ENVIRONMENTAL IMPACT STATEMENT

RED HILL
MINING LEASE

Section 03
Project Description

Section 03 Project Description

3.1 Overview of the Proposed Project

3.1.1 Introduction

The Red Hill Mining Lease is located adjacent to the existing Goonyella Riverside and Broadmeadow (GRB) mine complex in the Bowen Basin, approximately 20 kilometres north of Moranbah and 135 kilometres south-west of Mackay, Queensland.

BHP Billiton Mitsubishi Alliance (BMA), through its joint venture manager, BM Alliance Coal Operations Pty Ltd, proposes to convert the existing Red Hill mining lease application (MLA) 70421 to a mining lease (ML) and thus enable the continuation and potential future expansion of existing mining operations associated with the GRB mine complex. Specifically, the mining lease conversion will allow for:

- An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine (BRM).
- A future incremental expansion option of the existing Goonyella Riverside Mine (GRM).
- A future Red Hill Mine (RHM) underground expansion option located to the east of the GRB mine complex.

The three project elements described above are collectively referred to as 'the project'.

The key objectives of the project are to:

- Utilise existing BMA owned land on the GRB mine complex MLs to minimise the environmental impacts from additional infrastructure and to provide project efficiencies.
- Maximise resource recovery and sustain existing operations.
- Operate a profitable project to provide high-quality hard coking coal to the export market.
- Design, construct and operate a project that:
  - minimises adverse impacts on the social environment; and
  - complies with all relevant statutory obligations and continues to improve processes, which enhance sound environmental management.

The conversion of the Red Hill MLA to an ML is of strategic importance to the planning and further development of existing operations within and around the GRB mine complex. It is anticipated that development work for mining of panels 14, 15 and 16 associated with the BRM will commence in Financial Year (FY) 2016. The mining of these extensions will utilise existing mine infrastructure, be operated by the existing GRB mine complex workforce and extend the life of mine by approximately one year.

The GRM incremental expansion option refers to those project activities which are located within the existing GRB mine complex and associated with the proposed RHM underground expansion option. Timeframes for delivery of the GRM project components will be subject to the ultimate timing for commencement, the rate of development and scale of future production for the RHM underground expansion option once determined by the project owners.

At full production, the RHM underground expansion option and associated GRM incremental expansion have the potential to produce up to 14 million tonnes per annum (mtpa) of high-quality hard coking coal from the Goonyella Middle Seam (GMS) over a life of 20 to 25 years. Under this scenario, the potential capacity of the extended complex (GRB mine complex and RHM) would be up to approximately 32.5 mtpa.

Coal extraction will be by longwall mining using a thick seam mining (TSM) technique to maximise resource recovery. Coal will be processed on site in a coal handling and preparation plant (CHPP) and then loaded onto trains for shipment to a coal export terminal for export to overseas markets.

While the Red Hill underground expansion option is likely to be operated as an independent mine in terms of workforce, the proposed RHM will interface with the existing GRB mine complex in the following areas:

- Water for processing RHM coal will be sourced from the GRB mine complex and mine water generated from the RHM will be transferred to the GRB mine water management network. This interface will provide greater efficiency, maximise reuse, ensure mine water releases are managed holistically and reduce water related risks.
- CHPP, stockpiles and train load-out facilities will be co-located with the existing Riverside Mine coal handling facilities.
- Waste from coal processing will be dewatered and disposed of in mine waste disposal facilities established for the GRB mine complex.
- Access to existing infrastructure for the supply of raw water, power and communications.

The RHM construction phase has the potential to employ up to 100 per cent remote workforce of 2,000 people, while the operation phase has the potential to require up to 100 per cent remote workforce of 1,500 people. The estimated workforce numbers are subject to further assessment as part of on-going planning and may vary depending on the final rate of development, market demand, production rates and operational requirements as determined by the project owners.

It is proposed to accommodate the up to 100 per cent remote workforce in an on-lease accommodation village. The village location is shown on **Figure 3-1**.

3.1.2 Project Components

The project includes the following components:

- The extension of BRM longwall panels 14, 15, and 16 into MLA70421. Key elements include:
  - No new mining infrastructure is proposed other than infrastructure required for drainage of incidental mine gas (IMG) to enable safe and efficient mining.
  - Management of waste and water produced from drainage of IMG will be integrated with the existing BRM waste and water management systems.
  - The mining of the Broadmeadow extension is to sustain existing production rates of the BRM mine and will extend the life of mine by approximately one year.
  - The existing BRM workforce will complete all work associated with the extensions.
- The incremental expansion of the GRM including:
  - underground mining associated with the RHM underground expansion option to target the GMS;

  - a new mine industrial area (MIA);
  - a CHPP adjacent to the Riverside MIA on MLA1764 and ML1900 − the Red Hill CHPP will consist of up to three 1,200 tonne per hour (tph) modules;
  - construction of a drift for mine access;
  - a conveyor system linking RHM to the Red Hill CHPP;
  - associated coal handling infrastructure and stockpiles;
  - a new conveyor linking product coal stockpiles to a new rail load-out facility located on ML1900; and
  - means for providing flood protection to the mine access and MIA, requiring a levee along the west bank of the Isaac River.
- A potential new RHM underground expansion option to the east of the GRB mine complex, to target the GMS on MLA70421. Key aspects include:
  - the proposed mine layout consists of a main drive extending approximately west to east with longwall panels ranging to the north and south;
  - a network of bores and associated surface infrastructure over the underground mine footprint for mine gas pre-drainage (IMG) and management of goaf methane drainage to enable the safe extraction of coal;
  - a ventilation system for the underground workings;
  - a bridge across the Isaac River for all-weather access. This will be located above the main headings, and will also provide a crossing point for other mine related infrastructure including water pipelines and power supply;
  - a new accommodation village (Red Hill accommodation village) for the up to 100 per cent remote construction and operational workforces with capacity for up to 3,000 workers; and
  - potential production capacity of 14mtpa of high quality hard coking coal over a life of 20 to 25 years.

Table 3-1 and **Table 3–2** show the footprints of the existing GRB mine complex operations and the proposed project. The components of the proposed mining and infrastructure facilities associated with the project are shown in and **Figure 3-1**. Required changes to mining tenements are discussed in **Section 3.3**.

Table 3-1 Summary of Areas for Key Project Tenures

Description	Area (ha)	Comment
EIS study area	25,989	Encompasses the proposed mining activities for the project.
ML1763	10,299	Includes majority of existing GRM and BRM operations. The GRM incremental expansion will be located on this ML including the part of the RHM underground footprint, mine access, CHPP and MIA.
MLA70421	8,841.21	Will cover the Broadmeadow extension, the bulk of the RHM underground expansion option and include the accommodation village.

Table 3-2 Summary of Approximate Areas for Project Components

Description	Area (ha)	Comment
RHM underground footprint	3,600	Includes mining activities on both ML1763 and MLA70421.
Broadmeadow extension	121	Broadmeadow extension is located on MLA70421.
Red Hill MIA	30	Located on ML1763.
Red Hill CHPP	53	Located on existing ML1900.
Red Hill conveyor	55	Crosses ML1763, ML1764 and ML1900.
Red Hill accommodation village	108	Located on MLA70421.

3.2 Project Timing

Indicative project timing for the project is shown in **Table 3-3**.

Table 3-3 Indicative Project Timing

Phase	Indicative dates
Environmental impact assessment completed (Coordinator-General decision)	November 2014
EPBC approval decision	December 2014
Land acquisition and compensation	2014
Draft environmental authority	November 2014
Mining lease and EA grant	February 2015
Stage 1 – Broadmeadow extension to panels 14 and 15	2016 - 2018
Stage 2 – RHM Underground expansion option and GRM expansion option	Commencement dates not known.

A scenario for development and mining of the GRM incremental expansion and RHM underground expansion option is provided for the purposes of the EIS. The scenario is provided in order to fulfil the Terms of Reference (TOR) requirements and does not reflect a commitment by the project owners to proceed with the project. The project owners will undertake further assessment of the GRM incremental expansion and the RHM underground expansion option once the project approvals and tenure conversion are finalised.

The future RHM would have a mine life of approximately 20 to 25 years, as discussed in **Section 3.4.2**. Rehabilitation of surface disturbance caused by mining activities will be continuous as mining progresses and will continue after mining has ceased until completion criteria have been achieved.

3.3 Mining Tenure

The GRB mine complex currently operates on a number of mining leases: ML1763, ML1764, ML1802, ML1900, ML70038, ML70121, ML70193, ML70194, ML70287, ML70288 and ML70289.

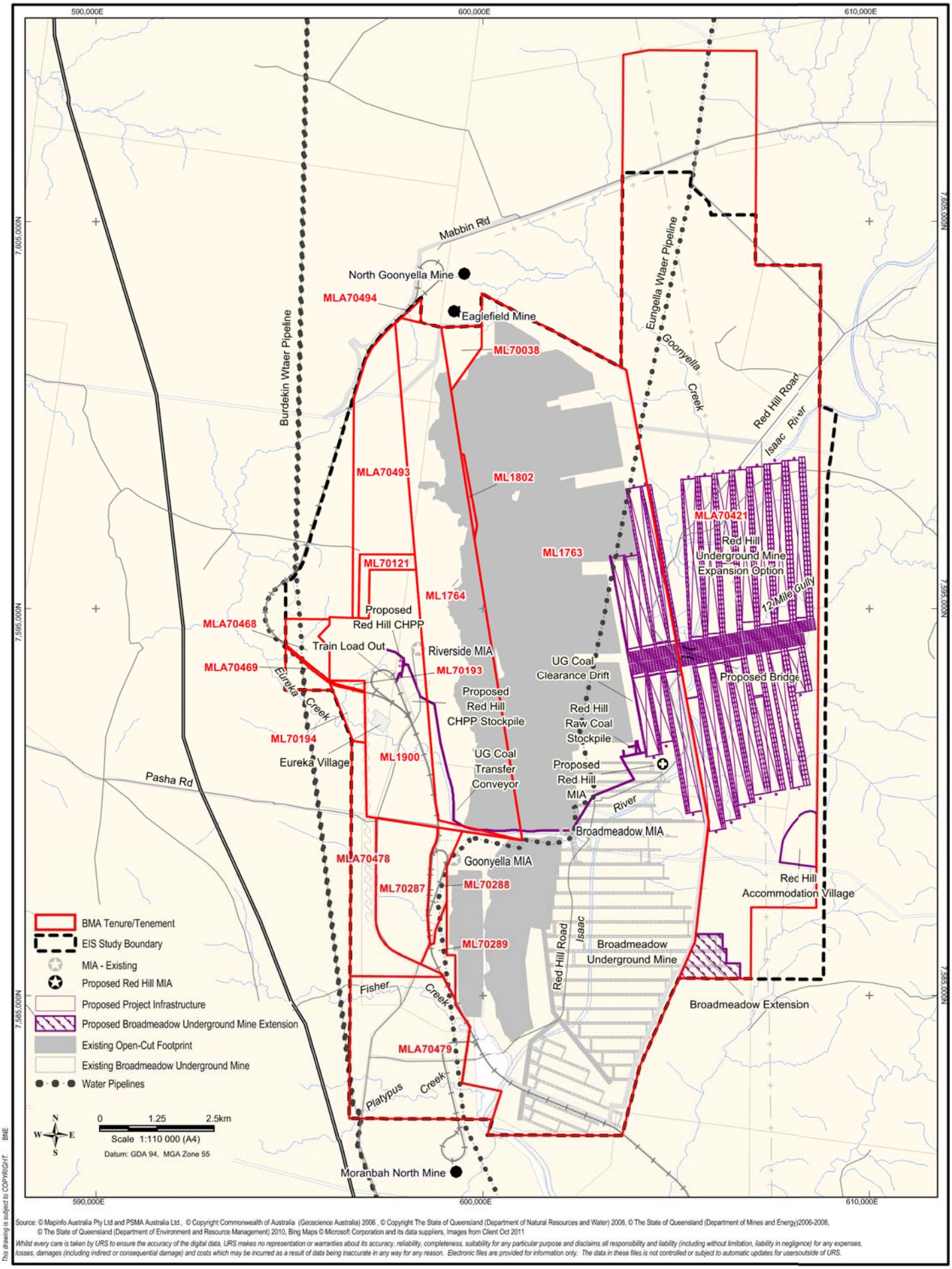
The BRM currently operates on ML1763. The extension of panels 14, 15 and 16 are to extend from ML1763 into the southern section of MLA70421 through the conversion to a mining lease.

Part of the RHM underground expansion option footprint and surface infrastructure and plant associated with the GRM incremental expansion option will be located on ML1763, ML1764, ML1900 and MLA70421. Further details of mining and land tenure are provided in **Section 5.1** and **Figure 3–1**.

The majority of the underground mine footprint, the RHM accommodation village, a bridge across the Isaac River and drainage of IMG associated with the RHM underground expansion option would be located on a new mining lease being sought through conversion of application tenure (MLA70421).

The northern extent of MLA70421 is beyond the EIS study area as indicated in **Figure 3–1**. Further approvals would need to be obtained prior to development in this area.

There are other tenures overlying the EIS study area which include exploration permits petroleum (EPP), petroleum leases (PL), petroleum pipeline leases (PPL) and special leases (SL). These are detailed in **Section 5.1**.



BMA
BHP Billiton Mitsubishi Alliance

RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

PROJECT OVERVIEW

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PROJECT DESCRIPTION

Figure: **3-1**

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Table 3-4 Description of Goonyella, Riverside and Broadmeadow Mine Complex Current and Proposed Operations

	GRB Mine Complex Current Pperations	Proposed Project
Project timing	Current operations will produce coal until approximately 2068 (life of mine 55 years from 2013).	Development work for mining of the Broadmeadow extension (panels 14 and 15) will commence in 2016 with mining of the extensions completed by approximately 2019. The extensions will have no impact on the life of mine for the GRB mine complex as the open cut activities are projected to continue until at least 2068. Timing for the construction of the GRM incremental expansion is associated with the timing for commencement, the rate of development and scale of future production for the RHM underground expansion option once determined by the project owners. Timing for the construction and mining of the RHM underground expansion option is not known.
Land requirement	The current mining leases cover an area of approximately 14,700 ha on a number of MLs as detailed in **Appendix F1**, Table 3.	The Broadmeadow extension is located on MLA70421 and has a surface area of approximately 121 ha. Part of the RHM underground expansion option and associated infrastructure for the GRM incremental expansion are located on the existing ML1763. The total footprint of the RHM underground expansion footprint is approximately 3,600 ha. The total area of MLA70421 is approximately 8,841 ha. The larger eastern portion of the RHM underground expansion option footprint is located on MLA70421 and the smaller western portion located on ML1763. The proposed accommodation village has a surface area of approximately 108 ha and is located on MLA70421.
Production rate	The GRB mine complex has approval to produce up to approximately 18.5 mtpa of product coal.	The Broadmeadow extension will not materially increase annual production and will sustain existing operations by approximately 1 year. The forecast total run of mine (ROM) coal to be mined out of extensions to panels 14 and 15 is approximately 5 million tonnes. The RHM underground expansion option and infrastructure associated with the GRM incremental expansion have the potential to increase the total mine complex production up to approximately 32.5 mtpa of product coal. Additional production from the RHM has the potential to reach up to 14 mtpa.

	GRB Mine Complex Current Pperations	Proposed Project
IMG management infrastructure	BRM has not historically required pre-drainage of IMG. Ventilation drainage and goaf drainage is adequate to manage gas levels.	Due to higher in-situ gas levels, pre-drainage of IMG will be required across much of the proposed Broadmeadow extension and RHM footprint to allow safe mining. Goaf drainage may also be required post-mining for the Broadmeadow extension and the RHM.
Mine Industrial Area (MIA)	Three MIAs are in place, one each for Riverside, Goonyella and Broadmeadow mines.	Product coal associated with the Broadmeadow extension will be processed at the existing BRM MIA. A new MIA would need to be established as part of the GRM incremental expansion in association with the RHM underground expansion option. The MIA would be located in the south-west corner of the proposed RHM footprint on ML1763.
Raw coal stockpiles (ROM stockpiles)	No change. ROM stockpiles are located adjacent to each of these MIA's.	No additional ROM stockpile is required in association with the Broadmeadow extension. Two new raw coal stockpiles adjacent to the RHM MIA would be required as part of the GRM incremental expansion. Timing for development of the ROM stockpiles is associated with the rate of development the RHM underground expansion option. Capacity will initially be 120,000 tonnes per stockpile, with the ability to expand to a total 450,000 tonnes each. Raw coal stockpiles would be fed by an overhead stacker system and an underground reclaim system utilising conical stockpiles.
Conveyors	Conveyors are used to move raw coal from ROM stockpiles to CHPPs and then to move product coal from CHPPs to train load out (TLO) facilities.	Product coal associated with the Broadmeadow extension will be conveyed using existing infrastructure at BRM. A new conveyor system will transfer coal from the RHM portal to the Red Hill CHPP. A second new conveyor will transfer coal from the CHPP to product stockpiles and then to the train load-out.
CHPP	Two CHPPs are in place, one each at the Riverside and Goonyella MIAs. Coal from the BRM is processed at these CHPPs.	Coal processing for the Broadmeadow extension will be undertaken within the existing BRM CHPP. A new CHPP will be located adjacent to the current Riverside CHPP as part of the GRM incremental expansion. It will likely consist of up to three 1,200 tph modules producing up to 14 mtpa of product coal. If required, for blending purposes, coal from RHM may be processed through Riverside or Goonyella CHPPs. Timing for construction of the CHPP will be driven by the timing and rate of development for the RHM underground expansion option.

	GRB Mine Complex Current Pperations	Proposed Project
Tailings disposal	Tailings from the two existing CHPPs are disposed of in existing Goonyella and Riverside tailings storage facilities.	Tailings from the Broadmeadow extension will be managed as part of the existing BRM operations and approved waste management practices. Tailings and coarse rejects from Red Hill CHPP will be dewatered and transferred by truck or conveyor to the existing GRB mine complex spoil/rejects disposal facilities.
Product coal stockpiles	Product coal stockpiles are located at existing TLO facilities.	No additional stock pile areas will be required for the Broadmeadow extension. Product coal will be managed as part of existing BRM operations. Two new product coal stockpiles with the capacity to hold approximately 450,000 tonnes each with the ability to expand to an additional 225,000 tonnes each. These will be located adjacent to the existing Riverside rail loop.
Train load-out (TLO)	There are currently two TLO facilities; one at the Riverside MIA and one at the Goonyella MIA connecting to trains using the existing Goonyella to Hay Point railway.	The product coal produced by the Broadmeadow extension will be processed and transported as part of the existing BRM operations. A new train load-out is proposed to be constructed adjacent to the existing Goonyella Riverside rail loop as part of the GRM incremental expansion in association with the RHM underground expansion option.
Sewage	There are four existing sewage treatment plants (STPs) on site: • Riverside STP; • Broadmeadow STP; • Eureka Village STP; and • lagoon system at Goonyella. In addition there are septic tanks associated with field activities.	The Broadmeadow extension does not require any additional mining infrastructure. New STP's would be required adjacent to the existing STP at the Riverside MIA, for the CHPP, at the new RHM MIA and the proposed Red Hill accommodation village. Mobile toilet facilities may be required during installation of IMG management infrastructure.

