BHP Mitsubishi Alliance

Progressive Rehabilitation and Closure Plan

Goonyella Riverside and Broadmeadow Mine

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Glossary of terms and abbreviations

Key terms and abbreviations, and associated definitions used in this report are listed below.

Term / Abbreviation	Description
3P grasses	Perennial, productive and palatable (3P) grasses
ACARP	Australian Coal Association Research Program
Administering authority	Department of Environment, Tourism, Science and Innovation (Queensland)
AD	acid/acidic drainage
AEP	Annual exceedance probability
AHD	Australian height datum
AMD	Acid and metalliferous drainage
AQP	Appropriately qualified person
ASC	Australian soil classification
BBAC	Barada Barna Aboriginal Corporation
BMA	BHP Mitsubishi Alliance
BOM	Bureau of Meteorology
BRM	Broadmeadow Mine
CEC	Cation exchange capacity
CHPP	Coal handling and preparation plant
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CQCA Agreement Act	*Central Queensland Coal Associates Agreement Act 1968*
DEM	Digital elevation model
DES	Department of Environment and Science (Queensland)
DESI	Department of Environment, Science and Innovation (Queensland)
DETSI	Department of the Environment, Tourism, Science and Innovation (Queensland) (the administering authority) (previously referred to as the Department of Environment, Science and Innovation and the Department of Environment and Science)
DM	Dry matter (with reference to vegetation)
DNRME	Department of Natural Resources, Mines and Energy

Term / Abbreviation	Description
DoR	Department of Resources (Queensland) (previously referred to as the Department of Natural Resources, Mines and Energy)
DSITI	Department of Science, Information Technology and Innovation (Queensland)
DTMR	Department of Transport and Main Roads (Queensland)
EA	Environmental Authority (in terms of the *Environmental Protection Act 1994*, Queensland)
EC	Electrical conductivity
EIS	Environmental impact statement
EP Act	*Environmental Protection Act 1994* (Queensland)
EP Regulation	Environmental Protection Regulation 2019 (Queensland)
EPP (Water and Wetland Biodiversity)	Environmental Protection (Water and Wetland Biodiversity) Policy 2019
ERA	Environmentally relevant activity (*Environmental Protection Act 1994*, Queensland)
ESP	Exchangeable sodium percentage
FCCM	Fort Cooper Coal Measures
FoS	Factor of safety
GDE	Groundwater dependent ecosystem
GLS	Goonyella Lower Seam
GMS	Goonyella Middle Seam
GRM	Goonyella Riverside Mine
GUS	Goonyella Upper Seam
IA	Improvement area "…*for a NUMA, means an area of land in the NUMA to which a management milestone for the NUMA relates*". (PRCP Guideline, 2024)
ICMM	International Council of Mining and Metals
IDC	Index of diversion condition
Interburden	Mineral (mining) waste located between mined coal seams
IRC	Isaac Regional Council
LOD	Land outcome document

Term / Abbreviation	Description
LSA	Land suitability assessment
MCM	Moranbah Coal Measures
MERFP Act	*Mineral and Energy Resources (Financial Provisioning) Act 2018* (Queensland)
MIA	Mine industrial area
Milestone criteria	"…*for a management milestone or a rehabilitation milestone, means a requirement that must be met to achieve the milestone*". (PRCP Guideline, 2024)
Mineral waste	Material comprising spoil, ± tailings, ± rejects, ± waste coal. Sometimes called 'mine waste' or 'mining waste'
ML	Mining lease
MM	Management milestone "…*for a NUMA, means each significant event or step necessary to achieve best practice management of the area and to minimise risks to the environment (section 112 of the EP Act)*" (PRCP Guideline, 2024)
NAF	Non-acid forming
NC Act	*Nature Conservation Act 1992* (Queensland)
NMD	Neutral and metalliferous drainage
NUMA	Non-use management area
OQMRC	Office of the Queensland Mine Rehabilitation Commissioner
Overburden	Mineral (mining) waste located above the top coal seams
PAF	Potentially acid forming
PMF	Probable maximum flood
PMLU	Post-mining land use "…*for land, means the purpose for which the land will be used after all environmentally relevant activities carried out on the land have ended (section 112 of the Environmental Protection Act 1994)*" (PRCP Guideline, 2024)
PRCP	Progressive rehabilitation and closure plan
PRCP Guideline	Progressive rehabilitation and closure plan Guideline (September 2024) (DESI, Queensland)
QA/QC	Quality assurance and quality control
RA	Rehabilitation area

Term / Abbreviation	Description
	"… *for a post-mine land use, means an area of land in the post-mine land use to which rehabilitation milestone for the post-mining use relates*" (PRCP Guideline, 2024)
RE	Regional ecosystem
Rejects	Waste material produced during coal processing
Residual void	An open pit resulting from the removal of ore and/or waste rock that will remain following the cessation of all mining activities and completion of rehabilitation processes, may include ramp voids
RHM	Red Hill Mine
RM	Rehabilitation milestone "…*for the rehabilitated land, means each significant event or step necessary to rehabilitate the land to a stable condition (section 112 of the EP Act)*" (PRCP Guideline, 2024)
ROM	Run-of-mine
RRR	Residual risk rating (with reference to the risk assessment)
SD	Saline drainage
Spoil	Rock material overlying and between 'target' coal seams, which is mined and placed in the spoil dumps (i.e. overburden and interburden)
SPR	Source-pathway-receptor
SQP	Suitably qualified person (for performing a regulatory function)
Stable condition	"…*defined in section 111A of the EP Act:* *Land is in a stable condition if -* • *the land is safe and structurally stable, and* • *there is no environmental harm being caused by anything on or in the land, and* • *the land can sustain a PMLU*." (PRCP Guideline, 2024)
STAC	Smart Transformation Advisory Council
TDS	Total dissolved solids
TLO	Train load-out
Transitional PRCP	"…*the holder of an existing EA for an ineligible mining activity relating to a mining lease that is transitioning into the new PRCP framework*" (PRCP Guideline, 2024)
TSF	Tailings storage facility
Underburden	Mineral (mining) waste located beneath the GLS
VM Act	*Vegetation Management Act 1999* (Queensland)

Term / Abbreviation	Description
Waste coal	Sub-economical coal that reports to the spoil dumps as waste
WBNM	Watershed Bounded Network Model
WEPP	Water erosion prediction program

INTRODUCTION

Goonyella Riverside Mine (GRM) and Broadmeadow Mine (BRM), operated by BHP Mitsubishi Alliance (BMA), are metallurgical coal mines located in the Bowen Basin, Queensland.

This transitional Progressive Rehabilitation and Closure Plan (PRCP) has been prepared for GRM and BRM in accordance with the requirements of the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act). This PRCP has been developed to meet the requirements of the *Environmental Protection Act 1994* (EP Act) and the Progressive Rehabilitation and Closure Plan Guideline (PRCP Guideline) (DESI, 2024a).

Environmentally relevant activities (ERAs) at GRM and BRM include Schedule 3 13: Mining black coal, Ancillary 31 - Mineral processing 2, Ancillary 60 - Waste disposal 2, Ancillary 56 - Regulated waste storage, Ancillary 08 - Chemical storage 3, and Ancillary 63 - Sewage treatment 1. These are undertaken under the conditions of the site Environment Authority (EA) EPML00853413, provided in Appendix A.

Environmental Authority Holder:	**QCT MINING PTY. LTD.; QCT Resources Pty Limited; QCT INVESTMENT PTY. LTD; BHP COAL PTY LTD; BHP Queensland Coal Investments Pty Ltd; Mitsubishi Development Pty Ltd; Umal Consolidated Pty Ltd**
Environmental Authority Number:	**EPML00853413 (26 February 2024)**
Tenements:	**ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421 (part), ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494**

As detailed in the PRCP Guideline, the main purposes of the PRCP are to (subject to transitional provisions):

- Require the holder of an EA to plan for how, where and when activities will be carried out on land in a way that maximises the progressive rehabilitation of the land to a stable condition (defined in section 111A of the EP Act)
- Provide for the condition to which the holder must rehabilitate the land before the EA may be surrendered.

This PRCP comprises two parts:

- Section A: Rehabilitation planning part - provides information about the site, details the rehabilitation methodologies and techniques, and includes evidence and justification to support the development of the proposed PRCP schedule; and
- Section B: PRCP schedule - includes maps of rehabilitation and closure outcomes for the site, and tables of time-based rehabilitation milestones.

This PRCP also includes Section C: Appendices, providing specialist studies and technical assessments used to support the development of the PRCP.

TRANSITIONAL PROVISIONS

Part 27, Chapter 13 of the EP Act sets out the transitional provisions following the commencement of the MERFP Act. In particular, BMA is a 'mining EA holder' for the purposes of the transitional provisions on the basis that, on commencement of the MERFP Act, BMA was "*the holder of an environmental authority* (EPML00853413) *for a mining activity relating to a mining lease authorising operations*" at GRM and BRM (section 750, EP Act).

The transitional provisions provide how an EA holder was to 'transition' into the PRCP regime. This was summarised, and additional guidance provided, within Section 6 of the PRCP Guideline, which states it applies to "*existing EA holders who must transition into the new PRC Plan framework*".

In accordance with the transitional provisions and requirements of Section 6 of the PRCP Guideline, BMA adhered to the following process to transition rehabilitation and closure outcomes from the GRM and BRM EA into the draft PRCP schedule:

1. Identifying rehabilitation and closure outcomes in the land outcome document (LOD) (EA EPML00853413)
2. Identifying post-mining land uses (PMLUs)
3. Identifying non-use management areas (NUMAs)
4. Defining rehabilitation areas (RAs) within the PMLU, or improvement areas (IAs) within the NUMA
5. Identifying milestones
6. Identifying milestone criteria
7. Identifying when the first rehabilitation milestone (RM) and management milestone (MM) must commence and completion dates for the milestones.

In accordance with transitional provisions (section 750, EP Act), the GRM and BRM EA (EPML00853413) is an approved LOD.

Acceptance criteria for rehabilitation requirements were included consistently across all BMA site EAs in 2018. Per BMA's understanding of the legislative intent, BMA has transitioned the EA rehabilitation requirements and acceptance criteria into the GRM and BRM PRCP.

Transitional timeline

The timeline of the key steps in the assessment process for this transitional PRCP includes:

- A Transition Notice for GRM and BRM was issued to BMA by the administering authority, dated 13 December 2021 (Appendix B). This Transitional Notice required submission of the GRM and BRM PRCP by 29 November 2024.
- The Transition Notice was issued following a pre-notification meeting held between the administering authority and BMA on 29 November 2021. This PRCP is based on the key aspects agreed on by the administering authority during this meeting, as documented in the *PRCP BMA – Goonyella Riverside Broadmeadow Mine Memo*, provided in Appendix C.
- Prior to the PRCP submission, a pre-lodgement meeting between the administering authority and BMA was held on 4 November 2024. This was arranged to discuss the key content of the site's draft plan, aimed at identifying any notable gaps or refinements needing to be addressed prior to the final submission.
- The GRM and BRM PRCP was submitted to the administering authority on 29 November 2024.
- An Information Request Notice was issued to BMA by the administering authority, dated 4 March 2025.
- DETSI were provided a site visit to GRM on 21 May 2025.
- The response to the Information Request and revised PRCP (plan, schedule and updated Appendices) were provided to the administering authority on 5 September 2025 and included the relevant PRCP schedule conditions and milestone criteria agreed during Saraji South Mine negotiations (August 2025).

KNOWLEDGE BASE REFINEMENT

Compilation of this PRCP has been supported by the rehabilitation and closure-related knowledge base for GRM and BRM at the time of submission of this PRCP (original submission 29 November 2024 with an update relating to the administering authority Information Request submitted on 5 September 2025). Relevant studies contributing to this knowledge base have been referenced throughout this PRCP, with key resources provided in Section C: Appendices.

As highlighted by the International Council of Mining and Metals (ICMM) in the Integrated Mine Closure Good Practice Guide, 3rd Edition (ICMM, 2025), *"the collection, updating, use and review of the knowledge base is an ongoing and iterative process over the mine life, used to inform the closure planning process"*. ICMM also indicate "*gaps and uncertainties will be identified over the mining life cycle, with studies, research and trials undertaken as needed to close knowledge gaps*" and "*the plans to address gaps and uncertainties over the life of the mine should be incorporated into the closure execution plan and used to inform closure planning and implementation*."

The Australian Government state in their Leading Practice Sustainable Development Program for the Mining Industry Mine Rehabilitation handbook that "*at worst, initiating closure operations when the site has not developed the skills, equipment and necessary technical knowledge to successfully carry out a large rehabilitation program can result in very poor outcomes requiring very costly remediation, and with greatly reduced probability of successful closure*" (DIIS, 2016).

Internal BHP guidance states that the knowledge base is the foundation for all other steps in the closure management process and review of the knowledge base should enable gaps and uncertainties to be identified for defining forward work plans. Without a robust, relevant and fit for purpose knowledge base, decisions may be made without the right level of detail or erroneous information, resulting in sub-optimal closure outcomes, increased closure risk and destruction of asset value through increased cost and/or time for closure implementation.

As the rehabilitation and closure knowledge base for GRM and BRM develops, it will be used to inform ongoing refinement of the plans for rehabilitation and closure, as well as this PRCP as required.

A: REHABILITATION PLANNING

1 PROJECT PLANNING

Legislative Requirement

In accordance with Section 126C(1)(b) and (c)(ii) of the EP Act, the rehabilitation planning part of the PRC Plan must include a description of:

- *each resource tenure, including the area of each tenure*
- *the relevant activities to which the application relates*
- *the likely duration of the relevant activities*
- *how and where the relevant activities are to be carried out, including maps.*

PRCP Guideline

The following spatial information must be submitted as part of the PRC Plan:

- *the location and maximum extent of disturbance footprint for the mine life*
- *the PMLUs and NUMAs for the area within the resource tenures*
- *any sensitive receptors.*

In addition to the list above, the PRC Plan must include spatial information outlining the rehabilitation and improvement areas that correspond to the proposed PRCP schedule. The spatial information must show the locations of the rehabilitation and improvement areas for a 10-year period (minimum).

All spatial information must be prepared and submitted in accordance with the guideline 'Spatial Information Submission' (ESR/2018/4337).

1.1 Project description

1.1.1 Geographic location

GRM and BRM are located 30km north of the town of Moranbah in the Bowen Basin and approximately 140km south-west of Mackay (Queensland) (Figure 1).

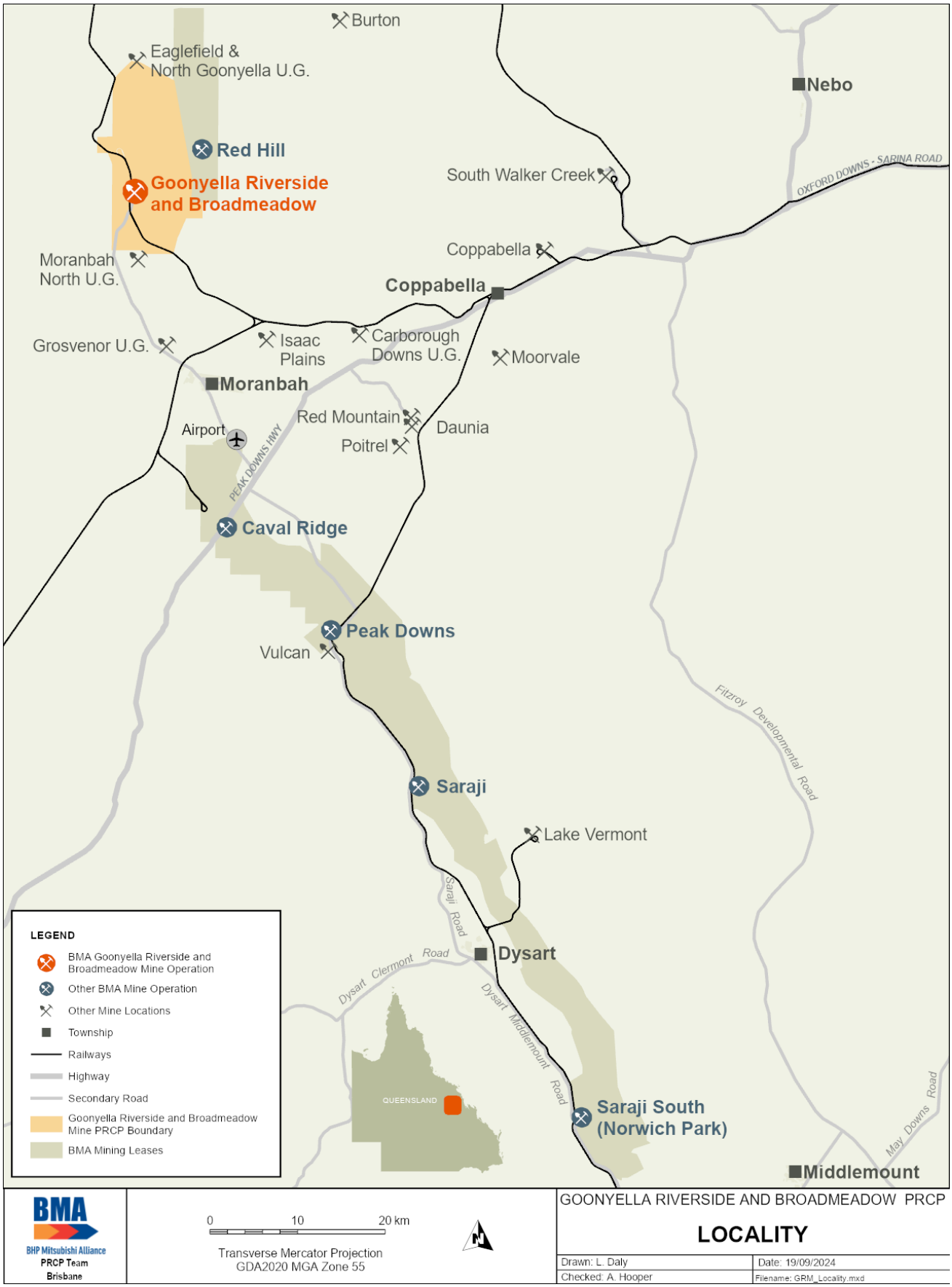

Figure 1: GRM and BRM location map

1.1.2 Mining tenements

GRM and BRM operates on the mining leases (MLs) listed in Table 1 and illustrated in Figure 2. The mining tenements associated with the GRM and BRM EA boundary cover 17,495 hectares (ha). The GRM and BRM PRCP boundary shown in Figure 2 aligns to the GRM and BRM EA boundary.

Table 1: GRM and BRM mining tenements

Lease number	Name	Date granted
ML1763	Goonyella	30 September 1971
ML1764	Riverside	13 July 1978
ML1802	Riverside Extended	2 November 1978
ML1900	Riverside West	9 December 1982
ML70121	Riverside Tailings Extension	5 December 1996
ML70193	Riverside West Extension North	23 November 2006
ML70194	Riverside West Extension South	23 November 2006
ML70287	Goonyella Tailings	3 November 2006
ML70288	Goonyella Industrial	2 April 2009
ML70289	West Airstrip Pit	30 July 2009
ML70421 (part)	Red Hill	22 September 2016
ML70468	Riverside West Extension 1	28 August 2014
ML70469	Riverside West Extension 2	28 August 2014
ML70478	Goonyella West 1	27 November 2015
ML70479	Goonyella West 2	27 November 2015
ML70493	Riverside Northwest	16 November 2015
ML70494	Riverside North	28 August 2014
ML700003	Mabbin	12 October 2015

The PRCP complies with EA condition A13 "*No mining to be undertaken on ML70478 and ML70479*".

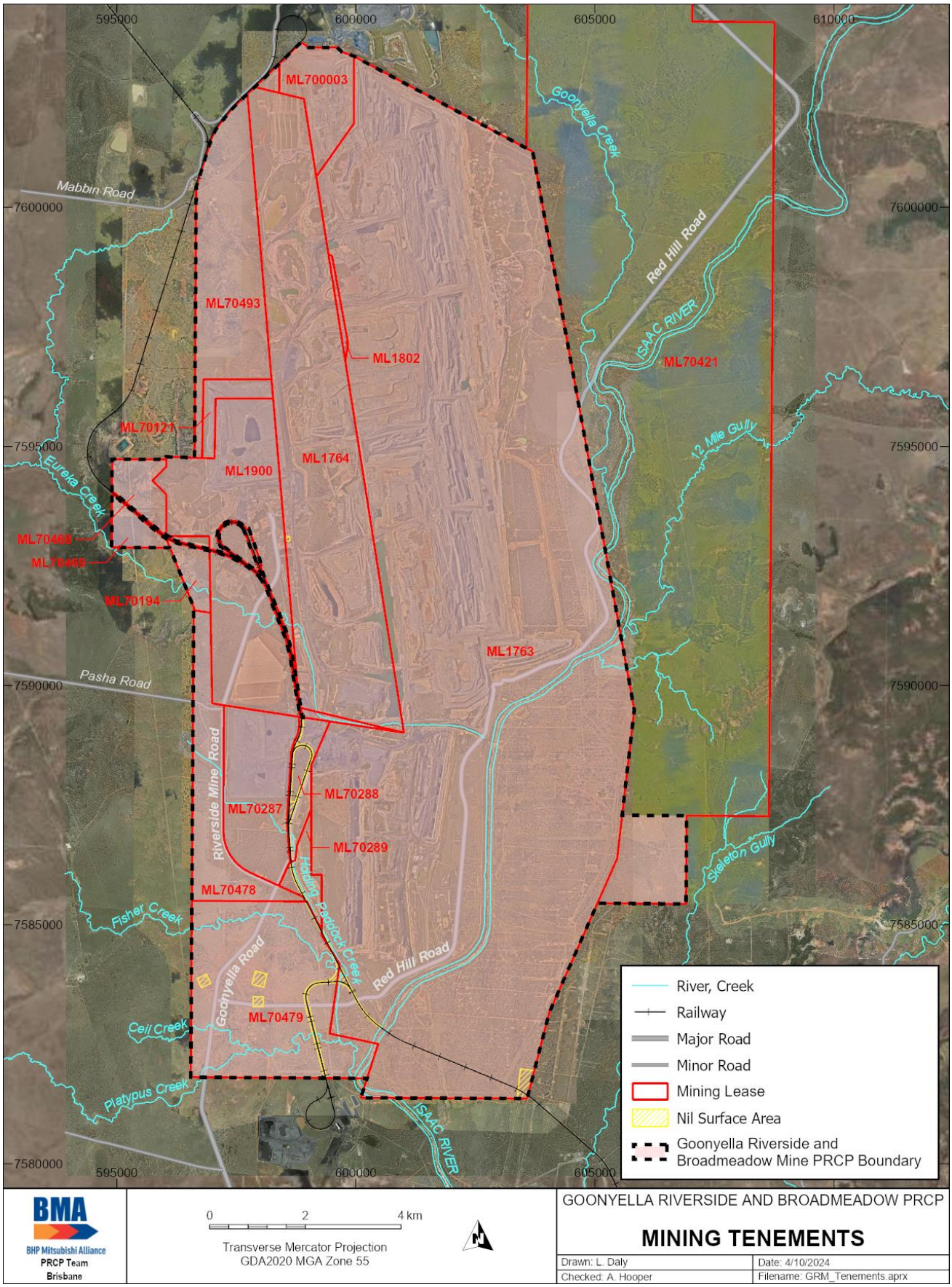

Figure 2: GRM and BRM mining tenements

1.1.2.1 Red Hill Mine

The BMA Red Hill Mine (RHM) is an approved underground mine located directly east of the GRM open cut operation and north of BRM. The RHM EA (EPML03337715) area overlaps with the GRM and BRM EA area on parts of ML1763 and ML70421. The EA overlap areas are detailed in the Red Hill Mining Lease environmental impact statement (EIS) (BMA, 2013a).

BMA is authorised to carry out activities under the EAs, including RHM underground mining on part of ML1763 and additional infrastructure to service RHM to be constructed on GRM and BRM. An extension to the BRM underground operation was approved within the Red Hill EIS.

1.1.2.2 Overlapping tenements

A petroleum Authority to Prospect (ATP1103) is held by CH4 Pty Ltd and a petroleum lease (PL486) is held by Arrow CSG (ATP 364) Pty Ltd over ML70421.

1.1.3 Primary mine features and infrastructure on-site

The current primary mine features and infrastructure, including BMA and third-party owned, within GRM and BRM are summarised in Table 2. The current site layout is shown in Figure 3.

Table 2: Primary mine features and infrastructure currently at GRM and BRM

Mine domain	Description
Voids and spoil dumps	• Goonyella Pit • Thiess Pit • Broadmeadow Pit • Isaac Pit • Airstrip Pit
Rejects dumps	• Riverside rejects dump • Goonyella rejects dumps
Tailings storage facilities (TSFs)	• GS1 • RS1 • DRE5 • R32 (Airstrip void)
Stockpiles	• Run-of-mine (ROM) coal stockpiles • Product coal stockpiles • Topsoil stockpiles • Rock stockpiles
Dams	• Mine affected water dams • Raw water dams • Sediment dams
Watercourse diversions	• Isaac River • Eureka Creek • Holding Paddock Creek

Mine domain	Description
	• Fisher Creek
Underground mining and infrastructure	• Subsidence areas • Highwall entries • Ventilation shafts • Gas drainage bores and associated infrastructure • Longwall mining equipment • Service infrastructure
Processing infrastructure	• Coal handling and preparation plants (CHPP) (Goonyella and Riverside) • Conveyors and transfer stations • Stackers and reclaimers • Surge bins and hoppers • Tunnels
Rail infrastructure	• Rail loop and spur • Train load-out (TLO) bin and facilities • Conveyors
General infrastructure	• Administration, crib, warehouse and various buildings • Workshops • Fuel, oil, chemical, explosive and water storage • Fuel and wash bays • Pipes and pumps • Sewage treatment plants • Landfills • Powerlines • Switchyard and substations • Communications and lighting towers • Eureka Camp • Fences
General disturbance	• Laydown areas • Access roads • Haul roads • Borrow pits (includes a quarry approved under EA EPPR00212113*) • Drains and culverts • Exploration

Mine domain	Description
Regional infrastructure (to remain at closure)	• Red Hill Road • Regional powerlines • Regional water pipelines

**Located within ML70479 (Lot 18 on Plan SP208194), BMA has an EA and a development permit for ERA 16 extractive and screen activities, threshold 2(b) extracting, other than by dredging, in a year, 5,000t to 100,000t of material.*

The site currently has two mine industrial areas (MIAs), located northeast of the Riverside rail loop and east of the Goonyella rail loop. The MIAs include coal processing infrastructure, coal stockpile areas, workshop/maintenance areas, various administration and warehouse buildings, laydown areas and storage yards, parking and fuel, oil, chemical and water storage.

An area located along the eastern boundary of the GRM and BRM EA is a culturally significant area known as Area 4. Previous disturbance has occurred in some areas of Area 4, however no further disturbance or mining will occur in this area. It has been agreed through consultation with the traditional owners that the existing disturbance in the area will be rehabilitated (Section 2).

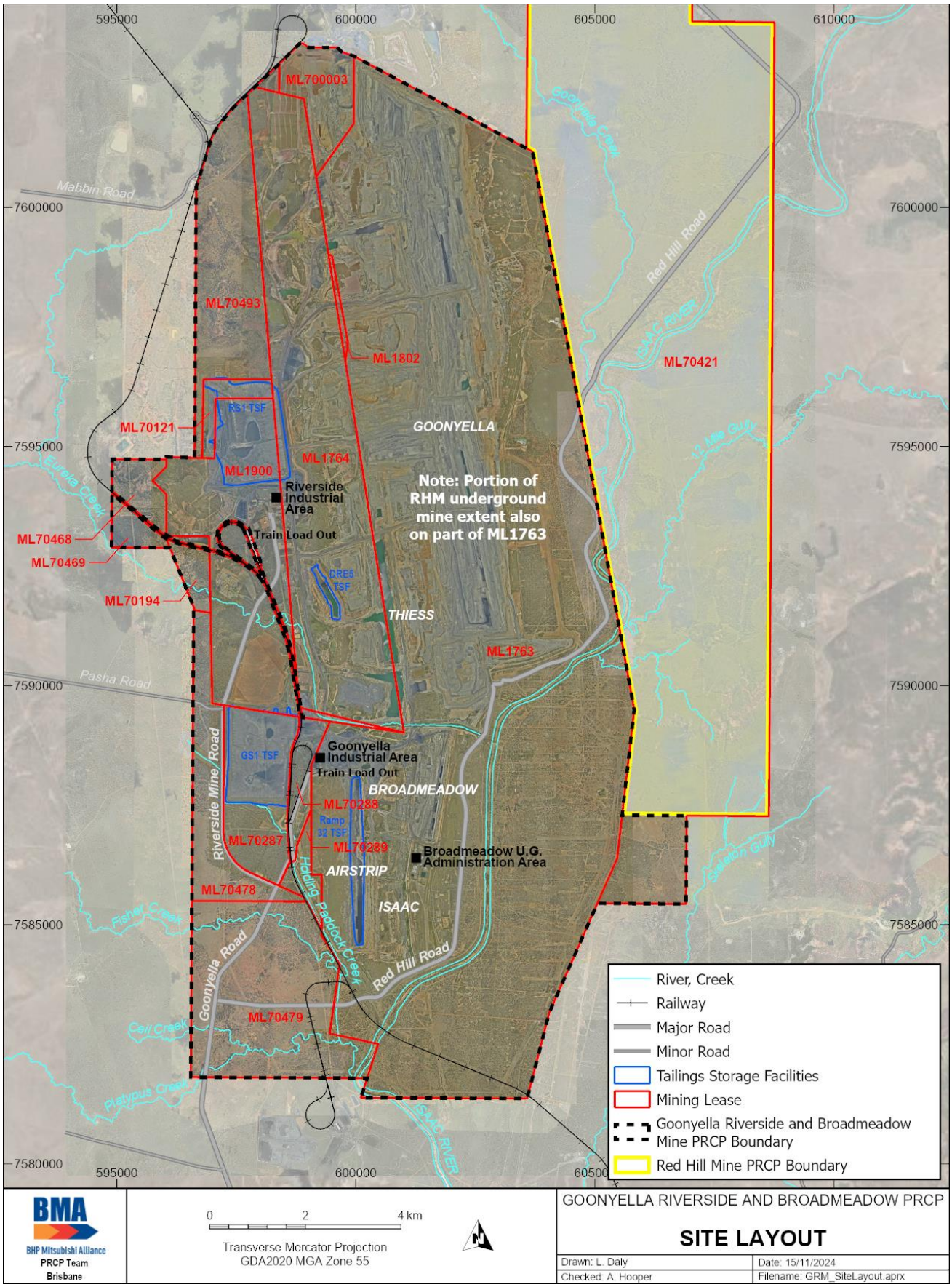

Figure 3: GRM and BRM site map

1.1.3.1 Red Hill Mine

RHM when executed, is currently planned to be accessed via Goonyella Pit residual void high-wall. RHM longwall panels are located within ML1763 and ML70421. The RHM underground operation shown in the PRCP within ML1763, is reduced from the proposed layout in the Red Hill EIS due to the GRM open cut operation extending further than planned at the time of the EIS. If the mine plan for the GRM open cut operation changes from the landform presented in this PRCP, the RHM underground operation may mine the full extent of the EIS approved footprint. If changes occur to GRM and BRM or RHM mine plans, a PRCP amendment will be submitted to the administering authority, if necessary.

Additional infrastructure to service RHM will be constructed on GRM and BRM. This additional infrastructure, as outlined in the Red Hill EIS (BMA, 2013a), includes:

- Red Hill CHPP
- Overland conveyors
- ROM coal stockpiles
- Product coal stockpiles
- MIA including workshop/maintenance areas, various buildings, laydown areas, parking, fuel storage, sewage treatment plant, water storage and supply, power
- Red Hill train load out
- Access to RHM undergrounds
- Powerlines and substations
- Pipelines

RHM coal will be processed predominately at the proposed Red Hill CHPP (planned near the Riverside rail loop) but may also be processed at Goonyella and Riverside CHPPs. RHM rejects and tailings will be disposed of within GRM and BRM.

The GRM and BRM PRCP will cover the rehabilitation and closure of all RHM mining activities and infrastructure within the PRCP boundary area shown in Figure 3. This includes the area where the GRM and BRM EA and RHM EA boundaries overlap on ML1763 and ML70421. The RHM PRCP (submitted 13 December 2024) covers the rehabilitation and closure of the area outlined in Figure 3.

1.1.4 Type of mining operation

GRM is an open cut coal mining operation and BRM is an underground coal mining operation. All coal is processed on-site before the product coal is transported by rail to the Hay Point Coal Terminal for export. Coal waste fines are disposed of in dedicated TSFs, and coarse rejects are disposed within the spoil dumps or designated reject dumping areas.

1.1.4.1 Open cut operations

GRM is a conventional open cut strip mine using both draglines and truck and shovel fleets. The majority of mining is orientated with strips in an approximate north-south direction, with pit development progressively working eastwards down dip.

Mining activities at GRM involve the removal and stockpiling of topsoil, drilling and blasting of overburden and interburden, mining of overburden and interburden by draglines and truck and shovel fleets, and mining of the coal by truck and shovel fleets. The overburden and interburden is placed in spoil dumps within the mined out void of the previous strips.

Coal is hauled from the pits to the CHPP, or to designated stockpiles. The coal is processed at either the Goonyella CHPP (ML1763) or the Riverside CHPP (ML1900).

1.1.4.2 Underground operations

BRM is an underground longwall mining operation using a thick seam mining technique. The underground operations are accessed from the Broadmeadow Pit. Access to future underground panels for BRM may occur from other GRM voids. The longwall panels are predominately orientated roughly west-east.

Prior to mining the longwall panels at BRM, a network of bores and associated surface infrastructure is installed progressively over the underground mine footprint as mining advances for mine gas pre-drainage and management to enable the safe extraction of coal.

Mining of each longwall panel commences from the far extent of the longwall block, working back towards the main headings. The roof of the mined-out longwall area collapses as mining progresses, which may result in subsidence on the surface.

The longwall continuous mining equipment includes:

- Self-advancing hydraulic powered roof supports which move with the shearer to support the roof
- Mechanised shearers to cut and remove the coal at the coal face
- Armoured face conveyors to remove the coal from the face and transfer it to the roadways to the surface

The coal seam is too thick to be extracted using conventional longwall mining therefore the thick seam mining technique, also known as top coal caving, is used to enable more coal to be extracted. The hydraulic roof support system can be raised and lowered, allowing coal above the area cut by the shearers to cave in behind the mining face as the hydraulic support is lowered, falling onto a rear armoured face conveyor to be extracted from the mine. Top coal caving is not authorised where it would result in the subsidence of the bed or banks of the Isaac River (EA condition J2).

Coal is transported from the longwall face to the surface coal stockpile via conveyors. Coal is trucked from the stockpile to either the Goonyella CHPP (ML1763) or the Riverside CHPP (ML1900) for processing.

Vertical shafts connect the mine workings to the surface to provide ventilation and emergency access to the surface if required.

RHM is approved as an underground longwall mining operation also using the same thick seam mining technique as BRM. The underground operations are currently planned to be accessed from the Goonyella Pit. The longwall panels are orientated roughly north-south.

1.1.5 Proposed duration of the operation

The Goonyella Mine commenced operation in 1971, merging with the adjoining Riverside Mine in 1982 to become GRM. BRM opened in 2005.

Current life-of-mine planning mines the GRM open cut until 2059 and BRM underground until 2051. RHM underground is currently planned to be accessed via the GRM voids, with development of the RHM underground planned to commence in 2060 at the end of mining at GRM, with mining planned until 2091. At GRM and BRM, infrastructure to support RHM operations and areas required for rejects and tailings disposal, will continue to be utilised until mining at RHM is complete.

Variations to the planned mining rates or mining extents of GRM and BRM or RHM may change the proposed duration of the operations, and as a result, when necessary, a PRCP amendment will be submitted to the administering authority. Variations to mining rates or mining extents may be due to business or market conditions, changes to technology or refined resource information. Due to the interconnection of RHM with GRM and BRM, changes to the GRM and BRM mine plans may bring forward the start of RHM.

1.2 Baseline information

PRCP Guideline (Section 3.1)

In addition to the legislative requirements, the following information about the site, where relevant, is considered necessary by the administering authority (as per section 126C(1)(j) of the EP Act) to decide whether to approve the PRCP schedule:

- *site topography (locally and regionally)*
- *climate (general and specific (rain, evaporation, temperatures)) including long-term projections*
- *geological setting*
- *site hydrology and fluvial networks*
- *groundwater levels and properties*
- *soil types, properties, and productivity*
- *land stability (pre-existing land degradation/erosion and predisposition to ongoing stability issues)*
- *vegetation communities and ecological data (including existing regional ecosystem mapping)*
- *fauna presence and populations*
- *pre-mining land use*
- *identification of underlying landholders*

Transitional PRC Plans must include any baseline information collected as part of an EIS process or original EA application. If this information is unavailable, the reasons should be explained in this section of the rehabilitation planning part. Transitional PRC Plans are not required to demonstrate how aspects of the mine site have been designed for closure for existing or approved disturbance. However, any expansion to an existing site must demonstrate how it has been designed for closure. The rehabilitation/improvement planning must include data from when mining first commenced up until planned surrender. The transitional provisions of the EP Act include an exceptional circumstance for when land is available for rehabilitation.

1.2.1 Site topography

The topography at GRM and BRM is relatively flat. The mine is located within a broad valley through which the Isaac River flows. The valley is defined to the west by the Denham Range and to the east by the Carborough Range. The southern end of the valley broadens out on to a wide flood plain. A low broad ridge to the north defines the northern part of the Isaac River catchment. The low hills located to the east of the Isaac River near the existing mine are strongly undulating with a well-developed system of drainage lines.

The topography of the Isaac River valley near the GRM and BRM area varies from approximately 250m Australian Height Datum (AHD) along the Isaac River to the east to approximately 325m AHD elevation along portions of the Denham Range that define the western edge of the valley. The relatively steep slopes associated with the Denham Range contrast with the extensive flat areas across the base of the river corridor, where gradients are generally less than 1:100.

1.2.2 Climate

GRM and BRM is located in a semi-arid climatic zone, which is characterised by high summer temperatures, warm dry winters and a distinct wet and dry season. Weather data was collected at the Moranbah Water Treatment Plant (Station No. 034038) between 1972 and 2012; and since 2012 it has been collected at the Moranbah Airport (Station No. 034035) (BOM, 2024).

1.2.2.1 Temperature

Maximum average temperatures range from 24°C in June/July to 35°C in December/January, with minimum average temperatures ranging from 9°C in July to 21°C in January/February.

1.2.2.2 Rainfall

Although rainfall occurs throughout the year, it is more prevalent in the summer months (Table 3).

Table 3: Moranbah monthly average rainfall for station no. 034038 and station no. 034035

Month	Station no. 034038 (mm)	Station no. 034035 (mm)
January	103.8	103.1
February	100.7	82.6
March	55.4	76.8
April	36.4	25.7
May	34.5	30.6
June	22.1	23.1
July	18.0	35.9
August	25.0	13.9
September	9.1	13.3
October	35.7	22.8
November	69.3	66.3
December	103.9	64.3
Annual	**614.2**	**560.8**

1.2.2.3 Evaporation

The evaporation rate is highest in the summer months - mean daily rate of 8.5mm in December; and lowest in the cooler months - mean daily rate of 3.5mm in June. The annual average rate of evaporation is approximately 2,300mm, which greatly exceeds the annual rainfall, a characteristic of semi-arid environments.

1.2.2.4 Wind

Wind records for Moranbah for January - April show an easterly predominance of moderate strength (1 - 20km/h), with easterlies dominating in May - July with some south-easterly influence. Easterly winds predominate for August - December which tends north to north-easterly from October to December.

1.2.2.5 Long-term climate projections

To account for potential future climate uncertainties within hydrologic designs and mine water planning, this PRCP and supporting technical studies have utilised the *BMA Climate Change Adaptation in Mine Water Planning and Hydrologic Assessments Guideline* (BMA, 2023). This guideline was developed specifically for the locations of the BMA assets to provide a consistent approach to the adoption of future climate variables. The approach and baseline data, on which the guideline was based, has been derived from Commonwealth Scientific and Industrial Research Organisation (CSIRO), Bureau of Meteorology (BOM), DETSI and other published sources and is aligned with the published projection database and methods including Consistent Climate Scenarios Projection Data and High-Resolution Projection Data.

1.2.3 Geological setting

GRM and BRM are located on the north-western margin of the Bowen Basin on the Collinsville Shelf. The Bowen Basin in the area is characterised by a relatively thin accumulation of sediments, gentle easterly dips and minor to moderate deformation. The lithology at GRM and BRM is characterised by typical basin-fill sediments, comprising mudstone, claystone, siltstone, sandstone (typically fine- to medium-grained), carbonaceous sediments and coal seams. Basalt is encountered within Tertiary-age material. The depth to base of weathering averages about 30m below natural surface but ranges from about 20m to 50m below natural surface, depending on the local topography.

The coal bearing sequences at GRM and BRM are primarily from the Permian-age Moranbah Coal Measures (MCM), with minor coal from the Permian-age Fort Cooper Coal Measures (FCCM). These coal measures are comprised of the following seam groups in stratigraphic order, from youngest to oldest:

- Goonyella F seam group; the base seam group of the FCCM comprising several plys. The Goonyella F is a minor seam group, which is not present in the western pit areas of GRM and BRM (i.e. post-closure, will only be exposed in Goonyella residual void). The Goonyella F seam group has not been mined as ROM coal to date, however some plys of the Goonyella F seam may be mined as ROM coal from the Goonyella Pit in later years
- Goonyella Upper Seam (GUS) group: the uppermost seam group of the MCM and a significant seam group at GRM and BRM that comprises several plys – not all of which are mined as ROM coal
- Goonyella P seam; a ‘waste’ seam group at GRM and BRM made up of GP1 and GP2 plys (i.e. P seam is not mined as ROM coal)
- Goonyella Middle Seam (GMS) group; a significant seam group at GRM and BRM that comprises of several plys, most of which are mined as ROM coal
- Goonyella Lower Seam (GLS) group; a significant seam group at GRM and BRM that comprises of several plys, most of which are mined as ROM coal
- Below the GLS group lies the GLL seam group, which is not mined at GRM and BRM

Seam splitting and coalescing occurs along the length (north-south) of the site.

Mining at GRM and BRM to date has been from the MCM and overlying Tertiary-age material. Based on the current mine plan, the FCCM will soon begin to be encountered during mining (starting at the northern end of Goonyella Pit), until the end of open cut mining. Due to the FCCM sub-cropping east of the current mining activities at GRM and BRM, the FCCM is not encountered in Thiess, Airstrip, R32 South or Broadmeadow-Isaac pits.

Overlying the FCCM/MCM is a thin veneer of Quaternary- and Tertiary-age sediments. Throughout the region, the Quaternary and Tertiary sediments are highly weathered, semi-consolidated and typically comprise sand, clay and gravel.

To date, all ROM coal mined from GRM has been from the GMS and GLS seam groups. As mining progresses eastwards (down-dip) the GUS seam group will become more prevalent. In the latter stages of mining in Goonyella Pit, some coal from Goonyella F seam may be mined as ROM.

All current ROM coal mined from BRM has been from the GMS seam group. Future mining will extract coal from the GMS and GLS seams.

A representative geological cross-section (indicatively west-east) is shown Figure 4. The seam groups are shown in the geological sections.

Underlying the MCM is the Permian-age Back Creek Group, which has geological similarities with the host rock of the MCM (i.e. quartzose to lithic sandstone, siltstone, carbonaceous shale and minor coal).

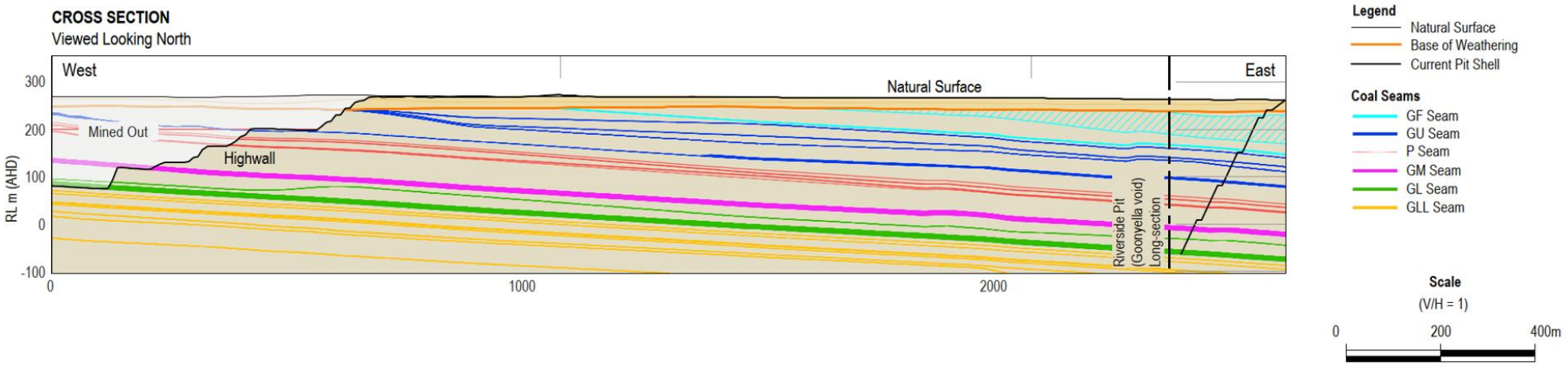

Figure 4: Representative geological cross-section of GRM and BRM (indicatively west-east)

1.2.4 Site hydrology and fluvial networks

GRM and BRM are located within the Fitzroy Basin, within the Isacc Connors Sub-basin and the upper Isaac River Catchment. The GRM operations, consisting of the open cut coal mine and supporting infrastructure, falls within the Isaac Western Uplands Tributaries and the Isaac and Lower Connors River Main Channel Sub-catchments. The BRM operations, consisting of the underground coal mine, predominantly lies within the Lower Connors River Main Channel Sub-catchment with a small portion of the south-eastern extent located in the Isaac Northern Tributaries Sub-catchment.

The surface water environmental values for the Isaac Western Upland Tributaries, the Isaac and Lower Connors River Main Channel and Isaac Northern Tributaries Sub-catchments are detailed in the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water and Wetland Biodiversity)) Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all water of the Isaac River Sub-basin (including Connors River) (DEHP, 2011) and summarised in Table 4.

Table 4: Surface water environmental values

Sub-catchment	Aquatic ecosystems	Irrigation	Farm supply/ use	Stock water	Aquaculture	Human consumer	Primary recreation	Visual recreation	Drinking water	Industrial use	Cultural and spiritual value
Isaac Western Upland Tributaries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Isaac and Lower Connors River Main Channel	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓
Isaac Northern Tributaries	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓

The watercourses within GRM and BRM are summarised in Table 5 and are shown in Figure 5.

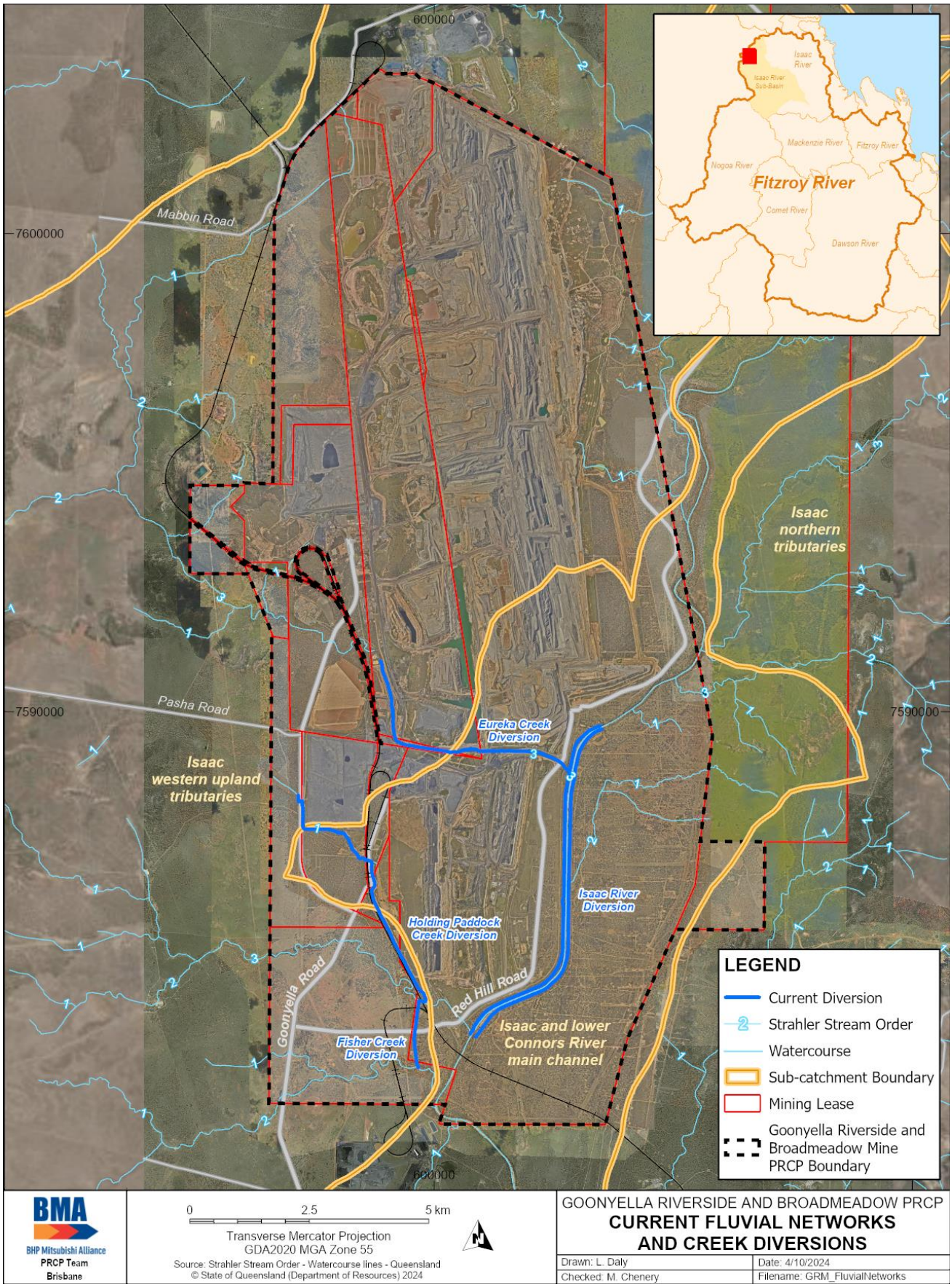

Figure 5: GRM and BRM fluvial network and diversions

Table 5: Watercourses and key drainage lines within and immediately surrounding GRM and BRM

Watercourse	Perennially	Hierarchy	Strahler Stream Order	Comment
Isaac River	Intermittent	Major	6	The Isaac River is the dominant major watercourse in the catchment. The Isaac River flows in a southerly direction before its confluence with the Mackenzie River approximately 250km to the south of the mine. The Isaac River has been diverted within the southern portion of the site.
Goonyella Creek and tributaries	Intermittent	Minor	1 - 2	Located to the east of GRM and north of BRM. The catchment includes the areas to the north and east of the Goonyella void. Confluence with the Isaac River is to the east of the Goonyella void.
Eureka Creek and tributaries	Intermittent	Minor	1 - 3	The upper catchment is located to the west of GRM including the area to the west of the Goonyella and Thiess spoil dumps. The watercourse is directed through a diversion between the Theiss and Broadmeadow/Isaac pits and through GS4A dam before its confluence with the Isaac River within the northern end of the Isaac River diversion.
Holding Paddock Creek	Intermittent	Minor	1	The upper catchment of Holding Paddock Creek is located to the west of the GS1 TSF. The creek has diversions directing the watercourse around the south-western corner of GS1 and to the west of the Airstrip Pit spoil dumps. Holding Paddock Creek has a confluence with Fisher Creek to the south of the Airstrip Pit.
Fisher Creek	Intermittent	Minor	3	The upper catchment is located to the west of ML70478 and ML70479 and drains to the east before being diverted to the south and into Platypus Creek to the south of Airstrip Pit.
Platypus Creek and Ceil Creek	Intermittent	Minor	2	The upper catchments of both Ceil Creek and Platypus Creek are located to the west of ML70479. The confluence of Ceil Creek is located in the undisturbed area in the south-western portion of GRM. Through diversions, Platypus Creek's lower reach also accepts flows from Fisher and Holding Paddock creeks. The confluence of Platypus Creek with the Isaac River is immediately to the south within the neighbouring Moranbah North Coal Mine MLs.

As part of the GRM and BRM mining operations, BMA currently holds water licences permitting:

- Impounding of water (Eureka Creek)
- Taking of water (Eureka Creek)

Water licences applicable to GRM and BRM surface waters are summarised in Table 6.

Table 6: Water licences applicable to GRM and BRM surface waters

Authorisation number	Authorisation activity	Authorised purpose	Approval date (most recent update)	Expiry date
56902L	Licence to take water: Eureka Creek	Site water management	05/03/2010	30/06/2111
56903L	Licence to interfere by impounding – embankment or wall: Eureka Creek	Impounding water	04/07/2014	30/06/2111

The *Central Queensland Coal Associates Agreement Act 1968* (CQCA Agreement Act) authorises diversion of the course of flow of the following watercourses:

- Isaac River
- Eureka Creek
- Holding Paddock Creek
- Fisher Creek

Within and surrounding the GRM and BRM mining tenure, there are some small dams that have been constructed to support grazing land uses. The on-tenure stock watering dams are predominantly located on the western side of the mining operations and have not been constructed by the EA holder or used by the mining operations.

Sediment dams and mine water dams are periodically constructed and relocated to meet progressive mining requirements. During operations, runoff from unrehabilitated spoil dumps and disturbed areas is directed into sediment dams. At closure, these dams will be rehabilitated and surface water from rehabilitated landforms will report to the receiving environment.

During mining operations, levees are utilised where appropriate to provide suitable levels of flood protection to the voids and operational areas. At closure, alternative flood mitigation measures will be utilised for the residual voids where required.

1.2.4.1 Fluvial Water Quality

Surface water quality within the fluvial network that intersects GRM and BRM has historically been assessed through the Receiving Environment Monitoring Program. This monitoring program has been undertaken in accordance with EA conditions F21 to F23. Surface water quality results are supplied to the administering authority as part of the EA annual reporting requirements.

Noting the surface water data collected to date has been collected for a variety of purposes with differing data quality objectives, the data presented in Table 7 is a summary of the data held within the Queensland Government administered WaTERS database (extracted 21 August 2024).

Table 7: Summary of upstream water quality results

Analyte	Unit	Summary statistics			
		Minimum	Maximum	Mean	95% UCL*
Electrical conductivity (EC)	µS/cm	1	9,264	1,060	1,076
Sulphate	µg/L	1	246	41	53
Nitrate	µg/L	0.01	1.20	0.27	0.32
Total nitrogen (TN)	µg/L	0.5	9.1	2.6	3.0
Total phosphorus (TP)	µg/L	0.02	3.24	0.69	0.83
C6 - C9	µg/L	0.02	0.02	0.02	NA
C10 - C36	µg/L	0.05	0.38	0.14	0.18
Al (dissolved)	µg/L	10	2,700	801	977
Cr (dissolved)	µg/L	1	5	2	2
Cu (dissolved)	µg/L	1	11	3	3
Fe (dissolved)	µg/L	26	2,030	542	672
Mo (dissolved)	µg/L	1	13	3	4
Ni (dissolved)	µg/L	1	30	4	5
Se (dissolved)	µg/L	10	10	10	NA
U (dissolved)	µg/L	1	1	1	NA
V (dissolved)	µg/L	10	10	10	NA
Zn (dissolved)	µg/L	5	41	9	14
Al (total)	µg/L	490	120,000	21,084	25,110
Cr (total)	µg/L	1	229	47	56
Cu (total)	µg/L	1	162	25	30
Fe (total)	µg/L	110	141,000	27,408	32,436
Mo (total)	µg/L	1	20	5	6
Ni (total)	µg/L	1	299	44	53
Se (total)	µg/L	10	10	10	NA
U (total)	µg/L	1	5	2	2

Analyte	Unit	Summary statistics			
		Minimum	Maximum	Mean	95% UCL*
V (total)	µg/L	10	260	62	72
Zn (total)	µg/L	6	302	54	67

Notes: This data summary is not intended for use as closure milestone criteria, only a high-level summary of surface water quality at GRM/BRM. Some data manipulation has been undertaken to provide the summary statistics in the table, including the removal of select outliers, removal of select sampling not considered representative of surface water quality and removal of results below detection limits.

** denotes Upper Confidence Limit (UCL)*

Monitoring results held within the WaTERS database also identify pH in surface water ranging between 5.09 to 9.84.

The data collected to date has been collected as part of the routine monitoring programs and to support specific projects. These programs have not been undertaken to specifically develop water quality limits for the site and additional work would be required to collect data that would support the development of site-specific values for closure in line with the *Assessing and managing water quality in temporary waters - Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Smith, et al., 2020).

On-going future monitoring during the operation of GRM and BRM is being undertaken though the Fitzroy Basin Regional Receiving Environment Monitoring Program and EA specified release monitoring.

1.2.5 Hydrogeology

A hydrogeological assessment, including conceptual and numerical modelling, has been undertaken to support the development of this PRCP. The detailed report – *Transitional PRCP - Goonyella Complex - Hydrogeology Assessment* (AECOM, 2024) is provided in Appendix D. The groundwater numerical model domain for GRM and BRM includes the MLs forming GRM, BRM and RHM, in addition to surrounding areas where the operations could influence groundwater conditions. As the operations at RHM have an influence on groundwater conditions at GRM and BRM, the interpretation of the hydrogeological conditions presented within this PRCP considers the RHM mining operations.

1.2.5.1 Groundwater take

In accordance with Section 334ZP of the *Mineral Resources Act 1989* and Section 1283 of the *Water Act 2000*, a water licence for the taking of, or interfering with, underground water is considered granted where the taking of underground water, required for the safe extraction of the resource or due to evaporative loses on an approved mining project, began prior to commencement of the *Water Act 2000*. As GRM commenced operations in 1971, a water licence is considered to be granted for the taking and interfering of underground water.

1.2.5.2 Groundwater environmental values

GRM and BRM are located within the Isaac Connors groundwater management area Zone 34 of the Fitzroy Basin. Within the groundwater management area, alluvial groundwater is managed as Groundwater Unit 1 and water within the hard rock aquifers as Groundwater Unit 2 (sub-artesian aquifers). The site is located in the groundwater chemistry zone of ‘sodic sequence’, which is saline, sodium and chloride dominated (DEHP, 2011). Volumetric limits apply to extraction of groundwater within the groundwater management area for non-stock and domestic purposes.

Groundwater resources are also scheduled under the EPP (Water and Wetland Biodiversity) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). Table 8 summarises the groundwater environmental values.

Table 8: Groundwater environmental values

Groundwater zone	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary Recreation	Visual recreation	Drinking water	Industrial use	Cultural and spiritual value
Isaac Groundwaters	✓	✓	✓	✓	-	-	✓	-	-	✓	-	✓

1.2.5.3 Hydrogeological units

Groundwater at GRM and BRM comprises the following key hydrogeological units:

- Quaternary alluvium – unconfined aquifer (sporadic discontinuous water-bearing strata of permeable unconsolidated irregular sequences of clay, silt, sand and/or gravel) localised along Eureka Creek, Goonyella Creek and regionally along the Isaac River where it is well developed
- Tertiary – including the Tertiary sediments, Suttor Formation, Basalt and Duaringa Formation, which form an unconfined aquifer overlying Triassic and Permian units regionally
- Late Permian age coal measures – including the Rangal Coal Measures, FCCM and MCM (Blackwater Group) consisting of:
  - Low permeability interburden units with aquitard properties
  - Coal seams that exhibit water bearing properties primarily associated with secondary porosity through cleats and fracturing
- Mid Permian – consisting of the Back Creek Group, which outcrops to the west of the site and underlies the Blackwater Group

The coal seams within the MCM are the primary aquifer at GRM and BRM. The coal seams can be characterised as semi-confined aquifers, with the upper, middle and lower coal seams forming the main hydrostratigraphic units locally. The MCM overburden and interburden act as aquitards and are typically dry, or very low yielding.

Quaternary alluvium

The Quaternary alluvial deposits unconformably overlie the Suttor Formation, Tertiary basalt, and Rewan Formation. In the proximity of GRM and BRM the alluvial deposits predominantly occur in close proximity of the Isaac River and the immediately surrounding floodplains. Along the Isaac River these deposits consist of clay, sandy clay, and sands and gravels with varying proportions of clay, to depths of up to 37m and typically between 15 and 35m. Investigations in the Isaac River immediately to the south of the site indicated the thickness of bed sands in the Isaac River was 2 to 3m.

The alluvium associated with Eureka Creek consists of up to 9m of silty sand, silty clay and poorly sorted sand and gravel. Onsite investigations in the alluvium of Eureka Creek indicated it was not continuous.

Hydrogeological investigations within the region indicated the permeability of the Isaac River alluvium ranged from 8.9 to 45.4m/day. The Quaternary flood deposits (riverbank sediments) are generally finer grained than the bed sands, with permeability values between 0.01 and 10m/day. Onsite, hydraulic testing of the Quaternary alluvium associated with the Eureka Creek has indicated a hydraulic conductivity of 0.001m/day, typical for silty clay type materials.

The Isaac River alluvium has limited effective storage, provides only limited volumes of baseflow, and does not contain permanent groundwater. More permanent groundwater resources may however occur in the deeper and relatively narrow parts of the Isaac River channel.

Due to the generally shallow saturated thickness and the lack of continuity of the more permeable gravel and sand sections, the Quaternary alluvium is not considered a significant aquifer as it has limited sustainable yield.

However, during periods of creek or river flow, the alluvium may become fully saturated and discharge to sub-cropping coal seams or other underlying aquifers. Drilling and monitoring onsite indicates that, where groundwater does occur, depth to groundwater in the Quaternary alluvium is approximately 3 to 13m below ground level. There is a marked separation between the measured alluvium groundwater levels and the piezometric levels associated with the deeper coal seam aquifers and thus it is unlikely that changes in groundwater levels in the coal would significantly impact on the alluvium hosted groundwater.

Regionally, groundwater flow within the alluvial aquifer is expected to follow topography and local drainage patterns.

Recharge of the alluvial aquifer, which is a porous media aquifer, is from surface water flow or flooding (losing streams), surface infiltration of direct rainfall and overland flow, where no substantial clay barriers occur in the shallow sub-surface. Available hydrologic data suggests that water infiltrates/drains to the base of the alluvium relatively quickly after rainfall events. This saturation is generally sporadic, producing semi-permanent, localised, relatively thin aquifers.

Groundwater discharge from the alluvium occurs through evapotranspiration from vegetation, short duration baseflow, and infiltration and recharge to the underlying older formations.

Tertiary Suttor Formation and Tertiary sediments

The undifferentiated Tertiary sediments and Suttor Formation occurs extensively throughout the area, though outcrop is not always continuous; it is eroded in areas to expose the underlying Permian rocks, with parts of the Tertiary sequence concealed by younger alluvium and colluvium. The Tertiary sediments generally consist of lenses of paleochannel gravels and sands separated by sandy silts, sandy clays and clays. A review of the borehole logs showed the Tertiary sediments vary in thickness up to approximately 80m with a typical thickness of 15m.

Groundwater level in the Tertiary deposits has been found to be between 4 and 17m below ground level and exists within the more permeable sand and gravel Tertiary sediments. Depending on the location, the Tertiary aquifer is either unconfined to confined, with the degree of confinement determined by weathering, overlying alluvium and clay content. There is a distinction between the Tertiary and the coal measure groundwater levels, indicating a separation between the hydrostratigraphic units.

Recharge of the Tertiary aquifers primarily occurs through direct infiltration of rainfall and overland flow and through overlying Quaternary alluvial aquifers. Primary discharge mechanisms in the Tertiary sediment aquifers are through flow into adjacent or underlying aquifers; evapotranspiration; and groundwater extraction.

A review of bore logs within the RHM footprint showed that the Tertiary sediments are dominated by low permeability clays and sandy clays with isolated areas of loose more permeable sand. Within the proximity of the Airstrip Pit, a hydraulic conductivity of 6.6×10^{-4}m/day was identified within the Tertiary sediments, indicating a predominantly clay lithology. Hydraulic conductivity within the sandstone/siltstone, sands and clays of the Tertiary Formation range between 2×10^{-7} to 24.6m/day.

Groundwater flow within the Tertiary sediments is limited due to the compartmentalisation associated with the variable clay contents and the discontinuous nature of the formation. Where groundwater flows occur, they are expected to be a subdued reflection of topography.

Permian Coal Measures

Groundwater occurrence within the Permian coal measures is largely restricted to the low to moderately permeable coal seams that exhibit both primary porosity and the more dominant secondary porosity through fractures and cleats. The GLS, GMS and GUS coal seams represent the most extensive Permian aquifers at GRM and BRM.

Permian overburden and interburden are characterised by low vertical hydraulic conductivity and confine the coal seam aquifers both above and below. Other sediments in the overburden and interburden are relatively impermeable (either due to high clay content or significant cementing) and form aquitards. The overburden and interburden is hydrogeologically ‘tight’ and hence very low yielding to essentially dry claystone, mudstone, sandstone, siltstone and shale.

Evidence from piezometric observations for the coal seam aquifers suggests the groundwater levels were slightly different for each seam, with the GUS seam being 1 to 2m higher than the GMS seam, and the GLS seam being up to 14m lower than the GMS seam at the same location. This variation in hydraulic heads between coal seams confirms the aquitard nature of the interburden and the limited potential for induced flow.

As operations at GRM commenced in 1971, there are no available pre-mining groundwater records for the area and therefore a data derived piezometric surface cannot be produced. Prior to development of the mining operations, groundwater flow direction in the coal seam aquifers is expected to have been from the north and west to the south and east across the site. This flow direction is consistent with recharge to the coal seams occurring at the subcrops in the west of the site and discharge occurring downgradient in the Isaac River sub catchment of the Bowen Basin. The current groundwater flow pattern has been altered locally with groundwater flow towards the existing mine pits and underground workings at GRM, BRM and other surrounding mining operations due to mine dewatering and depressurisation.

The occurrence of groundwater in the interburden is limited. Aquifers in the interburden are discontinuous with heterogeneous hydraulic properties creating isolated, lens-like aquifers. Due to the heterogeneity and discontinuity of the interburden aquifers within the Permian strata, the groundwater flow direction cannot be determined on a regional scale for these units.

Groundwater recharge in the Permian-Triassic strata aquifers occurs from:

- Infiltration of rainfall and overland flow in outcrop and sub-crop areas
- Downward seepage or through flow from overlying or adjacent alluvial or tertiary aquifers where no significant clay barriers exist
- Leakage between aquifers by faulting and other structural discontinuities in overburden and interburden sediments
- Water storage/placement within mining voids or other workings

Primary discharge mechanisms in the Permian-Triassic strata aquifers include:

- Dewatering for mine progression
- Downgradient Permian-Triassic strata outcrop areas
- Through flow into adjacent (outcropping or sub-cropping coal seams) or seepage into underlying aquifers (via structural discontinuities)

Interpreted hydraulic conductivity values for the MCM indicate that the cleats and joints in the coal are less open with depth, with a corresponding decrease in permeability. The following ranges of hydraulic conductivity at the site have been identified:

- GUS: 0.02m/day (limited data, no range available)
- GMS: 0.009 to 0.1m/day
- GLS: 7 x 10^{-7} to 3m/day
- Interburden: 9 x 10^{-7} to 9 x 10^{-5}m/day
- Overburden: 6 x 10^{-4} to 5 x 10^{-2}m/day

1.2.5.4 Groundwater quality

An assessment of groundwater quality for each of the hydrogeological units, based on the existing data held, was undertaken as part of the Hydrogeological Assessment (Appendix D). A summary of the currently known groundwater quality characteristics within each of the aquifers is provided below.

The groundwater data collection for the GRM and BRM historically has been sporadic and been undertaken for specific projects. Recent bore installations (2020) and monitoring programs have commenced, however the data is considered insufficient to provide statistical interpretations suitable to allow the development of site-specific milestone criteria.

Quaternary alluvium

The groundwater from the Quaternary alluvium is dominated by sodium and bicarbonate ions. Available data also indicates the aquifer has variable salinity relating to depth of the aquifer, distance from the area of recharge and its temporal nature. Monitoring results from 2020 to 2024 indicate the alluvium hosted groundwater ranges from fresh to highly saline. Generally, the alluvial groundwater has lower salinity than the Tertiary and Permian formations.

Alluvium major ions and nutrient results from the 1998 to 2011 monitoring data indicated variability over time and between locations. The EPP (Water and Wetland Biodiversity) 50th percentile water quality objectives for shallow (<30m depth) groundwater were exceeded by the median results for: sodium and chloride and by the maximum results for sodium; calcium; chloride; bicarbonate; sulphate; and fluoride.

Tertiary and Permian

The Tertiary and Permian age formations have variable salinity, ranging from brackish to saline. The Permian MCM and Back Creek Group has moderate to high salinity principally due to elevated levels of sodium and chloride ions. The Back Creek Group groundwater contains a relatively higher proportion of sulphate due to marine influence during deposition compared to the MCM.

Permian major ions and nutrients results from the available monitoring data indicated variability over time and between locations. The EPP (Water and Wetland Biodiversity) 50th percentile water quality objectives for deep groundwater (>30m depth) are exceeded by the median and maximum results for: sodium; calcium; magnesium, chloride; bicarbonate; sulphate; and fluoride.

1.2.5.5 Groundwater use

Groundwater use in the area within and surrounding GRM and BRM is limited with land users predominantly utilising surface water dams and water supplied through reticulated infrastructure. Groundwater use is generally limited by groundwater quality restricting its beneficial use without prior treatment.

A search of the Department of Regional Development, Manufacturing and Water Groundwater Bore Database was carried out for registered bores around the GRM and BRM area with a 5km buffer around the MLs. The search indicated there are 224 registered bores for the following uses:

- Groundwater monitoring – 190 bores
- Exploration – 20 bores
- Water supply – 8 bores
- Unknown – 6 bores

The Queensland Water Entitlement Database did not list any of the registered bores as having a water licence.

The BOM National Atlas of groundwater dependent ecosystems (GDEs) (GDE Atlas) (BOM, 2017) indicates the potential for moderate to high aquatic GDEs and moderate to low terrestrial GDEs being present within the GRM and BRM MLs. However, a review of the mapping indicates the mapped potential aquatic GDEs are dominated by anthropogenic infrastructure within the MLs including the TSFs, mine dams, in-pit water storages, constructed drains and diversions, and not natural ecosystems. The groundwater monitoring in the proximity of the site indicates the alluvial groundwaters are temporal in nature and therefore likely to only support aquatic ecosystems after recharge resulting from periods of flooding. Terrestrial ecosystems within the riparian zones of the Isaac River and its tributaries are potentially facultative GDEs with deeper rooted species accessing the temporal groundwaters within the alluvial and colluvial deposits.

1.2.5.6 Conceptual site model

A hydrogeological conceptual site model representing the PRCP extent of mining, at the last day of mining at GRM and BRM, is illustrated in Figure 6. This conceptual site model indicates the mining operations result in the following:

- Groundwater drawdown within the MCM, associated with passive dewatering into the GRM residual voids, results in inwards hydraulic flow gradients in the coal measures
- Drawdown in the MCM at the end of mining is at, or close to, the maximum expected to occur from GRM and BRM mining operations
- Residual voids capture seepage from spoil dumps
- Upon dewatering and the dissipation of groundwater mounding beneath the TSFs, the inward hydraulic gradients created to the Goonyella residual void result in the capture of groundwater from the areas in which the TSFs are located within the NUMA

- Little to no impact on surficial aquifers, which is intermittently saturated, including the Isaac River alluvium.
- Little to no impact on environmental receptors, including naturally occurring GDEs associated with the residual watercourses.
- Limited impact on anthropogenic receptors (i.e., private groundwater users).

