SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Appendix K-1
Rehabilitation Management Plan

BHP

Contents

Abbreviations

AEP	Annual Exceedance Probability
BMA	BM Alliance Coal Operations Pty Ltd
CHPP	Coal Handling and Preparation Plant
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
EA	Environmental Authority
EIS	Environmental Impact Statement
EPC	Exploration Permit for Coal
ERA	Environmentally Relevant Activity
EVNT	Endangered, Vulnerable and Near Threatened
FPC	Foliage Projective Cover
FY	Financial Year
ha	Hectares
IRC	Isaac Regional Council
km	Kilometres
LGA	Local Government Area
m	Metres
MIA	Mine Industrial Area
Mtpa	Million tonnes per annum
mm	Millimetres
ML	Mining Lease
MLA	Mining Lease Application
NATA	National Association of Testing Authorities
PRCP	Progressive Rehabilitation Closure Plan
PVMA	Pesticides and Veterinary Medicines Authority
Qld	Queensland
RE(s)	Regional Ecosystem(s)
RMP	Rehabilitation Management Plan
ROM	Run-of-mine
SMP	Subsidence Management Plan
SMUs	Soil mapping units
TEC(s)	Threatened Ecological Community(ies)

Saraji East Mining Lease Project

1 Rehabilitation Management Plan

1.1 Project background

The Saraji East Mining Lease Project (herein referred to as 'the Project') is a greenfield single-seam underground mine development on Mining Lease Application (MLA) 70383 and MLA 70459 commencing from within Mining Lease (ML) 1775. The Project is located within the Isaac Regional Council (IRC) Local Government Area (LGA) in the Central Queensland Bowen Basin, approximately 30 kilometres (km) north of Dysart and 170 km south-west of Mackay (Figure **1**).

The Project is located adjacent to the existing Saraji Mine, which BM Alliance Coal Operations Pty Ltd (BMA) currently operates on ML 1775, ML 70142, ML 1784, ML 1782, ML 2360, ML 2410, ML 70294, ML 70298, ML 70328 and ML 700021 under Environmental Authority (EA) Permit No. EPML00862313.

The Project Site is bound by Exploration Permit for Coal (EPC) 837, EPC 2103, MLA 70383, MLA 70459, ML 1775, ML 70142 and ML 1782.The Project Site encompasses approximately 11,427 hectares (ha) of land. Mining and the infrastructure required to support the Project is not proposed within the full extent of the Project Site with direct impacts constrained to a smaller area of some 3,425 ha within MLA 70383, MLA 70459, ML 70142 and ML 1775 (Figure 2).

The area to be mined will use the longwall coal extraction methodology. As mining activities retreat along the longwall panel, overlying strata collapses into the area known as goaf. The extent to which this subsidence can be seen at the surface depends on the type of overlying strata, the thickness of the extracted seam and the distance between the mining operations and the surface.

1.2 Purpose of the Rehabilitation Management Plan

BMA conducts progressive rehabilitation across available areas of the organisation's mining operations. Successful mine rehabilitation is contingent on suitable planning, including setting objectives, indicators and performance criteria to measure the progress of rehabilitation against. The purpose of this Rehabilitation Management Plan (herein referred to as 'the Plan') is to provide the framework within which progressive and final rehabilitation can be planned and executed for the Project. The purpose of the Plan is to:

- Identify potential rehabilitation risks associated with longwall mining
- Set rehabilitation objectives, indicators and performance criteria for rehabilitation activities in line with the *BHP Queensland Coal Rehabilitation Completion Criteria* (BHP, 2018)
- Provide a methodology for achieving rehabilitation objectives
- Ensure that the environmental impacts are managed and rehabilitated appropriately
- Minimise long term maintenance within any impacted watercourses.

The outcomes from implementation of the Plan include:

- Progressive rehabilitation that considers the *Mined Land Rehabilitation Policy* (Department of Environment and Science (DES), 2018)
- Properly managed waterways in relation to mine associated environmental impacts

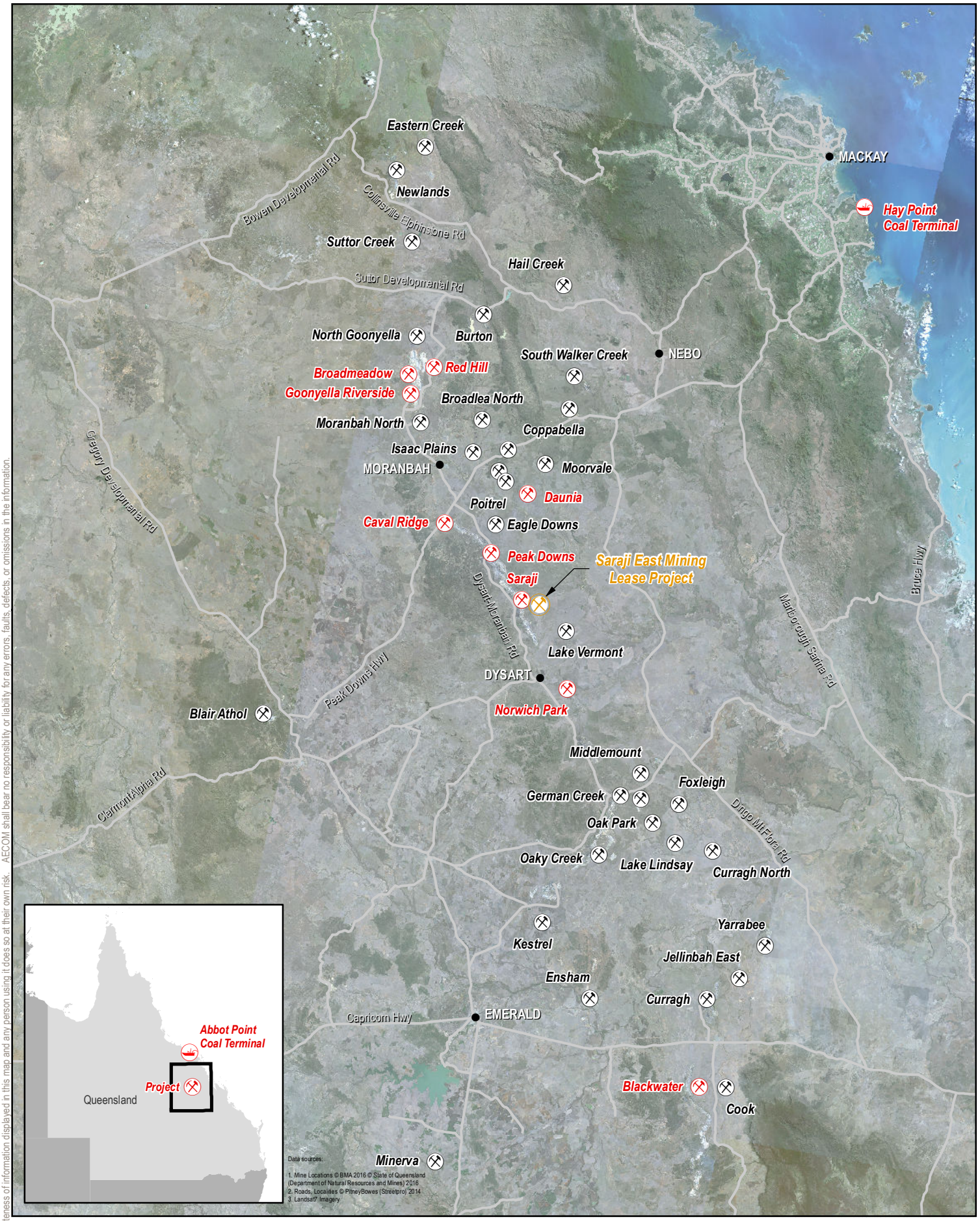
- Rehabilitation that achieves the post mining land use objectives in line with the *BHP Queensland Coal Rehabilitation Completion Criteria* (BHP, 2018)
- Waterways that are comparable to pre-mining conditions where practicable
- Mitigation of environmental risk.

The Plan will form a part of the Project's environmental management system intended to meet the obligations of the *Mined Land Rehabilitation Policy* (DES, 2018) and the EA. This Plan should be read and implemented in conjunction with the Saraji East Mining Lease Project Subsidence Management Plan (SMP). The SMP can be found in **Appendix K-2 Subsidence Management Plan** of the EIS.

The scope of the Plan includes:

1. Identification of applicable legislative requirements
2. Establishment of a rehabilitation hierarchy as applicable to the Project
3. Establishment of a proposed post mining land use
4. Setting goals and objectives of rehabilitation
5. Setting performance indicators and criteria for rehabilitation
6. Identification of potential residual risks
7. Establishment of a plan for progressive rehabilitation including a rehabilitation schedule
8. Establishment of the monitoring and maintenance requirements.

This Plan is applicable to the Project only.



LEGEND

- Saraji East Mining Lease Project
- Locality
- Major Road
- BMA Coal Terminal
- BMA Mine
- Other Mine

Figure 1
Regional Context

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Rehabilitation Management Plan
Saraji East Mining Lease Project

0 5 10 20
Kilometres

Scale: 1:1,500,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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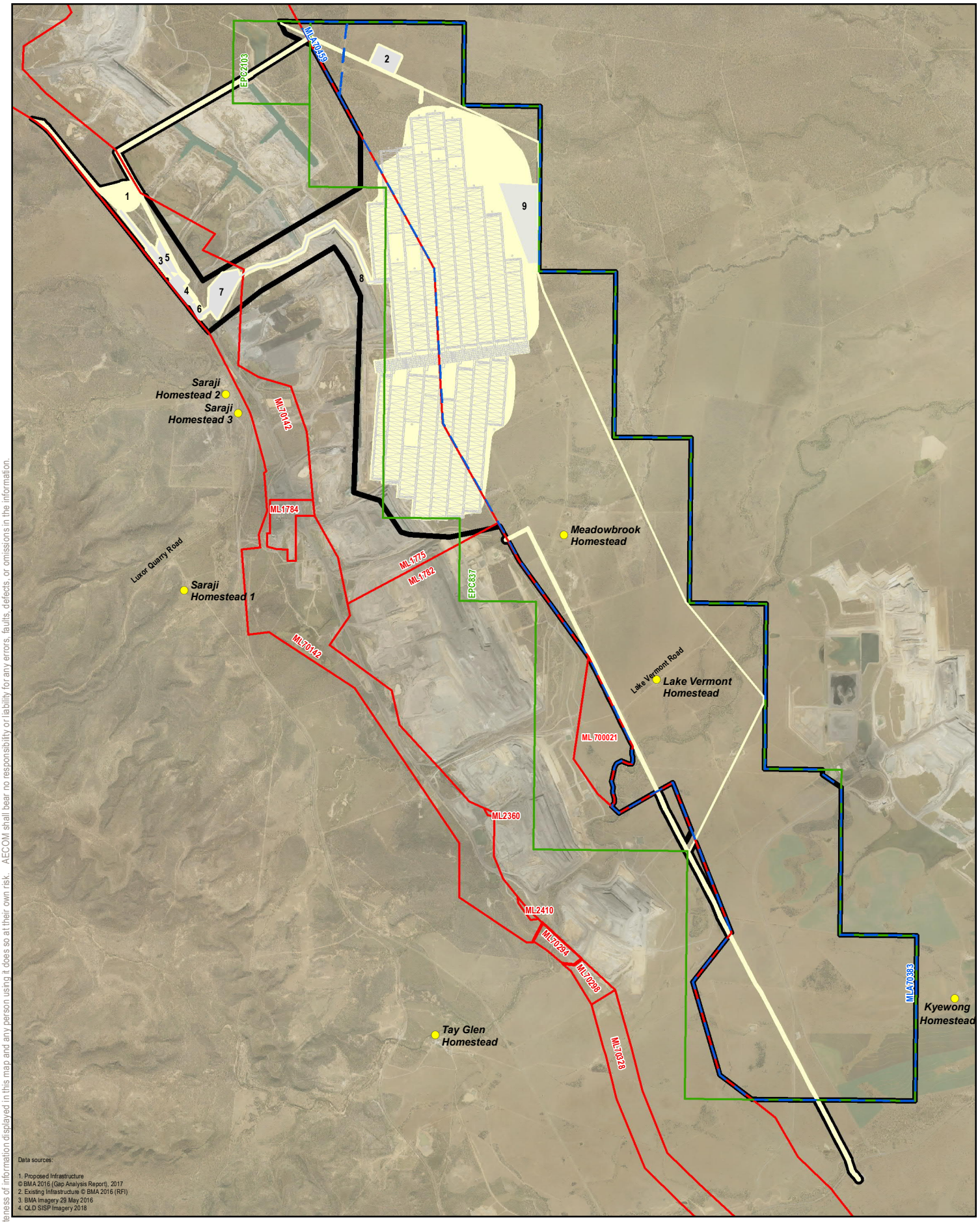

Data sources:

1. Proposed Infrastructure © BMA 2016 (Gap Analysis Report), 2017
2. Existing Infrastructure © BMA 2016 (RFI)
3. BMA Imagery 29 May 2016
4. QLD SISP Imagery 2018

LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground layout (optimised)
- Surface Infrastructure
- Homestead

Surface Infrastructure

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Accommodation Village

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Figure 2
Project Layout

Rehabilitation Management Plan
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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2 Legislative requirements

2.1 Legislation and guidelines

The Plan will meet the rehabilitation obligations outlined in:

- Guideline: Application requirements for activities with impacts to land (Version 4, Department of Environment and Heritage Protection (DEHP), March 2017)
- Guideline: Rehabilitation requirements for activities with impacts to water (Version 4.02, DES, March 2017)
- Guideline: Rehabilitation requirements for mining and resource activities (Version 2, DEHP, May 2014)
- Queensland Environmental Offsets Policy (Version 1.1, DEHP, December 2014).

These obligations and the area in which they are addressed in the Plan are summarised in Table 1.

