CAVAL RIDGE MINE

Horse Pit Extension Project

Environmental Authority Amendment Supporting Information Document

Status: Submission

Version: 5.0

DOCUMENT CONTROL

Reference	*Date*	Prepared	Checked	Authorised
HPE EA Amendment Supporting Document	24/03/2023	SLR and BMA		

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Abbreviations

%	Percentage
AASA	Application for additional surface area
ABN	Australian Business Number
ACARP	Australian Coal Association Research Program
AD	Acid/acidic drainage
AEP	Annual Exceedance Probability
AHD	Australian height datum
ALD	Assessment level decision
AMD	Acid and metalliferous drainage
ANC	Acid neutralising capacity
ANFO	Ammonium nitrate/fuel oil
AQOs	Acoustic quality objectives
AR&R	Australian rainfall and runoff
ASC	Australian Soil Classification
AUSRIVAS	Australian river assessment system
AWL	Associated water license

BCM	Bank Cubic Metre
BHP	BHP Minerals Australia
BMA	BM Alliance Coal Operations Pty Ltd
BVGs	Broad vegetation groups
CEC	Cation exchange capacity
CHPP	Coal handling and processing plant
cm	Centimetre
CQCA JV	Central Queensland Coal Associates Joint Venture (Comprising: BHP Coal Pty Ltd, QCT Mining Pty Ltd, Mitsubishi Development Pty Ltd, QCT Investment Pty Ltd, BHP Queensland Coal Investments Pty Ltd, QCT Resources Pty Limited, and UMAL Consolidated Pty Ltd.)
CSG	Coal seam gas
CVM	Caval Ridge Mine
DAWE	Department of Agriculture, Water and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DCS	Dust control system
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
DEWHA	Department of the Environment, Water, Heritage and the Arts
DNRM	Department of Natural Resources and Mines
DOTE	Department of the Environment
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
DSIT	Department of Science, Information Technology, Innovation and the Arts
DTW	Depth to Water
E	Endangered
EA	Environmental Authority
EC	Electrical conductivity
EIS	Environmental impact statement
EME	Earth-Moving-Equipment
EO	Environmental offsets
EP Act	Environmental Protection Act 1994
EPBC Act	Environment Protection and Biodiversity Conservation Act
EPPs	Environmental protection policies
ERA	Environmentally Relevant Activity
ESC	Erosion and sediment controls
ESCP	Erosion and sediment control Plan
ESD	Ecologically sustainable development
ESP	Exchangeable sodium percentage
FTE	Full time equivalent
FY	Financial Year
GDEs	Groundwater dependant ecosystems
GHG	Greenhouse gases
GMAs	Groundwater management areas
ha	Hectares

HES	High ecological significance
HSEC	Health, safety, environment and community
HVR	High value regrowth
IESC	Independent expert scientific committee
IPD	In pit spoil dumps
IRC	Isaac Regional Council
JORC Code	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves
kg	Kilogram
km	Kilometres
km^2	Square kilometres
LC	Least concern
LFC	Landscape fragmentation and connectivity
LOM	Life of mine
LOX	Limit of oxidation
m	Meter
m^3	Meters cubed
MAW	Mine affected water
mbgl	Metres below ground level
MCMs	Moranbah coal measures
mg/L	Milligrams per litre
MIA	Mine infrastructure area
MIC	Maximum instantaneous charge
ML	Mining lease
mm/s	Millimetre per second
MNES	Matters of national environmental significance
MPA	Maximum potential acidity
MPR	Mixed plant reject
MR	Mineral resources
MR Act	Mineral Resources Act 1989
MSES	Matters of state environmental significant
Mt/y	Million tonnes/y
Mtpa	Million tonnes per annum
MWMP	Mine water management plan
NA	Not applicable
NAF	Non-acid forming
NC	No concern
NCST	National committee on soil and terrain
NEPC Act	National Environment Protection Council Act 1994
NEPM	National Environment Protection Measures
NMD	Neutral mine drainage
OC	Of concern
OOPD	Out of pit dump
PAF	Potentially acid forming

PAF-LC	PAF low capacity
PDM	Peak Downs Mine
PMF	Probable maximum flood
PNC	Planning for noise control
PRCP	Progressive rehabilitation and closure plan
PTM	Poitrel mine
RE	Regional ecosystem
REDD	Regional ecosystem description database
REMP	Receiving environment monitoring program
ROM	Run-of-mine
ROPs	Resource operations plans
SA	Surface area
SIGNAL	Stream invertebrate grade number – average Level
SMU	Soil map units
SOPs	Standard operating procedures
STP	Sewage treatment plant
SWI	Standard work instruction
SWL	Sound power level
t/y	Tonnes/year
TARP	Trigger Action Response Plan
TDS	Total dissolved solids
TEPs	Transitional environment programs
TLF	Train load-out facility
tph	Tonnes per hour
TPHs	Total petroleum hydrocarbons
TQa	Tertiary-quaternary alluvium
TSS	Total suspended solids
W	Wetness
WMP	Water management plan
WQO	Water quality objective
WRPs	Water resource plans
WRR	Waste reduction and recycling
WWB	Water and wetland biodiversity

1 Introduction

1.1 The Application for Amendment

This document is referred to as the “Supporting documentation to the Amendment Application for Environmental Authority No. EPML00562013” (the EA Amendment Application). The Environmental Authority No. EPML00562013 (the EA) is held by the Central Queensland Coal Associates Joint Venture (CQCA JV). The EA relates to the Caval Ridge Mine (CVM) on Mining Lease (ML) 1775, ML 70403 and ML 70462, located approximately 7 km south of Moranbah in the Bowen Basin, Queensland as presented in Figure 1-1.

This EA Amendment Application seeks to secure approval for the Horse Pit Extension Project (The Project), comprising the extension of Horse Pit at CVM and related activities defined in detail under Section 3.

This documentation has been prepared to support the EA amendment Application under Section 226 of the Environmental Protection Act 1994 (EP Act). The ‘Project area’ is defined in this document as the area which encompasses the Project and its immediate surrounds as it relates to specific technical assessments, i.e., Groundwater Dependant Ecosystems (GDEs).

1.2 The Proponent

The Project proponent is BM Alliance Coal Operations Pty Ltd (BMA) as manager and agent on behalf of the CQCA JV. The CQCA JV is an unincorporated joint venture between BHP Group (50%) and Mitsubishi Corp. (50%). The Joint Venture arrangements are regulated in accordance with the Central Queensland Coal Agreement. This Joint Venture Agreement as amended most recently by Deed dated 28 June 2001 and a Strategic Alliance Agreement dated 28 June 2001, created BMA. Operations are managed by BMA on behalf of the CQCA JV under this Management Agreement.

BMA’s operations provide significant benefits to the local communities in which it operates, the broader Central Queensland region and to the Queensland economy as a whole. BMA is the largest employer in the Central Queensland region and plays a key role in its economic development. The substantial economic contribution in FY2021 is demonstrated by the following:

- A$3,391M spent by BMA on equipment, goods and services from other Queensland business
- A$1,379M spent by BMA on equipment, goods and services from interstate and New Zealand businesses
- US$617M in total payments to Governments (including corporate income taxes and royalties) related to BHP’s coal operations in Queensland which includes a 50% share of BMA plus the BMC South Walker Creek and Poitrel mines, and
- Over A$111M spent in local townships and communities via the CRES Local Buying Program (note: this includes payments related to the South Walker Creek and Poitrel mines as well as BMA’s operations).

In addition, BMA employs approximately 6,800 people directly (including contractors) in Central Queensland.

BHP’s long-term and ongoing commitment to sustainability is defined by ‘Our Charter’ and realised through ‘Our Requirements’ standards. These standards describe BHP’s mandatory minimum performance requirements and provide the foundation for the management systems at BHP operated assets. They are designed to help ensure BHP maintain and promote the long-term health of society and natural environment.

BMA is committed to the principles of sustainable development, including the wellbeing of its employees and communities. BMA is also committed to developing, implementing and maintaining management systems for health, safety, environment and the community that are consistent with best practices. This commitment is given practical effect by BHP’s Health, Safety, Environment and Community (HSEC) Management Standards, and the systems, procedures and operational protocols through which these standards are applied at a site level. Through these standards, BMA seeks to achieve its stated company goal of “zero harm to people and the environment”. The BMA EMS is aligned to ISO14001.

1.3 Horse Pit Extension Project Overview and Objectives

The Project proposes to extend the footprint of the existing Horse Pit at the CVM. As a result of exploiting efficiencies in mine sequencing and planning, mining activities are currently scheduled to reach the limit of the approved Horse Pit extent during Financial Year (FY) 2025, with some existing site infrastructure potentially being relocated from 2023. If approved, the extension is projected to extend the mine's life from the 2030s to the 2050s, protecting jobs and royalties into the future.

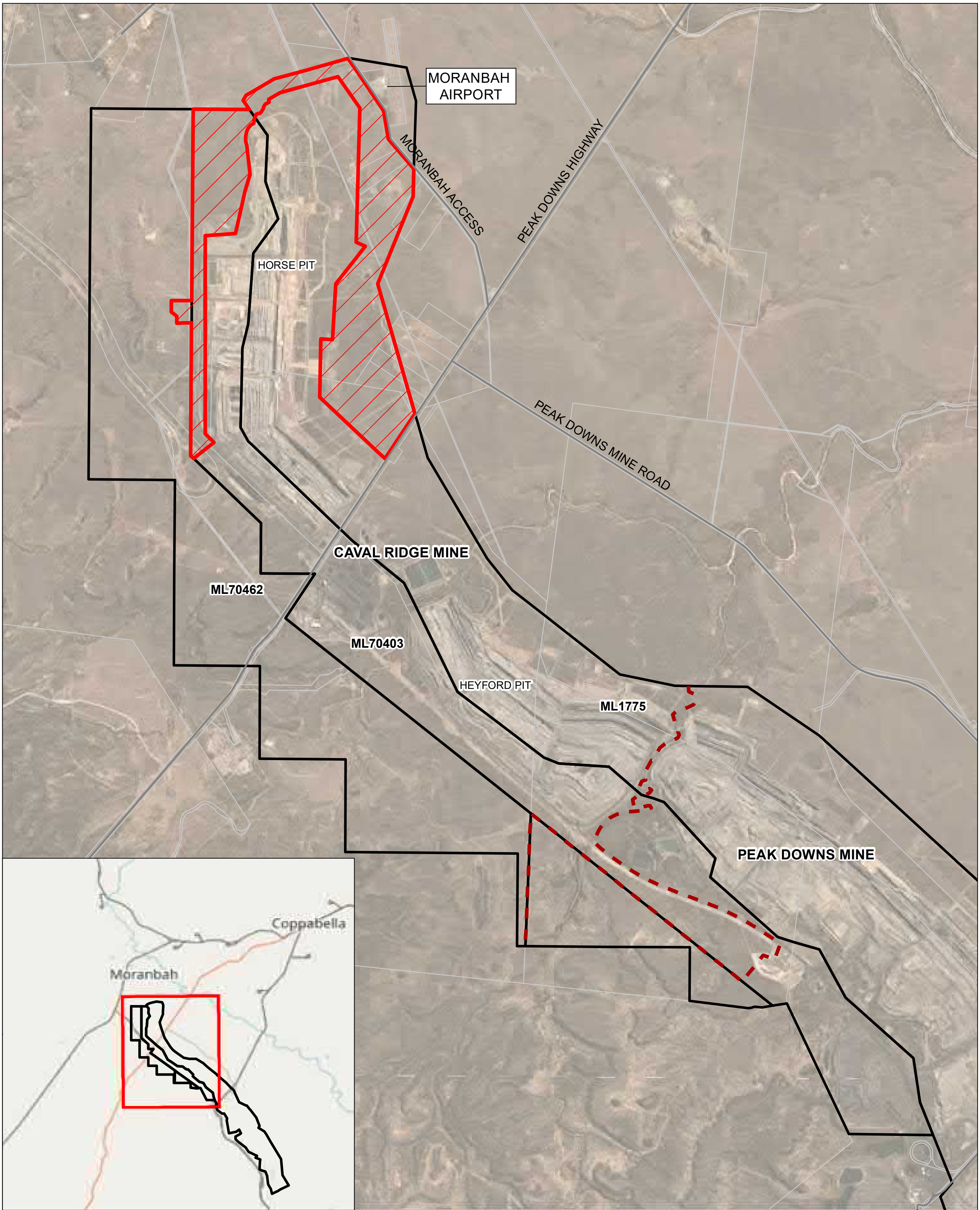
The key objectives of the Project are to:

- Continue to operate a sustainable and profitable mine
- Continue to operate a mine that complies with all relevant statutory obligations and continues to improve operations to ensure best practice environmental management
- Continue to operate a mine that does not compromise environmental and social indicators and standards
- Make efficient use of current infrastructure for the proposed capacity
- Reduce the disturbance to environmental values by minimising the footprint requirements, and
- Use similar proven strategies to those adopted at CVM, for example:
    - Early and progressive rehabilitation of disturbed areas
    - Protection of water quality by appropriate management systems, and
    - Adoption of appropriate landform designs to ensure sustainable final land use.

1.4 Structure of this Document

An overview of the Section and Appendices of this document is as follows:

- Section 1 – The Introduction includes details about the Proponent and a brief project overview and objectives.
- Section 2 – The Regulatory Considerations provides confirmation that this EA amendment application has been prepared in accordance with regulatory requirements.
- Section 3 – The Project Description includes an overview of the project location and description, providing context for the EA Amendment Application.
- Section 4 – Project Justification and Alternatives provides for an assessment of the justification and alternatives to the Project. An assessment addressing the 'standard criteria' is also provided in this Chapter.
- Section 5 – The Environmental Assessments outline a summary of the technical assessments supporting this EA Amendment Application.
- Section 6 – This section states BMA's intention as it relates to any amendment of the existing EA conditions.
- Appendices contain the Technical Reports for each relevant environmental discipline supporting the EA Amendment Application.



Projection: GDA 1994 MGA Zone 55
Scale: 1:100,000 at A4
Project No.: 620.13593
Date: 02-Nov-2021
Drawn by: PM

Roads
Caval Ridge Mine and Peak Downs Mine Boundary
Horse Pit Extension Project Area
BHP Tenements
Cadastre

Horse Pit Extension Project

Regional Locality

www.slrconsulting.com

BHP Mitsubishi Alliance

FIGURE 1-1

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Project Description\SLR62013593_PD_ProjectLocation_001.mxd

2 Regulatory Considerations

2.1 State Regulatory Approvals

There are two primary pieces of state legislation which are relevant to the Project. They are:

- EP Act, and
- *Mineral Resources Act 1989* (MR Act).

There are several other pieces of legislation that are also relevant to the Project. These are outlined where relevant under the environmental assessments provided in Section 5 and/or the associated technical reports provided in the Appendices.

2.1.1 Environmental Protection Act 1994

The EP Act was established "to protect Queensland's environment, while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends". Resource activities carried out on mining tenure are approved via the grant of an EA under Chapter 5 of the EP Act. When deciding whether to grant or refuse an application for an EA or an amendment to an EA or deciding on the conditions of the EA, the Department of Environment and Science (DES), the administering authority, must consider certain matters set out in the EP Act. The EP Act utilises several mechanisms to achieve its objectives. These include:

- Major and minor EA amendment application processes, including where applicable, an Environmental Impact Statement (EIS) process for resources projects
- Licensing or approving all Environmentally Relevant Activities (ERAs)
- Allowing for improvement through Transitional Environment Programs (TEPs)
- Issuing Environmental Protection Policies (EPPs)
- Regulating contaminated land, and
- Creating a general environmental duty.

In particular, the EP Act authorises the holder of an EA to apply to the DES for amendment to an EA under Section 224 at any time. The EA amendment application process is described below:

- EA Amendment Application
- Assessment Level Decision (ALD)
- Information stage (if requested by DES)
- Notification stage (if required)
- Decision Stage (including Notice of Decision)
- Draft EA issued
- Objections and Referral to the Land Court (if objections received)
- Land Court Process (if required), and
- EA Approved with Conditions.

An EA amendment is required where there is a proposed change to the nature and extent of authorised activities on an associated ML(s) and/or the conditions of the EA need to be amended. A major EA Amendment Application (not requiring an EIS) for a resource activity may be publicly notified should the DES decide that a substantial increase in the risk of environmental harm exists, and this risk is a result of substantial changes to contaminant releases or the results of these releases.

The CVM was assessed by the Coordinator-General via an EIS in 2010 with subsequent issue of an EA. The latest non-administrative amendment to the EA for the CVM came into effect on 17 August 2020. This amendment addressed Schedule D: Waste and reject conditions. In addition, conditions were moved to new schedules - Sewage Treatment (Schedule H) and Groundwater (Schedule I).

2.1.2 Assessment Level Decision

Within 10 business days after receiving an EA Amendment Application, the DES must make an ALD. The ALD process will determine whether the amendment application is a minor or major amendment (with or without an EIS). A major amendment for an EA under Section 223 of the EP Act “means an amendment that is not a minor amendment”. In light of this, an assessment of the proposed amendment for the Project against the minor amendment (threshold) criteria (as outlined in Section 223 of the EP Act) is presented in Table 2-1. This assessment demonstrates that the proposed amendment to the EA considered in this Report is not a minor amendment.

Table 2-1 Amendment Threshold Criteria

Amendment Threshold Criteria	This EA Amendment Application
The proposed amendment:	
(a) is not a change to a condition identified in the authority as a standard condition, other than – (i) a change that is a condition conversion; or (ii) a change that is not a condition conversion but that replaces a standard condition of the authority with a standard condition for the environmentally relevant activity to which the authority relates; and	The proposed amendment is not a change to a standard condition.
(b) does not significantly increase the level of environmental harm caused by the relevant activity; and	The proposed amendment will extend the footprint of Horse Pit into a new area, not previously assessed.
(c) does not change any rehabilitation objectives stated in the authority in a way likely result in significantly different impacts on environmental values than the impacts previously permitted under the authority; and	The proposed EA amendment does not change any rehabilitation objectives stated in the EA.
(d) does not significantly increase the scale or intensity of the relevant activity; and	The proposed amendment will extend the footprint of Horse Pit into a new area, not previously assessed. It involves a continuation of existing activities.
(e) does not relate to a new relevant resource tenure for the authority that is – (i) a new mining lease; or (ii) a new petroleum lease; or (iii) a new geothermal lease under the Geothermal Energy Act 2010; or (iv) a new GHG injection and storage lease under the Greenhouse Gas Storage Act 2009 (GHG Storage Act); and	The proposed amendment does not relate to a new relevant resource tenure for the EA.
(f) involves an addition to the surface area for the relevant activity of no more than 10% of the existing area; and	The proposed amendment does not increase the surface area authorised under the EA by more than 10%.
(g) for an environmental authority for a petroleum activity – (i) if the amendment involves constructing a new pipeline – the new pipeline exceeds 150 km: and (ii) if the amendment involves extending an existing pipeline – the extension will exceed 10% of the existing length of the pipeline; and	Not Applicable (NA).
(h) if the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit – the amendment application under section 224 seeks an amended environmental authority that is not subject to the standard condition for the relevant activity or authority, to the extent it relates to the permit.	NA

BMA’s proposal to extend the footprint of mining activities in Horse Pit will require, an EA Amendment Application and as such, an ALD will be triggered under the EP Act.

In addition, when considering an EA Amendment Application, the DES must consider certain matters set out in the EP Act. Section 143 of the EP Act describes the circumstances under which a resource activity may be assessed by an EIS process. The criteria that inform the decision-making process under Section 143 of the EP Act is outlined in the DEHP Guideline: "Triggers for environmental impacts statements under the Environmental Protection Act 1994 for mining and petroleum activities, 140210". BMA's assessment against the EIS triggers for the Project under this guideline has been outlined in Table 2-2.

Table 2-2 EIS Trigger Assessment for the Project

DES EIS Trigger	Trigger (Yes/No)	Justification
For existing mine extracting between 2-10 million tonnes/year (t/y) ROM ore or coal, an increase in annual extraction of more than of 100% or 5 million tonnes/y (Mt/y) (whichever is the lesser)	NA	
For existing mines extracting over 10 million t/y ROM ore or coal, an increase in annual extraction of more than 50% or 10 Mt/year (whichever is the lesser)	No	No increase in annual tonnage is proposed as part of this amendment.
For existing mines extracting more than 20 million t/y ROM ore or coal extraction, an increase in annual extraction greater than 25%	NA	NA
Proposed activities in a Category A or B environmentally sensitive area, unless previously authorised under Queensland legislation	See Table 2-3 below.	See Table 2-3 below.
A substantial change in mining operation, e.g., from underground to open cut, or (for underground mining), or a change from minor subsidence to potentially substantial subsidence	No	The Project is an extension to the existing Horse Pit operation at CVM. Therefore, the Project will utilise the existing mining techniques and infrastructure and remain as an open cut mine.
The introduction of a novel or unproven resource extraction process, technology or activity.	No	The Project will continue to utilise the existing extraction process and as such no novel or unproven resource extraction process will be introduced.

Table 2-3 Assessment of Category A & B Environmentally Sensitive Area for the Project

Category A & B Environmentally Sensitive Area	Triggered (Yes/No)	Reason
A Category A environmentally sensitive area means any of the following: (a) any of the following under the Nature Conservation Act 1992— (i) a national park (scientific); (ii) a national park; (iii) a national park (Aboriginal land); (iv) a national park (Torres Strait Islander land); (v) a national park (Cape York Peninsula Aboriginal land); (vi) a conservation park; (vii) a forest reserve;	NA	The Project is not located in any of these areas.
(b) the wet tropics area under the Wet Tropics World Heritage Protection and Management Act 1993;	NA	The Project is not located in any of these areas.
(c) the Great Barrier Reef Region under the Great Barrier Reef Marine Park Act 1975 (Cwlth);	NA	The Project is not located in any of these areas.
(d) a marine park under the Marine Parks Act 2004, other than a part of the park that is a general use zone under that Act.	NA	The Project is not located in any of these areas.
A Category B environmentally sensitive area means any of the following—	NA	The Project is not located in any of these areas.

Category A & B Environmentally Sensitive Area	Triggered (Yes/No)	Reason
(a) any of the following areas under the Nature Conservation Act 1992— (i) a coordinated conservation area; (ii) an area of critical habitat or major interest identified under a conservation plan; (iii) an area subject to an interim conservation order;		
(b) an area subject to the following conventions to which Australia is a signatory— (i) the 'Convention on the Conservation of Migratory Species of Wild Animals' (Bonn, 23 June 1979); (ii) the 'Convention on Wetlands of International Importance, especially as Waterfowl Habitat' (Ramsar, Iran, 2 February 1971); (iii) the 'Convention Concerning the Protection of the World Cultural and Natural Heritage' (Paris, 23 November 1972);	NA	The Project is not located in any of these areas.
(c) a zone of a marine park under the Marine Parks Act 2004;	NA	The Project is not located in a Marine Park.
(d) an area to the seaward side of the highest astronomical tide;	NA	The Project is not located in a tidal area.
(e) the following under the Queensland Heritage Act 1992— (i) a place of cultural heritage significance; (ii) a Queensland heritage place, unless there is an exemption certificate issued under that Act;	NA	There are no areas recorded on the Cultural Heritage Register in the Project area.
(f) an area recorded in the Aboriginal Cultural Heritage Register established under the Aboriginal Cultural Heritage Act 2003, section 46, other than the area known as the 'Stanbroke Pastoral Development Holding', leased under the Land Act 1994 by lease number PH 13/5398;	NA	There are no areas recorded in the Aboriginal Cultural Heritage Register in the Project area.
(g) a feature protection area, State forest park or scientific area under the Forestry Act 1959;	NA	The Project is not located in a State Forest/Park.
(h) a declared fish habitat area under the Fisheries Act 1994;	NA	The Project is not located in declared fish habitat.
(i) a place in which a marine plant under the Fisheries Act 1994 is situated;	NA	There are no marine plants protected under Fisheries Act 1994 in the Project area.
(j) an endangered regional ecosystem (RE) identified in the database known as the 'RE description database' kept by the department.	NA	The Project disturbance footprint is not located in an endangered RE identified in the database known as the 'RE description database'.

In summary, the assessment concludes that no EIS Triggers are relevant to the Project. Further, BMA anticipates that the ERAs listed on the current EA will remain the same.

2.1.3 Mineral Resources Act 1989

The MR Act provides for "the assessment, development and utilisation of mineral resources to the maximum extent practicable consistent with sound economic and land use management'. The principal objectives of the MR Act are to:

- Encourage and facilitate prospecting and exploring for and mining of minerals
- Enhance knowledge of the mineral resources of the State
- Minimise land use conflict with respect to prospecting, exploring and mining
- Encourage environmental responsibility in prospecting, exploring and mining

- Ensure an appropriate financial return to the State from mining
- Provide an administrative framework to expedite and regulate prospecting and exploring for and mining of minerals, and
- Encourage responsible land care management in prospecting, exploring and mining.

The MR Act provides that the Governor in Council may grant a ML for all or any of the following purposes:

- To mine the mineral or minerals specified in the lease and for all purposes necessary to effectually carry on that mining, and
- Such purposes, other than mining, as are specified in the ML and that are associated with, arising from or promoting the activity of mining.

A ML (with surface rights) under the MR Act is required to permit the conduct of mining and associated activities within the ML. Considering this, the Project will require two applications for additional surface area on two small portions of ML 1775 in the south-eastern section of the Project area to allow mining activities to occur. Refer to Section 3.3 and Figure 3-2.

2.2 Commonwealth Regulatory Approvals

Amongst other things, the Environment Protection and Biodiversity Conservation 1999 Act (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, or Matters of National Environmental Significance (MNES). The nine MNES categories protected under the EPBC Act are:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines), and
- A water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act requires an assessment and approval for any activity that has, or is likely to have, a significant impact on a MNES. Such an activity is deemed to be a ‘controlled action’. It is an offence to undertake a ‘controlled action’ without the approval of the Environment Minister. A referral to the Environment Minister has been made for the Project to confirm the approval pathway under the EPBC Act. The referral was submitted on 26 August 2021 and publicly notified on 9 September 2021. The Project was determined a ‘Controlled Action’ on 19 November 2021 requiring assessment via ’Preliminary Documentation’ for the following controlling provisions:

- Listed threatened species and communities (sections 18 & 18A), and
- A water resource, in relation to coal seam gas development and large coal mining development (section 24D & 24E).

The CVM Project was approved under the EPBC Act (2008/4417) in 2011 and a new submission under the EPBC Act has been made for the Horse Pit Extension Project.

2.3 Assessment Methodology

The initial step in developing the assessment methodology involved undertaking a gap analysis exercise considering the existing assessments that had been conducted for the CVM EIS. From this exercise, planned methodologies dictated forward work plans and allowed the various assessments to incorporate contemporary legislative, standards and guideline requirements. In order to adequately engage with the DES and address any issues of concern, a phased methodical approach has been undertaken by BMA. This approach focused on ongoing consultation with the DES to ensure baseline monitoring and technical assessments sufficiently addressed the potential environmental impacts. In addition, the assessment outlined appropriate mitigation measures commensurate to the identified environmental impacts.

The assessment methodology comprised the following key stages:

- Identification of environmental assessments to be conducted for the specific technical disciplines; and
- Technical Workshop Program (2 stage formal engagement with the DES to discuss the critical matter assessments).

Further details on each activity are provided below.

2.3.1 Environmental Assessments

The assessment methodology comprised of environmental assessments undertaken for the following critical matters.

- Land Resources
- Geochemistry
- Air Quality
- Noise and Vibration
- Surface Water Resources
- Groundwater Resources
- Terrestrial Ecology
- Aquatic Ecology and Stygofauna
- GDEs, and
- Waste Management.

These assessments were completed in line with relevant legislation, standards and guidelines.

2.3.2 Technical Workshop Program

The objective of the Technical Workshop Program was to develop and foster a close working relationship with the DES throughout the assessment process to ensure that the EA Amendment Application was based on appropriate data and sound methodologies. The workshop was separated into two sessions that took place on 20th and 21st October 2020, respectively. The workshop was an opportunity for the Project Team (comprised of the technical discipline specialists) to present their proposed methodologies to the DES. The workshop provided a forum for the DES and the Project Team to discuss requirements and to confirm the environmental assessment methodologies.

2.4 Consultation Activities

The key consultation activities undertaken for the Project are summarised in Table 2-4.

Table 2-4 Consultation Activities

Date	Consultation Purpose	Attendees	Location
20th October 2020	Technical Workshop (Session 1)	DES, BMA & SLR	Via Webex
21st October 2020	Technical Workshop (Session 2)	DES, DAWE, BMA & SLR	Via Webex
3 June 2021	DAWE Pre-lodgement Meeting	DAWE & BMA	DAWE Canberra
28 September 2021	Site walk-over with DES	DES & BMA	CVM
19 October 2021	DES Pre-lodgement Meeting	DES, BMA & SLR	Via Webex

3 Project Description

3.1 Background

The CVM is owned and operated by BMA, on behalf of the CQCA JV. The CVM project was approved by the Coordinator-General under the *State Development and Public Works Organisation Act 1971* in 2010 and has been in operation since 2014. Operations at CVM are carried out under the conditions of EA EPML00562013 and EPBC Approval (2008/4417).

The CVM is located primarily within ML 1775, with Harrow Creek acting as the southernmost boundary of CVM. Associated infrastructure for the CVM is located on ML 70403 and ML 70462. The CVM northern boundary is located approximately seven (7) kilometres (km) south-west of Moranbah in the Bowen Basin, Queensland. The CVM is an open cut mining operation using dragline and truck/shovel equipment that supplies hard coking coal product for the export market. CVM mines up to 15 million tonnes per annum (Mtpa) of Run-of-Mine (ROM) coal. CVM also receives ROM coal from BMAs neighbouring Peak Downs Mine (PDM), via conveyor, for processing. The future annual transfer of ROM coal from PDM is expected to vary between 5 and 11 million tonnes per annum.

The CVM includes two pits: Horse Pit (north of Peak Downs Highway) and Heyford Pit (north of Harrow Creek), both located within ML 1775, and In Pit Spoil Dumps (IPD). Existing infrastructure is located primarily within ML 70403 and ML 70462 and includes the Caval Ridge rail spur (Goonyella System), Train Load-out Facility (TLF) and coal stockpiles, ROM stockpiles, Out Of Pit Spoil Dumps (OOPD), Coal Handling and Processing Plant (CHPP), water management infrastructure and supporting infrastructure (i.e., roads, powerlines, laydown area, workshops and offices). The location of the CVM is presented in Figure 1-1.

The CVM EIS (2010) and subsequent EPBC Approval (2008/4417) (herein referred to as CVM EIS approval) was based on a 30-year mine plan across defined extents for Horse Pit and Heyford Pit. The CVM EIS approval related to open cut mining operations (using dragline and truck/shovel equipment) consisting of two pits, namely Horse Pit and Heyford Pit. The EIS described the removal of overburden primary using a dragline with an increased proportion removed using truck and shovel fleets as the pit deepens. Following this, the coal seams are mined using a combination of excavators, front-end loaders and large capacity coal haulers. The EIS also described that overburden and interburden spoil is predominantly disposed of into the pits behind the operating strip, with a smaller component to be disposed of at an out-of-pit spoil pile.

Due to changes in mine sequencing, improvements in mining efficiency and further resource definition, an extension to the CVM EIS approved mining footprint of Horse Pit is required to continue mining. The proposed Project represents a continuation of approved activities for a footprint that progressively works eastward beyond the CVM EIS approved extent.

This Section outlines the details of the Project.

3.2 Project Overview

The Project proposes to extend the footprint of the existing Horse Pit at the CVM. As a result of identifying efficiencies in mine sequencing and planning, mining activities are currently scheduled to reach the limit of the approved Horse Pit extent during FY2025, with some existing site infrastructure potentially being relocated from 2023. If approved, the extension is projected to extend the mine’s life from the 2030s to the 2050s, protecting jobs and royalties into the future. Exploration activities will be ongoing for the life of the mine.

BMA currently holds Surface Area (SA) rights to mine the remainder of ML 1775 exclusive of three areas of nil-SA to the east of Horse Pit and adjacent to the Peak Downs Highway, as outlined under Section 3.3. The nil-SA parcel in the east of ML 1775, immediately north of the Peak Downs Highway, will require an application for SA rights under the MR Act. The nil SA adjacent to the Peak Downs Highway, will also require an application for SA rights under the MR Act. The nil-SA associated with the Moranbah Airport and Moranbah Access Road in the north-east of ML 1775 is not included within the scope of the Project.

The Project covers the existing MLs: ML 1775, ML 70403 and ML 70462 and will be confined to the Horse Pit area north of the Peak Downs Highway. The Project overview is shown on Figure 3-1 and key elements of the Project are summarised below.

3.2.1 Mining Methodology

The key mining elements of the Project are detailed in Section 3.5 and summarised below:

- Progression of mining to the east beyond the CVM EIS approved extent of the existing Horse Pit from FY2025, exclusive of Moranbah Airport and the Moranbah Access Road
- Maximum CVM ROM coal production up to 15 Mtpa
- Revised CVM Life of Mine (LOM) to FY2056
- Spoil is progressively filled in pit voids behind (to the west of) the active strip as mining operations progress down dip, with final void remaining at closure. In addition based on spoil management calculations the Project includes development of an Out of Pit Dump (OOPD) in the north-west of ML 70403 (commencing in FY2028)
- Continuation of progressive rehabilitation of disturbed areas with the aim of progressing to a final landform design, including a final void of approximately 680ha in the far east of ML 1775 at the conclusion of mining
- Continuation of current open cut mining techniques employed at CVM
- Continuation of progressive disposal of mining waste and CHPP rejects to IPDs
- Continued use of the existing accommodation and workforce strategy, and
- Continuation of exploration activities.

3.2.2 Mine Infrastructure

The key mine infrastructure elements of the Project are detailed in Section 3.6 and summarised below:

- Relocation of enabling infrastructure, including: an Earth-Moving-Equipment (EME) Build Pad, blasting compound (two potential relocation options), go-lines, substations, back-access roads and powerlines as required by the progress of mining
- Extension of the haul road to access to the proposed OOPD in the north-west of ML 70403 including the construction of a bridge over Horse Creek
- Construction of two flood levees: the northern levee bounds a portion of Horse Pit and the western levee is located at the south-west extent of the proposed OOPD
- Relocation of mine water dams and pipelines as required by the progress of mining
- Expansion of sediment dam capacities and construction of new sediment dams, clean water diversion drains and mine affected water (MAW) drains to manage runoff associated with the proposed OOPD
- Relocation of the Peak Downs Highway dragline crossing
- Continued use of the CHPP complex, no upgrades to the CHPP are required as a result of the Project
- Continued disposal of dewatered tailings and rejects within spoil, and
- Continued use of the conveyor from PDM, Caval Ridge rail spur, TLF, product coal stockpiles, ROM stockpiles, IPDs, water management system and supporting infrastructure (i.e., roads, powerlines, laydown, workshops and offices).

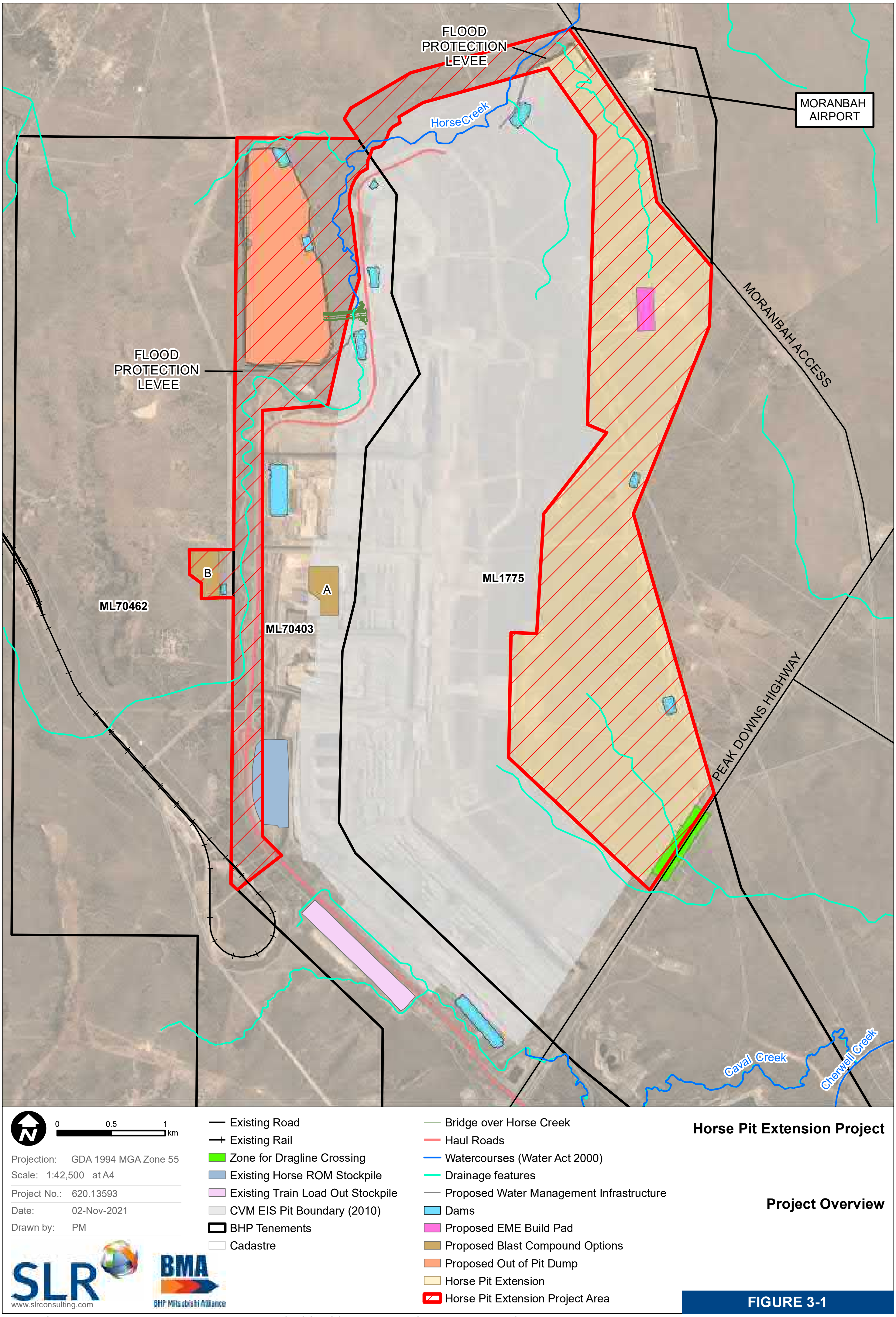
3.2.3 Mine Closure

The Project will extend the life of the CVM from 2030s to the 2050s. In accordance with Condition E3 of the EA, all areas significantly disturbed by mining activities must be rehabilitated in accordance with the defined requirements. In addition, all infrastructure (Condition E16 of the EA) constructed by or for the CVM must be removed from the site (except where agreement is reached). The Project will continue to implement existing rehabilitation and landform planning activities as current operations. In addition, the rehabilitation and closure activities will be guided by the Progressive Rehabilitation and Closure Plan (PRC Plan) for the mine.

The CVM PRC Plan will deliver the comprehensive details around rehabilitation of Horse Pit in line with the DES Guideline – Progressive rehabilitation and closure plans (PRC Plans) (ESR/2019/4964, DES 2021) requirements. BMA has been issued a transition notice by the DES and the submission date of the CVM PRC Plan is 1 December 2023, and the document is currently under preparation. BMA will be submitting a PRC Plan that includes the CVM existing approved activities and also the extension of Horse Pit (the subject of this EA amendment, scheduled to be approved prior to PRC Plan submission). Where available, PRC Plan related content has been provided in this application and further details will be included in the CVM PRC Plan submission in accordance with the DES PRC Plan Guideline (DES 2021) requirements.

The final landform design is based on mine planning information and other detail available at the time of preparation of the application for the amendment (submitted 15 December 2021). The main features of the final landform will be the overburden dumps to the west, and Horse Pit final void in the east. The design of the final landform has been developed through an understanding of the spoil type and volume, (waste characterisation), mining sequence and schedules, and required post mining land use outcomes. The closure landform (with the exception of the top of spoil dumps and residual void) will be free draining and will not require sediment dams or other water control structures. The design of spoil dumps is an important part of mine rehabilitation. The spoil dumps will be constructed in lifts (or benches) which will be regraded and reshaped to suitable slopes and contour characteristics prior to soil preparation and revegetation activities.

Environmental, economic and safety considerations are contemplated in order to minimise risk of failure.



Horse Pit Extension Project

Project Overview

FIGURE 3-1

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3.3 Mining Tenure and Land Ownership

3.3.1 Mining Tenure

The activities that are the subject of this EA Amendment will occur on ML 1775, ML 70403 and ML 70462, north of the Peak Downs Highway on the SA's associated with the CVM and two nil-SA's located within ML 1775. The two nil-SA's (associated with the proposed pit extension area and zone for dragline crossing) require an 'Application for additional surface area (AASA) on a ML', which will be lodged by BMA in conjunction with the EA Amendment Application.

Mining and associated exploration/infrastructure will be contained within ML 1775 on SA11, SA7 and the area of nil-SA on the eastern extent of the ML 1775 immediately north of the Peak Downs Highway. A second SA application is required for the nil SA adjacent to the Peak Downs Highway, which will be utilised for a future dragline crossing and access point. Infrastructure will continue to be contained primarily within ML 70403 and ML 70462, of which both leases are associated with approved SA's.

Details of relevant mining tenure associated with the Project is outlined in Table 3-1 and shown on Figure 3-2.

Table 3-1 Existing CVM Tenure

Tenure	Surface Areas		Holder	Grant date	Expiry date
	SA No.	SA Grant Date			
ML 1775	SA2	12-02-1987	BHP Coal Pty Ltd (40.75%) QCT Mining Pty Ltd (15.78%) Mitsubishi Development Pty Ltd (15.53%) QCT Investment Pty Ltd (12%) BHP Queensland Coal Investments Pty Ltd (8.5%) QCT Resources Pty Limited (6.69%) UMAL Consolidated Pty Ltd (0.75%)	22-12-1983	31-12-2031
	SA3	20-03-1995			
	SA4	30-05-1996			
	SA7	11-01-2000			
	SA10	19-06-2007			
	SA11	19-06-2007			
	AASA16	TBC (north of Peak Downs highway)			
	AASA TBC	TBC (dragline crossing area adjacent to Peak Downs Highway)			
ML 70403	SA1	1-01-2011	BHP Coal Pty Ltd (40.75%) QCT Mining Pty Ltd (15.78%) Mitsubishi Development Pty Ltd (15.53%) QCT Investment Pty Ltd (12%) BHP Queensland Coal Investments Pty Ltd (8.5%) QCT Resources Pty Limited (6.69%) UMAL Consolidated Pty Ltd (0.75%)	9-12-2010	31-12-2031
ML 70462	SA1	24-02-2014	BHP Coal Pty Ltd (40.75%) QCT Mining Pty Ltd (15.78%) Mitsubishi Development Pty Ltd (15.53%) QCT Investment Pty Ltd (12%) BHP Queensland Coal Investments Pty Ltd (8.5%) QCT Resources Pty Limited (6.69%) UMAL Consolidated Pty Ltd (0.75%)	24-02-2014	28-02-2035

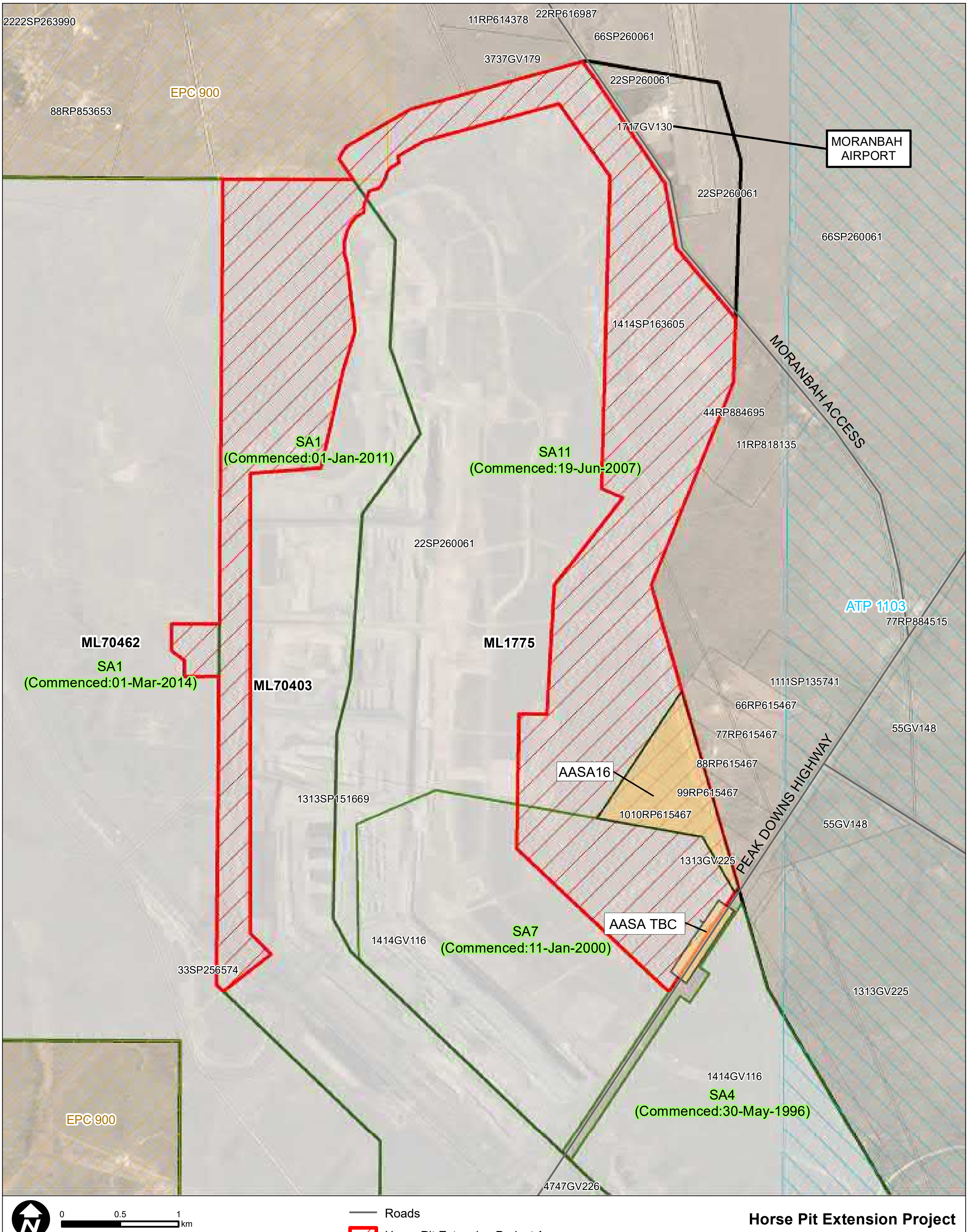
3.3.2 Land Ownership

Details of relevant land ownership tenure is outlined in Table 3-2 and shown on Figure 3-2.

Table 3-2 CVM Underlying Landholders and Titles

Landowner / counterparty	Land Title
BHP Coal Pty Ltd & Others[1]	2SP260061 (freehold)
	14SP163605 (freehold)
	4RP884695 (freehold)
	13SP151669 (freehold)
	14GV116 (freehold)
	13GV225 (freehold)
	7RP615467 (freehold)
	8RP615467 (freehold)
	9RP615467 (freehold)
	10RP615467 (freehold)
	18GV135 (freehold) [2]
	40SP278682 (freehold) [2]
	47GV226 (freehold) [2]
	3SP256574 (freehold) – CVM Rail Spur
BHP Coal Pty Ltd	4SP174999 (freehold) [2]
	17GV130 (Land Lease) – Moranbah Airport [2]
Private Landowner	8RP853653 (freehold)
Department of Transport & Main Roads	Peak Downs Highway (State Controlled Road 33A)
Department of Natural Resources, Mines & Energy	Stock Routes 404ISAA
Isaac Regional Council	Moranbah Access Road
	Unnamed Road parcel (splits 40SP278682)

[1] BHP Coal Pty Ltd (ABN 83 010 595 721), Umal Consolidated Pty Ltd (ABN 29 000 767 386), BHP Queensland Coal Investments Pty Ltd (ABN 56 098 876 825), Mitsubishi Development Pty Ltd (ABN 17 009 779 873), QCT Investment Pty Ltd (ABN 45 010 487 831), QCT Mining Pty Ltd (ABN 47 010 487 840), QCT Resources Pty Ltd (ABN 74 010 808 705).
[2] Properties outside of Project area.



Projection: GDA 1994 MGA Zone 55

Scale: 1:42,500 at A4

Project No.: 620.13593

Date: 02-Nov-2021

Drawn by: PM

Roads
Horse Pit Extension Project Area
Application for Additional Surface Area (AASA) extents
Surface Areas (SA)
Authority to Prospect (ATP)
Exploration Permit Coal (EPC)
Cadastre
BHP Tenements

Horse Pit Extension Project

CVM Tenure and Land Ownership

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FIGURE 3-2

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3.4 Resource Characterisation

3.4.1 Regional Geological Setting

The Bowen Basin is divided into broad morphotectonic zones, which represent areas of maximum sediment accumulation and adjacent shelf areas. Subdivision of these areas is broadly north-northwest to south-southeast in the northern part of the basin often bounded by major faults. In the northern extent of the Bowen Basin the significant elements are the Collinsville Shelf in the west and the Nebo Synclinorium to the east, both formed in extensional grabens in the early Permian (Johnson & Wheeler, 2008).

Post-depositional structure of the Bowen Basin sequence is dominated by compressional tectonics with the major direction of tectonic movement to the west and southwest in the north of the basin. This compressional tectonic phase has formed large meridional regional scale north-northwest trending easterly dipping thrust faults, the major structural elements in the Bowen Basin. The CVM is located on the north-western limb of the Permo-Triassic Bowen Basin.

3.4.2 Local Geology

The CVM is situated on the western limb of the northern Bowen Basin at the southern end of the Collinsville Shelf. The Permian coal measures in the region dip east at three to six degrees. Seam splitting is common at the CVM, specifically in the Horse Pit area, and results in local steepening of the coal seam dips. Structurally there is one major fault in the north of Horse Pit and some minor associated faulting.

Economic coal seams occur in the terrestrial Moranbah Coal Measures (MCMs) and consist of approximately 300 m of labile sandstone, siltstone, mudstone, tuffaceous claystone and coal. Underlying the MCMs is the German Creek Formation: a marine influenced formation with quartzose to labile sandstone, siltstone, mudstone and thin coal seams. Overlying the MCMs is the Fort Copper Coal Measures that are characterised by thick uneconomic banded coal seams and tuffaceous sediments.

Remnant Tertiary basalt flows occur in the north of the Horse Pit. Elsewhere, Quaternary sands and clayey sands up to 30 m thick overlay the Permian sequence.

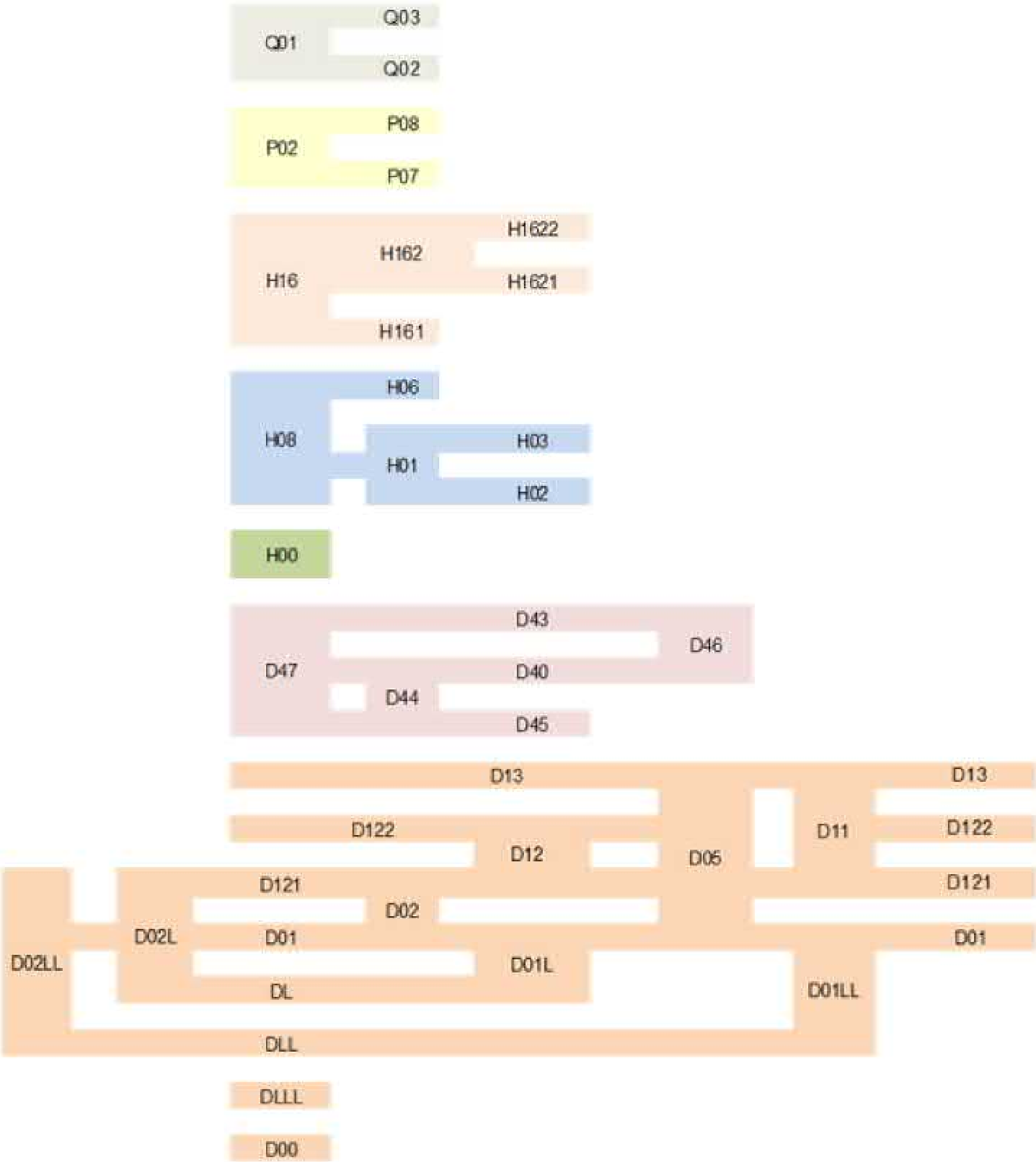
3.4.3 Seam Stratigraphy

The targeted seams at the CVM and the Horse Pit include all seams that comprise the MCMs exceeding 40 cm in thickness. The primary seam targets at Horse Pit are the Q seam to P seam, the Harrow Creek (H) group of seams, and the Dysart (D) seams. All seams greater than 40 cm are determined to be targets for coking coal production. Seam nomenclature is based on the seam position relative to the ‘P Tuff’, a regional sedimentary marker (1 – 2 m thick). The seams at CVM are outlined in descending stratigraphic order in Table 3-3 and the general stratigraphy at Horse Pit is illustrated on Figure 3-3.

Table 3-3 Stratigraphy of the MCMs at CVM

Coal Sequences	Description
Q seam	Comprises several coal intervals modelled as Q01, Q02, and Q03. Throughout CVM, the Q seam is a full seam (Q01), splitting into Q02 and Q03.
P seam	Splits from a single seam in the south into several plies northwards. The major units are modelled as P02, P07, and P08, so named due to the association with the P Tuff that is consistent through this part of the Bowen Basin.
Harrow Creek Seam	At CVM, H16 is present along with seam splits H162 and H161 while H15 is missing but substituted by its lowest splits H06, H03, H02 and H00.
Dysart Upper seam	Fully coalesced and is modelled as D47, but it splits into multiple units at both ends of the ML. At CVM, D47 splits to D43, D40 and D45. D43 and D40 are largely shaly while D45 is often less than 0.3 m thick.

Coal Sequences	Description
Dysart Main seam	Three (3) major splits (D13, D121 and D02) exist over most of Horse Pit. Frequent splitting and coalescing occur including in the north of Horse Pit where the DL seam sits within 30 cm and is modelled with the D02.
DL seam	A consistent 60 cm band occurs under the D02 throughout most of CVM. Two additional coaly bands sitting below the DL have been identified and modelled: DLL (approx. 20 cm thick) and DLLL (10-20 cm thick).
D00 & C01 seams	Two additional horizons below the D02 seam were identified as D00 and C01 seams. D00 seam is located approximately 20 m below D02. It averages 1 m thick but reaches a maximum of 2.0-2.5 m in places. At this time, initial quality results indicate a high ash coal and poor yielding seam. C01 occurs 50-55 m below the D02 and is about 1 m thick. It has only been logged in stratigraphic chip holes, no quality data is currently available for the C01. D00 and C01 seams are not planned to be targeted by mining at CVM or the Project.



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Projection: GDA 1994 MGA Zone 55
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LEGEND

Horse Pit Extension Project

Horse Pit Seam Stratigraphy

FIGURE 3-3

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3.4.4 Resources and Reserves

Coal resources and reserves estimates for the CVM were reported in the BHP Annual Report 2020 in accordance with the reporting guidelines of the 2012 Joint Ore Reserves Committee of The Australasian Institute of Mining and Metallurgy, Australasian Institute of Geoscientists, and Minerals Council of Australia ("JORC Code 2012"). The JORC Code classified resources and reserves identified for CVM are summarised in Table 3-4.

Table 3-4 JORC Classified Resources and Reserves (30 June 2020) – Caval Ridge Mine

Resources (Mt)				Reserves (Mt)		
Measured	Indicated	Inferred	Total	Proved	Probable	**Total**
332	216	147	695	232	101	333

The JORC classified reserves for the Project by target seam are presented in Table 3-5.

Table 3-5 JORC Classified Reserves (30 June 2020) – Target Seams Caval Ridge Mine

Target Seam Reserves (Mt)				
Dysart	Harrow Creek	P Seam	Q Seam	**Total**
140	128	54	11	333

3.4.5 Coal Washability

The coal quality summary for reserves outlined in Table 3-5 are presented in Table 3-6.

Table 3-6 Coal Quality Summary – Target Seams Caval Ridge Mine

Parameter	Dysart	Harrow Creek	P Seam	Q Seam	Average
Average Raw Ash (% ad)	28.19	31.71	30.97	31.00	30.04
Average Energy (MJ/kg ar)	31.44	30.74	29.58	30.06	30.83
Average RD (t/cu.m ar)	1.55	1.57	1.54	1.56	1.56
Average FC (% ad)	48.76	43.64	43.73	42.90	45.83
Average TS (% ad)	0.58	0.56	0.51	0.55	0.56
Average VM (% ad)	21.26	22.57	23.39	24.36	22.19

3.4.6 Resource Utilisation

There are three (3) areas within ML 1775 and the vicinity of the Project coal resources that have not been included in forward mining plans. Two of these areas are associated with Horse Creek (downstream of the existing diversion to the west of Horse Pit) that are not being targeted for mining given the costs and impacts associated with further diversions of Horse Creek. Further studies are required in relation to the area of nil-SA associated with the Moranbah Airport and Moranbah Access Road prior to any decision to seek approval to mine in that area. A buffer zone of approximately 100 m in width has been adopted along the eastern boundary of ML 1775 between the Moranbah Access Road to, and including, the Peak Downs Highway and the proposed pit extent. The zone will include some relocated infrastructure, as outlined in Section 3.6.

Resource within the nil-SA in the east of ML 1775, immediately north of the Peak Downs Highway, is proposed to be mined out commencing in FY2036 (subject to the application for SA right over this area), refer to Section 3.5.

3.5 Mine Planning and Design

3.5.1 Mining Method

The mining method utilised for the Project will be consistent with the current operations at the CVM, i.e., open cut mining methods utilising dragline and truck/shovel equipment. This is a proven mining method at the CVM that operates efficiently with resource geometry and offers operational flexibility. Operations are proposed to run seven (7) days per week on a 24hr basis.

Mining activities commence with vegetation clearing and topsoil stripping. All topsoil is stripped using earthmoving equipment, and relocated using front end loaders, trucks and/or scraper fleet, and will be stockpiled in preparation for progressive rehabilitation behind the active dumps. Direct respread will be the preferred method, where practical, to minimise topsoil handling, which reduces loss of viability from damage to soil structure and propagules.

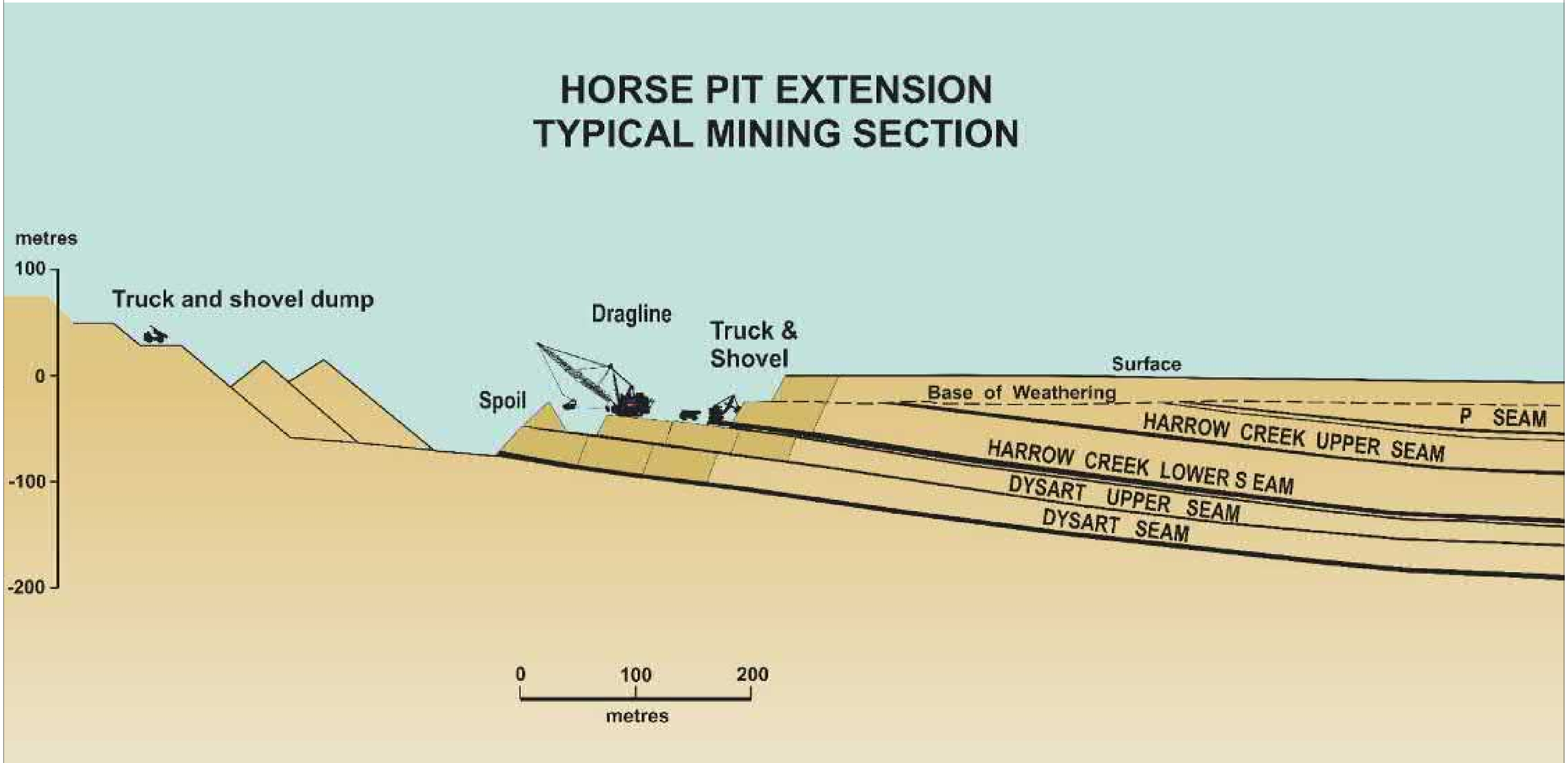
Following stripping, drilling and blasting will be undertaken to remove overburden and interburden material. These activities will continue and be managed as per current methods at the CVM. When hard rock is encountered, drilling and blasting is used to break-up the overburden into suitable sizes for loading and hauling. Similarly, through seam blasting is also undertaken as required. The removal of overburden will continue as per current methods by utilising a combination of truck/shovel fleets and draglines. At Horse Pit, all seam Limit of Oxidation (LOX) lines are mined, and mining continues down dip as target seams become deeper from the surface as mining progresses. Initially, overburden will be primarily removed using a dragline. In deeper extents of the pit, an increased proportion of the overburden material will be removed using truck/shovel. In general, excavated waste material will be placed in strip voids to the west of active strip as mining operations progress down dip to the east.

In addition, preparation for construction of a new OOPD will commence during FY2028 to the northwest of Horse Pit. Overburden material will be mined and managed via spoil disposal in existing in-pit dump area at the CVM as a priority, and the proposed OOPD location to the north-west of Horse Pit in ML 70403 when additional capacity is required.

The strip-mining technique currently in practice at the CVM will continue for the Project. The length of the strip is typically 1.5 km to 2 km, with strip widths of 60 m. The strips will be constructed in a north-south direction along the strike of the coal seams. The angle of the high wall will be dependent on the nature of the high wall materials and geotechnical conditions. Coal ramps will extend into the active pits with the surface haul roads connecting them to the ROM stockpiles.

The number of strips opened at any given time depends on the coal production schedule and equipment productivity requirements. Coal mining of upper and lower seams will continue to use a combination of excavators and loaders. Once the coal has been exposed, it is loaded by excavators and loaders into trucks for hauling on the network of haul roads to the CVM ROM coal stockpiles. The ROM coal will then be screened, crushed and stored in the raw coal stockyard for processing. Reject material from coal handling and processing is mixed with fine tailings and co-disposed with spoil in IPDs. Final dumps are capped with clean spoil material and will not include reject materials. The product coal is then stockpiled via conveyor and transported to the TLF for rail out via the CVM rail spur and Goonyella Line to the Hay Point Coal Terminal.

A typical mining section of the operating Horse Pit is shown in Figure 3-4 and a schematic of the mining process at the CVM is shown in Figure 3-5.



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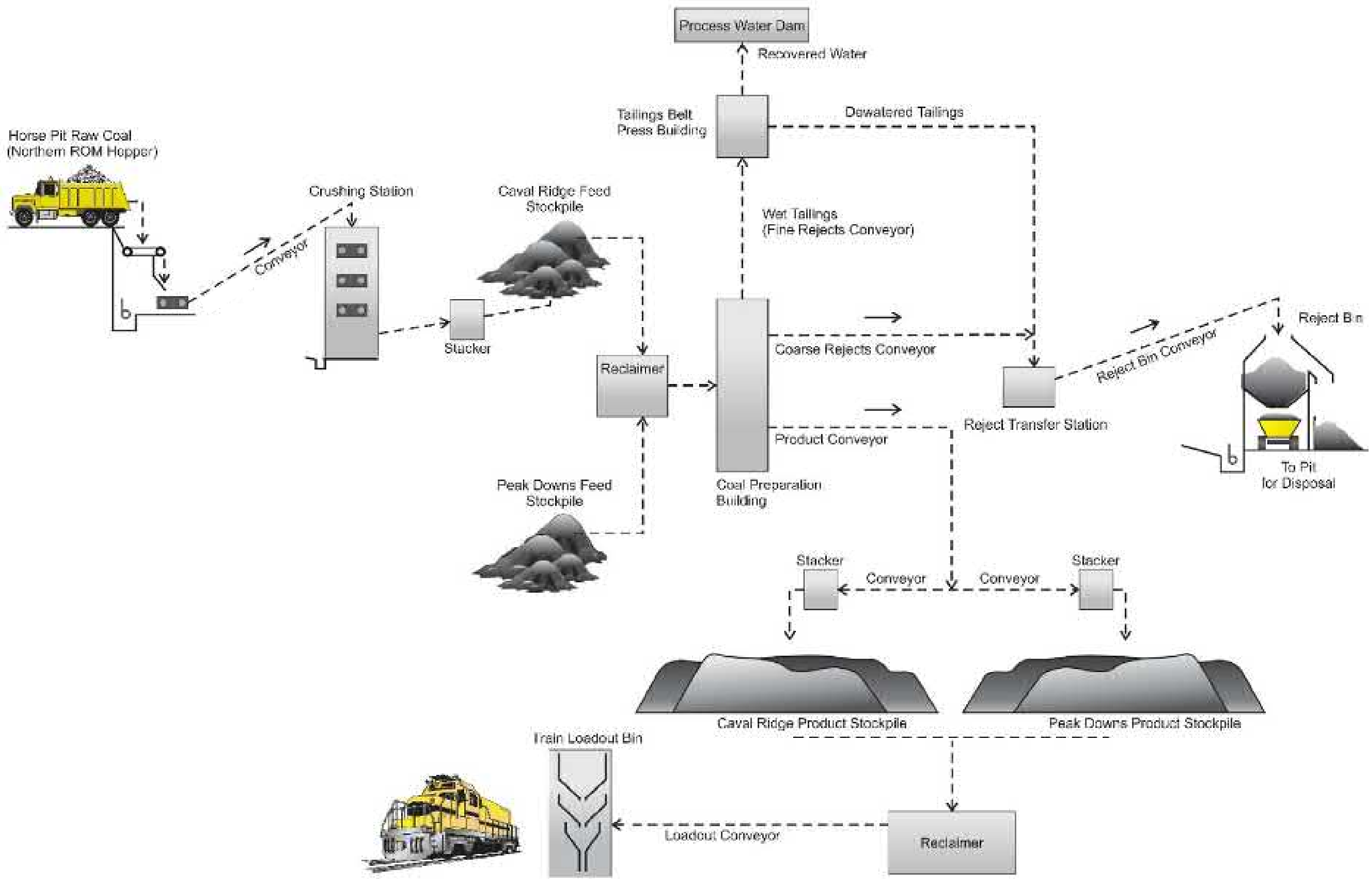
Horse Pit Extension Project

Typical Mining Section – Horse Pit Extension

FIGURE 3-4



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SLR BMA BHP Mitsubishi Alliance

Horse Pit Extension Project

Mining Process Overview

FIGURE 3-5

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3.5.2 Mine Sequence and Schedule

The mine schedule has been developed based on the prioritisation of high margin areas and maintaining a pit configuration and sequence which will allow optimal utilisation of draglines. The mine schedule has been optimised on the basis of air quality management considerations. The mine schedule also considers a targeted saleable blend of various seams with different qualities. The assumed commencement date of mining activities (eg vegetation clearing) outside the extent approved in the CVM EIS is FY2025, noting that various infrastructure items that intersect the extension of Horse Pit will require relocation prior to FY2025. The assumed date for the conclusion of mining is FY2056 and establishment of the final landform will align with the CVM Progressive Rehabilitation and Closure Plan (PRCP). The proposed mine schedule is presented in Figure 3-6.

Mining will continue to the east and mined-out areas in the west will be progressively rehabilitated. A final void will remain in the far east of ML 1775 at the conclusion of mining. The mining sequence for the Project will entail the following:

- Progressive land clearing and topsoil removal
- Stockpiling topsoil from disturbed areas for storage and use in future rehabilitation of the site
- Drill and blasting of overburden/interburden material (including through seam blasting)
- Pre-stripping/excavation of overburden material using excavators/shovels and trucks, draglines and dozers
- Side casting of lower overburden into the previously mined strip using a dragline
- Removal of overburden/interburden and placement in either the IPD or OOPD
- Loading and hauling of ROM coal using a combination of excavators, loaders and trucks (CVM will continue to receive ROM coal via conveyor from PDM), and
- Progressive rehabilitation by backfilling the mined-out pit, reshaping dumps, topsoiling/alternate growth media and revegetation.

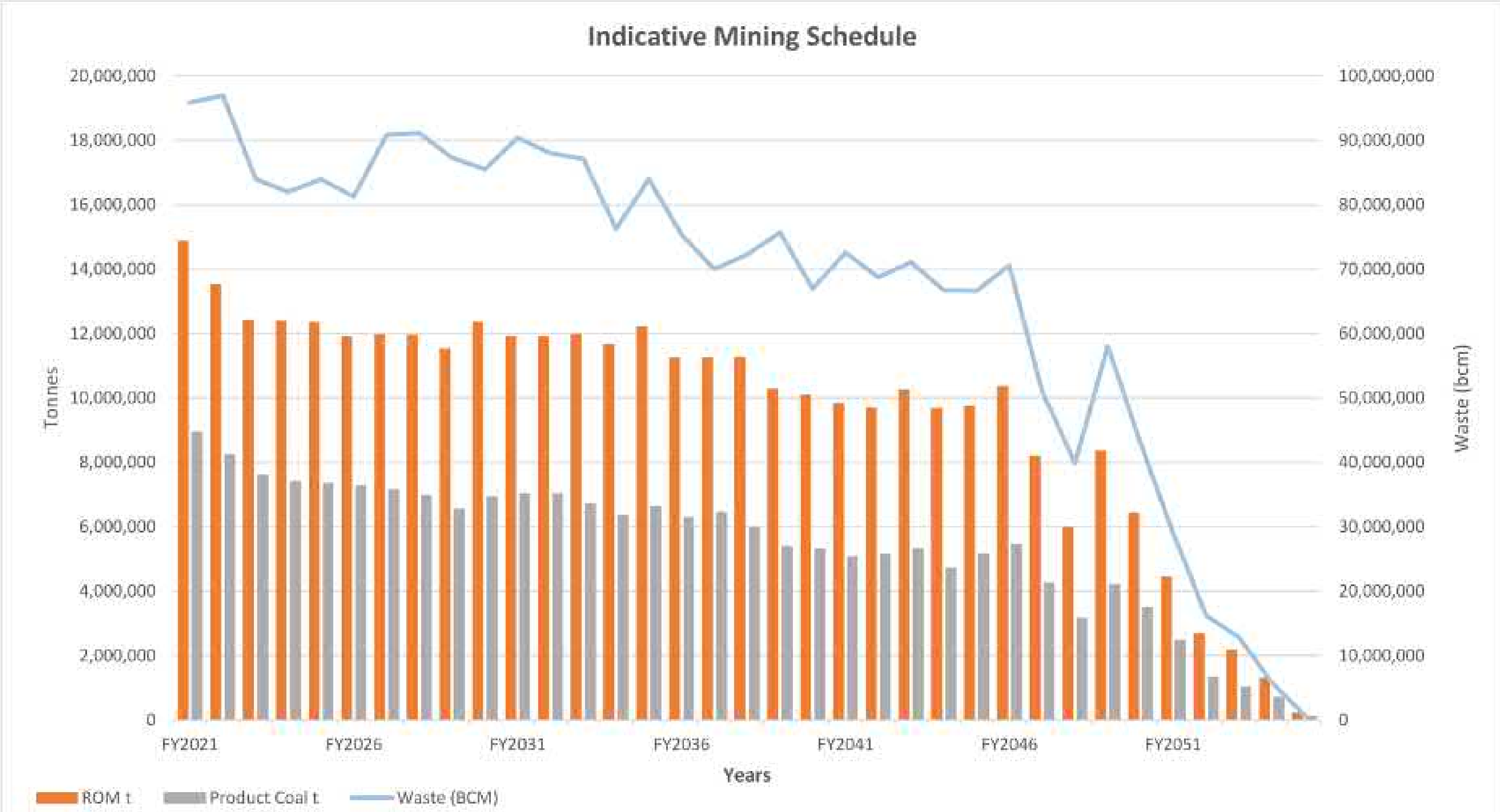
The 5-yearly mine plan outlining proposed progressive landform is presented in Figure 3-7 to Figure 3-13. The conceptual final landform including locations of elevated landforms (former OOPD) and the depressed landforms is presented in Figure 3-14.

3.5.3 Production Schedule

The maximum ROM coal production at CVM is up to 15 Mtpa, with an average annual ROM coal production of 12.5 Mtpa over the LOM to FY2056. Up to 11 Mtpa of ROM coal from PDM will be transferred by conveyor to CVM annually. Product coal output is likely to be up to 10 Mtpa, inclusive of ROM coal from PDM.

The final production sequence will depend on economic, scheduling and infrastructure constraints. Indicative ROM coal production is proposed to steadily decline from FY2038 to FY2056 from up to 15 Mtpa to less than 1 Mtpa in the final year of mining. Product coal will follow the same trend, decreasing from up to 9 Mtpa to less than 0.5 Mtpa.

The Project schedule showing ROM and product coal tonnes, and waste volume is presented in Figure 3-6.