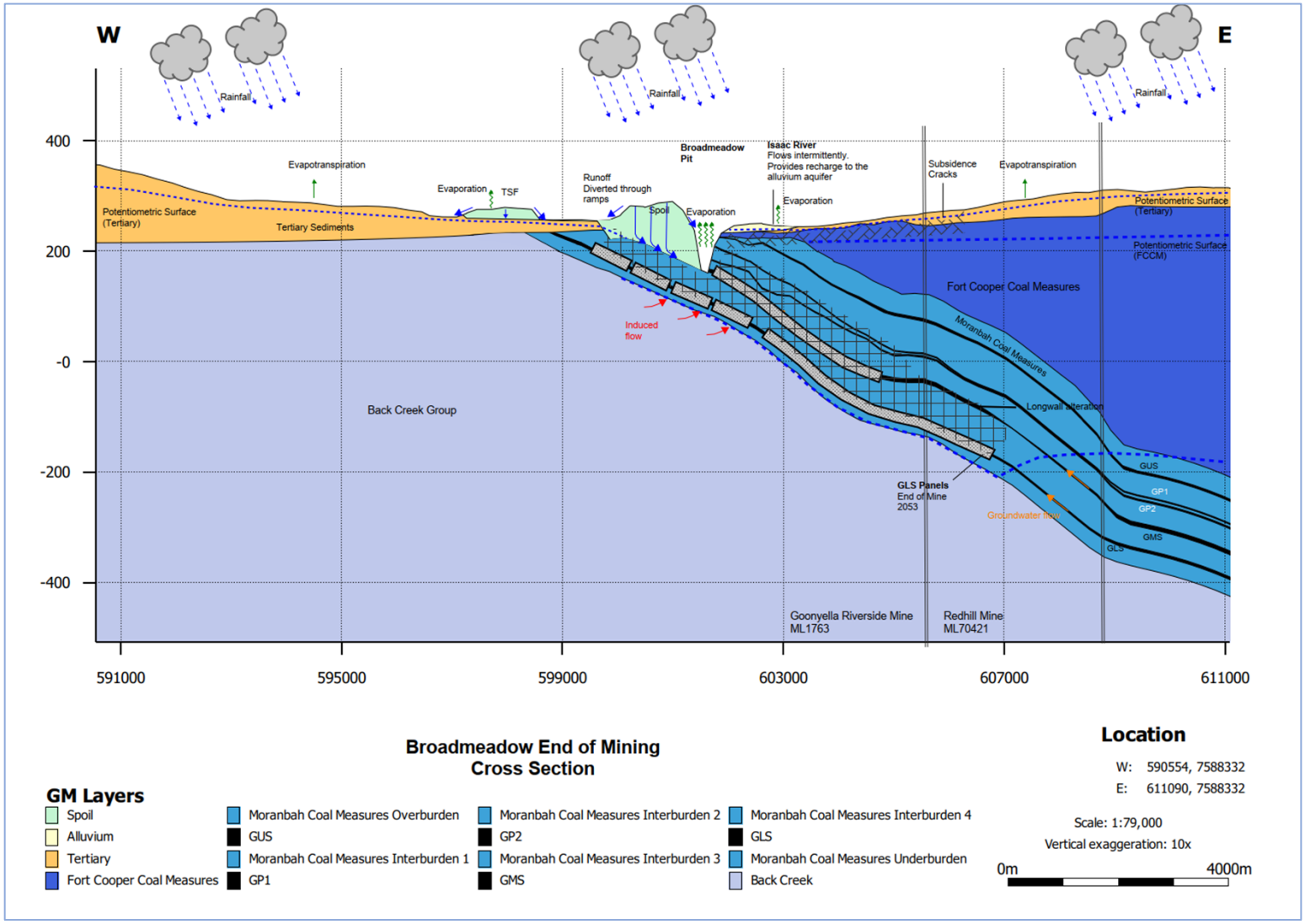

Figure 6: Conceptual site model of GRM and BRM at last day of mining (AECOM, 2024)

1.2.6 Soil types, properties and productivity

A number of baseline soil surveys have been undertaken at GRM and BRM. The soil information is detailed in the *Goonyella Riverside Mine Complex - Material Characterisation Study* (Landloch, 2024a), provided in Appendix E.

Based on the undisturbed topsoil characteristics, two soil management groups have been identified for rehabilitation: loam and clay topsoils. A summary of the Australian Soil Classification (ASC), soil management group, description and grazing land suitability class for the soil types are provided in Table 9. The soil mapping according to the ASC is shown in Figure 7 (some ASC categories identified in the pre-mining surveys listed in Table 9 are not shown as the spatial data was not available for this PRCP).

The pre-mining land suitability class of the soil types were assessed (GSS Environmental, 2011) in accordance with the *Guidelines for Agricultural Land Evaluation in Queensland* (DSITI & DNRM, 2015) classification system. This system allows for land to be allocated into five classes (with land suitability decreasing progressively from Class 1 to Class 5) which are derived from limitations that include soil type.

Table 9: GRM and BRM baseline soil types

Australian Soil Classification	Soil management group	Description	Land suitability class
Rudosol	Clay topsoil	Shallow rocky (skeletal) soils with a clay loam or clayey soil matrix associated with or underlain by shallow bedrock. Structurally stable with low potential for dispersion, generally of moderate salinity and strongly acidic.	3
Tenosol	Loam topsoil	Poor structure and loose sandy texture comprising deep (>1m) sand or silty sand grading to loamy or light clayey sand subsoils. Generally nondispersive and has low levels of salinity with a neutral pH.	4
Kandosol	Loam topsoil	Sandy loam surface to clay subsoils. The topsoil is non-dispersive to moderately dispersive, mainly non-saline to slightly saline.	2
Kurosol	Clay topsoil	Loamy surface duplex soil, acidic to strongly acidic dark brown heavy clay subsoil horizon. Moderately dispersive and slightly to moderately saline with a neutral pH.	5
Chromosol	Loam topsoil	Sandy and loamy surface duplex soils, non-sodic to marginally sodic sandy clay or medium to heavy clay subsoils. The topsoil is structurally stable with a low potential for dispersion. Most topsoil is non-saline although can be slightly saline and is slightly acidic to moderately alkaline.	2
Sodosol	Loam topsoil	Medium to deep hard-set loamy surface duplex soils, light medium to heavy clay deep subsoils. The topsoil is non-dispersive to moderately dispersive, is generally moderately saline, and is generally neutral with some instances moderately acidic.	3
Dermosol	Clay topsoil	Hard-set or thin weak self-mulching clay loam to medium clay surface horizon. Non-dispersive to moderately dispersive, is non-saline and varied from slightly acidic	3

Australian Soil Classification	Soil management group	Description	Land suitability class
		to moderately alkaline, with occasionally high gravel content.	
Vertosol	Clay topsoil	Cracking clay soils with self-mulching surface soils (often weak). The topsoil is mainly non-dispersive, occasionally moderately dispersive.	3

Table 10 summarises the chemical and physical parameters of the undisturbed soil management groups at GRM and BRM (GSS Environmental, 2011). Clay topsoils are neutral to moderately alkaline in pH, have non-saline electrical conductivity (EC) and moderate cation exchange capacity (CEC). Loam topsoils are slightly acidic to neutral in pH, have EC which is non-saline and a low to very low CEC.

Table 10: Summary of chemical properties of undisturbed GRM and BRM soils

Analysis (unit)	Soil management group and ASC			
	Clay soils		Loam soils	
	Brown kurosol (0 – 15cm)	Brown dermosol (0 – 10cm)	Red kandosol (0 – 20cm)	Brown kandosol (0 – 5cm)
Soil pH	7.2	8.3	6.3	6.8
Soil ECe (%)	0.34	0.80	0.30	0.38
CEC (meq/100g)	14.8	20.6	4.5	8.5
Exchangeable sodium percentage (ESP) (%)	9	2	4	0
Emerson Aggregate Test #	3(3)	2(3)	3(2)	5

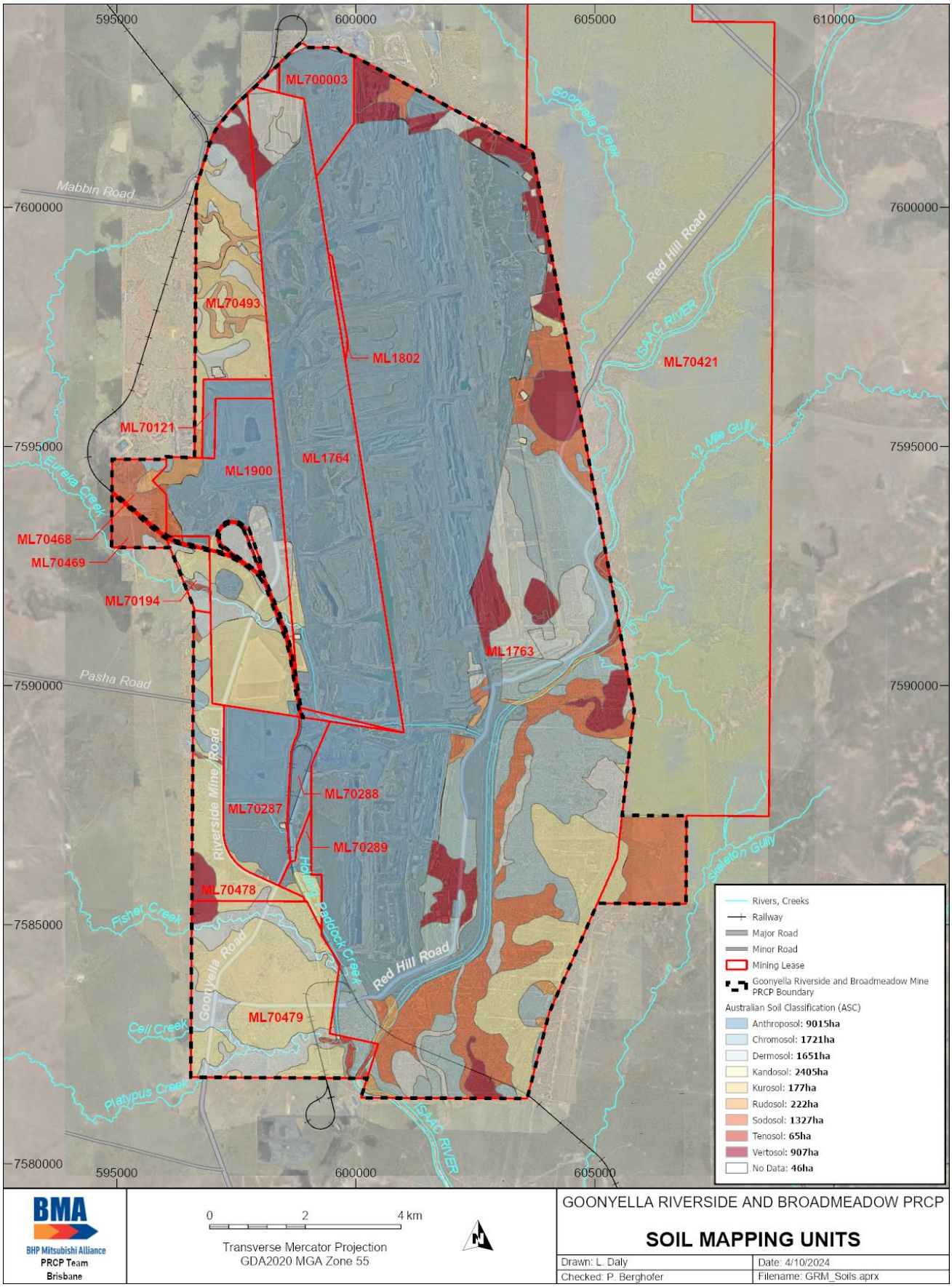

Figure 7: GRM and BRM soil mapping units (ASC)

1.2.7 Land stability

The pre-mining topography at GRM and BRM was generally flat to undulating and is consistent with the regional landscape. Non-mined land adjacent to GRM and BRM and within the Bowen Basin indicates surface erosion is common upon disturbance of soils and vegetation from cattle grazing and other land uses.

1.2.8 Vegetation communities and ecological data

A number of ecological assessments of vegetation communities and ecological values have been undertaken within the GRM and BRM site including:

- Goonyella Riverside Mine, Broadmeadow Mine and Red Hill Mine Ecology Assessment (ELA, 2023)
- Goonyella-Riverside Mine Terrestrial Ecology Survey Report (Engeny, 2023)
- Red Hill Mining Lease Environmental Impact Statement – Section 09 Terrestrial Ecology (BMA, 2013c)
- Biodiversity and Threatened Species Action Plan for Goonyella Riverside Mine (EcoServe and LAMR, 2006)

The results of the ecological assessments and desktop searches of the following ecological databases have been used to determine the vegetation communities and ecological values of the GRM and BRM site, as well as the fauna presence and habitats (Section 1.2.9):

- Wildlife Online Database (DESI, 2024c)
- Regional ecosystem mapping (DESI, 2024d)
- Matters of State Environmental Significance mapping (DESI, 2024e)
- Maps of environmentally sensitive areas (DESI, 2024f)

It is important to note that vegetation clearing and disturbance activities approved within the GRM and BRM site may have occurred since the previous ecological assessments.

1.2.8.1 Regional ecosystems

Regional ecosystem (RE) mapping for GRM and BRM is based on the results of ground-truthed vegetation surveys and mapping undertaken as part of previous ecological assessments (ELA, 2023; Engeny, 2023). The remnant vegetation cover on GRM and BRM has been altered over time because of clearing for agricultural land use purposes prior to mining and clearing for approved mining activities. The remaining areas of remnant and high value regrowth vegetation have been mapped in patches along the western edge of the site, as well as larger patches over the BRM underground operations.

The ground-truthed remnant, high value regrowth and regrowth REs mapped on GRM and BRM are listed in Table 11, with their associated *Vegetation Management Act 1999* (VM Act) class and biodiversity status, and are shown in Figure 8. The prevalent ground-truthed REs within GRM and BRM are RE 11.5.3, RE 11.4.9, RE 11.5.9, RE 11.4.8, RE 11.3.2 and RE 11.7.2.

Table 11: Regional ecosystems within GRM and BRM

RE descriptions	RE Code	VM Act class	Biodiversity status
Acacia harpophylla and/or *Casuarina cristata* open forest on alluvial plains	11.3.1	Endangered	Endangered
Eucalyptus populnea woodland on alluvial plains	11.3.2	Of concern	Of concern
Eucalyptus camaldulensis (sometimes *E. populnea* and/or *E. tereticornis)* woodland in drainage depressions	11.3.2b	Of concern	Of concern

RE descriptions	RE Code	VM Act class	Biodiversity status
Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	11.3.25	Least concern	Of concern
Eucalyptus tereticornis and/or *Eucalyptus* spp. woodland on alluvial plains	11.3.4	Of concern	Of concern
Corymbia tessellaris woodland. On alluvial sandridges to elevated levees and level terraces adjacent to larger stream channels which are irregularly flooded or possibly relict	11.3.4a	Of concern	Of concern
Eucalyptus cambageana woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	11.4.8	Endangered	Endangered
Acacia harpophylla shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	11.4.9	Endangered	Endangered
Eucalyptus populnea and/or *E. melanophloia* and/or *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	11.5.3	Least concern	No concern at present
Eucalyptus crebra and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and/or remnant surfaces	11.5.9	Least concern	No concern at present
Acacia harpophylla and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E. microcarpa* woodland on lower scarp slopes on Cainozoic lateritic duricrust	11.7.1	Least concern	Of concern
Acacia spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	11.7.2	Least concern	No concern at present
Eucalyptus melanophloia woodland to open woodland on Cainozoic igneous rocks	11.8.4	Least concern	No concern at present
Dichanthium sericeum grassland on Cainozoic igneous rocks	11.8.11	Of concern	Of concern
Acacia harpophylla-Eucalyptus cambageana woodland to open forest on fine-grained sedimentary rocks	11.9.1	Endangered	Endangered
Acacia harpophylla and/or *Casuarina cristata* open forest to woodland on fine-grained sedimentary rocks	11.9.5	Endangered	Endangered

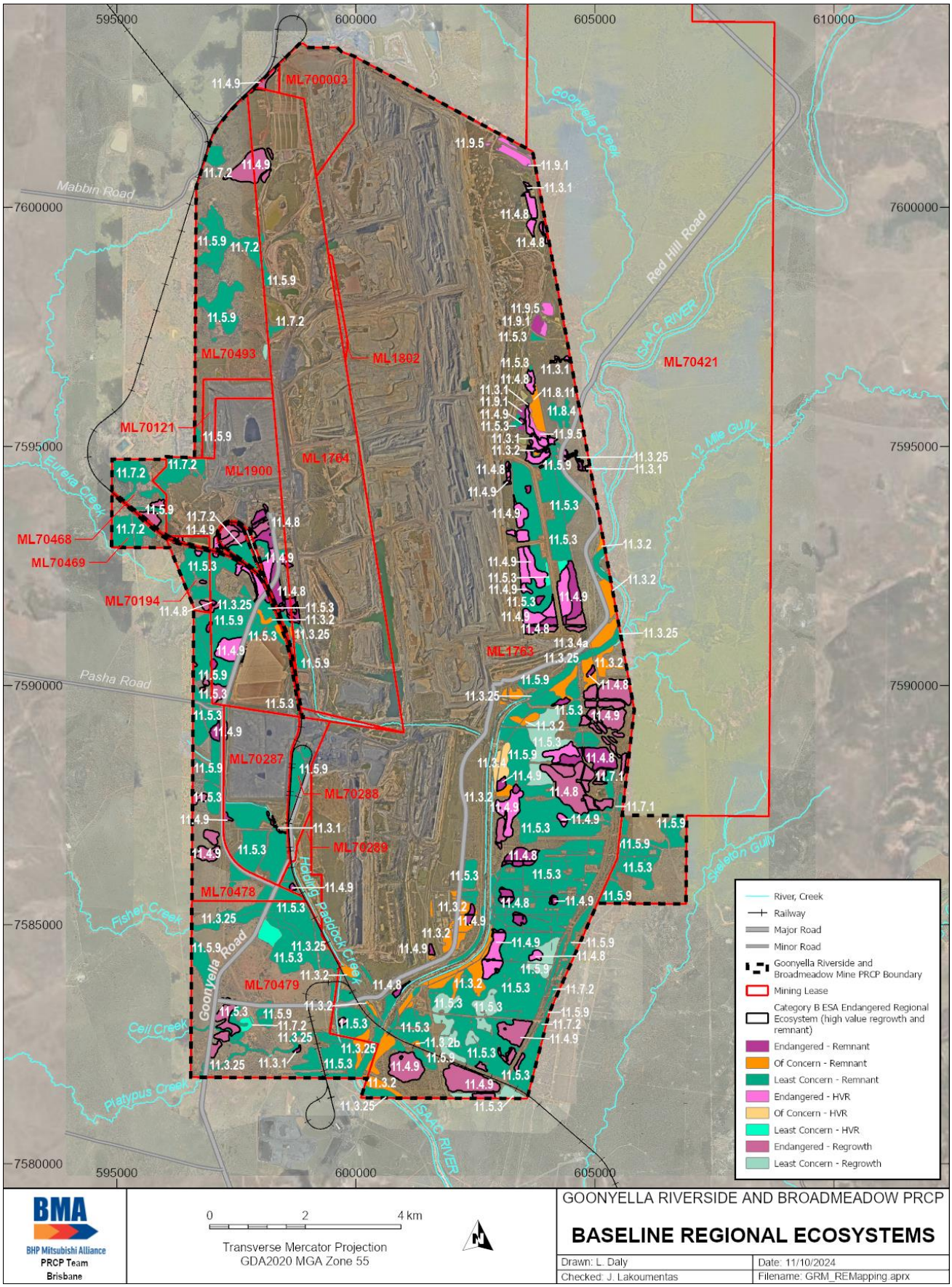

Figure 8: GRM and BRM regional ecosystems

1.2.8.2 Environmentally sensitive areas

Category B environmentally sensitive areas are defined under Schedule 19 of the *Environmental Protection Regulation 2019* to include Endangered REs based on the biodiversity status in the 'Regional ecosystem description database' (Queensland Herbarium , 2024).

The following REs with a current Endangered biodiversity status have been ground-truthed on GRM and BRM in association with Category B environmentally sensitive areas (ELA, 2023) (Figure 8):

- RE 11.3.1 *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
- RE 11.4.8 *Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains
- RE 11.4.9 *Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains
- RE 11.9.1 *Acacia harpophylla-Eucalyptus cambageana* woodland to open forest on fine-grained sedimentary rocks
- RE 11.9.5 *Acacia harpophylla* and/or *Casuarina cristata* open forest to woodland on fine-grained sedimentary rocks

1.2.8.3 State significant flora species

One state significant flora species under the *Nature Conservation Act 1992* (NC Act) has been recorded and is known to occur on GRM and BRM based on the results of ecological surveys:

- King blue grass *(Dichanthium queenslandicum*) (Vulnerable NC Act) (Engeny, 2023)

Numerous *Dichanthium queenslandicum* individuals forming a local and discrete population were recorded in the natural grassland vegetation community RE 11.8.11. (Engeny, 2023) (Figure 8).

1.2.9 Fauna presence and populations

1.2.9.1 State significant fauna species

The following threatened fauna species under the NC Act are known to occur on GRM and BRM based on the results of ecological surveys:

- Greater glider (*Petauroides volans*) (Endangered NC Act) (BMA, 2013c; ELA, 2023)
- Ornamental snake (*Denisonia maculata*) (Vulnerable NC Act) (BMA, 2013c; ELA, 2023)
- Squatter pigeon (southern) (*Geophaps scripta scripta*) (Vulnerable NC Act) (EcoServe and LAMR, 2006; BMA, 2013c; ELA, 2023)
- Australian painted snipe (*Rostratula australis*) (Endangered NC Act) (ELA, 2023)
- Sharp-tailed sandpiper (*Calidris acuminata*) (Vulnerable NC Act) (ELA, 2023)
- Marsh sandpiper (*Tringa stagnatilis*) (Special least concern NC Act) (ELA, 2023)
- Glossy ibis (*Plegadis falcinellus*) (Special least concern NC Act) (ELA, 2023)
- Short-beaked echidna (*Tachyglossus aculeatus*) (Special least concern NC Act) (EcoServe and LAMR, 2006; BMA, 2013c; ELA, 2023)

The greater glider has been recorded within *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines associated with RE 11.3.25 (ELA, 2023). The greater glider habitat predominantly consists of *Eucalyptus* spp. forests and woodlands fringing riparian corridors and flood plains, with hollow bearing trees associated with the Isaac River (BMA, 2013c; ELA, 2023) (Figure 9).

The ornamental snake has been recorded along Fisher Creek within GRM and BRM (ELA, 2023). Preferred habitat for the ornamental snake has been mapped in Figure 10 in association with areas with gilgai depressions and cracking clays (typically RE 11.4.8 and RE 11.4.9), as well as creek lines given their importance for habitat connectivity and species mobility between a highly fragmented landscapes (ELA, 2023).

Squatter pigeon has been detected on GRM and BRM during previous ecological surveys, with multiple species recorded during the recent 2023 survey (EcoServe and LAMR, 2006; BMA, 2013c; ELA, 2023). Squatter pigeon are ground-dwelling birds, predominantly foraging on seeds from grasses and tend to inhabit the grassy understorey of eucalypt woodlands and open grass areas including regrowth and modified areas such as paddocks (ELA, 2023). Squatter pigeons require access to permanent waterbodies for drinking, either natural or man-made, as long as there is bare ground at the water's edge. Squatter pigeon habitat has been mapped on GRM and BRM in association with remnant and regrowth eucalypt dominated REs within 1km of suitable water sources, including larger watercourses and waterbodies that hold pools of water for extended periods (Figure 11).

There have been no direct observations of the Australian painted snipe on GRM and BRM (ELA, 2023). However, the species was identified as known to occur as there have been several records within 50km of the site, including one undated historical record located within the RHM on the floodplains of the Isaac River (ELA, 2023). Suitable wetland habitat for the Australian painted snipe may be available in small areas within GRM and BRM where RE 11.3.2b has been identified. Areas with the presence of deep gilgai impressions and cracks (RE 11.4.8 and RE 11.4.9) are more likely to host suitable seasonal habitat in which the species may forage (ELA, 2023) (Figure 10).

Sharp-tailed sandpiper, marsh sandpiper and glossy ibis were observed in wetlands in the north-west of the site during post-wet season surveys in March 2022 (ELA, 2023). All species are known to occur in a variety of inland habitats, from muddy edges of shallow wetlands, permanent or ephemeral wetlands, swamps, lagoons, floodplains, marshes at the edge of lakes or wet meadows (ELA, 2023).

Short-beaked echidna has been recorded on GRM and BRM during previous ecological surveys (EcoServe and LAMR, 2006; BMA, 2013c; ELA, 2023). This species occurs in a wide range of habitats and is likely to occupy remnant and regrowth habitats within the site (Figure 8).

No observations of the koala have been recorded on GRM and BRM (ELA, 2023; Engeny, 2023), however the species was recorded within poplar box (*Eucalyptus populnea*) woodland in the mid-west of the RHM site (BMA, 2013b). Koala has been identified as likely to occur at GRM and BRM as suitable habitat associated with poplar box woodlands and red gum (*E. camaldulensis*) riparian woodlands exist for this species (BMA, 2013c). The eastern side of GRM and BRM has a higher connectivity with the Isaac River, with large tracts of eucalypt woodlands (RE 11.3.25) providing potential habitat for the koala (ELA, 2023) (Figure 9).

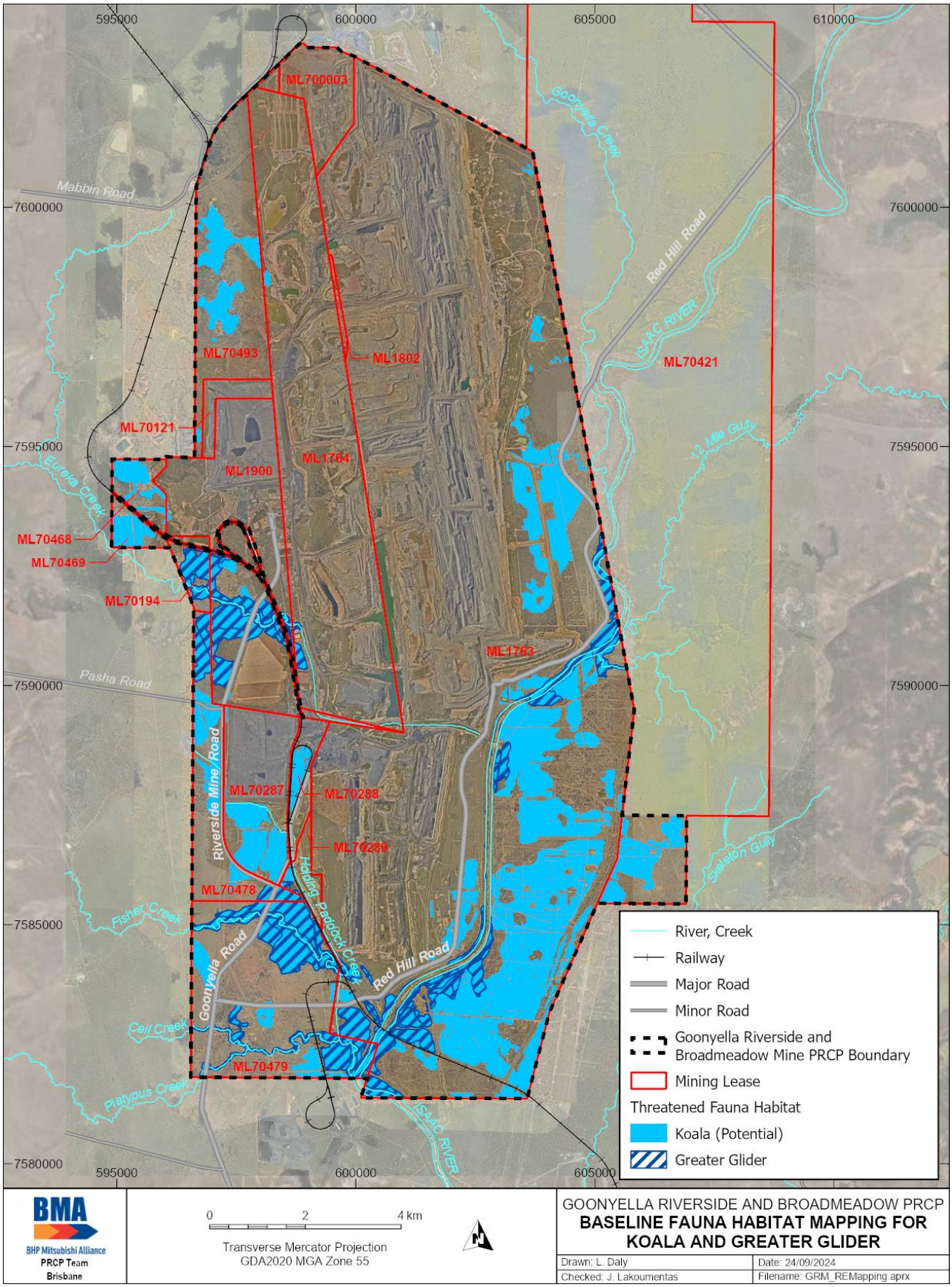

Figure 9: GRM and BRM fauna habitat mapping for koala (potential) and greater glider

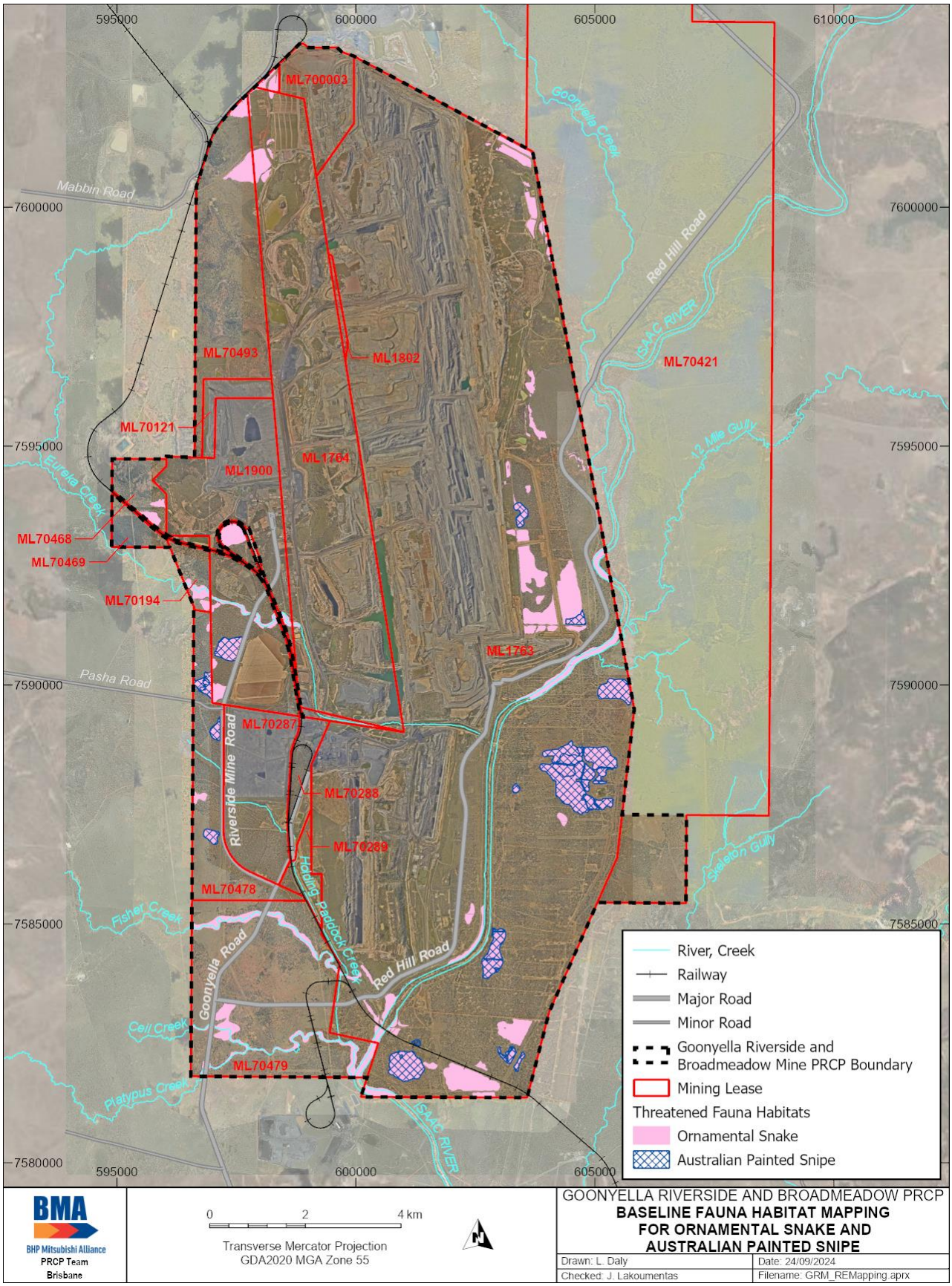

Figure 10: GRM and BRM fauna habitat mapping for ornamental snake and Australian painted snipe

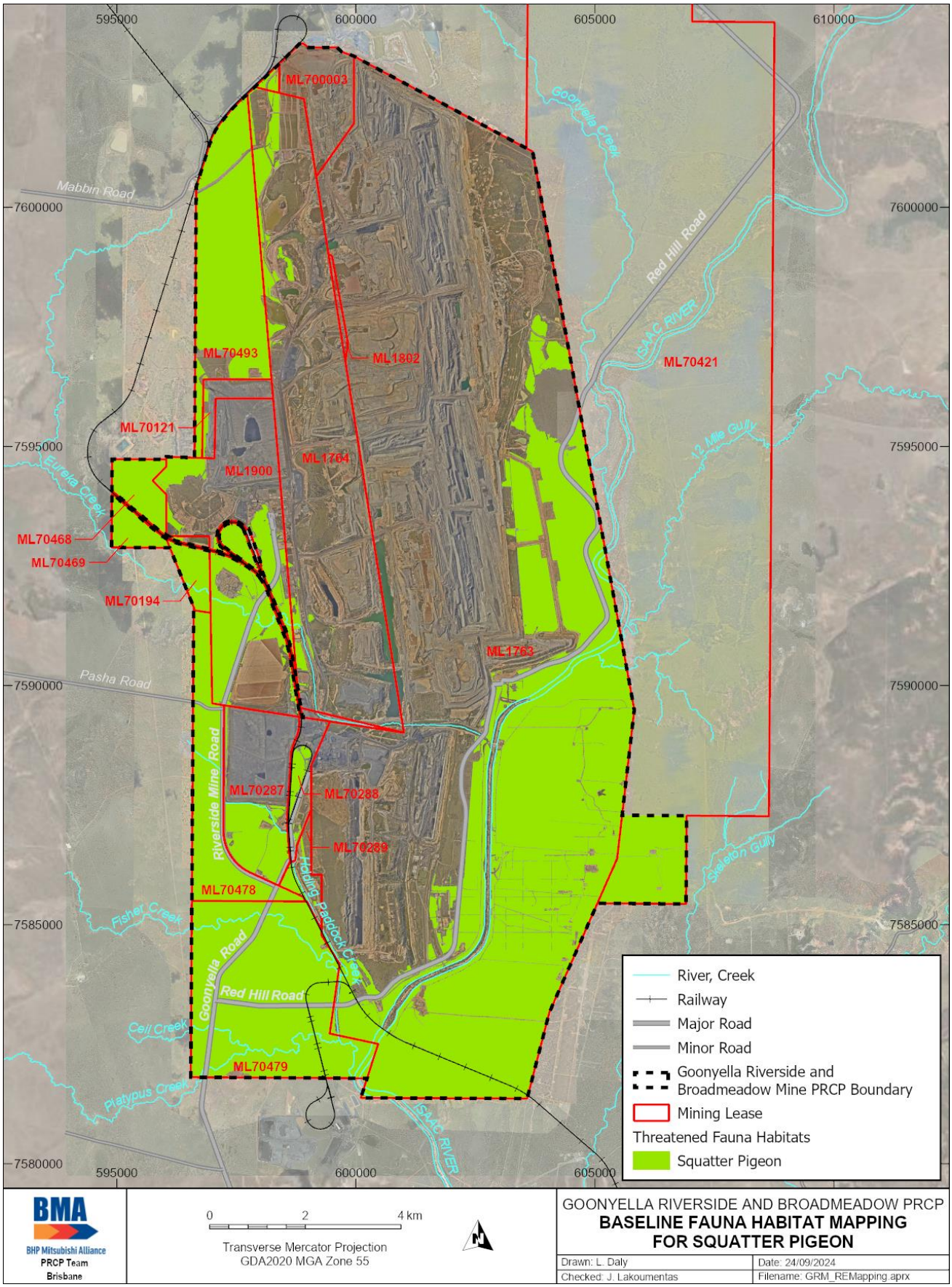

Figure 11: GRM and BRM fauna habitat mapping for squatter pigeon

1.2.10 Pre-mining land use

Prior to mining, the GRM and BRM site was predominately used for low intensity cattle grazing, resulting in extensive tree clearing over most of the area.

1.2.11 Contaminated land

Mining operations at GRM commenced in 1971, prior to the inclusion of modern environmental legislative requirements and standards. Therefore, pre-mining baseline contaminated land data and records pertaining to historical environmental incidents/management from the earlier GRM operations are not available.

Operations at GRM and BRM since the commencement of mining/exploration have included heavy industrial type activities and supporting infrastructure including:

- Drilling/exploration
- Extraction and processing of coal
- Chemical storage and formulation
- Waste storage and disposal
- Sewage treatment
- Operation of a variety of plant/equipment workshops and scrap yards
- Petroleum product storage and dispensing
- Explosive production, storage and use
- Operation of regulated structures, such as TSFs and other dams

The nature of these types of operations, which include the storage, handling, use and disposal of hazardous materials, have the potential to result in the contamination of land. Properties (Lot 411 SP285383, Lot 3 RP852526, Lot 5 RP852533, Lot 16 SP235299, Lot 10 SP235299, Lot 2 SP138791, Lot 2 CP90795, Lot 14 CP84639, Lot 200 SP259127, Lot 20 SP235298, Lot 18 SP208194, Lot 19 SP156188, Lot 171 SP23759 and Lot 2 CP907954) on which the GRM and BRM EA is located, have been identified as being listed on the Queensland Environmental Management Register for a range of notifiable activities including:

- Landfill
- Mine wastes
- Petroleum product or oil storage
- Livestock dip or spray race
- Abrasive blasting
- Chemical storage

At the time of the contaminated land searches (August 2021), the searched properties were not listed on the Queensland Contaminated Land Register and did not have Site Management Plans attached to the register listings.

The current GRM and BRM EA provides for the conditional on-site disposal of various wastes in voids, regulated structures, dedicated reject dumps, spoil dumps and in-situ below ground including:

- Rejects and tailings
- Sediment containing hydrocarbons
- Bulk rubber
- Inert waste
- Poly-pipe and other plastic
- Fibreglass
- Treated and untreated timber

- Asphalt
- Asbestos
- Treated sewage effluent
- Co-mingled hydrocarbons
- General wastes

Within ML1763, and in accordance with the EA, the site operates a general waste landfill. The EA also allows for the receipt of the above listed wastes from other BMA sites in Queensland.

Current management of contaminated land is undertaken in accordance with the EP Act and the EA conditions that require the reporting of releases of hazardous contaminants and monitoring of surface water, sediment and groundwater on a regular basis. Based on the long-term operation of heavy industrial activities and waste disposal at the site, it is anticipated that management of contaminated land will be required post-mining.

1.2.12 Underlying landholders

The GRM and BRM site comprises a combination of freehold and leasehold land owned held by BMA and/or related companies. Other freehold land holdings within the MLs include:

- Centurion Coal Mining Pty Ltd
- Private landowners
- State of Queensland
- Aurizon Network Pty Ltd (Goonyella Railway)
- Powerlink
- Isaac Regional Council (IRC)

The underlying landholders for GRM and BRM are illustrated in Figure 12.

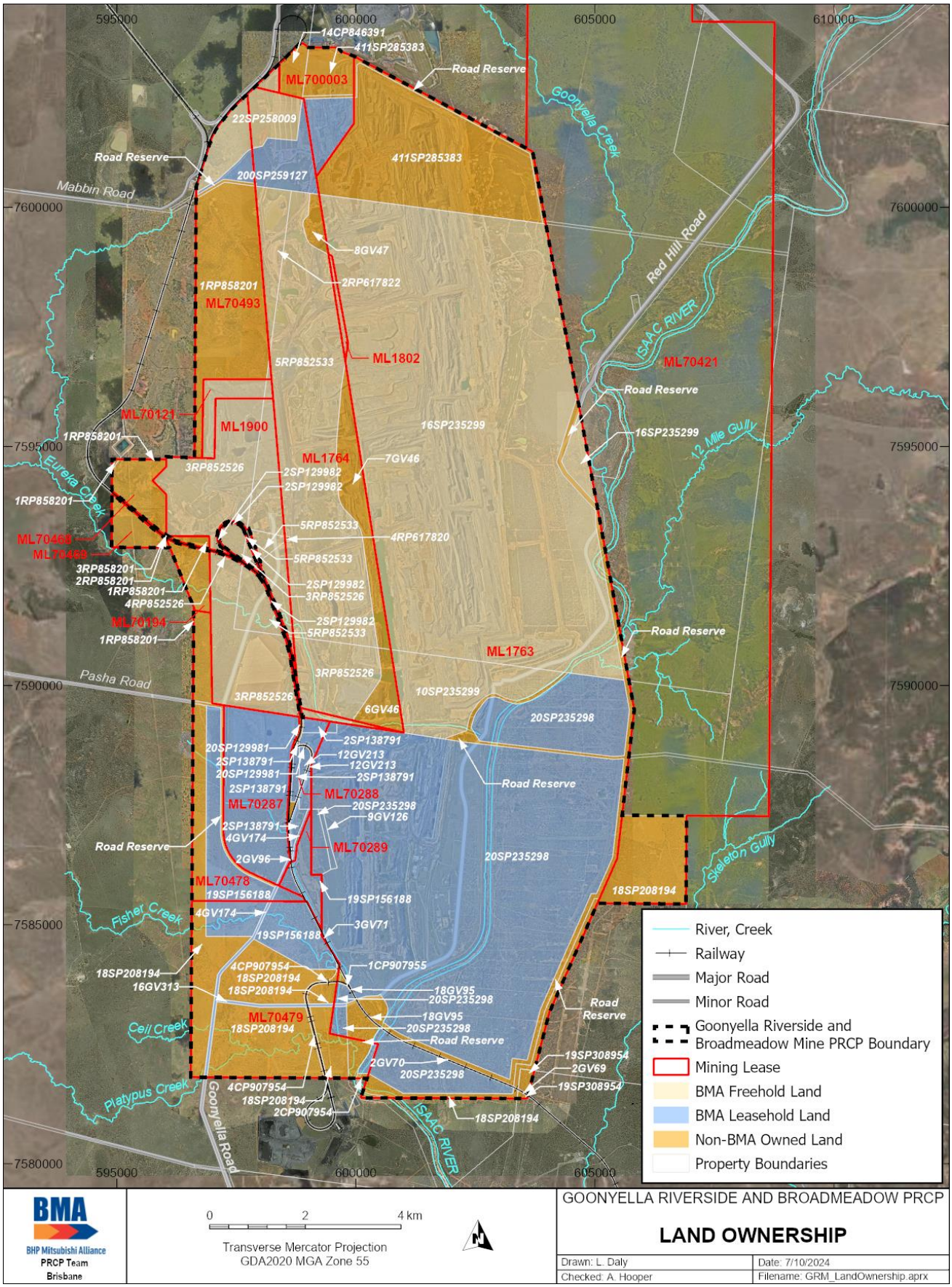

Figure 12: GRM and BRM land ownership

1.2.13 Sensitive receptors

The EP Act and PRCP Guidelines do not define 'sensitive receptor'. In the context of the PRCP, BMA define a sensitive receptor post-mining as any of the following (within the EA boundary):

- Residential building, for example dwelling, residential premise, or homestead
- Sensitive place for humans: educational institution, childcare, medical centre/health care or hospital
- Conservation or protected area
- QLD Aboriginal and Torres Strait Islander Cultural Heritage Register location/area
- Groundwater bore with supply/stock water use
- Waterway ecosystem
- Groundwater dependent ecosystem.

Sensitive receptor locations within the GRM and BRM EA boundary include waterway ecosystems (i.e. Isaac River, Eureka Creek, Holding Paddock Creek, Fisher Creek, Ceil Creek and Platypus Creek). Sensitive receptors were considered when planning the PMLUs, as well as the water management and revegetation rehabilitation and management methodologies.

1.3 Design for closure

As this PRCP for GRM and BRM is subject to transitional PRCP arrangements, it is not required to demonstrate how aspects of the mine site have been designed for closure for existing or approved disturbance (PRCP Guideline, Section 3.1).

However, this PRCP has been developed to manage progressive rehabilitation of the GRM and BRM site, aiming to minimise long-term management requirements as well as associated closure costs. Importantly, a focused design for closure underpins all sections of this plan, including:

- Engagement with relevant stakeholders presenting transitional PMLUs and NUMAs
- Defining and implementing rehabilitation practices based on scientific studies and data, as well as identified risks that could influence achievement of milestone criteria
- Demonstrating a successful rehabilitation trajectory towards achievement of these milestone criteria by ongoing site monitoring and maintenance

1.4 Rehabilitation and improvement planning

Legislative Requirement

In accordance with sections 126C(1)(b) and (c)(ii) of the EP Act, the rehabilitation planning part must include:

- *identification of all relevant activities on the mine site*
- *the predicted duration of each of the relevant activities proposed for the mine site*
- *the size/extent of the relevant activities*
- *whether the different relevant activities can be progressively rehabilitated.*

PRC Plan Guideline (Section 3.1)

Under section 126C(1)(j) of the EP Act, transitional PRC Plans must also include the following details about any existing rehabilitation already completed at the time of submission of the proposed PRC Plan:

- *a description of the rehabilitation works previously carried out*
- *when the rehabilitation works commenced and were completed*
- *whether the rehabilitation has been applied for or approved as progressively certified under the EP Act.*

1.4.1 Rehabilitation areas and relevant activities

The RAs included in the PRCP schedule for GRM and BRM are referred to throughout this PRCP. A RA is defined in the PRCP Guideline "*as an area of land in the post-mine land use to which a rehabilitation milestone for the post-mining use relates*".

The GRM and BRM RAs, as well as the relevant activities associated with each RA, are detailed in Table 12 and shown in Figure 29. As required by the PRCP Guideline, only PMLU areas where disturbance has occurred or will occur, is mapped as a RA. Areas along the western side of the site and undisturbed watercourse areas that are expected to remain undisturbed throughout the mine life are therefore not mapped as a RA.

The undisturbed area within the cultural heritage site known as Area 4 (Section 1.1.3), is also not mapped as a RA. Areas within Area 4 that were previously disturbed and require rehabilitation have been included in RA4.

To support ongoing operations, exploration and minor ancillary activities may be required in areas not mapped as a RA. Minor ancillary activities can occur without a PRCP amendment and may include roads, access tracks and culverts, fences, underground services, low-impact telecommunication facilities, electrical sub-stations and switch yards, transmission grid works and supply network works, storage depots, pipelines and pumps, groundwater bores, gas drainage bores, monitoring and investigation works and exploration activities (as agreed with the administering authority and included as a condition in the Saraji Mine PRCP schedule). Disturbance must be rehabilitated in accordance with the provisions detailed in *the Eligibility criteria and standard conditions for exploration and mineral development projects* (DEHP, 2016) or its successor, with the exception that land must be rehabilitated to a stable condition and achieve the proposed PMLU.

The predicted duration of the relevant activities, size and availability for progressive rehabilitation, are provided in Table 12. Any infrastructure that is beneficial to the PMLU may be retained and will not be available for rehabilitation.

Table 12: Relevant activities requiring rehabilitation at GRM and BRM

Relevant Activity	Predicted duration	Area (ha)	Availability for progressive rehabilitation
RA1 – Woodland habitat PMLU			
Spoil dumps	Active dumping of spoil to spoil dumps will continue until the end of open cut mining in 2059 Active dumping of rejects within spoil dumps will continue until the end of coal processing in 2092 Rehabilitation of final spoil dumps to revegetation is complete in 2103	5,557	• Progressive rehabilitation has commenced • Available for progressive rehabilitation once dump areas reach final position and settle, and are no longer required for associated infrastructure, access requirements, or to support RHM operations • Due to the depth of the mining operation and the size of the spoil dumps, areas become available as per the indicative dump progression shown in Figure 13 • Progressive rehabilitation is maximised by scheduling rehabilitation as soon as practicable after land becomes available • Low-wall areas become available once mining in each pit is complete or voids are no longer required to support mining operations • Some spoil areas will continue to be utilised for access to RHM and for RHM rejects dumping. These areas are

Relevant Activity	Predicted duration	Area (ha)	Availability for progressive rehabilitation
			available for rehabilitation once RHM mining and coal processing is complete • 70% of the total spoil dump area will be rehabilitated to revegetation by the end of mining at GRM
RA2/RA11 – Watercourse PMLU			
Watercourse diversions and crossings	Varying: with the latest utilised until the end of major rehabilitation activities in 2096 Rehabilitation of final watercourse areas to revegetation is complete in 2100	422	• Dependent on the location in relation to mining and closure activities and after subsidence (Isaac River): typically, crossings will be available for rehabilitation at the end of mining, coal processing or major rehabilitation activities • Holding Paddock Creek diversion, Fisher Creek diversion, Platypus Creek crossings and Celi Creek crossings are available at the end of mining and major rehabilitation at GRM (2061) • The majority of the Isaac River is available for rehabilitation post realisation of final subsidence (with RA11) (2057) and minor areas at the end of mining and major rehabilitation at RHM (2097) • Due to the proximity to the access corridor to RHM, Eureka Creek diversion is available for rehabilitation at the end of mining and major rehabilitation at RHM (2097)
RA3 – Cattle grazing PMLU			
CHPP and associated infrastructure; coal stockpiles	Utilised until the end of coal processing and train loading in 2096 Rehabilitation of final areas to revegetation is complete in 2122	1,286	• Available for rehabilitation in 2097 once coal processing of RHM coal is complete
Train load-out; associated infrastructure; and rail line (BMA owned)			• Available for rehabilitation in 2097 once coal loading of RHM coal is complete
Workshop; buildings and other infrastructure areas	Varying: with the latest utilised until the end of major rehabilitation activities in 2096 Rehabilitation of final areas to revegetation is complete in 2122		• Dependent on the use and location, or unless deemed beneficial to be retained for the PMLU: typically areas will be available for rehabilitation either at the end of mining or coal processing or after the major rehabilitation activities are complete (2096). Some areas will be available for rehabilitation at the end of GRM and BRM, with the remaining areas available at the end of RHM.

Relevant Activity	Predicted duration	Area (ha)	Availability for progressive rehabilitation
Mine dams			• Available for rehabilitation when no longer required for water management
Roads; laydown and general disturbance			• Dependent on the use and location, or unless deemed suitable to be retained for the PMLU: typically areas will be available for rehabilitation either at the end of mining (2061), coal processing (2097) or after the major rehabilitation activities are complete (2067). Some areas will be available for rehabilitation at the end of GRM and BRM, with the remaining areas available at the end of RHM.
RA4 – Woodland habitat PMLU			
Roads; laydown and general disturbance	Varying: with the latest utilised until the end of major rehabilitation activities in 2096 Rehabilitation of final areas to revegetation is complete in 2112	1,165	• Dependent on the use and location, or unless deemed suitable to be retained for the PMLU: typically areas will be available for rehabilitation either at the end of mining (2061), coal processing (2097) or after the major rehabilitation activities are complete (2067). Some areas will be available for rehabilitation at the end of GRM and BRM, with the remaining areas available at the end of RHM.
RA6 – Grassland PMLU			
Rejects	Active dumping of rejects will continue until the end of coal processing in 2096 Rehabilitation of final rejects areas to revegetation is complete in 2125	400	• Available for progressive rehabilitation after dump areas reach final position and settle, and are no longer required for associated infrastructure or access requirements • Rejects area available for rehabilitation now will be rehabilitated as soon as practicable once additional data is sourced for modelling and to develop the detailed cover design
RA7 – Cattle grazing PMLU / RA10 – Woodland habitat PMLU			
Existing rehabilitation		293	• Reshaping, growth media application and some revegetation activities have progressed
RA9 – Grassland PMLU			
Tailings storage facilities (TSFs)	Varying, depending on status and location Rehabilitation of final TSF areas to revegetation is complete in 2133	872	• GS1 TSF is available for rehabilitation now and will be rehabilitated as soon as practicable once the tailings are sufficiently dried out and in-situ strength profiles can be safely measured, along with sourcing of additional geochemical

Relevant Activity	Predicted duration	Area (ha)	Availability for progressive rehabilitation
			and geotechnical data to develop the detailed cover design • RS1 TSF is being covered with rejects and will be available for progressive rehabilitation when rejects placement is complete in 2062 • DRE5 and R32 will be available for rehabilitation once planned dumping of spoil above each TSF reaches the final spoil dump position and the area is no longer required for associated infrastructure or access requirements
RA20 – Cattle grazing PMLU / RA21 – Woodland habitat PMLU			
Underground mining subsidence	Final subsidence will be realised after flooding of the underground workings, complete within 5 years of final mining (BRM – 2056; RHM – 2096) Rehabilitation of final subsidence to revegetation is complete in 2102	2,513	• Available for initial operational repair of cracks and drainage works progressively during mining operations once the initial subsidence of GMS panels occurs and again once the initial subsidence of GLS panels occurs • Rehabilitation is scheduled after underground workings are flooded at the end of mining, once final subsidence is complete within 5 years of final mining
Underground mining infrastructure: ventilation shafts, gas drainage infrastructure; service infrastructure	Varying: with the latest utilised until the end of underground mining and final subsidence (BRM – 2056; RHM – 2096) Rehabilitation of final areas to revegetation is complete in 2102		• Infrastructure is available for removal once no longer required to support underground mining operations. Dependent on the use and location, this may be once mining in the associated longwall panel is complete or at the end of underground mining • Final rehabilitation of the underlying area is scheduled once final subsidence is complete after flooding of underground workings at the end of mining
Other			
Exploration; minor ancillary activities	Throughout the operational life		• Available for rehabilitation once activities are complete
IA1 – NUMA			
Residual voids (NUMAs)	Utilised until the end of mining each pit, or water storage or underground access Management of final void areas to surface	2,297	• Broadmeadow and Isaac residual voids will be available for improvement once closure of BRM undergrounds is complete in 2051 • Goonyella Pit residual void will be available for improvement once closure of RHM undergrounds is complete in 2091

Relevant Activity	Predicted duration	Area (ha)	Availability for progressive rehabilitation
	requirements is complete in 2094		• Thiess Pit residual void will be available for improvement at the end of mining at RHM in 2091 when it is no longer utilised as water storage • R32 South residual void will be available for improvement in 2060 when it is no longer utilised as water storage for GRM • All other residual voids are available for improvement once the PMLU low-wall spoil rehabilitation is complete for each pit and any partial backfill for flood mitigation is complete

Note: BMA uses a consistent set of RAs across their assets, and as such some RA numbers are not relevant at GRM and BRM

Further details on the availability of areas for progressive rehabilitation are included in Section 1.4.5. Non-BMA owned infrastructure is not covered in the PRCP.

1.4.1.1 EA progressive rehabilitation conditions

The GRM and BRM EA includes the following condition regarding the commencement of progressive rehabilitation:

- E4: "*Progressive rehabilitation must commence within two (2) years of when areas become available within the mining leases*."

All areas are included in the PRCP schedule for rehabilitation as soon as practicable after land becomes available. For infrastructure and general disturbance areas, rehabilitation is scheduled the year after the land becomes available to allow for final planning. Spoil dump areas are scheduled within two years after land becomes available to allow for final settlement, planning and availability of resources (as per EA condition E4). Subsidence areas are scheduled within a year of becoming available for rehabilitation, which is once final subsidence is realised after flooding of the underground workings occurs (complete within five years after final mining). This ensures final settlement of the overburden and subsequent surface cracking has occurred prior to final rehabilitation. Operational compliance activities, including initial crack repairs and drainage works of subsidence areas, will be undertaken progressively during operations as panels are mined.

1.4.2 Rehabilitation milestones

The RMs included in the PRCP schedule for GRM and BRM are referred to throughout this PRCP. A RM is defined in the PRCP Guideline as "*each significant event or step necessary to rehabilitate the land to a stable condition (section 112 of the EP Act)*". The RMs are detailed in Table 13.

Table 13: Rehabilitation milestones for GRM and BRM

RM	RM name
RM1	Infrastructure decommissioning and removal
RM2	Remediation and/or management of contaminated land
RM3	Landform development and reshaping
RM4	Surface preparation (cattle grazing, grassland)
RM5	Surface preparation (woodland habitat)

RM	RM name
RM6	Surface preparation (watercourse)
RM7	Revegetation (cattle grazing, grassland)
RM8	Revegetation (woodland habitat)
RM9	Revegetation (watercourse)
RM10	Achievement of surface requirements (cattle grazing)
RM11	Achievement of surface requirements (woodland habitat)
RM12	Achievement of surface requirements (watercourse)
RM13	Achievement of post-mining land use to a stable condition (cattle grazing – RA3, RA7, RA20)
RM14	Achievement of post-mining land use to a stable condition (woodland habitat – RA1, RA4, RA21)
RM15	Achievement of post-mining land use to a stable condition (watercourse – RA2, RA11)
RM18	Achievement of post-mining land use to a stable condition (woodland habitat, existing rehabilitation – RA10)
RM19	Achievement of surface requirements (grassland)
RM20	Achievement of post-mining land use to a stable condition (grassland – RA6, RA9)

1.4.3 Improvement areas and milestones

The IA and MMs included in the PRCP schedule for GRM and BRM are referred to throughout this PRCP.

An IA is defined in the PRCP Guideline as an "*area of land in the NUMA to which a management milestone for the NUMA relates*" and a MM is "*each significant event or step necessary to achieve best practice management of the area and to minimise risks to the environment (section 112 of the EP Act)*".

The GRM and BRM IAs and associated relevant activities are detailed in Table 14 and shown in Figure 29, and the MMs are detailed in Table 15.

Table 14: Improvement areas and relevant activities for GRM and BRM

IA	NUMA	Relevant activity
IA1	NUMA	• Residual voids

Table 15: Management milestones for GRM and BRM

MM	MM name
MM1	Achievement of structural stability
MM2	Achievement of surface requirements
MM3	Achievement of sufficient improvement

1.4.4 Existing rehabilitation

Progressive rehabilitation at GRM and BRM commenced in the early 1990's with approximately 1,280ha of rehabilitation undertaken. The majority of rehabilitation was revegetated to achieve a safe, stable and self-sustaining rehabilitation able to support a cattle grazing PMLU. More recently, rehabilitation has been planned to achieve areas of both cattle grazing PMLU and woodland habitat PMLU, depending on the location.

Several areas of existing rehabilitation have not been included in the PRCP schedule for the following reasons:

- Areas are planned to be dumped over in the current life-of-mine plans for additional spoil dump capacity, however once the final landform is available, the spoil will be progressively rehabilitated to achieve a sustainable woodland habitat PMLU
- Other areas will be re-disturbed by various mining activities, such as infrastructure. These areas are scheduled to be rehabilitated once the areas are no longer required for mining activities or infrastructure
- A portion requires substantial corrective action to achieve the nominated PMLUs, and in some cases the planned PMLU has changed to better align with the landforms and surrounding PMLUs. Some of these areas were rehabilitated in the 1990s and currently have extensive leucaena (*Leucaena leucocephala*) thickets. Rehabilitation seed mixes in the 1990s included leucaena as it was considered suited to the soils, provided soil stabilisation and was planted for cattle fodder (leucaena stems less than 2m high can be readily eaten by grazing livestock). However, if not controlled, leucaena can form dense thickets that hinder human and stock movements and exclude growth of other plants
- Rehabilitation of BRM GMS panel subsidence areas have been excluded as they may be subject to further subsidence when the GLS panels are mined and after flooding of underground workings at the end of mining

The PRCP schedule includes 293ha of existing rehabilitation progressing towards achievement of the nominated PMLUs, including 118ha of cattle grazing PMLU (RA7) and 175ha of woodland habitat PMLU (RA10). The existing rehabilitation progressing towards achievement of the PMLU is scheduled in the PRCP schedule for the next appropriate rehabilitation milestone as shown in Table 16.

Table 16: Existing rehabilitation in the PRCP schedule

RA	Cattle Grazing (ha)	Woodland Habitat (ha)			
	RM10	RM5	RM8	RM11	RM18
RA7	118	-	-	-	-
RA10	-	20	122	12	21
Total	**118**	**175**			

Representative areas of existing woodland habitat rehabilitation and their associated monitoring results have been summarised in Table 17.

The rehabilitation methodology of the existing GRM and BRM rehabilitation areas is most aligned to the following PRCP rehabilitation milestones:

- Cattle grazing – Weip dam (2024):
  - RM3: Bulk earthworks completed in accordance with design - reshaped to form a free draining landform with a mean slope of 5%
  - RM4: Applied topsoil at a minimum depth of 150mm
  - RM4: Applied ameliorants- gypsum and fertiliser
  - RM4: Deep ripped along the contour
  - RM7: Revegetated with a pasture seed mix with 16 kg/ha of grass species, 4 kg/ha of legume species and 5 kg/ha of cover crop (Japanese millet)

  - RM4: Applied hay mulch (sugarcane tops or sorghum fibre) following sowing

- Woodland habitat – various areas:
  - RM3: Reshaped to maximum mean slope of 17%
  - RM3: Applied rock mulch on steeper areas
  - RM5: Applied a thin veneer of topsoil (100mm)
  - RM5: Applied ameliorants, such as gypsum
  - RM5: Deep ripped, mixing growth media with rock
  - RM5: More recent rehabilitation has included application of surface mulch, such as straw
  - RM8: Seeded based on seasonal available seed mixes, no records are available on specific seed species
  - RM11: Sufficient groundcover to meet EA acceptance criteria as indicated by rehabilitation monitoring data.

Routine rehabilitation monitoring will continue to be implemented to identify any maintenance/corrective actions required to enable the existing rehabilitated areas to progressively achieve the RMs (Section 8).

No progressive certification applications under the EP Act have been applied for GRM and BRM rehabilitation areas.

Table 17: Representative existing rehabilitation areas

Area	RA10 - GRM13	RA10 – GRM24
Image		
PMLU	Woodland habitat	Woodland habitat
Coordinates (MGA2020 Zone 55)	599058 E, 7593052 N	598511E, 7600826N
Mean slope (%)	11	9
Rehabilitation year	1995/1997	Unknown (>10 years)
Total groundcover (%)	79	94
Tree canopy cover (%)	28	
Tree species	*Acacia decora* (pretty wattle), *Acacia harpophylla* (brigalow), *Acacia salicina* (sally wattle)	*Acacia salicina* (sally wattle)

Area	RA10 - GRM13	RA10 – GRM24
Shrub species	*Enchylaena tomentosa* (ruby saltbush), *Sesbania cannabina* (sesbania pea)	*Acacia salicina* (sally wattle)
Grasses	*Cenchrus ciliaris* (buffel grass*), *Chloris gayana* (rhodes grass),	*Cenchrus ciliaris* (buffel grass*), *Megathyrsus maximus var. maximus* (guinea grass*)
Other species	*Portulaca oleracea* (pigweed), *Pterocaulon redolens* (ragweed), *Salsola kali* (soft roly poly)	*Clitoria ternatea* (butterfly pea), *Glycine tabacina* (glycine pea), *Leucaena leucocephala* (leucaena*), *Macroptilium atropurpureum* (purple bush-bean*), *Malvastrum americanum**, *Rhynchosia minima* (least snout-bean), *Sida sp,* *Stylosanthes scabra* (shrubby stylo)

** Exotic species*

1.4.4.1 Subsidence areas

Operationally, BRM undertakes ongoing management of subsidence areas (RA11, RA20, RA21) to ensure safety and compliance to the EA which to date has included:

- Repairing subsidence cracks, including ripping and seeding, and monitoring of works
- Removal of gas drainage lines and rehabilitation of sumps/bore holes, ballast pads and minor infrastructure
- Installation of pile fields on the banks of the Isaac River to control/contain subsidence impacts
- Rehabilitation of exploration drill holes, including grouting and capping drill holes and backfilling of sumps
- Rehabilitation of laydown yards
- Sealing of shafts
- Drainage works
- Annual inspection of Isaac River by an appropriately qualified person (AQP)

1.4.5 Availability for progressive rehabilitation

1.4.5.1 Spoil dumps

As indicated in Table 12, the spoil dumps are the area predominantly available for progressive rehabilitation during mining at GRM. As mining progresses down-dip and the pits get deeper, the spoil dumps increase in height to fit the increased volume of spoil material. Increasing the dump height maximises the material dumped in-pit and reduces out-of-pit dumping. Due to the large size of the GRM spoil dumps, the outside spoil dump areas (the areas to be rehabilitated) are only a small proportion of the operational dump surface as the dumps advance, as shown in Figure 13. Areas become available for rehabilitation as spoil dumps reach the final spoil dump extents. For deep mines such as GRM, the amount of area available for rehabilitation progressively throughout the mine life is limited due to:

- Dumping occurs over multiple dump faces at various dump bench heights, with multiple dump access ramps. The dump access ramps change location over time as the dumps progress. These dump access ramps, plus the coal access ramps, restrict the dump footprint available and results in the separate dump areas progressing at different rates. The access ramps also limit the area available for progressive rehabilitation until they are no longer required. Numerous coal access ramp voids are planned to be backfilled towards the end of mining. Once backfilled, these areas become available for rehabilitation.

- Dumps can only increase in height once mining has progressed sufficiently to ensure the lower dump benches have also advanced sufficient distance for geotechnical stability of the spoil. This limits progressive rehabilitation to the outside of the lower dump benches as more spoil is dumped above. Significant areas become available for rehabilitation as the final and highest dump bench is completed dumping.
- The spoil dump low-walls continually advance with the mining operation and increase in height with the spoil dumps. The low-wall PMLU area of each pit becomes available for rehabilitation once mining and final backfill of the void is complete.

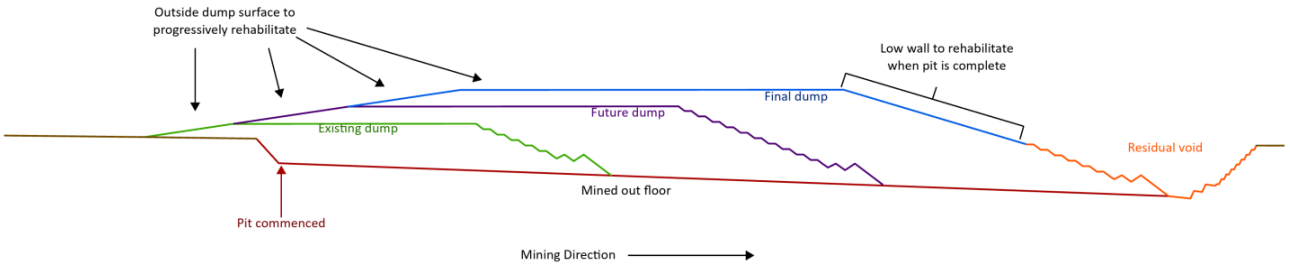

Figure 13: Indicative dump progression during life-of-mine (illustrative purposes only)

The spoil dump areas do not become available for progressive rehabilitation at a linear rate due to the mining and dumping sequence. Configuration of spoil dumps, ramp access, height and stability requirements to balance the required dump capacity all impact the release for rehabilitation. The area available for progressive rehabilitation is limited earlier in the schedule due to the mining sequence, with the majority of spoil dump areas becoming available for rehabilitation later in the schedule as dumps reach their maximum extents at a faster rate, and the low-wall areas become available once mining in each pit is complete.

However, by the end of open-cut mining in 2059, the vast majority of the spoil dumps (70%) (RA1, RA10) will have completed rehabilitation and achieved the execution milestones in the PRCP schedule (Section 10.5) to the point of revegetation (RM8) (Table 18). Therefore 70% of the spoil dumps will only require monitoring and maintenance from this point to achieve the PMLU.

After 2059, the spoil dump area not available for rehabilitation includes the Goonyella Pit low-wall (within RA1) and operational areas on the spoil dumps that are required until the end of mining at RHM e.g. haul roads and park-up areas, plus spoil areas required to support RHM for rejects and access.

1.4.5.2 Subsidence

As BRM underground mining progresses, ongoing management of subsidence areas will be undertaken to ensure safety and compliance to the EA. Subsidence areas will undergo operational repair works once initial subsidence of panels occurs after mining the GMS, and again once further subsidence occurs after mining the GLS. This will include repairing subsidence cracking and drainage works, if required.

Rehabilitation of subsidence areas is scheduled in the PRCP once the area is available for rehabilitation, which is when final subsidence is realised after flooding of the underground workings, at the end of mining the BRM GLS and at the end of mining RHM GMS (Section 6.4.1.1). This ensures geotechnical stabilisation occurs and there will be no further subsidence to impact the drainage works or cause further surface cracking, ensuring the rehabilitation achieves a PMLU to a stable condition.

1.4.5.3 Other areas

Other areas are typically required to support mining operations, such as infrastructure areas and voids, with limited area available for rehabilitation until mining is complete (Table 18). Areas associated with mining RHM are only available for rehabilitation once RHM mining or coal processing is complete (Table 12), including areas required for tailings and rejects disposal.

Table 18: PRCP schedule progressive rehabilitation summary

RA/ IA	Description	Total area (ha)	% of total site	RM 7-9 by 2059 (ha)	RM 7-9 by 2059 (%)	RM7-9 by 2094 (ha)	RM7-9 by 2094 (%)
RA1	Spoil dumps	5,557	32	3,771	68	4,611	83
RA2	Watercourse diversions and crossings	173	1	0	65	113	65
RA3	Infrastructure areas – CHPP, MIA, workshop, dams, coal stockpiles, roads, general infrastructure and disturbance	1,268	8	0	0	852	66
RA4	Roads, laydown areas and general infrastructure and disturbance	1,165	7	0	0	1111	95
RA6	Rejects areas	400	2	170	42	233	58
RA7	Existing rehabilitation – cattle grazing	118	1	118	100	118	100
RA9	TSFs	872	5	0	0	197	23
RA10	Existing rehabilitation – woodland habitat	175	2	175	100	175	100
RA11	Underground mining/subsidence – watercourse	249	1	0	0	206	83
RA20	Underground mining/subsidence – wattle grazing	434	2	0	0	406	93
RA21	Underground mining/subsidence – woodland habitat	2,079	12	0	0	1,963	94
IA1	Residual voids	2,297	13	428	19 (MM1/MM2)	2,297	100
PRCP Schedule total		**14,803**	**85**	**4,661**	**31**	**12,282**	**83**
	Undisturbed and excised area	2,692	15	-	-	-	-
Site total		**17,495**	**100**	**-**	**-**	**-**	**-**

2 COMMUNITY CONSULTATION

Legislative Requirement

In accordance with section 126C(1)(c)(iii) and (iv) of the EP Act, the rehabilitation planning part of the PRC Plan must include:

- *details of the consultation undertaken by the applicant in developing the proposed PRC Plan, and*
- *details of how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan.*

PRCP Guideline (Section 3.5)

In developing the proposed PRC Plan, the community should at least be engaged on the plan for the mine, PMLUs or NUMAs, areas of disturbance, rehabilitation and management methods, progressive rehabilitation, and closure timeframes. Ongoing community consultation should continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community.

Community consultation carried out through different processes (such as an EIS) may be used to address the requirements in section 126C(1)(c) of the EP Act. The details of this consultation must be provided in the rehabilitation planning part of the proposed PRC Plan).

Transitional PRC Plans are still required to meet the legislative requirements in section 126C(1)(c) of the EP Act. All proposed PRC Plans must contain a community consultation plan regardless of whether the site has an existing EA.

To comply with section 126C(1)(c)(iii) of the EP Act, the PRCP must include details of the consultation undertaken by the applicant in developing the proposed PRCP (Section 2.4). This includes previous consultation undertaken as part of existing EA approvals or regular engagement processes (Section 2.2.1), and consultation undertaken as part of PRCP development (Section 2.2.2).

To comply with section 126C(1)(c)(iv) of the EP Act, and the PRCP Guideline, the PRCP must include a community consultation plan which details how the applicant will undertake ongoing consultation in relation to the rehabilitation to be carried out under the plan (Section 2.3).

