Progressive Rehabilitation and Closure Plan

Isaac River Coking Coal Project

Coking Coal One Pty Ltd

EA applicant: Bowen Coking Coal Limited | November 2020

Prepared for: Department of Environment and Science
Prepared by: SGM environmental Pty Limited
Tenure number: MLA 700062 / ML 700063
Document ID: 20004-001
Version: V3-2
Date of submission: 16 November 2020

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Project number:	20B004
Document title:	Progressive Rehabilitation and Closure Plan | Isaac River Coking Coal Project
Revision:	V3-2
Date:	16 November 2020
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Document history and status

Revision	Date	Description	By	Review	Approved
V0-1	08/07/08	Draft	A Costin	T Rohde	T Rohde
V0-2	08/10/08	Draft	A Costin / G Greening	T Rohde	T Rohde
V1-1	27/08/20	Draft	A Costin / G Greening	T Rohde	T Rohde
V2-1	30/09/20	Draft	A Costin / G Greening	T Rohde	T Rohde
V3-1	16/11/20	Final	T Rohde / G Greening	J Vohland	T Rohde
V3-2	28/05/21	Final	J Vohland / G Greening	T Rohde	T Rohde

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3.0 Rehabilitation planning part

3.1 Project planning

The Isaac River Coking Coal Project (the Project) will be developed and operated by Coking Coal One Pty Ltd (the Proponent), a wholly owned subsidiary of Bowen Coking Coal Limited (BCC).

3.1.1 Location details

The Project is located 28 kilometres (km) south-east of Moranbah in the Bowen Basin in Central Queensland within the Isaac Regional Council (IRC) Local Government Area (LGA) (Figure 1).

Access to the Project will be via the Peak Downs Highway and Daunia Road / Annandale Road, which is approximately (~) 8.5 km west of Coppabella. From the Daunia Road, access will be via the existing access road corridor used for the Daunia Quarry.

3.1.2 Project description

3.1.2.1 Mining tenements

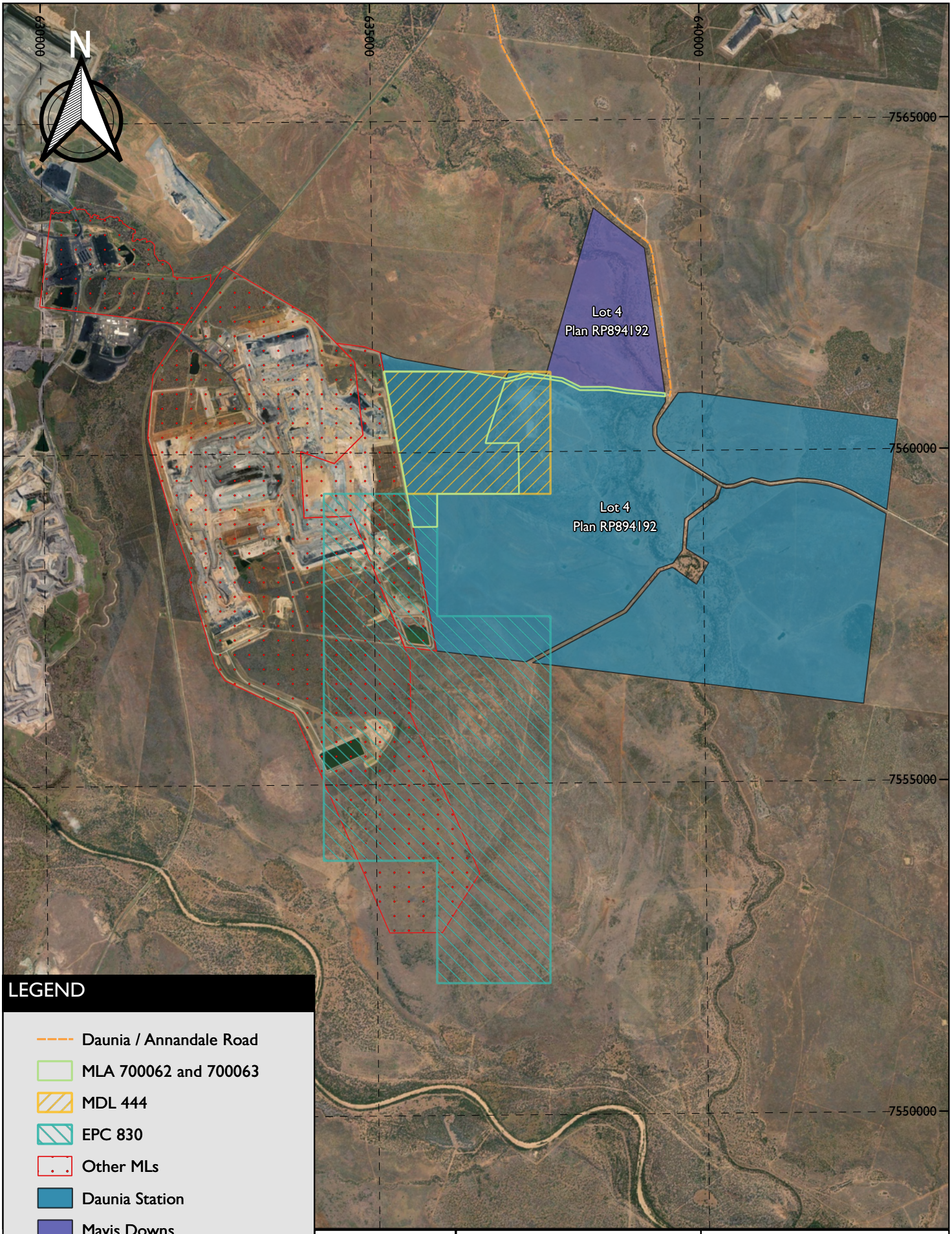
An environmental authority (EA) has not yet been approved; however, the Project includes other mining tenures including an exploration permit for coal (EPC), mineral development lease (MDL) and two mining lease applications (MLAs) one of which is a mining lease for transport (MLT) (Table 1 and Figure 2).

The MLAs covers part of the MDL and EPC. BCC is currently applying for a MLT over the existing access road corridor (MLA 700063) used by Daunia Quarry, which is outside the MDL and EPC.

Table 1 Tenure

Tenure type	Number	Area (hectares (ha))
MLA	700062	330.6
	700063	8.9

Project: Progressive Rehabilitation and Closure Plan		Client: Coking Coal One Pty Ltd	
Figure: 1	Title: Project Location	Design: SGM Environmental Pty Ltd	25.05.2021
		Scale: 1 : 2,750,000	
		CRS: GDA94 / MGA zone 55	



LEGEND

- Daunia / Annandale Road
- MLA 700062 and 700063
- MDL 444
- EPC 830
- Other MLs
- Daunia Station
- Mavis Downs

Scale 1 : 80 000

0 1 2 3 km

SGM environmental

Client: Coking Coal One Pty Ltd	Project: Progressive Rehabilitation and Closure Plan
Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 80,000 CRS: GDA94 / MGA zone 55	Title: Tenure Boundaries Figure: 2

3.1.2.2 Environmentally relevant activities

Activities that will, or have the potential to, release contaminants into the environment which may cause environmental harm are defined as environmentally relevant activities (ERAs) in the *Environmental Protection Act 1994 (*EP Act). In accordance with the *Environmental Protection Regulation 2019* (EP Regulation), the Project will be a site-specific EA mining project for the mining of black coal.