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Horse Pit Extension Project

Indicative Mine Schedule – Materials Movements

FIGURE 3-6

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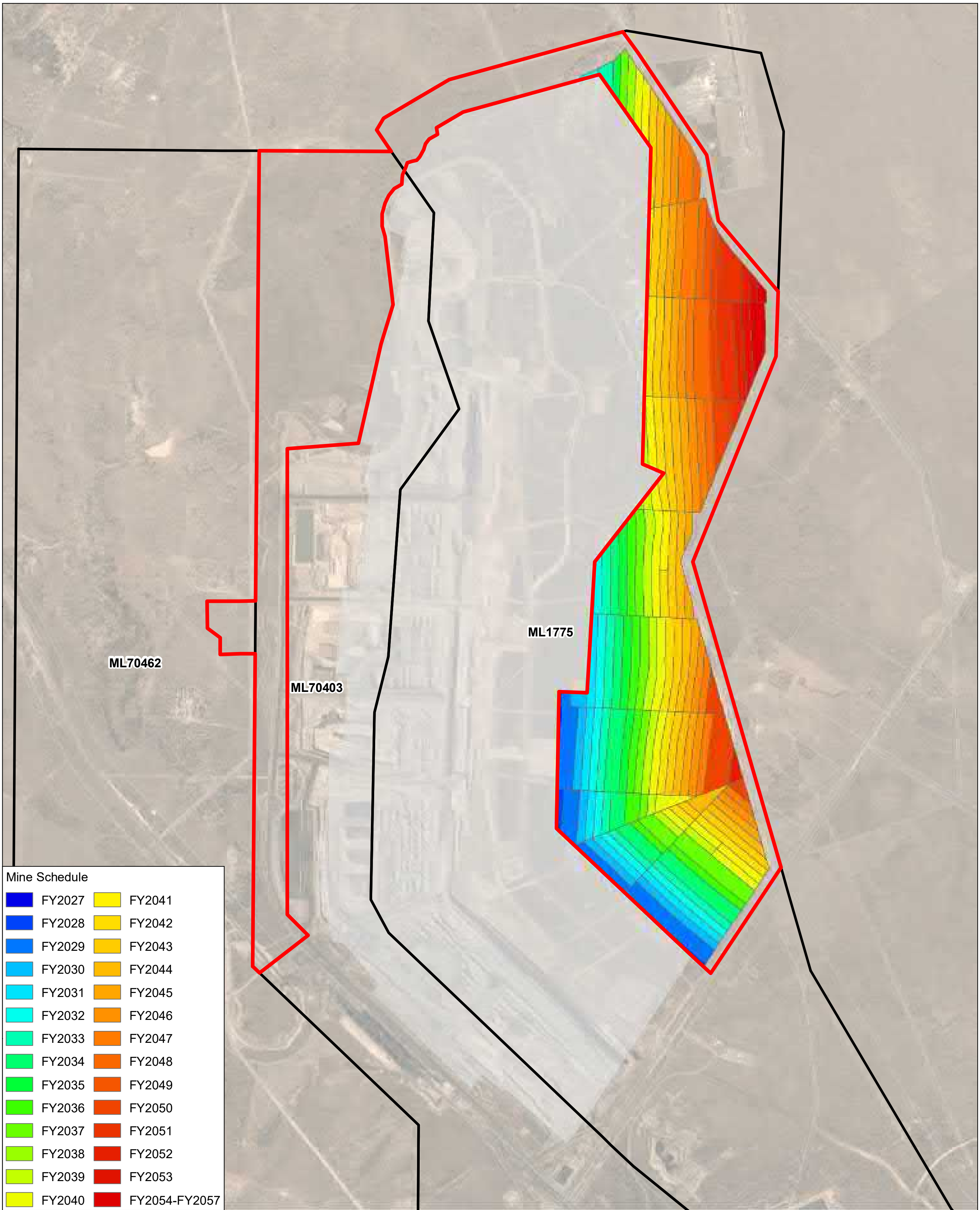

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4

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Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)
BHP Tenements
Cadastre

Horse Pit Extension Project

Mine Sequence

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FIGURE 3-7

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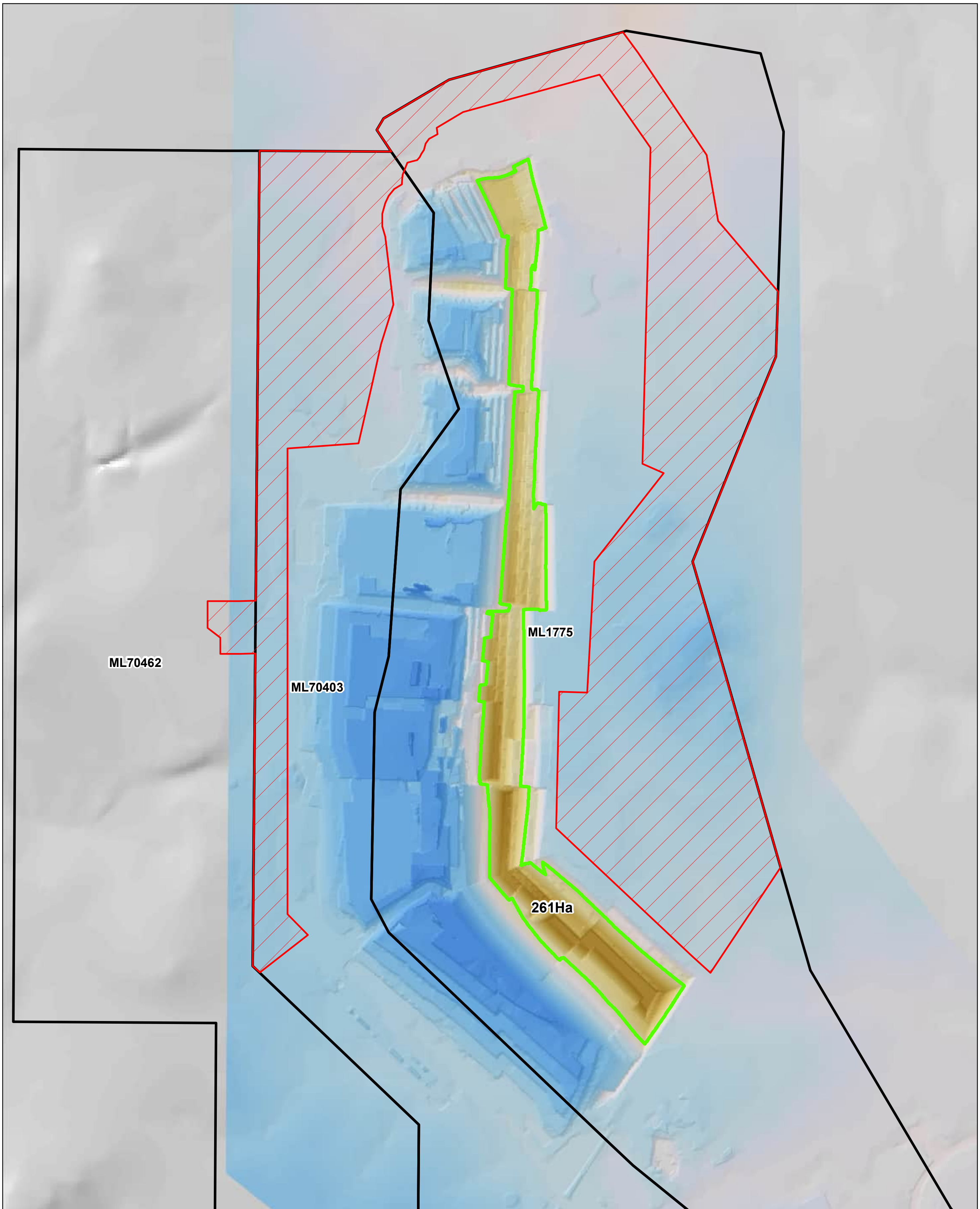

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Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
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Progressive Pit Extent
Horse Pit Extension Project Area
BHP Tenements
Elevation (mAHD)
High : 390
Low : 95

Horse Pit Extension Project

Progressive Landform FY2025

FIGURE 3-8

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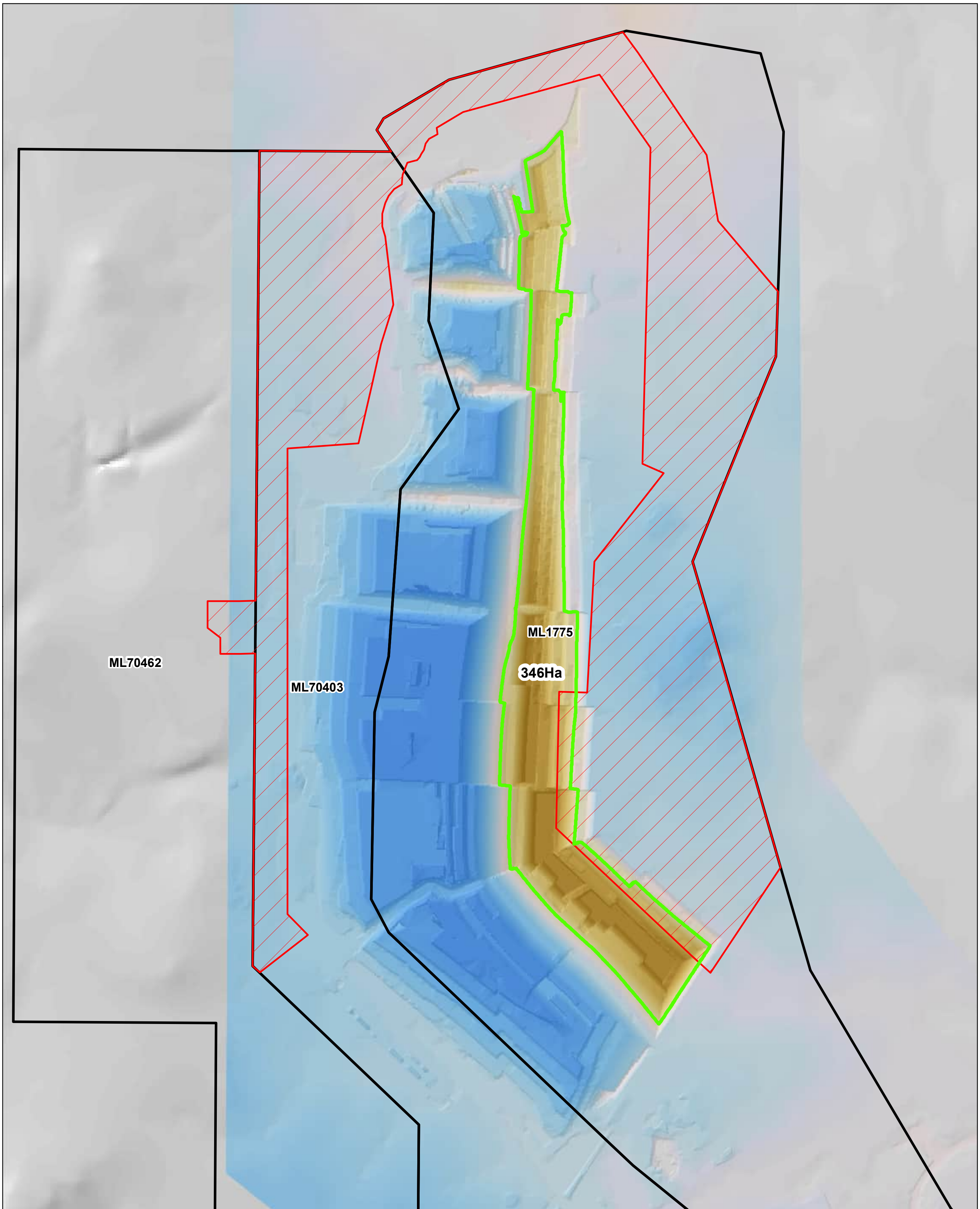

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Projection: GDA 1994 MGA Zone 55
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Progressive Pit Extent
Horse Pit Extension Project Area
BHP Tenements

Elevation (mAHD)
High : 390
Low : 95

Horse Pit Extension Project

Progressive Landform FY2030

FIGURE 3-9

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0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 18-Jan-2023
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Progressive Pit Extent
Progressive Out of Pit Dump Extent
Horse Pit Extension Project Area
BHP Tenements
Elevation (mAHD)
High : 390
Low : 95

Horse Pit Extension Project

Progressive Landform FY2035

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FIGURE 3-10

\\au.slr.local\Corporate\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Project Description\SLR62013593_PD_MiningProgressionLandform_FY2035_001.mxd

0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 18-Jan-2023
Drawn by: PM

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Progressive Pit Extent
Progressive Out of Pit Dump Extent
Horse Pit Extension Project Area
BHP Tenements
Elevation (mAHD)
High : 390
Low : 95

Horse Pit Extension Project

Progressive Landform FY2040

FIGURE 3-11

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0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4

Project No.: 620.13593
Date: 18-Jan-2023
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Progressive Pit Extent
Progressive Out of Pit Dump Extent
Horse Pit Extension Project Area
BHP Tenements

Elevation (mAHD)
High : 390

Low : 95

Horse Pit Extension Project

Progressive Landform FY2045

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FIGURE 3-12

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0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 18-Jan-2023
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BHP Mitsubishi Alliance

Progressive Pit Extent
Progressive Out of Pit Dump Extent
Horse Pit Extension Project Area
BHP Tenements
Elevation (mAHD)
High : 390
Low : 95

Horse Pit Extension Project

Progressive Landform FY2050

FIGURE 3-13

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0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4

Project No.: 620.13593
Date: 18-Jan-2023
Drawn by: PM

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BMA
BHP Mitsubishi Alliance

Progressive Out of Pit Dump Extent
Final Void
Horse Pit Extension Project Area
BHP Tenements

Elevation (mAHD)
High : 390
Low : 95

Horse Pit Extension Project

Conceptual Final Landform

FIGURE 3-14

\\au.slr.local\Corporate\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Project Description\SLR62013593_PD_MiningProgressionLandform_FY2055_001.mxd

3.5.4 Mine Waste Production

Overburden material will be mined and managed via the IPDs at CVM and the proposed OOPD to the north-west of Horse Pit in ML 70403. Where practical, overburden will be progressively backfilled into the mined-out pit as mining progresses. Estimates of overburden and parting volumes by target coal seam are outlined in Table 3-7.

Table 3-7 Overburden and Parting Volumes

Parameter	Unit	Target Seams				Total
		Dysart	Harrow Creek	P Seam	Q Seam	
Overburden Volume	Mbcm	-	-	-	350	350
Thick Parting Volume	Mbcm	1,057	695	266	45	2,062
Thin Parting Volume	Mbcm	71	62	19	7	159
Total Waste Volume	Mbcm	1,128	757	285	401	2,571

Coarse rejects and dewatered tailings from the CHPP will continue to be co-disposed with overburden to IPDs, as per ongoing operations at CVM. Further details of management of coarse rejects and tailings from the CHPP are outlined in Section 3.6.1.

3.5.5 Spoil Management

The primary objective of the spoil dumping strategy for the Project is to backfill the void where practical to reduce the final void area remaining at end of the Project life.

A new OOPD is proposed to the north-west of Horse Pit on ML 70403, which is considered to be a future elevated landform. The OOPD is proposed in order to provide the dump capacity required. In a lead up to start of mining in the Horse Pit extension area (2032) until the end of mine life, the northern extent of Horse Pit is associated with a substantial increase in mining intensity. This is due to progressive closure of Heyford Pit at this time and due to the southern end of Horse Pit being already at capacity at that point in time. With the spatial constraints (ie avoiding impact to Horse Creek which is in close proximity to the northern extent of the pit) there is significant pressure on spoil balance and as a result an OOPD in addition to dumping options already in place is required. Further details specific to the requirement for an OOPD is provided in Appendix J.

Preparation of the land (eg. vegetation clearing) at the proposed OOPD is expected to commence in FY2028. The location and extent of this proposed OOPD is presented on Figure 3-1 and the indicative progressive management of spoil over the revised LOM is outlined on Figure 3-7 to Figure 3-13.

3.5.6 Final Void

Mining will continue to the east and mined-out areas in the west will be progressively back-filled and rehabilitated where practical. A final void will remain in the east of ML 1775 at the conclusion of mining. The conceptual final landform including extents of the final void is presented in Figure 3-14.

BMA plans to explore additional opportunities to reduce the extent of the residual void through further backfilling operations over the life of the Project. Importantly, this may not be economically feasible due to increased haulage involving ‘double handling’ spoil amongst other factors, which significantly impacts operational costs and the overall economics of the Project. Rehabilitation, including post-mining land uses and completion criteria are discussed in Section 5.2.

3.5.7 Mining Equipment

The mining equipment currently utilised at the CVM will continue to be utilised for the Project. The current fleet is sufficient to sustain stripping and ROM Coal targets for the Project LOM. Additional equipment may be required on a temporary basis due to construction activities, increased stripping, haulage and mining demands. This practice is not uncommon.

The equipment fleet at CVM is a mix of contractor and BMA owned fleets. The mining equipment in operation at CVM is summarised in Table 3-8.

Table 3-8 Mining Equipment

Type	Model	Quantity
Drill	Sandvik PV235	5
	Atlas Copco D90KS	1
Dragline	Marion 8050	4
Shovel	CAT 7495	1
Excavator (600t)	Liebherr R996B	3
Excavator (400t)	CAT 6040BH	3
	Komatsu PC4000	1
	Hitachi EX3600	1
Loader 200t	CAT 994H	3
Track Dozer	CAT D10T	8
	CAT D11T	8
Wheel Dozer	CAT 854K	2
Haul Truck	CAT 797F	10
	CAT 793F	23
	CAT 789D	6
	CAT 793C	14
	CAT 789C	8

3.5.8 Blasting

Blasting will continue for the Project as currently employed at CVM, i.e., approximately 1 – 2 times per week. Blasting is utilised for overburden and interburden, including through seam blasting, as necessary at depth ranges from 7 m – 40 m. Subject to operational requirements, blasting occurs on any day of the week prior to 5 pm.

Quantities of explosives range from 500 tonnes to 2000 tonnes per shot and the potential blast size is approximately 200,000 bcm to 400,000 bcm for through seam blasts and 500,000 bcm to 1,500,000 bcm for overburden removal. The typical blast area is between 3 hectares (ha) – 6 ha. The predominate explosive used in blasting activities at the CVM is ammonium nitrate/fuel oil (ANFO), which is the most common explosive used in the mining industry in Queensland.

The storage, transportation and use of explosives will be in accordance with Australian Standard AS 2187.2-2006 Explosives - Storage and use - Use of explosives, the Explosives Act 1999, BMA's policies and procedures including the CVM Standard Work Instruction (SWI) Blast Control & Blast Guard (CVM-SWI-0275), and all other relevant legislation. All blasting activities at the CVM are undertaken by BMA.

The existing blasting compound location will interact with the extension of Horse Pit in FY2031 and as such will be relocated. Details of the blasting compound relocation are outline in Section 3.6.3.

3.5.9 Workforce Requirements and Arrangements

The operational workforce requirements for the Project will remain consistent with current operations for the Horse Pit at CVM. The operational workforce at CVM is up to 1,440 full time equivalent (FTE) employees and contractors. Construction of infrastructure required to support the Project is not expected to increase the workforce. The current workforce arrangements at the CVM will remain in place for the Project.

3.5.10 Hours of Operation

Mine operation hours will continue as per current operations at CVM, i.e., 24 hours per day, seven days per week, 365 days per year.

3.6 Mine infrastructure

The existing key mine infrastructure at the CVM will continue to be utilised for the Project, with some changes to locations of supporting infrastructure and water management infrastructure. The following mine infrastructure will continue to operate as per existing operations at the CVM:

- Main ROM and Horse Pit ROM coal stockpiles
- CHPP complex and product coal stockpiles
- Conveyor that transports ROM coal from PDM to the CVM CHPP
- Train load out facility, stockpiles and rail spur
- Existing IPDs
- Haul roads, and
- Exploration infrastructure.

The infrastructure requirements for the Project, including changes and additions to existing infrastructure are outlined in the following sub-sections. The Project overview, including proposed infrastructure, is outlined on Figure 3-1.

3.6.1 Coal Handling and Processing Plant

The existing CHPP has installed design capacity to process up to 19.8 Mtpa of ROM coal, which is sufficient to handle the ROM coal production rates for the Project in addition to ROM coal transferred from PDM for processing. As such, there is no proposed upgrade to the CHPP as part of this Project, however the process and capacity details for the CHPP are summarised below for completeness.

ROM coal is transported by dump truck to the Northern ROM Hopper before being transported via overland conveyor to the crushing station where it is crushed, screened and stacked. The CHPP is fed by a single feed conveyor with a feed rate capacity of 2,750 tonnes per hour (tph) through two modules of 1,375 tph each.

Product coal is conveyed through a transfer station to a stacking conveyor and stacker to the product coal stockpiles. The product coal is reclaimed and discharged through a batch weighing bin to the TLF. A reject conveyor discharges coarse and fine rejects to the reject bin. Process plant water is recycled to minimise raw water make-up requirements for CVM. The CHPP layout has been designed to contain local area and stockpile runoff.

Coarse rejects and dewatered tailings from the CHPP will continue to be co-disposed with overburden to existing IPDs, and the proposed OOPD, as per ongoing operations at the CVM.

3.6.2 Train Loadout Facility

The existing TLF has sufficient installed design capacity to accommodate the product coal production rates for the Project. As such, there is no proposed upgrade to the existing TLF.

3.6.3 Compounds and Facilities

3.6.3.1 EME Build Pad Relocation

The EME build pad is used for shutdowns of large-scale mining equipment such as draglines. As such, the EME build pad must remain located on the highwall side, to the east, of Horse Pit as access to the pad is required directly from the Peak Downs Highway. The existing EME build pad location will interact with the extension of Horse Pit in FY2030. As such, the pad will be relocated to a semi-permanent location in the north-east.

3.6.3.2 Blasting Compound Relocation

The existing blasting compound location will interact with the extension of Horse Pit in FY2031. The compound requires a 200 m equipment exclusion zone standoff distance that will interact with the mine plan by FY2026. The compound will be decommissioned and relocated as part of the Project.

BMA is considering two potential relocation options for the compound, both on the low wall side (i.e., to the west) of Horse Pit. Location A is located west of Horse Pit in ML 70403. Location B is located further to the west in ML 70462. BMA is considering the viability of these options and impact assessments for both locations have been completed where appropriate under Section 5.

3.6.3.3 BMA Accommodation Camp

The BMA accommodation camp in the far east of ML 1775 will interact with the extension of Horse Pit in FY2045. The camp is not occupied at present, and most camp rooms have been decommissioned and removed. The remaining structures and supporting infrastructure will be decommissioned, commencing no later than FY2043.

3.6.3.4 Go-Lines

Go-lines are planned and executed by the CVM Mine Operations/Mine Planning teams and generally move with relocations of back access roads (Refer to Section 3.6.4). Go-lines will be located on the low wall side of Horse Pit if required. Go-lines will be relocated in conjunction with back access road relocations as mining progresses.

3.6.3.5 Substations

There are several small temporary substations located across the Project area. All substations and transformers will be relocated as required due to the progress of mining or decommissioning of associated infrastructure.

3.6.4 Roads and Access Requirements

3.6.4.1 Site Access

The Project will not require changes to current site access arrangements at the CVM. Access to the CVM is via the Peak Downs Highway.

3.6.4.2 Back Access Roads

The main back access road runs north-south along the existing highwall, at the eastern side of Horse Pit. This back-access road is partially located within areas proposed to be mined out in the next five (5) years. Other existing back access roads will also eventually be mined out for the Project. These access roads will require relocation to the east as a result of the Project.

The mine schedule progresses east and terminates approximately 100 m from the boundary of ML 1775. This ‘exclusion zone’ is sufficient to accommodate the final back access road without impacting the proposed mine schedule and provides an adequate buffer distance to the ML boundary for other potential infrastructure requirements.

3.6.4.3 Haul Roads

The existing haul road is located on the western low wall side of the existing Horse Pit and is not expected to interact with the Project. Pit access and ramps will continue to progress east from existing alignments as Horse Pit progresses. A minor extension of the haul road will be required to access the proposed OOPD to the north-west of Horse Pit. This haul road extension will cross Horse Creek.

3.6.4.4 Blasting Compound Access

The relocated blasting compound will require medium vehicle access roads. The proposed access road for Location A will be located within already disturbed areas. The most direct route to Location B will require a crossing of the drainage line flowing into Horse Creek. The alternative route runs south to connect with an existing access road that avoids the crossing of Horse Creek.

3.6.4.5 Dragline Crossing

A dragline crossing of the Peak Downs Highway will be required ahead of mining of Horse Pit in the south immediately adjacent to the Peak Downs Highway. The exact location of this crossing is yet to be finalised by BMA; however, a crossing zone has been established for the purpose of the Project and is expected to be up to 45 m wide.

3.6.5 Powerline Relocation

There are three key powerlines that will interact with the Project:

- 66kV BMA owned powerline and its stub lines that provide power to CVM and PDM
- 11kV Ergon owned powerline that is aligned with the Moranbah Access Road, and
- 11kV BMA owned powerline that is aligned with the haul road, west of Horse Pit.

These powerlines will be relocated as required to allow the mining of Horse Pit to progress.

3.6.6 Water Management

The water management system at the CVM (and for the Project) is designed to manage the potential impacts of the Project's mining activities on water resources. The water management system has been designed in accordance with BMA's MAW and Erosion and Sediment Control (ESC) Standard (the Standard). The Standard details the basis and application of ESC and MAW control measures across all BMA Queensland operations. The Standard details the legislative context and guidelines for planning, design, construction, operations and maintenance of drainage and sediment control structures. There are several controls that inherently form part of the water management system at the CVM through planning, design and operational procedure. The overarching approach is presented graphically in Figure 3-15.

Figure 3-15 illustrates how catchment planning and separation of water types is included during the mine design process. Water types are identified and catchment boundaries delineated such that water can be managed commensurate with the risk to the surrounding environment. During planning, water (including runoff) is classified as:

- "actually or potentially sediment laden" (ESC);
- "MAW"; or
- "undisturbed".

Drains, pumps, pipes and storage structures are then selected to manage each type accordingly.

As the mine develops, the footprint and area of disturbance changes (via disturbance to new areas or progressive rehabilitation), and this process reoccurs. Water is routed through the appropriate water management structures accordingly. Planning these elements is essential for the operation of the system, for example calculating a sediment storage allowance in an ESC structure that is appropriate for the proposed maintenance regime of that structure. For storages, the structures are sized through calculation of a single intense event as well as through water balance modelling which considers the potential for cumulative events as well as bottlenecks in the overall system as water is transferred between storages.

The selection of specific water management control types and sizing is informed by a risk-based approach aimed to achieve a balance between capturing water running off disturbed areas and redirecting good quality water around mining activities to continue to flow downstream for users and the environment. Achieving this balance, particularly allowing good quality water to flow downstream, is critical to maintaining downstream environments as well as minimising the generation of MAW or ESC water (potentially deteriorating it through evaporation and creating legacy water inventory).

For the Project, ESC structures have generally been designed at the highest control hierarchy based on the above standards, resulting in a containment design criterion of a 10% Annual Exceedance Probability (AEP) 24-hour storm. Similarly, MAW storages have been designed to achieve a minimum annual spill probability of 5%. This is based on the Queensland DES requirement from the Manual (Table 5. Hydrological design criteria for 'failure to contain – overtopping' scenario) for significant consequence structures. This design requirement is applied to MAW structures in this project even if they are considered low consequence structures.

The selection of a design criteria for water management infrastructure is based on industry guidelines and research including but not limited to:

- *Risk ratings based on recommendations from Australian Soils and Landscapes Handbook* (CSIRO, 2004);
- *Best Practice Erosion and Sediment Control by the International Erosion Control Association* (IECA), (IECA, 2008);
- *Structures which are dams or levee as of part of environmentally relevant activities* (DES, 2019); and
- *The Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DEHP, 2016) (the Manual).

Following risk assessment and design, the system is supported through a number of active management controls during operation, many of these are legislated through the Project's EA and include but are not limited to:

- A site-specific ESC Plan and Water Management Plan (WMP);
- Trigger Action Response Plan (TARP) for the system and key structures;
- Release rules, procedures and telemetry (parameters of which are regulated within the Project's EA);
- Inspections and water level management;
- Maintenance procedures including dewatering, desilting, and inspections;
- Monitoring of water quality; and
- Wet season preparedness, including predictive water balance modelling and subsequent planning.

The CVM has one authorised (under the EA) release point for the release of MAW. All MAW from the CVM is ultimately being directed towards 12N Dam south of the Peak Downs Highway, positioned adjacent to Cherwell Creek. Under the CVM EA MAW must only be released from the authorised release point and there are a series of criteria that must be met in order to permit any release. Water quality release limits are defined within the EA as are receiving water flow criteria. Release events require monitoring prior to release (in order to determine if all criteria are met), during release and following release. A decision to release is largely dependent on the water demand and storage volumes at the time when conditions are appropriate (i.e. when criteria are met).

Figure 3-15 also shows the monitoring which occurs through compliance activities associated with the EA, BMAs internal operational monitoring and the Receiving Environment Monitoring Program (REMP).

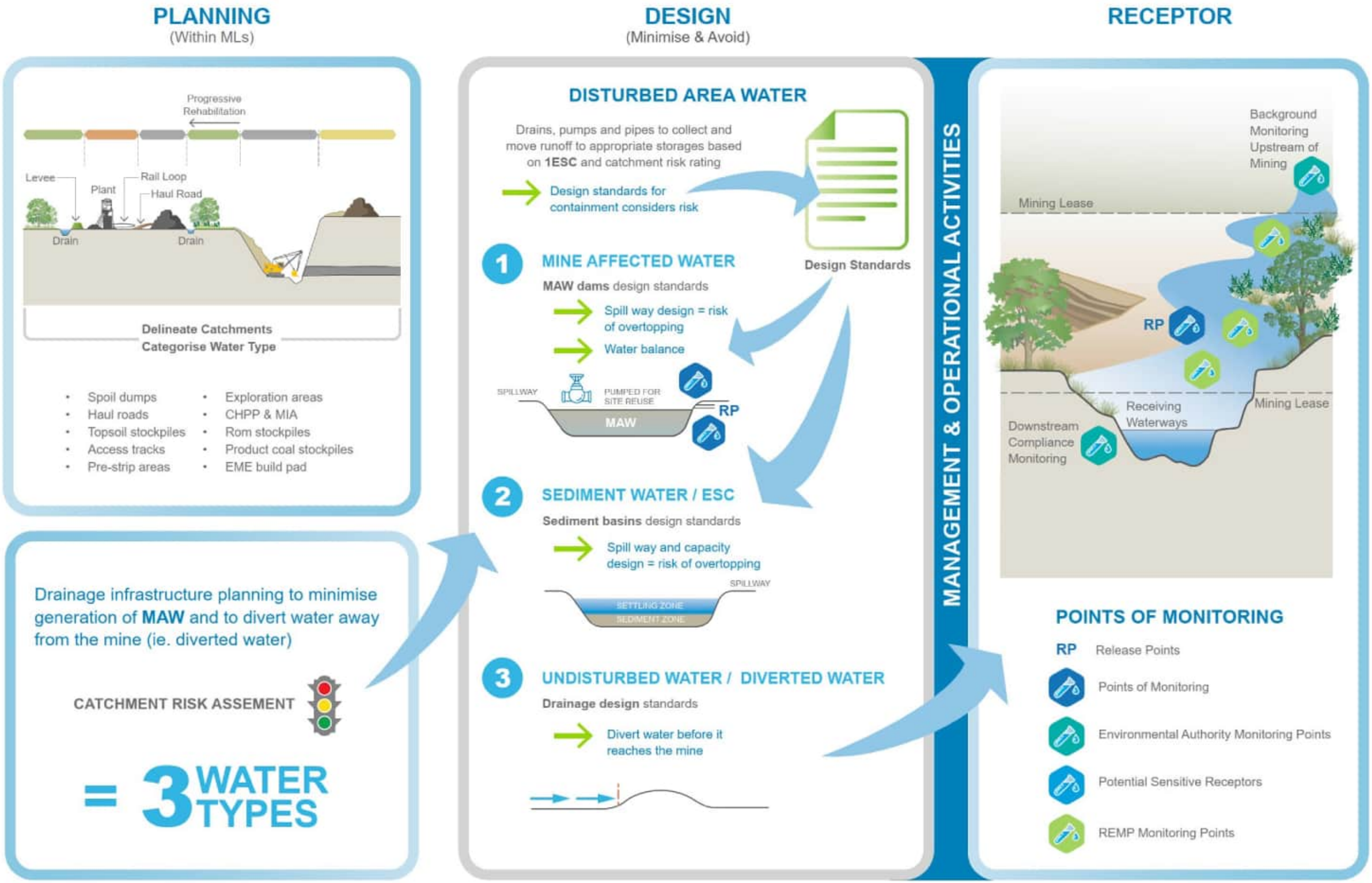
The Project will utilise the existing water management system at the CVM. Additional water management infrastructure and relocation of MAW dams will be required to facilitate the Project. An outline of the update to the water management system for the Project is shown in Figure 3-16.

3.6.6.1 Water Demand

Water demand for the Project is not expected to increase from the existing demand at CVM. The major water demand for CVM arises from coal processing and dust suppression. The mine water system has been configured to maximise the re-use of water on site with the aim to reduce the amount of raw water consumed by the operation. The key CVM operational water requirements are summarised in Table 3-9.

Table 3-9 Mine Water Demand

Water Use	Volume Required	Water Quality Requirements	Source
CHPP	7.0 ML/d	MAW	Mine Water Dam 12N and Raw Water Dam
Dust Suppression	10.3 ML/d	MAW	Mine Water Dam 12N and Raw Water Dam



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Drawn by:	PM

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Horse Pit Extension Project

Water Management Diagram – Horse Pit Extension

FIGURE 3-15

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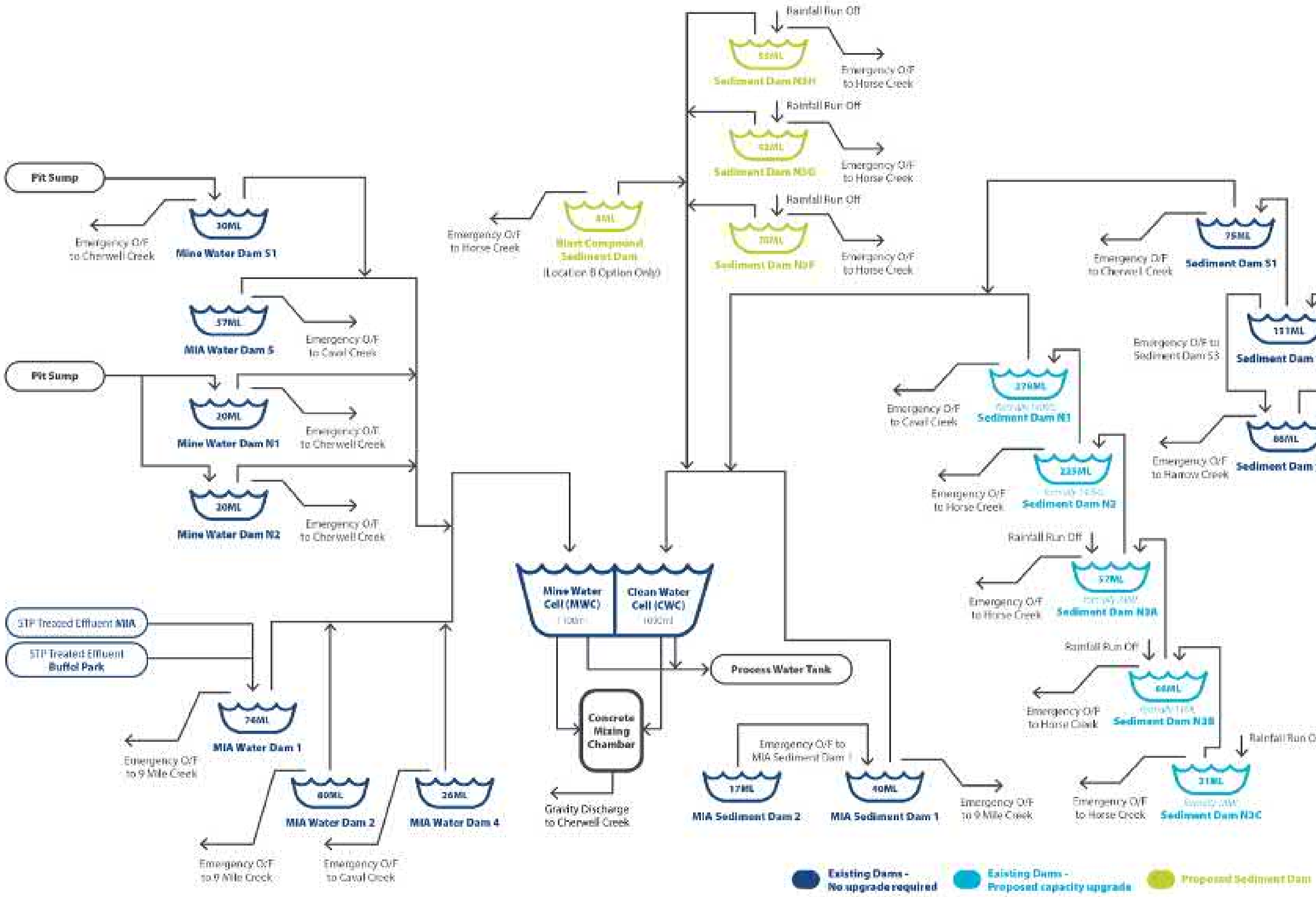

Project Number:	620.13593
Date:	02-Nov-2021
Drawn by:	PM

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Horse Pit Extension Project

Proposed Update to CVM Water Management System

FIGURE 3-16

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Project Description\SLR62013593_PD_WaterProcessDiagram_001.mxd

3.6.6.2 Water Supply

The Project will not require major changes to the existing supply at CVM. A summary of water supply components at CVM is provided below.

3.6.6.2.1 Mine Water

The major water demands for CVM (coal processing and dust suppression) is principally met by MAW. MAW is also utilised at CVM for firefighting purposes and is pumped into on-site water storages, mechanically filtered and stored in tanks ready for use.

3.6.6.2.2 Raw Water

Raw water is sourced via a branch off the Sunwater owned Burdekin pipeline. This water is sourced at the Burdekin Falls Dam and is used to fill the raw water dam as well as for potable water. CVM has an internal allocation to draw a maximum of 5,260 ML per annum of raw water. The GoldSim Water Balance Model for the CVM predicts an average of 3,200 ML of raw water will be required each year for the mine life. Raw water consumption is minimised by maximising the reuse of on-site MAW in the mining process and by employing techniques to minimise losses due to seepage and evaporation.

3.6.6.2.3 Potable Water

The quality of surface water runoff at CVM is not suitable for potable water and therefore only treated raw water is used. Raw water for potable purposes is sourced via the Sunwater owned Burdekin pipeline and treated at the on-site CVM Potable Water Treatment Plant to standards outlined in the CVM Potable and Raw Water Management Plan (WMP) and the Australian Drinking Water Guidelines (2011).

Water Transfer Agreement

A water transfer agreement exists between CVM, Saraji South Mine, PDM, and Saraji Mine. The water management systems of these individual mines are connected by the Central Regional Water Network (CRWN) Pipeline. The CRWN Pipeline is a backbone pipeline which extends from Saraji South to CVM allowing transfer of MAW between these operations. There is a CRWN water balance model (WBM) that links the individual WBM's developed for each of the sites providing information to support decision making regarding sizing of water infrastructure and management of water volumes. The agreement requires, the mine sites to operate in accordance with the specific conditions of the EA, General Environmental Duty, prevention of environmental harm and keeping of rigorous monitoring records. Monthly water reports are distributed outlining Trigger Action Response Plan (TARP) levels and water volumes at each site. This information is used to monitor the need for the transfer of water to and from CVM.

The combined model provides BMA with a tool that greatly reduces the number of unknowns, providing a greater confidence to the predictions across all operations (e.g., influence of cumulative releases on water quality and the potential need to reduce release rates). It also allows the system to transfer water between mine sites utilizing the CRWN mine affected water pipeline. This seeks to reduce the amount of raw water used on the site and reduce environmental harm by allowing water to be stored and released appropriately. This subsequently reduces the likelihood of uncontrolled releases across all sites and provides confidence in release volumes and impacts, considering cumulative releases on water quality. The model accounts for the EA conditions on all releases at all mines and considers the water quality requirements in the source / release storage and receiving waterbody.

While the CRWN pipeline does allow water to be sent to other mines this is predominantly undertaken to allow for water reuse at other operations during times of water scarcity and not for release. The ephemeral nature of all creeks which form approved release points for the CRWN mines result in a relatively short window of a potential release. The CRWN capacity varies over its length, but maximum capacity is typically in the order of 400 L/s. Even at this capacity the time required to move water to alternative release points means, coupled with infrastructure bottlenecks on the release infrastructure dams (such as their capacity), transfer of water to facilitate additional release of mine affected water is unlikely.

3.6.6.2.4 Treated Sewage Effluent

The Project will not require changes to sewage treatment management at CVM. Sewage from the Mine Infrastructure Area (MIA) and the CHPP is collected via a system of gravity and pumped rising sewerage mains and treated via a package sewage treatment plant (STP) within the MIA. The effluent is treated to a suitable quality to allow safe and efficient reuse on site.

3.6.6.3 Pit Dewatering

The existing water management strategy for pit dewatering will continue for the Project. MAW will be dewatered from the operational Horse North pits over the highwall and piped into either Mine Water Dam N1 or N2 throughout the operational life of the mine.

While pit dewatering is largely weather dependent, modelled forecast pit dewatering volumes for the Project have been established. The results demonstrated a static or decreasing annual dewatering volume across CVM. As the pit dewatering volumes have been forecast to not increase as a result of the Project, the pumping strategy will not be modified beyond relocating dams and extending pipelines, as outlined in Section 3.6.6.4.

3.6.6.4 Water Management Infrastructure

Existing water infrastructure at the CVM will interact with the extension of Horse Pit as the mining progresses and will require relocation. Details of the existing water management infrastructure and proposed relocation or expansion of this infrastructure is outlined in the following subsections. Details of changes and expansion of the water infrastructure for the Project are outlined on Figure 3-15.

3.6.6.4.1 Sediment Dams

BMA has reviewed the capacity of existing sediment dams to ensure suitable capacities are achieved for the Project. Sediment dams have been designed in accordance with the relevant standards and guidelines with controls informed based on a risk-based approach to water management, where there is a balance between capturing water running off disturbed areas and providing for good quality water to continue to flow downstream for users and the environment.

The existing sediment dams within the Project area will require expansion upgrades to accommodate increased catchments. In addition, the following new sediment dams are proposed:

- One (1) new sediment dam (capacity of 70 ML) is required to capture the runoff in the north of ML 1775 adjacent to the proposed northern flood levee
- Two (2) new sediment dams (combined capacity of 97 ML) are required to capture runoff from the proposed OOPD to the north-west of Horse Pit, and
- One (1) new sediment dam (capacity of 8 ML) is required to capture runoff from around the proposed blast compound (for Location B only). Within the compound (eg. at washdown bays or material transfer points) appropriate storage and handling of any contaminated water will be management in accordance with Conditions of the existing EA.

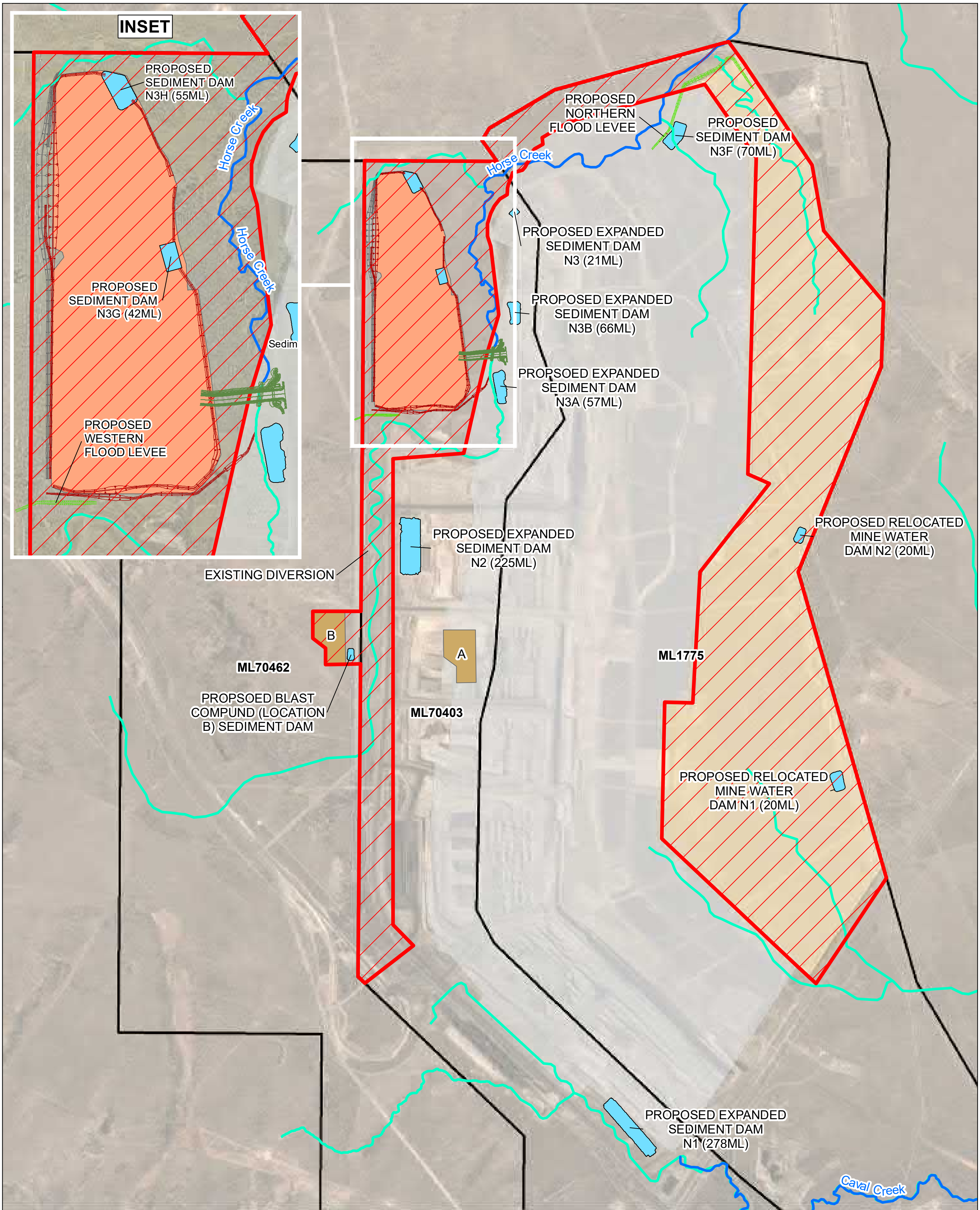
Each sediment dam will have permanent pump and pipeline infrastructure to enable dewatering to a larger storage as required. Sediment dam dewatering includes two streams, both will consist of pumping infrastructure upgrades including new pumps and pipelines. Details of water transfer are provided on Figure 3-15.

Details of the existing sediment dams proposed revised capacities and new sediment dams relevant to Horse Pit are provided in Table 3-10. The existing and proposed sediment dams that will manage runoff from the Project are outlined on Figure 3-17.

Table 3-10 Sediment Dam Summary (Horse Pit only)

Name	Existing Volume (ML)	Revised Volume (ML)	Location
Sediment Dam N1	140	278	Horse Pit
Sediment Dam N2[1]	225	225	Horse Pit
Sediment dam N3A	24	57	Horse Pit North
Sediment dam N3B	14	66	Horse Pit North
Sediment Dam N3C	18	21	Horse Pit North
Sediment Dam N3F[2]	NA	70	Horse Pit North
Sediment Dam N3G[2]	NA	42	Proposed OOPD
Sediment Dam N3H[2]	NA	55	Proposed OOPD
Blast Compound Sediment Dam[2]	NA	8	Location B Option
Total	**421**	**822**	**-**

[1] No expansion required. Existing sediment dam volume exceeds minimum requirements.
[2] Proposed new sediment dams.



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:42,500 at A4
Project No.: 620.13593
Date: 02-Nov-2021
Drawn by: PM

- Drainage features
- Watercourses (Water Act 2000)

Water Management Infrastructure
- Clean Water Diversion Drain
- Dirty Water Drain
- Flood Protection Levees
- Dams
- Bridge over Horse Creek
- Proposed Blast Compound Options
- Horse Pit Extension
- Horse Pit Extension Project Area
- CVM EIS Pit Boundary (2010)
- BHP Tenements
- Cadastre

Horse Pit Extension Project

Water Management Infrastructure

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FIGURE 3-17

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\Project Description\SLR62013593_PD_WaterInfrastructure_002.mxd

3.6.6.4.2 Mine Affected Water Dams

The volume of MAW is not expected to increase from current operations at the CVM as a result of the Project. Therefore, no expansion to volumes or additional MAW dams are required. The existing water management strategy involves the use of the MAW dams as transfer points, with all MAW from the CVM ultimately being directed towards 12N Dam south of the Peak Downs Highway. MAW will continue to be dewatered from Horse Pit over the highwall and piped into either N1 dam or N2 dam through the life of the Project.

The existing N1 and N2 MAW dams are currently used as staging dams for MAW including dewatered pit water and are located in the far east of ML 1775. The N1 and N2 MAW dams will be retained as separate structures of 20 ML each, with no proposed increase in capacity. These dams will be relocated as close as possible to the eastern extent of ML 1775 prior to being mined through and will include the extension of pipelines to the new locations. The pipelines will be relocated in a staged manner in accordance with the progression of mining with the final alignment to be confined within the exclusions zone on the far eastern boundary of ML 1775. The proposed total length of pipeline extensions required for the relocated dams is approximately 7 km.

Details of the existing MAW dams are provided in Table 3-11.

Table 3-11 Mine Affected Water Dam Summary

Name	Existing Volume (ML)	Location
Mine Water Dam N1	20	Horse Pit East
Mine Water Dam N2	20	Horse Pit East
Mine Water Dam MIA 1	76	MIA
Mine Water Dam MIA 2	80	MIA
Mine Water Dam MIA 4	26	MIA
Mine Water Dam MIA 5	57	MIA
Mine Water Dam 12N - MWC	1,100	Heyford Pit North
Total	**1,379**	**-**

3.6.6.4.3 Pipelines

Raw water is piped via the Burdekin pipeline along the western boundary of ML 70403, over the Peak Downs Highway to the raw water dam in the MIA on ML 70403, south of the Peak Downs Highway. This pipeline will not interact with any elements of the Project.

The Burdekin pipeline dissects ML 1775 adjacent to the Moranbah Access Road. This pipeline corridor is within the approximately 100 m wide exclusion zone in the east of ML 1775 and as such there is no relocation of this pipeline required. A minor tee-junction previously used to supply raw water to the BMA accommodation village will be removed prior to interaction with mining at Horse Pit.

MAW pipelines are used to dewater operational pits and transfer water between storages. These pipelines receive MAW from operational pits and facilitate bulk transfers of MAW. The MAW pipelines will be relocated in a staged manner as required by the relocation of storages discussed above and the progress of mining. The MAW pipelines will be progressively relocated to align with the back-access roads in accordance with the mine schedule. Ultimately, the final alignment of the MAW pipeline will be within the mining exclusion zone in the far east of ML 1775.

3.6.6.4.4 Surface Water Drains

The Project will require additional surface water drains to manage clean and dirty water in addition to the existing drains at CVM. These include one proposed clean water drain designed to convey a 100-year ARI flood immunity and capture the clean water catchment to the west of the proposed OOPD. The clean water drain flows south to north and parallel to the proposed OOPD in the west. The drain is approximately 2 km in length and contains a maximum cut depth of approximately 9.0 m. This drain will direct flow to a natural drainage feature north of the proposed OOPD. The drainage feature outflows to Horse Creek approximately 1 km to the east.

There are four proposed MAW water drains that bound the outer extents of the proposed OOPD. The MAW water drains are designed to convey a 10-year ARI flood immunity capturing all MAW water within the stockpile area. The total length of proposed MAW water drains is approximately 7 km with a maximum cut depth of approximately 9.0 m along the outer extents of the OOPD. The drains will direct flow to two proposed dams, as described above and shown on Figure 3-15 and Figure 3-17.

3.6.6.5 Flood Protection

3.6.6.5.1 Diversions

There are no proposed watercourse diversions or modifications to existing watercourse diversions required to facilitate the Project. There are three existing diversions at the CVM associated with Cherwell Creek, Caval Creek and the drainage line flowing into Horse Creek.

There are four mapped minor drainage lines that traverse proposed activities at the Project. These drainage lines are not determined watercourses under the Water Act 2000 (Water Act) and do not require formalised diversions. These drainage lines will be mined through as Horse Pit progresses. Earthworks will be required ahead of mining to convey upslope overland flow away from Horse Pit. There is also a minor drainage line that interacts with the north-west corner of the proposed OOPD. This drainage line will be realigned around the toe of the OOPD.

3.6.6.5.2 Flood Levees

Existing flood protection at the CVM is provided via the road running adjacent the drainage line flowing into Horse Creek and levees bounding various sections of the perimeter of Horse Pit. Flood immunity at the CVM has been designed to prevent pit inundation up to 0.1% Annual Exceedance Probability (AEP).

To facilitate the Project and maintain pit protection at the CVM, there are two proposed flood levees required to maintain a 0.1% AEP flood immunity. The proposed levees are designed to prevent ingress of clean water from Horse Creek to the mine pits. The two proposed flood levees have been designed to a concept level for the purpose of the EA Amendment for the Project. In accordance with the existing EA definitions, the two levees will be regulated structures and will be designed and constructed in accordance with the relevant requirements. The proposed levee locations and extents are summarised below:

- The northern levee bounds a portion of Horse Pit in the far north of ML 1775. This levee is approximately 1.4 km in length. The levee is to be constructed in a staged approach to allow free draining of the clean highwall catchment while providing pit protection.
- The western levee is located at the south-west extent of the proposed OOPD on the boundary of ML 70403 and ML 70462. This levee is approximately 400 m in length and is designed to protect the proposed OOPD from flooding.

The basis of design for the levees is outlined in Table 3-12 and the locations of the proposed flood protection levees are outlined on Figure 3-17. Additional design details relating to the levees is provided in Appendix J.

Table 3-12 Flood Levee Basis of Design

Component	Basis of Design
Flood Immunity	0.1% AEP with 0.5 m freeboard
Crest Width	10.0 m (as per current site levees)
Batter Slopes	1V:3H (no safety bunds)
Key Trench Width	3.0 m
Crest Treatment	100 mm gravel capping and guideposts (trafficable)
Batter Treatment	Topsoil/alternate growth media and seed

4 Project Justification and Alternatives

4.1 Justification

The CVM was constructed in 2012, with first coal in 2014. If approved, the extension is projected to extend the mine's life from the 2030s to the 2050s, projecting jobs and royalties for years to come. Significant mine engineering design has been undertaken to accommodate for the Project, which will utilise existing CVM infrastructure for coal processing, tailings disposal and rail loadout of product coal, amongst other things.

The Project facilitates an opportunity to further contribute to Australia's position as a primary global producer of high-quality coking coal products. The Project will extract otherwise under-utilised resources from an area already disturbed by previous land uses which provides benefits over establishing a mine at a greenfield site. The extension of the mine life at CVM will also see further economic benefits to local and regional communities. Activities associated with the Project are not expected to cause environmental harm to any nearby sensitive receptors such as residential housing and/or local businesses. However, mitigation measures will be implemented to prevent or minimise negative impacts on surrounding environmental values. The existing operations at CVM play a fundamental role by creating employment opportunities within local and regional communities, which in turn, increases regional stability and domestic productivity.

Overall, the Project will contribute to economic growth through sustained employment at the local and regional levels, primarily through local employment and business opportunities. BMA intends to invest, subject to approvals, approximately $100 million (estimated) per annum on average over the life of the mine.

The benefits are expected to be greatest in areas where direct activity will occur, such as major population and service centres, i.e., Moranbah and Mackay. In summary, the Project will continue to:

- support economic activity in the region and Queensland through direct and flow-on activity, and thus contribute local, regional and state economic growth
- provide local businesses with opportunities to continue to secure new contracts and increase sales to service the Project and workforce needs
- enable the local sourcing of goods and services as well as labour from the local region, preferentially to elsewhere in Queensland and Australia
- employ local, regional then state-based employees as an order of preference. Benefits may be further enhanced through skills transfer and on-the-job skills development. An estimated 1,500 direct jobs will be sustained as a result of the Project
- directly contribute to infrastructure development in the region, and
- directly contribute an estimated US$ 553.3M in royalties to the State of Queensland.

BMA plays a major role in the Moranbah community. Key beneficiaries of BMAs operations include the Moranbah State School, health organisations, indigenous groups, environmental wildlife carers, sporting groups, community social groups, and the local council. In addition, BMA funds environmental research through donations to the Great Barrier Reef foundation, Reef Catchments, Fitzroy Basin Association and Greening Australia organisations. Overall, the Project will contribute to economic growth through sustained employment at the local, regional and state levels, primarily through employment, local business opportunities and taxation revenues.

4.2 Alternatives

The Project location is defined by the nature and scale of the deposit. The Project is located on the western limb of the northern Bowen Basin. The Bowen Basin is characterised by a relatively thin accumulation of consolidated sediments, gentle easterly dips and minor to moderate deformation. Regionally, the stratigraphic sequence consists of Permo-Triassic consolidated sediments of the Bowen Basin overlain by a veneer of unconsolidated Quaternary alluvium and colluvium, poorly consolidated Tertiary sediments and, in places, remnants of Tertiary basalt flows. At the Project site, the MCMs, which contain the coal seams proposed to be extracted by the Project and are at outcrop/subcrop at the CVM, conformably overlie the Back Creek Group and further to the east down dip are conformably overlain by the Fort Cooper Coal Measures.

The Queensland State Government Detailed Surface Geology mapping shows that the Quaternary alluvium is localised along the Isaac River and its tributary Grosvenor Creek to the north, northeast and east of the Project. Along the Isaac River these deposits consist of clay, sandy clay, and sands and gravels with varying proportions of clay. Areas of thicker alluvium (up to 25 m thick) occur in the vicinity of the confluence of the Isaac River and its main tributaries such as Grosvenor Creek and Cherwell Creek.

Therefore, the Project area is constrained by resource, geographic, environmental, existing infrastructure and feasibility considerations. As such, the only Project alternative to that proposed by this EA amendment, is to not proceed with the Project. The direct consequences of not proceeding with the Project are the potential loss of sustained positive economic opportunities for the locality and the region. The potential positive impact of not proceeding with the Project is avoiding the potential environmental impacts. In this case, impacts on land, water and air (and associated physical, biological and social impacts) potentially arising from the Project, would not occur.

Should the Project not proceed, the following high-level impacts are highly likely to be realised:

- Loss of 1,500 jobs in regional Queensland
- Loss of up to A$206 million annual royalty payment to Queensland Government
- Negative economic impacts on local businesses in Moranbah, and
- Removal of community support.

4.3 Standard Criteria Assessment

The EP Act requires ERAs to be authorised by the DES. When considering an application for amendment to an EA or deciding on the conditions of an EA, the DES must consider certain matters set out in the EP Act. One of those matters is the ‘Standard Criteria’. The purpose of this assessment is to address each of these criteria to demonstrate how they will be met by BMA.

Schedule 4 of the EP Act defines the ‘Standard Criteria’ as:

a. *the following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment—*
   i. *the precautionary principle*
   ii. *intergenerational equity*
   iii. *conservation of biological diversity and ecological integrity, and*
b. *any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development, and*
c. *any relevant environmental impact study, assessment or report, and*
d. *the character, resilience and values of the receiving environment, and*
e. *all submissions made by the applicant and submitters, and*
f. *the best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows—*
   iv. *an environmental authority*
   v. *a transitional environmental program*
   vi. *an environmental protection order*
   vii. *a disposal permit*
   viii. *a development approval, and*
g. *the financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument, and*
h. *the public interest, and*
i. *any relevant site management plan, and*
j. *any relevant integrated environmental management system or proposed integrated environmental management system, and*
k. *any other matter prescribed under a regulation.*

Note criterion (c) has since been repealed.

4.3.1 Criterion (a) – Ecologically Sustainable Development

This section outlines the Project's compatibility with the objectives and principles defined in Australia's National Strategy for Ecologically Sustainable Development (ESD) (Commonwealth of Australia, 1992). The key ESD objectives defined in the National ESD Strategy are:

- To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations.
- To provide for equity within and between generations (the Intergenerational Equity Principle).
- To protect biological diversity and maintain essential ecological processes and life-support systems.

The National ESD Strategy also identifies three specific objectives for the mining sector:

- To ensure mine sites are rehabilitated to sound environmental and safety standards, and to a level at least consistent with the condition of surrounding land.
- To provide appropriate community returns for using mineral resources and achieve better environmental protection and management in the mining sector.
- To improve community consultation and information, improve performance in occupational health and safety and achieve social equity objectives.

4.3.1.1.1 Individual and Community Well-being and Welfare

The Project will provide significant benefits, particularly to local and regional communities in terms of sustained contributions to household employment and income, business opportunities (local and regional) and increased Government revenues and reinvestment. BMA also make significant donations to a variety of local organisations in the areas of education, health, indigenous groups, environment, sporting groups, and social community groups. A total of $8.9M was contributed during the FY2019 to Queensland community organisations.

4.3.1.1.2 The Intergenerational Equity Principle

The Project addresses the welfare of future generations while realising economic benefits. The welfare of future generations has been considered through minimising disturbance, building beneficial infrastructure and a post-mining landform. The Project aims to preserve, where possible, the ecological value areas and has designed the project footprint to minimise impacts as reasonably practicable. The use of existing infrastructure will improve the overall project efficiency and resource utilisation.

Building intergenerational equity requires that the Project consider the long-term use of the land and community impacts. The Project seeks to safeguard the welfare of future generations and achieve intergenerational equity by achieving a post-mining landform consistent with the former landscape recognising that mining has been undertaken in and around Moranbah since the early 1980's. This will be achieved through project design, operational management (including sound rehabilitation techniques) and environmental monitoring and reporting. The coarse rejects and tailings from the CHPP will be co-disposed with overburden to In-Pit Spoil Dumps, as per ongoing operations at CVM. This is designed to minimise erosion and is in line with current practice progressive rehabilitation techniques. BMA may also seek progressive "sign-off" on successfully rehabilitated landforms once they have met the requirements of the post mining land use acceptance criteria. A Progressive Rehabilitation Closure Plan (PRC Plan) will be prepared for the CVM incorporating the Project.

Water management practices on site will ensure that water quality in Horse, Grosvenor, Cherwell and/or Caval Creeks is not adversely affected by the Project. There will be some clearing of vegetation; however, the clearing will not threaten the existence of individual species or ecosystems. Rehabilitation and monitoring programs on site performed by BMA (or its contractors) will ensure that biodiversity is not compromised or significantly impacted as a result of the Project.

In summary, through the continued use of sound management practices (currently in practice) and monitoring of the impacts of the Project on the local environment, the Project will not significantly reduce, or fail to maintain, the health, diversity and productivity of the regional environment or affect future generations.

4.3.1.1.3 Protection of Biological Diversity and Essential Ecological Processes

Key decisions for the Project support the protection of biological diversity. Specifically, limiting the overall footprint of the Project (to the extent that is reasonable and practicable) by utilising existing infrastructure to avoid further clearing has protected ecological processes. The LoA plan has been prepared to incorporate the progressive rehabilitation of disturbed areas and to prevent or minimise environmental harm. The rehabilitation strategy will allow BMA to proactively measure the success of the rehabilitation in line with the post mine land use strategy to be incorporated into the PRC Plan (at the specified date).

In addition, the Project area has historically been subject to habitat degradation caused by agricultural activities, erosion and mining operations. The vegetation within the Project area is largely regrowth brigalow and eucalypt woodland communities. Much of the regrowth brigalow community occurs on soils with a heavy clay content and has a capacity to hold water creating local depressions.

A desktop assessment and two field surveys targeting threatened/protected wildlife and wildlife habitat, regulated vegetation, ecosystem function and other MNES and Matters of State Environmental Significant (MSES), respectively) was conducted. Despite the Project area being highly modified, it was found to support a diversity of wildlife, habitat features and vegetation communities.

The following conservation-significant ecological values were recorded within the Project area:

- two ornamental snake observations and preferred habitat within brigalow regrowth habitat (MNES and MSES)
- suitable habitat for an additional 3 threatened fauna species:
    - squatter pigeon (MNES and MSES)
    - Australian painted snipe (MNES and MSES), and
    - short-beaked echidna (MSES), and
    - suitable habitat for *Dichanthium queenslandicum* (MNES and MSES)
- 'of concern' prescribed RE 11.8.11 (MSES), and
- ecological connectivity value (MSES).

Despite this, avoidance and mitigation measures will be implemented to during the life of the Project as a demonstration of sound environmental practice. Specifically, these include, but not limited to:

- Clearing of vegetation to be avoided or minimised where practical
- Weed management practices to continue to be implemented to prevent spread of weeds
- Manage existing weeds, particularly around Horse Creek and drainage lines, and
- Rehabilitate mined land to reinstate native species where practical.

4.3.1.1.4 Mine Site Rehabilitation

The rehabilitation schedule and milestones will be outlined in the PRC Plan and will be measured (i.e., achieving a sustainable system for the proposed post-mine land use) accordingly. Demonstrating that the stated milestones are being met or on track to being met (as indicated by monitoring results) will demonstrate that the rehabilitated landscape has reached a stable and sustainable condition and is ready to be relinquished. A PRC Plan will be prepared for the Project (at the specified date) and will consist of two main sections: rehabilitation planning part and PRC Plan Schedule.

4.3.1.1.5 Provide Appropriate Returns for Mineral Resources and Achieve Better Environmental Protection and Management in the Mining Sector

The Project will produce a product that is subject to international demand for the foreseeable future and will provide significant revenues to the local, state and Commonwealth governments. The resource has been subject to detailed investigations to define the feasibility of its extraction and processing. The Project will not impact on other resources, such as other mineral deposits and/or gas in the region. There are no significant resources overlapping the Project that will be lost by its development.

4.3.1.1.6 ESD Guiding Principles

The guiding ESD principles defined in the National ESD Strategy are:

- Decision-making processes should effectively integrate both long and short term economic, environmental, social and equity considerations.
- Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the Precautionary Principle).
- The global dimension of environmental impacts of actions and policies should be recognised and considered.
- The need to develop a strong, growing and diversified economy which can enhance the capacity for environmental protection should be recognised.
- The need to maintain and enhance international competitiveness in an environmentally sound manner should be recognised.
- Cost-effective and flexible policy instruments should be adopted, such as improved valuation, pricing and incentives mechanisms.
- Decisions and actions should provide for broad community involvement on issues which affect them.

Each of these ESD guiding principles are addressed below.

4.3.1.1.7 Decision-Making Based on Long- and Short-Term Considerations

The Project will provide immediate and long-term benefits to the economic and social fabric of Queensland and in particular the Isaac Regional Council (IRC). The Project will contribute to the local, state and Commonwealth economies. BMA intends to invest, should the project be granted internal approval and moved to execution, more than $100 million per annum on average over the life of the mine.

4.3.1.1.8 The Precautionary Principle

The EP Act does not define the 'precautionary principle" but rather requires the DES to consider it in the decision-making process under Schedule 4 of the Standard Criteria definition. In light of this, it is considered appropriate to refer to the definition of the 'precautionary principle' as stated in Section 391 (2) of the EPBC Act, that being:

The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

To address this principle, BMA has undertaken an assessment of the risk of unacceptable environmental harm consistent with the precautionary principle. These findings have been incorporated into the development of appropriate environmental control strategies/mitigation strategies as outlined in the Technical Reports for each relevant environmental discipline. Further, BMA has the technical and financial support and resources to establish and maintain the proposed environmental protection controls/mitigation measures proposed for the Project.

4.3.1.1.9 Global Environmental Impact

The Project will produce insignificant quantities of greenhouse gases (GHG) compared to many other GHG producers and is not of a scale to negatively impact on the global environment. Reducing GHG emissions is a key component of BHP's climate change policy. BHP's short-term target is to maintain total operational GHG emissions at or below 2017 levels by FY2022. BHP's medium-term target to reduce operational GHG emissions (scope 1 and 2 from operated assets) by 30 per cent from FY2020 levels by FY2030 and in the long term maintain net-zero operational emissions by 2050.

4.3.1.1.10 Development of a Strong, Growing and Diversified Economy which can enhance the Capacity for Environmental Protection

The Project will extend the life of the CVM and therefore positive benefits to local, regional and state economies. There will be some flow-on effects to other areas of the Queensland economy as a result of the Project. BMA will encourage the use of local and regional suppliers and contractors during the life of the Project where possible via the existing Local Buy Foundation.

4.3.1.1.11 Enhancing International Competitiveness in an Environmentally Sound Manner

The Project will continue to enhance Australia's international competitiveness by adopting the latest technology (in mining and processing) while minimising environmental impacts. The Project will continue to be subject to an EA which will ensure that all environmental impacts are managed appropriately.

4.3.1.1.12 Cost-Effective and Flexible Policy Instruments

The Project will be managed in accordance with relevant Queensland and Commonwealth Government policies and standards.

4.3.1.1.13 Community Involvement in Decisions and Actions

BMA will undertake appropriate consultation with all relevant stakeholders including Commonwealth, State and Local government; community and business associations; surrounding landholders and agistment licence holders; and traditional owners. The Project will utilise the existing formal complaint procedure.

4.3.2 Criterion (b) – Applicable Commonwealth, State or Local plans, Standards, Agreements or Requirements

Commonwealth, State and Local plans, agreements, standards and requirements have been considered in the environmental assessments for the Project.

4.3.2.1.1 Plans/Schemes

The construction and operation of the Project will be consistent with the IRC Planning Scheme.

4.3.2.1.2 Agreements

The Commonwealth government remains as a signatory to agreements on climate change, migratory birds, world heritage and biodiversity. There are four main principles of these conventions:

- the precautionary principle
- intergenerational equity
- conservation of biological diversity, and
- improved valuation, pricing and incentive mechanisms.

These principles, in relation to the Project, have been addressed above.

4.3.2.1.3 Standards and Requirements

The relevant standards are those set out under the National Environment Protection Council (Queensland) Act 1994 (NEPC Act). This reflects the Commonwealth legislation, which provides for standards that will have effect nationally. National Environment Protection Measures (NEPMs) outline national objectives for protecting and managing aspects of the environment.

The NEPMs relevant to the Project are:

- Ambient Air Quality
- Diesel Vehicle Emissions
- Movement of Controlled Waste, and
- National Pollutant Inventory.

These NEPM's have been considered during the environmental assessment stage for the Project.

4.3.2.1.4 Environmental Protection Policies

This section provides an assessment against the following EPPs relevant to the Project:

- *Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPP (WWB))*
- *Environmental Protection (Air) Policy 2019, and*
- *Environmental Protection (Noise) Policy 2019.*

4.3.2.1.5 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

BMA will update the existing WMP, as required, to incorporate those relevant aspects of the Project based on the existing practices in place at the CVM. MAW will be managed in accordance with the EA conditions for CVM. A water balance model for the Project has been conducted and is presented in Appendix E outlining the required water usages in line with the water requirements.

4.3.2.1.6 Environmental Protection (Air) Policy 2019

The EPP (Air) establishes guidelines for ambient air quality. Schedule 1 of the EPP (Air) provides air quality objectives for a range of air borne contaminants. An air quality assessment has been undertaken to quantify the investigate the potential for impacts from the Project’s emission sources on local air quality as informed by CVM’s EA conditions. The air quality assessment focuses on the quantification of the release of particulate matter into the environment with results from the dispersion modelling used to estimate changes in environmental outcomes that are attributable to the Project. The results of the assessment are presented in Section 5.4 and Appendix C, respectively. The management of emissions from the Project will be informed by CVM’s state of the art Dust Control System (DCS). Dust controls that are in place to mitigate air emissions from the Project are also discussed.

4.3.2.1.7 Environmental Protection (Noise) Policy 2008

The EPP (Noise) covers environmental values and acoustic quality objectives. The environmental assessment for noise and vibration presents the results of noise modelling undertaken for the Project and is presented in Section 5.5 and Appendix D, respectively. Mitigation measures have been detailed in the environmental assessment to reduce the noise and vibration impacts from site operations.

4.3.3 Criterion (d) – Environmental Impact Study

BMA has prepared environmental assessments commensurate to a major EA Amendment Application subject to the provisions of the EP Act. These environmental assessments have focussed on the critical matters of air quality, noise and vibration, surface water resources, groundwater resources, terrestrial ecology, aquatic ecology, GDEs and waste. The environmental assessments conducted have considered, the existing environmental values, the impacts of the Project and the mitigation measures to be implemented to reduce these impacts.

4.3.4 Criterion (e) – Character, Resilience and Values of Receiving Environment

The CVM is situated amongst a coal mining precinct in the northern Bowen Basin where resource extraction, agriculture and livestock grazing are the predominant land uses. As a result, the landscape has been highly modified. The vegetation within the 1172 ha Project area is largely regrowth brigalow and eucalypt woodland communities. Much of the regrowth brigalow community occurs on soils with a heavy clay content and capacity to hold water creating local depressions at the soil surface, i.e., melon holes or gilgai.

Horse Creek (Stream Order 3) traverses the north eastern section of the Project area where it diverges into three smaller, unnamed, Stream Order 1 drainages. Outside the Project area, Horse Creek connects to the Isaac River (Stream Order 6) via Grosvenor Creek (Stream Order 5) approximately 5 km east of the ML 1775 boundary. Despite the highly modified landscape within and surrounding the Project area, this drainage system remains relatively intact. Permanent water sources, such as farm and mine dams associated with CVM activities are scattered throughout the Project area.

The terrestrial ecology assessment identified and characterised the ecological values within the Project area, highlighting those classified as MNES and MSES.

The terrestrial ecology assessment identified the following ecological values within the Project area:

- Five broad vegetation groups
- Eight ground-truthed REs (three endangered and one of concern RE)

- 66 fauna species recorded in the field
- 168 flora species recorded in the field
- Occurrence of generic fauna habitat
- Occurrence of animal breeding places, and
- Ecological connectivity value.

The ecological values that qualify as MNES or MSES are summarised in Section 5.8 and Appendix G, respectively. Further, the environment surrounding the Project site has been thoroughly described in the environmental assessments and summarised under Section 5.

4.3.5 Criterion (f) – Submissions made by Applicant and Submitters

The EA Amendment and associated environmental studies will constitute BMAs submission in support of the Project's Amendment Application for the EA. BMA will undertake an appropriate level of formal and non-formal key stakeholder consultation during the EA Amendment process. Further to the formal public notification process, BMA will respond to complaints and concerns from the public during all phases of the Project should they arise.

4.3.6 Criterion (g) – Best Practice Environmental Management

Best practice environmental management is defined in the EP Act, section 21 as: The management of the activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the measures currently used nationally and internationally for the activity.

The Project will update the existing environmental management plans to meet the guidelines set out in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME, 1995).

4.3.7 Criterion (h) – Financial Implications

The Project will financially benefit the local and regional communities directly, not only in value adding but also in providing communities with employment and opportunity. The Project has the technical and financial support to establish and maintain commitments associated with infrastructure requirements and environmental management controls.

4.3.8 Criterion (i) – Public Interest

The Project will provide sustained employment and wealth for the region. Issues of community interest and concern will be dealt with appropriately during the EA Amendment process. BMA will continue to engage with the relevant key stakeholders throughout the life of the Project as an extension of its existing key stakeholder program.

4.3.9 Criterion (j) – Site Management Plan

An Environmental Management Framework exists at the CVM. The existing environmental management plans will be updated accordingly stating the management strategies to prevent or minimise the potential for environmental harm from the Project and will also set out a framework to manage environmental obligations set out in the EA.

4.3.10 Criterion (k) – Proposed integrated environmental management system

The Project will operate in accordance with the existing Environmental Management Framework and other related documentation.

4.3.11 Criterion (l) – Other matters

An EA under the EP Act is required for undertaking a resource activity, which includes a mining activity authorised under a ML. A single EA is required for all resource activities that are carried out as a single integrated operation. In this regard, an application to amend EPML00562013 has been prepared for the Project. BMA do not propose to amend any EA conditions as part of this application.

5 Environmental Assessments

5.1 Land Resources

A Soil and Land Resource Assessment including post-mining land use impacted by the Project was completed by SLR. The assessment is provided in Appendix A and is summarised below.

5.1.1 Relevant Guidelines

The following guideline and standards were used for the Soil and Land Resource Assessment:

- Australian Soil and Land Survey Field Handbook, 3rd edition. National Committee on Soil and Terrain (NCST) CSIRO Publishing, 2009
- Guidelines for Surveying Soil and Land Resources, 2nd edition, Australia. NCST, 2008
- Regional Land Suitability Frameworks for Queensland. Department of Natural Resources and Mines and the Department of Science, Information Technology, Innovation and the Arts (DNRM and DSIT), 2013, and
- Isbell, R. F., The Australian Soil Classification, 2nd Edition, 2016.

5.1.2 Environmental Values

5.1.2.1 Land Systems and Land Use

5.1.2.1.1 Vegetation and Land Use

The Project area is highly modified from historic vegetation clearing and subject to ongoing direct and indirect effects of the operation of the CVM. However, the Project area was found to support a diversity of wildlife, habitat features and vegetation communities.

The vegetation within the Project area is largely regrowth brigalow and eucalypt woodland communities. Much of the regrowth brigalow community occurs on soils with a heavy clay content. Historically the Project area has been used for agriculture, predominantly cattle grazing native and improved pastures.

Details of vegetation at the Project area are outlined under Section 5.8 and the Terrestrial Ecology Impact Assessment provided in Appendix G.

5.1.2.1.2 Topography

The topographic elevations in and around the Project area range from approximately 220 metres AHD (northeast of the Project area) to 250 mAHD (at the southern end of the Project area). The Project area itself is mainly situated on the Isaac River floodplains, at an altitude of approximately 315 mAHD. Most of the Project area is situated on gently undulating lowlands and plains with slopes of 0 to 5 %.

5.1.2.1.3 Land Systems

Three land systems occur within the Project area, with the majority dominated by lowlands with brigalow and cracking clay soils on weathered and fresh Permian shales and lithic sandstone. Minor land systems are hills with lancewood and narrow-leaved ironbark on weathered Tertiary and Permian rocks in the central west of the Project area, along with lowlands with box and texture contrast soils on undissected Tertiary land surface in the very south of the Project area.

5.1.2.2 Soil Classification and Description

The on-site soils assessment and subsequent laboratory analysis indicated a total of three soil orders within the Project area according to the Revised Australian Soil Classification (Isbell, 2016). These included Vertosols, Chromosols and Dermosols. Representative profile descriptions for all detailed sites (prefix H) are provided in Section 4.1 of the Soil and Land Resource Assessment Appendix A.

5.1.2.2.1 Vertosols

These are soils with the following:

- A clay field texture or 35% or more clay throughout the solum except for a thin, surface crusty horizons 0.03 m or less thick; and
- When dry, open cracks occur at some time in most years1. These are at least 5 mm wide and extend upward to the surface or to the base of any plough layer, peaty horizon, self-mulching horizon, or thin, surface crusty horizon; and
- Slickensides and/or lenticular peds occur at some depth in the solum.

The Vertosols were further classified into:

- Self-Mulching Brown Vertosols;
- Self-Mulching Black Vertosols;
- Red Vertosols; and
- Grey Vertosols.

Self-Mulching Brown and Black Vertosols were identified as dominant soils types.

The Vertosols on site generally consisted of brown to very dark brown light to heavy clay A horizons (topsoil) with moderate structure, overlying a medium to heavy medium clay B2 horizon with strong sub angular blocky structure. The topsoil showed neutral, non-sodic and non-saline properties with a few locations showing alkaline, sodic and saline properties. The B2 horizon generally showed strongly alkaline, strongly sodic and highly saline properties.

5.1.2.2.2 Chromosols

Chromosols are soils other than Hydrosols with a clear or abrupt texture contrast between the A horizon and a B horizon, which the major part of the B2 horizon is non-sodic and not strongly acidic.

The Chromosols were further classified into:

- Eutrophic Red Chromosols; and
- Eutrophic Brown Chromosols.

Both the Chromosols were identified as dominant soil types.

The Chromosols on site generally consisted of brown loam A horizons (topsoil) with weak structure, overlying a light-to-light medium clay B2 horizon with moderate angular blocky structure. The topsoil generally showed neutral, non-sodic and non-saline properties, whilst the B2 horizon showed mild to strong alkalinity, non-sodic to marginally sodic and non-saline to slightly saline properties.

5.1.2.2.3 Dermosols

These are soils other than Vertosols, Hydrosols, Calcarosols and Ferrosols which:

- Have B2 horizons with a structure more developed than weak throughout the major part of the horizon; and
- Do not have clear or abrupt textural B horizons.

The Dermosols were further classified into:

- Eutrophic Brown Dermosols;
- Eutrophic Black Dermosols; and
- Eutrophic Red Dermosols.

All Dermosols were not identified as a dominant soil type.

The Dermosols on site generally consisted of very dark brown clay loam to light clay A horizons (topsoil) with weak to moderate structure, overlying a light medium clay B2 horizon with strong sub angular blocky structure. The topsoil showed neutral, non-sodic and non-saline properties, whilst the B2 horizon generally showed strongly alkaline, strongly sodic and non-saline to highly saline properties.

5.1.2.2.4 Soil Map Units

Within the Project area, a total of three Soil Map Units (SMU) were identified based on the dominant Australian Soil Classification (ASC) soil types. The majority soil type within the Project area is a Self-Mulching Vertosol, with a smaller area of Eutrophic Chromosols. The dominant and sub-dominant soil types per SMU are shown in Table 5-1 and a summary of the SMUs are included in Section 4.2 of the Soil and Land Resource Assessment Appendix A.