A community consultation register has been compiled to support the development of this PRCP – *Goonyella and Broadmeadow PRCP Community Consultation Register* is provided in Appendix F.

2.1 Stakeholders

The PRCP Guideline requires that the applicant must attempt to consult all relevant members of the community, noting that the community may include, but are not limited to:

- Affected landholders (such as underlying and adjoining land holders, and holders of land necessary for access to the land to which the proposed PRCP relates)
- Traditional Owners
- Local government
- Local community groups

The Queensland Government Information Sheet *Community consultation for Progressive Rehabilitation and Closure Plan* (last revised on 16 February 2024) (DESI, 2024b), states that community members to be included in consultation must have a genuine, demonstrable and legitimate interest in:

- The land where the activity will occur
- The land adjacent to where the activity will occur
- The land/amenities surrounding where the activity will occur that are likely to be impacted by the activity (e.g. groundwater/drinking water users within the surrounding area or community located upstream or downstream of the activity)

Genuine interest may include direct impact interest (e.g. underlying and adjacent land holders), cultural interest (e.g. Traditional Owners), land use interest (e.g. overlapping tenure holders, or local government), or heritage, environmental, recreational or health interests (e.g. state or local government, or relevant community groups).

The stakeholders identified as having a genuine, demonstrable and legitimate interest in the ongoing rehabilitation and closure planning at GRM and BRM are listed in Table 19, along with BMA's existing relationship and the stakeholders potential areas of interest with respect to the GRM and BRM PRCP.

2.2 Consultation to date

2.2.1 Pre-PRCP consultation

The following rehabilitation and closure-related engagement took place for GRM and BRM prior to development of the GRM and BRM transitional PRCP:

- Engagement with Barada Barna Aboriginal Corporation (BBAC) has been ongoing since 2021 on PRCP development and rehabilitation execution, specifically on provision of seed for rehabilitation and contracting opportunities for rehabilitation execution
- Engagement with affected (underlying) landowners has been undertaken to develop compensation, leasing and agistment agreements, as BMA must rehabilitate in accordance with the requirements of the EP Act which are satisfied through the PRCP
- During 2018 and 2019, BMA engaged with the administering authority to implement the current EA conditions in relation to PMLUs and acceptance criteria, which were included in the EA Table E1: Rehabilitation Requirements
- BMA engaged with the administering authority in relation to how the PRCP Guideline elements (particularly regarding transitional arrangements) and the current EA conditions related to rehabilitation and closure would transition to PRCPs
- Since 2021, information about the PRCP process, the schedule for development of PRCPs for BMA assets and PRCP progress briefings has been provided to IRC at routine meetings, noting the GRM and BRM PRCP would be submitted in November 2024
- BMA has engaged with nearby landholders on land management and lease/license conditions, and on operational, environmental management and/or water matters, as required

2.2.2 Transitional PRCP consultation

Consultation as part of the development of the GRM and BRM transitional PRCP has included letters sent via letter box drop, post or email to more than 6,500 premises in Moranbah and Dysart, including property owners, households, business and community groups. These stakeholders are listed in Table 19 and include:

- Barada Barna People, via BBAC
- Widi People of the Nebo Estate #2
- Private owners of freehold land within 5km of the GRM and BRM EA area, including licensees of BMA-owned land
- Moranbah residents, business owners and community organisations via a letter drop to all premises
- IRC
- Members of the Moranbah Smart Transformation Advisory Council (STAC)
- Isaac Business Chamber
- Owners and operators of utility assets within and adjacent to GRM and BRM
- Nearby mining tenement holders and petroleum (gas) tenement holders
- Queensland Government departments

In addition to the consultation letters, BMA distributed information about PRCPs to individuals, businesses and organisations via:

- BMA's Coal Connect, an online weekly newsletter to the GRM and BRM workforce and all internal coal personnel

- BMA's Community Connect, a bi-monthly newsletter distributed to more than 15,000 community members and GRM and BRM suppliers throughout the Bowen Basin

BMA's Community Hotline for the general public was also available during consultation for the community to request more information about PRCPs and continues to be available for any future queries.

2.3 Community consultation plan

The PRCP Guideline requires the community consultation plan to include:

- Objectives of the community consultation
- Consultation process, including proposed frequency of consultation
- Information to be released for community consultation
- How community feedback will be considered in the PRCP

Whilst many stakeholders in the Isaac region are well-educated about mining operations, there is less understanding of planning for life-of-mine, rehabilitation and closure planning. The community consultation plan recognises the following social context:

- Talk of closure planning will lead to community concerns, requiring careful and consistent communication
- PRCP consultations by a range of companies for a variety of assets will represent considerable cumulative demands on stakeholders, and a coordinated, strategic approach will be required to manage consultation fatigue
- Community members are becoming increasingly aware of climate change and the impacts of resource activities and energy policies on the environment

Accordingly, community and stakeholder expectations with regards to mine rehabilitation are expected to increase over time and need to be continuously assessed.

2.3.1 Objectives

The objectives of the community consultation include:

- To engage stakeholders in developing objectives and aspirations for PMLUs and landform, and social value opportunities to be considered in the PRCP
- To support transparent access to information about the GRM and BRM PRCP and implementation, enabling opportunities for the Moranbah and Dysart communities, GRM and BRM suppliers and government agencies and representatives to provide inputs and feedback on rehabilitation and closure outcomes
- To engage with utility owners and operators and adjacent mining and energy tenement holders, to provide information about GRM and BRM closure planning that supports them to manage their assets and interests

2.3.2 Consultation process

The consultation process to enable ongoing PRCP-related engagement is detailed in Table 20. The process includes the relevant stakeholders, engagement type and proposed consultation frequency to achieve the consultation objectives.

BMA continues to engage with neighbouring landholders on land management, lease/licence conditions, and operational matters, as required.

Stakeholder titles are correct as at the time consultation was undertaken. Some stakeholder titles (e.g. names of Queensland Government departments) may change over time and will be updated as necessary in future PRCP amendments.

2.3.3 Information to be provided

2.3.3.1 Consultation to date

The transitional PRCP consultation letters provided information about GRM and BRM and rehabilitation and closure planning and encouraged the stakeholders (Section 2.2.2) to contact BMA if they would like to discuss the PRCP. The information provided to stakeholders through the transitional PRCP consultation letters included:

- Introduction of Queensland Government requirements for mine rehabilitation and closure planning
- EP Act requirements for rehabilitation
- PRCP requirements
- PRCP submission date
- Location of GRM and BRM
- EA details
- Approved activities at GRM and BRM
- MLs within GRM and BRM EA area
- Estimated mine life of GRM and BRM
- BMA's commitment to progressive rehabilitation
- Rehabilitation objective and methods
- Progressive rehabilitation timeframes (in general terms)
- EA approved PMLU options
- Inclusion of residual voids as NUMAs
- Commitment to future engagement in PRCPs
- An invitation to seek information or discussion about PRCPs
- Contact details for further information or discussion

The information provided to the community as part of the transitional PRCP consultation via Coal Connect and Community Connect included:

- Progressive rehabilitation as a key focus for BMA
- PRCP requirements and purpose
- Timing for the development of the GRM and BRM PRCP
- Life of BMA assets that are subject to transitional PRCPs
- Commitment to ongoing engagement
- Contact details for further information or discussion

Consultation and engagement conducted by BMA to date was to transition the PMLUs and NUMAs within the EA to the PRCP. The BMA Community Hotline was also available during consultation for the community to request more information about PRCPs and continues to be available for any future queries.

2.3.3.2 Ongoing consultation

Information to be released for community consultation, as part of future GRM and BRM PRCP implementation will include:

- The rationale and scope for PRCPs
- Approved mining activities, PMLUs and NUMAs for GRM and BRM
- On-site activities and areas of disturbance

- Proposed rehabilitation methods, schedule and milestones
- Progress against rehabilitation milestones
- Alignment with long-term transformation planning occurring through governments
- Opportunities for community consultation as part of the PRCP's implementation

Communication tools could include:

- Frequently asked questions and answers and a PRCP fact sheet available to support consultation activities
- Face to face and virtual meetings, forums or workshops
- Updates and fact sheets about the GRM and BRM PRCP

Additional information to be shared with specific stakeholders is detailed in Table 20.

2.3.4 How feedback will be considered

The PRCP community consultation register (Appendix F) will be updated to include the consideration of issues raised and the outcomes of engagement as part of the community consultation activities outlined in Table 20. All stakeholder feedback recorded in the community consultation register will be considered in framing and detailing future PRCP amendments for GRM and BRM. This may include feedback on, for example:

- Planned PMLUs and NUMAs
- Alternative PMLUS
- Vegetation species most suitable to the approved PMLUs
- Rehabilitation methods to protect cultural heritage and achieve optimal use for the PMLUs
- PRCP schedule
- Water management (e.g. availability for beneficial use as part of the PMLUs, or adjacent uses)
- Development of business capacity programs to equip local and Indigenous businesses for rehabilitation works.

The PRCP will be evaluated to ensure PMLUs and NUMAs are consistent with the outcomes of consultation with the community.

2.4 Community consultation register

The community consultation stakeholders, the consultation undertaken, and feedback received are documented in the community consultation register (Appendix F). The community consultation register is compliant with section 126C(1)(c)(iii) of the EP Act and includes:

- Identification of each community member/stakeholder
- Previous engagements with the community
- Consultation date(s)
- Description of consultation type
- Information provided to the community
- Issues raised/discussed by the community
- How issues have been considered
- Decisions/outcomes of engagement
- Commitments made by BMA

2.5 Feedback to date

All feedback received to date as part of the consultation for the PRCP, is documented in the community consultation register (Appendix F) and summarised in Table 19. There were no enquiries or feedback received following the transitional PRCP consultation letters apart from an acknowledgement of receipt of the letter. There were also no responses or enquiries to letters to Moranbah premises or to the information provided via Community Connect and Coal Connect.

Table 19: GRM and BRM identified stakeholders, current BMA relationships, potential PRCP areas of interest and consultation outcomes

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
Traditional owners			
• Barada Barna People (QCD380/08), represented by BBAC	• BMA has a constructive working relationship with Barada Barna People, who are the registered native title holders of land which includes GRM and BRM. • BBAC and BMA meets regularly as part of the BBAC-BMA Relationship Committee. • BMA holds a Native Title Project Agreement with BBAC on behalf of Barada Barna people. GRM and BRM falls within the Agreement area. The Agreement was signed in July 2024. This Agreement sets a new way forward in the relationship between BMA and the Barada Barna people, providing intergenerational benefit. Under the Agreement, BMA will provide support towards priority community projects that enable Barada Barna people to live and work on-country, strengthening this important connection. • From a rehabilitation and closure perspective, BMA is working with	• Aspirations around rehabilitation and potential commercial opportunities as a PMLU • How operational management and/or rehabilitation could contribute to future use of the areas • Recognition and management of cultural heritage impacts • Native Title and land acquisition interests • PMLUs, NUMAs and landforms • Future access to and ownership of land • Environmental management/stewardship • Employment and business opportunities in rehabilitation, environmental management and monitoring	• Existing PMLUs and NUMAs were discussed with BBAC and they expressed their desire to be involved in the activities required to support execution of the rehabilitation and management milestones for PMLUs and NUMAs • Area 4 is an area of cultural significance for the Barada Barna People, located along the eastern boundary of the GRM and BRM EA. It has been agreed that no further mining disturbance will occur in this area. Area 4 includes land that is both: - Undisturbed - Land previously disturbed that will be rehabilitated to a PMLU that matches the surrounding undisturbed areas (RA4)

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
	BBAC specifically on provision of seed for rehabilitation and contracting opportunities for rehabilitation execution.		
• Widi People of the Nebo Estate #2	• BMA has a constructive relationship with Widi People, meeting as needed. There are no agreements with Widi People with respect to GRM and BRM.		• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM
Underlying landowners, nearby landowners and licensees of BMA land			
• Private landowners and licensees within 5km • Moranbah North Coal Pty Ltd & Others (Anglo American Australia) • Centurion Coal Mining Pty Ltd (previously Peabody (Bowen) Pty. Ltd.) • Aurizon Network • IRC • Department of Resources (DoR)	• BMA has longstanding relationships with the private landowners and licensees of BMA-owned land • BMA engages with landowners through letters, emails and regular meetings, including on an as-needs basis with regard to licenses and land management • BMA engages with corporate and government owners of land within the EA area on an as-needed basis	• Environmental management /stewardship • PMLUs, NUMAs and landforms • PRCP schedule • Future access to and ownership of land when it is no longer required for mining • Water usage, quality and access to groundwater and surface water (e.g. water allocations, water pipelines, etc.) • Potential impacts on roads, road reserves and rail infrastructure • Potential impacts on land, water, property and future business value	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
		relating to PMLUs, and timing of impacts	
Local Government			
• IRC	• BMA has a long established and cooperative relationship with IRC • BMA provides regular updates on PRCPs to IRC, as part of biannual IRC-BMA meetings which discuss a range of topics, and as part of additional issue-specific meetings from time to time	• Local employment • Impacts on Council services and infrastructure • Stock routes • Rehabilitation progress and PRCP schedule • PMLUs, NUMAs and landforms • Management of closure impacts on employment and businesses • Alignment of rehabilitation plans with local and regional planning goals • Economic transformation (towards post-mining) and community sustainability • Potential impacts on environmental qualities, amenity or traffic conditions during closure or rehabilitation activities • Potential cumulative impacts of closure of multiple mining assets in a	• Transitional provisions for the PRCP were discussed. IRC understand the PMLUs as per the EA are being transitioned into the PRCP. • IRC requested further information and engagement to understand how BMA and IRC could work together on potential innovative approaches to end of life mines and long term futures of the local communities post-mining. These innovative approaches would need to provide commercial viability as well as ecological and social functionality. IRC have been interested to understand the challenges to facilitate future changes. BMA has committed to engage with IRC on this going forward • Red Hill Road – the PRCP landform proposes a realignment of Red Hill Road. To effect realignment, BMA acknowledge it would need to apply for and obtain, a Works On Road Corridor Permit from IRC.

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
		similar timeframe (e.g. job and population losses)	Engineering studies will need to be completed before the permit is applied for. Concerns raised by IRC in relation to any realignment proposal for Red Hill Road will be considered during the permitting process. If changes are made to the proposed realignment as a result of future planning or permitting processes that impact the PRCP schedule, a PRCP amendment will be required.
Residents, businesses and community groups			
• Moranbah residents, businesses and community groups	• BMA engages with Moranbah residents, businesses and community organisations through stakeholder meetings, media and social media, and Community Connect, a regular BMA newsletter • Engagement activities with community members ranges from one-off responses to enquiries, to community events and forums, and ongoing engagement processes such as partnerships with community organisations and industry bodies	• Timing of closure • Rehabilitation obligations and progress • Environmental management /stewardship • Employment continuity • PMLUs, NUMAs and landforms • Management of closure impacts on employment and businesses • Economic and community sustainability	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
		• Local employment and business opportunities in rehabilitation works	
• Moranbah STAC	• The Smart Transformation Project, including the Moranbah STAC was established by BMA in 2019. STAC members meet every two months to consider a range of issues and priorities related to the future and sustainability of the communities and economies of Moranbah.	• As above, with a particular focus on community and economic development and transformation	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM
• Isaac Business Chamber	• The Isaac Business Chamber was established in early 2024 and represents businesses across the IRC local government area. BMA has engaged with Isaac Business Chamber through community forums.	• As above, with a particular focus on business and economic development opportunities associated with mining and/or rehabilitation works	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM
Utility owners/easement holders with assets within the EA area			
• Aurizon Network • Powerlink • Sunwater • IRC • Telstra • Whitehaven Coal	BMA has constructive working relationships and engages with utility owners as required (issue-specific or transactional engagement) with respect to: • Goonyella Hay Point Railway, North Goonyella Railway, Goonyella Mine Loop and Riverside Mine Loop (owned by Aurizon Network on land owned by	• Impact on assets/asset value • Remediation of impacts on assets • Any service disruptions and mitigations • Crossing/interface agreements • Timeframe for decommissioning utilities that service GRM and BRM	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
	Department of Transport and Main Roads (DTMR)) • Road reserves for Red Hill Road, Riverside Access Road, Pasha Road and Mabbin Road (IRC) • Eungella Pipeline and Burdekin Pipeline (and various easements) within the EA area (Sunwater) • Powerlines and powerline easements (Powerlink) • Access easement within the EA area (Telstra) • Braeside West Water Pipeline in close proximity to the EA (Whitehaven Coal)	• Cost of decommissioning utilities	
BMA operations			
• BMA workforce (including contractors)	• BMA maintains ongoing communication with its workforce through 'toolbox' talks, email communications and a weekly digital newsletter, Coal Connect	• Timing of closure • Rehabilitation obligations • Employment continuity • Management of closure impacts on employment and businesses • Economic and community sustainability	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
		• Local employment and business opportunities in rehabilitation works	
BMA suppliers			
• GRM and BRM suppliers	• BMA has relationships with an extensive network of small business suppliers in the Isaac, Mackay and Whitsunday regions. BMA communicates with suppliers through the BMA community-related Local Buying Program portal, and via Community Connect.	• Loss of supply opportunities with closure • Opportunities to participate in supply chain for closure and/or rehabilitation works • Economic transformation (towards post-mining) • Economic and community sustainability	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM
Overlapping/adjoining/nearby resource interests			
• Moranbah North (Anglo American Metallurgical Coal Pty Ltd.) • Eaglefield and Centurion (Centurion Coal Mining Pty Ltd (previously Peabody (Bowen) Pty. Ltd.))	• BMA liaises with overlapping, adjoining and nearby mining and resource interests on an as-needed basis • BMA also engages with overlapping and nearby petroleum resource holders in accordance to *Mineral and Energy Resources (Common Provisions) Act 2014* (Qld) requirements for petroleum overlap activities	• TLO access • Future land use and ownership • Collaboration on good industry rehabilitation and closure practices • Potential future use of land within the EA area for resource extraction purposes	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
• Wealth Mining Pty Ltd • Mayfair Energy Pty Ltd • Wards Well (Stanmore SMC Pty Ltd) Overlapping and nearby Authority to Prospect and Petroleum Commercial Area: • CH4 Pty Ltd (Arrow) • Arrow CSG (Apt 364) Pty Ltd • North Queensland Pipeline No 1 Pty Ltd • Enertrade Pty Ltd		• Potential for any disruption of resource activities due to closure or rehabilitation works • Cumulative impacts and opportunities of mine closures	

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
Queensland Government			
Queensland Government departments: • DoR • DTMR • DETSI	• BMA has constructive working relationships with DoR and DETSI • DoR's Deputy Director-General Georesources has asked to be kept informed on PRCP • DTMR owns land within the EA	• Legislative compliance • Resource development • Employment and growth opportunities • Public interest • Environmental management • Economic transformation (towards post-mining) • Financial assurance • Environmental risk management • Future PMLUs, NUMAs and landform • Company responses to stakeholder views • Industry best practice, and innovative future-looking approaches	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
Offices of the Ministers for: • Resources and Critical Minerals • Environment, Science and Innovation, and the Great Barrier Reef • Energy and Clean Economy Jobs • Agricultural Industry Development and Fisheries; and Rural Communities • Regional Development and Manufacturing, and Water Members of Parliament • Member for Burdekin • Shadow Minister for Natural Resources and Mines • Shadow Minister for Environment and the Great Barrier Reef • Shadow Minister for Science and Innovation	• BMA conducts regular engagement with Ministers and Members of Parliament. Employment growth and sustainable community and economic development are key priorities for Queensland Government stakeholders	• Legislative compliance • Resource development • Employment and growth opportunities • Public interest • Environmental management • Economic transformation (towards post-mining) • Financial assurance • Environmental risk management • Future PMLUs, NUMAs and landform • Company responses to stakeholder views • Industry best practice, and innovative future-looking approaches	• No feedback was received in relation to PMLUs or NUMAs at GRM and BRM

Stakeholder	Existing BMA relationship	Potential areas of interest	Outcomes of community consultation during PRCP development and extent to which each proposed PMLU or NUMA is consistent with those outcomes
• Shadow Minister for Energy and Cost of Living • Shadow Minister for Water and the Construction of Dams • Shadow Minister for Regional Development and Manufacturing			

Table 20: Process to be followed for ongoing community consultation for GRM and BRM PRCP

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP**	
• Barada Barna People • Widi People of the Nebo Estate #2 • Private landowners and licensees within 5km of the GRM and BRM EA area • Other underlying landowners within EA area - Anglo American Australia, Centurion Coal Mining Pty	Meet with landholders, licensees, BBAC, Widi People and IRC to provide an update on the PRCP and progress with rehabilitation, and invite their inputs and feedback on: • PMLUs, NUMAs and post-mining landforms, including any particular values or opportunities in specific disturbed areas • Rehabilitation methods which would optimise future woodland habitat and/or grazing opportunities, and potential land management requirements • Shared value initiatives, e.g. infrastructure retention, capacity building, environmental management, or research partnerships • Rehabilitation methods, schedule and progress towards milestones.	As required, to a schedule agreed with representatives

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP**	
Ltd (previously Peabody (Bowen) Pty. Ltd.), Powerlink, Aurizon Network, IRC, DoR and DTMR		
• Private landowners and licensees within 5km of the GRM and BRM EA area	Advise the landowners and licensees in writing regarding any substantive changes to the GRM and BRM PRCP that have potential to affect interests in freehold land within or adjacent to the EA area.	As required, as part of the PRCP amendment process
	Meet with landowners and licensees to discuss any substantive changes to the PRCP and progress with rehabilitation, and invite their inputs and feedback on: • Land use/management/rehabilitation issues as relevant to the private freehold land • Access to water resources • Shared value initiatives, e.g. infrastructure retention, capacity building, environmental management, or research.	As required, as part of the PRCP amendment process
	Correspond and if requested meet with landholder and licensees during the pre-closure, closure/decommissioning and rehabilitation periods, to reduce the potential for works to impact on their amenity, land use, property access or access to water.	Annually for at least five years prior to the forecast end of mining, or as agreed with the landowner
• Barada Barna People • Widi People of the Nebo Estate #2	Meet with BBAC and Widi People to provide an update on the PRCP and progress with rehabilitation, and invite inputs and feedback on: • Involvement of businesses owned by Barada Barna People and/or Widi People in rehabilitation works • Pipeline of opportunities relating to rehabilitation work and land management	As part of regular updates to a schedule agreed with Traditional Owners

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP**	
• IRC	Meet with IRC as part of consultation on proposed amendments to the PRCP, to invite their inputs and feedback on: • Future use and management of land owned by IRC within the EA area • Impacts and opportunities pertaining to IRC assets within the EA area • IRC's strategic analysis and planning for the area • Challenges, opportunities and community aspirations of relevance to mine closure and rehabilitation • IRC's intended economic and social transition approaches • Shared value initiatives, e.g. infrastructure retention, capacity building, environmental management or research.	As required, to a schedule agreed with IRC
	Provide progressive rehabilitation information as part of regular meetings with IRC.	As required, to a schedule agreed with IRC
	Engage with IRC to seek inputs on: • Any impacts of GRM and BRM's closure and/or rehabilitation works on Council assets or services • Any impacts of GRM and BRM's closure and/or rehabilitation works on community amenity • Rehabilitation methods and potential land/water management requirements.	Annually for at least five years prior to the forecast end of mining, or as agreed with representatives
• BMA personnel	Keep the BMA workforce updated via internal newsletters/emails or toolbox talks if there are substantive changes to the PRCP, e.g., significant changes in rehabilitation milestones or plans for the cessation of mining at GRM and BRM and including a communication channel for personnel to ask questions or contribute to discussions about PRCPs and rehabilitation.	Ongoing engagement process

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**1. To engage stakeholders in developing objectives and aspirations for post-mining land use and landform, and social value opportunities to be considered in the PRCP**	
	Commencing five years prior to the forecast cessation of mining, provide regular updates to BMA personnel on the implementation of closure, and seek personnel's feedback on rehabilitation progress.	Annually for at least five years prior to the forecast end of mining
• Moranbah residents, community members, business owners and community groups	Via workshops or focus groups, seek involvement in articulating community aspirations for rehabilitation, and economic transformation opportunities related to PMLUs or NUMAs.	As required, or as agreed with representatives
	Provide community updates if there are any substantive changes and associated PRCP amendments required, via mail-out letters.	As required, as part of the PRCP amendment process
	Provide updates and briefings on PRCPs to the Moranbah STAC.	On request

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**2. To support transparent access to information about the GRM and BRM PRCP and implementation, enabling opportunities for the Moranbah and Dysart communities, GRM and BRM suppliers and government agencies and representatives to provide inputs and feedback on rehabilitation and closure outcomes**	
• Moranbah residents, community members, business owners, community groups	Using community forums such as interagency meetings, community meetings, supplier networks, partnership meetings and business network meetings, provide regular community updates on GRM and BRM PRCP and implementation.	Ongoing engagement process
	Invite input to final planning for closure, including management of closure impacts, via a workshop, community forum or other means.	Three years prior to the forecast end of mining
• GRM and BRM suppliers	Provide regular updates about business supply opportunities resulting from progressive rehabilitation work packages, including through the Isaac Business Chamber.	As required
	Participate in initiatives led by IRC, Isaac Business Chamber, industry or local communities which aim to harness social value from mine closure and rehabilitation planning, and/or work towards economic transformation.	As required, or as agreed with representatives
	Provide information about the pending closure of GRM and BRM and potential future supply opportunities as part of closure and rehabilitation to local businesses, Traditional Owner businesses and GRM and BRM suppliers.	Three years prior to the forecast end of mining, subsequent consultation to be agreed

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**2. To support transparent access to information about the GRM and BRM PRCP and implementation, enabling opportunities for the Moranbah and Dysart communities, GRM and BRM suppliers and government agencies and representatives to provide inputs and feedback on rehabilitation and closure outcomes**	
• Elected representatives and Queensland Government agencies	Provide updates via letters and/or meetings on PRCPs to: • DoR – Deputy Director-General, Georesources • DoR – Director, Native Title Services and Coal Hub • DTMR • Offices of the Ministers for: - Resources and Critical Minerals - Environment and the Great Barrier Reef; and Science and Innovation - Energy and Clean Economy Jobs - Agricultural Industry Development and Fisheries; and Rural Communities - Regional Development and Manufacturing; and Water • Queensland Parliament Member for Burdekin • Shadow Minister for Department of Resources • Shadow Minister for Environment and the Great Barrier Reef • Shadow Minister for Science and Innovation • Shadow Minister for Energy and Cost of Living • Shadow Minister for Water and the Construction of Dams • Shadow Minister for Regional Development and Manufacturing	As required, or as agreed with representatives

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**3. To engage with utility owners and operators, and adjacent mining and energy tenement holders, to provide information about GRM and BRM closure planning that supports them to manage their assets and interests**	
• Queensland Rail, DTMR and Aurizon Network	Maintain correspondence with Queensland Rail, DTMR and Aurizon Network regarding progressive rehabilitation activities as they affect rail assets or operation and undertake consultation regarding the decommissioning of rail interfaces.	As required, or as agreed with representatives
Utility owners and operators: • DTMR • Aurizon Network • Powerlink • IRC • Sunwater • Telstra • Whitehaven Coal	Engage with utility owners and easement holders that have interests in land or infrastructure within the EA area to: • Inform them of closure timelines and rehabilitation activities relevant to land or infrastructure in which they have an interest • Seek inputs about potential impacts on utility/transport assets and/or service capacity, and any specific management measures to avoid impacts on utility assets and services. • Develop agreements in relation to the use, rehabilitation and/or management of land owned by utility owner and operators within the EA.	Three years prior to the forecast end of mining
	• Maintain engagement regarding progressive rehabilitation and undertake consultation regarding crossing/interface agreements, as required if rehabilitation will affect utilities.	Initiated three years prior to decommissioning

Stakeholders	Engagement type	Proposed consultation frequency
Consultation objective	**3. To engage with utility owners and operators, and adjacent mining and energy tenement holders, to provide information about GRM and BRM closure planning that supports them to manage their assets and interests**	
Nearby mining interests: • Moranbah North (Anglo American Metallurgical Coal Pty Ltd.) • Eaglefield and Centurion (Centurion Coal Mining Pty Ltd (previously Peabody (Bowen) Pty. Ltd.)) • Wealth Mining Pty Ltd • Mayfair Energy Pty Ltd • Wards Well (Stanmore SMC Pty Ltd) Overlapping and nearby ATPs and Petroleum Commercial Area: • CH4 Pty Ltd (Arrow) • Arrow CSG (Apt 364) Pty Ltd • North Queensland Pipeline No 1 Pty Ltd • Enertrade Pty Ltd	• Write to advise overlapping, adjacent and nearby resource interests if there are any substantive changes to the closure and rehabilitation schedule in future iterations of the GRM and BRM PRCP.	As required, as part of the PRCP amendment process

Relationship with PRCP schedule
GRM and BRM has transitional provisions and approved land outcomes identified in the EA. Specific community engagement on the proposed PMLUs and NUMAs within the EA being transitioned to the PRCP, and the proposed rehabilitation approach, has been undertaken prior to submission of the transitional GRM and BRM PRCP. Consultation will continue as per the process documented in the community consultation plan.

3 POST-MINING LAND USES

Legislative Requirement

In accordance with section 126C(1)(d) of the EP Act, the rehabilitation planning part of the PRC Plan must state the extent to which each post-mining land use for land identified in the PRCP schedule for the plan is consistent with:

- *the outcome of consultation with the community in developing the plan, and*
- *any strategies or plans for the land of a local government, the State or the Commonwealth.*

PRCP Guideline (Section 3.2)

A PMLU is defined under section 112 of the EP Act as the purpose for which the land will be used after all relevant activities for the PRC Plan carried out on the land have ended. Relevant activity for a PRC Plan is defined in the EP Act as the relevant activities to be carried out on land the subject of the plan. It is not the intention of this definition to include third-party activities or assets that continue to exist once mining activities have ceased, such as third- party pipeline easements, power easements or overlapping tenures for other EAs.

The rehabilitation planning part of the PRC Plan must include a detailed description of the nominated PMLU(s) for the site. The description must include (where relevant), but is not limited to:

- *a description of the use of the land*
- *if applicable, the specific vegetation types (e.g. RE 13.2.9) or land suitability classification (e.g. Class 4)*
- *identification of any permanent or essential management infrastructure to be included as part of the PMLU*
- *completion criteria for measuring whether the PMLU has be successfully achieved*

Where a PMLU has been previously addressed in a land outcome document and is able to be transitioned into the PRCP schedule, the holder is not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those PMLUs.

However, the legislative requirements under section 126C(1)(d) of the EP Act still apply. All PMLUs transitioned into the PRCP schedule must still meet the requirements of a PMLU explained in this section, particularly that the PMLU can be rehabilitated to a stable condition.

Where PMLUs have not been pre-approved, the applicant must include all of the requirements stated in this section.

3.1 Nominated PMLUs

A number of PMLUs are permitted for GRM and BRM under the EA (Table E1 in the GRM and BRM EA), of which the following three are proposed as PMLUs:

- Cattle grazing
- Woodland habitat
- Watercourse

A substantially similar PMLU to cattle grazing is also planned to provide improved rehabilitation outcomes:

- Grassland

The proposed PMLUs are illustrated in Figure 14 and have been recommended based on the closure landform, existing vegetation, ecological values, pre-mining land uses and the outcomes of the rehabilitation and closure studies supporting this PRCP. The PMLUs are underpinned by rehabilitation objectives that focus on achieving a safe, stable, non-polluting and sustainable post-mining landscape (as defined in the EA).

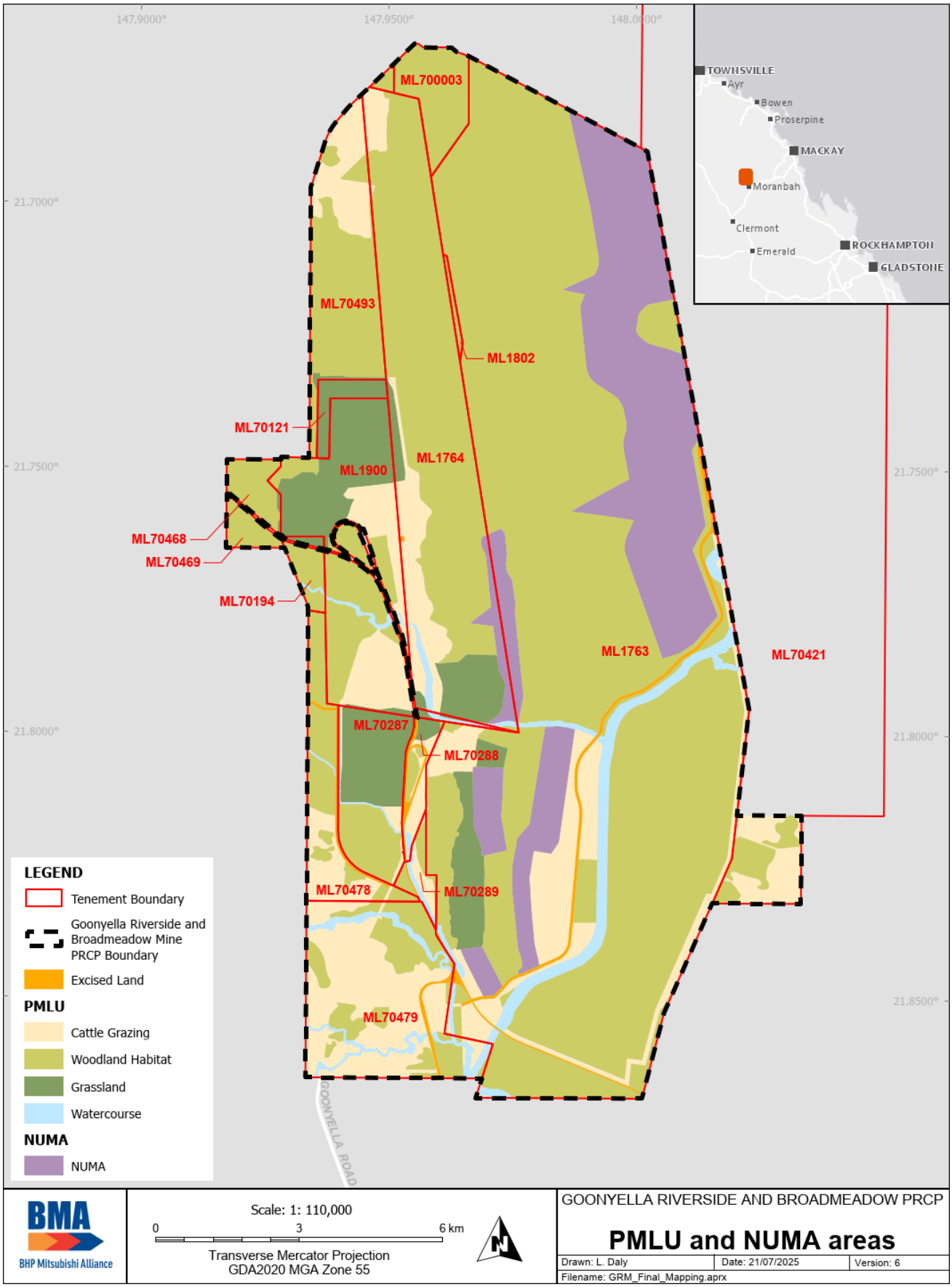

Figure 14: GRM and BRM PMLUs and NUMAs

3.1.1 Cattle grazing

The EA objectives, indicators and acceptance criteria for cattle grazing PMLU are listed in Table 21. As the GRM and BRM EA is an approved LOD, BMA has transitioned the relevant EA acceptance criteria, as per the legislative intent of the transitional provisions, to the final milestone criteria of achievement of the PMLU to a stable condition of cattle grazing (RM13).

At GRM and BRM, cattle grazing PMLU is predominately planned for:

- Lower gradient slope areas disturbed by mining activities
- Areas that require shallow rooted species
- Areas where there was significant clearing for agricultural land uses prior to mining, including underground subsidence areas (in accordance with EA condition)
- Stock route SR:831ISAA of the Queensland stock route network.

Table 21: GRM and BRM EA PMLU objectives, indicators and acceptance criteria: cattle grazing

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Stable	Rehabilitation is geotechnically stable	Factor of Safety	≥1.5
	Rehabilitation is erosionally stable	Extent, slope gradient and groundcover	1. Groundcover >50% 2. 70% of slopes ≤20%
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: a) The *Environmental Protection (Water) Policy 2009* schedule documents water quality objectives for relevant groundwater chemistry zones; or b) Local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
Able to sustain the agreed PMLU	Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment (LSA) for cattle grazing	Land suitability class ≤3 or not different from pre-mining class if ≥4. Assessment completed in accordance with *LSA Framework for Open-Cut Coal Mine Rehabilitation*

Goal	Objective	Indicator	Acceptance criteria
			2018 (A rule-set for LSA sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland) unless otherwise agreed in writing between the administering authority and the environmental authority holder.
		Leucaena stem density	<250 stems >2m height per ha (1 per 40m^2), mean total area

Pre mining cattle grazing land suitability class

The pre-mining land suitability assessment specified in the EA acceptance criteria is based on the five land suitability classes defined under *Guidelines for Agricultural Land Evaluation in Queensland* (2nd edn) (DSITI & DNRM, 2015). Land suitability decreases progressively from Class 1 (suitable land with negligible limitations) to Class 5 (unsuitable land with extreme limitations). The GRM and BRM pre-mining land suitability class assessment results for cattle grazing are discussed in Section 1.2.6.

Post-mining cattle grazing land suitability class

The post-mining cattle grazing land suitability assessment referred to in the EA acceptance criteria was *A rule-set for land suitability assessment of sustainable beef cattle grazing on land rehabilitated after open-cut coal mining in the Bowen Basin Queensland*, developed by Short (2018).

The PRCP milestone criteria for achieving the PMLU to a stable condition for cattle grazing (RM13) will be assessed according to the land suitability framework presented in the *Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin: Technical Paper 1* (Short, 2025) from the Office of the Queensland Mine Rehabilitation Commissioner (OQMRC) (Table 22). This land suitability framework has minor changes from the rule-set referred to in the EA and will be adopted for the PRCP to align with the OQMRC leading practice paper. Land suitability decreases progressively from Class 1 (suitable - land capable of attaining maximum grazing productivity) to Class 5 (unsuitable - land that is not suitable for cattle grazing).

Rehabilitation activities will aim to achieve a land suitability class of 3 or better. However, monitoring of cattle grazing reference sites has shown that land in the broader area often decreases to class 4 and class 5 due to various limitations. Therefore, cattle grazing rehabilitation at GRM and BRM can be class ≥4, if not different to pre-mining (as per the EA acceptance criteria).

Reference sites (Section 8.4.1) will also be assessed according to the land suitability framework (Table 22) to enable a comparison between the performance of cattle grazing rehabilitation and the representative cattle grazing land suitability class of the broader area.

Table 22: Regional land suitability framework for beef cattle grazing PMLU rehabilitation in the Bowen Basin (Short, 2025)

Limitation	Indicator	Suitable			Unsuitable	
		Class 1	Class 2	Class 3	Class 4	Class 5
Water availability	Soil water storage (mm)	>75	75 - 60	<60 - 40	<40 - 30	<30
Nutrient deficiency	Available-P (mg/kg) in 0-0.1m depth increment	>20	20 - 14	<14 - 8	<8 - 4	<4
Nutrient availability and toxicity	pH in 0-0.1m depth increment	7.3 - 6.6	< 6.6 - 6.0 >7.3 - 7.9	<6.0 - 5.6 >7.9 - 8.4	<5.6 - 5.0 >8.4 - 9.0	<5.0 >9.0
Surface condition	Surface condition	Fine (peds <10mm)	Coarse (peds >10mm)	Surface crust	Very hard setting	Massive
Salinity	ECe (dS/m) in effective rooting depth (0-0.6m depth increment)	<2	2 - 4	>4 - 10	>10 - 16	>16
Rockiness	Gravel, 20 - 60mm (%) Cobble, 60 - 200mm (%) Stone, 200 - 600mm (%) Boulders, >600mm (%)	<20 <10 <2 0	20 - 50 10 - 20 2 - 10 <2	>50 - 70 >20 - 50 >10 - 20 2 - 10	>70 - 85 >50 - 75 >20 - 50 >10 - 20	>85 >75 >50 >20
Slope gradient	Slope gradient (%)	<5	5 - 10	<10 - 15	>15 - 20	>20
Microrelief	Vertical (m)	0	<0.2	0.2 - 0.4	>0.4 - 0.6	>0.6
Water erosion	Slope (%), ESP <6 (%) in 0-0.1m soil depth increment Slope (%), ESP >6-14 (%) in 0-0.1m soil depth increment Slope (%), ESP >14 (%) in 0-0.1m soil depth increment	<5 <3 <1	5 - 8 3 - 6 1 - 2	>8 - 12 >6 - 10 >2 - 4	>12 - 18 >10 - 12 >4 - 6	>18 >12 >6
Sub-soil erosion	ESP (%) at 0.5m depth	<6	6 - 14	> 14 - 23	>23 - 34	>34
Potentially acid forming materials	Strongly acid conditions (pH <4.5) within (x) m depth	>3	3 - 2	<2 - 0.9	<0.9 - 0.6	<0.6

3.1.2 Grassland

For areas that require a cover with shallow rooted species to manage risk, and cattle may impact the stability and integrity of the cover, a substantially similar PMLU to cattle grazing is proposed - grassland. The objective of this PMLU is stability, therefore this PMLU will not be grazed and vegetation cover is not a priority, to ensure contaminants are not released to the receiving environment. The milestone criteria for the grassland PMLU reflects the requirement for stability, with seeding with shallow rooted species, similar to cattle grazing PMLU, and rock may be utilised on steeper areas for erosional stability.

At GRM and BRM, grassland PMLU is planned for tailings and rejects cover areas (RA6, RA9).

3.1.3 Woodland habitat

3.1.3.1 Planned woodland habitat

The EA objectives, indicators and acceptance criteria for a woodland habitat PMLU are listed in Table 23. As the GRM and BRM EA is an approved LOD, BMA has transitioned the relevant EA acceptance criteria, as per the legislative intent of the transitional provisions, to the final milestone criteria of achievement of the PMLU to a stable condition of woodland habitat (RM14).

At GRM and BRM, woodland habitat PMLU is planned for:

- Spoil dumps, including the low-wall within RA1(the low-wall within RA1 includes extending the woodland habitat PMLU into the Goonyella residual voids, 20m below ground level)
- Areas adjacent to existing vegetation
- Subsidence areas impacting remnant vegetation (in accordance with EA condition)

Table 23: GRM and BRM EA PMLU, indicators and acceptance criteria: woodland habitat

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5 unless an alternative is justified by an appropriately qualified person
	Rehabilitation is erosionally stable	Groundcover (steep slopes, >15%)	80%
		Groundcover (lesser slopes, ≤15%)	50%
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Deep drainage from rehabilitation achieves relevant water quality	EC	Not significantly different to: the *Environmental Protection (Water) Policy 2009* schedule documents water quality objectives

Goal	Objective	Indicator	Acceptance criteria
	objectives for groundwater		for relevant groundwater chemistry zones; or local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
Able to sustain an agreed post-mining land use	Native bushland characteristics	Species richness: Trees Shrubs Grasses	 ≥2 ≥3 ≥4
		Tree canopy cover	≥16 %

3.1.3.2 Existing woodland habitat

For areas of existing woodland habitat rehabilitation (RA10), BMA has transitioned the relevant EA acceptance criteria to the final milestone criteria of achievement of the PMLU to a stable condition (RM18). In accordance with the EA and practices at the time of rehabilitation establishment, the existing woodland habitat areas were not designed to allow for the collection of surface water quality samples representative of the specific rehabilitation area. Criteria associated with the collection of surface water samples has not been transitioned for the existing rehabilitation areas.

3.1.4 Watercourse

The EA objectives, indicators and acceptance criteria for a watercourse PMLU are listed in Table 24. These criteria were developed specifically for diversions, although they can be applied to watercourse rehabilitation. As the GRM and BRM EA is an approved LOD, BMA has transitioned the relevant EA acceptance criteria, as per the legislative intent of the transitional provisions to the final milestone criteria of achievement of the PMLU to a stable condition of watercourse (RM15).

The watercourses that transverse through GRM and BRM, and any associated diversions, are assigned a watercourse PMLU (Section 1.2.4).

The lateral limits of the watercourse PMLU were defined based on the following considerations:

- Aerial imagery of the watercourses and drainage diversion/structures and associated riparian vegetation/regional ecosystems (Section 1.2.8)
- Strahler stream orders (Section 1.2.4)
- Flood modelling (Section 6.1.2)
- Diversion designs (Section 6.1.7)

The disturbed areas within the watercourse PMLU include the diversions (Isaac River, Eureka Creek, Holding Paddock Creek and Fisher Creek), various watercourse crossings and subsidence impacted areas.

Table 24: GRM and BRM EA PMLU objectives, indicators and acceptance criteria: watercourse

Goal	Objective	Indicator	Acceptance criteria
Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined	Hazard assessment	No significant difference

Goal	Objective	Indicator	Acceptance criteria
	landscapes subject to the same land use		
Stable	Rehabilitation is erosionally stable	Geomorphic index (Index of Diversion Condition (IDC) method)	Greater or equal to upstream or downstream values
Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
Able to sustain an agreed post-mining land use	Riparian vegetation	Riparian vegetation index (IDC method)	Greater or equal to upstream or downstream values

3.2 Community considerations

The PMLUs of cattle grazing, woodland habitat and watercourse as presented in the EA and this PRCP, is consistent with the outcomes of community consultation completed to date (Section 2). No concerns on these proposed PMLUs were raised during community consultation, including:

- Consultation with BBAC - the PMLUs have been discussed with the BBAC as part of ongoing consultation regarding the development of the PRCPs. This consultation included discussion on opportunity for BBAC's involvement in rehabilitation activities as it relates to the proposed PMLUs, specifically on the provision of seed and contracting opportunities for rehabilitation execution.
- Consultation with IRC – BMA has provided regular PRCP briefings to the IRC which have detailed that the proposed PMLUs as per the EA, are being transitioned into the PRCP. IRC and BMA have agreed to continue to engage on future opportunities, challenges and community aspirations, relevant to mine rehabilitation and closure as they develop.

The proposed PMLU of grassland, which is substantially similar to cattle grazing, was requested by the administering authority via consultation during a site visit to GRM in May 2025 (during the information stage), to improve the rehabilitation outcomes for areas that require stability.

3.3 Regional planning integration

The PMLUs at GRM and BRM consider pre-mining land uses, current adjacent land uses (cattle grazing and coal mining) and already approved PMLUs in the GRM and BRM EA (Section 3.1).

Under the Isaac Regional Planning Scheme (Isaac Regional Council, 2021), GRM and BRM is located in a *rural zone*. This includes primary production uses (such as cropping, intensive horticulture, aquaculture, grazing, intensive animal industries, animal husbandry and animal keeping), renewable energy facilities and extractive industries, outdoor recreation and small-scale tourism facilities. The purpose of the rural zone includes providing "*for other uses and activities that are compatible with: (i) existing and future rural uses and activities; and (ii) the character and environmental features of the zone…*" (Isaac Regional Council, 2021).

Land use performance outcomes (PO11) for this rural zone include ensuring development:

'(a) is consistent with the rural character of the locality;

(b) supports the primary rural function of the zone;

(c) protects rural, natural and scenic values of the locality; and

(d) includes boundary re-alignments where used to align with mining or petroleum tenements'.

Concurrently, the Queensland Government, via its Mackay, Isaac and Whitsunday Regional Plan (DLGP, 2012), maps GRM and BRM in a regional landscape and rural production area, which includes land used for agriculture, natural economic resources (including extractive resources), water catchment, traditional uses, conservation areas and native forests.

The defined uses for both of these regional plans are consistent with the PMLUs planned for GRM and BRM.

Relationship with PRCP schedule
The proposed PMLUs for GRM and BRM are consistent with pre-mining land uses, current adjacent land uses and transition the EA approved, or substantially similar PMLUs. These PMLUs can also be aligned to future land use development outcomes defined as part of State and regional plans. The PMLU extents consider the closure landform, growth media, pre-mining land uses, existing vegetation, ecological values, watercourses and surrounding public infrastructure.

4 NON-USE MANAGEMENT AREAS

Legislative Requirement

In accordance with sections 126C(1)(d), (g) and (h) of the EP Act, for each proposed non-use management area, the rehabilitation planning part of the PRC Plan must:

- *state the reasons the applicant considers the area cannot be rehabilitated to a stable condition*
- *include copies of reports or other evidence relied on by the applicant for each proposed non-use management area*
- *state the extent to which the proposed non-use management area is consistent with the outcome of consultation with the community in developing the plan, and*
- *state the extent to which the non-use management area is consistent with any strategies or plans for the land of a local government, the State or the Commonwealth.*

PRCP Guideline (Section 3.3)

A NUMA is defined in the EP Act as an area of land the subject of a PRC Plan that cannot be rehabilitated to a stable condition after all relevant activities for the PRC Plan carried out on the land have ended. Proposed NUMAs must be justified under the criteria set out in section 126D(2) of the EP Act.

The rehabilitation planning part of the PRC Plan must also include:

- *information demonstrating that the proposed footprint of each NUMA is as small as practicable*
- *an assessment of the NUMA location options, having regard to the constraint of the resource location, with an analysis of the potential environmental harm and sensitivity of the surrounding environment of each option*
- *a description of the proposed location of each NUMA and the environmental values of the surrounding environment*
- *evidence showing how the proposed location will prevent or minimise environmental harm.*

In accordance with section 126D(1)(c) of the EP Act, the applicant must develop and implement management milestones within the PRCP schedule which achieve best practice management and minimise environmental harm for any NUMAs contained in the proposed PRC Plan. As part of the development of management milestones, the applicant must conduct a NUMA specific risk assessment to identify and quantify risks and associated controls. The risk assessment should have an overarching goal of identifying and controlling any significant risks to the community and the environment.

The proposed PRC Plan must include a detailed description of the nominated NUMA(s) for the site. The description must include, but is not limited to:

- *description of the land at surrender; any relevant safety features; completion criteria for measuring whether the NUMA has achieved sufficient improvement.*

Where a NUMA has already been identified in a land outcome document and is able to be transitioned into the PRCP schedule, the applicant is not required to comply with sections 126C(1)(g) or (h) or 126D(2) or (3) of the EP Act. NUMAs transitioned into the PRCP schedule are not required to complete the information requirements under section 126C(1)(j) of the EP Act in this section for those NUMAs. However, the legislative requirements under section 126C(1)(d) of the EP Act still apply.

Where a NUMA has not been pre-approved and is proposed as part of the transition into the PRC Plan, the applicant must include all of the requirements identified in this section.

As outlined in Section 754 (3) of the EP Act and Section 6.3.2 of the PRCP Guideline *"a NUMA will be taken to be pre-approved if a land outcome, the same or substantially similar to a NUMA, is contained in a land outcome document"*. Residual voids are authorised under Schedule E (Condition E6 and E7) of the EA as the LOD. BMA has transitional arrangements for residual voids as pre-approved NUMAs.

As per the PRCP Guideline, if a NUMA has already been identified in a LOD, the applicant is not required to comply with Sections 126C(1)(g) or (h), or Section 126D(2) or (3) of the EP Act and is not required to complete the information requirements under Section 126C(1)(j) of the EP Act for the approved NUMAs. However, GRM and BRM is still required to meet the legislative requirements under Section 126C(1)(d) of the EP Act.

As the LOD does not state the area or the location of the proposed NUMAs, the PRCP Guideline requires this PRCP to include detail on how the total area will be minimised and how the location of the proposed NUMAs will minimise risk to the environment.

4.1 Nominated NUMAs

The GRM and BRM NUMAs include the residual voids of Goonyella Pit, Thiess Pit, Broadmeadow Pit, Isaac Pit, R32 East and R32 South (Figure 14). Due to the pit progression down dip, the residual void of the main Goonyella Pit is located along the eastern approval limits within ML1763. The location of the residual voids in the southern end of the site is based on economic coal limits. Ramp voids are part of the residual voids.

The extent of the NUMAs is designed to achieve an area that is safe and structurally stable and includes: the residual void high-wall and end-wall below ground level and the associated wall set-backs at natural ground level to achieve a factor of safety (FoS) of 1.5; the residual void low-wall (and ramp walls) from 20m below ground level and the associated wall set-backs to achieve FoS of 1.5 (Goonyella Pit); the residual void low-wall (and ramp walls) below natural ground level and the associated wall set-backs to achieve FoS of 1.5 (Thiess Pit, Broadmeadow Pit, Isaac Pit, R32 East Pit and R32 South Pit); the residual void floor; and a safety bund and fence. The total proposed NUMA area is 2,297ha.

The NUMAs will incorporate safety features to prevent intentional access, including:

- A safety bund and fencing constructed at the NUMA extents to prevent human and livestock access
- Signage at regular intervals along the fence

The breakdown of the NUMA area into the high-wall, low-wall and void lake components are detailed in Table 25. This information is not a requirement of the PRCP Guideline but was required by DETSI for the assessment of Saraji Mine PRCP (approved 4 September 2024). R32 East is a box-cut, therefore the low-wall is not dumped spoil and has been reported as high-wall.

Table 25: Breakdown of GRM and BRM NUMA areas

Void	High-wall/end-wall void area (ha)	High-wall/end-wall set-back area (ha)	Low-wall void area (ha)	Low-wall set-back area (ha)	Void lake area (ha)
Goonyella	443	145	828	36	224
Thiess	58	26	73	-	36
Broadmeadow	54	31	72	-	15
Isaac	24	26	34	-	17
R32 East	59	33	-	-	16
R32 South	21	8	11	3	6

4.2 Minimising environmental impacts

Technical studies undertaken to support this PRCP have assessed, refined and optimised the NUMA locations and extent to minimise the potential for environmental harm. These studies resulted in the iterative refinement of the closure landform and NUMA design as documented below.

The NUMA locations and extent in the preliminary closure landform were used as the basis for the following void studies:

- Initial voids in flood plains modelling
- Initial void water balance modelling
- Initial void water quality modelling
- Initial void geotechnical assessment

Based on the outputs of these initial PRCP studies, the closure landform was redesigned to increase the distance of the high-wall and end-wall from the approved extents and watercourses, to achieve structural stability of FoS ≥1.5 within the NUMA extents and to limit interaction with the flood plain.

The refined closure landform, including refined NUMA locations and reduced NUMA extent, was then used as the basis for the following studies:

- Updated voids in flood plains modelling (Section 5)
- Updated void water balance modelling (Section 6.3)
- Updated void water quality modelling (Section 6.3)
- Updated void geotechnical assessment (Section 6.3)
- Groundwater modelling (Section 6.1.1)
- Rehabilitation flood modelling (Section 6.1.2)

The final NUMA locations and extent were further optimised based on the outcomes of all the final studies. This resulted in the final modifications to the closure landform to ensure the NUMAs minimise risk to the environment:

- Goonyella void: landform on the southern end-wall and sections of the high-wall to mitigate the risk of flooding into the residual void up to the 0.1% annual exceedance probability (AEP) (including climate change 20% increase in rainfall intensity) (Section 6.1.2)
- Thiess void: partial backfill of the ramps to reduce the catchment into the residual void (Section 6.1.1.1, Section 6.3)
- Isaac void: landform on the southern end-wall and sections of the high-wall to mitigate the risk of flooding into the residual void up to the 0.1% AEP (including climate change 20% increase in rainfall intensity) (Section 6.1.2)
- Airstrip void: full backfill of the void to a free draining landform to minimise the potential for environmental harm from partial backfill (Section 6.1.1.2)
- Reshaping the area between Airstrip void and R32 South void to mitigate the risk of flooding into the residual void up to the 0.1% AEP (including climate change 20% increase in rainfall intensity) (Section 6.1.2)

The studies presented in this PRCP are based on the NUMAs within the PRCP closure landform. The final NUMA locations and extents do not present an unacceptable risk of environmental harm outside of the tenure boundary due to:

- Flooding into the residual voids being mitigated up to the 0.1% AEP flood level (including climate change 20% increase in rainfall intensity) (Section 6.1.2)
- The residual voids create an inward hydraulic gradient maintained by evaporation from the void lakes, which minimises the potential for any contaminant migration via groundwater beyond the tenure boundary (Sections 6.1.1.2 and 6.3.2.3)

- Minimising potential for interconnectivity between the deeper Permian and shallower aquifers, which support different groundwater qualities (Section 6.3.2.2)
- Long-term pit water levels remaining below the spill point, and therefore, minimising the risk of residual voids overtopping and releasing void water to surface waters and/or the receiving environment (Section 6.3.2.1)
- The design of the NUMA extent to achieve structural stability, resulting in no geotechnical damage beyond the NUMA (Section 6.3.1)

Consideration has also been given to alternative NUMA solutions, such as partial or complete backfilling of the residual voids in excess of the backfill planned for flood mitigation. These considerations include the following:

- Complete backfilling of the residual voids will create flow-through or source conditions from the spoil and backfilled voids and increase the height of recovered groundwater, increasing the potential risk of interconnecting aquifers and impacting off-tenure areas such as the Isaac River Quaternary alluvium.
- Partial backfilling of residual voids (i.e. reducing the depth of the residual void) also increases the height of groundwater recovery, increasing the potential for flow-through or source conditions and increasing the potential risk of interconnecting aquifers and impacting off-tenure areas. EIS studies completed within a similar nearby environmental setting for the Winchester South mine (Whitehaven Coal, 2022), indicated partial backfilling to reduce the depth of the residual void, in the Bowen Basin environment, creates a surface lake of higher elevation, that also progresses towards brine levels of salinity over time. Saline residual void lakes of higher elevation have the potential to create additional complete exposure pathways to receptors through interconnecting of aquifers, releases to groundwater systems driven by increased hydraulic heads and overtopping into surface water systems.

Retaining the residual voids as presented in this PRCP (including backfill required for flood mitigation), maintains the strength of the inward groundwater hydraulic gradients: maximises the retention of groundwaters that have percolated through disturbed spoil profiles/other operational areas; retention of leachate from waste disposal areas; minimises the potential for connection of aquifers of different qualities; minimises the potential for overtopping during extreme weather events; and are key to managing the risk of potential environmental harm outside of the GRM and BRM tenure boundary.

4.3 Minimising NUMA area

The NUMA area proposed in this PRCP has been minimised from the original mine plans (Table 26). The preliminary PRCP closure landform incorporated a number of key strategies to minimise the NUMA area at GRM and BRM, including:

- Backfill of the pits during mining – spoil is dumped in the mined-out pit voids, resulting in over 72% of the mined-out pit void being progressively backfilled to ground level by the end of mining, including complete void backfill of Red Hill, Mitsui, Dampier and Eureka pits
- Backfill of ramp voids – backfill of ramp voids has commenced to minimise the final void area and this will continue throughout the life of the operation to maximise the backfill during mining
- Steepening the residual void high-walls and low-walls while maintaining the required geotechnical stability. Steepening the high-walls and low-walls is also part of the rehabilitation strategy to minimise risk to the environment by reducing the catchment area into the voids.

As detailed in Section 4.2, the development of the PRCP closure landform involved an iterative design process to allow the results of the supporting technical studies to be incorporated into the landform design. The final iteration of the closure landform submitted in the PRCP included further minimisation of the NUMA area by:

- Increasing the set-back of the high-wall and end-wall from the lease boundary, cultural significant areas, and watercourses to achieve the required FoS
- Void backfill of:
  - Goonyella void – partial backfill of northern end
  - Thiess void – backfill of ramps to reduce catchment
  - Airstrip void – complete backfill of void above tailings (R32 TSF), eliminating the NUMA

- Extending the PMLU on the low-wall into the residual void, 20m below ground level for those pits with further mining, as was negotiated during the assessment of the Saraji Mine PRCP (approved 4 September 2024)

Table 26: NUMA area minimisation

	NUMA area prior to minimisation	Preliminary PRCP landform design	Final PRCP landform design (minimise risk to the environment)
Void rea (ha)	2,589	2,569	1,991
NUMA area (ha)	2,915*	2,895	2,297
Reduction (ha)	-	20	618
Reduction (%)	-	1	21

**Set-back area estimated to be the same as the preliminary PRCP closure landform design*

4.4 Community considerations

Residual voids as NUMAs as presented in the EA and this PRCP, is consistent with the outcomes of community consultation completed to date (Section 2). No concerns on the proposed NUMAs were raised during community consultation, including:

- Consultation with the BBAC – the plan for residual voids as NUMAs has been shown to the BBAC as part of ongoing consultation in regard to the development of the PRCPs. This consultation included discussion of opportunity for BBAC's involvement in closure activities.
- Consultation with IRC – BMA has provided regular PRCP briefings to the IRC which have detailed the plan for residual voids as NUMAs. IRC and BMA have agreed to continue to engage on future opportunities, challenges and community aspirations, relevant to mine rehabilitation and closure, as they develop.

4.5 Regional planning integration

Both the local Isaac Regional Planning Scheme (Isaac Regional Council, 2021) and the broader Mackay, Isaac and Whitsunday Regional Plan (DLGP, 2012) identify mineral and extractive resource industries - in particular, coal and coal seam gas, as significant components of the current and future regional economic development.

Relationship with the PRCP schedule
The proposed NUMAs for GRM and BRM are designed to be safe, structurally stable and minimise the risk of environmental harm. Retention of residual voids as pre-approved NUMAs, as part of the rehabilitated landscape, is consistent with the GRM and BRM LOD.

5 VOIDS IN FLOOD PLAINS

Legislative Requirement

In accordance with section 126D(3) of the EP Act, if land the subject of the proposed PRCP schedule will contain a void situated wholly or partly in a flood plain, the schedule must provide for the rehabilitation of the land to a stable condition.

PRCP Guideline (Section 3.4)

Section 41C of the EP Regulation states the decision considerations for a void situated wholly or partly in a flood plain. A void is considered to be located in a flood plain if the flood plain modelling shows that, when all relevant activities carried out on the land have ended, the land is the same height as, or lower than, the level modelled as the peak water level 0.1% AEP for a relevant watercourse under the guideline Australian Rainfall and Runoff (2019) (ARR).

Where a land outcome document has a pre-approved land outcome for a void with a location specified, flood plain modelling is not required. If a void has been identified as a NUMA in a land outcome document but the location is not identified, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline. While the provision in the EP Act relating to voids located within a floodplain having to rehabilitate to a stable condition does not apply, the PRC Plan must include how the proposed location of the void minimises risks to the environment. Therefore, the flood plain modelling is required to support the assessment of the proposed location of the void.

If there are no land outcomes identified in a land outcome document, the applicant is required to carry out flood plain modelling in accordance with this section of the guideline.

A voids in flood plain assessment has been undertaken by an AQP to support the development of this PRCP. The detailed report – *Goonyella Complex Progressive Rehabilitation and Closure Plan Voids in Floodplain Report* (SLR, 2024a), is provided in Appendix G.

5.1 Background

The GRM and BRM closure landform includes residual voids as pre-approved NUMAs for Goonyella Pit, Thiess Pit, Broadmeadow Pit, Isaac Pit, R32 East Pit and R32 South Pit (Figure 14). The locations of these residual voids are not identified in the LOD (EA EPML00853413) and therefore, in accordance with the PRCP Guideline transitional PRCP provisions, a voids in flood plain assessment has been undertaken.

5.2 Relevant watercourses

A 'relevant watercourse' for the purpose of the voids in flood plain assessment is defined as (State of Queensland, 2022):

(a) a watercourse classified as stream order 4 or higher under the Strahler stream order classification system; or

(b) if a watercourse mentioned in paragraph (a) is permanently diverted under—

(i) a condition, or proposed condition, of an environmental authority mentioned in the Water Act 2000, section 98; or

(ii) a water licence or proposed water licence under the Water Act 2000;

(iii) the watercourse as permanently diverted.

Within the proximity of GRM and BRM, the only relevant watercourse with a Strahler stream order of four or greater that could have a flooding influence, is the Isaac River. In the proximity of the site, the Isaac River has a Strahler stream order of six.

5.3 Void in flood plain landform

The intent of the voids in flood plain modelling is to represent the flood plain within the mining tenure without 'artificial features' as defined by *Environmental Protection Regulation 2019* (State of Queensland, 2022). As mining commenced at GRM in 1971, a single source of pre-mining topographical information was not available. The pre-mining digital elevation model (DEM) landform used for the purpose of voids in flood plain modelling,

was developed using a combination of BMA LiDAR datasets and publicly accessible Geoscience Australia one second Shuttle Radar Topographic Mission Hydrological DEM topographical data. Terrain modifiers were used to assist the alignment of the different topographical data sets and to provide reasonable interpretations of drainage alignments within the lower resolution Geoscience Australia one second Shuttle Radar Topographic Mission Hydrological DEM topographical data.

As part of the removal of artificial features, the GRM and BRM diversions, including the Isaac River diversion, have been removed and the pre-mining alignments used. The pre-mining diversion alignments have been mined through and used for the placement of spoil and are therefore no longer suitable alignments for post-mining watercourses.

Off-tenure artificial features, such as surrounding mine sites, dams and infrastructure corridors that have the potential to impact the flood plain were assessed for their potential to influence flood hydraulics at GRM and BRM. As part of the assessment of off-site artificial features, the Burton Gorge Dam was identified as having the potential to influence flooding conditions at GRM and BRM and has been included in the model.

5.4 Modelling

Hydrologic modelling was undertaken to estimate runoff hydrographs at various locations throughout the catchment of the Isaac River. The model was developed using the Watershed Bounded Network Model (WBNM) Version 2019, which is an industry standard rainfall-runoff routing software package. The Isaac River model covers a catchment area of approximately 1,250 km^2, spanning from the catchment headwaters upstream of Burton Gorge Dam to approximately 6km downstream of GRM and BRM.

Hydraulic modelling was undertaken for the Isaac River in the vicinity of GRM and BRM, including the proposed residual voids. The industry standard hydrodynamic modelling software TUFLOW (build 2023-03-AD) was utilised for the hydraulic modelling.

Further details of the voids in flood plain modelling are contained in Appendix G.

5.5 Results

The results of the void in flood plain assessment for peak water levels and depths for the 0.1% AEP event are illustrated in Appendix G. The results indicate:

- The southern extents of the Goonyella and Theiss residual voids are located within the modelled flood plain
- Broadmeadow, Isaac, R32 South and R32 East residual voids (located in the proximity of the pre-mining alignment of the Isaac River) are predominantly located within the modelled flood plain

The final closure landform design (Section 6.1.5) provides for maintaining the diversion's alignment and flood protection to the final residual voids up to and including a 0.1% AEP flood level including a climate change increase in rainfall intensity of 20% (Section 6.1.2). This final closure landform design therefore minimises risks to the environment from flooding of the residual voids, as per the transitional requirements.

Relationship with the PRCP schedule
The residual voids are partly located within the modelled flood plain for the void in floodplain assessment. The location and extent of the residual voids, combined with other aspects of the landform design, including backfill of final voids and placement of spoil dump and landforms, provides protection to the residual voids from flood events up to and including a 0.1% AEP and minimises risks to the environment, as per the transitional requirements.

6 REHABILITATION AND MANAGEMENT METHODOLOGY

Legislative Requirement

In accordance with section 126C(1)(e) and (i), the rehabilitation planning part of the PRC Plan must:

- *For each proposed post-mining land use for land, state the proposed methods or techniques for rehabilitating the land to a stable condition in a way that supports the rehabilitation milestones under the proposed PRCP schedule.*
- *For each proposed non-use management area, state the proposed methodology for achieving best practice management of the area to support the management milestones under the proposed PRCP schedule for the area.*

PRCP Guideline (Section 3.6)

The proposed rehabilitation or management methodologies will underpin the development of the milestone criteria and support how the proposed PMLU will be achieved or the NUMA will be managed. As per section 126C(1)(j) of the EP Act, the administering authority requires information describing how the proposed rehabilitation or management methodologies have been developed and will be implemented.

This section identifies a number of studies or reports that must be provided in the proposed PRC Plan. If any of the required information outlined below is not relevant to the specific operation, the applicant must provide justification in the PRC Plan outlining why the information is not required.

PRCP Guideline (Section 3.6.1)

This section outlines the range of information that the administering authority considers is necessary to underpin the development of the rehabilitation or management methodologies applicable to new and existing mines for most domains. The applicant must include the information as appendices to the rehabilitation planning part.

6.1 General rehabilitation practices

6.1.1 Hydrogeology

PRCP Guideline (Section 3.6.1)

Assess the hydrogeology of the site and all connected strata, and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the design of rehabilitation strategies and choice of PMLU or NUMA.

A hydrogeological assessment including conceptual and numerical modelling, has been undertaken to support the development of this PRCP. The detailed report – *Transitional PRCP - Goonyella Complex - Hydrogeology Assessment* (AECOM, 2024), is provided in Appendix D. The groundwater numerical model domain for GRM and BRM includes the MLs forming GRM, BRM and RHM, in addition to surrounding areas where the operations could influence groundwater conditions. As the operations at RHM have an influence on groundwater conditions at GRM and BRM, the interpretation of the hydrogeological conditions presented within this PRCP considers the RHM operations.

The key hydrogeological units present within and immediately surrounding GRM and BRM are detailed in Section 1.2.5 and include:

- Quaternary alluvial - Unconfined aquifer (sporadic discontinuous water-bearing strata of permeable unconsolidated sand or gravel) localised at and near to the Isaac River, Eureka Creek and Goonyella Creek, and more regionally along the Isaac River
- Tertiary sediments - consisting of clay, silt, sand, gravel, colluvium, fluvial, and lacustrine deposits. Unconfined discontinuous aquifer with groundwater generally restricted to more porous media that overlies Permian units
- Permian coal measures - Low permeability interburden/overburden units with aquitard properties and coal seams that exhibit water bearing properties primarily associated with secondary porosity through cleats and fracturing

6.1.1.1 Groundwater modelling

To support the assessment of potential groundwater impacts, numerical groundwater modelling was undertaken in accordance with the Australian Groundwater Modelling Guidelines (Barnett, et al., 2012), the Murray Darling Basin Commission Groundwater Flow Modelling Guideline (Aquaterra, 2001) and the Independent Expert Scientific Committee Explanatory Note for Uncertainty Analysis (IESC, 2018). The numerical groundwater model was adapted from the existing 2013 RHM groundwater model, which had been built using MODFLOW-SURFACT™ modelling package. The numerical groundwater model was updated to: reflect current available data; increase the model domain providing coverage for the area of interest; incorporate the PRCP closure landform/mining progression; and to achieve alignment with updates to the Australian Groundwater Modelling Guidelines.

The model update utilised MODHMS® (Hydrogeologic Inc., USA) that extends on the original MODFLOW-SURFACT™ modelling package to enhance the simulation capabilities and robustness. MODHMS® is based on the standard MODFLOW groundwater modelling code. The MODFLOW code was developed by the United States Geological Survey (McDonald and Harbaugh 1984) for three-dimensional, groundwater flow modelling. The MODFLOW code is the most widely used code for groundwater modelling and is considered an industry standard.

The objectives of the groundwater modelling, as required for input into the PRCP, were to:

- Assess the potential groundwater related impacts at completion of mining and until conditions stabilise post rehabilitation
- Assist in demonstrating the suitability of the closure landform for the PMLUs (i.e. evaluate the residual voids included in the final landform to determine influence on groundwater resources)
- Demonstrate the closure landform is non-polluting with respect to potential poor-quality water leaving the MLs within groundwater
- Demonstrate that groundwater receptors post-closure are not adversely impacted by the closure landform

The model layer elevations in the refined-grid area were generated based on the GRM, BRM and RHM geological model, and publicly available data outside of the model's domain. The groundwater numerical model layers utilised are summarised in Table 27.

Table 27: Numerical groundwater model layers

Layer	Unit
1	Tertiary, alluvium
2	FCCM
3	Overburden
4	GUS coal seam
5	Interburden
6	GP1 coal seam
7	Interburden
8	GP2 coal seam
9	Interburden
10	GMS coal seam
11	Interburden

Layer	Unit
12	GLS coal seam
13	Underburden
14	Back Creek Group

Due to the proximity of the RHM operations to the east and down dip, the dewatering/depressurisation and subsequent flooding of RHM underground workings has a significant influence on groundwater within GRM and BRM. Therefore, the GRM and BRM model results are discussed with consideration of RHM's influence on groundwater and the timing of RHM operations.