The Project has the potential to involve two ERAs applicable to the construction and operational stages (Table 2).

Table 2 Project ERAs

ERA number	Description of activity
13	Mining black coal.
8 (1) c	Chemical storage — more than 500 cubic metres (m^3) of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3.

Due to the small-scale nature of the Project, ERA 8 is not expected to apply.

Activities that have been identified as likely to cause land contamination are defined as notifiable activities in Schedule 3 of the EP Act. Any person undertaking these notifiable activities must tell the Department of Environment and Science (DES) and the land will be recorded in the *Environmental Management Register* (EMR). Potentially notifiable activities are listed in Table 3.

Table 3 Project notifiable activities

Item number	Description of activity
7	Chemical storage (other than petroleum products or oil under item 29).
24	Mine wastes: storing hazardous mine or exploration wastes, including, for example, tailings dams, overburden or WRDs containing hazardous contaminants; and mining or processing, minerals in a way that exposes faces, or releases groundwater, containing hazardous contaminants.
29	Petroleum products or oil storage in above ground tanks.
37	Waste storage, treatment, or disposal — storing, treating, reprocessing or disposing regulated waste including operating a sewage treatment facility with on-site disposal facilities.

3.1.2.4 Primary mine features / infrastructure

The Project will include the following primary mine features in MLA 700062 (the features) (Figure 3):

MLA 700062:

- one open-cut pit (OC1);
- one run of mine (ROM) coal stockpile;
- one out-of-pit WRD (WRD1);
- mine industrial area (MIA) including:
  - administration offices;
  - petroleum, oil and lubricant storage and handling facilities;
  - vehicle and equipment wash down facilities;
  - vehicle fuelling facilities;
  - workshops and store facilities;
  - laydown and hardstand areas;
  - electrical power substations and associated facilities;
  - water supply for firefighting; and
  - internal roads and carparking;
- haul roads and internal light and heavy vehicle roads (roads); and
- water storage, supply and distribution:
  - sediment dam one, two and three (SD1);
  - mine water dam (MW1);
  - raw water dam (RW1)
  - water distribution pipelines;
  - surface water drainage structures.

MLA 700063:

- Daunia Quarry access road.

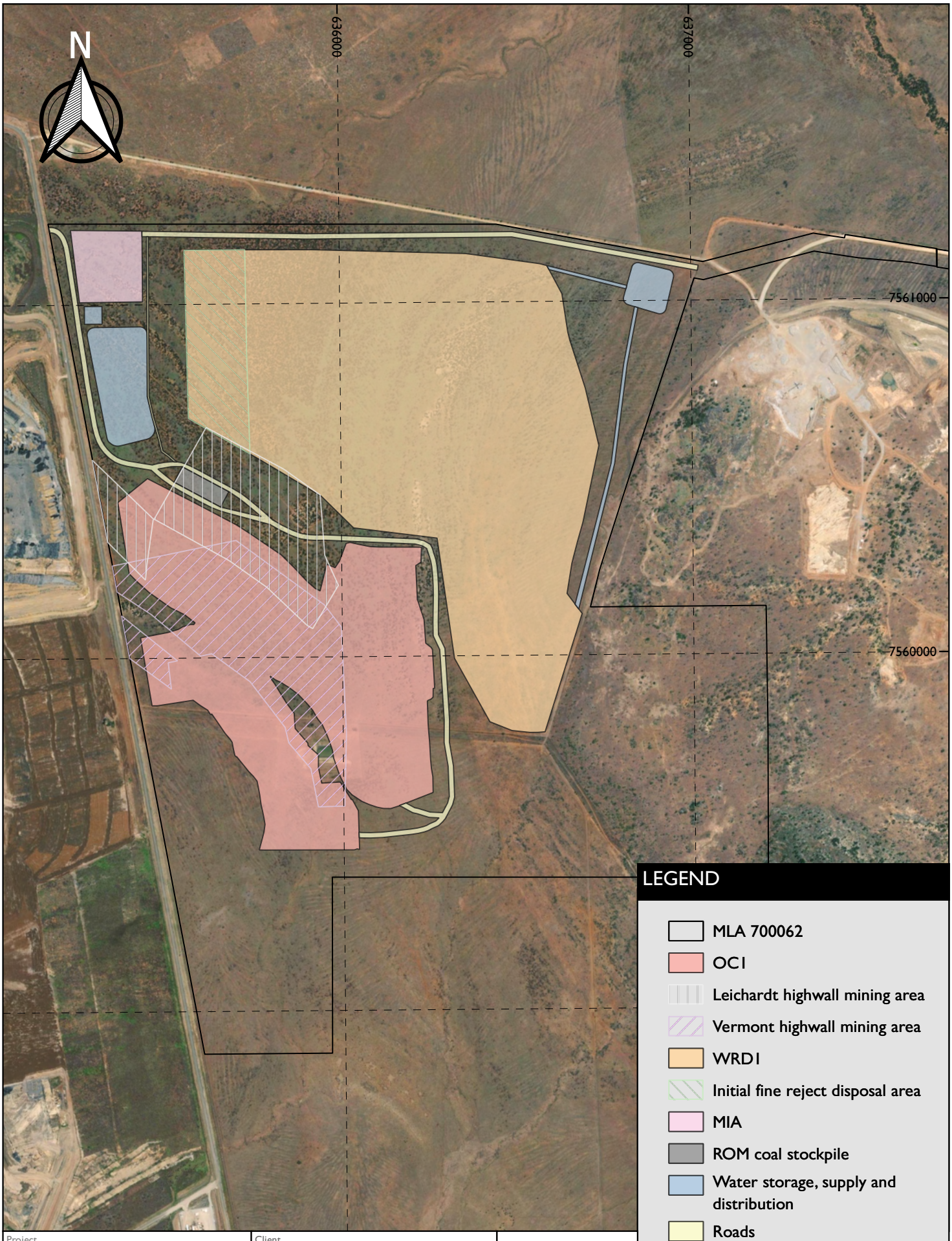
The Project does not include a coal handling and processing plant (CHPP) or train load out (TLO). Instead ROM coal will be hauled to the Red Mountain (RM) CHPP ROM stockyards for crushing and screening prior to processing and stockpiling. Product coal will be loaded onto trains at the RM TLO.