Table 1 Regulatory obligations for the Rehabilitation Management Plan

Description	Reference	RMP Reference
Provide a drawing/site plan showing the impacts arising from subsidence associated with the Environmentally Relevant Activity (ERA).	Guideline: Application requirements for activities with impacts to land (DEHP, 2017)	Section 7
Describe in detail all land disturbance associated with the ERA.	Guideline: Application requirements for activities with impacts to land (DEHP, 2017)	Section 5
Demonstrate how the ERA will be managed to minimise the extent and severity of disturbance. This should include identifying any staged disturbance, progressive rehabilitation, measures to manage or minimise impacts to biodiversity and any anticipated long-term impacts including identification of areas that will no longer provide any beneficial land use after ERA has ceased. Additionally, areas of subsidence must be identified.	Guideline: Application requirements for activities with impacts to land (DEHP, 2017)	Section 9,10
Where contaminant release to waters or disturbance of waters (i.e. reshaping of the bed and banks of a watercourse) is proposed, the applicant must identify how the Project Site will be rehabilitated. The RMP must provide for the following (where relevant): • a schematic representation of the watercourse, post disturbance clearly showing any realignment or reshaping of the features of the watercourse • rehabilitation objectives for contaminant levels within waters (including waters left in residual voids post operations) • decommissioning of bores	Guideline: Application requirements for activities with impacts to water (DES, 2017)	Sections 9,10

Description	Reference	RMP Reference
• a monitoring program to demonstrate the rehabilitation success • completion criteria, indicators and objectives • procedures for rehabilitation maintenance or redesign.		
RMP shall include general and site specific goals.	Guideline: Rehabilitation requirements for mining and resource activities (DEHP, 2014)	Section 9.4
The post mining land use for each domain must be identified.	Guideline: Rehabilitation requirements for mining and resource activities (DEHP, 2014)	Section 8 and 9.4
RMP shall include risk assessment documenting the probability and consequence of future environmental harm for each domain.	Guideline: Rehabilitation requirements for mining and resource activities (DEHP, 2014)	Section 6
The applicant should consider the rehabilitation hierarchy when assigning a final land use. Rehabilitation objectives must achieve the highest practicable level in the rehabilitation hierarchy, address potential environmental impacts and propose a final land use that is acceptable to the local community, government and any other relevant stakeholders. Rehabilitation objectives must specify in sufficient detail so to be capable of assessment by the administering authority.	Guideline: Rehabilitation requirements for mining and resource activities (DEHP, 2014)	Section 2.2
Rehabilitation indicators must provide a defensible measurement of rehabilitation progress towards objectives.	Guideline: Rehabilitation requirements for mining and resource activities (DEHP, 2014)	Section 9.7
Completion criteria must provide a clear definition of successful rehabilitation for each domain. There must be at least one completion criteria for each indicator.	Guideline: Rehabilitation requirements for mining and resource activities (DEHP, 2014)	Section 9.7
Offsets are required where impacts to remnant vegetation are unavoidable.	Queensland Environmental Offsets Policy (DEHP, 2014a)	Section 10.5

Additionally, the *Biosecurity Act 2014* (Qld) imposes a general obligation on persons to take all reasonable and practical measures to mitigate or minimise the impact of biosecurity risks on human health, social amenity, the economy and the built environment (Queensland Government, 2017). Failing to manage the impact of invasive plants and animals on a property is considered to exacerbate the effects or potential adverse effects of a biosecurity matter.

2.2 Rehabilitation hierarchy

The rehabilitation hierarchy of DES (formerly DEHP) Guideline – Rehabilitation requirements for mining resource activities (EM1122 Guideline) outlines the preferred methodologies to mining activities that minimise the risk of environmental harm. The EM1122 Guideline states that strategies listed higher in the hierarchy should be adopted in preference to those listed lower, unless there are significant environmental, economic or social issues that override a higher selection. The rehabilitation hierarchy is summarised as follows, in order of preference:

1. avoid disturbance that will require rehabilitation
2. reinstate a “natural” ecosystem as similar as possible to the original ecosystem
3. develop an alternative outcome with a higher economic value than the previous land use
4. reinstate previous land use (e.g. grazing or cropping)
5. develop lower value land use
6. leave the project site in an unusable condition or with a potential to generate future pollution or adversely affect environmental values.

This rehabilitation hierarchy will apply differently to each of the post mining land uses outlined in Section 8. In assessing the applicable goals of the hierarchy, BMA will consider the pre-mining land use, any compensation agreements regarding land including stakeholder values, the potential uses of the rehabilitated land and the surrounding environmental values.

2.3 Mined Land Rehabilitation Policy

The recently passed *Mineral and Energy Resources (Financial Provisioning) Act 2018* amends the *Environmental Protection Act 1994* (EP Act), replacing the Plan of Operations and Financial Assurance (FA) with Estimated Rehabilitation Cost (ERC) and Progressive Rehabilitation and Closure Plan (PRCP). The Project will comply with the *Mineral and Energy Resources (Financial Provisioning) Act 2018.*

The *Mined Land Rehabilitation Policy* is an outcome of the *Mineral and Energy Resources (Financial Provisioning) Act 2018.* The objective of the *Mined Land Rehabilitation Policy* (DES, 2018) is for land disturbed by mining activities to be rehabilitated to a safe and stable landform that does not cause environmental harm and is able to sustain a post mining land use which has been approved through a PCRP.

Further, it states that voids situated wholly or partially in a floodplain are to be rehabilitated to a safe and stable landform that is able to sustain an approved post mining land use that does not cause environmental harm.

The Project will comply with the *Mineral and Energy Resources (Financial Provisioning) Act 2018.* A Progressive Rehabilitation and Closure Plan (PRCP) will be developed prior to construction commencing and will demonstrate that the proposed Project will:

- be rehabilitated to a safe and stable landform
- not cause environmental harm
- sustain post mining land uses

3 Baseline conditions

3.1 Landform

A soils assessment was undertaken for the Project Site, in which 23 soil mapping units were identified. The Project Site includes areas of gently undulating plains with gradational to duplex sandy soils to uniform clays with microrelief to areas of drainage depressions near active alluvia areas.

3.2 Surface water

The **Surface Water Quality Technical Report** (AECOM, 2019c) as well as the **Hydrology, Hydraulics and Geomorphology Technical Report** (Alluvium, 2019) completed as part of the Environmental Impact Statement (EIS) details the baseline values for the Project. This includes the pre-subsidence channel geometry of specific reaches of the three waterways and their surrounding areas, namely:

1. Boomerang Creek
2. Plumtree Creek
3. Hughes Creek.

The pre-subsidence surface water assessments undertook the following characterisation of environmental values in each watercourse:

- morphological characterisation of each affected watercourse to determine stream forms, dominant geomorphic processes and stream trajectory
- sediment transport modelling
- generation of hydrographs and peak discharge estimates
- development of 1d hydraulic models
- determination of the key hydraulic characteristics for stream power, shear stress and velocity for a range of flow events
- determination of key sediment transport characteristics for a range of flows
- determination of key flood characteristics for depth, velocity and extents.

Geomorphologic assessment was undertaken as part of the **Hydrology, Hydraulics and Geomorphology Technical Report** (Alluvium, 2019) and will act as baseline for the Project. The baseline included assessment of the geomorphic character, behaviour and condition of the potentially impacted waterways using qualitative (expert observation) and quantitative (terrain, hydraulic and sediment transport modelling) measures, including:

- morphological characterisation of each affected watercourse to determine stream forms, dominant geomorphic processes and stream trajectory
- determination of key sediment transport characteristics for a range of flow events
- 1D hydraulic and sediment transport modelling to estimate the in-channel energy conditions.

Baseline of rainfall and flow event monitoring data in each waterway as well as water physico-chemical properties was collated. Together, these studies describe the prevailing surface water conditions of each waterway. The initial pre-subsidence surface water monitoring will be utilised to

determine trigger levels and compliance limits against which monitoring during operations and post-closure can be compared.

3.3 Ecology

The **Terrestrial Ecology Technical Report** (AECOM, 2019d) completed as part of the EIS documents the baseline for ecological values across the Project. Flora and fauna surveys were conducted to determine the ecological values of the Project Site. These baseline studies have ground truthed regional ecosystems (REs) that may be impacted.

The information collected from baseline studies allows for changes in vegetation community structure to be detected.

An aquatic ecology survey was undertaken for the Project, in which no conservation significant species were identified.

4 Objectives

The rehabilitation objectives to be achieved for the Project are as follows:

- rehabilitation processes and outcomes will be consistent with the EIS, which forms the basis for any approvals.
- rehabilitation will comply with the relevant regulatory requirements, and regulatory consensus will be attained on the successful closure and rehabilitation of the project site.
- the project site will be rehabilitated to an agreed final land use compatible with the surrounding land fabric and land use requirements.
- the rehabilitation will be sustainable in terms of final land use.
- waste substances that have the potential to affect land use or result in pollution will be secured and safely contained.
- the rehabilitated project site will not present an unacceptable hazard to persons, stock or native fauna.
- the site will be clean and tidy and any remaining structures will be left in a condition that provides for the safety of the public.

5 Domains

5.1 Overview

The Project Site has been divided into domains to assist in providing land use-specific rehabilitation objectives and performance indicators and criteria. These domains are representative of the activity occurring in each area and the potential post mining land use and capability of the land following completion of those activities. The Project domains are:

- subsided riverine areas
- subsided non-riverine areas
- surface infrastructure
- future subsidence areas.

5.2 Subsided riverine

This domain includes the lower, upper and middle reaches of any of the waterways which are subject to subsidence. Waterways within the Project Site comprise:

- Boomerang Creek
- Plumtree Creek
- Hughes Creek.

These waterways may be broken into the pillar zones and non-pillar zones of each panel to enable targeted application of mitigation methodologies. This domain includes any non-remnant riparian vegetation associated with waterways, as well as remnant vegetation which are not associated with waterways.

5.3 Subsided non-riverine areas

This domain includes all subsided areas which are not associated with the waterways outlined in Section 5.2 and includes grazing pasture areas.

5.4 Surface infrastructure

This domain includes the following:

- drill pads and infrastructure hardstand areas including the incidental mine gas network
- surface infrastructure including accommodation camps, roads, bores, dams, pipelines, stormwater management systems, powerlines, Mine Industrial Area (MIA), Coal Handling and Preparation Plant (CHPP), rail loops and vent shafts.

5.5 Future subsidence areas

This domain consists of any areas from Figure 8 that are yet to undergo subsidence. The schedule for subsidence is outlined in Section 9. Areas within this domain will cease to be considered a future subsidence area once each panel is subsided. Due to the rate at which panels will be subsided, this domain will generally decrease in area (by approximately one panel each year).

6 Risk assessment

The risk assessment for each domain is shown in Table 5. The risk assessment utilises the risk matrix shown in Table 2, and likelihood assessment, shown in Table 3. Table 4 presents the consequence table.

Table 2 Risk Matrix

Likelihood	ARI Level	Low L1	Minor L2	Moderate L3	Major L4	Critical L5	EWRM
A - Almost Certain	1	High	High	Extreme	Extreme	Extreme	10
B - Likely	<10	Moderate	High	High	Extreme	Extreme	3,1,0.3
C - Possible	<100	Low	Moderate	High	Extreme	Extreme	0.1
D - Unlikely	<1000	Low	Low 3	Moderate	High	Extreme	0.03
E - Rare	>1000	Low 1	Low 2	Moderate	High	High	

Table 3 Likelihood assessment

Likelihood selected severity happens	Recurrence	Chance	Likelihood
Happens often	>1/year	>80%	10
Easily happen	1-2 years	50%	3
Has happened (here or elsewhere)	5 years	20%	1
Possible	10 years	10%	0.3
Conceivable	50 years	2%	0.1
Extreme circumstances	>50 years	1%	0.03
Assume reasonable effectiveness of preventative control. Likelihood based on improved controls (if event has happened)			

Table 4 Consequence table

Severity level	Health and safety	Environment	Community	Reputation	Legal	Financial
7	>50 fatalities. Permanent impairment >30% of body to more than 500 persons.	Permanent severe impact(s) to land, biodiversity, ecosystem services, water resources or air.	Severe, widespread community health, safety or security impacts (>1000 households) or human rights violations; complete destruction of >1000 houses or community infrastructure; complete irreversible desecration of multiple structures, objects or places of global significance.	Crisis event or publication of highly confidential inside information resulting in international media, government, regulator or NGO campaigning and employee condemnation of the company (>6 months). Long term damage to company reputation.	Bankruptcy affecting the business or multiple assets. Not getting or losing the right to develop or operate the business or multiple assets. Investigation for alleged severe regulatory breach, criminal breach or international law violation with company wide, long term impact. Defendant to high profile civil proceedings with company-wide, long term impact.	>US$2.5 billion
6	>20 fatalities. Permanent impairment >30% of body to more than 100 persons.	Severe impact(s) (>20 years) to land, biodiversity, ecosystem services, water resources or air.	Extensive community health, safety or security impacts (>200 households) or human rights violations; extended serious disruption to people's lives (>1000 households); extensive damage to >1000 houses or community infrastructure or structures, objects or places of global cultural significance.	Crisis event or publication of confidential inside information resulting in international media, government, regulator or NGO campaigning and employee condemnation of the company (<6 months). Ongoing condemnation results in damage to the reputation of the company.	Bankruptcy affecting an asset. Not getting or losing the legal right to develop or operate an asset. Investigation for alleged severe regulatory breach, criminal breach or international law violation. Defendant to multiple, high profile civil proceedings.	Between US$1 billion and US$2.5 billion
5	2-20 fatalities. Permanent impairment to >30% of body to more than 10 persons.	Serious or extensive impact(s) (<20 years) to land, biodiversity, ecosystem services, water resources or	Serious community health, safety or security impacts (>50 households) or human rights violations; extended disruption to people's lives (>200 households), extensive damage to >200 houses	Serious national and international media attention. General public and NGO adverse reaction with interest from regulators (<3 months). Structured campaigning from	Impairment of legal right to develop or operate an asset. Investigation for alleged high profile regulatory breach or criminal breach. An alleged breach of compliance-related	Between US$250 million and US$1 billion

Severity level	Health and safety	Environment	Community	Reputation	Legal	Financial
		air.	or structures, objects or places of national cultural significance.	employees, NGOs or communities having a major impact on the business or asset reputation.	laws will be a high profile regulatory breach. Defendant to high profile civil proceeding. Public inquiry into BHP or an issue critical for the resources industry.	
4	Single fatality. Permanent impairment >30% of body to one or more persons.	Major impact(s). (>5 years) to land, biodiversity, ecosystem services, water resources or air.	Serious community health, safety or security impacts (<50 households). Multiple allegations of human rights violations; extended disruption to people's lives (>50 households); extensive damage to >50 houses; moderate irreversible damage to structures, objects or places of national cultural significance.	Adverse national media attention. General public and NGO adverse reaction with interest from regulators with no material outcome. Structured campaigning from employees, NGOs or communities having a major impact on the business or asset reputation.	Investigation for alleged major regulatory breach. Defendant to major civil proceeding.	Between US$25 million and US$250 million
3	Permanent impairment <30% of body to one or more persons. Restricted or lost days due to injury or illness.	Moderate impact(s) (<1 year) to land, biodiversity, ecosystem services, water resources or air.	Moderate community health, safety or security impacts (<50 households). Single allegation of human rights violation; moderate disruption to people's lives (<50 households); extensive damage to <50 houses; moderate reversible damage to structures, objects or places of national cultural significance.	Attention from regional media or heightened concern by local community. Criticism by community, NGOs or activists. Asset reputation adversely affected.	Legal issue resolvable with moderate consequences. Losing or not getting the legal right to develop or operate (or approval for) a non-core activity.	Between US$2.5 million and US$25 million
2	Objective but reversible impairment. Medical	Minor impacts (<3 months) to land, biodiversity, ecosystem services,	Minor community health, safety or security impacts (<10 households) or human rights infringements; inconvenience to livelihoods <6	Adverse local public or media attention and complaints. Heightened scrutiny from regulator. Asset reputation is	Legal issue resolvable with minor consequences.	Between US$250,000 and US$2.5 million