	GRB Mine Complex Current Pperations	Proposed Project
Water supply	Water recovered from dewatering of open-cut and underground mining operations is recirculated around the site. Raw water supply is from existing allocations from the Burdekin and Eungella pipelines. Raw water supply requirements vary depending on rainfall. Approximately 3% of the water requirements for the CHPPs must be potable water. Potable water is also required for amenities, underground mine use and to top-up mine water in low rainfall periods. BMA has an existing water supply allowance of about 20,000 megalitres (ML) per year for its Bowen Basin operations from existing supplies. This has the possibility of increasing to around 35,000 ML/year with existing planned upgrades to the water supply network.	Water will be recovered from mine dewatering and IMG management in association with the Broadmeadow extension and the RHM underground expansion option. Water will be transferred to the GRB mine water management network. Product coal will be processed as part of the existing BRM operations. The Red Hill CHPP will also feature water recovery through dewatering of tailings/rejects. A small proportion of water requirements for the proposed Red Hill CHPP must be supplied with raw water. The remainder will be supplied from the GRB mine water or raw water depending on site water inventories. Potable water is also required for amenities, underground mine use and to top-up mine water in low rainfall periods. The project demand for raw water will vary from year to year. Minimum requirements are around 900 ML/year, but may increase if mine water is not available from the GRB mine complex for input into the Red Hill CHPP. An additional tie-in to the Eungella pipeline will be constructed in the vicinity of the Red Hill MIA. No additional allocations are sought for the proposed project.
Site water management network	Water is recirculated within the GRB mine complex and, when required to reduce water volumes on site, water is discharged from the authorised discharge point on Eureka Creek in accordance with the existing EPML00853413 (formerly EA MIN100921609).	Water from the proposed Broadmeadow extension and RHM underground expansion option will be transferred to the existing GRB mine water management network for recirculation within the mine site. When required, water from the integrated water management network will be discharged from the authorised discharge point on Eureka Creek in accordance with the existing EPML00853413 (formerly EA MIN100921609).
Out-of-pit and in-pit spoil and rejects disposal	Spoil and rejects are currently placed in designated disposal areas within the current mining leases.	Rejects will be placed in designated disposal areas within the current mining leases for GRB mine complex. No new disposal areas will be established for the Broadmeadow extension or GRM incremental expansion.
Mine access	Riverside and Goonyella mine access is via Goonyella Road. Broadmeadow Mine access is via Red Hill Road.	There are no changes to the access requirement for Broadmeadow Mine as a result of the proposed Broadmeadow extension into MLA70421. Minor changes are required to provide access to the new CHPP proposed as part of the GRM incremental expansion. The intersection on Red Hill Road will provide access to the Red Hill MIA proposed as part of the GRM incremental expansion. A new bridge across the Isaac River is proposed above the main heading to allow access to the RHM underground expansion option mine footprint, IMG management infrastructure and accommodation village. A network of sealed, gravel and dirt roads will provide access to the IMG management network and Red Hill accommodation village.

	GRB Mine Complex Current Pperations	Proposed Project
Power	Existing power is provided from 132 kilo Volt (kV) transmission lines which link to on site substations.	The existing power supply for the Broadmeadow operations will be sufficient for the mining of the Broadmeadow extension. In association with the GRM incremental expansion and the RHM underground expansion option, 66 kV transmission lines are required to be constructed to provide power from the existing GRB mine complex. A 132/66 kV substation would be required for the CHPP. The new substation and 66 kV powerlines would provide power to the underground operations and MIA. Works will take place within the existing and proposed mining leases.
Road realignments and upgrades	The following road upgrades are proposed or have recently been undertaken as part of current operations: • re-alignment of Mabbin Road; and • designating a new Red Hill stock route.	There are no off-lease road upgrades or realignments proposed specifically for the project. The analysis indicates that the Goonyella Road/Curtin Street, Goonyella Road/Moranbah Access Road/Mills Avenue and Peak Downs Highway/Moranbah Access Road intersections have the potential to be impacted by the project and operate outside typically accepted performance thresholds. Goonyella Road/Curtin Street is anticipated to have the potential to be significantly impacted by the project, with the potential for an intersection upgrade to accommodate project traffic. The Goonyella Road/Moranbah Access Road/Mills Avenue and Peak Downs Highway/Moranbah Access Road intersections are likely to warrant upgrading regardless of the project. BMA will engage with Council and the Department of Transport and Main Roads regarding their plans to upgrade these intersections and make a proportionate contribution towards the cost of the upgrade works (i.e. not fully fund). The timing for consultation with IRC regarding their proposed upgrade solutions and any contribution would need to occur prior to the commencement of construction once the project owners have made a commitment to proceed with the project, determined the proposed staging and finalised its proposed workforce numbers and associated traffic volumes.
Construction workforce	Not applicable	No additional mining infrastructure is required for the Broadmeadow extension. A potential construction workforce of up to 2,000 persons depending on the rate and scale of development determined by the project owners for the GRM incremental expansion and RHM underground expansion option. Hours of construction will be 24 hours a day seven days a week.

	GRB Mine Complex Current Pperations	Proposed Project
Operational workforce	The operational workforce required to meet the existing approved production of 18.5 mtpa is approximately 2,400 personnel.	There will be no change to the workforce at BRM arising from the proposed Broadmeadow extension. A potential operational workforce of up to 1,500 for the GRM incremental expansion and RHM underground expansion option. This is based on an average of 400 to 500 staff per longwall and additional numbers required during shutdowns and longwall moves. These events would occur periodically. Up to 50 staff would be employed at the new Red Hill CHPP. Workforce numbers will be subject to further assessment as part of project planning once the project owners have determined the timing, scale and rate of future development.
Workforce accommodation	The majority of the current workforce is accommodated either in Moranbah or at the onsite Eureka Village.	A new accommodation village will be constructed to provide accommodation for up to 3,000 workers associated with the GRM incremental expansion and the RHM underground expansion option. The village capacity accounts for a potential overlap between construction and operation phases. Operations will run 24 hours a day 7 days a week.

3.4 Mineral Resources

3.4.1 Coal Resource Estimate

The project is situated on the north-western margin of the Bowen Basin, on the stable Collinsville Shelf. Three major coal bearing geological formations of Permian age occur in the region, these include the Rangal Coal Measures, the Fort Cooper Coal Measures, and the Moranbah Coal Measures.

The Rangal Coal Measures outcrop in the far eastern corner of MLA70421. The Fort Cooper Coal Measures contain thick, stone banded, poor quality coal seams which are not considered economic under current circumstances. These in turn overlie the Moranbah Coal Measures which are the productive measures targeted by the RHM. The Moranbah Coal Measures typically contain up to seven coal seams which are separated by inter-banded sandstones, siltstones and claystones and include several tuff units. The main tuff unit, the ‘‘P’’ Tuff, is recognisable across the area and is a useful correlation marker within the formation.

Three main coal seams are present in the proposed mining area: the Goonyella Upper Seam (GUS), the GMS and the Goonyella Lower Seam (GLS). These seams split and coalesce across the mining tenements and various combinations are mined in the adjacent open-cut mines to the west of the proposed RHM. The proposed RHM will only target the GMS which yields high quality coking coal. The GMS is between 5 and 10.5 metres thick within the target mining area and there are known areas of faulting.

More information on the local and regional geology and coal resources is provided in **Section 5.3.2**.

The current BMA coal resource estimate (Joint Ore Reserves Committee (JORC) compliant) is contained in **Section 5.3.2**. These estimates are based on an existing geological model of the coal reserve and will be refined with further exploration, particularly in the east of the proposed RHM footprint.

Note that resource estimates and characteristics are approximate at this stage, and are typically confirmed several years ahead of mining each section. Possible sterilisation of coal resources is discussed in **Section 5.3.2**.

3.4.2 Proposed Red Hill Mine Production

The Broadmeadow extension will not materially increase annual production rates for the BRM and processing of coal will be undertaken by the existing operations using existing infrastructure.

The elements of the Goonyella incremental expansion are associated with the proposed RHM underground expansion option. Timeframes for delivery of these project components will be subject to the ultimate timing for commencement, the rate of development and scale of future production for the RHM underground expansion option once determined by the project owners.

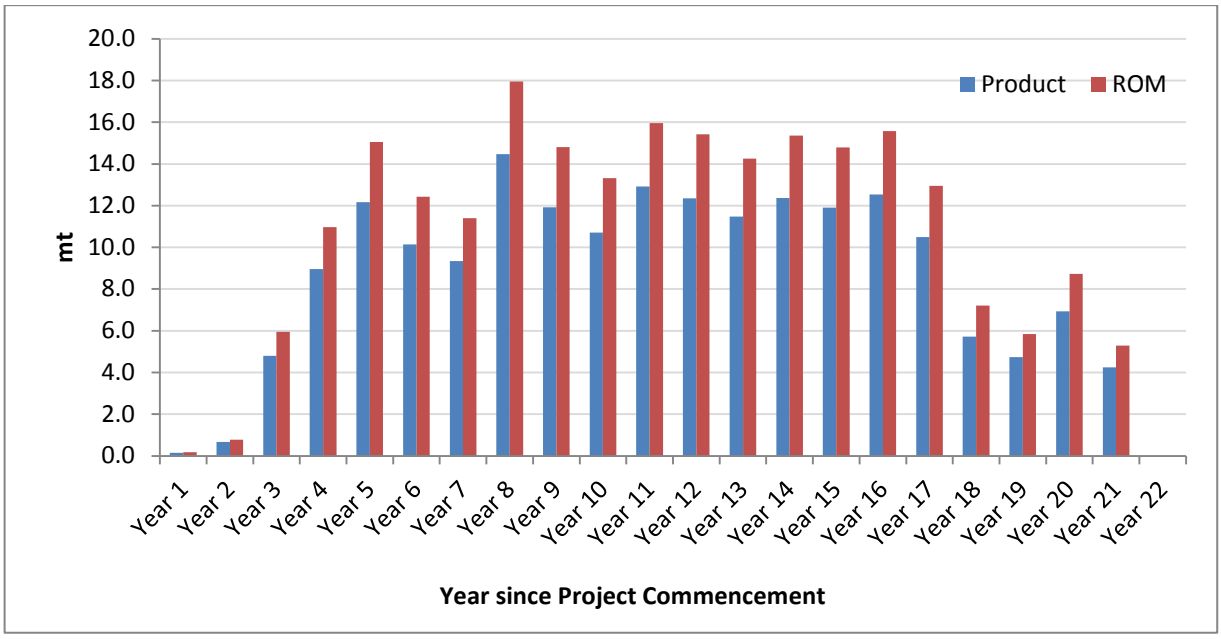
The proposed RHM underground expansion option will target the GMS. Depending on the rate and scale of development, the RHM underground expansion option will have an estimated life of mine of about 20 to 25 years extracting 234 million tonnes of ROM coal which when processed will produce 190 million tonnes of product metallurgical coal. Annual production rates are affected by a number of factors, and forecast of annual production figures over this period are indicative only. Ongoing

refinement of the mine plan, resource definition, and market requirements will impact timing for project commencement, annual production rates and mine life.

At peak production, with two longwalls operating simultaneously, up to 18 mtpa of raw coal would be extracted from RHM which, when processed, would be expected to produce up to 14 mtpa of product coal.

Figure 3–2 shows the indicative forecast annual production for the RHM underground expansion option based on development of two longwall underground mines. Sequencing of production and annual production rates may vary significantly from what is shown in **Figure 3–2**. Production rates from the BRM will not increase as a result of the proposed Broadmeadow extension.

Figure 3-2 Indicative Production Profile – Red Hill Underground Expansion Option



3.4.3 Ongoing Evaluation and Exploration Activities

Exploration activities have been undertaken over the Broadmeadow extension area and RHM underground mine footprint which extends across the existing lease ML1763 at Goonyella Riverside and MLA70421. The activities provide an indication of the overall resource quantity and characteristics and the results have been used to provide input into initial mine planning for the Broadmeadow extension and RHM underground expansion option. The exploration techniques used included seismic surveys, conventional geological drilling and core sampling.

More detailed evaluation and definition of the resource will continue ahead of detailed mine planning for the RHM underground expansion option. Detailed mine planning is undertaken on a cyclical basis with detailed mine plans typically covering about five years ahead. This detailed evaluation allows highly faulted or otherwise unsuitable areas to be identified and, if possible, avoided.

Exploration activities for the Broadmeadow extension and RHM footprints are also providing information on gas content and geotechnical characteristics. Understanding of these matters is critical to successfully managing the risk of potential outburst and for safe mine development.

3.5 Overview of the Current GRB Mine Complex

BMA operates the existing GRB mine complex. The environmental approval for the mine complex is environmental authority EPML00853413 (formerly EA MIN100921609). The GRB mine complex currently produces approximately 14.5 mtpa. BMA's current plans are for the GRB mine complex to produce up to approximately 18.5 mtpa.

The layout of the existing GRB mine complex is shown in **Figure 3-1**. The GRM is an open-cut operation consisting of 12 pits which are mined using a conventional dragline and truck-shovel pre-strip methods. Multiple coal seams are all extracted in the same operation. The BRM is a punch longwall mine that has been developed from former open-cut mine pits in the adjacent open-cut operation.

To support the mining operation, the GRB mine complex includes two CHPPs that are located at the Goonyella MIA and the Riverside MIA. The CHPPs remove the non-coal materials and reduce the coal to the specified size range. Rejects are placed into designated reject dumps. Tailings are pumped to licensed tailings storage facilities and the water is reclaimed for re-use in the CHPPs and for dust suppression. There is also a third MIA at BRM.

Following processing, product coal is transported by rail to the BMA-owned Hay Point, Dalrymple Bay and Abbot Point Coal Terminals, from where it is shipped to overseas markets.

3.6 Proposed Underground Mining Operations

3.6.1 Overview

The project covers the proposed Broadmeadow extension, GRM incremental expansion and the RHM underground expansion option as shown in **Figure 3-3**.

For the Broadmeadow extension, mining of the new areas will occur through extension of longwall panels 14, 15 and 16 of the existing BRM. TSM methodology will be used for resource extraction. Due to the gas content in the GMS and adjacent seams, a combination of gas drainage management techniques may be required. This is discussed further in **Section 3.8**. As coal is extracted from the GMS, subsidence will occur in the overlying strata, including the GUS. This is discussed further in **Section 3.6.5**.

The proposed RHM footprint extends across the existing GRM ML1763 and the MLA70421.

The proposed RHM is a proposed longwall operation mining the GMS to the north of the existing BRM. The mine development scenario provided in this EIS describes development as a conventional underground operation with drifts for access and services located on ML1763 and two sets of main headings for longwall access and coal transport. The main headings and longwall panel orientation is illustrated in **Figure 3-3** and is influenced both by the need to manage IMG, as well as maximising extraction given geological constraints such as faults (offsets) and dips in the coal seam. The longwall panels are orientated in a generally north/south direction and extend across MLA1763 on GRM and MLA70421. Some further optimisation of the longwall panel positioning may occur.

TSM methodology will be used for resource extraction. This is described further in **Section 3.6.3**. As coal is extracted from the GMS, subsidence will occur in the overlying strata, including the GUS. This is discussed further in **Section 3.6.5**. Due to the gas content in the GMS and adjacent seams, a combination of gas drainage management techniques will be required. This is discussed further in **Section 3.8**.

3.6.2 Mine Access

The Broadmeadow extension will not require a separate access and underground mining will extend from the existing longwall panels at BRM across the boundary between ML1763 into MLA70421.

Access to the underground workings for the RHM underground expansion option is proposed to be via a drift of approximately 2,000 metres in length which will intersect the GMS at an approximate depth of 200 metres. Construction of the drift would most likely commence with a cut and cover style construction method, progressing to an underground tunnelling construction method such as road header machinery. Alternatively, a more conventional drill and blast technique may be utilised. Drift construction is expected to take up to two years. Spoil will be disposed of to the existing GRB mine complex stockpiles or used on site, subject to suitability. Further information on spoil disposal from drift and mine access construction is provided in **Section 6**.

