	0.002	0.1	0.02
	R64	0.005	0.2	0.03		R63	0.003	0.1	0.03
	R65	0.013	0.4	0.07					
	R66	0.009	0.3	0.05					
	R67	0.009	0.3	0.05					
6	R10	0.012	0.4	0.04					
	R34	0.024	0.8	0.07					
	R35	0.022	0.7	0.06					
	R36	0.02	0.7	0.06					
	R37	0.019	0.6	0.06					
	R41	0.018	0.6	0.05					
	R42	0.024	0.8	0.07					
	R47	0.011	0.4	0.13					
	R50	0.014	0.5	0.04					

Note1: Total deposition over 12-month construction period.

Note 2: Although this receptor is outside district lines, it has been assigned in this HHRA to the closest neighbouring district listed.

Note 3: It is recognised that the calculated percentage increase is highly dependent on the assumed existing soil dust Pb, which is uncertain for any specific receptor location. Nevertheless, as the latter have been based on recently collected data it is considered unlikely that the existing soil/dust Pb concentrations would differ dramatically from those assumed. Overall, since the increment at all locations was predicted to be very small, this uncertainty is unlikely to impact on the overall conclusion.

8.3.3.2. Operations

The health risks of the MOD6 operational activities were evaluated under two scenarios: Scenario 1 (S1) business as usual case or current operations (including background) and Scenario 2 (S2) proposed MOD6 future operations (including background) and compared these to the NHMRC (2015) BPb management goal and the BHOP original human health risk assessment as adjusted from air quality results from the PPR.

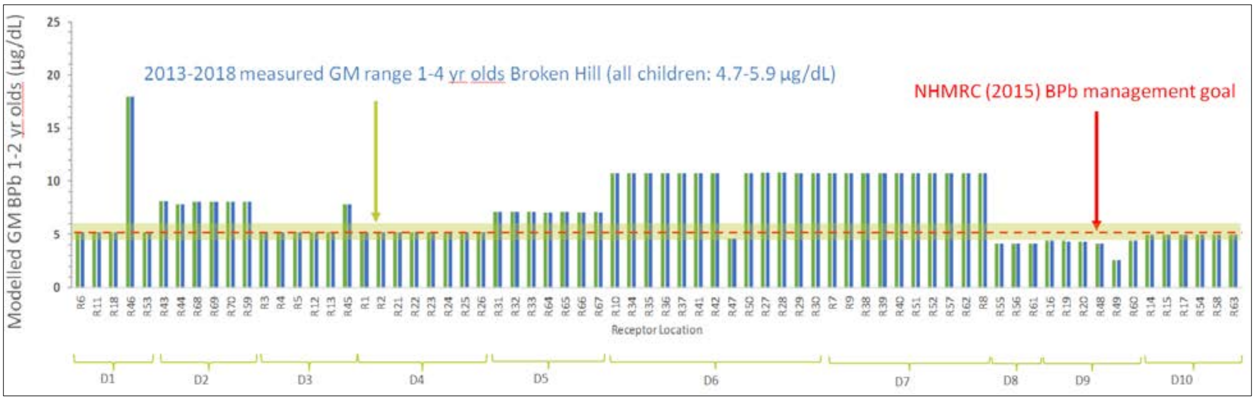
Figure 8-21 shows the modelled geometric mean (GM) BPb in the most sensitive population in Broken Hill (1 - 2 year old children) assumed to live at the various receptor locations, compared with the NHMRC Pb management goal.

This shows that the GM BPb were essentially the same for both S1 (current) and S2 (future MOD6) operations. This was due to the vast majority of modelled BPb was attributable to the contribution from existing soil Pb (and dust), and that the mine related contribution to overall Pb intakes is comparatively low; both scenarios result in very similar modelled GM BPb.

SLR found that the GM BPb for populations of 1 – 2 year old children who were assumed to spend all their time at R46 (Zinc Lakes Playground), R45 (Patton Park Playground) or receptor locations in Districts 2, 6 and 7 were predicted to be higher than the NHMRC Pb management goal of 5 ug/dL. This was due to the high assumed existing soil / dust Pb concentrations at these locations (Pb 700 – 2,450 mg/kg).

Importantly SLR found that the future MOD6 operations would not change the absolute GM BPb predictions as there was no material difference between the results.

Figure 8-21 Comparison of S1 and S2 with the NHMRC Pb Management Goal

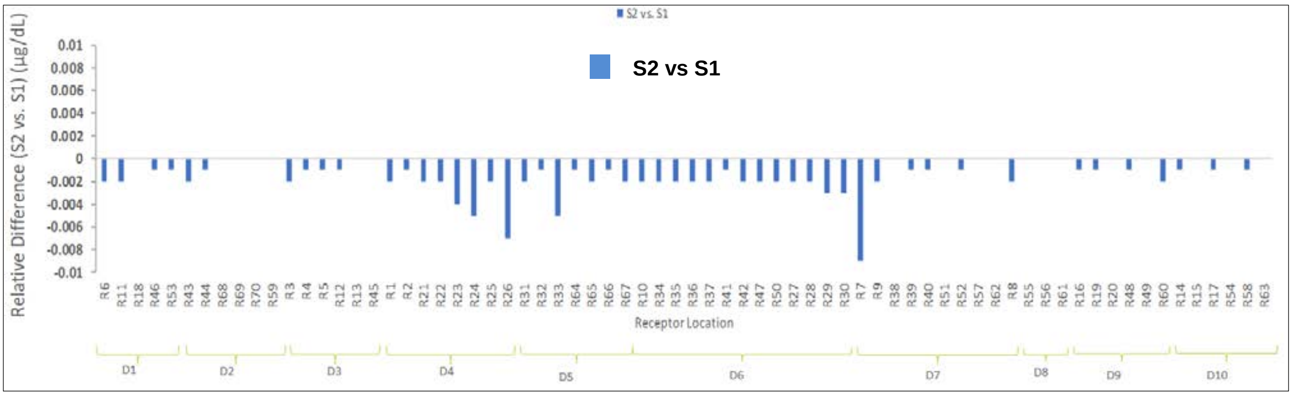


Scenario 1 Current Operations **Scenario 2 MOD6 Future Operations**

Figure 8-22 shows the relative difference (in µg/dL) of GM BPb between S2 and S1. The modelled relative change ranges between 0 (none) to a decrease of 0.009 µg/dL for S2. SLR considered that such a level of precision in absolute BPb level is considered unwarranted due to the inherent uncertainties with any modelling approach and that such small changes are within the margin of error of ±2 µg/dL for routine BPb testing (NHMRC 2016) and would not be distinguishable in a Pb monitoring program.

Therefore, the change in BPb as a result of MOD6 operation was concluded to be negligible.

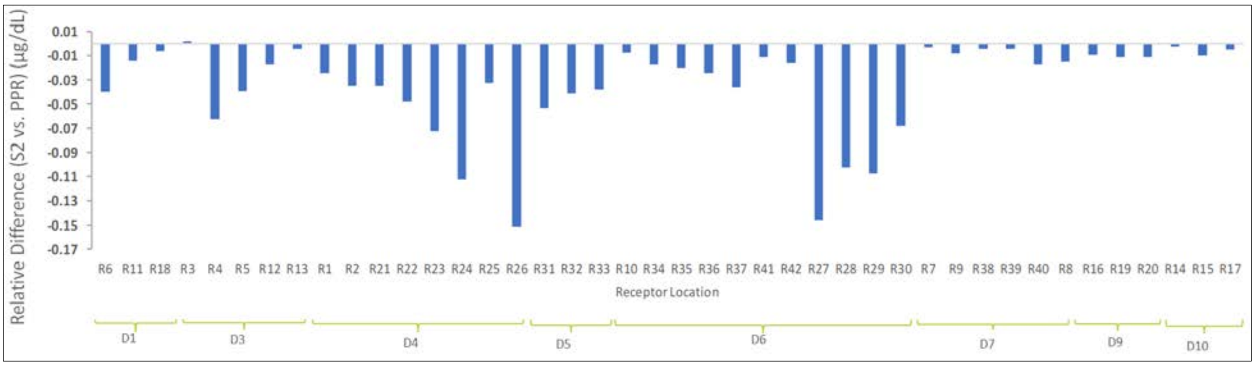
Figure 8-22 Proposed MOD6 Future Operations (S2) Compared to Existing Operations (S1)



A comparison between the modelled BPb for Scenario 2 (future MOD6 operations including background) and the PPR (original approval for Rasp Mine) shows that modelled GM BPb levels for a population of 1 – 2 year old children at the original 42 receptors, vary from a slight increase at R3 of 0.002 µg/dL (essentially a negligible change and within the error rate for routine BPb testing) to a decrease of 0.15 µg/dL at R26 for S2. The comparison is presented in **Figure 8-23**.

SLR concluded that although these differences are small, overall MOD6 operations (including background) is predicted to result in lower BPb levels than the original approval (ie the PPR, including background).

Figure 8-23 Proposed MOD6 Future Operations (S2) Compared to PPR (Original Approval)



S2 Future MOD6 Operations vs PPR original Project Approval HHRA predictions as updated

8.3.4. Impact Assessment Results - Other metals

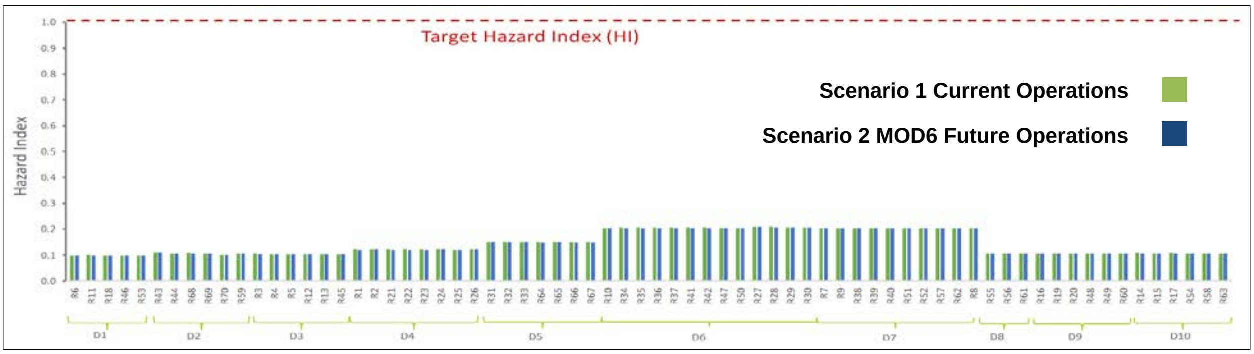
SLR reviewed analysis results for a range of materials including ore, tailings, waste rock and samples from Free Areas to identify other chemicals of potential concern. These were determined as As, Cd, Cr, Fe, Mn, antimony (Sb), barium (Ba), beryllium (Be), copper (Cu), mercury (Hg), silver (Ag) and zinc (Zn).

For these metals SLR calculated the lifetime TWADI from incidental ingestion of metal in soil / dust in addition to inhalation exposure. The concentration in soil was calculated from the annual average dust deposition rate for the remaining mine life and the existing soil metal concentrations were available. The inhalation exposure concentration was identified from the annual average concentrations in PM_{10}. Results were compared intakes compared with TDI and the chronic AGV.

Target Hazard Index (HI) for each metal was derived by SLR for other metals by summing the hazard quotients (HQs) of the individual metals. The HQs consisted of an estimate of the lifetime TWADI of ingestion of metal in soil / dust compared with the TDI for each metal, with the TDI adjusted for background intakes including home grown produce. These HQs were then added to those calculated from a comparison of the modelled annual average metal in PM_{10} with the chronic AGV. The results are shown in **Figure 8-24**.

SLR estimated that exposure to other metals are well below their respective health guidelines. In addition, the probability of additive effects between the metals is considered to be very low; thus the risk of exceeding health based TRV, TDI and AGVs as a result of MOD6 activities is very low. **Figure 8-24** shows the calculated HI for each identified other metal of potential concern. These HIs are low indicating the likelihood of exceeding the chronic TDIs and / or AGVs as a result of MOD6 future operations is also low.

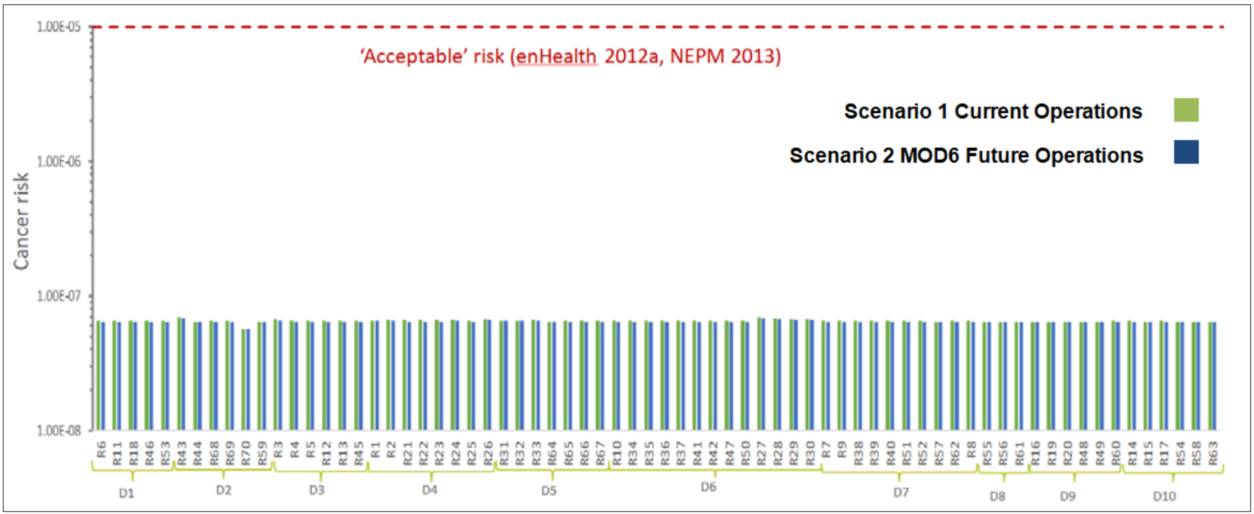
Figure 8-24 Chronic hazard indices for all evaluated receptors



Two metals were identified by SLR for their cancer risk. Nickel and chromium were considered potential genotoxic carcinogens via the inhalation route of exposure and were assessed for cancer risk. The estimated summed cancer risk was compared with a target acceptable risk of 1 x 10^{-5} as recommended by enHealth and NEPM.

The highest estimated cancer risk modelled was for nickel 6.9 x10^{-8} (R27 S1) which is more than two orders of magnitude below the one in one hundred thousand risk that NSW and other health jurisdictions consider as negligible or acceptable. The established cancer risks for nickel inhalation from current operations and proposed operations for MOD6 are shown in **Figure 8-25**.

Figure 8-25 Incremental cancer risk at all receptor locations



8.3.5. Mitigation Measures and Monitoring

8.3.5.1. Existing Mitigation Measures

Existing mitigation measures would continue to be implemented during the construction and operational stages of MOD6:

- Continued testing of waste rock material for surface use, including all crushing, for Pb content to ensure that only material <0.5%Pb is used.
- Continued application of chemical dust suppressant in exposed areas and project related Free Areas with potential for dust generation.
- Continued restricted access to the Free Areas.
- Dust control for unsealed roads with a water truck and / or chemical dust suppressant and speed restrictions. Grading would also be avoided under dry conditions and would only be carried out when determined necessary.
- Sealed roads would be kept clean, and street sweepers would continue to be used.
- All vehicles that have travelled onto the active areas of the Mine site to be cleaned through the car / truck wash prior to exiting site.
- Employees and contractors who have worked in lead areas to shower prior to leaving site.
- Other mitigation strategies for dust as outlined in Section **8.2.10**.

8.3.5.2. MOD6 Mitigation Measures

The following mitigation measures would be undertaken in addition to the existing measures already undertaken:

- Sealing of haul road from new portal to ROM pad.
- Use of larger trucks for tailings harvesting activities.
- Progressive rehabilitation of exposed Free Areas.
- In-pit disposal and encapsulation of box cut material (as all material assumed to be >0.5%Pb).

In addition the following management plans would be updated:

- Air Quality Management Plan (BHO-ENV-PLN-010).
- Community Lead Management Plan (BHO-ENV-PLN-008).

8.3.6. Monitoring

The activities included in the AQMP would continue to be implemented to track trends and changes in air quality that could affect dust emissions and consequently changes in lead deposition in soil. Monitoring includes meteorological monitoring, Pb (TSP), dust deposition (including deposited lead), PM_{10} and TSP.

8.4. Vibration, Overpressure and Flyrock

Prism Mining Pty Ltd (Prism) was commissioned by BHOP to complete an assessment for potential vibration, overpressure and flyrock impacts resulting from blasting activities for the boxcut, portal and decline, *Blasting Impact Assessment for the Proposed Boxcut and Portal/Decline at Rasp Mine (MOD6)*, March 2021 (Blasting Report) (**Appendix F1**). A summarised version of this report for risks associated with TSF2 was also provided, *Letter Report - Blast Vibration Assessment at TSF2,* March 2021 (**Appendix F2**) (Blasting Impact Report). Prism also provided the preliminary blasting parameters required to meet vibration limits for surface blasting with the aim of minimising potential impacts to the local community.

Prism based their assessment on their extensive experience of blasting practices undertaken at the Rasp Mine and the following standards and guidelines:

- *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration,* Australian and New Zealand Environment Council, September 1990.
- *Explosives Storage and Use (Appendix J)*, AS2187.2-2006, Australian Standards.
- *On-Bench Practices for Open Cut Mines and Quarries, AESIG Code of Practice, June 2019.*
- *Blast Guarding in an Open Cut Mining Environment, AESIG Code of Practice, November 2018.*
- *Safe Distances When Using Explosives, Guidance Note, Worksafe Victoria.*

Golder provided recommendations for blasting limits together with other relevant information in relation to blasting vibration near the Rasp Mine tailings storage facilities, *Rasp Mine – Potential Impact of Blasting on Tailings Storage Facility*, 4 October 2019 (Appendix K in the Golder Report, **Appendix B1**).

Blasting limits used in the assessment were taken from the PA (Schedule 3 Condition 18) and the EPL Condition L5.

Requirements by Dams Safety NSW for TSF2 were also considered, *CBH Resources Rasp Mine proposal to mine within Blackwood Notification Area, RASP*, Chief Inspector, Resources Regulator, November 2019 (**Appendix M**).

Appropriate factors of safety based on the maximum expected flyrock range were used to identify a controlled blast clearance area for flyrock management within the Lease.

The Blasting Report demonstrates how blasting within the proposed boxcut and portal / decline for MOD6 activities can be carried out in compliance with appropriate standards for ground vibration, overpressure and flyrock.

8.4.1. Description of Blasting Area and Material

The majority of the boxcut to be excavated is fill material, and would not require blasting. However, the lower access slot to the portal, some material above the first catch-bench, the portal entrance and some of the decline from the portal would require blasting from surface, as discussed in **Section 3.6.5 Concept Blasting Strategy.** The location of the boxcut with respect to mine infrastructure and surrounds is shown in **Figure 8-26**.