Severity level	Health and safety	Environment	Community	Reputation	Legal	Financial
	treatment injury or illness.	water resources or air.	months; moderate damage to <50 houses or community infrastructure; minor, reversible damage to structures, objects or places of regional cultural significance.	adversely affected with a small number of people.		
1	Low level short term subjective symptoms or inconvenience. No medical treatment.	Low level impacts to land, biodiversity, ecosystem services, water resources or air.	Single low level community health, safety or security impact; low level inconvenience <2 weeks; minor, reversible low level disturbance or minor damage to a single house or structure, object or place of regional cultural significance.	Public concern restricted to local complaints. Low level interest from local media or regulator.	Low level legal issue resolvable without legal proceedings or substantive third party engagement.	<US$250,000

Table 5 Risk assessment of key domains within the Project Site

Domain	Environmental value	Control measures	Severity level	Likelihood	Residual risk after measure
Subsided riverine and remnant vegetation	**Surface water** - interruption to bedload sediment transport continuity by subsidence, creating deepening downstream.	**Avoid -** installation of upstream pile fields, crack treatment. **Mitigate –** instream grading, channel re-profiling.	Level 3	B – Likely	High
	Surface water – bank erosion upstream of subsidence. Gully erosion is likely where waterways drop into subsided areas.	**Avoid** - targeted revegetation of embankments with riparian species, installation of erosion control matting on embankments, embankment arming structures. **Minimise** – conduct early post subsidence inspection and identification of high risk areas. Maintain adequate riparian vegetation cover. **Mitigate** – construction of drop structures at head erosion features.	Level 3	C – Possible	High
	Surface water - Loss of flows into instream tension cracks. Potential for gully development along cracks tunnel erosion where ponding occurs.	**Minimise** - maintain adequate plant population and cover to limit cracking and erosion risk of soil. **Mitigate** – crack repair	Level 3	C – Possible	High
	Ecology – vegetation mortality in subsided areas due to cracking and ponding.	**Avoid** – crack repair **Minimise** – conduct early post subsidence inspection and identification of high risk areas. **Mitigate** – rehabilitate with species that are similar to the pre-existing regional ecosystem.	Level 2	C – Possible	Moderate

Domain	Environmental value	Control measures	Severity level	Likelihood	Residual risk after measure
	Ecology – vegetation mortality due to grazing pressure.	**Avoid** - exclusion of grazing in high risk areas and fencing ecologically sensitive or significant areas.	Level 2	D – Unlikely	Low
		Minimise - adjust grazing pressure to match pasture availability and productivity.			
		Mitigate – de-stock where there is evidence of overgrazing.			
	Ecology – subsidence impacts to threatened ecology communities (TECs) such as such as Brigalow (*Acacia harpophylla* dominant and co-dominant) and Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin resulting in vegetation mortality.	**Mitigate** – rehabilitate with vegetation communities that are demonstrably similar to pre-existing regional ecosystem.	Level 3	C – Possible	High
	Ecology – impacts to Endangered, Vulnerable and Near Threatened (EVNT) species such as Ornamental snake, Australian painted snipe, Squatter pigeon (southern), Greater glider, Grey falcon, Koala, Caspian tern, Fork-tailed swift, Latham's snipe, White-throated needletail.	**Mitigate** – establish, enhance or promote threatened species habitat by retaining coarse woody debris and stags as well as rehabilitating with plant species used as habitat.	Level 2	D – Unlikely	Low
	Ecology – increasing the populations of restricted weeds or introductions of prohibited weeds during the construction and operational phases.	**Avoid, minimise and mitigate** – implement general weed control procedures in Section 11.	Level 1	B – Likely	Moderate
Subsided non-riverine areas	**Ecology –** low pasture yields due to changed hydrogeology results in inability to support livestock.	**Avoid** - exclusion of grazing in high risk areas.	Level 1	D - Unlikely	Low
		Minimise - adjust grazing pressure to match pasture availability and productivity.			
		Mitigate – de-stock where there is evidence of overgrazing.			

Domain	Environmental value	Control measures	Severity level	Likelihood	Residual risk after measure
	Surface water - ponding results in eutrophication and release of contaminated water into waterways.	**Avoid** - regrading stream beds in areas of persistent ponding likely to experience eutrophication.	Level 2	C -Possible	Low
	Surface water and ecology – low pasture cover exacerbates erosion and soil loss.	**Avoid** - targeted revegetation of embankments with riparian species, installation of erosion control matting on embankments, embankment armouring structures.	Level 3	B - Likely	High
		Minimise – conduct early post subsidence inspection and identification of high risk areas. Maintain adequate riparian vegetation cover.			
	Surface water and groundwater – water quality not suitable for livestock consumption.	**Mitigate** - surface water monitoring and cattle exclusion.	Level 3	D – Unlikely	Low
	Low geotechnical stability results in land being unsuitable for grazing.	**Mitigate** - GIS data used to delineate areas of potential risk.	Level 3	D – Unlikely	Moderate

7 Predicted subsidence

Prior to the underground mining, the land has been utilised for cattle grazing and mine associated infrastructure. Due to the gradual nature of the subsidence, it is expected that grazing activities will continue during mining operations but out of direct operational areas while any related subsidence occurs. Native vegetation outside of the surface infrastructure footprint will be retained in a way that is compatible with the pre-existing land use for biodiversity values.

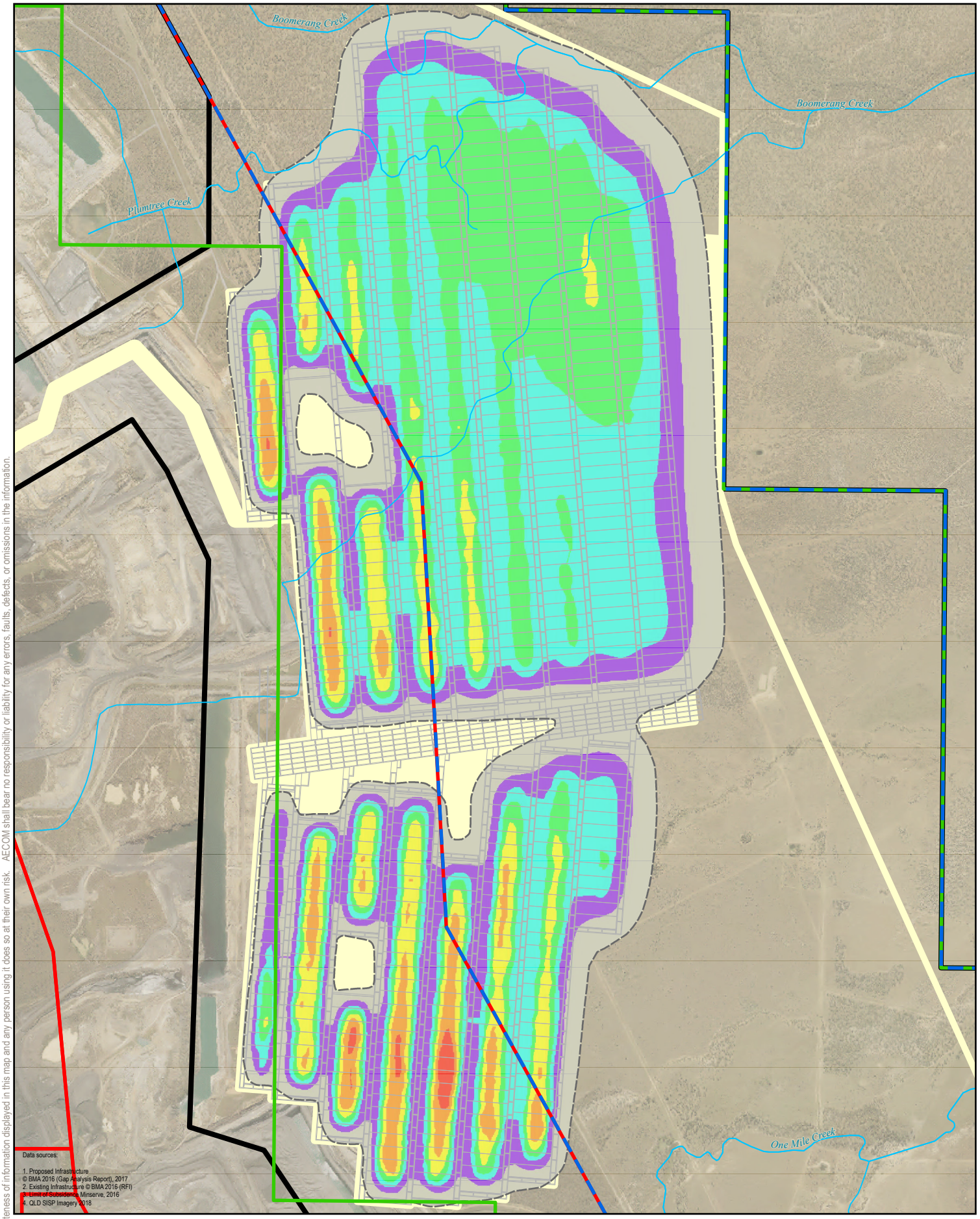
Based on conservative assessment of the maximised underground mine layout, the modelled subsidence extent can be seen in Figure 3; over the northern panels:

- The maximum predicted subsidence is 3.2 metres (m)
- The deepest panel is 440 m below ground level
- Hughes Creek, Plumtree Creek and Boomerang Creek intersect the northern panels.

Over the southern panels:

- The maximum predicted subsidence is 3.5 m
- The deepest panel is 350 m below ground level.

Full details of the predicted subsidence impacts are outlined in the SMP.



LEGEND

- Project Site
- Project Footprint
- Underground Mine Layout (Maximised)
- Limit Of Subsidence
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Modelled Subsidence Contour

- < 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- > 3.0m

N

Figure 3
Subsidence Contours of the Project Site

Rehabilitation Management Plan
Saraji East Mining Lease Project

0 0.25 0.5 1
Kilometres

Scale: 1:38,000 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 7/12/2020 VERSION: 0

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8 Rehabilitation land uses

8.1 Post mining land uses

BHP's *Queensland Coal Rehabilitation Completion Criteria* (BHP, 2018) outlines the completion criteria for meeting satisfactory rehabilitation for post mining land uses. Post mining land uses across BHP's operations typically include:

- grazing land
- dryland cropping
- woodlands habitat
- watercourses
- water storages.

Queensland Coal Rehabilitation Completion Criteria notes that final voids are not considered a post mining land use as they are difficult to justify as an acceptable rehabilitation post mining land use. No voids are proposed as part of the Project (areas within existing ML's will be subject to rehabilitation as approved for the existing Saraji Mine where applicable).

8.2 Land suitability

Changes to the proposed land surface will occur progressively over the functional 20 year mine life. Clearing activities will be staged with the mining schedule of each longwall panel to minimise the exposure of disturbed areas and degradation of topsoil. To prepare for clearing in areas allocated for surface infrastructure, soil will be stripped and will create potential for erosion and acid sulphate soils. With erosion and sediment controls, and setting aside of topsoil, these features should not affect long term land suitability.

The surface infrastructure including the CHPP and MIA, water management infrastructure, roads and construction village will be installed as identified in Section 3.6.2 of the EIS and Figure 2. Previously disturbed areas will be utilised where possible. Vegetation removal will be limited to the footprint associated with surface infrastructure, where it cannot be avoided. Some earthworks may be required to level the sites. These changes are not anticipated to affect the land use suitability for rehabilitation.

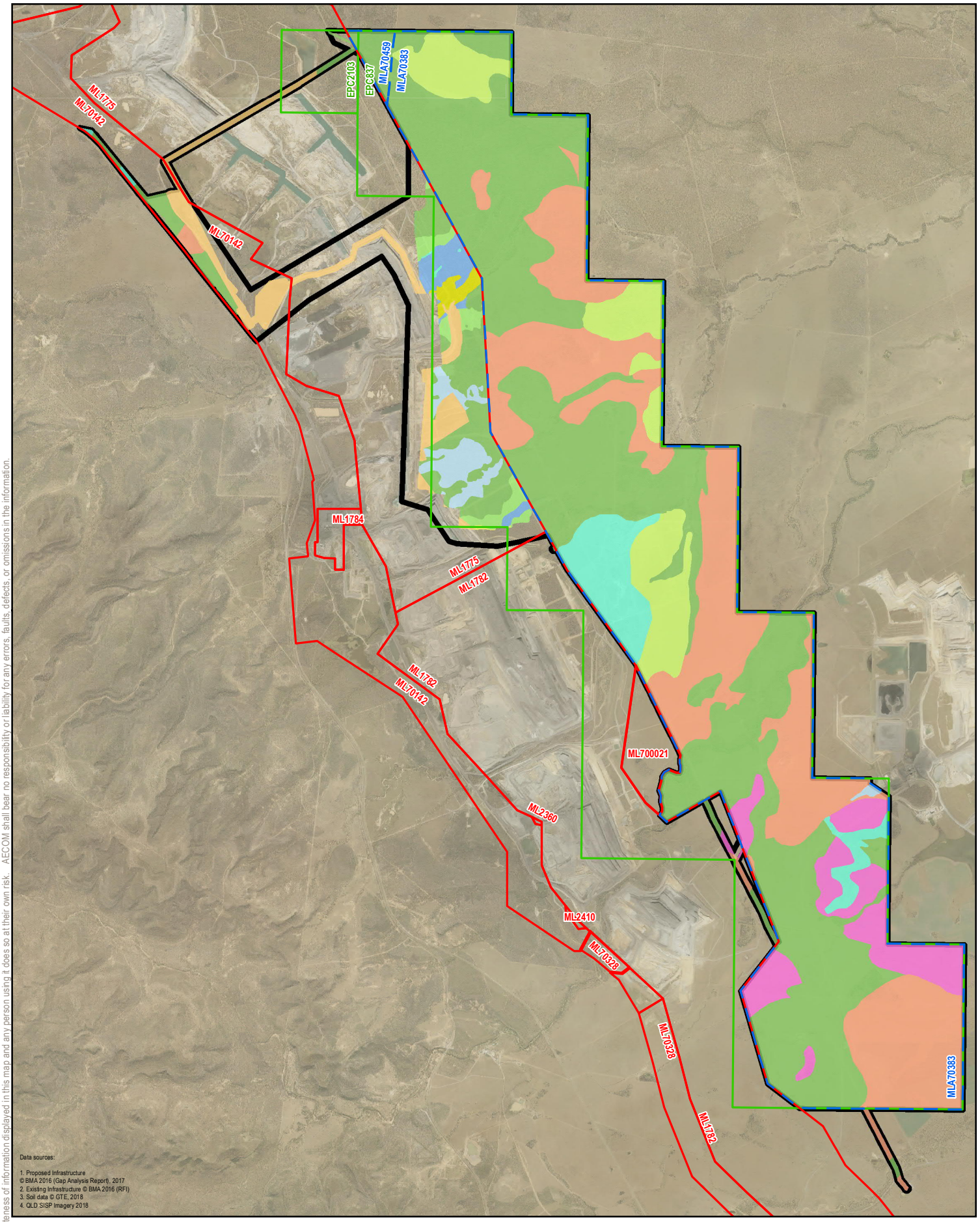
The most notable change to the landscape will come from subsidence. Prior to the underground mining, the land has been utilised for cattle grazing and mine associated infrastructure. Due to the gradual nature of the subsidence, it is expected that grazing activities will continue during mining operations but out of direct operational areas while any related subsidence occurs. Subsidence modelling indicates a maximum surface depression of 3.5 m. These areas will be monitored for signs of erosion.