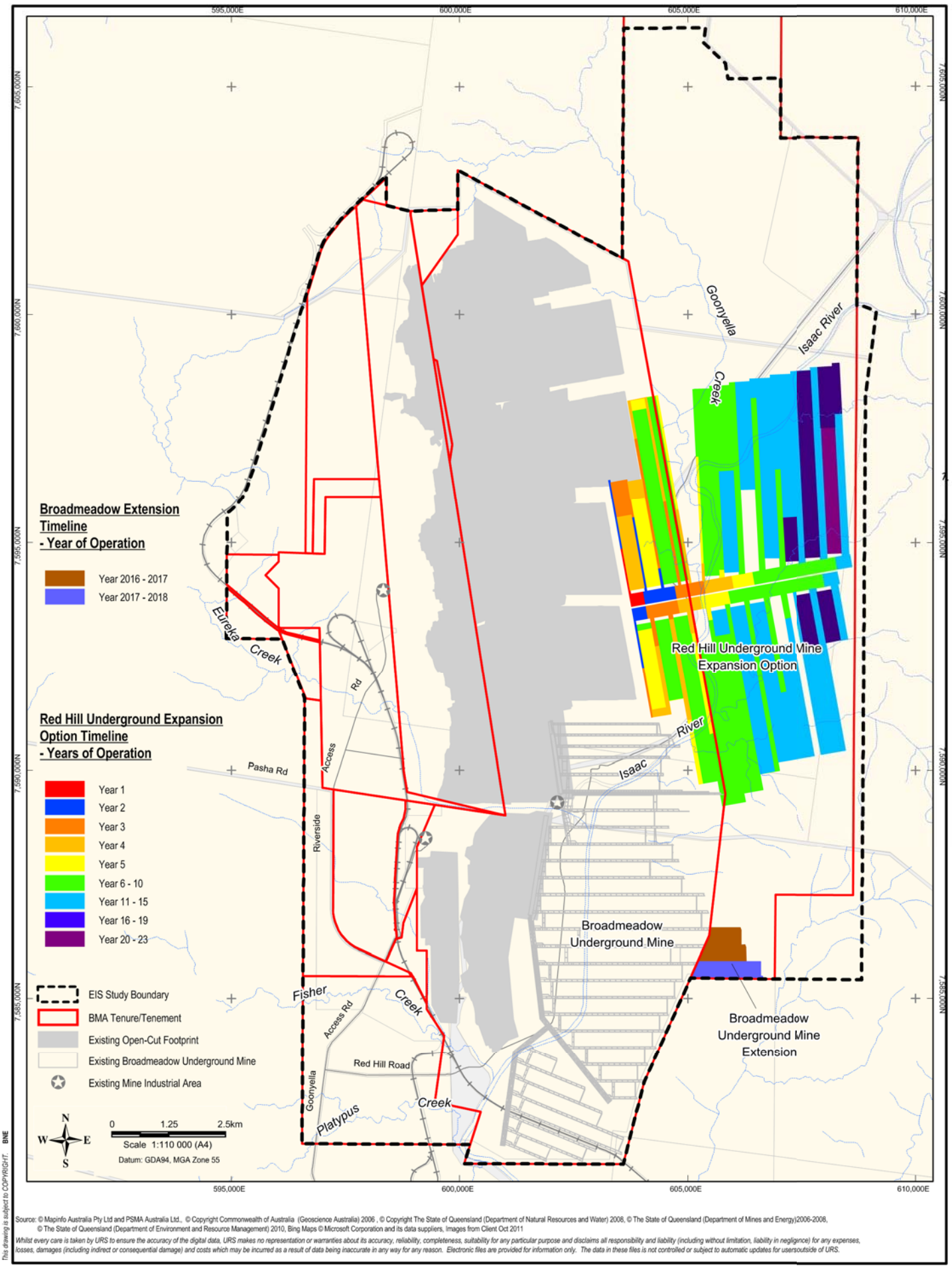
Once the target depth has been reached, the main entrance to the mine, known as pit bottom, will be established and transportation and ventilation systems installed. Conveyors will be installed in the drift to bring coal to the surface, and roadways and other infrastructure requirements will also be established.

3.6.3 Proposed Mining Methodology

The Broadmeadow mine is an existing longwall mine utilising TSM technology which will extend panels 14, 15 and 16 into MLA70421. At RHM, mining is proposed to commence from the main heading, with panels extending along strike, roughly north and south, of the main heading. An indicative mine sequence for underground mining is shown in **Figure 3-3**. The mine schedule is likely to vary depending on the rate of development, product demand and other factors.

The longwall panels are created by driving parallel development headings known as gate roads on either side of the panel from the main heading to the extent of the longwall block. The headings are then connected together across the end of the longwall panel, which allows the longwall machinery to be installed and the ventilation circuit to be set up.

The current layout for the RHM underground expansion option has development headings running approximately north-south at 320 metre spacing. This spacing is subject to optimisation in future planning and the detailed design phases. Roadways are separated by sections of unmined coal called pillars, which remain in place after mining is completed. The pillars provide roof support for the roadways, which are developed by continuous miners. Roadways form passages for access, ventilation, machinery, electrical supply, communication systems, water, and compressed air lines. The roadways connect to main east-west headings, which connect to inclined drifts providing access to the surface. Vertical shafts provide ventilation and emergency access to the surface if required.



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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

INDICATIVE UNDERGROUND PRODUCTION SEQUENCE

URS

PROJECT DESCRIPTION

Figure: **3-3**

File No: **42627136-g-1006.wor** Drawn: **VH** Approved: **CT** Date: **24-06-2013** Rev.**A** A4

For the Broadmeadow extension, the initial development will be undertaken for panels 14 and 15. Panel 16 is also proposed to be extended but is subject to further planning and detailed design. These panels are currently accessed directly from adjacent open-cut highwalls and hence a drift and main headings are not required.

The longwall panels are extracted from the furthest mining extent, working back towards the main headings. The longwall continuous mining equipment includes:

- a series of self-advancing hydraulic powered roof supports which move along the panel progressively with the shearer as mining proceeds to support the roof;
- mechanised shearers to cut and remove the coal at the coal face; and
- armoured face conveyors to remove the coal from the face and transfer it to the roadways.

From the longwall mining equipment, the coal is conveyed along the headings and then via the drift to the surface utilising a system of conveyors.

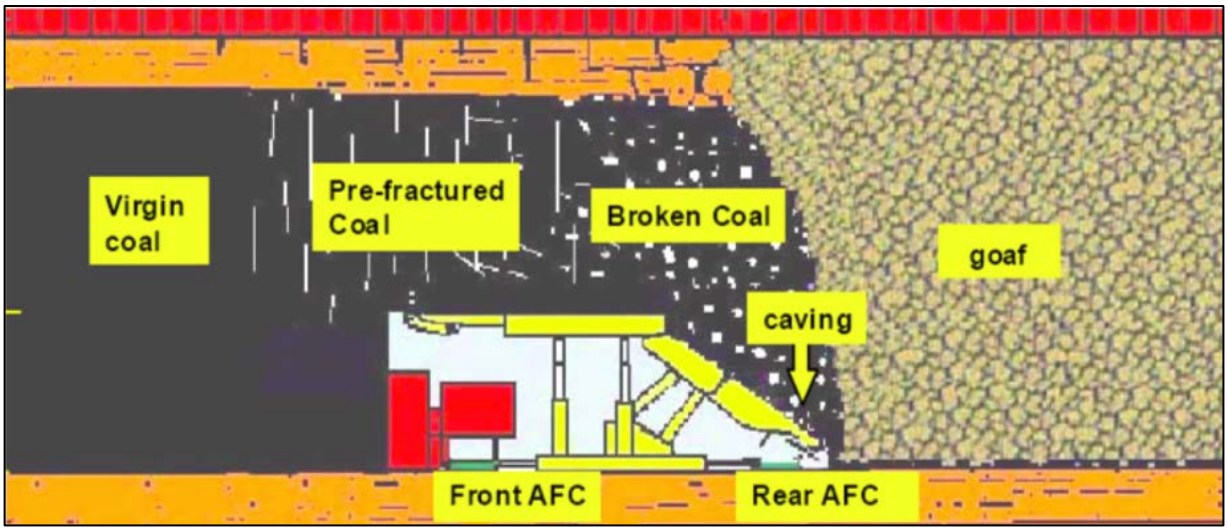
The roof of the mined-out area behind the roof supports is allowed to collapse as mining progresses. This area is referred to as the goaf.

Development equipment includes the following for each section:

- a continuous miner/bolter;
- electric shuttle cars;
- breaker feeder; and
- a conveyor belt to carry coal along longwalls to the mains conveyor.

As the GMS is up to 10 metres thick, it is too thick for the entire depth of the seam to be extracted using conventional longwall mining, which can typically only remove up to six metre thickness. A TSM technique is therefore proposed. The TSM equipment differs from conventional longwall mining equipment in that it has a hydraulic roof support system that can be raised and lowered, allowing coal above the area cut by the shearers to cave in behind the mining face, falling onto a rear armoured face conveyor (AFC) as shown in **Figure 3–4**. The equipment is generally lower than conventional mining equipment, with the height of the roof supports typically three to four metres. As the coal above the mining equipment is fractured by the mining activity, it then breaks into pieces relatively easily as the hydraulic support is lowered, allowing it to cave in and be extracted from the mine.

Figure 3-4 Schematic Drawing of Thick Seam Mining



Key: AFC = Armoured Face Conveyor

Potential new equipment requirements for the RHM underground expansion option mining operations are as follows:

- drift conveyors and trunk conveyors with a capacity of 7,000 tph and longwall maingate/tailgate conveyors with a capacity of 5,300 tph;
- diesel equipment including load haul dumpers, personnel transporters, graders, mobile generator, ambulance and mobile crib rooms;
- development equipment for construction of roadways, including miners, shuttle cars, and ventilation devices;
- longwall mining equipment, including roof supports and conveyor sets, shearers and longwall installation and relocation equipment;
- electrical equipment including power cables, lighting and switchboards;
- water and compressed air reticulation systems;
- ventilation systems including shafts, fans and control devices;
- emergency response and first aid equipment; and
- communications and IT systems.

3.6.4 Groundwater Inflow

Groundwater ingress will vary over the life of the Broadmeadow extension and RHM underground expansion option depending on the characteristics of the particular part of the coal seam being mined, the number of panels targeted, and the rate of mining. Estimates undertaken as part of groundwater modelling for the projects proposed underground mining indicate that groundwater ingress could reach a peak of around two gigalitres per year during the last five years of operation for the RHM. However, the volume of ingress will be impacted by the rate and timing for development. Some groundwater will be removed prior to interception by mining through pre-drainage of IMG, which has the potential to reduce inflows to the underground. It is estimated that a peak of up to 800 ML per annum of groundwater may be derived from IMG pre-drainage.

Groundwater inflow will be pumped from the RHM and Broadmeadow extension to the GRB mine water management network described in **Section 3.9** and **Section 7**.

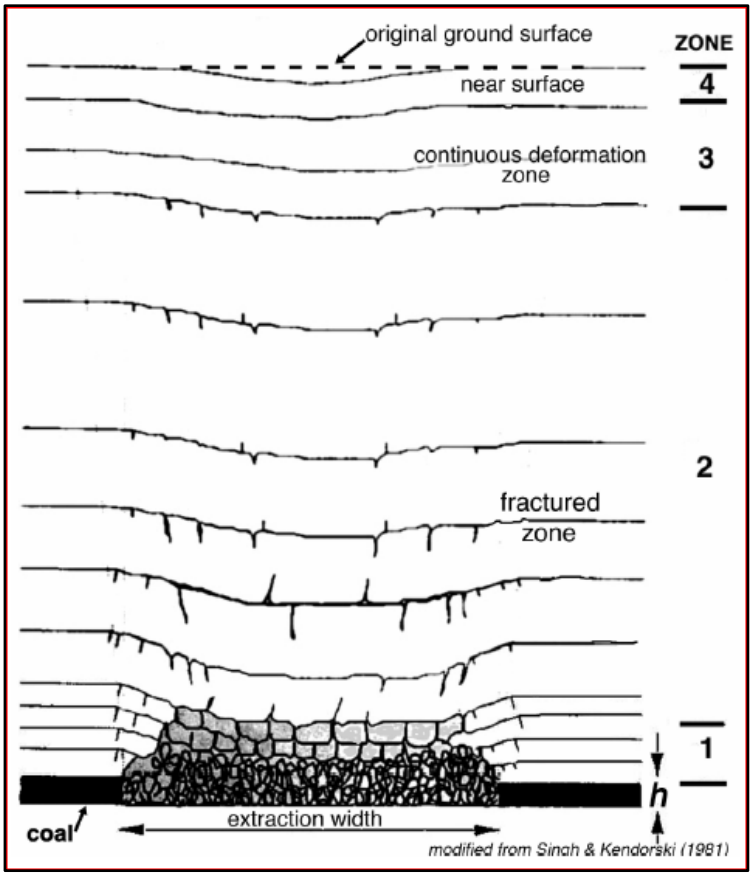
3.6.5 Predicted Subsidence

Subsidence impacts will occur over the Broadmeadow extension and the footprint of the RHM underground expansion option. Longwall extraction creates a void which causes the overlaying strata behind the longwall supports to fall into the mine void after the supports have moved ahead. This is referred to as goaf. This can result in subsidence of the overlying strata, depending on properties of the overlying rock that can be expressed on the surface, where the ground surface subsides to a lower level relative to the original ground level. **Figure 3-5** shows a conceptualisation of the effect of the longwall cave in on the overlying geological strata and, ultimately, the ground surface.

For longwall mining, maximum subsidence depths occur along the centre of the mined out panels, with the pillars and main heading remaining at or close to pre-mining ground levels. Subsidence generally starts to occur shortly after mining and within one to two months, most of the subsidence has occurred. Subsidence is generally complete within about 12 months of mining. The time frame and depth of subsidence can vary depending on the type of rock overlaying the mined area, as well as the depth to the mine.

Subsidence of a relatively flat surface typically results in a gently undulating landform. However, the final surface depends on pre-mining topography, geology, the seam thickness extracted, width of panels, and the depth of the longwall mining. **Figure 3-6** illustrates the modelled predicted subsidence that could occur as a result of the proposed underground operations. Modelling has been undertaken on a conservative basis and predicts average subsidence of three to five metres and maximum subsidence of up to six metres. The subsidence modelling report is provided in **Appendix I7** and further discussion of subsidence-related impacts is provided in **Sections 5.4** and **7.3**.

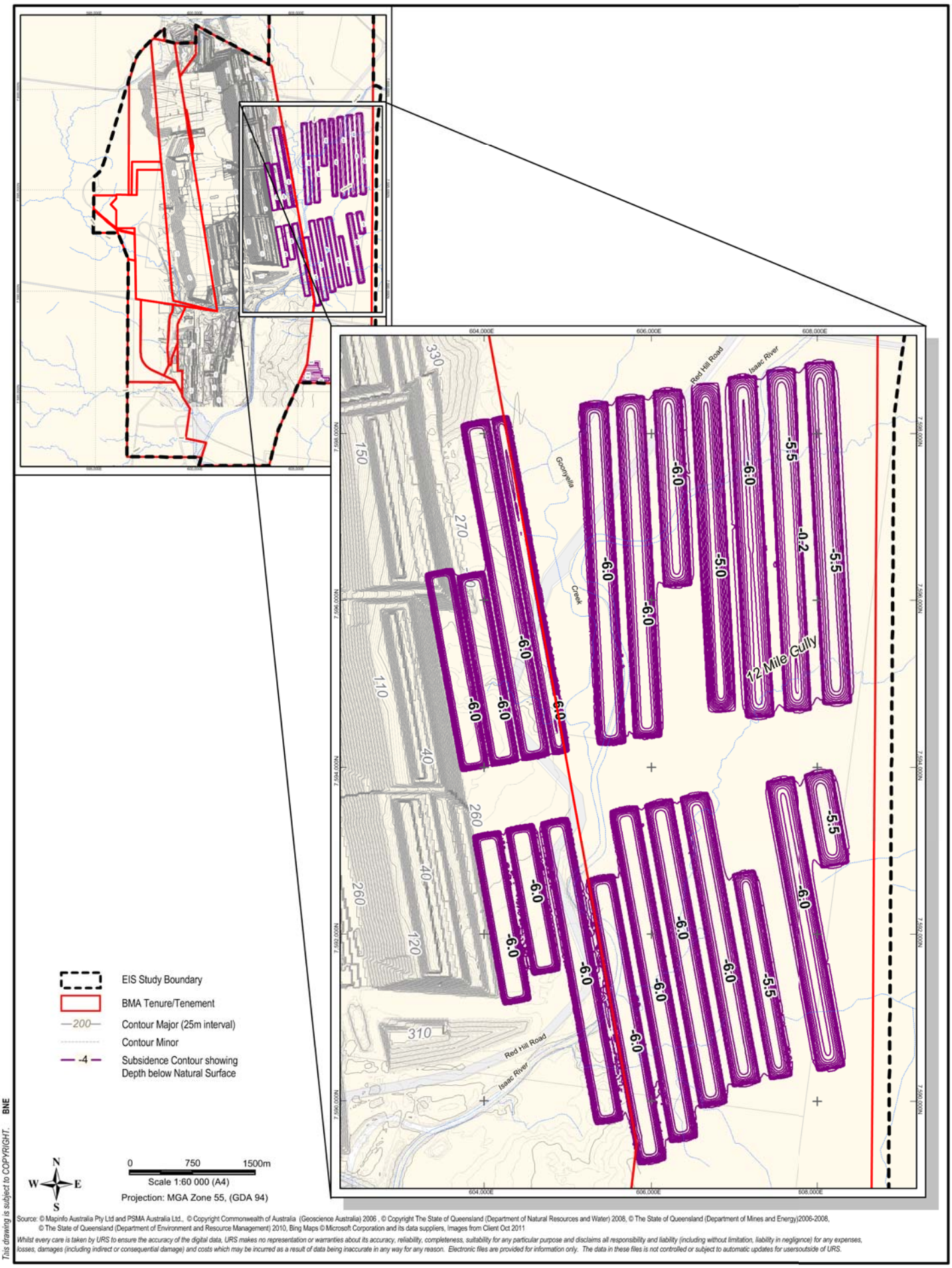
Figure 3-5 Typical Subsidence Profile (from Winters and Capo 2004)



3.6.6 Ventilation

Ventilation systems will be installed progressively in the underground mine workings to maintain air quality in the underground mine. As the RHM underground expansion option and the Broadmeadow extension have relatively high gas content, ventilation will particularly focus on maintaining safe methane levels inside the mine. The mine ventilation system will also remove dust and exhaust gases from diesel powered equipment.

The ventilation system will utilise vertical ventilation shafts to connect mine workings to the surface, and a series of pipes and ducts within the underground workings to assist with circulation of air. Fans will draw fresh air through the ventilation system and out of the ventilation shafts. Up to three active ventilation shafts will be required per operating longwall at any one time. The number of ventilation shafts required, and design of the ventilation system will be determined during detailed design.



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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

PREDICTED SUBSIDENCE

URS | **PROJECT DESCRIPTION** | Figure: **3-6**

File No: **42627136-g-1014.wor** | Drawn: **VH** | Approved: **CT** | Date: **06-06-2013** | Rev.**A** | A4

3.7 Surface Infrastructure and Facilities

3.7.1 Mine Industrial Area

As the Broadmeadow extension will be operated as part of the existing BRM, a new MIA is not required for this component.