Climate change considerations have been included within the modelling through the water balance model and have been based on the *BMA Climate Change Adaptation in Mine Water Planning and Hydrologic Assessments Guideline* (BMA, 2023). To derive the groundwater model predictions the average annual residual void lake levels from three climate scenarios that represented a reasonable range have been used (Appendix O).

To account for the influence that groundwater and the void lakes have on each other, the groundwater model and the void water balance models (Section 6.3) were aligned through an iterative modelling approach. The iterative alignment approach included the inclusion of the water balance model void lake outputs within the groundwater model, the groundwater model was re-run to refine the groundwater inflows to the voids, which were then used to re-run the water balance model. This process was repeated until the variance between the iterations in the model outputs indicated an appropriate level of alignment had been achieved.

During the alignment of the models, the output data was also used to inform changes to the landform design where required to minimise the potential for environmental harm. This included landform changes to minimise the residual void catchments through the backfilling of ramp voids and placement of high-wall landforms. The Airstrip void, which in the original closure landform was a NUMA, was backfilled to minimise the potential for environmental harm and minimise the NUMA area.

Further details on the model build, calibration and design are contained in Appendix D.

6.1.1.2 Residual void groundwater inflow

The Goonyella residual void is the deepest and largest residual void that will remain at GRM (Section 6.3.4) and therefore has the greatest influence on the groundwater levels in the post-mining environment. The modelled lake levels of the Goonyella residual void are >100m deeper than other residual voids on the tenure with void lake levels stabilising around 20mAHD. The model predictions indicate the void will maintain sink conditions to both the spoil and natural rock aquifers from the completion of dewatering activities for the entire simulation period. Predicted groundwater levels immediately surrounding the residual void (20 to 35mAHD), remain lower than surrounding groundwater levels, including across the remainder of the tenure, driving an inward hydraulic gradient towards the residual void.

The R32 East and R32 South residual voids, which are located adjacent to the backfilled Airstrip void/R32 TSF, develop into groundwater sinks to both the surrounding spoil and natural rock formations. There is some variability in the fluxes in the initial 30 years post completion of mine dewatering activities, resulting from the more climatically driven void lake levels compared to the slower recovering groundwater. Fluxes out of the voids are limited to the spoil and the void lake water quality model predictions, within the period of potential outward fluxes, indicates the total dissolved solids (TDS) will be within the range that has been monitored within the Permian hosted groundwater at the site. With void lake levels predicted to be approximately 162mAHD (R32 East) and 173mAHD (R32 South), these two residual voids create relatively small inward hydraulic gradients when compared to the Goonyella residual void.

The Broadmeadow residual void maintains sink conditions to the spoil formations located to the north and west and a periodic source to natural rock formations. Although the model predictions over the simulation period suggest the flux to groundwater is decreasing over time and the void may eventually become a sink to both spoil and natural rock. Further details on the flow path simulation for outward fluxes from this void are discussed in Section 6.1.1.4 and indicate the flow paths post-mining will be towards the Goonyella residual void.

The Thiess and Isaac residual void lakes are sources to both spoil and natural rock hosted groundwater. Thiess residual void, which is located up dip from the Goonyella residual void, has a modelled stabilised lake level of approximately 203mAHD. The Isaac residual void has a modelled stabilised lake level of approximately 179.5mAHD. Water quality modelling within these voids indicates that TDS levels stabilise below 10,000mg/L, which is within the range present within the Permian aquifers, and therefore, outflows from these voids are unlikely to present a risk of environmental harm through contamination of groundwater. Also, as detailed in Section 6.1.1.4, outward fluxes, after completion of mining at RHM and stabilisation of the groundwater levels, from the residual void lakes would migrate towards the Goonyella residual void and be retained within the tenure.

Consideration has been given to alternative residual void options, such as partial backfilling to above the groundwater levels. However, in the environmental setting in which the residual voids are located, void lakes are still expected to form on top of the backfill material, as void lake in-flows are primarily sourced from rainfall derived water. The void lakes that form on top of backfill material will have greater hydraulic head gradients towards the surrounding groundwater aquifers increasing the volumes of outflows from the void lakes and increase the potential for interconnection of aquifers and overtopping.

The initial iterations of the closure landform design included the Airstrip void as a NUMA, with partial backfill of tailings which reduced the overall depth of the residual void to the base of the GMS coal seam. The predictive water balance and groundwater modelling results indicated that this residual void presented an increased risk of environmental harm due to: the increased hydraulic head toward surrounding groundwater units; contact between the void lake and shallow geological units; and increased risk of overtopping during extreme wet weather conditions. The partial backfilling of the residual void resulted in poorer groundwater environmental outcomes. Based on these modelling results the closure landform was redesigned to fully backfill the Airstrip void, to form a free draining surface that will support a PMLU and minimise the potential for environmental harm. Maintaining the strength of the Goonyella residual void lake creates inward hydraulic gradients for GRM and BRM tenure and thus provides long term management of groundwater contaminant migration for the site.

6.1.1.3 Groundwater levels

As mining operations commenced at GRM in 1971, prior to available data on groundwater levels for the area, a pre-mining groundwater potentiometric surface cannot be determined. Groundwater model simulations of groundwater recovery in the post-mining environment have been undertaken and are detailed in Appendix D.

As the alluvium and Tertiary sediments are underlain by Permian overburden with relatively low hydraulic conductivity and recharge is from precipitation and losing streams, there is limited to no change predicted by the numerical groundwater model for the alluvium in the post-mining landform. GDE locations, associated with the Isaac River, are modelled not to have any change in groundwater levels associated with the closure landform. Drawdown of groundwater in the Tertiary sediments in the proximity of the residual voids is expected to be maintained post-mining, with much of the tenure area expected to remain dewatered.

Modelling of the GMS groundwater levels indicates the following:

- The underground mining operations at RHM influence groundwater levels in the GMS at GRM and BRM. The RHM dewatering/depressurisation, in the period immediately after the completion of mining at GRM and BRM, draws down groundwater levels, and then through post-mining flooding of the RHM underground workings increase the rate of groundwater recovery.
- The GMS groundwater levels are predicted to remain drawn down across GRM and BRM as a result of the residual voids maintaining an inward hydraulic gradient toward the tenure, however the post-mining groundwater levels are modelled to partially recover after the completion of mining at RHM.
- The lower groundwater levels in the GMS are not predicted to induce flows from the Back Creek Group and Tertiary materials located to the west of the tenure.

Modelling of the GLS groundwater levels indicates the following:

- The underground mining operations at RHM influence GLS groundwater levels at the GRM and BRM site. The dewatering and depressurisation at RHM, in the period immediately after the completion of mining at GRM and BRM, lower groundwater levels and then through post-mining flooding of the RHM underground workings increase the rate of groundwater recovery.
- The injection of water and flooding of the BRM underground workings at the completion of mining results in a recovery of the GLS groundwater levels of approximately 50m.

- The Goonyella residual void maintains a drawdown in the GLS and an inward hydraulic gradient.

Groundwater levels at the registered supply bores within 20km of GRM and BRM, identified one bore that will be adversely impacted post-mining. Groundwater bore RN182313 (Cleanskin Gully bore), which was drilled to 25.34 m and intersects FCCM, is located adjacent to the Goonyella residual void high-wall in the proximity of the ML boundary between GRM and RHM. Groundwater at this location will be drawn down beyond the depth of the bore. Noting this bore is located within the BMA operational area and adjacent to the Goonyella high-wall, the on-going use of this bore for supply purposes is not considered plausible.

6.1.1.4 Flow path simulation

An assessment of the potential contaminant migration paths within groundwater were assessed through particle tracking simulation within the groundwater model, which is detailed in Section 15.6 of Appendix D. To assist with understanding of the particle movement during the progressive completion of mining operations, particle tracking was completed for:

- 2061 at the time of completion of the BRM and GRM mining operations (dewatering to support the RHM operations occurring)
- 2093 at the completion of dewatering and flooding of the underground at RHM
- 2199 after stabilisation of groundwater and void lakes

The particle tracking simulation commencing in 2061 within and surrounding the residual voids indicates that particles move out of the Isaac, R32 South and Thiess residual voids to the west, which is likely associated with the re-establishment of groundwater within the in-pit spoil dumps. The Broadmeadow and Thiess residual voids also show particles moving to the east towards the underground workings. Noting that dewatering/depressurisation associated with mining at RHM during this period significantly influences hydraulic gradients at GRM and BRM and draws particles to the underground workings where they would be actively pumped out to mine affected water storages located at GRM and BRM.

The particle tracking simulation commencing in 2093 indicates that particles both within and surrounding the residual voids continue to migrate towards the underground workings associated with RHM and towards the Goonyella residual void. Particles that migrate into the RHM underground workings remain within the underground workings for the simulation period. Particles that migrate to the west out of the residual voids do turn and follow the groundwater gradients towards the Goonyella residual void and RHM underground workings or remain within the spoil. Particles placed on the eastern side and down dip of the Goonyella residual void in the proximity of the GRM ML boundary migrate back towards the Goonyella residual void, confirming the Goonyella residual void is acting as a groundwater sink.

The 2199 particle tracking simulation is a long-term assessment for the 100-year period after 2199 when the groundwater and void lakes in the GRM and BRM area, and the influence from RHM, have stabilised. This simulation is representative of the long-term post-mining groundwater conditions. Particles that migrate out of the Thiess, Isaac and Broadmeadow residual voids, and immediately surrounding the residual voids, all migrate towards the Goonyella residual void. Particles within R32 East and R32 South, remain within these residual voids confirming they are acting as groundwater sinks. Particles placed outside and down dip to the east of the Goonyella residual void also migrate back towards the residual void. Figure 15 illustrates the predicted particle movements between 2199 and 2299 for particles placed in Theiss, Broadmeadow, Isaac and R32 East and R32 South residual voids and groundwater contours for the GMS in 2299.

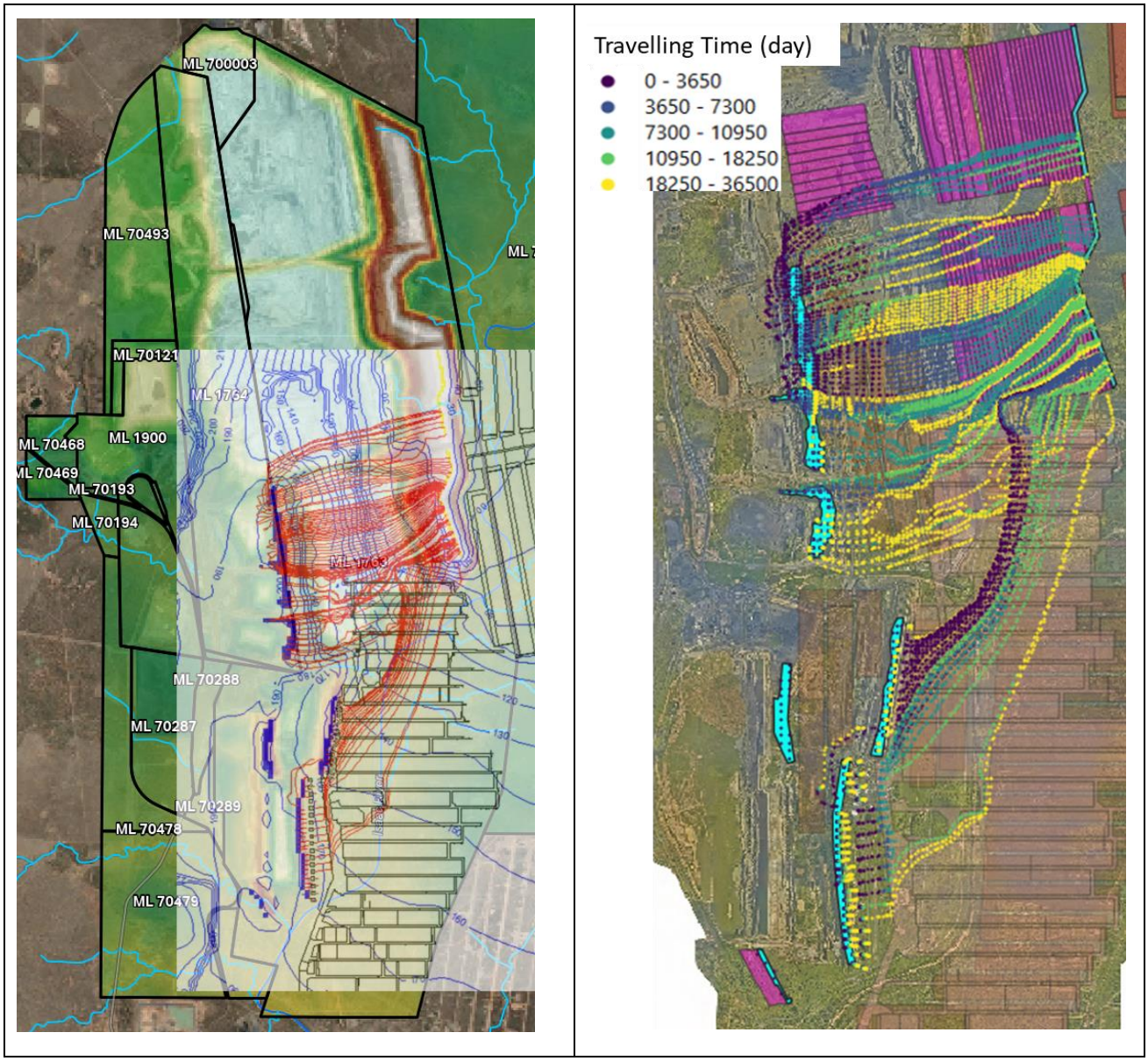

Figure 15: Particle tracking post-mining and stabilisation of groundwater (2199 – 2299)

As part of the 2199 particle tracking simulation, TSF areas and reject areas were also assessed through placement of particles within the underlying Tertiary material. Due to the Tertiary material remaining dewatered over much of the GRM and BRM area, and the underlying Permian overburden having a low hydraulic conductivity limiting the potential for interconnection of the aquifers, the modelled particles did not move within the simulation period. Where Tertiary groundwaters were present in the proximity of the southern end of RS1 TSF, Riverside MIA and the Riverside rejects dump, the modelled particles migrated towards the Goonyella residual void within the simulation period.

6.1.1.5 Post-mining conceptual site model

An evaluation of the source-pathway-receptor (SPR) linkages based on the modelling results for the post-mining environment, where groundwater conditions have stabilised, has identified the following key features:

- The Goonyella residual void lake level predictions stabilise markedly below the post-closure recovered groundwater elevations for all directly impacted hydrostratigraphic units, and below the other five residual void lake levels. The Goonyella residual void forms a terminal groundwater sink that creates an inward groundwater hydraulic gradient towards the void and effectively limits any potential poor-quality groundwater migrating away from the tenure.

- Residual groundwater drawdown within the MCM coal seams resulting from dewatering within the approved mining operations, with ongoing evaporative discharge from the residual voids, results in continued inward hydraulic flow gradients in the coal measures to three of the six residual voids:
  - Groundwater outflow from Thiess and Isaac residual voids is predicted to be captured within Goonyella residual void
  - Broadmeadow residual void outflows is predicted to be captured within Goonyella residual void upon stabilisation of the groundwater and void lakes, with long term model predictions indicating outflows from the residual void lake will reduce or cease in the long term
- The Goonyella residual void is predicted to capture seepage from mine waste (TSF, rejects, MIA) and spoil areas
- The Goonyella residual void is predicted to influence groundwater levels within the BRM underground workings, where after water is introduced the (recovered) groundwater levels within the area of the underground workings are predicted to decrease marginally:
  - The GMS groundwater levels are predicted to increase by 200m in 2092 (water introduced into the underground workings) from the initial 2024 groundwater elevations, which are then predicted to decrease by 10m by 2199 due to ingress into Goonyella residual void
  - The GLS groundwater levels are predicted to increase by 60m in 2092 (water introduced into the underground workings) from the initial 2024 groundwater elevations, which are then predicted to decrease by 10m by 2199 due to ingress into Goonyella residual void
- Little to no impact on surficial aquifers including the Isaac River alluvium caused by the closure landform
- Little to no impact on environmental (GDEs) receptors caused by the closure landform
- The continuous evaporative losses from the void lakes indicate the residual voids will maintain inward groundwater hydraulic gradients that will prevent the mobilisation of contaminants beyond the tenure boundaries through groundwater migration
- No anthropogenic receptors are identified to be impacted by the closure landform

A visual representation of the post-mining conceptual site model is provided in Figure 16.

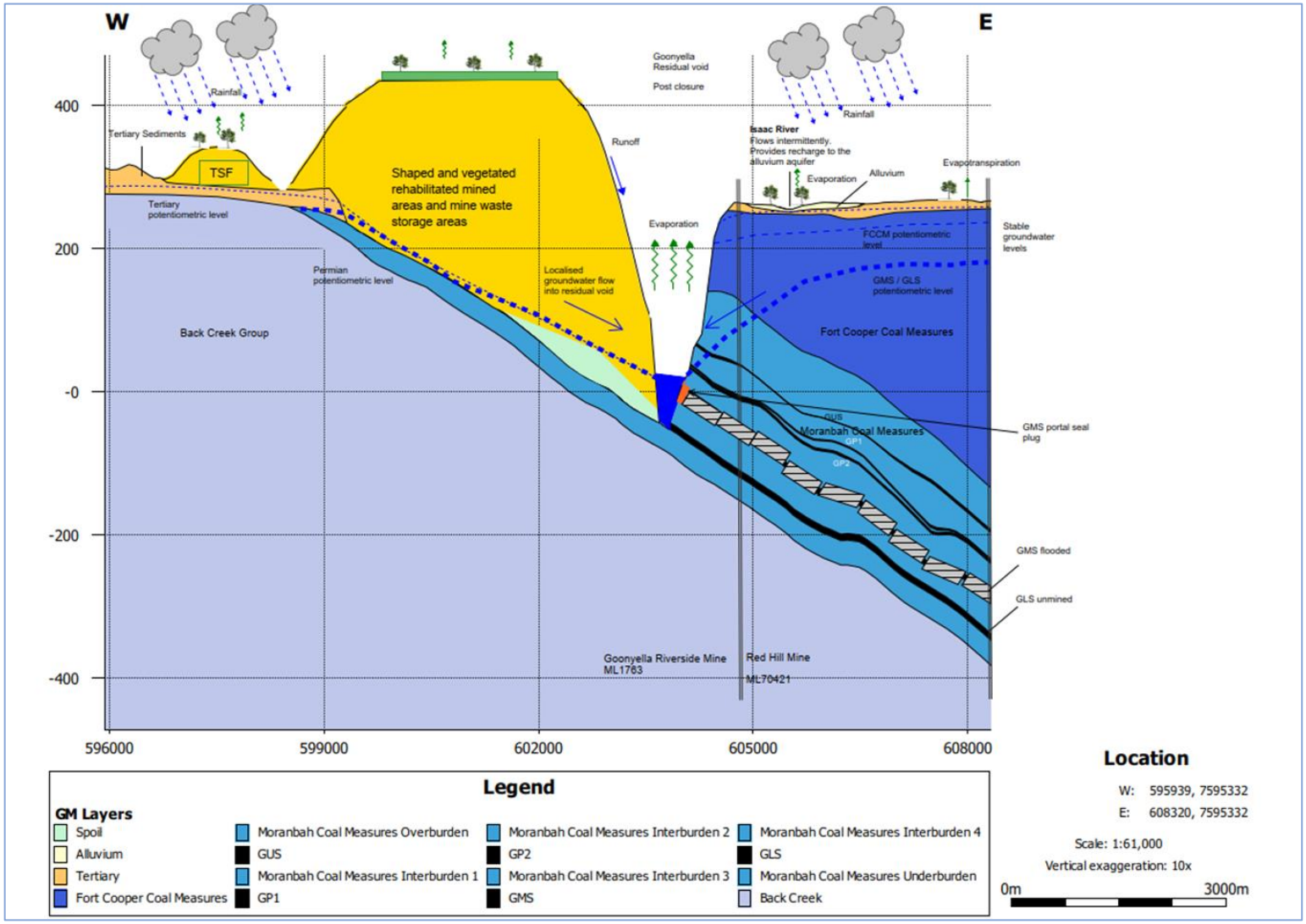

Figure 16: GRM and BRM post-mining conceptual site model (AECOM, 2024)

Relationship with the PRCP schedule
Groundwater, once stabilised, will have an inward hydraulic gradient towards the site which is centred on the Goonyella residual void. Seepage from the spoil dumps, MIA, TSFs and rejects will migrate towards and be captured in the Goonyella residual void, which acts as a terminal groundwater sink. The closure landform will have little to no additional impact to environmental or anthropogenic receptors. Groundwater is not anticipated to require any active management post-mining. Confirmation of groundwater quality, and the relationship between the void lakes and groundwater to demonstrate the development of the residual voids as sinks, will be completed through planned rehabilitation monitoring and modelling.

6.1.2 Flooding

PRCP Guideline (Section 3.6.1)

Section 3.4 of this guideline requires flood plain modelling for the purpose of voids located within a flood plain being rehabilitated to a stable condition. In addition to this, the applicant must also assess the flooding susceptibility and influence across the site. If flooding is a consideration, develop a hydrologic model of the catchment and a hydraulic model of the proposed mining area. Knowledge of flooding is integral to the rehabilitation planning process, including the placement and design of mine domains.

A rehabilitation flood assessment, including consideration of flow alteration, simulated flood levels for a range of design storm events and development of a flooding risk profile, has been undertaken to support the development of this PRCP. The detailed report - *Goonyella Complex Progressive Rehabilitation and Closure Plan Rehabilitation Flood Assessment* (SLR, 2024b), is provided in Appendix H.

The flood modelling was undertaken on an iterative approach with the closure landform design development. Information from the initial round of rehabilitation flood modelling was used to inform further development of the closure landform design. The final closure landform design included refinements comprising of backfill of Airstrip void, backfill of ramp voids, inclusion of high-wall landforms to provide flood protection, increased stand-off distances from tenure boundary and watercourses, and removal of culverts and other infrastructure from watercourses/floodplains. Upon finalising the landform design, the flood modelling was re-run and the flood risk profile and other interpretations updated to reflect the final closure landform design, which is presented within this PRCP.

6.1.2.1 Flood modelling

A review of the watercourses in the vicinity of GRM and BRM was undertaken using hydrologic streamline data sourced from DoR. The following watercourses were identified as potentially having flood extents that could interact with GRM and BRM:

- Isaac River
- Twelve Mile Gully
- Goonyella Creek
- Eureka Creek
- Fisher Creek
- Platypus Creek

Hydrologic model

A hydrologic model was developed for the GRM and BRM catchments using WBNM Version 2017. The rainfall-runoff routing program, Storm Injector Version 1.3.9.0 was utilised to assist in setup and analysis of Australian Rainfall and Runoff design storm ensembles and to review model results.

The hydrologic model covers a total area of 1,240km^2. Catchment land use was adopted based on the closure landform and aerial imagery, with a predominant land use assessed to be rural. Therefore, the majority of the catchment was modelled as fully pervious.

The WBNM model was simulated for the 39%, 2%, 1%, 0.1% AEP and probable maximum flood (PMF) events with a range of storm durations between 1 hour to 48 hours and 10 temporal patterns for each duration in accordance with Australian Rainfall and Runoff.

Flood frequency analysis was undertaken for the gauge at Isaac River at Burton Gorge (130402A). Data for this gauge is available between 1964 and 1988 (24 years). A second gauging station was considered, Isaac River at Goonyella gauge (13414A), however due to the construction of the Burton Gorge Dam in 1992, the data from this stream gauging station was considered not suitable for flood frequency analysis.

Validation assessment of the WBNM model indicated the results were comparable to the peak flows from the flood frequency analysis, regional flood frequency estimation at the Burton Gorge and the previous WRM (2019) assessment, although the outcome suggests that the 0.1% AEP results may be conservative on the high side.

Hydraulic model

2-dimensional hydraulic modelling was undertaken as part of the assessment, including:

- Fluvial model to quantify flooding conditions within the Isaac River, Eureka Creek, Platypus Creek and Fisher Creek for a range of design storm events. The results of the model were utilised to assess the risk of inundation of the residual voids and stability of the final landform
- Pluvial model to simulate local catchment rainfall runoff behaviour over the areas of the closure landform where subsidence will potentially occur. A direct rainfall (Rain-on-Grid) approach was applied. The model results were utilised to investigate potential ponding in subsidence areas.

The hydrodynamic modelling software TUFLOW (Build 2023-03-AE) was used for the hydraulic modelling.

The fluvial model set up utilised the closure landform and a model grid size of 10m. Two hydraulic structures were included in the model, which were associated with culverts under Goonyella Road and the Coppabella to North Goonyella section of the Goonyella System rail alignment. The fluvial model was used to simulate a range of design storm events including 39%, 2%, 1%, 0.1% AEP and PMF. Three climate change scenarios (6%, 11% and 20% increase in rainfall intensities) were also run for the 0.1% AEP.

Pluvial hydraulic modelling was undertaken for the area potentially subject to subsidence from underground mining as part of BRM and RHM operations (Section 6.4.1). The pluvial modelling set up utilised evaporation data from the State government SILO database Long Paddock (Queensland Government, 2024) (average evaporation rate 5.52mm/day, or 0.23mm/h) and GRM and BRM soil types (Landloch, 2024a), which were converted to the corresponding United States Department of Agriculture soil types used in TUFLOW software.

Within the BRM subsidence area, a combination of conceptual drains and backfill have been incorporated to limit potential depths of inundation and residual ponding. Where reasonably practical, and outside of the watercourse alignments and existing dams/drains, the modelled depth of inundation was designed to target 1m or less in a 2% AEP event which achieves a predominantly free draining landform. Free draining of the subsidence panels for the purpose of this assessment is where the landform sheds the majority of the surface water from the landform and towards the local drainage lines, and where any residual collection of water on the landform does not persist for more than one month under typical dry weather conditions.

Within the existing watercourse alignments, water depths may exceed 1m in a 2% AEP event and residual ponding was considered consistent with the PMLU of watercourse.

The conceptual design of the backfill and cutting of drains, where reasonably practical, limited surface disturbance, interference with endangered REs and limited disturbance of the banks of the Isaac River.

6.1.2.2 Fluvial flood levels and rehabilitation domains

The fluvial TUFLOW model results are shown on Figures 5-5, 5-6 and B1 1-1 to B3 8-3 contained in Appendix H. The results indicate that flood heights up to and including the 0.1% AEP climate change event, with 20% increase in rainfall intensity, do not result in the inundation of residual voids in the final closure landform. PMF events do result in flooding of all residual voids with the exception of R32 East. Flood waters entering residual voids during a highly unlikely PMF scale event, which includes significant inundation of surrounding areas/floodplains and high flows within the fluvial network, will not adversely impact surrounding receptors.

Interaction between floodwaters and other landforms such as spoil dumps, reject dumps and out of pit TSFs is generally limited with some interaction occurring at the southern end of the Goonyella spoil dumps, to the west of the Airstrip and Theiss spoil dumps and along the diversion reach of Eureka Creek. The velocities of the flood

waters that interact with these landforms are relatively low (<1m/s) and limited to events that are above 2% AEP. Higher velocities and depths are generally limited to the alignment of the watercourses and are consistent with the watercourse's natural reaches.

To the west of the Isaac River, where mining related disturbances have occurred, subsidence rehabilitation areas are proposed to be backfilled and the landform has limited impact from flooding up to and including the 0.1% AEP climate change event with 20% increase in rainfall intensity. Subsidence areas to the east of the Isaac River are located within the floodplain and inundation occurs from the 2% AEP and above. The velocities of the floodwaters within the floodplain are relatively low (<1m/s).

6.1.2.3 Pluvial ponding in subsidence areas

The pluvial model results, included in Appendix H (Figures 5-8 and C1 1-1 to C1 1-3), show the inundation depths in subsidence areas to the east of the Isaac River are equal to or less than 1m in the 2% AEP event, except for areas where there are existing channels/ponds/dams, watercourses and the southernmost subsidence panels which are subject to temporal ponding.

Within the watercourses it is expected that natural sediment transport and deposition processes that occur during flows will result in the self-healing of subsidence areas over time. The presence of ponding within the watercourse alignments is considered consistent with the PMLU of watercourse.

Outside of the watercourse alignments, the limiting of inundation/ponding within the subsidence areas was achieved through the inclusion of backfill and installation of drains to allow for flow overland to the watercourses (Figure 5-5 of Appendix H). Subsidence areas to the west of the Isaac River are proposed to be backfilled to form a free draining surface. Drains are not considered practical in this area due to the depth of modelled subsidence. A combination of backfill and drains are proposed for the subsidence areas to the east of the Isaac River. The conceptual design of the backfilling and cutting of drains has limited the number of disturbance locations on the banks of the Isaac River and the level of surface disturbance required to achieve a reduction in inundation depth. The incorporation of the conceptual backfill and drains achieves a peak inundation depth of 1m in a 2% AEP event and provides a landform that is predominantly free draining to the watercourses.

The southernmost subsidence panels do not achieve a free draining state with three areas of temporal ponding between 1 – 1.5m deep remaining. The presence of existing channels and dams/ponds (non-mining related) within these subsidence panels increase the depth and complexity to drain these areas. To drain these subsidence panels would require off tenure works and/or significant surface disturbance to provide the gradient to allow the water to flow overland to the watercourses. To assess the persistence of the ponding in these southern subsidence panels, the pluvial model was run for a three-month period with the initial water depth set at full. The model results showed that, with no additional rainfall, infiltration and evaporation would empty the ponds between 37 and 70 days.

The subsidence modelling results (Section 6.4.1) are a conservative estimate, and actual depths will vary to that presented in the subsidence model. Therefore, the proposed backfill and drains cut in the subsidence landform are a proof of concept only, and further refinement and design based on actual depths of subsidence will be required.

6.1.2.4 Alteration of flow upstream and downstream

An assessment of the alteration of flows has been undertaken to gauge potential impacts of the closure landform to surrounding land users and environments. The assessment compared the pre- and post-mining catchments, with the post-mining scenario removing areas such as the residual voids, that will not contribute to flows within the Isaac River. The assessment found the post-mining landform resulted in up to a 9% decrease in downstream peak flows (20% AEP) within the Isaac River compared to the pre-mining environment. This was predominantly due to the loss of catchment from the residual voids.

Upstream flows did not change between the pre- and post-mining landforms.

6.1.2.5 Flooding risk profile

A flood risk profile was developed based on the rehabilitation flood modelling results. Details of the flood risk profile are contained in Appendix H and the GRM and BRM PRCP risk assessment summarised in Section 7.

Through the iterative closure landform design and modelling approach, the closure landform was developed to minimise the potential for environmental harm and to create a stable landform. As a result of this process, the flood risk profile identified low risk levels associated with flooding and the GRM and BRM closure landform. Therefore, no critical controls were required.

Relationship with the PRCP schedule
The interaction between flooding and the proposed final closure landform presents low risk. The closure landform provides an appropriate level of protection from inundation to the residual voids, flooding does not adversely impact on the stability of the closure landform and cumulative flows from the GRM and BRM rehabilitated area are similar to pre-mining conditions. For subsidence impacted areas, a concept design for the backfill and cutting of drains has limited inundation/ponding within the cattle grazing and woodland habitat PMLUs.

6.1.3 Waste characterisation

PRCP Guideline (Section 3.6.1)

Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility.

All mined material should be classified on its propensity to be potentially acid or non-acid forming, to generate neutral metalliferous or saline drainage, and its susceptibility to weathering.

A material characterisation assessment has been undertaken to support the development of this PRCP. The detailed report – *Goonyella and Broadmeadow Mine PRCP Environmental Geochemical Characterisation and Risk Assessment of Mineral Waste* (BHP, 2024), is provided in Appendix I.

6.1.3.1 Background

GRM and BRM has three main types of mineral waste:

- Spoil (overburden and interburden) currently comprises approximately 98% of all mineral waste at GRM and BRM and includes weathered waste (Tertiary and Permian-age) and fresh (unweathered) waste (all Permian-age). Spoil comprises several subtypes of material, the most relevant from a geochemical perspective being carbonaceous spoil (approximately 7% of all present and future spoil) and non-carbonaceous spoil (approximately 93% of all present and future spoil) subgroups. For the geochemical assessment, spoil samples were sourced from drillholes (primarily as drill-core).
- Tailings are generated at the CHPPs from processing ROM coal and typically represent the clay, silt and fine sand fractions of ROM waste. Throughout operations at GRM and BRM, tailings have been disposed as a slurry into a number of TSFs – the current (active) TSF being R32 in-pit TSF. Tailings comprise approximately 0.5% of all mineral waste at GRM and BRM. For the geochemical assessment, tailings samples were sourced from the active CHPPs and inactive TSFs, representing fresh and aged material, respectively.
- Rejects are generated at the CHPPs from processing ROM coal and typically represents coarser and rockier seam roof, partings and floor material. Rejects from the Riverside CHPP were historically disposed at Riverside rejects dump (beside Riverside CHPP) and currently at RS1 TSF. Rejects from the Goonyella CHPP are predominantly disposed at various rejects areas near the CHPP and in the Thiess/Airstrip area. Some rejects have been used in construction of TSF embankments and infrastructure pads (e.g. ROM and coal stockpile pads). Rejects comprise approximately 1.5% of all mineral waste at GRM and BRM. For the geochemical assessment, rejects samples were sourced as fresh samples from the CHPPs; and aged samples from Riverside rejects dump and inactive TSFs.

Coal is generally not considered mineral waste, with the exception of small quantities of sub-economic seams that may report to the spoil dump, and remnant coal exposed on pit high-walls (such as in residual voids).

Mineral waste (and coal) samples have undergone environmental geochemical characterisation and assessment with regard to their potential to generate acid and metalliferous drainage (AMD), which comprises

acid drainage (AD), neutral and metalliferous drainage (NMD) and/or saline drainage (SD) (salinity due to sulphate derived from sulphide oxidation). Additionally, samples have been assessed with regard to their potential to generate salinity (non-oxidative) and for spoil materials, their sodicity and dispersion potential. With respect to AD, each sample has been broadly characterised as either non-acid forming (NAF) or potentially acid forming (PAF).

The mine domains representing potential sources of AMD/salinity at GRM and BRM and having a direct relevance to mineral waste characterisation and management at GRM and BRM at closure, are spoil dumps, TSFs, rejects dumps and residual voids.

GRM and BRM currently has four TSFs, of which R32 in-pit TSF is operational and DRE5 is back-up capacity. At closure, RS1 and GS1 TSFs will remain as 'stand-alone' rehabilitated landforms. DRE5 and R32 in-pit TSFs will be buried under spoil landforms (Section 6.1.3.5).

6.1.3.2 Geochemical assessment of mineral waste

The geochemical characteristics of each waste type (and coal) have been assessed with respect to their ability to generate AMD by leveraging on historical geochemical data (defined as pre-2019), augmented with data acquired through an aggressive sampling and analytical program (2019-2024) designed to close identified knowledge gaps and fulfil the PRCP requirements. Overall, the geochemical data available to assess the geochemical properties of key mineral waste types and associated landforms include:

- 1,312 samples of interburden, overburden, coal roof/floor and partings tested to assess the AMD hazard; and 1,541 samples tested to define the salinity hazard, with a subset of overburden/interburden samples assessed for dispersivity and sodicity. The overburden/interburden samples were selected from drill cores that are representative of the vertical and lateral geological (lithological) variability encountered at GRM.
- 467 samples of tailings tested to assess AMD and salinity hazard; comprising 244 'fresh' samples collected from the CHPPs and 223 'aged' samples collected from GS1 and RS1 TSFs.
- 338 samples of rejects tested to assess AMD and salinity hazard; comprising 118 'fresh' samples collected from the CHPPs, 146 'aged' samples collected from GS1 and RS1 TSFs, and 74 'aged' samples collected from Riverside rejects dump.
- 26 coal samples tested to assess the AMD hazard and 30 coal samples tested to define the salinity hazard. The coal samples were selected from drill cores that are representative of the vertical and lateral geological (lithological) variability encountered at GRM, BRM and RHM.

The environmental testing protocol included a variety of analytical techniques that are consistent with industry and regulatory accepted guidelines (e.g. GARD Guide (INAP, 2009)).

6.1.3.3 Geochemical classification of mineral waste

The test work results were used to understand the geochemical properties of each individual material type (source) and assign a geochemical classification. This data (and AMD classifications) was then used to infer the geochemical hazard posed by each mineral waste type in their relative proportions within each landform.

The key findings from the geochemical assessment are summarised as follows:

Spoil

- Approximately 97% of spoil samples were classified as NAF or were expected to be NAF (and have been classified as UC(NAF)). Spoil material represented by these samples have very low to low sulphur concentration, excess acid neutralising capacity and have a low potential to generate AMD. Three percent of spoil samples were classified as 'PAF' and typically had higher (but still low to moderate) sulphur concentration and generally slightly lower acid neutralising capacity compared to NAF samples. Of the PAF samples, about one-third were associated with coal seam floor, roof and partings, which mostly report to the CHPPs as rejects. The remaining two-thirds (approximately) of PAF spoil samples were widely distributed throughout bulk NAF overburden and interburden.
- Soluble multi-element results indicated that, under controlled laboratory conditions, leachate from NAF spoil has low concentration of soluble metals and metalloids, while the few PAF samples encountered can mobilise moderate soluble metal concentrations. If the samples tested are representative of the spoil

produced at GRM (past, current and future), as a bulk source material, spoil is expected to have low capacity to generate AMD.

- Spoil is expected to generate contact water that is non-saline to slightly saline (i.e. EC less than 900µS/cm; but mostly less than 450µS/cm), almost entirely as the result of non-oxidative processes (i.e. from the dissolution of salts and not oxidation of pyrite). Spoil is also 'sodic' to 'strongly sodic' with potential for dispersion (based on the high sodicity values). Emerson aggregate class testing found that about 30% of the spoil samples tested were dispersive to some degree. The remaining samples had Emerson aggregate class values suggesting the samples were non-dispersive.

Tailings

- Approximately half (51%) of tailings samples tested (aged and fresh) have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, whereas the remaining 49% have a relatively low to low-moderate potential to generate AMD as either AD and/or NMD and/or SD. Overall, bulk tailings are assessed as having a moderate-high potential to generate AMD. There were only slight geochemical differences between the fresh and aged tailings samples.
- Under controlled laboratory conditions, most tailings samples subjected to freshwater (deionised water) leaching contained low concentrations of soluble metals and metalloids. A small number of samples (predominantly PAF samples) produced weakly acidic to pH-neutral leachate with moderate metals and metalloid concentrations. Under leaching conditions designed to promote oxidation and generation of AMD (i.e. peroxide leach), PAF samples produced weakly to highly acidic leachate with moderate to high soluble metals and metalloid concentrations. The results suggest that under acid/acidic conditions, some tailings are capable of generating elevated metal and metalloid loads.
- Tailings on-site are expected to generate contact water that is slightly to moderately saline (i.e. EC less than 2,000µS/cm), with the salinity linked to both non-oxidative processes (i.e. from the dissolution of salts and not oxidation of pyrite) and oxidative processes (i.e. from the oxidation of pyrite to produce sulphate). However, due to the generally low to low-moderate total S concentration (with some exceptions) the sulphate loads are not expected to be high.

Rejects

- Approximately 22% of rejects samples tested (aged and fresh) have a moderate to high potential to generate AMD as either AD and/or NMD and/or SD, whereas the remaining 78% have a relatively low to low-moderate potential to generate AMD as either AD and/or NMD and/or SD. The potential for SD is generally low, due to the generally low total S concentration. Overall, bulk rejects have a moderate potential to generate AMD.
- Under controlled laboratory conditions, most rejects samples subjected to freshwater (deionised water) leaching contained low concentrations of soluble metals and metalloids. A small number of samples produced moderate metals and metalloid concentrations. Under leaching conditions designed to promote oxidation and generation of AMD (i.e. peroxide leach), PAF samples produced moderately to highly acidic leachate with moderate to high soluble metals and metalloid concentrations. The results suggest that under acid/acidic conditions, some rejects are capable of generating elevated metal and metalloid loads.
- Rejects on-site are expected to generate contact water that is non-saline to slightly saline (i.e. EC less than 900µS/cm), with the salinity linked to both non-oxidative processes (i.e. from the dissolution of salts and not oxidation of pyrite) and oxidative processes (i.e. from the oxidation of pyrite to produce sulphate). However, due to the generally low total S concentration (with some exceptions) the sulphate loads are not expected to be high.

Coal

- Coal is not regarded as waste and ROM coal remains on-site for a relatively short period of time. However, some minor coal seams/plys will report directly as waste, and remnant coal (seams) will be exposed on the high-walls of residual voids at closure. The assessment has shown that coal samples have variable geochemical properties, with approximately 77% of the samples conservatively classed as PAF. Similar to other source material tested, coal samples with potential for AMD can release moderate concentrations of metals and metalloids in contact with water, under controlled laboratory conditions. Based on the geochemical properties and samples assessed for this report, it expected that as a bulk source material, coal will have a low-moderate capacity to generate AMD.

6.1.3.4 Geochemical risk of final landforms

The closure landform for the geochemical assessment comprise of spoil landforms (including two TSFs located within spoil landforms), GS1 TSF, RS1 TSF, Riverside rejects dump and the residual voids. Each of these landforms contain variable proportions of spoil, rejects, tailings and/or coal. Based on operational practices and life-of-mine waste management, at closure it is expected that:

- Spoil landforms will predominantly comprise spoil (overburden, interburden). Thiess landform will contain about 16% rejects and Broadmeadow-Isaac landform will contain about 3% rejects. The Thiess and Airstrip landforms also contain tailings as DRE5 TSF and R32 TSF, respectively.
- GS1 TSF comprises tailings (predominantly) with rejects embankments, and will be capped/covered by spoil. RS1 TSF has two compartments: western and eastern. The western compartment comprises only rejects, which will be capped/covered by spoil. The eastern compartment is comprised of about 85% tailings and 15% rejects, and will also be capped/covered by spoil. Only GS1 and RS1 TSFs will remain as surface tailings facilities not incorporated into a spoil dump. DRE5 TSF will become part of Thiess spoil landform and R32 TSF will become part of Airstrip spoil landform.
- Riverside rejects dump and rejects near Goonyella CHPP are comprised almost exclusively of rejects.
- Highwalls will comprise overburden, interburden and coal seams (including seam roof, partings and floor).
- Pit floors will comprise coal (conservative assessment as coal will be mined out).

A geochemical source hazard assessment was applied to the source material types comprising carbonaceous and non-carbonaceous spoil, tailings, rejects and coal (where relevant). The source hazard score is a formula that leverages on the geochemical test work results to estimate the propensity (ability) to generate AMD, the AMD capacity (severity) and the quantity (volume/%) of material that could produce AMD within each landform. The AMD score for each landform was then used to estimate the likelihood of each landform to generate AMD.

The potential environmental risk posed by each landform (containing variable proportions of each mineral waste type) was determined for each landform using a SPR approach – whereby the environmental geochemical risk is determined taking into account the geochemical source hazard of the landform, the plausible environmental and human health receptors of AMD from the landform and the plausible pathways between the source (landform) and the receptor. The outcome of this assessment informed development of appropriate management and rehabilitation measures for relevant landforms at closure.

Potential pathways and receptors for AMD and salinity have been identified for all final landforms at GRM and BRM. Details on the identification of pathways and receptors are found in Section 6.1.1 and Appendix D .

For the purpose of this SPR assessment, the following mechanisms for AMD and salinity to enter plausible pathways and report to plausible receptors have been identified:

- Source - spoil landforms:
  - Surface water run-off (pathway) from a nominated spoil landform (including TSFs and rejects located within spoil landforms) reports to a nominated watercourse (receptor)
  - Seepage from a nominated spoil landform (including TSFs and rejects located within spoil landforms) enters a shallow permeable strata (pathway) and reports to a nominated watercourse (receptor)
  - Seepage from a nominated spoil landform (including TSFs and rejects located within spoil landforms) enters groundwater (pathway) and reports to a nominated residual void (receptor)
- Source – GS1 TSF landform:
  - Surface water run-off (pathway) from the TSF reports to drainage leading to Holding Paddock Creek and Eureka Creek (receptors)
  - Seepage from the TSF enters a shallow permeable strata (pathway) and reports to Holding Paddock Creek and Eureka Creek (receptors)
  - There are no plausible groundwater receptors from GS1 TSF landform (post-closure)
- Source – RS1 TSF landform:
  - Surface water run-off (pathway) from the TSF reports to drainage leading to Eureka Creek (receptor)

  - Seepage from the TSF enters a shallow permeable strata (pathway) and reports to drainage leading to Eureka Creek (receptor)
  - Seepage from the TSF landform enters groundwater (pathway) and reports to Goonyella residual void
- Source – Riverside rejects landform:
  - Surface water run-off (pathway) from the rejects landform reports to drainage leading to Eureka Creek (receptor)
  - Seepage from the rejects landform enters a shallow permeable strata (pathway) and reports to drainage leading to Eureka Creek (receptor)
  - Seepage from the rejects landform enters groundwater (pathway) and reports to Goonyella residual void
- Source – Goonyella CHPP rejects landform (GS2):
  - Surface water run-off (pathway) from the rejects landform reports to Eureka Creek (receptor)
  - Seepage from the rejects landform enters a shallow permeable strata (pathway) and reports to Eureka Creek (receptor)
  - There are no plausible groundwater receptors from GS2 rejects landform (post-closure)
- Source – Goonyella CHPP rejects landform (GS11):
  - Surface water run-off (pathway) from the rejects landform reports to Eureka Creek and R32 East residual void (receptors)
  - Seepage from the rejects landform enters a shallow permeable strata (pathway) and reports to Eureka Creek, R32 East residual void and backfilled Airstrip void (R32 TSF) (receptors)
  - Seepage from the rejects landform enters groundwater (pathway) and reports to R32 East residual void
- Source – high-wall and floor
  - Run-off from high-wall of residual void (pathway) reports to nominated residual void (receptor)

The outcomes of the SPR are summarised below:

- Spoil landforms: With respect to AMD, the overall SPR risk rating from final spoil landforms is Low. With respect to non-oxidative salinity the overall SPR risk from final spoil landforms is also rated as Low.
- GS1 TSF landform: With respect to AMD, the overall SPR risk rating from the post-closure TSF landform is Low to Medium. The Low-Medium risk rating applies to AMD associated with seepage via shallow permeable strata into Holding Paddock Creek. With respect to non-oxidative salinity the overall SPR risk from the post-closure TSF landform is rated as Low.
- RS1 TSF landform: With respect to AMD, the overall SPR risk rating from the post-closure TSF landform is Low. With respect to non-oxidative salinity the overall SPR risk from the post-closure TSF landform is also rated as Low.
- Riverside, GS2 and GS11 rejects landforms: With respect to AMD, the overall SPR risk rating from these final rejects landforms is Low. With respect to non-oxidative salinity the overall SPR risk from these final rejects landforms is also rated as Low.
- Residual voids: The final receptor for seepage from the spoil landform (for each spoil landform) and run-off from the high-wall (of each void) is the void lake/residual void. The AMD assessment has found that it is unlikely that undiluted salinity or AMD from a flooded post-closure residual void floor would impact on residual void water quality to any significant degree, as other processes such as evapoconcentration are the key drivers of void lake water quality (WSP, 2024). Therefore, the AMD SPR risk rating on the overall water quality of the residual voids is Low.
- Modelling undertaken by AECOM (2024) shows that seepage from Thiess and Broadmeadow-Isaac void lakes into groundwater would report to (be captured by) Goonyella residual void, and that seepage from Goonyella residual void outwards into the regional groundwater aquifer is implausible due to Goonyella

void being a strong groundwater sink. Modelling also indicates residual voids R32 East and R32 South are groundwater sinks.

6.1.3.5 Management and rehabilitation measures

The geochemical characterisation, SPR, and residual risk assessment conducted in support of this PRCP informed the following mineral waste management and rehabilitation measures with regards to AMD and salinity management:

- Residual voids: will remain as NUMAs
- Spoil dumps: spoil dumps will be reshaped and rehabilitated. No specific AMD management measures are proposed for the spoil as operational mixing is expected to be sufficient to manage the small quantity of interburden/overburden that has been characterised as potential for AMD. Monitoring will be conducted to ensure that spoil landforms can achieve their nominated PMLU.
- GS1 TSF: will be covered by an engineered spoil cover. A concept cover design with at least 2m of spoil cover is proposed, with the detailed design and thickness of spoil cover to manage the AMD hazard of the out-of-pit TSF to be determined following control implementation to address the knowledge base gaps (Section 6.1.6)
- RS1 TSF: will be covered by an engineered spoil cover. A concept cover design with at least 2m of spoil cover is proposed, with the detailed design and thickness of spoil cover to manage the AMD hazard of the out-of-pit TSF to be determined following further assessment (Section 6.1.6)
- DRE5 in-pit TSF: will be covered by at least 2m of spoil
- R32 in-pit TSF (Airstrip void): will be backfilled by spoil. A concept cover design with at least 2m of spoil cover is proposed, with the detailed design and thickness of spoil cover to manage the AMD hazard of the out-of-pit TSF to be determined following further assessment (Section 6.1.6)
- Riverside rejects dump: is already covered with spoil and partially rehabilitated. Further works to close knowledge base gaps and implement controls to manage the AMD hazard of rejects are required to ensure an appropriate cover design is installed to enable achievement of the PMLU
- Other rejects dumps: conceptual cover is a minimum 2m spoil cover with final thickness of spoil cover to manage the AMD hazard of rejects to be determined following further assessment (Section 6.1.6)
- All other rejects: will be managed during operations (disposed within spoil) and progressively covered by spoil. No additional remediation for the rejects (at closure) is required. The rejects will be covered by a minimum 2m of spoil.
- ROM pads: remove remnant coal from the ROM pads and dispose within spoil. The former ROM pads will be reshaped, covered with growth media, ripped and seeded.
- Coal stockpiles: remove remnant coal from the coal stockpile pads and dispose within spoil. Cover with growth media, rip and seed.

Relationship with the PRCP schedule
The geochemical AMD risks posed by the spoil dumps and residual voids are Low, Low to Low-Medium for TSFs and Low for rejects. The management and rehabilitation measures proposed in this PRCP manage the risk associated with mineral waste during rehabilitation and closure.

6.1.4 Soil and capping material

PRCP Guideline (Section 3.6.1)

The rehabilitation and management methodology should include that soil assessment activities are supplemented by additional surveys conducted at appropriate intervals to assess soil resources in planned disturbance areas. In addition to the assessment of soils, the proposed rehabilitation methodologies in the rehabilitation planning part must also address topsoil management. Topsoil management must ensure sufficient topsoil quantity and quality is available in those instances that waste rock or tailings cannot support the proposed PMLU. Integrated soil and waste rock characterisation and mapping should form the foundation of the rehabilitation strategies. The available soil resources and capping material should be assessed prior to the commencement of operations.

A growth media assessment has been undertaken to support the development of this PRCP. The detailed report – *Goonyella Riverside Mine Complex - Material Characterisation Study* (Landloch, 2024a), is provided in Appendix E. Soil surveys have been conducted for the proposed mining footprint (refer to Section 1.2.6).

6.1.4.1 Quality of available resources

The quality of the stockpiled topsoil is more representative of the material available for rehabilitation once topsoil is stripped and mixed in stockpiles, compared to undisturbed in-situ soil (Landloch, 2024a). The key chemical and physical properties of the stockpiled topsoil by soil management groups, and spoil material available for rehabilitation at GRM and BRM, is summarised in Table 28. The characterisation of these materials show that amelioration will be required for them to be suitable to support a PMLU (Section 6.1.4.3).

Permian spoil has been used as an alternative growth media in rehabilitation at GRM and other BMA sites. It has been found that with amelioration, this material can provide a suitable substrate for native woodland species, and it will continue to be used as a growth media where suitable. Fresh Permian spoil is also considered a resource for rehabilitation to provide the rock component to increase batter slope resistance to erosion and to stabilise steeper areas. The key chemical and physical properties of the fresh Permian spoil are summarised in Table 28, however Landloch (2024) recommend discrete testing should be conducted prior to rehabilitation, which will be completed by an AQP as part of their growth media assessment (Section 6.1.4.3).

Table 28: Key physiochemical properties of stockpiled soil management groups and spoil material

Rehabilitation resource	Properties
Clay topsoil	• Slight to strongly alkaline (pH 7.7 – 9.0) • Low to high salinity (EC 0.1 – 1.0dS/m) • Non-sodic to strongly sodic (ESP 5.8 – 21.8%) • Low available nutrients (N,P,K) • Clay content >35% • Low to moderate permeability, indicating that movement of water to depth will be limited without management • Dispersive to stable (1 – 7 Emerson Aggregate Test)
Loam topsoil	• Moderate to strongly alkaline (pH 6.5 – 8.3) • Low salinity (<0.2dS/m) • Non-sodic to sodic (ESP 1.5 – 7.1%) • Low available nutrients (N,P,K) • Clay content >35% • Moderate to high permeability, indicating that movement of water to depth will be reasonably rapid • Slightly dispersive to slaking (3a – 5 Emerson Aggregate Test)

Rehabilitation resource	Properties
Permian spoil	• Moderately alkaline to strongly alkaline (pH 8.3 – 9.9) • Low to moderate salinity (EC 0.28 – 0.80dS/m) • Sodic to strongly sodic (ESP 6 – 36%) • Low to adequate nutrient holding capacity (ECE) • Rock content often >50% • Moderate permeability, indicating that movement of water to depth will be reasonably rapid

6.1.4.2 Quantity of available resources

The rehabilitation at GRM and BRM requires growth media to support vegetation establishment for the planned PMLUs. There is sufficient quantity of growth media available on-site for rehabilitation of disturbed areas to cattle grazing, grassland, woodland habitat and watercourse PMLUs. The volume of topsoil available for rehabilitation includes the volume of topsoil currently stockpiled at site (6,619,361m^3, as at April 2023) and the future topsoil to be stripped (estimated at 1,661,770m^3 for the future mining areas), totalling 8,281,131m^3. There is also suitable Permian spoil which can be ameliorated to develop an alternative growth media. An alternative growth media will be used for the low-wall PMLU and may be used on some woodland habitat areas where it is assessed by an AQP to be suitable to achieve the PMLU.

The volume of growth media required for rehabilitation of each PMLU is shown in Table 29. These volumes only include existing and future disturbance areas where growth media needs to be replaced. The required volumes do not include disturbed areas such as exploration, cleared and existing rehabilitation which already have topsoil. The areas in Table 29 therefore do not align to the total area of the RAs. The volume shown for watercourse is conservative as it assumes all diversion and crossing areas require topsoil. Excess topsoil volume will be utilised in areas where there will be a beneficial outcome, such as cattle grazing areas.

Table 29: GRM and BRM required growth media volumes for PMLUs

PMLU	Growth media	Area (ha)*	Cover depth (m)	Volume required (m^3)
Cattle grazing	Topsoil	512	0.15	768,000
Grassland	Topsoil	1,271	0.15	1,907,229
Woodland habitat	Topsoil	5,062	0.10	5,062,000
	Alternative growth media	1,146	0.30	3,438,000
Watercourse	Topsoil	347	0.15	520,959
Total	**Topsoil**	**7,193**		**8,258,188**
	Alternative growth media	**1,146**		**3,438,000**

** Does not include disturbed areas where topsoil is still in place*

Rock will be utilised on the steeper final landform slopes to improve the erosion resistance (Section 6.1.5.3). Rock will be sourced from the mined fresh Permian overburden and interburden, with sufficient quantity available on-site for the planned rehabilitation. Rock will be used directly on rehabilitation areas or stockpiled when required to ensure sufficient quantity for the planned rehabilitation.

6.1.4.3 Resource management

During mining operations, topsoil is stripped according to the recommended depths from the pre-mining soil surveys. The topsoil is either used directly on rehabilitation areas or stockpiled progressively for later use in rehabilitation. Topsoil is stripped with caution to ensure as little contamination with subsoils occurs as possible. The locations of current topsoil stockpiles are shown in Appendix E. Stockpile locations and volumes will vary throughout the life of the operation as stockpiled topsoil is used on rehabilitation and new stockpiles are created as mining advances. All stockpile locations can be accessed for loading and haulage to rehabilitation areas. The spatial location of stockpiles is recorded in a geographic information system and a volume inventory is maintained.

An assessment of the growth media (topsoil or Permian spoil) characteristics will be completed by an AQP (as per condition A8 of the EA) prior to rehabilitation, to determine the amelioration requirements and surface treatments. The assessment will consider the growth media qualities, rock, landform and revegetation plan (Section 6.1.8) for the proposed PMLU, plus the land suitability framework (Section 3.1.1.3) when planning cattle grazing rehabilitation. After application of the required ameliorants, areas will be ripped along the contour to key in the growth media with the underlying spoil, reduce compaction, improve water infiltration and create surface roughness to slow surface runoff.

The recommended amelioration and surface treatments will be undertaken as part of the rehabilitation execution activities. The growth media depth, potential amelioration options and the surface treatments to support the establishment of vegetation for each PMLU, are shown in Table 30. Opportunities to utilise other amelioration and surface treatment methods may be investigated. The relationship between soils and vegetation ecosystems for the PMLUs is detailed in Section 6.1.8.

Table 30: Growth media ameliorant options and surface treatments for the GRM and BRM PMLUs

PMLU	Growth media	Ameliorant options	Surface treatments
Cattle crazing and grassland	Topsoil – minimum depth of 150mm is sufficient to store moisture and nutrients to initiate and sustain pasture growth	• Elemental Sulphur • Manures • Urea • Diammonium phosphate • Superphosphate • Fertiliser • Gypsum • Incorporated organic matter • Surface mulching (e.g. hay mulch)	• Ameliorate growth media as recommended by an AQP (if required) • Rip along contour • Direct seed as per seed mixes and rates for cattle grazing or grassland revegetation (Section 6.1.8.5)
Woodland habitat	Topsoil – minimum depth of 100mm is applied to support establishment of woodland species and to limit the effects of competition from exotic pasture species Or Permian spoil – minimum depth of 300mm	• Elemental Sulphur • Manures • Superphosphate • Fertiliser • Gypsum • Incorporated organic matter • Surface mulching (e.g. hay mulch)	• Ameliorate growth media as recommended by an AQP (if required) • Deep rip along contour to mix growth media with rock • Direct seed as per seed mixes and rates for woodland habitat revegetation (Section 6.1.8.6)

PMLU	Growth media	Ameliorant options	Surface treatments
Watercourse	Topsoil – minimum depth of 150mm to encourage a vegetative cover to provide erosion resistance	• Elemental Sulphur • Manures • Superphosphate • Gypsum • Incorporated organic matter • Surface mulching (e.g. hay mulch)	• Ameliorate growth media as recommended by an AQP (if required) • Rip along contour as required • Direct seed as per seed mixes and rates for watercourse revegetation (Section 6.1.8.7)

Relationship with the PRCP schedule
There is a sufficient quantity of suitable growth media available on-site to use for rehabilitation of disturbed areas to cattle grazing, grassland, woodland habitat and watercourse PMLUs. Suitable Permian spoil will be ameliorated to develop an alternative growth media for the low-wall PMLU areas and potentially other woodland habitat PMLU areas. An assessment of the growth media characteristics will be completed by an AQP prior to rehabilitation, to determine the amelioration and surface treatments required to achieve the planned PMLU.

6.1.5 Landform design

PRCP Guideline (Section 3.6.1)

The final landform design must be based on the proposed PMLUs and NUMAs and demonstrate that the land will be safe and structurally stable.

A landform design assessment has been undertaken to support the development of this PRCP. The detailed report – *Erosion and Landform Evolution Simulations to Support Waste Landform Design: Goonyella Riverside Mine Complex* (Landloch, 2024b) is provided in Appendix J.

Landform design considers the landform development and reshape of all relevant activity areas after the removal of infrastructure, and prior to placement of growth media and seed.

The final closure landform design has been refined based on the outcomes of the studies undertaken to support this PRCP. The major refinements included changes to the mining limits to ensure geotechnical stability of the residual voids is achieved (Section 6.3.1), residual void extents to mitigate the risk of flooding (Section 6.1.2) and spoil dump slope angles for erosional stability based on the materials available on-site (Section 6.1.5.3).

6.1.5.1 3D design

The conceptual 3D closure landform design for GRM and BRM is provided in Figure 17.

Figure 17: Conceptual 3D GRM and BRM closure landform design

6.1.5.2 Method of determining landform design

The relevant activities (Section 1.4.1) considered when determining the landform design are detailed in Table 31.

Removal of infrastructure (Section 6.5) and contaminated land requirements (Section 6.5.3) will be completed where required, prior to reshaping of the closure landform. After reshaping of the final landform, the required growth media and ameliorants are applied to support the PMLU (Section 6.1.4), the area is seeded (Section 6.1.8), and monitoring and maintenance completed to ensure rehabilitation is tracking to a stable condition (Section 8).

Table 31: Landform structures at GRM and BRM and proposed designs

Landform structure	Landform design
Spoil dumps (RA1)	• Maximum dump heights up to 150m above ground level to fit the quantities of waste scheduled to be mined • 20m dump lift heights • Dump slopes within PMLU areas to be reshaped to be free draining with maximum 15% slopes or up to maximum 30% slopes with rock on the final landform surface • Runoff to be restricted from the top of the landform onto the batter slopes where required to manage erosion • Spoil dumps achieve FoS ≥1.5
Rejects dumps (RA6)	• Dump slopes within PMLU areas to be reshaped to be free draining with maximum 15% slopes or up to maximum 30% slopes with rock on the final landform surface • Covered by a free-draining landform (Section 6.1.6) • Minimum 2m spoil cover (Section 6.1.6) • Landform achieves FoS ≥1.5
TSFs (RA9)	• Area will be reshaped with maximum 30% slopes with rock on slopes >15% • Covered by a free-draining landform (Section 6.1.6) • Minimum 2m spoil cover (Section 6.1.6) • Landform achieves FoS ≥1.5
Infrastructure and general areas – CHPP and associated infrastructure, administration, workshop, stockpile areas, laydown areas, roads, dams, drains, rail area, train load-out and associated infrastructure (RA3, RA4)	• Area will be reshaped with maximum 12% slopes for cattle grazing PMLU • Area will be reshaped with maximum 15% slopes for woodland habitat PMLU
Subsidence areas (RA20, RA21)	• Areas to the west of Isaac River are to be backfilled to make free draining (RA20) (Section 6.1.2, 6.4.4) • Areas to the east of Isaac River are to be backfilled and/or drainage installed to limit inundation to maximum 1m depth in a 2% AEP rainfall event (RA21) (Section 6.1.2, 6.4.4) where practical

Landform structure	Landform design
Residual voids (IA1)	• Set-back of the high-wall and end-wall to achieve structural stability of FoS ≥1.5 within the NUMA extents or a minimum of 50m where against the tenure boundary (Section 6.3.1) • Set-back from the low-wall crest to achieve structural stability of FoS ≥1.5 within the NUMA extents or a minimum of 25m for erosion protection of PMLU (Section 6.3.1) • The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the tenure boundary • Low-walls are free draining into the void lake with a maximum of 37 degree slopes • Flood mitigation to a level 1m above the 0.1% AEP (including climate change event, with 20% increase in rainfall intensity) flood levels where required to prevent flood ingress (Section 6.1.2)
High-wall landform	• Flood mitigation to a level 1m above the 0.1% AEP (including climate change event, with 20% increase in rainfall intensity) flood levels where required to prevent flood ingress (Section 6.1.2): - Goonyella Pit: landform on the southern end-wall and sections of the high-wall - Isaac Pit: landform on the southern end-wall and sections of the high-wall • The functional requirements include: - Prevention of surface flow of floodwater into the void - Geotechnically stable when floodwater is against the watercourse-side batter - Prevention of seepage flow of floodwater into the void - No greater maintenance post-closure than other land with similar use, therefore utilise the same geometry, materials and rehabilitation treatments • The standard design for preliminary planning includes: - Key trench through any permeable layer on the ground surface - Not to be constructed out of dispersive material - Maximum 30% slopes with rock for scour protection - Minimum height to include appropriate freeboard for flood heights and materials - Minimum crest width of 10m • The final design will be completed by an AQP based on the latest flood modelling (flood duration against the landform, maximum water levels, flow velocity and bed shear stress), and materials data prior to construction

Materials available for landform rehabilitation

The landform at GRM and BRM utilises materials available on-site that will achieve the required landform stability. Rock will be utilised on the steeper landform surface to improve the erosion resistance (Section 6.1.5.3). Rock will be sourced from the mined overburden and interburden, with sufficient quantity available on-

site for the planned rehabilitation. Rock will be used directly on rehabilitation areas or stockpiled when required to ensure sufficient quantity for the planned rehabilitation.

Growth media details to support revegetation are included in Section 6.1.4.

Hydrological and hydrogeological assessments

The final landform will predominately be free draining where required to limit impacts, except for: the catchment into the residual voids; and limited areas of temporal ponding within the south-eastern subsidence areas (Section 6.1.2). Rehabilitation will include:

- Reshaping of the spoil dumps with no permanent berms or water management on slopes
- Reshaping of the rehabilitated mine dams to be free draining
- Removal of any road culverts and fill material from within the watercourse extents
- A combination of backfill and drainage of subsidence areas to limit inundation and ponding where practical (no ponding within NUMA areas)

Free draining is considered to be where the landform sheds the majority of the surface flows from the landform and towards the local drainage lines, and where any residual collection of water on the landform does not persist for more than one month under typical dry weather conditions.

A rehabilitation flood assessment, including hydrologic and hydraulic modelling, has been completed for the GRM and BRM closure landform (Section 6.1.2). The flooding risk profile, developed as part of this assessment, identified the risks to the landforms from flooding to be low with mitigation measures in place. Mitigation measures adopted for GRM and BRM to reduce the risk of flooding into the residual voids up to and including the 0.1% AEP (with climate change 20% increase in rainfall intensity) include: backfill of Airstrip void; backfill of ramp voids; inclusion of high-wall landforms; increased stand-off distances from tenure boundary and watercourses; and removal of culverts and other infrastructure.

Landforms that form part of flooding impact mitigation measures will be permanent structures that are constructed with the same materials, procedures and geometry as other spoil landforms and require no more maintenance than other rehabilitated areas. These landforms will be designed by an AQP based on the latest flood modelling and materials data prior to construction.

The flood water interaction with the spoil dumps is at the extremity of the flooding extent where flood waters have relatively low velocities and depths (Section 6.1.2). Outer landform slopes that interact with flood waters up to a 0.1% AEP will incorporate controls, if required, to minimise potential instability of the landform from interaction with floodwaters.

The hydrogeological assessment (Section 6.1.1), and pit lake water balance modelling (Section 6.3.2), identified the residual voids, through the evaporative losses from the void lakes, will maintain inward hydraulic gradients to the tenement. The residual voids provide long term groundwater management by minimising the potential for off-site contaminant migration and interconnection of aquifers.

6.1.5.3 Long-term landform stability

Material testing, erosion modelling and landform evolution modelling of the spoil dumps has been completed (Landloch, 2024b) to establish the slope profiles for the materials at GRM and BRM to ensure long-term landform stability (Appendix J). The slope profiles will be applicable for the same materials for all landforms.

The landform study included:

- Simulations of runoff and erosion for a range of landform options using the Water Erosion Prediction Program (WEPP)
- Derivation of parameters for the SIBERIA landform evolution model
- Landform evolution simulations using SIBERIA for the 3D landform of GRM and BRM spoil dumps, which were designed based on the WEPP results

The runoff and erosion simulations using the WEPP model and the landform evolution simulations using the SIBERIA model indicate that the proposed landforms and slope profiles (Table 31) at GRM and BRM can be expected to be stable over the long-term, provided the target levels of groundcover are achieved. Total

groundcover manages erosion risk, which includes a combination of rock, vegetation and organic litter cover. In the WEPP and SIBERIA models, the rock cover component is incorporated into the material parameters and a range of vegetation cover is modelled. Vegetation cover includes plants, plant litter, tree leaf litter, twigs and woody debris that protect the soil surface from erosion.

The modelling in Appendix J gives an indication of the vegetation cover to meet target erosion rates for the representative materials modelled, but it does not determine the exact vegetation cover required. The results in Appendix J demonstrate that rockier materials require lower vegetation cover to achieve the target erosion rates on the same slopes. Exact vegetation cover varies with the rock component and therefore the milestone criteria refers to total groundcover, as this manages the erosion risk. The modelling results support the total groundcover levels in the EA acceptance criteria.

To establish the vegetation cover as soon as possible and limit the window of erosion risk, the following measures are planned:

- Ripping along the contour to key the growth media with the underlying spoil, reduce compaction, improve water infiltration and create surface roughness to slow water flow (Section 6.1.4.3)
- Application of seed at the optimal time when there is sufficient soil moisture in the profile to assist germination and sustain establishment (Sections 6.1.8.5, 6.1.8.7 and 6.1.8.9)
- Inclusion of a sterile cover crop in the seed mix, which establishes quickly on the exposed surfaces and works to provide a root system that will stabilise the surface (Sections 6.1.8.5, 6.1.8.7 and 6.1.8.9)
- Surface mulching where appropriate, to provide instant groundcover (e.g. hay mulch) (Section 6.1.4.3)
- Monitoring as scheduled and maintenance as required (Section 8).

6.1.5.4 Method of construction

The majority of the spoil dumps are dumped within the mined-out pit extents and comprise of dragline spoil at the base of the dump (~80m high) with haul trucks dumping ~20m lifts above the dragline spoil.

6.1.5.5 Quality assurance/quality control

The proposed actions referenced in Table 31 are the key controls that will be put in place to manage the landform risks associated with achieving the PMLUs. Designs will be completed for each rehabilitation area prior to execution of the rehabilitation activities and earthworks, and included as part of the rehabilitation workpack, or current work process, at the time of execution.

Quality assurance and quality control (QA/QC) activities are built into all necessary execution and verification activities of these controls. Monitoring and reporting processes will verify controls and ensure that controls are executed effectively (Section 8).

6.1.5.6 Trial methodology

Modelling has indicated the proposed landforms will be stable and monitoring will verify if the landforms are on a path towards achievement of the milestone criteria and eventual certification; or whether corrective actions, maintenance or changes to the rehabilitation methodology is required. No trials are planned at GRM and BRM for landform design.

6.1.5.7 Limitations and assumptions

The limitations and assumptions of the final landform design include:

- The final closure landform is dependent on the mining schedule, which can change due to increased geological knowledge as mining progresses, market factors and technology. These changes may result in differences to the landform, such as varying heights, ramp locations or access bridges within the final voids, but the key considerations to ensure long-term stability, such as slope profiles and materials, will be maintained in the final closure landform design.
- The closure landform has been designed with maximum dump heights to ensure all modelling is conservative. It is not anticipated that all areas of the spoil dumps will reach these heights

- A swell factor of 25% has been assumed for the dump scheduling. This is a standard factor based on experience in the Bowen Basin.
- Angle of repose of the spoil dumps is 37°
- Landform evolution modelling has been completed for up to 300 years based on the best available inputs at this time and the material testing completed at GRM and BRM to date. It is expected materials with higher levels of rock will become available as mining progresses, requiring lower levels of vegetation cover to limit erosion to target levels.
- The slope profiles established through the erosion modelling and landform evolution modelling for the materials at GRM and BRM are applicable to all landforms.
- Due to the size of the spoil dumps and dumping in lifts, the majority of settlement of the 'constructed' landforms is expected to occur during placement with only minor settlement expected after rehabilitation. According to Australian Coal Association Research Program (ACARP) project C19022 (Williams, 2015), spoil settlement consists of three components: self-weight settlement (80% occurs during placement and decreases exponentially with time); collapse settlement (most occurs during placement); and degradation settlement (variable timeframe depending on material, but most may occur during placement and approaches a limit over time). The landform will be monitored to ensure a free draining landform is maintained where required.
- The landform has been designed with maximum modelled subsidence (Section 6.4) which is based on the best available inputs at this time
- The proposed drainage works to manage the subsidence inundation (Section 6.1.2) are based on the modelled subsidence, however the design of the final drainage works will be completed when final subsidence is realised, after flooding of the underground workings. This ensures that the drainage is based on the actual subsidence and achieves the required outcomes.

Relationship with the PRCP schedule
The final closure landform design has been refined based on the outcomes of the studies undertaken to support this PRCP and minimise risk. Dump slopes have been designed based on the materials available on-site and the erosion modelling. The closure landform design, including the spoil dumps, residual voids and other disturbed areas, achieves a safe and stable landform. The milestone criteria to achieve a stable condition is for total groundcover as this manages the erosion risk.