The Project Site pre-mining land use is most suited to grazing practices with marginal suitability for cropping with soil water availability being the greatest limitation. The proposed post mining land use for the Project Site is expected to return to grazing land, consistent with the surrounding pastoral land use that dominates the region. Native vegetation outside of the surface infrastructure footprint will be retained in a way that is compatible with the pre-existing land use for biodiversity values. However, where extensive vegetation mortality occurs as result of persistent ponding, associated with subsidence, it will be revegetated with species that are tolerant of inundation.

Whether or not it is a previously mined area, grazing will cause damage to the soils and land suitability if not managed appropriately in accordance with the limits of the land suitability class. Required soil conservation practices include erosion and sediment control, stocking rate control and establishment or re-establishment of permanent pasture.

Based on the lack of suitable land available and minimal water availability, dryland cropping is not proposed as a rehabilitation method except for areas verified as strategic cropping land (SCL) to the south of the Project Site. These will be rehabilitated to suitable dryland cropping lands.

Mapping of pre-mine beef cattle grazing suitability, pre-mine rainfed cropping suitability and agricultural land class over the Project Site are shown in Figure 4, Figure 5 and Figure 6 respectively.



Data sources:

1. Proposed Infrastructure © BMA 2016 (Gap Analysis Report), 2017
2. Existing Infrastructure © BMA 2016 (RFI)
3. Soil data © GTE, 2018
4. QLD SISP Imagery 2018

LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Grazing Suitability

- Class 1
- Class 2
- Class 3
- Class 4
- Class 5
- Class 3 / 4
- Class 3 levees, class 5 on creek banks
- Class 4 levees, class 5 on creek banks
- Class 3 some, class 4 and 5 on stream banks and overlain banks
- Class 4 minor, class 5 in eroded or drainage areas
- Disturbance

N

Figure 4
Pre-mine Beef Cattle Grazing Suitability

Environmental Impact Statement
Saraji East Mining Lease Project

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Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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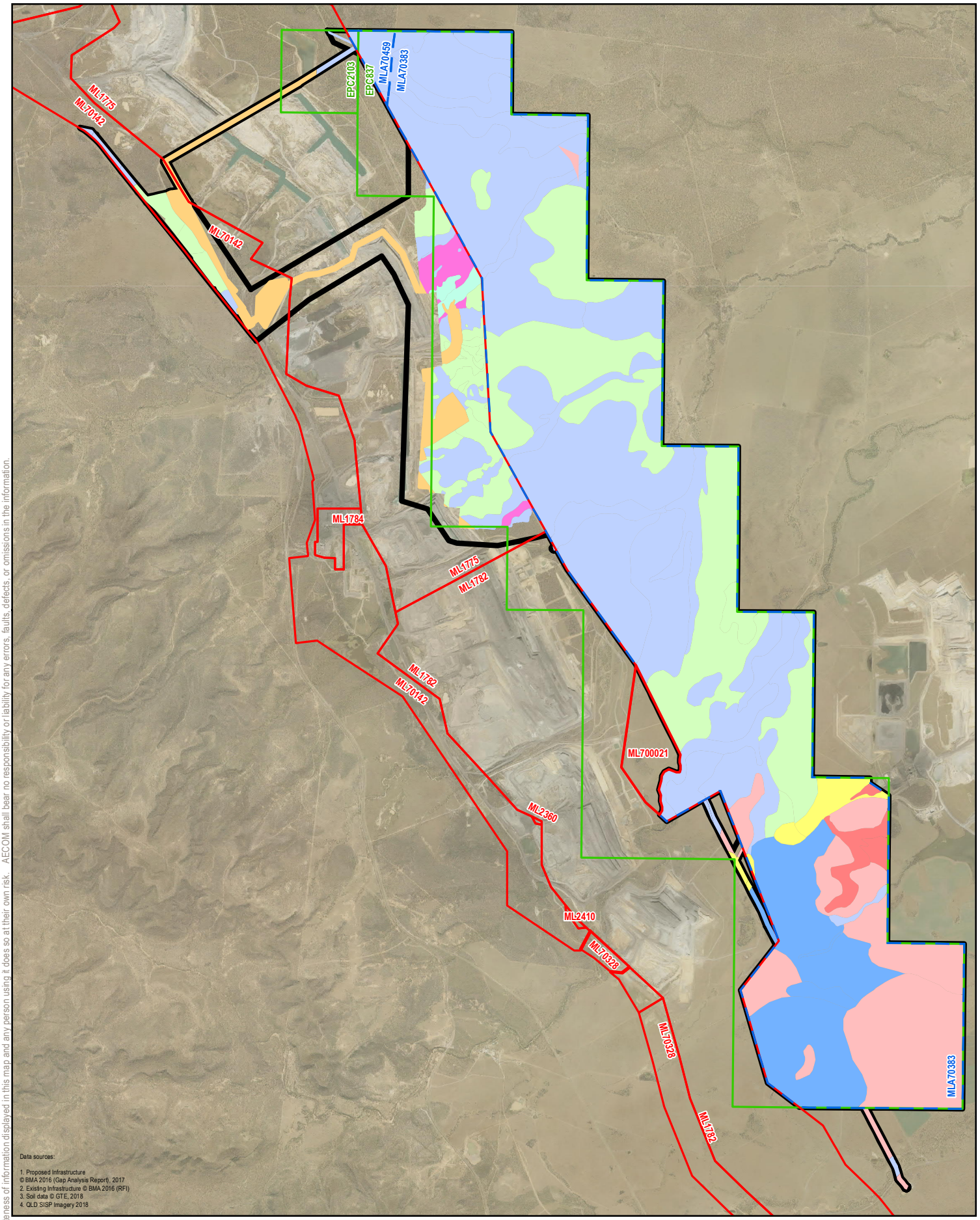

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LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Cropping Suitability

- Regional Frameworks Class 3
- Regional Frameworks Class 4
- Regional Frameworks Class 5
- Cropping Class 2
- Cropping Class 4
- Cropping Class 5
- Class 4 on levees, Class 5 on creek banks
- Class 4 minor, Class 5 on stream banks
- Disturbance

N

Figure 5
Pre-mine Rainfed Cropping Suitability

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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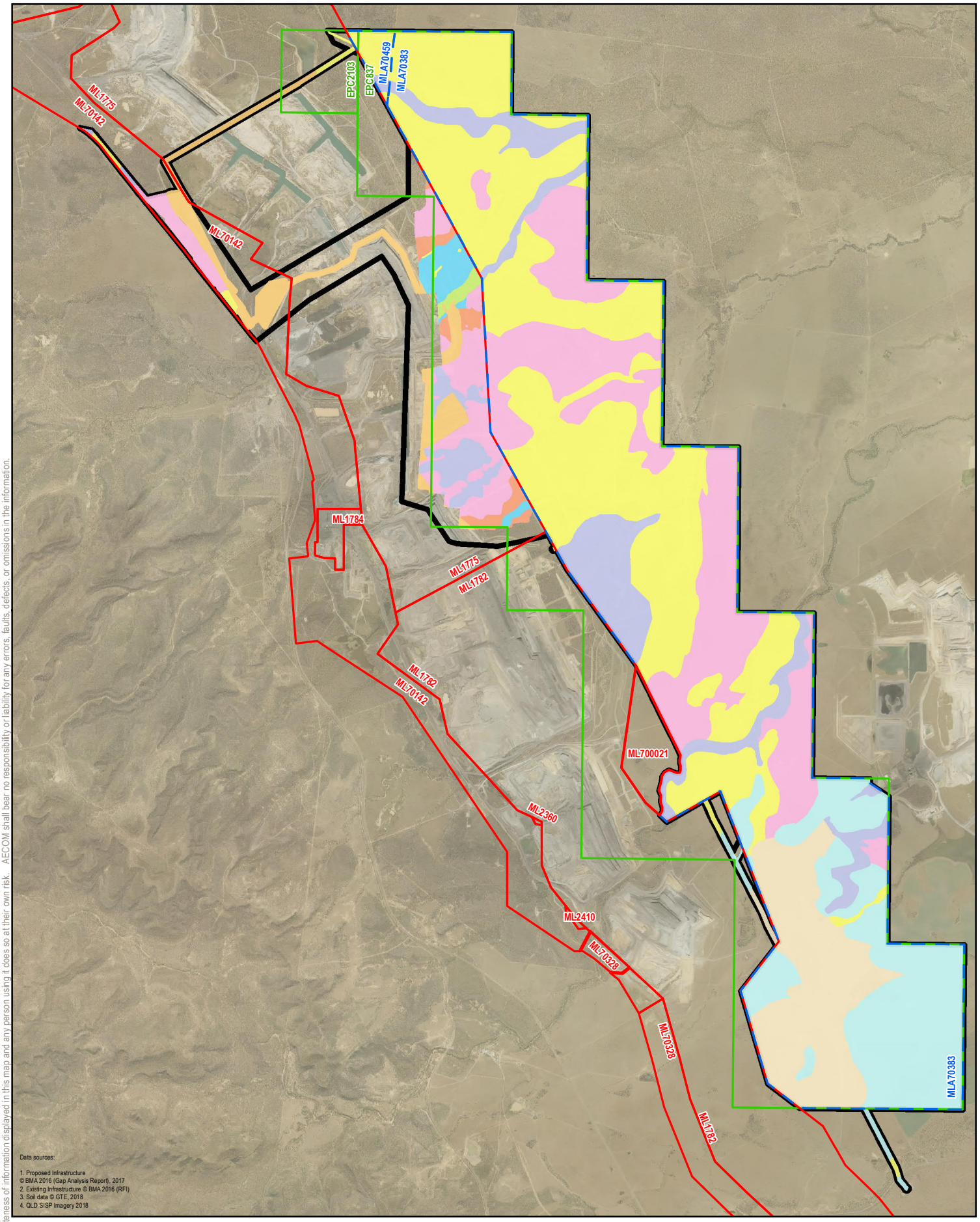

Data sources:

1. Proposed Infrastructure © BMA 2016 (Gap Analysis Report), 2017
2. Existing Infrastructure © BMA 2016 (RFI)
3. Soil data © GTE, 2018
4. QLD SISP Imagery 2018

LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Agricultural Land Class

- Class A1
- Class B
- Class C1
- Class C1 / C2
- Class C1 / C3
- Class C2
- Class C2 / C3
- Class C3
- Disturbance

N

Figure 6
Agricultural Land Classes

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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DATE: 4/12/2020 VERSION: 1

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8.3 Strategic Cropping Land

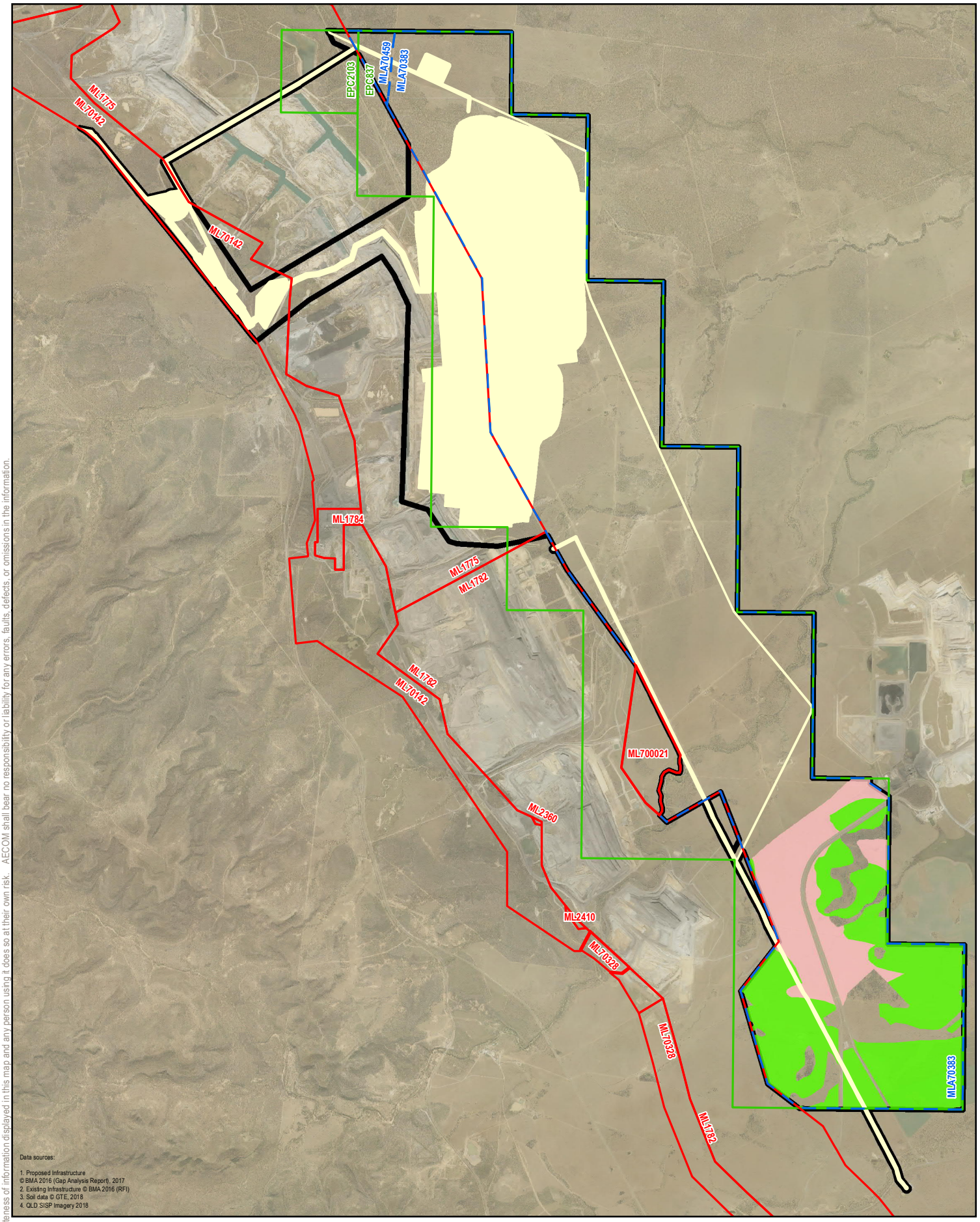
Strategic cropping areas (SCAs) are areas that are highly suitable for cropping because of a combination of the land's soil, climate and landscape features.

State-mapped SCL is in the southern extents of the Project Site, in MLA 70383. The SCL assessment identified soil mapping units (SMUs) within the SCL Assessment Area. The SCL map units were assessed against the SCL criteria (Figure 7).

SCL map units 3, 7, 8, 9, 12, 15, 16 and 17 meet the SCL criteria as they did not exhibit any limitation relating to SCL. SCL map unit 13 exhibited limitations relating to SCL criteria soil pH; however, most of the analysed sites did meet the SCL criteria, therefore SCL map unit 13 is likely SCL. The classification and assessment of SCL soil types is subject to change as part of the ongoing Regional Interests Development Approval (RIDA) process which is proceeding in parallel to the EIS.