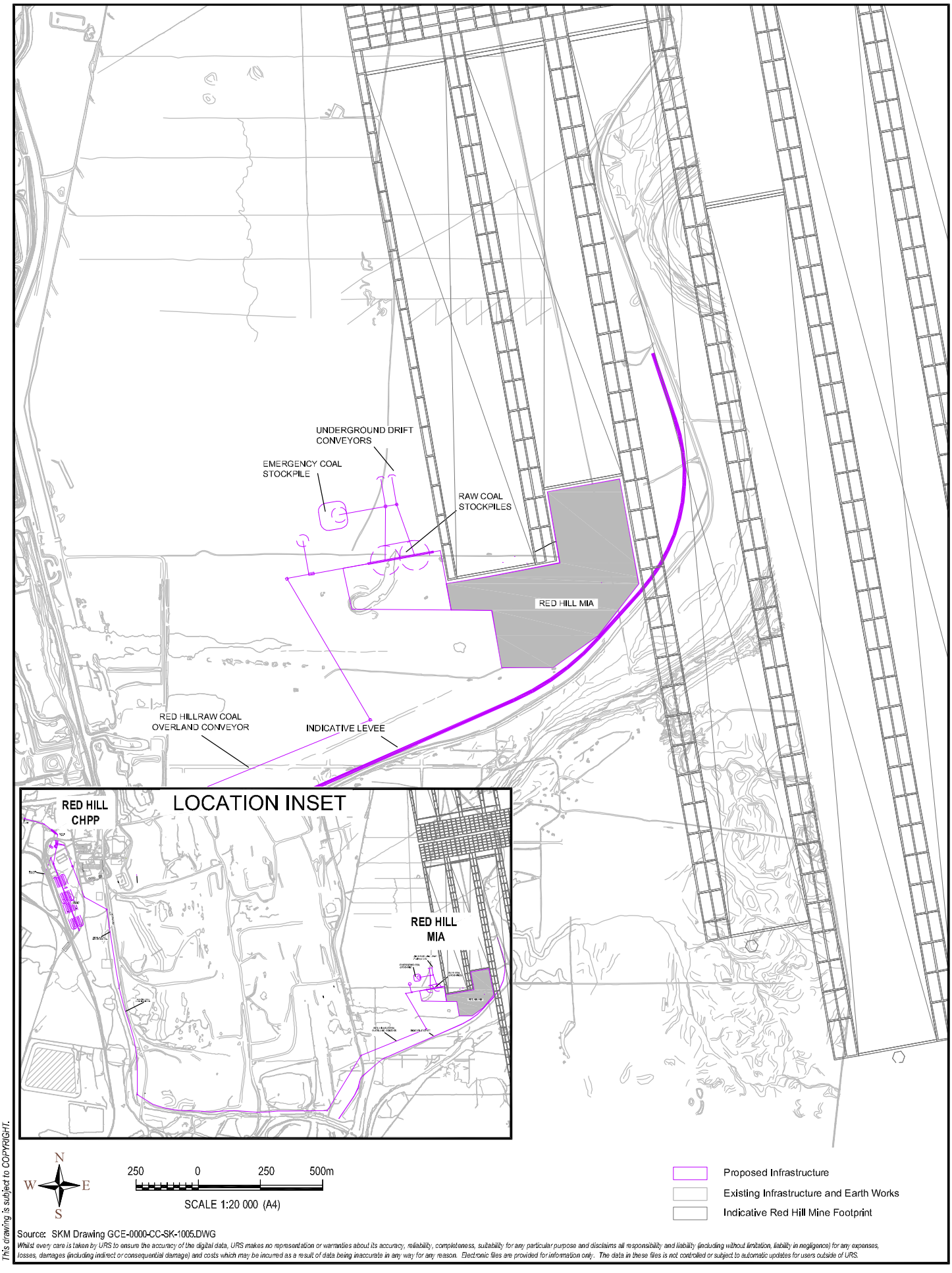
The GRM incremental expansion option includes a new MIA in association with the RHM underground expansion option. **Figure 3-7** illustrates the indicative footprint for the Red Hill MIA located near the top of the drift.

The MIA would include:

- site offices, security gatehouse and washrooms;
- laydown, storage and parking areas, including adequate car parking for visitors and maintenance workers and bus pick up and drop off areas;
- power and water supply to support operations. A raw water dam will be located adjacent to the MIA with nominal capacity of 50 ML;
- equipment hardstands, workshops, maintenance areas and laboratories. Equipment maintenance will take place in workshops on hardstand surfaces;
- vehicle wash-down facilities for light vehicles and heavy equipment. Wastewater from wash-down areas will be captured and treated to remove hydrocarbons, seeds and plant matter and suspended solids before being recirculated to the site water management network;
- package sewage treatment plant. This is discussed further in **Section 7.3.3**;
- waste storage area. Waste storage and management is discussed further in **Section 15**;
- fuel storage and refuelling area. Diesel and oil storages will be designed to Australian Standard (AS) 1940 - *Storage and handling of flammable and combustible liquids*. The refuelling area will be fully contained with rollover bunds, draining to an oil-water separator. Total on site storage capacity will be in the order of 200 kilolitres. Diesel will be brought to the site by road tanker from Moranbah or Mackay;
- hazardous goods storage. Small quantities of solvents, other cleaning chemicals and gas bottles will be stored at the MIA in enclosed storages. Refer to **Section 20** for further information on hazardous goods use and storage; and
- emergency services rescue equipment.

The MIA will have a fully contained mine water network from which surpluses will be transferred to GRB mine complex. Stormwater will be directed to sediment basins for treatment prior to release or recirculation to the mine water network.

As the MIA is within the Isaac River floodplain, flood protection will be required. The current design includes a levee to be constructed along the western bank of the Isaac River to protect the MIA, stockpiles and drift entrance from flooding. This will provide protection of the MIA and underground mining area in floods up to the predicted Q1000 flood event. Flood mitigation options will be further assessed in detailed design.



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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

INDICATIVE RED HILL MIA

URS

PROJECT DESCRIPTION

Figure: 3-7

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3.7.2 Internal Roads

The Broadmeadow extension will not necessitate change to the existing internal road network for BRM.

Additional internal roads and a bridge crossing the Isaac River will be required as part of the GRM incremental expansion option and the RHM underground expansion option.

The proposed CHPP is close to existing internal roads and minimal additional internal road construction is required to access this area.

The MIA and underground mine will be accessed via the construction of a short internal road from Red Hill Road.

A two lane, all weather bitumen road will be constructed from the Red Hill MIA to the proposed Red Hill accommodation village.

A new bridge will across the Isaac River on the alignment of the main headings will provide access to the accommodation village, access for IMG drainage and also to access environmental monitoring and management areas. The bridge will be designed to provide a suitable level of flood immunity and also to minimise impediment to flood flows within the river channel or floodplain. These requirements will be determined during detailed design. This bridge may also be used to support gas and water pipelines from IMG management activities to the east of the Isaac River.

An all-weather access road will also be constructed along the main headings. Temporary and permanent access tracks to provide access to the IMG pre-drainage infrastructure will be constructed along the pillars (refer to **Section 3.8.5.3**).

A maintenance access road will also be constructed along the conveyor corridors. This road will only be used to maintain the conveyors.

3.7.3 Raw Coal Stockpiles and Handling

Product coal from Broadmeadow extension will be processed as part of the existing BRM operations.

Raw coal stockpiles (also known as ROM stockpiles) will be located north-west of the MIA at the top of the drift proposed for the GRM incremental expansion and RHM underground expansion option. The underground drift conveyors will discharge coal from the underground mine to stockpiles, via a primary sizing station, which will crush any coal lumps to a maximum size of 300 millimetres. A magnet will also remove large iron-containing objects that might be present as contaminants. The rate of delivery to the raw coal stockpiles will typically be 4,000 tph, with a maximum rate of 7,000 tph. Capacity will initially be 120,000 tonnes per stockpile, with the ability to expand to a total 450,000 tonnes each.

Stockpile sizes will be determined during detailed mine planning to ensure underground mining activities are never disrupted due to lack of raw coal stockpile capacity, and to ensure continuous flow can be maintained to the CHPP.

Coal will be reclaimed from the raw coal stockpiles and pass through a secondary sizing system which will first screen out coal pieces less than 120 millimetres in size, sending these directly to the transfer conveyor, and then crushing larger coal pieces to 120 millimetres or less in a rotary breaker. Magnets will also remove iron-containing contaminants. A small reject stockpile will store rejects and iron containing materials for reclaim or disposal with wastes from the existing GRB mine complex.

Weighing systems will be installed at each stage to record the mass of coal passing through the process.

Dust suppression water sprays will be provided at the stockpiles and sizing equipment. This process is shown on **Figure 3-8**.

3.7.4 Conveyors

The sized product coal from the RHM underground expansion option will be sent by overland conveyor through the Goonyella Mine to raw coal surge bins at the proposed Red Hill CHPP.

An overland conveyor will transfer coal from the raw coal stockpiles adjacent to the Red Hill MIA to the CHPP. The proposed route for this conveyor is shown on **Figure 3-7** and **Figure 3-9**. Dust controls will be installed on the conveyors. Options for suppression include enclosure of transfer chutes, partial enclosure of transfer points and partial enclosure of surge bins. Water sprays will also be fitted at transfer points.

3.7.5 Red Hill CHPP

3.7.5.1 Overview

A CHPP removes dirt, rock and other impurities from the ROM coal before it is sold as product coal. This increases the value of the coal, and reduces transportation costs as impurities do not need to be transported. The CHPP uses physical and mechanical processes to clean coal and remove impurities and fine materials from the coal.

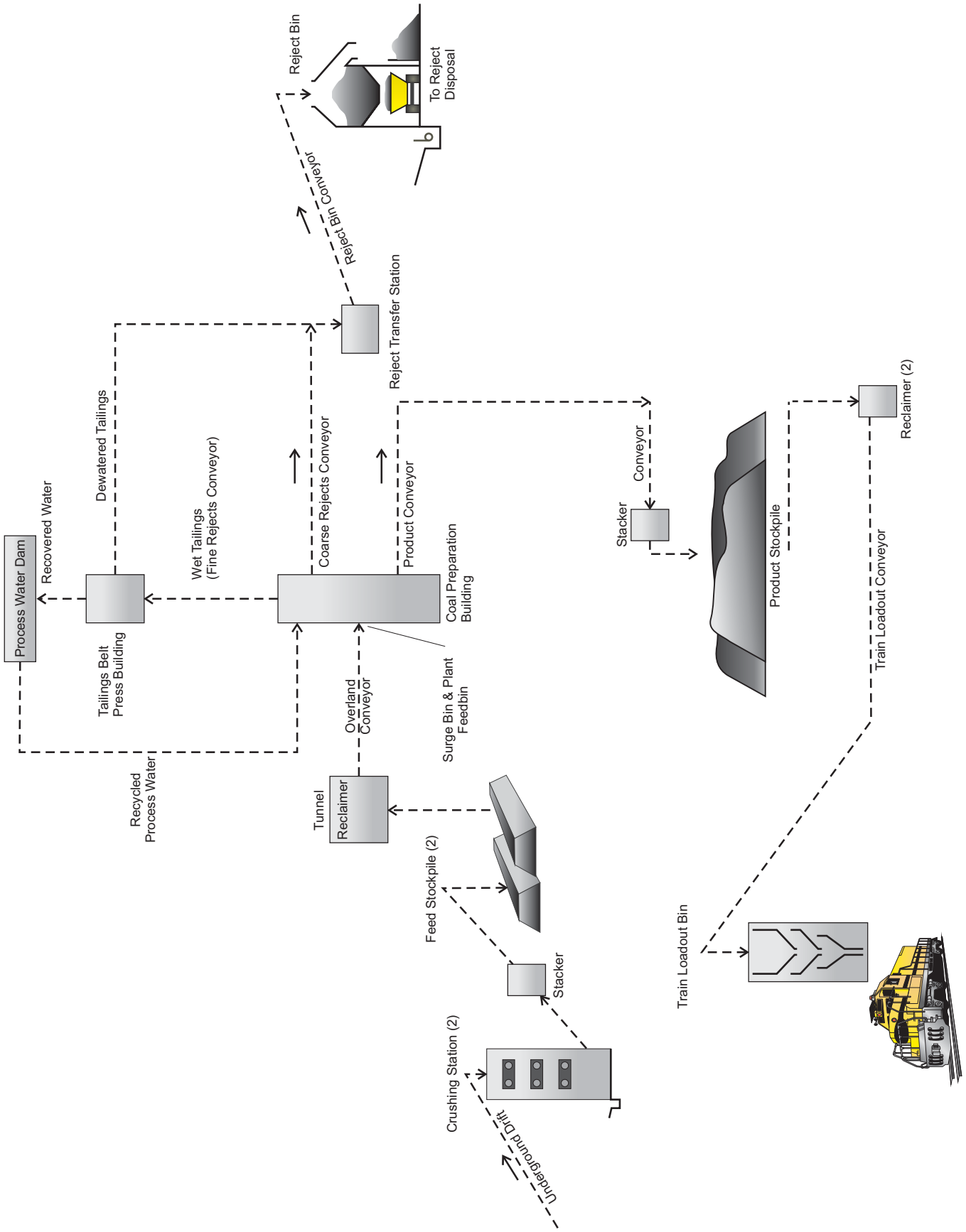
As the existing CHPPs at the GRB mine complex have limited spare capacity, a new CHPP will be required to meet the production rate from the new RHM underground expansion option. The Red Hill CHPP will be located to the south of the existing Riverside MIA and developed as part of the GRM incremental expansion. The Red Hill CHPP will follow a standardised BMA design. The current conceptual design has two modules, each capable of processing 1,200 tonnes of coal per hour, giving a total capacity of 2,400 tonnes per hour. A third module, also of 1,200 tonnes per hour capacity may be installed at a later date. **Figure 3-9** shows the layout of the Red Hill CHPP and **Figure 3-8** is a schematic process flow diagram for the project.

The CHPP operations and maintenance activities occur 24 hours per day, up to 363 days per year. Components will include large diameter cyclones, reflux classifiers and flotation columns. Belt press filters will be used to dewater fine rejects so that only dewatered tailings are produced.

While primarily intended to treat coal from the proposed RHM, coal conveyor systems will allow for the Red Hill CHPP to receive coal from other parts of the GRB mine complex where this may be required for blending to create particular product types. Similarly, coal from RHM may occasionally be processed at the existing Riverside or Goonyella CHPPs to meet product specifications.

The CHPP area will include the CHPP itself as well as rejects management systems, offices and amenities, control room, chemical and diesel storage, a water treatment (recycling) plant, maintenance facilities and stormwater management system.

Coal from the Broadmeadow expansion will typically be processed at the existing Goonyella and Riverside CHPPs.



Source: BMA Supplied

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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

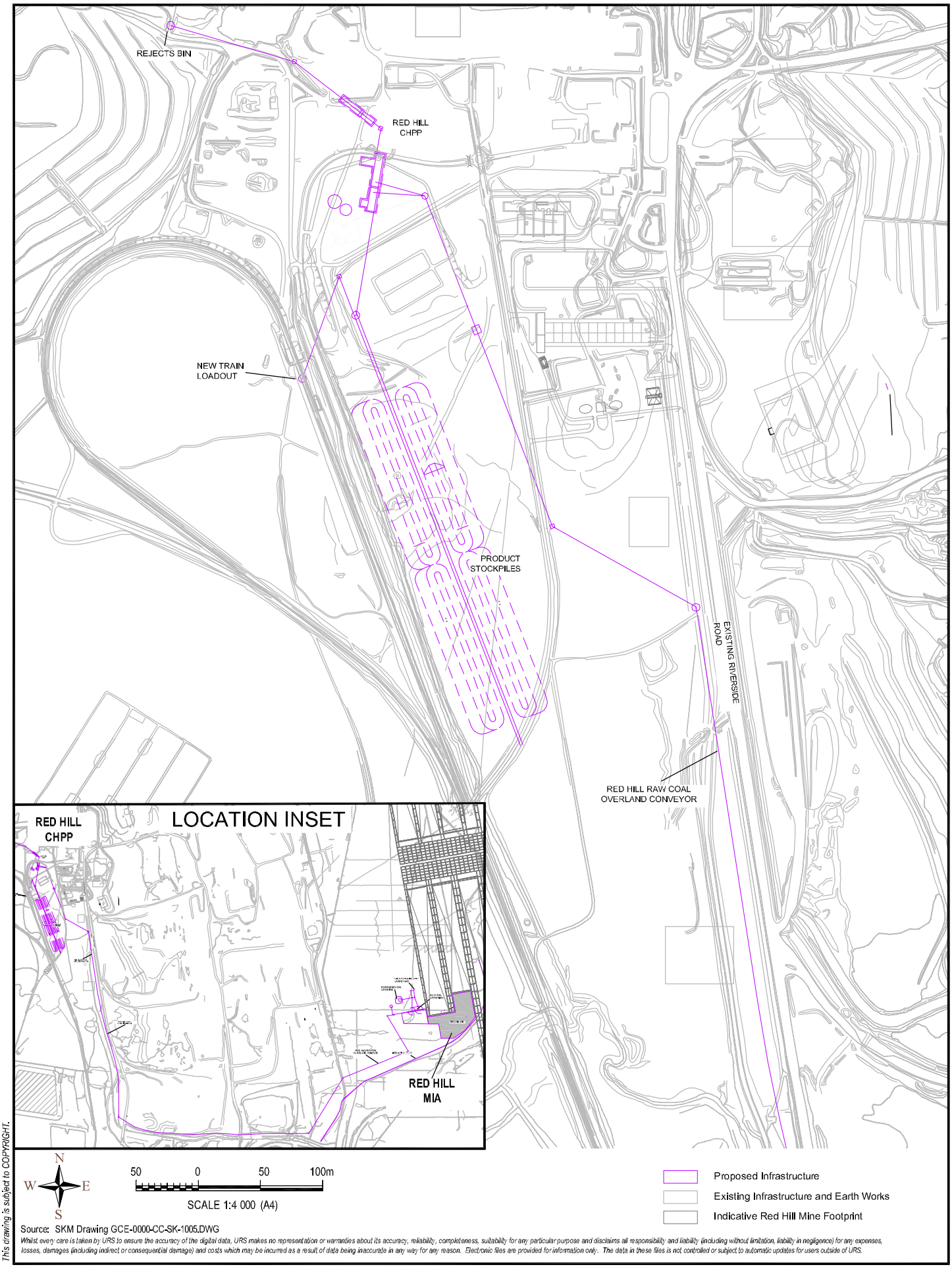
SCHEMATIC PROCESS FLOW

URS

PROJECT DESCRIPTION

Figure: **3-8**

File No: **42627136-g-1026.CDR** Drawn: **VH** Approved: **CT** Date: **06-06-2013** Rev.**A** A4



Source: SKM Drawing GCE-0000-CC-SK-1005.DWG

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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

INDICATIVE RED HILL CHPP AND CONVEYOR ROUTE

URS

PROJECT DESCRIPTION

Figure: **3-9**

File No: **42627136-1032.dwg** Drawn: **VH** Approved: **CT** Date: **06-06-2013** Rev. **A** A4

3.7.5.2 Process

The CHPP process will commence with delivery of coal into the surge bins from the overland conveyor. Coal will pass by gravity from the surge bins into a tertiary sizing system where coal size will be reduced to a typical maximum size of 65 millimetres. Smaller rocks will also be removed by the tertiary sizing unit.