The haul road connecting the Project to the RM CHPP and RM TLO will be located within ML 70115 and ML 1781 (which adjoins the MLAs for the Project), and are held by BHP Mitsui Coal Pty Ltd. The RM CHPP and RM TLO are located on ML 70312, which is also held by BHP Billiton Mitsui Coal Pty Ltd.

Coal will be transported to the ROM coal stockpile before being transported to the RM CHPP where it will be processed. Coal rejects will initially be contained and dewatered at the RM CHPP. The dewatered coal rejects will be returned from the RM CHPP to the Project and placed in cells formed as part of WRD1. Once in-pit dumping starts, coal rejects will be disposed in-pit.

3.1.2.5 Type of mining operation

The Project will start by truck and shovel mining in an open-cut pit before transitioning to highwall mining. The highwall operation will in-part overlap the open-cut pit and will maximise coal extraction from the Vermont (VEM) and Leichhardt (LHD) seams.



Project: Progressive Rehabilitation and Closure Plan		Client: Coking Coal One Pty Ltd	
Figure: 3	Title: Primary Features	Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 15,000 CRS: GDA94 / MGA zone 55	

3.1.2.6 Proposed duration of operation

The Project is expected to start in 2024 and continue for five years until 2028. Beyond 2028, an additional three years (until 2031) is needed for rehabilitation works. Rehabilitation monitoring will continue beyond 2028 until the mining tenures are relinquished.

3.1.3 Baseline information

3.1.3.1 Site topography

a Local

Topography across the Project ranges from 212 to 251 metres (m) above sea level. There is a 39 m difference between the lowest point in the Project north-east and the highest point in the south-east; however, the Project can be considered flat grading to gently undulating (Figure 4).

b Regional

The region surrounding the Project is relatively flat, with the Kerlong Range to the north and the Cherwell Range to the south-east. These generally rise to a maximum height of 400-500 m above sea level.

3.1.3.2 Climate

The climate of the Project and region is classified as hot semi-arid climate (BSh) by Köppen and Geiger. These climates tend to have hot summers and warm to cool winters, with some to minimal rainfall. High variability in rainfall, temperature and evaporation are common in Central Queensland.

Local rainfall, evaporation and temperature data has been sourced from surrounding Bureau of Meteorology (BoM) weather stations:

- Moranbah Water Treatment Plant (station 034028) — operated from 1972 to March 2012. This station was located ~30 km west of the Project; and
- Moranbah Airport (station 034035) — operational from March 2012. This station is located ~25 km west of the Project.

a Rain

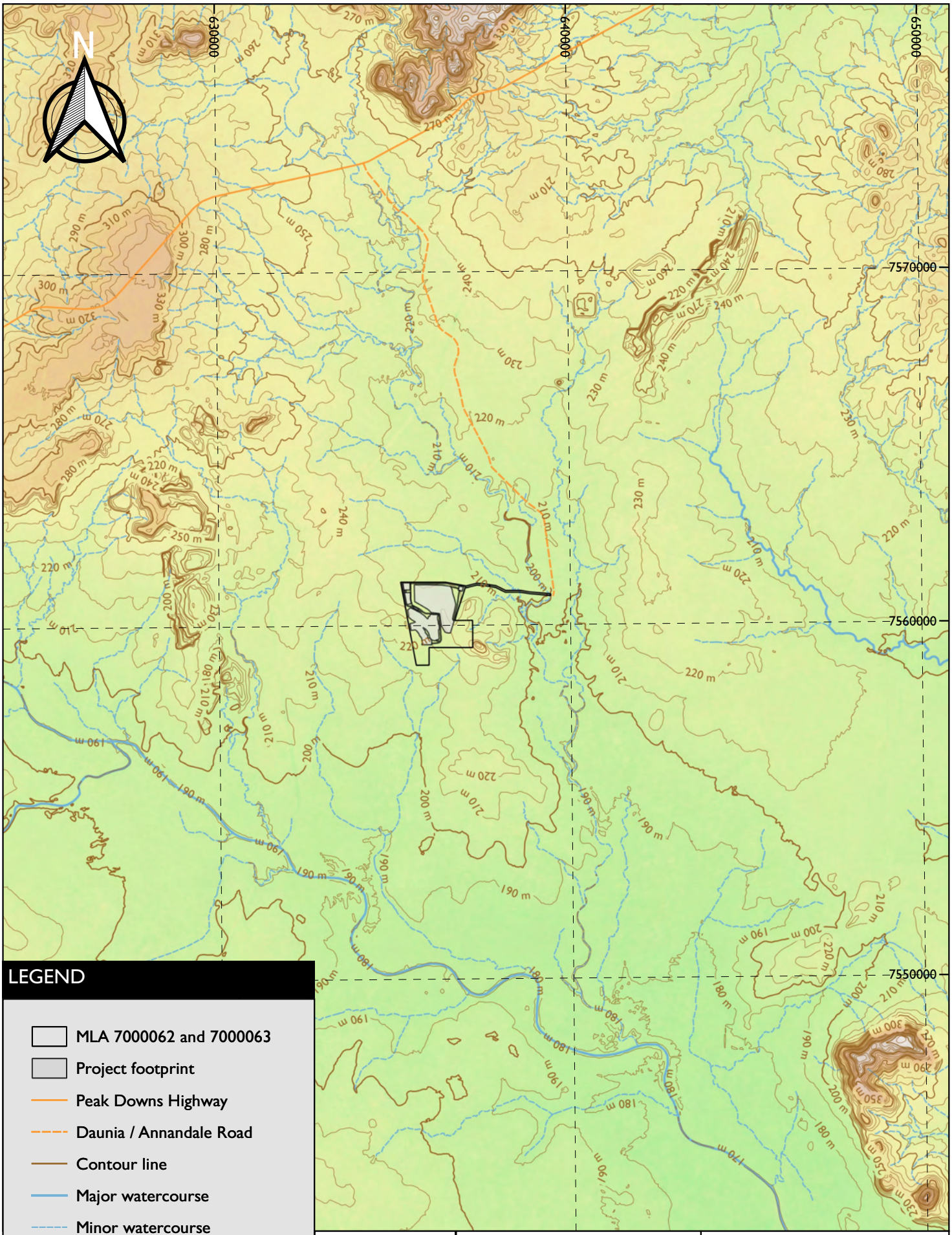
January, February and December exhibit the highest mean monthly rainfall, averaging above 100 millimetres (mm). The driest month of the year is September averaging under 10 mm of rainfall. The average annual rainfall for the region is 614.2 mm per year. Average monthly rainfall for both weather stations is given in Table 4.

b Evaporation

The average annual potential evaporation at the Project is estimated to be 2,306.4 mm, 3.8 times higher than annual rainfall. The evaporation rate varies seasonally, with the highest evaporation rates occurring in the months between October and March. Monthly average evaporation for the Moranbah Water Treatment Plant (not available for Moranbah Airport) is given in Table 5.

c Temperatures

The mean annual maximum temperature is 29.7 degrees Celsius (˚C) with the hottest months being November through to February (over 33 ˚C). The mean annual minimum temperature is 16.7 ˚C. with the coolest months being June through to August (below 12 ˚C). Average monthly minimum and maximum temperature for both weather stations are given in Table 6.