Table 5-1 Soil Map Unit Soil Types

Soil Map Unit	Dominant Soil Type	Sub-Dominant Soil Type	Hectares (Study Area %)
1A	Self-Mulching Brown-Black Vertosol	Dermosols, Grey Vertosol	757 (62%)
1B	Self-Mulching Brown-Black Vertosol	Dermosols, Grey Vertosol, Red Vertosol	404 (33%)
2	Eutrophic Red-Brown Chromosol	Nil	53 (5%)
		Total	**1,214**

If undisturbed, soils within all SMUs require standard Erosion and Sediment Controls (ESC). The topsoil is suitable for stripping and reuse using standard management controls. The subsoils in these SMUs generally exhibit strong alkalinity, high sodicity and high salinity. If the subsoil is exposed and not managed, in addition to severe agricultural productivity limitations, impacts may include:

- Erosion hazards including tunnel erosion
- Impeded soil infiltration and permeability
- Slumping failure of batters, and
- Soil dispersion leading to soil structure breakdown, increased run-off and increased turbidity run-off.

5.1.2.3 Soil Resources

Based on the soil survey results, topsoil and subsoil resources are summarised in Table 5-2.

Table 5-2 Available Soil Resource Summary

Topsoil Map Unit	ASC Soil Type	Hectares	Topsoil Strip Depth (m)	Topsoil Volume (m^3)
1A	Self-Mulching Brown-Black Vertosol	757	0.16	1,211,200
1B	Self-Mulching Brown-Black Vertosol	404	0.14	565,600
2	Eutrophic Red-Brown Chromosol	53	0.30	159,000
Topsoil Volume Available				**1,935,800**
Topsoil Less 10% Handling Loss				**1,742,220**
Topsoil Map Unit	**ASC Soil Type**	**Hectares**	**Topsoil Strip Depth (m)**	**Topsoil Volume (m^3)**
1A	Self-Mulching Brown-Black Vertosol	757	0.84	6,358,800
1B	Self-Mulching Brown-Black Vertosol	404	0.86	3,474,400
2	Eutrophic Red-Brown Chromosol	53	0.70	371,000
Subsoil Volume Available				**10,204,200**
Subsoil Less 10% Handling Loss				**9,183,780**

5.1.3 Potential Impacts

Potential impacts to land resources and rehabilitation considered include the following:

- Reduced land resources due to mining activities (such as stripping topsoil) and land use;
- Reduced land use availability due to mining operations land use;
- Soil loss due to wind or water erosion;
- Reduction in soil quality and fertility including nutrient loss;
- Inability to achieve post-mine land uses; and
- Contamination of land due to leaks or spills from plant, storage facilities or infrastructure and/or transport of contaminated soil or water and introduction into previously uncontaminated areas.

The Soil and Land Resource Assessment takes into consideration Land Suitability, Agricultural Land and Land Capability Assessments with comparison to pre- and post-mining disturbance and the post-mining conceptual final landform.

The Project area for this assessment covers a total approximate area of 1,214 ha and includes all land proposed to be disturbed by the Project (i.e. Approximately 910 ha of disturbed land). The Project area and proposed disturbance footprint is depicted in Section 1.3 of the Soil and Land Resource Assessment Appendix A and the proposed disturbance types and areas summarised in Table 5-3.

The conceptual final landform for CVM includes two notable landform changes compared to the pre-mine landform. Firstly, a single proposed final void as shown in Figure 3-14, of which the majority lies within the eastern portion of the Project area. In addition to the proposed final void, the elevation of the OOPD area in the north-western portion of the Project area will increase compared to the pre-mine landform in some parts by over 100 m. The conceptual final landform is depicted on Figure 3-14 and discussed further in Section 5 of the Soil and Land Resource Assessment in Appendix A. The CVM PRC Plan is currently under preparation. The PCR Plan will define the required land use categories.

Table 5-3 Proposed Disturbance Types and Disturbance Areas

Disturbance Type	Disturbance Area (ha)[1]
Horse Creek Bridge (including 20m Buffer)	1.90
Zone for Dragline Crossing	6.01
Dams (within Project area)	8.47
Water Management Infrastructure (including 20m Buffer)	44.07
EME Build Pad	6.34
Blast Compound (Option B)	10.31
Infrastructure Corridor	70.65
Out of Pit Dump	107.31
Horse Pit Extension	655.65
Total Disturbance Area Footprint	**910.71**

[1] The proposed disturbance areas exclude areas of overlap such that the total disturbance area footprint is representative of the actual proposed disturbance area. For instance, the HPE area encompasses the EME Build Pad and some Dams, so the HPE area presented in this table does not take into account the EME Build Pad and Dam areas.

5.1.3.1 Land Suitability

5.1.3.1.1 Pre-Mining

The Land Suitability Assessment indicates 1,161 ha of land within the Project area is rated as Class 5 for cropping and Class 3 for grazing, consisting of SMU 1A and 1B. The main limitations for the area were soil wetness (w) and soil water availability (m). The balance of the Project area (53 ha) is rated as Class 4 for cropping and Class 2 for grazing, consisting of SMU2. The main limitation for this area is soil water availability (m). Results for the pre-mining Land Suitability Assessment are detailed in Section 5.2.1 of the Soil and Land Resource Assessment Appendix A.

5.1.3.1.2 Post-Mining

Land suitability classes for areas not scheduled for the proposed mining activity disturbances will remain the same. This includes some Class 5 cropping (Class 3 grazing) areas and the entirety of the Class 4 cropping (Class 2 grazing) area comprising approximately 303 ha of the Project area.

Land suitability classes for areas scheduled for the proposed disturbance that are outside the boundary of the proposed final void area, will be managed and rehabilitated. The approaches in Section 5.1.4 aim to return land to an appropriate land suitability class. The OOPD area will include steeper slopes than the pre-mining landform and present additional limitations to that land, however as this area has been assessed as the least suitable category (i.e., Class 5) pre-mining, the suitability cannot decrease further. The PRC Plan for CVM will define the required land use categories.

The proposed final void area will impact on pre-mining Class 5 land areas comprising approximately 597 ha of the Project area, which results in a 51% shift in the total amount of Class 5 land within the Project area.

Changes in the areas of land suitability classes within the Project area between pre- and post-mining and the post-mining land suitability classes are detailed under Section 5.2.2 of the Soil and Land Resource Assessment Appendix A.

5.1.3.2 Agricultural Land

5.1.3.2.1 Pre-Mining

The Agricultural Land Assessment indicates the entire Project area (1,214 ha), consisting of SMU 1A, 1B & 2, is rated as Agricultural Land Class C1, pastureland, suitable for grazing improved and native pastures. Results for the pre-mining Agricultural Land Assessment are shown in Section 5.4.1 of the Soil and Land Resource Assessment **Appendix A.**

5.1.3.2.2 Post-Mining

Agricultural land classes for areas not scheduled for the proposed mining activity disturbances will remain the same. This includes Class C1 areas comprising approximately 303 ha of the Project area.

Agricultural land classes for areas scheduled for the proposed disturbance that are outside the boundary of the proposed final void area, will be managed and rehabilitated. The approaches in Section 5.1.4 aim to return land to an appropriate land class. However, the OOPD area will include steeper slopes than the pre-mining landform and present additional limitations to that land, which will likely result in a Class C3 categorisation. Current estimates show, approximately 186 ha of land will be rehabilitated to the pre-mining class of C1 and 128 ha to Class C3, which represents a 11% shift of Class C1 to C3 land.

The agricultural land class for the proposed final void area will be Class D land as the area is defined to have ‘no-use’. The proposed final void area will impact on pre-mining Class C1 areas comprising approximately 597 ha of the Project area, which will result in a 49% shift of Class C1 to Class D land.

Changes in the areas of agricultural land classes within the Project area between pre- and post-mining and the post-mining agricultural classes are detailed under Section 5.4.2 of the Soil and Land Resource Assessment Appendix A.

5.1.3.3 Land Capability

5.1.3.3.1 Pre-Mining

The Land Capability Assessment indicates 1,161 ha of land within the Project area is rated as Class VI land that is not suitable for cultivation, but is well suited to grazing, consisting of SMU 1A and 1B. The main limitations for the

Class VI area are erosion hazard (Es) and surface condition (Ps). The balance of the Project area (53 ha) is rated as Class V, land that in all other characteristics would be arable, but has limitations that make cultivation impractical and/or uneconomic for cropping. The main limitation for the Class V area is erosion hazard (Es) and surface condition (Ps). Results for the pre-mining Land Capability Assessment and the detailed Land Capability Assessment are provided in Section 5.6.1 of the Soil and Land Resource Assessment Appendix A.

5.1.3.3.2 Post-Mining

Land capability classes for areas not scheduled for the proposed mining activity disturbances will remain the same. This includes some Class VI areas and the entirety of the Class V area comprising approximately 303 ha of the Project area.

Land capability classes for areas scheduled for the proposed disturbance that are outside the boundary of the proposed final void area, will be managed and rehabilitated. The approaches in Section 5.1.4 aim to return land to an appropriate land capability class. However, the OOPD area will include steeper slopes than the pre-mining landform and present additional limitations to that land, which will likely result in a Class VII categorisation. Current estimates show, approximately 186 ha of land will be rehabilitated to the pre-mining class of VI and 128 ha to Class VII, which represents a 11% shift of Class VI to VII land.

The land capability class for the proposed final void will be Class VIII land as the area is defined to have 'no-use'. The proposed final void area will impact on pre-mining Class VI areas comprising approximately 597 ha of the Project area, which will result in a 51% shift of Class VI to Class VII land.

Changes in land capability classes within the Project area between pre- and post-mining are detailed under Section 5.6.2 of the Soil and Land Resource Assessment Appendix A.

5.1.4 Mitigation and Management Measures

5.1.4.1 Soil Sourcing, Substitution, Placement and Amelioration

Topsoil will be stripped for use in later rehabilitation. The topsoil will either be stockpiled until suitable re-contoured areas are available, or directly returned immediately across areas to be rehabilitated. The results of the land resources assessment identified that the topsoil and subsoil resources are adequate for the rehabilitation of the disturbed areas. In addition to the topsoil, there are subsoil resources available. However, the subsoil would require amelioration to allow it to be utilised as topsoil or for use in rock mulch as a topsoil substitute.

Topsoil from SMUs 1A and 1B (both Vertosols) could be stripped to a depth of 0.2 m without intrinsically changing the material properties of the won topsoil, given the already high clay content of the topsoil (A horizon) and similar chemical properties of the B21 horizons in these SMUs. This will provide an additional 361,080 m^3 of available topsoil for later use.

Soil will be stripped in a slightly moist condition wherever possible. Material will not be stripped in either an excessively dry or wet condition. Stripping operations will not be undertaken during excessive dry periods to prevent pulverisation of the natural soil aggregates. Similarly, stripping during wet periods will not be undertaken to prevent damage of the resource through compaction by equipment.

To reduce soil degradation during stripping operations preference will be given to using equipment, which can grade or push soil into windrows such as graders or dozers for later collection by open bowl scrapers or for loading into rear dump trucks by front-end loaders. This will minimise compaction impacts of heavy equipment that is often necessary for economical transport of soil material. These techniques are examples of preferential, less aggressive soil handling systems, which will be adopted by BMA.

5.1.4.2 Soil Placement and Management

All soils removed will be placed in designated stockpile areas. Freshly stripped and placed topsoil retains seed that is more viable, micro-organisms and nutrients than stockpiled soil. Vegetation establishment is generally improved by the direct return of topsoil and is considered 'best practice' topsoil management. Where long term storage stockpiles are required, accurate records will be maintained indicating stockpile volumes with areas to be covered by each stockpile upon decommissioning and rehabilitation.

The following management and mitigation strategies will be implemented by BMA to reduce degradation during stockpiling operations:

- Locations of stockpiles will be recorded using GPS along with data relating to the soil type and volume;
- An inventory of available soil will be maintained and updated regularly to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities;
- The surface of soil stockpiles will be left in as coarsely structured condition as possible to promote rainfall infiltration and minimise erosion prior to cover vegetation becoming established. The coarse structure will also prevent anaerobic zones forming;
- Soil types with significantly different properties will be stockpiled separately;
- Storage time will be minimised, where possible. If long-term stockpiling is required, stockpiles will be seeded with an annual cover crop species that produce sterile florets or seeds will be sown. A rapid growing and healthy annual pasture sward provide sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species, enhance the desirable micro-organism activity in the soil and minimise the erosivity potential of the stockpile;
- Topsoil will be spread to depths according to target requirements; and
- Where possible, topsoil will be re-spread directly onto rehabilitation areas. Topsoil will be spread, treated with fertiliser, and seeded in one consecutive operation, reducing the potential for compaction and topsoil loss to wind and water erosion.

5.1.4.3 Soil and Material Balances

The soil volumes referenced in Table 5-2 approximate the total soil resources within the project area.

The soil survey and laboratory results were used to determine depth of soil material suitable for recovery and reuse as material in rehabilitation. Factors requiring management considerations include stones, sodicity, salinity and alkalinity of subsoils. Actual volumes of topsoil and subsoil from SMUs 1A and 1B which can be stripped due to surface disturbance is 1,439,820 m³ of Vertosol topsoil, as summarised in Table 5-4. There is no proposed disturbance within SMU 2.

Table 5-4 Actual Disturbance Stripping Volumes

Topsoil Map Unit	ASC Soil Type	Hectares	Topsoil Strip Depth (m)	Topsoil Volume (m3)
1A	Self-Mulching Brown-Black Vertosol	757	0.16	1,211,200
1B	Self-Mulching Brown-Black Vertosol	164	0.14	229,600
Topsoil Volume Available				**1,599,800**
Topsoil Less 10% Handling Loss				**1,439,820**

5.1.4.4 Summary

The following general management strategies employed at the CVM will continue for the Project to minimise the extent and severity of land disturbance and constraints on rehabilitation thus mitigating risks that could result in environmental impacts:

- Disturbance will be undertaken using a permitting system and limited by minimising clearing including re-use of already disturbed areas and existing infrastructure to support the mine plan;
- Appropriate storage and management of hydrocarbons and hazardous materials within the MIA to prevent contamination of land e.g., bunding;
- Disturbance to be undertaken in consideration of weather and environmental, water flows, that could affect land resources during early mining activities;
- Topsoil will be stripped prior to mining and direct re-spread will be undertaken when possible to minimise topsoil handling and reduce damage to soil structure and propagules;
- Topsoil that is not directly re-spread will be stockpiled for re-use in rehabilitation and amelioration of long-term stockpiles/windrows;

- Appropriate surface water management measures to be implemented including clean water diversion, use of in pit sumps and sediment dams to capture mine affected runoff and stormwater as outlined in the updated Surface WMP;
- Establishment of engineered waste dumps, levees and other landforms with suitable amended materials design and features for erosion protection and location for optimal effectiveness, land suitability, and efficiency; and
- Monitoring and maintenance of rehabilitation until post-mining land use and sustainable vegetation is established.

5.2 Rehabilitation

Rehabilitation within the Project area will be in accordance with the CVM rehabilitation commitments as per the proposed PRC Plan, due to be submitted to the DES in December 2023. A PRC Plan is being prepared for CVM and will include the extension of Horse Pit (the Project) and the resultant landform. The PRC Plan consists of two main sections: rehabilitation planning part and PRCP Schedule. A summary of rehabilitation methodology that may be included in the PRC Plan are outlined in the below sections.

The schedule for the commencement of rehabilitation proposed for the Project is shown in Table 5-5. The hectares significantly increase from 2057 when the lowwall area of the spoil dump becomes available for rehabilitation.

Table 5-5 Horse Pit Rehabilitation Schedule

Date rehabilitation commences	Area (ha)
10/12/23	15
10/12/25	46
10/12/28	149
10/12/33	262
10/12/38	481
10/12/43	611
10/12/48	777
10/12/53	857
10/12/58	1393
10/12/63	1953

As part of the mine planning processes, landform planning is undertaken and areas deemed available for rehabilitation (ie. not requiring further disturbance by mining activities) are identified. For example dump locations that have reached capacity and will have no further material placed. These areas can then be considered for suitability for commencement of rehabilitation activities, primarily reshaping and stabilising works in the first instance. Aspects such as size of the area, condition of the material and other characteristics drive the timing of commencing rehabilitation activities of the each of the areas. For example rehabilitation of a small available area may be postponed until adjacent area is available and as such a larger contiguous area can be actioned using comparable resource allocations.

The PRC Plan will further detail the planning, milestones and schedule.

5.2.1 Final Landform and Void

A conceptual final landform has been developed for the Project and is shown in Figure 3-14. The figure shows conceptual illustration of the landform elevation once mining activities are complete. It should be noted that recontouring and shaping activities are not necessarily reflected.

For the Project, the final landform will be achieved through partial backfill of the final void during operations. As mining continues to the east, strip voids in the west will be progressively filled with waste. Dump capacity will be satisfied by the existing Horse Pit dump extent and the proposed out of pit dump (OOPD). As dump areas reach capacity, reshaping activities will be required to prepare the surface for rehabilitation activities. The proposed landform was considered against a number of other backfilling options using multi-criteria analysis which are detailed further in Appendix J.

Consistent with the CVM EIS (2010) the main features of the extended Horse Pit landform will be the elevated overburden dumps to the west, and Horse Pit void in the east. The pit floor is typically 1 to 2 strips wide to allow for equipment and material movements. The final Horse Pit void depicted in the CVM EIS will migrate to the east, with spoil material progressively backfilling the void as the mine progresses in strips. The final residual void associated with the Project will be comparable to the final residual void described in the CVM EIS. The length of the final void will likely be marginally less than that approved in the CVM EIS and the void itself will be approximately two strips wide at the base of the final void.

Consistent with the EA conditions that apply to the existing Horse Pit, there will be a residual void with no post-mining land use. The residual void is designed to achieve an area that is safe and structurally stable. Structural stability is achieved through geotechnical assessments to include wall set-backs at natural ground level to achieve a factor of safety of 1.5, therefore no geotechnical damage is expected beyond the set-back. Safety features are incorporated to prevent unrestricted access by humans and livestock and will include a safety bund constructed at the set-back distance to achieve a factor of safety of 1.5, as well as fencing and signage.

The location of the residual void will not present an unacceptable risk of environmental harm outside of the tenure boundary due to:

- Mitigating the risk of flooding into the residual void up to the 0.1% Annual Exceedance Probability (AEP) flood level through backfilling of the north end of the final void at the end of mining;
- Containing potential site-wide contaminants within the mining tenements as the residual voids:
    - Act as long-term groundwater sinks;
    - Do not overtop (release void water to surface waters or the surrounding landscape) as long-term pit water levels remain well below the spill point; and
- Preventing interconnectivity between the deeper Permian and shallower alluvial aquifers).

Additional detail relating to the stability of the void is provided in Appendix J.

The final landform will be a combination of land uses (eg cattle grazing, woodland habitat and watercourse) which are detailed in the PRC Plan. The post mining land uses (PMLUs) are developed based on the landform, topsoil availability and quality, consideration of the pre-mining land use, existing vegetation and ecological values and location of relevant watercourses. Acceptance criteria are defined for each of the PMLUs in Table E1 of the EA and these criteria will be applied for the Project.

5.2.2 Rehabilitation Goals

In accordance with the conditions of the EA (specifically Condition E3), all areas significantly disturbed by mining activities will be rehabilitated in accordance with Table E1 (of the EA). Table E1 outlines objectives, indicators and acceptance criteria for rehabilitation relating to goals for creating land that is:

- Safe to humans and wildlife;
- Non-polluting;
- Stable; and
- Able to sustain an agreed post-mining land use.

The stability of the post-mine landform will be achieved by applying sound rehabilitation practices. The rehabilitation practices will be designed to stabilise the landform, protect downstream water quality and aid a sustainable outcome for the Project area. The Project will undertake rehabilitation activities in accordance with the existing conditions of the EA (Schedule E).

5.2.3 Vegetation Establishment

5.2.3.1 Timing

In general, revegetation operations will consider both the season and timing of potential germination during the drier months. Where possible, direct seeding of native vegetation will be undertaken in the months October to February (inclusive).

5.2.3.2 Revegetation

The revegetation methods for all types of disturbed land within the Project area will consist of the following:

- Respreading of freshly stripped or stockpiled topsoil;
- Amelioration of spoils as recommended by an AQP;
- Application of appropriate fertiliser for plant establishment, after soil chemical analysis, if required; and
- Seeding with the appropriate seed mix. Revegetation planning will consider appropriate seed mixes for growth media and PMLU. Revegetation planning will further consider use of appropriate species based on limiting factors to vegetation growth such as salinity, sodicity, acidity as well as selecting species adapted to particular substrates from the surrounding area and ecosystems.

Where appropriate, material will be placed on steep sloped to aid stability. Contour ripping will be used as an erosion control measure immediately after surface preparation and before revegetation. A seed mix containing appropriate species to support the nominated post mining land use will be used to establish a sustainable vegetation cover.

5.2.3.3 Erosion and Sediment Control

The principal objectives of erosion and sediment control for rehabilitation areas are to:

- Minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters;
- Segregate contact water (surface run-off from disturbed catchments e.g. active areas of disturbance, stockpiles, and rehabilitated areas until stabilised) from clean water (surface run-off from catchments that are undisturbed or relatively undisturbed by Project-related activities and rehabilitated catchments) and maximise the retention time of contact water so that any discharge from the disturbance area is in line with the EA;
- Avoid the potential for runoff and incorporate suitable erosion and sediment control measures in accordance with the CVM Erosion and Sediment Control Plan (ESCP);
- Manage surface flows upstream of any surface disturbance during Project works so that rehabilitation activities are not affected by excessive run-on water;
- Establish sustainable long-term surface water management features following rehabilitation of the site, including implementation of an effective revegetation and maintenance program; and
- Monitor the effectiveness of ESC and maintain, in accordance with the requirements of the CVM ESCP.
- Land disturbance will be restricted to that necessary for the Project;
- Disturbance will be controlled using the CVM Permit to Disturb process and in accordance with the EA;
- All available topsoil will be salvaged for use in rehabilitation, where practicable;
- Erosion from topsoil stockpiles will be managed in accordance with the CVM ESCP, which requires stockpile sites to be located outside the limits of drainage lines, with controls to prevent mobilising stockpiled material and capture sediment;
- Topsoil stockpiles will be managed in accordance with the BHP Coal Topsoil Management Procedure;
- Stormwater and runoff from catchments directly upstream of the Project area will be diverted away from the Site during Project works;
- Hazardous materials will be stored in bunded areas or stored such that contaminated runoff is not generated; and
- Vehicles will be confined to maintained tracks and roads.

5.3 Geochemistry

A geochemical assessment of mineral waste that may be produced by the Project was completed by Terrenus Earth Sciences. The assessment report is provided in Appendix B and summarised herein.

Mineral waste is the broad term for ‘geologic’ (soil and rock) materials disturbed during mining and processing of coal and comprises overburden and interburden (collectively called spoil) and coal reject materials produced from the CHPP (all grain sizes, including dewatered tailings).

Geochemical data was obtained from a range of sources – from sampling and analysis undertaken in 2007 (prior to CVM mining approvals), and through to recent data collected by BHP Minerals Australia (BHP) in 2020. All data is from samples collected within the Horse Pit area and Project area. The number of samples of each key mineral waste group/type that have been assessed (relative to all samples assessed) are approximately proportional to the likely quantity of each key mineral waste group/type (relative to total mineral waste quantity).

Data is available for 505 samples. All samples were assessed with respect to their ability to generate acid and metalliferous drainage (AMD) and salinity. AMD includes acid/acidic drainage (AD), neutral mine drainage (NMD) and saline drainage from sulfide oxidation. Samples representing materials likely to report to final landform surfaces (i.e., potential spoil) also underwent assessment for sodicity and dispersion potential.

The geochemical characteristics associated with mineral waste materials are discussed by type:

- Non-carbonaceous spoil material (n=402 samples) – estimated to represent about 90 % of the total mineral waste. Of this, about 15 % will be weathered (mostly weathered Permian-age material)
- Carbonaceous spoil material (excluding coal reject) (n=41 samples) – estimated to represent approximately 5 % of the total mineral waste. Of this, essentially all will be unweathered (fresh). This material type comprises materials that are carbonaceous and/or coaly (excluding coal from target seams)
- Coal reject (n=31 samples) – mineral wastes (of varying particle sizes – fine to coarse) from the CHPP. Estimated to represent approximately 5 % of the total mineral waste, and
- Coal (n=31 samples) – will predominantly report as ROM coal that is stored temporarily on a ROM pad pending processing, however a small proportion of coal from non-target seams/plys will report as waste.

5.3.1 Environmental Values

5.3.1.1 Geochemical Characteristics of Non-Carbonaceous Mineral Waste

5.3.1.1.1 AMD Potential of Non-Carbonaceous Mineral Waste

Non-carbonaceous overburden/interburden, as a bulk material, is expected to generate pH-neutral to alkaline contact water (run-off and seepage).

The total sulfur (total S) concentration of this material is very low, with a maximum total S concentration of 0.46 % (90th percentile = 0.09 %). As such and combined with moderate acid neutralising capacity (ANC) values and very low maximum potential acidity (MPA) values, almost all samples (98 % of samples) were classified as non-acid forming (NAF). Less than 1.5 % of samples were classified as potentially acid forming (PAF) – primarily due to low ANC values. The remaining samples had an ‘Uncertain’ acid classification. ANC is expected to be about 50-60 % readily-available for non-carbonaceous overburden/ interburden, as a bulk material.

Total metal and metalloid concentrations are generally very low compared to average element abundance in soil in the earth’s crust. Soluble multi-element results indicate that leachate from non-carbonaceous material is expected to contain low concentrations of soluble metals and metalloids.

Non-carbonaceous material – which represents about 90 % of the total mineral waste at CVM – has a negligible potential to generate AMD as either AD and/or NMD. Additionally, due to the very low total S (and negligible sulfide) concentrations, the potential for saline drainage from sulfide oxidation is also negligible.

5.3.1.1.2 Salinity Potential of Non-Carbonaceous Mineral Waste

Non-carbonaceous overburden/interburden has electrical conductivity (EC) values ranging from 113 to 3,720 µS/cm, with median and 90th percentile values of 546 and 839 µS/cm.

Non-carbonaceous overburden/interburden is expected to generate low- to medium-salinity contact water (run-off and seepage). Due to the very low total S concentrations, the potential for sulfate-derived salinity (from sulfide oxidation) is negligible.

5.3.1.1.3 Sodicity and Dispersion Potential of Non-Carbonaceous Mineral Waste

Non-carbonaceous overburden/interburden samples (n=66) had relatively high cation exchange capacity (CEC) values and moderate-to-high exchangeable sodium percentage (ESP) values, resulting in 75 % of samples being classified as ‘strongly sodic’ and the remaining samples being classified as ‘sodic’. The CEC and ESP values suggest that most materials would be subject to some degree of dispersion.

Non-carbonaceous overburden/interburden is expected to be sodic to strongly sodic with some potential for dispersion.

5.3.1.2 Geochemical Characteristics of Carbonaceous Mineral Waste (excluding coal reject)

AMD Potential of Carbonaceous Mineral Waste

Carbonaceous overburden/interburden, as a bulk material, is expected to generate pH-neutral to alkaline contact water (run-off and seepage).

The total S concentration of this material is generally low, with a 90th percentile value of 0.38 %. As such, and combined with moderate ANC and low MPA values, 80 % of samples were classified as NAF and 5 % were classified as PAF. The remaining 15 % of samples had an ‘Uncertain’ acid classification [of which most are expected to achieve a final NAF classification]. ANC is expected to be about 50-60 % readily-available for most carbonaceous overburden/ interburden materials.

Total metal and metalloid concentrations are generally very low compared to average element abundance in soil in the earth’s crust. Soluble multi-element results indicate that leachate from non-carbonaceous material is expected to contain low concentrations of soluble metals and metalloids – similar to non-carbonaceous materials.

Carbonaceous material has a low potential to generate AMD as either AD or NMD. Additionally, due to the low total S (and low sulfide) concentrations, the potential for saline drainage from sulfide oxidation is also low.

5.3.1.2.1 Salinity Potential of Carbonaceous Mineral Waste

Carbonaceous overburden and interburden has similar EC values to non-carbonaceous materials – ranging from 177 to 918 µS/cm, with median and 90th percentile values of 319 and 759 µS/cm.

Consistent with non-carbonaceous overburden/interburden, carbonaceous materials are expected to generate low- to medium-salinity contact water (run-off and seepage). Due to the low total S concentrations, the potential for sulfate-derived salinity (from sulfide oxidation) is low.

5.3.1.2.2 Sodicity and Dispersion Potential of Carbonaceous Mineral Waste

Carbonaceous overburden/interburden samples (n=11) had CEC and ESP values comparable to non-carbonaceous samples, resulting in all 11 samples being classified as ‘strongly sodic’. The CEC and ESP values suggest that most materials would be subject to some degree of dispersion, however Emerson Class testing on nine samples shows no dispersion, resulting in some uncertainty regarding dispersion potential.

Consistent with non-carbonaceous overburden/interburden, carbonaceous materials are expected to be sodic to strongly sodic. The potential for dispersion is unclear, however would be expected to be similar to non-carbonaceous materials.

5.3.1.3 Geochemical Characteristics of Coal Reject

5.3.1.3.1 AMD Potential of Coal Reject

Coal reject, as a bulk material, is expected to generate pH-neutral to alkaline contact water (run-off and seepage).

The total S concentration of this material spans a much wider range compared to non-carbonaceous material, but is generally low to moderate, with a maximum total S concentration of 1.16 % and 90th percentile value of 1.0 %. The ANC of samples spanned a wide range – and the ANC is expected to be only partially available (approximately 50 % availability), with iron dolomite (+/- siderite) as the dominant acid neutralising mineral. As such, coal reject samples had a wide range of acid classifications, with 23 % of samples classified as NAF and 67% of samples classified as PAF or PAF Low Capacity (PAF-LC). The remaining 10% of samples (3 samples) had an Uncertain classification, however the available data suggests that all of these 'uncertain' samples are expected to be NAF [classified as UC (NAF)].

Total metal and metalloid concentrations are very low compared to average element abundance in soil in the earth's crust. Soluble multi-element results indicate that leachate from coal reject material is expected to contain low concentrations of soluble metals and metalloids – similar to carbonaceous materials.

<u>About two-thirds of coal reject samples were classified as PAF or PAF-LC and, therefore, have a moderate to high potential to generate AMD in an uncontrolled and unmitigated environment. Due to the moderate total S concentrations (median = 0.65 %), the potential for saline drainage from sulfide oxidation is also moderate to high.</u>

<u>When managed as per the current coal reject management strategy (i.e., buried within overwhelmingly NAF and low- to medium-salinity in-pit bulk spoil), the potential for disposed coal reject to generate AMD is low.</u>

5.3.1.3.2 Salinity Potential of Coal Reject

Coal reject has EC values similar to potential spoil materials – ranging from 213 to 1,730 µS/cm, with median and 90th percentile EC values of 407 and 1,065 µS/cm, respectively. The tailings and fine reject samples appear to span a greater range of EC compared to the coarse reject and MPR samples.

<u>Coal reject is expected to generate low- to medium-salinity contact water (run-off and seepage). Due to the moderate-to-high total S concentrations, the potential for sulfate-derived salinity (from sulfide oxidation in an unmitigated environment) is moderate to high.</u>

<u>However, when managed as per the current coal reject management strategy (i.e., buried within overwhelmingly NAF and low- to medium-salinity in-pit bulk spoil), the potential for sulfate-derived salinity from disposed coal reject is low.</u>

5.3.1.4 Geochemical Characteristics of ROM Coal

5.3.1.4.1 AMD Potential of ROM Coal

ROM coal, as a bulk material, is expected to generate pH-neutral to alkaline contact water (run-off and seepage).

The total S concentration of this material is generally low, with similar total S distribution to carbonaceous spoil material (90th percentile value of 0.40 %). As such and combined with ANC values that are generally significantly higher than their corresponding MPA values, 84 % of samples were classified as NAF and 10 % were classified as PAF. The remaining samples had an 'Uncertain' acid classification.

Total metal and metalloid concentrations (from two test results) are very low compared to average element abundance in soil in the earth's crust. Soluble multi-element results (from two test results) indicate that leachate from ROM coal is expected to contain low concentrations of soluble metals and metalloids – similar to carbonaceous and non-carbonaceous spoil materials.

<u>ROM coal material has a low potential to generate AMD as either AD or NMD, however some seams – such as P seam – are expected to pose a higher AMD potential. Additionally, due to the relatively low total S (and sulfide) concentrations, the potential for saline drainage from sulfide oxidation is also low.</u>

5.3.1.4.2 Salinity Potential of ROM Coal

Coal has EC values similar to carbonaceous spoil and coal reject materials – up to 895 µS/cm, with median and 90th percentile EC values of 457 and 836 µS/cm, respectively.

On a ROM pad, coal is expected to generate low- to medium-salinity contact water (run-off and seepage). Due to the relatively low total S concentrations and the short exposure (temporary storage) of ROM coal, the potential for sulfate-derived salinity (from sulfide oxidation) is low.

5.3.2 Potential Impacts

The assessment considered geological and geochemical data within the existing Horse Pit and the Horse Pit Extension Project area. The geological environment is consistent between the existing mining area and the Project area. The assessment has demonstrated that the data collected since CVM commenced operations is consistent with the earlier data collected (and assessed) prior to mining operations. The assessment has demonstrated that the environmental geochemical characteristics of new mineral waste materials expected to be generated by the Project are consistent with current mineral waste materials being generated at CVM.

The AMD hazard posed by coal reject from the upper seams (e.g., P seam) is slightly greater than coal reject from the middle and lower seams (e.g., Dysart and Harrow Creek seams). As mining extends eastwards the upper seams will feature more prominently in coal reject compared to the current situation. However, despite the future increase in the proportion of upper seam coal reject the small proportion of all coal reject co-disposed within the much larger proportion of ‘low AMD hazard’ spoil will still pose the same low AMD hazard for bulk spoil within the Project area as per the current mining area and spoil disposal areas.

5.3.3 Mitigation and Management Measures

5.3.3.1 Management and Mitigation of Spoil Piles

The management of overburden and interburden (spoil) materials generated by the Project will be consistent with the current approved mine waste management strategy – comprising the disposal of overburden and interburden as low-wall spoil, then progressively rehabilitated – with run-off and seepage captured by the mine water management system.

Where highly sodic and/or dispersive spoil is present it will not, wherever practicable, report to final landform surfaces and will not be used in construction activities. Tertiary spoil has generally been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program [ACARP], 2004 and 2019).

It may not be practical to selectively handle and preferentially emplace highly sodic and dispersive spoil during operation of the Project. Therefore, in the absence of such selective handling, spoil landforms will be constructed with short and low (shallow) slopes and progressively rehabilitated to minimise erosion. Where practical, and where competent rock is available, armouring of slopes may also be completed.

If rock is used for construction activities, this will be limited, where practical, to unweathered Permian sandstone, as this material has generally been found to be more suitable for construction and for use as embankment covering on final landform surfaces.

Surface water run-off and seepage from waste rock emplacements, including any rehabilitated areas, will be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids (TDS) and a broad suite of soluble metals/metalloids.

With the implementation of the proposed management and mitigation measures, overburden is regarded as posing a low risk of environmental harm.

5.3.3.2 Management and Mitigation of Coal Reject

The management of coal reject materials generated by the Project will be consistent with the current approved coal reject management strategy – comprising the disposal (burial) of dewatered tailings and Mixed Plant Reject (MPR) within low-wall spoil at designated disposal areas. Coal reject will also undergo monitoring for AMD and related environmental aspects.

Based on the current assessment, coal reject material is regarded as posing a moderate to high AMD hazard (unmitigated) with respect to generation of acidity and/or sulfate. As such, the burial and management of coal reject materials (as per the current approved CVM coal reject disposal practices) will continue, so as to minimise sulfide oxidation and potential generation of AMD. Seepage would be confined within the footprint of the open-cut pit and would drain into/towards open-cut pit areas (and therefore be captured by the mine water system). Surface water run-off would drain into mine dams/drains and also be captured by the mine water system. Therefore, when buried deeply amongst alkaline NAF spoil the overall risk of environmental harm and health-risk that emplaced coal reject poses is low.

The management measures for coal reject are addressed in the CVM Mining Waste Management Plan that is certified by an appropriately qualified person in accordance with Condition E12 of the CVM EA.

5.3.3.3 Validation of Coal Reject Characteristics

BMA will undertake validation test-work of coal reject during development of the Project (i.e., as the Horse Pit transitions into the Project area), particularly whenever new seams/plys or ROM coal blends are being processed. Test-work would, at minimum, comprise a broad suite of environmental geochemical parameters, such as pH, EC (salinity), acid-base account parameters and total and soluble metals/metalloids.

5.3.3.4 Management of ROM Coal and ROM Stockpiles

Surface water run-off and seepage from ROM stockpiles would not report off-site and would be managed as part of the mine water management system. ROM coal generated by the Project is expected to have a low degree of risk associated with potential acid, salt and soluble metals generation. Surface water run-off from ROM coal and product coal stockpiles would also be assessed on a periodic basis.

ROM coal would be stored on-site for a relatively short period of time (days to weeks) compared to mineral waste materials, which would be stored at the site in perpetuity. Management practices are therefore different for ROM coal (compared to spoil) and would largely be based around the operational (day-to-day) management of surface water run-off from ROM coal stockpiles, as is currently accepted practice at coal mines in Australia.

The mine water management system is monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS, acidity and a broad suite of soluble metals/metalloids.

5.4 Air Quality

5.4.1 Overview

Dust emission sources can be attributed to both anthropogenic and non-anthropogenic sources. The CVM is located approximately 7km southwest of the township of Moranbah which (on review of data obtained from the DES Moranbah (Utah Street) dust monitoring station) shows significant variability in locally and regionally influenced dust levels.

Moranbah is in the vicinity of several open cut mines including: CVM, Peak Downs Mine located 12km southeast; Poitrel Mine, Daunia Mine and Millennium Mine located 14km to the northeast, Isaac Plains Mine 20km to the east-northeast; and Goonyella Riverside Mine location 30km to the north. In addition there are non-mining activity dust sources and non-anthropogenic factors such as drought conditions and temperature inversions that play a role in dust levels.

To consider the potential impact of dust levels as a result of the Project at CVM an Air Quality Assessment (AQA) (Appendix) has been conducted. The CVM currently manages operations related to dust using a suite of management measures and supported by a monitoring network used to trigger escalating alarms when dust conditions approach EA Condition limits. The Project will continue to operate using this approach and as a result the AQA focuses on the quantification of changes to operational risk due to the release of dust as open cut mining operations progresses eastward. That is, confirming if the existing management and monitoring decision making approach is suitable to manage dust (as conditioned by the EA) generated by the Project.

Changes in operational risk are considered through understanding the predicted frequency and extent of additional mitigation measures that may be required, in excess of ‘typical’ (or Business as Usual, BAU) dust management practices, in order to maintain the standard of air quality required by CVM’s EA conditions.

The key elements of the AQA study included:

- Defining assessment objectives for total suspended particulates (TSP), dust deposition and particulate matter with an aerodynamic diameter of less than 10 micrometres (PM_{10}) based on CVM’s current EA conditions (Permit Number EPML00562013).
- Identifying assessment locations used to represent sensitive receptor locations based on CVM’s current EA.
- Estimating background levels for dust deposition and TSP based on historical data from the CVM ambient air monitoring network.
- Estimating the extent to which the 24 hour average concentration of PM_{10} as recorded by the CVM ambient air monitoring network were attributable to CVM mining operations
- Defining dust emission scenarios for current operations based on BAU dust management practices (i.e., the Project Without (BAU) Case) and proposed operations (i.e. the Project With (BAU) Case).
- Undertaking dispersion modelling using the TAPM/CALMET/CALPUFF suite of modelling tools based on one year of hourly varying meteorology.
- Developing results for dust deposition, TSP and PM_{10} for the Project Without (BAU) Case and the Project With (BAU) Case.
- Defining and assessing a series of mitigation scenarios that were applied to the Project With (BAU) Case. The results of these mitigation scenarios are used to demonstrate the extent to which additional mitigation measures (i.e. in excess of BAU) may be required in order to mitigate Project risk associated with PM_{10}.

Assessing whether or not the mitigation measures outlined in CVM’s current TARP are sufficient to mitigate Project related risk. Noting that current mining operations are associated with an inherent level of operational risk, the operational risk that was attributed to the Project was the net change in risk assessed as the difference between Project With (BAU) Case and the Project Without (BAU) Case.

5.4.2 Environmental Values

5.4.2.1 Assessment Locations

The CVM EA provides the following definitions regarding sensitive and non-sensitive places:

a. *A sensitive place means any of the following:*
   i. *a dwelling, residential allotment, mobile home or caravan park, residential marine or other residential premises; or*
   ii. *a motel, hotel or hostel; or*
   iii. *an educational institution; or*
   iv. *a medical centre or hospital; or*
   v. *a protected area under the Nature Conservation Act 1992, the Marine Parks Act 1992 or a World Heritage Area; or*
   vi. *a public park or gardens.*

b. *Despite paragraph (a), the following places are not sensitive places:*
   i. *subject to paragraph (c), a place that is the subject of an alternative arrangement; or*
   ii. *a mining camp (i.e., accommodation and ancillary facilities for mine employees or contractors or both, associated with the mine the subject of the environmental authority), whether or not the mining camp is located within a mining tenement that is part of the mining project the subject of the environmental authority. For example, the mining camp might be located on neighbouring land owned or leased by the same company as one of the environmental authority holders for the mining project, or a related company; or*
   iii. *a property owned or leased by one or more of the environmental authority holders, or a related company, whether or not it is subject to an alternative arrangement.*

c. *A place that is the subject of a current alternative arrangement in relation to a particular type(s) of environmental nuisance, is not a sensitive place for the purposes of that type(s) of environmental nuisance, however remains a sensitive place for the purpose of other types of environmental nuisances.*

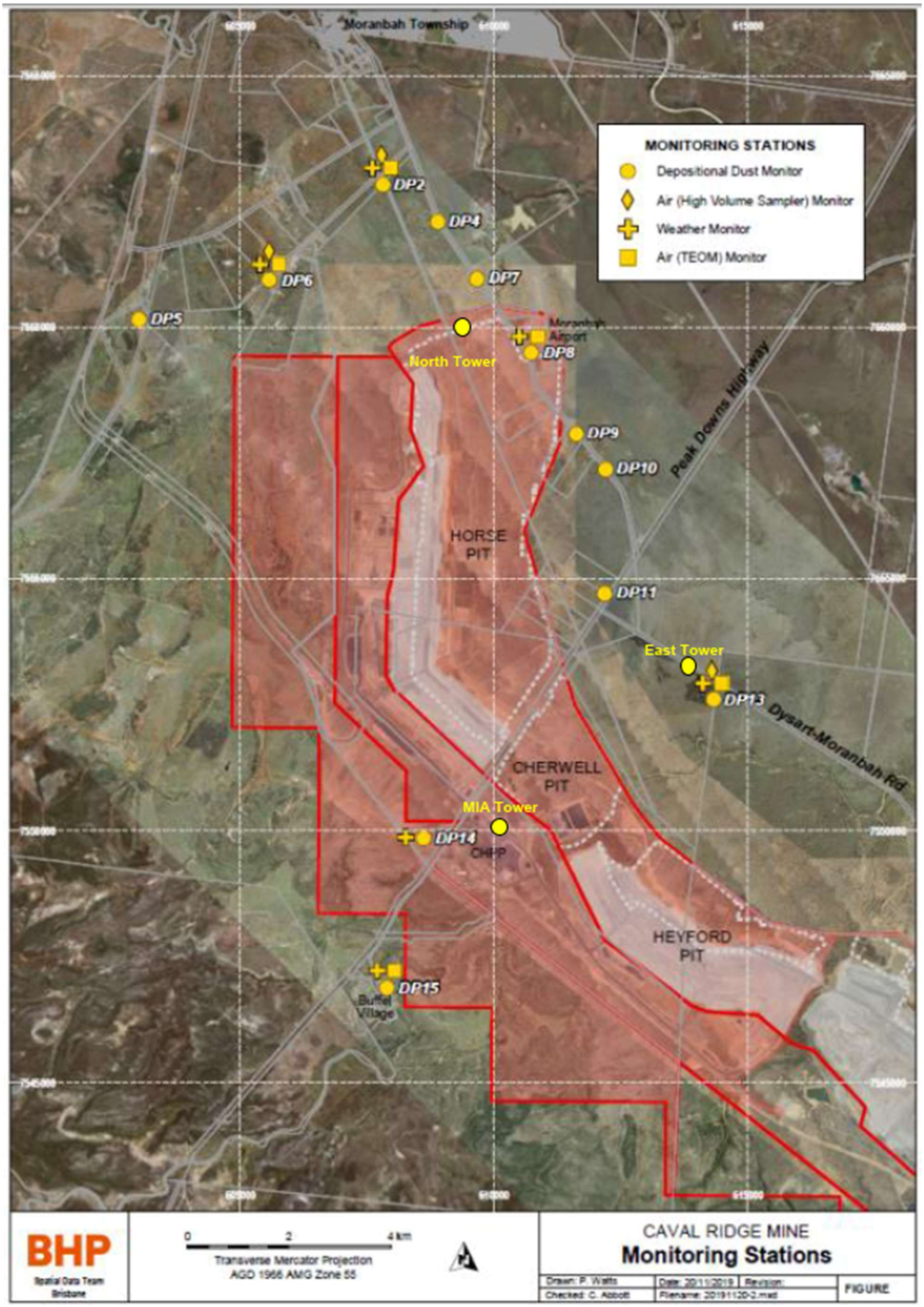
The CVM ambient air monitoring network was established between 2010 and 2012, and includes five ambient air monitoring stations (sites 2, 6, 8, 13 and 15) that continuously monitor a range of dust and meteorological parameters (Figure 5-1) and an additional monitoring station that only collects meteorological data (i.e., Site 14/DP14).

Specifically, Site 2 (Surrogate for Moranbah Township, DP2), Site 6 (Long Pocket Road, DP6) and Site 8 (Moranbah Airport, DP8) are currently interpreted by BMA as being representative of sensitive receptor locations, whilst Site 13 (DP13) is used as a background monitoring station and Site 15 (DP15) is located at BMA's Buffel Village and is not considered a sensitive receptor under CVM's EA.

More recently (2021/2022), CVM has commissioned three temperature inversion towers: the c. 50 m MIA tower, the c. 60 m East Tower adjacent to Site 13, and the North Tower located on the CVM ML, just south of Site 2 (Figure 5-1).

In general, results presented as part of the AQA focused on the three CVM ambient air monitoring network locations considered representative of sensitive receptor locations (i.e., Site 2, Site 6 and Site 8) all of which are located in the vicinity of the northern boundary of Horse Pit (Figure 5-1).

Figure 5-1 CVM Monitoring Stations and Temperature Inversion Towers



5.4.2.2 Assessment Criteria

The EA specifies ambient air quality objectives for dust deposition, TSP and PM_{10} as summarised in Table 5-6.

Table 5-6 CVM Ambient Air Quality Objectives

Pollutant	Averaging Period	Project Goal	Allowable Exceedances	Source
Dust deposition	Monthly	120 mg/m²/day	None	CVM EA condition (B5(a))
TSP	Annual	90 µg/m³	None	CVM EA condition (B5(b))
PM_{10}(1)	24 hour	50 µg/m³	None	CVM EA condition (B6) (2)

Note (1): Condition (B6) of Environmental Authority Permit Number EPML00562013 states that: The holder must take all reasonable and practical measures to meet the objective of the concentration of particulate matter generated by the mining activities with an aerodynamic diameter of less than 10 micrometres (PM_{10}) of 50 micrograms per cubic metre (50 µg/m³) suspended in the atmosphere over a 24 hour averaging time at any sensitive or commercial place.

Note (2): Interpreted as the incremental contribution of CVM mining activities as assessed by the methodology incorporated into the CVM Dust Control System.

The EPP Air also provides air quality objectives relating to dust.

5.4.2.3 Existing Air Quality

5.4.2.3.1 Meteorological Environment

A discussion of the meteorological environment is provided in Appendix C. Key outcomes relevant to the AQA include:

- Seasonal variability in wind speed and direction, with increased frequency of light winds during the night and an increased frequency of elevated winds during the day time hours.
- Drier conditions (rainfall) during the winter months.

Detailed understanding of the meteorological conditions was undertaken to identify conditions that lead to an increased risk of elevated levels of dust. In general, worst-case meteorological conditions for open-cut mining operations fall into two categories:

- Temperature Inversions: Characterised by calm conditions and the development of low level temperature inversions (typically in winter) that trap dust close to the Earth’s surface. Dust levels under these conditions have been observed to increase rapidly over very short periods of time. Inhibiting the dispersion of dust away from the source, the strength and duration of a temperature inversion event can be very difficult to forecast. The collapse of the inversion layer (typically just after sunrise) is associated with a rapid rate of dispersion of the trapped dust and an associated reduction in ground level concentrations.
- Wind Events: Elevated wind conditions that lead to the generation of significant windblown dust, particularly from exposed areas. Wind events are typically associated with elevated levels of visible dust and an increase in dust deposition. Wind events in the Bowen Basin are likely associated with summer storms or a synoptic front associated with a regional weather system. The minimum wind speed required to initiate wind erosion will vary depending on the properties of the exposed material, however, in general a lift off velocity of c. 5.4 m/s is suggested by the literature (e.g. NPI, 2012). Monitoring data highlighted that wind speeds above 5.4 m/s are an infrequent occurrence in this area and are more likely to occur during the daytime hours.

Analysis of data from 2015 to 2020 assessed the occurrence of both categories of these worst-case meteorological conditions identified:

- infrequent elevated levels of dust associated with high wind speeds (ie wind events); and
- frequent elevated levels of dust associated with low wind speeds.

5.4.2.3.2 Background Air Quality

Data recorded by the CVM monitoring network was used to:

- Develop estimates of background levels of TSP and dust deposition; and
- Develop estimates of CVM's contribution to the 24-hour average concentration of PM_{10} for the period 2015 through 2020.

Historical data from the CVM Site 2 monitoring station has been used to estimate background levels of TSP and dust deposition for comparison with EA Condition (B5(a)) and (B5(b)) objectives. Specifically, data for the period 12/11/2013 through 31/03/2015 (AED 2015) was used to develop background estimates for TSP and dust deposition as this period was considered to be representative of pre-mining- dust levels. These estimates are summarised in Table 5-7.

Table 5-7 Estimate of Background Levels of TSP and dust deposition

Pollutant	Averaging Period	Estimated Background Level	Source
TSP	Annual	39 µg/m^3	BMA CVM Site 2
Dust deposition	Monthly	44 mg/m^2/day	BMA CVM Site 2

As noted in Table 5-6, the EA condition B6 for PM_{10} is interpreted as a mine incremental and therefore a background value has not been included in the results presented for PM10 in Section 5.4.3 and Section 5.4.4. Instead, consideration of mine contribution associated with the Project Without (BAU) case and Project With (BAU) case has been used to highlight predicted changes in PM_{10} that may occur when comparing emissions for the current mining operations with the Project, ie the predicted change in PM_{10}.

5.4.3 Potential Impacts

5.4.3.1 Dust Emission Sources

To assess potential impacts of the Project, a series of dust emission sources are modelled such that key drivers can be identified and dust levels can be predicted under various scenarios. Through understanding the contribution of various emission sources, predictions can be compared against relevant thresholds and the effectiveness of targeted mitigations measures can be investigated.

Dust emission sources that have been explicitly modelled include (and are limited to):

- Coal mining, hauling and dumping
- Waste removal by dragline
- Waste removal by Truck and Shovel fleets including the loading of trucks, hauling and truck dumping
- Reject haulage
- Dozer dragline support
- Dozer operations in support of in-pit coal operations
- Dozer operations in support of waste handling
- CHPP activities (crushing, stacking, reclaiming)
- Wind erosion of exposed areas.

The incorporated dust emission sources is considered to represent the majority of significant site-based dust generating emissions sources with those excluded considered to be immaterial.

5.4.3.2 Dust Emission Inventory

Estimates of the amount of TSP and PM_{10} released into the atmosphere associated with the activities noted in Section 5.4.3.1 were based on the NPI Emission Estimation Technique Manual for Mining V3.1 (NPI, 2012), supplemented with those from the US EPA's AP42 (USEPA, 1995) as required and/or considered appropriate. The EETM (NPI, 2012) has been used to provide data to estimate the amount of TSP and PM_{10} emitted from the various activities on a mine site, based on the amount of coal and overburden material mined. (Calculations are not based on dispersion modelling). Details of the development of the emission factors used in the AQA are provided Appendix C.

The TSP and PM_{10} emissions inventories for the Project Without (BAU) case for selected years of mining is presented in Table 5-8 with those for the Project With (BAU) case presented in Table 5-9.

Table 5-8 Project Without (BAU) Case: Emissions Inventory for Selected Years of Mining

Activity	Units	FY2030	FY2040	FY2050
TSP				
Coal Handling	kg/year	1,796,981	0	0
Rejects Handling	kg/year	597,230	0	0
Waste Handling	kg/year	10,525,409	0	0
Dragline	kg/year	832,166	0	0
CHPP	kg/year	132,071	0	0
Wind Erosion - Disturbance	kg/year	5,357,616	0	0
Subtotal (No WSD)		13,883,856	0	0
Total		19,241,472	0	0
PM_{10}				
Coal Handling	kg/year	565,995	0	0
Rejects Handling	kg/year	162,135	0	0
Waste Handling	kg/year	3,613,112	0	0
Dragline	kg/year	192,595	0	0
CHPP	kg/year	55,699	0	0
Wind Erosion - Disturbance	kg/year	2,678,808	0	0
Subtotal (No WSD)		4,589,536	0	0
Total		7,268,344	0	0

Table 5-9 Project With (BAU) Case: Emissions Inventory for Selected Years of Mining

Activity	Units	FY2030	FY2040	FY2050
TSP				
Coal Handling	kg/year	1,734,589	1,680,279	1,184,815
Rejects Handling	kg/year	1,246,388	1,021,059	497,127
Waste Handling	kg/year	10,068,466	8,235,709	4,250,940
Dragline	kg/year	799,808	665,611	533,589
CHPP	kg/year	396,454	396,454	396,454
Wind Erosion - Disturbance	kg/year	6,170,544	5,224,464	3,412,896
Subtotal (no WSD)	kg/year	14,245,705	11,999,111	6,862,926
Total	kg/year	20,416,249	17,223,575	10,275,822
PM_{10}				
Coal Handling	kg/year	551,749	522,141	363,792
Rejects Handling	kg/year	338,368	277,196	134,960

Activity	Units	FY2030	FY2040	FY2050
Waste Handling	kg/year	3,564,939	2,898,824	1,548,590
Dragline	kg/year	184,784	153,975	123,669
CHPP	kg/year	149,652	149,652	149,652
Wind Erosion - Disturbance	kg/year	3,085,272	2,612,232	1,706,448
Subtotal (no WSD)	kg/year	4,789,492	4,001,788	2,320,662
Total	kg/year	7,874,764	6,614,020	4,027,110

5.4.3.3 Overview of Dispersion Modelling

Regional, three-dimensional wind fields that are used as input into the dispersion model were prepared using a combination of The Air Pollution Model (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Hurley, 2008), CALMET, the meteorological pre-cursor for CALPUFF (Scirer, 2000). One year of hourly meteorology corresponding to 2019 was developed.

The dust dispersion model that was used for this assessment is based on the CALMET/CALPUFF suite of modelling tools (Scirer, 2000) and one year of hourly varying meteorology developed using TAPM/CALMET.

The dispersion modelling provides a prediction of results, based on a number of assumptions, and the outcomes should be interpreted with this in mind. Assumptions and interpretation guidance is provided in Appendix C.

5.4.3.4 Interpretation of Results

5.4.3.4.1 Dust Deposition

Table 5-10 presents' results for the maximum monthly average dust deposition at the location of each of the monitoring stations and includes a background level of 44 mg/m^2/day. Results for three specific years of mining are included as well as an average over the life of mine i.e., 18 years of mining for the Project Without (BAU) case and 36 years for the Project With (BAU) case.

The predicted number of exceedances of the EA Condition B5(a) objective of 120 mg/m^2/day for dust deposition is presented in Table 5-11. Results presented highlight Site 6 as the highest risk location. The Project Without (BAU) case is predicted to be associated with on average 1.3 exceedances per year, increasing to 1.8 exceedances per year for the Project With (BAU) case (or from 13 exceedances in 10 years to 18 exceedances in 10 years).

To date, there have been no ongoing issues in relation to dust deposition at sensitive receptor locations as recorded by the CVM monitoring network.

Table 5-10 The Maximum Monthly Average Dust Deposition (mg/m²/day)

Receptor	Project Without (BAU) Case				Project With (BAU) Case			
	FY30	FY40	FY50	Average LOM	FY30	FY40	FY50	Average LOM
Mine years assessed	1			18	1	1	1	36
Background	44	-	-	44	44	44	44	44
Site 2	101	-	-	61	86	106	96	84
Site 6	150	-	-	**122**	**131**	**165**	**127**	**123**
Site 8	87	-	-	75	71	**121**	**157**	96
Site 13	87	-	-	68	75	61	58	63
Site 15	112	-	-	94	104	71	63	80
Note: Results include a background level of 44 mg/m²/day.								

Table 5-11 Annual exceedances of the Monthly Average Dust Deposition (mg/m²/day)

Receptor	Project Without (BAU) Case				Project With (BAU) Case			
	FY30	FY40	FY50	Avg/year LOM	FY30	FY40	FY50	Avg/year LOM
Mine years assessed	1			18	1	1	1	36
Site 2	0	-	-	0	0	0	0	0
Site 6	4.0	-	-	**1.3**	0.8	4.0	1.2	**1.8**
Site 8	0	-	-	0	0	1.0	2.0	0.4
Site 13	0	-	-	0	0	0	0	0
Site 15	0	-	-	0	0	0	0	0

5.4.3.4.2 Particulate Matter as TSP

Table 5-12 presents results for the annual average concentration of TSP at the monitoring locations. Results presented in this table include a background level of 39 µg/m³. Results for three specific years of mining are included as well as an average over the life of mine i.e. 18 years of mining for the Project Without (BAU) case and 36 years for the Project With (BAU) case.

The predicted number of exceedances of the EA Condition B5(b) objective of 90 µg/m³ for the annual average concentration of TSP are presented in the Table 5-12. Results suggest that there will be no significant change in operational risk associated with the Project with the average over the LOM for the Project With (BAU) case not differing significantly from that of the Project Without (BAU) case.

Results of the assessment does not highlight exceedances of EA Condition B5(b) as being a significant risk to operations.

Table 5-12 The Annual Average Concentration of TSP (µg/m³)

Location	Project Without Case				Project With Case			
	FY30	FY40	FY50	Average LOM	FY30	FY40	FY50	Average LOM
Mine years assessed	1			18	1	1	1	36
Background	39	-	-	39	39	39	39	39
Site 2	68	-	-	56	60	70	66	59
Site 6	**96**	-	-	74	79	**99**	82	78
Site 8	53	-	-	61	54	69	76	60
Site 13	52	-	-	62	55	49	46	49
Site 15	73	-	-	62	66	55	50	57

Note: Results include a background level of 39 µg/m³.

Table 5-13 Predicted Number of Exceedances of the Annual Average Concentration of TSP of 90 µg/m3

Location	Project Without (BAU) Case				Project With (BAU) Case			
	FY30	FY40	FY50	Avg/year LOM	FY30	FY40	FY50	Avg/year LOM
Mine years assessed	1			18	1	1	1	36
Site 2	0	-	-	0	0	0	0	0
Site 6	**1**	-	-	**0.11**	0	**1**	0	**0.14**
Site 8	0	-	-	0	0	0	0	0
Site 13	0	-	-	0	0	0	0	0
Site 15	0	-	-	0	0	0	0	0

Note: Results include a background level of 39 µg/m³ for the annual average concentration of TSP.

5.4.3.4.3 Particulate Matter as PM10

(Note: Results for the 24 hour average concentration of PM_{10} presented in this section are based on output from the dispersion modelling that has been corrected using the methodology summarised in Appendix C).

Table 5-14 presents results for the maximum mine contribution to the 24 hour average concentration of PM_{10} at the location of the monitoring stations. Results for three specific years of mining are included as well as an average over the life of mine. A summary of results for the predicted number of EA Condition B6 exceedance days is presented in Table 5-15.

Results presented in the Table 5-14 highlight Site 6 as being associated with the most risk to operations for both the Project With (BAU) case and the Project Without (BAU) case.

Infrequent exceedances of Condition B6 objective of 50 µg/m³ for the 24 hour average concentration of PM_{10} are suggested for Site 2, Site 6, Site 8 and Site 15 for both the Project With (BAU) case and the Project Without (BAU) case with PM10 exceedance days at Site 6 predicted to increase from 2.4 to 3.9 per year (i.e. 24 over 10 years to 39 over 10 years).

CVM's ability to manage dust risk associated with PM_{10} is demonstrated in Section 5.4.4.

Table 5-14 The Maximum 24 Hour Average Concentration of PM_{10} (µg/m³)

Location	Project Without (BAU) Case				Project With (BAU) Case			
	FY30	FY40	FY50	Average LOM	FY30	FY40	FY50	Average LOM
Number of mine years	1			18	1	1	1	36
Site 2	**62**	-	-	38	49	**57**	46	41
Site 6	**87**	-	-	**53**	**65**	**89**	**74**	**59**
Site 8	47	-	-	36	34	**63**	**83**	44
Site 13	44	-	-	24	29	29	23	23
Site 15	**54**	-	-	39	**52**	**52**	36	42

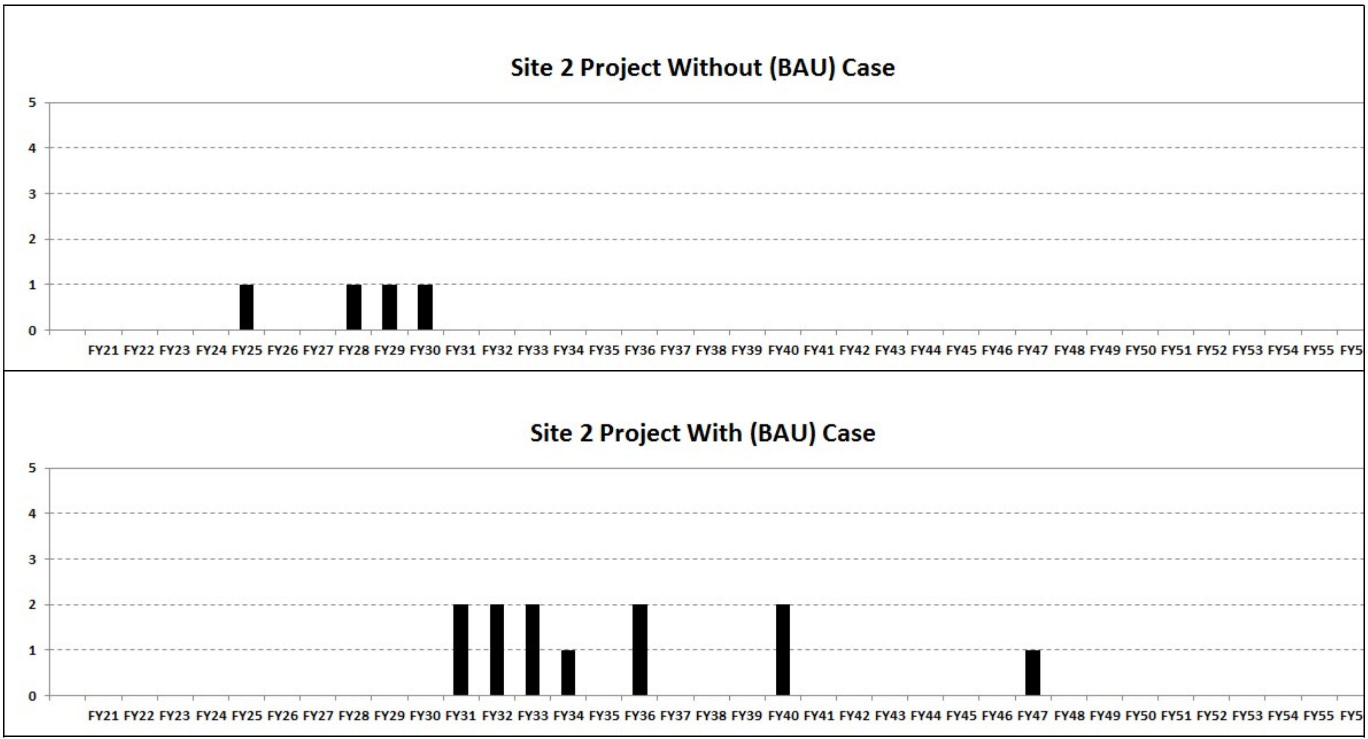
Table 5-15 The Predicted Number of Exceedance Days (EA Condition B6)

Location	Project Without (BAU) Case					Project With (BAU) Case				
	FY30	FY40	FY50	Avg/year LOM	Total over LOM	FY30	FY40	FY50	Avg/year LOM	Total over LOM
Number of mine years	1			18	18	1	1	1	36	36
Site 2	1	-	-	0.2	4	1	8	2	1.4	12
Site 6	10	-	-	2.4	43	3	12	4	3.9	142
Site 8	0	-	-	0.2	4	0	2	8	1.4	50
Site 13	0	-	-	0	0	0	0	0	0	0
Site 15	2	-	-	0.6	11	1	1	0	0.5	18

Presented in Figure 5-2 through Figure 5-4 are plots of the number of predicted exceedance days for each year of the life of the mine at the location of Site 2, Site 6 and Site 8. Results are presented for both the Project Without (BAU) case and the Project With (BAU) case.

Results for Site 2 (Long Pocket Road east) presented in Figure 5-2 suggest a marginal increase in the number of exceedance days per year (from c. 1 to c. 2) that will have to be managed by operations as a result of the Project. To date, mining operations at CVM have not been significantly impacted by dust levels at this location, ie operations have not be required to make significant changes to activities as a result of dust.

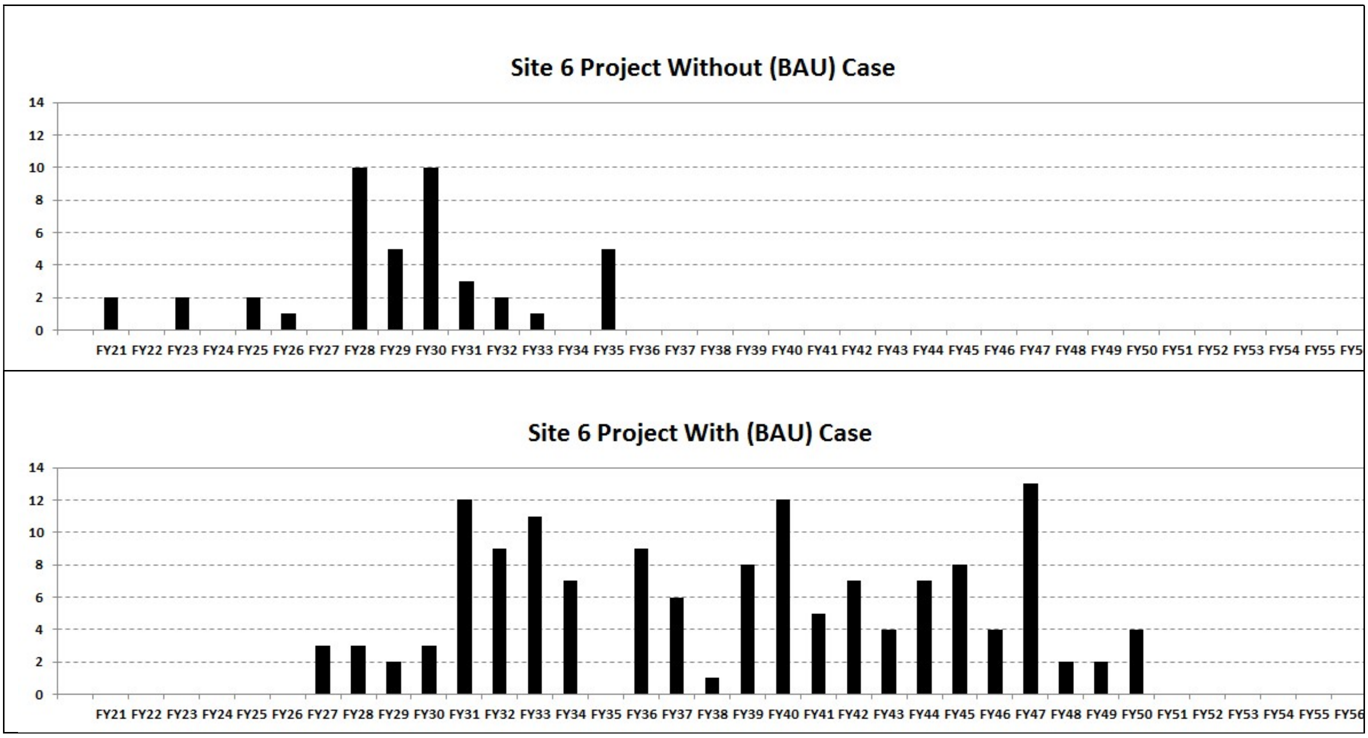
Figure 5-2 Site 2 Variations in Predicted PM_{10} Exceedance Days over the LOM



Results presented in Figure 5-3 for Site 6 (Long Pocket Road west) suggest that the peak predicted number of dust exceedance days per year is comparable between the two cases with just the duration for which additional operational dust management strategies may need to be implemented, extending for a longer period due to the Project. It is further noted that for both BAU cases, dust risk levels are predicted to increase from c. 2 exceedance day per year to c. 12 exceedance days per year in approximately 7 to 10 years' time.

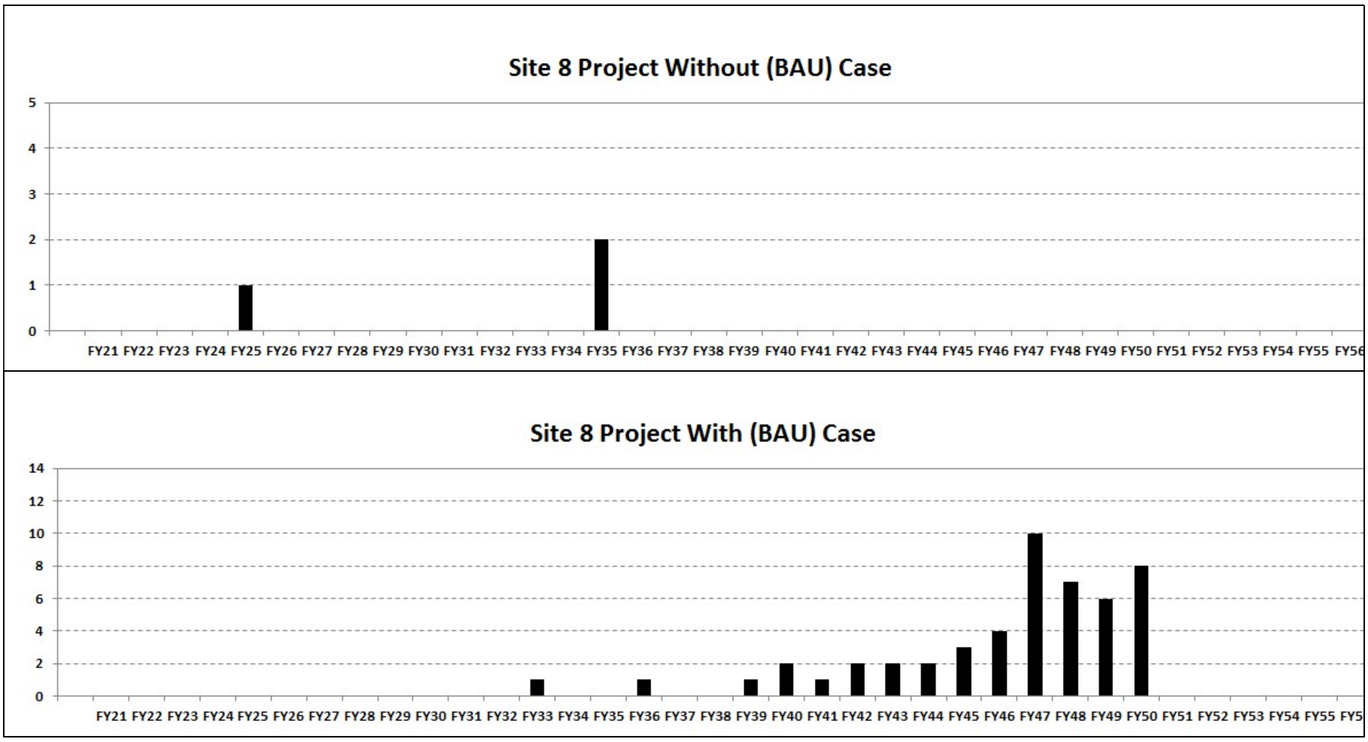
Results presented in Table 5-14 for the maximum 24 hour average concentration of PM_{10} suggest that the magnitude of the predicted exceedance days in both cases is comparable. This suggests that a similar level of operational dust management strategies will be required to be implemented in order to comply with the EA Condition B6 objective for both cases.

Figure 5-3 Site 6 Variations in Predicted PM$_{10}$ Exceedance Days over the LOM



Results presented in Figure 5-4 for Site 8 (Moranbah Airport) suggest a slight increase in operational dust risk due to dust levels at this location towards the end of the life of the Project. As mining activities progress eastward the number of dust exceedance days per year is predicted to peak at c. 10 for the Project With (BAU) case.

Figure 5-4 Site 8 Variations in Predicted PM$_{10}$ Exceedance Days over the LOM



5.4.4 Mitigation and Management Measures

Dust management practices at CVM are continually improving. Increased operational pressure was experienced during the recent period of prolonged drought throughout central Queensland. Calendar years 2018 and 2019 were more challenging operationally than during any other period in the mine's history.

Informed by a state-of-the-art ambient air monitoring network and three temperature inversion towers, the CVM Dust Control System (DCS) and supporting trigger action response plan (TARP) form the foundation of dust management at CVM.

Day-to-day operations utilise a suite of dust mitigation measures outlined in the TARP in response to alarms triggered by the DCS. These mitigation measures include:

- Truck/Excavator/Shovel Operations
    - Prioritise water carts to high dust emitting operations
    - Ensure all available watercarts are being used, hot seat water carts and reduce grading to only essential work
    - Reduce vehicle speeds to reduce visible dust
    - Reduce number of active trucks
    - Change dig/dump method
    - Cessation of activities
- Dragline:
    - Ensure drop height does not exceed 6m
    - Partial filling of dragline bucket (below crest)
    - Avoid over-dragging the bucket during fill
    - Lift bucket cleanly away from the face, and hoist up with minimum spillage
    - When emptying the bucket, restrict the drop height as far as practical and especially during windy conditions
    - Ongoing visual monitoring for dust emissions by trained personnel, with operations modified or stopped to restrict visible dust from leaving the mine site
    - Avoid bucket rotation during emptying
    - Cessation of activities
- Dozer Push/Grader:
    - Relocate dozer to sheltered area and modify task to lower emission activity
    - Cessation of activities
- Drill and Blast:
    - Drill rigs will be equipped with effective dust suppression systems which are available and activated during drilling.
- Coal Mining:
    - Prioritise water carts to areas generating dust
    - Drive to conditions
    - Minimise haul distances and traffic volumes
    - Maintain a consistent profile of loaded material to reduce spillage and the potential for wind entrainment of material being hauled
    - Cessation of activities
- CHPP and Stockpile Coal:
    - Visual inspection
    - Water sprays on stacker/reclaimer units
    - Dust suppression sprays on all transfer points where conveyors are running
    - Operation of fogging systems on outlets from sizing stations

In addition to day-today options for mitigating dust generated by mining activities, other avoidance activities will also influence the generation of dust. For example, reducing the footprint of disturbance through:

- Mine or infrastructure plan developments
- Rehabilitation of areas not needed for mining activities any further
- Implementing interim measures for surface stabilisation of suitable areas to reduce dust generation potential

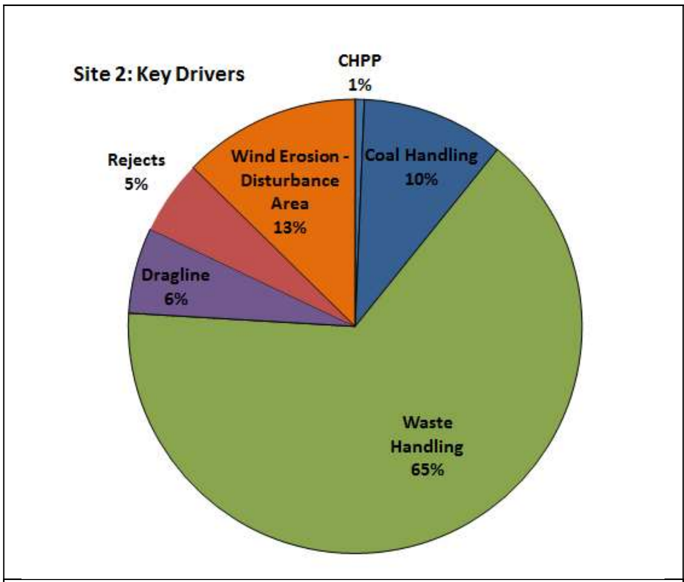
Implementation of these approaches is determined during periodic mine planning practices, informed by mine planners, rehabilitation schedules, environmental team members and operations leaders.

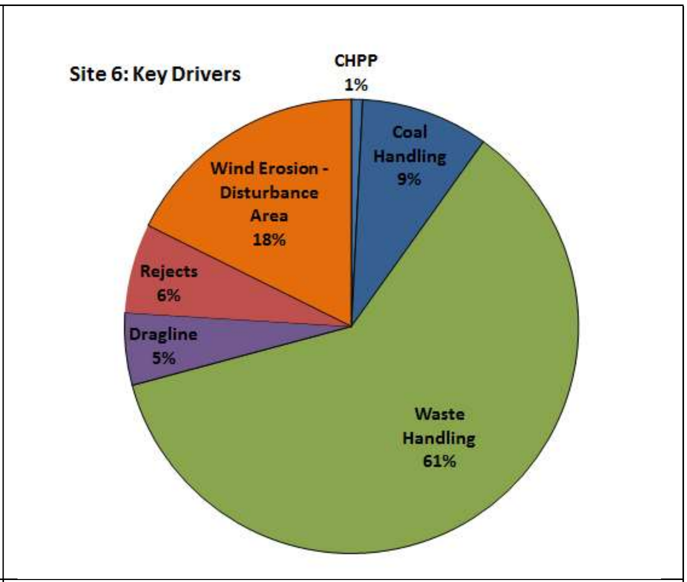
5.4.4.1 Key Drivers to Dust Risk

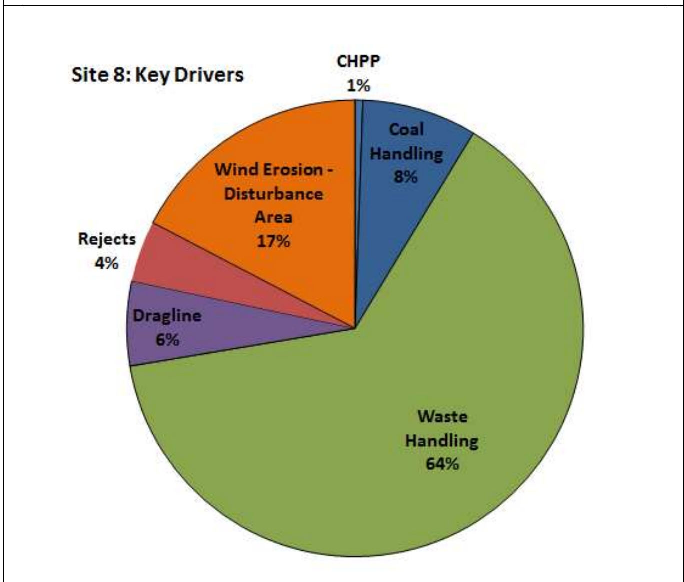
An investigation into the key drivers of PM_{10} risk (Section 5.4.3) for the Project With (BAU) case, highlighted waste material handling using Truck and Shovel mining methods as being the activity associated with highest risk at each of the three key monitoring station locations i.e. Site 2, Site 6 and Site 8 (Figure 5-5).