The next step in the process is desliming, which is a washing process that removes very fine materials, thus improving the quality of the coal. As the effectiveness of different de-sliming techniques depends on the size of coal particles, the coal is mixed with water and then separated into coarse and fine streams for de-sliming.

Fine coal, with typical particle size less than 2.5 millimetres, is initially passed through a series of centrifuges and then to a flotation circuit which relies on gravity to separate the product coal from impurities. The product coal is then passed through a series of centrifuges to remove water and, once dried, is directed to the product coal conveyor. Reject material (impurities) from the fine coal is passed into a separate reject stream.

Coarse coal, with particle size 2.5 to 65 millimetres, mixed with water, passes through a centrifuge (dense medium cyclone) which separates out the very fine material from the coarser material. The product coal is then drained and rinsed on a sloping screen and excess water is removed in another centrifuge before the coarse coal is released to the product coal conveyor. Reject material from the centrifuge and the draining and rinsing screens pass into a separate reject stream.

The product conveyor will transfer product coal to stockpiles adjacent to the train load-out facility. Coal stackers will place the coal on one of two stockpiles of capacity approximately 300,000 tonnes, with segregation within stockpiles for different product types. Reclaimers will then be used to load the product coal onto trains (refer to **Section 14**).

Management of reject material is discussed in **Section 6**.

Chemicals used in the CHPP are described in **Section 20**.

3.7.5.3 Red Hill CHPP Waste Management

The rejects materials from the Red Hill CHPP will consist of the following:

- Dense medium coarse reject material. This material will be dewatered on the rejects drain and rinse screens and transported via the rejects conveyor to the rejects bin.
- Fine reject material. This material will be transported to the fine coal reject dewatering screen and dewatered using filter, centrifuge, and de-aeration techniques. Dewatered rejects will be transported via the reject conveyor to the rejects bin.
- Flotation tailings material. Tailings from the flotation cells will be transferred to a high rate tailings thickener. Solids from the thickener underflow will be pumped to multiple belt press filters. Under normal operating conditions, the solids discharged from the belt press filters (dewatered tailings) will be transferred by a conveyor and discharged onto the coarse rejects conveyor feeding the rejects bin.

Water from dewatering of reject and tailings materials will be recovered and recycled through the CHPP.

The rejects bin will be designed to ensure an adequate capacity to suit the proposed reject handling fleet. The bin will be emptied on an as-needs basis and will discharge via a pneumatically operated bottom dump gate for loading into haul trucks.

The dewatered tailings and rejects will be placed in the existing waste storage facilities serving the GRM. New tailings or rejects storage facilities are not required for the project. The management of mine waste is detailed in **Section 6**.

3.7.5.4 Red Hill CHPP Water Management

The estimated demand for process water for Red Hill CHPP is 125 litres per tonne of raw coal. At full production, this equates to about 1,790 ML/year. Water supply to the Red Hill CHPP will prioritise reuse of mine water from the GRB mine water management network. In extended dry periods when mine water is not available, make-up water is supplied from external pipeline supply to the site.

A small proportion of the CHPP total process water demand requires raw water as mine water is not of suitable quality.

Wash-down water and dust suppression will be provided throughout the CHPP and at conveyor transfer stations. A potable water system will be provided around the Red Hill CHPP area and will also service the site offices and workshops. Potable water will be supplied from a small potable water treatment plant at the CHPP. Fire water will be supplied by a different system and a constant volume is stored on site, regardless of mine demand.

Waste water generated from the CHPP itself will also be treated and recirculated for reuse within the CHPP to minimise raw water requirements. This water will be treated through a bank of clarifiers to remove the majority of any residual solids present in the water. Solid wastes from this water treatment will be disposed of with rejects.

3.7.5.5 Surface Water Management

The Red Hill CHPP site is within an existing catchment contained by the broader site water management network. Clean water will be diverted around the CHPP. Dirty water, comprising runoff of dirty and sediment laden water from the Red Hill CHPP area will be directed to a sediment pond, overflowing into the mine water dams. From here the mine water will be collected for reuse on site as process water.

The Red Hill CHPP will be constructed above the 1:100 Annual Exceedence Probability (AEP) flood levels for Eureka Creek, the nearest significant surface water system.

3.7.5.6 Fire Protection System

The fire protection system for Red Hill CHPP will include heat and fire detection systems to provide early fire detection. The fire protection system will consist of the following:

- Manual call points will be located at exits from switch rooms and on each level of the CHPP building. These are connected to a fire indication panel.
- Fire hydrants will be located around the materials handling buildings, Red Hill CHPP and office/workshop facilities. Type and spacing of hydrants will be in accordance with Australian standards and building code requirements.

- Standard hose reels will be located along conveyor gantries spaced at 30 metre intervals on alternate sides of conveyors.
- Standard hose reels will be located throughout Red Hill CHPP, the nearby offices and workshops in accordance with the relevant standards and the statutory and local council requirements.
- Portable fire extinguishers consisting of dry chemical powder, carbon dioxide and wet chemical types will be installed in designated areas of the site in accordance with relevant standards and statutory and local council requirements.
- Sub-fire indicator panels with automatic detection and alarm system for fault detection will be located in the Red Hill CHPP switch rooms.
- Fire suppression systems will be located in all Red Hill CHPP switch rooms.
- Control room and offices will be supplied with standard building fire suppression systems.

3.7.6 Product Stockpiles and Train Load-out

Product stockpiles will be located adjacent to the existing rail loop as shown on **Figure 3-1** and **Figure 3-9**. Stockpiles will include water sprays to manage dust emissions. A reclaim and conveyor system will then transfer the product coal to a new train load-out for export.

3.7.7 Power

The existing power requirements for BRM will not change as a result of the Broadmeadow extension.

The current GRB mine complex operations have a power requirement of 50 megawatts (MW). The GRM incremental expansion and RHM underground expansion option will require approximately 50 MW of additional power. New power lines are currently being constructed, which will allow a supply of 104 MW, thus covering both the existing operations and the proposed RHM underground expansion option.

New power reticulation for the project will involve:

- supply to the Red Hill CHPP and related infrastructure via a new 66 kilovolt (kV) overhead line from the existing GRM 132/66 kV substation to a new 66/11 kV substation to be located adjacent north of the existing Riverside rail loop; and
- supply to the Red Hill underground operations (underground and MIA) will be via a connection to relocated 66 kV infrastructure on the eastern side of the project study area, which will also require augmentation of the existing 66 kV infrastructure and construction of tie-lines around the northern lease area.

There may also be a need for temporary power lines for infrastructure associated with IMG management across the RHM underground footprint.

Subject to the likelihood of subsidence based on final mining plans the Powerlink 132 kV switchyard located north of the RHM may require relocation at a future date. The Powerlink 132 kV overhead line traversing the Red Hill mining lease will require relocation at a future date. This is discussed further in **Section 5.1**.

All required power reticulation is within existing mining leases.

3.7.8 Eungella Pipeline

The Eungella pipeline runs across the proposed RHM footprint (**Figure 3–1**). Depending on the extent of subsidence, this pipeline may be affected by the project. If it is predicted to be affected, the pipeline will be replaced or relocated from its current location. This will be done in consultation with asset owners, currently Sunwater, through Eungella Water Pipeline Pty Ltd. This is discussed further in **Section 5.1**.

3.7.9 Accommodation Village

No additional accommodation will be required in association with the Broadmeadow extension as all mining activities will be carried out by the existing BRM workforce.

A dedicated accommodation village will be provided for the construction and operation workforce associated with the GRM incremental expansion and RHM underground expansion option. The capacity of the Red Hill accommodation village will be up to 3,000 persons and will allow for construction and operation workforce requirements as provided in **Section 3.12**. The proposed location of the project accommodation village is shown on **Figure 3-1**.

Design of the Red Hill accommodation village has not yet been undertaken, but it is expected to be a modular construction that allows a small village to be constructed for the initial workforce and then for the capacity to be increased as required to meet construction workforce growth over the construction period. In addition to single rooms with en-suite bathrooms, facilities to be provided at the accommodation village are expected to include:

- kitchen, food service and dining room facilities;
- recreation facilities including a gymnasium, bar and outdoor seating areas; and
- reception area, management offices and cleaning and maintenance facilities.

Power and water will be supplied from the RHM power and water supply systems, with reticulated power and water to follow the access road alignment.

Sewage management is discussed in **Section 7.3.3**.

3.8 Incidental Mine Gas Management

3.8.1 Introduction

Assessments indicate that the target GMS and the overlying GUS and underlying GLS all have high methane gas contents. As the methane is not the primary target of the mining activity, it is referred to as IMG. The methane is confined in the coal seam by overlying lower permeability rock formations and water pressure, but once the coal seam is disturbed or accessed during mining, methane gas can be released in quantities that have potential to impact safe and efficient underground mining operations.

Methane is flammable and explosive under some conditions and therefore poses a significant hazard to operations if not managed properly. High levels of methane can also displace oxygen to the extent that adequate oxygen supply may not be available for workers.

For the Broadmeadow extension and the RHM underground expansion option, the IMG levels are such that pre-drainage of the gas in the GUS, GMS and GLS will be required in most areas of the

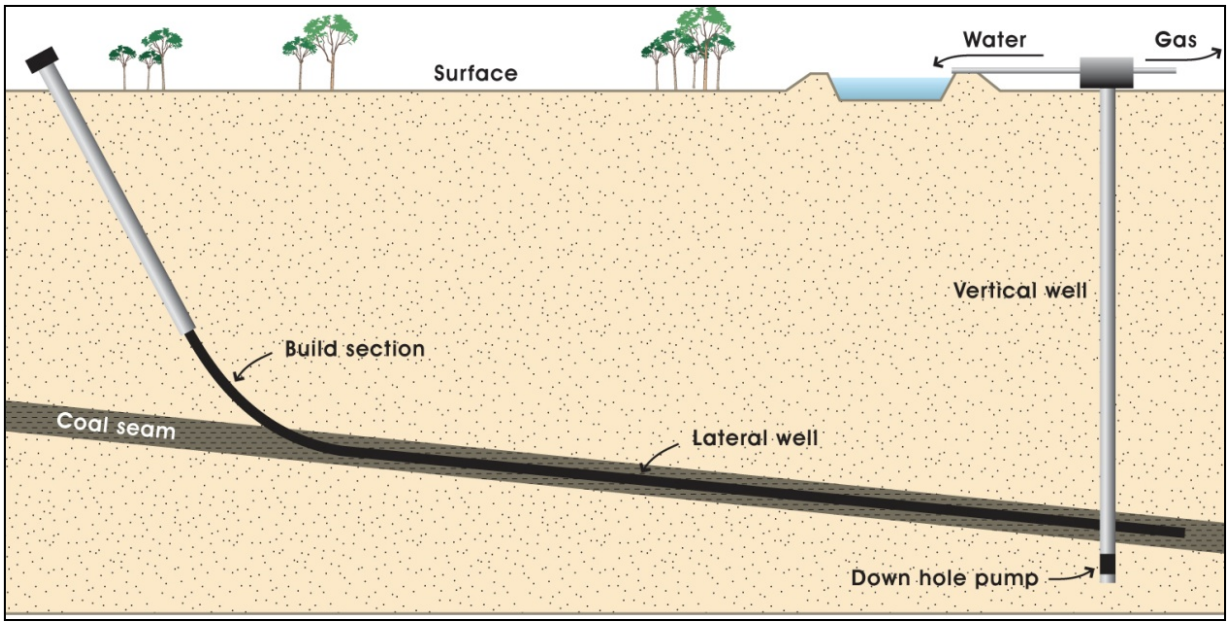
mine prior to extraction of the resource from the GMS. IMG will also need to be managed during mining through ventilation and after mining through goaf drainage techniques. Methane gas levels are generally lower on the western side of the proposed mine, increasing to the east and south.

3.8.2 Pre-drainage of IMG

3.8.2.1 Gas Extraction Wells

Pre-drainage of IMG will involve installation of a network of gas extraction wells from the surface to the seam connected to gathering lines and IMG process, monitoring and control facilities on the surface. The most likely method for pre-drainage IMG extraction is surface to in-seam (SIS) wells. These wells involve the use of directional drilling techniques to drill down from the surface and laterally along the seams requiring pre-drainage of IMG. The lateral wells are drilled to intersect vertical wells that are also drilled from the surface before the laterals wells. The vertical wells are used to collect and bring the IMG and associated water to the surface. **Figure 3–10** shows an indicative layout of surface to inseam drilling.

Figure 3-10 Indicative Layout of Surface to Inseam Drilling

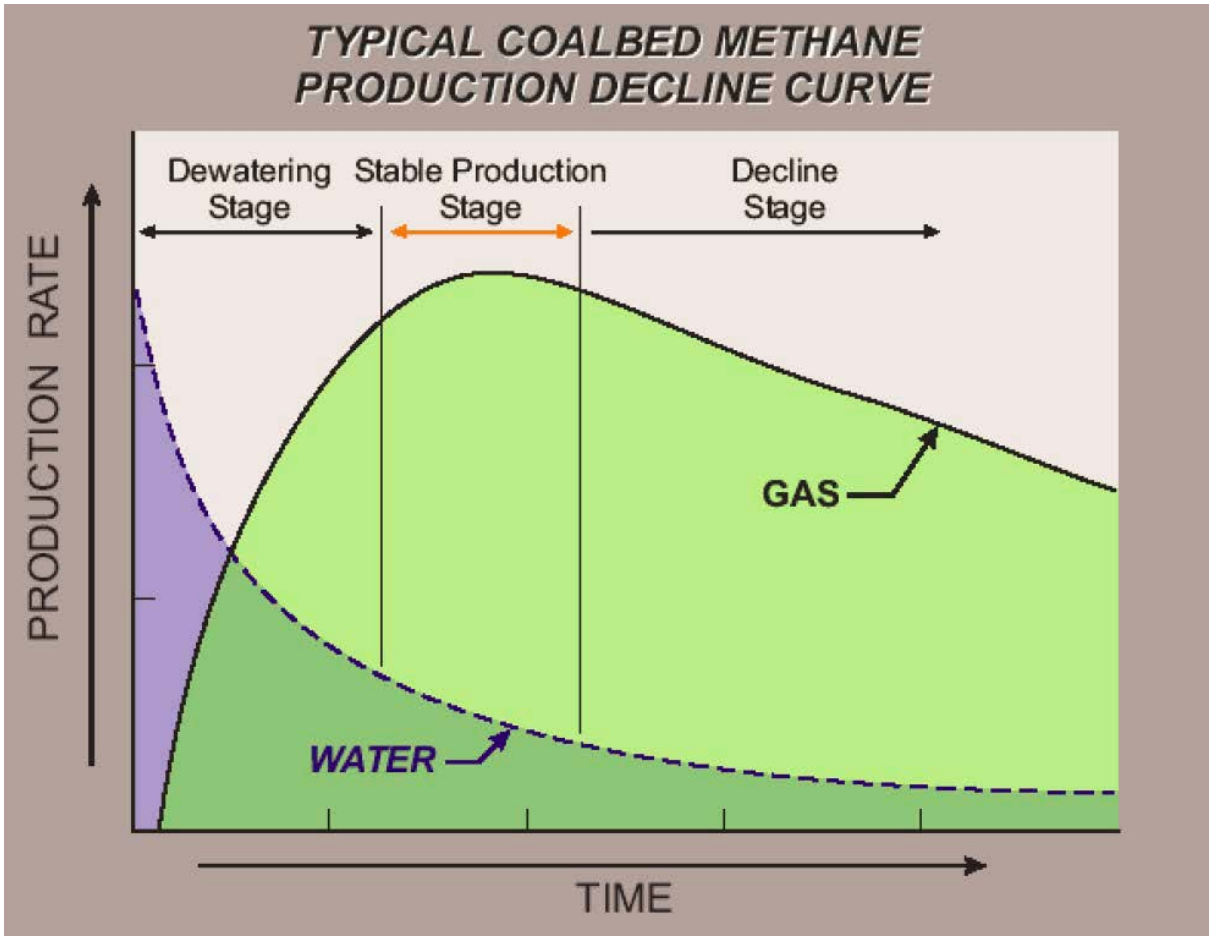


SIS extraction wells are cased to isolate the well from the surrounding rock formations except where they intersect the coal seam. A down-hole pump is normally installed in the vertical well to dewater the coal seam. The reduction in water pressure from the down-hole pump allows the gas to desorb from the coal seam and flow into the wells for capture at the surface. The SIS lateral drilling technique is used in low permeability coal seams so that it intersects a larger area of coal cleats, which increases permeability and transmissivity within the coal seam. The SIS technique also reduces the number of surface well head facilities required to effectively drain IMG under these conditions. No hazardous chemicals will be introduced to the gas extraction wells.

Both methane gas and water is extracted from the IMG pre-drainage wells. Equipment on the surface separates gas and water, directing each into separate pipes. Initially, there is a higher proportion of water to gas. As groundwater levels decrease resulting in depressurisation of the coal seam, the

quantity of water extracted reduces and the quantity of gas extracted increases. **Figure 3-11** shows an indicative pattern of water and methane production for a gas extraction well. Note that the production curves can differ from site to site as this is highly dependent on permeability and depth of the coal seam. Management of water is discussed in **Section 7.3**.