Figure 8-26 Boxcut Location - Mine Infrastructure and Surrounds

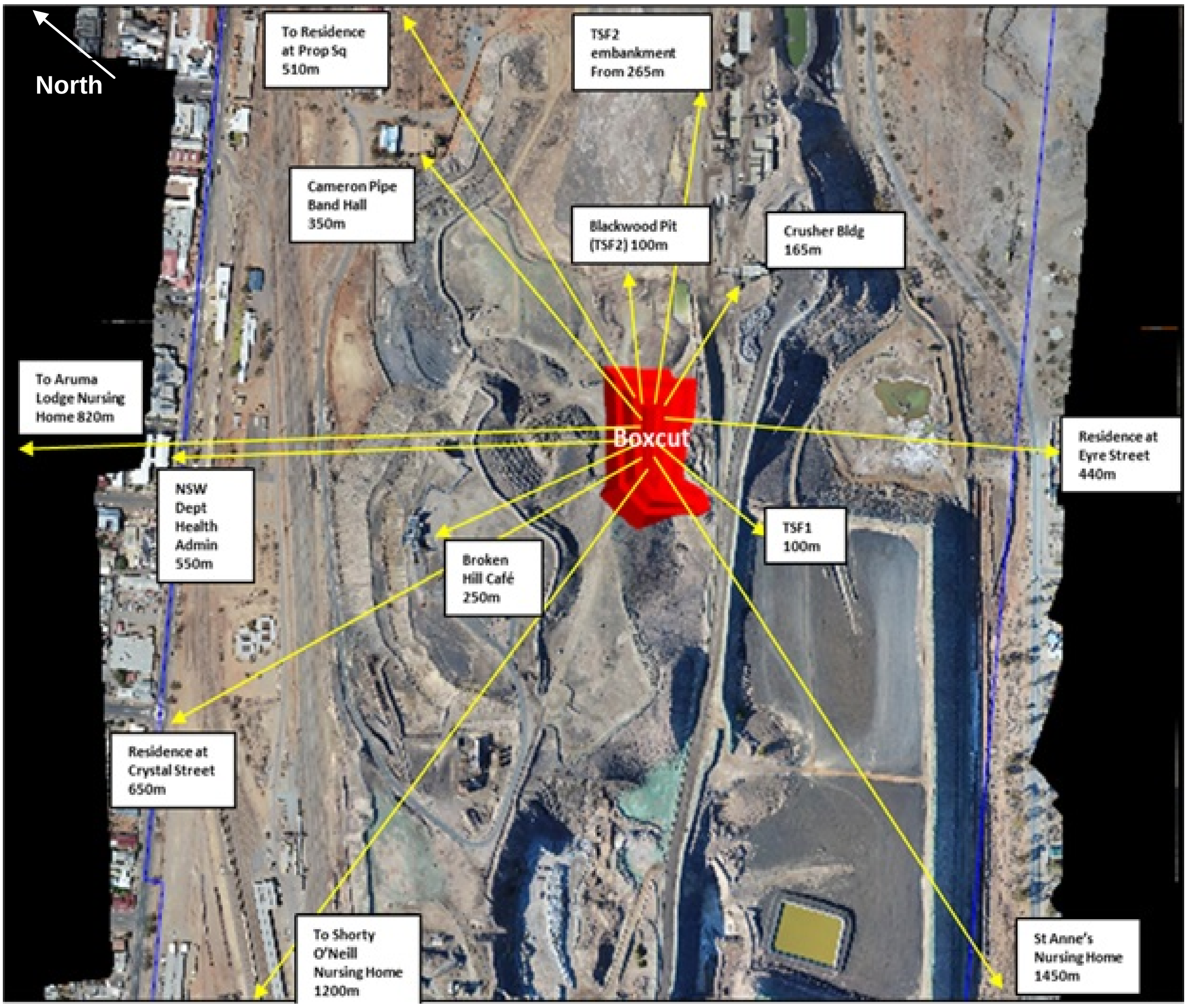
The geotechnical assessment for the boxcut (**Appendix G1**) suggests that surface bench blasting within the boxcut would be required within weathered material beneath the overlying fill material which would be removed using free dig methods. The decline would be advanced a relatively short distance (20 m or less) from the portal entrance into Transitional material and then Fresh Rock material with the remainder of the decline developed from underground workings.

Other aspects from the geotechnical assessment that may influence the blasting design include:

- Identified areas of fragmented and highly fractured zones were intersected during exploration drilling within and around the boxcut area, characterised by '*sheared, low strength material in various states of weathering*'.
- While the boxcut is not anticipated to intersect significant underground workings, the long history of mining in the area does require that risks associated with drilling, blasting and mining above voids and adjacent to old shafts need to be considered.
- Ground conditions at the portal batter were described as '*poor to very poor'* and blasting in that area would need to be reviewed with respect to slope stability and support requirements, as conditions are encountered. Careful consideration of wall damage from blasts in that area would be necessary, with controlled limits for blasting to be assessed once less critical blasting outcomes have been reviewed.

Blasting impacts were considered for a number of receptors as shown in **Figure 8-27** these included the closest residents (440 m), commercial and other non-industrial properties (Café - 250 m) and BHOP infrastructure, including the tailings storage facilities.

Figure 8-27 Receptors for Blasting Assessment – Boxcut, Portal and Decline



8.4.2. Methodology

8.4.2.1. Vibration Blast Parameters

Prism used generic guidelines to estimate blasting impacts in order to demonstrate that environmentally compliant and safe blasting can be achieved for a range of likely blast requirements and ground conditions. Once the overlying fill material has been excavated these can be further refined as the boxcut is fully defined.

Therefore it has been assumed that conventional surface blast designs, yielding powder factors in the range 0.65 to 0.8 kg/m^3, would provide adequate fragmentation. Presplit blasting may be required at the 70-degree portal batter, or alternative 'smooth wall' and/or 'limits' blasting methods may be utilised.

A small number of development rounds would also be required to be fired from surface (daytime construction events), in order to establish the portal and the start of approximately 400 m of decline. It has been estimated that this may involve as few as 5 or 6 development blasts, fired from the portal entrance and similar to underground development blasts already in use at Rasp Mine.

A general approach has been used to estimate a reasonable range of preliminary operational blasting parameters to be used as a starting point for modelling, these are shown in **Table 8-27**. The approach taken by Prism was based on Blast Dynamics and Dyno Nobel (various) as referenced in the Blasting Report. The preliminary blasting parameters were also informed by blasting experience at the site and relevant Australian Standards for blast vibration.

Table 8-27 Preliminary Range Blast Parameters

Parameter	Moderate Intensity Blasting		High Intensity Blasting	
Blast hole diameter	76	89	76	89
Bench height	8 to 10	10 to 12	8 to 10	10 to 12
Hole angle (degrees)	90	90	90	90
Rock density (g/cc)	2.2 to 2.6	2.2 to 2.6	2.2 to 2.6	2.2 to 2.6
Explosive density (g/cc)	1.1	1.1	1.1	1.1
Charge density (kg/m)	5.0	6.8	5.0	6.8
Burden (m)	2.4	2.8	2.2	2.6
Spacing (m)	2.8	3.2	2.5	3.0
Stem height (m)	2.2	2.5	2.1	2.4
Mass charge per hole (kg)	35 to 45	60 to 75	35 to 45	60 to 75
Powder factor (kg/m^3)	~0.65	~0.65	~0.08	~0.08
Timing	17 m/s to 25 m/s inter-hole delays and 25 m/s to 42 m/s or 67 m/s inter-row delays on a limited number of rows for sequential firing.			

8.4.2.2. Overpressure

The method used for estimating likely overpressure impacts from surface blasts was based on the calculation of distances to the 120 dBL contour (D120) or 115 dBL contour (D115) in front of the free-face and behind the face by Terrock (2013). For vertical holes at 90 degrees, the D115 and D120 distances 'behind' a buffered blast (no free face) were used as the main limiting criteria, as it was considered that free-face blasting should not be required within the boxcut if properly sequenced.

If presplit blasting was required around the portal (70 degree design batter) conservative levels of confinement using a combination of stemming and conveyor belt matting were recommended by Prism to mitigate overpressure levels.

It is anticipated that the majority of blasts in the decline would be conducted from underground to avoid overpressure impacts to surface areas.

8.4.2.3. Flyrock

To estimate potential flyrock distances, Prism used the 'cratering' model by McKenzie (2009) as a general reference and the empirical models for rifling (stemming ejection) and face burst from a free face by Moore and Richards (2005).

8.4.3. Blasting Criteria

Table 8-28 and **Table 8-29** list the blasting criteria as indicated in the PA (Schedule 3 Condition 18) and EPL (L5). These apply when blasting is measured at the nearest affected residential or other sensitive receiver.

Table 8-28 Blasting Criteria (excluding Block 7)

Location	Airblast Overpressure (dB (Lin Peak))	Ground Vibration (mm/s)	[a]Allowable Exceedence
Residence on privately owned land	115	5	[b]5% of the total number of blasts over a 12 month period
	120	10	0%
Public infrastructure	-	100	0%

Table 8-29 Blasting Criteria (Block 7)

Location	Airblast Overpressure (dB (Lin Peak))	Ground Vibration (mm/s)	[a]Allowable Exceedence
Residence on privately owned land	115	[c]3 (interim)	[b]5% of the total number of blasts over a 12 month period
	120	10	0%
Broken Hill Bowling club, Italio (Bocce) Club, Heritage Items within CML7	-	50	0%
Perilya Southern Operations	-	100	0%
[d]Public infrastructure	-	100	0%

Notes to **Table 8-28** and **Table 8-29:**

a The allowable exceedance must be calculated separately for development blasts and production blasts;

b The 5% allowable exceedance does not apply to production blasts until the Proponent has successfully completed a Pollution Reduction Program aimed at achieving this goal, as required by the EPA under the Proponent's EPL (No.12559), or as otherwise agreed with the EPA;

c The interim criteria applies unless and until such time that the Proponent has written consent from the Secretary to apply site specific criteria in accordance with condition 19 of this approval; and

d The Proponent must close South Road to pedestrians if blasts are expected to exceed a peak particle velocity ground vibration of 65 mm/s at the road reserve surface, while the blast firing occurs.

These criteria do not apply if the Proponent has a written agreement with the relevant owner to exceed these criteria, and has advised the Department in writing of the terms of this agreement.

The lower levels of 5 mm/s for vibration and 115 dBL for peak overpressure were used for design purposes in the Blasting Report. The AS2187 guidelines for the avoidance of structural damage at non-residential, commercial and industrial locations were used to define appropriate ground vibration and overpressure limits at such locations surrounding the project. Blast parameters selected to meet stringent residential amenity limits have been demonstrated to also meet damage limits for non-residential, commercial and industrial locations, at closer proximity to the proposed boxcut than the nearest residences.

Appropriate ground vibration limits for the nearest adjacent tailings facilities at TSF1 and TSF2 were based on recommendations provided by Golder. Golder investigated known adverse impacts to tailings storage facilities from vibration blasting and could find no evidence of damage for blasts up to 100 ppv. However to ensure factors of safety Golder made the following recommendations:

- TSF1 – a limit of 25 ppv;
- TSF2 – a limit of 50 ppv, and
- TSF3 – a limit of 100 ppv.

In addition Prism referenced the mandated requirements by the Dams Safety NSW (BHOP Approval Mining Near a Declared Dam October 2019 – Annexure D Condition 14.1):

> *"The Company shall ensure the peak particle velocities generated as a result of mining will not exceed 30 mm/s at any point on the Blackwood Tailings Dam embankments."*

In reference to other sensitive locations Prism applied the following:

- Residential locations – PA and EPL conditions for both vibration and overpressure.
- Commercial buildings – 15 mm/s for ground vibration.
- Non sensitive industrial sites – 25 mm/s for ground vibration.
- A conservative target for peak overpressure of 115 dBL, noting that cosmetic damage to structures has not been found for levels below 133 dBL which is a target level for non-residential buildings.
- A factor of safety of 4 for a flyrock clearance zone of 300 m (where flyrock is expected to range up to 75 m).

8.4.4. Modelling Results

8.4.4.1. Ground Vibration

Using the preliminary blasting parameters as identified in **Table 8-27** as a starting point Prism identified the blasting parameters that would be required to achieve the ground vibration limits / targets as specified. **Table 8-30** provides the modelled results outlining the blasting parameters required to be within the target / limit at each of the selected receptors. At all locations with the exception of TSF1 a maximum charge of 75 kg can be applied. At TSF1 ground vibration limits were exceeded when a charge mass of 75 kg was applied (a peak of 45.5 mm/s, calculated at twice the average result, which Prism deemed as highly conservative). As recommended by Prism these results need to be confirmed with in-situ results and actual blast data as blasting would consist of small blasts on weak ground with relatively low levels of vibration transmission. Prism recommend a starting point of 35 kg for blasts 100 m from TSF1 with blasts reviewed and adjusted based on actual results.

Table 8-30 Ground Vibration – Estimated Levels

Location	K^2 factor (average)	K^2 factor (upper)	Exponent b^2	Minimum distance (m)	Maximum[1] charge (kg)	Peak vibration average (mm/s)	Peak vibration upper (mm/s)	Target/ Limit (mm/s)	Achievable (Yes/No)
Nearest residential locations[3]									
Nearest residence at Eyre Street	1140	2280	-1.6	440	75	2.1	4.3	<5	Y
Nearest resident at Proprietary Square[3]	1140	2280	-1.6	510	75	1.7	3.4	<5	Y
Nearest residence at Crystal Street[3]	1140	2280	-1.6	650	75	1.7	2.3	<5	Y
Nursing home locations									
Aruma Lodge	1140	2280	-1.6	820	75	0.8	1.6	<5	Y
Shorty O'Neill's	1140	2280	-1.6	1200	75	0.4	0.9	<5	Y
St Anne's	1140	2280	-1.6	1450	75	0.3	0.6	<5	Y
Commercial / non-residential locations									
Broken Hill Café	1140	2280	-1.6	250	75	5.3	10.5	<15	Y
Cameron Pipe Band Hall	1140	2280	-1.6	350	75	3.1	6.1	<15	Y
NSW Dept Health Building	1140	2280	-1.6	550	75	1.5	3.0	<15	Y
Industrial facilities									
Rasp Mine Processing Plant	1140	2280	-1.6	165	75	10.2	20.4	<25	Y
TSF2 Blackwood Pit (closest point)	1140	2280	-1.6	100	75	22.7	45.5	<75[4]	Y
TSF2 Blackwood Pit (EMB3)	1140	2280	-1.6	280	75	4.4	8.8	15 – 30	Y
TSF1 Historic Pit (first blast worst case)	1140	2280	-1.6	100	35[5&6]	12.4	24.7	<25	Y[6]

Notes:

1. Maximum required charge mass of 75kg/hole is based on the 'worst case' (i.e. highest impact) blast parameter ranges for surface blasting, presented in Table 1. A conservative MIC of 35kg has been suggested for the first blast in order to assess vibration impact at TSF1 and TSF2.
2. Site constant 'k' and site exponent 'b' are used to define the relationship between peak vibration (mm/s) at a distance from the blast (m), with a maximum charge (kg). These parameters should be validated for more accurate vibration estimation once operational blasting begins.
3. Residential limits defined under ANZEC guidelines. Non-residential limits defined under AS2187.
4. Modelled to meet Dams Safety limit at embankments.
5. Blasting proposed with MIC's up to 75kg may present compliance issues for some blasts, with respect to the suggested TSF1 limits

Location	K^2 factor (average)	K^2 factor (upper)	Exponent b^2	Minimum distance (m)	Maximum[1] charge (kg)	Peak vibration average (mm/s)	Peak vibration upper (mm/s)	Target/ Limit (mm/s)	Achievable (Yes/No)

of 25mm/s PVPPV. The first Boxcut blast has therefore been proposed with an initial MIC of 35kg, in order to validate the ground vibration models used in this report.

6. Modelled 75kg blasts at 100m has shown to be above the recommended blast limit. Maximum charge would only increase from 35kg as blasting experience shows limits can be met.

8.4.4.2. Overpressure

To achieve the required overpressure limits as specified, Prism increased the stem heights from the preliminary blasting parameters (up to 2.5 m for 76 mm holes and 3.1 m for 89 mm holes). **Table 8-31** provides the modelling results for overpressure from blasting indicating overpressure compliance (115 dBL and 120 dBL) for buffered blasts at the closest residential locations (440 m) is achievable using increased stem heights, with pattern size adjusted to achieve powder factor requirements. **Table 8-32** shows how these modelled results translate to selected receptor locations.

Table 8-31 Overpressure – Estimated Levels (using increased stem height)

Parameter	Revised moderate intensity blasting parameters for overpressure control				Revised high intensity blasting parameters for overpressure control			
Diameter (mm)	76	76	89	89	76	76	89	89
Bench height (m)	8	10	10	12	8	10	10	12
Burden (mm)	2.3	2.3	2.7	2.7	2.1	2.1	2.5	2.5
Spacing (m)	2.8	2.8	3.1	3.1	2.5	2.5	2.8	2.8
Charge density (kg/m)	5	5	7	7	5	5	7	7
Charge mass (kg)	33	42	55	68	33	42	55	68
Stem height (m)	2.4	2.5	3	3.1	2.4	2.5	3	3.1
Stem height (diameters)	32	33	34	35	32	33	34	35
Powder factor (kg/m^3)	0.64	0.66	0.65	0.67	0.78	0.81	0.78	0.81
Ka115 Behind	220	220	220	220	220	220	220	220
D115 (m) Behind	410	403	413	408	410	403	413	408
Ka120 Behind	180	180	180	180	180	180	180	180
D120 (m) Behind	248	244	250	247	248	244	250	247
Ka115 in front	290	290	290	290	290	290	290	290
D115 (m) in front	910	990	1071	1150	1143	1243	1299	1394
Ka120 in front	250	250	250	250	250	250	250	250
D120 (m) in front	628	683	739	794	788	858	896	962

Table 8-32 Maximum Overpressure at Identified Selected Locations

Location	Minimum distance (m)	Estimated peak blasting overpressure (dBL)	Target / Limit (dBL)	Achievable (Yes/No)	Comments
Nearest residential locations					
Nearest residence at Eyre Street	440	113	<115	Y	Amenity limit
Nearest residence at Prop Sq	510	112	<115	Y	Amenity limit
Nearest residence at Crystal Street	650	109	<115	Y	Amenity limit
Nursing home locations					

Location	Minimum distance (m)	Estimated peak blasting overpressure (dBL)	Target / Limit (dBL)	Achievable (Yes/No)	Comments
Aruma Lodge	820	106	<115	Y	Amenity limit
Shorty O'Neills	1200	101	<115	Y	Amenity limit
St Anne's	1450	99	<115	Y	Amenity limit
Commercial / non-residential locations					
Broken Hill Café (unoccupied)	250	120	<133	Y	Damage criteria
Cameron Pipe Band Hall (unoccupied)	350	116	<133	Y	Damage criteria
Cameron Pipe Band Hall (occupied)	350	116	<120	Y	Amenity limit (upper limit)
NSW Dept Health Admin Building (occupied)	550	111	<120	Y	Amenity limit (upper limit)
Industrial facilities					
Rasp Mine Processing Plant (unoccupied)	165	126	<133	Y	Damage criteria
Rasp Mine Processing Plant (occupied)	300	118	<120	Y	Amenity limit (upper limit) at blast clearance distance

8.4.4.3. Flyrock

Table 8-33 provides modelling results for the estimated flyrock range from blasting. The data indicates the potential distance that flyrock could travel from the boxcut using the increased stemming heights as required to meet overpressure limits. Results show that the maximum range of flyrock is estimated from 41 m for a 76 / 89 mm hole blast with cratering (vertical) holes, to 74 m for a 89 mm hole blast with stemming ejection (vertical holes).

Table 8-33 Estimated Flyrock Range

Parameter	Revised moderate intensity blasting parameters				Revised high intensity blasting parameters			
Diameter (mm)	76	76	89	89	76	76	89	89
Bench height (m)	8	10	10	12	8	10	10	12
Burden (m)	2.3	2.3	2.7	2.7	2.1	2.1	2.5	2.5
Spacing (m)	2.8	2.8	3.1	3.1	2.5	2.5	2.8	2.8
Charge density at 1.1g/cc (kg/m)	5	5	7	7	5	5	7	7
Charge mass (kg)	33	42	55	68	33	42	55	68
Stem height (m)[1]	2.4	2.5	3	3.1	2.4	2.5	3	3.1
Stem height (diameters)	32	33	34	35	32	33	34	35
Powder factor (kg/m3)	0.64	0.66	0.65	0.67	0.78	0.81	0.78	0.81
Maximum fly-rock range (calculated) (m)								
Stemming ejection (vertical holes) [2]	66	63	74	71	66	62	74	71
Stemming ejection (angled presplit holes) [1]	51	48	38	36	51	48	38	36
Cratering (vertical holes) [2]	45	41	44	41	45	41	44	41

Notes: 1 Stem heights modified for overpressure control also mitigate fly-rock risks.
2 Blast clearance required at up to 300m to satisfy a factor of safety of up to four times maximum fly-rock range. Presplit charge density <2kg/m for decoupled cartridge explosives.