'Wind erosion – disturbance area' is also shown as a key contributor to dust risk (albeit to a lesser degree than waste handling). While the Moranbah region would generally be considered meteorologically calm when considering wind, the nature of mining activity is such that there will always be a footprint of disturbed land susceptible to wind generated dust. Day-to-day operations will continue to respond to escalating dust alarms however aspects such as longer term mine planning, closure rehabilitation scheduling and identification of priority areas for interim surface stabilisation will likely have the most substantial influence in reducing wind generated dust.

Figure 5-5 Project With (BAU) Case: Key Drivers based on an Average over the LOM







5.4.4.2 Modelled PM_{10} Mitigation Scenarios

Results presented in Section 5.4.4.1 highlighted waste material handling by truck and shovel mining methods as being the key driver to predicted PM_{10} impacts at Site 2, Site 6 and Site 8. Therefore modelled dust reduction scenarios focused on mitigation measures that target these sources. A summary of the mitigation scenarios that were investigated is provided in Table 5-16.

It is noted that the percentage reduction for the scenarios listed in the table may be achieved using one or more of a combination of dust mitigation options (which in practice will be informed by the TARP) for example:

- Reducing haul distances where possible
- Reducing vehicle speed and thus vehicle kilometres travelled (VKT) per hour
- Reducing the number of operating trucks

Two additional mitigation scenarios have been included in Table 5-16 that focus on dust mitigation strategies other than truck and shovel mining methods:

- Draglines only operating in key areas on high risk days.
- The cessation of all mining activities in key areas on high risk days.

Note that in practice, high risk areas and high risk days will be as identified by the DCS.

Table 5-16 The Project With (BAU) Mitigation Scenarios

Scenario	Description	Comments
25% Reduction in Waste Material Handling	• A reduction in Truck & Shovel activity (including loading, hauling and dumping of waste material) by 25% in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
50% Reduction in Waste Material Handling	• A reduction in Truck & Shovel activity (including loading, hauling and dumping of waste material) by 50% in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
75% Reduction in Waste Material Handling	• A reduction in Truck & Shovel activity (including loading, hauling and dumping of waste material) by 75% in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
100% Reduction in Waste Material Handling	• A reduction in Truck & Shovel activity by 100% (i.e. stopped operating) in key source areas on high risk days	• Assumes all other activities are operating as per BAU in key source areas on high risk days
Dragline Only	• Dragline operations as per BAU • All other activities have ceased in key source areas on high risk days	• Assumes all other activities are operating as per BAU in other areas of site on high risk days
Shutdown	• All mining activities have ceased.	• Assumes all activities in key source areas on high risk days have ceased operating

5.4.4.3 Results from the PM_{10} Mitigation Scenarios

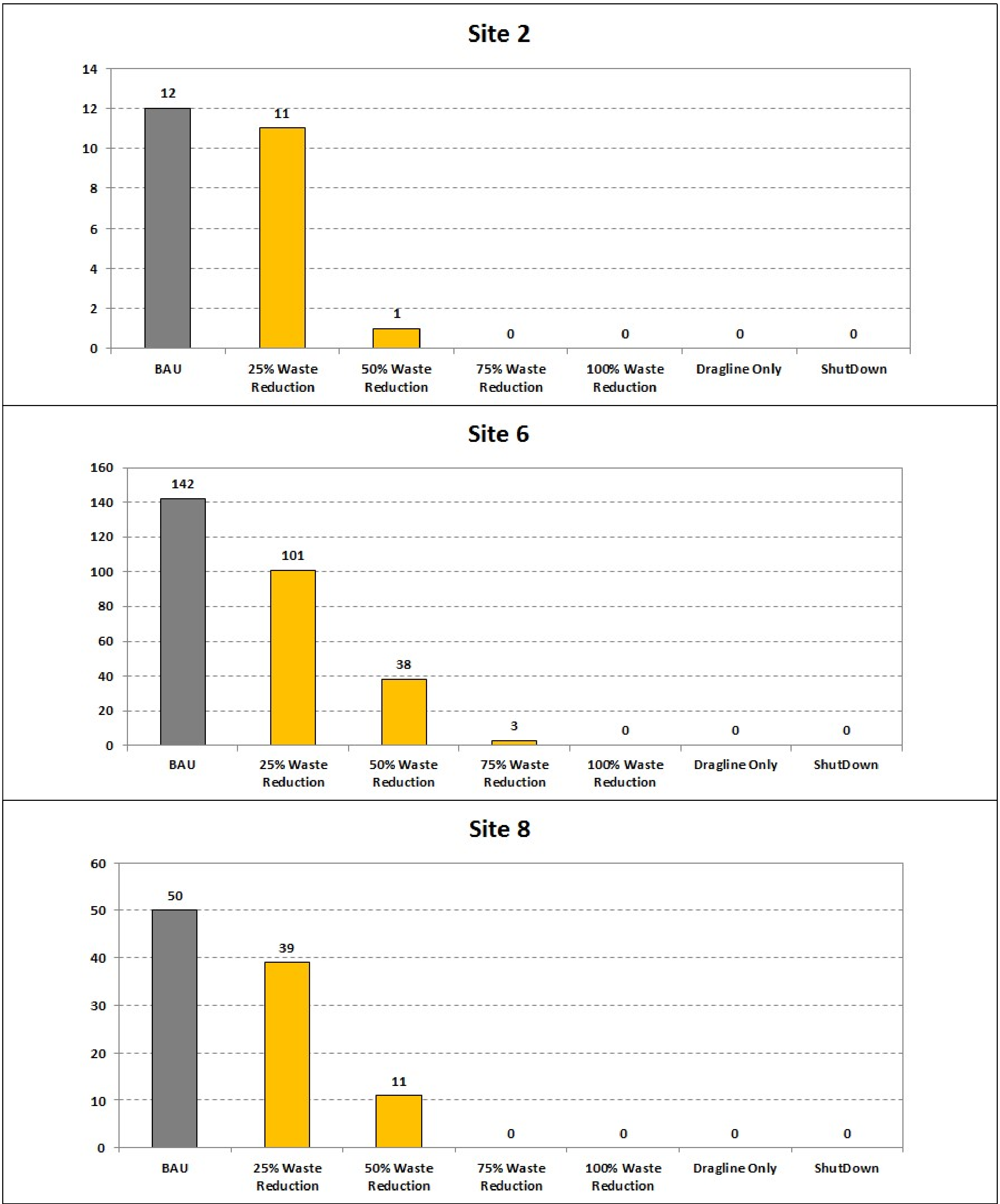
Presented in Figure 5-6 are the results from the dispersion modelling for the PM10 mitigation scenarios as outlined in Table 5-16 highlighting the extent to which additional dust control measures are predicted to be required to mitigate EA Condition B6 exceedance days. When interpreting the results presented in the figures the following are noted:

- The number above the grey column associated with the Project With (BAU) case indicates the total number exceedances of the CVM EA condition B6 that are predicted to occur over the LoM (c.f. Figure 5-2 through Figure 5-4).
- The value above the remaining columns highlights the number of exceedances days that are mitigated by implementing the noted mitigation measure when required. For example, 12 exceedance days are predicted to occur in total at the location of the Site 2 monitoring station over the LoM. A total of 11 of these days are predicted to be mitigated by implementing a strategy that is associated with a 25% reduction in waste handling by truck and shovel mining methods in key areas on high risk days. The remaining exceedance day is predicted to be mitigated through the implementation of a strategy that is associated with a 50% reduction in waste handling by truck and shovel in key areas on high risk days.

Results of the mitigation scenarios suggest that the range of mitigation measures available to site (as informed by the TARP) will be sufficient to adequately manage operational dust risk in accordance with CVM’s current EA requirements.

The background dust environment at Moranbah (DES Moranbah (Utah Street) dust monitoring station data) is known to be variable and hence modelling comparison to an absolute EPP(Air) threshold comes with challenges. Similar to the study of performance against EA Condition B6, dispersion modelling for mitigation scenarios when performance is measured against EPP(Air) also suggests the range of mitigation measures available to site will be sufficient to adequately manage operational dust risk.

Figure 5-6 The Extent to Which Mitigation may be Required (EA Condition B6)



5.4.4.4 Comparison of the Project With (BAU) and (Fully Mitigated) Cases

Presented in Table 5-17 is a comparison of the predicted number of PM_{10} exceedance days (EA Condition B6) for the Project With (BAU) case (Section 5.4.3.4), and the Project With (Fully Mitigated) case for the mitigation scenarios presented in Section 5.4.4.2.

As noted, results presented in the table suggest that the range of mitigation measures available to site (as informed by the TARP) will be sufficient to adequately manage operational dust risk in accordance with CVM's current EA requirements.

Table 5-17 The Predicted Number of PM_{10} Exceedance Days (EA Condition B6)

Location	Project With (BAU) Case					Project With (Fully Mitigated) Case	
	FY30	FY40	FY50	Avg/year LOM	Total over LOM	Avg / year LOM	Total over LOM
Number of mine years	1	1	1	36	36	36	36
Site 2	1	8	2	1.4	12	0	0
Site 6	3	12	4	3.9	142	0	0
Site 8	0	2	8	1.4	50	0	0
Site 13	0	0	0	0	0	0	0
Site 15	1	1	0	0.5	18	0	0

5.4.5 Summary

Results of the assessment suggest that dust impacts due to mining operations will be able to be managed in accordance with EA Condition B6 (PM_{10}). Mitigation measures in excess of BAU practises will be required to be implemented as informed by the site's state-of-the-art Dust Control System and TARP.

Results of the assessment suggest that both the Project With (BAU) case and the Project Without (BAU) case may lead to potential infrequent exceedances of EA Condition B5 objectives for TSP and dust deposition. The quantification of the potential for improved TSP and dust deposition outcomes that may result in association with the mitigation scenarios that have been investigated in relation to PM_{10} (Section 5.4.4.2) has not been undertaken due in part to the significant differences in associated timescales i.e. 30 day average for dust deposition and annual average for TSP. Furthermore, the lack of a real time monitoring option for dust deposition means that the assessment of compliance (or otherwise) with EA condition B5(a) will not be able to be determined in a manner which will allow for the development of alarms within the DCS. It is further noted that the dispersion model output correction methodology has only been applied to results for PM_{10}. Similar correction factors for TSP and/or potential correction factors for dust deposition have not been developed as part of this assessment. However, it is reasonable to assume that the strict management of dust in accordance with EA Condition B6 will be associated with improved air quality outcomes for TSP and dust deposition as well.

As mining operations progress eastward, the findings of the assessment suggests that there will be a net increase in the frequency of alarms generated by the site's DCS and the requirement to implement additional dust mitigation strategies under the site's TARP.

The development and adherence to a strict continual improvement plan for CVM that includes key triggers for review and refinement of the plan will assist in minimising operational risk.

It is noted that the CVM DCS is currently undergoing an upgrade that includes the implementation of additional functionality designed to improve site's ability to manage dust more proactively.

Based on the results outlined in Section 5.4.4.4 for the Project With (Fully Mitigated) case, no specific changes to the range of dust management strategies that form part of CVM's dust management practices that have been designed to meet current EA condition requirements are suggested as a result of Project-related air quality impacts.

Nonetheless, seeking opportunities to reduce operational risk by incorporating dust reduction strategies into mine planning practices over all planned timeline horizons (e.g. LOM, 5-year, 90-day, and weekly) is recommended.

5.5 Noise and Vibration

The noise and vibration impact assessment report has been prepared for the Project and is included as Appendix D. The assessment involved modelling of operational noise emission from the Project and total CVM noise as well as air blast overpressure and ground vibration modelling for the Project at the nearest receptors surrounding CVM. The noise and vibration impact assessment is summarised in the sections below.

5.5.1 Environmental Values

5.5.1.1 Existing Receptors

The CVM EA outlines noise and vibration conditions, including limits, under Schedule C. The definitions section of the CVM EA provides the definitions regarding sensitive and non-sensitive places, as outlined under Section 5.4.2.1

Based on the definitions, noise and vibration receptors surrounding and potentially impacted by the Project are listed in Table 5-18 and identified on Figure 5-7. A total of four (4) isolated noise sensitive receptors (i.e., R1, R2, R6 and R7) at distances ranging from 2.2 km to 5.7 km to CVM have been identified and considered in this assessment. The township of Moranbah, located approximately 5.5 km north of CVM, was also included in the assessment (i.e.R3-R5).

Table 5-18 Noise and Vibration Receptors

ID	Receptor	Easting (m) [1]	Northing (m) [1]	Ownership Status	Sensitive Receptor?	Distance to ML 1775 or 70403
R1	541 Railway Station Rd (9RP853653)	603,655	7,561,407	Privately owned	Yes	3.9 km
R2	881 Long Pocket Road (22SP263990)	605,416	7,561,101	Privately owned	Yes	2.2 km
R3	Moranbah Township (south-west)	607,232	7,565,669	Privately owned	Yes	5.6 km
R4	Moranbah Township (south-central)	609,572	7,565,756	Privately owned	Yes	5.5 km
R5	Moranbah Township (south-east)	611,564	7,565,501	Privately owned	Yes	5.5 km
R6	Winchester Downs	621,706	7,552,774	Privately owned	Yes	5.7 km
R7	Skyville	606,140	7,545,570	Privately owned	Yes	4.8 km
R8	Buffel Park	606,693	7,550,721	BMA owned	No	1.7 km
R9	Tomaren	603,063	7,560,372	BMA owned	No	4.0 km
R10	Grosvenor Downs (Anglo owned)	611,242	7,562,768	Anglo owned	No	2.4 km
R11	Horse Creek	611,913	7,557,483	BMA owned	No	0.6 km
R12	Buffel Park Village Accommodation	607,554	7,547,120	BMA owned	No	2.5 km

[1] Based on GDA 1994 MGA Zone 55 coordinate reference.

5.5.1.2 Existing Acoustic Environment

The Project mining operations with the potential to generate noise emissions, which form the basis for this Assessment, are as follows:

- Progressive land clearing and topsoil removal
- Stockpiling topsoil from disturbed areas for storage and use in future rehabilitation of the site
- Drill and blasting of overburden/interburden material (including through seam blasting)
- Pre-stripping/excavation of overburden material using excavators/shovels and trucks, draglines and dozers
- Side casting of lower overburden into the previously mined strip using a dragline
- Removal of overburden/interburden and placement in either the IPD or OOPD

- Loading and hauling of ROM coal using a combination of excavators, loaders and trucks (CVM will continue to receive ROM coal via conveyor from PDM), and
- Progressive rehabilitation by backfilling the mined-out pit, reshaping dumps, topsoiling and revegetation.

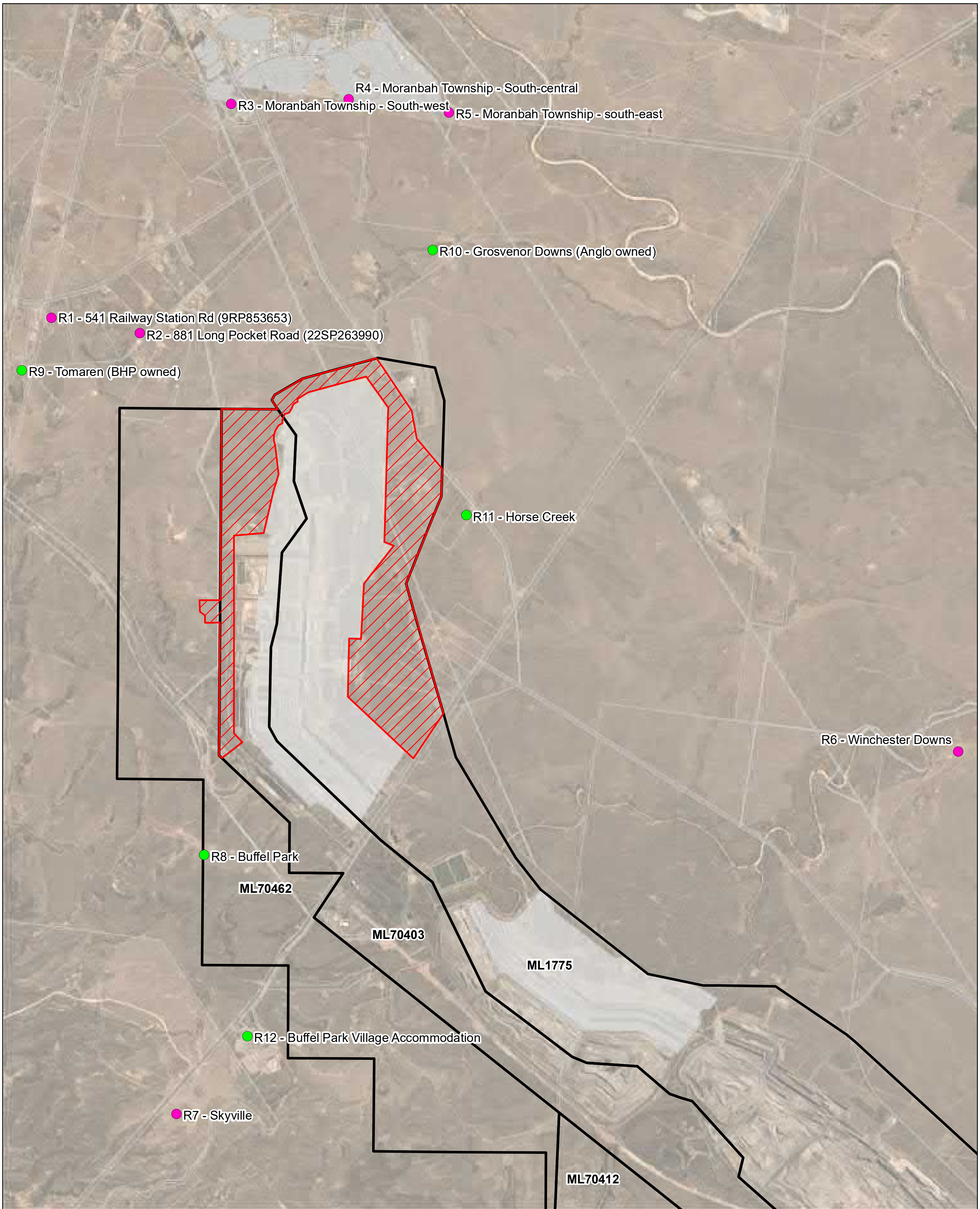
To assist with defining the existing (pre-Project) acoustic environment, unattended and operator attended noise monitoring was completed at four (4) receptor locations surrounding CVM during April and May 2020. The results of the unattended noise monitoring is summarised in Table 5-19.

CVM noise was observed by SLR to be audible (to varying degrees) at monitoring locations R2 (881 Long Pocket Road), R7 (Skyville/Buffel Park boundary) and R12 (Buffel Park Village). Consequently, Rating background levels (RBL) have only been reported for monitoring location R6 (Winchester Downs).

Table 5-19 Summary of Unattended Noise Logging Results

Monitoring Location	Ambient LAeq Noise Levels, dBA			Rating Background Level LA90, dBA [1]		
	Daytime	Evening	Night-time	Daytime	Evening	Night-time
R2. 881 Long Pocket Rd	51	51	45	-	-	-
R7. Skyville/ Buffel Park Village boundary	41	34	34	-	-	-
R12. Buffel Park Village adjacent to carpark	50	45	43	-	-	-
R6. Winchester Downs	41	59	49	26	24	24

[1] Where practicable, the seasonal influences of insect noise have been removed.



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:100,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

- Sensitive Receptors
- Non-sensitive Receptors
- Horse Pit Extension Project Area
- BHP Tenements
- CVM EIS Pit Boundary (2010)
- Cadastre

Horse Pit Extension Project

Noise Sensitive Receptors Surrounding the Project

FIGURE 5-7

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_4_Receptors_001.mxd

5.5.1.3 Noise and Vibration Assessment Criteria

Potential noise and vibration (blasting) impacts from the Project have been assessed against the noise and vibration limits prescribed in the existing CVM EA as well as the requirements of the EP Act and EPP(Noise). Table 5-20 outlines the operational mining noise criteria referenced in this assessment.

Table 5-20 Summary of Operational Mining Noise Criteria

Reference	Noise Criteria dBA, Assessable at a Residential Noise Sensitive Receptor		
	Daytime	Evening	Night-time
CVM EA - LAeq, adj, 15min	30	30	30
CVM EA - LA1, adj, 15min	52 [1]	52 [1]	52 [1]
EPP(Noise) – LAeq,15min	42 [2]	42 [2]	37 [2]
EPP(Noise) – LA1,15min	52 [2]	52 [2]	47 [2]

[1] Internal criterion from CVM EA with a conservative 7 dB façade reduction to derive an externally assessable criterion.

[2] Internal criteria adopted from EPP(Noise) with a conservative 7 dB façade reduction to derive an externally assessable criterion. The derived daytime and evening criteria are lower than the reported 'outdoor' noise criteria for a residential receptor (by 10 dBA).

Potential blasting impacts from the Project (i.e., air blast overpressure and ground vibration), have been assessed against the current CVM EA blasting limits (which also align with the EPP(Noise)) (Table 5-21).

Assessment criteria is discussed in detail under Section 4 of the Noise and Vibration Assessment provided in Appendix D.

Table 5-21 Blasting Assessment Criteria

Parameter	Sensitive or Commercial Place Blasting Limits
Ground vibration peak particle velocity	For vibrations of more than 35 Hz – no more than 25 mm/s peak particle velocity at any time.
	For vibrations of no more than 35 Hz – no more than 10 mm/s peak particle velocity at any time.
Air blast overpressure level	115 dB (Linear peak) for four (4) out of five (5) consecutive blasts regardless of the interval between blasts, and not greater than 120 dB (Linear peak) at any time.

5.5.2 Noise and Vibration Assessment Methodology

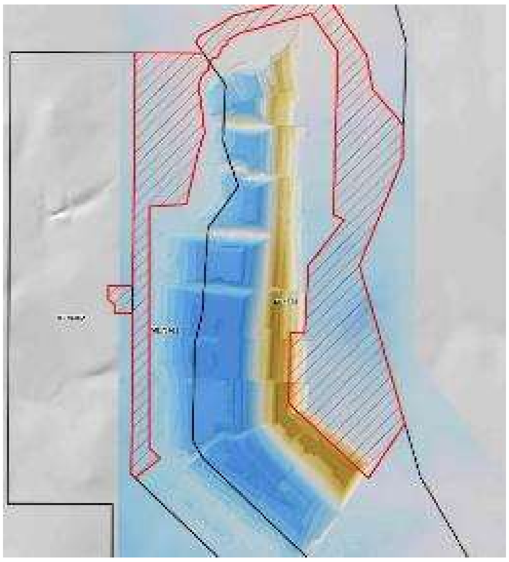
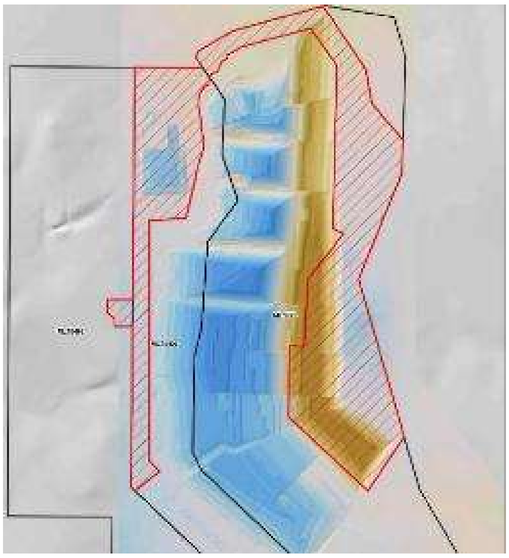
The selection of noise modelling/assessment scenarios for the Project was based on assessing activities with the greatest potential to result in noise at the identified sensitive receptors. This included when plant and equipment (noise sources) would be at the closest proximity to receptors (i.e., due to active mining pits and waste dumps) and where there would be limited screening of noise from on-site structures or topography.

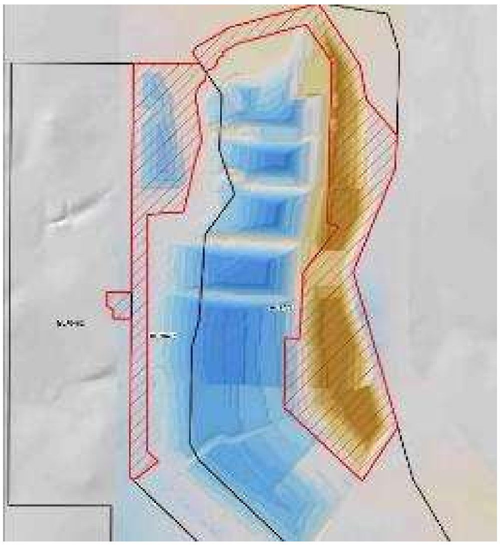
The assessment scenarios in Table 5-22 were developed to assess potential 'typical worse-case' noise levels with consideration of the following:

- Progressive mining within the Project area including the eastward progression of Horse Pit and adjacent waste dumps
- BMA advised ROM and product coal output estimated over the life of the Project, and
- Development of the new OOPD in the north-west corner of ML 70403 (preparation works commencing in FY2028).

The Project is expected to require only minor “construction-type” activities (i.e., in comparison to the Project operational activities) and therefore the assessment has not included a construction phase scenario. This is discussed further in Section 2 of the Noise and Vibration Assessment provided in Appendix D.

Table 5-22 Assessed Operational Scenarios and Associated Mining Activities

Scenario/Year of Operation	Scenario Justification	Mine Plan Diagram
FY2030	Scenario modelled to assess the initial progression into the Project area (i.e., southern end) as well as coinciding with the peak ROM tonnage (for CVM) post-commencement of mining in the Project area.	
FY2040	Scenario modelled to assess the further extension eastward and into the northern tip of the Project area as well as the initial development of the OOPD.	

Scenario/Year of Operation	Scenario Justification	Mine Plan Diagram
FY2050	Scenario modelled to assess the bulk of Horse Pit operations within the Project area as well as the expansion of the OOPD towards the northern limit of ML 70403.	

The noise assessment was based on the assumptions and exclusions detailed in Section 5 of the Noise and Vibration Assessment provided in Appendix D and summarised below:

- The noise assessment involved modelling of mine noise sources located within the Project area and the remaining CVM (i.e., including equipment in Heyford Pit and the CVM CHPP).
- Predicted mine noise emission levels, have been reported as:
  - Project only noise emission levels, and
  - Total CVM noise emission levels.
- The type and quantity of equipment proposed to be operated for future CVM operations and the allocation of equipment between Horse Pit and Heyford Pit was based on the modelling conducted by SLR (then Heggies) for the CVM EIS.
- Modelling of haul trucks (waste or coal) was completed via line sources calculating a noise emission level for a typical path travelled over a 15 minute period.
- All remaining equipment has been modelled as point sources in a typical location for the pit/activity.
- Operations will be continuous (refer to Section 3.5.10) and no allowance was made for plant to be temporarily idle or not in use.
- To assess LA1 noise levels, a +8 dB relationship between the LAeq and LA1 has been applied where mobile mining equipment was identified as the dominant noise source.
- The Project would not require any material change to existing fixed plant operating at CVM, modelling of these sources was based on modelling of the CHPP completed by SLR in 2013.
- Rail noise has been excluded from this assessment as rail operations are not proposed to change as a result of the Project.

All noise modelling has been completed via a SoundPLAN (version 8.2) computer noise model using the Conservation of Clean Air and Water Europe (CONCAWE 1981) prediction methodology. Concurrent to the modelled mine scenarios outlined under Table 5-22, other key model inputs included:

- Default weather parameters recommended by PNC
- Mine equipment make, model and numbers relevant to the assessed operational scenarios, and
- Assumed overall sound power level (SWL) data and source emission heights for each equipment item – developed by SLR based on details from similar recently assessed coal mining projects.

The noise prediction modelling approach, including weather parameters and equipment inputs, is further detailed under Section 5.2 and Table 18, Table 19 and Table 20 of the Noise and Vibration Assessment provided in Appendix D.

A cumulative noise assessment was also undertaken for sensitive receptors exposed to noise emission from surrounding mines including PDM and Poitrel Mine (PTM). From the initial review of sensitive receptors surrounding CVM and baseline noise monitoring results, sensitive receptor R6 (Winchester Downs) was identified as potentially being impacted by mine noise emission from multiple mine sites including CVM. The cumulative noise assessment was based on the following information sources:

- Noise modelling predictions for the Project
- In the absence of relevant noise modelling for PDM, use of noise modelling predictions from the Project to estimate the contribution from PDM given the mines are a comparable distance from sensitive receptor R6, and
- Previous noise modelling conducted by SLR for PTM.

The cumulative noise assessment approach is detailed under Section 5.3 of the Noise and Vibration Assessment provided in Appendix D.

The assessment of potential Project blast impacts included review and analysis of historical blasting results for CVM as follows, including:

- Log of site blasting details including shot ID, shot location (centroid coordinate) and maximum instantaneous charge (MIC, kgs), and
- Blast log containing 184 blasts between 3 January 2019 and 16 November 2020, from which approximately 120 have been used in the analysis.

Composite blast site laws were derived for the purpose of calculating airblast overpressure and ground vibration levels from future blasts within the Project disturbance area. The blasting assessment approach is detailed under Section 5.4 of the Noise and Vibration Assessment provided in Appendix D.

5.5.3 Potential Impacts

5.5.3.1 Predicted Operational Noise Levels

The predicted noise levels from the modelled operational scenarios (FY2030, FY2040 and FY2050) for the Project and total CVM noise are summarised in Table 5-23 for neutral and adverse weather conditions.

Table 5-23 Predicted Project and CVM Operational Noise Levels

ID	Reference	Predicted Noise Level (LAeq dBA)					
		FY2030		FY2040		FY2050	
		Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather	Neutral Weather	Adverse Weather
R1	541 Railway Station Rd	20 (<10)	25 (<10)	20 (14)	25 (19)	20 (16)	26 (22)
R2	881 Long Pocket Road	24 (<10)	30 (<10)	25 (20)	30 (26)	26 (24)	32 (30)
R3	Moranbah Township (S-W)	15 (<10)	19 (<10)	15 (11)	20 (16)	15 (11)	20 (16)
R4	Moranbah Township (S-C)	18 (<10)	22 (<10)	16 (<10)	21 (14)	16 (11)	20 (16)
R5	Moranbah Township (S-E)	15 (<10)	20 (<10)	15 (<10)	19 (14)	15 (10)	19 (15)
R6	Winchester Downs	18 (<10)	22 (<10)	15 (<10)	20 (<10)	15 (<10)	19 (<10)
R7	Skyville	25 (<10)	31 (<10)	25 (<10)	31 (<10)	25 (<10)	31 (<10)
R8	Buffel Park	41 (<10)	47 (<10)	40 (14)	47 (20)	40 (18)	47 (24)
R9	Tomaren	21 (<10)	26 (<10)	20 (14)	26 (20)	21 (16)	26 (22)
R10	Grosvenor Downs	20 (<10)	25 (<10)	21 (16)	27 (22)	22 (18)	27 (24)
R11	Horse Creek	30 (<10)	36 (12)	33 (22)	39 (28)	32 (28)	38 (33)
R12	Buffel Park Village	33 (<10)	39 (<10)	33 (<10)	39 (12)	33 (10)	39 (16)

"S-W" is south-west, "S-C" is south central, and "S-E" is south-east.
Noise levels in brackets represent the Project noise emission level.
Bold noise levels represent an exceedance of the EA 30 dBA LAeq, adj, 15 min noise limit for noise sensitive receptors only.
Where a noise level prediction is below 10 dBA, this has been reported as '<10'.
Receptors R8 to R12 are not regarded as noise sensitive receptors.

From the noise prediction modelling results presented in Table 5-23, the following key outcomes were identified:

- Predicted Project and total CVM noise emission levels are below the EPP(Noise) AQOs derived external 37 dBA LAeq criteria at all noise sensitive receptors
- The highest predicted total CVM noise level was 32 dBA LAeq at sensitive receptor R2 (881 Long Pocket Road) for the FY2050 scenario under adverse weather conditions (temperature inversion). Regarding this highest predicted LAeq noise level, the following is noted:
    - This represents a marginal 2 dBA exceedance of the existing CVM EA noise limit of 30 dBA LAeq, adj, 15 min
    - The contribution of the Project to this highest predicted LAeq noise level was 30 dBA, which in isolation is compliant with the EA noise limit
    - The highest predicted noise level at R2 is primarily attributed to a D10 dozer working on the northern extent of the OOPD with clear line of sight to the north-west towards Long Pocket Road (i.e., a predicted noise level of 27 dBA). and
- The Project is predicted to have a negligible effect on CVM noise emission levels at R7 even under adverse weather conditions, and
- With regard to the two predicted marginal exceedances of the existing CVM EA noise limit, it is commonly accepted within the acoustics industry that differences in noise levels of 1 or 2 dB are negligible and imperceptible to the human ear.

Regarding LA1 noise level predictions, a +8 dB relationship between the LAeq and LA1 noise level descriptor has been used where the noise modelling indicated mobile mining equipment to be the dominant noise source. Accordingly, the highest predicted LA1 noise level was 40 dBA at sensitive receptor R2 (where LAeq was 32 dBA, i.e., the result for R2, 'Adverse Weather' in FY2050 described in Table 5-23) for the FY2050 scenario under adverse weather conditions (temperature inversion). This highest predicted L A1 noise level is compliant with the EPP (noise) derived external 47 dBA LA1 criterion and the existing CVM EA derived external noise limit of 52 dBA LA1, adj, 15 min. Operational noise levels are further discussed under Section 6.1 of the Noise and Vibration Assessment provided in Appendix D.

5.5.3.2 Cumulative Noise Levels

Based on the cumulative noise impact assessment detailed in Table 5-24, cumulative mine noise emission levels from CVM, PDM and PTM have the potential to result in a combined noise level of 27 dBA LAeq at sensitive receptor R6. The predicted cumulative noise level complies with all forms of noise assessment criteria and therefore cumulative noise impacts are not anticipated as a result of this Project. Cumulative noise is further discussed under Section 6.2 of the Noise and Vibration Assessment provided in Appendix D.

Table 5-24 Cumulative Mine Noise Under Adverse Weather Conditions at R6

Blast Category	Predicted LAeq (dBA) Noise Level from:			Cumulative LAeq (dBA) Noise Level
	CVM (with Project)	PDM	PTM	
R6 – Winchester Downs	22	22 [1]	22 [2]	27

[1] Estimated from CVM modelling.
[2] From SLR predictive modelling of future PTM operations.

5.5.3.3 5.1.1.3 Blasting

Blasting impact results are based on the calculated offset distance from the nearest anticipated blast point for the Project. The predicted airblast overpressure levels show that both the 115 dBL (20% exceedance case) and 120 dBL (maximum) blasting criteria can be achieved during blasting for the Project. The predicted ground vibration levels indicate that the 10 mm/s for the 1% exceedance allowance criterion can be achieved for all Project blasting.

The predicted airblast overpressure levels at sensitive receptor R2 is summarised in Table 5-25 and predicted ground vibration levels at sensitive receptor R2 is summarised in Table 5-26.

Table 5-25 Predicted Airblast Overpressure Levels at Sensitive Receptor R2

Blast Category	Assessed MIC (kg)	Distance to R2 (m)	Airblast Overpressure (dBL)	
			115 dBL Criterion 20% Exceedance Allowance	120 dBL Criterion 1% Exceedance Allowance
All Project blast types	1,313 – 2,377	4,500	105 - 106	114 - 115

The range in prediction represent the average and upper 10th percentile of MIC's for the Project.

Table 5-26 Predicted Ground Vibration Levels at Sensitive Receptor R2

Blast Category	Assessed MIC (kg)	Distance to R2 (m)	Ground vibration (mm/s) 10 mm/s Criterion (1% Exceedance Allowance)
All Project blast types	1,313 – 2,377	4,500	0.3 – 0.4

The range in prediction represent the average and upper 10th percentile of MIC's for the Project.

5.5.4 Mitigation and Management Measures

The operational noise, cumulative noise and blasting impact results indicate the Project will comply with the EPP(Noise) AQOs and the CVM EA. The operation of CVM will continue in accordance with the CVM EA, including the ongoing monitoring requirements.

With regard to the marginal 2 dBA exceedance at sensitive receptor R2 (881 Long Pocket Road) for the FY2050 modelled scenario under adverse weather, while this would tend not to warrant further investigation, based on the points made in Section 6.1.1 of the Noise and Vibration Assessment provided in Appendix D, noise mitigations will be incorporated to target the reference noise assessment criterion of 30 dBA LAeq. These mitigations and/or management measures will be required for mobile equipment operating at the OOPD in the north-west corner of ML 70403. These measures will include:

- Management of mobile equipment to avoid operating in areas of the OOPD with clear line of sight to Long Pocket Road during adverse (i.e. Temperature inversion) weather conditions.
- Careful design and operation of the OOPD, such as constructing and maintaining an acoustic bund along the northern edge of the OOPD during the daytime period would allow OOPD operations during adverse (temperature inversion) weather conditions to occur with the required shielding.
- If restriction of OOPD operating hours or the construction of an acoustic bund is not practicable, mobile mining equipment operating on the OOPD will be fitted with noise suppression kits. For this assessment, the modelling indicated a D10 dozer operating in the north-west corner of the OOPD was primarily responsible for the predicted 2 dBA noise limit exceedance.
- BMA will also utilise noise suppression kits for D10 dozers to reduce SWLs (by up to 6 dBA), which is predicted to result in the required reduction of overall CVM noise emission at R2, and thereby achieving compliance with the 30 dBA assessment criterion.

5.6 Surface Water Resources

5.6.1 Background

The Project area is primarily located within the Horse Creek Catchment with a small portion within the Cherwell Creek Catchment. Horse Creek and Cherwell Creek are tributaries of the Isaac River. The Isaac River is part of the Isaac-Connors sub-catchment, which is part of the Fitzroy River Basin.

Horse Creek is located on the western side of the existing Horse Pit. The creek flows in a northerly direction towards the boundary of ML 1775 before flowing northeast towards the confluence with Grosvenor Creek. Upstream of the Project area Horse Creek has previously been diverted to allow for current mine operations. It should be noted that the diverted portion of the drainage line flowing into Horse Creek is not defined as a watercourse and has a stream order of less than 4. As such, the existing diversion is not a regulated watercourse diversion under the Water Act 2000. Horse Creek is defined a watercourse downstream of the proposed Haul Road crossing as presented in Figure 3-17. Neither the existing diversion nor the remaining natural course of Horse Creek will be modified as part of the Project.

Horse Creek converges with Grosvenor Creek approximately 2.3 km downstream from the ML boundary. Horse Creek flows into Grosvenor Creek infrequently due to a weir located at the downstream end of Horse Creek. The location of the weir is depicted in Figure 3-17. The catchment area of Horse Creek to the junction with Grosvenor Creek is 57 km2 with the Project covering just over 4 km^2 of that catchment.

The headwaters of Cherwell Creek are located to the west of the current MLs. Cherwell Creek has a total catchment area of over 700 km2 and flows north easterly from the headwaters, through the existing MLs to the confluence with Isaac River. Major tributaries of Cherwell Creek include Caval Creek, Coalhole Creek, Harrow Creek and JB Gully. The Project area is located on a small, unnamed tributary of Cherwell Creek, located upstream of the confluence of Cherwell Creek and Harrow Creek. The Project area intersects approximately 3 km2 of the overall 700 km2 Cherwell Creek catchment. Figure 5-9 illustrates the location of the Project area relative to the local waterways.

5.6.2 Environmental Values

The Environmental Values for the Project are listed in the EPP (WWB) for Isaac River Sub-basin Environmental Values. The Project is located within the Isaac Western Upland and Tributaries Sub-catchment, and in close proximity to the Isaac River.

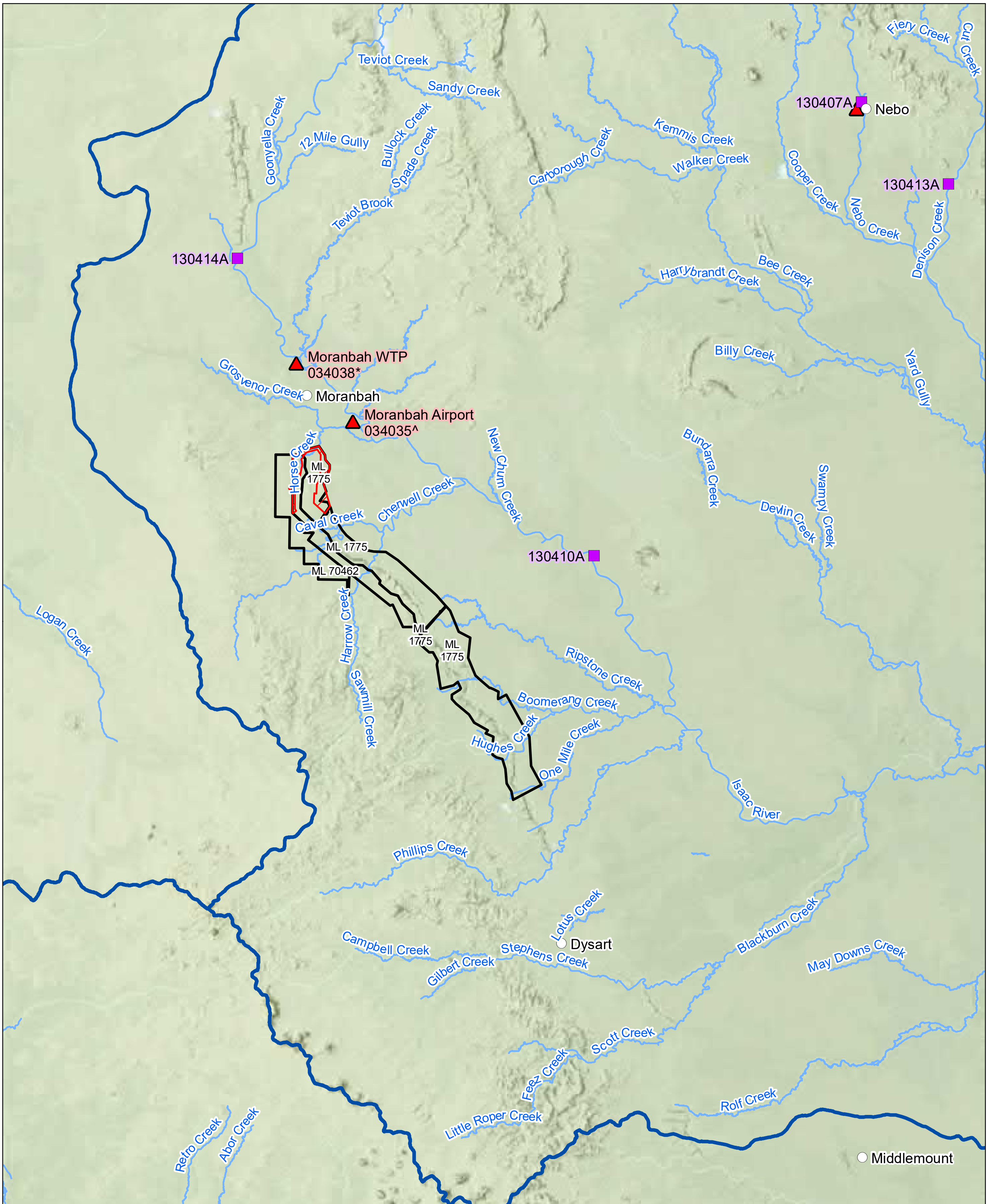
All relevant EVs need to be considered when evaluating a water body. The level of environmental and water quality protection must be determined to maintain each of the EVs. Management goals that are established to protect the environmental values should reflect the specific problems and/or threats to the values, desired levels of protection and key attributes that must be protected (ANZECC & ARMCANZ, 2000).

The EVs applicable to the Project are:

- Aquatic Ecosystems – applying to the Isaac River and Lower Connors River Main Chanel sub-basin only
- Visual recreation
- Stock Watering
- Aquatic Foods (cooked)
- Irrigation, and
- Cultural and Spiritual Values.

Values for aquatic foods (cooked) and irrigation are listed due to their potential to apply to the downstream Isaac River, although there are no existing users in close proximity to the site. Due to the ephemeral nature and location of Horse or Cherwell Creeks to the Project area, it is considered that EVs for primary recreation, secondary recreation, aquaculture and drinking water do not apply. In addition, there are no stock water or industrial users located along Horse or Cherwell Creeks, therefore these EVs do not apply.

Aquatic ecosystems have been identified as an environmental value for the Project and therefore the most stringent Water Quality Objective (WQO) has been adopted to protect all identified EVs. Table 5-27 outlines the guideline WQOs identified for the protection of aquatic ecosystems.



0 5 10 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:600,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

Localities
DNRM Streamflow Gauges
Gauge Location
Watercourses
Regional Subcatchment
Horse Pit Extension Project Area
BHP Tenements

Horse Pit Extension Project

Local Surface Water Resources

FIGURE 5-8

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_5_Local_Surface_Water_Resources.mxd

Table 5-27 Guideline Values for the Protection of Aquatic Ecosystems

Management Intent (Level of Protection)	Parameter	Water Quality Objectives
Upper Isaac River Catchment (refer plan WQ1301) Parameter		
Aquatic Ecosystems, Moderately Disturbed	Ammonia N	<20 µg/L
	Oxidised N	<60 µg/L
	Organic N	<420 µg/L
	Total nitrogen	<500 µg/L
	Filterable reactive phosphorus	<20 µg/L
	Total phosphorus	<50 µg/L
	Chlorophyll a	<5.0 µg/L
	Dissolved oxygen	85%–110% saturation
	Turbidity	<50 NTU
	Suspended solids	<55 mg/L
	pH	6.5–8.5
	Conductivity (EC) baseflow	<720 µS/cm
	Conductivity (EC) high flow	<250 µS/cm
	Sulfate	<25 mg/L

Notes: N = nitrogen, EC = electrical conductivity, ND = no data, µg/ L = micrograms per litre, mg/L = milligrams per litre, NTU = Nephelometric Turbidity Units, µS/cm = microSiemens per centimetre

5.6.2.1 Water Quality

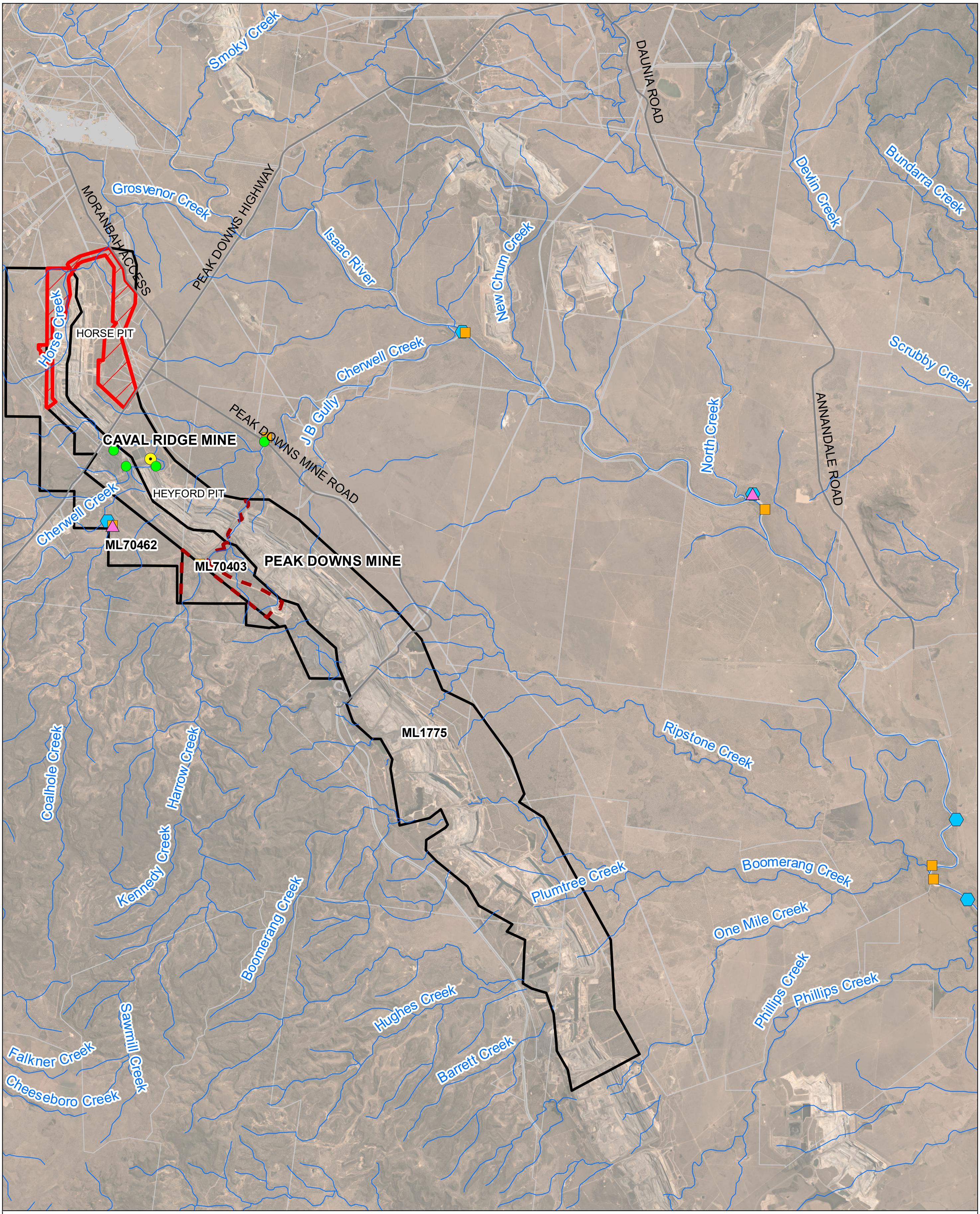
Water quality sampling was undertaken at seven (7) monitoring locations within and downstream of the Project site as part of the annual Receiving Environment Monitoring Program (REMP). Figure 5-9 illustrates the sample locations.

In summary, the analysis undertaken as part of the aquatic ecology assessment for this Project, provided in of the Aquatic Ecology Impact Assessment in Appendix H, concluded that:

"Overall, aquatic ecosystem values of waterways and wetlands in the vicinity of the Project were low to moderate and were considered to be similar to and representative of ephemeral systems in the broader region. Sites on waterways with higher stream orders (i.e., Cherwell Creek and Grosvenor Creek) typically had higher ecological value than sites on waterways with low stream orders (i.e., Horse Creek, Caval Creek and unnamed tributaries). Mapped lacustrine wetlands were assessed as having moderate aquatic ecological value (particularly due to their provision of dry season refuge for aquatic flora and fauna) and palustrine wetlands were assessed as having low aquatic ecological value (as they were dry during the field surveys). The value of wetlands in the vicinity of the Project to terrestrial flora and fauna was limited to riverine wetland areas within ML 1775 and ML 70403 along Nine Mile Creek and Cherwell Creek (E2M 2020)."

5.6.2.2 Existing Water Users

A search of the Queensland Government database for licenced water users was undertaken on the 21 of March 2021. No licenced surface water users were identified within a 10 km radius of the Project area. However, as part of this assessment, aerial photography was also reviewed, resulting in the observation of an unlicensed constructed weir located on Horse Creek just upstream of the confluence with Grosvenor Creek. Due to the reduction within the Horse Creek Catchment from the Project (of approximately 9 km^2), this downstream user is potentially affected. The nearby licenced water users are shown in Figure 5-10.



0 1 2 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:250,000 at A4
Project No.: 620.13593
Date: 03-Nov-2021
Drawn by: JG

MAW Release Point
Overflow Release Point
Receiving Water Point
Release Point
REMP Locations

Watercourses
Roads
Caval Ridge Mine and Peak Downs Mine Boundary
Horse Pit Extension Project Area
BHP Tenements
Cadastre

Horse Pit Extension Project

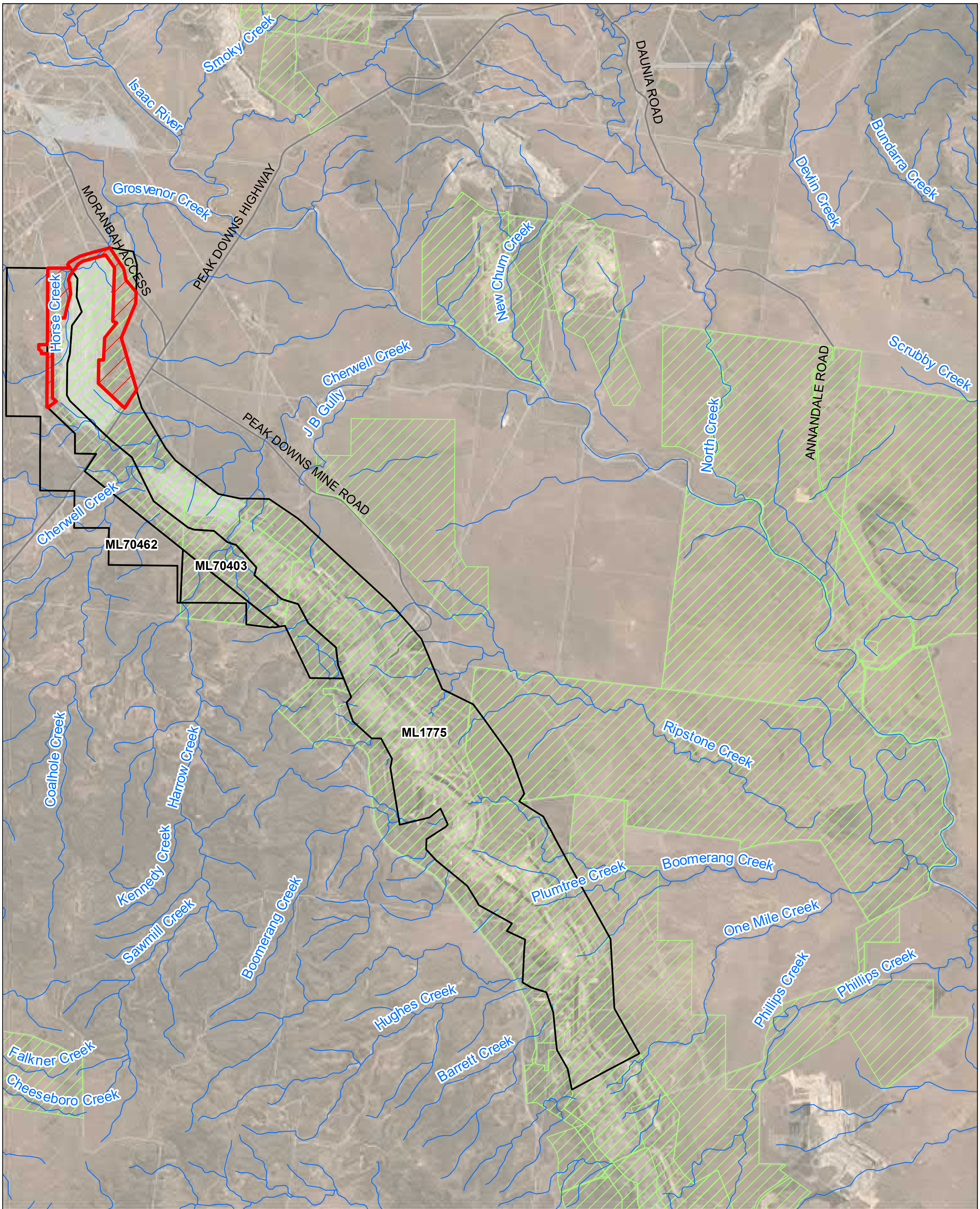
Water Quality Monitoring Location

SLR
www.slrconsulting.com

BMA
BHP Mitsubishi Alliance

FIGURE 5-9

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\SW Summary Chapter\SLR62013593 Water Quality Monitoring Locations.mxd



0 2.5 5 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:250,000 at A4

Project No.: 620.13593

Date: 13-Dec-2021

Drawn by: PM

- Watercourses
- Roads
- Water Users
- Horse Pit Extension Project Area
- BHP Tenements
- CVM EIS Pit Boundary (2010)
- Cadastre

Horse Pit Extension Project

Water Users

FIGURE 5-10

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_6_Water_Users.mxd

5.6.3 Water Management Infrastructure

5.6.3.1 Surface Water Storage

The existing water infrastructure at CVM involves the use of sediment and MAW dams as transfer points. All sediment dam transfers are directed to the clean water cell of 12N Dam, whilst MAW is directed to the MAW cell of 12N Dam. For the Project MAW will continue to be dewatered from Horse Pit over the highwall and piped into either N1 dam or N2 dam throughout the life of the Project. There are currently seven (7) MAW structures and 11 sediment dam structures used to manage surface water at CVM. MAW pipelines are used to dewater operational pits and transfer MAW between dam storages.

The water storage assessment determined that the existing water infrastructure (i.e. capacity of sediment dams, location of some MAW dams and associated pipelines) in use at CVM is insufficient for the planned extension of Horse Pit. As a result, reconfiguration of the water infrastructure is part of the Project, including the relocation and expansion of existing water infrastructure as well as construction of additional water infrastructure. The N1 and N2 dams will be relocated as close as practical to the eastern extent of ML 1775 prior to being mined through and pipelines will be extended as required.

Four (4) new sediment dams will be constructed to capture runoff from the OOPD, Blast Compound area and other disturbance areas associated with the Project. In addition, two (2) new flood protection levees will be constructed and upgrades or relocations of existing dams will be part of the water management strategy for the Project. Water management infrastructure is further discussed under Section 3.6.6 and illustrated on Figure 3-16 and Figure 3-17 with detailed information provided in Section 3.3 of the Surface Water Impact Assessment Technical Report in Appendix E.

5.6.3.2 Flood Immunity

A portion of Horse Creek that is not defined as a watercourse was previously diverted (upstream of the road crossing location) to prevent the ingress of flood water into the adjacent mine workings of CVM. As presented in Figure 3-17, the location of the crossing represents the point at which Horse Creek is a defined watercourse. More recently, a tributary of Horse Creek, located to the east of the CVM, has been partially realigned to reduce ingress of flood water into the Horse Pit. There are no proposed watercourse diversions or modifications to existing watercourse diversions required for the Project.

There are four (4) mapped minor drainage features that traverse the Project area, discharging into both Horse Creek and Cherwell Creek. These drainage lines will be mined through as Horse Pit progresses eastwards. Earthworks will be required ahead of mining to convey upslope overland flow away from the pit.

To facilitate the Project and maintain pit flood immunity during operations (up to 0.1% Annual Exceedance Probability (AEP) at CVM, two (2) additional regulated flood levees are required to be constructed as follows:

- The northern levee (Horse Pit North levee) bounds a portion of Horse Pit in the far north of ML 1775. This levee will be approximately 1.4 km in length. The levee is to be constructed in a staged approach to allow free draining of the clean highwall catchment while providing pit protection.
- The western levee (Horse Pit West Levee) is located at the south-west extent of the proposed OOPD on the boundary of ML 70403 and ML 70462. This levee will be approximately 400 m in length and will protect the proposed OOPD from flooding of Horse Creek to the south.

The basis for design of the levees is outlined under Section 3.5.2 of the Surface Water Impact Assessment Technical Report in Appendix E.

5.6.4 Potential Impacts

5.6.4.1 Flooding

A flooding assessment of Horse Creek has been conducted for the 50%, 10%, 5%, 2%, 1%, 0.1% AEP and Probable Maximum Flood (PMF) events. The flood assessment has been conducted using current industry standards (Australian Rainfall and Runoff (AR&R)) for hydrology and the most up-to-date topographical information from 2019. Flood modelling has been carried out to determine flood extents and depth for rare events along with stream power, bed shear stress and velocities for the 50% and 2% AEP events. Details of the flood modelling are provided in Section 4 of the Surface Water Impact Assessment Technical Report provided in Appendix E.

Protecting the pit from flood ingress and OOPD will require the construction of the Horse Pit North and Horse Pit West levees. The flood model indicates that as a result of the Horse Creek levees, flood immunity of the Project is achieved for flood events up to and including the 0.1% AEP event. The results also indicate that a freeboard in excess of 500 mm is achieved by the proposed levees for the 0.1% AEP event. Results of the flood model indicate that the confinement of the floodplain due to the levee construction does not result in adverse impacts to Horse Creek. The flood extent for the 0.1% AEP is illustrated in Figure 5-11, with the impact of the works on flood behaviour illustrated in Figure 5-12.

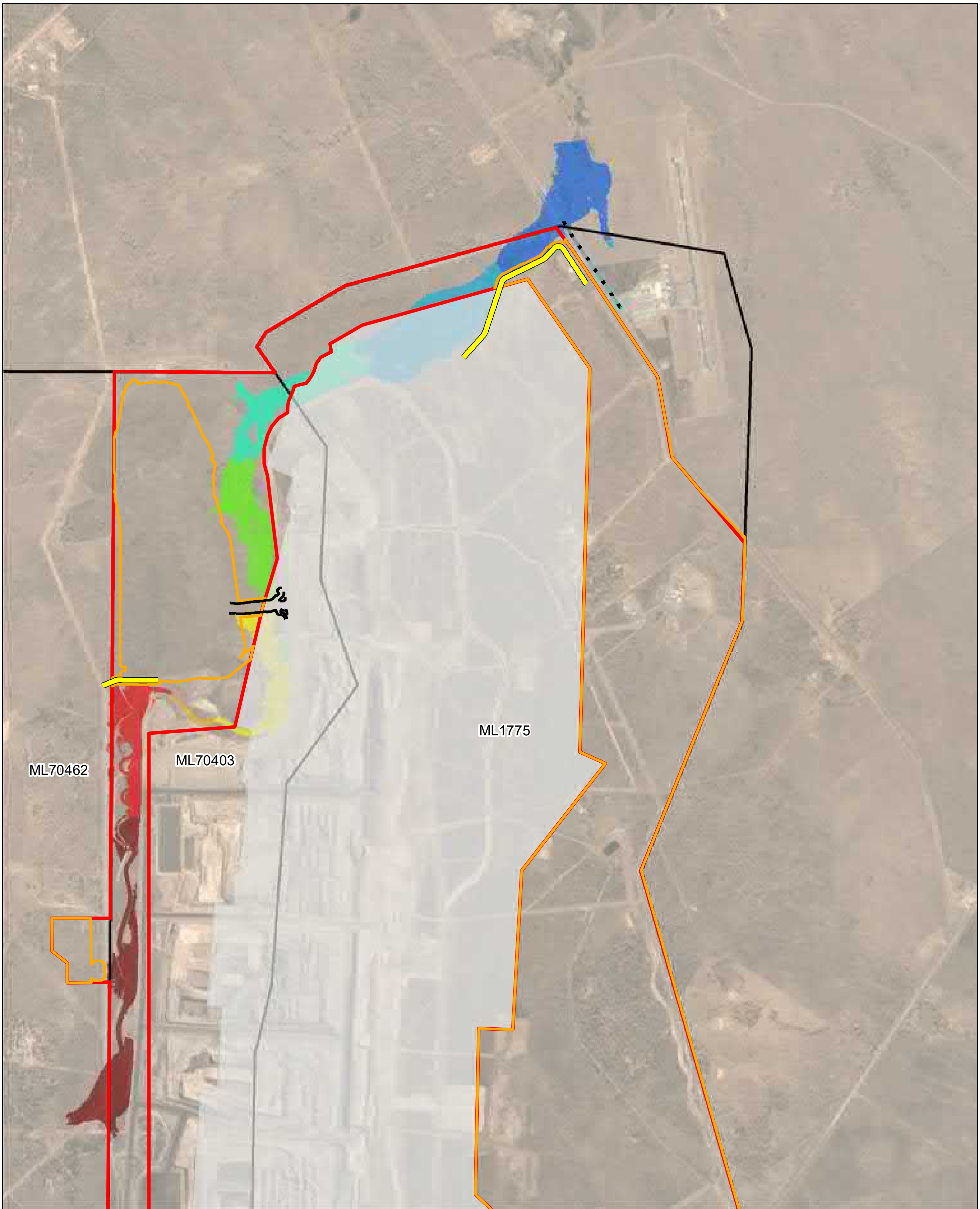
The proposed road crossing of Horse Creek to the OOPD provides a 0.1% AEP flood immunity to the haul road and the OOPD during operations. Results of the flood modelling indicate the culverts of the road crossing will cause flood affluxes upstream in the 0.1% AEP event, however, the afflux is contained within the extents of the Horse Creek floodplain, contained on the ML and has no impact on existing mine infrastructure. Modelling indicates the Horse Pit North Levee will result in some flood afflux to the north of the levee of up to 500 mm. The afflux is wholly contained within the existing flood extent of Horse Creek, with no additional flood areas observed.

The flood behaviour within the Horse Creek channel was also reviewed against the ACARP design criteria, and the existing flood behaviour, with the comparison presented in Table 5-28. The results indicate that the construction of the levees does not change the key stability criteria stated in the ACARP. Erosion protection for the levees will need to be considered as part of the detailed design process to account for the sodic nature of the soils in the region.

Flood modelling results for all AEPs are presented in Appendix B of the Surface Water Resources Technical Report in Appendix E.

Table 5-28 ACARP Creek Diversion Criteria – Qualitative Assessment

Scenario	ACARP Criteria	Existing	Post levee construction
50% AEP event			
Stream Power (Watts/metre^2)	<60	<120 with isolated areas up to 150	<120 with isolated areas up to 150
Velocity (Metres/second)	<1.5	0.5 to 1.5	0.5 to 1.5
Shear Stress (Newtons/metre^2)	<40	<40 (local areas of up to 100)	<40 (local areas of up to 100)
2% AEP event			
Stream Power (Watts/metre^2)	<150	60-120	60 to 210
Velocity (Metres/second)	<2.5	1.0 to 1.5	1.0 to 1.8
Shear Stress (Newtons/metre^2)	<80	<60 for most, <110 in low flow channel	<60 for most, <110 in low flow channel



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:35,000 at A4

Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

Proposed Drain
Proposed Levee
Proposed Road
Project Disturbance Area
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)
BHP Tenements

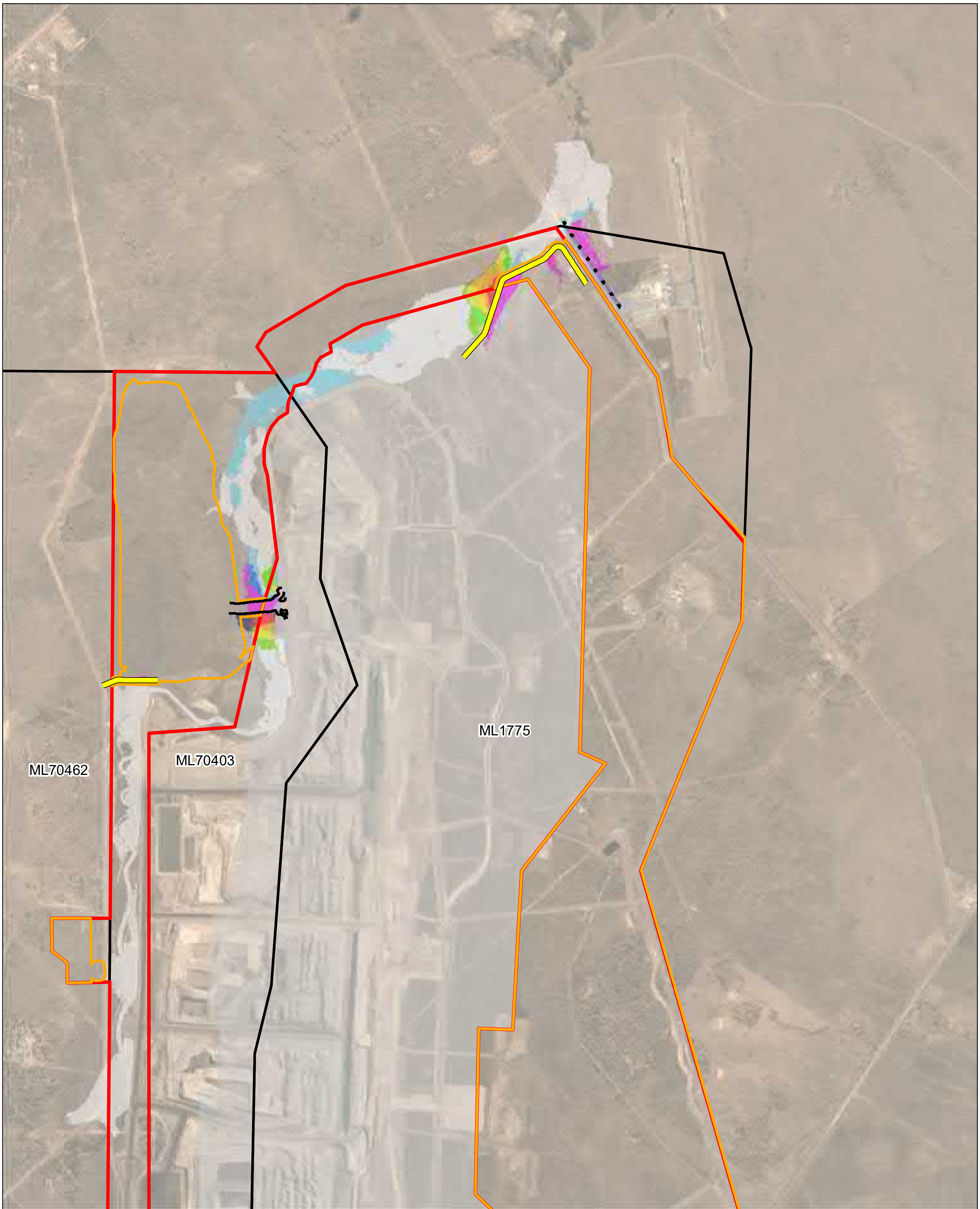
Level (mAHD)
Below 220
220 - 225
225 - 230
230 - 235
235 - 240
240 - 245
245 - 250
Above 250

Horse Pit Extension Project

Developed Site 0.1% AEP Flood Levels

FIGURE 5-11

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_8_Developed_Site_01%_AEP_Flood_Levels_02.mxd



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:35,000 at A4

Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

Proposed Drain
Proposed Levee
Proposed Road
Project Disturbance Area
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)
BHP Tenements

Afflux (mm)
Below -50
-50 - -10
-10 - 10
10 - 50
50 - 100
100 - 200
200 - 500
Above 500
Was wet now dry
Was dry now wet

Horse Pit Extension Project

Water Surface Level Afflux 0.1% AEP

FIGURE 5-12

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_9_Water_Surface_Level_Afflux_01_%_AEP_02.mxd

5.6.4.2 Mine Water Releases

The Project will utilise the existing water management system at CVM. Additional water management infrastructure and relocation of MAW dams will be required to facilitate the Project, however no addition MAW capacity is required. The water management system was examined through water balance modelling using the GoldSim software. The modelling was undertaken at a daily time step and predicts the ability of the system to manage a range of climate scenarios over the LOM. The modelling considers the mine footprint, groundwater inflows, changes to the water management infrastructure, controlled releases and the current EA conditions. The water balance modelling is detailed in Section 7.2 and Appendix C of the Surface Water Impact Assessment Technical Report in Appendix E.

The results of the water balance modelling indicate that the Project's proposed amendments to water management infrastructure is sufficient to manage MAW within the current EA conditions. The controlled release regime, which is currently authorised under the current EA conditions, aims to minimise impacts to downstream water users and the environment through:

- allowing discharge of good quality water when appropriate baseflow conditions exist in Cherwell Creek and Isaac River, and
- a release regime that is based on known flow and water quality thresholds, which minimises the risk of uncontrolled releases.

5.6.4.3 Catchment Area Reduction

As a result of the Project operations, the catchment area is expected to reduce by the following:

- 7% of Horse Creek
- 0.5% of Grosvenor Creek, and
- 0.4% of Cherwell Creek.

The Isaac River has a catchment area of approximately 3,400 km2 at the confluence of Grosvenor Creek, and therefore, the catchment area reduced by the Project is in the order of 0.2%. This represents an insignificant reduction in catchment area due the Project.

It should be noted that predicted reduction in runoff will be less than simply the reduction in flows generated by the catchment captured. This is due to the overflows from sediment dams and controlled releases during large rainfall events. Analysis of the potential impact of this reduced catchment on flow frequency and duration, was undertaken through the scaling of the available flow record from the Burton Gorge gauge (130410A). The daily historical flow record at the gauge 130410A was scaled relative to the catchment area of the Isaac River, downstream of the Project area (at the confluence of Cherwell River 3,400 km2). The scaling of flows was also undertaken for this area, less the additional area captured by the surface water management system of 7 km2. This was undertaken for flow thresholds of 0.5 m3/s, 1 m3/s, 3 m3/s and 6 m3/s. The number of days over the threshold were identified, as well as the duration of the flow (i.e., how long the flow lasts) over this threshold, commonly referred to as the spell duration.

The full assessment is provided in Section 6.2 of the Surface Water Impact Assessment Technical Report in Appendix E and predicts insignificant changes to the occurrences of higher or medium flows, and almost no change to the spell durations. This analysis is considered conservative as it does not account for controlled releases and overflows from the Project's clean water and sediment dams. As such, the Project is unlikely to cause changes to the flow regime that may result in impacts to downstream users or the environment.

5.6.4.4 Water Quality Impacts

The Project has the potential to impact on water quality and subsequently the downstream environment through its construction and operation. Impacts on water quality and aquatic ecology are discussed further in of the Aquatic Ecology Impact Assessment in Appendix H. Changes to water quality in watercourses generally have the potential to impact on aquatic ecosystems through the following processes:

- influencing the success of the life cycles of aquatic species (i.e., affecting cues for movement, migration and breeding)
- changing the diversity of habitats through sedimentation and contamination, and
- sedimentation and contamination influences habitat condition and further affects water quality.

However, as discussed in Section 5.1.5.8 of the Aquatic Ecology Impact Assessment in Appendix H, clean water captured on site in clean water storages is expected to have the similar water quality as the receiving environment waterways and is not expected to have any impacts to the water quality. In addition, MAW will be captured in existing storage facilities with sufficient capacity and freeboard to accommodate for the Project water requirements.

5.6.4.5 Creek Geomorphology

The drainage channels and watercourses in and around the Project area are ephemeral in nature therefore, a significant rainfall event is typically required in order to restore flow.

The geomorphology assessment identified that Horse Creek has a consistent cross section and long section with an overall slope of 0.3 per cent. and has mostly a sandy bed with vegetated banks. Moderate to extreme bank erosion was evident with erosion observed on the outer banks as well as aggradation of sediments on the riverbed, particularly as a result of grazing activities. In the event of rainfall, the flow velocity in the creek is mostly between 0.5 to 1.5 m/s and reaches a velocity of 3.5 m/s in the middle of the diversion.

In most cases, it was apparent that a localised change in flow regime (such as concentration of a flow path from a dam outlet or along a cattle track) allowed gully and sheet erosion to take place due to the highly dispersive nature of the soils. The highly dispersive nature of the soils will need to be noted and managed for any proposed waterway works (in accordance with CVM EA condition F11). Further information on the geomorphological characteristics of Horse Creek, including photographic examples of erosion, can be found under Section 2.7 of the Surface Water Impact Assessment Technical Report provided in Appendix E.

In summary, the survey found that the existing waterways of Horse Creek and other unnamed tributaries running through the Project area, were largely unchanged from those observed by URS in 2009 as part of the CVM EIS and provided existing management practices are implemented, no significant impacts on creek geomorphology are expected as a result of the Project.

5.6.4.6 Cumulative Impacts

The surface water assessment incorporated both the existing (and already approved) activities at CVM in addition to the proposed activities (and amendments to existing infrastructure) for the Project. As a result, the cumulative impacts due to the Project and the CVM have been accounted for in this assessment.

The design of the Project is such that surface water impacts such as flooding and MAW can be managed in accordance with the existing CVM EA conditions.

5.6.5 Mitigations and Management Measures

The primary purpose of the CVM WMP is to identify potential risks to the environment from operations at the mine and controls necessary to mitigate any impact. Through a process of planning and implementation of measures, the release of contaminants to the receiving environment is minimised in order to ensure the water resource does not adversely impact the local and regional environment. Development of the CVM WMP is a condition of existing CVM EA. BMA will update the WMP for CVM to incorporate the Project.

Overall, the design of the Project infrastructure, informed by a WBM, incorporates separation of MAW and other runoff area catchments to avoid MAW impacting catchments surrounding the CVM. Additional measures described below establish further measures to manage the storage or MAW (as it relates to capacity), the quality of water stored and the reuse of water, such that the requirement to release water is minimised. The WBM undertaken guides the Project design such that any release of water will be undertaken in accordance with the existing CVM EA conditions.

5.6.5.1 Proposed Water Management Infrastructure

The water management strategy for the Project includes additional water management infrastructure to manage potential impacts to surface water resources. BMA will update the WMP for CVM to incorporate the Project. The updated WMP will include the new disturbance areas for the Project and involve the following management actions:

- Where possible, stormwater runoff from undisturbed areas, both on and surrounding the mine site is diverted away from disturbed areas and directly into adjacent waterways (i.e., Horse Creek and Cherwell Creek) (in accordance with CVM EA Condition F27)
- Sediment laden runoff is captured in sediment dams and used for dust suppression to minimise the likelihood of offsite water discharges (in accordance with CVM EA Condition F27)
- MAW is prioritised for water demands at CHPP and dust suppression with makeup water from the Burdekin pipeline or it is discharged off-site via the release dam in compliance with CVM's EA release conditions
- Infrastructure and mining areas are protected from flooding from Horse Creek and Cherwell Creek using flood levees and/or bunding
- All significant quantities of hydrocarbon and chemical products stored on site, are stored in temporary or permanent bunding
- Sediment transport to be reduced through progressive revegetation. For example, progressive rehabilitation is applied to areas no longer required for operational use
- Standard Operating Procedures (SOPs) are in place at CVM and will be updated as required to accommodate the Project
- The continued implementation of the BMA's Environmental Management System will ensure that roles and responsibilities for mining activities that may affect surface water are clearly defined and that appropriate management actions are developed and implemented for these mining activities to provide a commensurate level of environmental protection
- All water management structures are designed and constructed using practical hydraulic parameters based on an appropriate risk-based rainfall event, catchment size, slopes, discharge design and soil types. The design criteria and standards will be as per relevant standards and guidelines for MAW management and erosion and sediment control. Design and construction will be in accordance with the existing CVM EA conditions. Each structure will have a consequence category assessment (CCA) completed in accordance with the Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933). (See Section 9.1 of Appendix J for further detail on design of structures and risk of failure, seepage and overtopping at addressed)
- Spill capture and retention devices are used for refuelling and similar areas
- Runoff from oily water areas is treated using an oil-water separator, and
- Disturbance is kept to an operational minimum for safe operation to reduce the area exposed.