6.1.6 Cover design

PRCP Guideline (Section 3.6.1)

A cover design is required for the surface treatment of a mine landform or other waste material. Hence, the cover system design must be appropriate for the type(s) of waste the project will generate and reflect a risk-based approach. Where waste has the potential for AMD, neutral mine drainage or saline mine drainage, an appropriate cover system must be designed.

The cover design should include:

- *identification and specification of the objectives of the cover system*
- *a detailed description of the design including the thickness of each layer*
- *a detailed description of construction methodology including any proposed staging of the cover system*
- *a quantitative assessment that identifies the location and quantity of proposed capping material available on-site*
- *proposed QA/QC for the construction of the cover system including the timely implementation of corrective actions where deviations from the design are identified.*

As detailed in the PRCP Guideline, a cover system is required where there is potential for materials to cause AMD, NMD or SD, to ensure contaminants are not released to the receiving environment.

6.1.6.1 Conceptual cover design objectives and concepts

Section 6.1.3 identified that the GRM and BRM TSFs and rejects dumps will require a cover to manage the potential risk. The AMD source hazard rating of the GRM and BRM tailings and rejects (Appendix I) is similar to the other BMA sites.

DRE5 and R32 are in-pit tailings and will be buried by spoil during mining operations. RS1 and GS1 are standalone facilities. Conceptual cover designs have been completed to support the development of this PRCP. Detailed cover designs will be developed for each facility by an AQP once deposition and dewatering of the tailings, or dumping of rejects is complete, and sufficient data is sourced to close knowledge base gaps and ensure the detailed cover design adequately mitigates the risks. The minimum requirements for cover are a free-draining landform with a minimum of 2m spoil cover.

The key objectives of a cover for TSFs and rejects at GRM and BRM are:

- To allow shallow infiltration but minimise recharge of tailings moisture through deep infiltration of rainfall
- To avoid upward movement of solutes from tailings into the vegetation rooting zone
- To support and spread the anticipated surface load pressures enough so that the bearing capacity of the tailings is not exceeded
- To accommodate long-term consolidation settlement in the tailings and rejects, such that the first two objectives and surface erosional stability are not compromised.

For rejects (RA6) and TSF (RA9) areas, the first rehabilitation milestone will commence as soon as practicable, once ground works and knowledge base data collection, updated modelling and detailed designs and plans are finalised. Where required, as soon as practicable for a TSF includes an additional 10 years for active dewatering and the development of a sufficient crust after final tailings deposition.

Ground works and knowledge base data collection will include: drilling and installation of additional boreholes, monitoring, tailings and rejects material testing, waste characterisation, geotechnical characterisation and land contamination investigation. Sufficient data enables the hydrogeochemical model to be updated and the development of detailed cover designs for the rejects dump and TSFs. For the facilities within RA1, these activities are undertaken prior to spoil dumping. Further detail on each TSF at GRM and BRM is included in Section 6.2.

Before cover construction commences, a detailed cover design will be developed by an AQP that will use the latest geochemical and geotechnical information and data available for the specific TSF and rejects dump to ensure the cover achieves the cover objectives and manages the specific facility risk. The detailed cover design will include the final specifics on the cover, including materials, composition and thicknesses, as well as the construction design. An amendment will be submitted if addressing the knowledge base gaps results in changes to the cover design and the PRCP schedule.

Construction design for the TSF cover cannot be finalised until in-situ strength profiles of the tailings are measured. Testing for strength profiles should be done as soon as practicable before cover works commence, once the tailings are dewatered with a sufficient crust to safely work on. In-situ infiltration tests to confirm construction materials and methodology may be undertaken after suitable spoils have been identified and must be completed before the design is finalised.

The magnitude and rate of consolidation settlement depends on composition (size grading), existing pre-consolidation, and the disposition of drainage paths, all of which vary within the three-dimensional tailings deposit. Consequently, settlement estimates are not included in the conceptual cover design; instead, settlement will be assessed and allowed for as part of detailed design and especially by adaptive design revision during the construction phase.

6.1.6.2 GS1

GS1 is an aboveground turkey's nest facility located to the west of the Goonyella CHPP. The TSF will be rehabilitated as a discrete single landform (RA9). The proposed cover will include:

- 2m minimum thickness of spoil. Additional thickness may be required to create a final landform surface that will shed rainfall without ponding, with slopes consistent with the PMLU.

- Topsoil and erosion management practices consistent with the PMLU.

Final thickness will be refined as part of the detailed design. Selection of appropriate materials for the cover will be assessed by an AQP during the detailed design phase.

The construction sequence will require a geomechanical design, separate to the detailed cover design, including bearing capacity and/or stability analysis. QC/QA during construction will confirm minimum cover thickness. After completion of the bulk earthworks spoil layer, the landform may be left while further consolidation settlement occurs, before the final trim to the final design profile. The area would then be rehabilitated, including topsoil placement and seeding.

GS1 is available for rehabilitation now and will be rehabilitated as soon as practicable once the tailings are sufficiently dried out and in-situ strength profiles can be measured, along with sourcing of additional geochemical and geotechnical data to enable assessment of the facility specific risks and a detailed cover design to be developed to manage the risks. The as soon as practicable timing reflects the level of uncertainty associated with dewatering of GS1, as well as the time needed for the data collection required to develop the detailed cover designs.

Infrastructure to the west and east of GS1 restrict the construction of the cover as the final slope will extend close to or into these areas. Construction of the final 82ha of cover on the western and eastern side of GS1 is therefore scheduled to be undertaken with the rehabilitation of the neighbouring infrastructure areas at the end of operations.

6.1.6.3 RS1

RS1 is an aboveground turkey's nest facility located to the north of the Riverside CHPP (RA9). Rejects are currently being dumped on the west compartment, therefore RS1 is considered a combined waste facility. The cover will include:

- 2m minimum thickness of spoil. Additional thickness may be required to create a final landform surface that will shed rainfall without ponding, with slopes consistent with the PMLU.
- Topsoil and erosion management practices consistent with the PMLU.

Final thickness will be refined as part of the detailed design. Selection of appropriate materials for the cover will be assessed by an AQP during the detailed design phase.

QC/QA during construction will confirm minimum cover thickness. After completion of the bulk earthworks spoil layer, the landform may be left while further consolidation settlement occurs, before the final trim to the final design profile. The area would then be rehabilitated, including topsoil placement and seeding.

RS1 is available for rehabilitation once rejects dumping in the area is complete, and will be rehabilitated as soon as practicable once additional geochemical and geotechnical data is sourced to enable assessment of the facility specific risks and a detailed cover design to be developed to manage the risks. Infrastructure to the south and east of RS1 restrict the construction of the cover as the final slope will extend close to or into these areas. Construction of the final 58ha of cover on the southern and eastern side of RS1 is therefore scheduled to be undertaken with the rehabilitation of the neighbouring infrastructure areas at the end of operations.

6.1.6.4 DRE5

DRE5 is an in-pit TSF used for emergency deposition, located south-east of the Riverside CHPP, on the east side of the main haul road. The TSF will be buried by spoil (RA1) and the area is planned to be backfilled above the tailings with a single layer of bulk spoil (>2m) to create a non-ponding landform.

Because the single layer spoil is simple bulk fill, no specific testing is required for QC/QA during construction except to confirm minimum cover thickness. After completion of the bulk earthworks spoil layers, the landform may be left while further consolidation settlement occurs, before the final trim to the final design profile. The area would then be rehabilitated, including topsoil placement and seeding.

6.1.6.5 R32

R32 is an active in-pit TSF located south-east of the Goonyella CHPP, on the east side of the main haul road (RA9). The TSF is planned to be backfilled during mining operations, once tailings deposition in the facility is

complete and it is safe to dump over the dewatered tailings. Active dewatering and development of a sufficient crust (estimated to take 10 years) is required before in-situ strength profiles can be measured, along with sourcing of additional geochemical and geotechnical data to enable assessment of the facility specific risks and a detailed cover design to be developed to manage the risks.

The area is planned to be backfilled above the tailings with a single layer of bulk spoil (>2m) to create a non-ponding landform. Because the single layer spoil is simple bulk fill, no specific testing is required for QC/QA during construction except to confirm minimum cover thickness. After completion of the bulk earthworks spoil layers, the landform may be left while further consolidation settlement occurs, before the final trim to the final design profile. The area would then be rehabilitated, including topsoil placement and seeding.

6.1.6.6 Rejects

The AMD source hazard rating of the various rejects locations (Appendix I) is the same as the other BMA sites, therefore the rejects are planned to be covered with at least 2m of spoil. The landform will be free-draining. The areas would then be rehabilitated, including growth media placement and seeding.

Riverside rejects dump is available for rehabilitation now and will be rehabilitated as soon as practicable once additional data is sourced to close knowledge base gaps and to ensure an appropriate cover design is installed to enable achievement of the PMLU.

Relationship with the PRCP schedule
The geochemical assessment determined the AMD source hazard rating of the GRM and BRM tailings and rejects is the same as the other BMA sites, therefore the minimum cover design requirements are the same to manage the risk and achieve the cover objectives. All facilities will be covered with at least 2m of spoil to create a free-draining landform. Detailed cover designs cannot be finalised until tailings are dried and in-situ strength profiles of the tailings can be safely determined. Detailed cover designs are to be developed by an AQP prior to construction, based on sufficient information and data to assess the facility specific risks and ensure an appropriate cover is installed to enable achievement of the PMLU.

6.1.7 Water management

PRCP Guideline (Section 3.6.1)

The rehabilitation planning part must include a description of the following:

- *a description of the contaminants that pose a risk to environmental values of the receiving environment*
- *source, pathway and fate of contaminants that have the potential to impact environmental values*
- *infiltration and seepage intervention and collection controls*
- *surface water diversions and long-term management requirements*
- *dewatering requirements*
- *ongoing water management and reduction requirements (i.e. treatment).*

The closure landform design for GRM and BRM is intended to provide rehabilitated landforms that meet the nominated PMLU and NUMA milestone criteria without the need for ongoing water management. The key considerations, which are discussed in more detail in the relevant sections of this PRCP, taken into account in the assessment of ongoing water management requirements post-mining include:

- Subsidence areas within BRM will undergo rehabilitation works that will include a combination of backfill and installation of drains between subsidence panels to render the area predominantly free draining and to limit inundation to 1m or less in a 2% AEP rainfall event where practical (Section 6.1.2). The limited residual ponding will be confirmed by an AQP to not adversely impact the attainment of the PMLU.
- With the exception of the catchment of the residual voids and limited subsidence areas, the closure landform, will be predominantly free draining where appropriate to prevent impacts. The catchments of the

residual voids have been limited as far as practical to minimise the reduction of flows within the watercourses and remove the need for management of residual water storages (Section 6.1.5).

- All mining-related dams will be decommissioned and removed (Sections 6.1.5 and 6.5)
- Final residual voids will remain as NUMAs, which through evaporation from the void lakes, will maintain inward groundwater hydraulic gradients, minimising the potential for the loss of contaminants beyond the mining tenure through groundwater migration. The inward hydraulic gradients are centred on the Goonyella residual void (Section 6.3).
- Rehabilitated landforms provide residual void flood protection up to and including a 0.1% AEP flood event including a climate change 20% increase in rainfall intensity (Section 6.1.2)
- TSFs are covered and rehabilitated to a stable landform (Sections 6.1.5 and 6.2). Future disposal may result in tailings contained within the residual voids
- The acid neutralising capacity of the spoil is sufficient to neutralise acid forming materials within the spoil dumps (Section 6.1.3)
- Modelling of flow paths through particle tracking simulations within groundwater indicate that groundwater particles within the tenure will predominantly migrate toward the Goonyella residual void and some to the R32 South and R32 East residual voids, and not into off-tenure environments. Other residual voids assist with maintaining the tenure wide inward groundwater hydraulic gradients through evaporative losses of water from the void lakes, although fluxes of water from these void lakes to the Goonyella residual void are anticipated (Section 6.1.1)
- Contaminated land investigations (RM2) will be undertaken at the completion of mining and within individual rehabilitation areas to confirm the suitability of the site for the PMLUs and provide additional information on source areas, preferential pathways and potential risks
- Forward work plans and any required realignment and rehabilitation works will be undertaken to render the watercourse diversions to a suitable condition, supporting their progression to a relinquishable state (Section 6.1.7.4)
- Conceptual site models that assess SPR linkages have been prepared for relevant technical studies including hydrogeology (Section 6.1.1), waste characterisation (Section 6.1.3) and voids (Section 6.3) and show a low likelihood of complete exposure pathways to off-tenure receptors

6.1.7.1 Contaminants and sources

Since commencement of operations at GRM in 1971, the site has been used for heavy industrial type activities, including operation and maintenance of coal processing facilities, vehicles, plant, TSFs, general waste landfills and other infrastructure. These heavy industrial type activities include the storage, use and disposal of a variety of hazardous materials. GRM and BRM's facilities have and will continue to evolve over time with modern engineering and environmental standards, however, the duration and nature of the operations increase the likelihood of contaminated land being present at closure. Therefore, it is considered likely that investigation and some remediation/management will be required in areas that present a contaminated land risk.

In line with the requirements of the EP Act and the EA, areas of identified land contamination that present an unacceptable risk to human health or the environment during the operations will be subject to investigation and remediation efforts, where appropriate. Further contaminated land investigations and remediation/management works are likely to be required at GRM and BRM upon decommissioning of infrastructure to render the areas suitable for the PMLU at closure.

The predominant hazardous materials identified with potential to cause contamination at GRM and BRM and impact PMLUs and/or the receiving environment include:

- Hydrocarbons: including diesel, oils, greases, methyl isobutyl carbinol and other solvents
- Aqueous Film-Forming Foam: historical use of products containing Perfluoroalkyl and Polyfluoroalkyl Substances species of concern
- Nitrogen: associated with explosive formulation
- Carbonaceous material: potential saline and acidic/alkaline leachate

- Metals

Current operational water management includes the segregation and containment of water from mine operational areas. This water is collected within on-site mine dams and recycled within the mine operations, transferred to other BMA operations, or released under the conditions of the EA. Mine affected water includes runoff from CHPP area, MIA and water removed from the pits. Mine affected water dams have the potential to accumulate impacted water and sediments and therefore are a potential secondary source of contamination. All mine affected water dams will be assessed for potential accumulation of contaminants and appropriately decommissioned to form free draining areas.

Geochemical risks relating to AMD have been assessed for each of the residual relevant landforms (Section 6.1.3.4). The spoil landforms and residual voids, once pit lakes have been established, has been assessed to present a Low AMD hazard. TSF landforms, in their current state without any cover/cap, present a Moderate to Moderate-High AMD hazard, noting the future covers and rehabilitation works will be designed to reduce this hazard. Reject disposal sites have been assessed to present a Low-Moderate to Moderate AMD hazard. The waste characterisation conceptual model indicates the Goonyella residual void, which will be the dominant groundwater sink within the tenure boundary, and to a lesser extent R32 South and R32 East residual voids, will be the final destination of AMD leachate mobilised through groundwater. These residual void NUMAs maintain an inward hydraulic groundwater gradient for the tenure through evaporative water loses from the void lakes and thereby provide long-term mitigation for any AMD leachate releases to groundwater.

Covers over TSFs and rejects areas will minimise the potential for complete exposure pathways to be formed through surface water runoff and allow the closure landforms to be predominantly free draining to surrounding watercourses. It is noted that plausible exposure pathways are assumed through ground seepage from the out-of-pit TSFs and rejects areas to surface water drainage features. However, dewatering of the tailings and TSF covers, which will limit the infiltration of water and generation of leachate, will reduce the potential for mobilisation of contaminants through leachate seepage to surface water receptors.

Contaminated land investigations will be undertaken to assess areas for potential contamination where appropriate (RM2). These investigations will assess the range of potential contaminants that are utilised or generated during operations and will provide an assessment of the risk presented to achievement of the PMLUs and the receiving environment.

6.1.7.2 Pathway of contaminants

Contaminated land assessments within areas that present a reasonable risk of contamination (RA1, RA3, RA4, RA6 and RA9), will be undertaken as part of closure activities to confirm sources, pathways and receptors within the post-mining environment. The assessments will include both progressive assessments of individual rehabilitation areas and EP Act compliant assessments at the completion of mining. These contaminated land assessments will inform required remediation works and allow for the management of identified unacceptable risks associated with potential contaminant pathways.

The closure landform surfaces will be predominantly free draining directly to the surrounding watercourses and will not require on-going surface water management beyond that required under normal operations of the PMLU. Potential contaminant pathways for the closure landform surface include surface water runoff, generation of airborne particulate and through direct contact with the PMLUs. Through landform designs, remediation works and other engineering controls the closure landform surfaces are intended to be suitable for the direct discharge of surface water runoff to the surrounding watercourses and for use of the area for the nominated PMLU.

Numerical groundwater predictive modelling and particle tracking modelling indicate that an inward hydraulic gradient is maintained for the mining tenure (Section 6.1.1). This gradient is driven by evaporative losses from the residual void lakes and is centred on the larger/deeper Goonyella residual void, which acts as a groundwater sink. This inward hydraulic gradient provides for the long-term collection of potential contaminants introduced by GRM and BRM mining activities within the groundwater. The R32 South and R32 East residual voids also act as groundwater sinks in the proximity of the R32 in-pit TSF (Airstrip void). The remaining residual voids (Isaac, Broadmeadow and Theiss) contribute to the inward groundwater hydraulic gradients through evaporative losses from the void lakes. However, these voids do not act as groundwater sinks as the deeper residual voids have a stronger influence on the height of groundwater recovery post-mining. The modelling results indicate that fluxes out of the Isaac, Broadmeadow and Theiss residual voids migrate to Goonyella, R32 South and R32 East residual voids and not off-tenure.

During the initial stabilisation phase immediately post-mining, the more rapid recovery and higher climate influence on the void lakes (when compared to groundwater) may result in some variability in the flux between groundwater aquifers and void lakes. Outflows from the residual voids are limited to climate-driven events that result in periodic outflows, predominantly into the spoils. Flow path modelling indicates that these events do not result in loss of groundwaters beyond the tenure boundary (Section 6.3). Based on the water quality modelling of the void lakes (Appendix O), the predominantly rainfall derived water within the lakes has a salinity comparable to the surrounding Permian aquifers during the potential period of outward fluxes. Therefore, the outward fluxes from the void lakes are not expected to adversely impact surrounding groundwater quality.

6.1.7.3 Fate of contaminants

The contaminated land investigations undertaken as part of RM2 will include fate and transport modelling for identified contaminant plumes, where required, to understand the mobilisation, evolution and risks of contaminants.

Any contamination remaining at closure will not present an unacceptable risk to the proposed PMLUs, or adversely impact environmental values. Contamination identified in the contaminated land investigations that presents an unacceptable risk to the nominated PMLUs or the receiving environment will be subject to remediation to reduce the level of contamination to an acceptable level and/or implementation of engineering controls that minimise the potential for migration of contaminants and complete exposure pathways.

Due to the duration and nature of the operations at GRM and BRM, the level of contamination at closure is uncertain. The remediation or engineering controls required to render the area suitable for the intended PMLUs is therefore also uncertain. The length of time scheduled for RM2 reflects the level of uncertainty associated with each RA. The contaminated land investigations undertaken in RM2 will identify the measures required, and progression through RM2 will be accelerated if less time is required for remediation or installation of engineering controls to manage the risk.

Where contamination is contained within the subsurface, the inward groundwater hydraulic gradients created by the residual voids will minimise the potential migration of contaminants beyond the tenure boundary. The modelling undertaken indicated contaminant migration would terminate within one of the residual voids that are acting as a groundwater sink.

6.1.7.4 Surface water diversions and management requirements

GRM and BRM has diversions within four watercourses – Isaac River, Eureka Creek, Holding Paddock Creek and Fisher Creek, which were designed and constructed to enable mining. Each diversion has been assessed against the EA PMLU goals of being safe, structurally stable, not causing environmental harm and able to sustain a watercourse PMLU. The assessments concluded that all four watercourse diversions require realignment and rehabilitation. Diversion concept designs, based on both the Department of Natural Resources, Mines and Energy (DNRME) - *Guideline: Works that interfere with water in a watercourse for a resource activity—watercourse diversions authorised under the Water Act 2000* (DNRME, 2019) and ACARP (2014) guidelines, have been developed for these diversions:

- *PRCP Concept Design Report – Isaac River Diversion* (Engeny, 2025), provided in Appendix K
- *PRCP Concept Design Report – Eureka Creek Diversion* (Engeny, 2024a), provided in Appendix L
- *PRCP Concept Design Report – Holding Paddock Creek Diversion* (Engeny, 2024b), provided in Appendix M
- *PRCP Concept Design Report – Fisher Creek Diversion* (Engeny, 2024c), provided in Appendix N

The diversion details and forward work plan commitments for the relinquishment of the watercourse diversions requiring realignment are summarised in Table 32. The diversion concept designs will be progressed to functional designs. Prior to commencing any watercourse rehabilitation construction works, all applicable environmental approvals, including under the *Water Act 2000*, will be obtained.

Table 32: GRM and BRM watercourse diversion details and forward work plans

Details	Isaac River	Eureka Creek	Holding Paddock Creek	Fisher Creek
Diversion authorisation	Constructed under the CQCA Agreement Act	Constructed under the CQCA Agreement Act	Constructed under the CQCA Agreement Act	Constructed under the CQCA Agreement Act
River catchment	Fitzroy Basin	Fitzroy Basin	Fitzroy Basin	Fitzroy Basin
Upstream catchment area (km^2)	876	93	32	64
Year of construction	1985 to 1987	1987	1985	1986
Diversion length (km)	7.8	5.9	6.1	1.5
Diversion assessment outcome	At closure, the existing diversion alignment is not expected to achieve a watercourse PMLU to a stable condition. Diversion requires implementation of the forward work plan commitments	At closure, the existing diversion alignment is not expected to achieve a watercourse PMLU to a stable condition. Diversion requires implementation of the forward work plan commitments	At closure, the existing diversion alignment is not expected to achieve a watercourse PMLU to a stable condition. Diversion requires implementation of the forward work plan commitments	At closure, the existing diversion alignment is not expected to achieve a watercourse PMLU to a stable condition. Diversion requires implementation of the forward work plan commitments
Operational phase	Routine monitoring and maintenance of the diversion during the operational phase of the mine	Routine monitoring and maintenance of the diversion during the operational phase of the mine	Routine monitoring and maintenance of the diversion during the operational phase of the mine	Routine monitoring and maintenance of the diversion during the operational phase of the mine
Forward work plan - diversion construction	Post realisation of final subsidence, progress concept design (Appendix K) to functional design, including undertaking site-specific investigations to ensure the design addresses key risks	When surrounding rehabilitation activities are planned, progress concept design (Appendix L) to functional design, including undertaking site-specific investigations to ensure the design addresses key risks	When surrounding rehabilitation activities are planned, progress concept design (Appendix M) to functional design, including undertaking site-specific investigations to ensure the design addresses key risks	When surrounding rehabilitation activities are planned, progress concept design (Appendix N) to functional design, including undertaking site-specific investigations to ensure the design addresses key risks

Details	Isaac River	Eureka Creek	Holding Paddock Creek	Fisher Creek
	Construction of the realignment diversion channel in line with the final functional design developed based on DNRME (2019) and ACARP (2014) guidelines	Construction of the diversion in line with the final functional design developed based on DNRME (2019) and ACARP (2014) guidelines	Construction of the diversion in line with the final functional design developed based on DNRME (2019) and ACARP (2014) guidelines	Construction of the diversion in line with the final functional design developed based on DNRME (2019) and ACARP (2014) guidelines
Forward work plan – infrastructure	Removal and rehabilitation of current or future mine infrastructure near the diversion The railway and a corridor for Red Hill Road will remain	Removal and rehabilitation of current or future mine infrastructure near the diversion, decommissioning of GS4A Weir	Removal and rehabilitation of current or future mine infrastructure near the diversion	Culverts to meet the accepted development requirements for fish passage and design standards for public road/rail crossings Removal of the existing rail loop is to occur prior to closure, and a corridor for Red Hill Road will remain
Forward work plan – final landform	Re-grade, apply growth media and revegetate adjacent spoil dumps	Re-grade, apply growth media and revegetate adjacent spoil dumps	Re-grade, apply growth media and revegetate adjacent spoil dumps	Re-grade, apply growth media and revegetate adjacent spoil dumps

6.1.7.5 Ongoing water management

On completion of rehabilitation works, ongoing water management or dewatering is not envisaged to be required due to the following:

- The surface of the closure landform, excluding the residual voids and limited subsidence areas, will be free draining where required to prevent impacts
- Inundation of water within subsidence areas will be managed through backfill and installation of drains between subsidence panels to limit inundation depths to 1m within a 2% AEP rainfall event and to render the area predominantly free draining, where practical
- The potential for contamination will be assessed as required by the PRCP schedule (RM2) and remediation and/or management works undertaken to render the site suitable for the nominated PMLUs.
- The residual voids will maintain an inward hydraulic gradient towards the tenure and minimise the potential for off-site migration of contaminants
- Residual voids will not overtop or interconnect the deeper Permian aquifers with the shallower Alluvial aquifers
- Watercourse diversions will be realigned where required and rehabilitated to form a stable landform that allows relinquishment of the diversions
- Disturbed areas within natural watercourses will be reshaped into defined bed and banks and blended in with adjacent undisturbed areas

Section 8 of this plan includes both groundwater and surface water monitoring programs that will be undertaken as part of the rehabilitation works. The monitoring program provides the assessment of groundwater quality and levels within key locations that will inform 5-yearly updates of the numerical groundwater model. Through the groundwater model predictive outputs, groundwater flow paths, levels and the progression towards the residual voids developing into groundwater sinks will be confirmed. Should the monitoring results or groundwater model predictions indicate a reasonable potential for environmental harm, the site will be in non-compliance with the PRCP schedule and rectification works specific to the non-conformance will be undertaken. Where triggered, a PRCP amendment will also be undertaken.

Relationship with the PRCP schedule
The closure landform design with residual voids will provide a landscape that does not require any ongoing active water management. The watercourse diversions will be realigned, where required, and rehabilitated to form a stable watercourse PMLU that allows for relinquishment of the diversions. Rehabilitation of subsidence areas will limit the inundation/ponding of water.

6.1.8 Revegetation

PRCP Guideline (Section 3.6.1)

The revegetation plan must propose activities that will establish self-sustaining vegetation communities that are appropriate for the intended PMLU (e.g. natural ecosystems, grazing, forestry and some agricultural and other land uses). Revegetation should, therefore, not only establish a ground cover, but also, in some domains, establish associated fauna habitat and other ecological services.

The rehabilitation planning part must include details of the site preparation required for rehabilitation activities.

6.1.8.1 Revegetation objectives

The revegetation objectives of the planned PMLUs of cattle grazing, grassland, woodland habitat and watercourse are consistent with the rehabilitation milestone criteria:

- Cattle grazing:
  - Achieve >50% vegetation groundcover

  - Establishment of cattle grazing pasture with land suitability class ≤3
- Grassland:
  - Achieve groundcover ≥50% on slopes ≤15%, or ≥80% on slopes >15%
  - Establishment of grass species to support stability
- Woodland habitat:
  - Achieve groundcover ≥50% on slopes ≤15%, or ≥80% on slopes >15%
  - Establishment of vegetation with BioCondition site-based attributes, or
  - Establishment of vegetation from substitute REs (RE 11.3.2b and RE 11.3.27f) suited to temporal ponding (applicable if ponded areas remains)
- Watercourse:
  - Achieve riparian vegetation index ≥ upstream or downstream values

There are no revegetation objectives for the planned NUMAs.

The above revegetation objectives for groundcover consider groundcover to be anything in contact with the soil surface, for example live cover, standing dry cover, organic litter (including leaves, hay, woody debris) or rocks.

Infrastructure, such as fencing, may be required to restrict livestock from areas revegetated to achieve a grassland PMLU. No infrastructure is proposed for other areas unless temporary fencing is required to restrict stock or access from subsided areas while vegetation re-establishes.

6.1.8.2 Species of conservation significance

GRM and BRM have no obligations under the EA requiring specific inclusion of species of conservation significance in the revegetation planning. Nonetheless, areas adjoining undisturbed Endangered or Of Concern REs (Section 1.2.8) or threatened species habitats (Section 1.2.9) will be rehabilitated to a woodland habitat PMLU wherever possible. This approach will provide connectivity between rehabilitated areas and existing vegetation and habitat values. Similarly, areas rehabilitated to a watercourse PMLU will connect existing riparian habitat values for several conservation significant species.

6.1.8.3 Fauna habitat and use requirements

There are no obligations under the EA to establish fauna habitat and/or fauna use in the rehabilitation areas for GRM and BRM. However, areas adjoining undisturbed threatened fauna species habitats (Section 1.2.9) will be rehabilitated to a woodland habitat PMLU wherever possible, and disturbed areas of watercourses will be rehabilitated to a watercourse PMLU, including the Isacc River riparian zone.

Woodland habitat and watercourse revegetation will include a combination of *Eucalyptus, Corymbia* and non-Eucalyptus framework tree species and woody understorey species that will provide broad habitat values for highly mobile fauna taxa including birds and mammals (e.g. kangaroos and wallabies), as well as longer term foraging and shelter opportunities for common fauna species and several species of conservation significance (e.g. koala and echidna).

6.1.8.4 Revegetation seed provenance

The provenance (where the seed comes from) is a consideration for all species. Although the local provenance boundary locations may differ between species, as a preference seed should be sourced from the Brigalow Belt North bioregion.

Proof of provenance will be sought from the seed supplier(s) along with germination and viability certificates for all purchased seeds.

6.1.8.5 Cattle grazing and grassland revegetation species and seeding rates

Cattle grazing PMLU is predominately planned for the lower gradient areas disturbed by mining activities, areas that require shallow rooted species, stock routes and/or areas where there was significant clearing prior to mining (RA3, RA7, RA20). Grassland PMLU is planned for areas that require shallow rooted species, but where cattle may impact the stability and integrity of the TSF or rejects cover (RA6, RA9).

The growth media for cattle grazing and grassland will be pre-stripped topsoil, spread over rehabilitated landforms at a depth ≥150mm, and ameliorated as recommended by an AQP (Section 6.1.4). Rehabilitation of subsided areas (RA20) will utilise the in-situ topsoil for any minor disturbance areas such as minor crack repairs, or topsoil stripped and stockpiled from the area where topsoil is needed for larger crack repairs, drainage works or backfilled areas.

The recommended revegetation species mix for cattle grazing PMLU is based on seeding native and naturalised exotic species that are perennial, productive and palatable (3P) grasses and legumes, cognisant of grazing best management practice (DES, 2022a; Future Beef, 2022). 3P grasses have been recommended based on species known to occur on GRM and BRM, as well as a selection of pasture species suitable for the soil management groups described in Section 6.1.4. The same grass species have been recommended for the grassland PMLU.

The recommended species list and seeding rates are detailed in Table 33. A seeding rate of 16kg/ha of coated grass seed and 4kg/ha of uncoated legume seed is recommended for a cattle grazing PMLU and a seeding rate of 25kg/ha of coated grass seed is recommended for a grassland PMLU. All seed mixes will also include Japanese millet (*Echinochloa esculenta*) or similar as a sterile cover crop to protect topsoil from erosion. The cover crop will establish quickly on the exposed surfaces to provide vegetative cover and a root system that will stabilise the surface and prevent erosion until new seedlings have established. Where bare soil is exposed due to subsidence cracking, seeding rates will be recommended by an AQP based on the extent of impact.

Species availability may vary, however at least four 3P grass species including at least two native species and two legumes listed in Table 33 are required for cattle grazing revegetation. The cattle grazing or grassland seed mix composition and seeding rates may be adjusted by an AQP based on the results of ongoing rehabilitation monitoring (Section 8).

Seed mixes are recommended to be sown in the warmer months of the year from September to March, when the probability of rainfall is highest. Seeding may be undertaken at other opportune times, such as for unseasonal climatic conditions.

No seeding of Leucaena (*Leucaena leucocephala*) is planned at GRM and BRM.

Table 33: Recommended species list and seeding rates for cattle grazing and grassland PMLUs

Scientific name	Common name	Topsoil suitability		Seeding rate (kg/ha)	
		Clays	Loams	Cattle grazing	Grassland
Grass species					
Astrebla lappulacea, A, squarrosa, A. elymoides	Mitchell grasses (curly, bull and hoop)	✓	-	2[c] (per species)	5[c] (per species)
Bothriochloa bladhii	forest blue grass	-	✓	4[c]	5[c]
Bothriochloa ewartiana	desert bluegrass	✓	✓	2[c]	3[c]
Bothriochloa insculpta cvv. *Bisset**	Bisset creeping blue grass	✓	✓	4[c]	5[c]
Chloris gayana cvv. *Callide**	Callide Rhodes grass	✓	✓	4[c]	5[c]
Chloris gayana cvv. *Katambora**	Katambora Rhodes grass	✓	✓	4[c]	5[c]
Dichanthium aristatum	Angleton grass	✓	-	4[c]	5[c]

Scientific name	Common name	Topsoil suitability		Seeding rate (kg/ha)	
		Clays	Loams	Cattle grazing	Grassland
Dichanthium sericeum subsp. sericeum	Queensland blue grass	✓	-	4[c]	5[c]
Heteropogon contortus	black spear grass	✓	✓	2[c]	3[c]
Leersia hexandra	swamp rice grass	✓	✓	4[c]	5[c]
Leptochloa digitata	umbrella cane grass	✓	✓	4[c]	5[c]
Megathyrsus maximus var. *pubiglumis**	green panic	-	✓	4[c]	5[c]
*Panicum coloratum var. makarikariense**	bambatsi panic	✓	-	4[c]	5[c]
Panicum decompositum	native millet	✓	✓	4[c]	5[c]
*Setaria incrassata**	purple pigeon	✓	-	4[c]	5[c]
*Urochloa mosambicensis**	Sabi grass	-	✓	4[c]	5[c]
Grass species - Total seed weight (coated)				**16[c]**	**25[c]**
Legume species					
*Chamaecrista rotundifolia**	Wynn cassia	-	✓	2	-
*Macroptilium bracteatum**	burgundy bean	✓	-	2	-
Rhynchosia minima var. australis	rhynchosia	✓	✓	2	-
Rhynchosia minima var. minima	rhynchosia	✓	✓	2	-
*Stylosanthes hamata**	shrubby stylo	-	✓	2	-
*Stylosanthes seabrana**	stylo	✓	-	2	-
Legume species - Total seed weight (uncoated)				**4**	**0**
Cover Crop					
Echinochloa esculenta	Japanese millet	✓	✓	5[c]	10

[c] *Seeding rate for coated seed. If not coated, use half the prescribed rate; * Naturalised exotic grass species*

6.1.8.6 Woodland habitat revegetation

Woodland habitat PMLU is planned on rehabilitated landforms associated with the spoil dumps, near existing vegetation communities and areas of remnant vegetation affected by subsidence.

The approach to woodland habitat revegetation has considered the following OQMRC publications:

- *Evaluating methods for assessing native ecosystem mine rehabilitation success* (Spain, Nuske, & Gagen, 2023)
- *Native ecosystem rehabilitation in Queensland Implications for leading practice* (OQMRC, 2023)

The species selection for the woodland habitat revegetation areas has considered the ecological functional groupings according to the role or function they perform in both rehabilitation and non-mined environments (Table 34) (Emmerton et al., 2016a, Emmerton et al., 2016b). Short lived wattles (*Acacia* spp.) have been

excluded from the species mix as they are unlikely to provide the necessary structure and longer-term ecological function. Intermediate lifespan wattles have been limited in the seed mix. Framework tree species and shrubby understorey species are maximised to provide longer-term ecosystem resilience, structure and function. Competitive pasture species have been excluded from the seed mix and only non-aggressive grass species are recommended (Emmerton et al., 2016b).

Table 34: Life form and functional groups assigned to species based on their structural form or ecological function

Life form and functional group	Code	Explanatory notes
Framework trees		
Eucalypt/ Bloodwood (Corymbia) species	E/C	*Eucalyptus, Corymbia*, occasionally Angophora species (of any height) which can form an upper storey and often form recognisable vegetation communities but may exist within other communities.
Non-eucalypt, non-acacia species	NE/NA	Non-eucalypt, non-wattle species (of any height) which can form recognisable communities, or which may exist in isolation and are capable of becoming part of the upper storey.
Long lived acacias	LLA	Wattle species which may form recognisable communities or exist as part of the upper storey in other communities
Woody understorey components		
Shrubby understorey	SU	A shrub is defined as: a woody plant that is multi-stemmed from the base (or within 200 mm from ground level) up to 8m in height or if single stemmed, less than 2m tall (Eyre, et al., 2015). It therefore may include species which are sometimes regarded as small to medium trees.
Groundcover shrubs	GCS	Shrubs which form a groundcover.
Vines/creepers	V/C	Vines or creepers that are perennial and have a woody component.
Intermediate lifespan acacias	ILA	Sub-dominant acacias which do not form a community in undisturbed natural ecosystems but can become dominant in rehabilitation areas.
Short lifespan wattles	SLA	Wattles prevalent as an understorey in eucalypt communities with some level of disturbance and relatively short lived (≤10 years).
Introduced woody perennials	IWP	Introduced woody species potentially becoming weeds in some circumstances.
Groundcover components		
Competitive pasture grasses	CPG	Aggressive introduced pasture grass species (considered to detract from ecosystem values).
Introduced grasses	IG	Less competitive naturalised species (less aggressive than the CPG group).
Native grasses	NG	Perennial and annual native grasses. Includes grass like plants (e.g. *Cyperus, Dianella, Lomandra*).

6.1.8.7 Woodland habitat seed species and seeding rates

Spoil dumps (RA1)

The spoil dumps are elevated, sloped anthropogenic landforms, comprised of mudstones, claystones, siltstones and sandstones (Section 6.1.5). These landforms vary from pre-mining landforms and do not align with any specific land zone under the RE framework (Wilson & Taylor, 2012).

Woodland habitat revegetation of the spoil dumps aims to achieve a 'hybrid' ecosystem as defined by Spain, et al. (2023). This will be achieved through revegetation with key framework tree, shrub and grass species known to occur within representative REs within and surrounding GRM and BRM, as well as species that are better adapted to the macro climatic (i.e. drought, fire, flooding rains, climate change) and micro climatic factors associated with the final spoil landform (i.e. growth media, physical and chemical variation, variation in slope, aspect, altitude).

The representative REs known to occur within or surrounding GRM and BRM, based on their listing in the relevant Technical Descriptions of Regional Ecosystems (Queensland Herbarium, 2018) (Section 1.2.8.1), that best align with the woodland habitat rehabilitation landforms (i.e. hilly, rocky terrain and/or substrates with poorer soils) include:

- RE 11.5.3 - *Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces
- RE 11.5.9 - *Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and/or remnant surfaces
- RE 11.7.2 - *Acacia spp.* woodland on Cainozoic lateritic duricrust. Scarp retreat zone.

The growth media for woodland habitat includes pre-stripped topsoil and ameliorated Permian spoil, as discussed in Section 6.1.4. The growth media will be ameliorated, if recommended by an AQP, prior to deep ripping and seeding (Section 6.1.4). Where topsoil is being used, the depth will be a minimum of 100mm to limit the effects of competition on woodland species due to the potential loads of exotic pasture species (i.e. buffel grass) (Emmerton et al., 2016a) and to provide the best chance of successful establishment of woody species (Spargo & Doley, 2016).

The recommended woodland habitat species for RA1 are listed in Table 35, along with the associated life form and functional group, preferred growth media and recommended seeding rates. The woodland habitat revegetation plan includes 6 kg/ha of framework tree species, 4 kg/ha of woody understory species and 10kg/ha of grasses. Planting will also include the addition of a sterile cover crop (e.g. Japanese millet or similar) seeded at 5kg/ha to provide initial groundcover.

Seed availability may vary, however seed mixes should ensure that at least six species from each of the main revegetation groups listed in Table 35, including framework tree, woody understorey and grasses, are sown at the overall recommended rate to achieve the required species richness. If recommended species are not available, substitute species from RE 11.5.3, RE 11.5.9 or RE 11.7.2 should be used.

Revegetation species and rates for woodland habitat may be adjusted by an AQP, to ensure continuous improvement of the rehabilitation outcomes, based on the results of ongoing monitoring (Section 8).

The preferred seeding timing for woodland habitat is either April/May or September/early October when there is sufficient soil moisture in the profile. Sowing in cooler months offers longer periods of surface moisture resulting from rain events, as well as reduced grass competition. Seeding may be undertaken at other opportune times, such as for unseasonal climatic conditions.

Table 35: Recommended species list and seeding rates for woodland habitat PMLU (RA1)

Species name*	Common name	Life form and functional group code	Clays	Loams, ameliorated spoils	Seed rates (kg/ha - uncoated weight)
Framework tree species					
Acacia catenulata	bendee	LLA	-	✓	0.3 - 1
Acacia rhodoxylon	rosewood	LLA	-	✓	0.3 - 1
Acacia shirleyi	lancewood	LLA	-	✓	0.3 - 1
Alphitonia excelsa	red ash	NE/NA	✓	✓	0.3 - 0.5
Angophora leiocarpa	smooth barked apple	E/C	-	✓	0.3 - 0.5
Atalaya hemiglauca	whitewood	NE/NA	✓	✓	0.3 - 0.5
*Corymbia citriodora subsp. citriodora***	lemon scented gum	E/C	-	✓	0.3 - 0.5
Corymbia clarksoniana	Clarkson's bloodwood	E/C	✓	✓	0.3 - 1
Corymbia dallachiana	Dallachy's gum	E/C	✓	✓	0.3 - 0.5
Corymbia erythrophloia	red bloodwood	E/C	✓	✓	0.3 - 1
Eucalyptus cambageana	Dawson's gum	E/C	-	✓	0.3 - 0.5
Eucalyptus crebra	narrow leafed ironbark	E/C	✓	✓	0.6 - 2
Eucalyptus exserta	Queensland peppermint	E/C	-	✓	0.3 - 0.5
Eucalyptus melanophloia	silver leafed ironbark	E/C	✓	✓	0.3 - 1
Eucalyptus populnea	poplar box	E/C	✓	✓	0.3 - 0.5
Eucalyptus thozetiana	Thozet's gum	E/C	✓	✓	0.3 - 0.5
Lysiphyllum carronii	red bauhinia	NE/NA	✓	✓	0.3 - 0.5
Lysiphyllum hookeri	white bauhinia	NE/NA	✓	✓	0.2 - 0.5
Terminalia oblongata	yellowwood	NE/NA	✓	✓	0.2 - 0.5
Framework tree species - Total seed weight (uncoated)					**6**
Woody understory species					
Acacia conferta	crowded-leaf wattle	ILA	-	✓	0.3 - 0.5
Acacia excelsa	ironwood wattle	LLA	✓	✓	0.3 - 0.5
Acacia sericophylla	desert oak	ILA	-	✓	0.3 - 0.5
Breynia oblongifolia	coffee bush	SU	✓	✓	0.3 - 0.5
Capparis lasiantha, C. canescens, C. loranthifolia.	wait-a-while	V/C	✓	✓	0.2 - 0.5
Carissa ovata	currant bush	GCS	✓	✓	0.3 - 1

Species name*	Common name	Life form and functional group code	Clays	Loams, ameliorated spoils	Seed rates (kg/ha - uncoated weight)
*Cassia brewsteri***	Leichhardt bean	SU	✓	✓	0.3 - 0.5
*Dodonaea viscosa***	sticky hop bush	SU	✓	✓	0.3 - 0.5
Eremophila mitchellii	false sandlewood	SU/NE/NA	✓	✓	0.3 - 0.5
Erythroxylon australe	cocaine tree	SU	✓	✓	0.2 - 0.5
Geijera parvifolia	wilga	SU	✓	✓	0.2 - 0.5
Grevillea striata	beefwood	SU/NE/NA	-	✓	0.3 - 0.5
Grewia latifolia	dogs balls	SU	✓	✓	0.3 - 0.5
Hakea lorea	bootlace oak	SU/NE/NA	✓	✓	0.3 - 0.5
Jasminum didymum	native jasmine	V/C	✓	✓	0.3 - 0.5
Petalostigma pubescens	quinine	SU/NE/NA	✓	✓	0.3 - 0.5
Pittosporum angustifolium	Gumby Gumby	SU/NE/NA	✓	✓	0.3 - 0.5
Senna artemisioides	silver cassia	SU	✓	✓	0.3 - 0.5
Woody understory species - Total seed weight (uncoated)					**4**
Grass species					
Aristida spp (i.e. A. calycina, A. latifolia, A. ramosa, A. caput-medusae, A. jerichoensis, A. personata, A. calycina)	three awned spear grass	NG	-	✓	1 - 2
Bothriochloa decipiens var. decipiens	pitted blue grass	NG	✓	✓	1 - 2
Bothriochloa ewartiana	desert bluegrass	NG	✓	✓	1 - 2
Chrysopogon fallax	golden beard grass	NG	✓	✓	1 - 2
Cymbopogon refractus	barbwire grass	NG	✓	✓	1 - 2
*Cynodon dactylon var. dactylon***	couch	IG	✓	✓	2
Dichanthium sericeum	Qld bluegrass	NG	✓	✓	1 - 2
Panicum effusum	hairy panic	NG	✓	✓	1 - 2
Panicum queenslandicum	Yabila grass	NG	✓	-	1 - 2
Paspalidium distans	shot grass	NG	-	-	1 - 2
Themeda triandra	kangaroo grass	NG	✓	✓	1 - 2
Grass species - Total seed weight (uncoated)					**10**
Cover Crop					
Echinochloa esculenta	Japanese millet	Cover crop	✓	✓	5

** If recommended species are not available, substitute species from RE 11.5.3, RE 11.5.9, RE 11.7.2*
***Species adapted to moderate to high salinity tolerance* (DERM, 2011)

Adjacent to existing vegetation (RA4)

The revegetation plan for RA4 aims to achieve woodland habitat with at least two framework trees, three shrubs and four grasses from the existing remnant REs (Section 1.2.8.1). The growth media will be pre-stripped topsoil, spread over rehabilitated landforms at a depth ≥100mm, and ameliorated as recommended by an AQP (refer to Section 6.1.4).

The revegetation seed mix will be recommended by an AQP based on the location of the rehabilitation in relation to the adjacent REs and should consider the species and the rates listed in Table 35. Minimal disturbance is planned for some RA4 areas, therefore growth media replacement and seed application may not be required in all areas.

Underground mining areas (RA21)

Rehabilitation of RA21, including areas with minor surface cracks, will utilise the in-situ topsoil. For larger crack repairs that require infilling with material, drainage works and/or subsidence backfill areas, the topsoil stripped and stockpiled from the area prior to the works will be re-spread once works are complete.

The conceptual surface water hydraulic design for the RA21 subsidence areas provides for a predominantly free draining landform with a maximum of 1m depth of peak inundation within a 2% AEP rainfall event (Section 6.1.2). Where seeding is required, these areas will be seeded with similar species as the surrounding REs (Section 1.2.8.1), as recommended by an AQP. The areas to be revegetated will include where topsoil has been disturbed or replaced (such as crack repairs, drainage works, or backfilled areas), or previously cleared areas where additional seeding is required to achieve the revegetation objectives. Some areas within RA21 may have limited impacts from mining, therefore an AQP may recommend lower seeding rates or no seed application, based on an assessment of existing vegetation (such as species richness and cover).

Where temporal ponding does remain (Section 6.1.2.3) and seeding is required, the revegetation plan aims to achieve a fringing woodland habitat with tree, shrub, grass and sedge species capable of persisting in the altered abiotic and biotic conditions. Revegetation of the temporal ponded areas will follow the 'substitute' approach as described by Spain, et al. (2023) and will be based on seeding with species from the following substitute REs:

- RE 11.3.2b - *Eucalyptus camaldulensis* (sometimes *E. populnea* and/or *E. tereticornis*) woodland in drainage depressions
- RE 11.3.27f - *Eucalyptus coolabah* and/or *E. tereticornis* open woodland to woodland fringing swamps

Revegetation of areas with temporal ponding will utilise in-situ topsoil and seed with the recommended species listed in Table 36. The revegetation plan includes 6kg/ha of framework tree species, 4kg/ha of woody understory species and 10kg/ha of ground species. Seed availability may vary, however seed mixes should ensure that at least four species from each of the main revegetation groups (i.e. framework tree, woody understorey and ground species) are sown at the overall recommended rate to achieve the required species richness. Revegetation species and rates for woodland habitat may be adjusted by an AQP, to ensure continuous improvement of the rehabilitation outcomes, based on the results of ongoing monitoring (Section 8).

Table 36: Recommended species list and seeding rates for woodland habitat PMLU (RA21 – temporal ponded areas)

Species name	Common name	Life form	Seed rate (kg/ha - uncoated weight)
Framework tree species			
*Casuarina cristata**	belah	E/C	1 - 2
*Eucalyptus camaldulensis**	river red gum	E/C	1 - 2
Eucalyptus coolabah	Coolabah	E/C	1 - 2
Eucalyptus populnea	poplar box	E/C	0.5 - 1
*Eucalyptus tereticornis**	Queensland blue gum	E/C	1 - 2
*Melaleuca bracteata**	black tea tree	NE/NA	0.5 - 1

Species name	Common name	Life form	Seed rate (kg/ha - uncoated weight)
Terminalia oblongata	yellowwood	NE/NA	0.5 - 1
Framework tree species - total seed weight (uncoated)			**6**
Woody understorey species			
*Cassia brewsteri**	Leichardt bean	SU	0.5 - 1
Dodonaea viscosa	sticky hop bush	SU	0.5 - 1
Eremophila bignoniiflora	emu bush	SU	0.5 - 1
Eremophila mitchellii	false sandalwood	SU	0.5 - 1
Ficus opposita	sandpaper fig	SU	0.5 - 1
Geijera parvifolia	wilga	SU	0.5 - 1
Lysiphyllum carronii	red bauhinia	NE/NA	0.5 - 1
Psydrax oleifolia		SU	0.5 - 1
Woody understorey species - total seed weight (uncoated)			**4**
Ground species			
Bothriochloa bladhii	Forest blue grass	NG	0.5 - 1
Bothriochloa decipiens var. decipiens	pitted blue grass	NG	0.5 - 1
Chrysopogon fallax	golden beard grass	NG	0.5 - 1
*Cyperus spp. (C. gracilis, C. polystachyos, C. fulvus, C. exaltatus)**	sedges	Native other	0.5 - 1
Eleocharis spp. (E. sphacelata, E. pallens, E. plana)	spike like sedges	Native other	0.5 - 1
Iseilema sp. (I. vaginiflorum, I. membranaceum)	Flinders grass	NG	0.5 - 1
Leersia hexandra	swamp rice grass	NG	0.5 - 1
Leptochloa digitata	umbrella cane grass	NG	0.5 - 1
Panicum decompositum var. decompositum	native millet	NG	0.5 - 1
Paspalidium caespitosum	brigalow grass	NG	0.5 - 1
Paspalidium distans	Shot grass	NG	0.5 - 1
Paspalidium jubiflorum	Warrego summer grass	NG	0.5 - 1
Ground species - total seed weight (uncoated)			**10**

** Medium salinity tolerance (DERM 2011)*

6.1.8.8 Watercourse revegetation

Watercourse revegetation activities will be implemented to establish riparian vegetation associated with a watercourse PMLU for the following areas:

- Future watercourse diversions
- Existing watercourse diversions requiring additional revegetation activities
- Natural watercourses which have been impacted by mining activities e.g. crossings, subsidence cracks

The existing watercourse diversions that have been previously revegetated are discussed in Section 6.1.7.4 and will be monitored to inform operational maintenance requirements (Section 8.3).

The revegetation zones for natural watercourses (Figure 18) are defined as follows:

- Upper bank: defines the lateral limits of both sides of the watercourse. It does not include the land adjacent. The upper bank generally extends down the riparian profile and is dominated by taller *Eucalyptus* spp., with a mixed woody and grassy understorey.
- Mid bank: occurs between the upper and lower banks and will vary in size depending on the watercourse geomorphology or diversion design. The mid bank may include benches created from high flow events. The vegetation on the mid bank comprises a mix of species including scattered *Eucalyptus* spp., as well as species that are more adapted to periodic inundation of water and can withstand some disturbance from floods (e.g. *Melaleuca* spp.).
- Lower bank (including bank toe): commences at the edge of the low flow channel or stream bed and extends up the bank to the area affected by more regular lower flows. The vegetation in the lower bank is dominated by scattered trees adapted to wetter environments (i.e., *Melaleuca* spp) and a high ground cover of grasses, reeds, sedges and rushes.

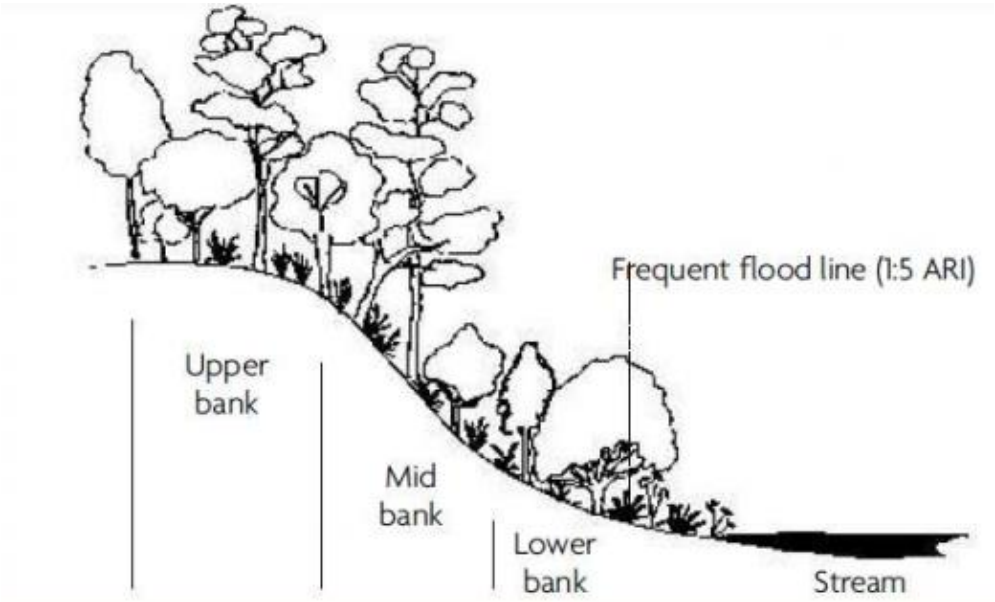

Figure 18: Typical riparian revegetation plantings zone (Vegetation Matters, 2014)

The growth media for watercourse PMLU will be pre-stripped topsoil, spread over the bank areas of the rehabilitated landforms at a depth ≥150mm, and ameliorated if recommended by an AQP (Section 6.1.4).

6.1.8.9 Watercourse revegetation species and seeding rates

The watercourse revegetation species are based on selecting framework trees, woody understorey and groundcover species associated with the predominant natural watercourse RE 11.3.25 occurring on GRM and BRM and associated with Isaac River (Figure 8).

The recommended watercourse revegetation species and seeding rates are listed in Table 37 and Table 38. The planned seeding rate for upper and mid banks is 20kg/ha comprised of 6kg/ha uncoated framework tree, 4kg/ha uncoated woody understorey species and 10kg/ha uncoated ground species.

The planned seeding rate for lower banks is 15kg/ha comprised of 5kg/ha uncoated framework tree and 10kg/ha uncoated ground species. The revegetation on the lower banks has been designed to establish a higher percentage of groundcover species, including grasses and rushes. Competitive pasture species have been

excluded from the seed mix and only non-aggressive grass species are recommended. Short lived wattle species have also been excluded in the seed mix. Where bare soil is exposed due to subsidence cracking, seeding rates will be recommended by an AQP based on the extent of impact.

Planting in all revegetation zones will also include the addition of a sterile cover crop (e.g. Japanese millet or similar) seeded at 5kg/ha to provide initial groundcover.

The preferred seeding timing for watercourse revegetation is August to October. There is low chance of frost and less likelihood of significant rainfall in this period allowing the best opportunity for vegetation to establish in a relatively non-erosive period. Seeding may be undertaken at other times, such as for opportune unseasonal climatic conditions, or when required to immediately seed bare areas resultant from subsidence cracking management.

Table 37: Recommended species list and seeding rates for watercourse PMLU – upper and mid banks

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
Framework tree species			
*Acacia stenophylla**	river myall	LLA	0.5 - 1
Alphitonia excelsa	red ash	NE/NA	0.5 - 1
Angophora floribunda	rough barked apple	E/C	0.5 - 1
Angophora leiocarpa	smooth barked apple	E/C	0.5 - 1
Angophora subvelutina	broadleaf apple	E/C	0.5 - 1
*Casuarina cristata**	belah	E/C	0.5 - 1
*Casuarina cunninghamiana**	river she oak	NE/NA	0.5 - 1
*Corymbia tessellaris**	Moreton Bay ash	NE/NA	0.5 - 1
Eucalyptus camaldulensis subsp. *obtusa**	river red gum	E/C	1 - 2
Eucalyptus coolabah subsp. *coolabah*	Coolabah	E/C	1 - 2
Eucalyptus melanophloia	silver leaved ironbark	E/C	0.5 - 1
Eucalyptus populnea	poplar box	E/C	0.5 - 1
Eucalyptus tereticornis subsp. *tereticornis**	Queensland blue gum	E/C	0.5 - 1
Lysiphyllum hookeri	white bauhinia	NE/NA	0.5 - 1
*Melaleuca bracteata**	black tea tree	NE/NA	0.5 - 1
Terminalia oblongata	yellowwood	NE/NA	0.5 - 1
Framework tree species - total seed weight (uncoated)			**6**
Woody understorey species			
Acacia excelsa	ironwood wattle	ILA	0.5 - 1
Acacia fasciculifera	scaly bark	ILA	0.5 - 1
Carissa ovata	current bush	GCS	0.5 - 1
*Cassia brewsteri**	Leichardt bean	SU	0.5 - 1
Dodonaea viscosa	sticky hop bush	SU	0.5 - 1

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
Eremophila mitchellii	false sandalwood	SU	0.5 - 1
Erythroxylum australe	cocaine tree	SU	0.5 - 1
Ficus coronata	creek sandpaper fig	SU	0.5 - 1
Ficus fraseri	white sandpaper fig	SU	0.5 - 1
Ficus opposita	sandpaper fig	SU	0.5 - 1
Grevillea striata	beefwood	SU	0.5 - 1
Grewia latifolia	dogs balls	SU	0.5 - 1
Hakea lorea	bootlace oak	SU	0.5 - 1
Mallotus philippensis	red kamala	SU	0.5 - 1
Petalostigma pubescens	quinine	SU	0.5 - 1
Woody understorey species - total seed weight (uncoated)			**4**
Ground species			
Bothriochloa bladhii	forest blue grass	NG	1 - 2
Capillipedium spicigerum	scented top	NG	1 - 2
Cymbopogon refractus	barbwire grass	NG	1 - 2
*Cynodon dactylon**	couch	IG	2
Dichanthium sericeum subsp. sericeum	Queensland bluegrass	NG	1 - 2
Digitaria brownii	cotton panic	NG	1 - 2
Eulalia aurea	silky brown top	NG	1 - 2
Eustrephus latifolius	wombat vine	V/C	1 - 2
Heteropogon contortus	bunched speargrass	NG	1 - 2
Jasminum simplicifolium subsp. australiense	stiff jasmine	V/C	0.2 - 0.5
Lomandra longifolia	mat rush	NG	0.2 - 0.5
Panicum effusum	hairy panic	NG	1 - 2
Paspalidium distans	shot grass	NG	1 - 2
Rhynchosia minima	Rhynchosia	V/C	1 - 2
Themeda triandra	kangaroo grass	NG	1 - 2
Ground species - total seed (uncoated)			**10**
Cover Crop			
Echinochloa esculenta	Japanese millet	Cover crop	5

* *Species adapted to moderate to high salinity tolerance* (DERM, 2011)

Table 38: Recommended species list and seeding rates for watercourse PMLU – lower banks

Species name	Common name	Life form and functional group code	Seed rate (kg/ha - uncoated weight)
Framework tree species			
*Casuarina cunninghamiana**	river she oak	NE/NA	0.5 - 1
Lophostemon suaveolens	swamp box	NE/NA	0.5 - 1
*Melaleuca bracteate**	black tea tree	NE/NA	0.5 - 1
Melaleuca fluviatilis	weeping tea-tree	NE/NA	0.5 - 1
*Melaleuca leucadendra**	broad-leaved tea tree	NE/NA	0.5 - 1
*Melaleuca linariifolia**	snow in summer	NE/NA	0.5 - 1
Melaleuca trichostachya	flax-leaf paperbark	NE/NA	0.5 - 1
*Melaleuca viminalis**	red bottlebrush	NE/NA	0.5 - 1
Framework tree species - total seed weight (uncoated)			**5**
Ground species			
Bothriochloa bladhii subsp. bladhii	forest blue grass	NG	1 - 2
Cymbopogon refractus	barbwire grass	NG	1 - 2
*Cynodon dactylon***	couch	IG	2 - 3
*Cyperus spp. (C. gracilis, C. polystachyos)***	sedge	NG	2 - 3
Dichanthium sericeum subsp. sericeum	Queensland bluegrass	NG	1 - 2
Eleocharis spp.	spike-rush	NG	0.5 - 1
Eustrephus latifolius	wombat vine	V/C	0.5 - 1
Leptochloa digitata	Umbrella cane grass	NG	0.5 - 1
Lomandra longifolia	spiny-headed mat rush	NG	2 - 3
Themeda triandra	kangaroo grass	NG	0.5 - 1
Ground species - total seed weight (uncoated)			**10**
Cover Crop			
Echinochloa esculenta	Japanese millet	Cover crop	5

** Species adapted to moderate to high salinity tolerance* (DERM, 2011)*; ** Bank toe area only*

6.1.8.10 Reference sites

Existing reference sites for cattle grazing, woodland habitat and watercourse PMLUs are detailed in Section 8.4.

Relationship with the PRCP schedule
The revegetation approach for the PMLUs focuses on selection and establishment of suitable species based on the growth media and rehabilitated landforms. Woodland habitat and watercourse rehabilitation strongly considers the inclusion of framework tree species, woody understorey and grass/ground species from REs suited to the landforms and substrates. The recommended species will best support achievement of the cattle grazing, grassland, woodland habitat and watercourse PMLUs.

6.2 Tailings storage facilities

PRCP Guideline (Section 3.6.2)

The tailings require characterisation to determine the geochemistry, rheology and geotechnical parameters that influence the rehabilitation or management strategies and the capacity of the site to support revegetation.

The design for a TSF must include relevant elements:

- *lining of TSF (i.e. embankments and base of structure)*
- *leak detection systems*
- *cellular design of TSF*
- *seepage collection systems*
- *design storage allowance*
- *spillway location*
- *designing TSF for progressive rehabilitation.*

6.2.1 Tailings context

Tailings is generated at the CHPP from washing ROM coal, and typically represents the clay, silt and fine sand fraction of rejects. Tailings comprise approximately 0.5% of all mineral waste at GRM and BRM (Section 6.1.3) and are disposed into TSFs.

There are currently four TSFs at GRM and BRM: GS1, RS1, DRE5 and R32. R32 is the current active facility and DRE5 is a back-up facility. Locations of the TSFs are shown in Figure 19, with the current status of each summarised in Table 39. As is typical of historical TSFs, engineering documentation is limited. BMA has completed investigation and assessment works to retrospectively describe the blueprint and characterisation for the GRM and BRM TSFs.

Table 39: Summary of GRM and BRM TSFs

TSF	Structure		Current status	Operational period	Spillway location	Decant location	Regulated structure	Rehabilitation strategy
	Type	Description						
GS1 (RA9)	Central decant turkey's nest	Above ground facilities with partial or complete perimeter embankments. The depth of tailings is typically less than 20m, with material having been deposited such that supernatant water was collected at a decant pond at one edge of the facility	Decommissioned	1970 – 2020	Northern Spillway – Eastern end of northern embankment Southern spillway – centre of western embankment	Central to GS1 North and GS1 South	Yes	• Source in-situ strength profiles, additional geochemical and geotechnical data and develop detailed cover design • Remove infrastructure (RM1) • Contamination assessment and management (RM2) • Cover, reshape, topsoil and seed (RM3, RM4, RM7)
RS1 (RA9)	Central decant turkey's nest			1983 – 2021	North-eastern corner	Northern cell	Yes	• Source additional geochemical and geotechnical data and develop detailed cover design • Remove infrastructure (RM1) • Contamination assessment and management (RM2) • Cover, reshape, topsoil and seed (RM3, RM4, RM7)
DRE5 (RA1)	In-pit	Disused mining void	Back-up storage	2021 – 2022	N/A	To be constructed in the southern end	No	• Contamination assessment and management (RM2) • Bury with spoil, reshape spoil, growth media and seed (RM3, RM5, RM8)

TSF	Structure		Current status	Operational period	Spillway location	Decant location	Regulated structure	Rehabilitation strategy
	Type	Description						
R32 (RA9)	In-ramp	Disused mining pit ramp that is being filled with tailings	Active	2019 – current	N/A	Suction will be relocated to suit desired formation of the beach	No	• Active dewatering after final deposition of tailings to develop a crust, source in-situ strength profiles, additional geochemical and geotechnical data and develop detailed cover design • Contamination assessment and management (RM2) • Backfilled with spoil, reshape spoil, growth media and seed (RM3, RM4, RM7)

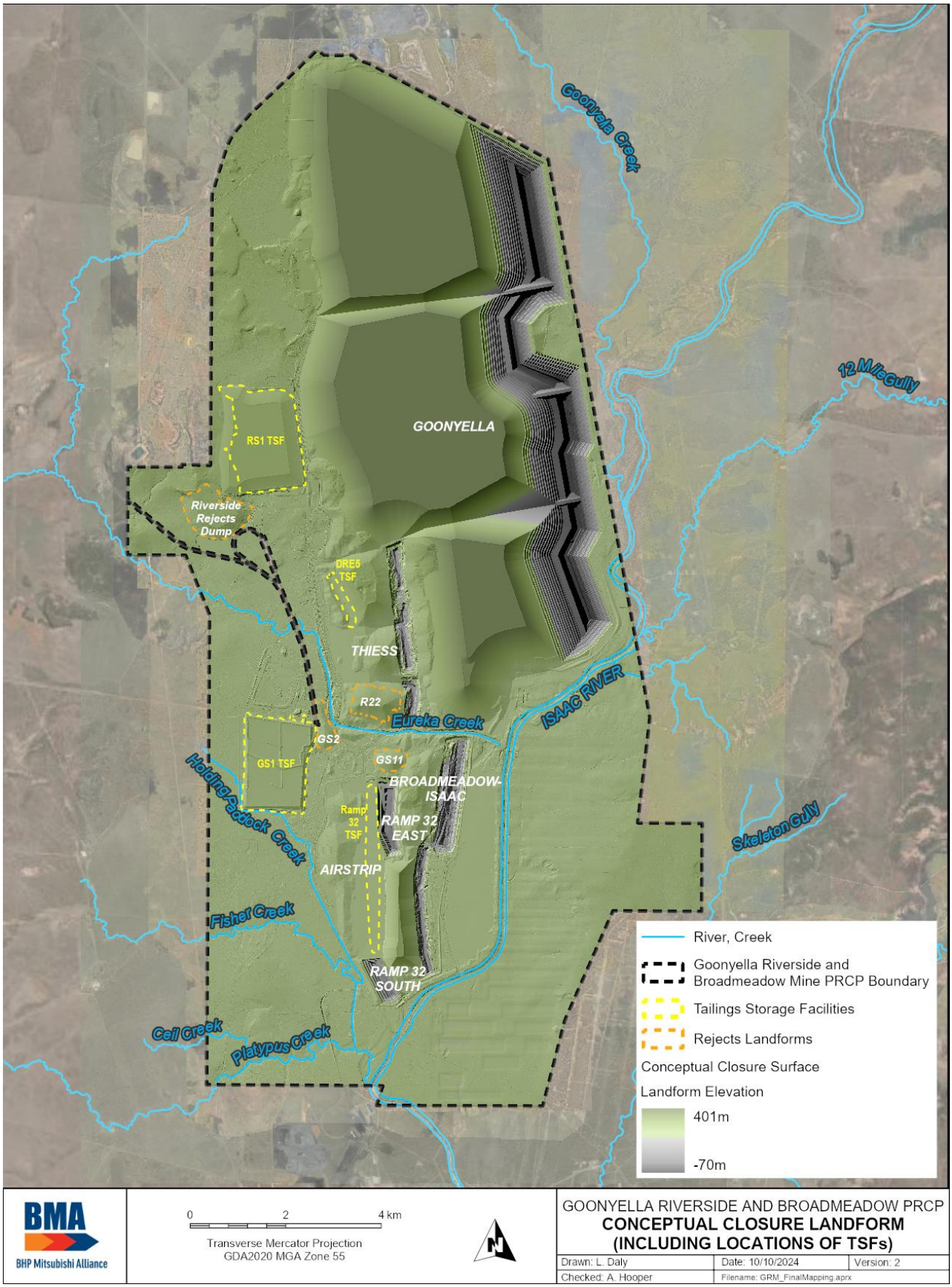

Figure 19: GRM and BRM tailings storage facilities

Based on current life-of-mine planning GS1 and RS1 will remain as discrete capped TSFs while DRE5 and R32 will be covered by spoil. The future tailings disposal strategy for the site will be in accordance with EA condition D6 and will be developed during the remaining life-of-mine, accompanied by a PRCP amendment, if required.

As per condition D6 of the EA, future tailing disposal may include the placement of tailings into voids provided a consequence category assessment in accordance with EA condition G1 has been completed. As well as a consequence category assessment, additional assessments will be undertaken as per the void requirements of the PRCP Guideline to confirm the placement of the tailings in the void does not present an unacceptable risk of environmental harm, prior to future tailings disposal.

The void suitability assessment will include the following:

- Consequence category assessment: in accordance with EA condition G1
- Hydrogeological assessment: including characterisation of the immediately surrounding groundwater aquifer (quality and heights), numerical modelling, groundwater fate and transport modelling and an evaluation of the sink/source relationship with the void
- Void water balance modelling: including an assessment of the sink/source relationship with the groundwater
- Geochemistry and water quality modelling: including an assessment of the impact the placement of the tailings in the void will have on void water quality
- Conceptual site modelling: including an assessment of potentially complete exposure pathways
- Geotechnical stability and safety assessment

The assessments will provide the following:

- Assessment by an AQP that residual voids continue to meet required stability and safety criteria
- Assessment by an AQP that residual voids continue to manage risk of causing environmental harm by:
  - Continuing to act as a long-term groundwater sink
  - Permian aquifers and shallower hydrogeological units are not inter-connected
  - No identified, reasonably likely complete exposure pathways, beyond the tenure boundary
- Identification of changes if required to the PRCP schedule

Where the above studies confirm the placement of tailings does not present an unacceptable risk of causing environmental harm, and there are no changes to the management of the residual void or the PRCP schedule, the residual void will remain a NUMA as outlined within this PRCP. This will typically be where: residual void lakes are maintained on top of the tailings; the residual voids post-mining are modelled to establish as long-term groundwater sinks; Permian aquifers and shallower hydrogeological units are not inter-connected; there are no identified reasonably likely complete exposure pathways; and any leachate is not likely to impact environmental values beyond the tenure boundary.

Where the placement of the tailings in the void requires changes to the PRCP schedule, a PRCP amendment will be submitted prior to the future tailings disposal.

6.2.2 Tailings characterisation

Detailed characterisation work of all the GRM and BRM TSFs has been completed in accordance with the requirements of Section 3.6.2 of the PRCP Guideline, where relevant to the TSF operation and life cycle status. Geochemical, rheological and geotechnical characterisation work has been undertaken through site investigation programs and laboratory testing for both fresh (CHPP sourced) and aged (TSF sourced) samples. Site investigations have occurred to extract in-situ samples of tailings from GS1 and RS1 TSFs, where safe access was possible. Limited testing has been undertaken for the active TSF R32, and the back-up TSF DRE5 as they could not be safely accessed for further investigation and sampling.

Key characterisation parameters that could influence the rehabilitation or management strategies of the TSFs are summarised below.

6.2.2.1 Geochemical characterisation

Dedicated sampling and analysis have been undertaken to evaluate the geochemical nature of the tailings (Section 6.1.3 and Appendix I).