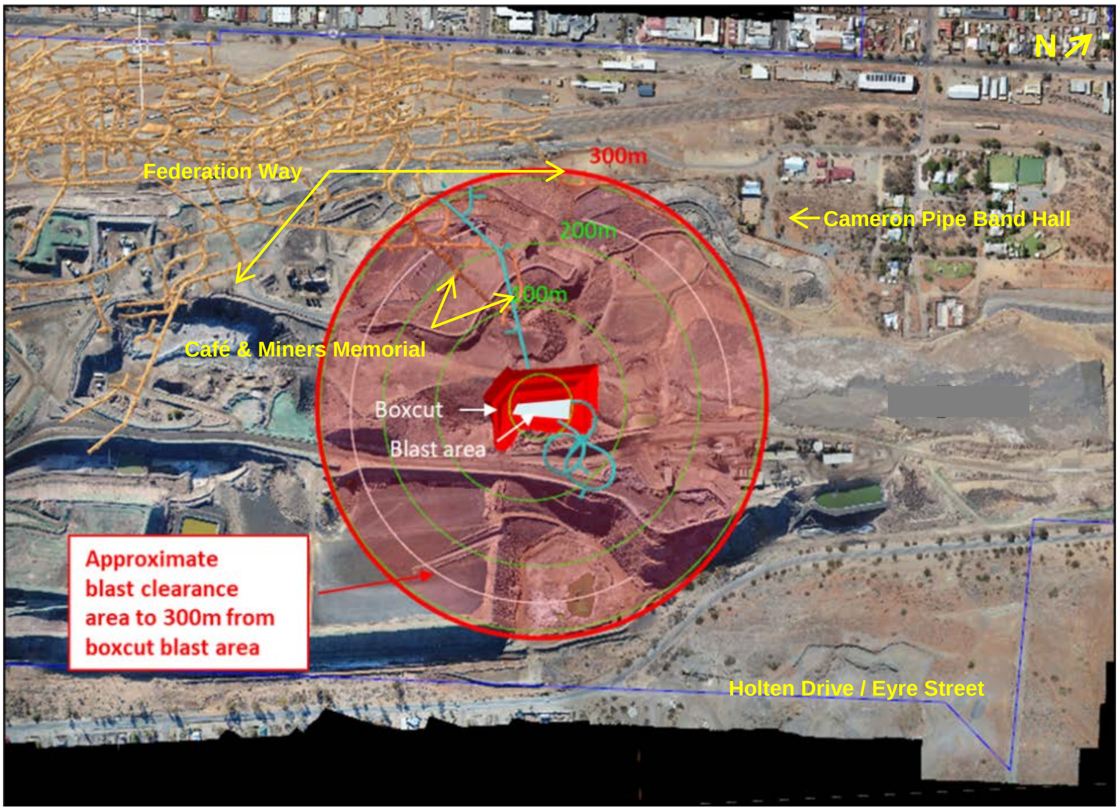
Prism has calculated clearance zones based on factors of safety of - two for infrastructure and four for persons. Therefore with a maximum flyrock range of 74 mm (as shown in **Table 8-33** for Stemming ejection (vertical holes), a clearance zone of 150 m would be required to protect infrastructure and a 300 m clearance zone would be required to protect persons. Clearance zones are shown in **Figure 8-28**.

Evacuation of all persons within the 300 m ‘red’ zone would be required prior to blasting. For an added level of safety Holten Drive / Eyre Street would also be closed and, on recommendation from Prism, the Cameron Pipe Band Hall evacuated, although both lay outside the evacuation zone.

To ensure safety of persons and infrastructure BHOP propose to undertake a risk assessment process including consultation with relevant neighbours including, Crown Lands and BHCC, to ensure all entry points are identified and areas are fully evacuated. This would ensure that adequate notification is made prior to blasting events.

No residential housing or other commercial or industrial premises (apart from the Café and Miners Memorial, both located on CML7 and the Cameron Pipe Band Hall which is located on a surface exclusion zone within CML7) would need to be evacuated.

Figure 8-28 Flyrock Blast Clearance Distance



Modelling by Prism shows that blasting within the proposed boxcut and associated portal / decline area would be achievable using conventional surface and tunnel development blasting methods, based on identified distances to sensitive receivers, within ANZEC guidelines and PA / EPL limits.

8.4.5. Mitigation Measures and Monitoring

8.4.5.1. Mitigation Measures

BHOP has an extensive program for underground blasting at the Rasp Mine including risk assessment processes, blast design reviews and sign-off procedures, guidelines for blasting parameters, community notification of blasts. These are detailed in the BHOP Technical Blasting Management Plan (BHO- PLN-MIN-002).

The following mitigation measures would be undertaken for MOD6 blasting activities in addition to any relevant existing measures:

- As recommended by Prism, an appropriately qualified project supervisor would be engaged to establish a blast management plan and oversee the process of surface blasting.

- Mine blasting vibration data, as blasting is undertaken, would be used to confirm modelling results and identify peak ground vibration and overpressure trends.
- A conservative starting point of 35 kg would be used for blasting near (approximately 100 m) TSF1 to validate the modelling results and ensure blasting limits are not exceeded.
- Conservative stem heights would be used, as per blast design, to achieve required overpressure levels.
- There would be no free-face blasting.
- A flyrock clearance zone of at least 300 m would be installed prior to each blast with evacuations of the Café, Miners Memorial and Cameron Pipe Band Hall and closing of Federation Way and Holten Drive during blasting.
- Identity conditions surrounding the portal and assess in regards to blasting methods once known.
- BHOP would conduct a more detailed risk assessment for potential impacts to site infrastructure prior to blasting (crusher).
- Establish a trigger warning (70% of target) for blasts within 100 m of TSF1 and TSF2.
- Consultation with relevant neighbours, including Crown Lands and the BHCC, notifications would be conducted prior to blasting events.
- Update the Technical Blasting Management Plan (Technical Blasting Management Plan (BHO-PLN-MIN-002).

In addition a Surface Blasting Management Plan would be developed prior to the commencement of surface blasting activities and would include but not limited to requirements for risk assessments, blast plan and design, supervision, clearance zones with identified access points and evacuation requirements, record keeping and review of blasting parameters used.

8.4.5.2. Monitoring

BHOP have a network of blast vibration monitors surrounding the Mine site, as shown in **Figure 8-29** and a system using roving monitors when blasting queries are raised or investigation is required. These would continue to be used during and following the MOD6 works, in accordance with the PA / EPL conditions (V1 to V5 shown in green).

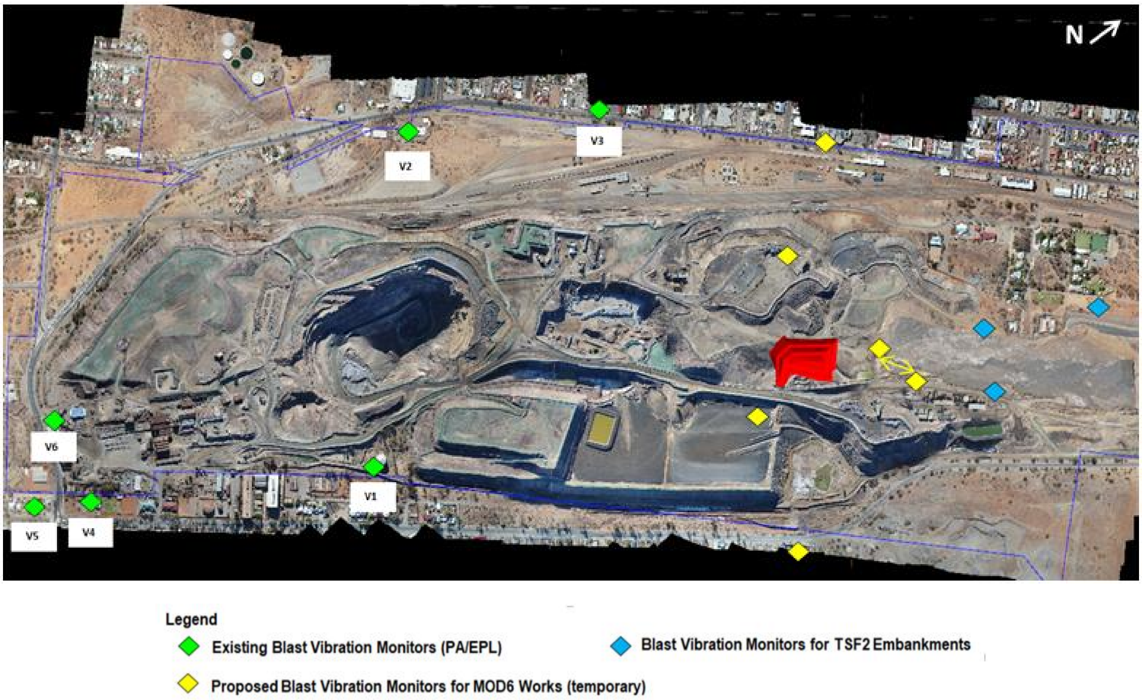
Three vibration blast monitors have been installed on each of the embankments at TSF2 as required by Dams Safety, NSW (shown in blue). These would remain for the active life of the facility and while blasting events are planned to occur in the Blackwood – Notification Zone.

BHOP propose to use a series of installed and roving monitors to measure ground vibration and overpressure for MOD6 works (indicative locations shown in yellow and would be confirmed during detailed design):

- Two blast vibration monitors would be installed in line with the boxcut blasting works north and south of the boxcut to be located near residential areas to monitor and confirm amenity ground vibration limits are met. The location of these monitors would be confirmed during detailed design in consultation to ensure appropriate siting and level of security.
- A blast vibration monitor would be installed at the Café / Miners Memorial to monitor and confirm damage ground vibration limits are met. The location of the monitor would be confirmed during detailed design in consultation to ensure appropriate siting and level of security.
- Two blast vibration monitors would be installed at TSF1 co-placed with the VWPs as to monitor and confirm ground vibration targets, as advised by Golder to monitor vibration levels at and within the TSF1 tailings. Golder have been engaged to advise on the installation of these monitors.
- A roving blast monitor would be used alternating between the closest points of TSF2 and Embankment 3 to the boxcut as recommended by Prism. The location would on blasting results to monitor and confirm targets are met.

A trigger warning level of 70% of the PPV limits described would be applied to the blast design and a redesign of the blast undertaken where predictions exceed required targets / limits (following preliminary blast parameters). This condition would be reflected in the BHOP Technical Blasting Management Plan (BHO-PLN-MIN-002) for TSF2 embankments and the Surface Blasting Management Plan (to be developed) for MOD6 construction works.

Figure 8-29 Current Blasting Vibration Monitoring Network



8.5. Kintore Pit Slope Stability

During the risk assessment two potential risks were identified in relation to the stability of slopes within Kintore Pit. The first related to the historic tailings slope located in the north wall of the Pit and the second related to the waste rock stockpile located to the south-west within the Pit.

BHOP engaged GCE to undertake an assessment with particular reference to the impact of wet tailings abutting these structures:

- Kintore Open Pit – Slope Stability Analysis of Existing In-Pit Waste Rock Dump, During Tailings Placement, August 2019 (**Appendix G3**).
- Kintore open Pit – Stability Analysis of Pit Slope Comprising Historic Tailings, Letter Report, August 2019 (**Appendix G4)**.

8.5.1. Kintore Pit – Historic Tailings Slope Stability

A risk identified through the risk assessment process was the potential for the historic tailings slope to fail through water ingress into the tailings from the fresh tailings deposited into the Pit and any rainfall that may settle on the fresh tailings deposited against the historic tailings slope.

The placement of the historic tailings is unknown however it was some time prior to the commencement of Kintore Pit in 1983. At the commencement of works for the exploration decline in 2007 a safety bund was installed at the base of this slope to protect personnel and plant. This tailings slope has remained stable throughout the tenure of the Rasp Mine operation.

GCE conducted a two-dimensional limit equilibrium analysis of the historic tailings slope to assess the stability of the slope with various slope configurations, incorporating the progressive filling of the Pit with fresh tailings and associated transient groundwater saturation profiles. The study was conducted on the deposition of filtered tailings with no placement of waste rock.

GCE used the industry standard Roscience Inc. software *Slide* to conduct the limit equilibrium slope stability analysis. Circular failure was considered as the most likely failure mode given the weak, consistent and structure-less material properties assigned to the historic tailings which were modelled to behave similarly to massive weak rock and / or soil.

GCE did not observe any structure within the exposed tailings slope that may induce kinematic style failure mechanisms such as toppling, wedge or planar failure.

GCE applied a factor of safety of 1.3 to the modelling as the slope would be effectively covered and buttressed by the placement of future tailings. Three configurations were assessed:

- Slope Configuration 1 - As is case, with no fresh tailings deposited in the Pit.
- Slope Configuration 2 - With 25 m of fresh tailings deposited.
- Slope Configuration 3 - With 50 m of fresh tailings deposited.

Samples of the historic tailings were collected and tested with results derived from the combination of direct shear testing, saturated and unsaturated UCS testing of intact samples. Results were considered by GCE, in line with their experience of such materials and understanding of the slope performance to date, that the tailings material tested successfully under dry conditions however, total disintegration and strength loss was observed under saturated conditions

GCE also assessed the impact that groundwater may have on the slope stability. Three groundwater conditions were assessed for each slope configuration:

- Dry – no groundwater applied to the model.
- Flat – a horizontal piezometric surface applied at the level of the top surface of the fresh tailings.
- Sloped – a sloping piezometric surface applied from a 50 m setback from the Pit crest down to the level of the top surface of the fresh tailings. This was considered a worst case scenario and unlikely to occur as observations of the historic tailings wall over the years of the Rasp Mine operations has shown it to be effectively free draining and it is assumed to be highly porous.

The results from the stability analysis are summarised in **Table 8-34**.

Table 8-34 Summary of Stability Modelling Results for the Historic Tailings Wall

Configuration	**Groundwater**		
	Dry	**Flat**	**Sloped**
Slope 1 (no fresh tailings)	FoS min = 1.142 Multi batter slope scale failure.	FoS min = 1.142 Multi batter slope scale failure.	FoS min = 0.875 Significant slope scale failure indicated.
	FoS < 1.3 Numerous failure surfaces indicating significant slope scale failure potential.	FoS < 1.3 Numerous failure surfaces indicating significant slope scale failure potential	FoS < 1.3 Significant slope scale failure, including floor heave indicated.
		No material change from dry condition.	Significant reduction in stability from dry condition. Low likelihood of transient groundwater condition.
Slope 2 (25 m fresh tailings)	FoS min = 1.164 Slope scale failure	FoS min = 1.164 Slope scale failure.	FoS min= 1.116 Slope scale failure.
	FoS < 1.3 Significant slope scale failure indicated.	FoS < 1.3 Significant slope scale failure indicated.	FoS < 1.3 Significant slope scale failure, including floor heave indicated.
	Stability slightly increased	No material change from dry	Significant reduction in stability from dry condition.

Configuration	Groundwater		
	Dry	Flat	Sloped
	from Slope 1 case.	condition.	Low likelihood of transient groundwater condition.
Slope 3 (50 m fresh tailings)	FoS min = 1.421 Slope scale failure to top of tailings.	FoS min = 1.421 Slope scale failure to top of tailings.	FoS min = 1.420 Slope scale failure to top of tailings.
	FoS < 1.3 No failure surfaces indicated.	FoS < 1.3 No failure surfaces indicated.	FoS < 1.3 No failure surfaces indicated.
	Stability significantly increased from the Slope 1 case.	No material change from dry condition.	No material change from dry condition.

The slope stability analyses conducted by GCE highlights the potential for slope scale instability of the historic tailings slope under certain hydrogeological conditions. Circular failure or composite failure with a major circular component was considered by GCE as the most likely potential failure mechanism.

When potential worst case sloped piezometric groundwater surfaces were incorporated at various levels in the modelling it was shown to significantly reduce the stability of the historic tailings slope wall. Modelling results for Slope Configuration 1, the 'as is' case, indicates a minimum FoS of 0.875 for the sloped groundwater case. However, this was considered by GCE to be a worst case as the slope has been observed, over the years of the Rasp operations, to be effectively free draining and the consolidated tailings material permeable.

GCE concluded that the progressive placement of fresh tailings against the existing historic tailings slope is expected to increase the stability of the slope.

GCE confirmed that the stability analysis conducted was not compromised by the proposed co-placement of tailings and waste rock into Kintore Pit and that the stability of the historic tailings slope would further improve with this method.

Mitigation measures and proposed monitoring is outlined in **Section 8.5.3**.

8.5.2. Kintore Pit – Waste Rock Stockpile Slope Stability

A risk identified through the risk assessment process was the potential for the waste rock stockpile, located along the south-east wall within the Pit, to become unstable and result in a safety risk to personnel working in TSF3. The waste rock stockpile was formed by end tipping and dozing over the edge. It commenced in 2007 with the development of the exploration decline. At the end of 2020 approximately 1.4 Mt of material had been placed. The stockpile is approximately 60 m in height with a slope of 35^{o}. The waste rock slope has remained stable during development of this stockpile.

GCE conducted a two-dimensional limit equilibrium analysis of the waste rock slope to assess the stability of the slope with varying fresh tailings fill levels and degree of potential water saturation. The study was conducted on the placement of filtered tailings with no placement of waste rock.

GCE used the industry standard Roscience Inc. software *Slide* to conduct the limit equilibrium slope stability analysis. GCE considered circular failure as the most likely failure slope failure mechanism.

Similarly to the historic tailings slope assessment, three slope configurations (as is case, 15 m of fresh tailings and 30 m of fresh tailings) with three different groundwater cases (dry, flat and sloped) were applied to the model.

Table 8-35 Summary of Stability Modelling Results for the Waste Rock Stockpile

Configuration	Groundwater		
	Dry	Flat	Sloped
Slope 1 (no fresh tailings)	FoS < 1.0	FoS min = 1.142	FoS min < 1.0

Configuration	Groundwater		
	Dry	**Flat**	**Sloped**
	Very minor shallow sloughing style instability is indicated. which may manifest as minor riling considered typical of waste rock slopes.	Multi batter slope scale failure.	Indicates moderate slope instability. As the material is free draining GCE considered this failure very unlikely.
	FoS < 1.3 Very shallow circular failure (sloughing) is indicated.	FoS < 1.3 Very shallow circular failure (sloughing) is indicated.	
Slope 2 (15 m fresh tailings)		FoS min = 1.36 Potential for slope instability.	FoS min= 1.7 Potential for slope scale failure.
	FoS < 1.3 Very shallow circular failure (sloughing) is indicated at the top surface level of the tailings.	FoS < 1.81 Potential for circular failure resulting in floor heave through the tailings is indicated.	FoS < 1.39 Potential for circular failure resulting in floor heave through the tailings is indicated.
Slope 3 (30 m fresh tailings)	FoS < 1.3 Very shallow circular failure (sloughing) is indicated at the top surface level of the tailings.	FoS < 1.3 Very shallow circular failure (sloughing) is indicated at the top surface level of the tailings.	FoS < 1.3 Very shallow circular failure (sloughing) is indicated at the top surface level of the tailings.
	.	FOS = 1.52 Potential for slope scale instability (upper exposed slope above tailings only) is indicated.	FoS < 1.65 Potential for circular failure resulting in floor heave through the tailings.

The assessment indicates that the waste rock slope may experience shallow sloughing of the near surface materials and that the placement of engineered fill against the toe would improve the stability of the slope. The analyses also indicated that the current, free draining, waste rock dump slope has a FoS for overall slope scale stability, of greater than 1.3.

The modelling highlights the potential for shallow, circular style failure (sloughing) in all cases. This may materialise as minor rilling, which is typical of waste rock slopes.

During Kintore Pit preparation works approximately 260,000 t of the material stored in the stockpile would be transferred into the base of the Pit reducing the height of the waste rock stockpile by up to 15 m. It is proposed to place the drainage lines, as part of the seepage collection system, on the surface of the subgrade layer and no excavations would be required at the toe of the waste rock stockpile.

GCE confirmed that the stability analysis conducted was not compromised by the proposed co-placement of tailings and waste rock into Kintore Pit and that the stability of the waste rock stockpile slope was expected to increase with this method.

8.5.3. Mitigation Measures and Monitoring

8.5.3.1. Mitigation Measures

Tailings Slope

- A safety bund (minimum 2 m height) would be installed along the length of the toe of the historic tailings slope and would remain during tailings placement, to support the tailings and provide protection for personnel working in the Pit. The bund would be constructed with waste rock as part of the perimeter placement and would be progressively moved and re-established as the level of the tailings deposited rises in the Pit.
- A detailed risk assessment of the historic tailings slope would be conducted to identify safe methods for fresh tailings deposition at the historic tailings slope. In addition to the placement of

waste rock the surface of the historic tailings may be selectively protected by a layer of geotextile (or alternative product) prior to the placement of waste rock. The outcome from the risk assessment would be detailed in the Operations and Management Plan for TSF3 to be developed during detailed design.

- Development of an Operations and Management Plan for TSF3 to be in place prior to the commencement of tailings deposition.

Waste Rock Slope

A safety bund (minimum 2 m height) would be installed along the length of the toe of the waste rock stockpile and would remain during tailings / waste rock placement, to support the stockpile and provide protection for personnel working in the Pit. The bund would be constructed with waste rock as part of the perimeter placement and would be progressively moved and re-established as the level of the tailings deposited rises in the Pit.

8.5.3.2. Monitoring

Tailings Slope

Groundwater monitoring bores would be installed in the historic tailings slope to monitor water ingress into the slope. A trigger value would be established to indicate if the level of the piezometric surface is approaching the worst case Slope Configuration 3 when a stand-off distance would apply. Monitoring would be detailed in the Operations and Management Manual for TSF3 which would be developed during detailed design.

Waste Rock Stockpile

During Kintore Pit preparation works and during operations when tailings and waste are placed in the Pit an inspection program would be implemented to identify development of cracking in the waste rock stockpile slope and early signs of movement. Inspection details would be developed during detailed design and incorporated into the Operations and Management Manual for TSF3.