Under the *Regional Planning Interests Act 2014* (RPI Act), no more than 2% of SCL may be permanently impacted by a development. The total area of the mapped SCL is calculated as the area of a polygon that covers one or more lot and plans under the ownership of a single landholder. The area of impact is the area of mapped SCL that will potentially be impacted by the Project, whether or not the land can be restored to its pre-activity condition after the activity ceases. An overhead 66 kilovolt (kV) powerline is proposed to extend off-lease and connect to the Dysart Substation, south of the Project Site (Figure 7). Within the verified SCL, impacts under the ownership of that single landholder are less than 2% of the property area.

BMA will reinstate the SCA to pre-disturbance condition as soon as practical and no later than six months after the decommissioning of the resource activities. Rehabilitation will involve dryland cropping within the impacted areas. Methodologies of restoration are outlined in Section 9.



Data sources:

1. Proposed Infrastructure
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2. Existing Infrastructure © BMA 2016 (RFI)
3. Soil data © GTE, 2018
4. QLD SISP Imagery 2018

LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Strategic Cropping Land

- SCL - Verified SCL
- SCL - Non - SCL Area

N

Figure 7

Verified SCL on SCL Assessment Area

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

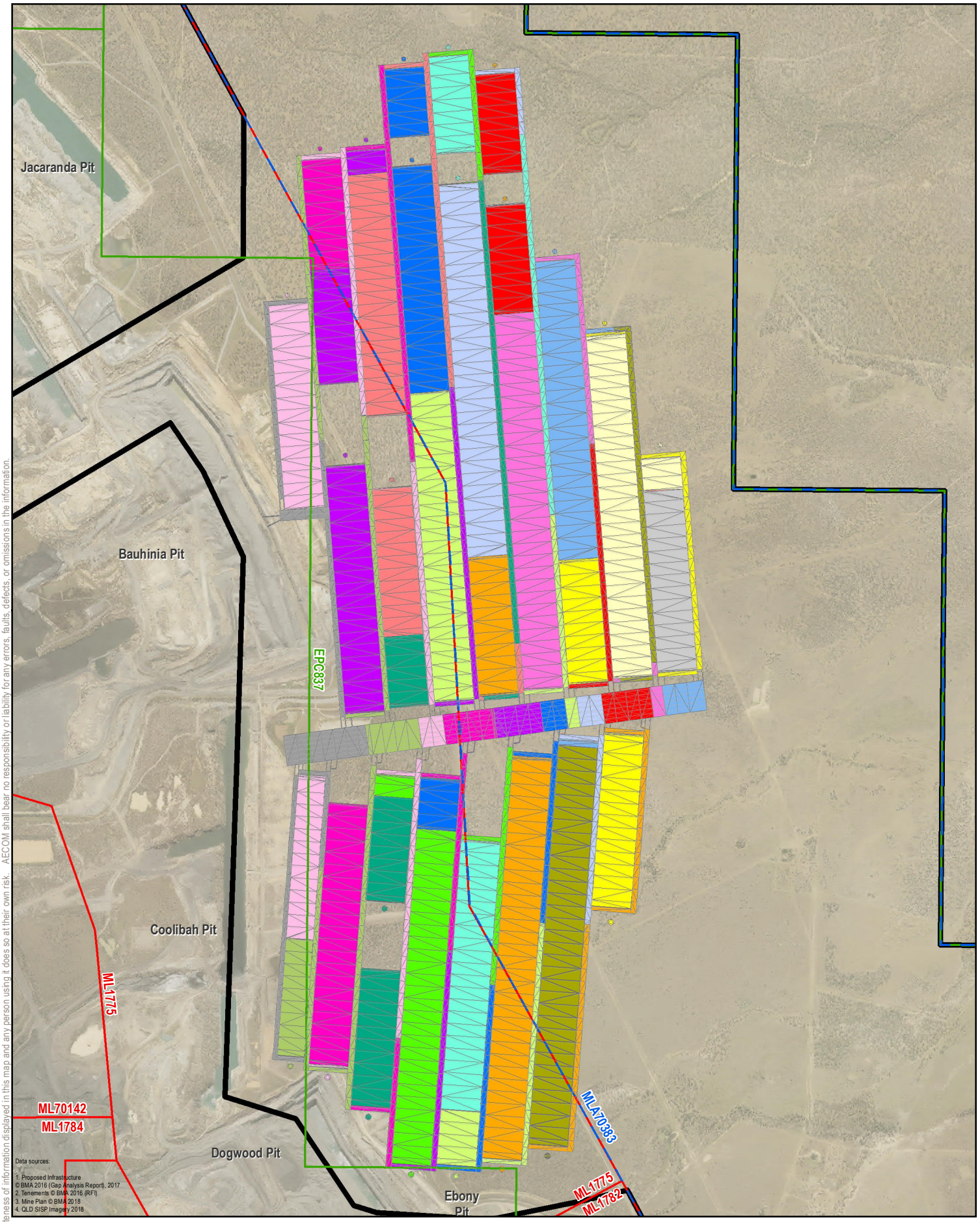
BHP

DATE: 4/12/2020 VERSION: 1

9 Rehabilitation strategy

All areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining landcover or to a condition where maintenance requirements are consistent with an agreed post mining land use. Rehabilitation will be undertaken progressively with the proposed optimised mining sequence nominally between financial year (FY) 2023 and FY 2042 (see Figure 8). All rehabilitation methods will be conducted so that:

- factors influencing changes in land suitability include changed physical, chemical and biological properties of soil, changes in slope and slope length and changes in soil depth and the quality of the underlying spoil are limited
- the potential for erosion is minimised
- surface water impacts including bedload sediment interruption, bank erosion, loss of flow and ponding is minimised
- previously vegetated areas will be revegetated to be sustainable vegetation communities
- the vegetation within the rehabilitated area is not significantly different to surrounding unmined landscapes subject to the same land use.



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1. Proposed Infrastructure © BMA 2016 (Gap Analysis Report), 2017
2. Tenements © BMA 2016 (RFI)
3. Mine Plan © BMA 2018
4. QLD SISP Imagery 2018

LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground layout (optimised)

Optimised Mine Plan (Financial Year)

2023	2030	2037
2024	2031	2038
2025	2032	2039
2026	2033	2040
2027	2034	2041
2028	2035	2042
2029	2036	

N

Figure 8
Mine Plan

Rehabilitation Management Plan
Saraji East Mining Lease Project

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Kilometres

Scale: 1:40,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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9.1 Current rehabilitation at Saraji Mine

The Project Site is located adjacent to, and in some cases overlaps, areas which are currently approved as the existing BMA Saraji Mine. The existing Saraji Mine is an active, open cut mine owned by the Central Queensland Coal Associate (CQCA) Joint Venture, namely BHP Coal Pty Ltd, BHP Queensland Coal Investments Pty Ltd, Umal Consolidated Pty Ltd, QCT Resources Pty Limited, QCT Mining Pty Ltd, QCT Investments Pty Ltd and Mitsubishi Development Pty Ltd. The CQCA is an unincorporated joint venture between BHP(50 per cent) and Mitsubishi Corporation (50 percent). The existing Saraji Mine is operated by BMA under a management agreement.

The existing Saraji Mine is approved to undertake open cut operations on ML 1775, ML 70142, ML 1784, ML 1782, ML 2360, ML 2410, ML 70294, ML 70298, ML 70328 and ML 700021 under Environmental Authority (EA) Permit No. EPML00862313. The existing Saraji Mine is not within the scope of this report and BMA will continue to undertake open cut mining operations, and related activities (for example rehabilitation), at the existing Saraji Mine in accordance with the terms of its existing approvals.

Rehabilitation works at Saraji Mine will be carried out under the Saraji Mine Rehabilitation Management Plan (RMP). The Saraji Mine RMP establishes site-wide strategies to achieve rehabilitation by prioritising stability of the final landform, and the return of land use to grazing, where appropriate. This approach recognises the challenging nature of the spoil material, the climate, the elevated spoil landforms and significant change in local topography, and the scarcity of topsoil resources.

The recently passed *Mineral and Energy Resources (Financial Provisioning) Act 2018* amends the *Environmental Protection Act 1994* (EP Act), replacing the Plan of Operations and Financial Assurance (FA) with Estimated Rehabilitation Cost (ERC) and Progressive Rehabilitation and Closure Plan (PRCP). The Project will comply with the *Mineral and Energy Resources (Financial Provisioning) Act 2018.* While a Progressive Rehabilitation and Closure Plan (PRCP) for the existing Saraji Mine may be developed in future, the scope of the Project will not change the rehabilitation objectives of the existing mine and preparation of a PRCP for the existing mine is beyond the scope of this EIS.

In accordance with the existing Saraji Mine RMP and existing approved EA conditions, rehabilitation of disturbed land will commence within two years of the mined area becoming available. Progressive rehabilitation is proposed in areas disturbed by mining activities associated with the project. Progressive rehabilitation is discussed further in Section 10.1. The overall operational mine life of the existing Saraji Mine extends to the 2040s, followed by a period of final rehabilitation.

The scope of the Project will not change the long-term rehabilitation objectives of the existing mine. Existing approved EA conditions do not need to change as a result of the Project to allow rehabilitation to progress when areas become available for rehabilitation. Existing approved EA conditions for the Saraji Mine will apply to the area of open cut that overlaps the Project Site. If needed, a consistency review of the Saraji Mine EA would be undertaken and a modification sought if the Project were to alter or introduce any additional ERAs to site operations.

9.2 Rehabilitation of utilised pre-existing Saraji Mine infrastructure

The Project will utilise existing infrastructure as part of the existing Saraji Mine operations where practical, including:

- use of the Saraji Mine CHPP for processing project coal in years where run-of-mine (rom) tonnes exceeds 7 million tonnes per annum (mtpa)
- use of an integrated power supply network for Saraji Mine and the project
- use of the existing open-cut pit for mine access and highwall entry to minimise the environmental impacts, costs, time and risks involved in construction of a new mine portal
- haul roads and trucks for the transportation of rom coal from the proposed CHPP to the existing Saraji Mine CHPP
- use of open-cut spoil dumps to distribute and dispose of rejects, including tailings that are dewatered, from the Project's CHPP.

Where possible, above-ground infrastructure will be located within previously disturbed areas on the existing Saraji Mine. Rehabilitation of the above infrastructure will be in accordance with the existing Saraji Mine RMP.

9.3 Rejects management

All rejects (including tailings that are dewatered) will be trucked to the Saraji Mine's existing in-pit spoil dumps for disposal. No new tailings and coarse rejects management facilities are required for the Project as conveyers are proposed in the Project CHPP. Rejects that have been dewatered by the belt press filters will be co-disposed with rejects (coarse), which will be placed into existing spoil dumps by truck or conveyor and buried in spoil. Rehabilitation of the existing tailings and coarse rejects management facilities will therefore be undertaken as per the existing commitments in the Saraji Mine RMP.

In the unlikely event that reject haulage falls behind, the rejects bin will overflow to the designated bunker. The bunker will provide access for a loader to remove rejects material as required.

The scope of the Project will not change the rehabilitation objectives for the existing mine. Existing approved EA conditions do not need to change as a result of the Project to allow rehabilitation to progress when areas become available for rehabilitation. Existing approved EA conditions for the Saraji Mine will apply to the area of open cut that overlaps the Project Site.

9.4 Landform design and planning

The proposed post mining landform is suitable primarily for cattle grazing, with dryland cropping where SCL is verified and potential for riparian rehabilitation. This approach is in accordance with level one and two of the rehabilitation hierarchy.

The domains and post mining land use areas are summarised in **Table 6**. Post mining land use of the final rehabilitated Project is envisaged in Figure 9. The rehabilitation strategy for each individual domain is discussed below.

Table 6 Indicative post mining land use for each domain

Domain	Post mining land use				
	Grazing land	Woodland habitat	Watercourse	Water storage	Dryland cropping
Subsided riverine and remnant vegetation areas	X (if present pre-disturbance)	X (where present post disturbance)	X		
Subsided non-riverine areas	X (if present pre-disturbance)	X (where present post disturbance)			
Surface infrastructure	X (if present pre-disturbance)			X	X

9.4.1 Subsidence impacts to riverine areas

Subsidence related impacts to watercourse areas include impacts to morphology, riffle and pool sequences, widening and bank stability and groundwater drawdown.

A SMP has been prepared for the Project. It provides a plan for documenting and reporting annual progress and management of impacts against objectives. The key components of the SMP are:

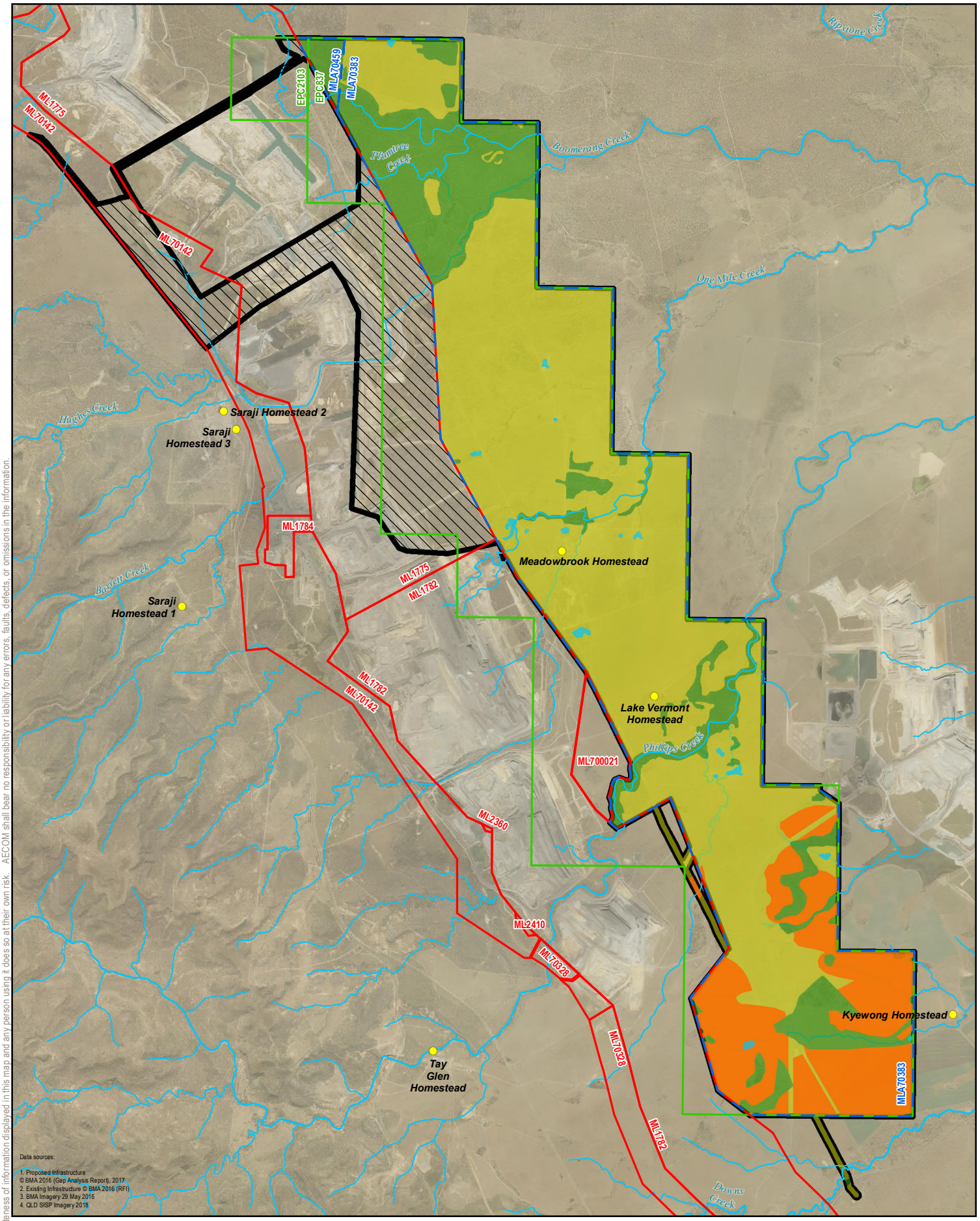
- ongoing subsidence monitoring, evaluation, review and improvement program
- managing bed and bank stability
- vegetation management
- panel catchment management, including rehabilitation of subsidence cracking
- infrastructure protection or relocation, where necessary.