6.2.2.2 Rheological characterisation

Rheological testing suites were completed for GS1 and RS1 TSFs. Testing covered a range of solids concentrations from low density slurry to typical long-term settled condition. All samples displayed shear thinning behaviour as shear rates increased, with shear viscosity decreasing by about three orders of magnitude over the shear rates investigated. Particle size distribution data and Atterberg limits indicate that both DRE5 and R32 tailings share similar composition to those of GS1 and RS1, although the former may be somewhat less plastic. Therefore, it is expected the rheological behaviour would be similar.

Rheological characterisation primarily relates to pumpability and flow behaviour soon after deposition and therefore has limited relevance to the long-term behaviour in TSFs. It can provide an indication of the relative potential for liquefaction in the period from deposition to closure; however, any tendency to flow behaviour reduces over time as the tailings consolidate past a critical state.

6.2.2.3 Geotechnical characterisation

Geotechnical properties for tailings should be considered in the following two groups:

- Those that are inherent to the material regardless of its situation (e.g. particle size distribution, specific gravity, plasticity)
- In-situ properties that are affected by the inherent characteristics but also by the stress conditions and moisture distribution within the TSF (e.g. moisture content and dry density, settling density, shear strength, consolidation). Subsequently, stress and moisture are governed by containment, the weight of overlying material, the location of drainage paths, and time since deposition.

While the inherent properties are essentially constant for a particular sample of tailings, in-situ properties may vary with location and time. Some in-situ properties may be monitored during operation of the TSF to assess the effectiveness of deposition practices, but strength and moisture-density profiles are most useful after deposition has finished and close to when detailed rehabilitation works are being designed and undertaken.

Inherent properties

The inherent properties of historical tailings samples are summarised in Table 40. Based on the data, tailings at GRM and BRM are typically dominated by the silt size fraction (0.075mm to 0.002mm) but are classified as Intermediate Plasticity Sandy Silty Clay and Low Liquid Limit Sandy Silt based on Atterberg Limits (AS1726:2017 Geotechnical Site Investigations). This is typical of coal tailings in the Bowen Basin, including the relative absence of high plasticity clays (that cause the greatest problems with settlement and strength).

Tailings do not contain gravel, therefore the proportion of gravel in some samples indicates the samples may have also contained coarse rejects.

Table 40: Summary of GRM and BRM tailings testing of inherent geotechnical properties

Parameter	Unit	GS1	RS1	DRE5	R32
Particle size distribution					
Clay	%	8 - 27	12 - 32	5 - 15	7 - 16
Silt	%	24 - 71	28 - 72	28 - 50	41 - 49
Sand	%	12 - 54	13 - 50	38 - 67	35 - 51
Gravel	%	0 - 14	0 - 11	0	0

Parameter	Unit	GS1	RS1	DRE5	R32
Specific gravity					
Specific gravity	t/m^3	1.51 - 2.76	1.46 - 2.70	1.72 - 1.93	1.62 - 1.84
Atterberg limits					
Liquid limits	%	17 - 47	33 - 49	29 - 37	33 - 38
Plastic limit	%	20 - 28	18 - 28	22 - 25	22 - 27
Plasticity index	%	6 - 22	10 - 21	6 - 12*	6 - 16**

** 1 of 6 samples non-plastic*
*** 3 of 6 samples non-plastic*

In-situ properties

Moisture content and dry density have use in computing consolidation stresses but give only an indirect and approximate indication of strength. Moisture content and densities are summarised in Table 41. A limited number of density determinations were made on samples from GS1 and RS1 which indicate the dry densities are typical of coal tailings.

Table 41: Summary of GRM and BRM TSF moisture content and density

Parameter	Unit	GS1	RS1	DRE5	R32
Moisture content	%	11 - 44	5 - 44	61 - 100*	54 - 71*
Wet density	t/m^3	1.27 - 2.07	0.79 - 2.07	-	-
Dry density	t/m^3	0.88 - 1.76	0.75 - 1.76	-	-

**Historic results, possibly sampled at the end of pipe*

Settling characteristics are relevant to the performance of TSFs in their operational phase - specifically, how the tailings solids beach, how quickly the surface water clears and can be decanted, and the volume of decant water that can be recovered. Settling behaviour is observed during operations and testing would only be undertaken if issues have been identified. This was not the case at any facility at GRM and BRM. By the time a TSF reaches closure, the tailings will have settled and hence this settling is not an important property in the context of GRM and BRM rehabilitation and closure planning.

Tailings has minimal shear strength when initially discharged and strength is only gained over time as the deposit dewaters, densifies, and develops a drier surface crust. Shear strength testing is not considered relevant until deposition is completed and the facility is approaching rehabilitation. Consequently, no profiling was undertaken at DRE5 and R32.

Vane shear strength testing of the tailings, both peak and remoulded undrained shear strength, measured from GS1 and RS1 are presented in Table 42.

Table 42: Summary of GRM and BRM TSF peak and remoulded shear strengths

Parameter	Unit	GS1	RS1
Peak shear strength	kPa	34 - 272	24 - 97
Remoulded shear strength	kPa	7 - 136	7 - 33
Test Depth	m BGL	5 - 21.2	4 - 17

Consolidation and desiccation parameters, obtained from laboratory oedometer tests and soil water characteristic curve tests respectively, are not in-situ measurements but are used with other in-situ data to predict settlement (as distinct from settling) and densification over time.

Oedometer consolidation tests were reported for eight samples, with the following median parameter values:

- Compression Index C_c = *0.10*
- Recompression Index C_r = *0.02*
- Coefficient of permeability k_{sat} = *1e-9m/s*
- Coefficient of consolidation c_v = *25m²/yr but varying over a wide range*

The consolidation values are within ranges measured for coal tailings in the Bowen Basin and on the side of the distribution representing lower total consolidation settlement. This is consistent with the significant proportions of sand and silt. Results of the soil water characteristic curve testing are summarised in Table 43.

Table 43: Summary of GRM and BRM soil water characteristic testing of tailings

Sample location	Volumetric water content (cm³/cm³)				
	0kPa	10kPa	33kPa	100kPa	1500kPa
GS1	0.51 - 0.69	0.43 - 0.47	0.36 - 0.41	0.29 - 0.37	0.15 - 0.24
RS1	0.55 - 0.56	0.46 - 0.47	0.40 - 0.43	0.33 - 0.37	0.22 - 0.24
DRE5	0.39 - 0.56	0.29 - 0.44	0.26 - 0.43	0.19 - 0.38	0.09 - 0.23
R32	0.45 - 0.49	0.43 - 0.44	0.40 - 0.41	0.38 - 0.40	0.12 - 0.26

In summary, geotechnically, tailings in the GRM and BRM TSFs are typical of coal tailings produced and deposited in the Bowen Basin.

6.2.3 Tailings management at closure

GS1 TSF, RS1 TSF and R32 TSF will be rehabilitated as part of RA9. DRE5 will be buried by spoil dumps and therefore will be rehabilitated as part of RA1. As detailed in Section 6.1.6, the minimum cover for tailings to manage risk and achieve the cover objectives will be a non-ponding landform with at least 2m of spoil cover. Detailed cover designs and construction methodologies for each TSF are to be finalised once the tailings have sufficiently dried out and in-situ strength profiles can be measured, along with sourcing of additional geochemical and geotechnical data. The first rehabilitation milestone will commence as soon as practicable after tailings disposal in each TSF is complete to allow for this work.

The length of time scheduled for the ‘as soon as practicable’ commencement of the first rehabilitation milestone reflects the level of uncertainty associated with dewatering of the TSFs, as well as data collection required to develop the detailed cover designs. The data collected and updated modelling will reduce the uncertainty and provide critical inputs into the development of the detailed cover designs to achieve a stable condition.

Contaminated land investigations will be undertaken to assess TSFs for potential contamination as part of RM2 (Section 6.1.7). These investigations will assess the risk to achievement of the PMLUs and to the receiving

environment. If there is any contamination identified that presents an unacceptable risk will be subject to remediation to reduce the level of contamination to an acceptable level and/or implementation of engineering controls that minimise the potential for migration of contaminants and complete exposure pathways.

The length of time scheduled for RM2 reflects the level of uncertainty associated with contamination and the required remediation and/or engineering controls. The contaminated land investigations undertaken in RM2 will reduce the uncertainty, and progression through RM2 will be accelerated if less time is required for remediation or installation of engineering controls to manage the risk.

The covers for GS1, RS1 and R32 TSFs will be constructed as per the detailed designs. Construction of the covers, reshaping and final refinements to ensure a non-ponding landform following settlement may take at least 10 years. DRE5 will be buried by the reshaped spoil dumps. The areas will then be rehabilitated to the planned PMLUs, including growth media placement and seeding.

An amendment will be submitted if the results of the improved TSF geotechnical and geochemical understanding results in changes to the PRCP schedule.

Relationship with the PRCP schedule
DRE5 will be buried by the spoil dumps, rehabilitated to a woodland habitat PMLU and assessed according to the rehabilitation milestones for RA1 (spoil dumps). GS1, RS1 and R32 TSFs will be covered with at least 2m of spoil to achieve a non-ponding landform and rehabilitated to a grassland PMLU (RA9). Final materials, thicknesses and the construction plan of the cover will be refined as part of the detailed designs once the final geochemical and geotechnical data is available for each specific TSF.

6.3 Voids

PRCP Guideline (Section 3.6.3)

The information requirements of this domain are dependent on the nature of the proposed PMLU or NUMA for the void. For mine sites with voids, the rehabilitation planning part must include a void closure plan, which includes options for minimising final void area and volume; final void dimensions; pit wall geotechnical and geochemical stability, final slope angles, void hydrology, groundwater modelling, water balance and predicted long-term water quality.

A geotechnical report should focus on how the void will achieve post-closure slopes that will exhibit stability characteristics consistent with the planning and design of the post-closure mine void.

If floodwaters are likely to move over backfilled material, an assessment of the hydraulic properties must be conducted to assess whether instability may occur.

The rehabilitation and management strategies in the plan must include the supervision, verification and auditing of engineering works carried out to achieve the post-closure void landform, to ensure construction is consistent with the geotechnical design.

The rehabilitation and management strategy must also include confirmation that the post-closure landform demonstrates the level of stability as specified by the design.

A void closure plan has been compiled to support the development of this PRCP. The detailed plan – *Void Closure Plan - Goonyella Riverside/Broadmeadow Mine* (WSP, 2024) is provided in Appendix O.

As per the EA, a residual void is "*an open pit resulting from the removal of ore and/or waste rock that will remain following the cessation of all mining activities and completion of rehabilitation processes*". Therefore, for this PRCP, a residual void is considered to be the remaining mined-out pit below ground level after backfill.

For GRM and BRM, the residual voids in the final closure landform include:

- Goonyella Pit
- Thiess Pit
- Broadmeadow Pit
- Isaac Pit
- R32 East Pit
- R32 South Pit

These residual voids are pre-approved as NUMAs (Section 4). The NUMA extents achieve an area that is safe and structurally stable and include additional set-backs from the void high-wall and end-wall crests and the low-wall crest within the NUMA, if required to achieve wall geotechnical stability (FoS = 1.5), and a safety bund, signage and fencing.

6.3.1 Geotechnical stability

The void closure plan includes a geotechnical stability analysis of the proposed closure landform residual void high-walls, end-walls and low-walls. The analysis determined the FoS of the walls and the set-back distances, for long-term pit wall stability for the high-walls, end-walls and low-walls, to meet the minimum FoS of 1.5.

The set-back distance from the void wall crests are included within the NUMA extent to ensure stability and that no assets (BMA, third-party, or of significant environmental value) are within this boundary at closure.

The low-wall analysis results are shown in Table 44. The as-dumped design of the residual void low-walls meets the minimum FoS for all residual voids and therefore no additional set-back distance from the low-wall crest is required. A minimum 25m set-back will be designed between the low-wall crest within the NUMA area and the PMLU boundary to ensure any erosion within the NUMA does not impact the surrounding PMLUs. R32 East is a box-cut, therefore the low-wall is not dumped spoil and has not been included in this analysis.

Table 44: Summary of GRM and BRM residual void low-wall stability analysis

Void	Low-wall spoil height (m)*	Low-wall floor dip (°)	Minimum FoS		Additional set-back required at NUMA boundary (m)
			Overall slope (global stability)	Slope outside NUMA (local stability)	
Goonyella	400	4.6	1.6	2.3	0
Thiess	320	2.9	3.1	3.9	0
Broadmeadow	263	2.9	2.8	4.7	0
Isaac	340	3.4	1.8	2.4	0
R32 South	250	3.0	2.0	6.8	0

**Spoil height is the full low-wall from toe of low-wall to the spoil dump crest (includes NUMA and RA1 low-wall area)*

The high-wall and end-wall analysis results are shown in Table 45. The as-mined design of the high-walls and end-walls for all residual voids except the Goonyella residual void meet the minimum FoS of 1.5 without additional set-back distance. The Goonyella residual void high-wall and end-walls has a FoS of less than 1.5 and therefore an additional set-back distance from the high-wall crest has been included in the final landform design to ensure the minimum FoS of 1.5 is achieved. A minimum distance of 50m will be designed between the residual void crest and the toe of the safety bund for all residual voids where it is against an external tenure boundary. R32 East is a box-cut, therefore the high-wall analysis is also applicable to the low-wall.

Table 45: Summary of GRM and BRM residual void high-wall stability analysis

Void	Depth of Tertiary/ Weathered (m)	Depth of Fresh Permian (m)	FoS at crest	Distance from toe of wall to achieve FoS=1.5 (m)
Goonyella	27	277	1.05	497
Thiess	27	50	2.13	99
Broadmeadow	20	71	1.86	100
Isaac	23	55	2.09	94
R32 East	19	76	1.82	101
R32 South	28	41	2.17	98

The Broadmeadow residual void high-wall contains the roadway entry points to access the BRM longwall operation and Goonyella residual void high-wall is currently planned as the roadway entry points to access the RHM longwall operation. Subsidence modelling predicts no subsidence over the roadways and mains pillars (Section 6.4.1.1), therefore no, to minimal subsidence impact is expected on the residual void walls.

High-wall stability in areas where there are underground access points is a focus during the design of the final wall during operations and is factored into the FoS stability assessment of the high-wall. Further assessment of the long-term geotechnical stability will be undertaken as part of the final assessment prior to closure.

6.3.2 Void hydrology

6.3.2.1 Water balance

A dedicated void water balance model based on the final closure landform design (Section 6.1.5), was completed for the period 2016 to 2199 (184 years) except for the Goonyella residual void where it was run until 2259. The water balance model modelled the water balance behaviour (including climate change considerations) within the residual voids over time (Appendix O). The results are summarised in Table 46.

Key findings show that after 2100 the water levels start to stabilise for all residual voids except Goonyella residual void where the water level stabilises a century later. This indicates a simulated mean inflow being very similar to the mean outflow and mean water balance has reached an equilibrium. As the lake levels establish well below the spill level and as there is an established inward hydraulic flow to the Goonyella residual void, the residual voids have a low risk of overtopping. Environmental harm beyond the tenure boundary is not expected and therefore, no management activities are required.

Table 46: Summary of GRM and BRM water balance model findings

Void	Spill level (m AHD)	Mean water flows (2016 - 2199)		Long-term mean void lake level (m AHD)
		Inflows (ML/yr)	Outflows (ML/yr)	
Goonyella	254	3,929	3,929	21
Thiess	256	572	573	202
Broadmeadow	230	218	218	155
Isaac	230	179	179	180

Void	Spill level (m AHD)	Mean water flows (2016 - 2199)		Long-term mean void lake level (m AHD)
		Inflows (ML/yr)	Outflows (ML/yr)	
R32 East	256	213	213	162
R32 South	240	88	88	173

6.3.2.2 Groundwater modelling

The residual voids within GRM and BRM will, through evaporative losses from the void lakes, maintain an inward groundwater hydraulic gradient towards the tenure, which is centred on the Goonyella residual void. The pit lakes that form within the residual voids also remain below the shallow geological units, limiting the potential for interconnection of groundwater aquifers of different quality. Therefore, the groundwater model indicates that the residual voids, through the evaporative losses from the void lakes, provide on-going groundwater management and minimise the potential for environmental harm beyond the tenure boundary.

6.3.2.3 Water quality

The void closure plan includes an analysis of the void water quality (geochemical stability), and identified the following key findings across the residual voids:

- Evapoconcentration processes will drive water quality in the residual voids
- Acidic conditions are unlikely to develop and pH is modelled to remain within the neutral to alkaline range for all residual voids
- TDS increases in the voids over time driven by evapoconcentration
- Brackish conditions develop in Isaac and Thiess residuals voids before stabilising. Whereas, brackish to mildly saline conditions develop in the Goonyella residual void and brackish to brine conditions develop in Broadmeadow, R32 East and R32 South residual voids within the model simulation period and show an increasing trend over time
- Stratification is likely in the residual voids due to steep sides, high TDS and maximum water depths present

The residual voids establish a continued inward hydraulic gradient towards the tenure, which is centred on the Goonyella residual void. Therefore, the residual voids provide long term groundwater management by minimising the potential for environmental harm through contaminant migration beyond the tenure boundary.

6.3.3 Options for minimising final void

The pits will be progressively backfilled during the operation to minimise the final void to the final operational mining strip. Multiple ramp voids are planned to also be progressively backfilled, minimising the number of ramps remaining at closure. Over 72% of the mined-out pit void will be progressively backfilled by the end of mining.

As detailed in Section 4.3, the final residual voids presented in the PRCP have been further minimised from the original mine plans including:

- Multiple ramp voids will be progressively backfilled, minimising the number of ramps remaining at closure and the void area
- Steepening the residual void high-walls and low-walls while maintaining the required geotechnical stability. Steepening the high-walls and low-walls is also part of the rehabilitation strategy to minimise risk to the environment by reducing the catchment area into the voids.
- Increasing the set-back of the high-wall and end-wall from the tenure boundary and watercourses to achieve the required FoS (Section 6.3.1)

- Complete backfill of Airstrip void above tailings (R32 TSF) to eliminate the void and minimise the potential for environmental harm from partial backfill (Section 6.1.1.2)

Additional backfill will be dependent on the mining sequence of the final strips, which may change during the remaining operational period as new geological data becomes available and market factors change, and to ensure backfill does not result in an unacceptable risk of environmental harm beyond the tenure boundary. As GRM and BRM have significant mine life remaining, opportunities for further backfill of the final voids may be refined over the life of the operation and finalised as mining approaches the final strips.

6.3.4 Residual void dimensions and wall angles

Outcomes of the void geotechnical and geochemical stability analyses, void water balance modelling, site-wide hydrogeological and rehabilitation flood modelling have resulted in optimisation of the residual void dimensions towards minimising the extent of the NUMAs.

The residual void extents are defined by the high-wall, end-wall and low-wall crests at natural ground level. The maximum void dimensions and overall wall angles, measured from the wall toe to the wall crest at ground level, are shown in Table 47.

Table 47: Proposed residual void dimensions and overall wall angles

Void	Maximum depth (m)	Maximum length* (m)	Maximum width (m)	High-wall overall slope (°)	End-wall overall slope (°)	Low-wall overall slope (°)
Goonyella	324	11,630	1,270	37	37	21
Thiess	66	3,850	390	41	37	21
Broadmeadow	86	2,450	430	35	35	21
Isaac	52	2,650	210	50	45	21
R32 East	114	1,600	430	35	41	21
R32 South	79	1,030	400	35	41	21

**Along strike (reported as width in Appendix O)*

The residual void high-wall and end-wall profiles will remain as the final excavated wall profile, with numerous mining benches of varying face angles and heights. The wall design and angles may vary with the final geotechnical design which will be developed as mining approaches the final pit limits, to ensure it is based on the latest material and geotechnical data.

The final low-wall profile within the NUMA area will remain as the final as-dumped profile, with dragline spoil and truck dump lifts within the NUMA area remaining at angle of repose. The truck dumps are offset from the dragline spoil by two spoil peaks and each truck dump lift is offset. The wall design and angle may vary with the final geotechnical design which will be developed as mining approaches the final pit limits, to ensure it is based on the latest material, pit floor and geotechnical data.

The NUMA extents achieve an area that is safe and structural stability and include the additional set-backs from the residual void high-wall and end-wall crests to achieve a minimum FoS of 1.5 (low-walls meet the FoS without any additional set-backs), plus a safety bund (Section 6.3.1).

6.3.5 Improvement and management strategies

The residual voids become available for improvement either: when they are no longer being used for water storage (Theiss, R32 South); once underground mining is complete and workings have been flooded (Goonyella, Isaac, Broadmeadow); or once mining and any reshaping of surrounding spoil dumps is complete

(RA1) (R32 East). This is for safety reasons to eliminate the risk of any injury or damage within the NUMA area from the reshaping and rehabilitation activities.

To support attainment of residual voids that are safe and do not present an unacceptable risk of off-tenure environmental harm, the improvement and/or management activities provided in Table 48 will be undertaken.

Table 48: Improvement and/or management strategies for the GRM and BRM residual voids

Residual void closure aspect	Closure objective			Improvement and/or management strategy
	Safety	Stability	Non-polluting	
Geotechnical stability	✓	✓	-	• As mining approaches the final limits, an AQP is to re-assess the void geotechnical wall designs and set-backs based on the latest available data • Review and adjust the mine plan and closure landform, if needed, to account for any revised set-back requirements • Use a minimum FoS of 1.5 as guidance for ongoing void closure planning. (This may be refined over the mine life should industry research provide optimised guidance on observational methods and consequence assessment). • A minimum distance of 50m to be designed between the residual void high-wall crest and the toe of the safety bund where the residual void is against a tenure boundary
Void hydrology	✓	✓	✓	• At cessation of mining activities, review and update the void water balance modelling, incorporating identified changes to the closure landform and spill point elevations, rainfall and evaporation, surface water runoff, groundwater inflows, and climate projections • Residual void catchments are minimised as far as practical and predominantly include only the low-wall areas • Implement management strategies if future modelling identifies an unacceptable risk of environmental harm outside the tenure boundary • Obtain certification from an AQP that the residual voids do not present an unacceptable risk of environmental harm outside the tenure boundary • If necessary, identify and implement mitigation measures for appropriate protections works of landforms where floodwaters from watercourses interact with final closure landforms • Low-walls are free draining into the void lake with a maximum of 37 degree slopes
Void hydrogeology	-	-	✓	• At cessation of mining activities, review and update the groundwater modelling, incorporating updated void water balance model outputs and in-field groundwater sampling data, as required

Residual void closure aspect	Closure objective			Improvement and/or management strategy
	Safety	Stability	Non-polluting	
				• Implement management strategies if future modelling identifies an unacceptable risk of environmental harm outside the tenure boundary • Residual voids maintain inward hydraulic flow within the tenure boundary post closure (demonstrated through groundwater modelling) • Obtain certification from an AQP that, upon completion of mining, residual voids do not present an unacceptable risk of environmental harm outside the tenure boundary • Residual voids must not overtop
Void water quality	-	-	✓	• At cessation of mining activities, review and update the void geochemical assessment, including additional or refined data from in-pit surface water samples, surface and groundwater samples, and biochemical modelling • Implement management strategies if future modelling identifies an unacceptable risk of environmental harm outside the tenure boundary (not identified in current modelling) • Obtain certification from an AQP that the residual voids will not present an unacceptable risk of environmental harm outside of the relevant tenure boundary
Void access control	✓	-	-	• On cessation of mining activities: - Construct a safety bund at the geotechnical set-back distance - Erect fencing and signage (where required) around the safety bund - Obtain certification from an AQP that the residual void is safe to humans and livestock - Undertake monitoring and maintenance of exclusion fences and bunds - Close underground access points in accordance with AQP recommendations
Erosion	✓	✓	✓	• A minimum distance of 25m to be designed between the residual void low-wall crest within the NUMA and the PMLU • Any erosion sediment to be contained within the residual void • The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the tenure boundary

Relationship with PRCP schedule
All residual voids will be managed as NUMAs. Long-term geotechnical stability of low-walls, end-walls and high-walls is achieved within the NUMA extents. The residual voids have a low likelihood of overtopping and will stabilise to be ongoing groundwater sinks post-mining which will not present an unacceptable risk of environmental harm outside of the tenure boundary. The geotechnical stability and safety requirements, as well as water levels and water quality will be managed by the management milestones specified in the PRCP schedule.

6.4 Underground mining

PRCP Guideline (Section 3.6.4)

For underground mining operations, the rehabilitation planning part must include:

- *a geotechnical study*
- *an assessment of groundwater interactions and potential lowering of groundwater levels*
- *the development of a hydrogeological conceptual model*
- *subsidence analysis and modelling and a subsidence vegetation/habitat impact assessment*
- *consideration of how potential entries to underground workings will be sealed (i.e. through some form of capping or back filling)*
- *how surface ponding and cracking will be mitigated*
- *identification of post-closure stabilisation of underground workings in order to manage the potential for unplanned surface subsidence and unplanned ground collapse such as sinkholes and pot holing.*

BRM is an underground longwall mining operation using top coal caving (Section 1.1.4.2). The underground mine is accessed via the Broadmeadow residual void. The current life-of-mine plan for BRM proposes a total of 27 longwall panels in the GMS with a mining depth ranging from 100m to 320m from surface and 24 longwall panels in the GLS ranging in depth from 110m to 410m from surface. The longwall panels are orientated roughly west-east and are typically 2km – 3km in length and approximately 320m in width (Figure 20).

The longwall shearer mines a 3.8m cut and the top coal caving method enables coal in the roof to cave and be extracted. Top coal caving is not undertaken in the vicinity of the Isaac River as per EA condition J2.

Underground longwall mining is also approved at RHM and will be accessed via the Goonyella residual void. Access to the longwall panels and rehabilitation associated with surface impacts from the RHM longwall panels on ML1763 are covered within the GRM and BRM PRCP. The RHM underground operation within ML1763, is reduced from the approved layout in the EIS due to the GRM open cut operation extending further than planned at the time of the EIS. The full extent of the EIS approved footprint for RHM may be mined if there are further changes to the GRM open cut operation. If changes occur to GRM and BRM or RHM mine plans, a PRCP amendment will be submitted to the administering authority, if required.

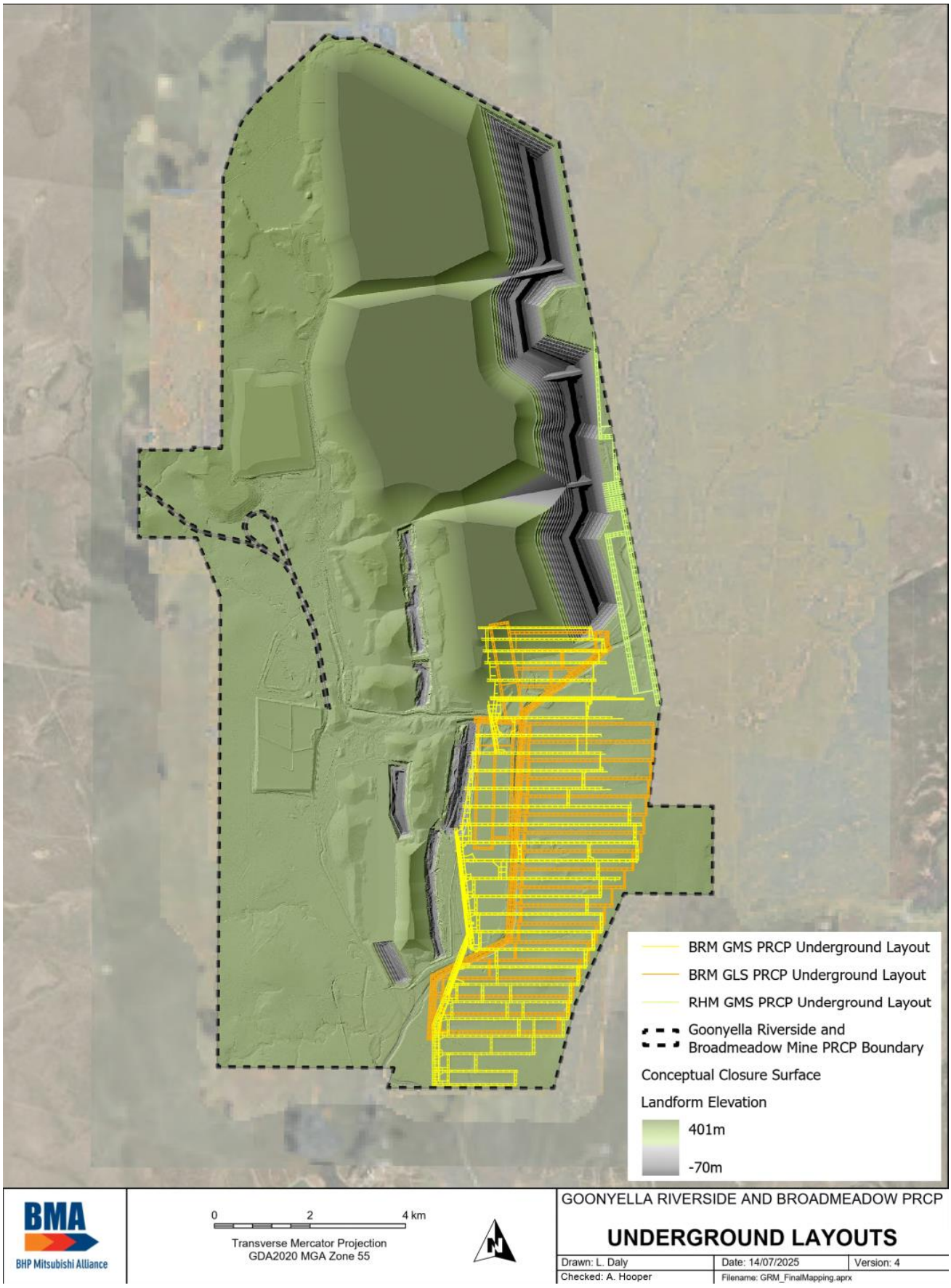

Figure 20: BRM and RHM underground mine layouts

6.4.1 Geotechnical study

An underground geotechnical study has been compiled to support the development of this PRCP. The detailed report – *Geotechnical considerations for closure of underground mines at BMA Broadmeadow* (Byrnes Geotechnical, 2024) is provided in Appendix P. This report shows additional mining of north-west underground panels in the GLS, which has since been removed from the mine plan. This does not impact the geotechnical study except for the extent of mining in the GLS seam. The modelled subsidence, tilts and strains within the areas planned to be mined (Figure 20) are still appropriate.

6.4.1.1 Subsidence

For longwall mining, maximum subsidence depths occur along the centre of the mined-out longwall panels. The mains pillars and the associated roadways are designed to be stable during the operations – both in terms of roof collapse in the roadways and stability of the pillars. The mains pillars are designed with high stability factors such that failure over the long term is unlikely and the vertical subsidence on the surface is expected to be minimal, if any.

Subsidence generally starts to occur shortly after mining, with initial subsidence typically 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. The final surface depends on pre-mining topography, geology, the seam thickness extracted, width of panels, and the depth of the longwall mining.

When coal is extracted from a longwall panel, the overburden load carried by the coal is redistributed onto the chain pillars on each side of the longwall panel. This increase in overburden load may result in the chain pillars (between the longwall panels) failing over time, resulting in additional minor subsidence.

Full realisation of subsidence at the surface is only achieved once the underground mine has been flooded post-mining. Flooding can occur either naturally with the re-establishment of the natural groundwater or directly by active pumping post-mining. Upon flooding, the goaf undergoes additional softening and consolidation, and further subsidence occurs. BRM and RHM underground mines are planned to be purposely flooded at the end of mining.

Underground mining of the GMS has been undertaken at BRM since 2005, therefore the behaviour of subsidence of the GMS prior to flooding is well understood. The life-of-mine plan also mines the GLS beneath the GMS. The subsidence modelling for the extraction of both the GMS and GLS at BRM is shown in Figure 21. The figure also shows the extent of the RHM subsidence (GMS) within the GRM and BRM PRCP area.

The modelling indicated that BRM is expected to have 25km^2 of subsided ground on the surface. The maximum vertical subsidence is modelled as less than 7m with a maximum slope of about 8% (4.7°) and strains that range from -35mm/m to +35mm/m. The modelling predicts the maximum subsidence is through the center of each longwall panel, with minor subsidence above the chain pillars and no subsidence over the mains pillars. This aligns to actual subsidence experienced to date in the Bowen Basin.

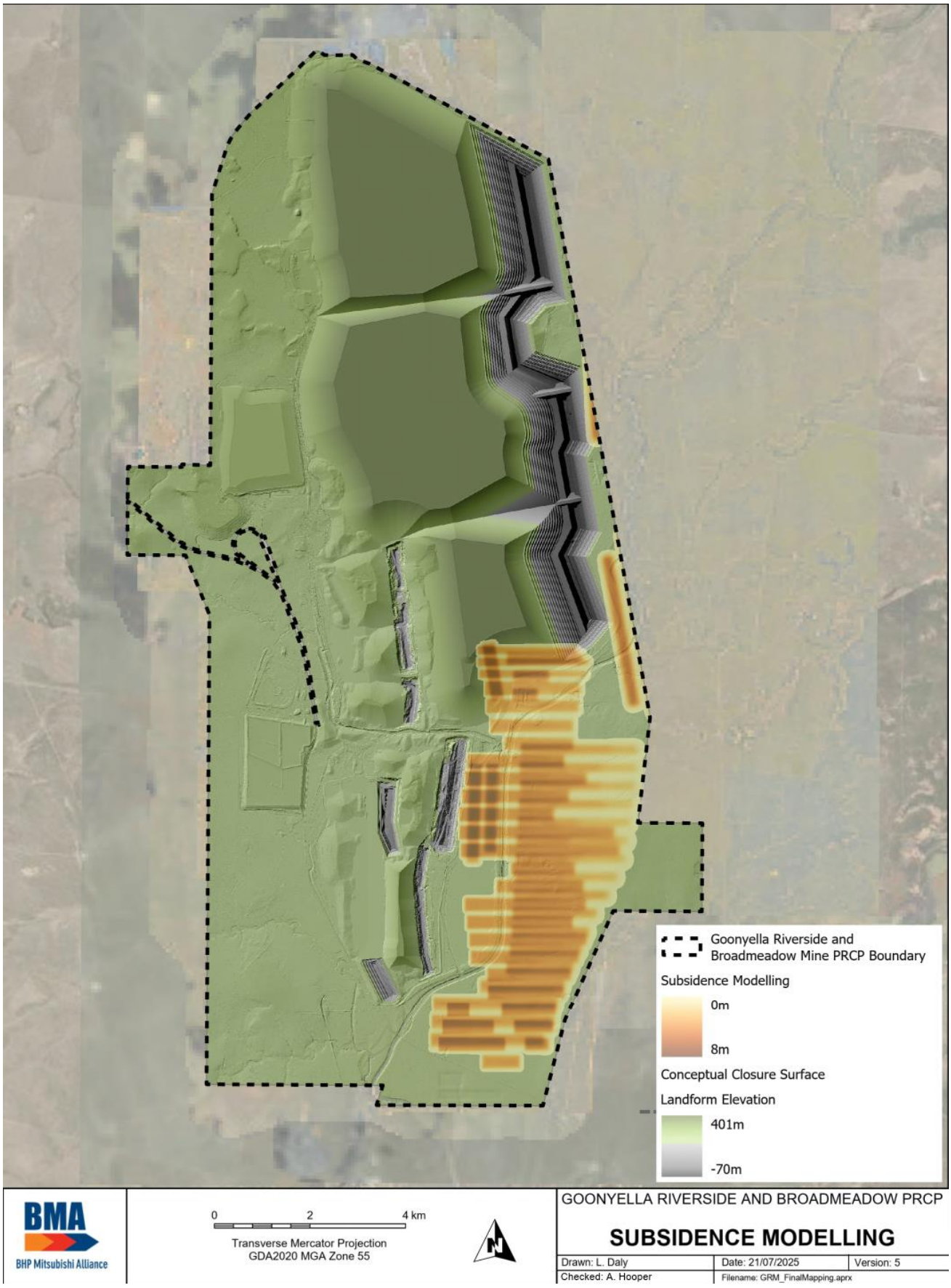

Figure 21: BRM and RHM modelled subsidence

6.4.1.2 Cracking

For longwall operations, such as BRM, where larger panel 'width:cover' depth ratios occur, cracking is to be expected at the surface. Cracking may present in longitudinal (parallel to the panel edge) or arcuate (parallel to the mining face) fractures along each longwall panel. The relationship between the width of the cracking and the predicted tensile strain depends on the spacing of the cracks at the surface. Maximum cracking depth is expected to be no greater than 10m from the surface and is not directly connected to the goaf below.

Subsidence cracks are managed according to the erosion and safety risk, and the likelihood to self-heal. At BRM, surface geology is predominantly quaternary sands and clays overlying Tertiary deposits, which means surface cracks are likely to self-heal over time.

Subsidence cracking will undergo operational repair works once initial subsidence of panels occurs after mining the GMS, and again once further subsidence occurs after mining the GLS. Rehabilitation of subsidence areas is scheduled in the PRCP once the area is available for rehabilitation, which is once final subsidence is complete after underground workings are flooded at the end of mining. Areas above BRM are available for rehabilitation after flooding of the GMS and GLS and areas above RHM panels are available for rehabilitation after flooding of the GMS. This ensures geotechnical stabilisation occurs and there will be no further subsidence and surface cracking.

6.4.1.3 Underground entries

BRM underground workings are currently accessed through high-wall entries in the Broadmeadow residual void. RHM underground workings are planned to be accessed via the high-wall in the Goonyella residual void. Given that the residual voids will become void lakes and the underground workings will be flooded with water, there is no requirement for seals to prevent water egress. A dry seal is therefore suitable which will prevent physical access into the mine but is permeable to allow movement of water. This may include backfill at the mine entries and covering the opening at least double the height.

At the cessation of underground mining at BRM and RHM, an AQP will provide a plan for the closing of the mine entrances.

6.4.1.4 Flooding of the underground

As indicated in Section 6.4.1.1, flooding of the underground workings can occur either naturally with the re-establishment of the groundwater or directly by active pumping post-mining. BRM (GMS and GLS) and RHM (GMS) are planned to be purposely flooded at the end of mining. This will be undertaken with guidance from an AQP to ensure a safe, stable and non-polluting outcome.

Purposely flooding the workings will enable the full subsidence at the surface to be realised quicker and ensure geotechnical stabilisation of the closure landform. Rehabilitation of subsidence areas (RA11, RA20, RA21) is scheduled in the PRCP following flooding, to ensure no further subsidence or surface cracking will impact the achievement of PMLU.

6.4.2 Groundwater interaction

Interaction with the groundwater at closure has been modelled in Section 6.1.1. The modelling includes additional mining of north-west underground panels in the GLS, which has since been removed from the mine plan.

The modelling includes the active flooding of the underground workings and accounts for the hydrogeological changes associated with fractured overburden.

Post flooding and stabilisation of the groundwater within the goaf, the groundwater hydraulic gradients are towards the Goonyella residual void. The Goonyella residual void provides long-term groundwater management for BRM through the capture of any poor-quality groundwater within the mined-out coal seams.

6.4.3 Surface water interaction

The pluvial model results based on a conceptual hydraulic design are detailed in Section 6.1.2.3. To the west of the Isaac River, subsidence areas are proposed to be backfilled to levels similar to natural ground level in order to form a predominantly free draining landform. Drains are not considered practical in this area due to the depth of modelled subsidence.

To the east of the Isaac River, and where appropriate, subsided longwall panels will be partially backfilled and/or connected post subsidence with drains that flow towards the Isaac River or its tributaries to reduce inundation/ponding and achieve a predominantly free draining landform. The backfilling and cutting of drains will aim to achieve a peak depth of inundation at or below 1m for a 2% AEP rainfall event with the intention to maintain a landform that can support a woodland habitat ecosystem of a similar composition to the existing REs.

The pluvial modelling has identified three areas (the southernmost subsidence panels) of residual temporal ponding (1 – 1.5m) that will not be free draining. Preventing ponding in these panel locations would require off tenure disturbances or significant surface disturbances to achieve a predominantly free draining landform. Pluvial modelling indicates the three areas of temporal ponding, from full level with no additional rainfall, will be emptied within 70 days through evaporation and infiltration.

To limit the impacts associated with rehabilitation of subsidence areas, the conceptual design for the surface hydraulics, where practical, limits disturbance of endangered REs, utilises existing drains and flow paths and minimises the number of disturbance points on the banks of the Isaac River.

The conceptual hydraulic design has been based on the predicted subsidence for the current mine plans and is a proof of concept. Final design for the backfill and drainage network will need to be based on actual subsidence levels to achieve the nominated PMLU. The drainage channels will be designed by an AQP on a case by case basis and will include an assessment of the surface materials and application of ameliorants if required. The AQP may also recommend the use of rock for stability, particularly where the drainage channels flow into watercourses to limit head cut erosion.

Ponding resulting from subsidence within the watercourses are expected to self-heal over time as a result of natural sediment transportation processes. Ponding within the watercourses is considered consistent with the PMLU of watercourse and will not be subject to active rehabilitation works to limit ponding.

6.4.4 Rehabilitation strategies

6.4.4.1 Surface infrastructure

Surface infrastructure related to the underground mining including gas drainage infrastructure, ventilation infrastructure, water management and boreholes, will be decommissioned progressively as areas are no longer required to support the underground mining. Decommissioning will be in accordance with Section 6.5 and will include:

- Removal of all above ground infrastructure
- Bore holes to be cut off below the ground, grouted and capped according to the *Coal Mine Safety and Health Act 1999* and the Code of Practice for construction and abandoning coal seam gas wells current at the time
- Ventilation shafts to decommissioned as per the relevant standards at the time of decommissioning
- Pads around each bore, redundant access tracks and other infrastructure surface disturbance areas will be ripped, topsoiled and seeded
- Water and gas pipelines will be drained and removed to a depth of 0.5m below the surface

Regional infrastructure will be moved or repaired in consultation with the relevant owners if subsidence impacts the operation of the infrastructure or causes a safety risk.

6.4.4.2 Surface cracks

The surface geology indicates surface cracking from mining at BRM and RHM is likely to self-heal. Mechanical repair of surface cracks will be limited to those cracks assessed as low probability to self-heal and likely to

adversely impact achieving the PMLU. This will minimise unnecessary vegetation and soil disturbance and potential for additional erosion issues.

Where surface cracks are assessed as not self-sealing and adversely impacting the PMLU, rehabilitation will include:

- Minor surface cracks:
  - Undertake minimal clearing of area around cracks
  - Disturbance of areas to infill minor cracks
  - Topsoil placement where required
  - Seed bare areas with appropriate species as recommended by an AQP to achieve the PMLU (Section 6.1.8)
- Larger surface cracks:
  - Undertake minimal clearing of areas around cracks
  - Strip topsoil from areas adjacent to the crack and stockpile
  - Infill cracks
  - Respread topsoil where topsoil has been removed
  - Seed disturbed areas with appropriate species as recommended by an AQP to achieve the PMLU (Section 6.1.8)

Installation of temporary fencing may be required to restrict access while vegetation re-establishes.

Repair of initial cracking is undertaken progressively as part of mining operations. Final crack repairs will be scheduled after flooding of the underground workings when realisation of final subsidence has occurred.

6.4.4.3 Inundation areas

Subsidence areas will be managed to minimise the potential for adverse impacts to the PMLU through a combination of drains and backfill to limit potential depths of inundation. Where drainage and backfill can be achieved without significant disturbance to endangered REs, it will be designed and installed to enable water to flow to the Isaac River or its tributaries.

Based on the pluvial modelling (Section 6.1.2.3), the rehabilitation of subsided areas is proposed to include:

- RA20: areas to the west of the Isaac River, which have been subject to mining related surface disturbances, are proposed to be backfilled in order to create a predominantly free draining final landform. Drains are not practical in this area due to the depth of modelled subsidence, however they may be utilised if the actual subsidence is less than modelled.
- RA21: areas to the east of Isaac River are proposed to use a combination of backfill and drains to minimise inundation to a maximum of 1m depth in a 2% AEP rainfall event, where practical
- Topsoil placement over backfilled areas or larger crack repairs (Section 6.1.4)
- Seeding backfill or disturbed areas (Section 6.1.8)
- Installation of temporary fencing if required to restrict access while vegetation re-establishes

A maximum inundation depth of 1m in a 2% AEP rainfall event is proposed to balance the impacts of inundation with minimising impacts to endangered REs required for the installation of the drains and backfill. In RA21 where disturbance to install drainage and backfill would be extensive or where drainage would be located off tenure, areas subject to temporal ponds and/or areas that are not free draining may be left, if no further practical options are identified. The pluvial modelling indicates three areas of temporal ponding between 1 – 1.5m will remain in the southernmost subsidence panels (Section 6.1.2.3). The model indicates these ponds with no additional rainfall would empty from infiltration and evaporation within 37 and 70 days.

The proposed backfill and drainage are a proof of concept based on the subsidence modelling (Section 6.4.1). The modelled subsidence is a conservative estimate and actual depths will vary.

Initial backfilling and drainage works is undertaken progressively as part of mining operations. Final drainage design and works will be scheduled after flooding of the underground workings when realisation of final subsidence has occurred, to ensure the drainage to the Isaac River is possible topographically.

6.4.4.4 Vegetation/habitat

The revegetation plan for cattle grazing in the underground mining and subsidence impacted areas is aligned to other cattle grazing PMLU areas. Subsided areas will be backfilled to make the areas predominately free draining prior to topsoil and seeding, and the remaining exposed surface cracks will be repaired and seeded (Section 6.1.8.5).

The dominant PMLU planned for the underground mining and subsidence impacted areas is woodland habitat. The revegetation plan for areas impacted by surface cracking, backfilling, drainage works, or temporal ponding is outlined in Section 6.1.8.7. The revegetation species for the underground mining areas will be dependent on whether the final landform is free draining or will have temporal ponding (Section 6.4.4.3). The majority of the area will be revegetated with similar species to the existing/surrounding REs, with the species seed mix and rates recommended by an AQP. Revegetation of the areas with temporal ponding will aim to achieve a fringing woodland habitat capable of persisting in the altered abiotic and biotic conditions. These areas will be seeded with a species mix derived from substitute REs (RE 11.3.2b and RE 11.3.27f) suited to ponding.

The revegetation plan for watercourses impacted by subsidence is outlined in Section 6.1.8.9. The revegetation species are based on selecting framework trees, woody understorey and groundcover species associated with the predominant natural watercourse RE 11.3.25.

Minimal vegetation disturbance is expected in most of the underground mining and subsidence impacted areas, therefore seed application may not be required in all areas. Where disturbance is required to undertake rehabilitation of the subsidence areas, impacts to existing vegetation will be minimised where possible.

6.4.4.5 Hydrogeological

The hydrogeological modelling (Section 6.1.1) indicates that Quaternary alluvial material groundwater levels are not adversely impacted within the in the post-mining environment. Therefore, GDEs associated with the Isaac River are not impacted by changes to groundwater levels.

Groundwater hydraulic gradients within the underground mining area, post flooding and stabilisation of the groundwater levels, are towards the Goonyella residual void. Evaporative loses from the void lake maintain the residual void as a terminal sink providing long term groundwater management.

Beyond maintaining the Goonyella residual void groundwater sink, no active rehabilitation strategy is required post-mining for the groundwater within the area of underground mining.

6.4.4.6 Watercourses

The major watercourse within the BRM subsidence area is the Isaac River, which has been diverted.

Subsidence under the Isaac River is restricted under the EA Schedule J: Watercourse Subsidence and therefore vertical displacement is minimised. Operational watercourse subsidence impacts are managed through compliance with the EA conditions. Drainage is installed to control and limit the entry of surface flows from the subsidence areas into the Isaac River. Rock armour and timber pile fields are also used to reduce erosion of the banks.

Subsidence created ponding within the watercourse will be retained as part of the watercourse PMLU and is expected to undergo self-healing during the natural sediment transportation process. This approach will minimise the disturbance of the ecosystems within the watercourse and minimise impacts to water quality. Operational monitoring of the Isaac River to date has indicated that sediment inputs from upstream have infilled some of the subsidence panels, and the timber pile fields provided adequate bank erosion mitigation during the period of infilling (Alluvium, 2024). It is expected that self-healing and sediment migration processes will continue such that watercourse bank stability will not be adversely impacted by subsidence at achievement of the PMLU.

Operational watercourse subsidence impacts, including initial crack repairs, will be managed through compliance with the EA conditions (J1 to J14).

6.4.5 Monitoring

Monitoring requirements for subsidence areas rehabilitated to woodland habitat or cattle grazing PMLUs are outlined in Sections 8.1 and 8.2.

Subsidence monitoring of the Isaac River will be undertaken as outlined in Section 8.3 and as per the frequency in the EA (currently annually). Monitoring will assess the geomorphic and riparian performance of the river and will identify any mitigation measures or rehabilitation requirements, including identification and repair of active erosion and operational subsidence cracking. The Isaac River monitoring points, including the subsidence reach, have been established as a part of the watercourse monitoring and are detailed in Section 8.4.

Post-mining monitoring will continue after the achievement of the relevant PMLU to a stable condition.

Relationship with PRCP schedule
Areas impacted by BRM and RHM underground mining will be rehabilitated to cattle grazing, woodland habitat and watercourse PMLUs. Initial surface cracks will be repaired progressively during operations and final scheduled rehabilitation will be undertaken post realisation of final subsidence. Subsided areas will be managed by backfilling and/or installing drainage to limit inundation/ponding.

6.5 Built infrastructure

PRCP Guideline (Section 3.6.5)

The administering authority's expectation of rehabilitation relating to built infrastructure is that it will be decommissioned, demolished, salvaged and/or disposed of unless it is being formally retained by the landholder to achieve an appropriate PMLU.

The rehabilitation planning part must include:

- *Identification of infrastructure that will be decommissioned and the methods for decommissioning.*
- *A description of infrastructure that will remain post-rehabilitation and the identification of ongoing maintenance requirements.*
- *Evidence of agreement for any infrastructure that will have ownership transferred.*

In accordance with EA condition E10: "*All infrastructure, constructed by or for the EA holder during the mining activities including water storage structures, must be removed from the site prior to surrender, except where agreed in writing by the post-mining landowner/landholder*." However, the EA further notes that "*this is not applicable where the landowner/landholder is also the environmental authority holder*", which is applicable for parts of GRM and BRM (Section 1.2.12).

Table 49 details the infrastructure associated with the mining activities at GRM and BRM. BMA owned surface infrastructure, not beneficial to the PMLU, will be decommissioned and removed in accordance with the EA conditions. Surface infrastructure that may be retained to support the PMLUs will have a demonstrable benefit and required agreements in place prior to rehabilitation and may include selected: fencing; access tracks; services related infrastructure; sheds and buildings; hardstand areas/transport logistics areas; and water related infrastructure.

Infrastructure not constructed for the purpose of mining, such as dams used for grazing, gates, cattle grates, stock handling/watering areas, access tracks, fire breaks etc., will not be removed as part of rehabilitation works.

Priority will be to repurpose, salvage or recycle any infrastructure to be removed. Demolition and disposal within the mining voids or spoil dumps will only be undertaken when repurpose, salvage or recycle alternatives are deemed by BMA not to be viable. This approach is in line with the waste and resource management hierarchy outlined in the Queensland Waste Management and Resource Recovery Strategy created under the *Queensland Waste Reduction and Recycling Act 2011*.

Table 49: Infrastructure associated with the approved GRM and BRM mining activities

Category		Infrastructure
Built infrastructure	Steel, concrete and brick infrastructure	• CHPPs • Conveyors and transfer stations • Stackers and reclaimers • Surge bins and hoppers • Tunnels • Train load-outs • Various buildings e.g. administration, crib rooms, warehouse, laboratory, storage, sheds • Workshops • Fuel, oil, chemical, explosive and water storage • Fuel and wash bays • Sewage treatment plants • Fences
	Supporting services	• Pipes and pumps • Power lines • Switchyard and substations • Communication and lighting towers • Concrete pads and bitumen • Culverts
Water infrastructure		• Mine water dams • Raw water dams • Sediment dams • Drains
Underground infrastructure		• Longwall shearers and hydraulic roof supports • Conveyors • Gas drainage bores and associated infrastructure • Ventilation shafts

The timing of the decommissioning and removal of infrastructure is based on the proposed timing for the end of mining, processing of the final coal or rehabilitation activities for the GRM and BRM operation, or the RHM operation for infrastructure that will be utilised for RHM.

Any regional or third-party infrastructure associated with roads, power, water and communications supply to landowners or townships is not included in the PRCP schedule.

Further detail on the rehabilitation stages after decommissioning of the infrastructure, such as landform reshape, surface preparation, revegetation and monitoring are covered in the relevant sections of this PRCP.

6.5.1 Built infrastructure

Decommissioning of the built infrastructure with no beneficial use to the PMLU or the neighbouring RHM operation, will follow the resource management hierarchy and will include:

- Disconnecting services
- Removing surface built and service infrastructure through salvage or recycling activities, or demolishing and burying in the mining voids or spoil dumps
- Removing below-ground built and service infrastructure to a depth of 0.5m below the surface and recycling, or burying in the mine void or spoil dumps, or covering to a minimum depth of 0.5m to enable establishment of the PMLUs
- Removing concrete, bitumen and aggregate to a depth of 0.5m below the surface and recycling, or burying in the mine void or spoil dumps, or covering to a minimum depth of 0.5m to enable establishment of the PMLUs
- Disposing of demolition-related putrescible and hazardous wastes at an appropriately licenced facility.

Ventilation shafts and other boreholes/shafts may not be removed to a depth of 0.5m and may remain at ground level if the relevant standards and guidelines at the time of closure require the cap to be on the surface.

Below-ground infrastructure, services, waste and underground equipment deeper than 0.5m in relation to the final landform surface can be retained provided it can meet the following:

- Pipelines have been drained
- Below-ground infrastructure (installed after the approval date of this transitional PRCP) is mapped
- The intended PMLU is not compromised

6.5.2 Water infrastructure

Decommissioning of the water-related infrastructure constructed for the mining activities with no beneficial use to the PMLU will include:

- Removing any remaining water to the residual voids or in accordance with:
  - EA condition F24: "*Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as farm dams or tanks, or used directly at properties owned by the environmental authority holder or a third party for the purpose of: a) supplying stock water subject to compliance with the quality release limits specified in Table F7 (Stock Water Release Limits); or b) supplying irrigation water subject to compliance with quality release limits in Table F8 (Irrigation Water Release Limits); or c) supplying water for construction and/or road maintenance in accordance with the conditions of this environmental authority*".
  - EA condition F25: "*Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as dams or tanks, for the purpose of supplying water to any operation licensed for either ERA13 (mining black coal) or ERA31 (mineral processing). The volume, pH and electrical conductivity of water transferred must be monitored and recorded*".
  - EA condition F26: "*If the responsibility for mine affected water is given or transferred to another person in accordance with conditions F24 or F25: a) the responsibility for the mine affected water must only be given or transferred in accordance with a written agreement (the third party agreement); and b) the third party agreement must include a commitment from the person utilising the mine affected water to use it in such a way as to prevent environmental harm or public health incidents and specifically make the persons aware of the General Environmental Duty (GED) under section 319 of the Environmental Protection Act 1994, environmental sustainability of the water disposal and protection of environmental values of waters; and c) the third party agreement must be signed by both parties to the agreement*".
- Disposing of mine dam sediment according to the results of an assessment by an AQP

- Removing any mine dam liners
- Breaching mine dam walls and reshaping of the area to make it free draining
- Removing culverts and drains constructed for mining activities and operations

6.5.3 Contaminated land investigation

In accordance with the EA conditions, contaminants must not be released in a manner that constitutes environmental harm, and spillage of any wastes, contaminants or other materials must be cleaned up as quickly as practicable, stored in accordance with relevant standards and handled in a way that prevents environmental harm.

At completion of mining operations and prior to landform reshaping, surface preparation and revegetation, a contaminated land investigation will be undertaken by a suitably qualified person (SQP) in accordance with the National Environment Protection (Assessment of Site Contamination) Measure for the relevant RAs (RM2). The contaminated land investigation will assess the site for the presence of contamination with the potential to adversely impact the nominated PMLUs and/or environmental values. Should land contamination be identified, the potential risks will be assessed and, where required, remediation will be undertaken. A Contaminated Land Investigation Document will be completed in accordance with the EP Act, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan to allow the ML area to be safely utilised for the nominated PMLUs.

Where the progressive rehabilitation areas being investigated for contaminated land do not align with legal cadastral property boundaries, the investigations will not fulfil the requirements of an EP Act compliant Contaminated Land Investigation Document. To support the assessment of contaminated land risks of individual progressive rehabilitation areas, the contaminated land investigations will be completed by a SQP to a standard that can be used as part of a future EP Act compliant Contaminated Land Investigation Document. Prior to the relinquishment of the MLs, the progressive rehabilitation contaminated land investigations will be collated to produce an EP Act compliant Contaminated Land Investigation Document that will be used to confirm the suitability of the site for the PMLUs, and to amend Environmental Management Register listings or to submit Site Management Plans, where required.

Verification will be undertaken as part of the final rehabilitation milestone of achievement of PMLU to a stable condition to confirm there are no changes to the contaminated land status completed for RM2 and the requirements of any Site Management Plans have been met.

Relationship with PRCP schedule
Surface infrastructure owned by BMA and not beneficial to the PMLU or the neighbouring RHM operation, will be decommissioned and removed at the end of mining GRM and BRM. Infrastructure required to support RHM will be removed at the end of mining RHM. Below ground infrastructure will be removed if required, to a depth of 0.5m or covered to enable establishment of the PMLU provided there is no ongoing risk of environmental harm and the intended PMLU is not compromised. A contaminated land investigation will be undertaken at the completion of operations and prior to final landform development and shaping. Remediation and/or management of any identified contamination that has the potential to present unacceptable risks to the nominated PMLU or environmental values, will be undertaken.

6.6 Summary of key rehabilitation and management practices

The key rehabilitation activities and associated rehabilitation milestones are shown in Table 50, and the key management/improvement activities and associated management milestones are shown in Table 51.

Table 50: Key rehabilitation activities and rehabilitation milestones for GRM and BRM

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
RA1	• Spoil dumps	• Assessment of contaminated land risks • Reshape the landform with maximum 30% slopes • Cover >15% slopes with minimum 0.5m rock • Construct landforms to restrict runoff from landform tops onto batter slopes, if required using appropriate controls • Install erosion and sediment controls, if required • Landform achieves FoS ≥1.5 • Spread topsoil to a minimum thickness of 100mm or alternative growth media to a minimum thickness of 300mm • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Deep rip along contour of slopes • Seed as per recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	• Progressive rehabilitation has commenced • Progressive rehabilitation of spoil dump areas as soon as practicable after areas become available • Rehabilitation of spoil dump low-wall area will commence once mining in each pit is complete or voids are no longer required to support mining operations	• RM2 • RM3 • RM5 • RM8 • RM11 • RM14
RA2	• Watercourse diversions • Watercourse crossings	• Remove watercourse crossings and culverts • For watercourse diversions requiring realignment and rehabilitation, construct diversions in line with the final functional designs	• Dependent on the location in relation to mining and closure activities, areas are available either at the end of mining or at the end of the major rehabilitation activities	• RM1 • RM3 • RM6 • RM9

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Reshape the disturbed areas within natural watercourse bed and banks to a profile similar to the pre-disturbance condition • Spread topsoil a minimum thickness of 150mm, where topsoil has previously been removed • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Deep rip along contour of slopes as required • Seed as per recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a watercourse PMLU	• Holding Paddock Creek diversion, Fisher Creek diversion, Platypus Creek crossings and Celi Creek crossings are available at the end of mining at GRM • Isaac River is available for rehabilitation post realisation of final subsidence (with RA11) • Eureka Creek is available for rehabilitation at the end of mining at RHM	• RM12 • RM15
RA3	• CHPP and associated infrastructure • Administration, crib and general buildings • Workshop, fuel, oil and chemical storage • Sewage treatment plants • Coal stockpiles	• Disconnect services • Remove BMA owned surface built and service infrastructure where there is no beneficial use to the PMLU • Remove BMA owned below ground built and service infrastructure within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU • Remove concrete and bitumen within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU • Remove machinery and equipment where there is no beneficial use to the PMLU • Remove waste not authorised under the EA waste schedule, including demolition waste	• Dependent on the use and location in relation to mining and closure activities: areas only associated with GRM and BRM are available for rehabilitation at the end of mining at GRM; the majority of the MIA, including CHPPs are available for rehabilitation at the end of mining at RHM	• RM1 • RM2 • RM3 • RM4 • RM7 • RM10 • RM13

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
	• Mine dams • Roads • TLO and rail infrastructure • Laydown areas • General infrastructure and disturbance	• Assess mine dam water and sediment and dispose appropriately • Assessment of contaminated land risks • Reshape the landform to be maximum 12% slopes • Install erosion and sediment controls, if required • Spread topsoil a minimum thickness of 150mm, where topsoil has previously been removed • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Rip along contour of slopes • Seed with recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU		
RA4	• Roads • Laydown areas • Conveyors • Exploration • General infrastructure and disturbance • Area 4 disturbance	Where required, dependent on the extent of the disturbance: • Disconnect services • Remove BMA owned surface built and service infrastructure where there is no beneficial use to the PMLU • Remove BMA owned below ground built and service infrastructure within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU	• Exploration rehabilitation is commenced within six months after exploration activities are complete (as per *Eligibility criteria and standard conditions for exploration and mineral development projects*) • The remaining areas are dependent on the use and location in relation to mining and closure activities: the majority of areas are only associated with GRM and BRM and are available for rehabilitation at the end of mining at GRM; a small portion of the area is required for access to RHM and is	• RM1 • RM2 • RM3 • RM5 • RM8 • RM11 • RM14

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Remove concrete and bitumen within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU • Remove waste not authorised under the EA waste schedule, including demolition waste • Decommission drillholes, bores, sediment ponds and sumps • Assessment of contaminated land risks • Reshape the landform maximum 15% slopes • Install erosion and sediment controls, if required • Spread topsoil to a minimum thickness of 100mm, where topsoil has previously been removed • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Rip along contour of slopes • Seed with recommended seed mix and rate • Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	available for rehabilitation at the end of mining at RHM	
RA6	• Rejects	• Additional data collection and material testing to inform a detailed cover design • Remove infrastructure • Assessment of contaminated land risks • Cover rejects with free-draining landform with minimum 2m of spoil	• Riverside rejects dump is available for rehabilitation now and will be rehabilitated as soon as practicable once additional data is sourced to develop the detailed cover design • Progressive rehabilitation of other rejects dump areas as soon as	• RM1 • RM2 • RM3 • RM4 • RM7

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Reshape the landform with maximum 30% slopes • Cover slopes >15% with at least 0.5m rock • Landform achieves FoS ≥1.5 • Spread topsoil to a minimum thickness of 150mm • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Deep rip along contour of slopes • Seed as per recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a grassland PMLU	practicable after areas become available	• RM19 • RM20
RA7	• Existing rehabilitation	• Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU	• Progressive rehabilitation has already commenced	• RM10 • RM13
RA9	• TSFs	• Active dewatering (where required), additional data collection, material testing and detailed cover design • Remove infrastructure, such as pumps and pipelines • Assessment of contaminated land risks • Cover TSF with free-draining landform with minimum of 2m of spoil • Reshape the landform with maximum 30% slopes • Cover slopes >15% with at least 0.5m rock • Landform achieves FoS ≥1.5 • Spread topsoil to a minimum thickness of 150mm	• GS1 TSF is available for rehabilitation now and will be rehabilitated as soon as practicable once the tailings are sufficiently dried out and data is sourced to develop the detailed cover design • RS1 TSF is scheduled for rehabilitation once dumping of rejects over the area is complete • DRE5 and R32 will be available for rehabilitation once planned dumping of spoil above each TSF reaches the final spoil dump position and the area is no	• RM1 • RM2 • RM3 • RM4 • RM7 • RM19 • RM20

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Rip along contour of slopes • Seed as per recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a grassland PMLU	longer required for associated infrastructure or access requirements	
RA10	• Existing rehabilitation	• Spread topsoil to a minimum thickness of 100mm or alternative growth media to a minimum thickness of 300mm • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required) • Deep rip along contour of slopes • Seed as per recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU	• Progressive rehabilitation has already commenced	• RM5 • RM8 • RM11 • RM18
RA11	• Watercourses, diversions and crossings impacted by underground mining/ subsidence	• Remove watercourse crossings and culverts • Rehabilitate surface cracks that do not self-heal and adversely impact achieving the PMLU • For watercourse diversions requiring realignment and rehabilitation, construct diversions in line with the final functional/ detailed designs • Reshape watercourse crossings to a profile similar to the pre-disturbance condition	• Initial operational repair of subsidence cracks and drainage works occur progressively during operations after mining each coal seam • Final rehabilitation is scheduled once final subsidence is complete after underground workings are flooded at the end of mining: areas above BRM are available for rehabilitation after	• RM1 • RM3 • RM6 • RM9 • RM12 • RM15

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Install erosion and sediment controls , if required • Spread topsoil a minimum thickness of 150mm, where topsoil has previously been removed • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required by the plan) • Deep rip along contour of slopes as required • Seed as per recommended seed mix and rates • Undertake monitoring and maintenance to demonstrate achievement of a watercourse PMLU	flooding of the GMS and GLS; areas above RHM are available for rehabilitation after flooding of the GMS	
RA20	• Subsidence • Underground mining infrastructure • General infrastructure and disturbance within underground mining area	• Remove surface built and service infrastructure where there is no beneficial use to the PMLU • Remove below ground built and service infrastructure and underground equipment within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU • Seal shafts and gas drainage • Backfill subsidence areas to make predominantly free draining • Rehabilitate surface cracks that do not self-heal and adversely impact achieving the PMLU • Install erosion and sediment controls , if required • Spread topsoil a minimum thickness of 150mm, where topsoil has previously been removed	• Initial operational repair of subsidence cracks and drainage works occur progressively during operations after mining each panel • Final rehabilitation is scheduled once final subsidence is complete after flooding of the underground workings at the end of mining: areas above BRM are available for rehabilitation after flooding of the GMS and GLS	• RM1 • RM3 • RM4 • RM7 • RM10 • RM13

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required by the plan) • Rip along contour of slopes • Seed with recommended seed mix and rates • Install temporary fencing if required to restrict access to subsided areas while vegetation establishes • Undertake monitoring and maintenance to demonstrate achievement of a cattle grazing PMLU		
RA21	• Subsidence • Underground mining infrastructure • General infrastructure and disturbance within underground mining area	• Remove surface built and service infrastructure where there is no beneficial use to the PMLU • Remove below ground built and service infrastructure and underground equipment within 0.5m of the surface or cover to a minimum depth of 0.5m where there is no beneficial use to the PMLU • Seal shafts and gas drainage • Backfill and/or install drainage to limit subsidence inundation to a maximum 1m depth for a 2% AEP rainfall event, where practical to make the area predominantly free draining • Rehabilitate surface cracks that do not self-heal and adversely impact achieving the PMLU • Reshape infrastructure areas with maximum 15% slopes • Install erosion and sediment controls , if required	• Initial operational repair of subsidence cracks and drainage occurs progressively during operations after mining each panel • Final rehabilitation is scheduled once final subsidence is complete after flooding of the underground workings at the end of mining: areas above BRM are available for rehabilitation after flooding of the GMS and GLS; areas above RHM are available for rehabilitation after flooding of the GMS	• RM1 • RM3 • RM5 • RM8 • RM11 • RM14

RA	Relevant activities	Rehabilitation activities	Commencement of rehabilitation timing	RMs
		• Spread topsoil to a minimum thickness of 100mm, where topsoil has previously been removed • Assess growth media characteristics to determine ameliorant and other treatment requirements • Apply ameliorants and other treatments (if required by the plan) • Rip along contour of slopes • Seed with recommended seed mix and rate • Install temporary fencing if required to restrict access to subsided areas while vegetation establishes • Undertake monitoring and maintenance to demonstrate achievement of a woodland habitat PMLU		

Table 51: Key management/improvement activities and management milestones for GRM and BRM

IA	Relevant activities	Management/improvement activities	Improvement timing	MMs
IA1	• Residual voids	• Design high-walls, end-walls and low-walls to achieve a FoS ≥1.5 within the NUMA extents • Design a minimum distance of 50m between the residual void crest and the toe of the safety bund, where against a tenure boundary or watercourse • Design a minimum distance of 25m between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform • Design residual voids to prevent overtopping	• Available for improvement once the PMLU low-wall spoil reshaping is complete for each residual void and the void is no longer being utilised for underground access or water storage: R32 East, R32 South, Broadmeadow and Isaac voids are available for improvement progressively; Thiess and Goonyella void are available for improvement at the end of mining of RHM	• MM1 • MM2 • MM3

IA	Relevant activities	Management/improvement activities	Improvement timing	MMs
		• Undertake predictive groundwater modelling • Backfill voids or construct high-wall landforms at the end of mining for flood mitigation as per final flood model • Low-walls to free-drain into the void lake with maximum 37 degree slopes • Close underground entries • Construct safety bund or equivalent landform at geotechnical set-back distance to prevent access to the residual voids • Erect fencing and signage around the perimeter of the safety bund, where required • Undertake monitoring to demonstrate achievement of sufficient improvement • Undertake monitoring and maintenance of exclusion fences and bunds		

7 RISK ASSESSMENT

Legislative Requirement

In accordance with section 126C(1)(f) of the EP Act, the rehabilitation planning part of the PRC Plan must identify the risks of a stable condition for land described as a post-mining land use not being achieved, and how the applicant intends to manage or minimise the risks.

PRCP Guideline (Section 3.7)

As per section 126C(1)(j) of the EP Act, the administering authority considers it necessary for the proposed PRC Plan to contain a risk assessment of all proposed NUMAs. The risk assessment must be carried out to identify the risks of the NUMA causing environmental harm and not being safe and structurally stable and detail how the applicant intends to manage and minimise the identified risks.

The AS ISO 31000:2018 Risk Management – Guidelines (Standards Australia, 2018) describes risk assessment as the overall process of risk identification, risk analysis, risk evaluation and risk treatment. Each of these aspects must be included in the risk assessment in the rehabilitation planning part.

Information requirements in this section apply to all applicants whether or not they are an existing EA holder. Existing holders may have the required information available from previously submitted plans/reports/applications that, if still valid, can be used in the PRC Plan.

7.1 Identifying, assessing and treating risks

7.1.1 Risk methodology

A risk-based approach to the GRM and BRM PRCP has been undertaken in term of the method described in Figure 22.

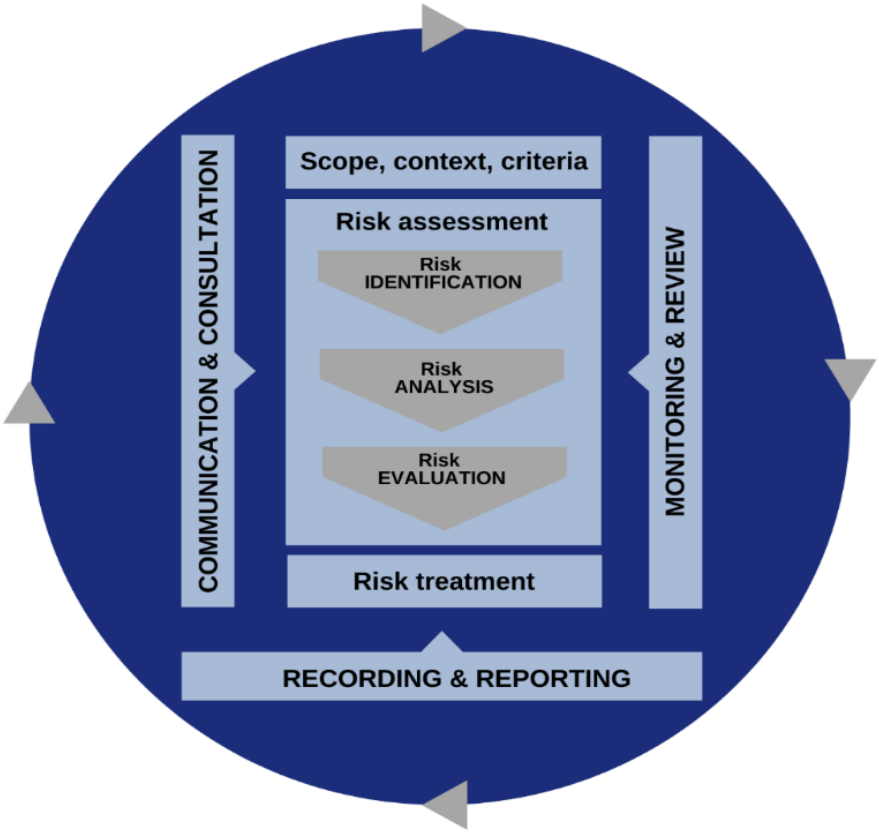

Figure 22: ISO 31000-compliant risk-based approach followed for the GRM and BRM PRCP

7.1.2 Risk identification

The risk event - a stable condition for land described as a PMLU not being achieved - was assessed per ISO 31000 methodology described in Figure 22 above, where stable condition is defined as per section 111A of the EP Act

For GRM and BRM, the PMLUs being assessed are cattle grazing, grassland, woodland habitat and watercourse (Section 3).