8.6. Tailings Liquefaction and Inrush

8.6.1. Liquefaction Background

Liquefaction is the process where the shear strength of contractive saturated or near-saturated soil or tailings (that is susceptible to liquefaction) reduces due to increased pore pressure, loading or deformation mechanisms. Liquefaction can occur under cyclic loading conditions, for example, by an earthquake event, or under static conditions where:

- There is a rise in the phreatic surface and a resulting reduction in effective stress and shear strength.
- The rate of loading is greater than the rate of dissipation of pore pressures, resulting in a reduction in effective stress.
- Lateral extrusion of a soft and compressible material (tailings or foundation soils) that underlie stiffer (and usually coarser) material. In this instance the underlying soft materials undergo horizontal creep displacements with increase in pore pressures in the contractive materials, reducing the shear strength of the soft compressible contractive materials

BHOP engaged Golder to provide an assessment of the liquefaction potential for tailings stored in TSF1, TSF2, and in the proposed TSF3, Golder Report (**Appendix B1**) in Section 5.3 for TSF3 and Section 7.1.6 for TSF2, and the *Letter Report - Liquefaction Assessment of Tailings – Rasp Mine TSF1*, April 2020 (**Appendix B2**) for TSF1.

This section also addresses the potential for inrush and inundation to underground workings should the tailings liquefy together with the design and management measures to reduce this risk.

8.6.2. Description of Tailings Storage Facility

8.6.2.1. TSF1

TSF1 is located centrally within CML7 and is adjacent to Eyre Street. Three sides of TSF1 are surrounded by mining disturbed land with Horwood Dam to the north east, an historic covered tailings storage to the southwest (Mt Hebbard) and the existing Mine Haul Road to the north. The nearest residences are about 100 m to the south of the proposed facility, separated by a road and powerline corridor. There are also a number of active industrial premises in the area; a sand supply yard, wood cutters yard, unoccupied land and a land quarry approximately 500 m east of the facility.

The historic tailings dam was constructed using remnant tailings with a starter embankment of approximately 2 m to 3 m in height and progressively raised using the upstream construction method in raises of 2 m to 3 m. Decants were used to remove excess tailings process water and stormwater discharging to Horwood Dam. The existing upper surface of the tailings has been covered with a nominal 0.5 m thick layer of waste rock and capped with slag, waste rock has been placed over the sides of the tailings embankment.

The crest of the existing TSF1 walls is 324 mRL with the top of tailings varying between 322 and 323.5 mRL.

Management of TSF1 would be outlined in the updated PHMP Blackwood Tailings Storage Facility (TSF2) *(*BHO-PLN-MET-003).

8.6.2.2. TSF2

Blackwood Pit TSF2 is located to the north east of TSF1. The depth of Blackwood Pit varies from about 40 m at the western end to about 70 m at the eastern end. In the past, portions of the eastern end of the Pit have been back filled with mine waste. Old underground workings intersect the bottom of Blackwood Pit particularly at the western end. There is no connection between these old workings and current mine workings. Blackwood Pit was partially lined at the commencement of tailings deposition.

Tailings commenced deposition into TSF2 in April 2012 and has since deposited approximately 4.74 Mt (end 2020), the facility will reach maximum capacity in September 2022.

Management of TSF2 is outlined in the BHOP PNMP Blackwood Tailings Storage Facility (TSF2) and the BHOP Operation, Maintenance and Surveillance Manual (TSF2) (BHO-MAN-MET-029) (the Manual).

8.6.2.3. TSF3

Refer **Section 3.4** for description of Kintore Pit.

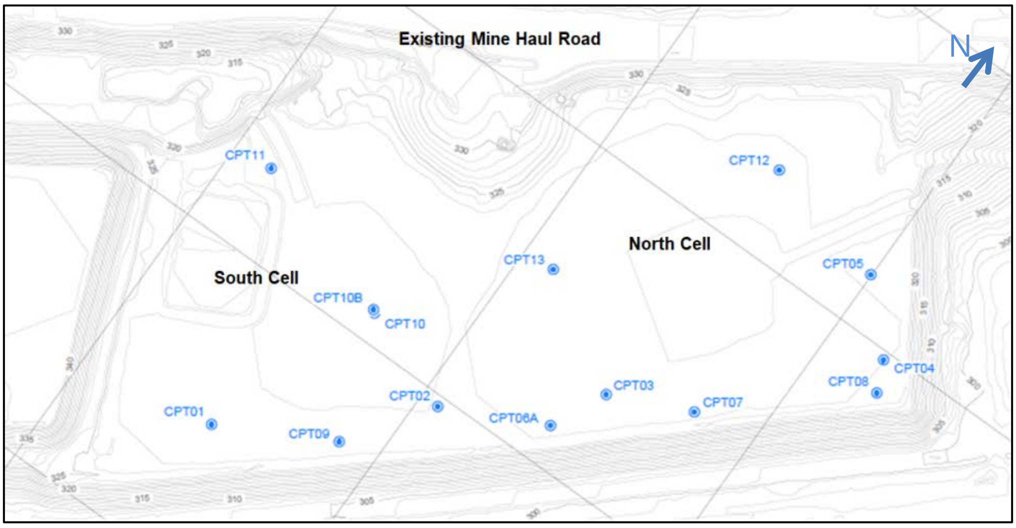
Management of TSF3 would be outlined in the BHOP Tailings Operation and Management Manual – TSF3 to be developed during detailed design.

8.6.3. Methodology & Results

8.6.3.1. Cone Penetration Testing

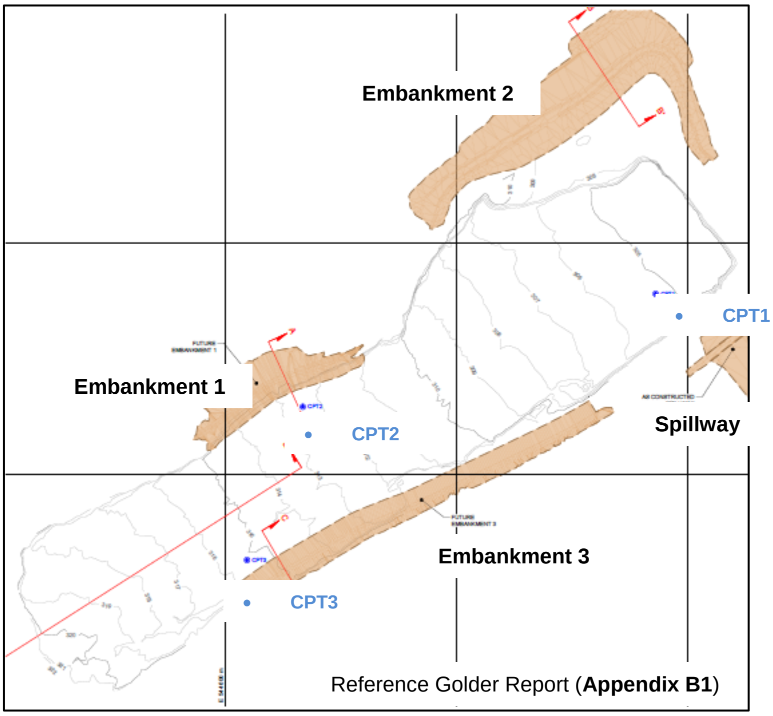
Golder conducted a screening level assessment on data received from two CPTu programs completed at TSF1, the first program in November 2019 (CPT01 – 05), and the second in March 2020 (CPT06A – 09), location of test sites are shown in **Figure 8-30**. The second investigation was carried out to measure conditions closer to the eastern edge of the facility, following an initial review of the results of the first program.

Figure 8-30 Location of CPT Testing – TSF1



Golder also assessed the risk of liquefaction of tailings in TSF2 utilising data collected from a CPTu program completed on the existing tailings in February 2020, testing sites are shown in **Figure 8-31**. The investigation was carried out in three locations on the tailings surface. Two of the locations were near Embankments 1 and 3 and the third CPTu test site was selected to be near the "low" spot of the tailings beach (north east end) where the tailings drying and desiccation conditions were expected to have been least favourable.

Figure 8-31 Location of CPT – TSF2



8.6.3.2. Depth to Saturation

A key factor in the potential for tailings to liquefy is its moisture condition. Excess pore pressures may be generated when tailings is subject to shear when it is saturated or in a near saturated condition. The in-situ pore pressure profiles were estimated based on the commencement of sustained positive pore pressures during penetration and the results of dissipation testing.

The results for TSF1 generally indicate that the tailings are saturated at depth below 14 m from surface, with three of the probes suggesting near saturation conditions at relatively shallow depths, as listed in **Table 8-36**. Both CPTu probes near the northern end of TSF1 indicated consistent near saturation conditions over most of the depth of tailings.

Table 8-36 TSF1 – Depth to Saturation and Contractive Tailings

CPT ID	Depth Probed (m)	Inferred Depth to Near Saturation (m)	Inferred Depth to Contractive Tailings (m)
CPT01	24.0	16.5	20.4
CPT02	23.2	16.3	19.3
CPT03	23.5	16.5	16.9
CPT04	25.2	3.0	22.0
CPT05	21.2	5.0	21.2 (none)
CPT06	30.5	28.0	24.0
CPT07	26.7	16.5	16.5
CPT08	27.0	14.4	24.0
CPT09	24.0	9.3	20.0

Results from the CPTu testing for TSF2 indicated that saturation conditions typically occurred in the tailings mass below 25 m from surface.

The deposition strategy for tailings in TSF3 has been designed to provide unsaturated tailings conditions given the use of partially dried compacted tailings, underlying drainage layer, and the removal of stormwater.

8.6.3.3. Static Liquefaction

The state parameter (Ψ) of the tailings has been estimated by Golder using methods proposed by Been & Jefferies (2015). The state parameter provides a framework for identification of tailings that may be prone to rapid strength loss for example, static liquefaction. Generally, tailings with Ψ < -0.05 is dilative (dense) and immune to brittle strength loss during rapid or cyclic shearing. When Ψ > -0.05, there is a risk of strength loss resulting from changes in stress, with the likelihood of occurrence and the severity of strength loss increasing with increasing Ψ.

TSF1

Generally, the upper portion of tailings in TSF1 (from surface to average 20 m depth) are inferred to be in a dilative state with a characteristic state parameter less than Ψ-0.05, and thus not susceptible to static liquefaction. In some probes, discrete layers of contractive tailings within the upper portion were identified; however the 85% percentile of test results indicates dilative tailings.

The lower portion of tailings (from average depth of 20 m to the base of the tailings (average 25 m)) are typically contractive having a characteristic state parameter greater than Ψ-0.05. On this basis Golder concluded that the lower portion of the tailings in TSF1 were in a condition that could result in static liquefaction, if trigger conditions exist.

Typical trigger conditions include:

- Rise in phreatic surface in the TSF.
- Creep deformation of the tailings slope resulting in redistribution of stresses due to strength shedding from contractive layers.
- Loss of containment due to changes in geometry at the slope toe area, or changes in loading near the slope.

TSF1 includes a bench along the east side of the facility which is also used as a road for light vehicle traffic. The bench is generally 10 m wide and 2 m to 3 m above ground level and falls from RL 308 m at the south to RL 300 m at the north. The height of the facility extends approximately 15 m to 23 m above this road / bench. This bench is formed from rock fill and it is understood that it was placed when the rock fill was installed on the outer slope of the facility in the early 1990's. A preliminary slope stability analysis was conducted of the outer slope of TSF1 along the north eastern side, with the top of contractive tailings at 2 m above the elevation of the bench. The remoulded shear strength of the dilative tailings was assumed based on the material being contractive. Based on this the FoS of the slope was estimated to be less than unity for the case if one of the trigger conditions occurred.

In summary the Golder assessment of TSF1 indicated the following:

- The bottom zone (average 14 m from surface) of tailings along the outer eastern portion of TSF1 are generally close to saturation;
- The in-situ state parameter is dilative for the majority of the upper layers, and contractive for the bottom zone;
- The conditions of the upper part of the tailings (average 20 m) do not support conditions of static liquefaction, whereas the conditions of bottom zone of the tailings (average 5 m) may support potential static liquefaction.

Golder recommended that the risk of static liquefaction of the north east side of TSF1 should be investigated further or strengthening works for the area developed and that further assessment of historical information related to this part of the site may assist in considering the conditions for this area in more detail. This recommendation is addressed in **Section 8.6.4**.

<u>TSF2</u>

Golder concluded from the state parameter analysis undertaken for TSF2 (March 2020) that the top layer (approximately 5 m) of tailings is dilative and over consolidated and are not likely to be at risk of saturation. This is likely due to a lower rate of rise, and relatively dry site conditions over the previous two years prior to the investigation. Location testing for CPT1 had numerous bands of contractive material below 5 m depth and location testing for CPT3 had a layer of strongly contractive tailings from about 24 m to 30 m below the tailings surface elevation.

Based on the results the lower portion of the tailings (below 5 m from surface) at the three locations in TSF2 are likely to be marginally at risk for static liquefaction.

The results also suggest that the tailings would have a stable surface under mobile vehicle loads.

8.6.3.4. Cyclic Liquefaction

<u>Credible Earthquake</u>

TSF1 and TSF2 were assessed by Golder against a maximum credible earthquake (MCE) with a return period of 1 in 10,000 to meet closure requirements as outlined in ANCOLD (2019) guidelines. Golder used data sourced from seismic hazard maps and peak ground accelerations for Australia (PGA) for various return periods up to 5,000 years as published by Geoscience Australia. In the absence of site specific hazard information Golder extrapolated from this data to estimate the PGA for a return period of 10,000 years, which it estimated at 0.147m/s^2 for this return period.

<u>Cyclic Resistance</u>

Cyclic liquefaction occurs where seismic loading results in increased pore pressures resulting from cyclically induced strain. The increase in pore pressures results in a decrease in vertical effective stress and corresponding reduction in strength. The cyclic resistance ratio (CRR) used by Golder is based on the method proposed by Robertson (2009) with the undrained shear strength capped to the critical state friction ratio of 1.2 (30°) based on a database of critical state properties for various soils presented by Been and Jefferies (1992).

The FoS against liquefaction is defined as CRR/CSR for a magnitude 7.5 earthquake.

For TSF1, data for all the CPTu's analysed indicate a FoS above 1 for a PGA from a return period of 10,000 years or less. This indicates that for TSF1 the tailings are not expected to liquefy under these conditions.

For TSF2, data for all the CPTu analysed indicate a FoS that is close to or just below unity for a significant portion of the tailings for a PGA from a return period of 10,000 years or less. This indicates that the tailings may liquefy under this event.

8.6.3.5. Liquefaction and Inrush

The location for the proposed boxcut and decline does not intersect known underground workings with the exception of the Wilson and Darling Shafts located on what would be the western wall of the boxcut. These shafts originally connected the underground workings to the surface however, it is understood these shafts were filled after abandonment. A known limitation with the underground historic data is accuracy and completeness of the available records. Investigative methods include both probe hole drilling and review of historic information. The proposed decline has a minimum standoff distance of 100 m from, and does not travel under, either TSF1 or TSF2

<u>TSF1 Inrush Risk from Boxcut and Decline Blasting Works</u>

BHOP has reconsidered potential impacts to TSF1 from the design, construction and installation of the boxcut and decline and in particularly blasting events. The optimisation of the boxcut and its new location further to the north has allowed a redesign of the decline, which would no longer be placed beneath TSF1. The decline has been designed to the east of the boxcut, beneath the current road network to the processing plant and ROM Pad, to avoid potential ore bearing rock. The closest point of the boxcut to TSF1 is now approximately 100 m from surface blasting and 130 m from underground blasting development for the decline.

The boxcut access road entrance to the portal is located above the TSF1 tailings level.

There are no known connections between the decline and TSF1 and no mining extending beneath TSF1. This has removed the risk of inrush and inundation from beneath this facility.

<u>TSF2 Inrush Risk from Boxcut and Decline Blasting Works</u>

There are no active mine workings beneath or in the vicinity of TSF2 as estimated using original survey mining plans. Underground mining activities for the decline development would be undertaken over 100 m to the west of TSF2 and as such no risk of inrush and inundation has been identified for this facility.

This risk would be reviewed in future PA modifications where underground mining extends close to and beneath TSF2.

<u>TSF3 Inrush Risk from Tailings Deposition</u>

Underground mining operations are currently located to the north and south-west of TSF3 and the operational areas are accessed via a decline through a portal at its base. The operational areas are also connected by a mine access tunnel (MLD) that joins the decline and passes below the base of TSF3. Historic mine plans show that shallow mine workings underlie the TSF3 base (10 m to 15 m), with numerous old vertical shafts located within the footprint of Kintore Pit (refer **Section 3.4**). The risk of inrush and inundation was identified as a critical risk for TSF3 and its design as a tailings storage facility.

Following an externally facilitated risk assessment workshop held at the Mine, it was agreed that the underground mine workings needed to be isolated from potential inrush risk from the proposed tailings deposition. To further reduce inrush risk it was also agreed that the tailings deposition operation in Kintore Pit would be an earthworks operation, with dewatered tailings to be placed and compacted in TSF3 to reduce the risk of liquefaction and inrush to underground operations from the tailings.

The use of dewatered tailings with geotechnical properties considered suitable for placement as engineered fill, was the key tailings risk reduction measure to be implemented for tailings deposition in TSF3.

BHOP conducted an investigation into the various pathways where liquid material (stormwater and tailings water) could flow from TSF3 towards underground mine workings, *Technical Report – Identification of Potential Inrush and Inundation Pathways from Present and Future TSF Facilities into Rasp Mine Underground workings (with a focus on Kintore Pit Proposed TSF3)*, BHOP, April 2020 (**Appendix K**) (Technical Report). This Technical Report presents the risks, potential pathways and proposed locations of mine plug(s) required if the tailings in TSF3 were to liquefy.

The Decline Plug (discussed in **Section 3.4.3.2**) would be installed prior to tailings deposition into TSF3. Further mine plugs or barriers are proposed and would be installed selectively and progressively, as required, to separate the historical mine workings from the active mine workings, if in-situ measurements (CPTu testing) of the placed tailings in TSF3 shows that it may be potentially liquefiable. The timing of plug construction would be linked to the periodic in-situ assessment of the placed tailings with respect to the risk of liquefaction and progress of tailings deposition in TSF3.

In addition Ground Control Engineering Ltd (GCE) conducted a geotechnical assessment of the MLD below Kintore Pit and in particular the rock mass surrounding potential plug locations, *Geotechnical Assessment of the MLD Drive Below the Kintore Pit*, Letter Report, GCE, July 2021 **Appendix G2**.

GCE concluded that:

- Kintore Pit was excavated through a complex network of historic underground workings from 1983 to 1990.
- The floor of Kintore Pit and underground workings are highly porous, water that enters the Kintore Pit drains through the historic workings into the underground mine and is currently removed by the mine dewatering system.
- The MLD passes within 2 m of old mine workings that intersect the base of Kintore Pit.
- Current mining operations have excavated a number of development drives through the old workings along the length of the MLD that would require engineered plugs or barricades if access through the MLD was to be maintained, **Figure 8-32**.
- An engineered plug or barrier is required to isolate the MLD from the Western Mineralisation Decline prior to the commencement of tailings deposition into Kintore Pit.
- Other plugs / barriers may be required lower in the mine.

GCE inspected and geotechnically mapped sections of the Western Mineralisation Decline between the portal and the Decline Plug location, the MLD drive, MLD Crowns and ML 525 drives to identify any major structures or ground conditions that may impact works associated with the placement of tailings into Kintore Pit. The ground conditions observed were generally good with only minor zones of lower strength rock associated with local shear zones. No major shear zones were identified during the mapping.