Figure 3-11 Typical Methane and Water Production Rates



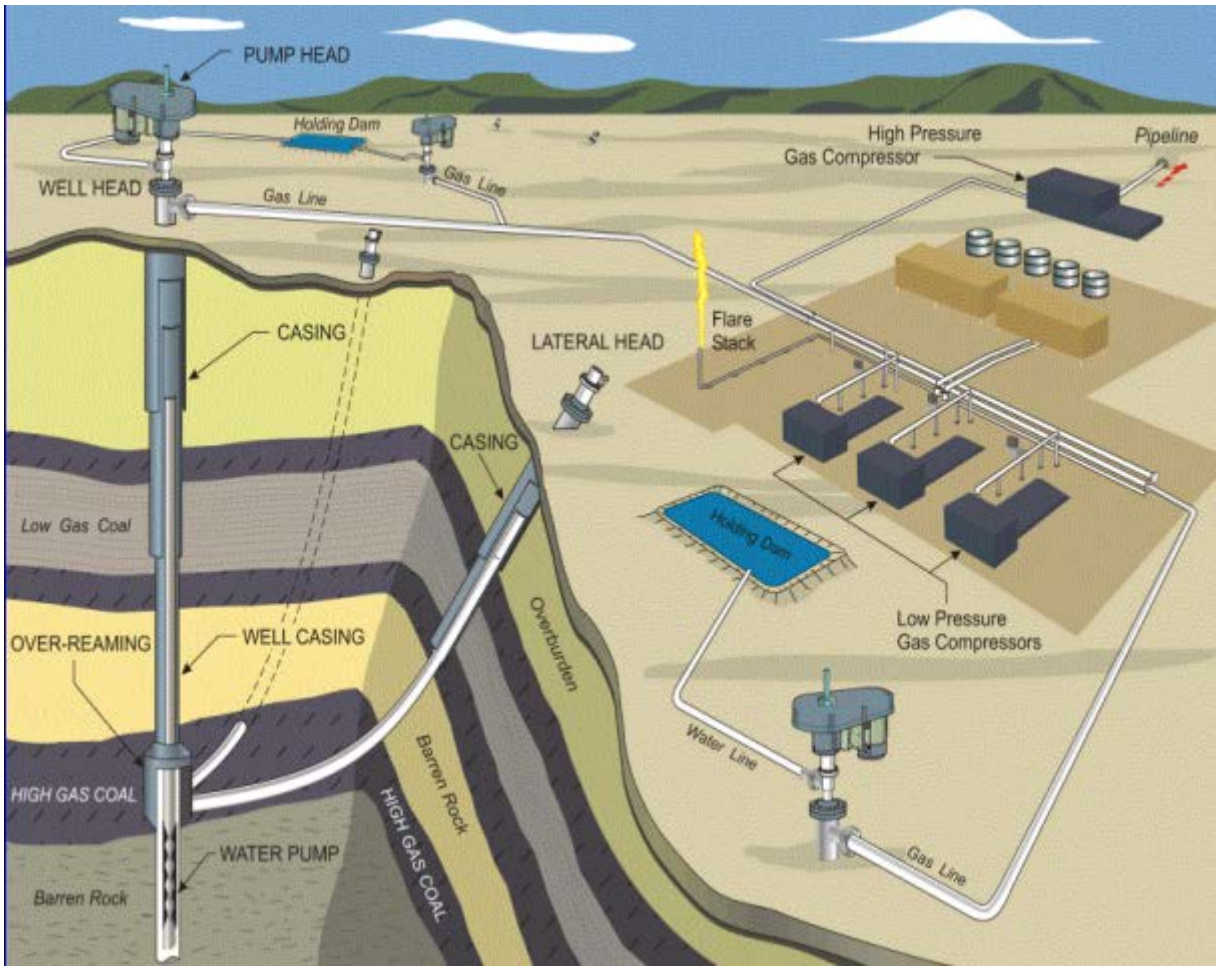
The number and location of gas extraction wells cannot be determined at this stage of the project as further investigations are required to determine the optimal means to remove IMG from the coal seams. However, it is expected that the wells will be installed in rows across each panel, with well spacing likely to be in the order of 50 to 250 metres apart depending on the mine's IMG management requirements. The number and spacing of rows of wells required for each panel will vary depending on the gas content and also the lead time for gas removal prior to mining (a higher density of wells will allow faster drainage of gas). It is expected that the rows of wells will be spaced at intervals of several hundred metres along each panel consistent with the in-seam lateral portion of the SIS well. As gas content generally increases towards the east of the mine, the density of gas extraction wells will also likely increase.

The gas extraction wells will be connected to water and gas pipelines to allow water and gas to be brought to central locations for further process management. Each well will also require power supply and vehicle access. This infrastructure will likely run along each of the pillars and each row of gas extraction wells will then connect into the central water and gas collection pipelines. Further information on construction and management of surface facilities is provided in **Section 3.8.5**.

An example schematic layout for the IMG pre-drainage infrastructure is shown in **Figure 3-12**. This shows the possible surface and subsurface layout of a single "Chevron" SIS well. The actual design and density of wells and surface infrastructure will vary across the mine, with higher density in the east compared to the west.

Gas flares will also be required for the situation where IMG cannot be collected. This is discussed further in **Section 3.8.2.3**.

Figure 3-12 Indicative Layout for IMG Drainage



In order to allow gas to be effectively removed from the seam ahead of mining of each longwall panel, it is expected that gas extraction wells may need to be installed up to fifteen years ahead of mining.

Closer to mining of each panel, and depending on the amount of gas present and ease of extracting the gas, underground inseam drainage wells may also be installed. Underground inseam drainage requires horizontal drilling into the unmined seam from the adjacent underground roadway and connecting these horizontal bores to gas collection pipes. Gas is then conveyed to the surface for management. Minimal water is produced by underground inseam drainage wells as a large amount of dewatering of the coal seam occurs on installation of the longwall development headings.

IMG pre-drainage wells will remain in place until immediately prior to mining, at which time they will be decommissioned and ventilation methods used to control gas during mining (refer to **Section 3.8.3**).

Decommissioning of the pre-drainage gas extraction wells involves:

- removal of pumps, tubing and all surface equipment;
- filling of the well with fluid and concrete plugs;
- cutting of the steel conductor pipe as far below ground level as possible; and
- reinstatement of disturbed areas in line with the rehabilitation plan in place at the time of decommissioning.

3.8.2.2 Management of Water

As discussed in **Section 3.8.2.1**, water is present along with gas in the coal seams and will be removed as part of the IMG pre-drainage activities. The quantity of water can be highly variable at different locations, but indicative volumes of 400 to 800 kilolitres per day per well may be expected in the early stages. This will reduce to 10 to 100 kilolitres per day after a period of six months to two years.

Water quality is also highly variable with location and geological conditions; however water associated with coal seams is typically quite saline, with total dissolved solids levels of 400 to 7,500 milligrams per litre (mg/L) being experienced. Within Queensland, reported water quality from coal seam gas extraction operations are as follows:

- 1,500 to 10,000 mg/L average (QGC 2010);
- 100 to 10,000 mg/L (Santos 2012); and
- 2,400 to 6,600 mg/L (APLNG 2010).

Further assessment of groundwater quality is provided in **Section 8**.

All water produced from gas extraction wells for the Broadmeadow extension and the RHM underground expansion option will be collected in pipes and conveyed to the GRB mine water management network. **Section 7** provides further information on mine water management.

Further design and process risk studies will be undertaken in the detailed design phase of the project to determine the need for an IMG production water dam, when this might be required to be built and the optimum capacity. The capacity will be driven by the likely number of days' storage that might be required in the event of a disruption to the Red Hill MIA dam or GRB mine water management network. It is expected this be would be approximately 10 ML which is sufficient to store approximately five days of production water. As it is possible to shut down the gas production wells, long term storage in the event of a serious malfunction with the water transfer system is not required.

As this IMG production water dam would contain water produced in the course of undertaking a mining activity (mine water), it will potentially be a regulated structure and may need to conform to the requirements of the following:

- EHP (2012a) *Guideline Structures which are dams or levees constructed as part of environmentally relevant activities*;
- EHP (2012b) *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*; and
- EHP (2009) *Code of Compliance Environmental authorities for high hazard dams containing hazardous waste*.

In the event the IMG production water dam is required, the proposal will be assessed against the relevant guidelines and constructed and managed accordingly.

The gas will also contain small amounts of water vapour which will condense and collect at low points along the gas collection pipeline network. Water will need to be drained from these low points from time to time and each low point will be equipped with a valve that can be opened to allow water to drain to small stationary tanks or to tanks mounted on trucks. This water will then be discharged into the water collection network and conveyed to the GRB mine water management network. The size and location of tanks for collection of water condensed at low points will be determined during detailed design, but these tanks are unlikely to exceed about one kilolitre.

It is expected that gas pre-drainage will also be required from the proposed Broadmeadow extension.

3.8.2.3 Management of Incidental Mine Gas

BMA is investigating two options for beneficial use of the IMG:

- use of the gas on site, for example to generate electricity in an on site power station for use within the mining operation; and
- transfer of the gas to a gas distribution and supply customer or the overlapping petroleum lease holder, as applicable.

If these options are not commercially or technically feasible, or cannot be undertaken within the existing legislative framework, the gas will be flared. Gas may also be flared under the following circumstances:

- during early gas pre-drainage phases, small mobile flares may be used before tie-in with a beneficial reuse scheme;
- when the quantity or quality of gas being produced is inadequate for any beneficial reuse, either on or off the mining lease; and/or
- for safety reasons at any time during mining operations.

The *Mineral Resources Act 1993* (MR Act) places restrictions on the use of IMG produced from a mining lease and BMA will ensure compliance with these requirements. Under a mining lease, IMG can either be:

- beneficially used for mining under the mining lease − typical beneficial use is power generation; or
- transferred to the petroleum lease holder if it holds a valid overlapping petroleum lease and if an agreement can be reached.

Other uses, including collecting and piping the gas off the mining lease for any commercial use, and generating electricity on the mining lease for sale to the grid are not allowed unless the mining lease holder also holds a petroleum lease or has an agreement with the overlapping petroleum lease holder, together with all necessary approvals to permit these activities.

The MR Act also only allows flaring of IMG in the event that it is not commercially or technically feasible to use the gas for a beneficial mining use or to use the gas under a petroleum lease that the mining lease holder might be able to obtain.

Under the MR Act venting of IMG is only allowed under the following circumstances:

- safety issues prevent any other option; or
- flaring is not technically practical.

It is not expected that venting of IMG will be required during the pre-drainage stage. In the event that venting is required, BMA will only proceed after the following has occurred:

a) BMA has given the PL holder written notice that gas is available; and

b) the PL holder has not responded or has refused to accept the gas within 20 business days (s318CO(5)-(6)).

Further discussion on greenhouse gas emissions associated with IMG is provided in **Section 12**.

3.8.2.4 Flares

Regardless of the proposed use of IMG, flares will be required for safety purposes, as it is not safe to shut off the gas wells in the event that gas cannot be beneficially used. Locations of flares will be determined during detailed design and will depend on the beneficial use and IMG surface infrastructure installation option progressed. At least one main central flare will be required.

Small capacity mobile flares may also be used at well sites during early well installation before tie-in with a gas collection network has occurred.

3.8.3 Ventilation Air Methane

As described in **Section 3.6.6**, ventilation systems will be installed progressively in the underground workings to maintain air quality. The ventilation system will remove methane from air in underground workings. Unless the gas content is high enough to allow beneficial reuse, ventilation air will be vented to the atmosphere. This is allowed under the MR Act where it is not technically feasible to reuse methane in ventilation air.

3.8.4 Goaf Methane Management

As longwall mining progresses, the roof of the longwall panel collapses into the mined out area. This area is known as the goaf. The goaf itself is usually highly permeable and subsidence also results in cracks and fractures in adjacent overlying and underlying coal seams and strata. Methane will continue to be present in goaf as it will migrate from these adjacent unmined areas. Hence, it is necessary to remove methane gas from the goaf to maintain safe and efficient mining conditions in the longwall mining area and adjacent workings.

To manage goaf methane vertical goaf gas wells are drilled from the surface at the near the edge of the underground longwall panel approximately 50 to 100 metres apart as mining progresses along each longwall area. Horizontal goaf gas wells may also be placed into the goaf to improve IMG capture. The well heads are sealed and connected to a low pressure vacuum system (typically two to five kilopascals) which extracts the gas in the goaf area. Large diameter pipelines convey the gas to a central location for either beneficial use or flaring (refer to **Section 3.8.2.3**). There is no water associated with goaf gas drainage as the coal measures are already dewatered during underground mining.

Goaf gas extraction wells are generally operated for three to six months after mining is completed in each section of the mine, after which time gas levels will be sufficiently reduced to meet stringent safety requirements.

Depending on methane concentrations and extraction rates, it may be possible to use goaf methane for a beneficial use in the same way as pre-drainage methane may be used. However, the potential for beneficial use of goaf methane is limited and will not be known until extraction commences as there is a wide range of factors affecting the concentration and extraction rate of methane from the goaf. If methane from the goaf cannot be beneficially used, it will be flared or vented.

3.8.5 Gas Extraction Infrastructure Development and Management

3.8.5.1 Introduction

As discussed in **Sections 3.8.2, 3.8.3** and **3.8.4**, a range of surface infrastructure is required to install and operate IMG management systems.

3.8.5.2 Well Location and Construction

As discussed in **Section 3.8.2.1**, IMG pre-drainage extraction wells will likely be placed in rows across each panel, that is, perpendicular to the panels, with approximate spacing of 50 to 250 metres between each well. Rows of wells will be spaced several hundred metres apart along each panel. The work area for initial establishment of wells will be up to 100 by 100 metres, with opportunity to reduce this when wells are located close together. After wells are installed, a well pad of about 50 by 50 metres will be retained for operations, with the surrounding area rehabilitated.

The location of the wells will be largely influenced by underground conditions and mining schedule so that gas extraction can be maximised and the risks to safe and efficient mining minimised. However, there is some flexibility in location and, wherever possible, the wells will be located to avoid the following features:

- drainage lines, riparian vegetation and flood prone areas;
- threatened ecological communities, including *Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin* and *Brigalow (Acacia harpophylla dominant and co-dominant)* (refer to **Section 9** for locations);
- habitat for conservation significant species such as the ornamental snake (if identified in future surveys); and
- areas identified as containing significant cultural heritage material.

Survey of well site locations for these features will form part of the well site selection and field planning. This stage will also identify whether there is any need for any of the following prior to or during construction:

- translocation of certain plants;
- survey and/or salvage of cultural heritage items;
- weed control;
- fauna spotters during vegetation clearing; and
- overland flow diversion.

Placement of goaf drainage wells has limited flexibility as these must be placed along the edge of the panel; however, use of previously disturbed areas will be maximised wherever possible and wells will not be placed within stream channels.

Construction of wells for pre-drainage and goaf drainage will require the following steps:

- site clearance and authorisation, including cultural heritage and ecological checks;
- clearing of vegetation. Unless heavily weed infested, vegetation will be set aside for reuse in rehabilitation;
- removal of topsoil. Topsoil will be set aside for use in rehabilitation;
- earthworks as required to prepare the drill pad;
- establishment of drilling support requirements including worker amenities and a pond for containment of drilling mud. Some facilities will be shared between adjacent wells;
- drilling and construction of wells including installation of casing, pipes and downhole pumps;
- for pre-drainage wells, construction of surface facilities required to service the well, including connections to power, water and gas pipelines, metering equipment, a separation unit to separate gas and water, flares and valves;
- for goaf drainage wells, connection to a vacuum system; and
- water storage and removal amenities, temporary drilling mud ponds and partial rehabilitation of that part of the drilling pad not required for operation. Rehabilitation will utilise vegetation and topsoil set aside from site clearing and will follow any requirements of the current site rehabilitation plan. A well pad of about 25 by 25 metres will be retained after initial rehabilitation.

Surface gas and water gathering pipelines, power and access tracks will also be constructed along each row of pre-drainage bores. These will connect into the main gas system infrastructure likely located along each pillar to avoid subsidence impacts.

More details on environmental controls to be utilised during well construction are provided in subsequent sections of this EIS.

3.8.5.3 Linear IMG Infrastructure

Linear IMG infrastructure will be installed on the surface above each gate road to service the pre and post drainage gas extraction wells and will consist of:

- a gas pipeline − this will typically be a buried pipeline, but may be above ground in some circumstances;
- a water pipeline − this will typically be a buried pipeline but may be above ground in some circumstances;
- above or below ground power supply; and
- a vehicle access track − the vehicle access track will initially be required for drill rig access, but can then be maintained as a light vehicle access track only.

This infrastructure will generally run in a straight line along each gate road, but there is some flexibility to optimise alignment to avoid environmental sensitivities. In particular, the linear infrastructure required to support gas drainage is likely to need to cross a number of minor streams and drainage lines. Gas and water pipelines and power supply is likely to cross the Isaac River at several locations

to allow for efficient collection of gas and water from pre-drainage gas extraction wells and goaf wells. Detailed design of the gas collection network will seek to minimise the number of crossings.

Stream and river crossing locations will be determined in consultation with an ecologist, geomorphologist, and cultural heritage representative. In locating crossings of streams and drainage lines, the following will be considered wherever possible:

- crossing the channel at right angles;
- avoiding significant areas of riparian and in-stream vegetation (this includes areas identified in **Section 10**);
- avoiding areas of cultural heritage significance − these will be confirmed as part of a Cultural Heritage Management Plan development (see also **Section 16**); and
- avoiding areas of potential erosion as identified in the geomorphological assessment (**Appendix I6**).

Stream crossings will generally comply with the *Guideline - activities in a watercourse, lake or spring associated with mining operations* (NRM 2012) or equivalent measures.

Road and vehicle access will not be provided across the Isaac River apart from the bridge at the main heading.

For the goaf drainage, surface infrastructure will consist of access tracks to goaf drainage wells, a large diameter gas pipeline connecting the wells and power supply. While goaf drainage wells will not necessarily be co-located with decommissioned pre-drainage gas extraction wells, existing access tracks and power lines will be utilised wherever possible.

Construction of linear infrastructure to support gas drainage will require the following steps:

- site clearance and authorisation, including cultural heritage and ecological checks;
- clearing of vegetation − unless heavily weed infested, vegetation will be set aside for reuse in rehabilitation;
- removal of topsoil − topsoil stockpiled for use in rehabilitation;
- for gas and water pipelines that are to be buried:
  - excavation of trenches and preparation of bedding material to support the pipelines *in situ*;
  - placement of pipes in trenches and quality checks to ensure that pipes are properly joined and sealed;
  - backfilling and compaction of trenches with excavated material;
  - replacement of topsoil;
  - rehabilitation utilising vegetation set aside from site clearing in accordance with the requirements of the current site rehabilitation plan; and
  - placement of markers warning of presence of underground pipelines.
- for power lines, construction will involve installation of power poles and stringing of powerlines on these poles or, if below ground power is used, power cables will be co-located with either gas or water pipelines; and

- for access tracks, construction will involve:
  - grading of the road surface − grading will be kept to a minimum required to allow access by drill rigs;
  - installation of roadside drains as required to prevent concentration of flows across the roadway; and
  - for stream and drainage line crossings, a pipe may be installed on the stream bed and a formed crossing created over the pipe.

Construction standards for gas pipelines will be based on the Australian Petroleum Industry Association (APIA) Code of Practice with adaptations as allowed following site specific risk assessment during detailed design.