5.6.5.2 Management Measures – Construction

To manage the potential for decreased water quality during construction of the levees and the Horse Creek crossing, the following mitigation measures will be implemented by BMA:

- Appropriate erosion and sediment control measures will be established as required to reduce the amount of runoff from disturbed areas in accordance with relevant standards and guidelines and in accordance with CVM EA conditions
- Bunding and appropriate storage of fuels and other hazardous and flammable materials will be undertaken in accordance with relevant standards and guidelines, and where practical, will be located away from any waterbodies
- Oil spill recovery equipment will be available when working adjacent to drainage channels with the ability to discharge off site. Spill kits will be located with construction crews conducting activities with the potential for significant spills. The CVM's existing SOP for spill management will be utilised
- Refuelling locations and handling of fuels shall be undertaken away from waterbodies
- Construction of the haul road crossing will occur during the dry season to minimise soil disturbance on adjacent waterways, and
- As soon as practical, disturbed areas will be rehabilitated.

5.6.5.3 Management Measures – Operations

The existing CVM controls to mitigate potential surface water impacts, including the CRWN, are considered appropriate to protect surface water quality and the downstream receiving environment. The following measures will be implemented by BMA:

- The existing WMP will be updated to incorporate modified and new water management infrastructure following construction
- The CRWN WBM will be updated as any water management infrastructure is modified or established such that operation of the CRWN Pipeline and the transfer agreement the relevant operations can continue to provide an approach to reducing risk associated with managing MAW volumes
- Sediment dams, pit water storage and other water management structures (e.g., bunds and drains) will be designed and operated in accordance with relevant standards, guidelines, the CVM EA and the WMP
- Water management at CVM is based on the separation and management of clean and MAW catchments
- Water capture within the Project's clean areas will be diverted around operational areas, and where practical, allowed to discharge off site as part of normal overland flow (in accordance with the CVM EA conditions). The operation of the freshwater dam will minimise the impact of the flood levees on the natural flow regime for undisturbed and rehabilitated catchments behind the levees
- Disturbed areas within the Project site will be diverted to sediment dams for treatment, and possible reuse for dust suppression and process water requirements. This will maximise their storage capacity to reduce the risk of off-site discharges
- The current REMP and associated water quality monitoring program will be continued.
- Fuel, dangerous goods and, hazardous chemicals will be managed as outlined by current standards, guidelines and in compliance with statutory requirements and the CVM EA
- The existing SOP for spills and emergency response procedures will continue to be utilised. Spill recovery and containment equipment will be available when working adjacent to sensitive drainage paths and within other areas, such as workshops
- The road crossing of Horse Creek will be managed in accordance with the measures outlined above for construction and operations. In addition to these, the erection of temporary waterway barriers during construction of any road crossings will include the provision to transfer flows from upstream of the works to the downstream channel without passing though the disturbed construction site
- Where MAW dams rely on pump operation to achieve acceptable overtopping frequency and likelihood these shall be fitted with automated stop/start and remote monitoring. They are de-watered to the site MAW management system within five days of a rain event subject to being safe to do so and access permitting. Water quality samples aim to be acquired within a week of the rain event.
- ESC structures and MAW dams are inspected pre and post wet season (at a minimum) and operational controls require dewatering to reset to the minimum operational level and provide the required settling storage for rainfall events. The spillway capacity of the dams is designed specific to the consequence category and catchment risk.

Through implementing the above management strategies for surface water management, the risk of adverse impacts to the water quality of Horse Creek and the Isaac River downstream of the Project is expected to be insignificant.

5.6.5.4 Flood Levee Management Measures

The proposed levees are designed to prevent ingress of clean water from Horse Creek to the mine pits. Flooding in excess of the design criteria which may result in a breach of the levees (rarer than a 0.1% AEP) could result in ingress of water to the mine pit. This water would then become MAW contained in the pit and would not pose risks to any sensitive downstream receptors or structures, as it would to be managed within the MAW management system.

The flood behaviour within the Horse Creek channel was reviewed against the Australian Coal Industry Research program (ACARP) design criteria and existing flood behaviour. The results presented in Appendix E indicate the construction of the levee does not change the key stability criteria noted in ACARP and as such impacts to downstream sensitive receptors and structures is expected to be minimal.

The levee will be designed in accordance with the existing EA conditions and the Manual (ESR/2016/1933). Potential for scour and erosion is considered as part of the levees detailed design and mitigation measures incorporated where required. Measures to mitigate risks to downstream receptors and structures during construction of the levees are stated in Section 6 in Appendix E. These will include local sediment and erosion control measures during construction and will be detailed in the ESC Plan for the levee.

In addition to this, the levees will be regulated structures and managed in accordance with the CVM EA conditions for regulated structures. These conditions are outlined in the Surface Water Impact Assessment Technical Report in Appendix E. No changes are proposed to these conditions as part of this EA amendment.

5.6.5.5 Water Quality Monitoring

Water quality monitoring will continue to be conducted as part of current EA conditions and in accordance with the REMP for the Project. As part of this EA amendment, it is proposed to continue the controlled release regime as part of the Mine Water Management System, in accordance with the existing CVM EA conditions.

5.6.5.6 Rehabilitation and Final Landform Modelling

The assessment of flood behaviour for the final landform was undertaken for the 0.1% AEP event, and is illustrated in Figure 5-13. As shown, results of the modelling indicate that the proposed final landform will provide flood immunity for the final void in 0.1% AEP event.

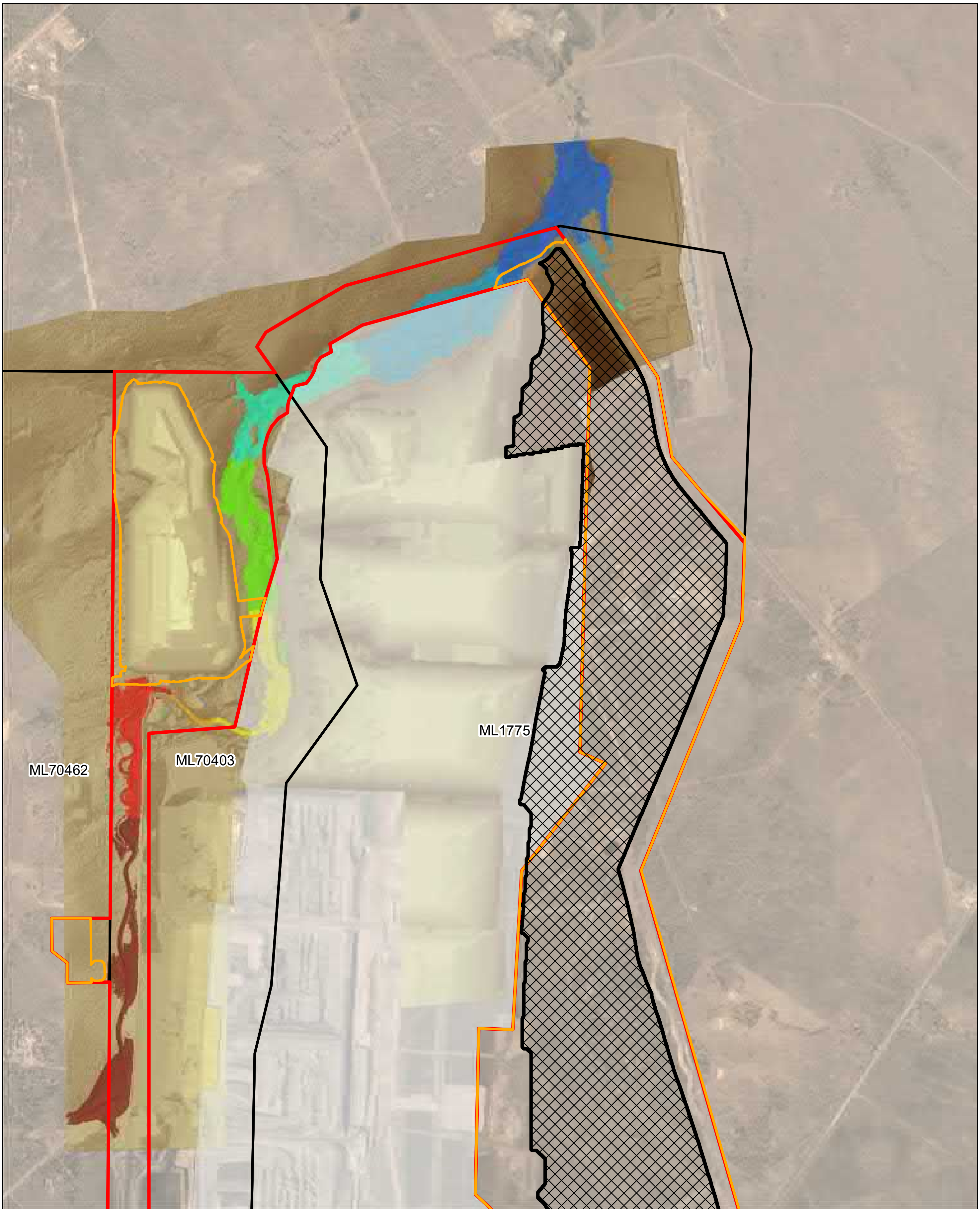
The final landform shows the removal of the Horse Creek levees, with the final landform forming part of the Horse Creek floodplain. The final landform protects the final void from the 0.1% AEP event. The flood protection landforms are very stable, rising from 10 m to 20 m height over a length of 1 km, with top widths of approximately 50 m. These areas will be well vegetated to prevent erosion and to mitigate the potential for increased sediment load downstream.

Water balance modelling of the potential inflows and outflows to the proposed final void was also undertaken as part of the assessment. The modelling involved an iterative process between groundwater and surface water modelling. Groundwater inflows to the GoldSim void water balance model were determined from the groundwater flux curve, presented in the Groundwater Impact Assessment Study provided in Appendix F. The model was simulated for a 100-year period and the resulting water level from the GoldSim model was calculated. The groundwater model was then simulated for the resulting pit lake levels. The iterative modelling found the predicted groundwater inflow rate would be 0.18 ML/d, with a final water level of 120 mAHD, or approximately 25 m of depth in the final void.

The salinity of the final void was also modelled to examine the impacts of the effects of evaporation and groundwater inflows on final void water quality. The salinity of the final void is predicted to increase post closure. The predicted salinity values increase in excess of 35,000 µs/cm over 100 years post closure. The CVM PRCP landform and design will implement appropriate measures to minimise the potential for the final void to cause environmental harm to the surrounding area. It is proposed to be submitted to DES in Q4 2022.

5.6.6 Summary

In summary, the potential impacts to environmental values associated with the Project are expected to be insignificant and contained within the MLs provided management measures are implemented. The existing CVM surface water management measures are suitable to mitigate potential water quality impacts. Some specific management measures have been identified for the construction of the levees and the Horse Creek Crossing. The management and mitigation measures are conditioned in the current EA through elements such as the WMP, REMP, Sediment and Erosion Control Plans and Regulated Structures Design and Inspection Conditions. In light of this, BMA is not proposing any changes to the conditions stated in the current Schedule F – Water EA conditions (EPML00562013) and Schedule G – Structures.



Projection: GDA 1994 MGA Zone 55
Scale: 1:35,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

0 0.5 1 km

Final Void Extent
Project Disturbance Area
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)
BHP Tenements

Elevation (mAHD)
390
270
210

Level (mAHD)
Below 220
220 - 225
225 - 230
230 - 235
235 - 240
240 - 245
245 - 250
Above 250

Horse Pit Extension Project

Final Landform Flood depths 0.1% AEP

FIGURE 5-13

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_10_Final_Landform_Flood_depths_01%_AEP_02.mxd

5.7 Groundwater Resources

A Groundwater Impact Assessment, including the development of a numerical groundwater model has been completed for this Project and is provided in Appendix F. The following sections summarise the legislative requirements, baseline conditions, impact assessment and management and monitoring measures. The term 'GW Study Area' used in this section refers to the regional area surrounding the Project and is synonymous with the numerical groundwater model boundary as outlined under Section 6 and on Figure 1-2 in the Groundwater Impact Assessment provided in Appendix F.

5.7.1 Legislative Requirements & Relevant Guidelines

5.7.1.1 Legislation

Relevant Commonwealth and Queensland legislation in relation to taking or interfering with groundwater resources at the Project are summarised below.

5.7.1.1.1 Environment Protection and Biodiversity Act 1999 (Commonwealth)

The EPBC Act is designed to protect national environmental assets, known as MNES. Under the 2013 amendment to the EPBC Act, potentially significant impacts on groundwater resources were included where they pertain to a coal seam gas or large coal mine development, known as the 'water trigger'.

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) is a statutory committee established under the EPBC Act that provides scientific advice to the Commonwealth Environment Minister and relevant state ministers. Guidelines have been developed in order to assist the IESC in reviewing coal seam gas or large coal mining development proposals that are likely to have significant impacts on water resources. This includes completion of an independent peer review of numerical groundwater modelling in accordance with the Australian Groundwater Modelling Guidelines (Barnett et al., 2012).

The Project was determined a 'Controlled Action' on 19 November 2021, and enacted the 'water trigger'. Refer to Section 2.2 for details.

5.7.1.1.2 Water Act 2000 (Queensland)

The Water Act and subordinate Water Regulation 2016, is the primary legislation regulating groundwater resources in Queensland. The purpose of the Water Act is to advance sustainable management and efficient use of water resources by establishing a system for planning, allocation and use of water.

The Water Act was amended in 2014 with introduction of the Water Reform and Other Legislation Amendment Act 2014 (WROLA Act). Changes to this legislation included giving new mines a limited statutory right to take groundwater they intercept through routine mining activities ('associated water'); for example, the groundwater contained within coal seams that is removed with extraction of the coal. The WROLA Act was later amended in 2016 with the introduction of the Water Legislation Amendment Act 2015 and the Environmental Protection (Underground Water Management) and Other Legislation Amendment Act 2016 (EPOLA Act), which came into effect on 6th December 2016. The EPOLA Act amends the EP Act and Water Act (Chapter 3), and removes the statutory right to water, requiring applicants to quantify and be licenced for the take of 'associated water'. That is, project proponents may be required to apply for and obtain an Associated Water License (AWL) under the Water Act. A component of the AWL application process includes greater emphasis on baseline data collection for environmental assessments. In addition, mine applications that are granted an AWL can be required to verify and update groundwater impact predictions through an underground water impact report three years following project approval, or at a frequency prescribed by the chief executive.

As part of the Project, BMA is proposing to exercise underground water rights during the period in which resource activities will be carried out at ML 1775. The Project will affect groundwater within the Isaac Connors Groundwater Management Area (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater 2 (sub-artesian aquifers). The extent of Groundwater Unit 1 (Isaac Connors Alluvium Groundwater Sub-area) is based on the mapped extent of Quaternary alluvium, which, whilst not mapped within the Project footprint, may be connected and interact with aquifers within the Project area.

BMA holds Water License 608364 for dewatering activities at the CVM (issued under the Water Act).

5.7.1.1.3 Management framework relevant to the Project

The Water Act is enacted under a framework of catchment specific Water Resource Plans (WRPs). A WRP provides a management framework for water resources in a plan area, and includes outcomes, objectives, and strategies for maintaining balanced and sustainable water use in that area. Resource Operations Plans (ROPs) implement the outcomes and strategies of WRPs. Groundwater Management Areas (GMAs) and their component groundwater units are defined under WRPs. Authorisation is required to take non-associated groundwater from a regulated GMA or groundwater unit for specified purposes. The specified purposes are defined under a WRP, the Water Regulation 2016 or a local water management policy.

Water resources within the Project area are captured under the Water Plan (Fitzroy Basin) 2011. The plan covers surface water (zone WQ1301) associated with Isaac River, and groundwaters (zone WQ1310 – Fitzroy Basin groundwaters).

As part of the Project, BMA is proposing to exercise underground water rights during the period in which resource activities will be carried out at ML 1775. The Project will affect groundwater within the Isaac Connors GMA (GMA – Zone 34) of the Fitzroy Basin under the Water Plan (Fitzroy Basin) 2011. This relates to both Groundwater Unit 1 (containing aquifers of the Quaternary alluvium) and Groundwater Unit 2 (sub-artesian aquifers). The extent of Groundwater Unit 1 (Isaac Connors Alluvium Groundwater Sub-area) is based on the mapped extent of Quaternary alluvium, which, whilst not mapped within the Project footprint, may be connected, and interact with aquifers within the Project area. As discussed further in Section 4.2 of Appendix F, the extent of alluvium has been refined based on information specific to the GW Study Area.

5.7.1.1.4 Water Act declared watercourses and drainage

The Water Act includes criteria for determining watercourses that require authorisation under the Water Act to take water, interfere with the flow of water, take quarry material or excavate and place fill in a watercourse. The Water Act also includes criteria for drainage features that may require authorisation to take or interfere with overland flow. In the GW Study Area, reaches of the Isaac River, Horse Creek and Cherwell Creek are defined as a watercourse under the Water Act criteria, and several small tributaries of these watercourses that traverse the Project area are defined as drainage features. These declared watercourses and drainage features may be relevant to the groundwater assessment for the Project if there is a component of surface water-groundwater interaction associated with them.

5.7.1.1.5 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP (WWB) aims to achieve objectives set out by the EP Act and applies to all waters of Queensland. EPP Water provides a framework to protect and/or enhance the suitability of Queensland waters for various beneficial uses by:

- Identifying environmental values and management goals for Queensland waters
- Providing state water quality guidelines and WQO to enhance or protect the environmental values c
- Providing a framework for making consistent, equitable and informed decisions, and
- Monitoring and reporting on the condition of Queensland waters.

Groundwater resources within the vicinity of the Project are scheduled under the EPP (WWB) as Isaac Groundwaters of the Isaac River Sub-basin of the Fitzroy Basin water plan (WQ1310). The legislated EVs for these groundwaters are:

- Biological integrity of aquatic ecosystems
- Human use EVs:
    - Suitability of water supply for irrigation
    - Farm water supply/use
    - Stock watering

- Primary recreation
- Drinking water supply, and
- Cultural and spiritual values.

The EPP (WWB) also provides limited WQOs for underground aquatic ecosystem protection in Fitzroy Basin groundwaters. These WQOs provided in the EPP (WWB) are classified by groundwater depth and regional chemistry zone.

5.7.1.2 Relevant Guidelines

There are several available guidelines designed to assist project proponents to meet the relevant legislative requirements to complete a groundwater assessment for coal mining proposals such as this Project. These guidelines are:

- Queensland DES Guideline - Requirements for site-specific and amendment applications—underground water rights - EP Act
- Queensland DES Guideline - Underground water impact reports and final reports - Water Act
- Information guidelines for proponents preparing coal seam gas and large coal mining development proposals – EPBC Act
- Information Guidelines explanatory note. Uncertainty analysis—Guidance for groundwater modelling within a risk management framework – EPBC Act
- Information Guidelines Explanatory Note. Assessing groundwater-dependent ecosystems – EPBC Act, and
- Australian groundwater modelling guidelines. Waterlines report. National Water Commission, Canberra, 2012.

5.7.2 Hydrogeological Regime at the Project

The geology of the Project area consists of Cainozoic sediments (alluvium and regolith), Cainozoic (Tertiary) basalt and Permian strata. The dominant Cainozoic surface geology in the Project area is alluvium localised along the Isaac River, to the north and east of the Project, a minimum distance of approximately 5 km from Project open cut pit. The geology and hydrogeology of the Project area are detailed under Section 4 and Section 5 of the Groundwater Impact Assessment in Appendix F.

The hydrogeological regime relevant to the Project comprises the following hydrogeological units:

- Isaac River Alluvium
- Regolith
- Tertiary-Quaternary Alluvium
- Tertiary Basalt
- Triassic Strata, and
- Permian Coal Measures (Blackwater Group).

Hydrogeologic features of all units are described further below. Figure 5-14 presents the mapped surface geology of the GW Study Area and Figure 5-15 presents indicative geological cross sections through the Project area.

5.7.2.1 Isaac River Alluvium

The extent and thickness of the unconsolidated sediments along the Isaac River east of the Project area was assessed as part of the Winchester South Project in March 2019, where geophysical surveys were undertaken (AgTEM and DC-ERT transects) adjacent to the Isaac River to improve understanding of the extent, permeability, and depth of alluvium. Detailed subcrop geology information was also identified as part of the survey. The results from the survey are summarised as follows:

- The rock weathering horizon is high in groundwater salinity, resulting in high EC. This weathering horizon is absent within the alluvium, as it has been eroded and replaced with recent alluvium. The absence of the highly conductive weathering horizon allows for clear identification of alluvial extents within the geophysical data.
- A shallow 8 to 10 m embayment of flat layered alluvium covers coal measures to the east of the survey extent. This alluvium has been mapped in previous reports (Douglas Partners, 2012) as a Cainozoic Sand Plain with somewhat different extents.

- The Isaac River alluvium is limited in extent away from the modern river channel.

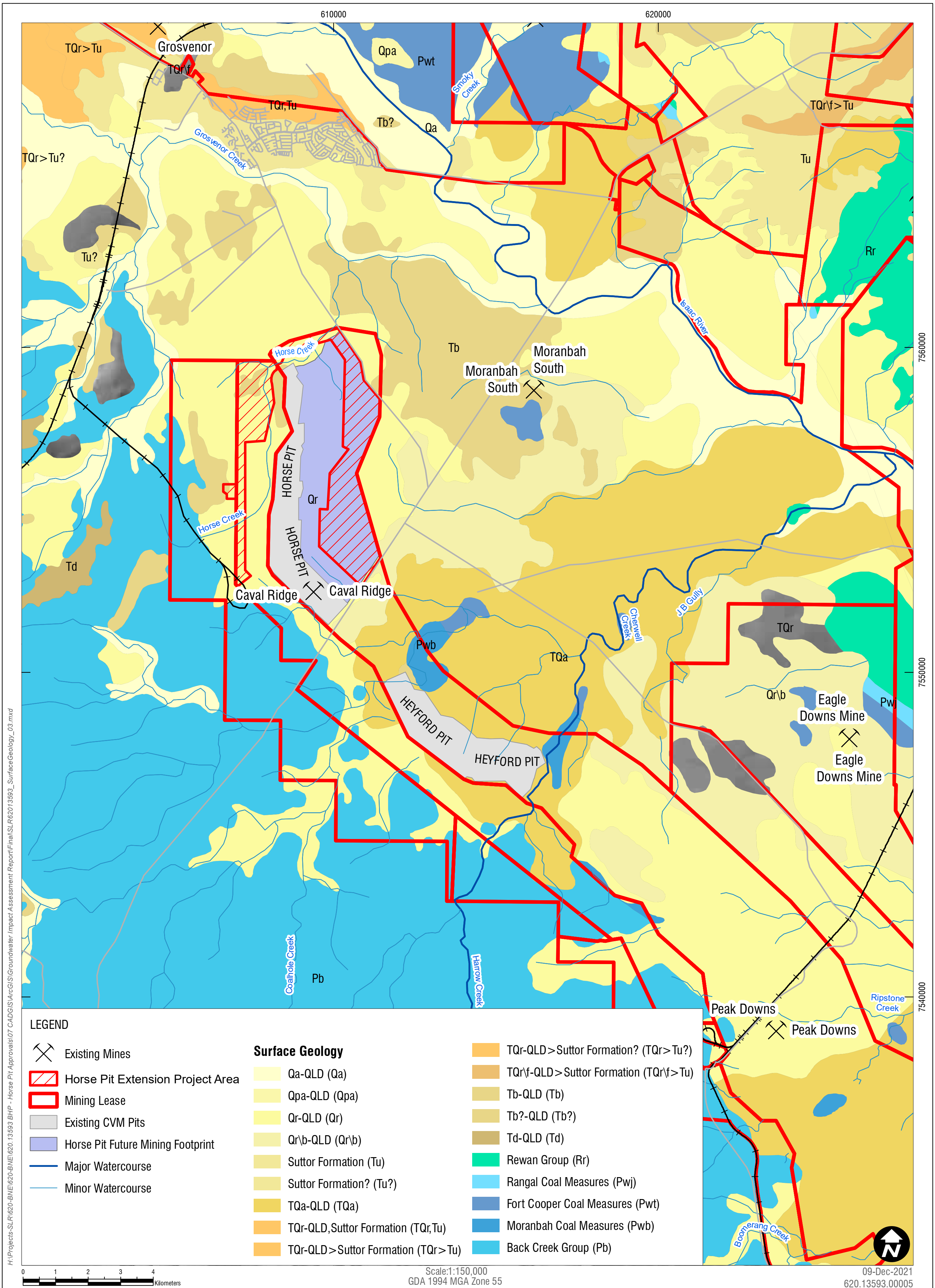
There will be no direct interception of alluvium by the proposed Project pit.

5.7.2.2 Regolith

The surficial regolith material covering much of the GW Study Area comprises Cainozoic (Quaternary to Tertiary) aged sediments, including alluvium and colluvium. Older alluvial (TQa) sediments are distributed extensively across the region and colluvium and residual deposits (Qr and Qr\b) are abundant in the north west of the GW Study Area and at site. The Cainozoic (Tertiary) aged Duaringa Formation (Tu) is also mapped at surface at the southern end of the GW Study Area. Drill logs in the Project area indicate the sequences exhibit similar geological characteristics and have therefore been grouped as ‘regolith’ within this report.

The regolith in the Project area comprises a heterogeneous distribution of fine to coarse grained sand, clay, sandstone, and claystone. The regolith material is generally 15 m to 45 m thick. The units are highly weathered, with the depth of weathering extending to a maximum of 50 metres below ground level (mbgl), into the underlying coal measures.

Regolith deposits over the Project area comprise older alluvial sediments, colluvium, residual deposits, and weathered Permian units. Project drill logs indicate unconsolidated sediments in the area comprise clay, silt, sand, gravel, and soil. Within the Project area, Permian units are, on average, weathered to a depth of 25 mbgl and Tertiary to Quaternary aged deposits are on average weathered to 25 mbgl.



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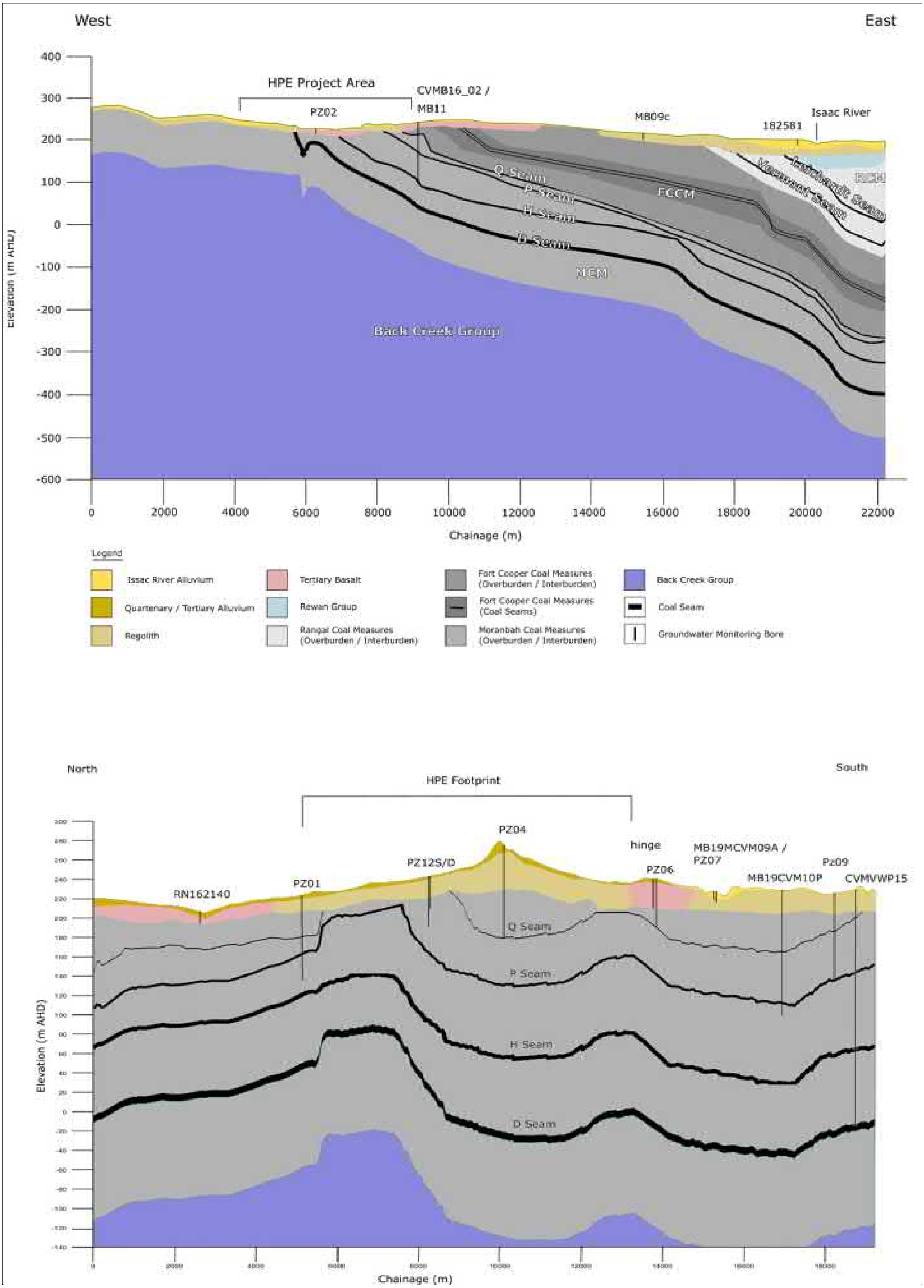
SLR BMA BHP Mitsubishi Alliance

Surface Geology

FIGURE 5-14



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Geological Cross Sections

FIGURE 5-15

5.7.2.3 Tertiary-Quaternary Alluvium

Tertiary-Quaternary alluvium (TQa) deposits distributed in the areas south of Horse Pit and across the south east of the GW Study Area. TQa is defined as a poorly consolidated or unconsolidated alluvial deposit in an ancestral valley, which has been dissected by more recent channel activity. The TQa deposits are located 1.7 km to the south of Horse Pit, extending to the south and south east across the GW Study Area along the courses of Cherwell Creek and Harrow Creek. Review of lithological logs and aerial imagery shows that deposits are also distributed along Horse Creek to the north of the Project area.

Groundwater drilling investigations undertaken by BMA at CVM in 2009, 2019 and 2020 have confirmed the presence of a localised alluvial deposit associated with Cherwell Creek. Drilling logs correlate with mapping showing that the alluvium extends along Cherwell Creek onto the CVM site. These drilling investigations show that within the Project area the Cherwell Creek alluvium extends from the creek approximately 1.7 km north towards Horse Pit, with the unit extent constrained by Tertiary basalt deposits.

Horse Creek extends along the western and northern site boundaries. Quaternary colluvium and residual deposits are mapped in association with Horse Creek along its course. Quaternary alluvium is only mapped 3.75 km to the north east of the Project area in association with Grosvenor Creek. The inferred extent of alluvial deposits associated with Horse Creek is believed to be constrained to the creek channel, with no evidence of deposition beyond these extents.

Harrow Creek is a tributary to Cherwell Creek that traverses the CVM ML directly to the south of Heyford Pit. Alluvial deposits are located adjacent to Harrow Creek, extending approximately 3 km south and 1 km south east. Drill hole logs show the alluvium in the area to comprise 2 m of silt and clay, overlying 6m of sands and gravels with bands of silt and clay.

5.7.2.4 Tertiary Basalt

Isolated patches of surficial Tertiary aged basalt area present within the north western areas of the Project area, and in the eastern and north-eastern areas of the GW Study Area. An aeromagnetic geophysical survey was undertaken over the CVM site as part of the CVM EIS (URS, 2008). The survey showed Tertiary basalts to underlie the Tertiary sediments within the Project area, extending from the north of the site to the south, along the ridge adjacent to Horse Creek.

Project drill logs align with the survey results, with basalt found to be present in the west of the Project area extending from monitoring bores in the north to the south of Horse Pit. At this point the basalt extends north east across the Project area. Review of monitoring well drill logs across the Project area show the basalt to consistently be up to 30 m thick. Within the Project area, the basalt is on average weathered to a depth of 25 mbgl. Exploration boreholes and monitoring wells across the Project area found the basalt to range from fresh to highly weathered with variable clay, and to be up to 35 m thick. The distribution of the less weathered, water bearing fracture and vesicular basalt has been to be found quite variable (URS, 2009).

5.7.2.5 Triassic Strata

The Triassic sedimentary rocks include the regionally extensive Rewan Group and an isolated pocket of Clematis Group approximately 10 km east of the Project area. The subcrop of Clematis Group is less than 100 m thick. The Clematis Group typically comprises cross-bedded quartzose sandstone with minor conglomerate and mudstone.

Regionally the Rewan Group unconformably overlies the Permian coal measures as in-fill material. The unit is absent in the Project area is present 10 km east of the Project though much of the GW Study Area, thickening towards the Isaac River. The Triassic aged Rewan Group includes two formations, the Rewan Formation that comprises green lithic sandstone, pebbly lithic sandstone, green to reddish brown mudstone and minor volcanolithic pebble conglomerate, and the underlying Sagittarius Sandstone unit that comprises lithic sandstone interbedded with mudstones and siltstones with scattered carbonaceous plant material.

5.7.2.6 Permian Coal Measures (Blackwater Group)

Permian coal-bearing sedimentary rocks of the Blackwater Group form the main economic resource of the numerous mines in the GW Study Area. In decreasing depth (age) order, the major coal measures in the GW Study Area include the:

- Moranbah Coal Measures
- Fort Cooper Coal Measures, and
- Rangal Coal Measures.

The MCMs are the lowermost coal-bearing sequence of the Blackwater Group and form the coal resource targeted by mining at CVM and at the Project. These coal measures subcrop at CVM on the western limb of the Bowen Basin, and are also mined at the Peak Downs and Saraji mines immediately south of CVM. The MCMs comprise volcanic lithic sandstones, with lesser siltstone, mudstone, conglomerate and coal. There are four main coal seams within the MCMs at the Project, in order of increasing depth these are known as the Q seams, P seams, the Harrow Creek (H) seams and the Dysart (D) seams. These main coal seams subcrop on the western part of the CVM.

The average combined thicknesses of the constituent plies comprising each seam is given:

- Q Seam combined thickness = 2 to 3.5 m
- P Seams combined average thickness = 2 m
- H Seam combined thickness = up to 12 m, and
- D Seam combined average thickness = up to 5 m.

From drillhole logs of monitoring bores within the Project area the MCMs were identified at the following depths. In general depths were shallowest in the west of the Project area and deepest in the east:

- Q Seam was encountered between 41 m bgl (192 mAHD) to 87 m bgl (185 mAHD)
- P Seams was encountered between 55 m bgl (169 mAHD) to 112 m bgl (122 mAHD)
- H Seam was encountered between 49.5 m bgl (168 mAHD) to 179 m bgl (55 mAHD), and
- D Seam was encountered between 30 m bgl (212 mAHD) to 256.5 m bgl (-22.4 mAHD).

The Fort Cooper Coal Measures conformably overlie the MCMs immediately east of CVM. Limited information local to the Project is available for the Fort Cooper Coal Measures. Regionally, however, the formation has a maximum thickness of approximately 350 m (HydroSimulations, 2018a) and drill logs indicate the Fort Cooper Coal Measures comprise lithic sandstone, conglomerate, mudstone, carbonaceous shale, coal, tuff and tuffaceous (cherty) mudstone. Coal seams above 30 m thickness within the Fort Cooper Coal Measures are the S seam (3 to 4 m thick) and the R seam (1 to 2 m thick) (BMA, 2020). The two seams are rarely found in ML 1775 and only at the eastern margins.

The Rangal Coal Measures, overlie the Fort Cooper Coal Measures. The transition between the Rangal Coal Measures and the Fort Cooper Coal Measures is marked by the Yarrabee Tuff which immediately overlies the Vermont Lower Seam. The Yarrabee Tuff is a basin-wide marker bed comprised of weak, brown tuffaceous claystone, and drillhole logs indicate the volcanic tuff has an average thickness of 0.7 m within the Project area. The Rangal Coal Measures comprise light grey, cross-bedded, fine to medium grained labile and well cemented sandstones, grey siltstones, mudstones, shale and coal seams. The non-coal portions of the sequence being predominantly sandstones, siltstones, mudstone and shales are referred to as interburden in the mining context.

5.7.2.7 Groundwater levels and flow directions

5.7.2.7.1 Alluvium

The groundwater flow direction in the alluvium was determined as likely to be topographically controlled, flowing from higher to lower elevations (URS, 2009). Alluvial groundwater levels are monitored at six bores as part of the Project. Monitoring data shows groundwater elevations in the alluvium are approximately 225 to 224.25 mAHD in the upstream (west) parts of the Cherwell Creek alluvium, and 213.3 to 212 mAHD in the downstream (east) parts of the alluvium, where it extends across CVM south of the Project. Monitoring bores in the north and south of the

Project area show generally declining groundwater elevations in correspondence to drier than average condition. A slight recovery in groundwater elevations was observed in some bores in early 2021, in response to wetter than average climatic conditions reported. Losing stream conditions in the Isaac River Alluvium have been observed as part of the Winchester South Project, Moorvale South Project and Olive Downs Project groundwater assessments. The water levels in the Isaac River alluvium clearly follow the flow direction of the Isaac River, with south-easterly flow gradients. Recharge to the alluvium is mostly from stream flow or flooding (losing streams) and ranging from approximately 3 mm/yr in the Isaac River Channel Alluvium to 1.3 mm/yr in other alluvium.

Groundwater within the alluvium is discharged as evapotranspiration from riparian vegetation growing along the Isaac River, as well as potential baseflow contributions after significant rainfall and flood events. Groundwater within the alluvium is also discharged through the landholder use of bores in the region.

5.7.2.7.2 Tertiary Basalt

The groundwater flow direction was determined as likely to be topographically controlled, with local flow from higher to lower elevations (URS, 2009). Tertiary basalt groundwater levels are monitored at six bores as part of the Project. Monitoring shows relatively stable groundwater levels at the Project. Monitoring of the basalt aquifer since late 2019 shows slightly declining trends at some bores. A slight recovery of groundwater levels is noted between December 2020 and February 2021 corresponding with wetter than average conditions over this period. The declining trends and slight recovery may be indicative of several influences including settling of the bores following drilling, climatic trends or impacts from mining activities. Groundwater elevations for the Tertiary basalt are based on measurements from the Project's basalt monitoring bores. Basalt groundwater elevations range from 224.6 mAHD to the south west of the Project area to 202.5 mAHD to the east. Flow within the basalt is therefore believed to be localised to these extents. Recharge to the basalt aquifers is likely to be via surface infiltration and overland flow in areas where the basalt is exposed and/or no substantial clay barriers occur in the shallow subsurface. A recharge rate for the Tertiary basalt has been calculated as 1.7 mm/yr.

Groundwater discharge occurs primarily via evapotranspiration. Discharge via baseflow to minor tributaries of Cherwell Creek (in areas intersected by the basalt) may also occur after significant rainfall and flood events. Vertical seepage through the basalt is limited by the underlying low hydraulic conductivity overburden of the Blackwater Group and other aquitards.

5.7.2.7.3 Regolith

The regolith is not expected to form a significant aquifer at CVM in relation to the Project. Monitoring records show generally stable groundwater levels, with slight recovery demonstrated in recent data. Exploration drilling suggests that the regolith is not commonly saturated. Overall, the regolith within the Project area and GW Study Area is largely unsaturated, with the presence of water restricted to lower elevation areas along the Isaac River and the lower reaches of its tributaries (i.e., Horse Creek and Cherwell Creek). Flow within the regolith where it is saturated reflects topography, flowing towards nearby drainage lines. The regolith material comprises low hydraulic conductivity strata (i.e., clay and claystone), which restricts rainfall recharge. A recharge rate for the regolith has been calculated as 0.1 mm/yr.

Groundwater discharge occurs primarily via evapotranspiration, with some baseflow to streams from the regolith under wet climatic conditions. Vertical seepage through the regolith is limited by the underlying low hydraulic conductivity of the Blackwater Group overburden and other aquitards.

5.7.2.7.4 Rewan Group

The closest bores to the Project area screened within the Rewan Group is bore RN141383 (MB3), which is part of the Eagle Downs Mine monitoring network and is located 17 km south east of the Project. The unit thickens towards the Isaac River, and can be up to 300 m thick within the GW Study Area. In general, the occurrence of the unit can vary regionally based on the structural setting. The Rewan Group comprises low hydraulic conductivity lithologies and is typically considered an aquitard, restricting groundwater flow. Groundwater elevations within the Rewan Group are above those recorded within the deeper Permian coal measures, indicating a downward hydraulic gradient. Monitoring trends show alluvial groundwater levels above the Rewan Group groundwater elevation, indicating a downward gradient from the overlying alluvium.

5.7.2.7.5 Permian Coal Measures Interburden

Monitoring bores within the overburden/interburden show that groundwater occurrence within the Permian coal measures interburden is largely restricted to weathered horizons or to secondary porosity through fractures. The data potentially indicates a subdued response to mining activities from the existing Horse Pit. Recharge to the Permian coal measures occurs at subcrop. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams in the direction of the hydraulic gradient to the east. Groundwater discharge occurs via evaporation and abstraction from active mine areas.

5.7.2.7.6 Permian Coal Measures Coal Seams

Groundwater occurrence within the Permian coal measures is largely restricted to the more permeable coal seams that exhibit secondary porosity through fractures and cleats. Regionally groundwater flow is to the east, consistent with local topography. Differences in piezometric heads within the confined coal seam aquifers of the MCMs drive groundwater flow eastwards across the Bowen Basin, from the slightly more elevated subcrop areas on the western flank of the Basin to the less elevated subcrop areas on the eastern flank. However, mining activities throughout the region have created locally modified groundwater flow systems within the Permian coal measures that are superimposed on these regional flow gradients. The influence of mining activities on groundwater elevations in the north of the Project area appears to be limited, with local flow direction inferred to be west to east in line with regional flow.

Groundwater within the Permian coal measures is confined and sub-artesian. For the shallower coal measures, groundwater elevations are generally at or below groundwater elevations within the overlying unconfined sediments, indicating a downward hydraulic gradient. However, with increased depth of cover and pressure the hydraulic gradient within the Permian coal measures reverses. This coincides with a decrease in hydraulic conductivity with depth.

Recharge to the Permian coal measures occurs where the unit occurs at subcrop at a recharge rate for the weathered Permian units of 0.1 mm/yr. Due to the low hydraulic conductivity of the interburden material, groundwater largely flows horizontally within the coal measures, along the bedding plane of the coal seams. Groundwater discharge occurs via evaporation and inflow from active mine areas.

5.7.2.8 Groundwater quality

Monitoring results generally indicate that Na and Cl are the dominant major ions in groundwater across the Project area. Surficial alluvial and basalt generally display a more mixed water type, with higher proportions of magnesium and bicarbonate ions. The dominant water types in the basalt and unconsolidated alluvium therefore generally Na-Mg-Cl and Na-Mg-Cl-HCO3. Regolith strata showed a similar water type but a greater proportion of the Cl ion. Non coal Permian bores also showed mixed water types of Na-Cl-HCO3 and Na-Mg-Cl. Within the MCMs only P seam monitoring bores consistently recorded a Na-Cl water type.

Water types of the Q seam, H seam, D seam were more variable. In general, deeper bores, typically in the east of the Project area, displayed Na-Cl water types, with shallower bores showing water types with higher proportions of calcium or magnesium ions. This is likely to be due to greater recharge from overlying surficial deposits in the shallower areas, the greater thickness of the unweathered material preventing the mobilisation of salts into the coal seams in the deeper locations. As the shallower bores are closer to the base of weathering, seepage of mobilised salts during recharge is more likely to occur. Within the deeper deposits, recharge from overlying units is likely to be less, with major ions distribution more influenced by secondary salinity mechanisms.

Surface water within the Isaac River is largely fresh, while water within the alluvium is fresh to saline with an average TDS of 556 milligrams per litre (mg/L) (marginal) and ranging between 10 mg/L and 5,620 mg/L. Where water is present within the regolith material, it is generally highly saline, but can be brackish to moderately saline with an average TDS of 7,101 mg/L and ranging between 1,110 mg/L and 18,600 mg/L. Water present in the Tertiary basalt is generally moderately saline with an average TDS of 3,538 mg/L, but can be fresh to highly saline ranging between 656 mg/L and 16,526 mg/L.

Water within the Permian MCMs is generally saline within the coal seams and moderately saline to saline interburden units but can range between fresh and highly saline. Coal seam units of the MCMs record an average

TDS of 7,598 mg/L, ranging between 720 mg/L and 24,704 mg/L. The interburden units of the Permian coal measures record an average TDS of 5,349 mg/L, ranging between 1,520 mg/L and 9,126 mg/L.

Water within the Permian Rangal Coal Measures is generally saline within the coal seams and saline interburden units but can range between fresh and highly saline. Coal seam units of the Rangal Coal Measures record an average TDS of 6,212 mg/L, ranging between 923 mg/L and 16,400 mg/L. The interburden units of the Permian coal measures record an average TDS of 3,436 mg/L, ranging between 421 mg/L and 18,400 mg/L.

Along the Isaac River, mostly freshwater quality is present with brackish to moderately saline water along the river and tributaries. Alluvial monitoring bores for the Project support this showing generally brackish to saline water along Cherwell Creek upstream of the Isaac River. The salinity within the coal measures appears to increase with depth. Bores within the coal measures near the subcrop areas in the west generally record moderately saline water quality, which increases to saline quality where the coal measures are deepest near the Isaac River. This supports the coal measures being largely recharged by rainfall where they occur at subcrop.

5.7.2.9 Anthropogenic groundwater use

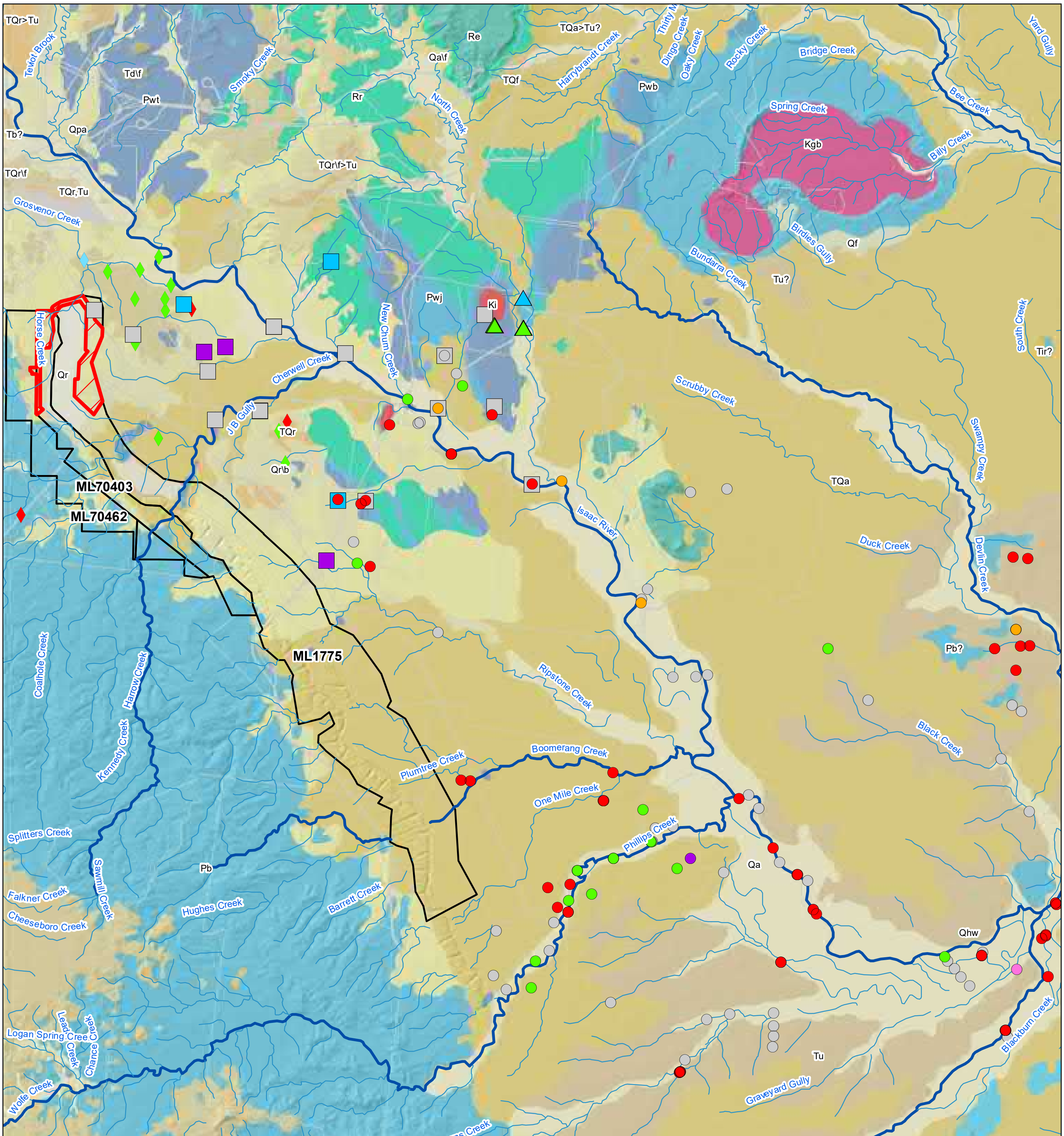
The Project's 2020 bore census (Appendix A3 of the Groundwater Impact Assessment Technical Report in Appendix F) identified the following:

- 17 bores were found to be existing and in use
- seven bores are existing but not in use (abandoned)
- one bore was decommissioned, and
- one bore was destroyed.

Of the existing and unknown bores with water use information available surveyed in the Project's bore census, one is used for Quarry water supply (gravel washing and dust suppression), four are used for stock water supply, 12 are used of groundwater monitoring and one is used for domestic water supply.

Results of the 2020 Project bore census found groundwater use in the area to be limited due to low yields, with many bores abandoned in favour of utilisation of connection to the water supply from the Eungella-Bingegang pipeline. Based on the bore census results, it has been determined that groundwater is not privately extracted from MCMs within 5 km of the Project. Given the increasing depth to the MCMs further from the Project, it is considered unlikely groundwater extraction is undertaken from the unit further east. Correlation of the total depths for the surveyed bores against the model layer elevations show that water extraction in the surveyed bores is primarily from the shallower Fort Cooper Coal Measures where it overlies the MCMs. The census results show groundwater take from private extraction is relatively insignificant with estimated yields for assessed stock water bores ranging from 1.6 to 4.7 ML/yr and yields from the one quarry water supply bore estimated at 6.57 ML/yr.

Field bore censuses have been conducted for the Moorvale South Project in 2019 (Golder Associates, 2019), the Olive Downs Project groundwater assessment in 2017 (HydroSimulations, 2018a), and the Project (SLR, 2020). Locations and uses of bores detailed in the combined bore censuses is outlined on Figure 5-16.



Surveyed Bores

- WS Bore Census (2019) - Monitoring
- WS Bore Census (2019) - Water Supply
- ODS Bore Census (2017) - Domestic
- ODS Bore Census (2017) - Exploration
- ODS Bore Census (2017) - Monitoring
- ODS Bore Census (2017) - Stock
- ODS Bore Census (2017) - Stock and Domestic
- ODS Bore Census (2017) - ODS Census, Stock/Monitoring
- ODS Bore Census (2017) - Unknown
- DNRME Database (2020) - Water Supply
- DNRME Database (2020) - Exploration
- DNRME Database (2020) - Unknown

Surveyed Bores

- HPE Bore Census (2020) - Monitoring
- HPE Bore Census (2020) - Quarry Water Supply
- HPE Bore Census (2020) - Stock

0 2.5 5 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:365,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

- Major Watercourse
- Minor Watercourse
- Horse Pit Extension Project Area
- BHP Tenements
- CVM EIS Pit Boundary (2010)
- Cadastre

Horse Pit Extension Project

Bore Censuses - Groundwater Use Surrounding the Project

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FIGURE 5-16

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5.7.2.10 Surface water - groundwater interaction and environmental groundwater use

The alluvium in the GW Study Area is underlain by low hydraulic conductivity stratigraphy (i.e., claystone, siltstone and sandstone), which restricts the rate of downward leakage to underlying formations. Localised perched water tables within the alluvium are evident where waterbodies continue to hold water throughout the dry period (e.g., pools in the Isaac River and floodplain wetlands) and occur where clay layers slow the percolation of surface water. Data indicates that surface water (flowing and ponded) elevations generally remain around 170 mAHD. The closest bore (RN13040180) to the Project with long-term groundwater level monitoring in the Isaac River alluvium indicates that rainfall derived recharge (including from stream flow) is a key source of water to this aquifer.

The Isaac River is largely a losing system with stream-stage above that of the local groundwater levels, resulting in the water draining through the alluvial sediments to the local groundwater system. Occasional periods of baseflow to the river from the underlying alluvium may occur after prolonged rainfall events or following flood events. Under these conditions, recharged alluvial sediments will drain to the river as the hydraulic gradient reverses and sustains streamflow for a short period after the rainfall event.

Technical assessments have been undertaken addressing GDEs in detail, namely the Aquatic Ecology Impact Assessment Report in Appendix H, and GDE Impact Assessment Report in Appendix I. A discussion of GDEs, outlining the findings of these assessments, is provided under Section 5.10.

5.7.3 Groundwater Impact Assessment

The impacts on groundwater from the development, operation, closure and post-closure of the Project have been evaluated. Potential impacts of the mine on the regional groundwater regime were assessed and are detailed in the Groundwater Impact Assessment Report in Appendix F and summarised in the following sections.

5.7.3.1 Project groundwater model

The numerical model was developed using GIS in conjunction with MODFLOW-USG. MODFLOW-USG is the latest version of industry standard MODFLOW code and was chosen as the most suitable modelling code for accomplishing the model objectives. The numerical groundwater model for the Project builds on the Olive Downs Project EIS model (the foundational regional Bowen Basin model) (HydroSimulations, 2018b). The foundational model was subsequently updated for the Moorvale South Project in 2019 (SLR, 2019b), for the Winchester South Project EIS in 2020 (SLR, 2020), and most recently for the Lake Vermont North Project (in conjunction with the Project). BMA has established groundwater data sharing agreements with the owners of each of these projects/mines, which allows for the sharing of groundwater data, models and documentation. Under these agreements, the groundwater models developed as part of each project/mine’s groundwater assessment have been adopted as a base for the Project groundwater assessment where relevant. Of note, the current update of the groundwater model reported herein is the first iteration to include data and information from the Lake Vermont North Project as well as several BHP sites (CVM, Poitrel, Daunia and Saraji). A range of model updates were deemed required to ensure the regional Bowen Basin model is fit for purpose for the Project, including extension of the model and grid and updated layers of mined seams and strata at CVM. The Project groundwater model is discussed in Section 6 of the Groundwater Impact Assessment Report in Appendix F and further discussed in Section 10 of Appendix J.

Predicted groundwater inflows to the Project’s pit average 0.55 ML/day over the duration of mining, reaching a predicted maximum of 0.75 ML/day during 2044. The predicted inflows are within the same order of magnitude as the groundwater inflows recorded at Horse Pit and Heyford Pit during 2018/2019 and are therefore realistic predictions for the Project.

Maximum drawdown impacts are predicted to exceed 1 m. In areas within the 1 m drawdown contour, the unit is considered impacted by drawdown. Importantly, no private bores are predicted to be impacted because of mining activities at the Project and no drawdown impacts are predicted for the Quaternary alluvium because of the Project.

The maximum predicted drawdown associated with the Project within the regolith is shown in Figure 5-17. The drawdown extent within the regolith (Layer 2) is largely confined to the Project area and is influenced by the distribution of predicted saturated zones in the regolith. The coal seams of the MCMs are the primary groundwater bearing units intercepted by the Project and will experience drawdowns as a direct result of mining at the Project. Groundwater level drawdown within the mined coal seams is influenced by unit structure and is confined to unit extents. Figure 5-18 to Figure 5-21 show the maximum predicted incremental drawdown for Q, P, H and D seams respectively in the MCMs. These figures show the extent of maximum predicted depressurization of the Permian coal measures is limited to the west of the Project area due to the structural geology (i.e., coal seams subcrop and the units do not exist west of the subcrop). The extents of maximum predicted incremental drawdown in the MCMs seams are between 10 to 12 km to the east and north east of the Project boundary. The cone of depression is predicted to be steepest at the working coal face.

5.7.3.2 Incidental Water Impacts

There will be no direct interception of the alluvium, including that associated with the Isaac River, by the proposed open cut pit for the Project. Any predicted interference of alluvial groundwater therefore largely relates to the potential for increased leakage from the alluvium to the underlying Permian coal measures that are depressurised because of the Project. Over the extent of Quaternary alluvium, model predictions show that there is zero predicted loss of water from the alluvium because of exercising the underground water rights for the Project, i.e., there is no predicted direct or indirect interference with alluvial groundwater because of the Project. Refer to Section 6.2 and Section 3.6.1 of Appendix B of the Groundwater Impact Assessment Report in Appendix F.

The model predicts that over the LOM, the change in the average rate of seepage from the Isaac River to the alluvium is insignificant and considered within the error threshold of model predictions (less than 3.65 ML/year). The model estimates less than 0.01% increased seepage from the Isaac River to the alluvium because of mining at the Project, an insignificant potential for flow rate reduction. There is also no change in net flow predicted in the creeks located within the vicinity of the Project area. Refer to Section 6.4 and Section 7.3 of the Groundwater Impact Assessment Report in Appendix F.

5.7.3.3 Cumulative Impacts

Cumulative impacts associated with approved and foreseeable open cut and underground coal mines surrounding the Project were assessed in accordance with IESC requirements. Modelling was undertaken. Together with all approved and proposed CVM mining, surrounding mines included within the model are the Olive Downs Project (Olive Downs South and Willunga), Moorvale South Project, PTM, Daunia Mine, PDM, Grosvenor Mine, Lake Vermont Mine, Eagle Downs Mine, Saraji Mine, Saraji East Project and the Winchester South Project. Results confirm that most of the predicted cumulative drawdown impacts are not related to the Project but result from these other existing and approved mining activities represented in the model. Maximum cumulative drawdown impact predictions are detailed in Section 6.5 of the of the Groundwater Impact Assessment Report in Appendix F.

5.7.3.4 Isaac Connors Groundwater Management Area

The Project does not directly intercept groundwater from Isaac Connors Groundwater Unit 1 (Quaternary alluvium) under the Water Plan (Fitzroy Basin) 2011. This is, all direct ‘groundwater take’ because of open cut pits for the Project is from Isaac Connors Groundwater Unit 2 (sub-artesian aquifers). Project ‘groundwater take’ because of open cut pits would be on average 133.9 ML/year from Groundwater Unit 2. The model predicts that for the long-term equilibrium condition post mining, there is negligible groundwater take from Groundwater Unit 1, and 146.5 ML/year groundwater take from Groundwater Unit 2 to the proposed final void. Refer to Section 6.2 and Section 7.1 of the Groundwater Impact Assessment Report in Appendix F.

5.7.3.5 Potential Impacts to Third Party Bores

Chapter 3 of the Water Act provides bore drawdown threshold triggers of 2 m for unconsolidated aquifers, and 5 m for consolidated aquifers. As shown in Figure 5-17 through Figure 5-21, there are no known privately-owned bores within the unconsolidated (Alluvium and Regolith) or consolidated (Permian coal measures) aquifers that lie within the predicted extent of Project related drawdown greater than 1 m.

The uncertainty results showed that no water supply bores in the alluvium are predicted to experience drawdowns greater than 1 m due to the Project even at the 95th percentile confidence interval. The uncertainty results showed that the 95th percentile maximum cumulative drawdown is predicted to be greater than 5 m at two water supply bores. Both bores are located to the west of the Project and are screened within the Fort Cooper Coal Measures. As per Table 2 of the IESC guidelines (2020), in terms of likelihood of exceedance, a percentile greater than 90% means that it is very unlikely that the maximum cumulative drawdown will be greater than 5 m at these bores.

5.7.3.6 Potential Impacts on Groundwater Quality

Potential sources that may result in impacts to groundwater quality include:

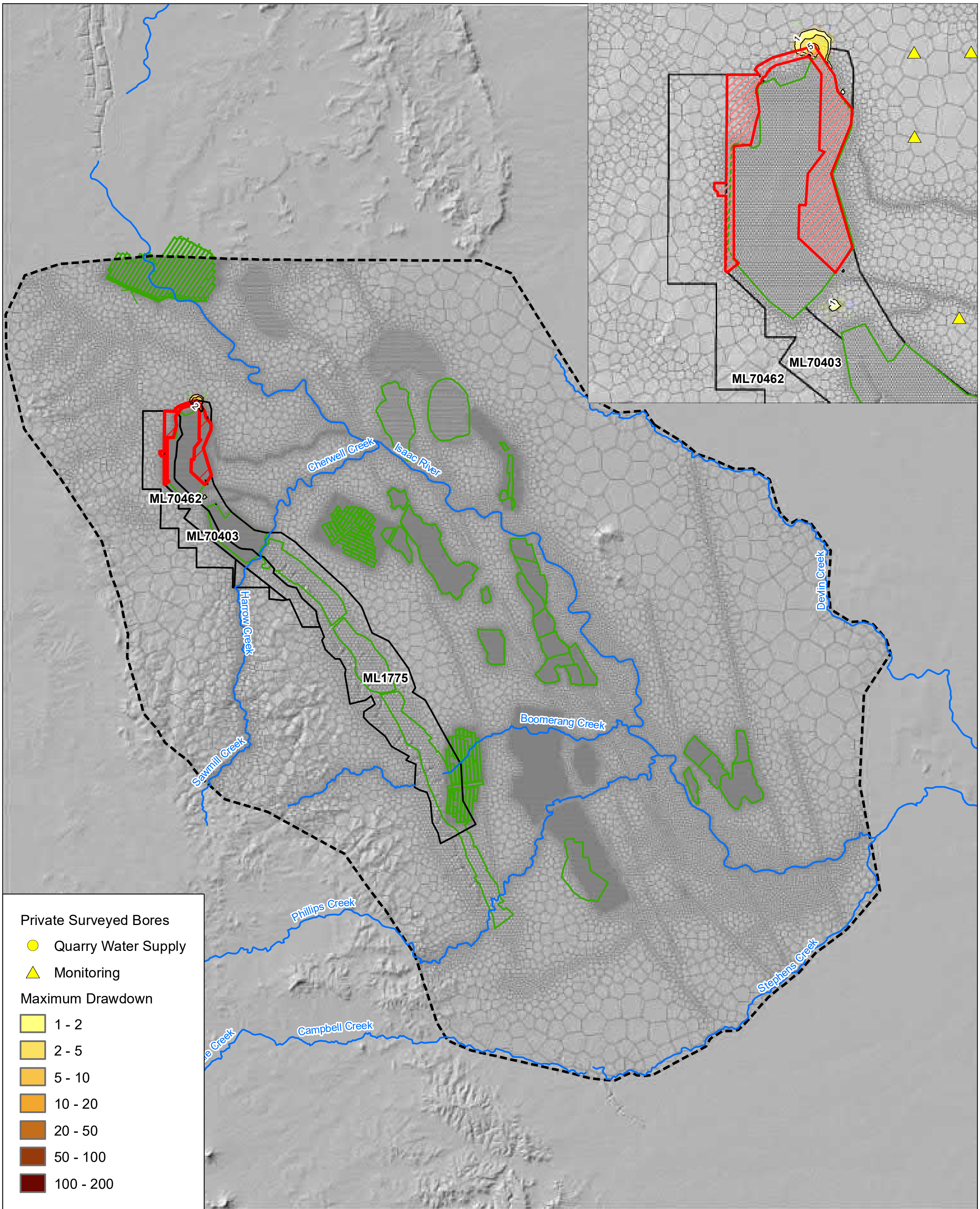
- The OOPD
- In pit waste rock emplacement areas, and
- Final void.

The out of pit waste rock emplacement areas may produce seepage because of rainfall inundation that theoretically could alter the existing groundwater quality. A geochemical assessment has been prepared by Terrenus Earth Sciences (2021) (refer to Section 5.2 and Appendix B) presenting the ‘assumed worst case’ scenario that included leachate analysis of waste rock material. The analysis found waste rock material is generally NAF, with the leachate averaging an EC of 391 µS/cm and low in sulfur content. The inward hydraulic flow gradients from the waste emplacement areas (comprising the OOPD and in pit waste rock disposal) to the open cut void would inhibit seepage to the alluvium and in-situ Cainozoic sediments present between the alluvium and regolith and the out of pit waste rock emplacements generally comprise surficial soil and clays, up to 10 m thick. The surficial clays would inhibit potential seepage from the OOPD to the underlying regolith and alluvium. Therefore, there would be no mechanism for seepage from the out of pit waste rock emplacement to impact on groundwater quality in the alluvium and regolith. Notwithstanding, leachate from the out of pit waste rock emplacement would generally be fresh and low in sulfur content, minimising the potential for a change in groundwater quality in the unlikely event seepage enters the groundwater system.

The in pit waste rock emplacement areas would be rehabilitated progressively as the mining operations progress. The Project would involve progressively backfilling the open cut pit as space becomes available with water levels within backfilled areas predicted to recover back towards pre-mining levels. Leachate would generally be fresh and low in sulfur content, minimising the potential for a change in groundwater quality in the unlikely event seepage enters the groundwater system.

A final void is proposed within the Project area to remain in perpetuity. Modelling predicts that the final void water levels would equilibrate to 120 mAHD. The predicted equilibrated final void water levels are between approximately 70 m and 90 m below the pre-mining groundwater levels, which means the final void would act as a sink to groundwater flow. Water within the final void would evaporate from the final void water body surface and draw in groundwater from the surrounding strata and runoff from the final void catchment areas. As the final void would act as a sink, evaporation from the final void water body would overtime concentrate salts in the final void water body. However, the gradual increase in salinity of the final void water body would not pose a risk to the surrounding groundwater regime as the final void would remain as a groundwater sink in perpetuity. This is further considered by the Surface Water Impact Assessment provided in Appendix E.

All workshop and fuel/chemical storage areas at CVM are developed in accordance with the requirements of the CVM EA and current Australian Standards. This includes refuelling areas and chemical storage areas to be designed with adequate bunding and equipped for immediate spill clean-up. These controls represent standard practice and a legislated requirement at mining operations for preventing the contamination of the groundwater regime. Therefore, it is unlikely groundwater contamination will occur with relation to workshops and fuel/chemical storage.



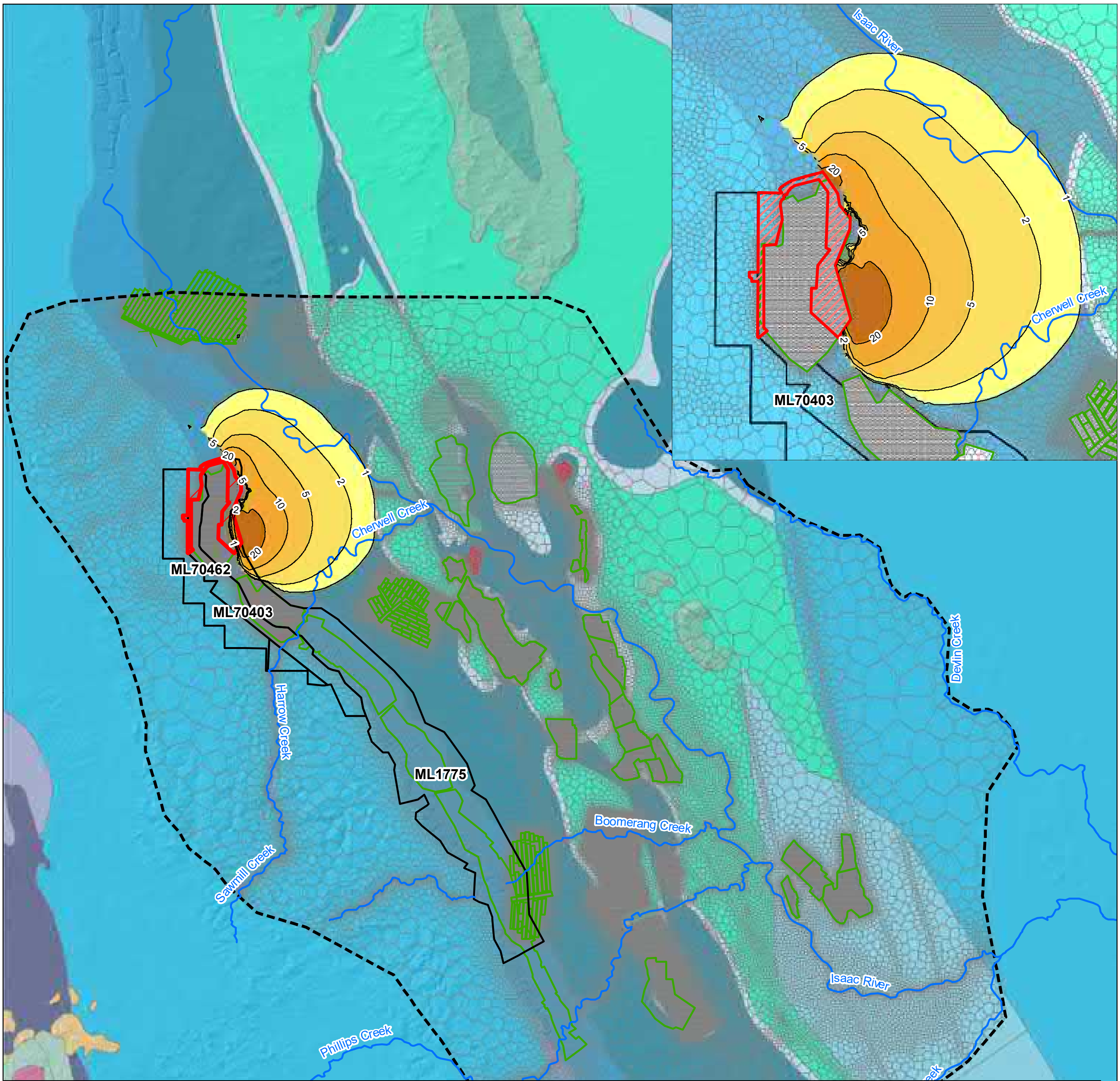
Projection: GDA 1994 MGA Zone 55
Scale: 1:475,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

Horse Pit Extension Project

Maximum Incremental Drawdown in Regolith (Layer 2)

FIGURE 5-17

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_14_Maximum Incremental Drawdown in Regolith (Layer 2)_02.mxd



Water Level Contours (mAHD)

Maximum Drawdown
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Solid Geology
- Anakie Metamorphic Group (PLEa)
- Back Creek Group (Pb)
- Blackwater Group (Pw)
- Blenheim Subgroup (Pbe)
- Bundarra Granodiorite (Kgb)
- Burngrove Formation (Pwg)
- Clematis Group (Re)
- Du-BBG (Du)
- Fair Hill Formation,Fort Cooper Coal Measures (Pwt)
- German Creek Formation (Pbd)
- Ki-CQ (Ki)
- Lizzie Creek Volcanic Group (Pvz)
- MacMillan Formation (Pbn)
- Moolayember Formation (Rm)
- Moranbah Coal Measures (Pwb)
- Mount Rankin Formation (Ca)
- Peak Range Volcanics (Tp)
- Rangal Coal Measures,Bandanna Formation,Baralaba Coal Measures (Pwj)
- Retreat Supersuite (Dgr)
- Rewan Group (Rr)
- Silver Hills Volcanics (DCs)

0 2.5 5 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:475,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

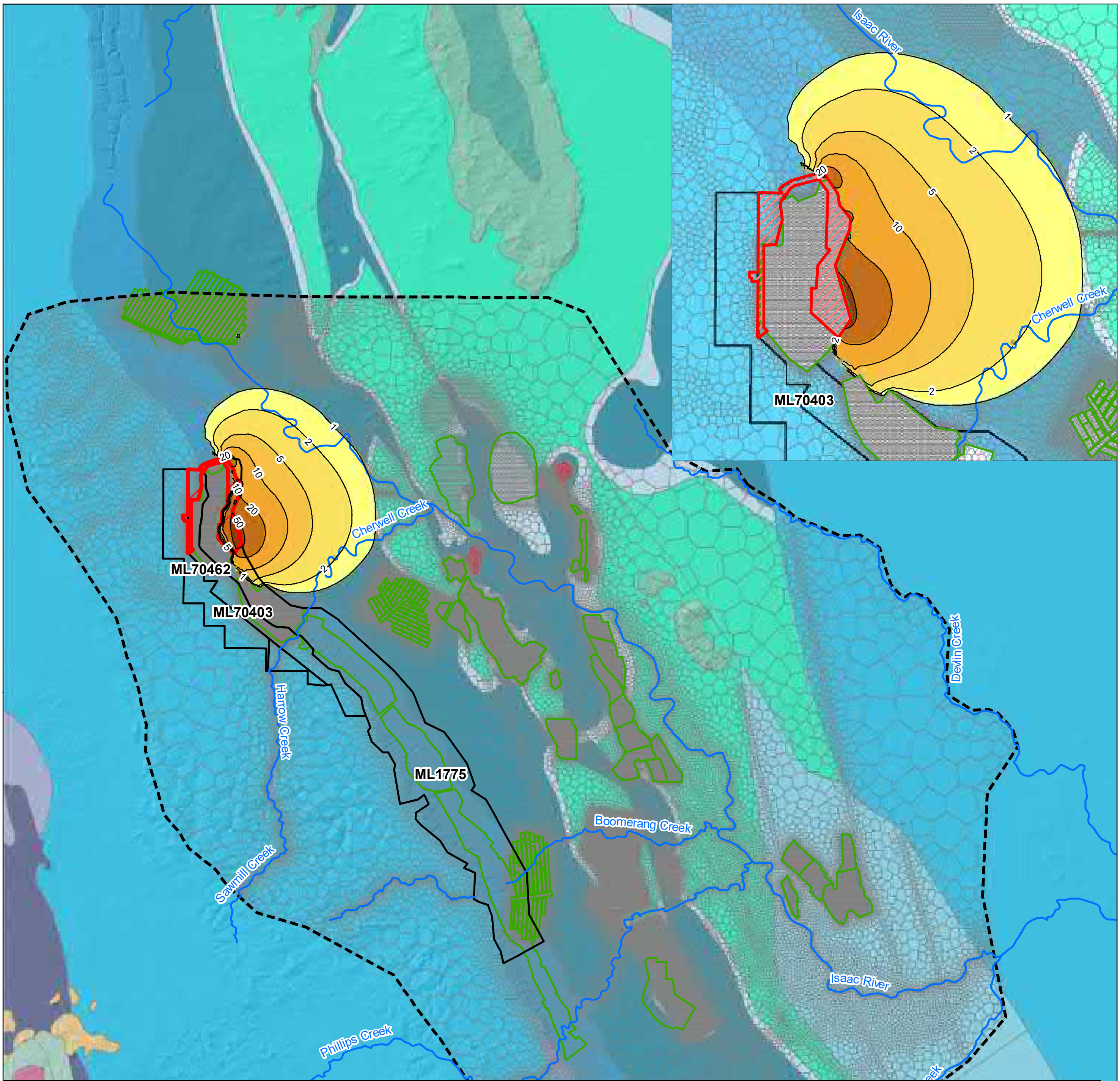
- Major Drainage
- Surrounding Mines
- Horse Pit Extension Project Area
- Model Boundary
- BHP Tenements
- CVM EIS Pit Boundary (2010)

Horse Pit Extension Project

Maximum Incremental Drawdown in Q Seam (Layer 12)

FIGURE 5-18

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_15_Maximum Incremental Drawdown in Q Seam (Layer 12)_02.mxd



— Water Level Contours (mAHD)

Maximum Drawdown
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Solid Geology
- Anakie Metamorphic Group (PLEa)
- Back Creek Group (Pb)
- Blackwater Group (Pw)
- Blenheim Subgroup (Pbe)
- Bundarra Granodiorite (Kgb)
- Burngrove Formation (Pwg)
- Clematis Group (Re)
- Du-BBG (Du)
- Fair Hill Formation,Fort Cooper Coal Measures (Pwt)
- German Creek Formation (Pbd)
- Ki-CQ (Ki)
- Lizzie Creek Volcanic Group (Pvz)
- MacMillan Formation (Pbn)
- Moolayember Formation (Rm)
- Moranbah Coal Measures (Pwb)
- Mount Rankin Formation (Ca)
- Peak Range Volcanics (Tp)
- Rangal Coal Measures,Bandanna Formation,Baralaba Coal Measures (Pwj)
- Retreat Supersuite (Dgr)
- Rewan Group (Rr)
- Silver Hills Volcanics (DCs)

0 2.5 5 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:475,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

- Major Drainage
- Surrounding Mines
- Horse Pit Extension Project Area
- Model Boundary
- BHP Tenements
- CVM EIS Pit Boundary (2010)

SLR

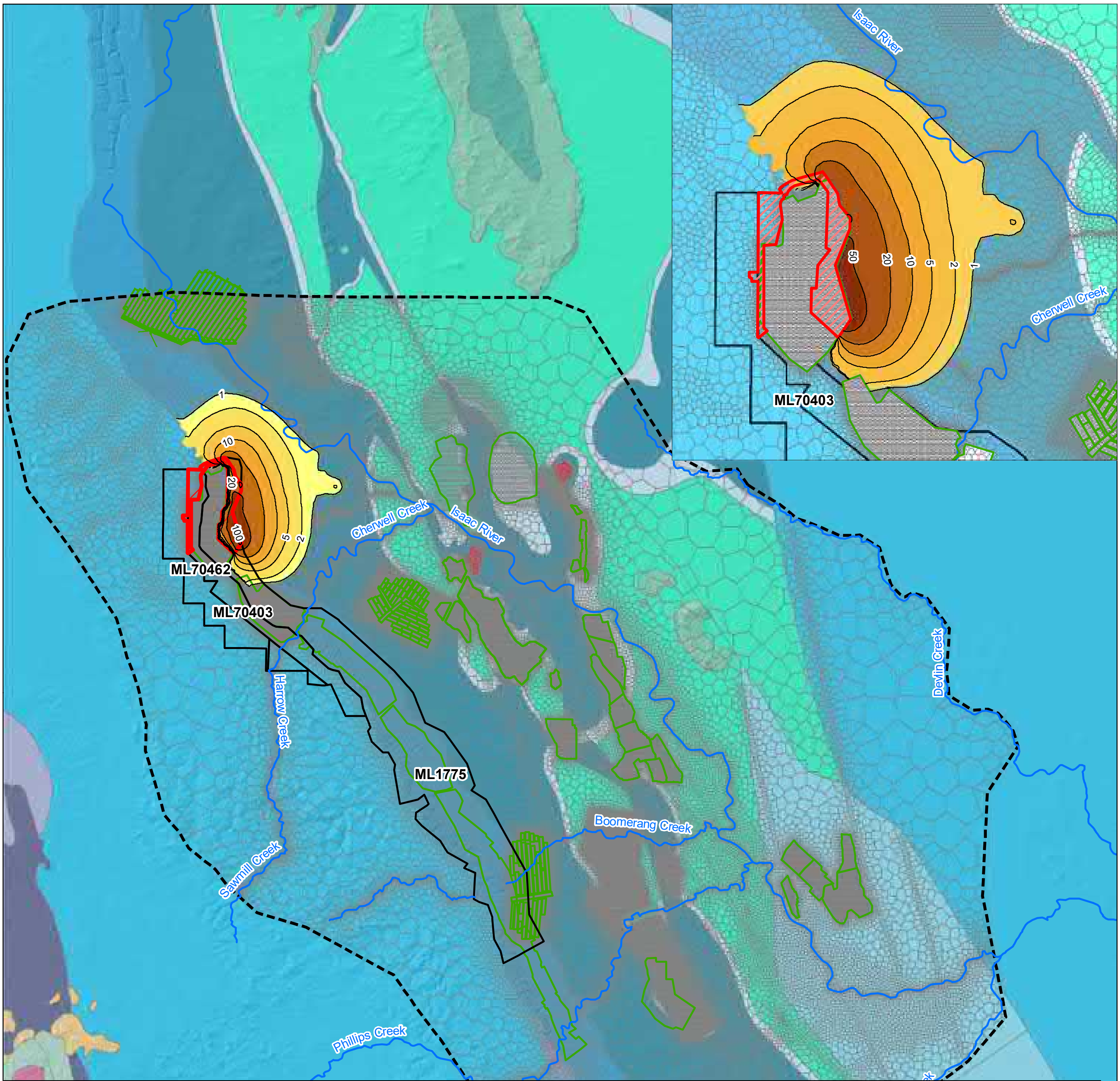
BMA
BHP Mitsubishi Alliance

Horse Pit Extension Project

Maximum Incremental Drawdown in P Seam (Layer 14)

FIGURE 5-19

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_16_Maximum Incremental Drawdown in P Seam (Layer 14)_02.mxd



Water Level Contours (mAHD)

Maximum Drawdown
- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Solid Geology
- Anakie Metamorphic Group (PLEa)
- Back Creek Group (Pb)
- Blackwater Group (Pw)
- Blenheim Subgroup (Pbe)
- Bundarra Granodiorite (Kgb)
- Burngrove Formation (Pwg)
- Clematis Group (Re)
- Du-BBG (Du)
- Fair Hill Formation,Fort Cooper Coal Measures (Pwt)
- German Creek Formation (Pbd)
- Ki-CQ (Ki)
- Lizzie Creek Volcanic Group (Pvz)
- MacMillan Formation (Pbn)
- Moolayember Formation (Rm)
- Moranbah Coal Measures (Pwb)
- Mount Rankin Formation (Ca)
- Peak Range Volcanics (Tp)
- Rangal Coal Measures,Bandanna Formation,Baralaba Coal Measures (Pwj)
- Retreat Supersuite (Dgr)
- Rewan Group (Rr)
- Silver Hills Volcanics (DCs)

N

0 2.5 5 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:475,000 at A4
Project No.: 620.13593
Date: 13-Dec-2021
Drawn by: PM

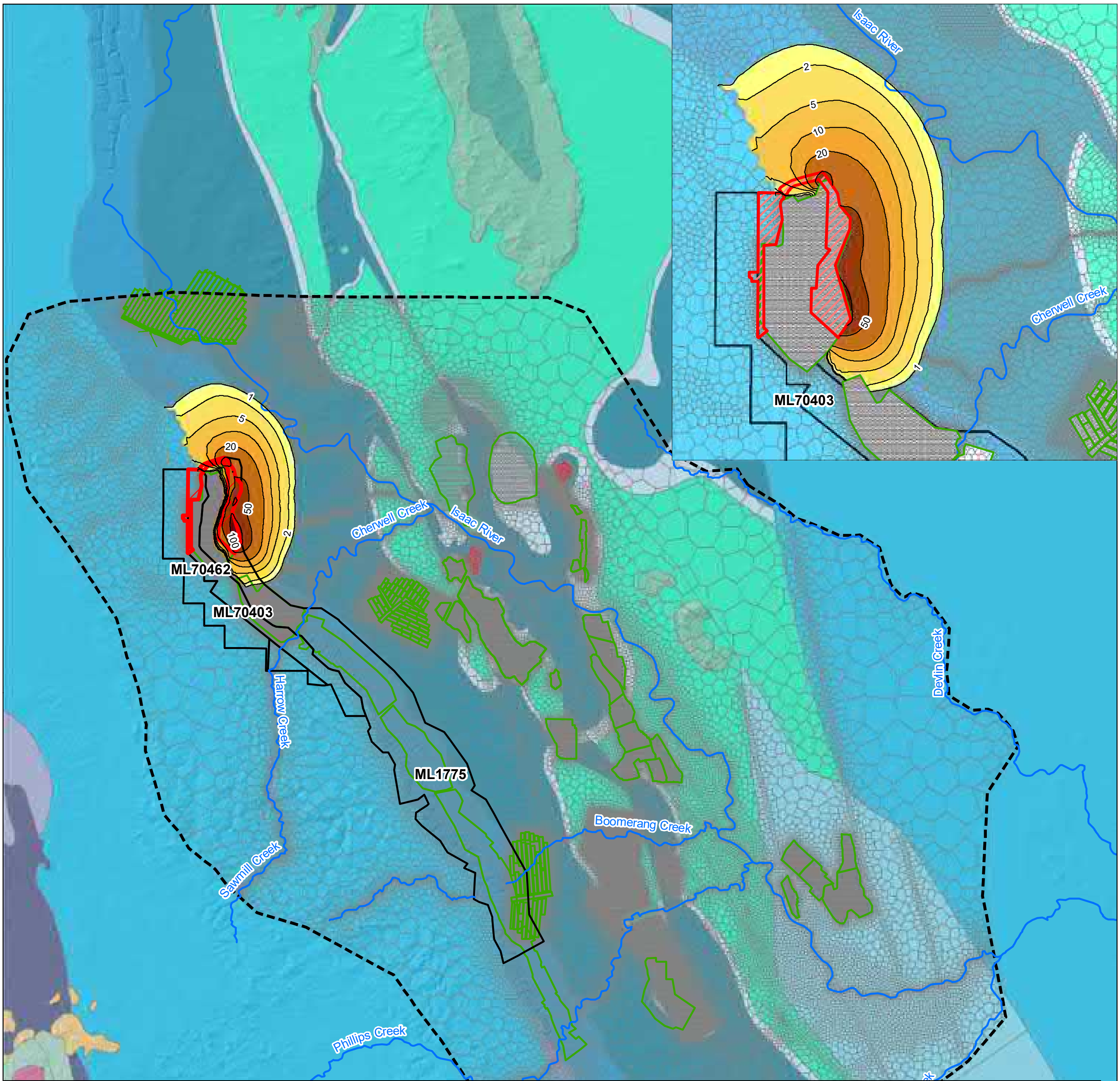
- Major Drainage
- Surrounding Mines
- Horse Pit Extension Project Area
- Model Boundary
- BHP Tenements
- CVM EIS Pit Boundary (2010)

Horse Pit Extension Project

Maximum Incremental Drawdown in H Seam (Layer 16)

FIGURE 5-20

H:\Projects-SLR\620-BNE\620-BNE\620.13593 BHP - Horse Pit Approvals\07 CADGIS\ArcGIS\EA Amendment\SLR62013593_EAAmd_F5_17_Maximum Incremental Drawdown in H Seam (Layer 16)_02.mxd



— Water Level Contours (mAHD)

Maximum Drawdown

- 1 - 2
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 50
- 50 - 100
- 100 - 200

Solid Geology

- Anakie Metamorphic Group (PLEa)
- Back Creek Group (Pb)
- Blackwater Group (Pw)
- Blenheim Subgroup (Pbe)
- Bundarra Granodiorite (Kgb)
- Burngrove Formation (Pwg)
- Clematis Group (Re)
- Du-BBG (Du)
- Fair Hill Formation,Fort Cooper Coal Measures (Pwt)
- German Creek Formation (Pbd)
- Ki-CQ (Ki)
- Lizzie Creek Volcanic Group (Pvz)
- MacMillan Formation (Pbn)
- Moolayember Formation (Rm)
- Moranbah Coal Measures (Pwb)
- Mount Rankin Formation (Ca)
- Peak Range Volcanics (Tp)
- Rangal Coal Measures,Bandanna Formation,Baralaba Coal Measures (Pwj)
- Retreat Supersuite (Dgr)
- Rewan Group (Rr)
- Silver Hills Volcanics (DCs)

N

0 2.5 5 km

Projection: GDA 1994 MGA Zone 55

Scale: 1:475,000 at A4

Project No.: 620.13593

Date: 13-Dec-2021

Drawn by: PM

- Major Drainage
- Surrounding Mines
- Horse Pit Extension Project Area
- Model Boundary
- BHP Tenements
- CVM EIS Pit Boundary (2010)

Horse Pit Extension Project

Maximum Incremental Drawdown in D Seam (Layer 18)

SLR

BMA BHP Mitsubishi Alliance

FIGURE 5-21

5.7.3.7 Groundwater Dependent Ecosystems

The Project is not predicted to have any significant impacts on potential or actual GDEs due to changes in groundwater quality or resources. Technical assessments have been undertaken addressing GDEs in detail, namely the Aquatic Ecology Impact Assessment in Appendix H, GDE Impact Assessment Report in Appendix I and assessment provided in Section 5.10.