In addition, the risk event - NUMAs do not achieve safe, structurally stable condition or causes environmental harm - was also assessed.

7.1.3 Risk analysis, evaluation and relevant treatments

The full risk assessment – *Goonyella and Broadmeadow Mine PRCP Risk Assessment* is included in Appendix Q and provides the risk analysis, risk evaluation and risk treatments for each risk scenario.

Worst case outcomes were assessed for each scenario, preventative and mitigating controls identified and then a residual risk rating (RRR) was calculated. The BHP likelihood and impact tables, as well as the RRR heat map ratings matrix are provided in Table 52, Table 53 and Table 54, respectively.

Table 52: BHP risk likelihood table

Likelihood	Frequency[1]	Probability[2]	Likelihood factor
Highly Likely	Risk likely to occur within a 1-year period	≥80% chance of the Risk occurring	3
Likely	Risk likely to occur within a 1 – 5-year period	60 – 79% chance of the Risk occurring	1
Possible	Risk likely to occur within a 5 – 20-year period	30 – 59% chance of the Risk occurring	0.3
Unlikely	Risk likely to occur within a 20 – 50-year period	10 – 29% chance of the Risk occurring	0.1
Highly Unlikely	Risk likely to occur beyond a 50-year period	<10% chance of the Risk occurring	0.03

[1] *Typically used when assessing ongoing or enduring Risks.*
[2] *Typically used when assessing project or one-off/discrete Risks*

Table 53: BHP risk impact table

Impact level	Descriptors	Impact factor
5	Significant and lasting impact to environment, climate, community or Indigenous peoples	1000
4	Significant impact to environment, climate, community or Indigenous peoples	300
3	Moderate impact to environment, climate, community or Indigenous peoples	100
2	Measurable but limited or temporary impact to environment, climate, community or Indigenous peoples	30
1	Minor, low level impact to the environment, climate, community or Indigenous peoples	10

Table 54: BHP RRR heat map

			Impact level	1	2	3	4	5
			Impact factor	10	30	100	300	1000
	Likelihood	Likelihood factor	Timeframe	Residual risk rating (with controls in place and effective)				
Likelihood	Highly Likely	3	Within 1 year	30	90	300	900	3000
	Likely	1	Within 1-5 years	10	30	100	300	1000
	Possible	0.3	Within 5-20 years	3	9	30	90	300
	Unlikely	0.1	Within 20-50 years	1	3	10	30	100
	Highly Unlikely	0.03	Beyond 50 years	0.3	0.9	3	9	30

With controls in place and implemented effectively, the RRR for the identified risk scenarios of the risk event – a stable condition for land described as a PMLU not being achieved, is deemed to be low (RRR of 30). The timeframes required for the risk and uncertainty to be assessed, and appropriate controls to be identified and implemented, have been factored into the duration of the RMs for each RA.

The risk treatments for each scenario that are necessary for achieving a stable condition for the land described as the PMLUs are shown below in Table 55.

Table 55: Necessary risk treatments identified to achieve a stable condition for the PMLUs

Aspect	Risk treatment
Risk event: Stable condition for land described as a post-mining land (cattle grazing, grassland, woodland habitat and watercourse) use is not achieved	
PMLU Scenario 1: Landform failure	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations
Proposed actions	• Materials characterisation • Growth media assessment to determine ameliorant and physical treatment requirements • Application of ameliorants and physical treatments as per assessment • Landform designed for materials available onsite and what can be achieved based on their properties • PMLU selected based on what is most appropriate for landform and materials • Groundcover of vegetation and rock (where appropriate on slopes only) to provide erosion resistance • Flooding of underground workings • Subsidence cracking repairs and drainage to reduce inundation/ponding to acceptable limits
Resource requirements	• Available material inventory • Erosion modelling • Equipment capabilities • Survey • Rehabilitation monitoring • Growth media assessment • Stockpile materials if required
Performance measures and constraints	• Comparison against design • Tracking against milestone criteria
Reporting and monitoring	• Rehabilitation and subsidence monitoring • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• From commencement of rehabilitation activities to final achievement of PMLU

Aspect	Risk treatment
PMLU Scenario 2: Alteration of hydrogeological conditions	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Environment team • Water team • Site operations
Proposed actions	• All imported hazardous materials to be stored and used in accordance with relevant standards and removed from site on completion of operations • Appropriate management, placement, and monitoring of waste (spoil, tailings, rejects) during operations • Future tailings disposal options to be assessed for potential release of contaminants to waters including groundwater and control/approvals put in place • Installation of relevant groundwater monitoring bores • Analysis of data and development of site-specific groundwater quality limits • Revisiting and updating the groundwater models every five years (commencing from 2050) • Contaminated land investigation to be undertaken at time of closure and implementation of remediation and/or site management plans as required • Landforms designed and constructed to minimise contaminant generation and transport, and minimise catchments and the potential for flooding of the residual voids • Cumulative groundwater modelling to be undertaken at mine closure
Resource requirements	• Groundwater monitoring infrastructure • Sample collection and laboratory analysis • Development of site-specific groundwater quality limits
Performance measures and constraints	• Compliance with PRCP Condition/milestone criteria
Reporting and monitoring	• Reporting of identified releases of contaminants to WaTERS under existing EA requirements • Groundwater monitoring data analysis and implementation of any necessary remediation activities identified
Risk timing and scheduling	• From establishment of landforms with sampling as per PRCP monitoring program

Aspect	Risk treatment
PMLU Scenario 3: Alteration of surface water systems	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Environment team • Water team • Site operations
Proposed actions	• All imported hazardous materials to be stored and used in accordance with relevant standards and removed from site on completion of operations • Appropriate management, placement, and monitoring of waste (spoil, tailings, rejects) during operations • Surface water monitoring undertaken in accordance with EA conditions • Installation of monitoring equipment at the relevant surface water monitoring locations • Analysis of data and development of site-specific surface water quality limits for relevant watercourses • Rehabilitation and monitoring of disturbed and/or diverted reaches of watercourses undertaken • Mine affected water dams to be decommissioned and areas rehabilitated • Contaminated land investigations will be undertaken progressively and at the completion of operations and implementation of remediation and/or site management plans as required • Landforms constructed to minimise the potential for flooding of the residual voids • Tailings and other waste disposal facilities appropriately covered • Subsidence landform to limit reduction in flows to Isaac River and reduce inundation/ponding to acceptable limits
Resource requirements	• Monitoring equipment installed in relevant watercourses • Surface water sampling • Development of site-specific surface water quality limits • Sampling equipment and infrastructure to allow collection of samples during runoff events • Flood and subsidence modelling • Subsidence monitoring • SQP to undertake contaminated land investigations and oversee on-going monitoring requirements
Performance measures and constraints	• Surface water PRCP Conditions/milestone criteria and water quality objectives
Reporting and monitoring	• Monitoring when surface water flows are available

Aspect	Risk treatment
	• Monitoring of subsidence • Reporting under existing EA requirements • Implementation of any necessary remediation or maintenance activities identified through monitoring
Risk timing and scheduling	• During runoff events suitable for the collection of surface water samples
PMLU Scenario 4: Watercourse diversion not achieving closure objectives	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Environment team • Water team • Site operations
Proposed actions	• Watercourse diversion concept designs to be progressed to functional designs when rehabilitation of surrounding areas commences or post realisation of final subsidence • Construction of any diversion channels in line with the final functional designs • Removal and rehabilitation of any mine infrastructure that presents an unacceptable risk to the diversion attaining a relinquishable state (e.g. drop structures, culverts and dams) • Rehabilitation of surrounding landforms • Watercourse diversion monitoring to relevant IDC standard and maintenance • Subsidence monitoring and repair of surface cracks
Resource requirements	• Progress diversion concept designs to functional designs, including flood modelling • Watercourse diversion monitoring • Collection and analysis of water samples
Performance measures and constraints	• Watercourse geomorphic index and riparian vegetation index milestone criteria • Surface water milestone criteria and water quality objectives
Reporting and monitoring	• Watercourse monitoring • Surface water quality monitoring and data analysis • Implementation of any necessary remediation or maintenance activities identified through monitoring
Risk timing and scheduling	• At scheduled frequencies from commencement of rehabilitation activities to final achievement of PMLU

Aspect	Risk treatment
PMLU Scenario 5: Contaminated land impacting on environmental receptors, rehabilitation and attainment of PMLUs	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform • Where necessary, due to current levels of uncertainty, the timeframes for RM2 reflect the time to support additional project work and analysis for TSFs and rejects dumps to implement any necessary mitigation or remediation plans
Responsibility for plan: • Approval • Implementation	• Environmental team • Water team • Site operations
Proposed actions	• Environmental monitoring and reporting as per the EP Act and existing EA requirements • All stored hazardous materials and infrastructure, that have a reasonable potential to release contaminants, will be appropriately recycled or disposed • Contaminated land investigations to be undertaken progressively and at the completion of operations to identify contamination that has the potential to adversely impact PMLUs • Implementation of remediation and/or site management plans as required to reduce potential contaminated land risks • Landforms designed to establish groundwater sinks
Resource requirements	• SQP to undertake contaminated land investigations and oversee on-going monitoring requirements • Sample collection, laboratory analyses and engineering controls
Performance measures and constraints	• Attainment of surface water and groundwater milestone criteria and a site suitability statement
Reporting and monitoring	• Contaminated land investigation report and reporting of water quality as per EA
Risk timing and scheduling	• Contaminated land investigations from commencement of rehabilitation • Water sampling as per PRCP monitoring program
PMLU Scenario 6: Flooding influences on rehabilitation and final landforms	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations

Aspect	Risk treatment
Proposed actions	• Removal of infrastructure from watercourses (e.g. culverts, drop structures), that could adversely impact flow • Decommissioning of dams • Design of landforms within flood extents that are safe and stable • Subsidence landform to limit inundation/ponding to acceptable limits • Establishment of vegetation suitable for the landform and reduces erosion risks • Undertake monitoring for potential landform risks and undertake maintenance
Resource requirements	• Flood modelling • Rehabilitation monitoring post flood events
Performance measures and constraints	• No inundation of residual voids and no significant failures of the landforms up to a 0.1% AEP event
Reporting and monitoring	• Monitoring of potential landform risks • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• As per PRCP monitoring program
PMLU Scenario 7: Rehabilitated landforms result in alteration of flood hydrology upstream and downstream	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations
Proposed actions	• Removal of infrastructure within watercourse alignments (e.g. culverts, drop structures) that could adversely impact flows • Decommissioning of dams • Subsidence crack repairs and drainage works to limit inundation/ponding to acceptable limits • Establishment of landforms that are stable • Provide appropriate level of flood protection for residual voids • Modelling, monitoring and maintenance works where required to maintain landforms
Resource requirements	• Flood modelling
Performance measures and constraints	• No unacceptable damage to infrastructure or ecosystems as a result of changes to flood regime or change to flood extent

Aspect	Risk treatment
Reporting and monitoring	• Rehabilitation monitoring post flood events • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• As per PRCP monitoring program
PMLU Scenario 8: Insufficient or inappropriate growth media and rock resources required for rehabilitation activities	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Technical services • Environment team • Site operations
Proposed actions	• Management of topsoil and rock stockpiling • Landform design based on available materials • Management of rehabilitation material application • Review the growth media and rock material balance periodically during operations • Growth media assessment to determine ameliorant and physical treatments • Application of ameliorants and physical treatments as per assessment
Resource requirements	• Topsoil and rock inventory • Burden model • Survey • Equipment capabilities • Rehabilitation monitoring • Growth media assessment
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Rehabilitation monitoring • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• From planning of soil stripping to final achievement of PMLU
PMLU Scenario 9: Insufficient management of mineral waste	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform

Aspect	Risk treatment
Responsibility for plan: • Approval • Implementation	• Technical services • Environment team • Site operations
Proposed actions	• Waste characterisation during operations • Ongoing sampling of tailings and rejects during operations • Tailings and rejects material appropriately disposed on-site • In-situ geochemical monitoring of landforms • Detailed cover design developed based on data collected once tailings deposition and drying or rejects dumping is complete • Install tailings and rejects cover as per detailed design
Resource requirements	• Data from waste characterisation • Mineral waste sampling data • In-situ geochemical monitoring • Detailed cover design • Rehabilitation monitoring • Surface and groundwater monitoring
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Rehabilitation monitoring • Waste characterisation sampling and analysis • Surface and groundwater monitoring • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• Throughout operations to final achievement of PMLU
PMLU Scenario 10: Failure of, or inappropriate engineered cover design	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform • Where necessary, due to current levels of uncertainty, the timeframe for the commencement of the first rehabilitation milestone reflects the time to close knowledge base gaps to assess the risks for the TSFs and rejects dumps and to develop detailed cover designs to achieve a stable condition
Responsibility for plan: • Approval • Implementation	• Environment team • Site operations • Technical services
Proposed actions	• Waste characterisation during operations

Aspect	Risk treatment
	• Ongoing sampling of tailings and rejects during operations • Tailings and rejects material appropriately disposed on-site • In-situ geochemical and geotechnical monitoring of landforms • Surface and groundwater monitoring • Detailed cover design developed based on data collected once tailings deposition and drying or rejects dumping is complete • Install cover as per detailed design • Restrict livestock from areas with a cover
Resource requirements	• Data from waste characterisation • In-situ geochemical and geotechnical monitoring • Final detailed cover design • Rehabilitation monitoring • Surface and groundwater monitoring
Performance measures and constraints	• Compliance to cover design • Tracking against milestone criteria
Reporting and monitoring	• Rehabilitation monitoring • Waste characterisation sampling and analysis • Surface and groundwater monitoring • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• From cover design to final achievement of PMLU
PMLU Scenario 11: Inadequate and/or inappropriate revegetation	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Environment team • Site operations
Proposed actions	• Growth media assessment to determine ameliorant and physical treatment requirements for the PMLU • Application of ameliorants and physical treatments as per assessment • Revegetation species and application rate aligned to growth media, landforms, subsidence impacts and PMLU • Management of seed selection, provenance and quality • Subsidence crack repairs and drainage works to limit inundation/ponding to acceptable limits • Rehabilitation and reference site monitoring

Aspect	Risk treatment
Resource requirements	• Growth media assessment • Seed • Rehabilitation and reference site monitoring
Performance measures and constraints	• Tracking against milestone criteria • Self-sustaining vegetation suited to PMLU
Reporting and monitoring	• Rehabilitation and reference site monitoring • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• From growth media planning to final achievement of PMLU
PMLU Scenario 12: Deterioration of built infrastructure conditions	
Reasons for selecting treatment option	• Studies and analysis to continue over the rehabilitation period to the end of mine life to demonstrate and confirm that these treatments achieve a stable condition for the proposed closure landform
Responsibility for plan: • Approval • Implementation	• Environment team • Site operations
Proposed actions	• Surface infrastructure not being retained on-site to be decommissioned and removed, and underlying land rehabilitated • Undertake a preliminary contaminated land assessment prior to the completion of the approved activities, conduct a detailed site investigation and implement remediation and/or site management plan if required • Capping and sealing of surface infrastructure for underground operations (e.g. shafts, holes)
Resource requirements	• SQP to undertake contaminated land investigations and oversee on-going monitoring requirements • Rehabilitation monitoring
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Rehabilitation monitoring • Implementation of any necessary remediation or maintenance activities identified through rehabilitation monitoring
Risk timing and scheduling	• Throughout operations to final achievement of PMLU

With controls in place and implemented effectively, the RRR for the identified risk scenarios of the risk event – NUMAs do not achieve safe, structurally stable condition or causes environmental harm off tenure, is deemed to be low (RRR of 10). The timeframes required for the risk and uncertainty to be assessed, and appropriate controls to be identified and implemented, have been factored into the duration of the MMs for each IA.

The risk treatments for each scenario that are necessary for achieving a safe and structurally stable NUMA that does not cause environmental harm are shown below in Table 56.

Table 56: Necessary risk treatments identified to achieve a safe and structurally stable NUMA that does not cause environmental harm

Aspect	Risk treatment
Risk event: NUMAs do not achieve safe, structurally stable condition or causes environmental harm off tenure	
NUMA scenario 1: Void walls do not achieve geotechnical stability	
Reasons for selecting treatment option	• Studies and analysis performed showed that these treatments achieve a safe and structurally stable condition for the NUMA
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations
Proposed actions	• Geotechnical assessment and final void design • Pit floor treatments as required during operations to improve low-wall stability • Geotechnical monitoring during operations • Updated geotechnical assessment to be completed as mining approaches final limits and wall design and NUMA extent adjusted if required • NUMA extents designed to include the required FoS limit • Bunding or equivalent landform, fencing and signage placed at FoS limit • Install physical barriers to underground access points
Resource requirements	• Geotechnical assessment and design • Underground access barrier design
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Geotechnical monitoring • Implementation of any necessary remediation or maintenance activities identified through monitoring
Risk timing and scheduling	• From detailed closure design of each void to relinquishment
NUMA scenario 2: Uncontrolled access to NUMA	
Reasons for selecting treatment option	• Studies and analysis performed showed that these treatments achieve a safe and structurally stable condition for the NUMA
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations

Aspect	Risk treatment
Risk event: NUMAs do not achieve safe, structurally stable condition or causes environmental harm off tenure	
Proposed actions	• Safety bunding, or equivalent landform, fencing and signage placed at FoS limit where required to restrict access • Geotechnical modelling completed to determine FoS limit • Visual inspections of safety bund, fencing and signage to identify required maintenance
Resource requirements	• Geotechnical modelling • Monitoring
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Document visual inspection • Geotechnical monitoring • Implementation of any necessary remediation or maintenance activities identified through inspections
Risk timing and scheduling	• From detailed closure design of each void to relinquishment
NUMA scenario 3: Uncontrolled flooding into residual voids	
Reasons for selecting treatment option	• Studies and analysis performed showed that these treatments achieve a safe and structurally stable condition for the NUMA
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations
Proposed actions	• Flood modelling including climate change scenarios • Flood mitigation (partial backfill and/or landform) designed to 0.1%AEP flood event which sufficiently manages the flood risk • Void flood mitigation installed
Resource requirements	• Flood modelling • Landform design
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Document visual inspection • Monitoring • Implementation of any necessary remediation or maintenance activities identified through monitoring
Risk timing and scheduling	• From detailed closure design of each void to relinquishment

Aspect	Risk treatment
Risk event: NUMAs do not achieve safe, structurally stable condition or causes environmental harm off tenure	
NUMA scenario 4: Water in the void causes environmental harm outside of the mining tenure	
Reasons for selecting treatment option	• Studies and analysis performed showed that these treatments achieve a safe and structurally stable condition for the NUMA
Responsibility for plan: • Approval • Implementation	• Technical services • Site operations
Proposed actions	• Groundwater and void lake water balance modelling • Void flood mitigation designed to 0.1% AEP flood event • Void flood mitigation installed • Groundwater quality and level monitoring • Flooding of the underground workings • Landform design to enable establishment of inward hydraulic gradients within the tenure boundary
Resource requirements	• Groundwater and void lake water balance modelling • Landform design • Monitoring
Performance measures and constraints	• Tracking against milestone criteria
Reporting and monitoring	• Groundwater level and quality monitoring • Water quality monitoring • Implementation of any necessary remediation or maintenance activities identified through monitoring
Risk timing and scheduling	• From detailed closure design of each void to relinquishment

Relationship with PRCP schedule
A risk-based approach has been adopted to develop the milestones in the PRCP schedule. This is primarily driven by a residual risk rating. Should a risk event materialise, the additional proposed actions identified in this risk section will be implemented and, where necessary, adjusted accordingly (in line with the risk treatment identified in this section).

7.2 Rehabilitation trials

PRCP Guideline (Section 3.7.1)

In accordance with section 126C(1)(j) of the EP Act, if rehabilitation trials are planned, the rehabilitation planning part must state:

- *the objective of the trial(s)*
- *the trial design including, but not limited to, the location, underlying land characteristics and potential issues*
- *the details of how the trial(s) will be carried out*
- *when the trial(s) will commence*
- *the duration of the trial(s)*
- *how the trial(s) will be assessed for success*
- *how the results of the trial(s) will be incorporated into rehabilitation strategies and the development of milestones, and*
- *where the trials have previously been carried out by the applicant.*

The information requirements in this section will apply to all applicants, whether or not they are an existing EA holder, who have planned or commenced rehabilitation trials. Existing EA holders can provide details of any rehabilitation trials that have occurred prior to the submission of the proposed PRC Plan.

No rehabilitation trials are proposed at GRM and BRM. Current rehabilitation practices will be executed in line with the PRCP rehabilitation milestone criteria for each PMLU.

8 MONITORING AND MAINTENANCE

PRCP Guideline (Section 3.8)

Under section 126C(1)(j) of the EP Act, the administering authority considers monitoring and maintenance necessary to decide if the PRC Plan is consistent with the requirements of the legislation. The rehabilitation planning part must contain a monitoring and maintenance program that identifies and describes the monitoring systems that will be carried out in order to demonstrate a milestone and milestone criteria have been achieved. The program must include, where relevant to the milestone and milestone criteria (but is not limited to):

- *schedule of monitoring, reporting and review for each milestone*
- *description of methodologies and standards, which could include field-based assessments and the application of new remote sensing, GIS and other relevant emerging technologies*
- *monitoring that enables the repeatable collection of relevant statistically valid data*
- *monitoring using appropriate quality assurance and data management processes and systems*
- *regular analysis of site data including multi-year comparison trends and bench-marking against analogue/reference sites*
- *contingency strategies if monitoring data indicates milestone criteria are not being met*
- *post-closure monitoring to ensure milestone criteria has been demonstrated*
- *intent of monitoring reports, such as provision of results and key findings*

The information requirements in this section will apply to all applicants whether or not they are an existing EA holder. However, existing holders may already have the required information available from previously submitted plans/reports/applications that, if still valid, could be used in the PRC Plan. If there has/is any monitoring or maintenance of areas already rehabilitated, details must be included in the PRC Plan.

8.1 Rehabilitation monitoring

Rehabilitation milestone monitoring will be undertaken at GRM and BRM by an AQP (as per condition A5 of the EA) to demonstrate achievement of the PMLUs of cattle grazing, grassland, woodland habitat or watercourse.

The RMs and associated milestone criteria for GRM and BRM are detailed in Section 1.4.2 and Section 10.4. A combination of monitoring, reporting and data analysis approaches will be used to demonstrate the achievement of the RMs as detailed in Table 57. Monitoring and maintenance activities will continue after rehabilitated areas achieve the final rehabilitation milestone (achievement of PMLU to a stable condition) and/or are certified.

Table 57: Rehabilitation milestones with relevant reporting requirements

Milestone reference	Rehabilitation milestone	Reporting requirements
RM1	Infrastructure decommissioning and removal	• Document visual inspections • Map of retained below-ground infrastructure (installed after the approval date of this transitional PRCP) • Document regulated waste removal • Assessment report for mine water dams
RM2	Remediation and/or management of contaminated land	• Contaminated Land Investigation Document, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan • Site assessment reports for individual areas of progressive rehabilitation that will be suitable to form part of a future Contaminated Land Investigation Document
RM3	Landform development and reshaping	• Survey/LiDAR of landform • Analysis of final landform against design • Assessment that the landform is geotechnically stable with FoS ≥1.5 (RA1, RA6, RA9)
RM4	Surface preparation (cattle grazing and grassland)	• Document growth media depth • Growth media assessment and amelioration and physical treatment plan • Document ameliorants and physical treatments applied
RM5	Surface preparation (woodland habitat)	• Document growth media depth • Growth media assessment and amelioration and physical treatment plan • Document ameliorants and physical treatments applied
RM6	Surface preparation (watercourse)	• Document growth media depth • Growth media assessment and amelioration and physical treatment plan • Document ameliorants and physical treatments applied
RM7	Revegetation (cattle grazing and grassland)	• Document seed mix, purity information, planting timing, seed application rates and areas

Milestone reference	Rehabilitation milestone	Reporting requirements
RM8	Revegetation (woodland habitat)	• Document seed mix, purity information, planting timing, seed application rates and areas
RM9	Revegetation (watercourse)	• Document seed mix, purity information, planting timing, seed application rates and areas
RM10	Achievement of surface requirements (cattle grazing)	• Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5
RM11	Achievement of surface requirements (woodland habitat)	• Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5
RM12	Achievement of surface requirements (watercourse)	• Rehabilitation monitoring as per Sections 8.1, 8.3 and 8.5
RM19	Achievement of surface requirements (grassland)	• Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5
RM13	Achievement of post-mining land use to a stable condition (cattle grazing – RA3, RA7, RA20)	• Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5 • Hazard assessment
RM14	Achievement of post-mining land use to a stable condition (woodland habitat – RA1, RA4, RA21)	• Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5 • Hazard assessment • Landform geotechnical FoS assessment (RA1)
RM15	Achievement of post-mining land use to a stable condition (watercourse – RA2, RA11)	• Rehabilitation monitoring as per Sections 8.1, 8.3 and 8.5 • Hazard assessment
RM18	Achievement of post-mining land use to a stable condition (woodland habitat, existing rehabilitation – RA10)	• Rehabilitation monitoring as per Section 8.1 and 8.2 • Hazard assessment
RM20	Achievement of post-mining land use to a stable condition (grassland – RA6, RA9)	• Rehabilitation monitoring as per Sections 8.1, 8.2 and 8.5 • Hazard assessment • Landform geotechnical FoS certification

8.1.1 Remote sensing and technology

The current rehabilitation monitoring program utilises the capture and analysis of field data. Future advances in monitoring could include developments in remote sensing, technology and/or digital data capture which may be incorporated into the program wherever practical.

8.1.2 Erosion monitoring

Erosion monitoring will be conducted for all PMLUs at the frequencies in Table 59 and Table 64, and will support achievement of surface requirements and the PMLU to a stable condition (RM13, RM14, RM15, RM18, RM20).

"*There is no consensus in Australia on a quantitative or precise definition of what constitutes minor, moderate and/or severe erosion*" (CSIRO, 2024). For this reason, the best approach to assess the state and severity of erosion is by an AQP during monitoring. Type of erosion and the associated severity will be recorded based on the erosion classifications in Table 58. For gully erosion, gully depth will also be recorded as 0.3 – 1.5m, 1.5 – 3.0m, or >3m.

Sheet, rill or gully erosion classified as severe according to the Australian soil and land survey field handbook (CSIRO, 2024) will be remediated (Table 58). All minor or moderate erosion, plus other erosion types, such as tunnel erosion, will be assessed by an AQP and will be remediated if assessed as requiring intervention to ensure the PMLU is achieved. This ensures the erosion is assessed holistically, such as to ensure repair will not cause more damage.

The rehabilitation milestones for the achievement of PMLU to a stable condition also require a safety hazard assessment to be completed, which also ensures any erosion that is a safety hazard is remediated.

Table 58: Erosion type and severity

Erosion type*	Erosion severity			
	No erosion	Minor	Moderate	Severe
Sheet erosion	No sheet erosion present	Indicators may include shallow soil deposits in downslope sediment traps (fencelines, farm dams). Often very difficult to assess as evidence may be lost with cultivation, pedoturbation or revegetation.	Indicators may include partial exposure of roots, moderate soil deposits in downslope sediment traps (fencelines, farm dams)	Indicators may include loss of surface horizons, exposure of subsoil horizons, pedestalling, root exposure, substantial soil deposits in downslope sediment traps (fencelines, farm dams)
Rill erosion (≤0.3m deep)	No rill erosion present	Occasional rills	Common rills	Numerous rills forming corrugated ground surface
Gully erosion (>0.3m deep)	No gully erosion present	Gullies are isolated, linear, discontinuous and restricted to primary or minor drainage lines	Gullies are linear, continuous and restricted to primary and minor drainage lines	Gullies are continuous or discontinuous and either tend to branch away from primary drainage lines and on to footslopes, or have multiple branches within primary drainage lines

**Erosion classification definitions* (CSIRO, 2024)

8.1.3 Subsidence cracking

Subsided areas will be assessed for subsidence cracking via LiDAR and/or on-ground inspections. Subsidence cracking will be monitored as scheduled in Table 59 and Table 64, but may be assessed more frequently based on risk. Subsidence cracking will be managed according to erosion risk and likelihood of self-healing (Section 6.4.4.2).

8.1.4 Drainage and ponded areas

Subsided areas may have drains constructed to reduce subsidence induced ponding and to control the entry of surface flows into the Isaac River and its tributaries (Section 6.4.4). Drains will be monitored as scheduled in Section 8.2.1, but may be assessed more frequently based on risk. Monitoring of the drains will be undertaken to ensure they remain stable and function as intended and to identify maintenance requirements. Areas subject to temporal ponding will be monitored for the standard PMLU rehabilitation parameters as detailed in Section 8.2.

8.2 Cattle grazing, grassland and woodland habitat monitoring

8.2.1 Monitoring schedule

The rehabilitation monitoring program follows a phased approach as detailed in Table 59. Initial monitoring is undertaken on an annual basis for the first three years to primarily assess vegetation establishment. This approach allows a timely assessment of the performance of rehabilitation post initial seeding and provides critical information to determine if rehabilitation is on track towards achieving surface requirements, or if maintenance is required.

Additional rehabilitation parameters are included into the monitoring program in years three, five, 10 and five-yearly thereafter, to assess and track achievement of surface requirements (RM10, RM11, RM19) and achievement of PMLU to a stable condition (RM13, RM14, RM18, RM20). The phased approach of the monitoring program enables regular analysis of rehabilitation monitoring data, including multi-year comparison of trends.

Monitoring of cattle grazing and woodland habitat reference sites will be undertaken for the parameters listed in Table 59 and will be implemented as per the monitoring schedule from Year 3.

Table 59: Cattle grazing, grassland and woodland habitat PMLUs monitoring schedule and measured rehabilitation parameters

Rehabilitation parameter	Monitoring schedule				
	Year 1	Year 2	Year 3	Year 5	Year 10+ (5-yearly thereafter)
Cattle grazing/grassland/woodland habitat PMLUs					
Landform and erosion	✓	✓	✓	✓	✓
Soil and spoil	✓	-	✓	✓	✓
Subsidence cracking (RA20, RA21)	✓	✓	✓	✓	✓
Cattle grazing PMLU					
Groundcover	✓	✓	✓	✓	✓
Species richness (3P grasses)	✓	✓	✓	✓	✓
Invasive plants	✓	✓	✓	✓	✓
Grazing land suitability assessment	✓	-	✓	✓	✓
Land condition	-	-	✓	✓	✓

Rehabilitation parameter	Monitoring schedule				
	Year 1	Year 2	Year 3	Year 5	Year 10+ (5-yearly thereafter)
Pasture condition	-	-	✓	✓	✓
Grassland PMLU					
Species richness (grasses)	✓	✓	✓	✓	✓
Invasive plants	✓	✓	✓	✓	✓
Groundcover	✓	✓	✓	✓	✓
Woodland habitat PMLU					
Groundcover (including native perennial grass cover, little cover, non-native plant cover)	✓	✓	✓	✓	✓
Species richness (trees, shrubs, grass, forbs/other)	✓	✓	✓	✓	✓
Tree height	-	-	✓	✓	✓
Tree canopy and shrub layer cover	-	-	✓	✓	✓
Recruitment	-	-	✓	✓	✓
Invasive species	✓	✓	✓	✓	✓
Tree stem count/basal area	-	-	✓	✓	✓

8.2.2 Rehabilitation monitoring sites

Permanent rehabilitation monitoring sites will be established as part of the initial rehabilitation monitoring (Year 1) and will be assessed during all phases of rehabilitation monitoring. The permanent field monitoring sites should be selected using the following criteria:

- Representative of rehabilitation slope or subsidence impacts
- Accessible (vehicle access preferred)

Selection of suitable reference sites for cattle grazing and woodland habitat PMLUs are discussed in Section 8.4.

8.2.3 General rehabilitation monitoring parameters

8.2.3.1 Landform and erosion

Landform and erosion will be assessed as part of all monitoring phases. Prior to commencing the field monitoring work, a desktop assessment using LiDAR data and aerial imagery will be completed to assess the rehabilitated slope against the landform design (Year 1), and the ongoing monitoring of the landform and slopes.

The desktop analysis will identify potential areas of ponding due to spoil dump settlement or subsidence, areas of deposition (where the ground level has increased over time), as well as the progression of erosion features such as developing gullies.

Field-based erosion monitoring will be conducted at the permanent monitoring sites, as well as any new areas identified in the desktop assessment. If erosion is present, an erosion monitoring transect will be established by running a 50m tape perpendicular to the slope and across the erosional activity identified by the LiDAR analysis.

8.2.3.2 Soil and spoil

The parameters detailed in Table 60 will be analysed during all monitoring events for soils and spoils. Soil profile pits or cores will be located within close proximity to the permanent rehabilitation monitoring sites. Surface sampling depth refers to top 0 – 10cm; and sub-surface sampling depth refers to layers at 10 – 30cm, 30 – 60cm and 90 – 100cm (sampling down to refusal).

Table 60: Soil and spoil analysis parameters for rehabilitation monitoring

Category	Analyte	Purpose of analyte	Depth	
			Surface	Sub-surface
Acidity / alkalinity	pH	Identify anomalies that may affect plant growth and sustainability.	✓	✓
Salinity	EC	Identify leaching profile. High salinity can lead to poor vegetation germination and establishment, reduced plant growth and vigour.	✓	✓
Exchangeable cations	CEC	Major factor in soil fertility. Controls soil stability, nutrient availability and buffers soil's chemical properties.	✓	✓
	Exchangeable Sodium Percentage (ESP)	ESP is a measure of the dominance of sodium ions on the soil's cation exchange complex. Sodicity in soils can lead to slaking and dispersion which impact soil structure and stability.	✓	✓
Organic matter	Organic carbon	An indicator of soil nutrient stores and a contributor to improvements in soil structure. Increases in organic carbon is a key indicator of rehabilitation success.	✓	-
Major elements	Total Nitrogen	Indicator of soil nutrient store and is also a major plant nutrient.	✓	-
	Extractable Phosphorous (Colwell method)	Indicator of phosphorous readily available to plants.	✓	-
	Total Phosphorous	Indicator of total store of phosphorous, some of which is readily available. Key indicator of potential for long-term success or failure of rehabilitation.	✓	-

8.2.4 Cattle grazing specific rehabilitation parameters

8.2.4.1 Groundcover

Groundcover will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring events. Groundcover type is recorded as either live cover (with native and non-native species recorded), standing dry cover, organic litter (fine and coarse organic material, such as fallen leaves, twigs, branches and hay), rocks, or bare ground. The percentage of total groundcover (anything in contact with the soil surface) is calculated. The percentage of cover will be assessed within five 1m x 1m quadrats and averaged to give a value for the monitoring point.

8.2.4.2 Species richness

The number of 3P grasses will be recorded as part of all monitoring phases.

8.2.4.3 Invasive plants

An invasive plant is a prohibited or restricted matter under the Queensland *Biosecurity Act 2014*, and is defined as a species that has, or is likely to have an adverse impact on a biosecurity consideration because of the introduction, spread or increase in population size of the species in an area. Prohibited invasive plants are currently not present or known to be present in Queensland and have therefore been excluded from any proposed criteria. A complete list of invasive plant species is listed in Schedule 2, Part 2 (Restricted matter – invasive biosecurity matter) of the *Biosecurity Act 2014*.

'Restricted' invasive plants will be assessed at the permanent rehabilitation monitoring sites and reference sites as part of all monitoring phases. The presence and percent cover of invasive plants, calculated as a percentage of the total vegetation cover, will be recorded at each site.

No seeding of leucaena is proposed at GRM and BRM. Leucaena is an acceptable species within a cattle grazing PMLU, when leucaena stem density is managed as per the transitional EA milestone criteria.

8.2.4.4 Grazing land suitability assessment

Land suitability class (Section 3.1.1.1) is assessed at Year 1 to determine the effectiveness of ameliorants or if further treatments are required. Ongoing land suitability assessments will be undertaken at the permanent rehabilitation monitoring sites as part of all monitoring events from Year 3. The land suitability class will be rated 1 to 5 as per the limitations in *Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin: Technical Paper 1* (Short, 2025) (Table 22).

8.2.4.5 Land condition

Grazing Land Management ABCD land condition, as described in the *Queensland Reef Protection Regulations Farming in Reef Catchments Grazing Guide* (DES, 2022a), will be assessed at the permanent cattle grazing rehabilitation monitoring sites from Year 3. This allows at least two seasons after seeding for pasture species to establish.

Land condition means "*the capacity of grazing land to respond to rain and produce useful forage*" (DES, 2022a). Indicators of land condition include "*the proportion of organic ground cover, density of desirable perennial pasture species (i.e. grasses that are perennial, productive and palatable (3P) for cattle), extent of erosion and presence of weeds*" (DES, 2022a). Land condition is classified into four broad categories under the framework based on indicators associated with pasture and soil condition (Table 61).

Table 61: Grazing Land Management ABCD Land Condition Framework (DES, 2022a)

Land Condition	Land Condition Features
Good – A	A condition land has all of the following features: • most land types in good condition will typically have at least 50% and often above 70% ground cover at the end of the dry season • good density of perennial grasses dominated by those species considered to be 3P grasses for that land type, little bare ground (less than 30 % in most years) • few weeds and no significant infestations • good soil condition: no erosion, good surface condition
Fair – B	B condition land has at least one or more of the following features, but otherwise is similar to A condition land: • land types will typically have at least 50% ground cover and less than 70% in most years at the end of the dry season • some decline of grasses that are 3P grasses, increase in other species (less favoured grasses, weeds) and/or bare ground (more than 30% but less than 50% in most years) • some decline in soil condition, some signs of previous erosion and current susceptibility to erosion
Poor – C	C condition land has one or more of the following features, but otherwise is similar to B condition land: • land with poor or degraded condition will typically have less than 50% ground cover at the end of the dry season • general decline of grasses that are 3P grasses, large amounts of less favoured species and/or bare ground (greater than 50% in most years) • obvious signs of past erosion and/or current susceptibility to erosion is high
Degraded – D	D condition land has one or more of the following features: • generally less than 20% ground cover • general lack of any perennial grasses or forbs • severe erosion or scalding, resulting in hostile environment for plant growth • often no long-term ability to carry stock

8.2.4.6 Pasture condition

Pasture condition will be assessed at the permanent rehabilitation monitoring sites from Year 3. The density and coverage of 3P grasses is a key indicator of pasture condition (DES, 2022a). Pasture condition monitoring will be undertaken in accordance with the Stocktake GLM method (Department of Agriculture and Fisheries, 2021). The assessment includes an estimate of the percentage dry matter (DM) yield in kg/ha comprised of preferred pasture species versus the percentage DM yield in kg/ha of annual and undesirable grasses. Based on the monitoring data, pasture condition will be rated as per the condition indicators in Table 62.

Table 62: Pasture condition assessment table

Condition rating	Condition indicators			
	Preferred pasture species		Annual grass % DM yield	Undesirable grasses and other weeds % DM yield
	DM yield (%)	Crown cover		
Excellent (A=1)	>80	Dense and plants healthy	<0	<20
Good (B=2)	60 - 80	High to moderate density and some plants unhealthy	20 - 39	20 - 29
Poor (C=3)	10 - 59	Moderate to low density and some plants dead	40 - 70	30 - 80
Very poor (D=4)	<10	Sparse and many plants dead	>70	>80

8.2.5 Grassland specific rehabilitation parameters

8.2.5.1 Groundcover

Groundcover will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring events. Groundcover type is recorded as either live cover (with native and non-native species recorded), standing dry cover, organic litter (fine and coarse organic material, such as fallen leaves, twigs, branches and hay), rocks, or bare ground. The percentage of total groundcover (anything in contact with the soil surface) is calculated. The percentage of cover will be assessed within five 1m x 1m quadrats and averaged to give a value for the monitoring point.

8.2.5.2 Species richness

The number of grasses (exotic and native) for each survey plot will be recorded as part of all monitoring phases.

8.2.5.3 Invasive plants

'Restricted' invasive plants will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring phases. The presence and percent cover of invasive plants, calculated as a percentage of the total vegetation cover, will be recorded at each site.

8.2.6 Woodland habitat specific rehabilitation parameters

The monitoring method for woodland habitat rehabilitation will be a modified *BioCondition – A condition assessment framework for terrestrial biodiversity in Queensland assessment manual – version 2.2* (BioCondition Assessment Manual) (Eyre, et al., 2015). The applicable site-based attributes will be assessed and recorded. The modified BioCondition Assessment Manual method will involve reducing the length of the transact when assessing some parameters (e.g. tree canopy and shrub layer cover).

The BioCondition Assessment Manual scoring tables will be used to determine the site-based attribute scores, whereby the 'benchmarks' in the scoring refers to the combined representative REs averaged benchmarks detailed in Table 63. The representative REs are as per Section 1.2.8 and the REs used to derive the species in the seed mix for RA1 (Table 35). The applicable site-based attributes have a maximum possible site score of 60.

Table 63: BioCondition benchmarks and scoring of site-based attributes for representative regional ecosystems

Site-based attributes	Maximum score for attributes	Benchmarks* for representative REs			Averaged benchmarks
		RE 11.5.3	RE 11.5.9	RE 11.7.2	Combined REs
Recruitment of dominate canopy species (%)	5	100	100	100	100
Native plant species richness - trees (#)	5	6	3	3	4
Native plant species richness - shrubs (#)	5	6	6	4	5
Native plant species richness - grasses (#)	5	6	9	5	7
Native plant species richness – forbs/other (#)	5	10	11	5	9
Tree canopy height (m)	5	16	17	15	16
Tree canopy cover (%)	5	20	25	40	20**
Shrub layer cover (%)	5	3	10	4	6
Native perennial grass cover (%)	5	19	26	15	20
Litter cover (%)	5	20	30	20	23
Non-native plant cover (%)	10	0	0	0	0
Maximum Site Score	**60**				

** Benchmarks for each applicable site-based attribute for each RE* (State of Queensland, 2024)

*** Tree canopy cover reduced to 20% as agreed with the administering authority.*

RA10 and RA21 woodland habitat rehabilitation will be monitored for the site-based attributes listed in Table 63, however rehabilitation performance will be measured by species richness and tree canopy cover attributes.

8.2.6.1 Groundcover

Groundcover will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring events. Groundcover type is recorded as either live cover (with native and non-native species recorded), standing dry cover, organic litter (fine and coarse organic material, such as fallen leaves, twigs, branches and hay), rocks, or bare ground. The percentage of total groundcover (anything in contact with the soil surface) is calculated. The percentage of cover will be assessed within five 1m x 1m quadrats and averaged to give a value for the monitoring point.

8.2.6.2 Species richness

All woody species are recorded for each survey plot. Species richness will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring phases. Species richness includes a full floristic

assessment and count of trees, shrubs, grasses (native and exotic), forbs and other ground species at each site.

8.2.6.3 Tree height

Tree height and height range will be assessed at the permanent rehabilitation monitoring sites from Year 3. Tree height (measured to the top of the highest leaves) refers to the median canopy height for trees in the canopy layer (Eyre, et al., 2015).

8.2.6.4 Tree canopy and shrub layer cover

Tree canopy cover and shrub layer cover will be assessed at the permanent rehabilitation monitoring sites from Year 3 using the line intercept method. The crown of each tree (single-stemmed woody plant greater than 2m tall) and the crown of each shrub (woody plant that is multi-stemmed from the base (or within 200mm from ground level) or if single stemmed, less than 2m tall) (Eyre, et al., 2015) is recorded and summed as a total tree canopy or shrub distance and converted to a percent cover at each monitoring site.

8.2.6.5 Recruitment

Recruitment will be assessed at the permanent rehabilitation monitoring sites from Year 3. Recruitment of canopy species is assessed by observing the proportion of the dominant canopy species regenerating (<5cm diameter at breast height) at each monitoring site.

8.2.6.6 Invasive plants

'Restricted' invasive plants will be assessed at the permanent rehabilitation monitoring sites as part of all monitoring phases. The presence and percent cover of invasive plants, calculated as a percentage of the total vegetation cover, will be recorded at each site.

8.2.6.7 Tree stem count/basal area

Tree stem count provides another measure of species' abundance which helps describe the vegetation community. The tree stem count records the number of individual trees in a 50m x 10m plot by species. A tree that branches into two or more stems 30cm above the ground is counted as one individual (Neldner, 2022).

Basal area is recorded by species using a single sweep of a Bitterlich stick or similar with basal area factor of 1 (BAF1) from the centre of the plot (Neldner, 2022).

8.3 Watercourse monitoring

Watercourse monitoring will be conducted at GRM and BRM to assess the performance of the diversions and rehabilitated watercourses disturbed by mining activities. The purpose of the monitoring is to assess the performance of the rehabilitated watercourses in achieving watercourse surface requirements (RM12) and achievement of PMLU to a stable condition (RM15).

Watercourse monitoring will be undertaken in accordance with the IDC methodology which is outlined in the *Monitoring and Evaluation Program for Bowen Basin River Diversions* (ID&A, 2001). The IDC is a quantitative monitoring method used to measure the geomorphic and riparian condition of diversions; however, it can be utilised for both diverted and rehabilitated reaches of watercourses. For rehabilitated watercourse reaches which are not diversions (such as where culverts are removed), a modified IDC method, with a reduced number of monitoring points within each reach, is required due to the reduced impact area.

The GRM and BRM monitoring schedule for watercourses is detailed in Table 64. The monitoring schedule indicates parameters will be measured at Year 1, Year 2, Year 5 and then 5-yearly thereafter. However, the Isaac River will be monitored as per the frequency in the EA conditions, if more frequent than Table 64.

The IDC methodology and monitoring consists of:

- Visual inspection of the diversion/rehabilitated watercourse, upstream and downstream reaches (i.e. reference sites)
- Assessment of geomorphic index and riparian vegetation index at nominated monitoring points within the diversion/rehabilitated watercourse, upstream and downstream reaches
- Determination of reach-averaged geomorphic index and riparian vegetation index and overall IDC scores for the diversion/rehabilitated watercourse, upstream and downstream reaches
- Comparison of the geomorphic index and riparian vegetation index and overall IDC scores for the diversion/rehabilitated watercourse reach to the relative upstream and downstream reaches.

In addition to the IDC index parameters, several other parameters will also be monitored as listed in Table 64.

Table 64: Watercourse PMLU monitoring schedule and measured rehabilitation parameters

Monitoring parameters		Monitoring schedule			
Parameter	**Monitoring detail**	**Year 1**	**Year 2**	**Year 5**	**Year 10+ (5-yearly thereafter)**
Geomorphic index parameters					
Stream width	Width of high flow channel (m) Width of active channel (m) Width of low flow channel (m)	✓	✓	✓	✓
Bank condition	Presence of erosion	✓	✓	✓	✓
Piping of banks	Presence of piping on the banks	✓	✓	✓	✓
Bed condition	Presence of aggradation or degradation within the channel bed	✓	✓	✓	✓
Spoil piles	Proximity of spoil dumps in relation to the monitoring point	✓	✓	✓	✓
Recovery	Presence or absence of benches with/without vegetation	✓	✓	✓	✓
Instream structures	Stability of each identified instream structure	✓	✓	✓	✓
Riparian vegetation index parameters					
Riparian zone	Width of riparian zone (m)	✓	✓	✓	✓
Structural intactness	Over-storey, understorey and ground cover (% density)	✓	✓	✓	✓
Regeneration	Presence or absence of regeneration on banks	-	-	✓	✓
Longitudinal continuity	Assess the gaps in the riparian vegetation corridor along the banks	✓	✓	✓	✓

Monitoring parameters		Monitoring schedule			
Parameter	**Monitoring detail**	**Year 1**	**Year 2**	**Year 5**	**Year 10+ (5-yearly thereafter)**
Additional parameters					
Erosion	Assessment of sheet, rill, gully, tunnel and mass movement	✓	✓	✓	✓
Groundcover	Groundcover (%)	✓	✓	✓	✓
Species richness - trees and shrubs	Native plant species richness for life-forms trees and shrubs	✓	✓	✓	✓
Tree canopy cover	Native tree canopy cover (%)	-	-	✓	✓
Tree canopy height	Tree median canopy height (m) for ecologically dominant layer or canopy layer	-	-	✓	✓
Recruitment of woody perennial species	Recruitment of woody perennial species in ecological dominant layer	-	-	✓	✓
Subsidence cracking	Assessment of subsidence cracks (RA11)	✓	✓	✓	✓

8.4 Reference Sites

Cattle grazing and woodland habitat reference sites have been established at the locations shown in Figure 23.

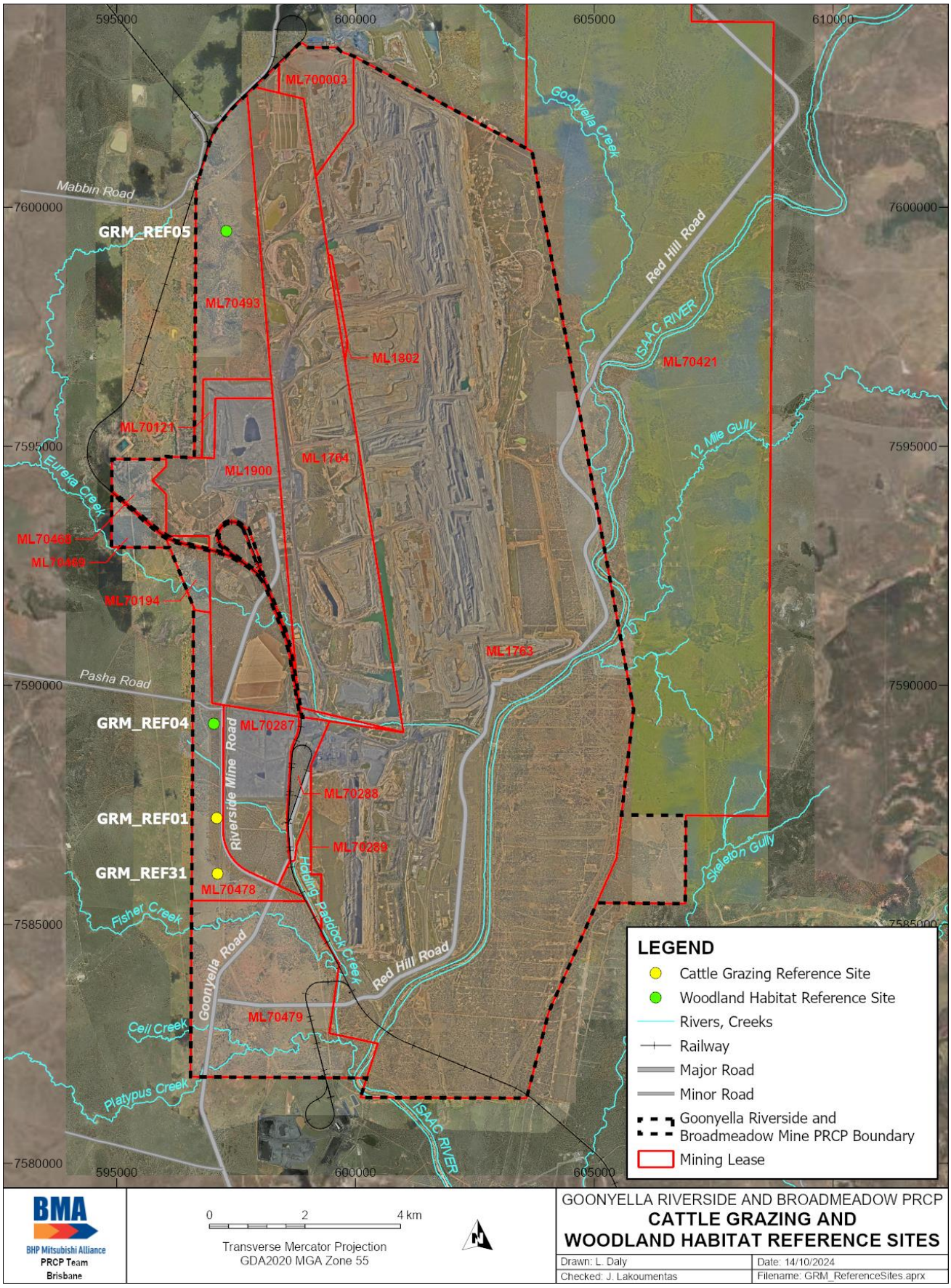

Figure 23: GRM and BRM cattle grazing and woodland habitat reference sites

8.4.1 Cattle grazing reference sites

The cattle grazing reference sites were monitored in 2023, and will continue to be monitored, in accordance with the cattle grazing monitoring requirements outlined in Sections 8.1 and 8.2. Existing cattle grazing reference site results have been summarised in Table 65. Land suitability classes for the cattle grazing reference sites were assessed against the land suitability framework (Short, 2025). Additional or alternative cattle grazing reference sites may be established in the future.

Table 65: GRM and BRM cattle grazing reference sites

Reference Sites – Cattle Grazing (monitored in 2023)		
Site ID	**GRM_REF01**	**GRM_REF31**
Images		
Coordinates (MGA2020 Zone 55)	597090 E, 7587217 N	597102 E, 7586067 N
Mean Slope (%)	<2	<2
Total groundcover (%)	100	92
Tree species	*Eucalyptus populnea* (poplar box)	*Atalaya hemiglauca* (whitewood), *Psydrax oleifolia* (Psydrax), *Lysiphyllum carronii* (red bauhinia)
Shrub species	*Archidendropsis basaltica* (dead finish), *Capparis mitchellii* (native orange), *Atalaya hemiglauca* (whitewood), *Cassia brewsteri* (Leichhardt bean)	*Lysiphyllum carronii* (red bauhinia), *Owenia acidula* (emu apple)
Grasses native	*Heteropogon contortus* (black spear grass), *Aristida calycina* (dark wiregrass), *Themeda triandra* (kangaroo grass), *Bothriochloa bladhii* (forest bluegrass)	*Aristida calycina* (dark wiregrass)
Grasses exotic	*Cenchrus ciliaris* (buffel grass*), *Urochloa mosambicensis* (sabi grass*), *Bothriochloa pertusa* (Indian couch*)	*Cenchrus ciliaris* (buffel grass*), *Bothriochloa pertusa* (Indian couch*), *Megathyrsus maximus var. pubiglumis* (green panic*)
Invasive plants	None observed	*Harrisia martinii (Harrisia cactus*)*

Reference Sites – Cattle Grazing (monitored in 2023)		
Site ID	**GRM_REF01**	**GRM_REF31**
Preferred pasture species	*Heteropogon contortus* (black spear grass), *Themeda triandra* (kangaroo grass), *Bothriochloa bladhii* (forest bluegrass), *Cenchrus ciliaris* (buffel grass*), *Urochloa mosambicensis* (sabi grass*), *Bothriochloa pertusa* (Indian couch*)	*Cenchrus ciliaris* (buffel grass*), *Bothriochloa pertusa* (Indian couch*)
Dry matter yield (kg/ha)	2,000 – 2,500	1,500 – 2,000
Land Condition	Good (A)	Poor (C)
Land Suitability Class	5	4
Limiting factors	Water availability and nutrient deficiency – available phosphorus	Nutrient deficiency – available phosphorus and nutrient availability and toxicity - pH

**Exotic species*

8.4.2 Woodland habitat reference sites

Woodland habitat reference sites have been established in areas of remnant vegetation undisturbed by mining as shown in Figure 23. The reference sites were monitored in 2023 or 2024, and will continue to be monitored, in accordance with the woodland habitat monitoring requirements outlined in Sections 8.1 and 8.2. A summary of existing woodland habitat reference site results has been provided in Table 66. Additional or alternative woodland habitat reference sites may be established in the future.

Table 66: GRM and BRM woodland habitat reference sites

Reference Sites – Woodland Habitat (monitored in 2023/2024)		
Site ID	**GRM_REF04**	**GRM_REF05**
Images		
Coordinates (MGA2020 Zone 55)	597038 E, 7589194 N	597297 E, 7599496 N
Mean slope (%)	<2	15

Reference Sites – Woodland Habitat (monitored in 2023/2024)		
Site ID	**GRM_REF04**	**GRM_REF05**
RE	11.5.3	11.7.2
Total groundcover (%)	65	78
Tree canopy cover (%)	33	57
Tree species	*Eucalyptus populnea* (poplar box), *Acacia excelsa* (ironwood), *Alphitonia excelsa* (soap ash)	*Acacia catenulata* (bendee), *Eucalyptus shirleyi* (silver leaved ironbark), *Eucalyptus thozetiana* (Thozets box), *Eucalyptus exserta* (Queensland peppermint)
Evidence of recruitment	Yes	Yes
Shrub species	*Archidendropsis basaltica* (dead finish), *Erythroxylon australe* (dogwood), *Atalaya hemiglauca* (whitewood), *Carissa ovata* (currant bush), *Cassia brewsteri* (Leichhardt bean), *Capparis lasiantha, Denhamia disperma* (orange bush), *Denhamia cunninghamii.*	*Erythroxylon australe* (dogwood), *Croton insularis* (croton), *Acacia catenulata* (bendee), *Everistia vacciniifolia* (small-leaved canthium), *Grewia latifolia, Capparis arborea* (brush caper berry), *Capparis lasiantha* (native orange)
Grasses native	*Aristida calycina* (dark wiregrass), *Themeda triandra* (kangaroo grass), *Enneapogon pallidus* (nine awn pale bottle washer), *Bothriochloa bladhii* (forest bluegrass)	*Aristida caput-medusae* (many headed wiregrass), *Enteropogon sp. (*windmill grasses), *Heteropogon contortus* (black spear grass), *Paspalidium rarum* (rare paspalidium)
Grasses exotic	*Cenchrus ciliaris* (buffel grass*)	*Megathyrsus maximus var. pubiglumis* (green panic*)
Invasive plants	*Harrisia martinii* (Harrisia cactus*)	*Harrisia martinii* (Harrisia cactus*)

**Exotic species*

8.4.3 Watercourse reference sites

Watercourse reference sites and diversion/subsidence monitoring points have been established in the Isaac River, Eureka Creek, Holding Paddock Creek, Fisher Creek and Platypus, as detailed in Table 67 and shown in Figure 24. Reference sites will be monitored in accordance with the watercourse monitoring requirements outlined in Section 8.3.

Where revegetation is required in a natural watercourse (such as where culverts have been removed), a proportional number of reference sites utilising a modified IDC method (ID&A, 2001) will be established due to the reduced impact area. These new watercourse reference sites will be established in relatively unmodified upstream sections of each watercourse.

Table 67: GRM and BRM watercourse reference site locations

Stream	Reference Type	Location ID	Location (MGA2020 Zone 55)	
			Easting	Northing
Isaac River	Upstream reach (current)	IR-U1	605421	7591089
Isaac River	Upstream reach (current)	IR-U2	605287	7590912
Isaac River	Upstream reach (current)	IR-U3	605084	7590790
Isaac River	Upstream reach (current)	IR-U4	604830	7590663
Isaac River	Upstream reach (future)	IR-U5	605541	7596687
Isaac River	Upstream reach (future)	IR-U6	605179	7596603
Isaac River	Upstream reach (future)	IR-U7	605141	7596328
Isaac River	Upstream reach (future)	IR-U8	605558	7595935
Isaac River	Diversion - subsidence reach	IR-LW102-3	604547	7590533
Isaac River	Diversion - subsidence reach	IR-LW103-4	604373	7590304
Isaac River	Diversion - subsidence reach	IR-LW104-5	603894	7589955
Isaac River	Diversion - subsidence reach	IR-LW105-6	603203	7589564
Isaac River	Diversion - subsidence reach	IR-LW106-7	602955	7589126
Isaac River	Diversion - subsidence reach	IR-LW107-8	602856	7588773
Isaac River	Diversion - subsidence reach	IR-LW108-9	602772	7588381
Isaac River	Diversion - subsidence reach	IR-LW109-10	602746	7588016
Isaac River	Diversion - subsidence reach	IR-LW110-11	602737	7587659
Isaac River	Diversion - subsidence reach	IR-LW111-12	602736	7587279
Isaac River	Diversion - subsidence reach	IR-LW112-13	602724	7586897
Isaac River	Diversion - subsidence reach	IR-LW113-14	602722	7586519
Isaac River	Diversion - subsidence reach	IR-LW114-15	602713	7586149
Isaac River	Diversion - subsidence reach	IR-LW115-16	602713	7585784
Isaac River	Diversion - subsidence reach	IR-LW116-17	602703	7585456
Isaac River	Diversion - subsidence reach	IR-LW117-18	602689	7585046
Isaac River	Diversion - subsidence reach	IR-LW118-19	602599	7584670

Stream	Reference Type	Location ID	Location (MGA2020 Zone 55)	
			Easting	Northing
Isaac River	Diversion - subsidence reach	IR-LW119	602301	7584317
Isaac River	Diversion reach	IR-Div1	601665	7584018
Isaac River	Diversion reach	IR-Div2	600836	7583389
Isaac River	Downstream reach	IR-MN471	600482	7582786
Isaac River	Downstream reach	IR-MN467	600271	7582324
Isaac River	Downstream reach	IR-MN463	599986	7581896
Isaac River	Downstream reach	IR-MN459	600231	7581459
Eureka Creek	Upstream reach	EC-U1	597546	7591690
Eureka Creek	Upstream reach	EC-U2	598032	7591256
Eureka Creek	Upstream reach	EC-U3	598493	7591520
Eureka Creek	Upstream reach	EC-U4	598758	7591284
Eureka Creek	Diversion reach	EC-Div1	598951	7590659
Eureka Creek	Diversion reach	EC-Div2	599129	7589483
Eureka Creek	Diversion reach	EC-Div3	600380	7589124
Eureka Creek	Diversion reach	EC-Div4	601780	7589148
Holding Paddock Creek	Upstream reach	HPC-U1	596462	7588852
Holding Paddock Creek	Upstream reach	HPC-U2	596621	7588628
Holding Paddock Creek	Upstream reach	HPC-U3	596914	7588438
Holding Paddock Creek	Upstream reach	HPC-U4	597117	7588278
Holding Paddock Creek	Diversion reach 1	HPC-Div1	597247	7587968
Holding Paddock Creek	Diversion reach 1	HPC-Div2	597262	7587550
Holding Paddock Creek	Diversion reach 1	HPC-Div3	597883	7587512
Holding Paddock Creek	Diversion reach 1	HPC-Div4	598412	7586930
Holding Paddock Creek	Diversion reach 2	HPC-D1	598733	7586123
Holding Paddock Creek	Diversion reach 2	HPC-D2	599136	7585296

Stream	Reference Type	Location ID	Location (MGA2020 Zone 55)	
			Easting	Northing
Holding Paddock Creek	Diversion reach 2	HPC-D3	599396	7584786
Holding Paddock Creek	Diversion reach 2	HPC-D4	599782	7584038
Fisher Creek	Upstream reach	FC-U1	599315	7584408
Fisher Creek	Upstream reach	FC-U2	599442	7584385
Fisher Creek	Upstream reach	FC-U3	599457	7584246
Fisher Creek	Upstream reach	FC-U4	599488	7584102
Fisher Creek	Diversion reach	FC-Div1	599649	7583873
Fisher Creek	Diversion reach	FC-Div2	599602	7583555
Fisher Creek	Diversion reach	FC-Div3	599558	7583177
Fisher Creek	Diversion reach	FC-Div4	599596	7582777
Platypus Creek	Upstream reach	PC-U1	599021	7582709
Platypus Creek	Upstream reach	PC-U2	599277	7582601
Platypus Creek	Upstream reach	PC-U3	599501	7582553
Platypus Creek	Upstream reach	PC-U4	599602	7582565
Fisher Creek - Platypus Creek	Diversion reach	FC-D1	599716	7582513
Fisher Creek - Platypus Creek	Diversion reach	FC-D2	599955	7582483
Fisher Creek - Platypus Creek	Diversion reach	FC-D3	599968	7582205
Fisher Creek - Platypus Creek	Diversion reach	FC-D4	599902	7581889

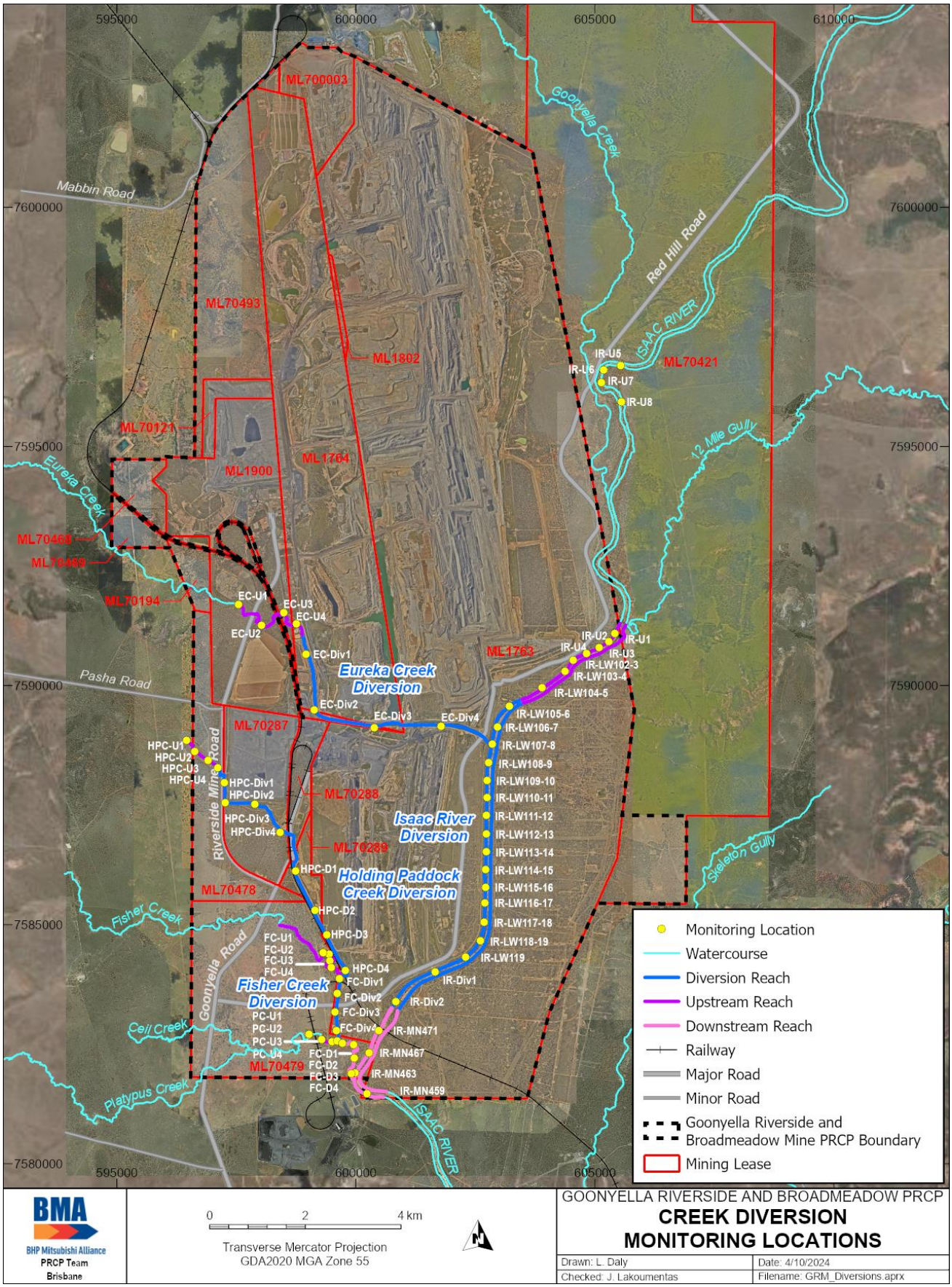

Figure 24: GRM and BRM creek diversion monitoring locations

8.5 Surface water monitoring

Surface water runoff monitoring will be undertaken for:

- Representative areas of rehabilitation as part of surface requirements (RM10, RM11, RM19) and to demonstrate achievement of PMLU to a stable condition (RM13, RM14, RM20) within areas of rehabilitation commenced post approval of this transitional PRCP
- Watercourse locations, included in Table 68 and shown in Figure 25, commencing prior to 2050.

Water quality monitoring will be undertaken in accordance with the *Monitoring and Sampling Manual: Environmental Protection (Water) Policy 2009* (DES, 2018).

The currently available surface water quality data has been collected for a variety of purposes, for which different sampling methodologies and data quality objectives were applied. Therefore, the currently available data is not suitable for the establishment of milestone criteria for closure. Also as per ANZG (2018), the default guideline values are for generic applications and may not be representative of local conditions and therefore are not suitable for use as water quality limits for a specific mine site. The execution of scopes for the collection of appropriate data sets to support the development of site-specific criteria have not formed part of the EA requirements and could not be completed within the transitional PRCP notice timeframes.

Water quality limits should be site-specific and developed through appropriate sampling analytical and quality plans that include data quality objective processes aligned with the intended use of the data. BMA have requested the transitional PRCPs be conditioned to allow the appropriate development of site-specific water quality limits. As the watercourses at GRM and BRM are highly ephemeral and do not support baseflows, the establishment of the site-specific water quality limits will be based on the ANZECC guidance for temporary waters (Smith, 2020).

Due to the variability and availability of the stream flows in the target ephemeral watercourses, there is some uncertainty around the timing for completing the establishment of site-specific water quality limits. Site-specific closure water quality limits should be developed prior to commencement of closure focused downstream watercourse monitoring program.

8.5.1 Rehabilitation area surface water monitoring

Representative areas of rehabilitation will be selected by BMA to conduct surface water runoff monitoring. Representative is defined in the EA as "*a sample set that covers the variance in monitoring or other data due to either natural changes or operational phases of the mining activities*". A range of factors should be considered including: timing of rehabilitation; PMLU; slope; underlying material type; and surface treatment. The objective of the rehabilitation area surface water sampling is to demonstrate that rehabilitation areas are progressing towards or have achieved a stable condition. The selected rehabilitation areas will be designed and constructed to allow the capture of surface water flows for sampling from the rehabilitated area's surface, without significant influence from surrounding operational areas. Depending on the nature of the rehabilitation area, the method of surface water collection may vary from area to area.

Samples from the selected rehabilitation areas will be collected and analysed for parameters transitioned from Table E1 of the EA and include pH, EC and turbidity, when suitable runoff occurs and when safe to do so. Rehabilitation area surface water runoff will be collected from rehabilitation areas designed and constructed post approval of this transitional PRCP.

8.5.2 Receiving environment surface water monitoring

The collection and analysis of surface water samples from watercourses will commence prior to 2050. The objective of the watercourse samples is to facilitate relinquishment of the site through confirming the rehabilitated site is not causing environmental harm through surface water discharges and has generated a stable landform suitable to support the PMLUs.

Surface water quality will be monitored at least once per month when flows at the downstream gauging station record ≥5m^3/second for the Isaac River and ≥1m^3/second for all other monitored creeks (when safe to collect samples). Due to the ephemeral nature of the watercourses that cross GRM and BRM, there are no baseflows

to allow scheduled sample collection, and therefore sampling will be undertaken following rainfall events that generate suitable flows.

The water quality within the watercourses, within the five-year period immediately prior to surrender, will be assessed via the following process:

1. Downstream monitoring results will be compared to the site-specific surface water quality limits (once developed). Where downstream monitoring results are below the surface quality limits, no further actions will be required.
2. Where exceedances of the surface water quality limits are identified at the downstream sample locations, the downstream results will be compared to the upstream results for that monitoring round. Where downstream results are equal to or less than the upstream results, no further actions will be required.
3. Where downstream results are above both the specified water quality limits and the upstream results, an AQP will be engaged to assess the risk to achieving a stable condition.
    a. Where risks are determined to be low, no further action will be taken.
    b. Where a risk greater than low is identified by the AQP, an assessment of potential environmental harm and any changes or rectification actions to rehabilitation activities will be assessed and implemented.
    c. Where 3(b). is triggered more than three times over five consecutive years prior to surrender, the five-year monitoring period is reset. Where potential environmental harm is identified and/or rectification actions to rehabilitation activities are required, at least five years of further surface water monitoring will be undertaken.