A corridor of up to 50 metres wide may be required along each gate road (pillar) during construction due to safety requirements associated with gas and water pipeline installation. Once pipelines are in place the ground above the pipelines can be stabilised and rehabilitated with grass species.

For stream crossings, construction of linear infrastructure will be conducted in the shortest possible time, and wherever possible will be constructed outside the wet season when there is no flow in streams. For Isaac River buried pipeline crossings, construction will take place in no flow conditions wherever possible.

Pipeline trenches will be backfilled and stabilised to prevent bank erosion. Soft structures will be used to stabilise bed and banks of streams; concrete will not be used.

Road crossings will be stabilised to minimise wash outs and bank erosion. Stabilisation may include placement of matting along banks.

3.8.5.4 Maintenance and Management of Gas Infrastructure

Ongoing maintenance and management of the surface gas infrastructure will be required as the gas infrastructure will be put in place in advance of mining and may remain in place for the duration of the mine life. Maintenance and management will include:

- regular inspections, maintenance and monitoring of IMG surface infrastructure and works as required to maintain safe operations and the overall gas drainage system integrity, including carrying out work-overs of existing IMG pre-drainage wells;
- regular inspections of stream crossings, and proactive stabilisation works as required to maintain bed and bank stability − this management requirement may be incorporated into the adaptive management program required to address subsidence impacts described in **Section 7.3.10**;
- regular inspections of roads and pipeline alignments to ensure that disturbed surfaces are stable and not subject to concentration of flows or erosion − repair works will be undertaken proactively to prevent erosion from occurring or worsening; and
- weed management.

3.8.5.5 Decommissioning

Gas drainage infrastructure will be decommissioned progressively as mining advances and the installed wells and surface infrastructure becomes redundant. All surface infrastructure will be removed and disturbed surfaces rehabilitated in accordance with the site rehabilitation management plan as required.

As areas disturbed by gas drainage infrastructure will be subject to subsidence, streams and drainage lines will be monitored and managed in accordance with the adaptive management program required to address subsidence impacts described in **Section 7**.

3.9 Water Management

3.9.1 System Overview

Key components of water management associated with the Broadmeadow extension are as follows:

- The panel extensions will not generate any additional raw water demands as the BRM operations have sufficient raw water supply to sustain operations.
- Groundwater extracted as part of IMG management and intercepted during underground mining will be transferred to existing water storage at the GRB mine complex.
- Groundwater produced as part of IMG drainage prior to mining of the Broadmeadow extension has been modelled as part of the total assessment and modelling undertaken for the RHM underground expansion option.
- Groundwater intercepted during mining of the Broadmeadow extension will be managed as part of the existing BRM water management system.

Key aspects of the RHM mine water management system for the project are described below:

- Raw water needs will be supplied from the BMA regional water allocation and transported via BMA's raw water pipeline network.
- Groundwater extracted as part of IMG management and intercepted during underground mining will be transferred to existing water storage at the GRB mine complex.
- Mine water runoff from the RHM MIA will be contained in the MIA dam prior to being transferred to existing water storage within the GRB mine complex.
- The majority of water demands for the processing of coal will be supplied from the GRB mine water inventory, with a small portion requiring a raw water source.

It is expected that for the majority of the RHM operational life, mine water demands associated with processing RHM coal will exceed the quantity of mine water generated at the RHM. As such, the GRB mine water management network will not require new licensed discharge points or changes to release conditions. This is discussed further in **Section 7.3.2**.

The interface between the RHM and GRB mine water management networks will provide greater efficiency, maximise the opportunity for mine water reuse, ensure mine water releases are managed holistically and reduce water related risks. The Broadmeadow extension is not expected to generate significant additional mine water. Water from BRM underground operations will continue to be managed through the existing BRM infrastructure.

The RHM will be responsible for the design, construction, maintenance, surveillance, operation and management of the mine water management infrastructure associated with the RHM operations. This will include management of risks associated with water containment, management and transfer.

GRB mine complex will assume responsibility for the management of mine water generated at RHM once it is transferred to existing water storages.

The Red Hill CHPP will be located within the GRB mine complex and water supply to the Red Hill CHPP will be managed and operated as part of the GRB mine water management system.

A detailed 'whole of operation' mine water balance model assessment was undertaken to support the EIS and to assess impacts on mine water management performance. A baseline scenario was set up in the model to represent the GRB mine water management system (without the project), and another scenario set up to represent the inclusion of the project. A mine water management overview report describing the context of the baseline and project case is presented in **Section 7** and **Appendix I2**. A technical report that details the mine water balance model is presented in **Appendix I3**. The overall purpose of the mine water balance assessments was to compare the performance of the GRB mine water management network with and without inputs from the project in terms of containment storage, water inventory and compliance with discharge criteria and conditions defined in the existing GRB mine complex EA.

3.9.2 Project Water Requirements

RHM operations will be supplied from a combination of mine water and raw water sources. The raw water demands include:

- water treated for potable uses (drinking water, amenities) – 75 ML/year;
- water used for the two new RHM mine longwalls – 730 ML/year, of which approximately 20 per cent may be recovered as mine water;
- water used in the RHM MIA – 70 ML/year; and
- raw water requirements for the Red Hill CHPP, which requires a small portion of its total water demand to be raw water – approximately 30 ML/year.

The Red Hill CHPP will predominantly utilise mine water when GRB mine complex has a sufficient mine water inventory. The Red Hill CHPP operational water demands (for 14 mtpa production) are expected to be approximately 1,900 ML/year.

The demand for raw water during periods when sufficient mine water is available to meet CHPP demands is predicted to be approximately 1,000 ML/year. The raw water demands could increase to up to 3,000 ML/year during periods when there is insufficient mine water inventory to meet the CHPP mine water demand. An additional tie-in to the Eungella pipeline will be constructed in the vicinity of the Red Hill MIA but no new allocations are required.

3.9.3 Raw Water Supply Infrastructure and Water Allocations

The Broadmeadow extension will sustain existing operations at BRM and will utilise existing infrastructure and not increase peak demand for water.

Sufficient raw water supply is available to meet the projected demands associated with the GRM incremental expansion and associated RHM underground expansion option including the proposed

accommodation village and average processing requirements in an average year. However, should there be a short-fall, a network of pipelines will be utilised to deliver external raw water.

The Sunwater Burdekin to Moranbah pipeline allows for the supply of 16,800 ML/year to the Bowen Basin coal mines and the town of Moranbah.

The BMA allocation from this source is 10,168 ML/year.

BMA's Eungella water pipeline also supplies water from the Eungella dam. BMA's Eungella (pipeline) 1 supplies 6,200 ML/year to the GRB mine complex and Peak Downs Mine.

In addition to the Sunwater Burdekin to Moranbah pipeline and the BMA Eungella (pipeline 1) supplies, supplementary water allocations for the BMA mines within the Bowen Basin include:

- an allocation of 7,400 ML/year from the BMA Bingegang Pipeline; Bingegang Weir on the Mackenzie River;
- Selma Weir - BMA Selma Pipeline to the Gregory Crinum Mine, 1,600 ML/year; and
- Bedford Weir - BMA Bedford East and Bedford West pipelines to Blackwater Mine, 2,281 ML/year.

BMA has an option for an additional 1,708 ML/year from the Burdekin to Moranbah pipeline.

3.9.4 Proposed Water Production

The Broadmeadow extension is expected to intercept only small quantities of water which will be managed in accordance with existing operations through transfer to the existing GRB mine water management system.

Groundwater interception at the RHM underground expansion option is estimated to produce between 1,000 to 2,000 ML/year. This will present as a combination of water recovered from the gas drainage program, water removed from the underground and water present in the raw coal.

As the RHM is an underground mine, only relatively minor quantities of mine water are generated from surface run-off. This will be from catchments within the Red Hill MIA and will be contained at the MIA prior to being transferred to the water storage facilities within the GRB mine complex.

The Red Hill CHPP will not produce additional tailings slurry water (mine water) because the plant will recover water from waste products following the belt press filter process (refer to **Section 3.7.7.4**). Water recovered from the belt press filter process will be reused in the CHPP.

Minor quantities of treated wastewater will be produced from sewage treatment plants at the MIA, accommodation village and CHPP. This is discussed further in **Section 3.11.4**.

3.9.5 Water Storage and Infrastructure Design and Management

The Broadmeadow extension and RHM underground expansion option may have a requirement to store water associated with the drainage of IMG prior to mining.

Proposed water management infrastructure will be designed, managed and monitored by suitably qualified people and, if required, in accordance with statutory requirements and guidelines, such as the referable dams guidelines and the Australian National Committee on Large Dams (ANCOLD). This includes:

- design and construction supervision of dam embankments undertaken by a suitably qualified and experienced engineer;

- regular dam inspections to be undertaken by a suitably qualified and experienced engineer;
- regular inspections during operation of mine water storages, integrity of embankments and spillways; and
- regular pipeline, drain, bund and levee inspections and maintenance will be undertaken during operation.

3.10 Transportation

3.10.1 Road Transport

The existing access and transport requirements will not change as a result of the Broadmeadow extension. The following potential impacts are associated with the proposed RHM underground expansion option.

Access to the MIA, mine entrance and accommodation village will be via Red Hill Road. Access to the CHPP will be through the main GRB mine complex site entrance off Goonyella Road. Internal road requirements are discussed in **Section 14**. There are no off-lease road upgrades or realignments proposed for the project. Prior to the commencement of construction for the RHM underground expansion option, monitoring of traffic volumes will be carried out at Goonyella Road (between Red Hill Road and the railway overpass). If peak traffic volumes consistently exceed 800 vehicles per hour (two-way), road improvements may be required. It is expected that construction and operation traffic will access the site from the Peak Downs Highway, via the Goonyella Road and Red Hill Road.

During construction, equipment and construction materials will be transported to the site by truck. Some over-dimensional loads will be required to transport pre-fabricated modules. The construction workforce is expected to be flown to Moranbah airport and then transported by bus to the site.

During operation, the up to 100 per cent remote workforce is also expected to make use of BMA airport assets and be transported to site by bus. This will be the main component of operation phase traffic. Some traffic will also be generated by light and heavy maintenance vehicles and heavy vehicles associated with the IMG pre-drainage requirements. An allowance has been made in the traffic modelling for an estimated 75 per cent of the construction workforce to transit through Moranbah Airport at the start and end of the assessed seven days-on/seven days-off roster while 25 per cent are assumed to transit through Mackay. Those travelling via Moranbah Airport have been assumed to utilise chartered bus services (20 person occupancy) to travel between the Red Hill accommodation village and Moranbah Airport. Those travelling to Mackay or beyond have been assumed to use light vehicles (single-occupant).

It is not proposed to export coal from the site by road, except in exceptional circumstances.

Transport of dangerous materials will be accordance to the *Australian Dangerous Goods Code, Seventh Edition* (2007) requirements.

More details of traffic generation and management are provided in **Section 13**.

3.10.2 Rail and Port

The Broadmeadow extension will not materially impact on existing production at BRM and will not impact on existing rail and port capacities.

Rail transport will not be utilised during the construction stage for the RHM underground expansion option. The assessment of rail and port capacities relates to the operations phase for the RHM underground expansion option.

It is intended that 100 per cent of the coal mined at the RHM underground expansion option will be transported to port facilities by rail. At peak production, the expansion option has the potential to require four to five trains each day, with a nominal train capacity of 12,000 tonnes and loading time of 2.5 hours per train.

The GRB mine complex is serviced by an Aurizon rail network. The Goonyella system transports coal from two existing rail loops on the west of the mine complex to the existing Hay Point, Dalrymple Bay and Abbot Point Coal Terminal for shipping. A conveyor will be constructed from the Red Hill CHPP to the Riverside rail loop and a new dedicated train load-out facility provided for Red Hill coal. BMA has obtained approval to expand its existing coal export facilities at Hay Point and coal from RHM would be exported through this terminal and the Dalrymple Bay and Abbot Point Coal Terminals.

The proposed train load-out for RHM will include equipment for spraying of a chemical veneer on coal after loading to minimise dust generation during transportation.

3.10.3 Shipping

As discussed in **Section 3.10.2**, annual production rates at BRM mine will not materially change as a result of the Broadmeadow extension and will continue to be railed to the Hay Point, Dalrymple Bay and Abbot Point Coal Terminals for shipping.

At peak potential production, the product coal from the GRM incremental expansion and RHM underground expansion will require approximately 150 extra ships per year to transport the product to market. Shipping will be spread across Handymax, Panamax, Small Cape and Large Cape vessels of approximate sizes of 50,000 dead weight tons (dwt), 80,000 dwt, 150,000 dwt and 220,000 dwt, respectively. BHP Billiton has separately completed an assessment of potential shipping impacts associated with its Bowen Basin operations.

3.10.4 Air Traffic

The existing air traffic requirements will not change as a result of the Broadmeadow extension as the work is to be undertaken by the existing BRM workforce. The following potential impacts are associated with the proposed RHM underground expansion option.

Air traffic associated with the RHM underground expansion option will utilise Moranbah Airport.

During operations, the RHM underground expansion option has the potential to result in up to approximately 30 additional flights per week. Moranbah Airport has recently been upgraded and has sufficient capacity to accommodate increased movements.

3.11 Waste Generation and Management

3.11.1 Mining and Coal Processing Wastes

The existing waste management practices for BRM will not materially change as a result of the proposed Broadmeadow extension as the annual production rates for BRM will not materially change. The following potential impacts are associated with the proposed RHM underground expansion option.

Establishment of mine access for the RHM underground expansion option (drift construction) and mining will produce a small amount of overburden/interburden waste that will be disposed of in existing spoil dumps established at the GRB mine complex. **Section 6** provides more detail on the geochemical composition of this waste.

Management of wastes from the coal processing and CHPP is discussed in **Section 3.7.5.3** and **Section 6**. Waste management associated with the construction activities for the GRM incremental expansion and RHM are discussed in **Section 3.13.13**.

3.11.2 Industrial and Amenities Wastes

A range of industrial and amenities wastes will be generated during operations, primarily at the proposed MIA, and also at the CHPP. These will include:

- regulated waste including hydrocarbon waste such as waste oil, oily water, oily sludge, grease, oil rags, oil filters, as well as coolant, drums, detergents, solvents, batteries, tyres, paints and resins;
- packaging and office waste including timber, pallets, paper, cardboard and plastic;
- vegetation waste from clearing associated with installation of IMG pre-drainage infrastructure;
- wood waste including off-cuts;
- tyres including light vehicle and mine truck tyres;
- waste from maintenance activities including scrap metal and conveyor belts;
- sewage, from worker amenities at the Red Hill MIA, CHPP, accommodation village and RHM;
- sewage sludge and treated wastewater from sewage treatment plants at the Red Hill MIA, CHPP and accommodation village;
- food waste, including waste from the kitchen at the accommodation village and from crib rooms at the Red Hill MIA, CHPP and RHM; and
- general wastes from cleaning of rooms and facilities at the accommodation village.

A waste inventory and further details on proposed management of industrial wastes is discussed in detail in **Section 15**.

3.11.3 Air Emissions

There is no surface mining infrastructure proposed as part of the Broadmeadow extension. The air quality impacts associated with the project relate to the construction and operation of the GRM incremental expansion and RHM underground expansion option.

Air emissions will consist of:

- fugitive dust from coal handling and transportation of coal;
- dust generated during surface works for IMG pre-drainage;
- exhaust emissions from fuel burning plant and equipment;
- fugitive dust, methane and vehicle emissions from mine ventilation shafts; and
- carbon dioxide and other combustion gases where IMG is flared.

Details of air emissions and management are provided in **Section 11**. **Section 12** contains details of potential greenhouse gas emissions.

3.11.4 Sewage

No additional sewage treatment infrastructure will be required in association with the mining of the Broadmeadow extension as work will be completed by the existing workforce. Some temporary facilities may be required during the establishment of IMG drainage infrastructure prior to the commencement of mining.

Sewage treatment facilities will be provided as follows:

- A sewage treatment plant will be located within the RHM MIA. Sewage from the underground mine amenities will be transferred to this sewage treatment plant.
- A sewage treatment plant will be located at the accommodation village.
- A new sewage treatment plant located adjacent to the Riverside MIA will treat sewage generated at the Red Hill CHPP facility.

Treated wastewater from the Red Hill MIA and CHPP will either be returned to the GRB mine water management system or irrigated. If returned to the mine water management system, this water will be treated to class A+ to address risks associated with pathogens.

Treated wastewater from the Red Hill accommodation village may either be transferred by pipe to the GRB mine water management system, or used for irrigation of landscaped areas at the accommodation village, with excess treated wastewater not required for landscape irrigation disposed of by irrigation of land adjacent to the accommodation village. If treated wastewater from the Red Hill accommodation village is to be returned to the mine water management network, it will be treated to class A+.

A management plan for irrigation with treated wastewater will be developed if irrigation is required.

3.12 Workforce and Employment

3.12.1 Construction

Construction phase works are not required for the Broadmeadow extension component of the project. However, gas drainage infrastructure will be required in advance of mining the panel extensions.

Workers from a range of industries will be required during construction of the GRM incremental expansion and RHM underground expansion option including construction of the mine access (drift), Red Hill MIA, CHPP and other components required for RHM and will likely include:

- civil and earthworks workers for drift construction; site preparation for the Red Hill accommodation village, MIA and CHPP; and installation of internal roads, pipelines and other services;
- structural and building workers to install buildings, and plant and equipment items including conveyors;
- mechanical and electrical works relating to major equipment and plant, including coal handling equipment;
- engineers and designers for all components;
- health, safety, environment and quality assurance specialists, including cultural heritage monitors;
- contract management and administration staff;
- drivers for trucks and buses; and
- Red Hill accommodation village management and staff, including catering and cleaning staff. This function is likely to be through a contracting arrangement where approximately 100 to 150 workers will be required for the accommodation village.

The GRM incremental expansion and the RHM underground expansion option have the potential to employ up to 2,000 workers during peak construction. However, this is subject to further assessment as part of on-going project planning; further specific details of the construction workforce by job type will be determined closer to the commencement of construction. Depending on the rate and scale of future development, construction would take approximately 30 months. Engineering, Procurement and Construction Management (EPCM) contractor/s will be appointed by BMA, and will oversee the delivery and management of the construction. Most construction workers will be employed by contractors sub-contracted by EPCM contractor/s for the various components.

The GRM incremental expansion and RHM underground expansion option is planned to operate with an up to 100 per cent remote workforce. However, there may be circumstances where construction personnel living locally may be employed in RHM. Details regarding BMA's current local buy program and workforce participation are detail in the social impact assessment provided in **Section 17**.