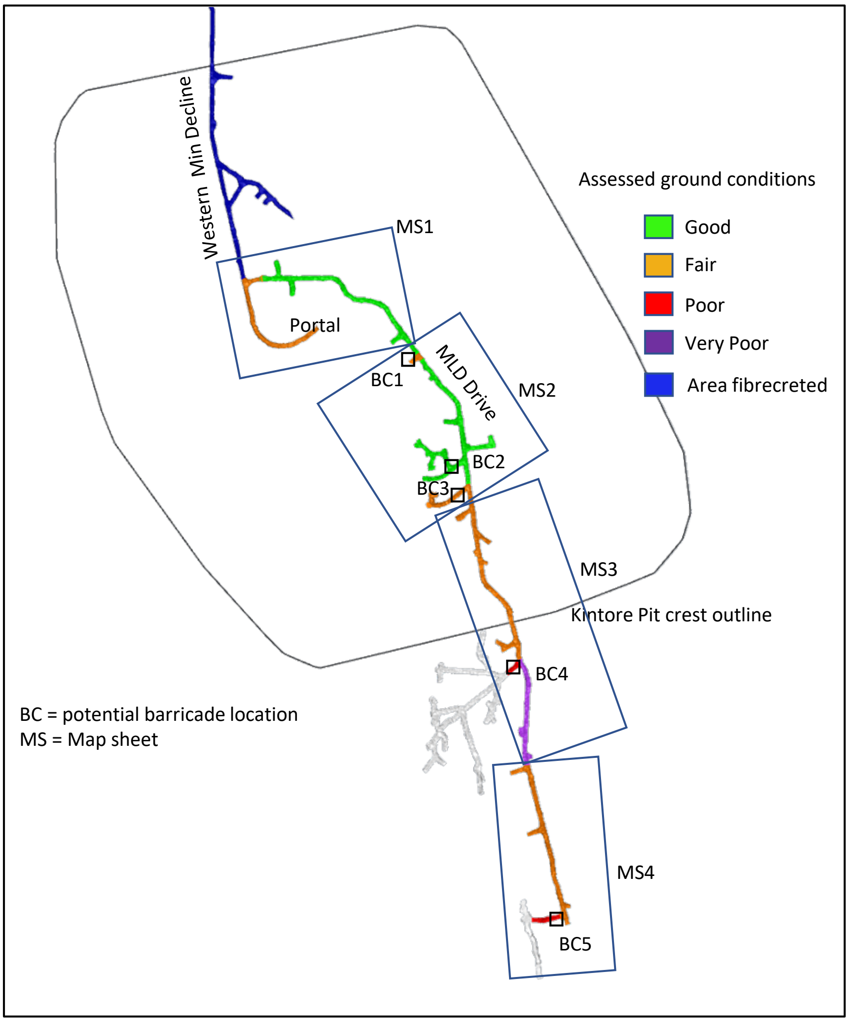
Several areas were noted as damp and one area was observed to have low water flows. Due to the highly (porous) nature of the old working fill material, there is potential for increased water flows if water is introduced to the tailings placed in Kintore Pit. As there is no definable crown pillar between the pit floor and the old workings, any water that enters Kintore Pit currently drains through the old workings and is collected and managed by the underground pumping network.

GCE recommended that if access to the MLD was required post tailings disposition, engineered barricades should be installed where the MLD drive intersects the old workings to control potential inundation risks, shown as B1 to B5 in **Figure 8-32**. The barricades should be installed prior to the commencement of tailings placement.

Alternatively where access to the MLD is not required post tailings disposal, GCE recommended that waste rock be placed in the MLD to prevent access prior to the commencement of tailings placement.

BHOP have accepted this latter recommendation and plan to close access to the MLD by filling the portal drive to the MLD intersection (or Decline Plug) and the MLD beneath Kintore Pit with waste rock. This relates to all drive areas shown within boxes (MS1 to MS4) in **Figure 8-32**. This avoids the need to install multiple barriers along the drive prior to tailings deposition.

Figure 8-32 Geotechnical Conditions MLD Drive beneath Kintore



These studies, together with seepage and water management requirements, were used by Golder in the design of the preparation works required for Kintore Pit as a tailings storage facility to ensure its integrity. Their outcomes are detailed in the Golder Report **Appendix B1** Section 5.3.

In summary the following measures have been included in the design features for Kintore Pit to minimise any potential for an inrush and inundation risk:

- Dried tailings, moisture content of tailings tested and confirmed prior to harvesting and deposition into Kintore Pit.
- Compacted tailings - tailings to be compacted to method specification (to be determined during commissioning) to achieve the required void ratio or compaction state to prevent liquefaction.
- Removal of stormwater from tailings fill area within TSF3, this is to ensure that all potential excess water is removed and is not allowed to settle on top of the tailings. The waste rock placed around the perimeter of TSF3 would be shaped so that rainwater, from the pit wall slope, would flow onto the tailings area and be removed by evaporation and/or pumping.
- Drainage at bottom of Kintore Pit, an extensive drainage system has been design to collect seepage from the road ramp into Kintore Pit, the area at the base of the Pit and along the base of

the waste rock stockpile. This drains would drain through the Decline Plug and be collected in the underground mine water management system.

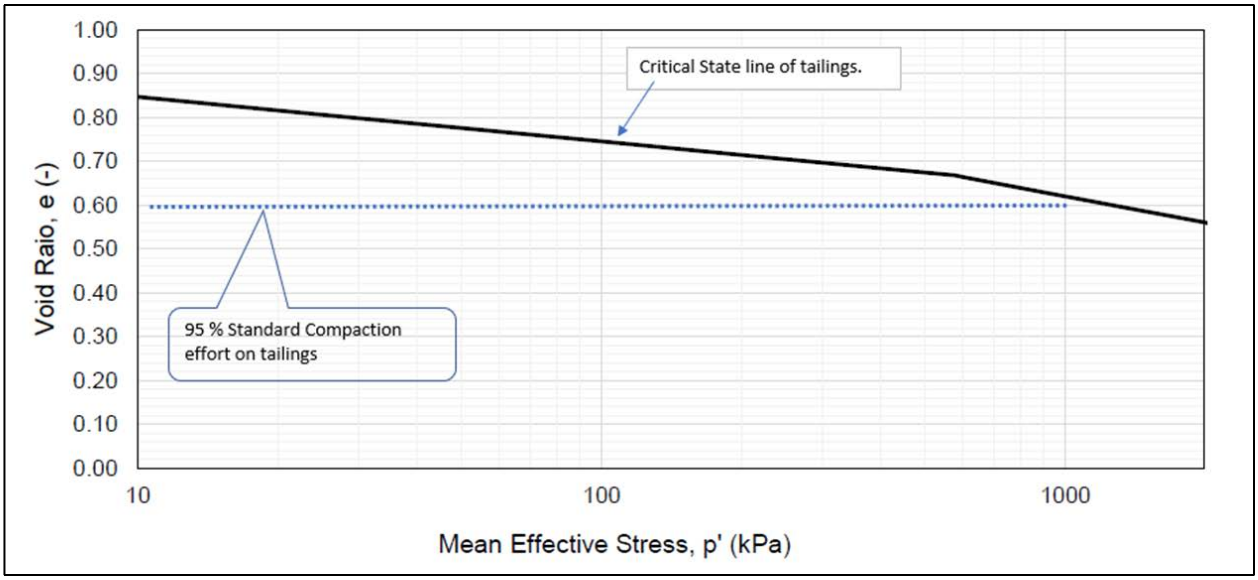
- Dry climate, Broken Hill experiences low annual average rainfall (259 mm) and high evaporation rates (2,600 mm).
- MLD and portal drive to the Decline Plug would be backfilled with waste rock, as recommended by GCE.
- Plug in decline, the Decline Plug to be installed at the intersection of the two drives (Western Mineralisation Drive and MLD) which is designed for a full hydraulic load, that is, that Kintore Pit is full of tailings and that the whole of the tailings has liquefied.
- Periodic investigation/assessment of placed tailings, CPT testing would be conducted every 10 m to 15 m of tailings placement to identify its condition for saturation and thus potential for liquefaction.
- Waste rock buttresses to be installed at known voids in the walls of Kintore Pit as the tailings rise and access becomes available.
- Additional plugs / barriers to be installed to isolate old from new workings (if required) based on the in-situ CPT testing results.

<u>TSF3 – Critical State Testing</u>

Golder also conducted critical state testing of the BHOP tailings to assess the required critical void ratio (and hence density) from compaction of the placed tailings to manage the risk of liquefaction of the tailings.

From the testing it was concluded that full stream tailings compacted to at least 95% Standard dry density is unlikely to be contractive and hence not liquefiable up to a confining pressure of approximately 1000 kPa as shown in **Figure 8-33**. This confining pressure is equivalent to a compacted tailings thickness of approximately 53 m. Golder based this estimate based on laboratory testing of tailings samples collected from the processing plant.

Figure 8-33 Critical State Line from Laboratory Testing



During tailings deposition operations the risk of liquefaction of the as-constructed tailings in TSF3 relative to depth is to be assessed from on-site specific measurements (such as the state parameter) using CPT probes. As such the risk of liquefaction would depend on the methods of deposition and compaction, as well as the effectiveness of the drying cycles.

To further reduce the possibility of water accumulation within the tailings in TSF3 it was decided that the pre-deposition works over the base of the Pit would include a drainage layer in the form of a seepage collection system and a waste rock layer. The mine plugs would be drained plugs, allowing water to pass through the plugs, with the intent of the plugs being able to retain any potential rapid migration of tailings, if they were to liquefy.

Kintore Pit TSF3 Operational Testing for Liquefaction Risk

The risk of compacted tailings liquefaction in TSF3 is considered to be low based on the Golder assessment. The tailings would be dried to approximately the Standard Optimum Moisture Content (SOMC) prior to transport to TSF3 and then placed and compacted, overlying a base drainage layer.

To confirm that the designed engineered properties are achieved during placement, CPT testing would be conducted on the placed materials after at least every 15 m thickness of engineered tailings placed.

The assessment would be carried out with a program of CPT testing to the full depth of deposit to confirm that the tailings mass is unsaturated and collect data to assess the risk of liquefaction. The CPT testing program would extend to the full depth of placed tailings as the highest loads would be at the bottom of the tailings thickness and it is this area where the most likely conditions for liquefaction may develop. The frequency of testing may transition to approximately every 10 m thickness of filling based on the outcomes of a geotechnical assessment of the characteristics of the placed engineered tailings.

Depending on the characteristics of placed materials the confining pressure at which the tailings become potentially liquefiable may be higher or lower than the 1000 kPa (approximately 53 m thickness). Once the assessed placed tailings approaches conditions that suggest it may be liquefiable, the proposed contingency plugs / barriers, as discussed in **Section 3.4.3.1,** are to be constructed to safeguard the integrity of underground workings. The concept design for these plugs considers both liquefied tailings conditions and earthquake loading.

8.6.3.6. Blasting from Ongoing Mining

Golder completed an assessment to the risk of tailings liquefaction from ongoing blasting activities at the Rasp Mine. The outcomes of this assessment are presented in the Golder Report (**Appendix B1**), *Technical Memorandum - Rasp Mine – Potential Impact of Blasting on Tailings Storage Facility'*, October 2019 (**Appendix K**).

Based on assessment of information provided by BHOP and summary of the work carried out by numerous researchers on the potential liquefaction of tailings, the following summarises the Golder findings and recommendations:

- TSF1 is an historic tailings facility with the upper portion of the deposit in a relatively dry state and moderate density based on the CPT testing which showed the lower portion of the tailings to be saturated and at a lower density. Based on these conditions a preliminary PPV of less than 25 mm/sec was suggested, and should be reviewed based on the results of the recommended piezometers, refer **Section 8.6.4**.
- Two of the embankments installed at TSF2 are partially constructed on desiccated and Two of the embankments installed at TSF2 are partially constructed on desiccated and compacted tailings, underlain by hydraulically placed tailings. CPT investigations prior to embankment construction confirmed the tailings were partially saturated and at a moderate density, with a low risk of liquefaction. Hence a PPV limit of 50 mm/s is considered to present a reasonable limit to avoid potential liquefaction.
- The containment of the proposed dewatered tailings in TSF3 is the Pit wall rock. Tailings is proposed to be compacted in layers within the Pit and operated to result in an un-saturated tailings mass. Hence blasting related liquefaction is not an issue under design conditions Golder suggested a PPV of 100 mm/s would provide a reasonable level to avoid potential liquefaction.
- Limiting excess pore pressure limits the risk of liquefaction and should be monitored with the installation of sensors, refer **Section 8.6.4**.

Dams Safety NSW has also imposed a condition of a maximum PPV limit of 30 mm/s at any point on the TSF2 embankments as a result of mining.

8.6.4. Mitigation Measures and Monitoring

8.6.4.1. Mitigation Measures

The following mitigation measures would be implemented to address liquefaction risks for TSF1, TSF2 and TSF3 for MOD6 works.

TSF1

- Validate ground vibration design predictions prior to boxcut / decline advancement, described in **Section 8.4**.
- Undertake further investigation of the risk of static liquefaction and identify any required works to be undertaken and completed prior to the commencement of MOD6 blasting activities.
- Update of the BHOP PHMP Blackwood Tailings Storage Facility (TSF2) to include TSF1.

TSF2

- Continue to monitor for any movement of the TSF2 embankments in line with requirements as outlined in the BHOP TSF2 Manual.

TSF3

The following summarises the proposed mitigation measures that would apply to control risk from inrush to underground workings from tailings placement in TSF3.

- Maintaining a moisture content of harvested tailings within the SOMC prior to deposition.
- Installing a Decline Plug as designed for hydrostatic pressure of the full potential depth of tailings plus water hammer effects as discussed in **Section 3.4.3.1.**
- Installing a seepage collection system and waste rock bridging layer to the base of Kintore Pit prior to tailings deposition.
- Timely removal of surface water from the tailings.
- Conducting CTP testing and monitoring, and installing additional plugs / barriers if required (**Section 3.4.3.1**).
- Installing waste rock buttresses over old workings as they appear, to reduce water ingress.
- Filling of the decline from the portal to the proposed plug with waste rock (9,680t).
- Filling of the MLD drive beneath Kintore Pit with waste rock (76,780 t).

In addition the BHOP PHMP Blackwood Tailings Storage Facility (TSF2) would be updated to include TSF3. Develop a Tailings Operation and Management Plan for TSF3 detailing tailings deposition and waste rock placement methods, geotechnical specifications for compacted tailings, geotechnical testing and quality assurance verification requirements (CPT testing) and water management. The PHMP for Inundation and Inrush (BHO-PLN-MIN-005) will also be updated as part of MOD6.

8.6.4.2. Monitoring

The following summarises the proposed monitoring measures.

TSF1

Monitoring would be undertaken of induced vibrations and pore pressure in the closest tailings from the blasting as it approaches TSF1.

Measurement of ground vibrations and tailings pore water pressures at the time of blasting would be used to monitor the level of tailings liquefaction (if any) and to modify the size of blasts to reduce the likelihood of liquefaction occurring. This data would provide a basis to assess the stability of TSF1 in relation to blasting at the site.

Pore water pressure sensors together with vibration monitors would be installed in the tailings for TSF1 along the northern edge to allow for site-specific assessment of:

- The PPV induced in the tailings (rather than in the rock only) and refinement of the vibration attenuation model within the tailings; and
- Potential rises in pore water pressure for given recorded PPVs.

Installation works would be completed by an experienced geotechnical engineer with the aid of a cone penetration test rig and operator to install to the required depth.

TSF2

The moisture content of deposited tailings at TSF2 would be monitored within each drying cell. This monitoring would be undertaken to the proposed harvesting depth to confirm whether deposited tailings have reached the target moisture content for harvesting (SOMC) and to what depth harvesting can be undertaken.

Pore pressure sensors together with vibration monitors have been installed in the tailings for TSF2 to allow for site-specific assessment and management of vibration blasts; two piezometers and one blasting vibration monitoring for each embankment.

TSF2 would continue to be monitored for vibration using the vibration monitors installed on each embankment against recommended PPV levels and the PPV limit imposed by Dams Safety NSW.

TSF3

The moisture content of deposited tailings at TSF2 would be monitored within each drying cell. This monitoring would be undertaken to the proposed harvesting depth to confirm whether deposited tailings have reached the target moisture content for harvesting (SOMC) and to what depth harvesting can be undertaken.

Pore pressure sensors together with vibration monitors have been installed in the tailings for TSF2 to allow for site-specific assessment and management of vibration blasts; two piezometers and one blasting vibration monitoring for each embankment.

TSF2 would continue to be monitored for vibration using the vibration monitors installed on each embankment against recommended PPV levels and the PPV limit imposed by Dams Safety NSW.

A trigger warning level of 70% of the preliminary PPV limits described would be applied to the blast design and a redesign of the blast should be undertaken if it is exceeded. This condition would be reflected in the updated BHOP Technical Blasting Management Plan.

8.7. Water

8.7.1. Raw Water Usage

Raw water consumption is not expected to be impacted by the proposed changes outlined in MOD6 as no additional usage or savings are likely from the changes.

Raw water consumption on site has increased from start up in 2012 peaking in 2018 and stabilising. Increased demand has occurred due to the installation and operation of the concrete batching plant, surface exploration drilling and the installation of an additional truck wash at the maintenance workshop wash bay. Annual site raw water consumption is shown in **Table 8-37**.

Table 8-37 Annual site raw water consumption

Year	ML
2014	254
2015	283
2016	277

Year	ML
2017	298
2018	353
2019	316
2020	322
2021	324[1]

Note 1: 2021 raw water consumption annualised based on 6 months data.

In addition water consumption has increased due to problematic ores which require a higher proportion of raw water (vs process water) in the Mill.

8.7.2. Groundwater Quality

An assessment of surface and groundwater resources, within the Project Area of the Mine was prepared by Golder Associates, *Hydrogeological Assessment for Proposed Mine Expansion, Rasp Mine*, *NSW, 2008b* and provided with the original EA at Annexure K*.* The information in this section has been taken from the original EA and provides updated information from Golder who was engaged to undertake an assessment of the potential impact of tailings placement in Kintore Pit on groundwater, Golder Report Section 7.2.3 (**Appendix B1**). ERM Perth also considered groundwater conditions in Section 2.4 of their report (**Appendix H**), discussed in **Section 8.9**.

8.7.2.1. Regional Groundwater Conditions

Broken Hill is situated on a watershed, with drainage to the north and south. Standing water levels depict general groundwater flow from north to south within the unconfined fractured groundwater system, which is predominantly controlled by natural drainage and the primary fracture orientation.

Groundwater resources in the vicinity of Broken Hill can be classified into three groups on the basis of aquifer type:

- Perched aquifers - perched groundwater present in the thin veneer of Quaternary sediments overlying the Proterozoic bedrock formations;
- Colluvial aquifers - groundwater present in thick sequences of colluvial sediments that have accumulated on downthrown fault blocks along the western margin of the Barrier Ranges; and
- Bedrock aquifers - groundwater present within structural features of the Proterozoic bedrock.

According to the Geoscience Australia *Assessment of Groundwater Resources in the Broken Hill Region* (Lewis et el, 2008), the main aquifers in the Broken Hill area consist of fractured rock aquifers of the Proterozoic Willyama Supergroup and Adelaidean sequences. These aquifers generally have low groundwater quality mainly due to elevated salinity and low yields.

Groundwater storage and flow within the bedrock aquifers is dominated by the structural geology of the formation including faults, lineaments and shear zones due to the low porosity of the rock mass (Caritat et al, 2006). Shear zones and faults, present across the Mine, are believed to be the primary structural features capable of storing and transmitting water. There is a predominant north-northeast trend to these structures, and hence the groundwater flow, in the area. Groundwater in the structural bedrock features is likely to be recharged either through direct infiltration into outcropping structures, or through leakage from perched aquifers.

There is unlikely to be significant interaction between groundwater present in bedrock structural features, and perched groundwater in shallow Quaternary deposits (Caritat, 2002).

At the Mine dewatering activities draws groundwater from a deep fractured rock basement aquifer with groundwater levels in excess of 100 m below surface. Hydraulic gradients are towards the Mine site due to these dewatering activities.

8.7.2.2. Regional Groundwater Quality

Groundwater in the Broken Hill region is generally found to be elevated in salinity. Caritat et al (2005) studied groundwater quality within the Curnamona Province (a 300 km by 300 km block of shallow to outcropping basement rocks that extends from Olary, in the north-east of South Australia, 450 kms north-east of Adelaide, to east of Broken Hill across the New South Wales border), including 46 sample sites associated with the Barrier Ranges which include Broken Hill. Chloride and sulphate levels were found to be elevated above safe drinking water criterion throughout the survey area. Previous investigations have shown variation in hydraulic conductivities and groundwater quality. On average, flow rates were estimated to be relatively low (0.1 m per year) and salinity concentrations usually highest after extended periods of low rainfall.

Lead and zinc levels were also found to be elevated above safe drinking water criterion at particular locations (refer **Table 8-38** taken from the EA). Elevated trace metal concentrations are typical of groundwater that occurs in mineralised bedrock. Heavy metal concentrations in the groundwater adjacent to mining leases were most likely the result of leaching from localised mineralisation, rather than groundwater pollution by on-site sources (Pasminco Mining Broken Hill 1995).