LEGEND

- MLA 7000062 and 7000063
- Project footprint
- Peak Downs Highway
- Daunia / Annandale Road
- Contour line
- Major watercourse
- Minor watercourse

Scale 1 : 150 000

0 2 4 6 km

	Client: Coking Coal One Pty Ltd	Project: Progressive Rehabilitation and Closure Plan	
	Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 150,000 CRS: GDA94 / MGA zone 55	Title: Topography of the Project and Region	Figure: 4

Table 4 Average monthly and annual rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean rainfall (mm) — Moranbah Water Treatment Plant	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	614.2
Mean rainfall (mm) — Moranbah Airport	115.7	119.9	73.0	38.8	19.6	22.7	23.7	11.2	11.7	5.0	55.7	54.9	533.7

Table 5 Average monthly and annual evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean evaporation (mm) – Moranbah Water Treatment Plant	248.0	207.2	210.8	171.0	133.3	105.0	114.7	151.9	198.0	248.0	255.0	263.5	2,306.4

Table 6 Average monthly and annual temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C) — Moranbah Water Treatment Plant	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7
Mean minimum temperature (°C) — Moranbah Water Treatment Plant	21.9	21.8	20.2	17.6	14.2	11.1	9.9	11.1	14.1	17.6	19.4	21.1	16.7
Mean maximum temperature (°C) — Moranbah Airport	35.3	32.3	32.0	30.0	27.2	24.2	24.2	26.9	30.1	32.9	35.1	35.3	30.3
Mean minimum temperature (°C) — Moranbah Airport	21.5	20.7	19.7	16.4	12.7	9.7	8.1	7.9	12.1	14.9	18.9	20.0	15.2

d Long-term projections

Rain

The *State of the Climate 2018* (CSIRO & BoM 2018) says that Australian rainfall is highly variable, which makes it difficult to identify significant trends over time. Northern Australia average annual rainfall has increased since national records began in 1900, largely due to increases in rainfall from October to April.

It is possible that future intense rain events could impact rehabilitation, particularly if erosion increases.

Temperature

The *State of the Climate 2018* (CSIRO & BoM 2018) and the BoM *Annual Climate Statement 2019* says Australia's weather and climate are changing in response to a warming global climate system. Australia has warmed by around 1 °C since 1910, with most of the warming having occurred since 1950. Australia's top four warmest years on record occurred in the last seven years — 2013, 2014, 2015 and 2019. 2019 was the warmest year on record. The warming trend occurs against a background of year-to-year climate variability, mostly associated with El Niño and La Niña in the tropical Pacific Ocean.

Sea surface temperatures in the Australian region have warmed by nearly 1 °C since 1900, with the past five years, 2013-2015, all in the region's five warmest years on record.

It is possible that future drought could impact rehabilitation, particularly if reduced plant available water causes vegetation stress.

Bushfire

The *State of the Climate 2018* (CSIRO & BoM 2018) and the BoM *Annual Climate Statement 2019* says Australia's shift to a warmer climate is accompanied by more extreme heat events on daily, multi-day and seasonal timescales. Australia-wide, increases in average temperature have been more notable across autumn, winter and spring, with the smallest trends in summer. Three out of the last seven years (2014, 2015 and 2019) have seen the warmest spring seasons on record. Recent attribution studies reveal that the underlying global warming trend was important in driving the unusually warm temperatures experienced during those three spring seasons.

Increased bushfires may impact the Project because they have the potential to destabilise rehabilitation. The *Mine Rehabilitation: Leading Practice Sustainable Development Program for the Mining Industry* (Grant et al. 2016) leading practice guidance is that a Project specific fire protection plan may be needed to protect rehabilitation for a number of years until vegetation is able to survive fire or have set seed so that it can re-established. Certification from an appropriately qualified person (AQP) should also be gained to establish that rehabilitation is resilient to fire.

3.1.3.3 Geological setting

The Project is in the northern part of the Permian-Triassic Bowen Basin containing principally fluvial and some marine sediments. The Bowen Basin is part of a connected group of Permo-Triassic basins in eastern Australia which includes the Sydney and Gunnedah Basins. Development of the basin in the Early Permian was in the form of a half graben which subsequently became areas of regional crustal sag. Variations in depositional patterns and deformation styles occur along strike suggesting the possibility of north-east trending deep seated crustal transfer faults, evidence for such occurs at the neighbouring Isaac Plains Mine.

The Bowen Basin has undergone oriented north-east to south-west extensional and compressional events. Structurally, the deposit lies on the western boundary of the deformed Nebo Synclinorium. Complex folding and faulting structures are common throughout the region. Further to the west is the structurally simple Collinsville Shelf.