9.4.2 Subsidence areas

Subsidence related impacts to land as a result of the Project include surface depression, cracking, ponding and possibly erosion. Grazing activities will continue during mining operations but out of direct operational areas while any related subsidence occurs.

According to the SMP prepared for the Project, the final landform for areas affected by subsidence will be achieved by:

- re-profiling tension cracked areas, ripping, topsoiling and seeding
- vegetation planting
- vegetation watering using void water or water of similar quality
- creating self-sustaining vegetation through correcting soil matter
- weed management.



LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Homestead

Post Mine Land Use

- Water storage
- Woodlands habitat
- Cattle grazing
- Dryland cropping
- Rehabilitation subject to development of Saraji Mine

N

Figure 9
Indicative Post Mine Land Use

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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9.4.3 Surface infrastructure

Mining and mine portal

Decommissioning of underground workings will be required at mine closure. Any mining equipment or service supply lines and cables that are no longer required and are not readily recoverable for salvage or reuse will be left in the underground mine.

Any mining equipment or service supply lines and cables that are no longer required and are not readily recoverable for salvage or reuse will be left in the underground mine. Entrances to the underground workings will then be blocked off and sealed to prevent access and ventilation shafts will also be decommissioned and sealed.

The mine portal will be rehabilitated in accordance with the existing Saraji Mine RMP including a final safety inspection and certification against mine safety legislation in place at the time of closure.

Mine facilities and infrastructure

The mining facilities and infrastructure areas includes the MIA, CHPP, ROM pad, roads, product stockpiles, construction village, waste management infrastructure and powerlines.

Following completion of the mine, these areas will be decommissioned and rehabilitated. Area that can be reused for future mining purposes will remain onsite. This may include, but is not limited to, the construction village and the CHPP.

All components suitable for reuse such as scrap metal will be sold, recycled or reused for other mining operations. All remaining waste will be disposed of at an authorised facility.

A contamination risk assessment will be conducted where required. Treatment will occur where needed. If the contamination cannot be treated then it may be disposed of at an authorised facility.

Once all unwanted material is removed, the areas will be ripped, and topsoil will be placed in accordance with the Topsoil Management procedure. The site will be rock raked to remove any potential rocks that may have been brought to the surface. The soil will be seeded or planted, fertilised and watered to assist in the establishment of grazing land.

Vent shafts and boreholes

The decommissioning (sealing/capping/grouting) of ventilation shafts, service boreholes, dewatering and monitoring boreholes will be completed in accordance with relevant standards and guidelines, in particular the relevant requirements of the *Minimum Construction Requirements for Water Bores in Australia* (Land and Water Biodiversity Committee 2003) or other relevant guidelines in place at the time of decommissioning.

Raw and process water dams

Water storages created for the project are unlikely to have any beneficial use for the future land use as none of them capture overland flow. The storages will have contained mine affected water and will need to be emptied. Therefore, the rehabilitation approach for the dams will include:

- testing the water quality that may have received mine affected or contaminated water
- disposing of or treating contaminated water

The removal of water storages will include:

- treatment of water storage to meet water quality requirements
- contained sediments will be removed for disposal at an authorised waste disposal facility
- the walls will be breached so that storage can no longer contain water
- the area will be graded and re-profiled to restore drainage and reduce ponding
- compacted surfaces will be ripped or otherwise de-compacted
- topsoil will be placed as per the topsoil management procedure
- revegetation will take place
- weeds will be managed

Gas drainage infrastructure

This infrastructure is the main cause of vegetation and soil disturbance across the mine footprint and will be installed and then removed progressively as mining progresses. Hence, a progressive rehabilitation approach will be taken.

Interim rehabilitation will be undertaken immediately after construction of each section of Incidental Mine Gas (IMG) management infrastructure, including:

- removal of temporary facilities associated with drilling
- rehabilitation of the bulk of the drilling pad area, leaving only a small area immediately around the well
- rehabilitation over gas and water pipeline trenches.

Final decommissioning of this infrastructure will be undertaken progressively, immediately prior to mining in each longwall panel, as follows:

- all facilities above ground surface level associated with wells will be removed
- wells will be cut off below ground level and grouted and capped to create a seal in accordance with guidelines on decommissioning of gas wells that are current at the time. after subsidence, wells will be checked and if standpipes have become exposed, standpipes will be cut below ground level again.
- pads around each well will be ripped, topsoil re-spread and the disturbed areas ripped, seeded and fertilised as necessary to support grazing
- water and gas pipelines will be emptied and made safe.

9.4.4 Future subsidence areas

Future subsidence areas are predicted to have similar impacts as those outlined in Section 9.4.2. The management measures outlined above and defined in the SMP will apply to these areas to produce the final landform.

9.5 Rehabilitation phasing

A conceptual rehabilitation program will be implemented using progressive rehabilitation based on current objectives for the Project and current anticipated dates of mine closure. The timing of specific rehabilitation projects may vary depending on the priority of the works in relation to:

- environmental risk
- scale of the project
- risk of stream flows (wet/dry season) interrupting works
- seasonal suitability (vegetation projects)
- mine plans and area availability
- subsidence settling times.

Rehabilitation phases to achieve the rehabilitation program will include:

- Phase 1 – Progressive rehabilitation of subsidence areas - generally follow subsidence of each panel as shown in Figure 3, with one panel subsiding each year (approximately)
- Phase 2 – Decommissioning – removal of surface infrastructure including buildings, contaminated materials and hazardous materials defined in Section 5.4
- Phase 3 – Landform establishment – incorporates gradient, slope, aspect, drainage, substrate material characterisation and morphology
- Phase 4 – Ecosystem establishment – corporates revegetated lands and habitat augmentation; species selection, species presence and growth together with weed and pest animal control / management and establishment of flora
- Phase 5 – Ecosystem sustainability – incorporates components of floristic structure, nutrient cycling recruitment and recovery, community structure and function which are the key elements of a sustainable landscape
- Phase 6 – Rehabilitation complete – Land use and landscape is deemed as suitable to be relinquished from the Mining Lease

An indicative summary of the rehabilitation program to be implemented throughout the life of the Project is detailed in Table 7. As the life expectancy of the Project is expected to align with the existing Saraji Mine, no changes are anticipated to the existing RMP timing.

Table 7 Indicative mine rehabilitation schedule

Phase	Year progressive rehabilitation starts	Year progressive rehabilitation ends
Phase 1	2024	2043
Phase 2	2043	2045
Phase 3	2045	2046
Phase 4	2046	2048
Phase 5	2048	2052
Phase 6	2052	2052

9.5.1 Phase 1 – Progressive rehabilitation of subsidence areas

Rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities within two years of becoming available. This will reduce the amount of disturbed land at any one time. Results of progressive rehabilitation will be used to refine rehabilitation methods for future application, such as the selection of appropriate drainage measures including the use of contour banks and the selection of plant species for re-establishment.

9.5.2 Phase 2 – Decommissioning

Phase 2 provides the processes for the removal of hardstand areas, buildings, contaminated materials and hazardous materials. Monitoring equipment will be decommissioned when no longer in use. Groundwater bore casings will be removed, bores will be infilled and the impacted footprint will be rehabilitated as required. There is the option to retain infrastructure if the landowner believes it is of value.

9.5.3 Phase 3 – Landform establishment

Landform establishment is the process involved to achieve initial stable landforms including slopes, initial erosion controls, and drainage lines with integrated landscape features, which are compatible with surrounding landforms. Whilst ensuring that the rehabilitated areas of native vegetation link with undisturbed native vegetation.

9.5.4 Phase 4 – Ecosystem establishment

The ecosystem and land use establishment phase incorporate requirements for:

- the management and control of weed and vertebrate pest species
- establishment of correct flora species selection in terms of the derived revegetation communities
- the development of systems to enhance opportunities for nutrient cycling
- the optimal use of onsite resources
- establishment of measures to prevent unnecessary access and rehabilitation of redundant tracks.

9.5.5 Phase 5 - Ecosystem sustainability

Ecosystem and land use sustainability incorporates the:

- development of land use and land capability which is consistent with the surrounding areas
- nutrient cycling
- species diversity and abundance for both flora and fauna
- vegetation communities capable of withstanding catastrophic events e.g. bushfire and extensive drought.

The criteria, performance measures and indicators for ecosystem and land use sustainability are provided for relevant domains in Table 8.

9.5.6 Phase 6 – Rehabilitation complete

On completing progressive rehabilitation of an area, BMA can apply for progressive rehabilitation certification of that area. On completing final rehabilitation, BMA can apply for surrender of the EA. Within six months from the completion of the final stage of the Project, a report will be completed by an appropriately qualified person to analyse actual impacts resulting from the final stage of the Project and notice of any outstanding offset debts for the authorised impacts.

Before applying for surrender of the ML, BMA will prepare a site investigation report under the *Environmental Protection Act 1994* (Qld) where any part of the area has been used for notifiable activities or is likely contaminated land. BMA will also carry out further work that is required as a result of the report to ensure that land is suitable for final land use.

9.6 Risk identification

There are reasons why a rehabilitated landform may fail to meet its rehabilitation objectives and final land use. The list below outlines potential risks to the Project. By identifying these risks and adopting the rehabilitation methods outlined below, it is anticipated that these risks will be greatly reduced. These risks include:

- services are not properly decommissioned or removed
- final landforms are not geotechnically stable
- surface slumping leading to drainage issues
- inadequate ground preparation
- construction of inadequate drainage and erosion and sediment control structures
- insufficient quantities of topsoil/subsoil/growth medium
- soils do not contain the right attributes to promote growth of vegetation
- soil is not spread at adequate depths on re-contoured areas
- poor seed quality
- inappropriate species chosen for the type of rehabilitation
- ineffective seeding techniques
- weeds are not adequately controlled
- seasonal influences on stream flow interrupting works
- seasonal influences impacting vegetation growth.

9.7 Success criteria

To comply with rehabilitation requirements set out in the EA of the Model mining conditions (DES, 2017) and the *Mined Land Rehabilitation Policy* (DES, 2018), the general rehabilitation goals and success criteria for areas disturbed by mining include sites that are:

- safe to humans and wildlife
- non-polluting and not cause environmental harm
- stable
- able to sustain an agreed post mining land use.

The rehabilitation methods detailed below (Section 10) are designed to achieve these general rehabilitation goals.

9.8 Rehabilitation objectives, indicators and completion criteria

The objectives, completion criteria, and indicators in Table 8 are drawn from BHP's *Queensland Coal Rehabilitation Completion Criteria* (BHP, 2018). The criteria, objective and goals outlined in Table 8 are preliminary and expected to undergo further development and refinement prior to disturbance and following the issue of the Project's EA.

Table 8 Preliminary Project completion criteria, objectives and indicators

Post mining land use	Goal	Objective	Indicator	Criteria
Cattle grazing	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5
		Rehabilitation is erosionally stable	Extent, slope gradient and groundcover	Groundcover >50% 70% of slopes ≤20%
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH Electrical conductivity (EC) Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Rehabilitation is suitable for sustainable cattle grazing	Land suitability assessment for cattle grazing	Land suitability class ≤3 or not different from pre-mining class if ≥4
			Leucaena stem density	<250 stems >2m height per ha (1 per 40 m^2), mean total area
Woodland habitat	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference

Post mining land use	Goal	Objective	Indicator	Criteria
	Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5 unless an alternative is justified by an appropriately qualified engineer
		Rehabilitation is erosionally stable	Groundcover (steep slopes, >15%)	80%
			Groundcover (lesser slopes, ≤15%)	50%
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Some native bushland characteristics	Species richness Trees Shrubs Grasses	 ≥2 ≥3 ≥4
			Tree canopy cover	≥16%
Watercourse	Safe to humans and wildlife	Safety hazards are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference

Post mining land use	Goal	Objective	Indicator	Criteria
	Stable	Rehabilitation is erosionally stable	Geomorphic index	Greater or equal to upstream or downstream values.
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
	Able to sustain an agreed post mining land use	Riparian vegetation	Riparian vegetation index	Greater or equal to upstream or downstream values.
Water storages	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of Safety	≥1.5
		Rehabilitation is erosionally stable (banks and immediate surrounds)	Groundcover	>50%
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.

Post mining land use	Goal	Objective	Indicator	Criteria
	Able to sustain an agreed post mining land use	Rehabilitation retains water that is a potential resource for cattle grazing, with quality according to ANZECC guidelines version October 2000	TDS Calcium Magnesium Nitrate Nitrite Sulphate	≤5,000 mg/L ≤1,000 mg/L ≤2,000 mg/L ≤400 mg/L ≤30 mg/L ≤1,000 mg/L
Dryland cropping	Safe to humans and wildlife	Safety hazards in rehabilitation are not significantly different to surrounding unmined landscapes subject to the same land use	Hazard assessment	No significant difference
	Stable	Rehabilitation is geotechnically stable	Factor of safety	≥1.5
		Rehabilitation is erosionally stable	Percentage of cultivation at >1% slope gradient with functional contour banks	100% of rehabilitated areas
	Non-polluting	Rainfall runoff from rehabilitation achieves relevant water quality objectives for receiving waters	pH EC Turbidity	Not significantly different to upstream values
		Deep drainage from rehabilitation achieves relevant water quality objectives for groundwater	EC	Not significantly different to: (a) the EPP (Water) schedule documents water quality objectives for relevant groundwater chemistry zones; or, (b) local water quality objectives developed in accordance with the Queensland Water Quality Guidelines.
	Able to sustain an agreed post mining land use	Rehabilitation is suitable for sustainable cropping	Land suitability assessment for cropping	Land suitability class ≤3 or not different from pre-mining class if ≥4

10 Rehabilitation methods

The domains outlined in Section 5 will be rehabilitated to achieve the relevant objectives. The rehabilitation methods are discussed individually below.

10.1 Progressive rehabilitation

All areas disturbed by mining activities (inclusive of the infrastructure corridor) will be rehabilitated to a stable landform and post mining land use.

A plan and schedule for progressive rehabilitation will be established to ensure rehabilitation occurs progressively with the proposed optimised mining sequence. Rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities within two years of becoming available. This will reduce the amount of disturbed land at any one time.