Table 8-38 Summary of Groundwater Chemical Data (2005)

ID	Name	Chloride (mg/L)	Sulphate (mg/L)	Lead (mg/L)	Zinc (mg/L)	EC (µS/cm)	TDS (mg/L)
BH100	Zig Zag Bore	***1360***	**993**	<0.001	0.0148	*5970*	**4718**
BH101	Alberta Well	***1260***	**764**	<0.001	0.0154	*5020*	**3569**
BH102	Old Corona Well	***1800***	**829**	0.0018	0.0115	*6630*	**4886**
BH103	Near Neds Tank	***3510***	**1810**	<0.001	<0.001	*13060*	**8407**
BH105	Warners Bore	**515**	253	<0.001	<0.001	2490	**1521**
BH106	Stevens Bore	***1110***	**734**	<0.001	<0.001	4870	**3417**
BH107	Brewery Bore	***3520***	**2570**	<0.001	0.0216	*13230*	**10053**
BH108	Poolamacca Well	***4520***	**2330**	0.0019	0.0687	*15500*	**11624**
BH109	Homestead Bore	***1710***	**881**	<0.001	0.022	*6690*	**4495**
BH115	Three Corners	***936***	**740**	0.0012	0.0082	4370	**3190**
BH116	Copper Mine Bore	***1160***	**577**	0.0022	0.0055	5090	**3899**
BH120	Nickatime Bore	***1870***	**2100**	<0.001	0.0557	*8380*	**6660**
BH121	Corner Bore	***1600***	**2100**	<0.001	0.0087	*7610*	**6086**
BH122	Gormans Bore	***1320***	**1610**	<0.001	0.1404	*6160*	**4905**
BH128	Old Corona Well Bore	**394**	201	<0.001	0.0048	2380	**1760**
BH130	Eight Mile Bore	***2570***	**1680**	<0.001	0.0215	*10240*	**7192**
BH131	Black Tank Bore	***5880***	**2750**	0.0032	0.0147	*18680*	**14231**
BH132	Silverton Commons Borehole 1	***3590***	**2110**	<0.001	0.0207	*13870*	**9889**
BH151	Mundi Mundi Ck Well	***4210***	**2400**	0.0011	<0.001	*14990*	**10986**
BH152	Sundown Borehole	***1410***	**1270**	0.0024	0.2581	*6650*	**4467**
BH153	Mt George Borehole	**332**	**654**	<0.001	0.0545	2640	**1721**
BH154	Mt George Well	***3860***	**2680**	<0.001	0.0045	*15490*	**10757**
BH155	Penrose Park #1	***12000***	**4150**	<0.001	0.0021	*34900*	**25390**
BH158	Limestone Well	***2010***	**1320**	0.0092	0.0993	*8680*	**5735**
BH159	House Bore	***884***	472	0.001	<0.001	4460	**2843**
SCK03	Farmcote Well	***4369***	**1698**	**0.029**	***12.5***	*15670*	**9925**
SCK04	Rangers Bore	***2404***	**999**	**0.072**	***8.3***	*8970*	**5785**

ID	Name	Chloride (mg/L)	Sulphate (mg/L)	Lead (mg/L)	Zinc (mg/L)	EC (µS/cm)	TDS (mg/L)
SCK05	Old Railway Bore	***1410***	**868**	**0.081**	***8.4***	*6620*	**4230**
SCK07	Springs Shear	**472**	202	0.027	***10.3***	2760	**1736**
SCK10	Ironblow Bore	***1066***	**747**	**0.13**	***10***	*5320*	**3428**
SCK11	Mulga Springs	***2462***	**769**	0.007	***13.6***	*10270*	**6381**
SCK12	Fords Well	***921***	304	0.006	***11***	4298	**2252**
SCK13	Stephens Creek Bore	**277**	100	**0.018**	***12.4***	1634	814
SCK14	Hidden Bore	***4784***	**2389**	**0.02**	***6.4***	*19260*	**11570**
SCK16	Parnell Bore	***4248***	**2647**	**0.12**	***7.2***	*18310*	**11099**
SCK17	Forking Bore	***2628***	**1829**	**0.033**	***8***	*11110*	**7338**
BH307	Elizabeth Bore	87	159	<0.001	0.0054	1697	**1364**
BH309	Jetpump bore	***2309***	**1171**	<0.001	0.043	*9300*	**5851**
BH310	LBH0005	***1051***	**573**	<0.001	0.0679	5190	**3303**
BH311	LA011	***5231***	**1677**	<0.001	0.0109	*17890*	**11251**
BH312	Oakdale Explo Bore	***851***	**614**	<0.001	0.0137	4760	**3088**
BH313	West Mountain Exploration Bore	**634**	**961**	<0.001	0.0126	4040	**2745**
BH314	Kadish Bore	73	58.1	<0.001	0.0206	792	598
BH331	Clevedale House Bore	**464**	229	<0.001	0.0108	2920	**2032**
BH337	House Bore	***1472***	**806**	<0.001	0.035	*7050*	**4272**
BH441	House Bore	***860***	483	<0.001	0.0501	3730	**2349**
Drinking Water Guidelines (ADWG 2004)		**250**[a]	**500**	**0.01**	**3**[a]	NA	**1000**[a]
Irrigation (ANZECC 2000)		700[b]	NA	2[c]/5[d]	2[c]/5[d]	5,200[e]	NA
Livestock (ANZECC 2000)		NA	2000[f]	0.1	20	NA	3000[g]

Notes to **Table 8-38**:
All results are expressed as milligrams per litre (mg/L) unless otherwise indicated.
Results in **Bold** exceed relevant drinking water criterion (ADWG, 2004)
Results in *italics* exceed relevant irrigation criterion (ANZECC, 2000)
Results underlined exceed relevant livestock criterion (ANZECC, 2000)
[a] denotes aesthetic guideline for ADWG (2004) provided as no health-based criterion exists
[b] concentration above which only salt tolerant plants are supported (ANZECC, 2000)
[c] denotes long term trigger value (LTV:100 years) criterion from ANZECC, 2000
[d] denotes short term trigger value (STV:20 years) criterion from ANZECC, 2000
[e] EC value above which only very salt tolerant plants are supported (ANZECC, 2000)
[f] concentration above which acute or chronic health effects may occur (ANZECC 2000)
[g] lowest concentration above which loss of production and a decline in animal condition and health is expected to occur (chickens: 3,000; dairy cattle: 4,000; beef cattle:5,000; horses and pigs:6,000; sheep:10,000) (ANZECC 2000)

The results of Caritat et al (2005) indicate that the groundwater resource associated with the bedrock aquifer is generally unsuitable for human consumption. The high concentration of total soluble salts renders the groundwater generally unsuitable for crop irrigation (with the exception of very salt tolerant crops) and is marginal for stock watering.

8.7.2.3. Current Surrounding Groundwater Users

ERM Perth conducted a review of potential receptors for their risk assessment (**Section 8.9**) and identified from a search of the BOM Australian Groundwater Explorer database a total of 47 registered bores. 40 of these are registered as groundwater monitoring bores, six for water supply (without specifying the type of supply) and one as "other". All water supply bores and the bore registered for "other" use are located to the north of the Mine, with the closest located approximately 1.6 km to the north of the Mine. These are all located to the north of the Globe Vauxhall Shear, which according to the Golder 2008 hydrogeological assessment, is understood to present a hydraulic barrier between the Mine site and groundwater bores located to the north of this shear zone. ERM Perth found that there are no bores located where they could be impacted by mine groundwater.

The closest potential aquatic groundwater dependent ecosystem (GDE), was identified by ERM Perth through the BOM GDE Atlas, and was located approximately 2.2 km to the north-east of the northern most point of the Mine site boundary. This potential GDE is the feature known as Imperial Lakes at Broken Hill and was not found to be impacted by groundwater quality at the Rasp Mine.

8.7.2.4. Water Quality at the Rasp Mine

In recent studies Golder found that the concentration of analytes in the existing mine water is generally higher that the concentration of analytes in the existing tailings filtrate, with the exception of calcium and alkalinity. In general the pH of the tailings filtrate was found to be close to neutral (pH 7) and slightly higher that the Mine water. Golder considered that this was expected given the measured higher alkalinity of the tailings filtrate relative to the mine water.

This was also the view of ERM Perth who concluded that the

> *"… Rasp Mine is located in a region with an arid climate and within a mineralised area. Consequently, groundwater would be expected to potentially be naturally elevated in metals and salinity."*

Golder conducted a comparison of the water quality of the collected groundwater at Shaft 7 with the water quality of the tailings filtrate from the current tailings stream into TSF2, both measured over the same period from 2018 to 2019. The results are presented in **Table 8-39**, which compares the average, maximum and minimum ranges of the test results for a range of analytes.

Table 8-39 Groundwater Quality vs Tailings Filtrate

	Units	Average		Maximum		Minimum	
		Underground water	Tailings filtrate	Underground water	Tailings filtrate	Underground water	Tailings filtrate
pH		6.3	7.1	6.6	9.8	6.1	5.6
Electrical Conductivity	µS/cm	12800	9064	14100	10500	11700	7990
Total Dissolved Solids @ 180 °C	mg/L	11606	7183	15200	12300	5000	5480
Total Alkalinity	mg/L	9.8	38	24	82	5	12
Sulphate as SO_4	mg/L	5466	3574	5860	4540	4900	2900
Chloride	mg/L	1620	1408	1910	2040	1290	1130
Calcium	mg/L	517	789	590	958	470	647
Magnesium	mg/L	294	49	354	149	247	3
Sodium	mg/L	1719	1251	1920	1470	1520	992
Potassium	mg/L	114	149	130	178	98	119
Cadmium	mg/L	2.4	0.05	2.71	0.411	2.02	0.0012
Lead	mg/L	1.6	0.40	4.66	2.13	0.438	0.001
Manganese	mg/L	333	18	492	165	245	0.097
Zinc	mg/L	956	3.4	1060	48.4	829	0.005

	Units	Average		Maximum		Minimum	
Iron	mg/L	1.9	0.39	3.22	1.71	0.38	0.05

Golder concluded that there would be negligible impact of tailings water on groundwater with perhaps some dilution of analytes. The potential impact on groundwater quality of the small volume of water calculated to report to the bottom of Kintore Pit, if water was not collected in the seepage collection system and re-used at the Mine site, was expected by Golder to result in at least equal or better quality than the current water quality.

Water quality would continue to be monitored in accordance with current EPL conditions.

8.7.3. Water Seepage Below TSF3

From their calculations Golder expected the seepage from dried tailings placed into Kintore Pit to result in no or negligible seepage, as the material is partially saturated during placement, would be compacted to a high density and there is no free water expected on the tailings during operation.

Some seepage may occur from stormwater which finds its way through the placed waste rock around the perimeter of the Pit, however the top of the waste rock surface will be shaped to direct rainfall runoff from the wall slopes to low depressions created on the tailings where this water would be removed by mobile pump, particularly for a high rainfall event. Low intensity rainfall may infiltrate the wast rock and seep to the bottom of the Pit where it would be collected by the underground water management system and reused (refer **Section 3.4.3.4)**. The volume of rainfall reporting to the bottom of the Pit would be similar or less (as pumping will occur for larger rainfall events) compared to what is currently the case.

8.7.4. Surface Water Management

There are a number of areas where MOD6 works will impact current management of surface rainfall currently managed under the Rasp Mine SWMP. These changes have been addressed by Golder (Golder Report **Appendix B1**, Section 11.0).

In summary these include the following:

- Boxcut - to accommodate water collection and flow around the boxcut and new Tails Harvesting Haul Road.
- S37 – to accommodate the underground mine services area.
- Little Kintore Pit – to be shaped once filled and capped to accommodate stormwater runoff from TSF3 (at closure).
- TSF3 – to remove rainfall from surface areas in a timely manner.
- Free Areas – to include the capture of rainfall in the depressions created within the capping surface.

There are no impacts identified for BHP Pit and current management measures would apply.

The Rasp Mine SWMP would be updated to accommodate these changes.

8.8. Traffic Interactions

BHOP recognises vehicle interaction as a principal hazard and as such the detailed design of the road system to accommodate the transport of ore, waste rock and harvested tailings would be subject to a robust process adopting required standards and guidelines throughout the design, construction and operation of this infrastructure. As part of the process of detailed design, specification would be developed through a formal risk assessment process to provide for the following; width, curvature, grade, intersections, visibility, pavement shape, construction materials, safety berms, barriers, guideposts and signs. Traffic flow and characteristics of the mine vehicles are also considered factors in the road design.

The design would incorporate the key control measures of mobile plant characteristics (align with Section 8.2 of the BHOP PHMP Roads and Other Vehicle Operating Areas (BHO-PLN-SAF-004) (Roads and Vehicles)) and also the design, layout, construction of all roads and other areas at the Mine used by mobile plant (aligning with Section 8.4 of the BHOP PHMP Roads and Vehicles). Design elements included in the concept design would provide for a clear driver line of sight is maintained, while at the same time considering the manoeuvrability of current and proposed vehicles using the area taking into consideration the physical spatial constraints of the immediate area.

The concept design has purposely removed the creation of converging road ways and replacing them with dedicated 90° intersections that would be supported by appropriate signage (stop signs for road ways meeting main haulage roads). In addition appropriate speed limits (proposed 25km/hr), controlled communication call up points (to align with existing site controls) and travel movement rules (providing for the right of way for heavy equipment / underground haulage trucks) consistent with current site traffic management requirements would also be implemented. The BHOP PHMP Roads and Vehicles would be updated to reflect the change in conditions.

Additional traffic on local roads from MOD6 construction activities would primarily consist of the transporting of materials, cement and rock fill, from Mawsons Quarry (located in Eyre Street opposite the Mine) 1.8 km along Eyre Street to the Mine entry. All deliveries would be during daytime only. Deliveries would occur over the period of construction at different intervals depending on the construction schedule. Cement delivers would peak at 3 trucks per hour over a day period during the installation of the Decline Plug and rock fill deliveries would peak at 2 trucks per hour over 7 days during the installation of the seepage collection system. Other truck deliveries would include poly pipe for various drainage activities. Eyre Street is a designated trucking route around the centre of Broken Hill and it is not expected that this additional traffic would be discernible from normal traffic movements along this road.

The numbers of contract personnel would vary over the duration of construction / preparation works peaking at 20. It is not expected that the additional traffic associated with their entry and exit from the Mine site would be discernible from the current traffic movements of site personnel or other contractors.

Internal mitigation measures to provide for the safety of personnel include:

- All road intersections to have good line of site and visibility with 90°.
- Segregation of ore and tailings haul trucks.
- Vehicle interactions between light and heavy vehicles would be restricted.
- Tails Harvesting Haul Road would operate as a single lane with right of way given to trucks hauling tailings and travel would be in one direction at a time.
- Update the BHOP PHMP for Roads and Vehicles (BHO-PLN-SAF-004).

8.9. Waste Rock Geochemical Characterisation

ERM Perth was engaged by BHOP to undertake waste rock characterisation and a geochemical risk assessment associated with waste rock management changes that are proposed for MOD6, Long Term Geochemical Degradation Assessment for Waste Rock – MOD6 Waste Rock Management Rasp Mine, March 2021 (Geochemical Report) (**Appendix H**).

In summary ERM Perth concluded that:

- The review of the waste rock characterisation results against the bedrock aquifer baseline water quality indicates that potential metalliferous drainage from the waste rock tested should have limited, if any, material impact on the existing water quality of the basement rock aquifer and although some samples showed potential acid forming results, a site inspection concluded that there was no evidence of acid drainage on the Mine site from almost 140 years of continuous mining.
- The risk assessment undertaken by ERM Perth concluded that for the waste rock placement domains potential complete Source – Pathway – Receptor (SPR) the linkages were limited to on-

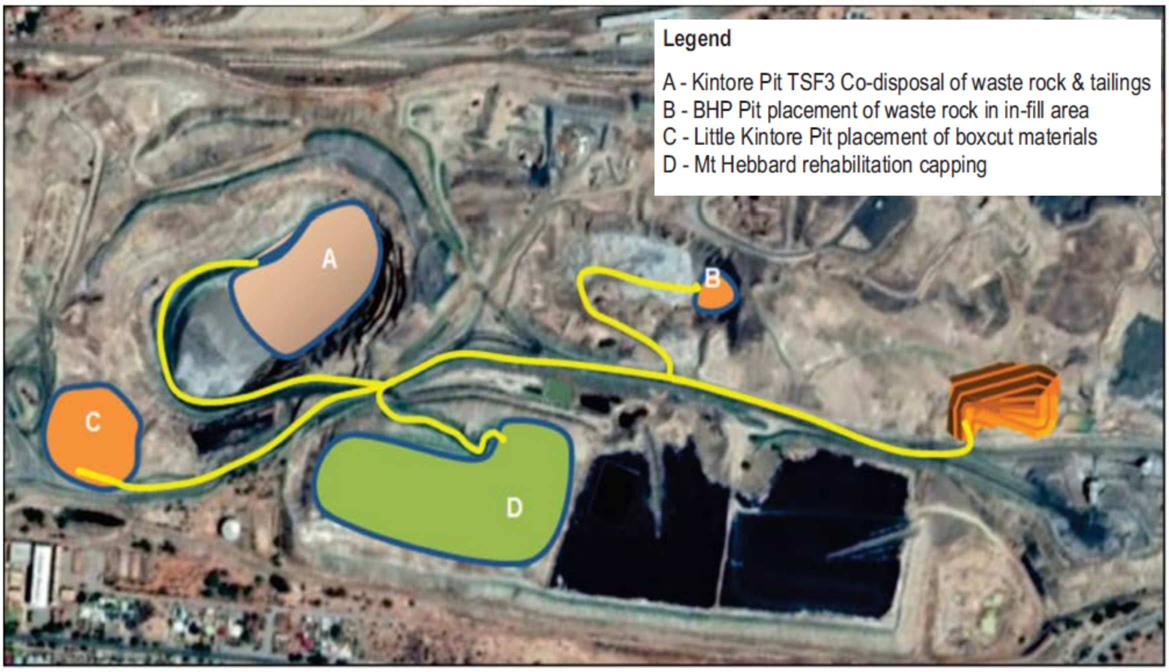
site receptors, site personnel. These were related to use of dewatering water and surface water onsite. Risk rankings for these potentially complete SPR linkages were considered to be low.

8.9.1. Proposed Waste Rock Placement

All waste rock materials encountered during excavation of the new boxcut are proposed to be stored in-pit. Waste rock material to be used for rehabilitation capping would be sourced from the stockpile in Kintore Pit or from underground development currently planned at 146,000 t per year until 2026 with 16,000 t a year of this material proposed for rehabilitation capping works.

Planned waste rock placement locations include Kintore Pit with a capacity of 4.3 Mm^3 (for tailings and waste rock placement), infill of BHP Pit (30,000 m^3), infill of Little Kintore Pit (174,000 m^3) and rehabilitation capping of Free Areas, at the top of Mt Hebbard is provided as an example (41 m^3). The different placement locations have been labelled as Domain A, B, C and D respectively for the assessment, **Figure 8-34**.

Figure 8-34 Proposed Waste Rock Placement



8.9.2. Assessment Methodology

This risk assessment was undertaken to assess potential long term geochemical degradation risks associated with the management and emplacement of waste rock that will be generated from underground mining and development and used as in-pit storage and surface rehabilitation capping. The ERM Perth assessment included a characterisation of waste rock properties and assessment of its potential water quality related risks associated with MOD6, using the source – pathway– receptor (SPR) linkage approach. The findings of the risk assessment will inform the development of a site-specific waste rock management plan with the goal of providing practical waste management solutions.

Geochemical testing was carried out on 50 waste rock samples considered to represent the lithologies commonly found at the Rasp Mine. These samples were geochemically tested using conventional static testing methods including their potential to generate acid and metalliferous drainage (AMD) with the results informing the source characterisation component of the risk assessment. A total elemental analysis was also undertaken.

Through the assessment, ERM Perth considered that the Net Acid Generation (NAG) test presented a conservative estimation for drainage quality in the long term, with NAG testing entailing aggressive oxidation of a pulverized rock sample. Evaluation of the NAG results is therefore considered to present a conservative assessment to potential long term geochemical degradation.

8.9.3. Existing Environment

The Broken Hill area and location of the Mine is underlain by the Willyama Supergroup consisting of metasediments and composite gneisses with lesser quartzofeldspatic and amphibhole/pyroxene rich gneisses. The Thackaringa Group, Broken Hill Group and Sundown Group of the Willyama Supergroup are present at and within the immediate vicinity of the Rasp Mine. The Thackaringa Group consists of migmatitic gneiss and quartzofeldspathic rock intercalated with psammopelites.

The Broken Hill Group conformably overlies the Thackaringa Group and consists of pelitic to psammopelitic metasediments with minor calc-silicate rocks, basis gneisses and amphibolites. The Broken Hill Group is overlain by the Sundown Group which consists of a succession of pelite, psammite, calc-silicate rocks and graphitic phyllite and schist. Waste rock will be generated from the groups described in **Table 8-40**.