5.7.4 Groundwater Management, Monitoring, and Impact Mitigation Measures

5.7.4.1 Mine-Affected Water

The mine plan and the conditions of the CVM EA (detailed under Schedule F) document requirement for the management MAW at CVM, and these will be implemented for the Project. Waste rock material will be emplaced in pit as the space becomes available and will in some areas form the walls of the final voids. Water within the final void is predicted to remain below pre-mining levels. Therefore, it is anticipated the final void would act as a groundwater sink, capturing water associated with in pit rejects, refer to Section 5.7.3.6.

Where MAW is not managed via passive evaporation, inflows to the open cut pits are pumped via in pit sumps where necessary to ensure safe operating conditions. The water inflows are collected and contained within mine water management system. Refer to Section 3.6.6 for details of the management of MAW and the proposed update to the water management system at CVM, and Figure 3-15 and Figure 3-17.

To facilitate the Project and maintain pit flood immunity at CVM up to 0.1% AEP, two additional flood levees will be constructed. Refer to Appendix E for details of pit flooding immunity.

5.7.4.2 Groundwater Use

No privately-owned bores are predicted to exceed relevant bore trigger thresholds in the Chapter 3 of the Water Act and therefore there are no existing privately-owned bores that would be impacted by the Project. However, it remains possible that in the future, privately-owned bores may be installed within the extent of drawdown related to the Project. In accordance with Chapter 3 of the Water Act, any impacts on such bore users that exceed the magnitude of impacts predicted in the groundwater assessment (Appendix F) will require “make good provisions” for the additional impacts to ensure the bore user has access to a similar quantity and quality of water for the authorised purpose. This may include deepening a bore to increase its pumping capacity, constructing a new water supply bore, providing water from an alternative source or financial compensation.

5.7.4.3 Groundwater Monitoring Program

A groundwater monitoring program is conducted at CVM in accordance with Schedule I of the current EA EPML00562013. The proposed EA mandated groundwater monitoring network is shown in Section 10.3.1 of Appendix J and in Table 5-29. The groundwater monitoring schedule will continue as per Schedule I of the current EA.

The groundwater monitoring program would continue throughout the life of the Project. Recording of groundwater levels from existing monitoring bores would continue and would allow natural groundwater level fluctuations (such as responses to rainfall) to be distinguished from potential groundwater level impacts due to depressurisation resulting from proposed mining activities. Groundwater quality sampling of existing monitoring bores would continue in order to provide longer term baseline groundwater quality at the Project, and to detect any changes in groundwater quality during and post mining.

A number of existing monitoring bores proposed to be incorporated in the Project groundwater monitoring bore network are likely to be mined-out as mining progresses. BMA is committed to replacing these bores at least 2 years prior to being mined-out. Bores will be relocated outside of the proposed future mining footprint and screened within the same hydrostratigraphic unit as the replaced bore to enable monitoring of predicted impacts to continue.

Table 5-29 Proposed EA Groundwater Monitoring Network

Bore ID	Easting (AGD66 Z55s)	Northing (AGD66 Z55s)	Target Aquifer	Monitoring Frequency	Monitoring Rationale
PZ01	609841	7560145	MCM Coal - D Seam	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore to monitor predicted drawdown in economic coal seam. Located in close proximity to MB20CRM01A and CVMVWP01 enabling monitoring and assessment of interconnectivity between HSUs. Important to show if predicted drawdown propagates into shallow aquifer potentially acting as water source to terrestrial GDEs.
PZ04	610731	7555326	MCM Coal - Q Seam	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in intercepted coal seam aquifer.
PZ07-D	612465	7550704	MCM Coal -Q Seam	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in intercepted coal seam aquifer.
PZ09	614326	7548822	MCM Coal - P Seam	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore located to east of Cherwell Pit / south east HPE to monitor predicted drawdown in intercepted coal seam aquifer.
PZ11-D	616791	7547600	MCM Coal - P Seam	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in intercepted coal seam aquifer. .
PZ12-S	610721	7557164	Tertiary Sediments	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in shallow unconfined aquifer (Tertiary Sediments).
PZ12-D	610712	7557219	MCM Interburden	WQ annually WL quarterly	Existing EA bore. Downgradient monitoring bore on east of ML to monitor predicted drawdown in MCM interburden.
MB19CVM09A	612446	7550699	Tertiary Quaternary Alluvium	WQ quarterly. WL quarterly	Existing HPE bore. Downgradient monitoring bore in south east of HPE to monitor predicted drawdown shallow aquifer (TQa). Required for continued assessment of availability of water for potential GDEs identified along Cherwell Creek. To be used for early identification of impacts to GDEs to downstream reaches of Cherwell Creek.
MB19CVM02P	611424	7549705	MCM Coal - D Seam	WQ annually WL quarterly	Existing EA bore. Upgradient monitoring bore on west of ML/ south of Horse Pit to monitor predicted drawdown in intercepted coal seam aquifer.
MB19CVM07T	611464	7552357	Tertiary Basalt	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in south east of HPE to monitor predicted drawdown in Tertiary basalt. Co-located with MB19CVM08P and CVMPB07_02 to monitor for potential propagation of predicted impacts from intercepted coal seams to shallower HSUs.
MB19CVM08P	611465	7552346	MCM Coal - H Seam	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in south east of HPE to monitor predicted drawdown in intercepted coal seam aquifer. Co-located with MB19CVM07T and CVMPB07_02

Bore ID	Easting (AGD66 Z55s)	Northing (AGD66 Z55s)	Target Aquifer	Monitoring Frequency	Monitoring Rationale
					to monitor for potential propagation of predicted impacts from intercepted coal seams to shallower HSUs
MB20CVM01A	609915	7560272	Tertiary Quaternary Alluvium	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in north east of HPE to monitor predicted drawdown shallow aquifer (TQa). Required for continued assessment of availability of water for potential GDEs identified along Horse Creek. To be used for early identification of impacts to GDEs at Grosvenor Creek / Horse Creek Confluence. Co-located with CVMVWP01 and in close proximity to PZ01, enabling monitoring of interconnectivity of HSUs.
MB20CVM04T	608193	7559651	Tertiary Basalt	WQ quarterly. WL quarterly	Existing bore. Upgradient bore monitoring shallow water table aquifer (Tertiary basalt) in north west of Project. Co-located with MB20CRM05P to monitor interconnectivity between coal seams and shallow units. Will also provide a downgradient seepage monitoring location to the proposed OOPD.
MB20CVM05P	608198	7559646	MCM Coal - D Seam	WQ quarterly. WL quarterly	Existing bore. Upgradient bore monitoring D Seam in the north west of Project. Co-located with MB20CRM04T to monitor interconnectivity between coal seams and shallow units.
MB20CVM06A	610802	7548890	Tertiary Sediments	WQ quarterly. WL quarterly	Existing bore. Upgradient bore monitoring located adjacent to upstream reach of Cherwell creek. TQa bore to monitor background conditions of shallow aquifer.
CVMMB16_01	611144	7558320	Tertiary Sediments	WQ quarterly. WL quarterly	Existing bore. Downgradient bore monitoring of shallow aquifer (Tertiary sediments) in the north east of Project. Co-located with CVMMB16_02 to monitor interconnectivity between coal seams and shallow units.
CVMMB16_02	611135	7558315	MCM Coal - H Seam	WQ quarterly. WL quarterly	Existing bore. Downgradient bore monitoring H Seam in the north east of Project. Co-located with CVMMB16_02 to monitor interconnectivity between coal seams and shallow units.
CVMPB07_02	611452	7552362	MCM Coal - P Seam	WQ quarterly. WL quarterly	Existing bore. Downgradient monitoring bore in south east of HPE to monitor predicted drawdown in intercepted coal seam aquifer. Co-located with MB19CVM07T and MB19CVM08P to monitor for potential propagation of predicted impacts from intercepted coal seams to shallower HSUs
CVMVWP01_01	609915	7560272	MCM Coal H Seam / D Seam	WQ quarterly. WL quarterly	Existing VWP. Downgradient VWP array co-located with MB20CRM01A in north east of the project. Monitoring of water levels in multiple coal seams to monitor predicted impacts and allow continued assessment of potential interconnectivity between impacted coal seams and shallow aquifers.
CVMVWP15_01	609915	7560272	Tertiary Sediments /	WQ quarterly.	Existing VWP. Monitoring of water levels in multiple HSUs to monitor predicted impacts and

Bore ID	Easting (AGD66 Z55s)	Northing (AGD66 Z55s)	Target Aquifer	Monitoring Frequency	Monitoring Rationale
			MCM Coal - P Seam / H Seam / D Seam	WL quarterly	allow continued assessment of potential interconnectivity between impacted coal seams and shallow aquifers.
CVMMB100_01	607640	7558446	TBC - Water Table aquifer	WQ quarterly. WL quarterly	Proposed bore to monitor potential seepage around proposed OOPD

Note: This table has been updated in response to the Request for Information (RFI) process to reflect the most current proposed monitoring network.

5.7.4.4 Impact Assessment Criteria

Once agreed with DES, groundwater monitoring criteria will be formalised in the EA to monitor for impacts on both environmental values and predicted changes in groundwater quality. Impact assessment criteria for the site will be documented in the EA. Groundwater quality trigger levels are being developed by BMA in consultation with DES and in consideration of the DES guideline on Using monitoring data to assess groundwater quality and potential environmental impacts (DES, 2021). The trigger levels will be established based on a statistically significant baseline dataset for the monitoring network. As per the DES (2021) guidelines, the triggers will be established in consideration of the Water Plan (Fitzroy Basin) 2011 WQOs, ANZECC and ARMCANZ (2000) criteria and site-specific conditions. Trigger criteria will be established for each groundwater unit potentially impacted by the Project.

5.7.4.5 Data Management and Reporting

Routine groundwater monitoring will be conducted in accordance with the EA. Investigation into the cause of any exceedance and development of an action plan to mitigate potential environmental harm will be conducted by suitably qualified personnel as required by the EA.

5.8 Terrestrial Ecology

This section describes the terrestrial ecology values within the Project area, the potential impacts on the environment and the proposed mitigation and management measures. The Project area represents the potential disturbance area for the Project and as such forms the basis for impact assessment within this chapter.

Terrestrial ecology assessments undertaken for the Project incorporated a broader 1,770 ha area, referred to as the ‘study area’, which encompassed the Project area and the adjacent area within ML1775 (excluding Moranbah airport), ML 70403 and a portion of ML 70462. Consideration of the broader study area allowed the assessment of landscape attributes such as habitat connectivity, resource distribution, migration, movement corridors and threatening processes, as well as allowing for changes to the Project area during detailed design.

This chapter summarises the findings detailed in the Terrestrial Ecology Impact Assessment provided in Appendix G.

5.8.1 Assessment Methodology

5.8.1.1 Desktop Assessment

The desktop assessment consolidated information from relevant databases, mapping, aerial imagery, and published literature to produce an initial characterisation of the ecological values of the Project area and surrounding landscape. The references sourced as part of the desktop assessment are detailed in Appendix B of the Terrestrial Ecology Impact Assessment in Appendix G.

5.8.1.2 Likelihood of Occurrence Assessment

A likelihood of occurrence assessment evaluates the qualitative probability that a conservation significant flora or fauna species might inhabit the Project area during all or part (e.g. breeding season or migration) of its life cycle. The objectives of the likelihood of occurrence assessment are to:

- guide the field survey design by highlighting conservation-significant species that:
    - are known to occur in the area;
    - are likely to occur in the area; and
    - have the potential to occur in the area.
- inform the terrestrial ecological assessment of possible risk of impact from the Project on conservation significant species/habitat known, likely or with the potential to occur in the Project area.

To determine whether a species is known, likely or has potential to occur in the Project area, the likelihood of occurrence assessment considers:

- species-specific ecological and physiological requirements;
- previously recorded species observations;
- the resources and constraints present in the Project Site informed by the desktop assessment; and
- the resources and constraints present in the Project Site informed by the field surveys.

Species considered known, likely or with the potential to occur in or near the Project area are collectively referred to as ‘target species’. Prescribed and recommended survey methodologies for the target species formed the basis of the field survey design.

5.8.1.3 Field Assessment

Two field surveys were conducted to verify the findings of the desktop and likelihood of occurrence assessments as well as identify and characterise the presence, extent and condition of terrestrial ecological values within the Project area.

The first survey was conducted between 25 November and 2 December 2019 during conditions consistent with a late ‘dry season’. The second survey was conducted between 19 and 27 March 2020 during survey conditions characteristic of the ‘wet season’.

The field survey methods employed adhere to the guidelines and methodologies prescribed or supported by the Queensland and Commonwealth governments.

5.8.1.3.1 Terrestrial Flora

Flora surveys were conducted to describe the contemporary composition, condition, state and extent of vegetation communities within the Project area as well as detect the presence and/or likelihood of occurrence of threatened flora species. Flora survey methods included:

- the identification of Broad Vegetation Groups (BVGs) (Neldner, et al., 2019b);
- the identification/verification of REs in accordance with the Queensland Government’s Methodology for Surveying and Mapping of REs and Vegetation Communities in Queensland (Neldner et al., 2019a);
- Tertiary and Quaternary vegetation surveys in accordance with the Queensland Herbarium’s CORVEG database to characterise vegetation communities;
- BioCondition assessments as per the Queensland Guide to Determining Terrestrial Habitat Quality Version 1.3 (DES, 2020);
- TEC assessments within relevant vegetation communities listed under the EBPC Act using key condition criteria and characteristics identified within ‘approved listing advices’ for each matter;
- random meander searches (Cropper, 1993) for threatened flora species within suitable habitat; and
- opportunistic searches for pest flora species identified under the Queensland Biosecurity Act 2014 and Weeds of National Significance.

Flora survey methods are described in detail in Appendix B of the Terrestrial Ecology Impact Assessment in Appendix G.

5.8.1.3.2 Terrestrial Fauna

Fauna surveys were undertaken in alignment with guidelines and methodologies prescribed or supported by the Queensland and Commonwealth governments, including:

- Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Version 3.0) (Queensland Herbarium, 2018);
- Survey guidelines for Australia’s threatened birds (Cth) (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2010);
- Survey guidelines for Australia’s threatened mammals (Cth) (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), 2011);
- Survey guidelines for Australia’s threatened reptiles (Cth) (DSEWPC, 2011b);
- Survey guidelines for Australia’s threatened bats (Cth) (DEWHA, 2010a);
- Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (Cth) (DSEWPC, 2011a);
- Species National Recovery Plans (Cth); and
- species-specific survey methods (e.g., common death adder (refer to Rowland & Ferguson, 2012)).

The terrestrial fauna survey methods employed included:

- systematic trap sites, consisting of a 15 m long drift fence, eight funnel traps and a baited camera trap;
- nocturnal spotlighting surveys, including vehicle and walked transects;
- standardised bird surveys;
- deployment of Anabat SD2 detectors;
- diurnal active searches investigating various habitat features (e.g., coarse woody debris, leaf litter, peeling bark, hollows logs) as well as making note of indirect evidence of fauna, such as burrows, scratches, scat, etc.
- opportunistic searches; and
- fauna habitat assessments to assess broad fauna habitat types as well as target species-specific habitat attributes in accordance with the Guide to Determining Terrestrial Habitat Quality Version 1.3 (DES, 2020).

Fauna survey methods are described in detail in Appendix B of the Terrestrial Ecology Impact Assessment in Appendix G.

5.8.1.4 Significant Impact Assessment

Significant Impact Assessments were conducted for MNES and MSES that were assessed as known, likely or having the potential to occur within the Project area. Significant impacts on:

- MNES were evaluated in accordance with the Commonwealth Environmental Offsets Policy 2012 and MNES Significant Impact Guidelines (Department of the Environment (DOTE), 2013); and
- MSES were evaluated in accordance with the Queensland Environmental Offsets Policy Version 1.10 (DES, 2021) and Significant Residual Impact Guidelines (Department of Environment and Heritage Protection (DEHP), 2014).

Significant impacts assessments for MNES and MSES are described in in Sections 7.1 and 7.2 of Appendix G. Definitions for preferred and suitable habitat is defined on a species basis under Section 5.2.3 of the Appendix A of the Terrestrial Ecology Impact Assessment in Appendix G.

5.8.2 Terrestrial Ecology Values

5.8.2.1 Terrestrial Flora

5.8.2.1.1 Regional Ecosystems

Native vegetation within the Project area was largely cleared in the late 1950s/early 1960s to support agricultural and grazing practices. The area was destocked prior to the development of the CVM. Seven REs were ground-truthed within the Project Site, which included 84.19 ha of remnant, 0.09 ha of high value regrowth (HVR) and 510.75 ha of regrowth REs. The summary of ground truthed REs within the Project area are outlined in Table 5-30 and depicted on Figure 5-22.

Table 5-30 Summary of Ground Truthed REs within the Project area

RE	VM Act class[1]	Biodiversity status	BVG	RE descriptions	Vegetation class	Ground truthed extent (ha)
11.3.1	E	E	25a	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	HVR	0.09
11.4.8	E	E	25a	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	Regrowth	0.14
11.4.9	E	E	25a	*Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	Regrowth	497.88
11.5.9b	LC	NC	18b	*Eucalyptus crebra, E. tenuipes, Lysicarpus angustifolius +/- Corymbia spp*. woodland on Cainozoic sandplains	Regrowth	10.55
11.7.1	LC	OC	25a	*Acacia harpophylla* and/or *Casuarina cristata* and Eucalyptus thozetiana or *E. microcarpa* woodland on lower scarp slopes on Cainozoic lateritic duricrust	Remnant	60.79
11.8.5	LC	NC	11a	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks	Regrowth	2.19
11.8.11	OC	OC	30b	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	Remnant	23.40

[1] E (Endangered), OC (Of Concern), LC (Least Concern) under the Queensland VM Act
[2] E (Endangered), OC (Of Concern), NC (No Concern at Present) under the REDD.

5.8.2.1.2 Broad Vegetation Groups

BVGs are a higher-level grouping of vegetation communities ordered broadly to reflect major ecological and vegetative patterns. The ground-truthed vegetation communities within the Project area can be categorised into four BVGs:

- BVG 11a (dry eucalypt open forests to woodland mainly on basalt area);
- BVG 18b (dry eucalypt woodlands on sandplains or depositional plains);
- BVG 25a (brigalow (*Acacia harpophylla*) open forests to woodlands on clays); and
- BVG 30b (native tussock grasslands).

5.8.2.1.3 Threatened Ecological Communities

The assessment identified no qualifying TECs within the Project area. Suitable REs associated with the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC and Natural Grassland of the Queensland Central Highlands and northern Fitzroy Basin TEC were present (i.e., RE 11.4.9 and RE 11.8.11, respectively); however, these communities did not meet the characteristics and condition thresholds required to qualify as a TEC. Refer to Appendix B of the Terrestrial Ecology Impact Assessment in Appendix G.

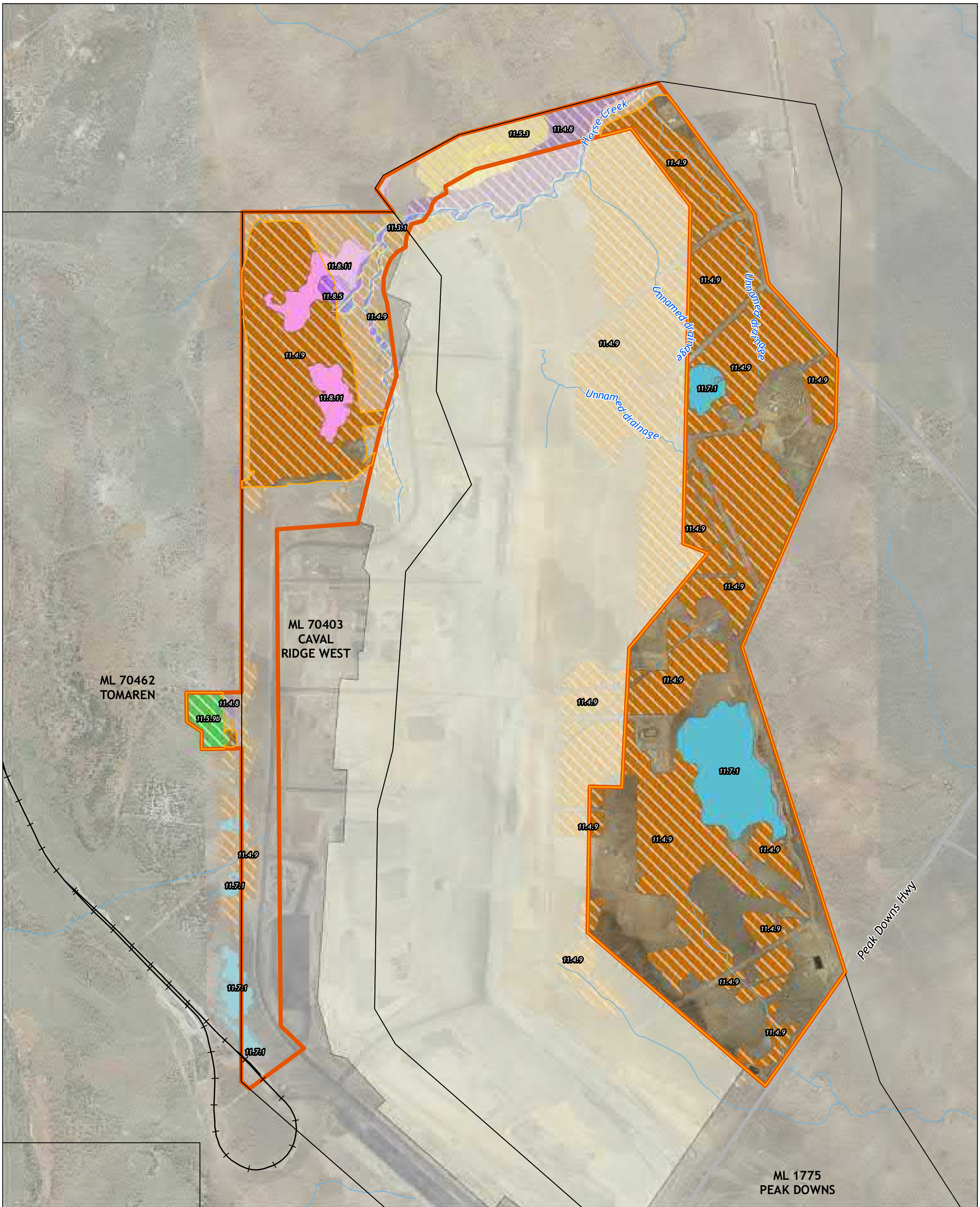
5.8.2.1.4 Threatened Flora

Results of the field assessments and likelihood of occurrence assessments identified one threatened flora species listed under the EPBC Act and the NC Act as likely to occur within the Project area, namely king bluegrass (*Dichanthium queenslandicum*). While king blue grass was not recorded during the field surveys, the species has been previously recorded (2011) within the CVM MLs and suitable habitat (remnant native grasslands) was recorded during the March 2021 field survey. Furthermore, the Project area contains Queensland Government mapped Essential Habitat as well as a high risk area on the Protected Plants Flora Survey Trigger Map.

King bluegrass is listed as Endangered under the EPBC Act and Vulnerable under the NC Act and occurs within native grasslands and open woodlands with a grassy understorey (DAWE, 2021). King bluegrass co-occurs with other Dichanthium and Bothriochloa species as well as other native grasses associated with heavy, black soil types (Simon 1982). Approximately 23.4 ha of suitable king bluegrass habitat occurs within the Project area, which comprises the area of RE 11.8.11 located to the west of the existing Horse Pit (Figure 5-23).

One threatened flora species, *Solanum adenophorum*, was considered to have the potential to occur within the Project area (Figure 5-23). *S. adenophorum* is listed as Endangered under the Queensland NC Act and occurs within remnant and regrowth brigalow and *Acacia cambagei* (gidgee) woodlands on deep cracking clays (Bean, 2004). This species was not detected within the Project area during ecological assessments; however, due to the species cryptic nature, its absence could not be confirmed. As such, potential *S. adenophorum* habitat has been mapped within the Project area (Figure 5-23).

A further four threatened flora species that were identified as target species during the desktop assessment, were considered unlikely to occur following field assessments and subsequent likelihood of occurrence assessments. These species included *Dichanthium setosum, Solanum elachophyllum, Bertya pedicellata* and *Cerbera dumicola*. Refer to Appendix B of the Terrestrial Ecology Impact Assessment in Appendix G.



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Coordinate System:	GCS GDA 1994
Scale:	1:40,000 at A4
Project Number:	QEJ19105
Date:	08/10/2021
Drawn by:	DL

SLR

BMA
BHP Mitsubishi Alliance

- Road
- Rail
- Watercourse
- Mining Lease
- Project Disturbance Areas
- Horse Pit Extension Project Area
- CVM EIS Pit Boundary (2010)

Ground-truthed Regional Ecosystems

Remnant	Regrowth
11.7.1	11.4.8
11.8.11	11.4.9
HVR	11.5.3
11.3.1	11.5.9b
11.3.25	11.8.5
11.5.3	

HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Ground-truthed Regional Ecosystems

Figure 5-22

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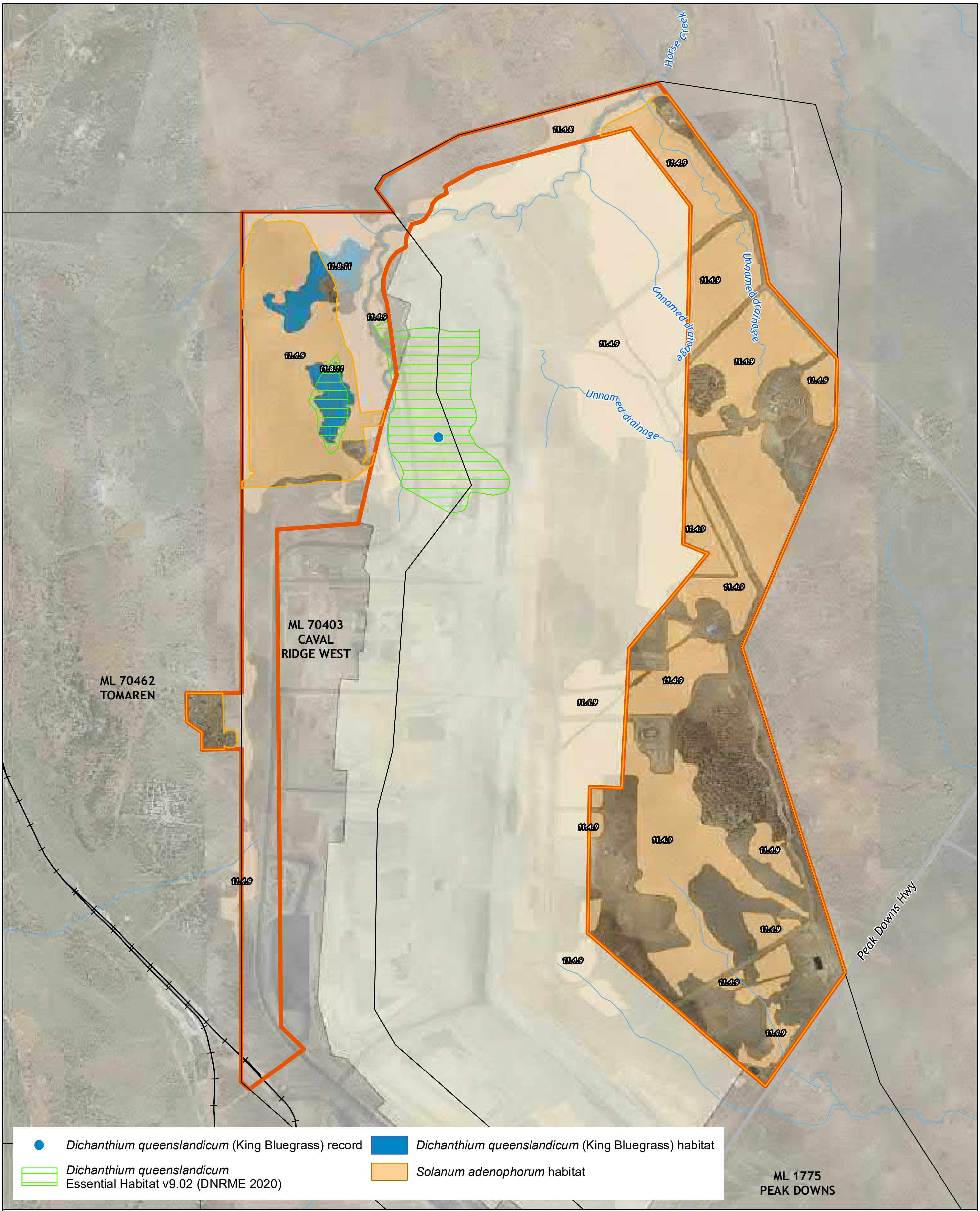

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Coordinate System:	GCS GDA 1994
Scale:	1:40,000 at A4
Project Number:	QEJ19105
Date:	08/10/2021
Drawn by:	DL

SLR BMA BHP Mitsubishi Alliance

Road
Rail
Watercourse
Mining Lease
Project Disturbance Areas
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)

HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Suitable habitat for threatened flora known or likely to occur

Figure 5-23

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5.8.2.2 Terrestrial Fauna

5.8.2.2.1 Threatened Fauna

Results of the field assessments and likelihood of occurrence assessments identified five threatened and Special Least Concern (non-migratory) fauna species listed under the EPBC Act and/or the NC Act as known, likely or with the potential to occur within the Project area, namely:

- ornamental snake (*Denisonia maculata*);
- squatter pigeon (*Geophaps scripta scripta*);
- Australian painted snipe (*Rostratula australis*);
- common death adder (*Acanthophis antarcticus*); and
- short-beaked echidna (*Tachyglossus aculeatus*).

Ornamental snake was recorded at two locations within the Project area during the wet season survey (March 2020). Both records were located within regrowth brigalow (*Acacia harpophylla*), representative of RE 11.4.9. The species is a habitat specialist dependent on the presence of gilgai for foraging and refuge habitat (Brigalow Belt Reptiles Workshop, 2010). A total of 167.84 ha of preferred ornamental snake habitat was ground-truthed within the Project Site (Figure 5-24).

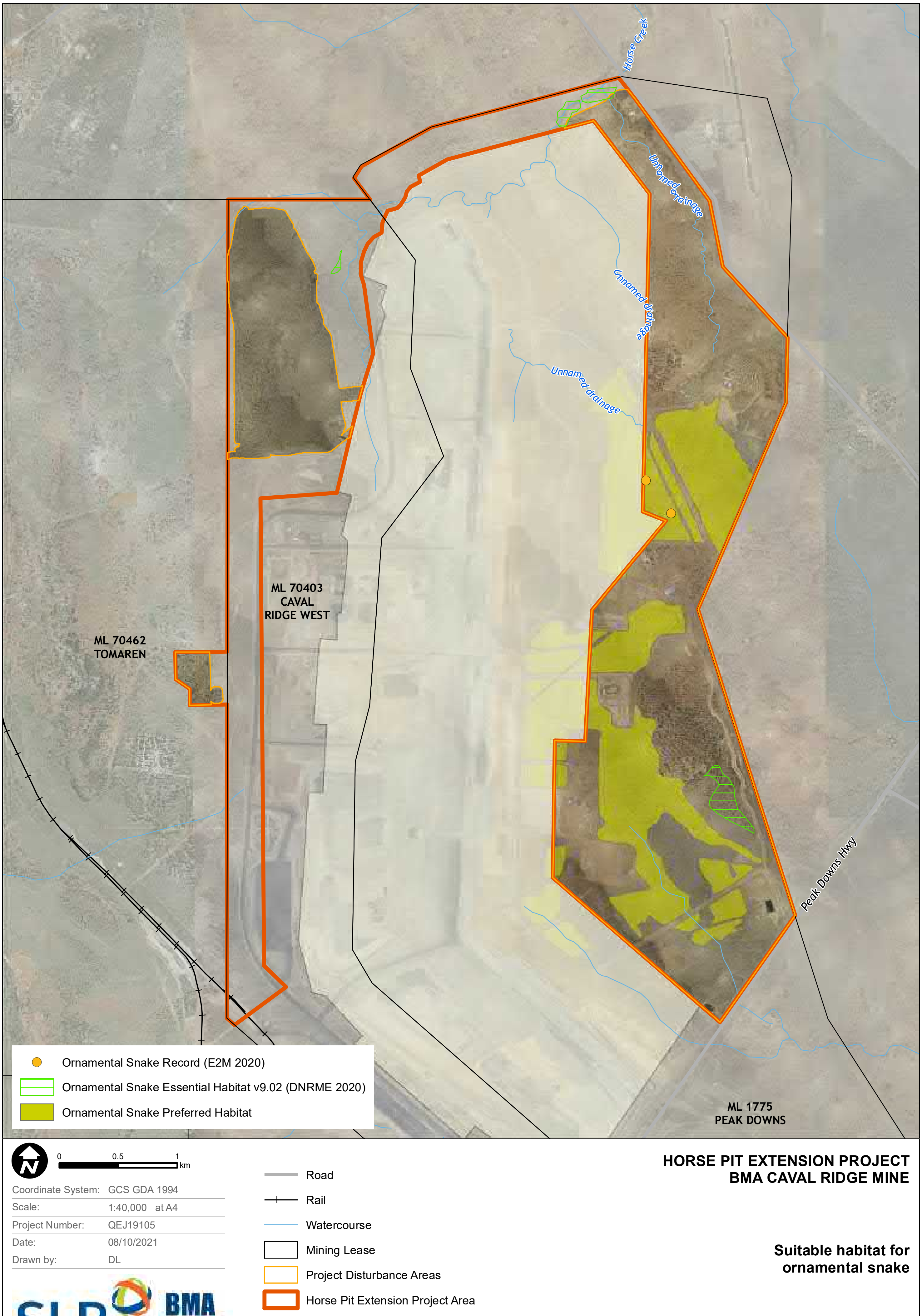
Although not recorded during 2019/2020 field surveys, squatter pigeon has been previously detected in the vicinity of the Project area in 2006 and 2008 during the terrestrial ecology studies associated with the CVM EIS. Squatter pigeon habitat in central Queensland is characterised by remnant or regrowth eucalypt and/or acacia open forest to woodland with patchy, relatively sparse ground cover, near (within 1-3 km) a permanent water source. Approximately 54.82 ha of preferred habitat and 28.71 ha of suitable habitat was identified within the Project area (Figure 5-25).

Australian painted snipe was not detected during the field assessments; however the species was recorded during ecological surveys for the Olive Downs Project located approximately 30 km away (DPM Envirosciences, 2018a). The Australian painted snipe generally inhabits shallow wetlands fringed with emergent vegetation and/or coarse woody debris (Rogers et al., 2005). Breeding habitat is typified by a small island composed of exposed mud with dense low cover within a shallow wetland (Rogers et al., 2005). While no breeding habitat occurs within the Project area, a total of 1.8 ha of intermittent foraging habitat (only when inundated) was observed along the small drainages within the Project area (Figure 5-26).

Common death adder was not detected during the field assessments. The species has a wide distribution throughout eastern and southern Australia, occurring within forests, woodlands, rainforests, grasslands and heathland with dense leaf litter and woody debris (Rowland & Ferguson, 2012). Due to the cryptic nature of the species, its absence was not able to be confirmed during field assessments. Approximately 80.47 ha of suitable habitat for the species was identified within the Project area in association with remnant and regrowth woodlands and grasslands with sufficient microhabitat features (refer to Figure 7 of the Terrestrial Ecology Impact Assessment in Appendix G).

One Special Least Concern species (non-migratory) under the NC Act, short-beaked echidna, was considered likely to occur within the Project area. Although the species was not recorded during the field assessments, the desktop assessment identified it had been previously recorded within the wider locality (ALA records; DES Wildlife Online). The species is considered a habitat generalist, occurring in a wide variety of habitats, including forest, woodlands, heath and grasslands. As a habitat generalist, the short-beaked echidna is likely to inhabit remnant and regrowth vegetation communities containing termite mounds, burrows, hollow logs and woody debris. Approximately 595.09 ha of short-beaked echidna habitat was present within the Project area (refer to Figure 8 of the Terrestrial Ecology Impact Assessment in Appendix G).

A further one threatened fauna species, Dunmall's snake (*Furina dunmalli*), was identified as a target species during the desktop assessment (refer to Section 3.3 of Appendix G-2). This species was considered unlikely to occur following field assessments and subsequent likelihood of occurrence assessment (refer to Section 5.2.3 of Appendix G-2).



Coordinate System:	GCS GDA 1994
Scale:	1:40,000 at A4
Project Number:	QEJ19105
Date:	08/10/2021
Drawn by:	DL

HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Suitable habitat for ornamental snake

Figure 5-24

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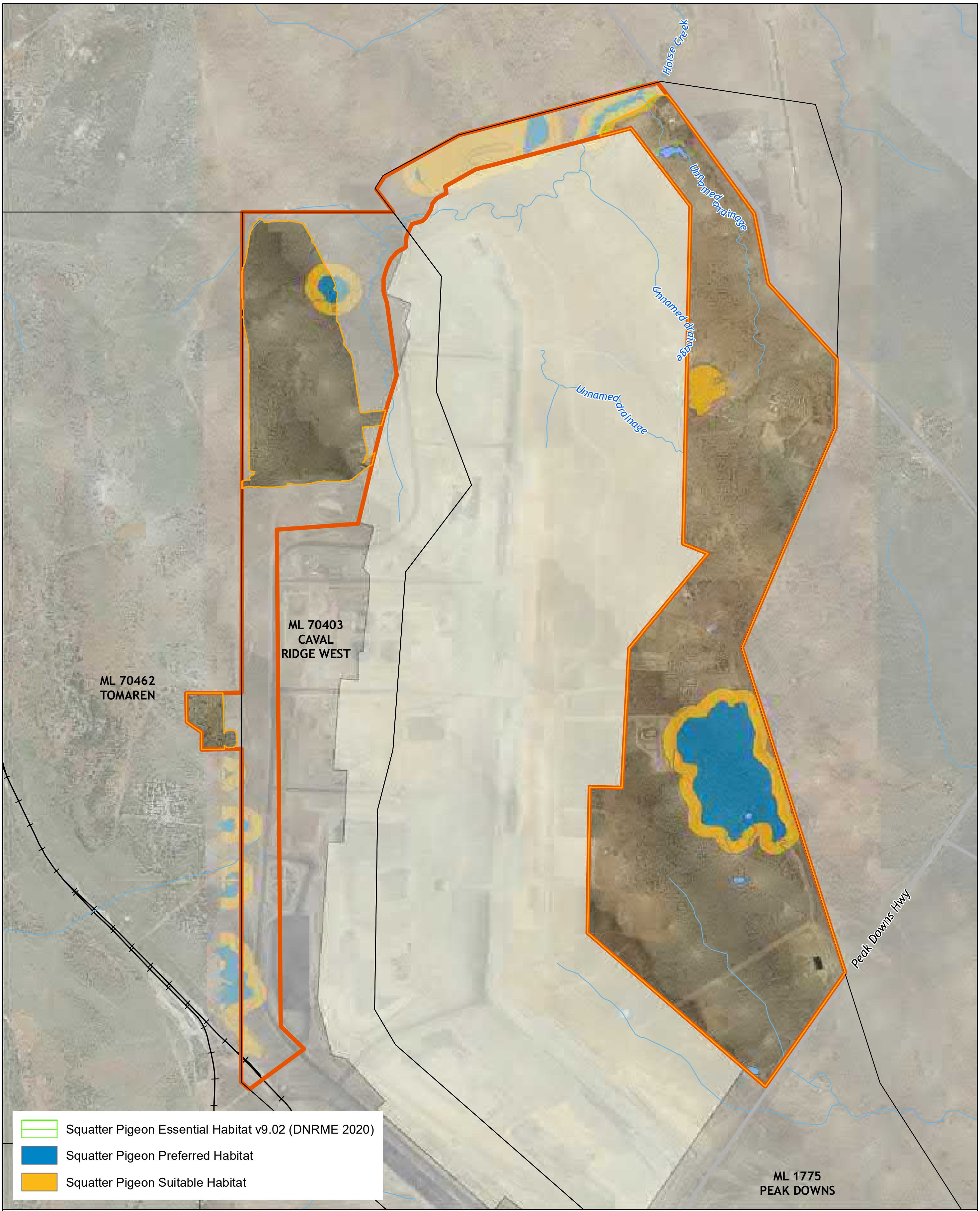

Coordinate System: GCS GDA 1994
Scale: 1:40,000 at A4
Project Number: QEJ19105
Date: 08/10/2021
Drawn by: DL

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HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Suitable habitat for squatter pigeon

Figure 5-25

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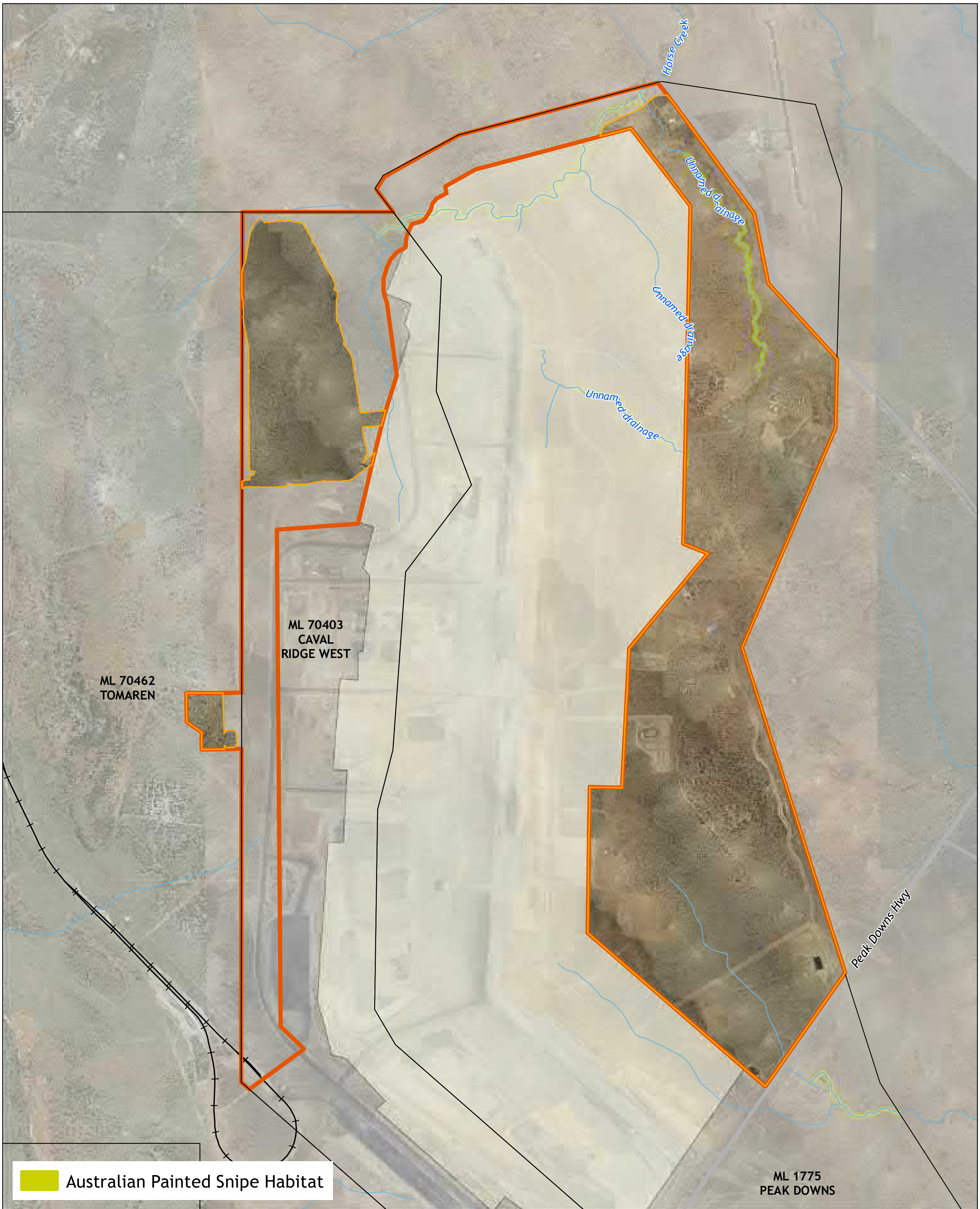

0 0.5 1 km

Coordinate System:	GCS GDA 1994
Scale:	1:40,000 at A4
Project Number:	QEJ19105
Date:	08/10/2021
Drawn by:	DL

SLR BMA BHP Mitsubishi Alliance

Road
Rail
Watercourse
Mining Lease
Project Disturbance Areas
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)

HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Suitable habitat for Australian painted snipe

Figure 5-26

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5.8.2.2.2 Animal Breeding Places

A variety of active and potential animal breeding places were recorded within the Project area during the field surveys, including:

- ephemeral water sources (i.e., wetlands, creek lines and dams);
- gilgai and soil cracks;
- bird nests;
- small hollow-bearing limbs and trees with small hollows recorded within the eucalypt woodland habitat (no large hollows were recorded within the Project area);
- stags;
- hollow logs and coarse woody debris; and
- arboreal termite mounds.

5.8.2.2.3 Migratory fauna

Results of the desktop, field and likelihood of occurrence assessments did not identify habitat for migratory species within the Project area. Furthermore, the Project area is unlikely to afford 'important habitat' for a migratory species, as defined under the Significant Impact Guidelines 1.1 MNES (DOTE, 2013).

5.8.2.3 Environmentally Sensitive Areas

Queensland Government mapping identifies one category of ESA as occurring within the Project area, namely Category B ESAs containing an Endangered RE. The field survey identified 0.09 ha of HVR Endangered RE 11.3.1, consistent with a Category B ESA. The ground-truthed ESA area was in association with fringing riparian vegetation along Horse Creek. Refer to ground truthed REs depicted on Figure 5-22.

In accordance with the EP Regulation, Category B Endangered (biodiversity status) REs include 'regrowth' and 'remnant' vegetation consistent with the descriptions identified under the Queensland Herbarium RE Description Database (REDD). Although other Endangered REs were observed within the Project Site in association with regrowth vegetation (i.e., REs 11.4.8 and 11.4.9), the maturity of vegetation observed did not meet the HVR definition, which has been applied by the Queensland Government in the mapping of Category B ESAs under the EP Act (DES, 2020a).

5.8.2.4 MNES and MSES

Assessment of the occurrence of MNES and MSES within the Project area is provided in Table 5-31 and detailed under the Terrestrial Ecology Impact Assessment in Appendix G.

Table 5-31 Summary of MNES and MSES within the Project area

Matter	Summary
MNES	
World Heritage Properties	No World Heritage places are within or of relevance to the Project area. The Project area is located approximately 140 km west of the Great Barrier Reef World Heritage Area
National Heritage Places	No National Heritage places are within or of relevance to the Project area. The Project area is located approximately 140 km west of the Great Barrier Reef National Heritage area.
Wetlands of International Importance	No Wetlands of International Importance are within or of relevance to the Project area. The Project area is located approximately: • 140 km south-west of Sarina Inlet - Ince Bay Aggregation; • 140 km west of the Great Barrier Reef World Heritage Area and Broad Sound; and • 150 km west of Four Mile Beach.
Great Barrier Reef Marine Park	The Project area is located approximately 140 km west of the Great Barrier Reef World Heritage Area.
Commonwealth Marine Area	No Commonwealth Marine Areas are within or of relevance to the Project area.

Matter	Summary
Listed Threatened Ecological Communities	Field assessments identified no qualifying TECs within the Project area.
Listed Threated Species	Three EPBC Act listed threatened species are known or likely to occur within the Project area, namely: • king bluegrass; • ornamental snake; and • squatter pigeon (southern subspecies). One additional EPBC Act listed threatened fauna species, the Australian painted snipe (*Rostratula australis*), has the potential to occur, with intermittent foraging habitat recorded along ephemeral creeks and drainage lines within the Project area.
Listed Migratory Species	No EPBC Act listed migratory species were recorded during field assessments within the Project area. Furthermore, no 'important habitat' for migratory birds was identified within the Project area.
MSES	
Regulated Vegetation	
Regulated vegetation containing an Endangered or Of Concern RE (Category B)	A total of 23.4 ha of remnant RE 11.8.11, which has an 'Of Concern' VM Act class, was ground-truthed within the Project Site. No remnant vegetation containing an Endangered RE was ground-truthed within the Project Site.
Regulated vegetation within a vegetation management wetland (as defined under the VM Act)	No prescribed REs that intersect with an area shown as a wetland on the vegetation management wetlands map were ground-truthed within the Project area.
Regulated vegetation within the defined distance of the defining banks of a watercourse (as defined under the VM Act)	No prescribed REs were ground-truthed within the defined distance of the defining banks of a VM Act watercourse or drainage feature within the Project area.
Connectivity Areas	
Prescribed REs that contains remnant vegetation	A total of 84.19 ha of connectivity area is located within the Project area, which comprises areas ground-truthed as remnant REs.
Wetlands and Watercourses	
Wetland in a wetland protection area (as defined under the EP Regulation)	No wetlands within a wetland protection area are mapped within the Project area.
Wetlands of high ecological significance (as defined under the EP Regulation)	No wetlands of high ecological significance are mapped within the Project area.
Wetland or watercourse in a high ecological value waters (as defined under the EP Regulation)	No wetlands or watercourses in high ecological value waters are mapped within the Project area.
Protected Wildlife Habitat	
An area of essential habitat for Endangered or Vulnerable wildlife	Essential habitat mapped within the Project area comprises: • 13.32 ha of king bluegrass essential habitat; • 8.08 ha of ornamental snake essential habitat; and • 0.19 ha of squatter pigeon essential habitat.
A high risk area on the flora survey trigger map and contains plants that are Endangered or Vulnerable wildlife	A total of 17.69 ha of high risk areas are mapped within the Project area. The desktop review identified this to be likely associated with the Vulnerable (NC Act) king bluegrass recorded within the CVM ML in 2011.

Matter	Summary
An area that is not shown as a high risk area on the flora survey trigger map, to the extent the area contains plants that are Endangered or Vulnerable wildlife	The Project area contains a total of 23.4 ha of suitable habitat for the Vulnerable (NC Act) king bluegrass.
An area of habitat for an animal that is critically Endangered, Endangered, Vulnerable or a Special Least Concern animal under the NC Act	Three NC Act listed threatened or Special Least Concern fauna species are known or likely to occur within the Project area, namely: • ornamental snake; • squatter pigeon (southern subspecies); and • short-beaked echidna. Two additional fauna species have the potential to occur within the Project area, namely: • common death adder; and • Australian painted snipe. One Special Least Concern (non-migratory) fauna, the short-beaked echidna, is also considered likely to occur within the Project area.
Protected Areas	
Protected areas declared under the NC Act for conservation	No Protected areas under the NC Act are within or of relevance to Project area. The Project area is approximately 40 km north-east of the Peak Range National Park.
Legally Secured Offset Areas	
Areas declared as an environmental offset protection area, high nature conservation value under the VM Act	No legally secured offset areas are within or of relevance to Project area.

5.8.3 Potential Impacts

5.8.3.1 Vegetation Clearing and Habitat Loss

The Project requires the progressive clearing of remnant, HVR and regrowth vegetation within the Project area. The Project area intersects seven REs comprising a total of 84.19 ha of remnant, 0.09 ha of HVR and 510.75 ha of regrowth REs (refer to Section 1.3.1.1 of Appendix G). Vegetation to be cleared includes:

- Areas of MNES EPBC Act listed species habitat;
- Areas of MSES including:
    - Protected wildlife habitat
    - Regulated vegetation; and
    - Connectivity areas.
- Environmentally Sensitive Areas.

Potential impacts of vegetation clearing and habitat loss on terrestrial ecology values within the Project area are summarised within Table 5-32.

Table 5-32 Summary of Potential Impacts of Vegetation Clearing and Habitat Loss within the Project area

Matter	Summary
MNES	
King bluegrass	23.40
Ornamental snake	167.84 (preferred*)
Squatter pigeon	54.82 (preferred*) 28.71 (suitable*)
Australian painted snipe	1.80
MSES – protected wildlife habitat	
King bluegrass	23.40
Ornamental snake	167.84 (preferred*)
Squatter pigeon	54.82 (preferred*) 28.71 (suitable*)
Australian painted snipe	1.80
Common death adder	80.47
Short-beaked echidna	595.09
MSES – regulated vegetation	
Of concern prescribed REs	23.4
MSES – connectivity area	
Connectivity areas	84.19
Environmentally sensitive areas	
Category B – Endangered RE	0.09

* Draft Central Queensland MNES fauna habitat definitions (Kerswell et al., 2020)

5.8.3.2 Disturbance to Animal Breeding Places

A variety of active and potential animal breeding places were identified within the Project area, which may be disturbed during vegetation clearing. Animal breeding places identified within the Project area included:

- ephemeral water sources (i.e., wetlands, creek lines and dams);
- gilgai and soil cracks;
- bird nests;
- small hollow-bearing limbs and trees with small hollows recorded within the eucalypt woodland habitat (no large hollows were recorded within the Project Site);
- stags;
- hollow logs and coarse woody debris; and
- arboreal termite mounds.

5.8.3.3 Fauna Mortality and Injury

Fauna mortality and injury is most likely to occur during vegetation clearing and subsequent stripping of topsoil. Particularly susceptible species are those which are unable to easily disperse and include:

- fauna that lives wholly or partially underground (i.e., fossorial), such as the ornamental snake;
- nocturnal fauna within tree hollows (e.g., possums and gliders) or under decorticating bark (e.g., microbats);
- juveniles of any species (with the exception of macropods and precocial species); and
- smaller wildlife (e.g., frogs, lizards, small mammals).

To a lesser extent, wildlife may be killed or injured via vehicle strike during the Project's construction and operation.

5.8.3.4 Pest Species

The presence and abundance of feral animals adversely impacts native fauna through increased predation, competition of resources and habitat degradation. Vegetation clearing, fragmentation and opening up contiguous areas of habitat allows feral animals access to previously unoccupied areas. The following pest fauna were observed within the Project area:

- cane toad (*Rhinella marina*);
- cat (*Felis catus*);
- deer (*Cervus sp.*);
- rabbit (*Oryctolagus cuniculus*);
- pig (*Sus scrofa*); and
- wild dog (*Canis lupus*).

Weed species are most often spread via seed in fill dirt taken from one area and introduced into another or transported via vehicles, machinery and equipment moving amongst sites. Weed species readily establish on disturbed soil, outcompeting the native species resulting in diminished species diversity and ecosystem function. The following weed species are already established within the Project area:

- Harrisia cactus (*Harrisia martini*);
- prickly pear cactus (*Opuntia stricta*);
- velvet tree pear cactus (*Opuntia tomentosa*); and
- parthenium (*Parthenium hysterophorus*).

5.8.3.5 Connectivity

Connectivity areas, as defined under the EP Regulation, applies to a prescribed RE to the extent the ecosystem contains remnant vegetation and if the ecosystem contains an area of land that is required for ecosystem functioning (a connectivity area). Connectivity areas within the Project area are limited to remnant REs 11.8.11 (23.40 ha) and 11.7.1 (60.79 ha). The collective 83.92 ha of remnant vegetation within the Project area will be progressively cleared to facilitate the pit extension.

The remnant vegetation provides little connectivity value in terms of ecological function concerning wildlife movement/corridors as the remnant communities occur in isolated patches within the Project area. Connectivity in terms of ecological function is best represented along Horse Creek which runs along the northern portion of the Project area. The riparian vegetation within the watercourse is characterised by regrowth and HVR habitat but does not meet the definition of connectivity under the Environmental Offsets Regulation 2014.

The impact to connectivity values, as defined by the State, are assessed using the Landscape Fragmentation and Connectivity Tool (LFC) (DES, 2018), as outlined in Section 7.2.4 of the Terrestrial Ecology Impact Assessment in Appendix G.

5.8.3.6 Edge Effects

Edge effects occur where previously intact remnant vegetation is partially cleared, exposing a new boundary of vegetation to disturbance. The impact of edge effects on flora and fauna can alter habitat composition and quality, resulting in a reduction of the effective area of habitat and an increase in competition for resources. These impacts can extend well into a habitat area, resulting in the eventual displacement of more sensitive native flora and fauna.

The Project area comprises areas predominantly subject to historical clearing, with minor areas of remnant vegetation to be impacted. The existing remnant vegetation provides little connectivity value in terms of ecological function concerning wildlife movement/corridors as the remnant communities occur in isolated patches within the disturbance area. Remnant vegetation, comprising 23.4 ha of RE 11.8.11, located in the northwest portion of the Project area will be directly impacted by the Project. The clearing will indirectly impact a portion of the remaining 8 ha of grassland via edge effects. Weed species, and to a lesser degree dust, are likely to indirectly impact the remaining remnant vegetation, potentially affecting species composition and structure.

5.8.3.7 Dust

Excessive dust deposition on foliage can cause impacts to vegetation, including reducing photosynthetic processes, respiration, transpiration, health and growth rates. Dust is more likely to affect vegetation near the source, such as fringing haul roads, near operating machinery and open pits.

5.8.4 Mitigation and Management Measures

The Commonwealth and State offset assessment frameworks prescribe an 'avoid, mitigate, offset' approach to managing environmental impact. Avoiding an environmental impact is typically achieved through planning and site selection; however, where avoidance cannot be reasonably achieved, environmental impact mitigation and management measures will be demonstrated.

The Project's environmental impact during the extension will be reduced via the implementation of the mitigation and management measures already in place as per the CVM environmental management framework:

- Air Emissions Management Plan, Version 7.2. CVM-PLN-0008. BMA. 2016
- Land and Biodiversity Management, Version 7A. CVM-PLN-0021. BMA. 2016
- Threatened Flora, Fauna and Ecological Communities Management Plan. CVM-PLN-0019. 2016, and
- Weed and Feral Animal Management, Version 2. BHP-PRO-0001. 2019.

Impacts to terrestrial ecology will be managed through the mitigation and management measures summarised in Table 5-33.

Table 5-33 Mitigation and management measures to potential impacts

Impact	Mitigation Measures
Vegetation clearing	• vegetation clearing will not occur outside the delineated boundaries • vegetation clearing will be confined to the smallest practicable area required for construction and operation
Habitat removal	• relocate fauna habitat features (hollow logs/limbs, coarse woody debris) where practical • pre-clearance surveys will be conducted ahead of clearing activities • no clearing without a fauna spotter catcher present (as per Condition E18 of the EA) • hollow-bearing limbs to be dismantled slowly and checked for fauna • use progressive vegetation clearing methods to provide fauna time to relocate • vegetation clearing will be confined to the smallest practicable area required for construction and operation
Dust	• dust suppression on haul and light vehicle roads (as required) • restrict land disturbance to what is necessary for the operation and minimise area of land disturbed at any one time • progressive rehabilitation to occur as areas become available
Weeds	• Vehicle hygiene: • All vehicles, machinery and equipment accessing landowner properties should be inspected and declared 'weed free' prior to entering' • no vehicles are to drive over topsoil stockpiles • vehicles are to remain on existing access tracks and avoid driving over weed populations • Disturbance and topsoil management: • all rehabilitation materials (e.g., seed, straw, hay) brought to site will be declared weed free and recorded in the site's document management system • movement of sand, gravel, rock, soil and organic matter must be controlled to ensure that it does not result in contamination by weed seeds • Where possible, all reasonable efforts will be made to limit the application of topsoil containing weed seeds • Weed monitoring, treatment and reporting: • conduct periodic weed monitoring to identify new weed outbreaks as well as verify the effectiveness of ongoing weed management controls • weed treatment chemical controls and herbicide application rates are conducted by an appropriately licensed person using the Department of Agriculture and Fisheries declared pest species fact sheet • treatment areas and infestations will be tracked and recorded using GIS/mapping to ensure effective management is being achieved • weed material disposed appropriately

Impact	Mitigation Measures
Fauna mortality and injury	• pre-clearance surveys will be conducted ahead of clearing activities • no clearing without fauna spotter catcher present • fauna contact avoided and limited to fauna spotter catcher • all fauna relocated to nearest undisturbed suitable habitat • implement fauna crossing signs and speed reduction, where practical • injured wildlife to be taken to nearest vet by fauna spotter catcher • clearing activities confined to the smallest practicable area required or construction and operation
Animal breeding places	• relocate fauna habitat features (hollow logs/limbs, coarse woody debris) • pre-clearance surveys will be conducted ahead of clearing activities • fauna spotter catcher present during clearing • hollow-bearing trees to be assessed for fauna
Feral animals	• a feral animal control program will be implemented when monitoring confirms there is an increasing trend in population (e.g., increase in the number of sightings), there is evidence feral animals are impacting on threatened species or neighbouring landholders raise valid concerns in regard to feral animals • feral animal monitoring will reflect suitable survey locations such as water sources (pigs) or crib huts (cats), suitable time of day (e.g., diurnal/nocturnal species) and the location of indirect sign of feral animal activity (e.g., scats, diggings) • feral cat and pig populations can be controlled using traps in accordance with the BHP Weed and Feral Animal Management procedure • feral dog and pig populations can be controlled using poison baits in accordance with the details specified in the BHP Weed and Feral Animal Management procedure
Edge effects	• weed hygiene protocols • feral animals excluded from site via exclusion fencing • baiting and other control measures implemented

5.8.5 Significant Impact Assessment

The Commonwealth and State offset assessment frameworks prescribe an ‘avoid, mitigate, offset’ approach to managing environmental impact. Impacts to MNES and MSES that remain after avoidance and mitigation measures have been applied may be required to be offset under the Commonwealth EPBC Act or the Queensland Offsets Act.

This section describes significant impact assessments undertaken to determine significant impacts to MNES and significant residual impacts to MSES. This section summarises results presented within the Terrestrial Ecology Impact Assessment in Appendix G.

5.8.5.1 Matters of National Environmental Significance

Residual impacts likely to arise from the Project were assessed against the Significant Impact Guidelines 1.1 MNES (DOTE, 2013) to determine if the Project is likely to result in a significant impact to MNES listed under the EPBC Act.

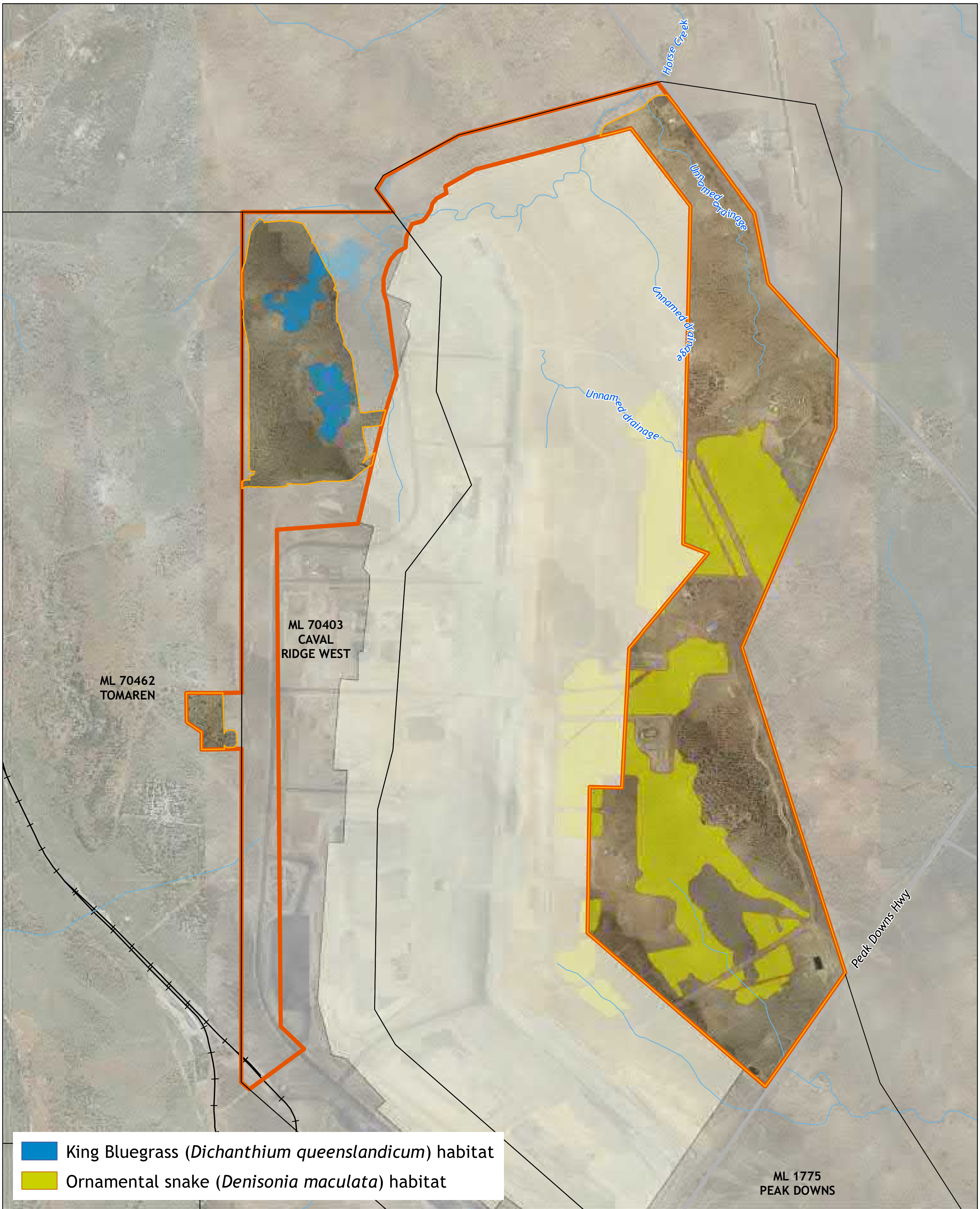
Significant impacts on two MNES were considered likely to result from the Project (Table 5-34), namely:

- King bluegrass (*Dichanthium queenslandicum*), listed as Endangered under the EPBC Act; and
- Ornamental snake (*Denisonia maculata*), listed as Vulnerable under the EPBC Act.

Significant impact assessments for MNES potentially impacted by the Project are summarised within Table 5-34. Detailed significant impact assessments are provided within Appendix G. The locations of MNES likely to be significantly impacted by the Project are depicted within Figure 5-27.

Table 5-34 MNES Significant Impact Assessment Summary

Environmental Matter	EPBC Acts status	Significant impact assessment summary	Significant residual impact (ha)
King bluegrass *Dichanthium queenslandicum*	Endangered	Significant impact likely The Project will require the clearing of 23.40 ha of king bluegrass habitat. The removal of 23.40 ha of suitable habitat for the species is likely to decrease the size of a potential population. A total of 8.04 ha of suitable habitat for the species will be retained adjacent to the Project area. The implementation of mitigation measures will assist in reducing potential indirect impacts associated with edge effects. Due to the limited extent of habitat for the species and direct loss of 23.40 ha of suitable habitat within the Project area, the Project is considered likely to: • lead to a long-term decrease in the size of a local population; and • adversely affect habitat critical to the survival of the species.	23.4
Ornamental snake *Denisonia maculata*	Vulnerable	Significant impact likely The Project will require the clearing of approximately 167.84 ha of ornamental snake habitat. Historical vegetation clearing, land development and ongoing mining operations have increasingly fragmented and degraded ornamental snake habitat within the CVM and the wider landscape. Species habitat within the Project area exists as an isolated patch disconnected from neighbouring habitats by the Peak Down Highway (south), Moranbah Access Road (east) and Horse Pit/CVM access tracks (west). The isolated habitat patch compounded by the diminished habitat quality limits the carrying capacity of the environment to support the species thereby restricting the size of the population within the Project area. However, in consideration of the nature of impacts and the local ornamental snake population meeting the definition of an 'important population', the Project is likely to lead to: • lead to a long-term decrease in the size of an important population; and • disrupt the breeding cycle of an important population.	167.84
Australian painted snipe *Rostratula australis*	Endangered	Significant impact unlikely The Project will require the clearing of 1.80 ha of potential intermittent foraging habitat for Australian painted snipe, which is associated with small drainages within the Project area. At a regional scale, there is approximately 24,260 ha of remnant and regrowth RE 11.3.1, 11.4.8, 11.4.9 and 11.3.3c within the Northern Bowen Basin sub-region (Queensland Herbarium, 2021). The loss of 1.80 ha within an existing mine is considered unlikely to result in a significant impact to the species.	NA
Squatter pigeon *Geophaps scripta*	Vulnerable	Significant impact unlikely The Project will require the clearing of 54.82 ha of preferred habitat and 28.71 ha of suitable habitat for the species. However, the species habitat within the Project area is not considered critical to the survival of the species nor is the squatter pigeon population within the Project area considered part of an important population. At a regional scale, there is approximately 162,662 ha of remnant and regrowth REs on landzones 5 and 7 that are dominated by eucalypts within the Northern Bowen Basin sub-region. The loss of 83.53 ha is considered unlikely to result in a significant impact to the species.	NA
Migratory species	-	Significant impact unlikely Results of the desktop, field and likelihood of occurrence assessments did not identify habitat for migratory species within the Project area. Furthermore, the Project area is unlikely to afford 'important habitat' for a migratory species, as defined under the Significant Impact Guidelines 1.1 MNES (DOTE, 2013).	NA



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Coordinate System:	GCS GDA 1994
Scale:	1:40,000 at A4
Project Number:	QEJ19105
Date:	08/10/2021
Drawn by:	DL

SLR BMA BHP Mitsubishi Alliance

Road
Rail
Watercourse
Mining Lease
Project Disturbance Areas
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)

HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Significant Impacts to Matters of National Environmental Significance

Figure 5-27

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5.8.5.2 Matters of State and Environmental Significance

Residual impacts likely to arise from the Project were assessed against the Queensland Environmental Offsets Policy – Significant Residual Impact Guideline (DEHP 2014) to determine if the Project is likely to result in a significant residual impact to MSES that are prescribed environmental matters listed under the Offsets Act.

Significant residual impacts on two prescribed environmental matters were considered likely to result from the Project (Table 5-35), namely:

- Regulated vegetation – RE 11.8.11 (remnant native grassland); and
- Connectivity.