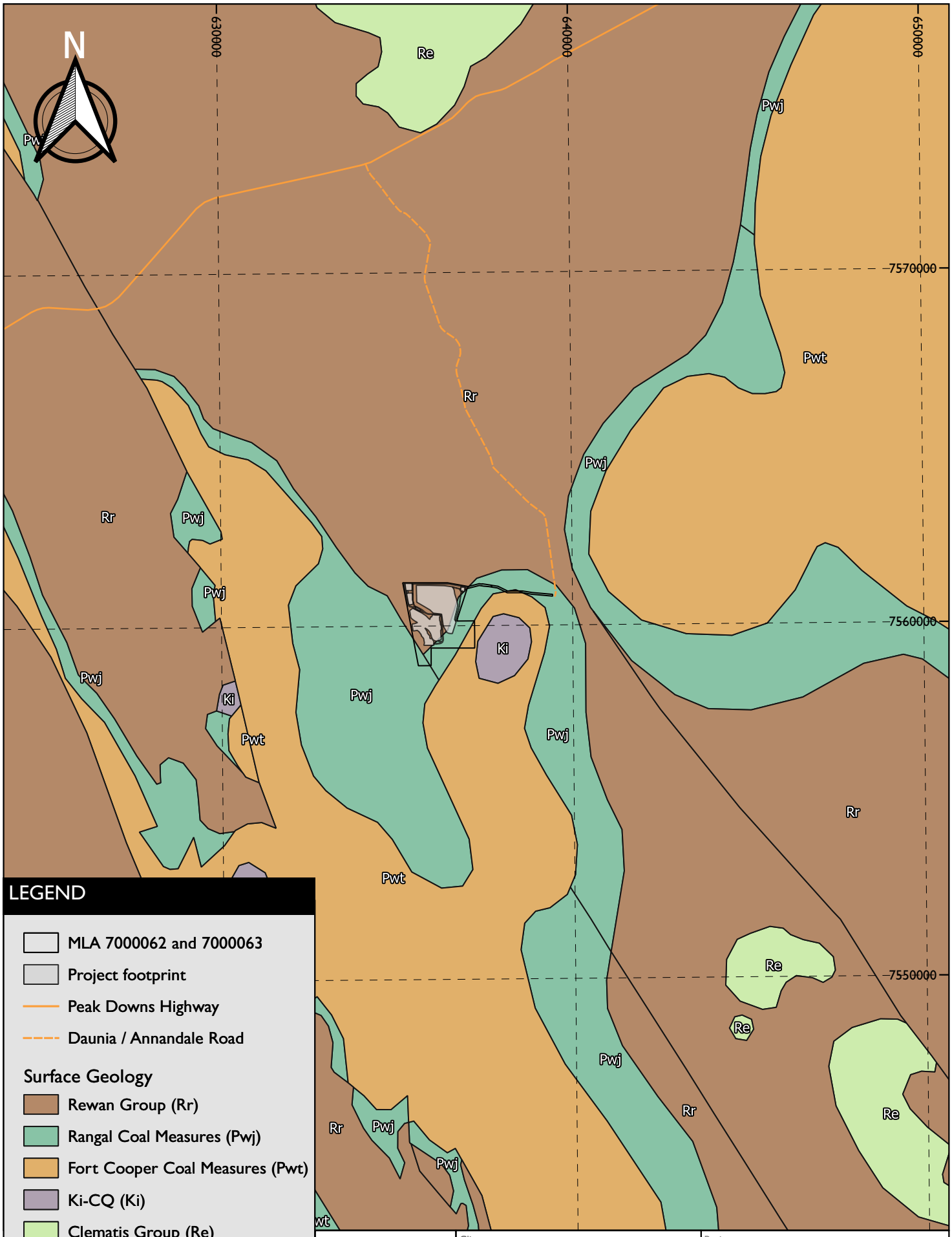
The Project is in the western and central Bowen Basin, where the target Permian stratigraphy strikes north to north-west and dips to the east off the Comet-Ridge. The local geology is complicated by multiple faults associated with the Jellinbah Fault system (Isaac Plains, New Chum and Daunia Faults). The general structure

interpreted from data collected from the two-dimensional (2D) seismic program and exploration drilling indicates that the resource is associated with a synclinal structure plunging to the north. The syncline lies to the west of the MDL at the western margin of a post Permian intrusive body. The western limb of the syncline is identified as hosting the targeted resource as the eastern limb is steep dipping against the interpreted intrusion and is poorly defined.

The stratigraphy comprises three main units (Figure 5):

- Cainozoic sediments, comprising alluvium and soils;
- Early Triassic Rewan Group; and
- Permian period coal measures, comprising Rangal and Fort Cooper Coal Measures.

The Project's economic coal seams are contained in the Late Permian Rangal Coal Measures, which are ~100 m thick. The Permian Rangal Coal Measures are underlain by the Fort Cooper Coal Measures and overlain by the Early Triassic Rewan Group.



Client: Coking Coal One Pty Ltd		Project: Progressive Rehabilitation and Closure Plan
Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 150,000 CRS: GDA94 / MGA zone 55	Title: Geological Setting	Figure: 5

3.1.3.4 Site hydrology and fluvial networks

a Catchment overview

The Project is in the North Creek catchment; an offshoot of the Isaac River catchment which falls within the greater Fitzroy Basin. Three main drainages are located within the catchment of the Project; one flows east-southeast to join North Creek, the other two flow generally south to join the Isaac River.

The Isaac River flows from the north-west to south-east and is the main watercourse within the Project. It is a seasonally flowing watercourse which experiences greater surface flow during the wet season (November to April) and shallow subsurface flows during the drier months (May to October). North Creek drains to the middle reaches of Isaac River, directly upstream of the Deverill stream gauging station.

North Creek is located east of the Project and is ephemeral ie only flowing after the catchment receives heavy rainfall. The catchment of North Creek is ~342 square kilometres (km^2). North Creek's flow and water quality are highly variable because of channels drying out or holding pools of water for an extended period when rainfall is low. Water quality of North Creek is influenced by land-use within the catchment. Pasture grazing and the Moorvale Mine, which is located ~6 km from the Project, are the two primary contributors to water quality in the North Creek catchment.

b Hydrologic modelling

Hydrologic modelling was done considering design rainfall depths and local catchment characteristics. The model was run with existing catchment characteristics and then re-run with the Project development included. This allowed for a comparison between the two states and an assessment of the potential impacts on peak flows and volumes. The Project has the potential to affect runoff quantity at three separate locations, these being the sub-catchments named as C01, C14 and C16. The reduction in catchment from internally-draining areas that would otherwise drain freely to North Creek or the Isaac River is given in Table 7.

Table 7 Change in catchment

Sub-catchment	Existing catchment (ha)	Project catchment (ha)	Reduction in catchment (%)
C01 (North Creek)	1,585.5	1,463.9	-7.7
C14 (Isaac River gully)	144.3	65.7	-54.5
C16 (Isaac River gully)	133.1	107.5	-19.3
Total	**1,862.9**	**1,637.1**	**-12.1**

Design storms, ranging in duration from one to nine hours, were simulated to determine the critical durations and peak flows (cubic metres per second (m^3/s)) for each of the sub-catchments. The results are given in Table 8.

Table 8 Summary of peak flow estimates

Sub-catchment	Annual exceedance probability (AEP)	Critical duration (mm)	Existing catchment (m^3/s)	Project catchment (m^3/s)	Change (%)
C01 (North Creek)	10%	360	35.4	33.0	6.8
	5%	360	47.1	43.9	6.8
	2%	360	65.7	61.4	6.5

Sub-catchment	Annual exceedance probability (AEP)	Critical duration (mm)	Existing catchment (m^3/s)	Project catchment (m^3/s)	Change (%)
	1%	360	80.5	75.1	6.7
	0.1%	360	150.4	138.5	7.9
C14 (Isaac River gully)	10%	180	5.8	3.0	48.3
	5%	180	8.0	4.2	47.5
	2%	180	10.1	5.3	47.5
	1%	180	11.7	6.4	45.4
	0.1%	120	26.5	14.3	46.0
C16 (Isaac River gully)	10%	180	6.6	5.6	15.2
	5%	180	8.9	7.5	15.7
	2%	120	11.4	9.7	15.1
	1%	120	13.7	11.6	15.3
	0.1%	90	30.2	25.7	14.9

c Water quality

Water quality sampling was done for the Olive Downs Coking Coal Project (the Olive Downs Project) between July 2017 and May 2018. Analysis for a range of chemical parameters were completed at eight sites, with sites SW1, SW2 and SW3 assessed as being relevant for the Project. SW1 is located on the Isaac River upstream of the Project and the confluence with North Creek. SW2 is located on North Creek downstream of the Project and upstream of the confluence with the Isaac River. SW3 is located on the Isaac River downstream of the Project and the confluence with North Creek. A summary of the water quality data is given in Table 9.