Table 8-40 Waste Rock Lithology Associated with Line of Lode Rock Units - Rasp Mine

Unit	Waste rock lithology	Alteration	Oxidation
4.3	Psammopelite	Fresh	Slight Fe
	Psammite		Down to depth of 30m coinciding with Ground water table above depth of mining
4.4	Amphibolite	Potosi Gneiss on top of Amphibolite Biotite selvage at base	
	Garnetiferous Amphilobolite		
	Quartz feldspar biotite garnet		
4.5	Psammopelite	Blue quartz silicification, Calcsillicates, low grade lead-zinc sulphides at base of B lode	
	Lodey Psammite		
	Psammite		
	Garnetiferous Psammite		
	Lodey garnetiferous Psammite		
4.6	Pelite	Fresh	
	±BIF		
	±Garnet Quartzite		
4.7	Garnet Rich Pelite Pelite	Garnet alteration (Fe, Ca, Mn), K feldspar, elevated Mn, anomalous lead zinc	
	Psammopelite		
	Psammite		
	Garnetiferous Psammite		
	Lodey garnetiferous Psammite		
	Pegmatite		

The main aquifers in the Broken Hill area consist of fractured rock aquifers of the Proterozoic Willyama Supergroup and Adelaidean sequences. These aquifers generally have low groundwater quality with elevated salinity, Total Dissolved Solids (TDS) and elevated metal concentrations presented in solution and low yields. Baseline pH level for the bedrock aquifer was reported to be 5.8.

Shallow groundwater seepage is encountered within the shallow disturbed and unconsolidated material overlying the basement rock. Shallow seepage is considered to be limited in extent with generally poor quality with high TDS, elevated metal concentrations and pH ranging between 5 to 8.

8.9.4. Acid Formation Criteria

The criteria used to determine the potential for acid formation was sourced from the Australian Mineral Industries Research Association (AMIRA) classification system described in **Table 8-41.**

Table 8-41 AMIRA Acid Generating Classification System

Classification	Criteria	Comment
Potentially Acid Forming (PAF)	NAPP > 0 NAG pH < 4.5	Sample always has a significant sulphur content, the acid generating potential of which exceeds the inherent acid neutralising capacity of the material
Non-Acid forming (NAF)	NAPP < 0 NAG pH ≥ 4.5	Sample may, or may not, have a significant sulphur content but the ANC availability is more than adequate to neutralise the acid that theoretically could be produced.
Uncertain (UC)	NAPP > 0 NAG pH ≥ 4.5 NAPP < 0 NAG pH < 4.5	An uncertain classification is used when there is an apparent conflict between the NAPP and NAG results.

8.9.5. Risk Assessment

The framework for the risk assessment was based on a SPR evaluation. In order to consider exposure in a receptor, a mechanism (pathway) must exist by which impact from a given source can reach a given receptor (which would constitute a SPR linkage). Whenever one or more of these elements are missing, the SPR linkage is incomplete and the potential risk to the identified receptor is considered unlikely.

In assessing potential environmental geochemistry risks associated with waste rock, potential SPR linkages were evaluated based on the existence of:

- A source of potential for acid and metalliferous drainage (AMD) associated with waste rock sources were determined based on the waste rock characterisation undertaken as part of the study and the location of the different areas were storage and/or emplacement of waste rock would take place.
- A mechanism for release of contaminants (pathways) from identified sources with a focus on solute transport in water (acidic and/or metalliferous leachate seepage to surface water or groundwater) and the presence of a transport medium (surface water or groundwater flow), was determined through review of underground dynamics on site, including the potential of groundwater transport in the deep fractured bedrock aquifer and shallow seepage within disturbed material overlying the basement rock.
- Potential receptors of impact included people using water from groundwater bores for potable water supply, vegetation and fauna associated with surface water bodies, groundwater dependant ecosystems, along with a mechanism for chemical intake by the receptors at the point of exposure (ingestion, dermal contact, or a combination thereof). For this assessment potential receptors were determined by a review of aerial imagery as well as a search of public databases within a 5 km radius of the central section of Rasp Mine.

A qualitative risk assessment was undertaken for the potentially complete SPR linkages identified, taking into consideration the potential consequence of the potential linkage as well as the likelihood of the risk being realised.

8.9.6. Impact Assessment Results

8.9.6.1. Geochemical results and characterisation

<u>Acid Drainage</u>

Waste rock testing results within the context of AMD potential / geochemical risk and classification show that:

- The total sulphur (S) content of the majority of the samples was found to be low (<0.3 weight %S) with only three psammopelite samples containing moderate to high sulphur (between 0.42 and 1.14 weight %S). NAG testing from these samples suggest that a portion of the measured sulphur within the highest sulphur bearing sample may be from non-acid generating sulphides.
- Based on the Australia Mineral Industries Research Association (AMIRA) classification system, the majority of samples (76 % of the samples) have been classified as non-acid forming (NAF). These are samples with low total sulphur content (<0.3 weight % S).
- Two psammopelite samples (4% of samples) were identified as potentially acid forming (PAF) and 10 samples (20% of samples) as uncertain (UC) using the AMIRA system. All PAF and UC samples had a weight %S >0.2%.
- Mineralogy testing demonstrated that most of the samples consist of quartz and very slow to slow reacting silicates.
- Garnets were identified in all samples, which can provide fast reacting silicate buffering. Galena and sphalerite were identified in one sample only, of the two classified as PAF.
- All rock type groupings, including the psammopelite rock type, had average net potential ratio (NPR) values ⩾2. The NPR ratio is the ratio of acid neutralisation capacity (ANC) over maximum potential acidity (MPA), with a ratio above 2 indicating that the material is NAF.
- While a small subset of samples have been identified as PAF, the central tendency in the data (and specifically the average NPR ratio ⩾2 for all rock types) indicate that the material is expected to be largely NAF.

The results clearly show that based on mineralogy and rock type, it is more than likely that the waste rock that would be brought from the underground workings to the surface can be categorised as NAF.

The results also align with site observations, which indicate that acidic drainage has not been identified at the site, across mining activities since 1880s.

<u>Metalliferous Drainage</u>

Results for metalliferous drainage from waste rock show that:

- Elemental enrichment, based on the total elemental data for the samples and using the geochemical abundance index (GAI), identified a number of elements enriched more than 12 times the average crustal abundance. The majority of these where identified for psammopelite samples and elements enriched at this level included Ag, As, Bi, Cd, Mo, Pb, Sb and Zn.
- Results from deionised water leach indicate that the samples have the potential for metalliferous drainage when the metal content of the leachate is compared to conservative freshwater aquatic ecology guidelines.
- Metals leaching at concentrations above the conservative aquatic guidelines for both the DI leachate and NAG liquor included (but were not limited to) Al, Cr, Cu and Pb.

ERM Perth noted that the NAG liquor data presented a conservative estimation for drainage quality in the long term, with NAG testing entailing aggressive oxidation of a pulverised rock sample. While the majority of samples have been classified as non-acid generating, the DI leachate and the NAG testing indicate that the majority of material sampled has potential to generate metalliferous drainage.

<u>Background Groundwater Quality</u>

Groundwater studies in the area and on site have demonstrated that groundwater within the bedrock aquifer is generally unsuitable for potable use or irrigation and marginal for stock watering. Baseline groundwater sampling is compared with the descriptive statistics for the waste rock leach testing results and results are shown in **Table 8-42**.

Table 8-42 Summary of Metalliferous Drainage Data vs Groundwater Baseline Data

Grouping	Ec ($\mu S/cm^2$)	SO4 (mg/L)	Cd (mg/L)	Pb (mg/L)	Mn (mg/L)	Zn (mg/L)	Fe (mg/L)
Groundwater Baseline	13,900	9,660	6.32	2.25	907	3,330	1.57
DI Leach - Median	320	37.5	0.0001	0.0015	0.009	0.005	0.1115
DI Leach – 90th Percentile	689	37.5	0.0001	0.0015	0.009	0.005	0.115
DI Leach - Maximum	1,900	432	0.0003	0.02	0.415	0.028	1.57
NAF Liquor - Median	210	45	0.0015	0.001	0.12	0.005	0.05
NAF Liquor – 90th Percentile	277	78	0.035	0.53	0.45	2.88	4.23
NAF Liquor - Maximum	709	312	0.31	5.93	1.02	87.5	33

Results show that all median leaching values were well below baseline values, with the exception of Fe for NAG liquor data.

ERM Perth concluded from the results obtained that the waste rock analysed, in comparison with the background groundwater baseline data, that there was potential for metalliferous drainage from the waste rock. However, ERM Perth found that this would have limited if any material impact on the existing water quality of the basement rock aquifer.

8.9.6.2. Evaluation of Potentially Complete SPR Linkages and Risk Ranking

Source-pathway-receptor flow charts were developed for each waste rock emplacement area, a summary of the complete SPR linkages for each waste rock placement domain is provided in **Table 8-43**.

Table 8-43 Results for Potentially Complete SPR Linkages

Waste Rock Domain	Source	Pathway	Receptors
A - D	Potential for metalliferous drainage from waste rock	1. Seepage to bedrock aquifer 2. Pumping of groundwater for dewatering purposes at the mine	On site workers
A - D	Potential for metalliferous drainage from waste rock	1. Seepage to bedrock aquifer 2. Pumping of groundwater for dewatering purposes at the mine	On site vegetation
D	Potential for metalliferous drainage from waste rock	Surface water drainage from waste rock emplacement facility	On site vegetation
D	Potential for metalliferous drainage from waste rock	Surface water drainage reports to on site dams	On site workers

The risk assessment concluded there was no or little risk as drainage remained within the Mine Lease and there were no waterways located on the site that would act as a pathway for contaminants.

The water is reused at the site in both underground operations and in the processing plant which assists in reducing the Mine's demand for raw water.

8.9.6.3. Mitigation Measures and Monitoring

Existing waste rock protocols and systems would continue to apply to the proposed modification. This includes specific management strategies for waste rock on site, its segregation criteria, placement and testing, BHOP Surface Placement of Material Testing Procedure (BHO-PRO-ENV-036).

ERM Perth recommended that %S should be tested and any material with a %S>0.2 should be placed in-pit for permanent storage. BHOP considered this recommendation an in line with site experience and the reported observation of ERM Perth that there was no evidence of acid drainage on the site from almost 140 years of mining, BHOP have opted not to implement this recommendation as it was not considered warranted.

BHOP plans to implement an operational testing program for the further collection of samples of waste rock as mining progresses. This will facilitate validation of current waste rock characterisation and will enable the assessment of material during the operational life of the Mine. Once a broader and solid database of samples have been analysed over the operations of the Mine, the plan will be updated accordingly to better approach the risks associated with the waste rock on site.

BHOP would continue with its current Pb testing for surface placed material.

8.10. Heritage

8.10.1. Heritage Background

The Rasp Mine is part of the historic Line of Lode, which is an ore body that runs through the City of Broken Hill. Mining has been conducted across the Line of Lode since the early 1880s when Charles Rasp formed a consortium and founded Broken Hill Proprietary company or as it is more commonly known - BHP. The site has been mined for almost 140 years leaving the site with a highly disturbed landform and a large number of heritage buildings and structures.

The entire City of Broken Hill was included on the National Heritage List (NHL) on 20 January 2015.

> *"The City of Broken Hill is of outstanding heritage value to the nation for its significant role in the development of Australia as a modern and prosperous country. This listing recognises the significance of over 130 years of continuous mining operations, its contribution to technical developments in the field of mining, its pioneering role in the development of occupational health and safety standards, and its early practice of regenerating the environment in and around mining operations.* (Australian Government, January 2015)."

There are no heritage items that would be affected by this modification; no heritage items are located within the Kintore Pit precinct or the area proposed for the new portal.

The BHCC Local Environment Plan (LEP) 2013 lists a number of structures with heritage classification located across CML7 and within its surface Lease areas. A number of these items are located within BHP Pit where continued crushing works are proposed and where waste rock in-fill would be placed. These heritage items are currently protected via a minimum 10 m stand-off distance, barriers and signage, and would not be affected by the proposed modification. **Figure 8-35** shows the location of these items within BHP Pit and is followed by a description for each item. Note this Figure also shows waste rock stockpiles and crushing facilities in operation as part of the MOD4 embankment works, and would be similar to proposed crushing works. Waste rock in-fill as part of MOD6 would be placed to the right of these stockpiles aligning to the current surface level in the Pit (level of stockpiles).

Austral Archaeology Pty Ltd (Austral Archaeology) completed a *Conservation Management Plan – Rasp Mine Broken Hill* (CMP), in January 2012 for the Line of Lode located across the section of CML7. In addition to the heritage items identified within and around BHP Pit, Austral Archaeology also identified an area with potential for discovery, as it is likely there may be more remains of the 1891 Amalgamating Mill buried under the small piles of mullock in this area (shaded area shown in **Figure 8-35**). This area would not be disturbed by proposed MOD6 works.

Figure 8-35 Heritage Items Located within BHP Pit

8.10.2. Description of Heritage Items Located in BHP Pit

The description provided for the heritage items provided in the following sections was sourced from the CMP. Reference identification is provided for heritage items as they appear in the Broken Hill City Council Local Environment Plans (LEPs) for both 2013 and 2006.

8.10.2.1. Stone Retaining Wall - Heritage Item Number 304 (I308)

The date for the origin of the Stone Retaining Wall is unknown however it was identified as likely to be significant as it is a remnant of the early BHP era, estimated to be between 1890s to early 1900s, shown in **Figure 8-36**. There is no documentary evidence to help establish the historical background of this feature although it would appear to date from the BHP open cut period in the 1890's through to the early 1900's. The open cut was no longer in use after 1907. It is a 5 m high dry stone retaining wall oriented north / south for 10 m turning gradually to the east for 5 m.

The Stone Retaining Wall is protected behind a post and wire fence and sign posted as a heritage item.

8.10.2.2. Building Foundation - Heritage Item Number 305 (I305)

This is a large concrete, brick and stone foundation, shown in **Figure 8-37**. The south end has a section of brick wall (about 10 courses of brick high) still standing and a concrete floor apron. The centre section has two east-west aligned stone walls with concrete floors either side and a dropped section in between possibly for a stairway. Each of these walls has steel reinforcing bolts through it as has the north end of the concrete floor. The east end of each of these walls has a number of stone piers with reinforcing bolts. The north end wall (also made of stone) is leaning heavily into the pit. There are some timber beams protruding from some of the wall sections. The far north walls are also made of stone standing 1.5 m high and have a concrete floor apron. All of this foundation is subsiding into the BHP Pit. On the north side of the central walls there is a semicircular groove cut into the stone for a machine footing. There is no documentary evidence to help establish the exact historical background of this feature. From inspection of early company plans it appears to correlate with the position of the 1891 Amalgamating Mill which was demolished in 1896.

The Building Foundation is protected by bunding and is sign posted as a heritage item.

Figure 8-36 Stone Retaining Wall ID 304 (I308)

Figure 8-37 Building Foundation ID 305 (I305) & Four Concrete Piers ID 306 (I306)

8.10.2.3. Four Concrete Piers - Heritage Item Number 306 (I306)

This heritage item consists of Four Concrete Piers of approximately 1 m in height each with a single central foundation bolt, shown in **Figure 8-37**. The piers are 1 m x 1 m at the base and 70 cm x 70 cm at the top and are spaced 5 m apart to form the four corners of a square. Origin is unknown, estimated to be between 1890s to early 1900s.

There is no documentary evidence to help establish the historical background of this feature although it would appear to date from the BHP open cut period in the 1890's through to the early 1900's. The open cut was no longer in use after 1907.

The Four Concrete Piers have been sign posted as a heritage item and bunding has been installed at both the top and base for protection.

8.10.2.4. BHP Headframe Ruins - Heritage Inventory Form Item Number 307 (I307)

Austral Archaeology considered that the remains of this early headframe were probably associated with the 1891 Wigg Shaft which dates from the earliest phases of BHP's mining operations and therefore highly significant. The headframe is shown in **Figure 8-38**. The remains of the headframe have two concrete headframe footings with timber uprights and one crossbar. The north side upright has about 1 m remaining while the south upright has 2.5 m remaining and has a number of iron bolts protruding from it. Just north of these footings is another concrete footing with no timber uprights.

This headframe may belong to one of two different shafts. It may be associated with either Knox Shaft sunk in 1885 or Wigg Shaft which was sunk in 1891. It is more likely that it belongs to the latter as company records of 1895 list the shafts inside the open cut and Wigg Shaft is one of them, while the Knox Shaft is not mentioned. Conversely, the Knox Shaft is the closest to the Amalgamating Mill and would at some stage have fallen to the open cut.

The BHP Headframe is protected behind a post and wire fence and is sign posted as a heritage item.

Figure 8-38 BHP Headframe Ruins ID 307 (I307)

8.10.2.5. Timber Chute - Heritage Inventory Form Item Number 308 (I309)

This feature consists of a 20 m timber chute in two sections running down the inside of BHP Pit from its rim (**Figure 8-39**). It is 1 m wide with a slightly concave base and short single plank side walls. Each sloping section is approximately 8 m long with a short 4 m flat section in between them.

With the original length is unknown, this may only represent half of the structure, or it could be all of it. The extant section appears to be complete. There is no documentary evidence to help establish the historical background of this feature although it would appear to date from the BHP open cut period in the 1890's and early 1900's. The open cut was no longer in use after 1907.

Figure 8-39 Timber Chute ID 308 (I309)

The Timber Chute is protected by a bund installed at its base and it is sign posted as a heritage item.

8.11. Visual Amenity

The MOD6 works are not expected to alter the visual mining aspect of the Mine site from perspectives within the City of Broken Hill.

The height of Kintore Pit when filled would not rise above the surrounding mining landform. **Figure 8-40** shows the Mine site from a high point to the north in Broken Hill (Mica Street Treatment Facility) looking south. Mt Hebbard is visible centrally in the photograph and is the highest point visible at 338 RL, the top of Kintore Pit would not be visible.

Figure 8-40 Looking South to CML7 from North Broken Hill

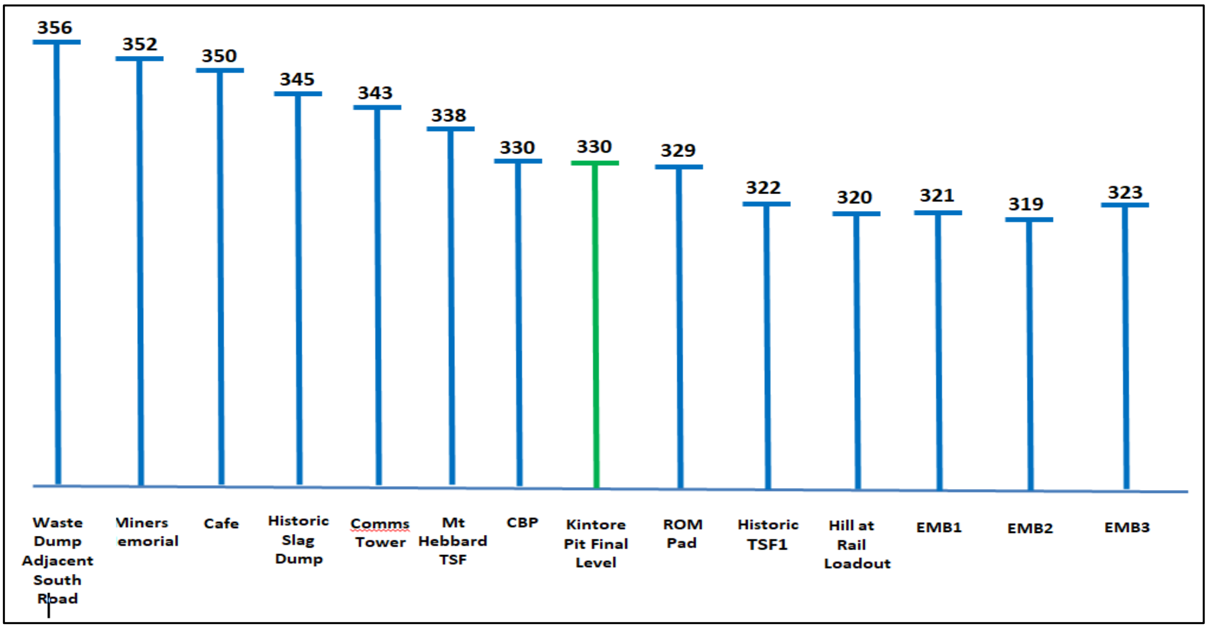
The boxcut would not be visible from the north of Broken Hill or the Café / Miners Memorial located centrally on CML7, the Tails Harvesting Haul Road as it exits the boxcut from its northern corner would be approximately 10 m below the current surface level and would not be visible from south Broken Hill as shown in **Figure 8-41**.

Figure 8-42 provides a comparison of the height of structures across the Lease (RL). The height of the filled Kintore Pit would be approximately the same height as the Concrete Batching Plant (located centrally and to the left behind noise bunding in **Figure 8-40**) and would not be visible.

There are no visual amenity impacts anticipated with MOD6 works.

Figure 8-41 Proposed Location of the Boxcut Looking North from South Broken Hill

Figure 8-42 Comparison of Structure Heights Across CML7 (RL)



9. SUMMARY OF MITIGATION MEASURES – MOD6

This Section summarises the mitigation measures to be implemented as a result of the Modification.