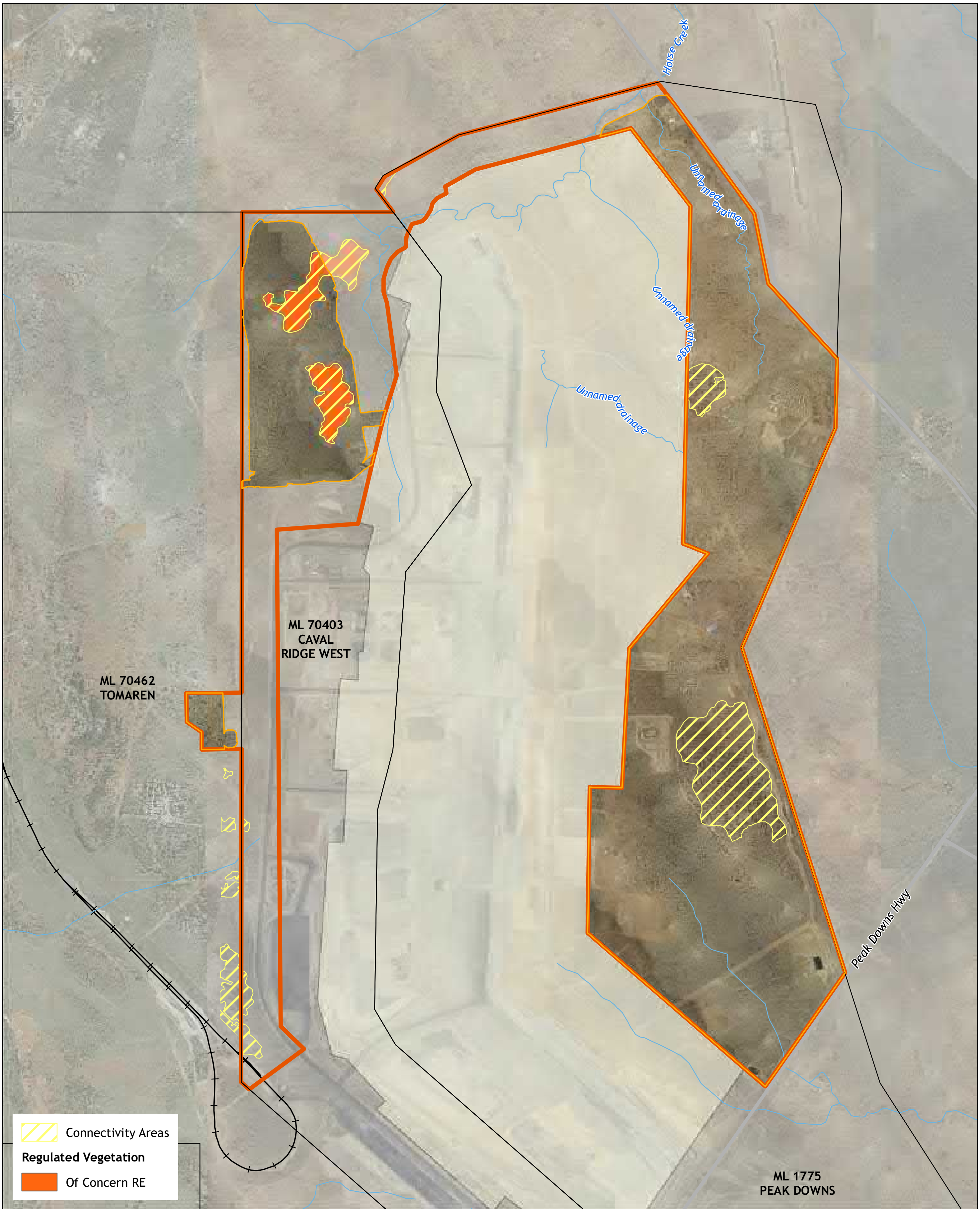
Significant residual impact assessments for MSES potentially impacted by the Project are summarised within Table 5-35. Detailed significant residual impact assessments are provided within Appendix G. The locations of MSES likely to be significantly impacted by the Project are depicted within Figure 5-28.

Protected wildlife habitat for species that are also MNES, namely king bluegrass, ornamental snake, Australian painted snipe and squatter pigeon, were assessed within Section 1.6.1 against the Commonwealth Significant Impact Guidelines 1.1 MNES (DOTE, 2013).

Table 5-35 MSES Significant Residual Impact Assessment Summary

Environmental Matter	NC Act status	Significant impact assessment summary	Significant residual impact (ha)
Regulated Vegetation			
Regulated vegetation – RE 11.8.11 (remnant native grassland)	Of Concern	Significant residual impact likely The removal of 23.40 ha of 'Of Concern' remnant RE 11.8.11 exceeds the significant residual impact test criteria of >5 ha on non-linear clearing in a grassland RE (DEHP 2014).	23.40
Connectivity			
Connectivity	N/A	Significant residual impact likely The LFC Tool (DES 2018) was used to assess the significance of impact on connectivity areas as defined in the Environmental Offsets Regulation 2014. The results of the Test 2 of the LFC returned a 'true' result indicating that the Project is likely to have a significant impact on connectivity within the disturbance area.	84.19
Protected wildlife habitats			
Common death adder *Acanthophis antarcticus*	Vulnerable	Significant residual impact unlikely The common death adder is a habitat generalist occurring within woodlands across a large geographic distribution. While the Project will require the clearing of 80.47 ha of potential habitat for the species, the clearing is considered unlikely lead to a significant residual impact to the species. Furthermore, the species has not been recorded within the Project area. If the species occurs within the Project area, it likely occurs at a low density or intermittently, reducing the potential habitat value of the Project area for the species.	NA
Short-beaked echidna *Tachyglossus aculeatus*	Special Least Concern	Significant residual impact unlikely Short-beaked echidnas are found throughout Australia in almost all habitat types. They are prevalent in urban areas as well as rural and are relatively tolerant of disturbance. As a habitat generalist, most vegetated areas within the Horse Pit disturbance area provide suitable habitat for the species. The species has not been documented within the Project area but is likely to utilise the eucalypt woodlands and regrowth brigalow as part of its range with	NA

Environmental Matter	NC Act status	Significant impact assessment summary	Significant residual impact (ha)
		adjoining habitat. Approximately 595 ha of potential echidna habitat is present within the disturbance area. The progressive removal of 595 ha will reduce the species extent of occurrence; however, with the mitigation measures imposed, the impact generated is expected to be negligible and ultimately reversible. The Project is considered unlikely to result in a significant residual impact to short-beaked echidna.	
King bluegrass *Dichanthium queenslandicum*	Vulnerable	Refer to **Table 5-34**.	167.84
Ornamental snake *Denisonia maculata*	Vulnerable	Refer to **Table 5-34**.	NA
Australian painted snipe Rostratula australis	Endangered	Refer to **Table 5-34**.	NA
Squatter pigeon *Geophaps scripta*	Vulnerable	Refer to **Table 5-34**.	NA
Essential habitat			
Essential habitat	N/A	In accordance with the Queensland Significant Residual Impact Guideline (DEHP 2014), a significant residual impact on DoR mapped essential habitat is assessed by applying the same criteria as the 'Endangered and Vulnerable wildlife habitat'. The Terrestrial Ecology Assessment Report (Appendix G) identified Queensland Government mapped essential habitat for king bluegrass, ornamental snake and squatter pigeon within the Project Site. As these species are also MNES, they were assessed in accordance with the Commonwealth Significant Impact Guidelines 1.1 MNES (DOTE, 2013).	-



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Coordinate System:	GCS GDA 1994
Scale:	1:40,000 at A4
Project Number:	QEJ19105
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Drawn by:	DL

SLR BMA BHP Mitsubishi Alliance

Road
Rail
Watercourse
Mining Lease
Project Disturbance Areas
Horse Pit Extension Project Area
CVM EIS Pit Boundary (2010)

HORSE PIT EXTENSION PROJECT
BMA CAVAL RIDGE MINE

Significant Residual Impacts to Matters of State Environmental Significance

Figure 5-28

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5.8.6 Summary

The development of the Project will have an environmental impact on flora, fauna and vegetation communities largely via the inherent loss of habitat associated with proposed disturbance. Project impacts on terrestrial ecology values will be mitigated through the application of the CVM environmental management framework.

Residual project impacts on MNES and MSES were evaluated against the Commonwealth and State environmental offset frameworks. The assessment found the project is likely to have a significant residual impact on four environmental matters as summarised in Table 5-36.

Other terrestrial ecology values likely to be impacted by the Project include:

- 0.09 ha of Category B Environmentally Sensitive Area under the EP Act, comprising a HVR Endangered RE; and
- Animal breeding places for threatened, Special Least Concern, colonially breeding and Least Concern fauna listed under the NC Act.

Table 5-36 MNES and MSES Significant Residual Impacts Likely to Result from the Project

Environmental Matter	Significant residual impact (ha)
Matters of National Environmental Significance	
King bluegrass (*Dichanthium queenslandicum*)	23.40
Ornamental snake (*Denisonia maculata*)	167.84
Matters of State Environmental Significance	
Regulated vegetation – RE 11.8.11 (remnant native grassland)	23.40
Connectivity	84.19

Under the Commonwealth EPBC Act Environmental Offsets Policy (DSEWPaC, 2012) and the Queensland Environmental Offsets Act 2014 (EO Act), significant residual impacts on MNES and/or MSES (respectively) are required to be offset. Two potentially suitable offset areas have been identified to acquit the Project's offset requirements:

- Lot 55 on Plan DSN318 ('Inderi'); and
- Lot 4 on Plan KL210 ('Croydon Station').

Both properties have been surveyed and confirmed to contain suitable habitat and area to acquit the Project's offset requirements. An offset strategy and offset area management plans are in preparation and will be submitted to the relevant regulators for approval prior to disturbance of relevant areas.

5.9 Aquatic Ecology and Stygofauna

This aquatic ecology chapter summarises the existing aquatic environment associated with the Project. It also assesses potential impacts and measures to minimise, manage and / or prevent potential adverse impacts on the aquatic ecological values of the waterways, wetlands and stygofauna communities. The Aquatic Ecology Impact Assessment is provided in Appendix H.

5.9.1 Assessment Methodology

A desktop review, aquatic ecology assessments and stygofauna pilot studies were completed to identify aquatic habitats, flora and fauna as well as stygofauna communities known or likely to occur in the vicinity of the Project.

5.9.1.1 Aquatic Ecology Desktop Review

A desktop assessment was completed to describe the aquatic habitat, flora and fauna of the region. Several databases and mapping resources as well as publicly available reports detailing aquatic ecology assessments completed in the region were reviewed.

5.9.1.2 Aquatic Ecology Field Surveys

Field surveys were completed in the early wet season (December 2019 survey) and the late wet season (the April 2020 survey), with an additional aquatic habitat survey also completed in the early wet season (November 2020 survey).

5.9.1.2.1 Site Locations and Indicators

In total 24 sites were surveyed, located upstream, within and downstream of the Project, refer to Figure 5-29. Not all sites were sampled during all surveys, with 14 sites surveyed in December 2019, 15 sites surveyed in April 2020 and eight sites surveyed in November 2020 (refer to Table 3.1 of the Aquatic Ecology Impact Assessment in Appendix H). A range of indicators were assessed at the 12 aquatic ecology sites in December 2019 and April 2020 depending on water and habitat availability, including: aquatic habitat, in-situ and analytical water quality, sediment quality, aquatic plants, macroinvertebrates (as an indicator of general ecosystem health), fish and turtles and aquatic ecological value. A sub-set of indicators were surveyed at four habitat assessment sites (which were all dry) in December 2019 and April 2020, including: aquatic habitat, aquatic plants and aquatic ecological value. In November 2020, only aquatic habitat was surveyed at the eight sites surveyed. The methodologies for each aquatic ecological indicator were in accordance with the Monitoring and Sampling Manual: Environmental Protection (Water) Policy (DES, 2018a) unless modified to suit the objectives of the assessment and are described in the sections below.

5.9.1.2.2 Aquatic Habitat

Aquatic habitat assessments were completed to describe the aquatic habitat condition, connectivity and ecosystem value of each site. Assessments were based on the Australian River Assessment System (AUSRIVAS) habitat assessment protocol, modified where required to suit the purpose of this assessment. In April 2020, at each site holding water (excluding wetland and dam sites), overall habitat condition was assessed based on the river bioassessment score protocol (DNRM, 2001).

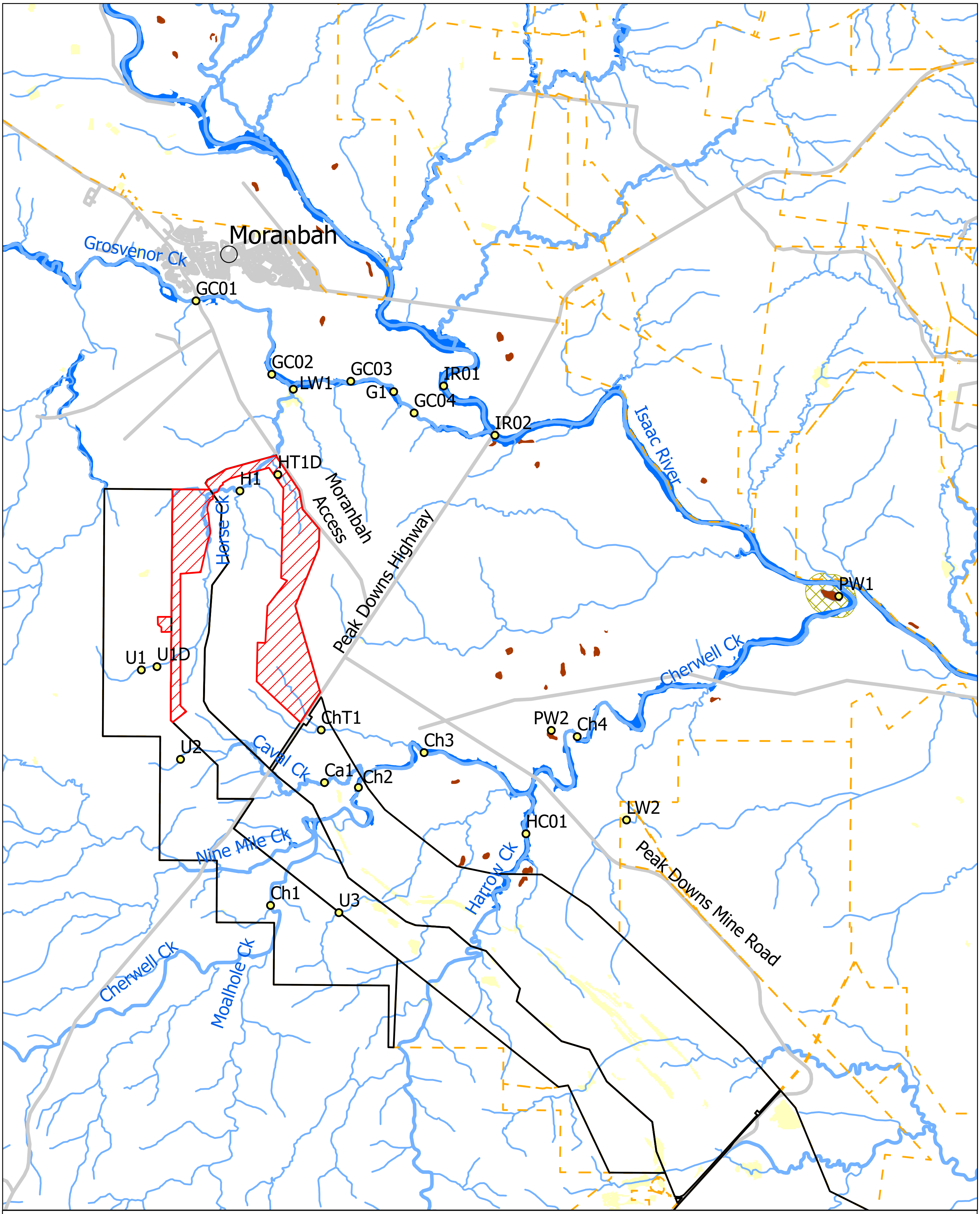
5.9.1.2.3 Water Quality

At each site that held sufficient water, physicochemical water quality (temperature, conductivity, pH, dissolved oxygen and turbidity) was measured using a calibrated YSI ProDSS multi-parameter water quality sonde. At each aquatic ecology sites, grab samples were also collected and analysed for TDS, total suspended solids (TSS), nutrients, total hardness, major ions, total and dissolved metals and metalloids, total petroleum hydrocarbons (TPHs) and benzene, toluene, ethylbenzene, xylene and naphthalene (BTEXN). Appropriate quality assurance / quality control methods were adhered to, including collection of a field blank and duplicate sample. Results were compared to relevant WQOs outlined in Table 3.2 of the Aquatic Ecology Impact Assessment in Appendix H, and based variously on the following:

- Australian water quality guidelines for toxicants (ANZG, 2018)
- Model Water Conditions for Coal Mines in the Fitzroy Basin (DES, 2018)
- Queensland Water Quality Guidelines (DEHP, 2013)
- Australian water quality guidelines (ANZECC & ARMCANZ, 2000), and
- Comet River sub-basin waters scheduled in the EPP (WWB).

5.9.1.2.4 Sediment Quality

At each aquatic ecology site, a single composite sediment sample was collected from a low-flow stream bank using a stainless-steel trowel, and analysed for concentrations of total metals and metalloids, particle size distribution, total organic carbon, TPHs and BTEXN. A field replicate was also collected at one site to assess within-site field variation. Results were compared to the default guideline values (DGVs) and guideline value-high (GV-High) (where available) outlined in see Table 3.3 of the Aquatic Ecology Impact Assessment in Appendix H.



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Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:150,000 at A4
Project Number:	1941
Date:	11/4/2021
Drawn by:	SW

LEGEND
- Survey Sites
- Horse Pit Extension Project Area
- CVM & PDM Mining Leases
- Mining Lease - Other
- Town
- Road

Waterways
- Waterway - Major
- Waterway - Minor

Wetlands
- Lacustrine Wetland
- Palustrine Wetland
- Riverine Wetland
- High Ecological Significance Wetland
- WPA Trigger Area

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Location of Aquatic Ecology Survey Sites (Dec 2019, April 2020 and November 2020)

FIGURE 5-29

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5.9.1.2.5 Aquatic Plants

At each aquatic ecology site (excluding wetland and dam sites) surveyed in December 2019 and April 2020, aquatic plant communities were semi-quantitatively assessed using ten replicated quadrats along a 100 m belt transect via visual assessment. The following were recorded in each quadrat: the location (i.e., on bank or in stream), growth form (i.e., submerged, emergent, floating), and per cent cover of each species (both native and exotic). At wetland and dam sites, aquatic plants were assessed via visual estimates of species diversity and total per cent coverage within the area of the wetland or dam. The total taxonomic richness and per cent cover were calculated to inform the interpretation of biological survey results and to assess the overall aquatic ecological value of the site. For aquatic habitat sites surveyed, aquatic plant diversity and abundance was qualitatively surveyed to assess the overall aquatic ecological value of the site.

5.9.1.2.6 Aquatic Macroinvertebrates

At each aquatic ecology site that held sufficient water, one AUSRIVAS macroinvertebrate sample was collected from a 10 m section of each available habitat type (e.g., bed / pool and edge) using a triangular AUSRIVAS dip net in accordance with standard AUSRIVAS methodology. Any macrocrustaceans (e.g., yabbies and freshwater crabs) caught during fish surveys (see below) were also recorded. Macroinvertebrates were appropriately preserved and transported to ESP’s laboratory where they were sorted, counted and identified to the lowest practical taxonomic level (in most instances family) to comply with standard AUSRIVAS methodology (including appropriate QA/QC checks). Standard macroinvertebrate indices were calculated for each site, including taxonomic richness, Plecoptera, Ephemeroptera and Trichoptera (PET) richness, and Stream Invertebrate Grade Number – Average Level (SIGNAL) 2 scores. Results were compared against the relevant biological objectives outlined in the EPP (WWB) for the Isaac River sub basin for upper Isaac River catchment freshwaters (DEHP 2013). SIGNAL 2 / family bi-plots were graphed to provide an indication of environmental conditions that may have influenced communities at each site (Chessman, 2003) (see Figure 3.5 of the Aquatic Ecology Impact Assessment in Appendix H).

5.9.1.2.7 Fish

At each aquatic ecology site that held sufficient water, fish communities were surveyed using a combination of methods depending on the habitat characteristics of the site, including fyke nets, seine nets and baited traps. Survey methods and effort used at each site during each survey are summarised in Table 3.5 of the Aquatic Ecology Impact Assessment in Appendix H. All native fish were identified, counted, and returned to the environment. The total length (cm) of fish of a subsample of 20 individuals per species caught at each site was measured. Pest fish were identified, counted and euthanised in accordance with permit conditions. The abundance of fish species caught at each site was calculated and tabulated. Life history stages of native fish were determined using length measurements (based on information in Pusey et al., 2014), graphed and discussed.

5.9.1.2.8 Turtles

Turtles were surveyed at aquatic ecology sites that contained any suitable potential turtle habitat. Turtles were surveyed in conjunction with fish surveys (i.e., fyke nets set for fish surveys were set to trap turtles also). Survey effort used at each site during each survey is summarised in Table 3.5 of the Aquatic Ecology Impact Assessment in Appendix H. Suitable turtle habitat and nesting habitat were noted if present, particularly features preferred by the listed species known to occur in the region. No suitable habitat for listed threatened turtle species was identified in the study area. As such, no further targeted surveys for these species were completed.

5.9.1.2.9 Aquatic Ecosystem Values

The overall aquatic ecosystem values of the waterways and wetlands were identified based on criteria developed in accordance with the Guidelines for Identifying High Ecological Values Aquatic Ecosystems (Aquatic Ecosystems Task Group, 2012), which identifies five core criteria that can be used to determine aquatic ecosystems of high value, including diversity, distinctiveness, vital habitat, naturalness and representativeness (see Table 3.6 of the Aquatic Ecology Impact Assessment in Appendix H).

5.9.1.3 Stygofauna Desktop Review

The desktop review was completed to summarise information available from desktop sources regarding stygofauna and habitat preference in Australia and Queensland, including information from the region.

5.9.1.4 Stygofauna Field Surveys

Two pilot studies were undertaken, the first in April 2020 and the second in November 2020. Methods were in accordance with the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (DES, 2019). A total of 23 bores were sampled:13 bores in April 2020 and 10 bores in November 2020. Bores were distributed throughout the Project area and comparable nearby bores outside of the Project area, refer to Figure 5-30 and Table 3.7 of the Aquatic Ecology Impact Assessment in Appendix H).

Water quality (conductivity and pH) was measured in situ at each bore using a calibrated multi-parameter water quality sonde. The full water column within each bore was then sampled for stygofauna by hauling a weighted phraetobiological net. Three hauls were completed with a coarse mesh net (150 µm) and three hauls were completed with a fine mesh net (50 µm). The composite stygofauna were appropriately preserved and samples were sorted in ESP's laboratory under a stereomicroscope and identified to the lowest practical taxonomic level.

5.9.2 Values

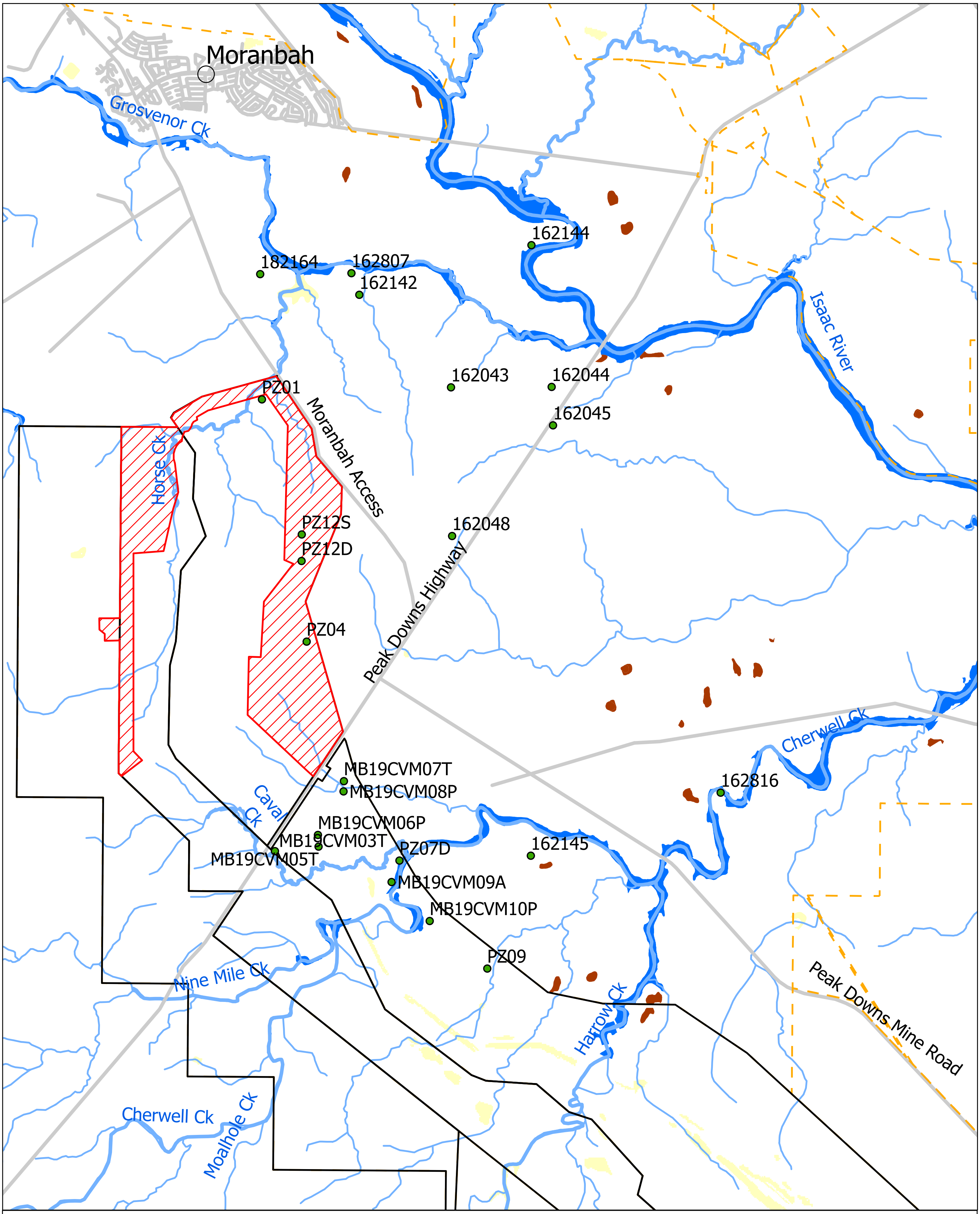
Results of all aquatic indicators surveyed as part of this assessment were consistent with results from previous aquatic ecology surveys at CVM and in the broader region. Biological communities (including aquatic plants, macroinvertebrates, macrocrustaceans, fish and turtles) recorded at sites in the vicinity of the Project were typical of ephemeral systems in central Queensland. All taxa recorded were common in the broader region. No aquatic plants listed as threatened are known to occur in the vicinity of the Project and none were observed during field surveys. In addition, no listed threatened fauna species known from the wider catchment, including white-throated snapping turtle (*Elseya albagula*), Fitzroy River turtle (*Rheodytes leukops*), silver perch (*Bidyanus bidyanus*) and platypus (*Ornithorhynchus anatinus*), or potential habitat for these species were identified.

5.9.2.1 Waterways and Wetlands

The Project is located within the Isaac River sub-basin, which is part of the wider Fitzroy River basin. The Isaac River sub basin covers an area of approximately 22,364 square kilometres (km2). The Isaac River originates north of Moranbah in the Great Dividing Range and flows in a south-easterly direction, flowing adjacent to the Project and eventually discharging into the Mackenzie River, approximately 150 km downstream of the Project. Ultimately, the Mackenzie River joins the Dawson River to form the Fitzroy River, which flows initially north and then east towards the east coast of Queensland and discharges into the Coral Sea southeast of Rockhampton approximately 315 km downstream of the Project. There are several waterways in the vicinity of the Project, refer to Figure 5-29, including:

- An unnamed waterway and its associated tributaries, the headwaters of which are located within the south eastern part of the Project area. These waterways flow in a south easterly direction, joining Cherwell Creek approximately 3.5 km downstream of the Project.
- Horse Creek, the tributaries of which originate to the west of CVM and flow in a north easterly direction around the western boundary of CVM and join Grosvenor Creek approximately 2.5 km downstream of the Project. The drainage line flowing into Horse Creek has been historically diverted around active mining areas, however an undiverted reach and several of its tributaries flow through the Project area.
- Grosvenor Creek, which originates to the north west of CVM and flows in an easterly direction joining the Isaac River approximately 7 km downstream. It is not within the Project area but is downstream of it.
- The Isaac River, which is located to the east of the Project and Cherwell Creek, which flows to the south of the Project. Neither are within the Project area but are located downstream of it; the Isaac River is approximately 9.5 km downstream of the Project at its confluence with Grosvenor Creek; and Cherwell Creek is approximately 3.8 km downstream of the Project at its confluence with the unnamed waterway.

In addition to waterways, one mapped lacustrine wetland considered to be modified by the presence of a farm dam is located downstream of the Project. Several farm dams that are unmapped but may provide aquatic habitat are located upstream, within and downstream of the Project. Palustrine wetlands are also mapped in the region, none of which are within the Project area. One wetland of High Ecological Significance (HES), regulated under the EP Act, is located on a mapped palustrine wetland approximately 20 km east (downstream) of the Project area. The HES wetland incorporates the mapped wetland and Wetland Protection Area. Several of the waterways and wetlands in the vicinity of the Project (upstream and downstream of the Project area) are mapped as moderate and high potential surface-expression GDEs. GDEs are discussed in detail under Section 5.10.



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Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	1941
Date:	11/4/2021
Drawn by:	SW

LEGEND

- Stygofauna Bore
- Horse Pit Extension Project Area
- CVM & PDM Mining Leases
- Mining Lease - Other
- Town
- Road

Waterways

- Waterway - Major
- Waterway - Minor

Wetlands

- Lacustrine Wetland
- Palustrine Wetland
- Riverine Wetland

HORSE PIT EXTENSION PROJECT

Location of Bore Sampled for the Stygofauna Assessment

FIGURE 5-30

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5.9.2.2 Aquatic Habitat

Aquatic habitat in waterways and wetlands in the vicinity of the Project was typical of ephemeral systems in the broader region, with seasonal patterns in habitat availability and quality evident at all sites. During the early-wet season surveys in December 2019 and November 2020, sites located on waterways (i.e., creeks and tributaries) were generally dry. However, some isolated dry season refuges were recorded at mapped lacustrine wetlands and unmapped farm dams. During the late-wet season survey in April 2020, most sites in both higher stream order waterways and lacustrine wetlands contained isolated pools, which would only connect and flow during and following periods of heavy rainfall. These pools provided moderate condition habitat for aquatic flora and fauna, including variable substrate (dominated by sand but with larger substrate types present in low abundance), in-stream woody debris and moderate to high coverage of trailing and overhanging bankside vegetation. Bed and bank stability were typically low to moderately disturbed from cattle access, terrestrial weeds and feral animals. Although riparian vegetation was reduced as a result of land clearing associated with the adjacent land uses, the banks remained moderately vegetated by predominantly mature native trees with a sparse to moderate groundcover of grasses.

The HES palustrine wetland (approximately 20 km downstream of the Project) met the definition of a wetland under the Queensland Wetland Definition and Delineation Guideline (DERM 2011a). This wetland was dry during December 2019 and was assessed as having low habitat value for aquatic flora and fauna, as it was in similar condition to other mapped palustrine wetlands in the area and would rarely be inundated (and therefore would rarely provide aquatic habitat). The dry bed contained some potential habitat features, including emergent aquatic plants. There were some terrestrial weeds growing in the dry bed and riparian vegetation was reduced due to clearing, but otherwise disturbance was relatively low. Based on the December 2019 survey, the wetland did not provide substantial aquatic habitat. This site was unable to be surveyed in April 2020 due to property access issues. However, it is possible that this wetland provides habitat for aquatic fauna during and after high rainfall / flow events. A second mapped palustrine wetland assessed during the field survey (i.e., site PW2, refer to Figure 5-29) did not contain any aquatic habitat features, and therefore was only of terrestrial ecological value and is not considered further.

5.9.2.3 Water Quality

Water quality in waterways and wetlands in the vicinity of the Project was highly variable, which is typical of ephemeral systems in the region. Water quality measured in situ was characterised by neutral to slightly alkaline pH (which frequently exceeded the WQO range), moderate to high EC (which frequently exceeded the WQO), variable saturation of dissolved oxygen (which were frequently outside of the WQO range), and high turbidity (which frequently exceeded the WQO). Laboratory-analysed results indicated moderate to high concentrations of nutrients and some metals (particularly aluminium and copper). Concentrations of these parameters were outside of the relevant WQOs at several sites during the field surveys (see Table 4.1 in of the Aquatic Ecology Impact Assessment in Appendix H). Overall, water quality in the vicinity of the Project was in moderate condition, likely influenced to some degree by surrounding land use and local geomorphology, which is characteristic of a moderately disturbed aquatic ecosystem.

5.9.2.4 Sediment Quality

Sediment quality was moderate to good in the vicinity of the Project, and likely influenced to some degree by surrounding land-use and local geomorphology, which is characteristic of a moderately disturbed system. Concentrations of most parameters were below the relevant DGVs during the surveys, except for chromium and nickel, which exceeded the DGVs or the GV high at some sites in the vicinity of the Project at times (see Table 4.2 and Table 4.3 of the Aquatic Ecology Impact Assessment in Appendix H). Bed sediments were mostly fine at all sites, and dominated by either silt / clay or sand, with smaller amounts of clay.

5.9.2.5 Aquatic Plants

A total of 19 native aquatic plant species from 13 families were recorded at sites in the vicinity of the Project across the December 2019 and April 2020 surveys (see Table 4.4 and Table 4.5 of the Aquatic Ecology Impact Assessment in Appendix H). Overall, aquatic plant diversity and coverage was low at most waterways (creeks) and mapped palustrine wetland sites, and higher at unmapped farm dams and mapped lacustrine wetland sites (all of which were dammed). Emergent species, namely sedges (Cyperus spp.), were the most widespread aquatic plants and were growing on the banks or in the shallow margins of the sites where they were recorded. There were few submerged and floating species, indicating that water is not likely to persist for the majority of the year (except at wetland sites that had been dammed and farm dam sites). No invasive species were recorded, although seven aquatic introduced species are known from the Isaac River sub-basin, one of which (olive hymenachne; *Hymenachne amplexicaulis*) is a Weed of National Significance and a restricted invasive plant under Queensland's Biosecurity Act 2014.

5.9.2.6 Aquatic Macroinvertebrates

Macroinvertebrate communities in bed and edge habitats were dominated by several tolerant taxa that were common across the majority of sites in moderate to high abundance, including non-biting midges (subfamilies Chironominae and Tanypodinae), biting midges (family Ceratopogonidae), diving beetles (family Dytiscidae), shrimp (family Atyidae), and pygmy water boatmen (family Micronectidae). Taxonomic richness, PET richness and SIGNAL 2 scores of macroinvertebrate communities were typically low to moderate at all sites. This result was expected given that most sites consisted of shallow, isolated pools during the field surveys (which do not provide ideal habitat for a wide range of macroinvertebrate taxa) and indicates that macroinvertebrate communities were in low to moderate condition relative to those expected in the broader region.

Results indicated that most sites provided favourable bed habitat for macroinvertebrates in December 2019. However, macroinvertebrate communities were likely influenced by a combination of harsh physical conditions and poor water quality in edge habitat in December 2019, and in both bed and edge habitat in April 2020 (see Figure 4.12 and Figure 4.13 of the Aquatic Ecology Impact Assessment in Appendix H).

5.9.2.7 Macrocrustaceans

Five species of macrocrustaceans were recorded during fish sampling, including freshwater crab (*Austrothelphusa transversa*), freshwater prawn (*Macrobrachium sp.*), orange-fingered yabby (*Cherax depressus*), common yabby (*Cherax destructor*), and redclaw yabby (*Cherax quadricarinatus*) (see Table 4.6 of the Aquatic Ecology Impact Assessment in Appendix H). All species have been recorded previously in the Isaac River catchment (DPM Envirosciences 2018, ALA 2020). Freshwater prawns were particularly abundant and were recorded at most sites. In contrast, only one redclaw yabby was recorded at one site in a farm dam on a tributary of Horse Creek (i.e., site HT1D) in December 2019. This species is not naturally occurring within the Isaac River sub-basin and has been historically translocated from northern Australia to become naturalised.

5.9.2.8 Fish

A total of 2,374 native fish, comprising seven species from six families, were recorded from the waterways and wetlands within the vicinity of the Project across the December 2019 and April 2020 surveys (see Table 4.8 of the Aquatic Ecology Impact Assessment in Appendix H). Fish communities were dominated by common small-bodied species, with the lack of large-bodied fish likely due to the paucity of deep pool habitat. Agassiz's glassfish (*Ambassis agassizii*), carp gudgeons (*Hypseloetris spp.*) and eastern rainbowfish (*Melanotaenia splendida splendida*) were the most abundant native species recorded during the December 2019 and April 2020 surveys, although bony bream (*Nematalosa erebi*) were also relatively abundant in December 2019. These species were also widespread in both the December 2019 and April 2020 surveys, occurring at all or most sites. Most sites that contained water provided habitat for fish from a range of life history stages during the late-wet season, including adults, intermediates, and juveniles (see Figure 4.14 and Figure 4.15 of the Aquatic Ecology Impact Assessment in Appendix H). Two exotic species of fish were also recorded in the April 2020 survey: Mozambique tilapia (*Oreochromis mossambicus*) and platy (*Xiphophorus maculatus*). Tilapia is listed as a restricted biosecurity matter and a noxious fish under the Biosecurity Act 2014; platy is a pest species but is not restricted or prohibited under Queensland legislation.

Many species of native fish known from the region migrate upstream and downstream, and between different aquatic habitats, at different stages of their life cycle. The waterways in the vicinity of the Project provide temporary habitat and aquatic fauna movement corridors during flow events. In the vicinity of the Project the Queensland Waterways for Waterway Barrier Works mapping indicates (Figure 4.18 of the Aquatic Ecology Impact Assessment in Appendix H):

- the Isaac River, Grosvenor Creek, Harrow Creek and Cherwell Creek are mapped as major risk (purple) of adverse impact to fish movement

- Horse Creek is mapped as high risk (red) of adverse impact to fish movement, and
- all other waterways are mapped as moderate risk (amber) or low risk (green) of adverse impact to fish movement.

5.9.2.9 Turtles

Turtles were not particularly abundant or widespread in the vicinity of the Project and were only caught in the mapped lacustrine wetland (see Table 4.9 of the Aquatic Ecology Impact Assessment in Appendix H). The species captured (Krefft's river turtle, *Emydura macquarii krefftii*) is considered widespread and common throughout waterways in Queensland.

5.9.2.10 Aquatic Ecological Value

Overall, aquatic ecosystem values of waterways in the vicinity of the Project were low to moderate and were considered to be similar to and representative of ephemeral systems in the broader region. Sites on waterways with higher stream orders (i.e., Cherwell Creek and Grosvenor Creek) typically had higher ecological value than sites on waterways with low stream orders (i.e., Horse Creek, Caval Creek and unnamed tributaries). This was primarily due to the presence of a wider variety of instream habitat types, provision of breeding habitat (with juvenile, intermediate and adult fish recorded at most sites), and provision of important connectivity and fauna passage during periods of high rainfall and flow.

Mapped lacustrine wetlands and un-mapped farm dams were assessed as having moderate aquatic ecological value. This was due to the presence of a moderate variety of instream habitat types (including deep pools), provision of breeding habitat (with juvenile, intermediate and adult fish recorded), and provision of dry season refugia for aquatic flora and fauna.

Although designated as a HES wetland, the mapped palustrine wetland was assessed as having low aquatic ecological value. This was because the site was dry during the field survey and would likely only hold water and / or connect to the Isaac River during periods of high rainfall and flood events. The site contained a low to moderate variety of potential instream habitat types in the dry bed.

5.9.2.11 Surface Expression GDEs

No differences were observed in aquatic ecological indicators between sites on mapped potential surface-expression GDEs and sites on other waterways and wetlands in the region. The field assessment concluded that the aquatic ecological value of mapped potential surface-expression GDEs was low to moderate at wetland and waterway sites. GDEs are discussed in detail under Section 5.10.

5.9.2.12 Stygofauna

Overall, aquifers within the Project area were considered to have a low likelihood of supporting stygofauna communities. Although stygofauna have been recorded from fractured rock aquifers (e.g., basalt and coal), they are less likely to occur where there is insufficient hydrological connection to limestone or alluvial aquifers (Doody, 2019). The alluvium aquifer in the area is unconfined and likely fed by surface water; as such groundwater available for stygofauna communities is likely to be limited and sporadic. Of the 33 bores that have previously been sampled within 30 km of the Project, none recorded true stygofauna. Eight of these bores contained stygoxene (i.e., inhabit mostly surface environments, only inhabit groundwater inadvertently and are unable to establish subterranean populations; Queensland Herbarium, 2021), including bores downstream of the Project area.

Bores sampled during the field surveys included a variety of aquifers from available lithologies, although alluvium bores were generally dry, with only two bores sampled (see Table 5.2 of the Aquatic Ecology Impact Assessment in Appendix H). EC and pH of groundwater was within the range known to support stygofauna at most bores (see Table 5.1 of the Aquatic Ecology Impact Assessment in Appendix H). No stygofauna specimens were recorded from bores sampled during the field survey. Of the 13 bores sampled in May 2020 and 10 bores sampled in November 2020, eight bores from each survey contained invertebrates. Most taxa identified were terrestrial specimens. One Oligochaeta species, two Acarina (mites) species and a cyclopoid copepod were identified as potentially being stygofauna in bores. However, these were generally likely to be stygoxene and not true stygofauna.

Stygofauna may be present in the Quaternary alluvial aquifers in the wider vicinity of the Project. The Isaac River and its tributaries are ephemeral, particularly in the upper reaches, which often experience prolonged dry periods (4T, 2012). Along with varied permeability, this indicates that the distribution of stygofauna in the upper reaches of the alluvium further from the main rivers, may only be highly localised (i.e., where there is sufficient groundwater storage to sustain populations) (4T, 2012). In the lower reaches, and where there are confluences and extensive river alluvium deposits, the likelihood of saturation and therefore the likelihood of occurrence of stygofauna is greater.

The generally high salinity of groundwater throughout the broader region suggests that the groundwater environment of the Isaac River catchment is not ideal for stygofauna (FRC Environmental, 2020; SLR Consulting Australia Pty Ltd, 2020).

Regionally, sampling for stygofauna at the Winchester South Project, just downstream of the confluence of Cherwell Creek and the Isaac River, was undertaken in 2019 and 2020 as part of the project's Aquatic Ecology Assessment (Ecological Service Professionals (ESP), 2022). The sampling was conducted consistent with the Guideline for the Environmental Assessment of Subterranean Aquatic Fauna (Department of Science, Information Technology and Innovation, 2015). A total of 11 bores were sampled as part of the stygofauna assessment, including three bores installed into the Isaac River Alluvium. No stygofauna species were recorded from any of the bores sampled during the Winchester South Project's stygofauna field survey (ESP, 2022).

Two bores in the Isaac River alluvium further downstream of the Winchester South Project were also sampled recently as part of the Olive Downs Coking Coal Project Aquatic Ecology Assessment (DPM Envirosciences, 2018). Again, no stygofauna were recorded during the study.

Along the Isaac River just upstream of the Cherwell Creek confluence, FRC Environmental (2020) undertook stygofauna sampling in 2019 for the Isaac Downs Project. Only one bore of 10 sampled in the Isaac River Alluvium contained stygofauna. Both identified taxa in the bore were stygoxenes (i.e. not obligate inhabitants of groundwater ecosystems). Stygofauna occurrence near to the project was therefore reported as 'limited'.

The previous studies discussed above demonstrate that the Isaac River Alluvium should not be considered a significant or widespread habitat for stygofauna, with stygofauna only identified in one of 15 bores installed into the alluvium in the vicinity of the Cherwell Creek confluence. Furthermore, the stygofauna taxa that were identified in the one bore were not obligate groundwater inhabitants (i.e. may also be found within surface water features) and therefore any impacts to the alluvium groundwater system itself would be unlikely to materially affect the stygofauna community at this bore.

5.9.3 Potential Impacts

5.9.3.1 Habitat Modification and Loss

Aquatic habitat, flora and fauna within the Project area would be directly removed or modified, including the upper reaches of Horse Creek, the upper reaches of Cherwell Creek, and an unmapped (isolated artificial) farm dam (site HTD1; refer to Figure 5-31). The upper reaches of Horse and Cherwell creeks were of low aquatic ecological value and the farm dam was of moderate ecological value during field surveys. All aquatic habitat, flora and fauna in these waterways were considered common to the region, and no aquatic species listed under the EPBC Act or NC Act were recorded or considered likely to occur. While their removal will mean a direct loss of available aquatic habitat, this is not expected to impact aquatic ecology on a regional scale, but rather on a very localised scale within the Project area.

5.9.3.2 Relocation of Minor Waterway

There are no proposed watercourse diversions or modifications to existing watercourse diversions required to facilitate the Project. A minor waterway (not mapped under the Water Act 2000 (Water Act)) that intercepts with the north-west corner of the proposed OOPD will be realigned around the toe of the OOPD, refer to Figure 5-31. This waterway is located high in the catchment at the headwaters of Horse Creek, rarely holds water and is of low aquatic ecological value. The relocation is this waterway is expected to have a temporary and low risk of potential impact to aquatic ecology. The low aquatic ecological value is expected to be reinstated within the realigned waterway. Where this is the case, risks to aquatic ecology are considered low and mitigation and management measures are not considered required.

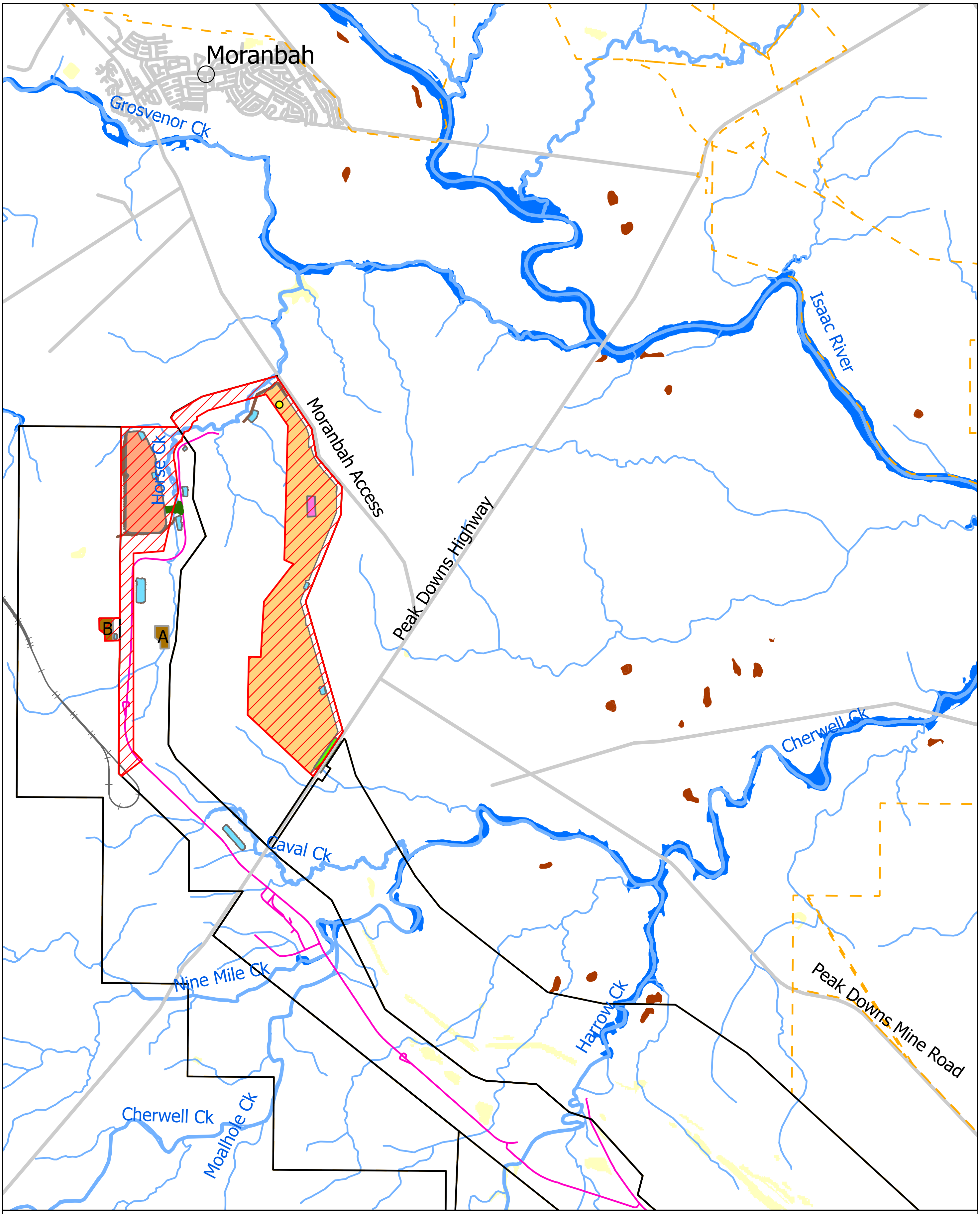
5.9.3.3 Changes to Habitat

Vegetation removal and earthworks associated with the Project may reduce or limit aquatic habitat available to fauna (e.g., woody debris, tree roots or undercut banks) in downstream areas (as the source of habitat material is removed), indirectly impacting aquatic fauna. These aquatic habitats can provide shelter, contribute organic matter and be important for reproduction and feeding areas for aquatic fauna. However, while these aquatic habitats (e.g., woody debris, tree roots or undercut banks) occur in some areas in the vicinity of the Project area, they are generally limited and unlikely to be significantly impacted. As such, no mitigation and management measures are considered required.

5.9.3.4 Restriction of Fish Passage

The removal of sections of waterways within the Project area, along with the potential installation of waterway crossings (i.e. for the haul road extension and medium vehicle access road) have the potential to prevent or restrict the movement of aquatic fauna, such as fish, refer to Figure 5-31. Sections of waterways to be removed within the Project area (i.e., headwaters of Horse and Cherwell creeks) are classified as low risk (green) of adverse impact to fish movement. They are low stream-order waterways that do not connect to important fish habitat upstream (while the farm dam, site HTD1, provided some dry season refuge it was poorly connected to the waterway). Sections of waterways crossed by the two potential waterway crossings associated with the Project (i.e., reaches of Horse Creek) are classified as medium (amber) risk to fish movement. Based on the results of the field survey, these waterways provide low to moderate aquatic ecological value, are largely disturbed by surrounding land use (including existing mining and agricultural operations), and do not connect to important fish habitat upstream.

Overall, connectivity through the waterways and wetlands within and upstream of the Project area is currently very limited due to the ephemeral nature of the area, and there are no important upstream breeding, feeding or refuge areas to consider (e.g., for threatened or priority species). Species that are found within the Project area are common within the region, are resilient, and have likely established communities that are not reliant on connections throughout the Project site. Therefore, removal and crossing of these waterways will have a minor direct impact on fish habitat and fish passage.



0 0.5 1 km

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:100,000 at A4
Project Number:	1941
Date:	11/4/2021
Drawn by:	SW

LEGEND

Label
- Site HT1D
- Horse Pit Extension Project Area
- CVM & PDM Mining Leases
- Mining Lease - Other
- Town
- Road

Key Infrastructure Components
- Dams
- Proposed EME Build Pad
- Proposed Blast Compound Options
- Proposed Out of Pit Dump
- Dragline Crossing Zone
- Horse Pit Extension
- Proposed Levee Drain
- Bridge over Horse Creek
- Proposed Roads
- Rail

Waterways
- Waterway - Major
- Waterway - Minor

Wetlands
- Lacustrine Wetland
- Palustrine Wetland
- Riverine Wetland

SLR BMA BHP Mitsubishi Alliance

HORSE PIT EXTENSION PROJECT

Mapped Waterways and Wetlands in the Vicinity of the Project

FIGURE 5-31

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5.9.3.5 Changes in Flow and Surface Water Hydrology

Changes to the flood regime, and the timing and magnitude of flows in watercourses, have the potential to directly and indirectly impact on aquatic ecosystems. Changes in flow and surface water hydrology as a result of the Project are largely restricted to those caused by changes in the catchment area in the upper reaches of waterways (i.e., catchment loss of 7 per cent of Horse Creek; 0.5 per cent of Grosvenor Creek; and 0.4 per cent of Cherwell Creek) and those caused by the construction of the bridge over Horse Creek and two proposed flood levees (Horse Pit North and Horse Pit West levees).

Very minor changes in water flows are expected in the Isaac River, with the Project resulting in a very small reduction (0.2 per cent) in catchment area at the confluence of Grosvenor Creek (Appendix E). Groundwater modelling also estimated that there will be an increase in seepage of less than 0.1 per cent from the Isaac River to the alluvium as a result of mining for the Project (due to the increased hydraulic gradient between the Isaac River and the underlying alluvium) (SLR 2021a). This increase represents an insignificant potential for flow rate changes in the Isaac River (SLR 2021a).

Minor changes to the timing of flows and time of inundation for an event are expected as a result of the Project. There will be minor to moderate changes (< 20 per cent) to the occurrence (number of events) and duration (number of days) during higher or medium flows (greater than 1 m3/s but less than 3 m3/s) as a result of the Project (SLR 2021b). Further, changes to the volume and peak discharge during 1 and 10 percent AEP events are expected to be moderate (< 20 per cent change) for Cherwell Creek near the Peak Downs Highway and very low (≤ 1 per cent change) for Horse Creek approximately 500 m downstream of the Moranbah Access Road. Given Cherwell Creek was assessed as having moderate aquatic ecosystem value and Horse Creek was assessed as having low aquatic ecosystem value, these changes in flow are considered acceptable for protecting the environmental values.

Modelling indicates flood immunity for the Project is achieved for flood events up to and including 0.1 per cent AEP events. The haul road over Horse Creek and levees will cause affluxes that are contained within the Horse Creek floodplain, particularly during 0.1 percent AEP events. Results of the flood model indicate that the confinement of the floodplain due to the levees construction does not result in adverse impacts to Horse Creek largely due to some reduction in retardment of flows due to the construction of the Haul Road crossing to the OOPD. Construction of the levee has the potential to increase scour and erosion particularly given the sodic soils in the region. However, at the conclusion of mining, the final landform is free draining and designed to be a stable landform, with the proposed final void expected to contain water (SLR 2021b). Given Horse Creek was assessed as having low aquatic ecosystem value, these changes in flood level are considered acceptable for protecting the aquatic ecosystem.

5.9.3.6 Bank Stability, Erosion and Stormwater Runoff

Vegetation clearing and earthworks (e.g., topsoil stripping) for the Project has the potential to influence bank stability and erosion, which, in turn, can increase turbidity, sedimentation and nutrients in downstream waterways. Risks are greater during times of high flow (when there is a greater risk of erosion and stormwater runoff) and close to the disturbed area and decrease with distance downstream. Aquatic species in the area are tolerant of variable water quality conditions, including periods of high suspended sediments, sedimentation, turbidity, and nutrients. Unmitigated risk of potential impacts to aquatic habitat and communities is considered medium.

5.9.3.7 Dust and Particulate Matter

Dust from increased mining activities may enter waterways and increase turbidity, sedimentation, nutrients and contaminants (e.g., from mining waste) in downstream and / or adjacent waterways. Unmitigated risk of potential impacts to aquatic habitat and communities is considered medium.

5.9.3.8 Water Releases

Surface water runoff from mining or waste disposal areas (e.g., the OOPD) can indirectly impact downstream environmental values. The existing water management strategy at CVM involves surface water infrastructure (such as drains, pipelines, sediment dams and MAW dams) to separate, transfer and store clean and MAW water for reuse or release, which is managed under the MWMP. No changes to the water demand or the existing supplies, including sewage treatment management, are required. However, relocation of MAW dams and additional water management infrastructure will be required to facilitate the Project. Clean water captured on site in clean water storages is expected to have the same water quality as the receiving environment waterways and is not expected to have any impacts to the water quality. The Project will require additional surface water drains and sediment dams to manage runoff. The majority of these sediment dams are designed to overflow to Horse Creek during significant rainfall events, with the exception being one expanded sediment dam, which will overflow to Caval Creek. It is expected that any overflow would be in conjunction with high rainfall and flow, which would dilute any contaminants in the receiving environment. This overflow is an existing feature of the water management system at CVM in accordance with Condition F19 of the EA.

The controlled release of MAW and associated contaminants (typically metals and hydrocarbons) can indirectly impact downstream environmental values. Where water releases remain in accordance with existing EA Conditions and potential impacts are assessed in the existing CVM REMP, the potential impacts to flora, fauna and environmental values of the receiving environment from releases of MAW as a result of the Project, are not expected.

5.9.3.9 Saline or Acid Drainage

There is a potential risk of saline or acid drainage from mining activities within the site or seepage generated by the proposed OOPD. The geochemical characteristics of mineral waste materials associated with the Project are mostly NAF (Appendix B). Non-carbonaceous overburden / interburden is expected to generate low to medium salinity run-off and seepage; due to very low total sulfur concentrations, the potential for sulfate-derived salinity is negligible (Appendix B). The salinity of water in the final void at the conclusion of mining is predicted to increase significantly post closure due to the constant inflow from highly saline groundwater (Appendix E). Potential impacts of saline or acid drainage and seepage at CVM are currently managed by maintaining compliance with the EA.

5.9.3.10 Spills of Hydrocarbons and Other Contaminants

There is a potential risk of fuels, oils and other chemicals required for vehicles and equipment used during the Project (including chemicals for blasting) to spill and enter waterways, impacting water quality and aquatic ecology. Where spills are small and short-term, aquatic ecosystems are likely to recover.

5.9.3.11 Litter and Waste

Where litter and waste associated with pre-mining activities, vehicle maintenance and mining operations enter aquatic ecosystems they have the potential to directly impact aquatic fauna due to entanglement. They can also indirectly impact aquatic flora and fauna by contributing to the degradation of water and sediment quality.

5.9.3.12 Proliferation of Aquatic Pests

Increases in invasive species can lead to significant indirect impacts to the community structure and health of aquatic ecosystems. However, the Project is unlikely to result in the addition of new invasive species of aquatic flora or fauna, or the growth and spread of aquatic pest species. This is due to its location within the catchment; because it does not involve the diversion of waterways into adjacent catchments; and because it does not result in additional habitat for invasive species.

5.9.3.13 Changes to Groundwater

Although no true stygofauna were recorded during the pilot study and they are considered unlikely to occur within the Project site, stygofauna communities may occur in the broader region, particularly in the unconsolidated sediments of the Isaac River alluvium, and therefore potential impacts associated with the Project were considered to the extent the Project may impact these areas:

- Groundwater modelling demonstrated that changes to groundwater quantity due to drawdown associated with the Project are likely to be localised, with no predicted direct or indirect interference with alluvial groundwater as a result of the Project (Appendix F). Changes to groundwater quantity are not expected in the unconsolidated sediments of the Isaac River alluvium, in the lower reaches of the Isaac River and at the confluences of larger tributaries (i.e., where stygofauna communities are likely to occur). Therefore, no impacts to stygofauna communities as a result of changes in groundwater quantity are expected as a result of the Project.

- Impacts to groundwater quality may result from saline or acid drainage, seepage, tailings disposal, hazardous and dangerous goods storage, and hydrocarbon and chemical spills (e.g., from fuels, lubricants and oils required for the operation of vehicles and machinery).
- Changes to groundwater interactions and connectivity can impact stygofauna communities and their habitat. However, areas potentially impacted by vegetation clearing, surface sealing / compaction, backfilling and rehabilitation works are within the Project area where stygofauna are unlikely to occur. Further, changes in catchment area and surface flow are likely to be localised and not expected to impact areas where stygofauna are likely to occur (i.e., unconsolidated sediments of the Isaac River alluvium, lower reaches of the Isaac River and at the confluences of larger tributaries). As such, any potential impacts associated with groundwater interactions are expected to be low risk.

5.9.4 Mitigation and Management Measures

5.9.4.1 Habitat Modification and Loss

Risks associated with habitat modification and loss are considered to be low and will be managed through the following mitigation measures to be implemented by BMA:

- limit the area disturbed at any one time
- progressive and timely reinstatement of the disturbed landform, and
- grading the finished slopes of all re-shaped landforms to allow for natural runoff to drain freely.

5.9.4.2 Restriction of Fish Passage

Potential risks of restriction of fish passage are low where the design of crossings considers fish passage and water flow to the extent practical. Waterway crossings will be constructed and designed to minimise direct impacts, including designing crossings (e.g., culverts) in consideration of fish passage and water flow (particularly during high flow events) to the extent practical. The use of temporary waterway barriers during construction of any road crossings will also include the provision to transfer flows from upstream of the works to the downstream channel without passing though disturbed areas.

These mitigation measures will be implemented by BMA, resulting in low residual risk of restriction of fish passage occurring.

5.9.4.3 Changes in Flow and Surface Water Hydrology

Potential impacts to flows and surface water hydrology will be managed by BMA through the following measures:

- limiting the area disturbed at any one time by careful mine stage planning, which minimises the area of catchment loss
- progressive and timely reinstatement and rehabilitation of the disturbed landform where practical, and
- design and construct the bridge over Horse Creek to minimise impacts to water flow and surface water hydrology.

Adopting these mitigation measures will result in low residual risk to aquatic ecology values..

5.9.4.4 Bank Stability, Erosion and Stormwater Runoff

CVM has an existing ESCP, Mine Water Management Plan (MWMP) and REMP to fulfil requirements of the existing EA. Potential impacts to aquatic ecology associated with bank stability, erosion and stormwater runoff associated with the Project will be reduced through the following measures:

- the existing CVM ESCP and MWMP will be expanded to include construction and operation of the Project, including sediment control measures and directing stormwater runoff away from waterways

- water quality monitoring is implemented during construction to ensure downstream water quality is not adversely impacted
- construction adjacent to waterways and of waterway crossings is completed during the dry season, where possible
- earthworks and stockpiles are planned prior to works and minimise where possible in accordance with the existing Topsoil Management Plan and the EA
- the Project is completed over stages over the life of the mine, and
- land is progressively rehabilitated as soon as practical, where appropriate.

The management plans outlined above have been used to control erosion and sediment-laden runoff of existing operations. Potential residual risks to aquatic ecology are expected to be minor where the existing ESCP, MWMP and measures to reduce impacts outlined above are implemented.

5.9.4.5 Dust and Particulate Matter

Potential impacts associated with increased dust and particulate matter associated with the Project will be managed under the existing EA requirements and Air Emissions Management Plan. Therefore, residual risk is considered to be low.

5.9.4.6 Water Releases

Potential impacts to aquatic ecology resulting from water releases will be minimised by:

- expanding the existing water management strategy and MWMP to incorporate the construction and operational phase of the Project to ensure the separation and management of clean and dirty water catchments
- expanding the current REMP and associated water quality monitoring program to incorporate the construction, operation and decommissioning phases of the Project
- design, construct and manage the proposed OOPD, levees, sediment dams, pit water storage and other water management structures (e.g., bunds and drains) in accordance with the water management strategy and EA conditions (including regulated structures, where relevant) to ensure that any surface water runoff is managed appropriately
- manage overflow released from new and expanded dams and MAW releases in accordance with the existing EA.
- a monitoring location will be installed on Horse Creek and a monitoring point on Horse Creek or Grosvenor Creek will be added to the REMP to assess potential impacts of overflow from new dams.

Where water releases remain in accordance with existing EA Conditions and potential impacts are assessed in the existing CVM REMP (including measures outlined above), the residual risk of potential impacts to flora, fauna and environmental values of the receiving environment from water releases as a result of the Project, are expected to be low.

5.9.4.7 Saline or Acid Drainage

Residual risk of potential indirect and direct impacts from saline or acid drainage and seepage are expected to be low risk and will be managed under the existing EA, including the MWMP. A final void closure monitoring and management plan will be developed to identify management measures to reduce the impacts of the final void water quality on the environment (including aquatic ecology) and any potential water users.

5.9.4.8 Spills of Hydrocarbons and Other Contaminants

Potential impacts from spills of hydrocarbons and other contaminants associated with the Project will be managed by BMA through the following:

- measures outlined in the existing EA and CVM: Waste Management Plan
- chemicals and hydrocarbons are stored and managed appropriately and in accordance with current statutory requirements

- appropriate containment and spill response procedures are implemented, including spill recovery and containment equipment being available when working adjacent to waterways, drainage channels and within other high-risk areas, and
- refuelling location and handling of fuels are undertaken away from waterways.

Provided the appropriate management of chemicals is maintained through the existing CVM EA requirements, the BMA Coal Standard Operating Procedure Hazardous Materials and the CVM: Waste Management Plan during pre-mining and operational activities, the risk of any residual indirect and direct impacts associated with leaks and spills on aquatic ecological values are likely to be low.

5.9.4.9 Litter and Waste

The risk of potential residual impacts from litter and waste associated with the Project is expected to be low where measures and requirements outlined in the CVM: Waste Management Plan, ESCP and EA are implemented.

5.9.4.10 Proliferation of Aquatic Pests

The risk of potential residual impacts from introduction of aquatic pests associated with the Project, is expected to be low where measures outlined in the existing Land and Biodiversity Management Plan are implemented, including weed hygiene protocols for vehicles and machinery during pre-mining and operational activities.

5.9.4.11 Changes to Groundwater

Where changes to groundwater quality are managed in accordance with CVM Water Management Plan and CVM Groundwater Monitoring and Management Plan and the EA, any residual impacts downstream of the Project (i.e., unconsolidated sediments of the Isaac River alluvium, lower reaches of the Isaac River and at the confluences of larger tributaries) are expected to be low risk. To manage the risk of impact to stygofauna communities that may occur within the broader region, as a result of changes to groundwater, the measures in the CVM Water Management Plan and the CVM Groundwater Monitoring and Management Plan will be implemented. Similarly, changes to groundwater quality and connectivity in the Project area will be managed in accordance with the conditions of the EA. The impact assessment identified this potential impact to be low risk.

5.10 Groundwater Dependant Ecosystems

A Groundwater Dependant Ecosystems (GDEs) Assessment was undertaken to identify and evaluate the GDE values associated with the Project and to determine whether GDEs would be significantly impacted. An assessment was undertaken in accordance with the IESC guidelines (Appendix I) and was subsequently built on with additional information captured in the section below. The content below summarises the Groundwater Dependant Ecosystems technical report (Appendix I) provides a more developed analysis. The Groundwater Dependant Ecosystems technical report (Appendix I) should not be read in isolation.

Assessment of impact to GDEs is being assessed by DCCEEW as part of the approval process under the EPBC Act. The EPBC Act approval process has included consultation with the Independent Expert Scientific Committee.

5.10.1 Background

GDEs are those ecosystems that depend on direct access to groundwater for ongoing maintenance and survival (Eamus, et al., 2006). A community that comprises some groundwater dependent species (i.e. indicator species), is typically considered to be a community that is groundwater-dependent (Eamus, et al., 2006).

There are three main types of GDE as defined by Eamus et al. (2006), including:

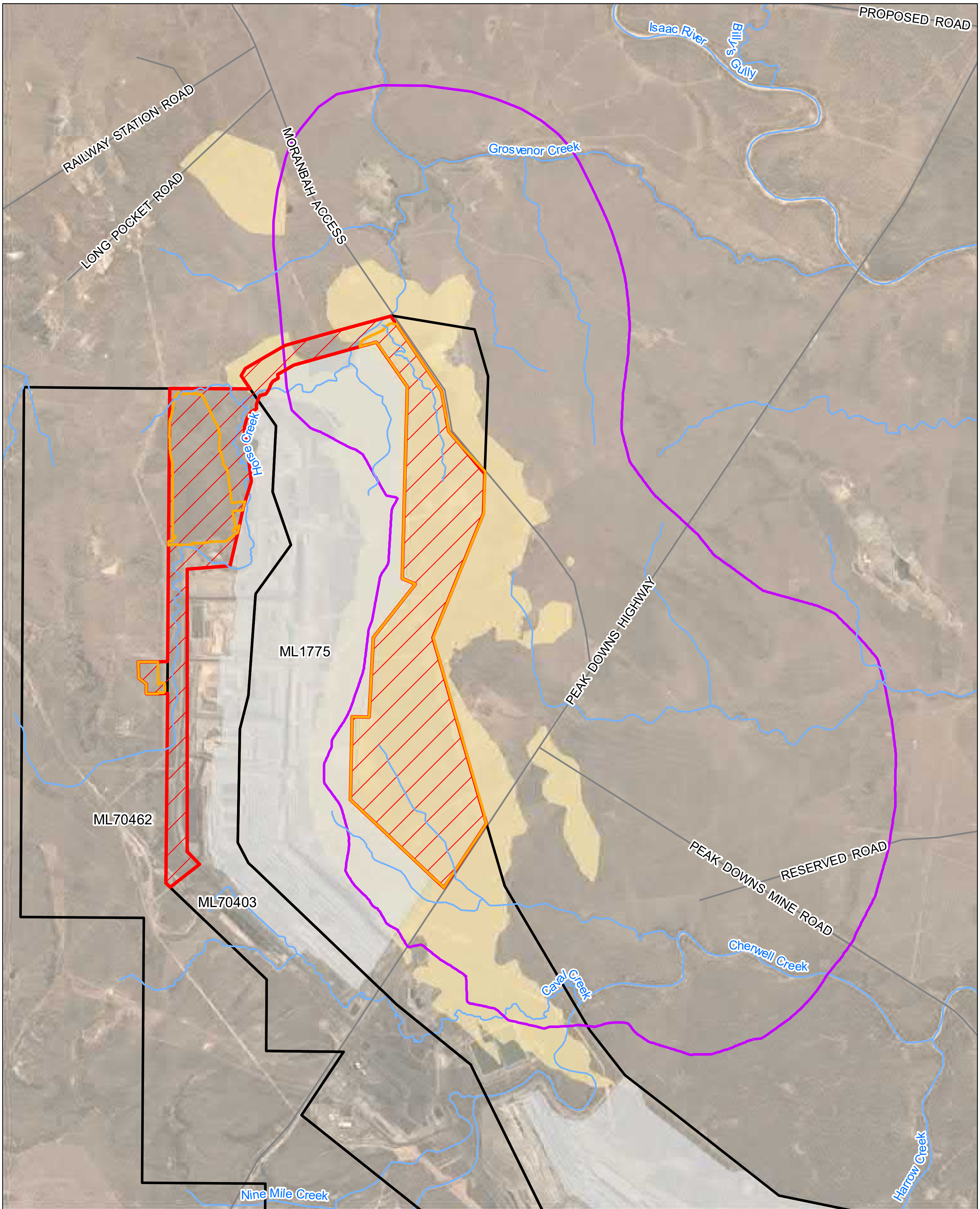
- Aquifer/cave ecosystems, occupied by stygofauna (Subterranean GDEs)
- Ecosystems dependant on the surface availability (discharge) of groundwater. These ecosystems are characterised by permanent provision of surface water (Aquatic GDEs), and
- Ecosystems dependent on access to subsurface groundwater, which includes many riparian communities (Terrestrial GDEs).

GDE communities can be determined by flora species composition and their relative dependence on groundwater for survival (Eamus, Froend, et al., 2006). Riparian and floodplain tree species are highly dependent on access to reliable water sources, including surface flows, soil moisture and groundwater (Kath et al., 2014). Particular flora species can be reliant on permanent access to groundwater and are considered to have ‘obligate groundwater dependency’ (Eamus, Hatton, et al., 2006). These species tend to occupy areas of the landscape that optimise access to groundwater, such as along the lower banks of waterways. For example, obligate species may include *Eucalyptus camaldulensis* (river red gum), *Melaleuca leucadendra* and *M. fluviatilis* (O’Grady et al., 2006; Roberts & Marston, 2000).

Other species have adapted to occasional access to groundwater, usually following floods when groundwater levels rise. These ‘facultative’ groundwater dependent species can utilise groundwater when it is available; however, can survive without (Eamus, Froend, et al., 2006). Facultative groundwater dependent species are usually located on the upper banks and floodplains of waterways, such river she-oak (*Casuarina cunninghamiana*) and coolibah (*E. coolabah*) (Eamus, Hatton, et al., 2006; Roberts & Marston, 2000).

5.10.2 Assessment of Potential GDEs

An assessment was conducted to determine the presence of GDEs and potential impact of the Project on GDE’s. This assessment involved a desktop assessment followed by field surveys for potential terrestrial GDEs and stygofauna within the modelled, predicted drawdown area (the Predicted Drawdown Extent – ie the modelled extent to which the depth to water will increase). The preliminary groundwater drawdown extent (herein referred to as Predicted Drawdown Extent) used for the GDE assessment comprised the north-eastern extent of ML 1775 and adjacent properties along the Peak Downs Highway, Moranbah Access Road and Peak Downs Mine Road as presented in Figure 5-32. The objective of the assessment was to identify and evaluate the potential GDE values associated with the Project and to determine whether any potential GDEs would be significantly impacted by the Project.



Projection: GDA 1994 MGA Zone 55
Scale: 1:70,000 at A4

Project No.: 620.13593
Date: 10-Dec-2021
Drawn by: PM

SLR BMA BHP Mitsubishi Alliance

- Preliminary Drawdown Area
- Predicted Drawdown Extent
- Road
- Watercourse
- Project Disturbance Area
- Horse Pit Extension Project Area
- Mining Lease
- CVM EIS Pit Boundary (2010)

Horse Pit Extension Project

GDE Project Overview

FIGURE 5-32

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5.10.2.1 Identifying TGDEs

To identify potential terrestrial GDE (TGDE) vegetation and determine reliance on groundwater a cumulative evidence-based decision approach (CEDA) was applied. Using best available data the approach draws on:

- Plant physiology and community mapping – vegetation community mapping has been collected via field surveys within the Predicted Drawdown Extent. Literature and data review of the key communities and species present has been undertaken to identify those known to use groundwater (and similarly, those that may use groundwater or are very unlikely to use groundwater). Where species/communities are very unlikely to use groundwater this is used as diagnostic evidence.
- Groundwater depth – groundwater is recognised as the limiting factors as it must be accessible to deep roots of vegetation. Where groundwater is too deep this region is used as diagnostic evidence.
- Plant relative persistent greenness and wetness (remote sensing-based Groundwater-dependent Ecosystem Mapping (GEM) data). The assessment identifies areas likely to be using groundwater and helps identify positive areas of TGDE.

These information sources in combination allowed for likely TDGEs to be identified for the Project locality and described in order to undertake impact assessment.

5.10.2.2 Describing the Change in Groundwater

As part of groundwater modelling undertaken for the Project, a Predicted Drawdown Extent was identified based on 1 m drawdown area from the detailed groundwater model.

The groundwater table for the Predicted Drawdown Extent was modelled as part of groundwater impact assessment undertaken for the Project (**Appendix F**). Modelling depicted the current depth-to-water (DTW) and the likely maximum drawdown associated with the Project.

The Project's groundwater model, used as the basis of the assessment of terrestrial GDEs. The robustness and appropriateness of the Project's updated version of the groundwater model was validated by an independent peer review (see Appendix J RFI Response for further detail). The model is considered appropriate and robust to inform the GDE assessment for the Project.

While drawdown of the groundwater aquifer is major impact pathway consideration for GDEs, the sensitivity of the GDE potentially impacted by changing groundwater regimes also needs to be considered. The complication is that TGDEs are often sustained by multiple sources of water, including direct rainfall, flooding, stored soil moisture and groundwater. The ratio of water requirements from these sources, coupled with the degree of adaptability of GDE vegetation to change dictates ecosystem sensitivity. Sensitivity to groundwater drawdown is likely to be less for a facultative GDE when compared to an obligate community. For example, under typical dry conditions (excluding anthropogenic activities), GDE indicator species, such as *Eucalyptus camaldulensis*, may still access the alluvial aquifer, in addition to any available surface flows to maintain functioning (Figure 5-33). While seasonal loss of canopy vigour and associated loss of foliage cover during extended drought may be observed, recovery of riparian condition following rainfall or river high flow would occur.

It should be noted that the Project's groundwater model has a mild tendency to overestimate the groundwater levels, particularly at lower elevation, than the actual levels (HydroAlgorithmics Pty Ltd, 2021). That is, the model has a tendency to predict shallower groundwater levels than reality. Since the model predicted depth to groundwater is a key input to the identification of potential TGDEs, the extent of likely TGDEs mapped in the assessment is considered conservative, incorporating a potentially larger area of terrestrial communities that may access groundwater than what is measured in reality (i.e. potential overestimation of TGDEs present). Consequently, the potential impacts to TGDEs based on the predicted drawdown extent is likely to also be an overestimation, with the actual impacts a subset of the identified GDE extent.

While there are limitations associated with the assessment of TGDEs and potential groundwater drawdown, mitigation measures to be implemented as part of the Project includes the ongoing monitoring of TGDEs as part of a Groundwater Dependent Ecosystem Monitoring and Management Plan (GDEMMP).

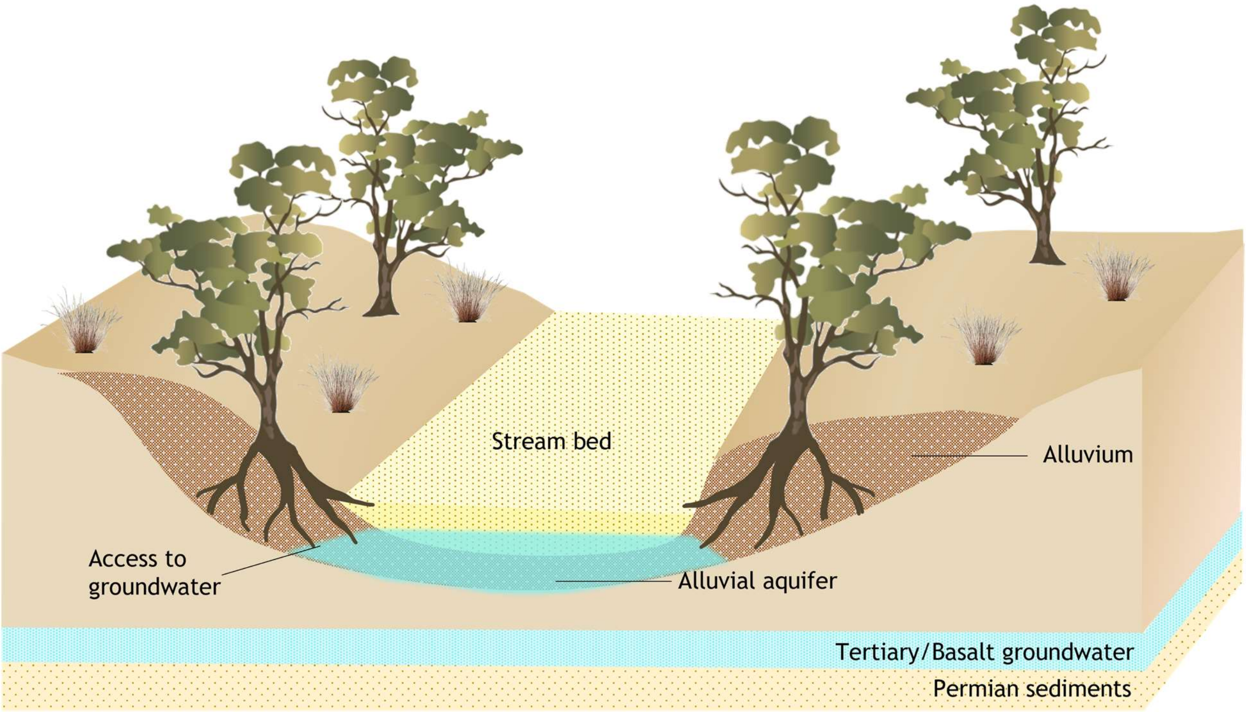


Figure 5-33 Terrestrial GDE during dry conditions

5.10.2.3 Identification of Vegetation Reliant on Groundwater

Determining the extent to which terrestrial vegetation communities are groundwater dependent is complex and generally relies on a number of lines of evidence. This assessment has been based on several data sources, including existing information from Commonwealth and Queensland mapping, remote sensing data analysed using IESC recommended methods and field-based surveys. The lines of evidence and how they assisted decision making around if communities are reliant on groundwater (i.e. potential TGDEs) is presented in Table 5-37.