Table 9 Surface water chemistry results

		Isaac River Sub-basin environmental values (EVs)			*Australian Drinking Water Guidelines* (ADWG)[1]		Sampling locations[2] (minimum-maximum (median))		
Analytes	**Units**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**SW1 (Isaac River upstream)**	**SW2 (North Creek downstream)**	**SW3 (Isaac River downstream)**
Physico-chemical									
pH	pH units	6.5-8.5	-	6.5-8.5	-	6.5-8.5	7.9-8.4 (8.3)	6.4-8.3 (7.6)	6.4-8.2 (7.5)
Electrical conductivity (EC)	Micro-siemens per centimetre (µS/cm)	130	-	2,985	-	-	389-475 (457)	124-516 (359)	218-358 (312)
Total hardness as calcium carbonate ($CaCO_3$)	Milligrams per litre (mg/L)	-	-	-	-	-	98-186 (132)	32-190 (127)	48-105 (79)
Fluoride	mg/L	-			1.5	-	0.2	0.2-0.3 (0.2)	<0.1-0.2 (0.2)
Sulfate	mg/L	-	-	1,000	-	250	3-8 (4)	1-2 (1)	4-9 (5)
Turbidity	Nephelometric turbidity units (NTU)	50	-	-	-	5	7-123 (23)	30-132 (56)	1-498 (10)
Suspended solids (SS)	mg/L	55	-	-			11-66 (13)	14-58 (25)	6-38 (11)

		Isaac River Sub-basin environmental values (EVs)			*Australian Drinking Water Guidelines* (ADWG)[1]		Sampling locations[2] (minimum-maximum (median))		
Analytes	**Units**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**SW1 (Isaac River upstream)**	**SW2 (North Creek downstream)**	**SW3 (Isaac River downstream)**
Dissolved oxygen (% saturation)	%	85-110	-	-	-	85	42.0-60.8 (54.5)	3.1-94.9 (29.0)	5.1-57.2 (30.3)
Total nitrogen (N)	mg/L	0.5	-	-	-	-	0.3-1.3 (0.5)	0.5-1.4 (0.8)	0.1-1.1 (0.5)
Total Kjeldahl nitrogen (TKN)	mg/L	-	-	-	-	-	0.3-1.3 (0.5)	0.5-1.4 (0.8)	0.1-1.1 (0.4)
Total phosphorus (P)	mg/L	0.05	-	-	-	-	0.02-0.10 (0.03)	0.04-0.25 (0.07)	0.01-0.28 (0.03)
Reactive phosphorus	mg/L	-	-	-	-	-	<0.01	<0.01	<0.01
Sodium (Na)	mg/L	-	-	-	-	180	33-57 (40)	4-50 (29)	19-39 (34)
Total metals									
Aluminium (Al)	Micrograms per litre (µg/L)	55	20,000	5,000	-	200	210-1,100 (290)	580-3,760 (905)	40-10,500 (185)
Arsenic (As)	µg/L	24	2,000	500	10	-	<1-2 (1)	<1-2 (2)	<1-4 (2)
Boron (B)	µg/L	370	500	5,000	4,000	-	<50-70 (50)	<50-80 (60)	<50-50 (<50)

		Isaac River Sub-basin environmental values (EVs)			*Australian Drinking Water Guidelines* (ADWG)[1]		Sampling locations[2] (minimum-maximum (median))		
Analytes	**Units**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**SW1 (Isaac River upstream)**	**SW2 (North Creek downstream)**	**SW3 (Isaac River downstream)**
Cadmium (Cd)	µg/L	0.2	50	10	2	-	<0.1	<0.1	<0.1
Chromium (Cr)	µg/L	1	1,000	1,000	50	-	<1-2 (<1)	<1-3 (1)	<1-11 (6)
Cobalt (Co)	µg/L	-	100	1,000	-	-	<1-2 (<1)	<1-2 (<1)	<1-4 (3)
Copper (Cu)	µg/L	1.4	5,000	1,000	2,000	1,000	<1-2 (<1)	<1-4 (3)	<1-11 (<1)
Iron (Fe)	µg/L	-	10,000	-	-	300	280-2,710 (430)	650-3,950 (1,160)	150-12,600 (725)
Lead (Pb)	µg/L	3.4	5,000	100	10	-	<1-1 (<1)	<1-2 (<1)	<1-9 (<1)
Manganese (Mn)	µg/L	1,900	10,000	-	500	100	157-781 (347)	94-1,430 (233)	75-1,100 (469)
Mercury (Hg)	µg/L	0.6	2	2	1	-	<0.1	<0.1	<0.1
Molybdenum (Mo)	µg/L	-	50	150	50	-	<1-2 (1)	<1	<1-1 (<1)
Nickel (Ni)	µg/L	11	2,000	1,000	20	-	<1-3 (2)	<1-4 (3)	<1-15 (2)
Selenium (Se)	µg/L	-	50	20	10	-	<10	<10	<10
Silver (Ag)	µg/L	50	-	-	100	-	<1	<1	<1
Uranium (U)	µg/L	-	100	200	17	-	<1	<1-2 (<1)	<1
Vanadium (V)	µg/L	-	500	-	-	-	<10	<10	<10-20 (<10)

		Isaac River Sub-basin environmental values (EVs)			*Australian Drinking Water Guidelines* (ADWG)[1]		Sampling locations[2] (minimum-maximum (median))		
Analytes	**Units**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**SW1 (Isaac River upstream)**	**SW2 (North Creek downstream)**	**SW3 (Isaac River downstream)**
Zinc (Zn)	µg/L	8	5,000	20,000	-	3,000	<5-10 (<5)	<5-12 (11)	<5-26 (17)
Dissolved metals									
Al	µg/L	55	20,000	5,000	-	200	20-150 (65)	40-610 (70)	20-520 (50)
As	µg/L	24	2,000	500	10	-	<1-2 (1)	<1-2 (1)	<1-1 (1)
B	µg/L	370	500	5,000	4,000	-	<50-60 (<50)	<50-100 (60)	<50-70 (60)
Cd	µg/L	0.2	50	10	2	-	<0.1	<0.1	<0.1
Cr	µg/L	1	1,000	1,000	50	-	<1	<1	<1
Co	µg/L	-	100	1,000	-	-	<1	<1	<1-1 (<1)
Cu	µg/L	1.4	5,000	1,000	2,000	1,000	<1	<1-2 (2)	<1-1 (<1)
Fe	µg/L	-	10,000	-	-	300	70-180 (105)	<50-520 (160)	60-630 (305)
Pb	µg/L	3.4	5,000	100	10	-	<1	<1	<1
Mn	µg/L	1,900	10,000	-	500	100	73-562 (287)	<1-922 (16)	11-1,050 (461)
Hg	µg/L	0.6	2	2	1	-	<0.1	<0.1	<0.1
Mo	µg/L	-	50	150	50	-	<1-1 (1)	<1	<1
Ni	µg/L	11	2,000	1,000	20	-	<1-2 (1)	<1-3 (2)	<1-2 (1)
Se	µg/L	-	50	20	10	-	<10	<10	<10