    The results of assessments completed by the AQP will be provided to the administering authority within six months of receiving the sampling results.

The surface water monitoring locations may be amended as required to account for changes to upstream land uses/stream dynamics or to improve the effectiveness of the monitoring program to measure progressive rehabilitation areas.

Table 68: Surface water monitoring locations

Sample location ID	Approximate location (MGA2020 Zone 55)		Description
	Easting	Northing	
MP10	596867	7582010	Platypus Creek Upstream
MP12/ST1	605185	7596107	Isaac River Upstream
GRMPRCPSW03	600862	7581401	Isaac River Downstream
GRMPRCPSW02	599900	7581866	Holding Paddock/Fisher/Platypus Creeks Downstream
GRMPRCPSW01	597237	7588131	Holding Paddock Creek Upstream
MP7	604556	7601907	Goonyella Creek Upstream
GRMPRCPSW04	605222	7594064	Goonyella Creek Downstream
MP8	598056	7585193	Fisher Creek Upstream
MP2	595793	7592252	Eureka Creek Upstream
MP1	602622	7588948	Eureka Creek Downstream

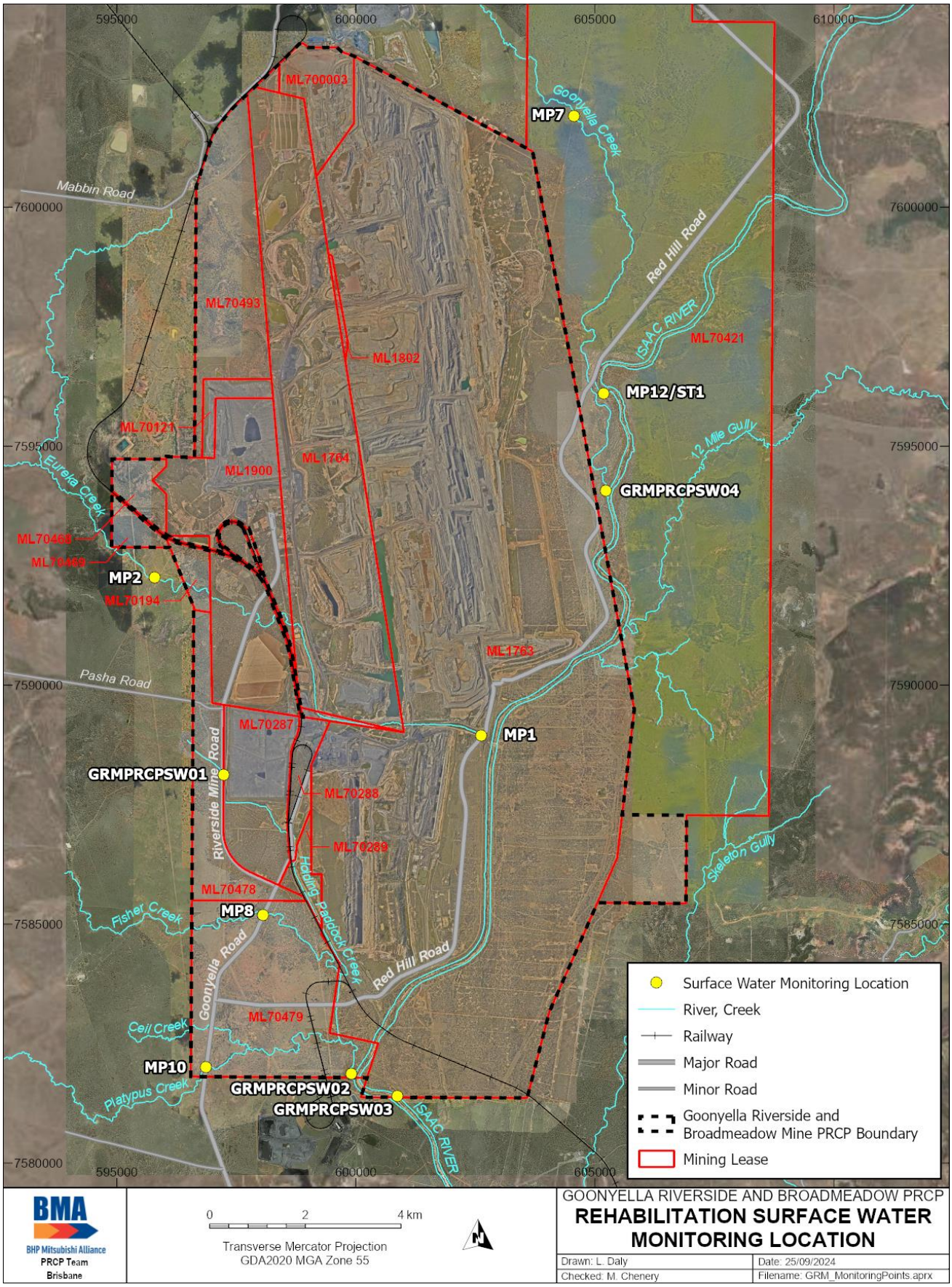

Figure 25: GRM and BRM surface water monitoring locations

8.6 Groundwater monitoring

In line with the *Guideline for Progressive certification for resource activities* (DES, 2022b), deep drainage water quality will be "*addressed holistically for a site at surrender*". The EA objective and acceptance criteria for groundwater is not considered relevant to progressive rehabilitation of discrete packages of rehabilitated land due to the scale and nature of groundwater aquifers.

8.6.1 Groundwater quality

The groundwater monitoring data currently held for the site has been collected for a variety of purposes, for which different sampling methodologies and data quality objectives were applied, and therefore, this data was not collected with the intent of using it to develop site site-specific criteria. Also, as per ANZG (2018), the default guideline values are for generic applications and may not be representative of local conditions, and therefore are not suitable for use as water quality limits. The execution of scopes for the installation of monitoring infrastructure and collection of appropriate data sets to support the development of site-specific criteria, could not be completed within the transitional PRCP notice timeframes.

Water quality limits should be site-specific and developed through appropriate sampling analytical and quality plans that include data quality objective processes aligned with the intended use of the data. BMA have requested this transitional PRCP is conditioned to allow for the appropriate development of site-specific water quality limits.

To allow sufficient time to install required monitoring infrastructure, and collect a reasonable data set of the required quality to support the development of the required site-specific criteria, the development of the criteria is expected to take in the order of 10 years. Water quality monitoring will be undertaken in accordance with the *Monitoring and Sampling Manual: Environmental Protection (Water) Policy 2009* (DES, 2018).

8.6.2 Groundwater levels

Monitoring of groundwater levels will focus on the relationship between the Permian groundwater level recovery and the residual void lake levels. Groundwater level/gradient trends over time will be assessed against the more dynamic pit lake levels with the data incorporated into the predictive numerical groundwater models. The numerical groundwater models will be used to confirm the residual voids are progressing to a stabilised state, where collectively they maintain the inward hydraulic Permian groundwater gradients within the tenure boundary. This will confirm the potential for adverse groundwater quality impacts are minimised to the surrounding aquifers and thus minimising the potential for an unacceptable risk of environmental harm off-tenure.

Due to the timeframes involved for the stabilisation of the void lakes and groundwater levels surrounding the mining voids, the intention of the groundwater level monitoring is to show progress towards development of long-term sinks and not to confirm the attainment of long-term sinks. Demonstrating the progress towards development of long-term sinks is to be done through assessment of trends and comparison to groundwater and void lake water balance model predictions by AQPs. The groundwater model and water balance model will be recalibrated and predictions rerun at least every five years commencing from 2050. These updates will incorporate up to date information and confirm the predictions for the residual voids.

8.6.3 Groundwater monitoring schedule

During operations, groundwater monitoring will continue as per the applicable EA conditions.

Following installation of rehabilitation groundwater monitoring bores by 2050, groundwater will be monitored six monthly and compared against the site-specific limits.

8.6.4 Groundwater monitoring locations

Groundwater monitoring to support the assessment of closure conditions will be undertaken on bores that provide a geographical distribution across GRM and BRM and coverage of the key hydrogeological units. The groundwater monitoring bore network to assess closure conditions will include selected bores existing at closure; and bores installed specifically to close data gaps, replace bores that may have been lost due to mining

disturbances or are otherwise not operational. The groundwater monitoring network to be utilised for assessment of rehabilitation are provided in Table 69 and shown in Figure 26.

The rehabilitation groundwater monitoring bore network may require maintenance or adjustment throughout the monitoring period. Where bores become inoperable or are not producing the required data due to damage to bores, changes in water levels, changes to the catchment or other site-specific circumstances, replacement bores or additional bores may be installed as required.

Table 69: Groundwater monitoring locations

Sample location ID	Approximate location (MGA2020 Zone 55)		Description	Hydro-stratigraphic unit
	Easting	Northing		
GRMMB04_01_HY	606953	7599206	East of tenement and the northern portion of the Goonyella residual void. Planned new bore	Alluvial/ Tertiary
GRMMB04_02_HY	606946	7599201	East of tenement and the northern portion of the Goonyella residual void. Planned new bore	-Alluvial/ Tertiary
GRMMB04_03_HY	606938	7599195	East of tenement and the northern portion of the Goonyella residual void	Fort Cooper Measures – Coal Seam
GRMMB05_02_HY_R01	606846	7585835	Eastern tenement boundary adjacent to the BRM underground workings	-
GRMPRCPGW01	604217	7598105	Eastern tenement boundary adjacent to the Goonyella residual void. New bore.	GLS
GRMPRCPGW02	605318	7591230	Eastern tenement boundary immediately to the south of Goonyella residual void. New bore.	GLS
GRMPRCPGW03	608507	7594779	East of the tenement and the central portion of the Goonyella residual void. New bore.	GLS
GRMPRCPGW04	603971	7582960	Eastern tenement boundary at the southern end of the tenement and to the east of BRM underground workings. New bore.	GLS
GRMPRCPGW05	601324	7584008	Southern end of Isaac residual void. New bore.	GMS
GRMPRCPGW06	601337	7584013	Southern end of Isaac residual void. New bore.	GLS
GRMPRCPGW07	601819	7584552	East of the Isaac residual void and south of the BRM workings on the western side of the Isaac River. New bore.	GMS

Sample location ID	Approximate location (MGA2020 Zone 55)		Description	Hydro-stratigraphic unit
	Easting	Northing		
GRMPRCPGW08	601782	7584552	East of the Isaac residual void and south of the BRM workings on the western side of the Isaac River. New bore.	GLS
GRMPRCPGW09	599917	7603131	Northern end of the tenement. New bore.	GMS
GRMPRCPGW10	599888	7603142	Northern end of the tenement. New bore.	GLS
MB20GRM01P	598166	7587224	South of RS1 TSF	-
MB20GRM05T	596800	7594815	West of GS1 TSF	Tertiary
MB20GRM06A	600019	7582050	Southern tenement boundary	Alluvial
MB20GRM07P	600011	7582058	Southern tenement boundary	-
MB20GRM08P	597833	7601252	Northwestern portion of the tenement and to the west of the Goonyella spoil dumps	-
MB20GRM10T	598120	7593518	Within the Goonyella mine industrial area and to the south of GS1	Tertiary
MB20GRM11T	596741	7588713	West of RS1 TSF	Tertiary
MB20GRM12A	598158	7587228	South of RS1 TSF	Alluvial
MB20GRM13T	598175	7587206	South of RS1 TSF	Tertiary
MB20GRM15T	599510	7584101	South of Airstrip pit/R32 TSF	Tertiary
MB20GRM16P	599509	7584097	South of Airstrip pit/R32 TSF	-
MB21GRBM04P	597027	7592094	Central western tenement boundary	-
MB21GRM83P	596753	7597005	North of GS1 TSF	-
MB21GRM85P	598117	7593510	South of GS1 TSF	-

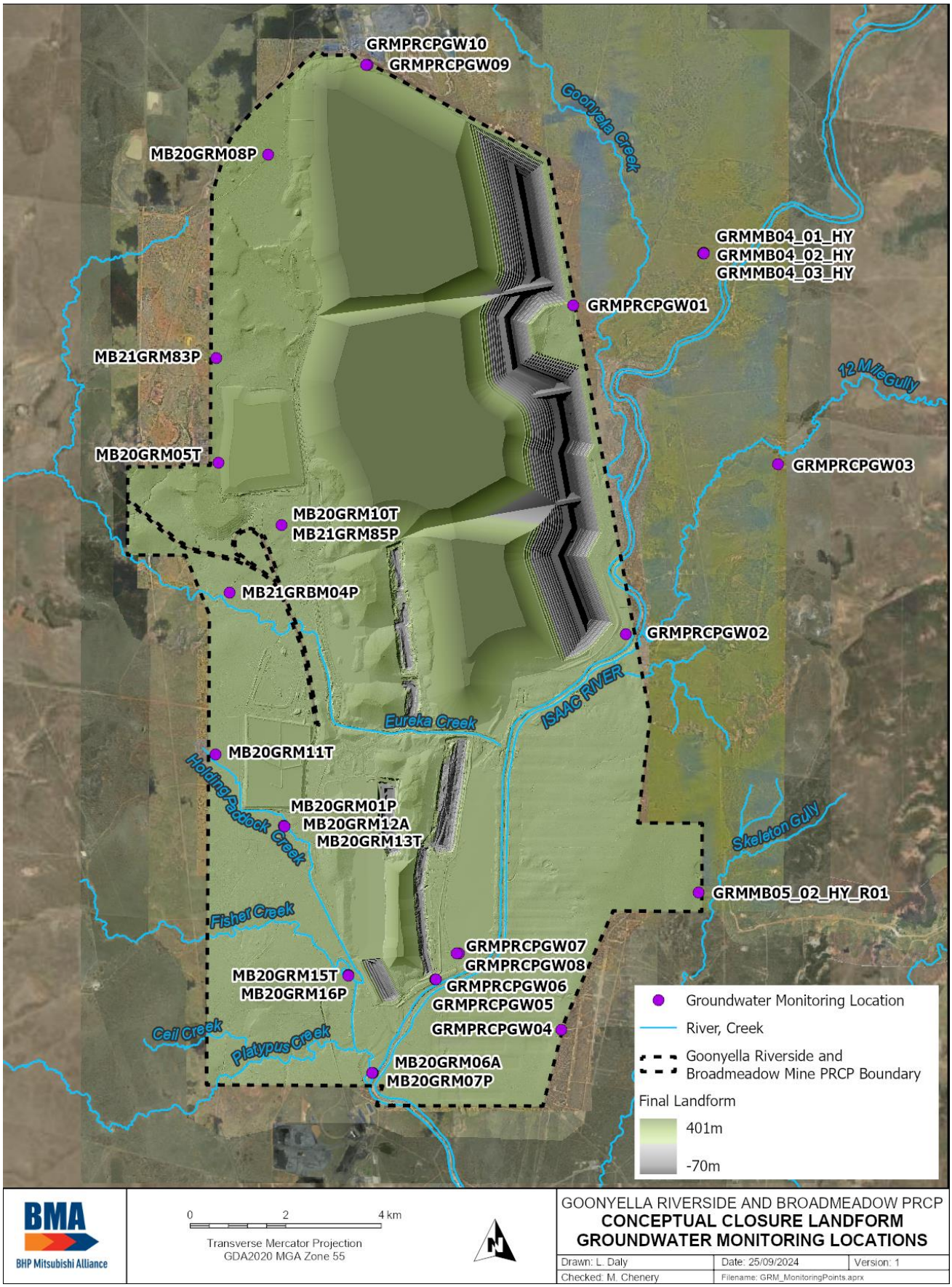

Figure 26: GRM and BRM rehabilitation groundwater monitoring bores

8.7 NUMA milestone monitoring

Management milestone monitoring will be undertaken at GRM and BRM by an AQP (as per condition A5 of the EA) to demonstrate achievement of the MMs, as they relate to achieving sufficient improvement of the NUMA extents. The MMs and associated milestone criteria for GRM and BRM are detailed in Section 10.5. A combination of monitoring, reporting and data analysis approaches will be used to demonstrate the achievement of the MMs prior to site relinquishment as detailed in Table 70.

Table 70: Management milestones with relevant reporting requirements

Milestone reference	Management milestone	Reporting requirements
MM1	Achievement of structural stability	• Final groundwater model and assessment • Final flood model and assessment • Final geotechnical assessment • Final void design • Survey/LiDAR of landform • Analysis of final landform against design • Document visual inspections of closed underground entries
MM2	Achievement of surface requirements	• Document visual inspections of safety bund, fencing and signage

MM3	Achievement of sufficient improvement	• Groundwater monitoring (Section 8.6)
		• Residual voids water quality and level monitoring (Section 6.3.5)
		• Certification that residual voids:
		  - Are safe to humans and livestock
		  - Are immune from flooding
		  - Highwall landforms are constructed to final design
		  - Safety infrastructure is installed as per design
		  - Will not present an unacceptable risk of environmental harm outside of the tenure boundary
		  - Will not impact on the stability of any adjacent rehabilitation areas, or their ability to sustain their PMLU
		• Document visual inspections of safety bund, fencing and signage

8.8 Achievement schedule

8.8.1 PMLUs

The timing of the rehabilitation milestones specific to achievement of surface requirements and achievement of cattle grazing, grassland, woodland habitat and watercourse PMLUs are listed in Table 71. These timeframes have regard to the risks presented in Section 7.

Achievement of surface requirements for cattle grazing (RM10) and grassland (RM19) is proposed within a 10-year timeframe from revegetation and a further five-years for achievement of PMLU to a stable condition for

cattle grazing (RM13) and grassland (RM20). There are a number of factors which can influence the successful establishment of grasses on post-mined land including landform, soil management and amelioration, species selection, seeding rates and seeding timing, plus rainfall. This will allow for sufficient time to demonstrate the ongoing sustainability of the PMLU for cattle grazing through rehabilitation monitoring data associated with pastures.

Achievement of surface requirements for woodland habitat (RM11) and watercourse (RM12) are proposed within a 10-year timeframe from revegetation. A further 10-years is allowed for initial establishment and successional processes and natural recruitment to occur, prior to achievement of the PMLUs to a stable condition (RM14, RM15 and RM18).

Table 71: Time for achievement of surface requirements and PMLUs rehabilitation milestones

RM	Rehabilitation milestone	Milestone achievement time after revegetation (in PRCP schedule)
RM10	Achievement of surface requirements (cattle grazing)	10-years
RM11	Achievement of surface requirements (woodland habitat)	10-years
RM12	Achievement of surface requirements (watercourse)	10-years
RM19	Achievement of surface requirements (grassland)	10-years
RM13	Achievement of post-mining land use to a stable condition (cattle grazing)	Up to 15-years
RM14	Achievement of post-mining land use to a stable condition (woodland habitat)	Up to 20-years
RM15	Achievement of post-mining land use to a stable condition (watercourse)	Up to 20-years
RM18	Achievement of post-mining land use to a stable condition (woodland habitat)	Up to 20-years
RM20	Achievement of post-mining land use to a stable condition (grassland)	Up to 15-years

8.8.2 NUMAs

The timing of the management milestones specific to achievement of sufficient improvement (MM3) is listed in Table 72.

Table 72: Timeline for achievement of sufficient improvement for NUMA management milestones

MM	Management milestone	Milestone achievement timeline (in PRCP schedule)
MM3	Achievement of sufficient improvement	Aligned with achievement of surrounding PMLUs (RM13, RM14, or RM15) to ensure maximum monitoring period to demonstrate minimising environmental harm

8.9 Data analysis and reporting

Rehabilitation monitoring data will be collected and analysed by an AQP and assessed against the milestone criteria. The data will be analysed to identify changes and trends, as well as map the trajectory of rehabilitation to identify whether it is on track to achieve the milestone criteria or requires corrective actions or maintenance.

The rehabilitation data will be stored and processed within internal geospatial and document management systems.

8.10 Maintenance

Maintenance will be implemented when monitoring identifies issues with the rehabilitation, or when milestone criteria are not being met. In order to select the most appropriate corrective actions, rehabilitation monitoring data will be analysed to identify the likely cause(s). Required maintenance/corrective actions will be included in rehabilitation budgets for completion. Records of maintenance activities will be retained by BMA.

To support ongoing operations, exploration and minor ancillary activities may be required in areas not within a RA in some circumstances (Section 1.4.2). Rehabilitation of these activities will be managed as part of maintenance works and executed as soon as practicable and within at least six months of the completion of the exploration or minor disturbance. Maintenance works may include removing infrastructure, reshaping the area, re-spreading stripped topsoil, applying seed mix aligned to the PMLU, weed control or managing erosion.

8.11 Quality assurance and quality control

The QA/QC process to be followed as part of GRM and BRM ongoing rehabilitation monitoring is illustrated in Figure 27. The process provides for initial execution of the rehabilitation in accordance with the rehabilitation plan, followed by verification of the execution against the rehabilitation plan. Based on the verification outcomes, allowance is made for implementation of corrective actions, as needed. All rehabilitated areas then undergo rehabilitation monitoring; and subsequent execution of maintenance actions identified through the monitoring (Section 8). This process allows for a repetitive execution-verification-corrective action-monitoring QA/QC approach, to ensure rehabilitation areas progress on a trajectory towards achievement of milestone criteria and eventual certification.

Figure 27: Rehabilitation monitoring quality assurance/quality control process

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B: PRCP SCHEDULE

10 PRCP SCHEDULE

Legislative Requirement

In accordance with section 126D(1) of the EP Act, the PRCP schedule in the PRC Plan must:

a) *describe the area of each resource tenure either a post-mining land use or non-use management area, and*

b) *for each post-mining land use state:*

   i. *each rehabilitation milestone required to achieve a stable condition, and*

   ii. *when each rehabilitation milestone is to be achieved, and*

c) *for each non-use management area state:*

   i. *each management milestone, and*

   ii. *when each management milestone is to be achieved, and*

d) *include maps showing the land mentioned in (a), (b) and (c).*

PRCP Guideline (Section 4)

The development and implementation of the PRCP schedule is an essential element of a PRC plan. The administering authority approves a PRCP schedule and applicants are required to comply with the conditions and milestones of the schedule. A PRCP schedule must include:

- *either a PMLU or NUMA for all land within the relevant resource tenures, including undisturbed land*
- *identification of when land becomes available for rehabilitation or improvement*
- *rehabilitation or management milestones to achieve the PMLU or NUMA outcomes*
- *milestone criteria that demonstrate when each milestone has been completed*
- *completion dates for each milestone to be achieved*
- *any conditions considered necessary or desirable.*

Applicants are required to develop and submit a proposed PRC plan when they make a site-specific application for an EA or receive a notice from the administering authority requiring the submission of a proposed PRC plan. The administering authority will assess the proposed PRCP schedule in conjunction with the rehabilitation planning part (see section 3 of this guideline) and decide whether to approve or refuse the PRCP schedule, amend the proposed PRCP schedule as necessary or impose milestones and conditions as necessary and impose conditions as necessary or desirable (see section 2.5 of this guideline). Once approved by the administering authority, the PRCP schedule becomes a legally binding and enforceable instrument with which the holder must comply.

10.1 Final site design

The final site design is provided in Figure 28.

10.2 Reference map

The reference map is provided in Figure 29.

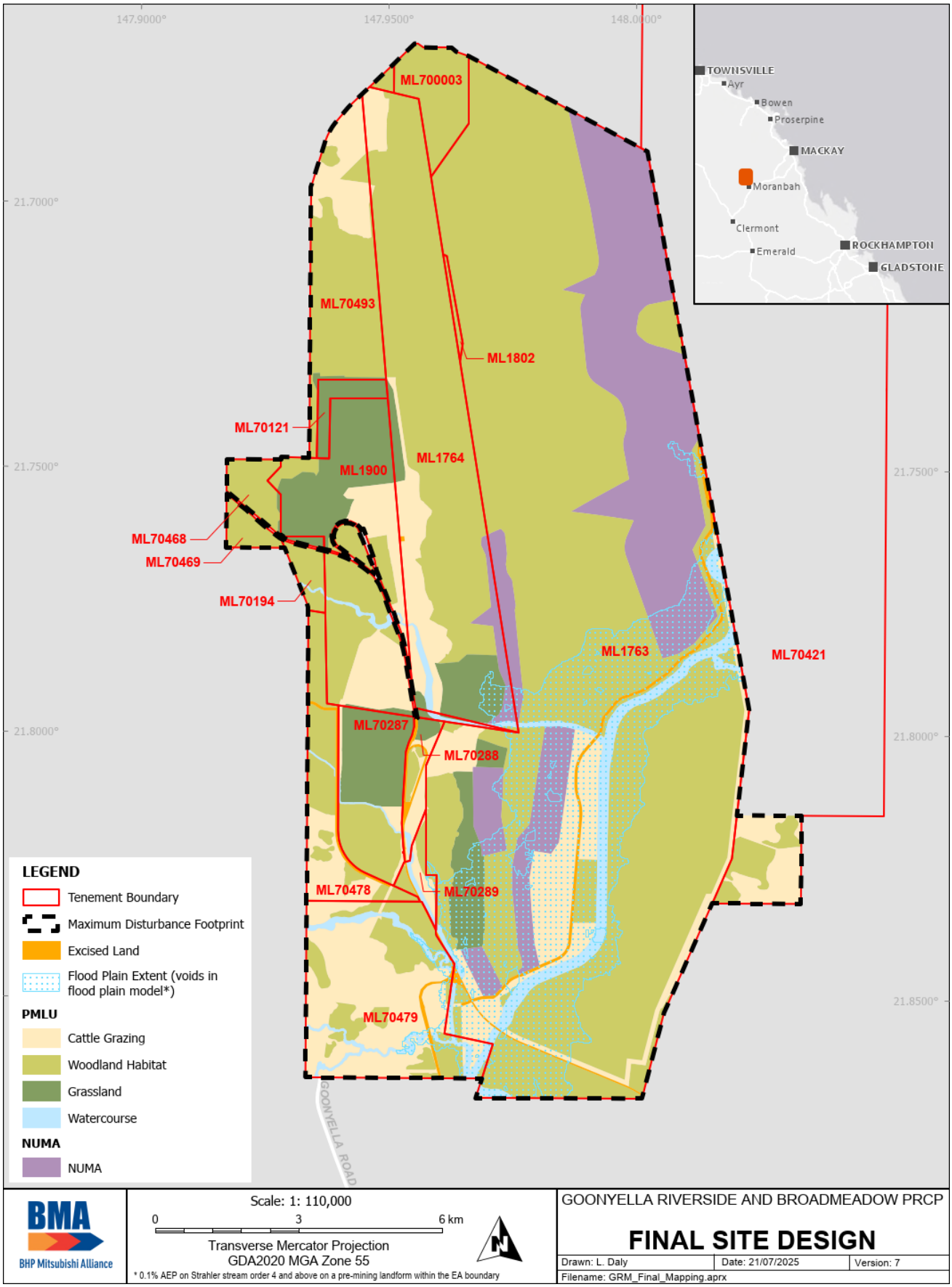

Figure 28: GRM and BRM final site design

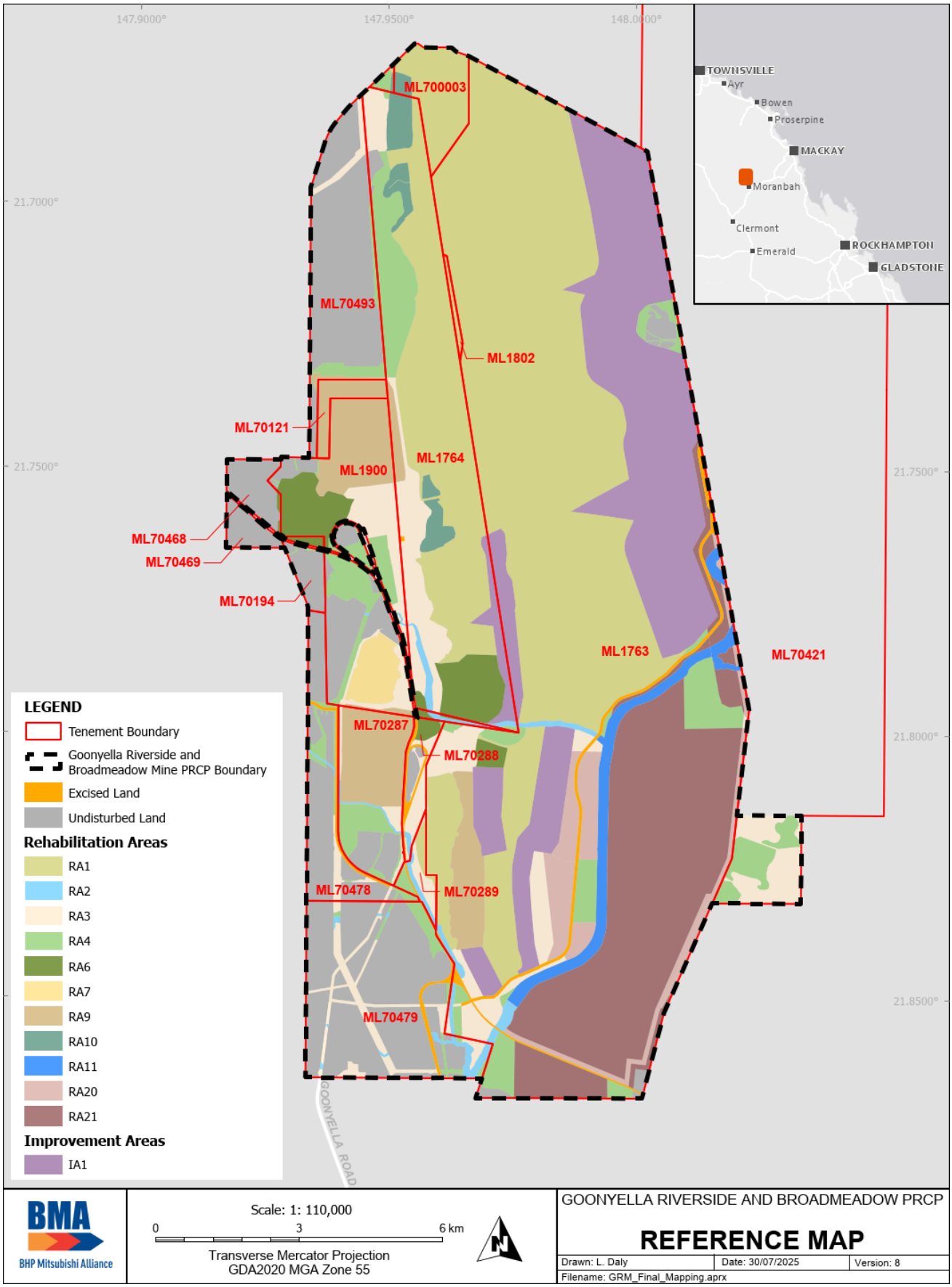

Figure 29: GRM and BRM reference map

10.3 Schedule Conditions

The groundwater and surface water conditions for the GRM and BRM PRCP are shown in Table 73.

Table 73: GRM and BRM PRCP conditions for groundwater and surface water

Condition #*	PRCP Condition
PRCP1	With respect to groundwater: **a)** The monitoring bores listed in Table 69: Groundwater monitoring locations must be installed by 2050; and **b)** The holder must develop site-specific groundwater quality limits by 2055 for the bores listed in Table 69: Groundwater monitoring locations; and **c)** Following monitoring bore installation as per **PRCP1(a)**, groundwater quality must be monitored six monthly at bores specified in Table 69: Groundwater monitoring locations; and **d)** The groundwater model and water balance model must be recalibrated and predictions rerun at least every five years commencing from 2050.
PRCP2	With respect to groundwater: **a)** Groundwater quality results for compliance bores have not exceeded the site-specific groundwater quality limits developed in accordance with the Queensland Water Quality Guidelines, for three consecutive results within the five-year period immediately prior to surrender; and **b)** Predictive groundwater modelling as per the Australian Groundwater Modelling Guidelines (current version), undertaken at the completion of all mining, confirms an inward hydraulic gradient is maintained and prevents environmental harm through the release of contaminants beyond the tenure boundary post-closure.
PRCP3	With respect to surface water: **a)** The holder must install monitoring equipment at the relevant surface water monitoring locations specified in Table 68: Surface water monitoring locations by 2050; and **b)** The holder must develop site-specific surface water quality limits by 2055 for the watercourses listed in Table 68: Surface water monitoring locations. **c)** Following completion of PRCP3(a), surface water quality must be monitored at least once per month during flow at downstream locations specified in Table 68: Surface water monitoring locations when flows at the downstream gauging station record ≥5m^3/second for the Isaac River and ≥1m^3/second for other monitored watercourses, when safe to collect samples.
PRCP4	With respect to surface water: **a)** Surface water quality monitored as per **PRCP3(c)** must not exceed the site-specific surface water quality limits derived in accordance with the Queensland Water Quality Guidelines within the five-year period immediately prior to surrender; and **b)** If the surface water quality exceeds criteria **PRCP4(a)**, the applicable upstream site must be compared to the downstream site result; and quality result measured at a downstream site must be equal to or less than the quality result measured at the applicable upstream site.
PRCP5	Where the surface water quality at the downstream site exceeds the upstream site result as per **PRCP4(b)**, an AQP[1] must complete an assessment of the cause of the exceedance

Condition #*	PRCP Condition
	and risk of rehabilitation not achieving a stable condition within the schedule timeframe and: **a)** Where there is a low risk to achieving a stable condition from the mining tenure (ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421, ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494), then no further action is to be taken; or **b)** Where there is a risk greater than low to achieve a stable condition, then an assessment of potential environment harm and any changes or rectification actions to rehabilitation activities must be determined and implemented. **c)** The EA holder will be non-compliant with **PRCP4**, if **PRCP5(b)** is triggered more than three times over five consecutive years prior to surrender and **PRCP4(a)** is reset. **d)** The assessment/s under **PRCP5** must be completed and provided to the administering authority within six months of receiving the relevant sampling results.
PRCP6	With respect to improvement area (IA1), the EA holder must develop a 'Groundwater Level Monitoring Network' (GLMN) inclusive of following steps: **a)** Identify by 2055 (or 4-years prior the end of mining), relevant regional aquifers (hydrogeological units) likely to be affected/connected individually or collectively by each residual void; **b)** Identify by 2055 (or 4-years prior the end of mining), relevant existing groundwater bores (from Table 69: Groundwater monitoring locations) and new additional groundwater monitoring bores if determined by an AQP[1] as required to ensure sufficient monitoring coverage for each regional aquifer mapped in accordance with **PRCP6(a)**; **c)** Independent AQP[1] endorse the proposed GLMN as per **PRCP6(a)** and **PRCP6(b)** is fit for purpose that is, to monitor and support predictions of residual voids behaviour as a sink; **d)** For existing groundwater monitoring bores identified in accordance with **PRCP6(b)** and approved as per **PRCP6(c)**, update the Table 69: Groundwater monitoring locations before the end of 2058 (or within 3 years of completion of **PRCP6(b)**) to reflect water level (mAHD) for the relevant bores; **e)** Depending on outcomes of **PRCP6(b)** and **PRCP6(c),** update the Table 69: Groundwater monitoring locations before the end of 2058 (or within 3 years of completion of **PRCP6(b)**) with new additional groundwater monitoring bore location co-ordinates, hydrogeological unit and water level (mAHD).
PRCP7	The GLMN developed in accordance with **PRCP6**, must be implemented by the EA holder by 2059 or at the end of mining whichever is earlier, inclusive of new groundwater bore installation as per **PRCP6**, and groundwater level monitoring.
PRCP8	Groundwater level must be monitored annually, at the bores identified under the GLMN (**PRCP6** and **PRCP7**), starting from 2059 or within 1 year of the end of mining whichever is earlier.

**PRCP condition numbering in PRCP schedule will change.*

10.4 Rehabilitation milestones

The rehabilitation milestones and milestone criteria for GRM and BRM are shown in Table 74.

Table 74: GRM and BRM rehabilitation milestones and milestone criteria

Milestone reference	Rehabilitation milestone	Milestone criteria
RM1	Infrastructure decommissioning and removal	**1.1** All infrastructure to be retained onsite must be safe, stable and not cause environmental harm. **1.2** All infrastructure and services to be retained onsite must have a signed landholder statement, declaring that they will accept responsibility for the infrastructure (except for those items in 1.3 and 1.4). **1.3** Underground shafts are closed according to Appropriately Qualified Person (AQP)[1] design (RA20, RA21). **1.4** Except for 1.3, below-ground infrastructure, services and waste (as per the Environmental Authority (EPML00853413) waste schedule) deeper than 0.5m in relation to the final landform surface can be retained provided it can meet the following: **a)** All pipelines have been drained; **b)** All below-ground infrastructure (installed after the approval date of this transitional PRCP) to be retained must be mapped; **c)** The intended PMLU is not compromised. **1.5** With the exception of 1.2, 1.3 and 1.4 above, the following are complete: **a)** All services disconnected, terminated and removed **b)** All buildings and associated infrastructure dismantled and removed **c)** All hardstand, concrete areas and roads (bitumen, blue metal, aggregate) removed **d)** All pipelines drained and removed **e)** All waste, not authorised under the Environmental Authority (EPML00853413) waste schedule, removed **f)** All surface water drainage infrastructure removed **g)** All drillholes, bores, sediment ponds and sumps decommissioned **h)** All machinery and equipment not required for rehabilitation works removed from site **i)** Mine water dams are decommissioned **j)** Watercourse crossings and culverts removed. **1.6** Assessment of mine water dams to be retained post closure is completed by an AQP[1] and identified sediment and water management actions to ensure the dams are safe and stable for post mine use are completed. [1]***Appropriately qualified person (AQP)*** *means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and*

Milestone reference	Rehabilitation milestone	Milestone criteria
		analysis on performance relating to the subject matter using the relevant protocols, standards, methods or literature.
RM2	Remediation and/or management of contaminated land	**2.1** Contaminated Land Investigation Document completed in accordance with the *Environmental Protection Act 1994*, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. **2.2** The Contaminated Land Investigation Document confirms the area within the mining leases (ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421, ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494) does not present an unacceptable risk to the post-mining land use. **2.3** Despite 2.1 and 2.2, where contaminated land investigations are undertaken for individual areas of progressive rehabilitation that do not cover an entire Lot on Plan, the investigations will be undertaken by a Suitably Qualified Person to a standard, that at the time of investigation, would be suitable to form part of a future *Environmental Protection Act 1994* compliant Contaminated Land Investigation Document for that property, and does not need to achieve all requirements for a contaminated land submission to the administering authority.
RM3	Landform development and reshaping	**3.1** Erosion and sediment control systems are designed by an AQP[1], installed, and fit for purpose. **3.2** Appropriate mitigative measures in place for outer landform slopes that interact with flood waters up to a 0.1% AEP, as modelled on the closure landform, and designed by an AQP[1] to minimise potential instability of the landforms from interaction with floodwaters. **3.3** The reshaped landforms are geotechnically stable with RA1, RA6 and RA9 achieving FoS ≥1.5. **Woodland Habitat (RA1, RA4)** **3.4** Landforms reshaped with: a) RA1: ≤30% slopes, with slopes >15% slopes covered with minimum 0.5m rock b) RA1: Runoff to be restricted from the top of the landform onto the batter slopes if required using appropriate measures of erosion control as advised and designed by an AQP[1] c) RA4: ≤15% slopes. **Watercourses (RA2)** **3.5** Disturbed natural watercourse bed and banks returned to a profile similar to the pre-disturbance condition. **Cattle Grazing (RA3)** **3.6** RA3 landforms are reshaped with slopes: ≤12%.

Milestone reference	Rehabilitation milestone	Milestone criteria
		Grassland (RA6, RA9) - Installation of cover **3.7** An AQP[1] to determine appropriate detailed cover design for installation based on geochemical and geotechnical characterisation of tailings and rejects, which at minimum achieves the following: a) Tailings and rejects to be capped with at least 2m of competent benign spoil; b) Reduces risk of upward movement of contaminants into the topsoil layer above the cover and reduce risk of environmental harm from contaminated seepage; c) Landforms are reshaped with slopes ≤30%; d) >15% slopes to be covered with minimum 0.5m rock, unless an alternative is justified by an AQP; and e) Landform surface to be free draining. **3.8** An independent AQP[1] to endorse installation of the cover system as per 3.7. **Underground Mining (RA11, RA20, RA21)** **3.9** Reshape watercourse crossings to a profile similar to the pre-disturbance condition (RA11). **3.10** Backfill and/or install drainage to limit subsidence inundation (RA20, RA21): a) To maximum 1m depth in a 2% AEP rainfall event demonstrated by modelling completed by an AQP[1], or b) Does not adversely impact achieving the PMLU as assessed by an AQP[1]. **Retained water structure** **3.11** Water storages are safe for stock access and have vegetated banks.
RM4	Surface preparation (cattle grazing and grassland)	**4.1** Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. **4.2** Assessment of growth media characteristics is completed by an AQP[1]: a) To target land suitability class ≤3 as per Table 22: Regional land suitability framework for beef cattle grazing PMLU rehabilitation in the Bowen Basin (RA3, RA20), and b) For target vegetation establishment suitable for designated PMLU (RA6, RA9). **4.3** Ameliorant and physical treatments are applied as identified in criteria 4.2. **4.4** Rip at least 300mm into soil/subsoil profile along contour of slopes.
RM5	Surface preparation (woodland habitat)	**5.1** Topsoil placed at minimum depth of 100mm or alternative growth media at minimum depth of 300mm, in areas where topsoil has previously been removed.

Milestone reference	Rehabilitation milestone	Milestone criteria
		5.2 Assessment of growth media characteristics is completed by an AQP[1] for target vegetation establishment suitable for designated PMLU. **5.3** Ameliorant and physical treatments are applied as identified in criteria 5.2. **5.4** Rip at least 300mm into soil/subsoil profile along contour of slopes.
RM6	Surface preparation (watercourse)	**6.1** Topsoil placed at minimum depth of 150mm in areas where topsoil has previously been removed. **6.2** Assessment of growth media characteristics is completed by an AQP[1] for target vegetation establishment suitable for designated PMLU. **6.3** Ameliorant and physical treatments are applied as identified in criteria 6.2. **6.4** Rip at least 300mm into soil/subsoil profile along contour of slopes.
RM7	Revegetation (cattle grazing and grassland)	**7.1** Completed seeding in accordance with Table 33: Recommended species list and seeding rates for cattle grazing and grassland PMLUs. **7.2** For cattle grazing PMLU, at least four species of 3P grasses and two species of legumes from Table 33: Recommended species list and seeding rates for cattle grazing and grassland PMLUs. **7.3** Stock exclusion has been established to prevent stock from grassland PMLU (RA6, RA9).
RM8	Revegetation (woodland habitat)	**8.1** Completed seeding in accordance with Table 35: Recommended species list and seeding rates for woodland habitat PMLU (RA1)*, or Table 36: Recommended species list and seeding rates for woodland habitat PMLU (RA21 – temporal ponded areas), or as recommended by an AQP[1] where vegetation is targeting a specific regional ecosystem (RA4, RA21)[2]. [2]*Seed application may not be required in all RA4 and RA21 areas.* **If recommended species are not available, substitute with species from RE11.5.3, RE11.5.9 or RE11.7.2.*
RM9	Revegetation (watercourse)	**9.1** Completed seeding in accordance with Table 37: Recommended species list and seeding rates for watercourse PMLU – upper and mid banks and Table 38: Recommended species list and seeding rates for watercourse PMLU – lower banks. **9.2** Species chosen for seeding in 9.1 reflects riparian vegetation.
RM10	Achievement of surface requirements (cattle grazing)	**10.1** >50% vegetation groundcover, of which ≥50% of dry matter yield is 3P pasture species as listed in Table 33: Recommended species list and seeding rates for cattle grazing and grassland PMLUs. **10.2** Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so, and the results are not significantly different to upstream values for pH, EC, turbidity (RA3, RA20).

Milestone reference	Rehabilitation milestone	Milestone criteria
		10.3 With respect to erosion in rehabilitated landforms: **a)** All erosion inclusive of tunnel erosion as per Table 58: Erosion type and severity is assessed by an AQP[1] and repaired if assessed as requiring intervention to ensure the stable PMLU achieved, and evidence that it is repaired as per AQP[1] advice; and **b)** Mass movement is absent. **10.4** Subsidence cracks are repaired if the cracks will not self-heal and they adversely impact achieving the PMLU as assessed by an AQP[1] (RA20).
RM11	Achievement of surface requirements (woodland habitat)	**11.1** Groundcover[3]: **a)** >15% slopes must achieve ≥80% groundcover, or **b)** ≤15% slopes must achieve ≥50% groundcover. **11.2** Vegetation meets the following: **a)** BioCondition score of ≥18/60 based on the averaged benchmarks for the representative regional ecosystems as listed in Table 63: BioCondition benchmarks and scoring of site-based attributes for representative regional ecosystems and as assessed by an AQP[1] using the modified 'BioCondition Assessment Manual' (version 2.2) methodology (RA1, RA4), or **b)** Species richness of ≥2 native trees, ≥3 native shrubs and ≥4 ground species (native or exotic) (RA10, RA21). **11.3** Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so, and the results are not significantly different to upstream values for pH, EC, turbidity (RA1, RA4, RA21). **11.4** With respect to erosion in rehabilitated landforms: **a)** All erosion inclusive of tunnel erosion as per Table 58: Erosion type and severity is assessed by an AQP[1] and repaired if assessed as requiring intervention to ensure the stable PMLU achieved, and evidence that it is repaired as per AQP[1] advice; and **b)** Mass movement is absent. **11.5** Subsidence cracks are repaired if the cracks will not self-heal and they adversely impact achieving the PMLU as assessed by an AQP[1] (RA21). [3] ***Groundcover:*** *anything in contact with the soil surface, for example, live cover, standing dry cover, organic litter (including leaves, hay, woody debris) or rocks*
RM12	Achievement of surface requirements (watercourse)	**12.1** Groundcover[3]: **a)** >15% slopes must achieve ≥80% groundcover, or **b)** ≤15% slopes must achieve ≥50% groundcover. **12.2** Geomorphic index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method[4]). **12.3** Vegetation meets the following:

Milestone reference	Rehabilitation milestone	Milestone criteria
		a) Species richness: i. ≥2 native trees; ii. ≥2 native shrubs representative of riparian vegetation RE 11.3.25; and iii. ≥2 grasses (native or exotic) **12.4** With respect to erosion in rehabilitated landforms: **a)** All erosion inclusive of tunnel erosion as per Table 58: Erosion type and severity is assessed by an AQP[1] and repaired if assessed as requiring intervention to ensure the stable PMLU achieved, and evidence that it is repaired as per AQP[1] advice; and **b)** Mass movement is absent. **12.5** Subsidence cracks are repaired if the cracks will not self-heal and they adversely impact achieving the PMLU as assessed by an AQP[1] (RA11). *[4]For watercourse rehabilitation not within a diversion (i.e. crossings/culverts), a modified IDC method with a reduced number of monitoring points within each reach will be used.*
RM13	Achievement of post-mining land use to a stable condition (cattle grazing)	**13.1** Hazard assessment completed by an AQP[1] to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. **13.2** Groundcover: >50% vegetation groundcover, with ≥50% of pasture dry matter yield consisting of 3P grasses as listed in Table 33: Recommended species list and seeding rates for cattle grazing and grassland PMLUs. **13.3** Achievement of land suitability class ≤3 as per Table 22: Regional land suitability framework for beef cattle grazing PMLU rehabilitation in the Bowen Basin , or ≥4 if not different from pre-mining class. **13.4** With respect to erosion in rehabilitated landforms: a) No evidence of erosion classified as severe as defined by Table 58: Erosion type and severity; and b) Mass movement is absent; and c) An AQP[1] determines that any erosion present, including tunnel erosion, will not compromise the achievement of a PMLU to a stable condition. **13.5** Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so, and the results are not significantly different to upstream values for pH, EC, turbidity. **13.6** *Leucaena leucocephala* plants >2m high do not exceed stem density of 250 stems per hectare (1 per 40m^2) mean of total area. **13.7** Restricted invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of vegetation groundcover, with the exception of *Parthenium hysterophorus* which must not exceed 10% vegetation groundcover and assessed by an AQP[1] as appropriately managed.

Milestone reference	Rehabilitation milestone	Milestone criteria
		13.8 Final landform survey confirms no built infrastructure remains other than those that form part of landholder agreement and meets exception as per RM1.4. **13.9** Subsidence cracks are repaired if the cracks will not self-heal and they adversely impact achieving the PMLU as assessed by an AQP[1] (RA20). **Retained infrastructure/ Water storage** **13.10** Infrastructure to be transitioned to a future landholder is deemed fit for purpose, safe and stable by AQP and accepted, by signed agreement with the future landholder. **13.11** All retained dams are safe, stable for native animals and stock access and have vegetated banks. **13.12** Water storages monitored for water quality annually must meet ANZECC 2000 stock water guideline values, for a minimum of 5 consecutive years.
RM14	Achievement of post-mining land use to a stable condition (woodland habitat)	**14.1** Hazard assessment completed by an AQP[1] to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. **14.2** Rehabilitation is assessed as geotechnically stable by an AQP[1] with FoS ≥1.5 (RA1). **14.3** With respect to erosion in rehabilitated landforms: **a)** No evidence of erosion classified as severe as defined by Table 58: Erosion type and severity; and **b)** Mass movement is absent; and **c)** An AQP[1] determines that any erosion present, including tunnel erosion, will not compromise the achievement of a PMLU to a stable condition. **14.4** Groundcover[3]: **a)** >15% slopes must achieve ≥80% groundcover, or **b)** ≤15% slopes must achieve ≥50% groundcover. **14.5** Vegetation meets the following: **a)** BioCondition score of ≥35/60 based on the averaged benchmarks for the representative regional ecosystems as listed in Table 63: BioCondition benchmarks and scoring of site-based attributes for representative regional ecosystems and as assessed by an AQP[1] using the modified 'BioCondition Assessment Manual' (version 2.2) methodology (RA1, RA4), or **b)** Species richness of ≥2 native trees, ≥3 native shrubs, ≥4 ground species (native or exotic), and tree canopy cover of ≥16% (RA21) **14.6** Restricted invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of vegetation groundcover, with the exception of *Parthenium hysterophorus* which must not exceed 10% vegetation groundcover and assessed by an AQP[1] as appropriately managed. **14.7** Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do

Milestone reference	Rehabilitation milestone	Milestone criteria
		so, and the results are not significantly different to upstream values for pH, EC, turbidity. **14.8** Subsidence cracks are repaired if the cracks will not self-heal and they adversely impact achieving the PMLU as assessed by an AQP[1] (RA21). **14.9** Final landform survey confirms no built infrastructure remains other than those that form part of landholder agreement and meets exception as per RM1.4.
RM15	Achievement of post-mining land use to a stable condition (watercourse)	**15.1** Hazard assessment completed by an AQP[1] to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. **15.2** With respect to erosion in rehabilitated landforms: **a)** No evidence of erosion classified as severe as defined by Table 58: Erosion type and severity; and **b)** Mass movement is absent; and **c)** An AQP[1] determines that any erosion present, including tunnel erosion, will not compromise the achievement of a PMLU to a stable condition. **15.3** Geomorphic index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method[4]). **15.4** Watercourse vegetation meets the following: **a)** Riparian vegetation index score: greater than or equal to upstream or downstream values (Index of Diversion Condition method[4]) **b)** Species richness: • ≥2 native trees; and • ≥2 native shrubs; • ≥2 grasses (native or exotic) **c)** Tree canopy cover ≥13%. **15.5** Restricted invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of vegetation groundcover, with the exception of *Parthenium hysterophorus* which must not exceed 10% vegetation groundcover and assessed by an AQP[1] as appropriately managed. **15.6** Diversion has an IDC score >10 as defined in 'Criteria for functioning river landscape units in mining and post-mining landscapes' (ACARP Project number C20017). **15.7** AQP[1] must consider the following in closure design determination for diversions being retained in the landform: **a)** Incorporate natural features (including geomorphic and vegetation) present at the location of the diversion; **b)** Maintain the pre-existing hydrologic characteristics of surface water for the area in which the watercourse diversion is located; **c)** Maintain the hydraulic characteristics of the local watercourses without requiring on-going maintenance; **d)** Maintain sediment transport and water quality regimes that allow the diversion to be self-sustaining, while minimising any

Milestone reference	Rehabilitation milestone	Milestone criteria
		impacts to upstream and downstream water quality, geomorphology, or vegetation; **e)** Maintain equilibrium and functionality in all substrate conditions at the location of the diversion; and **f)** Geotechnically and erosionally stable. **15.8** Subsidence cracks are repaired if the cracks will not self-heal and they adversely impact achieving the PMLU as assessed by an AQP[1] (RA11). **15.9** Watercourse bank stability is not adversely impacted by subsidence as assessed by an AQP[1] (RA11). **15.10** Final landform survey confirms no built infrastructure remains other than those that form part of landholder agreement and meets exception as per RM1.4.
RM18	Achievement of post-mining land use to a stable condition (woodland habitat - existing rehabilitation)	**18.1** Hazard assessment completed by an AQP[1] to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. **18.2** Groundcover[3]: **a)** >15% slopes must achieve ≥80% groundcover, or **b)** ≤15% slopes must achieve ≥50% groundcover. **18.3** Vegetation meets the following: **a)** Species richness: • ≥2 native trees; • ≥3 native shrubs; and • ≥4 grasses (native or exotic) **b)** Tree canopy cover ≥16% **18.4** Restricted invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of vegetation groundcover, with the exception of *Parthenium hysterophorus* which must not exceed 10% vegetation groundcover and assessed by an AQP[1] as appropriately managed. **18.5** With respect to erosion in rehabilitated landforms: **a)** No evidence of erosion classified as severe as defined by Table 58: Erosion type and severity; and **b)** Mass movement is absent; and **c)** An AQP[1] determines that any erosion present, including tunnel erosion, will not compromise the achievement of a PMLU to a stable condition.
RM19	Achievement of surface requirements (grassland)	**19.1** Groundcover[3]: a) >15% slopes: ≥80% groundcover, or **b)** ≤15% slopes: ≥50% groundcover, or **c)** ≤5% slopes: ≥50% groundcover, consisting of ≥50% vegetation groundcover. **19.2** With respect to erosion in rehabilitated landforms: **a)** All erosion inclusive of tunnel erosion as per Table 58: Erosion type and severity is assessed by an AQP[1] and

Milestone reference	Rehabilitation milestone	Milestone criteria
		repaired if assessed as requiring intervention to ensure the stable PMLU achieved, and evidence that it is repaired as per AQP[1] advice; and **b)** Mass movement and tunnel erosion are absent. **19.3** Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so, and the results are not significantly different to upstream values for pH, EC, turbidity.
RM20	Achievement of post-mining land use to a stable condition (grassland)	**20.1** Hazard assessment completed by an AQP[1] to confirm safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use. **20.2** Rehabilitation is assessed as geotechnically stable by an AQP[1] with FoS ≥1.5. **20.3** With respect to erosion in rehabilitated landforms: **a)** No evidence of erosion classified as severe as defined by Table 58: Erosion type and severity; and **b)** Mass movement and tunnel erosion are absent; and **c)** An AQP[1] determines that any erosion present will not compromise the achievement of a PMLU to a stable condition. **20.4** Groundcover[3]: **a)** >15% slopes: ≥80% groundcover, or **b)** ≤15% slopes: ≥50% groundcover, or **c)** ≤5% slopes: ≥50% groundcover, consisting of ≥50% vegetation groundcover. **20.5** Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so, and the results are not significantly different to upstream values for pH, EC, turbidity. **20.6** Vegetation: ≥2 grass species (native or exotic). **20.7** Restricted invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of vegetation groundcover, with the exception of *Parthenium hysterophorus* which must not exceed 10% vegetation groundcover and assessed by an AQP[1] as appropriately managed.

10.5 Management milestones

The management milestones and milestone criteria for GRM and BRM are shown in Table 75.

Table 75: GRM and BRM management milestones and milestone criteria

Milestone Reference	Management milestone	Milestone criteria
MM1	Achievement of structural stability	**IA1.1** Highwall landforms must: **a)** Prevent surface flow of floodwater into the void **b)** Be geotechnically stable when floodwater is against the watercourse-side batter **c)** Prevent seepage flow of floodwater into the void **d)** Not be constructed with dispersive material **e)** Have maximum 30% slopes with rock for scour protection **f)** Minimum height to include appropriate freeboard for flood heights and materials. **IA1.2** The final design for highwall landform must be completed by an AQP[1] based on the latest flood modelling and materials data prior to construction. **IA1.3** Final residual voids are not subject to inundation from floodwaters up to and including the 0.1% AEP. **IA1.4** The high-wall, end-wall and low-wall achieve a FoS ≥1.5 within the NUMA extents as determined by an AQP[1]. **IA1.5** A minimum distance of 50m is to be designed between the residual void crest and the toe of the safety bund, where against an external perimeter mining lease (ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421, ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494) boundary or a watercourse. **IA1.6** The location of the voids and associated safety bunds does not cause instability or degradation to the land outside of the mining lease (ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421, ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494) boundary. **IA1.7** Low-walls are free draining into the void lake with a maximum 37 degree slopes. **IA1.8** Residual voids must not overtop. **IA1.9** Flood mitigation as per IA1.3 have appropriate scour protection to sustain flood velocities. **IA1.10** Residual voids maintain an inward hydraulic gradient within the relevant mining lease (ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421, ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494) boundary post-closure as demonstrated by groundwater modelling defined in condition PRCP2. **IA1.11** Underground entries are closed according to AQP[1] design.

Milestone Reference	Management milestone	Milestone criteria
MM2	Achievement of surface requirements	**IA2.1** Competent safety bund or equivalent landform in place around the perimeter of residual void to prevent access to the residual void, at the geotechnical set-back distance. **IA2.2** Fencing erected, where required to prevent access to the residual void, around the perimeter of the safety bund. **IA2.3** Warning signage placed along the fence line (nominally one sign every 100m). **IA2.4** A minimum distance of 25m is to be designed between the residual void low-wall crest within the NUMA and the safety bund or equivalent landform in IA2.1.
MM3	Achievement of sufficient improvement	**IA3.1** Certification from an AQP[1] that: **a)** The residual void is safe to humans and livestock **b)** Residual voids are monitored for water level annually, in accordance with PRCP8 and shown to be on a trajectory to the establishment of a residual void sink, at surrender **c)** The water level and quality in the void will not cause environmental harm to the surrounding environment, as demonstrated by residual void water level, groundwater level, quality monitoring and modelling **d)** Voids retain flood immunity, supported by flood modelling re-run at end of life and calibrated against the final landform **e)** The highwall landform has been constructed in accordance with the final design as per IA1.2 **f)** Erosion and sediment control measures have been installed and are operating as per design. **g)** Appropriate safety infrastructure at the geotechnical set-back distance has been installed to prevent access to the NUMA **h)** The residual void will not present an unacceptable risk of environmental harm outside of the relevant external perimeter mining lease (ML1763, ML1764, ML1802, ML1900, ML700003, ML70121, ML70193, ML70194, ML70287, ML70288, ML70289, ML70421, ML70468, ML70469, ML70478, ML70479, ML70493 and ML70494) boundary **i)** Erosion of the landform within the NUMA area will not negatively impact on the stability of any adjacent rehabilitation areas, or their ability to sustain their PMLU. **IA3.2** Monitoring and maintenance of exclusion fences and bunds to be carried out to ensure they remain effective.

10.6 Schedule

The GRM and BRM PRCP schedule is provided below.

Post-mining land uses (PMLU)											
Rehabilitation area	RA1										
Relevant activities	Spoil dumps										
Total rehabilitation area size (ha)	5557										
Commencement of first milestone: RM2	10/12/2025										
PMLU	Woodland Habitat										
Date area is available	10/12/2025	10/12/2033	10/12/2038	10/12/2043	10/12/2048	10/12/2053	10/12/2058	10/12/2063	10/12/2068	10/12/2073	10/12/2078
Cumulative area available (ha)	186	479	750	1264	1884	2729	3771	4611	4611	4611	4611
Milestone completed by	10/12/2033	10/12/2038	10/12/2043	10/12/2048	10/12/2053	10/12/2058	10/12/2063	10/12/2068	10/12/2073	10/12/2078	10/12/2083
Milestone Reference	Cumulative area achieved (ha)										
RM2	186	479	750	1264	1884	2729	3771	4234	4611		
RM3	186	479	750	1264	1884	2729	3771	4234	4611		
RM5	186	479	750	1264	1884	2729	3771	4234	4611		
RM8	186	479	750	1264	1884	2729	3771	4234	4611		
RM11			186	479	750	1264	1884	2729	3771	4234	4611
RM14					186	479	750	1264	1884	2729	3771

Date area is available	10/12/2083	10/12/2088	10/12/2093								
Cumulative area available (ha)	4611	4611	5557								
Milestone completed by	10/12/2088	10/12/2093	10/12/2098	10/12/2103	10/12/2108	10/12/2113	10/12/2118	10/12/2123			
Milestone Reference	Cumulative area achieved (ha)										
RM2			5011	5557							
RM3			5011	5557							
RM5			5011	5557							
RM8			5011	5557							
RM11					5011	5557					
RM14	4234	4611					5011	5557			

Post-mining land uses (PMLU)										
Rehabilitation area	RA2									
Relevant activities	Watercourse diversions and crossings									
Total rehabilitation area size (ha)	173									
Commencement of first milestone: RM1	10/12/2061									
PMLU	Watercourse									
Date area is available	10/12/2061	10/12/2064	10/12/2074	10/12/2097						
Cumulative area available (ha)	113	113	113	173						
Milestone completed by	10/12/2064	10/12/2074	10/12/2084	10/12/2100	10/12/2110	10/12/2120				
Milestone Reference	Cumulative area achieved (ha)									
RM1	113			173						
RM3	113			173						
RM6	113			173						
RM9	113			173						
RM12		113			173					
RM15			113			173				

Post-mining land uses (PMLU)																
Rehabilitation area	RA3															
Relevant activities	CHPP, workshops, fuel/oil/chemical storage, buildings, train load outs, dams, coal stockpiles, roads, general infrastructure and disturbance															
Total rehabilitation area size (ha)	1286															
Commencement of first milestone: RM1	10/12/2061															
PMLU	Cattle Grazing															
Date area is available	10/12/2061	10/12/2067	10/12/2070	10/12/2074	10/12/2076	10/12/2080	10/12/2082	10/12/2086	10/12/2091	10/12/2092	10/12/2097					
Cumulative area available (ha)	492	852	852	852	852	852	852	852	852	852	1286					
Milestone completed by	10/12/2064	10/12/2070	10/12/2074	10/12/2076	10/12/2080	10/12/2082	10/12/2086	10/12/2091	10/12/2092	10/12/2097	10/12/2100	10/12/2120	10/12/2122	10/12/2132	10/12/2137	
Milestone Reference	Cumulative area achieved (ha)															
RM1	492	852									1286					
RM2			492		852							1286				
RM3				492		852							1286			
RM4				492		852							1286			
RM7				492		852							1286			
RM10							492		852					1286		
RM13								492		852					1286	

Post-mining land uses (PMLU)															
Rehabilitation area	RA4														
Relevant activities	Roads, laydown areas, conveyors, general infrastructure and disturbance, Area 4														
Total rehabilitation area size (ha)	1165														
Commencement of first milestone: RM1	10/12/2061														
PMLU	Woodland Habitat														
Date area is available	10/12/2061	10/12/2067	10/12/2069	10/12/2073	10/12/2076	10/12/2079	10/12/2082	10/12/2086	10/12/2092	10/12/2097					
Cumulative area available (ha)	644	1111	1111	1111	1111	1111	1111	1111	1111	1165					
Milestone completed by	10/12/2063	10/12/2069	10/12/2073	10/12/2076	10/12/2079	10/12/2082	10/12/2086	10/12/2092	10/12/2096	10/12/2099	10/12/2102	10/12/2109	10/12/2112	10/12/2122	10/12/2132
Milestone Reference	Cumulative area achieved (ha)														
RM1	644	1111								1165					
RM2			644		1111							1165			
RM3				644		1111							1165		
RM5				644		1111							1165		
RM8				644		1111							1165		
RM11							644	1111						1165	
RM14									644		1111				1165

Post-mining land uses (PMLU)															
Rehabilitation area	RA6														
Relevant activities	Rejects dumps														
Total rehabilitation area size (ha)	400														
Commencement of first milestone: RM1	10/12/2031														
PMLU	Grassland														
Date area is available	10/12/2025	10/12/2034	10/12/2044	10/12/2049	10/12/2059	10/12/2062	10/12/2071	10/12/2091	10/12/2092						
Cumulative area available (ha)	170	170	170	170	170	233	233	233	400						
Milestone completed by	10/12/2034	10/12/2044	10/12/2049	10/12/2059	10/12/2069	10/12/2071	10/12/2091	10/12/2096	10/12/2101	10/12/2106	10/12/2116	10/12/2121	10/12/2126	10/12/2136	10/12/2146
Milestone Reference	Cumulative area achieved (ha)														
RM1	170					233			400						
RM2		170					233					400			
RM3			170					233					400		
RM4			170					233					400		
RM7			170					233					400		
RM19				170						233				400	
RM20					170						233				400

Post-mining land uses (PMLU)										
Rehabilitation area	RA7									
Relevant activities	Existing Rehabilitation									
Total rehabilitation area size (ha)	118									
Commencement of first milestone: RM10	10/12/2024									
PMLU	Cattle Grazing									
Date area is available	10/12/2024									
Cumulative area available (ha)	118									
Milestone completed by	10/12/2034	10/12/2039								
Milestone Reference	Cumulative area achieved (ha)									
RM10	118									
RM13		118								

Post-mining land uses (PMLU)															
Rehabilitation area	RA9														
Relevant activities	Tailings Storage Facilities														
Total rehabilitation area size (ha)	872														
Commencement of first milestone: RM1	10/12/2033														
PMLU	Grassland														
Date area is available	10/12/2025	10/12/2036	10/12/2056	10/12/2062	10/12/2073	10/12/2076	10/12/2091								
Cumulative area available (ha)	197	197	197	537	537	537	872								
Milestone completed by	10/12/2036	10/12/2056	10/12/2066	10/12/2073	10/12/2076	10/12/2081	10/12/2093	10/12/2103	10/12/2113	10/12/2118	10/12/2123	10/12/2133	10/12/2138	11/12/2143	11/12/2148
Milestone Reference	Cumulative area achieved (ha)														
RM1	197			537			677	872							
RM2		197					537		677		872				
RM3			197					537			677	872			
RM4			197					537			677	872			
RM7			197					537			677	872			
RM19					197				537			677		872	
RM20						197				537			677		872

Post-mining land uses (PMLU)										
Rehabilitation area	RA10									
Relevant activities	Existing Rehabilitation									
Total rehabilitation area size (ha)	175									
Commencement of first milestone: RM5	10/12/2024									
PMLU	Woodland Habitat									
Date area is available	10/12/2024	10/12/2024								
Cumulative area available (ha)	155	175								
Milestone completed by	10/12/2024	10/12/2026	10/12/2028	10/12/2034	10/12/2036	10/12/2038	10/12/2044	10/12/2046	10/12/2048	
Milestone Reference	Cumulative area achieved (ha)									
RM5	155	175								
RM8	33	155	175							
RM11	21			33	155	175				
RM18				21			33	155	175	

Post-mining land uses (PMLU)										
Rehabilitation area	RA11									
Relevant activities	Watercourses, watercourse diversions and crossings within underground mining/subsidence area									
Total rehabilitation area size (ha)	249									
Commencement of first milestone: RM1	10/12/2057									
PMLU	Watercourse									
Date area is available	10/12/2057	10/12/2060	10/12/2070	10/12/2097						
Cumulative area available (ha)	206	206	206	249						
Milestone completed by	10/12/2060	10/12/2070	10/12/2080	10/12/2100	10/12/2110	10/12/2120				
Milestone Reference	Cumulative area achieved (ha)									
RM1	206			249						
RM3	206			249						
RM6	206			249						
RM9	206			249						
RM12		206			249					
RM15			206			249				

Post-mining land uses (PMLU)										
Rehabilitation area	RA20									
Relevant activities	Subsidence, underground mining infrastructure, general infrastructure and disturbance within underground mining area									
Total rehabilitation area size (ha)	434									
Commencement of first milestone: RM1	10/12/2057									
PMLU	Cattle Grazing									
Date area is available	10/12/2057	10/12/2062	10/12/2072	10/12/2097						
Cumulative area available (ha)	406	406	406	434						
Milestone completed by	10/12/2062	10/12/2072	10/12/2077	10/12/2102	10/12/2112	10/12/2117				
Milestone Reference	Cumulative area achieved (ha)									
RM1	406			434						
RM3	406			434						
RM4	406			434						
RM7	406			434						
RM10		406			434					
RM13			406			434				

Post-mining land uses (PMLU)										
Rehabilitation area	RA21									
Relevant activities	Subsidence, underground mining infrastructure, general infrastructure and disturbance within underground mining area									
Total rehabilitation area size (ha)	2079									
Commencement of first milestone: RM1	10/12/2057									
PMLU	Woodland Habitat									
Date area is available	10/12/2057	10/12/2062	10/12/2072	10/12/2097						
Cumulative area available (ha)	1963	1963	1963	2079						
Milestone completed by	10/12/2062	10/12/2072	10/12/2082	10/12/2102	10/12/2112	10/12/2122				
Milestone Reference	Cumulative area achieved (ha)									
RM1	1963			2079						
RM3	1963			2079						
RM5	1963			2079						
RM8	1963			2079						
RM11		1963			2079					
RM14			1963			2079				

Non-use management area (NUMA)										
Improvement area	IA1									
Relevant activities	Residual voids									
Total size (ha)	2297									
Commencement of first milestone: MM1	10/12/2032									
NUMA	NUMA									
Date area is available	10/12/2032	10/12/2056	10/12/2060	10/12/2092						
Cumulative area available (ha)	108	380	428	2297						
Milestone completed by	10/12/2034	10/12/2058	10/12/2062	10/12/2094	10/12/2148					
Milestone Reference	Cumulative area achieved (ha)									
MM1	108	380	428	2297						
MM2	108	380	428	2297						
MM3					2297					

C: APPENDICES

Appendix A: Environment Authority (EPML00853413) (26 February 2024)

Appendix B: DES (13 December 2021) - Progressive Rehabilitation and Closure Plan Transition Notice Ref. EPML00853413

Appendix C: BHP (29 November 2021) - Progressive Rehabilitation and Closure Plan – Goonyella Riverside / Broadmeadow Mine Complex Pre-Notification Memo

Appendix D: AECOM (2024) – Transitional Progressive Rehabilitation and Closure Plan – Goonyella Complex Hydrogeology Report

Appendix E: Landloch (2024a) – Goonyella Riverside Mine Complex - Material Characterisation Study

Appendix F: Progressive Rehabilitation and Closure Plan Community Consultation Register

Appendix G: SLR (2024a) – Goonyella Riverside Mine Progressive Rehabilitation and Closure Plan Voids in Floodplain Report

Appendix H: SLR (2024b) – Goonyella Complex Progressive Rehabilitation and Closure Plan Rehabilitation Flood Assessment

Appendix I: BHP (2024) – Goonyella Riverside and Broadmeadow Mine Progressive Rehabilitation and Closure Plan Environmental Geochemical Characterisation and Risk Assessment of Mineral Waste

Appendix J: Landloch (2024b) – Erosion and Landform Evolution Simulations to Support Waste Landform Design: Goonyella Riverside Mine Complex

Appendix K: Engeny (2025) – PRCP Concept Design Report – Isaac River Diversion

Appendix L: Engeny (2024a) – PRCP Concept Design Report – Eureka Creek Diversion

Appendix M: Engeny (2024b) – PRCP Concept Design Report – Holding Paddock Creek Diversion

Appendix N: Engeny (2024c) – PRCP Concept Design Report – Fisher Creek Diversion

Appendix O: WSP (2024) - Void Closure Plan Goonyella Riverside/Broadmeadow Mine

Appendix P: Byrnes Geotechnical (2024) - Geotechnical considerations for closure of underground mines at Broadmeadow

Appendix Q: Goonyella Riverside and Broadmeadow Mine Risk Assessment