When no longer in use, surface infrastructure and monitoring equipment will be decommissioned (or retained if the landowner believes it has value). Groundwater bore casings will be removed, bores will be filled in and the impacted footprint rehabilitated as required.

Initial stable landforms including slopes, erosion controls and drainage lines will be established and integrated with landscape features compatible with surrounding landforms, while maintaining native vegetation.

The criteria, performance measures and indicators for ecosystem and land use sustainability are provided for relevant domains in Table 8. On completing rehabilitation milestones, BMA will demonstrate land is suitable for final land use and completion criteria have been met (refer Section 9.8).

10.2 Weed suppression

While the Project is operational, weed suppression will occur in accordance with a site Weed and Feral Animal Management procedure. As the most likely source of a new weed infestation is through a freshwater system or infected machinery, weed suppression efforts will focus on:

- waterways
- hardstand areas
- drill sites
- along either side of haul roads and drill sites
- the incidental mine gas network footprint.

10.3 Subsidence areas

Land surface disturbance will be limited to the minimum required for operational success. Disturbed areas exhibit significantly greater impacts from subsidence and cracking due to the typically unstable nature of these areas. Limiting disturbance is therefore a primary control to reduce impacts. Any disturbance will be pursuant to the BMA Permit to Disturb process.

Where required, cracks will be reshaped, scarified and stabilised, topsoil applied if necessary and then direct seeded. Interim erosion control devices, such as hay bales and geotextile barriers, will be provided as necessary to divert surface runoff away from remediated area until ground cover is

established. Where necessary, minor ephemeral drainage lines may need to be reshaped to slow surface water velocities and loosely placed rock to dissipate runoff energy.

While it is not expected to occur, surface cracking of rock exposures in drainage lines may be sealed by cement or chemical grout, as appropriate.

10.3.1 Waterway management

Suitable drainage will be incorporated into the rehabilitation design to ensure the post mining landform can safely shed surface runoff whilst minimising the potential for erosion. Where necessary, riverbed earthworks will be undertaken to re-profile waterways to a natural state.

Re-profiling will aim to restore a stable waterway with appropriate drainage patterns that allow for the normal flow of water. Re-profiling may involve the construction of contour banks and in-creek regrading to ensure flow is maintained. No realignment or diversions are planned for any of the waterways.

Where monitoring of waterways within the subsidence zone reveals instream cracks greater than 50 mm and those cracks fail to self-correct within 12 months of detection, the following corrective measures will be implemented as required:

- ripping
- tyning
- grading
- compaction
- crack infilling with concrete or clay.

Similar works may be undertaken when sedimentation or ponding has adversely altered stream flows. Where erosion from subsidence has impacted a waterway and natural recovery does not occur within 12 months of detection, the following corrective measures will be implemented as required:

- channel re-profiling such as the construction of contour banks and in-creek regrading to ensure flows are maintained
- embankment armouring
- vegetation planting
- erosion control matting on embankments
- bed stabilisation such as pervious weirs
- construction of drop structures at head cut erosion features to minimise risk of further erosion.

10.3.2 Bank stabilisation

Where required bank stabilisation through rock chutes and embankment armouring will be implemented in waterways to:

- reduce the velocity of surface flow
- mitigate erosion and scouring
- reduce sediment entrainment
- capture large woody debris.

Rock chutes and armouring have the added advantage of reducing erosion and improving bank stability. They may be installed in sections of waterways which are at high risk of erosion and instability. Structures will be designed by a civil engineer or geomorphologist. Examples of rock chute establishment and embankment armouring are shown in Plate 1 and Plate 2.

Additionally, pile fields may be installed on the upstream pillar zone of each panel. Timber piles are driven as far as practicable into the lower banks of the waterway. The pile will be designed by a civil engineer or geomorphologist. The pile fields stabilise and protect the bank until each panel is infilled with sand. Pile fields also provide erosion protection at each pillar zone by reducing the flow velocity, increasing deposition of silt and assisting with vegetation establishment, which further reduces erosion and enhances bank stability.

Where practicable, riparian areas will be fenced and cattle will be excluded from the waterways to mitigate erosion. Other mitigation measures, which may be used to stabilise waterways prior to impacts occurring, include:

- installation of weirs
- channel re-profiling such as the construction of contour banks and in-creek regrading to ensure flows are managed
- vegetation planting
- erosion control matting on embankments
- construction of drop structures at head cut erosion features to minimise further erosion.

Re-sloping will be undertaken in accordance with the *BHP Queensland Coal Rehabilitation Completion Criteria* (BHP, 2018).

Plate 1 Rock chute

Plate 2 Armouring of river bank

10.3.3 Drainage establishment for large and persistent ponding

Where vegetation which is tolerant of inundation fails to establish, or where establishing this kind of vegetation cover is inappropriate, there is potential to mitigate the possible loss of flow through Boomerang Creek, Plumtree Creek and Hughes Creek by installing permanent drainage works to drain, or partially drain, ponding created by subsidence.

Where ponding is large (greater than three metres deep) and persistent (longer than 12 months), permanent drainage infrastructure will be built as required to improve drainage. Drainage designs for any ponded areas will consider:

- actual subsidence depths
- the rate of sediment infilling
- the rate of pond formation.

Channels will be designed with gradients that protect against erosion damage and sedimentation. Where practical, channels will use natural materials and be reflective of the characteristics of natural gully drainage features in the surrounding landscape. The regrading or use of rock armouring to limit head cut erosion may be required (Section 8.2).

Batter slopes, where required, will be designed to be stable, compatible with surrounding landform slopes, and compatible with proposed rehabilitation treatment methods. Where dispersive or sodic subsoils are identified, measures will be implemented to treat erodible soils (e.g. through gypsum application) or ensure adequate vegetative cover.

The design flow capacity will be compatible with landscape function of the drainage connection between subsidence ponds.

10.4 Soil management

Appropriate topsoil management during construction and rehabilitation is crucial to successful rehabilitation of disturbed areas. Topsoil management during construction and operation will include land clearing for gas management, road construction, infrastructure and surface facilities footprints, levees and water storage construction. Although underground mining will result in subsidence of the land surface, this will not significantly disturb the topsoil (apart from cracking) and does not necessitate its recovery, except in some instances post subsidence where re-contouring, drainage control or crack repair is required and, as such, topsoil salvage may be required prior to any earthworks.

A detailed Topsoil Management procedure will be prepared which takes into account the areas to be disturbed, based upon disturbance type, the volumes of soils required for eventual rehabilitation, the management of stockpiling soils, area of placement and volumes of topsoil material to be stripped.

A general overview of the soil stripping, stockpiling and application process is detailed below.

10.4.1 Topsoil stripping

Once the Project Site has been decommissioned, the compacted areas such as the incidental mine gas network footprint and haul roads that are not required for operations will be rehabilitated through deep ripping/rock raking.

The Project is proposing surface disturbance of approximately 1,155 ha over the life of the Project. In general, the Project Site possesses reserves of topsoil and subsoil that are sufficient for rehabilitation. The basic principle in determining useable depths of topsoil for rehabilitation is its quality in comparison to the spoil requiring rehabilitation. In general, the quality of the topsoil must exceed that of the spoil. Preliminary investigation presents the recommended stripping depths for each SMU and total estimated available topsoil and subsoil reserves within the Project Site. Topsoil stripping depths are outlined in **Table 9** shown in **Figure 10**.

The general protocol for the topsoil stripping includes:

- a pre-ripping assessment (i.e. digging test pits) to manage unexpected topsoil changes
- deep ripping to maximise soil recovery.
- rock raking to remove buried or exposed surface rock greater than 0.5 metres (m) in diameter. rocks may be stockpiled for future use as rock armour. some smaller rocks may also be left in groups on the surface to reduce the risk of erosion until vegetation can be established.
- ripping to be completed
- machinery to be weed free
- disturbance areas to be stripped progressively to reduce topsoil stockpiles and the extent of erosion.

10.4.2 Topsoil stockpiling

Stockpile locations will be close to disturbance areas within the Project footprint based on the following:

- not within proximity to overland water flow areas or drainage lines
- protected from wind prone areas
- areas that are not subject to stock grazing, machinery or vehicle movement
- areas that are not subject to drainage from higher areas to prevent erosion.

Stockpiles will be low mounds at a maximum height of 3 m over the maximum surface area, with a greater number of lower mounds preferable. Stockpiles are to remain stockpiled for an extended period of time and will be sow with species outlined in Section 10.5.2 and at a rate outlined in Section 10.5.3.

If necessary, soil ameliorants will be added to improve the physical and chemical properties of the topsoil growing medium and subsoil. Examples of possible ameliorants for rehabilitation activities include:

- Gypsum
- Compost
- Mulch.

The proportions of ameliorants will be determined by a suitably qualified agronomist. Effort will be made to source any ameliorants locally to reduce the probability of a weed infestation.

Where practical, cleared vegetation will be mulched and stockpiled for future use. The minimum expectations for the management of mulch stockpiles in order to reduce the likelihood of any health, safety and environmental risks are outlined below:

- **Leachate management –** materials with a potential to produce leachate will be stockpiled in a sealed or bunded location where practicable. Covering mulch stockpiles to reduce the potential for leachate generation is not recommended because it enhances the combustion risk.
- **Combustion** – organic materials can produce heat as a result of biological degradation. Therefore, they should be aerated to reduce the risk of overheating and spontaneous combustion. This biological breakdown produces methane and therefore represents a toxic hazard, which may be both acute and chronic, and can result in asphyxiation or explosion. While the stockpiles are not expected to produce large quantities of methane and heat, the following precautions should be implemented where appropriate:
  - Stockpiles will be kept in small piles (< 3 m high)
  - Aerobic conditions will be maintained by keeping stockpiles uncovered and to allow for dilution of gasses
  - There should be enough spacing and no obstructions between mulch stockpiles in order to allow for easy access of emergency vehicles. The distance between stockpiles should be equivalent to the height
  - Activities that can produce sparks or flames (such as welding) will not occur near the mulch stockpiles.

- **Location –** stockpiles will not be located within 50 m of any drains, drainage lines, waterways or flood zones. Additionally, stockpiles should be located outside of flood zones and groundwater recharge area. Stockpiles will not be located within 10 m of retained trees or within the dripline of any trees.

10.4.3 Erosion and sediment control

Potential hazards arise from exposed soil being subject to erosion during rehabilitation and ahead of infrastructure. Sediment and erosion controls that may be employed include:

- minimising erosion of exposed land by restricting clearing areas, minimising soil exposure, and diverting potential runoff from undisturbed areas
- preventing exposed subsoils through minimising length of time subsoils are exposed and using erosion control measures such as gravelling, mulching, sediment fencing, and erosion control blankets
- contour ripping.

10.4.4 Topsoil application process

There are three options for topsoil application:

- business as usual topsoil application - by applying topsoil to 200 mm depth across the largest area possible, taking into account topsoil availability and alternative options
- low intensity application of topsoil with other ameliorants - using 100 mm topsoil as an inoculant, or applied in strips with ameliorants and growth media substitution on competent waste material
- revegetate directly on spoil material - with minor use of alternative ameliorants in place of topsoil on competent waste material.

A pre-mining land resources and soil investigation of the Project Site identified the land capabilities of the soil. This investigation identified that the soil classes where topsoil management is required were within the ranges suitable to create stable landforms compatible with the surrounding landscape and proposed final land use identified in Section 8.

The following measures may be applied to minimise the loss of topsoil material within rehabilitated areas and promote successful vegetation establishment:

- balance the topsoil requirement for rehabilitation areas against stored stockpile inventories and proposed stripping volumes
- maximise the opportunities for direct placement of topsoil from pre-strip to rehabilitation areas
- minimise the length of time that topsoil material is to be stockpiled
- during removal of soils from the stockpiles, take care to minimise structural degradation of the soils
- respread topsoil material in even layers at a thickness appropriate for the landform and land capability of the area to be rehabilitated
- contour rip to encourage rainfall infiltration and minimise run-off
- soon after respreading, seed with sterile cover crops and pasture grasses and/or native tree species to establish revegetation cover as early as possible

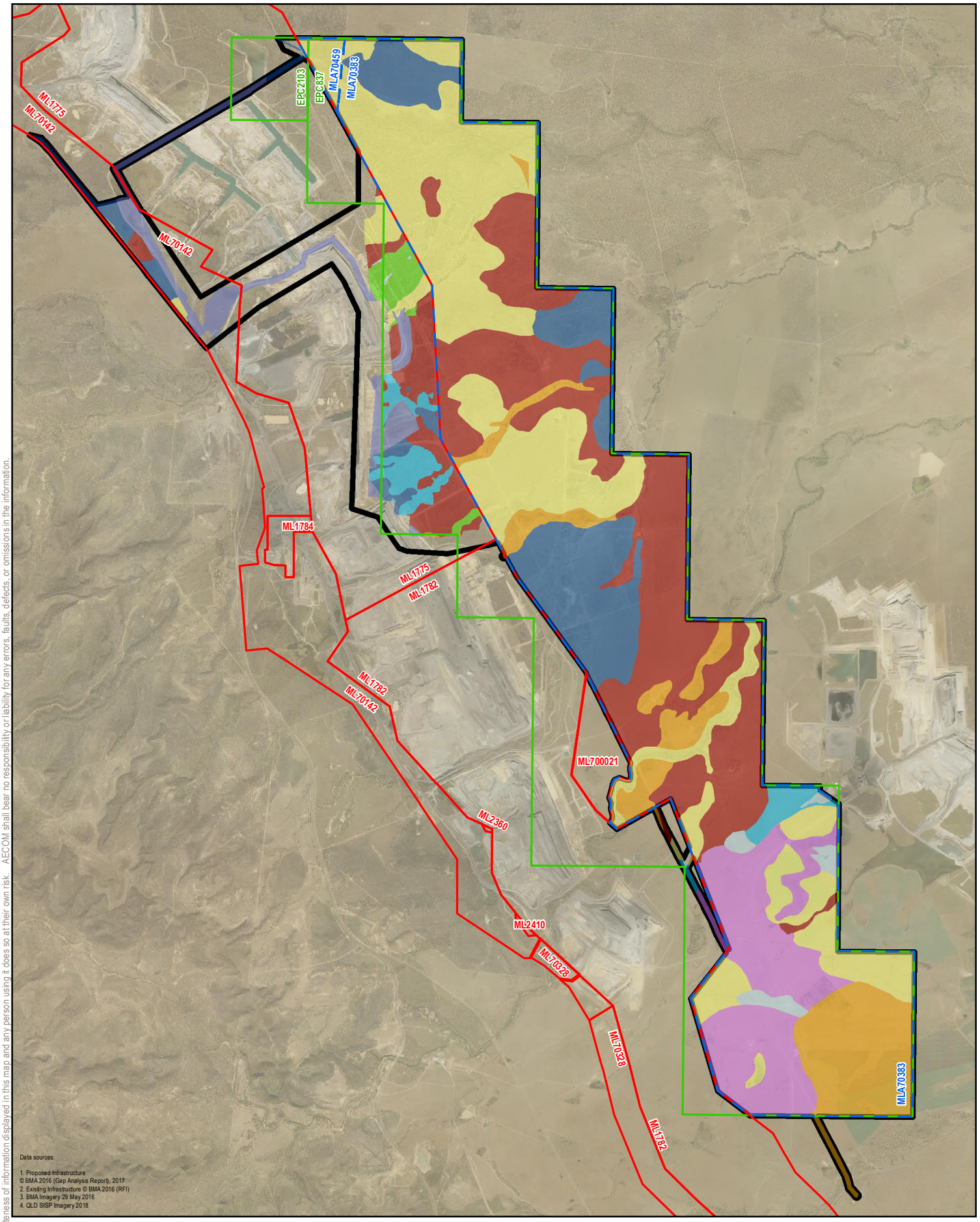
- construct contour banks in accordance with the applicable landform design criteria to limit slope lengths and control run-off
- construct collection drains and sedimentation dams to collect run-off and remove suspended sediment
- regularly inspect and maintain rehabilitation areas to facilitate sediment and erosion control and revegetation success
- monitor rehabilitated areas for declared plants and environmental weeds, and control significant weed outbreaks using chemical or mechanical control methods
- apply appropriate fire, grazing and hygiene management procedures.