		Isaac River Sub-basin environmental values (EVs)			*Australian Drinking Water Guidelines* (ADWG)[1]		Sampling locations[2] (minimum-maximum (median))		
Analytes	**Units**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**SW1 (Isaac River upstream)**	**SW2 (North Creek downstream)**	**SW3 (Isaac River downstream)**
Ag	µg/L	50	-	-	100	-	<1	<1	<1
U	µg/L	-	100	200	17	-	<1	<1-2 (<1)	<1
V	µg/L	-	500	-	-	-	<10	<10	<10
Zn	µg/L	8	5,000	20,000	-	3,000	<5-10 (<5)	<5	<5

1. Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP 2011) and Australian Drinking Water Guidelines (NHMRC & NRMMC 2011).
2. Green = 95% protection exceedance, yellow = irrigation EV exceedance, orange = stock EV exceedance, red = ADWG health exceedance, blue = ADWG aesthetic exceedance.
3. Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 200).
4. Table 9 of Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP 2011).
5. Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP 2011).

3.1.3.5 Groundwater levels and properties

a EVs and water quality objectives

The Project is wholly within the Isaac River Sub-basin. Specific EVs and water quality objectives (WQOs) were released in 2011 as part of the *Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part) including all waters of Isaac River Sub-basin (including Connors River)* (DEHP 2011). The Project is located within the Isaac northern tributaries. The EVs defined for this zone, which are applicable to the Project are:

- aquatic ecosystems — where baseflow supports permanent streams and water holes to some extent (eg seasonally or permanently). This interaction can occur in tidal and estuarine zones, as well as in freshwater areas;
- irrigation — used to grow crops and pastures for commercial purposes;
- farm supply / use — used to provide stock water supplies;
- primary recreation — supports recreational use which involves direct contact and a high probability of water being swallowed (eg diving, swimming, surfing, water skiing and windsurfing);
- drinking water — used for potable water supply; and
- cultural and spiritual values — supports both indigenous and non-indigenous values (eg cultural heritage, symbols, landmarks and lifestyles).

WQOs vary across the Fitzroy Basin and are defined based on groundwater chemistry zones (GCZs). The applicable GCZ for the Project is zone 34 (Isaac Groundwater). The WQOs for this zone are given in Table 10.

Table 10 WQOs for groundwater resources

		Deep groundwater[1]			Shallow groundwater[1]		
Water quality indicator	**Unit**	**20th percentile**	**50th percentile**	**80th percentile**	**20th percentile**	**50th percentile**	**80th percentile**
EC	µS/cm	3,419	6,100	16,000	498	2,150	8,910
Hardness (as $CaCO_3$)	mg/L	359	919	3,208	163	674	2,228
pH	pH units	7.4	7.8	8.03	7.1	7.75	8.1
Alkalinity	mg/L	156	275	536	154	435	752
Calcium (Ca)	mg/L	46	145	442	18	84	215
Magnesium (Mg)	mg/L	35	115	491	27	108	389
Na	mg/L	480	1,100	2,565	135	747	1,500
Chloride (Cl^-)	mg/L	753	1,900	5,905	171	1,309	3,185
Sulfate	mg/L	25	138	398	12	140	318
Bicarbonate	mg/L	188	330	650	187	536	878
Nitrate	mg/L	0.01	2.15	14.92	0	0.95	5.3
Silicon dioxide	mg/L	16	25	36	21	36	52
Fluorine	mg/L	0.02	0.155	0.4	0.1	0.28	0.5
Fe	mg/L	0	0.05	0.246	0	0.03	0.14
Mn	mg/L	0	0.05	0.291	0	0.01	0.16
Zn	mg/L	0.01	0.025	0.317	0	0.015	0.06

		Deep groundwater[1]			Shallow groundwater[1]		
Water quality indicator	**Unit**	**20th percentile**	**50th percentile**	**80th percentile**	**20th percentile**	**50th percentile**	**80th percentile**
Cu	mg/L	0.017	0.03	0.03	0	0.01	0.03
Sodium adsorption ratio (SAR)	-	10.5	15.6	24.65	4.37	10.85	18.21
Residual alkali hazard (RAH)	Milliequivalents per litre (meq/L)	0	0.24	6.25	0	0	2.3

1. Groundwater WQOs are given for two depths (shallow less than (<) 30 m below ground level (bgl) and deep greater than (>) 30 m bgl).

b Hydro stratigraphic units

Hydro stratigraphic units (HSUs) are zones within a hydrogeological system that have similar hydrogeological properties. At the broadest level, HSUs are categorised as aquifers (stores groundwater) and aquitards (barriers to groundwater). The HSUs within a 5 km buffer of MDL 444 are given in Table 11.

Table 11 Project HSUs

HSU	Description	Aquifer / aquitard
Alluvium	Up to 20 m of sand, clays, sandy clays and minor gravel at the base.	Not present at the Project Local aquifer along North Creek and Isaac River
Granitoid Intrusion	Felsic igneous intrusion within eastern third of MDL 444. Primary porosity is very low, and any secondary porosity is restricted to sparse jointing. The unit will act as a barrier to groundwater flow.	Aquitard / Lateral Flow Barrier
Early Triassic Rewan Group	Lithic sandstone, pebbly lithic sandstone and green to reddish brown mudstone. The Rewan Group comprises low permeability lithologies and is typically considered an aquitard.	Aquitard
Permian Coal Measures: • Rangal Coal Measures; and • Fort Cooper Coal Measures.	The Rangal Coal Measures comprise light grey, cross bedded, fine to medium grained labile sandstones, grey siltstones, mudstones and coal seams and are ~100 m thick. The Fort Cooper Coal Measures are composed of tuffaceous sandstones, siltstones, mudstones and coal seams. Groundwater is found in the coal seams and in the lower permeability sandstone / siltstone units. The coal seams form the main groundwater bearing units with low permeability interbeds generally confining the individual seams. The coal seams are dual porosity with a minor matrix porosity and a dominant secondary porosity in fractures.	Siltstone / Mudstone Interburden / Overburden — Aquitards Coal Seams — Minor aquifers

c Hydrogeological properties

Recharge and discharge

Two recharge locations were identified near the Project:

- North Creek (Alluvium deposits):
  - ephemeral, with recharge of bank storage likely only occurring during flow events;
  - bank storage will most likely undergo evapotranspiration by vegetation around the creek; and
  - bank storage may recharge deep groundwater through the weathered rock layer.
- Coal seam (Permian strata):

- vertical movement of groundwater is restricted by the confining interburden layers;
- flow direction to the west, sub-horizontal through the seams toward BHP Billiton Mitsubishi Alliance (BMA) Daunia Mine; and
- recharge typically occurring at seam outcrops or sub-crops.