Table 5-37 TGDE Assessment Data Sources

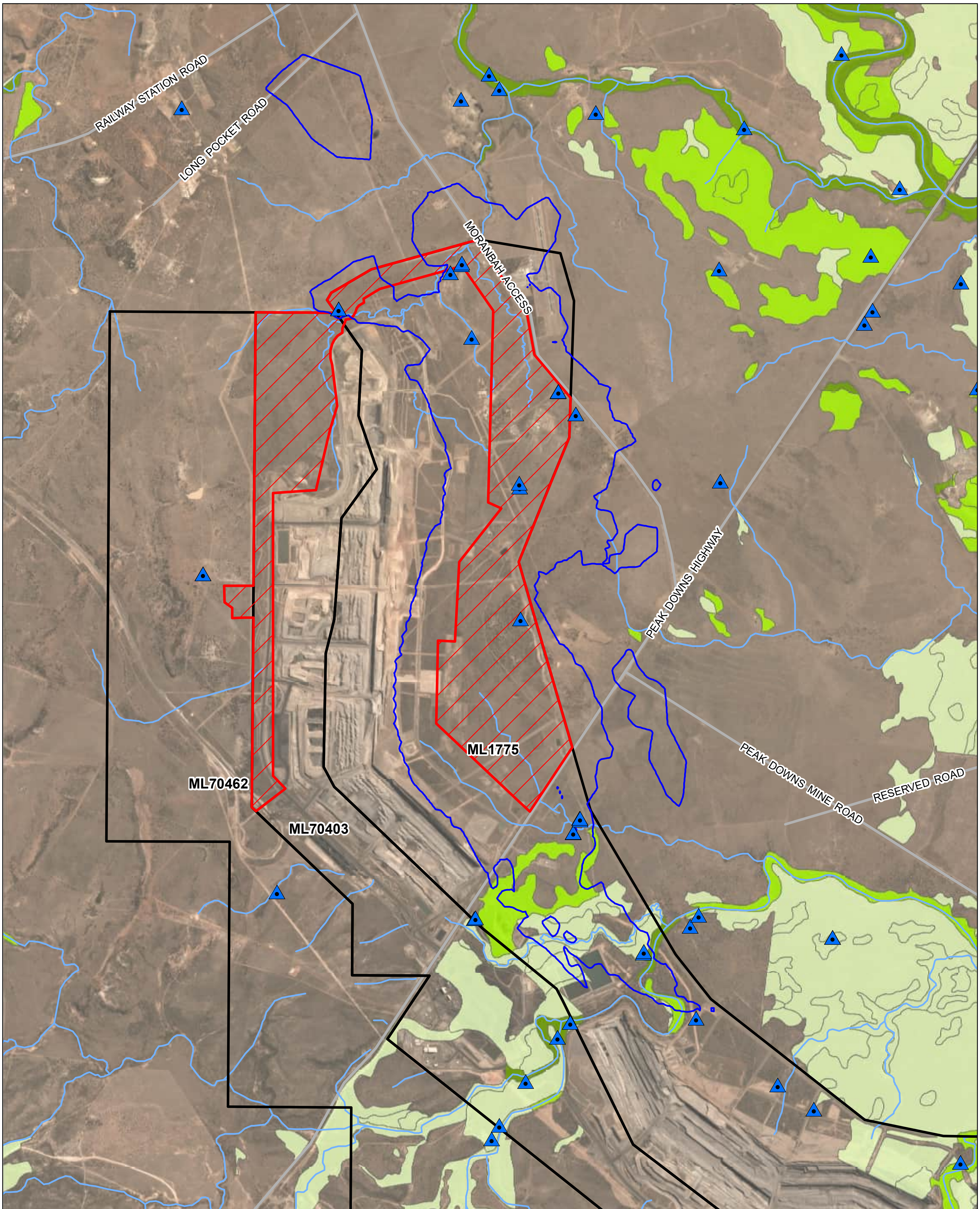
Line of evidence	Data source for this study	Use in decision making
Commonwealth & state government mapping products	Bureau of Meteorology GDE Atlas Regional ecosystem mapping Map of Queensland Wetland Environmental Values (DES, 2021) Queensland Wetland Data (DES, 2021a)	Data provided at a variety of scales and used for: • Identifying wetlands and other potential GDEs; • Targeting areas for field verification; • Understanding surface geology and likelihood of interactions between vegetation and groundwater; and • All data contributes to decision making but not definitive in isolation.
Vegetation types	Field surveys Scientific literature	Critical information about vegetation communities and their ecological attributes, particularly: • Known reliance on groundwater; and • Likely rooting depth of key tree species.
Groundwater modelling	Predicted Drawdown Extent	Understanding predicted impact area
	Modelled Groundwater Table impact: Horse Pit Extension Project Groundwater Assessment (SLR 2021)	• Critical information about existing depth to groundwater and whether it is shallow enough for vegetation to access; and • Critical information to predict potential impacts (including location and scale) to any potential TGDEs from drawdown.
Groundwater bore data	Site groundwater data	Important inputs into groundwater models
Remote sensing analysis	Remote Sensing of Terrestrial GDEs: Using the GEM method (2rog Consulting 2021)	Method recommended by IESC that may be used for: • Regional scale data that may be useful to supplement field assessments; • Highlights vegetation areas that are relatively greener and wetter than surrounding areas; and • Selection of dry (drought) images and wet images provides contrast to identify vegetation likely to be accessing groundwater sources.

5.10.2.4 Commonwealth and State Government Mapping

The National Groundwater Dependent Atlas (2016) (GDE Atlas) identified 154 ha of TGDEs mapped within the Predicted Drawdown Extent. Mapped TGDE areas were in association with watercourse and floodplain vegetation as well as areas containing underlying basalt, located within the southern extent in association with Cherwell and Caval creeks. The GDE Atlas (by the Bureau of Meteorology) mapping within the Predicted Drawdown Extent is shown in Figure 5-34 and extent summarised in Table 5-38. The GDE Atlas mapped TGDEs within the Predicted Drawdown Extent are largely associated with riparian and floodplain communities (land zone 3) and intersect eight (8) RE communities (Table 5-38 and Table 5-39).

Table 5-38 GDE Atlas areas within the Predicted Drawdown Extent

GDE Atlas category	Area (ha)	Associated RE Type
Low potential TGDE	88.03	11.3.2, 11.3.7, 11.3.25, 11.4.9, 11.5.3 and 11.5.9b
Moderate potential TDGE	61.76	11.3.25, 11.4.8, 11.4.9 and 11.8.5
High potential TDGE	4.54	11.3.25



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:70,000 at A4

Project No.: 620.13593
Date: 01-Sep-2022
Drawn by: JG

QLD Registered Groundwater Monitoring Bore
Predicted Drawdown Extent
Watercourses
Project Area
BHP Tenements

Terrestrial GDE

High potential GDE - from national assessment
Moderate potential GDE - from national assessment
Low potential GDE - from national assessment

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Bureau of Meteorology
Mapped Terrestrial GDEs

SLR

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FIGURE 5-34

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Table 5-39 Regional Ecosystems Associated with GDE Atlas Mapping

RE Type	RE Description
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.
11.3.7	*Corymbia* spp. woodland on alluvial plains.
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains
11.4.9	*Acacia harpophylla* shrubby woodland with Terminalia oblongata on Cainozoic clay plains
11.5.3	*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces.
11.5.9b	*Eucalyptus crebra* and other *Eucalyptus spp.* and *Corymbia spp*. woodland on Cainozoic sand plains and/or remnant surfaces.
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.

In addition, desktop mapping identified:

- There are no DNRME (now Department of Resources (DoR)) mapped GDE springs located within the Predicted Drawdown Extent or within close proximity;
- No Ramsar or important wetlands are mapped within the Predicted Drawdown Extent; and
- No wetlands of high ecological significance are mapped within the Predicted Drawdown Extent.

Due to the lack of mapped terrestrial vegetation associated with surface expression, indicator species within the groundcover (e.g., grasses and forbs) are considered unlikely to occur in the Predicted Drawdown Extent. As such, potential TGDE indicator species were restricted to canopy tree species and some subcanopy/shrub species, comprising extensive root systems that may access groundwater levels.

5.10.2.5 Indicator species and depth to groundwater diagnostic criteria

In order for vegetation to access groundwater in the subsurface, root structures need to access the capillary zone located above the groundwater level. Eamus et al. (2006) suggests that groundwater existing at depths greater than 10 m has reduced importance to vegetation. While the probability of use of groundwater by vegetation is reduced at depths of 10 to 20 m, use of groundwater is likely where DTW is 0 to 10 metres below ground level (mbgl), possible at depths of 10 to 20 mbgl and unlikely at depths greater than 20 mbgl (Eamus, Hatton, et al., 2006).

Following literature review and field survey the following likelihood of communities constituting a TGDE was determined:

- Likely interaction: Modelled groundwater table is within adequate range (<10 mbgl) to be accessed by indicator species (i.e. canopy species);
- Possible interaction: Modelled groundwater table is between 10 to 23 mbgl reducing the likelihood of access to groundwater by indicator species; and
- Unlikely interaction: Modelled groundwater table is outside of the range (>23 mbgl) to be accessed by indicator species.

Vegetation surveys of potential TGDE communities at targeted locations (i.e. mapped GDE Atlas) were conducted in accordance with the Queensland Government's Methodology for Surveying and Mapping Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al., 2020)

A comprehensive literature review was then undertaken to identify potential TGDE indicator species observed during the field survey to evaluate the species' reliance of groundwater for long-term viability. Based on information identified within the desktop assessment and literature review, as well as the modelled groundwater table data, an assessment of the likelihood of vegetation and groundwater interaction could be undertaken.

Potential indicator species were only identified within two riparian and floodplain communities (REs 11.3.2 and 11.3.25) and a community on sandy, depositional plains (RE 11.5.3). The literature review did not identify any potential indicator species in the remaining RE types. Only two areas of the Predicted Drawdown Extent contain these RE types: in the north along Horse Creek, and in the south associated with Caval and Cherwell creeks.

Potential TGDE indicator species occurring within REs 11.3.2 and 11.3.25 consist of *Eucalyptus camaldulensis* and *E. populnea*. While the maximum rooting depths in *E. camaldulensis* and *E. populnea* are relatively unknown, a number of studies have identified critical groundwater depths that can assist determining an approximate limit to root growth for the species (Kath et al 2014). Horner et al. (2009) identified evidence of mortality of *E. camaldulensis* on floodplains of the Murray River when groundwater depths reached thresholds of 12 to 15 m deep. Similarly, modelling by Kath et al. (2014) identified correlation between decreased tree condition when groundwater depths reached thresholds of between 12 and 23 m for *E. camaldulensis* and between 13 and 27 m for E. populnea on the Condamine floodplain.

Naumburg et al. (2005) found groundwater decline can inhibit tree roots from accessing available moisture, contributing to water stress and impacting tree condition, particularly during extended drought conditions (Kath et al., 2014). Based on these studies, it has been assumed that the root zone of *Eucalyptus* camaldulensis and *E. populnea* is up to approximately 23 m deep. Therefore, areas of REs 11.3.2 and 11.3.25 that occur where the DTW is between 5 and 23 mbgl are considered to be possible TGDEs.

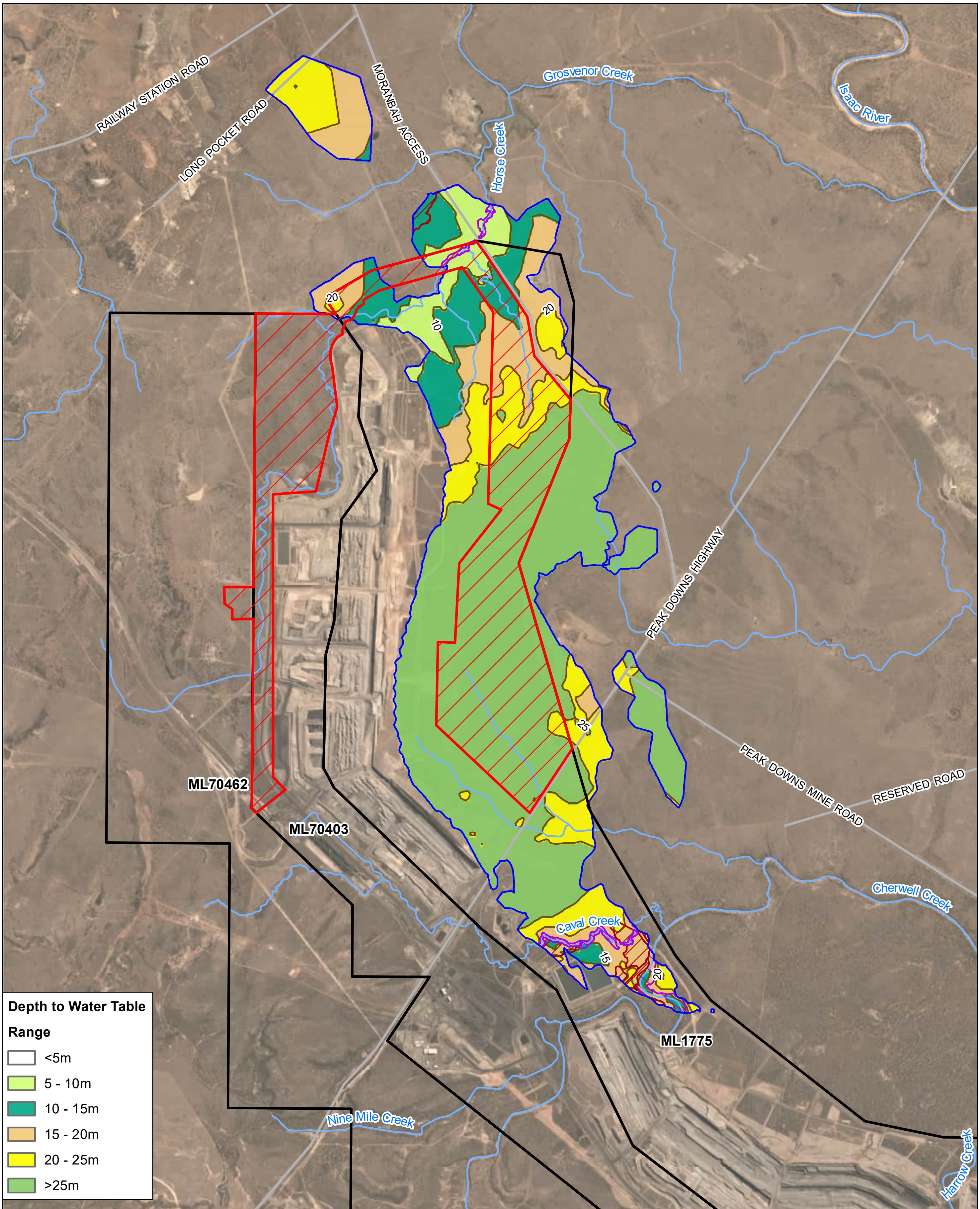
Areas of HVR and remnant RE 11.3.25 along Horse Creek are modelled with a DTW between 5 to 10 mbgl (**Figure 5-35**). Due to the proximity to the groundwater table, this community is considered likely to be a GDE. Furthermore, as the root depths associated species are within the threshold identified by previous studies, coupled with the existing modelled DTW, areas containing RE 11.3.25 are facultative, utilising groundwater when available however not dependent on access for ongoing persistence.

The modelled groundwater table for areas of RE 11.3.2 located within the floodplain of Cherwell Creek and Caval Creek were identified to be around 15 to 25 mbgl. As these areas are also within the threshold of the root depths identified by previous studies RE 11.3.2 is also considered a possible TGDE (facultative).

Rooting depths for other common tree species within floodplain vegetation was also limited. Studies undertaken by O’Grady et al. (2006) within the Daly River in the Northern Territory noted *Casuarina cunninghamiana*, was relatively opportunistic, accessing groundwater at low elevations and relying on soil water at higher elevations in the landscape. O’Grady et al. (2006) also found Melaleuca species fringing riparian corridors to be accessing groundwater, however, are likely to be facultative as opposed to obligate.

A review of modelled groundwater table identified the DTW for areas of RE 11.5.3 to range between 15 to 25 mbgl. As groundwater depths are likely to be greater than 10 mbgl, associated communities (i.e. RE 11.5.3) are considered to be possible TGDEs (facultative). Areas of RE 11.5.3 with a DTW greater than 20 m are considered unlikely to be a TGDE.

Figure 5-36 and **Figure 5-37** show the location of the vegetation communities in the context of the DTW.



0 0.5 1 km

Projection: GDA 1994 MGA Zone 55
Scale: 1:70,000 at A4
Project No.: 620.13593
Date: 01-Sep-2022
Drawn by: JG

Predicted Drawdown Extent
Watercourses (Water Act 2000)
Drainage features
Project Area
BHP Tenements

Ground-truthed Terrestrial GDE Vegetation Communities

Communities on sandy depositional plains
Riparian and floodplain communities

Horse Pit Extension Project EPBC Act Preliminary Documentation (EPBC 2021/9031)

Overview of Depth to Water

SLR BMA BHP Mitsubishi Alliance

FIGURE 5-35

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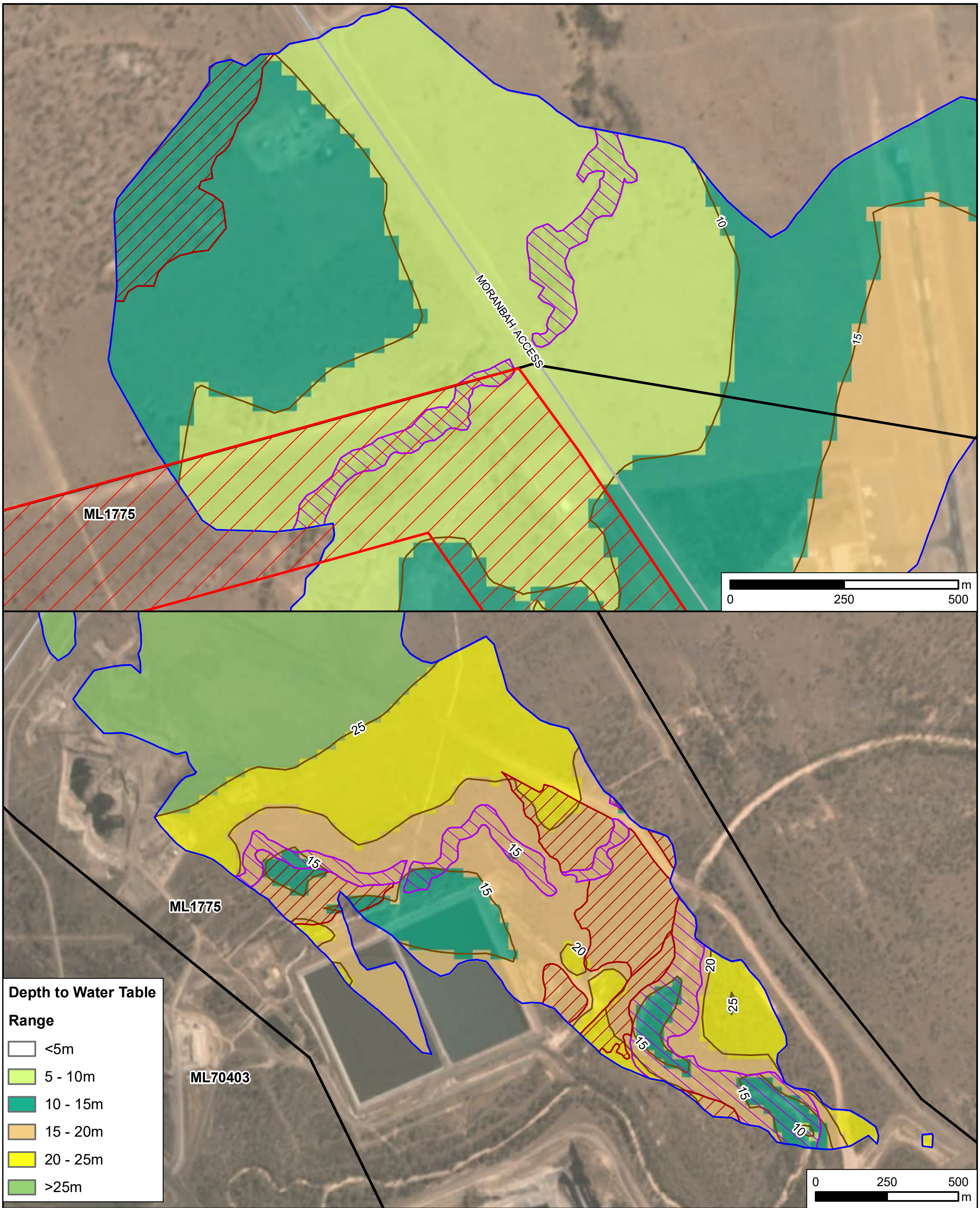

Roads
Project Area
BHP Tenements
Predicted Drawdown Extent
Communities on sandy depositional plains
Riparian and floodplain communities

Projection: GDA 1994 MGA Zone 55
Project No.: 620.13593
Date: 01-Sep-2022
Drawn by: JG

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Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Depth to Water in Relevant Potential Terrestrial GDE Areas

FIGURE 5-36

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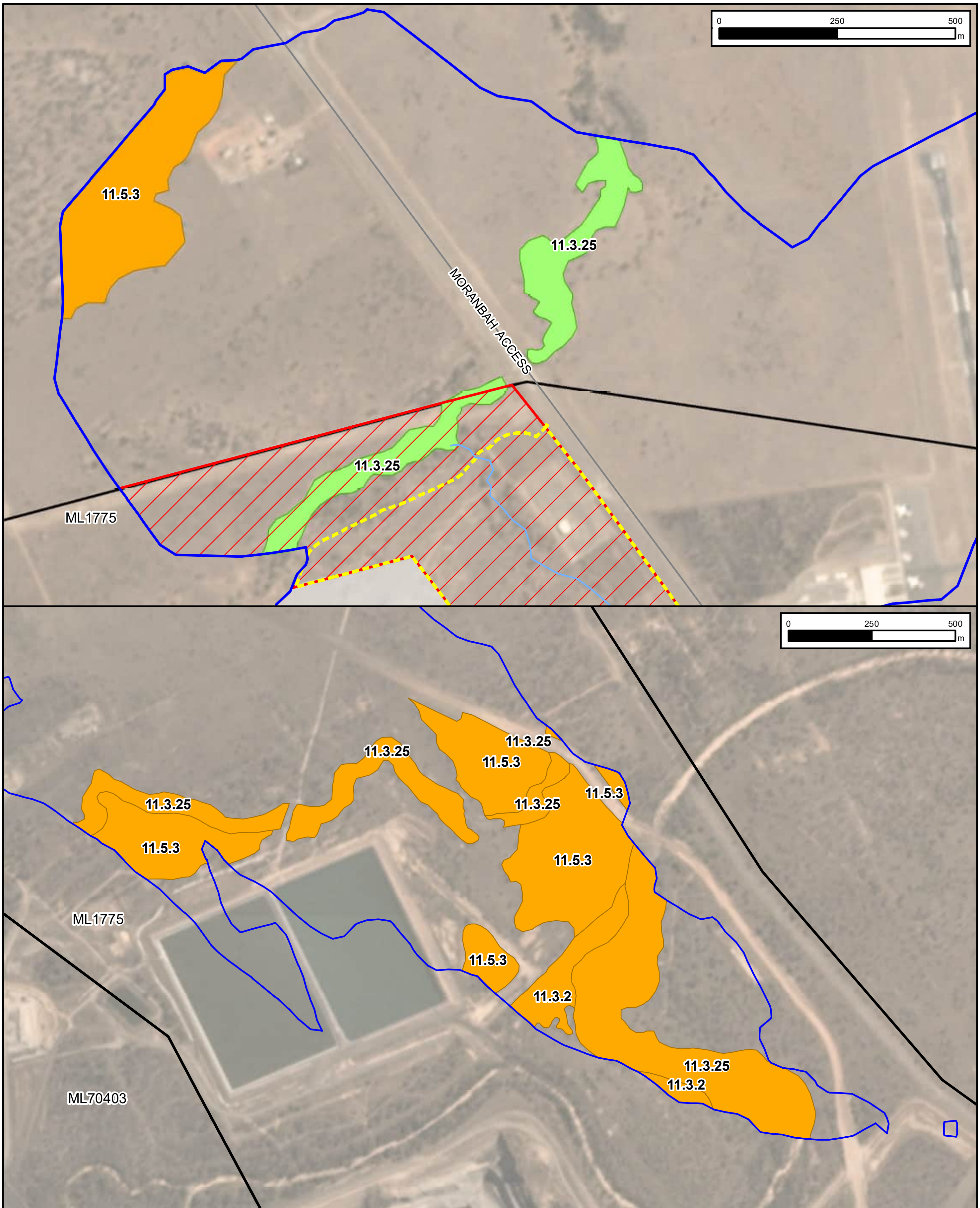

Projection: GDA 1994 MGA Zone 55
Scale: Various
Project No.: 620.13593
Date: 01-Sep-2022
Drawn by: JG

Road
Predicted Drawdown Extent
Project Area
Disturbance Footprint
BHP Tenements

Ground-truthed Terrestrial GDE
Likely
Possible

Horse Pit Extension Project
EPBC Act Preliminary Documentation
(EPBC 2021/9031)

Terrestrial GDE Likelihood based on Depth to Water and Indicator Species

SLR
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FIGURE 5-37

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The extent of vegetation communities considered to be likely and possible TGDEs within the Predicted Drawdown Extent is depicted in Figure 5-38. In summary, of the vegetation communities assessed as part of the field survey, only small areas of riparian vegetation, comprising remnant and HVR RE 11.3.25 within the northern extent of the Predicted Drawdown Extent were considered likely to be a TGDE. Other remnant and HVR communities comprising RE 11.5.3, 11.3.2 and 11.3.25 within the southern extent of the Predicted Drawdown Extent were considered possible TGDEs, with DTW between 10 to 25 mbgl.

Based on available literature and current modelled groundwater table, all of the likely and possible TGDEs identified are considered to comprise facultative TGDE species, utilising groundwater when available however not dependent on access for ongoing persistence. All other vegetation within the Predicted Drawdown Extent were considered unlikely to be groundwater dependent.

A summary of vegetation communities (i.e. RE) identified as potential TGDEs, associated indicator species observed, and justification is provided in Table 5-40. In total, 6.21 ha of likely TGDEs and 64.88 ha of possible terrestrial were identified within the Predicted Drawdown Extent.

Table 5-40 Summary of Potential Terrestrial GDEs *

RE	Indicator Species	Area (ha)	TGDE likelihood and rationale
11.3.2	*Eucalyptus populnea*	0.78 HVR 3.85 Remnant	Possible TGDE (facultative) • Mapped as low potential by GDE Atlas; and • Modelled DTW between 15-25 mbgl.
11.3.25	*Eucalyptus camaldulensis* *E. populnea* *Melaleuca fluviatilis* *Casuarina cunninghamiana*	6.21 HVR 26.5 Remnant	Likely TGDE (facultative) • Modelled DTW for 6.21 ha in northern area between 5-10 mbgl. Possible TGDE (facultative) • Modelled DTW for 26.5 ha in southern area between 15-20 mbgl.
11.5.3	*Eucalyptus populnea*	9.28 HVR 28.52 Remnant	Possible TGDE (facultative) • Modelled DTW for 34.06 ha between 15-25 mbgl; and • Other areas of the community located where DTW modelled >20 m = unlikely GDE.

* Prior to further remote sensing analysis discussed in **Section 4.4.2.3**.

5.10.2.6 Remote sensing diagnostic criteria

The study reported in Appendix E (and summarised above sections) considered where groundwater is available to plants for use (i.e., DTW) and if indicator species are present. The outcomes of that assessment identified three (3) vegetation communities considered to be likely or possible TGDE within the Predicted Drawdown Extent.

The remote sensing-based GEM approach has been used to identify potential TGDEs by contrasting relative ‘greenness’ and ‘moisture status’ of vegetation communities in wet and dry periods using remotely sensed data (Appendix E). The approach is used to highlight particular landscape features using multi-spectral indices that relate to vegetation greenness and wetness. By considering these indices between known (using meteorological data) wet and dry periods, inferences can be made regarding those areas that appear to maintain greenness/wetness when surface runoff is unavailable (and vice versa).

The analysis can be summarised as follows:

- Selection of Landsat Enhanced Thematic Mapper (ETM) imagery from wet and dry periods using weather records and the Landsat ETM archive;
- Generate the Normalised Difference Vegetation Index (NDVI) and Normalised Difference Moisture Index (NDMI, also known as the Normalised Difference Wetness Index) for the images;
    - NDVI of vegetated areas will tend toward positive values whereas water, bare soil and built-up areas will have zero or negative values – this provides a regional image of where vegetation is located and where not;
    - NDMI provides an indication of vegetation water content;

- Combine the ‘wet’ image NDVI and NDMI with the ‘dry’ image NDVI and NDMI into a single 4 band image and reclassify to group areas of similar index values into classes/categories of likelihood. For example:
  - Where all indices for both wet and dry periods are positive the probability of TGDE presence is higher. The analyses suggests that during both wet and dry periods the vegetation maintains ‘greenness’ and ‘wetness’ so likely to have permanent or episodic access to groundwater;
  - Where the wetness indicator (NDMI) is negative during the dry period the analysis identifies that the vegetation is not maintaining wetness through the dry period and therefore unlikely to be accessing groundwater; and
  - Where GEM class data is negative, the result is less diagnostic and instead considered to be evidence contributing to the community being an unlikely TDGE.

As discussed in Section 3.1.2 of Appendix I, the outcomes of the GEM analysis did not identify any TGDEs directly within the Predicted Drawdown Extent. However, it is noted that the spatial resolution is an important limitation to consider when using imagery and mapping. The Landsat data has a resolution of 30m pixels and as such the GEM class data derived following the index analyses also has a 30m pixel size. As such, narrow riparian corridors, such as those that are known to occur in the CVM region, and small wetland communities may not be identified. Recognising this limitation, the GEM analysis was explored further to consider if there are vegetation areas in the wider region that may be displaying likely TGDE values.

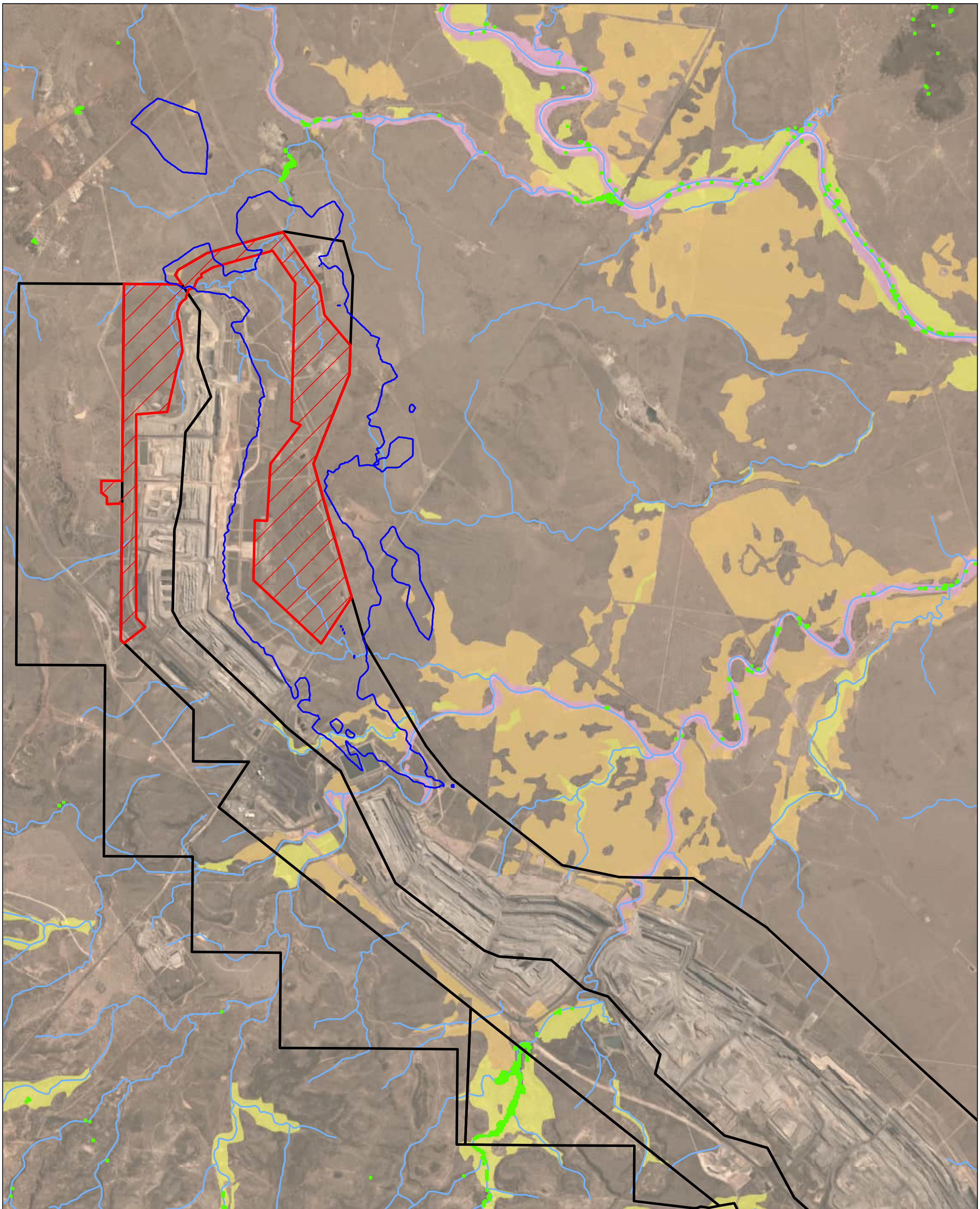
Figure 5-38 shows the positive GEM class data within the Predicted Drawdown Extent and surrounds.

The GEM output shows no positive GEM class areas within the Predicted Drawdown Extent, however on a regional scale there is a positive GEM class indication along the riparian areas of the Isaac River and Cherwell Creek. The regional ecosystem type in these riparian locations is 11.3.25, as a result all areas of 11.3.25 within the Predicted Drawdown Extent are categorised as likely TDGE. The remaining vegetation communities are considered unlikely TGDE as there is no indicators (using the GEM approach) to suggest there is permanent or episodic access to groundwater.

5.10.2.7 Summary of Results

Assessment undertaken first considered the DTW and presence of TGDE indicator species within the known vegetation communities of the Predicted Drawdown Extent. The assessment highlighted three (3) communities meeting the criteria for ‘likely’ TGDE (areas of 11.3.25) and ‘possible’ GDE (areas of 11.3.2 and 11.5.3). Through additional analysis using remote sensing techniques it was determined that all areas of 11.3.25 should be considered likely TGDE with the remainder reclassified to unlikely based on the remote sensing criteria.

The total area of likely TGDE within the Predicted Drawdown Extent is 32.71 ha.



Projection: GDA 1994 MGA Zone 55
Scale: 1:97,248 at A4
Project No.: 620.13593
Date: 01-Sep-2022
Drawn by: JG

Predicted Drawdown Extent
Watercourses
Project Area
BHP Tenements

Positive GEM
Regional Ecosystem
11.3.2
11.3.25
11.5.3

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Remote Sensing Diagnostic Output

FIGURE 5-38

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5.10.3 Potential Impacts

Potential impacts to the likely TGDE within the Predicted Drawdown Extent as a result of the Project are related to:

- Direct disturbance – in the event vegetation clearing is required;
- Groundwater drawdown – specifically a reduced access to water at the root depth for some species within the communities present;
- Changes in groundwater quality – specifically if there is a spill event that leads to a contamination of groundwater; and
- Changes in surface water quality – noting the facultative nature of the indicator species identified, an event that leads to a deterioration of surface water quality also has potential to impact TGDE.

5.10.3.1 Direct disturbance

No terrestrial GDEs as mapped by the National Groundwater Dependent Atlas are located within the Disturbance areas for the Project (see Appendix I). Furthermore, no likely (RE 11.3.25 along Horse Creek) or potential terrestrial GDEs (RE 11.3.2, 11.3.25 and 11.5.3) are located within the Disturbance Footprint and will require removal as a result of the Project.

5.10.3.2 Potential Impact due to drawdown

The mining process reduces water levels in surrounding groundwater units due to interception of groundwater in the mined geology. To understand the potential impact the assessment has been undertaken to identify if the drawdown is likely to impact the maintenance of ecosystem function of the TGDE (i.e., impact to a supporting service, Section 5.2.1 of the *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoE 2013). To determine this impact two aspects have been considered:

- Are there areas of likely TGDE where predicted drawdown will result in movement of groundwater away from the vegetation root zone?
- If so, what is the context of the potential loss with regard to the functioning of the TGDE ecosystem?

A drawdown of any particular magnitude has potential to impact TGDEs differently based on the species present, the starting level of groundwater and the extent to which drawdown will move groundwater beyond the zone in which it is accessible to vegetation. The impact assessment focusses on understanding if the predicted drawdown reduces the accessibility of the water from the root zone for the applicable TGDE.

To consider the risk of impact the following criteria have been applied (Table 5-41).

Table 5-41 Risk of Impact Due to Drawdown

Drawdown depth	Risk of impact to GDE	Next steps
Groundwater level remains above root zone at maximum drawdown	No – TGDE unlikely to be impacted by drawdown; access to groundwater is maintained	Continue project with appropriate mitigation measures
Groundwater level remains within 1 m above root zone at max. drawdown	Potential – TGDE may be impacted by drawdown; access to groundwater may be affected	Implement adaptive monitoring over time to determine whether potential impacts arise
Groundwater level is below root zone at max. drawdown	Yes – TGDE likely to be impacted by drawdown; access to groundwater is compromised	Implement appropriate measures to address impacts. This may include further avoidance or mitigation and/or offsets

Section 5.10.2.3 identifies 32.71 ha of likely TGDE (RE 11.3.25) within the Predicted Drawdown Extent. The indicator species identified for 11.3.25 include *Eucalyptus camaldulensis, E. populnea, Melaleuca fluviatilis* and *Casuarina cunninghamiana*. Outcomes of the literature review led to an assumption that the root zone of *E. camaldulensis* and *E. populnea* is up to approximately 23 mbgl (for the purposes of this assessment within the 20-25 mbgl range).

The impact assessment documented in Section 6.1 of **Appendix E** tabulated the extent to which the predicted drawdown would increase the DTW beyond the threshold of root depth for the indicator species. When considering the additional assessment described in **Section 5.10.2.6** accounting for more detailed remote sensing interpretation, a revised impact table is shown below (with reference to the criteria shown in **Table 5-42**). Of the total area of likely TGDE, only 15.91 ha is located within an area where the TGDE is considered at risk (i.e. drawdown may reduce access to the root zone of vegetation).

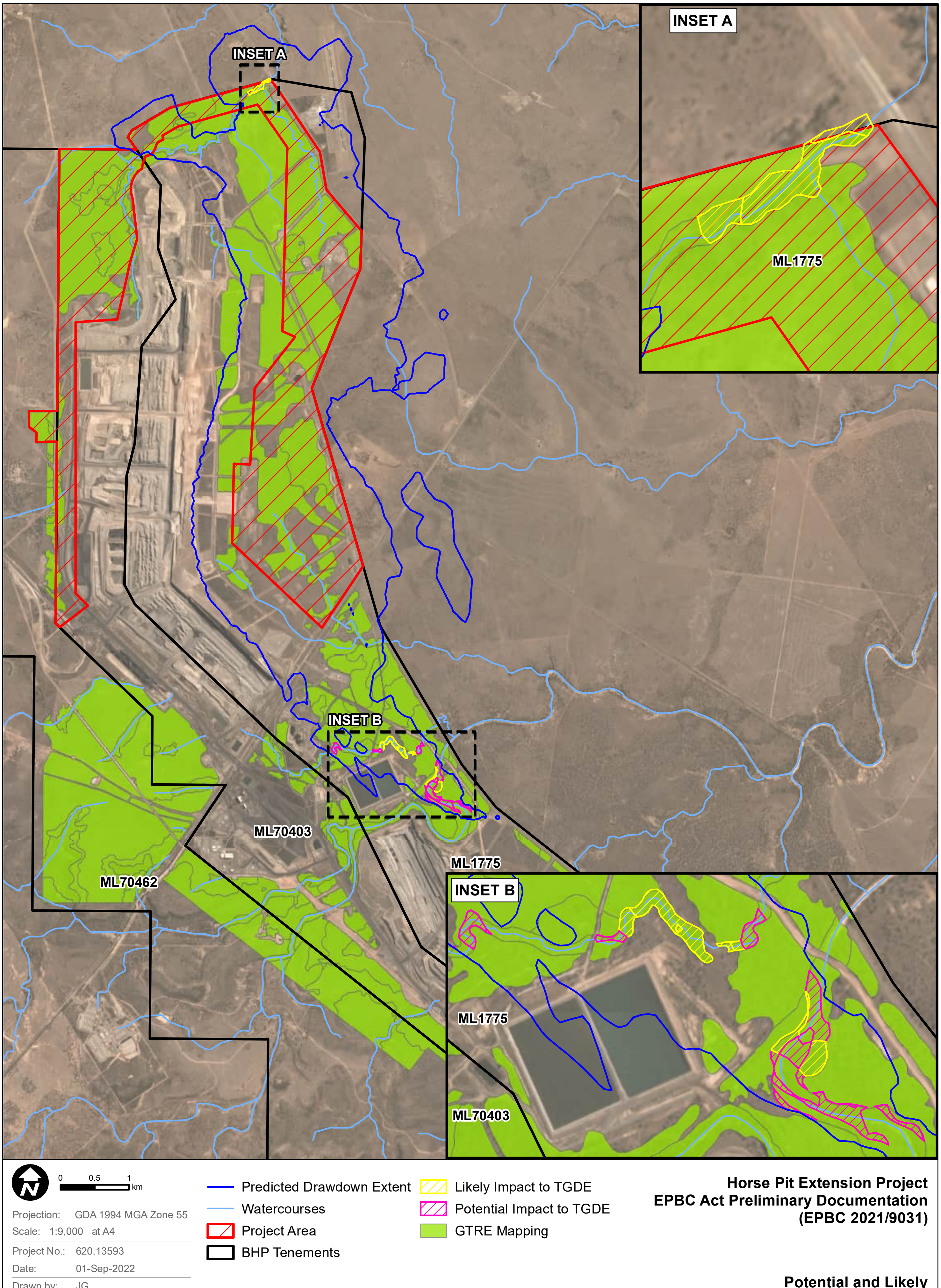
Table 5-42 Extent of Potential Impact to Likely Terrestrial GDE due to Predicted Drawdown

Current depth to groundwater	Modelled drawdown	New maximum predicted DTW	Potential impacts to likely TGDE
5 – 10 mgbl	2 m (1-2 m)	7 – 12 mbgl	No – access to groundwater is maintained
	5 m (2-5 m)	10 – 15 mbgl	No – access to groundwater is maintained
	10 m (5-10 m)	15 – 20 mbgl	No – access to groundwater is maintained
	20 m (10-20 m)	25 – 30 mbgl	Yes - 0.63 ha of vegetation affected
	50 m (20-50 m)	55 – 60 mbgl	Yes - 1.18 ha of vegetation affected
10 – 15 mgbl	2 m (1-2 m)	12 – 17 mbgl	No – access to groundwater is maintained
	5 m (2-5 m)	15 – 20 mbgl	No – access to groundwater is maintained
	10 m (5-10 m)	20 – 25 mbgl	Potential - 1.0 ha of vegetation potentially affected
	20 m (10-20 m)	30 – 35 mbgl	Yes - 0.06 ha of vegetation affected
	50 m (20-50 m)	60 – 65 mbgl	No likely GDEs occur within this existing depth to groundwater
15 – 20 mgbl	2 m (1-2 m)	17 – 22 mbgl	No – access to groundwater is maintained
	5 m (2-5 m)	20 – 25 mbgl	Potential - 7.12 ha of vegetation potentially affected
	10 m (5-10 m)	25 – 30 mbgl	Yes - 2.68 ha of vegetation affected
	20 m (10-20 m)	35 – 40 mbgl	Yes - 2.94 ha of vegetation affected
	50 m (20-50 m)	65 – 70 mbgl	No likely GDEs occur within this existing depth to groundwater
20 – 25 mgbl	2 m	22 – 27 mbgl	Potential – 0.3 ha of vegetation potentially affected
	5 m	25 – 30 mbgl	No likely GDEs occur within this existing depth to groundwater
	10 m	20 – 35 mbgl	No likely GDEs occur within this existing depth to groundwater
	20 m	40 – 45 mbgl	No likely GDEs occur within this existing depth to groundwater
	50 m	70 – 75 mbgl	No likely GDEs occur within this existing depth to groundwater

While the indicator species in this vegetation community may experience an increased depth to the groundwater as a result of the Project, it should also be acknowledged that these communities are considered facultative. The total extent of potential and likely impacts to TGDEs is:

- The total area of likely TGDE where drawdown is considered to potentially impact the community is 8.42 ha (drawdown predicted to maintain within 1 m above root zone at maximum drawdown); and
- The total area of likely TGDE where drawdown is considered likely to impact the community is 7.49 ha (drawdown predicted reduce groundwater level below the root zone at maximum drawdown).

These potential and likely impact areas are outline on Figure 5-39.



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Potential and Likely Terrestrial GDE Impact Areas

FIGURE 5-39

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The likely TGDEs identified within the Project's Predicted Drawdown Extent (derived from the Project's groundwater model) are consistent with other terrestrial GDEs identified within the Isaac River drainage sub-basin and surrounding landscape. Terrestrial GDE assessments undertaken for the Olive Downs Coking Coal Project identified likely TGDEs (facultative) in association with riparian vegetation (RE 11.3.4 and RE 11.3.25) and aquatic habitats associated with the Isaac River (Pembroke Olive Downs Pty Ltd, 2019). These included terrestrial riparian vegetation (RE 11.3.25) associated with the North Creek, Cherwell Creek and the downstream reaches of Ripstone Creek (Pembroke Olive Downs Pty Ltd, 2019).

Terrestrial GDE assessments undertaken for the Isaac Downs Project identified GDEs in association with riparian communities along the Isaac River, comprising RE 11.3.25 (3D Environmental, 2019). These TGDE communities, located on the immediate fringing alluvial high bank of the River, were identified as interacting with the shallow groundwater in the alluvial aquifer (3D Environmental, 2019). Further back from the immediate River edge however, trees on the upper banks of the Isaac were considered likely to have no, or limited dependence on groundwater, and therefore have a low potential to be GDEs (3D Environmental, 2019). Generally, the Isaac Downs Project assessment found that TGDEs are limited to deeper rooted eucalypt species along the immediately fringing riparian zone, within tens of metres of the River channel. There was no evidence of GDEs outside this area. It is worth noting that the HPE Project's groundwater model does not predict any groundwater drawdown at the Isaac River where these GDEs were identified.

Assessments for the Winchester South Project identified riparian vegetation associated with the Isaac River and Cherwell Creek (RE 11.3.25) had a moderate to high potential of being a TGDE, with any dependency on groundwater in the Quaternary alluvium likely to be facultative (Whitehaven Coal Pty Ltd, 2021). It was also concluded that the riparian vegetation surrounding these ephemeral wetlands (RE 11.3.27 and 11.3.3c) have a moderate potential of also being a TGDE, with any dependency on groundwater also likely to be facultative (Whitehaven Coal Pty Ltd, 2021). Some areas of vegetation associated with RE 11.5.3, but also with RE 11.3.2 and RE 11.3.4, were considered to have low potential of meeting the definition of a TGDE, due to the poor quality (high salinity) of the groundwater source (Whitehaven Coal Pty Ltd, 2021).

5.10.3.3 Potential impact due to changes in groundwater quality

Section 6.3 of Appendix I identifies the potential impact of a change in groundwater quality to likely TGDEs.

Leaks, spills and improper disposal of wastes, including waste rock can lead to the leaching of compounds into the groundwater following rainfall events. Contamination of groundwater can impact the condition and health of TGDEs as they access this water source in the root zone.

5.10.3.4 Summary and Significance of Potential Impact to TGDE

The outcomes of the assessment of impacts identified:

- TGDE are the only type of GDEs identified within the Predicted Drawdown Extent.
- Areas of likely TGDE that may be impacted as a result of groundwater drawdown (associated with areas of RE 11.3.25). This included 7.49 ha of vegetation likely impacted, and 8.42 ha of vegetation categorised as potentially impacted. Only two (2) areas of the Predicted Drawdown Extent contain the potential TGDEs: in the north along Horse Creek, and in the south associated with Caval and Cherwell creeks (**Figure 5-39**).
- Within the Predicted Drawdown Extent, RE 11.3.25 is comprised of *Eucalyptus camaldulensis* woodlands occurring along riparian corridors. Associated species within the community include *E. populnea, Melaleuca fluviatilis, Casuarina cunninghamiana, Lysiphyllum hookeri* and *Acacia salicina*. The community is in a moderate condition across the Predicted Drawdown Extent, with some evidence of non-native plant cover, which decreases native species diversity in the ground layer. RE 11.3.25 as a community that generally provides preferred habitat for koala and squatter pigeon, although neither of the species were recorded.
- Potential impacts to groundwater and surface water quality as a result of mining activities that require management to avoid a possible indirect impact to health and condition of TGDE vegetation.

Overall, the extent of likely TGDE that is potentially impacted is small (total 15.91 ha, with only 7.49 ha likely to be impacted). The total loss of ecosystem function of this small area represents the worst-case scenario of the extent of impacts. In addition, when considering the small extent in combination with the facultative nature of the species/communities the impact to TGDE as a result of the Project is not considered significant.

The likely TGDE is facultative, and species may not necessarily be adversely impacted by a change in the depth to groundwater. In the case of facultative communities, groundwater drawdown is likely to have minimal impacts on vegetation resulting in a small decline in vegetation characteristics such as canopy cover and height during drier years, rather than total loss. Such impacts may only be visible during periods of drought when several successive years of below average rainfall occur. While the condition of vegetation may deteriorate slightly overall for some periods, a functional vegetation community remains. As a precaution, monitoring will be undertaken to identify the nature of an impact (should it be realised) and facilitate application of targeted management.

5.10.4 Mitigation and Management Measures

5.10.4.1 Groundwater Drawdown

Changes to groundwater quantity and interactions are not expected in the unconsolidated sediments of the Isaac River alluvium, in the lower reaches of the Isaac River and at the confluences of larger tributaries (i.e., where GDEs and stygofauna communities are likely to occur). Therefore, no impacts to potential GDE communities are expected because of the Project, and residual risk from changes to groundwater is low.

5.10.4.2 Groundwater Quality

To minimise potential impacts on groundwater quality, existing mitigation measures outlined in the EA conditions will continue to be implemented, including:

- Implement annual monitoring of groundwater quality to identify trends and changes over time, and
- Fuel, dangerous goods and hazardous chemicals will be managed as outlined by current standards, guidelines and in compliance with statutory requirements.

Furthermore, ongoing groundwater quality monitoring will be conducted, as outlined below.

5.10.4.3 Surface Water Quality

To manage the potential for decreased surface water quality during construction and operation, existing mitigation measures outlined in the EA conditions will continue to be implemented. These measures have been outlined under Section 5.6.5.

5.10.4.4 Monitoring and Management

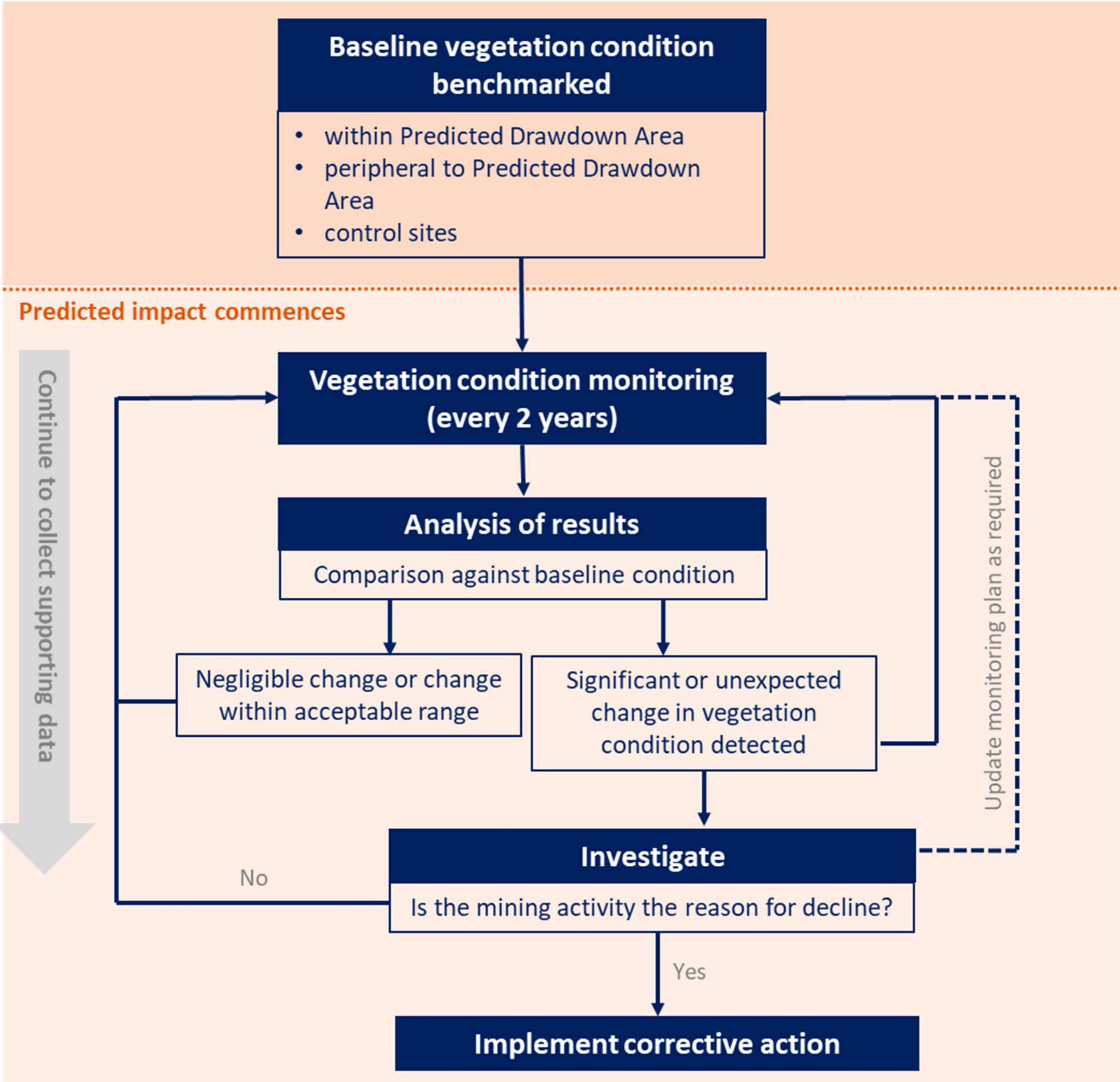
Impact assessment determined that the impact to the likely TGDE is not significant when assessing against the *Significant impact guidelines 1.3*. A Groundwater Dependent Ecosystem Monitoring and Management Plan (GDEMMP) will be developed with the key objective of monitoring TGDE condition and functioning to verify the outcomes of the significance impact assessment and identify any unexpected impacts.

The approach to the monitoring will comprise the following broad components, with the adaptive management cycle demonstrated in the graphic below:

- **Baseline characterisation** – Vegetation condition of the likely TGDE areas will be benchmarked based on a number of monitoring events undertaken prior to any predicted impact (ie prior to drawdown nearing boundaries of the predicted extent). Existing data will be built upon with a minimum of four additional monitoring events to collect appropriate seasonal and spatial data. Monitoring will be undertaken within the Predicted Drawdown Area, peripheral to the Predicted Drawdown Area and at chosen control sites.
- **Undertake verification monitoring** – the condition and functioning of likely TGDE vegetation will be monitored at a minimum of every 2 years during the impact phase of the Project. The objective of the monitoring is to detect a change in vegetation condition of likely TGDE areas within the area peripheral to the Predicted Drawdown Area.
- **Analyse results** – data collected will require analysis and comparison to baseline benchmarks. Where a decline in likely TGDE vegetation condition and function is detected the significance of the decline will be assessed in accordance with significant impact guidance
- **Investigate relationship with other environmental parameters** – where a significant decline in likely TGDE condition and function is detected, an investigation will be triggered to assess if the decline is related to HPE

Project mining activities. This step will require drawing upon other supporting datasets (for example groundwater level and quality data, surface water flow and quality data, or other environmental datasets). Where the HPE Project mining activities are a contributing factor in a significant impact, corrective actions will be identified and implemented.

Following the investigation, the adaptive management cycle will be completed by identifying opportunity to update the GDEMMP based on the outcomes of an investigations providing updated monitoring or mitigation approaches, or improvements as required.



5.10.5 Summary

This Section summarises the assessment undertaken to determine the likely presence of terrestrial groundwater dependent vegetation that may be impacted by the Project. The GDE Atlas maps terrestrial GDEs within the Predicted Drawdown Extent as low potential (88.04 ha) and moderate potential (61.76 ha), with minor areas of high potential (4.54 ha). This mapping in conjunction with vegetation community mapping guided survey design and literature review.

Assessments of vegetation communities within the Predicted Drawdown Extent identified approximately 6.21 ha of vegetation communities considered likely terrestrial GDE (riparian communities RE 11.3.25) associated with Horse

Creek. Vegetation considered possible terrestrial GDE, totalling 64.88 ha, associated with riparian corridors, floodplains and sandy plains were also identified within the southern extent in association with Caval Creek and Cherwell Creek.

Interpretation of the modelled groundwater drawdown data showed 1.81 ha of likely GDE along Horse Creek that is expected to be subject to a DTW increase beyond the threshold of indicator species root depths (12-23 m). An additional 36.92 ha of possible GDE vegetation is also expected to be subject to a DTW increase beyond the threshold of indicator species root depths.

While the indicator species in vegetation communities within the area of likely GDE and possible GDE may experience an increase in depth to the groundwater, these communities are considered to be facultative. Facultative vegetation access groundwater when it is available rather than relying on it for survival. The conclusion that vegetation in the Predicted Drawdown Extent uses groundwater facultatively is further supported by the results of the GEM method assessment. The GEM method assessment did not identify any likely GDEs in the Predicted Drawdown Area. Due to the facultative nature of these vegetation communities, likelihood and scale of impact (i.e., area), the Project is considered unlikely to result in a significant impact to vegetation communities that may access groundwater.

5.11 Waste Management

Wastes generated by the Project will be managed as per Schedule D4: Waste of the EA and the existing Waste Management Plan in place at the CVM: Waste Management Plan (CVM WMP). The objective of the CVM WMP is to minimise adverse impacts on environmental values such as, the health and wellbeing of site personnel, the diversity of ecological processes and associated ecosystems surrounding the CVM and other environmental factors including land resources, surface and groundwater resources and air quality. Waste generated by the Project will be managed in the same way. As such the existing CVM WMP is adequate to continue management of waste streams at the CVM and the Project, as provided by Condition D2 of the EA.

This section provides an assessment of the waste management aspects for the Project, including the identification of solid and liquid waste streams, regulatory framework and outlines existing waste management strategies employed under the CVM WMP.

5.11.1 Potential Impacts

The potential impacts of waste generation from the Project include the following:

- A beneficial impact is financial remuneration and improved external relations as a result of recycling programs, including the recycling of tyres, batteries and scrap metal
- Appropriately managing storage and disposal of waste streams also results in a potential beneficial environmental outcome as risk of environmental harm is reduced
- By appropriately managing storage and disposal of waste streams, potential environmental contamination is also reduced
- Wastage of raw materials (e.g., wastage of materials, such as steel and concrete)
- Wastage of embedded energy and GHG emissions
- Consumption of landfill space (e.g., where waste is sent to local landfills)
- Generation of landfill leachate and landfill gas (e.g., from waste sent to local landfills)
- Risks to human health or safety (e.g., through poor management of hazardous materials)
- Pollution of soil, groundwater, or surface water (e.g., through accidental spills or releases), and
- Lost opportunity for resource re-use/recycling if product is disposed.

5.11.2 Waste Management Objectives

BMA has established the following waste management objectives for CVM and these will apply to the Project:

- Minimise waste-related adverse effects to the integrity and function of the air, land and water environmental values
- Minimise the generation of waste through applying the avoidance, minimisation and mitigation principles to reduce, reuse, recycle, treat and dispose of waste, and
- Ensure safe management and disposal of waste that cannot be reused or recycled.

5.11.3 Waste Management Strategy

Environmental harm will only occur if wastes are not managed properly, especially where there is the potential for waste to cause land, surface water, and/or groundwater contamination. The waste management strategy proposed for the Project will be consistent with Schedule D4: Waste of the EA and the CVM WMP and will incorporate the continued operation, and decommissioning phases. Waste planning for the Project, as at the CVM, will allow for flexibility in the management of all wastes likely to be generated.

Under the EA, reprocessing and disposal of certain waste streams is permitted on ML 70462, ML 70403 and ML 1775. Under the EA, waste is permitted to be disposed of as follows:

- In spoil emplacements – rejects and sediment containing hydrocarbons, and
- In pits or voids, spoil emplacements and left insitu below ground level - bulk rubber, inert waste, poly-pipe and other plastic, fibreglass, treated and untreated timber, asphalt, and asbestos.

In addition, the EA provides for the reprocessing of spoil or overburden, vegetation, water or sediment containing hydrocarbons, fuels, oils, lubricants, coolants, bulk rubber, inert waste, poly-pipe and other plastic, fibreglass, treated and untreated timber, and asphalt.

Waste that cannot be reprocessed or disposed of as per the EA and CVM WMP will be disposed of to the landfill at the PDM under the PDM EA (EPML00318213) or transported offsite to an alternate licenced waste disposal facility. The Project will not result in a new process or varied process for reprocessing of any waste. As such the existing CVM WMP is adequate to continue management of waste streams at the CVM and the Project, as provided by Condition D2 of the EA.

5.11.4 Waste Management Plan

The objective of the CVM WMP is to minimise adverse impacts on environmental values such as, the health and wellbeing of site personnel, the diversity of ecological processes and associated ecosystems surrounding the CVM and other environmental factors including land resources, surface and groundwater resources and air quality.

The CVM WMP uses the waste management hierarchy as a framework for prioritising waste management practices to achieve the best environmental outcome. The production of waste is avoided where possible on-site. However, where the production of waste is unavoidable, waste re-use is the preferred option, followed by waste recycling and finally disposal. The waste management hierarchy is presented in Figure 5-40.

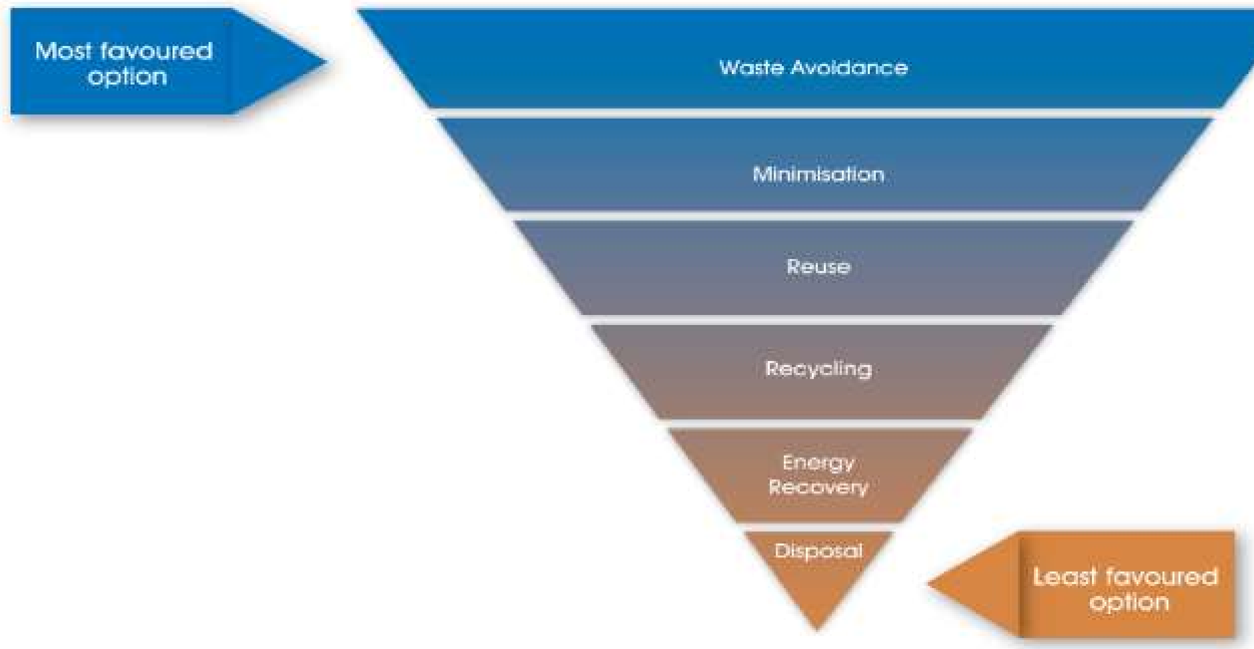


Figure 5-40 Waste Management Hierarchy

5.11.4.1 Waste Avoidance and Minimisation

The CVM WMP documents measures to manage wastes at CVM in a variety of ways as outlined below:

- Bulking up – materials such as lubricants, chemicals and other high use materials are purchased and stored in bulk to reduce associated packaging waste.
- Rationalisation Programs – where product varieties are restricted and consequently the number of different waste streams reduced.
- Materials Tracking Programs – enables the tracking of material usage and distribution to assist with the identification of inefficiencies and development of strategies to reduce material usage.
- Compaction – Most general waste produced on site is compacted prior to disposal by the waste contractor.

One of the largest sources of waste is the various packing materials, which accompany equipment and material shipped to site. Shipping and packing specifications at CVM require packing materials to be minimised and, where possible, the use of environmentally responsible packaging materials. Additionally, the choice of returnable containers, reusable packing material and biodegradable materials is preferred over synthetic, non-recyclable packing material.

5.11.4.2 Waste Segregation

Waste segregation will apply to the management of all waste streams for the Project, as per the existing CVM WMP. Segregation will occur at the point of generation and will cover the handling and removal of a variety of wastes. For example, paper, cardboard, metal cans and plastics carrying the recycle symbol will be segregated for recycling. Maintaining segregation of different types of waste during generation, storage or transportation, makes recovery achievable.

The waste that is generated can be separated into the following main groups: general waste, recycled waste, and regulated waste. Segregation of these waste streams at CVM involves the use of colour-coded and signed bins and waste storage locations. Separate skips are provided to maintain segregation and maximise economic reuse and recycling, in preference to disposal to landfill.

5.11.4.3 Waste Reuse, Recycling and Recovery

Waste reuse, recycling and recovery measures at CVM include water conservation, treatment and reuse, efficient energy usage and classification and sorting of general wastes. General wastes are classified and sorted into the following categories:

- Timber, lumber and wood
- Steel/iron
- Plastics labelled for recycling
- Tyres
- Paper and carton, and
- Used oil.

5.11.4.4 Waste Disposal

Waste generated on-site during the operational and decommissioning phases that cannot be recycled, reused or disposed of at CVM under the EA will be disposed of to the landfill at the PDM under the PDM EA (EPML00318213) or transported offsite to an alternate licenced waste disposal facility. All wastes transported from the site will be transported by licensed waste transport carriers.

5.11.5 Waste Production

Waste generated from the Project will be managed under the CVM WMP and will generally comprise waste from vegetation clearing and site preparation activities such as stripping, general waste streams and regulated wastes. Key waste producing activities, potential waste produced and associated potential impacts are summarised in Table 5-43 and key waste types and collection and recycling or disposal measures are outlined in

Table 5-44.

Table 5-43 Waste Generation and Potential Impacts

Activity	Waste Produced	Potential Impacts
Operations		
Pit preparation	• Waste rock • Green waste • Dust emissions • Gaseous emissions, and • Sediment runoff.	• Potential impacts from management of waste rock is considered under Section 5.1, 5.2, 5.6 and 5.7 • Green waste production may result in increased risk of sedimentation from temporary storage of green waste and potential for spread of exotic species. Refer to Section 5.8. • Dust and gaseous emission impacts are addressed under Section 5.4. • Potential impacts from sediment runoff is addressed under Section 5.6.
Waste rock dump preparation and development	• Acid drainage • Green waste • Dust emissions • Gaseous emissions, and • Sediment runoff.	• Potential impacts from management of waste rock is considered under Section 5.1, 5.2, 5.6 and 5.7 • Spoil is overwhelmingly NAF with excess ANC and has a negligible risk of developing acid conditions. Geochemistry of waste rock is discussed in detail under Section 5.2. • Green waste production may result in increased risk of sedimentation from temporary storage of green waste and potential for spread of exotic species. Refer to Section 5.8. • Dust and gaseous emission impacts are addressed under Section 5.4. • Potential impacts from sediment runoff is addressed under Section 5.6.
Construction of bridge over Horse Creek and haul roads	• Construction material wastes • Green waste • Dust emissions • Gaseous emissions, and • Sediment runoff.	• Potential impacts from construction material wastes include visual impacts, contamination of land and/or waters, and stockpiling of this waste may result in erosions and sedimentation of waterways. • Green waste production may result in increased risk of sedimentation from temporary storage of green waste and potential for spread of exotic species. Refer to Section 5.8. • Dust and gaseous emission impacts are addressed under Section 5.4. • Potential impacts from sediment runoff is addressed under Section 5.6.
Maintenance of plant and equipment	• Waste oil and filters, and • Hydrocarbon contaminated materials.	• Potential impacts from hydrocarbon wastes include contamination of land and/or waters resulting in potential to impact water quality and ecosystem function. Refer to Section 5.1, 5.2, 5.6, 5.7 and 5.9.
Vehicle Servicing	• Batteries • Tyres • Waste oil and filters, and • Hydrocarbon contaminated materials.	• Potential impacts from these wastes include visual impacts, contamination of land and/or waters resulting in potential to impact water quality and ecosystem function. Refer to Section 5.1, 5.2, 5.6, 5.7 and 5.9.
Production of general wastes	• Putrescible & organic (food waste) • Plastics • Paper, and • Other packaging wastes.	• Potential impacts from these wastes will be negligible and may include visual impacts and risk to human health from vermin as a result of inappropriate disposal.
Sewage Effluent Production	• Sewage, and • Treated sewage wastewater.	• Potential impacts from these wastes include visual impacts, contamination of land and/or waters resulting in potential to impact water quality and ecosystem function. Refer to Section 5.1, 5.2, 5.6, 5.7 and 5.9. • Inappropriate management of this waste may also result in human health risks and odour nuisance.
Decommissioning		
Demolition of BMA accommodation camp	• Demolition wastes: concrete, plastics, metals, wood waste • Dust emissions • Gaseous emissions, and • Sediment runoff.	• Potential impacts from demolition wastes include visual impacts, contamination of land and/or waters, and stockpiling of this waste may result in erosions and sedimentation of waterways. • Dust and gaseous emission impacts are addressed under Section 5.4. • Potential impacts from sediment runoff is addressed under Section 5.6.

Activity	Waste Produced	Potential Impacts
Relocation of compounds, facilities and other infrastructure	• Demolition wastes: asphalt, concrete, plastics, metals, wood waste • Green waste • Dust emissions • Gaseous emissions, and • Sediment runoff.	• Potential impacts from demolition wastes include visual impacts, contamination of land and/or waters, and stockpiling of this waste may result in erosions and sedimentation of waterways. • Green waste production may result in increased risk of sedimentation from temporary storage of green waste and potential for spread of exotic species. Refer to Section 5.8. • Dust and gaseous emission impacts are addressed under Section 5.4. • Potential impacts from sediment runoff is addressed under Section 5.6.

Table 5-44 Waste Management

Waste Type	Characteristics	Collection and Recycling/Disposal
General Waste	Any clean, non- hazardous solid waste that is not categorised into another waste stream, including: • Food scraps • Other non-recyclables, including some plastics, and • Operational and/or demolition waste which is classified as nonhazardous.	Collection on-site and storage in segregated area. Waste that cannot be recycled, reused or disposed at CVM under the EA will be disposed of to the landfill at the PDM under the PDM EA (EPML00318213) or transported offsite to an alternate licenced waste disposal facility.
General Demolition and Construction Wastes	Large waste items, including: • Bulk non-recyclable packaging • poly-pipe and other plastic • fibreglass • treated and untreated timber • asphalt, and • asbestos.	As per Condition D7 of the CVM EA, these wastes will be disposed of in pits or voids, in spoil emplacements and left in-situ below ground level. If these wastes cannot be recycled, reused or disposed at CVM, these will be disposed of to the landfill at the PDM under the PDM EA or transported offsite to an alternate licenced waste disposal facility.
Recyclable Waste	Any clean, non- hazardous solid waste that is designated as recyclable, such as cardboard, paper, glass bottles, milk and juice cartons, aluminium and steel cans, plastic bottles and containers (Type 1,2,3).	Recyclable waste is segregated and collected on-site. Recyclable waste is then transported to the waste contractor Materials Recovery Facility located in Clermont for consolidation and processing. Waste is segregated and bailed, crushed and/or transported to various companies for reuse.
Inert Waste	Inert wastes include bricks, pavers, ceramics, concrete, glass, steel, or similar waste that does not biodegrade or decompose. Including wastes from the relocation of infrastructure, construction and demolition.	These wastes are stored in bins and skips across site which are routinely collected. As per Condition D7 of the CVM EA, these wastes will be disposed of in pits or voids, in spoil emplacements and left in-situ below ground level. If these wastes cannot be recycled, reused or disposed at CVM, these will be disposed of to the landfill at the PDM under the PDM EA or transported offsite to an alternate licenced waste disposal facility.

Waste Type	Characteristics	Collection and Recycling/Disposal
Regulated Waste (Hydrocarbon waste including Polychlorinated biphenyls)	Any hydrocarbon material or material contaminated by hydrocarbons, including: • Oily rags and other used absorbent materials, hydraulic hoses, small oil containers and grease cartridges • Grease extracted during maintenance activities and spilled grease resulting from machinery component failure, including dragline grease • Any liquefied waste hydrocarbon, such as engine oil, waste diesel, etc • Oily water. • Fuels and liquids collected/ removed from equipment • Hydrocarbon contaminated soil • Any waste contaminated with polychlorinated biphenyls • Sediment layer remaining after industrial sources have been processed through an oily water separator • Oily water flowing into separators from fuel bays, wash-down bays and workshop floors, and • Used waste oil and fuel filters.	• These wastes are captured and stored in appropriately bunded areas, with bins provided for separation and collection and of oily water separators and waste oil collectors • The site includes provision of spill response equipment, regular maintenance and pump out of oily water interceptors and collectors • Waste oil is put through a cleaning process and is used for the production of blasting material where appropriate • Excess oil is recovered and sold as waste oil, and • Hydrocarbon wastes that cannot be reused or recycled are collected by a licensed contractor as a regulated waste and transported to a licenced waste disposal facility.
Regulated Waste (Batteries)	Any batteries from light / heavy vehicles.	Battery wastes are collected in designated containers in the workshops. Battery waste is routinely collected and transported offsite to a licenced waste disposal facility.
Regulated Waste (Sewage)	Untreated liquid waste from sanitary systems.	Treated wastewater from the site STP may be used to irrigate areas or for dust suppression, industrial reuse or evaporated from mine water dams. Sewage from site crib huts is pumped out by a waste contractor and transported to the Buffel Park STP for treatment. Treated water is pumped back to CVM into the mine water system.
Waste Drums	Waste drums are defined as any 205 L and 20 L drums that is no longer required for use.	Waste contractor removes drums offsite, where they are crushed and consolidated. The recovered oil is collected for recycling and the crushed carcasses are recycled.
Green Waste	Cleared vegetation and green garden waste.	Suitable material is used on site to provide fauna habitat. Remaining material is mulched and utilised for rehabilitation and revegetation, as provided for by Condition D4 of the CVM EA. If green waste cannot be recycled, reused or disposed at CVM, it will be disposed of to the landfill at the PDM under the PDM EA or transported offsite to an alternate licenced waste disposal facility.
Bulk rubber waste	Rubber waste includes: • Any tyre from a vehicle, that is no longer required for use, including heavy and light vehicle tyres • Spent conveyor belts, and • Other rubber waste.	As per Condition D7 of the CVM EA, this waste will be disposed of in pits or voids, in spoil emplacements and left in-situ below ground level. If these wastes cannot be recycled, reused or disposed at CVM, it will be disposed of to the landfill at the PDM under the PDM EA or transported offsite to an alternate licenced waste disposal facility.
Infectious Waste	Infectious wastes (also called biomedical waste).	Waste contractors change out bins which are transported offsite for disposal by licensed contractor.

Waste Type	Characteristics	Collection and Recycling/Disposal
Miscellaneous Chemicals	Any non-hydrocarbon chemical that is no longer required for use on site, has been contaminated or has passed its expiry date.	Waste contractor to dispose of as regulated waste in accordance with the product's Safety Data Sheet (SDS). In accordance with the SDS, waste chemicals are to be recovered to containers, labelled appropriately and transferred to the Waste Chemicals area in the CVM Warehouse.

5.11.6 Summary of Mitigation Measures and Commitments

A summary of the waste management mitigation measures and commitments are presented below:

- Identification and minimisation of waste streams
- Improve where possible on the waste disposal and management techniques currently adopted
- All waste generated on-site will be disposed of in accordance with the EA and CVM WMP
- Contracts with external companies will place responsibility on all contractors to adopt best practice waste minimisation procedures
- Waste monitoring and auditing will be undertaken, and
- Training will be provided to personnel and contractors in relation to waste management requirements and practices.

6 Environmental Authority Amendments

Based on the outcomes of the assessments undertaken it is understood that revised conditions relating to groundwater monitoring locations and environmental offsets may be required.

As part of the assessment process BMA will engage with the DES regarding changes to existing EA conditions as part of this proposed amendment.