The rosters for the construction workforce will be determined by EPCM contractor/s and the RHM project team. All rosters adopted for the construction workforce will comply with BMA's fatigue management policy.

Construction will consist of surface and underground activity. Rostering will be determined in line with the fatigue management procedures of RHM. The defined rosters may include the utilisation of fatigue management days. EPCM contractor/s will appoint an accommodation village management contractor which will implement an accommodation village management plan. The accommodation village management plan will address the management of fatigue management days, and will include organising opportunities for the remote workers to travel into Moranbah.

The rosters for the construction workforce will be finalised closer to mobilisation by the contractors construction manager.

3.12.2 Operations

The Broadmeadow extension will be undertaken by the existing BRM workforce.

The RHM underground expansion option has the potential to employ up to 1,500 workers during peak operations and is to operate with an up to 100 per cent remote workforce. However, this is subject to further assessment as part of on-going project planning and will be confirmed closer to the commencement of operations. The operational workforce numbers are indicative and will depend on the intensity of mining operations at various stages through the life of mine.

Depending on the rate and scale of development, there is a potential overlap between construction and operational phases. Some operations workers will commence during the construction phase, particularly those involved in installation of IMG pre-drainage infrastructure and some of the operator/maintainer underground workers.

The operations workforce for the underground expansion option will consist of:

- Operators and maintainers who mainly work underground on longwall development and coal extraction but will also operate above ground equipment such as conveyors, stockpile stacker and reclaimers and other coal handling equipment. The role includes operation and maintenance of equipment above and below ground. Including the teams involved in moving longwall equipment, approximately 400 to 500 workers are required for each longwall.
- A specialist team involved in moving the equipment from one longwall to another. This team will be used infrequently, typically one to two times per year and is likely to be resourced through a contractor. As above, including operators and maintainers, approximately 400 to 500 workers are required for each longwall.
- Management, supervisory and administrative personnel relating to mine operations. This will include mine planning, health, safety and environment specialists, quality control, and finance management functions.
- CHPP operators and maintainers. The CHPP will require approximately 50 workers.
- A team of drilling crew and civil construction crews who will install and maintain the IMG pre-drainage and goaf drainage systems. The number of workers will vary throughout the mining program. Cultural heritage monitors will also be required for some of this work.
- Accommodation village management staff and associated personnel, including catering and cleaning staff. This function is likely to be resourced through a contracting arrangement where approximately 100 to 150 workers will be required to operate the accommodation village.

Additional contract maintenance workers will be required for specialised maintenance tasks throughout the operations phase of RHM.

It is anticipated that a proportion of the workforce recruited for RHM will be inexperienced and require training by BMA.

A range of rosters are proposed for workers engaged in RHM operations. The preferred operational work roster for RHM is still to be finalised. The roster pattern will consider:

- operating practices of the mine;
- travel time from an employee's point of origin to place of residence, in line with BMA's fit for work policies and procedures;
- commute arrangements; and

- operational accommodation village size (i.e. the number of units).

Mining industry operations with remote workforces typically tend to be operated on an even time roster basis. That is, employees spend the same amount of days at home as they do at work.

3.13 Construction

3.13.1 Overview

The proposed Broadmeadow extension does not require the construction of additional mining infrastructure and the mining will be undertaken by the existing BRM operations.

The timeframe for construction of the GRM incremental expansion and RHM underground expansion option will depend on the rate of development determined by the project owners. The scenario presented for the purposes of modelling the potential impacts of the project assumes that construction is expected to take two to three years. Construction activities may take place up to 24 hours a day, seven days a week. While the contracting strategy has not been finalised, it is expected that one or more contractor companies will be appointed to carry out construction works.

This section describes construction activities for the following components of the project:

- Red Hill MIA;
- bridge across the Isaac River;
- CHPP including coal handling and conveyors and associated stockpiles;
- Red Hill accommodation village; and
- internal roads, pipes, powerlines and water management network.

Note that construction of the mine access (drift) and mine underground infrastructure is described in **Section 3.6.2**.

3.13.2 Site Access and Temporary Laydown Area and Facilities

The existing access arrangements will not change as a result of the Broadmeadow extension.

Site access for construction of the RHM underground expansion option will be from Goonyella Road and Red Hill Road. Temporary laydown areas will be established in existing disturbed areas to support the initial construction activities within GRM on ML1763 and on MLA70421 and construction of infrastructure associated with gas drainage and the accommodation village. These laydown and storage areas will include worker amenities and offices to support the initial workforce.

For each component of the surface infrastructure and facilities, contractors will establish work areas at the construction site. These areas will generally consist of:

- site security controls to prevent unauthorised access;
- drainage and stormwater management;
- equipment laydown and unloading areas;
- vehicle access and car parking;

- offices and amenities – toilet facilities will initially be through use of chemical toilets, until permanent sewage treatment systems are installed;
- diesel storages and refuelling facilities. Diesel storages will comply with AS 1940 *Storage and handling of flammable and combustible liquids* and refuelling facilities will be contained using rollover bunds, with the contained area draining to an oil water separator; and
- equipment maintenance areas. Only minor maintenance will be carried out on construction sites and will take place in hardstand areas.

Emergency response and safety equipment will be available at each temporary work area. The type of equipment will depend on the risks present, but will include first aid, fire fighting equipment and fuel/chemical spill response equipment.

These areas will be progressively rehabilitated where surface areas are no longer required to support construction activities.

3.13.3 Site Preparation

For all components of surface infrastructure and facilities associated with the RHM underground expansion option, site preparation will consist of the following steps:

- If the area has not been previously disturbed, final checks for cultural heritage and ecological values will be undertaken. Procedures for site clearance will be detailed in construction environmental management plans to be prepared by each construction contractor company.
- Existing buildings, fences and other structures will be removed and waste disposed of.
- Drainage structures will be installed. These may be temporary or permanent depending on the site, but will focus on diverting clean stormwater around the construction site and containing dirty stormwater. When site preparation commences in the wet season, drainage structures will be installed prior to or simultaneously with vegetation clearing wherever possible.
- Vegetation will be cleared. Whether vegetation is cleared to ground level only, or removed completely will depend on the location and will be detailed in construction environmental management plans to be prepared by each construction contractor. Vegetation may be set aside for use in rehabilitation or removed as waste, depending on levels of weed infestation.
- Topsoil will be removed and either utilised at an alternative location for rehabilitation or set aside for post-construction rehabilitation.
- Erosion and sediment controls will be installed.
- All areas significantly disturbed will be rehabilitated to a safe, non-polluting and stable landform with a self-sustaining vegetation cover. Where possible, rehabilitation will be undertaken progressively.
- Major hazardous materials to be transported, stored and/or used on site will be handled and disposed of in accordance with the Work Health and Safety Regulation 2011, *Hazardous Substances Code of Practice 2003* and Material Safety Data Sheets (MSDS) provided by the suppliers.

Plant and equipment involved in site clearance activities will include, but not be limited to, excavators, dozers, scrapers, graders, and water carts.

3.13.4 Construction Utilities

Power for construction activities associated with the RHM underground expansion option will initially be available from either:

- 66 kV overhead line feeding the Riverside MIA and operations; or
- portable diesel generators.

Once power supply to each component of the mine is in place, this will be able to be used for construction power supply.

Water supply will be available from the existing mine water management network, and will be transported to required areas by truck until reticulated water pipelines can be installed.

Construction of amenities and sewage treatment systems will be a priority in the construction schedule; however, they will not be available during the early stages of construction. Portable toilets will be used temporarily at each work area until permanent amenities and sewage treatment systems are installed. Alternatively, where larger workforces are present and construction of amenities and sewage treatment systems cannot be undertaken early, sewage may be stored in tanks and pumped out by authorised contractors for disposal at authorised sewage treatment facilities off site.

3.13.5 Earthworks

Earthworks will also be required for a range of construction components to:

- create level surfaces and foundations for construction of hardstand areas, stockpiles and structures;
- create roadways;
- create pads for the installation gas drainage infrastructure;
- excavate trenches for placement of underground services; and
- excavate for coal handling equipment.

Earthworks will also be undertaken to create a levee bank west of the Isaac River if this is required to protect the MIA and mine entrance from flooding.

Where the excavated material has properties suitable for engineering purposes, it will be re-used as bulk fill, road sub-base, construction material for laydown areas, and foundations and levees. Excavated material that is unsuitable for any other use will be disposed of within mined-out pits or in the out-of-pit spoil dumps at the GRB mine complex. This will be undertaken in accordance with the existing approved overburden management practices. Some materials will need to be imported to make up deficits in cut materials and to meet particular quality requirements.

Drainage, erosion and sediment controls will be utilised during earthworks to minimise impacts on downstream water quality and loss of soil. Further details on erosion and sediment control are provided in **Section 5.3.3**. Dust suppression using truck mounted water sprays will also be implemented where necessary on exposed areas and spoil stockpiles.

All areas significantly disturbed by earthworks will be rehabilitated to a safe, non-polluting and stable landform with a self-sustaining vegetation cover. Where possible, rehabilitation will be undertaken progressively.

3.13.6 Concrete and Asphalt Batching

Concrete and asphalt will be required for construction of a range of components associated with the GRM incremental expansion and RHM underground expansion option, including:

- roadways and car parks (asphalt);
- hardstand areas (concrete and asphalt); and
- foundations for buildings, infrastructure and mechanical equipment.

Provision of concrete and asphalt will be the responsibility of contractors appointed for construction of various components of the project and sourced from mobile temporary plants. It is not expected that a permanent concrete or asphalt batch plant will be established at the site. Instead, contractors may either:

- source concrete and asphalt from external suppliers in the region; or
- bring mobile concrete or asphalt plants to the site temporarily.

Quantities of concrete, asphalt and bitumen will be determined following detailed design.

In both cases, the owner of the plant will be responsible for obtaining and maintaining the necessary approvals, including an environmental authority under the *Environmental Protection Act 1994*. The owner's approvals will likely contain conditions relating to avoidance and management of emissions, wastes and other environmental impacts of the concrete or asphalt plants.

3.13.7 Quarry Material Requirements

Crushed rock and aggregate will be required for road construction and building/equipment foundation preparation as well as preparation within the GRM incremental expansion and the RHM underground expansion option. Quarry materials will be obtained from existing authorised quarry operations in the region, if suitable material is not available on site.

3.13.8 Levee Construction

A levee may need to be constructed as part of the GRM incremental expansion option along the western side of the Isaac River as shown on **Figure 3-7** to protect the Red Hill MIA and mine access from flooding. The final requirements for flood protection will be determined during subsequent detailed design.

If the levee is the preferred solution, it would be designed to provide protection in the 1 in 1,000 AEP event with 0.5 metres of freeboard to the embankment crest. Final flood immunity will be determined during detailed design.

It is expected that this levee embankment would be classified as a regulated structure and would be hydraulically designed in accordance with the recently approved EHP (2012b) *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*. A suitably qualified and experienced engineer as defined by the guideline for regulated dams will certify the design and the structure once in place.

A geotechnical investigation would be required at the design phase to:

- Characterise the subsurface conditions of the levee to estimate the extent of excavation required to construct a suitable cut-off for protection against piping failure (formation of an erosion hole from one side of the levee to the other) of the levee foundation.
- Identify sources of material considered suitable for construction of the levee embankment. The levee would be designed to cater for possible moderately long durations of potential flooding and would also need sufficient erosion resistance from flooding and direct rainfall.

The levee embankment design would also consider the following:

- location to avoid riparian vegetation as far as practicable without compromising performance of the levee;
- slope stability;
- erosion from flooding of the Isaac River and direct rainfall;
- protection against piping failure through the foundation, and through the levee embankment; and
- ease of maintenance, including a sufficiently wide crest for vehicle access, if required.

3.13.9 Road Works and Bridge

No external road works or road realignments are required as part of the construction phase for the Broadmeadow extension, GRM incremental expansion and RHM underground expansion option.

Internal access roads for the GRM incremental expansion and RHM underground expansion option will be two lane, gravel or bitumen roads, depending on the level of usage.

Road construction will consist of:

- clearing and grading of the road alignment and installation of road drainage (refer to **Section 3.13.3**);
- cut and fill as required to achieve vertical alignment;
- depending on the type of road surface, laying of road base and bitumen or gravel to form the road surface; and
- stabilisation of shoulders and batter slopes created by cut and fill.

Road works and specific standards are described further in **Section 14**, including the timing for engagement with the Isaac Regional Council regarding any potential proportionate contribution towards intersection upgrades.

The bridge across the Isaac River associated with the GRM incremental expansion will involve some clearing of vegetation; however, disturbance to riparian vegetation will be minimised. Guidelines established for activities in a watercourse, lake or spring associated with mining operations will be utilised to guide environmental management requirements (NRM 2012).

3.13.10 Accommodation Village

As the Red Hill accommodation village provides accommodation for construction workforce as well as operation workforce, it will be one of the first components to be constructed as part of the RHM underground expansion option. The accommodation village is expected to consist of pre-fabricated units that will be assembled on site.

Construction of the Red Hill accommodation village will include:

- clearing and grading of the site (refer to **Section 3.13.3**);
- establishment of internal site access routes and construction laydown areas (refer to **Section 3.13.2**);
- earthworks (refer to **Section 3.13.5**);
- placement of foundations, hardstand areas and underground services;
- installation of sewage and water treatment plants;
- assembly of village components including units and shared facilities;
- building fit outs, including connection to water, sewage, power and internal finishing and furnishing; and
- demobilisation of construction equipment and facilities, removal of wastes.

3.13.11 MIA and Raw Coal Stockpiles and Handling Area

Construction of the MIA and raw coal stockpile and handling area for the GRM incremental expansion option and the RHM underground expansion option will involve:

- clearing and grading of the site (refer to **Section 3.13.3**);
- establishment of internal site access routes and construction laydown areas (refer to **Section 3.13.2**);
- earthworks to create a level surface and also to create excavations for coal reclaim equipment and other buried equipment (refer to **Section 3.13.5**);
- placement of foundations and hard stand areas for stockpiles, coal handling and sizing equipment and buildings;
- installation of underground services;
- assembly of equipment and buildings - most equipment and buildings will be pre-fabricated in modules and brought to the site for final assembly;
- building fit outs, including connection to water, sewage, power, internal finishing and furnishing; and
- demobilisation of construction equipment and facilities, removal of wastes.

3.13.12 Red Hill CHPP, Conveyors and Product Stockpiles

Construction of the CHPP and associated conveyors and stockpiles for the GRM incremental expansion will involve:

- clearing and grading of the site (refer to **Section 3.13.3**) (note that the footprint of the CHPP and conveyors is within the existing GRB mine complex footprint);
- establishment of internal site access routes and construction laydown areas (refer to **Section 3.13.2**);
- earthworks to create a level surface and also excavations for coal reclaim equipment (refer to **Section 3.13.5**);
- placement of foundations and hard stand areas for stockpiles, CHPP, buildings and conveyors;
- installation of underground services;
- assembly of equipment and buildings - most equipment and buildings will be pre-fabricated in modules and brought to the site for final assembly;
- building fit outs, including connection to water, sewage, power, internal finishing and furnishing; and
- demobilisation of construction equipment and facilities, removal of wastes.

3.13.13 Construction Waste Management

A range of wastes will be generated during construction of the GRM incremental expansion option and the RHM underground expansion option, including:

- vegetation waste from site clearing;
- food waste from worker amenities;
- sewage effluent from worker amenities and sewage sludge and treated wastewater from sewage treatment plants;
- excess spoil from excavations;
- waste concrete and concrete wash out wastes;
- packaging wastes including timber, cardboard and plastic;
- metal off cuts from fabrication of buildings and mechanical plant;
- waste oil and hydrocarbon contaminated materials from vehicle and equipment maintenance; and
- waste tyres from vehicle and equipment maintenance.

A full construction waste inventory and details of how construction waste will be managed is provided in **Section 15**. Waste management will focus on avoiding or reducing wastes wherever possible, followed by recycling wastes wherever waste recycling services are available. Waste storage areas will be established at all construction areas and will provide for:

- secure storage of any hazardous wastes; and
- segregation of waste streams to maximise recycling opportunities.

3.13.14 Contractor Demobilisation

On completion of works each contractor will be responsible for:

- reinstating or stabilising disturbed areas;
- removing all wastes;
- removing any contaminated soils or other contaminated material; and
- removing all temporary facilities, equipment and excess materials.

3.13.15 Construction Equipment

A wide range of construction equipment will be required for construction of the various components of the project including, but not limited to:

- scrapers and excavators for initial ground clearing;
- bulldozers, scrapers, dump trucks, graders, rollers and compactors for earthworks, road works and foundation preparation;
- water trucks for dust suppression and to add water to aid compaction of surfaces;
- lifting equipment including mobile cranes;
- elevated work platforms;
- B-double and B-triple trucks and semitrailers for delivery of materials and components;
- air compressors, portable generators;
- welders;
- winches; and
- portable toilets.

3.14 Rehabilitation and Decommissioning

Subsidence management and rehabilitation for the Broadmeadow extension will be undertaken in accordance with the management plans in place for BRM.

Current objectives in relation to post mining land use for the GRM incremental expansion option and RHM expansion option are that rehabilitation will return disturbed areas included in the EIS study area disturbed by the project to a stable landform capable of supporting cattle grazing as per the current land use.

Rehabilitation will occur progressively throughout the mining activity as disturbed areas become available either at the completion of a designated mined area or once infrastructure is no longer required by existing or propose operations. Final rehabilitation and closure activities will commence once mining activity has ceased. **Section 5.5** sets out the overall objectives and strategy for rehabilitation and decommissioning as well as initial success criteria and anticipated rehabilitation and decommissioning methods and activities. While ultimately dependent on the actual rate of development and mining, the mine closure may not take place for an estimated 25 years, so it is likely that accepted strategies and practices for rehabilitation and closure will have changed and, hence, rehabilitation and closure planning is a dynamic process.

BMA will prepare a rehabilitation management plan at the commencement of operations, covering the matters set out in **Section 5.5**, and will then prepare a closure plan five years prior to the anticipated closure. In addition, BMA will prepare a subsidence management plan for the RHM expansion option as specified in **Section 7**, setting out the adaptive management approach for subsidence of the Isaac River.

It should be noted that rehabilitation of waste disposal areas for mineral wastes (rejects and dewatered tailings) will be in accordance with the Goonyella Riverside Broadmeadow Rehabilitation Management Plan (BMA 2011).