Table 9 Recommended topsoil stripping depths and recommended use

SMU	Recommended topsoil strip depth	Recommended topsoil use
2/20	0.00-0.30 metres below ground level (mbgl)	Strip the A horizon of the duplex soils (20 to 30 centimetres (cm)) avoiding the lighter coloured B horizon clays. Where clay soils are present, stripping should only take place to a maximum of 30 cm. Poorer surface structural characteristics are indicated and replacement should only be on relatively low slope angles.
12	0.00-0.40 mbgl	Strip the upper 40 cm, avoiding lower A2 or B horizon materials. Replacement should only be on very low slope angles as nutrition is low and structure is weak.
13	0.00-0.25 mbgl	Strip the A horizon (15 to 25 cm) avoiding B horizon clays which are generally dispersive. Only reuse the soil on almost flat areas (<0.5%) as the soil has very poor physical characteristics with low infiltration rates and is prone to surface sealing. If sufficient volumes of other soils are available for rehabilitation, the SMU may be better discarded.
16/23	0.00-0.25 mbgl	Strip the A horizon material (20 to 25 cm) avoiding bleached A2 material (where present) or B horizon clays. The material should only be used on flatter slopes as structural instability is indicated.
17	Nil	Generally nil, minor SMU with little seed source.
18	0.00-0.50 mbgl	Strip the surface 50 cm as soil in most areas, however close to the creek systems, around 90 cm of useable material (essentially a germination medium for flatter slopes) may be present. Avoid the inclusion of lower clay layers as some of these materials in the Hughes and Spring creek areas may be very dispersive. Overall structure is weak and the material should not be reused on steep slopes.
19	0.00-0.50 mbgl	Strip the surface 50 cm as better quality soil.
3	0.00-0.30 mbgl	Strip the upper A horizon (20 to 30 cm) avoiding the lighter coloured A2 or B horizon clays. Replacement should only be on very low slope angles as nutrition is low and structure is weak.
4	0.00-0.30 mbgl	For use as topsoil, limit stripping to the surface 30 cm in most areas (avoiding light brown subsoil materials). Patches of very dark clays containing carbonate could be taken to a total depth of 50 cm. The soils are suitable for replacement on elevated slopes as good nutrition and reasonable structural characteristics are evident. Initial plant establishment may be slowed by salinity.
5	0.00-0.20 mbgl	Strip the surface 20 cm as topsoil and a seed source in most areas. In occasional areas depth may be as little as 10 cm (structure is poor and the material should not be reused on steep slopes).
8	0.00-0.15 mbgl	The surface 10 to 15 cm (A horizon) may be useful on very flat areas (do not strip the scalded areas).
A1	0.00-0.40 mbgl	Topsoil may be retrieved for the major extent of the sandy A horizon. The material is suitable for use on all level to gently sloping rehabilitation areas.

SMU	Recommended topsoil strip depth	Recommended topsoil use
A2	0.00-0.30 mbgl	Topsoil should only be retrieved from the upper 20 cm as salinity risk increases below this level. The material is suitable for use on lower sloping rehabilitation areas and should ideally be placed to a depth of 20 cm.
A2g	0.00-0.10	
A3	0.00-0.50 mbgl	Topsoil strip depth may extend well past the nominated 50 cm strip depth although more intensive testing for EC and structural assessments should be conducted beforehand. The sandy loam topsoil may be taken until hard clayey subsoil is encountered. The material is suitable for use on most level to gently sloping rehabilitation areas and should ideally be placed to a depth of 20 cm or more.
A4	Nil	
A4c	0.00-0.10	
A5	0.00-0.10	
B1	0.00-0.50 mbgl	Excellent quality topsoil which could be taken deeper than the 50 cm nominated depth (up to 90cm) or double stripped. The material is suitable for use on all rehabilitation areas and should ideally be placed to a depth of 20 cm or more.
B2	0.00-0.30 mbgl	Topsoil should not be taken deeper than the 30 cm nominated depth as below this depth the subsoil is quite hard and coarse structured which would seal if placed on rehabilitation. The material is suitable for use on flatter rehabilitation areas as it tends to erode. It should ideally be placed to a depth of 20 cm or more.
B2bl	0.00-0.10	
B2g	Nil	
B2s	0.00-0.15	
B3	0.00-0.30 mbgl	These soils are traditionally variable in quality – particularly between mounds and depression positions. The mounds are better quality than many other melon hole situations and are not excessively saline or sodic above about 50 cm depth. Nevertheless, topsoil should not be taken deeper than the 30 cm because of the risk of contamination from saline subsoil. The material is suitable for use on flatter rehabilitation areas as it tends to erode. It should ideally be placed to a depth of 20 cm or more.
B3bl	0.00-0.10	
B4	0.00-0.20 mbgl (mound) and 0.00 mbgl (depression)	Melon hole soils often vary considerably between mounds and depression positions. The flat areas between depressions (mounds) offer rehabilitation potential however the dark crusting clay depressions should be avoided. It is important that stripping does not go too deep as useable topsoil will be contaminated. The material is preferred on flatter rehabilitation areas and should ideally be placed to a depth of 20 cm or more.
B5	Nil	

SMU	Recommended topsoil strip depth	Recommended topsoil use
E1	0.00-0.50 mbgl	The loose surface topsoil for reuse in mine rehabilitation may be stripped moist or dry. These soils offer large quantities of good porous material with a variety of applications in mine rehabilitation. Stripping depth will normally exceed 60 cm. The material is suitable for use on most rehabilitation areas as it tends to infiltrate water rapidly and remain loose. It should ideally be placed to a depth of 20 cm or more.
E1r	Nil	
E2	0.00-0.40 mbgl	These soils are high quality clay soils with a high moisture retention capacity however the establishment of permanent pasture cover on rehabilitation may take considerable time as problems occur with germination of fine seeded plants in the shrinking and swelling medium. The soils are often saline below 50 cm depth so a depth cut off of 40 cm is nominated. The material is more suited for use on flatter rehabilitation areas as it tends to erode and the establishment of a protective surface cover may take longer than expected. It should ideally be placed to a depth of 20 cm or more.
E3	0.00-0.20 mbgl	Stripping of these soils should not proceed into the clayey subsoil as the material is hard, impervious and generally dispersive. It is preferable to take less soil than risk contamination with the poor subsoil. Use should normally be limited to rehabilitation of level sites.
T1	0.00-0.20 mbgl	The upper sandy loam may be stripped to the harder pale coloured clay subsoil. In most cases 20 cm of soil would be available for stripping. The preferred rehabilitation application is flat sites only due to high erosion potential.
T2	0.00-0.20 mbgl	The T2 SMU at 10 – 20 cm horizon is a well-drained and higher quality soil which overlies very dense fine sandy loam. It is expected to set hard and seal if placed over rehabilitation. The preferred rehabilitation application is flat sites only due to high erosion potential.



Data sources:

1. Proposed Infrastructure
© BMA 2016 (Gap Analysis Report), 2017
2. Existing Infrastructure © BMA 2016 (RFI)
3. BMA Imagery 29 May 2016
4. QLD SISP Imagery 2018

LEGEND

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)

Topsoil Stripping Depth

- 0-00m
- 0-10m
- 0-15m
- 0-20m
- 0-25m
- 0-30m
- 0-40m
- 0-50m
- Disturbance

N

Figure 10
Topsoil Stripping Depth

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 7/12/2020 VERSION: 1

Filename: \\aubne1fp003\Projects\605X\60507031\4. Tech Work Area\4.99 GIS\02_MXDs\06 Environmental Impact Statement\K-1 Subsidence and Rehab Plans\Rehab Management Plan\60507031_G346_v0_A4P.mxd

10.5 Revegetation

10.5.1 Biodiversity offsets

While mitigation and management measures for impacts on terrestrial ecology focus on maximising retention of vegetation across the Project Site, offsets may be required where residual impacts are realised. Offsets will be undertaken in accordance with the Project's Offset Strategy (AECOM, 2019b).

10.5.2 Species selection

Appropriate seed mix will be selected based on the post mining land use. Where the post mining land use is grazing, the species composition will aim to include a suitable mix of palatable, perennial and productive (3P) grasses and legumes.

Native vegetation outside of the surface infrastructure footprint will be retained in a way that is compatible with the pre-existing land use for biodiversity values observed during the baseline ecological studies. Where vegetation impacts have occurred as a result of recurrent ponding, the area will be revegetated with species that are tolerant of periodic inundation.

All seed suppliers must be accredited and where possible, guarantee that seed supplied is free from declared weed seed.

10.5.3 Seeding rate

Seeding rate will be based on the number of each species per gram, factoring in viability information about each species if known. If seed quality information is unknown, rates will factor in an assumption of 90% mortality/non-viability. Groundcover species will be over sown relative to rates observed in the analogue sites, especially where rehabilitation is within 20 m of a waterway. This will reduce the time that topsoil is bare and therefore susceptible to weed invasion and erosion. Seed treatment methods such as osmo-priming, coating or other methods to break dormancy may be used.

The appropriate seeding rate for domains can form a part of the ongoing monitoring in accordance with the BMA monitoring program that is current at the time of rehabilitation.

10.5.4 Seed delivery

Suitable seeding methods include:

- Direct drill air seeding after ripping
- Hydro seeding using a custom slurry.

Hydro seeding may be used in particularly dry sites that are susceptible to erosion. For other seeding methods, the rehabilitation site will be irrigated several days before sowing and again after sowing where practicable. If this is not practicable, sowing will be timed to coincide with the commencement of the wet season. Soil ameliorants may be added where appropriate.

Where slopes are less than a 1:3 slope angle and erosion is not of concern, seed species will be dry broadcast seeded. Vegetation may take up to two years to establish following broadcast seeding so weed management will be carried out in accordance with the site Weed and Feral Animal Management procedure.

11 Rehabilitation maintenance

11.1 Weed management

11.1.1 General weed control procedure

Weed management will occur in accordance with a site Weed and Feral Animal Management procedure.

The most appropriate method of targeted herbicide will be chosen depending on the weed species present. Hardy species may require re-treatment after the initial treatment to ensure mortality of individual plants. Aggressive and targeted herbicide application regimes are most effective and economical when applied to species in the early phases of invasion. Chemical treatments will be coupled with regular weed monitoring to ensure early detection of new weed species. All herbicides must be registered chemical products with the Pesticides and Veterinary Medicines Authority (PVMA) and managed in accordance with site chemical management procedures and safety data sheets.

A number of restricted weed species are known to occur within the Project Site.

11.1.2 Weed wash-down procedure

A vehicle wash-down will be completed before and after any vehicle is used for rehabilitation works or enters rehabilitation areas in order to mitigate weed invasion. This includes any light vehicles or plant, such as excavators, as well as any slashing equipment and other machinery used by contractors.

Disposal of reproductive material must occur in accordance with the requirements of the *Biosecurity Act 2014* (Qld).

11.2 Feral animal control

If necessary, feral animal controls, such as baiting and shooting, may be undertaken to control the population of pests as required. Where appropriate, feral control measures will target large and hard-footed mammals such as deer and pigs, as they tend to cause erosion and other land disturbance. Feral animal control should also focus on waterways as these are the most sensitive receptors to erosion.

11.3 Burning

Controlled hazard reduction burns may be used. Burning can be used to:

- manage weed growth
- protect pioneer and established shrubs
- ensure waterway stability bank integrity.

12 Rehabilitation monitoring

12.1 Rehabilitation monitoring

Rehabilitation monitoring will be undertaken in accordance with the BHP monitoring program current at the time of rehabilitation.

The purpose of rehabilitation monitoring is to collect sufficient data to identify any potential design non-conformances and issues affecting the rehabilitation that will require future maintenance and monitoring. Monitoring will focus on the following rehabilitation factors:

- erosion
- vegetation
- soil
- landform.

Where appropriate photographic monitoring will be conducted for land resources and water resources. Photographic baseline surveys will include a detailed pre-mining photographic record of the creeks as they pass over the subsided areas. The monitoring locations will be identified and mapped in GIS and will form the basis of the monitoring program. Photographic monitoring will be:

- conducted on the channel reach for 1 km upstream of the subsidence area
- conducted downstream of the subsided areas
- include a geomorphologic assessment of the entire reach
- include photos of:
  - predicted pillar / creek intersection
  - the intersection of predicted centre of each longwall panel
  - any additional points of likely impact identified during the recording process.

The pre-subsidence photographic assessment may break the watercourses into distinct reaches (e.g. lower, middle and upper reaches). Monitoring control locations will be established and will capture any catchment-wide variations.

The data from the monitoring program will be used to determine whether the final rehabilitation outcomes have been met. Monitoring is split into four phases:

1. **Initial monitoring** - conducted within 12 months of the establishment of a newly rehabilitated site to establish baseline conditions and comprises:
   a) monitoring plot establishment
   b) soil and spoil profile characterisation
   c) soil laboratory analysis for an extended suite of analytes
   d) LiDAR analysis of rehabilitation design, erosion features and sediment loss
   e) field survey for erosion features.
2. **Event based monitoring** – occurs on an as-needs basis and targets the structural performance of land features after rainfall or other disturbance events.

3. **Minor monitoring** – conducted on an alternate four-yearly cycles with major monitoring and consists of a subset of the methodologies used in the major monitoring.
4. **Major monitoring** – conducted two years after initial monitoring and then every four years and provides a detailed assessment of the current state of rehabilitation and comprises:
    a) desktop review of previous monitoring reports
    b) LiDAR analysis of rehabilitation design, erosion features, sediment loss and persistent bare ground
    c) field based assessment including soil and spoil, erosion and vegetation monitoring.

Rehabilitation will generally be undertaken after the wet season to mitigate against seasonal variability and ensure that the vegetation and soil conditions are comparable.

12.2 Rehabilitation reporting

Monitoring data collected, including historical data, will be compared against completion criteria outlined in Section 9.8 to determine if the rehabilitation is meeting the objectives. Reporting will occur in accordance with the Project's EA.

12.3 Subsidence monitoring and reporting

Monitoring of subsidence features and impacts will occur in accordance with the methodology outlined in the Project's Subsidence Management Plan.

Reporting for subsidence impacts will occur in accordance with the SMP.

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