9.1. Noise

In addition to the existing management and mitigation measures, the following specific noise management strategies would be implemented for MOD6:

- Limited construction works on Sundays (only within Kintore Pit) and no works on Public Holidays.
- All construction works (external to Kintore Pit) would be undertaken during daytime hours only.
- Noise bunding for the new Tails Harvesting Haul Road would be installed around the west side of the boxcut where the road connects to the existing Mine Haul Road.
- Harvested tailings transfer to Kintore Pit would occur during daytime hours only.
- Update of the Noise Monitoring & Management Plan (BHO-PLN-ENV-009).
- Prior to construction activities BHOP would prepare a Construction Environment Management Plan, which would identify all reasonable and feasible measures to minimise noise during construction.

9.2. Air Quality

In addition to the existing management and mitigation measures, the following specific air quality management strategies would be implemented for MOD6:

- Use of larger haul trucks for the future tailings harvesting operations transferring tailings from TSF2 to TSF3 (50 t trucks to be used).
- Use of a water truck and chemical dust suppressant in TSF3 as required.
- Sealing of the new Mine Ore Haul Road from the portal to the ROM pad.
- Permanent in-pit storage of material excavated from the boxcut in Little Kintore Pit and BHP Pit.
- Adaption of the water spray system designed for TSF2 (approved MOD4) to accommodate the tailings harvesting operations.
- Develop a rehabilitation program and schedule for capping of the Free Areas.
- Update of the BHOP Air Quality Management Plan (BHO-PLN-ENV-010).

9.3. Community Health

In addition to existing measures the following mitigation measures would be undertaken for MOD6:

- Sealing of haul road from new portal to ROM pad.
- Use of larger trucks for tailings harvesting activities.
- Progressive rehabilitation of exposed 'free' areas (capping / rock armouring).
- In-pit disposal and encapsulation of box cut material (as all material assumed to be >0.5%Pb).
- Update to the AQMP (BHO-PLN-ENV-010).
- Update the Community Lead Management Plan (BHO-ENV-PLN-008).

9.4. Vibration, Overpressure and Flyrock

The following mitigation measures would be undertaken for MOD6 blasting activities in addition to any relevant existing measures:

- As recommended by Prism, an appropriately qualified project supervisor would be engaged to establish a blast management plan and oversee the process of surface blasting.
- Mine blasting vibration data, as blasting is undertaken, would be used to confirm modelling results and identify peak ground vibration and overpressure trends.

- A conservative starting point of 35 kg would be used for blasting near (approximately 100 m) TSF1 to validate the modelling results and ensure blasting limits are not exceeded.
- Conservative stem heights would be used, as per blast design, to achieve required overpressure levels.
- There would be no free-face blasting.
- A flyrock clearance zone of at least 300 m would be installed prior to each blast with evacuations of the Café, Miners Memorial and Cameron Pipe Band Hall and closing of Federation Way and Holten Drive during blasting.
- Identity conditions surrounding the portal and assess in regards to blasting methods once known.
- BHOP would conduct a more detailed risk assessment for potential impacts to site infrastructure prior to blasting (crusher).
- Consultation with relevant neighbours, including Crown Lands and the BHCC, notifications would be conducted prior to blasting events.
- Establish a trigger warning (70% of target) for blasts within 100 m of TSF1 and TSF2.
- Update the Technical Blasting Management Plan (BHO-PLN-MIN-002).
- Develop a Surface Blasting Management Plan prior to the commencement of surface blasting activities and would include, but not limited to, requirements for risk assessments, blast plan and design, supervision, clearance zones with identified access points and evacuation requirements, record keeping and review of blasting parameters used.

9.5. Kintore Pit Slope Stability

To ensure safety requirements within Kintore Pit the following measures would be undertaken for MOD6:

- A safety bund (minimum 2 m height) would be installed along the length of the toe of the historic tailings slope and waste rock stockpile and would remain in place during tailings / waste rock placement by progressively re-establishing the bund as the level of the tailings deposited rises in the Pit.
- Conduct a detailed risk assessment of the historic tailings slope to identify safe methods for fresh tailings deposition, this may require the installation of a geotextile (or alternative product) placed over the tailings slope prior to the placement of waste rock.
- Develop an Operations and Management Plan for TSF3 to be in place prior to the commencement of tailings deposition.

9.6. Tailings Liquefaction and Inrush

The following mitigation measures would be implemented to address liquefaction risks for TSF1, TSF2 and TSF3 for MOD6 works.

TSF1

- Validate ground vibration design predictions prior to boxcut / decline advancement, described in **Section 8.4**.
- Undertake further investigation of the risk of static liquefaction and identify and required works to be undertaken and completed prior to the commencement of MOD6 blasting activities.
- Update of the BHOP PHMP for Blackwood Tailings Storage Facility (TSF2) *(*BHO-PLN-MET-003) to include TSF1.

TSF2

- Continue to monitor for any movement of the TSF2 embankments as outlined in the BHOP TSF2 Operations, Maintenance and Surveillance Manual (BHO-MAN-MET-029).

TSF3

The following summarises the proposed mitigation measures that would apply to control risk from inrush to underground workings from tailings placement in TSF3:

- Maintain a moisture content of harvested tailings within the SOMC prior to deposition.
- Install a Decline Plug as designed for hydrostatic pressure of the full potential depth of tailings plus water hammer effects as discussed in **Section 3.4.3.1.**
- Install a seepage collection system and waste rock bridging layer to the base of Kintore Pit prior to tailings deposition.
- Timely removal of surface water from the tailings.
- Conduct CTP testing and monitoring, and install additional plugs / barriers if required (**Section 3.4.3.1**).
- Install waste rock buttresses over old workings as they appear, to reduce water ingress.
- Fill the decline from the portal to the proposed plug with waste rock.
- Fill the MLD drive beneath Kintore Pit with waste rock.
- Update the BHOP PHMP Blackwood Tailings Storage Facility (TSF2) *(*BHO-PLN-MET-003) to include TSF3.
- Develop a Tailings Operation and Management Plan for TSF3 detailing tailings deposition and waste rock placement methods, geotechnical specifications for compacted tailings, geotechnical testing and quality assurance verification requirements (CPT testing) and water management.

9.7. Water

The BHOP Site Water Management Plan (BHO-PLN-ENV-004) would be updated to include the following:

- Boxcut - to accommodate water collection and flow around the boxcut and new Tails Harvesting Haul Road.
- S37 – to accommodate the underground mine services area.
- Little Kintore Pit – to be shaped once filled and capped to accommodate stormwater runoff from TSF3 (at closure).
- TSF3 – to remove rainfall from surface areas in a timely manner.
- Free Areas – to include the capture of rainfall in the depressions created within the capping surface.

9.8. Traffic Interactions

Mitigation Measures to be considered during detailed design include:

- All road intersections to have good line of site and visibility with 90^{o}.
- Segregation of ore and tailings haul trucks.
- Vehicle interactions between light and heavy vehicles would be restricted.
- Tails Harvesting Haul Road would operate as a single lane with right of way given to trucks hauling tailings and travel would be in one direction at a time.
- Update the BHOP PHMP Roads and Other Vehicle Operating Areas (BHO-PLN-SAF-004).

9.9. Waste Rock Geochemical Characterisation

An operational testing program for the further collection of samples of waste rock as mining progresses will be implemented by BHOP to validate current waste rock characterisation and enable the assessment of material during the operational life of the Mine. A Waste Rock Management Plan would be developed.

9.10. Heritage

There are no additional mitigation measures resulting from MOD6.

9.11. Visual Amenity

There are no additional mitigation measures resulting from MOD6.

10. MOD6 JUSTIFICATION AND CONCLUSIONS

This Section outlines the conclusion and provides a justification for the Modification as sought.

The proposed modification would be implemented with appropriate management of the potential risks and impacts during both construction and future operations and meet all legislative requirements. The completion of MOD4 works without incident or community complaint has shown that these types of earthwork activities can be effectively managed.

Modelling indicates that noise criteria for construction, as listed in the PA, would be met at all receivers at all times. Peak noise at receptors would be for short durations and mainly during the daytime. The timing of works within Kintore Pit is consistent with current mining operations and waste rock and ore haulage movements. Modelling has shown there would be no impact to sleep disturbance.

In addition some out of hours activities are proposed which would enable the overall duration of constructions works to be reduced by more than six months.

All air quality metrics are predicted to be below their respective NSW EPA air criteria for both construction and future operations. Although there is a minor increase to Pb levels during construction, this is of short duration and as identified is not expected to affect blood Pb levels.

A decrease in Pb emissions and hence blood Pb levels is expected for future operations.

Placing tailings on the Lease in a disused pit results in no additional land disturbance, no interruption to local land use and farmers, no dust and noise from associated off-site road traffic and reduced costs for design, construction and operation tailings storage. It also allows an open pit mine void to be filled.

Providing waste rock (<0.5%Pb) capping over Free Areas provides a permanent solution to a historic mine legacy and reduces dust and Pb bearing dust emission from the site.

BHOP also considers that the proposed MOD6 works are consistent with the principles of ESD for the following reasons:

- **Precautionary principle** – baseline Site, local data and relevant standards and guidelines have been used in the assessments of the potential impacts for MOD6 works. Management measures have been proposed where potential impacts have been predicted.
- **Intergenerational equity** – the MOD6 works would allow for the continued operation of the Mine which allows the continued employment of mine personnel well as independent contractors. Construction and operation of the MOD6 works, as well as the continued operation of the Mine, would result in other economic benefits to Broken Hill through the purchase of goods and services and associated employment.
- **Conservation of biological diversity and ecological integrity** – no vegetation would be removed for the MOD6 works and there would be no impact to known fauna and thus biodiversity values.
- **Improved valuation, pricing and incentive mechanisms** – BHOP has committed to a number of measures to enable the MOD6 works to be undertaken with no material impact on the blood lead levels of the local community. Assessments for noise, air quality and vibration have shown that State guidelines and limits (as assessed) can be met.

The proposed modification would also allow the following benefits:

- Permit mining at the Rasp Mine to continue post 2022 with additional storage of tailings;
- Significantly reduce the surface distance of hauling ore from underground to the ROM Pad thereby reducing impacts from noise and dust;
- Ensure continued employment of 186 full-time employees, 32 full-time contractors and indirectly over 200 casual contractors that provide specialist services when required;

- Engagement of approximately 20 contractors during construction and an additional 6 full time employees for operations
- Allow the resource to be fully utilised, and
- Allow BHOP to continue to support the economic growth of Broken Hill.

Without approval of the MOD6 the Rasp Mine will cease operation in 2022 when current capacity for tailings storage is attained.

11. ACRONYMS

This Section provides a list of acronyms used in this MR.

AEP	Annual Exceedance Probability
AEMR	Annual Environment Management Report
AHD	Australian Height Datum
ANCOLD	Australian National Committee on Large Dams incorporated
Ag	Silver
AGV	Air Guideline Value
Al	Aluminium
AMD	Acid and Metalliferous Drainage
AMIRA	Australian Mineral Industries Research Association
ANF	Acid Neutralising Capacity
ANZECC	Australian and New Zealand Environment and Conservation Council
AQMP	Air Quality Management Plan
AR	Annual Review
ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standards
As	Arsenic
AWS	Patton Street Automatic Weather Station
BHCC	Broken Hill City Council
BHNM	Broken Hill North Mine
BHOP	Broken Hill Operations Pty Ltd
BAU	Business As Usual
Bi	Bismuth
BOM	Bureau of Meteorology
BPb	Blood lead level
°C	Centigrade
CABC	Controlled Air Burst Chamber
CBP	Concrete Batching Plant
CBH	CBH Resources Ltd
Cd	Cadmium
CML7	Consolidated Mine Lease 7
CPTu	Cone Penetration Test
Cr	Chromium
CRR	Cyclic Resistance Ratio
Cu	Copper

CSR	Cyclic Stress Ratio
dB	Decibels
D8	Dozer
DCP	Development Control Plan
DDG	Dust Deposition Gauge
DOL	Dolerite
DPIE	NSW Department of Planning, Industry and Environment
DPE	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EA	Environment Assessment Report
EC	Electrical Conductivity
EIS	Environment Impact Statement
EMM	EMM Consulting Pty Limited
EMR	Environmental Management Report
EPL	Environmental Protection Licence 12559
EP&A Act	NSW *Environment Planning & Assessment Act 1979*
EPA	NSW Environment Protection Authority
ERM	Environmental Resource Management Australia Pacific Pty Ltd
ESD	Ecologically Sustainable Development
Fe	Iron
FEL	Front End Loader
FoS	Factor of Safety
ft	foot
g	grams
GAI	Geochemical Abundance Index
GDE	Groundwater Dependent Ecosystem
Golder	Golder Associates Pty Ltd
GPE	Garnet pelite
GQ	Garnet quartzite
GR	GR Engineering Services Ltd
GCE	Ground Control Engineering Pty Ltd
H	Horizontal Distance
ha	hectare
HIL	Health Investigation Level
HHRA	Human Health Risk Assessment
HMS	HMS Consultants Australia Pty lTd
HRA	High Risk Activity
HVAS	High Volume Air Sampler

ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
kg	kilogram
km	kilometres
kPa	Kilopascals
kph	kilometres per hour
Ktpa	Thousands of tonnes per annum
kW	kilowatts
kV	kilovolts
L	litre
LEP	BHCC Local Environment Plan
LoM	Life of Mine
LTI	Loss Time Injury or Illness
m	metres
mm	milimeters
M	million
m^2	square meters
m^3	cubic metres
MCA	Multi Criteria Analysis
MCE	Maximum Credible Earthquake
Mdt	Million dry tonnes
mg	milligram
ML	Mining Lease
Ml	Megalitres
MNES	Matters of National Environmental Significance
Mo	Molybdenum
MTI	Medically Treated Injury or Illness
MOD1	Relocation of the main ventilation shaft
MOD2	Crushing of ore permitted to occur at any time
MOD3	Extend underground mining into Block 7 (includes the Zinc Lodes)
MOD4	BHOP Modification for the erection of a Concrete Batching Plant and the construction of embankments to extend the life of TSF2
MOD5	Proposed modification for a Stores Warehouse extension, installation of a cement silo and adjustments to air quality monitoring requirements.
MOD6	Proposed modification to the PA for placing tailings and waste rock in Kintore Pit, Relocation of the mine access portal, Tailings harvesting, periodical rock crushing and waste rock for rehabilitation capping.
MOD7	Proposed modification to utilise rock fill material in BHP Pit for TSF2 Embankment Construction

MOD8	Underground Mining Extension Perilya Sub Lease
MPa	Megapascal
MR	Modification Report
MOP	Mining Operations Plan
MPA	Maximum Potential Acidity
MPL	Mining Purpose Lease
MLD	Main Lode Drive
NAF	Non Acid Forming
NAPP	Net Acid Production Potential
NEPM	National Environment Protection Measure
NGER	National Greenhouse and Energy Reporting
NHL	National Heritage List
NHMRC	National Health Medical Research Council
NMLs	Noise Management Level
Normandy	Normandy Mining Investments
NPfI	Noise Policy for Industry 2017
NPR	Net Potential Ratio
NSW	New South Wales
OD	Outside Diameter
OOH	Out of Hours
PA	Project Approval 07_0018
Pb	lead
PDN	Primary Dewatering Network
PEL	Pacific Environment Ltd
Perilya	Perilya Broken Hill Operations Pty Ltd
the Pit	Kintore Pit
PAF	Potentially Acid Forming
PGA	Peak Ground Accelerations
PHMP	Principal Hazard Management Plan
PLC	Programmable Logic Controller
PM	Psammopelitic
PM2.5	Particulate matter with equivalent aerodynamic diameter of 2.5 micrometres
PM10	Particulate matter with equivalent aerodynamic diameter of 10 micrometres
PNTL	Project Noise Trigger Levels
PPR	Preferred Project Report
PPV	Peak Particle Velocity
Prism	Prism Mining Pty Ltd
RBL	Rating Background Level

RL	Reduced Levels
ROM Pad	Run of Mine Pad (for ore storage prior to crushing)
RR	Resource Regulator
RWI	Restricted Work Injury or Illness
S	Sulphur
Sb	Antimony
SEE	Statement of Environmental Effects
SEPP	NSW State Environment Planning Policy
SLR	SLR Consulting Australia Pty Ltd
SOMC	Standard Optimum Moisture Content
SPM	Garnet spotted psammopelite
SPR	Source Pathway Receptor
SSD	State Significant Development
SWMP	Site Water Management Plan
t	tonnes
TDI	Total Daily Intake
TEOM	Tapered Element Oscillating Microbalance
the Mine	The Rasp Mine
tpa	tonnes per annum
tph	tonnes per hour
TRV	Toxicity Reference Value
TSF1	Historic tailings storage facility
TSF2	Blackwood Pit tailings storage facility
TSF3	Proposed Kintore Pit storage facility
TSP	Total Suspended Particulates
TWADI	Time Weighted Average Daily Intake
UC	Uncertain (waste rock potential acidic drainage)
UCS	Uniaxial Compressive Strength (measure of rock strength)
U/G	Underground
μg	microgram
μS	microsiemens
V	Vertical Rise
v	volts
VWP	Vibrating Wire Piezometers
WMD	Western Mineralisation Decline
XRF	X-Ray Fluorescence Analyzer
Zn	zinc

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Appendix A1

Project Brief – Rasp Mine MOD6

BHOP

September 2020

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Appendix A2

Consolidated Project Approval -07_0018 (MOD8)

Department of Planning, Industry and Environment

April 2021

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Appendix A3

Issues to be Considered in MOD6 Assessment, Letter Correspondence

S. Donoghue

October 2020

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Appendix B1

Rasp Mine – Tailing and Waste Rock Management MOD6

Golder Associates Pty Ltd

June 2021

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Appendix B2

Liquefaction Assessment of Tailings – Rasp Mine TSF1

Golder Associates Pty Ltd

April 2020

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Appendix C1

Rasp Mine, Broken Hill MOD6 – Air Quality Assessment

ERM Australia Pacific Pty Ltd

May 2021

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Appendix C2

MOD6 Air Quality Assessment Addendum

J Barnett, R Francis & D Roddis

ERM Australia Pacific Pty Ltd

May 2021

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Appendix D1

Human Health Risk Assessment for Rasp Mine, Modification 6

SLR Consulting Australia Pty Ltd

December 2020

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Appendix D2

HHRA for Rasp Mine MOD6 Addendum, Letter Correspondence

T Hagen

SLR Consulting Australia Pty Ltd

May 2021

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Appendix E1

Rasp Mine Modification 6 – Kintore Pit TSF3 – Noise Impact Assessment

EMM Consulting Pty Ltd

May 2021

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Appendix E2

Addendum to MOD6 Noise Impact Assessment – TSF2 tailing harvesting haul road update, Letter Correspondence

T Villierme

EMM Consulting Pty Ltd

May 2021

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Appendix F1

Blasting Impact Assessment for the Proposed Boxcut and Portal/Decline at Rasp Mine (MOD6)

Prism Mining Pty Ltd

March 2021

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Appendix F2

Letter Report - Blast Vibration Assessment at TSF2

Prism Mining Pty Ltd

March 2021

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Appendix G1

Geotechnical Assessment of the Rasp Mine Box Cut, Letter Report

C Tucker

Ground Control Engineering Pty Ltd

July 2021

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Appendix G2

Geotechnical Assessment of the MLD Drive Below the Kintore Pit, Letter Report

C Tucker

Ground Control Engineering Pty Ltd

July 2021

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Appendix G3

Kintore Open Pit – Slope Stability Analysis of Existing In-Pit Waste Rock Dump, during Tailing Placement, Letter Report

C Byrne & C Tucker

Ground Control Engineering Pty Ltd

August 2019

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Appendix G4

Kintore Open Pit – Slope Stability Analysis of Pit Slope Comprising Historic Tailing, Letter Report

C Byrne & C Tucker

Ground Control Engineering Pty Ltd

August 2019

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Appendix H

Long Term Geochemical Degradation Assessment for Waste Rock – MOD6 Waste Rock Management Rasp Mine

Environmental Resources Management Australia Pty Ltd (Perth)

March 2021

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Appendix I

Rasp Mine – Dust Management Options Assessment

Mine Earth

July 2021

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Appendix J

Rasp Mine – Tailing Storage Facility Options Assessment

Golder Associates Pty Ltd

September 2017

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Appendix K

Technical Report – Identification of Potential Inrush and Inundations Pathways from Present and Future TSF Facilities into Rasp Mine Underground Workings (with a focus on Kintore Pit Proposed TSF3)

Rasp Mine Technical Services Team

April 2020

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Appendix L

Rasp Mine – Waste Rock Classification

Pacific Environment Ltd

March 2017

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Appendix M

CBH Resources Rasp Mine proposal to mine within Blackwood Notification Area, RASP

Chief Inspector, Resource Regulator

November 2019

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Appendix N

Description of Modifications for Project Approval -07_0018

BHOP

August 2021