During mine operations, groundwater will generally be discharged into the open-cut pit, which will act as a sink.

On a regional scale, aquifer recharge is mainly through direct infiltration of rainfall, overland flow and surface water flow. Discharge is generally through evapotranspiration from vegetation, infiltration, and recharge to underlying older formations.

Groundwater bores

A search of the Department of Natural Resources, Mining and Environment (DNRME) groundwater database identified 19 bores within a 5 km radius of the Project. Seven groundwater monitoring bores were drilled and constructed at the Project in April and May 2019 to investigate groundwater levels, hydrogeochemistry and hydraulic testing within the Rangal Coal Measures. The bores, along with their major hydrogeological properties, are given in Table 12.

Table 12 Groundwater bore properties

Bore number	Distance from Project (km)	Easting	Northing	Status	Drilled depth (m bgl)	Water level 23/10/2019 (m bgl)	Water level 25/02/2021 (m bgl)	Hydraulic conductivity[1] (metres per day (m/day))
Registered bores								
RN162470	1.2	635300	7560237	Existing	87.00	49.96	-	-
RN182319	1.3	635195	7560065	Existing	85.00	85.00	-	-
RN162842	2.1	637684	7558650	Existing	-	-	-	-
RN141977	2.3	634274	7559644	Destroyed	120.00	64.00	-	-
RN141980	2.7	633974	7561390	Destroyed	104.00	-	-	-
RN141974	2.9	633659	7559552	Destroyed	104.00	60.82	-	-
RN141157	3.1	639587	7560479	Existing	66.00	38.48	-	-
RN162841	3.6	639594	7558477	Existing	-	20.20	-	-
RN162839	4.0	632495	7559750	Destroyed	-	35.00	-	-
RN141976	4.1	632727	7558534	Existing	100.00	35.00	-	-
RN141979	4.2	632644	7558608	Destroyed	110.00	-	-	-
RN162527	4.2	632576	7561914	Existing	49.00	33.85	-	-
RN141975	4.2	632684	7558440	Destroyed	102.0	23.29	-	-
RN162469	4.2	632534	7561905	Destroyed	75.00	34.43	-	-
RN162828	4.3	634323	7556584	Existing	-	-	-	-
RN141978	4.5	632367	7558407	Destroyed	90.00	31.00	-	-

Bore number	Distance from Project (km)	Easting	Northing	Status	Drilled depth (m bgl)	Water level 23/10/2019 (m bgl)	Water level 25/02/2021 (m bgl)	Hydraulic conductivity[1] (metres per day (m/day))
RN162471	4.6	632332	7558326	Destroyed	78.00	36.69	-	-
RN162528	4.8	631776	7561217	Existing	56.43	21.60	-	-
RN182169	4.8	640143	7557252	Existing	27.00	-	-	-
RN162992	4.9	631627	7559539	Existing	109.00	33.37	-	-
Project installed bores								
PPD001A	-	653970	7559367	Existing	51.20	44.54	41.47	-
PPD001B	-	653970	7559367	Existing	79.00	39.00	39.02	0.024
PPD002B	-	635900	7559986	Existing	55.10	39.40	39.34	0.058
PPD002C	-	635900	7559986	Existing	102.00	39.93	40.41	0.006
PPD003A	-	635611	7559923	Existing	51.10	43.90	43.82	0.002
PPD003B	-	635611	7559923	Existing	69.00	42.95	43.00	0.009
WW04A	-	636619	7560695	Existing	54.20	36.92	36.35	0.050

1. Median values calculated from rising head and falling head data.

Levels and flow

Hydraulic testing of the same stratigraphic units found at the Project was carried out during the Olive Downs Project development 10 km to the south. Both horizontal and vertical hydraulic conductivities from Olive Downs Project are given in Table 13 (HydroSimulations 2018) and are assumed to be indicative of the Project.

Table 13 Regional hydraulic conductivity

	Olive Downs Project		**Bowen Basin**		**Bowen Basin storativity**	
Stratigraphic unit	**Horizontal (m/day)**	**Vertical (m/day)**	**Horizontal (m/day)**	**Vertical (m/day)**	**Sy (%)**	**Ss (m^{-1})**
Alluvium (aquifer)	0.26 to 8.7	-	0.007 to 1.5	0.1 to 1	0.03 to 1	1×10^{-5} to 0.001
Soil / weathered rock	0.17 to 0.62	-	-	-	-	-
Rewan Group (aquitard)	1.8×10^{-6} to 0.0052	7.8×10^{-7} to 1.1×10^{-5}	1.1×10^{-5} to 0.05	2.2×10^{-8} to 5×10^{-4}	0.005 to 1	1×10^{-6} to 5×10^{-4}
Rangal Coal Measures — interburden (aquitard)	6.2×10^{-7} to 0.006	3.1×10^{-7} to 4.5×10^{-6}	1×10^{-4}	7×10^{-8}	5×10^{-2}	1×10^{-5}
Rangal Coal Measures — coal seams (aquifer)	5.2×10^{-4} to 0.12	-	1×10^{-6} to 5	1×10^{-6} to 1	1×10^{-2} to 8×10^{-2}	1×10^{-6} to 5×10^{-4}
Fort Cooper Coal Measures — interburden (aquitard)	8.2×10^{-4}	-	2.0	4.0	0.007	-
Fort Cooper Coal Measures — coal seams (aquifer)	-	-	1×10^{-5} to 5.3	1×10^{-8} to 8×10^{-5}	5×10^{-4} to 0.01	5×10^{-6} to 5×10^{-4}

Groundwater levels decline to the west of the Project, caused by dewatering of the neighbouring BHP BMA Daunia Mine, with a steep decline to 164 m AHD at bore RN182319 in the north-west. The bores also show a decline in water levels to the west, reinforcing the impact of the BHP BMA Daunia Mine dewatering.

The local groundwater flow direction is south to the south-east. The groundwater gradient in this direction averages 0.001 m/m. Regional groundwater flow is also to the south / south-east, towards the Isaac River. Dewatering at BHP BMA Daunia Mine has led to the development of a cone of depression with groundwater contours beneath the Project bending to a north-west to south-east orientation, resulting in a local flow direction of west toward the Project open-cut pit. The low hydraulic conductivity values of the Rangal Coal Measures mean that volumetric flow rate is low, even where the groundwater gradient is steepened by dewatering operations.

d Chemistry

Seven bores, as well as one other pre-existing bore (Bore 11), have been sampled and analysed for major ions and metals. In May 2019, the seven bores were sampled again. Followed by further sampling events in July 2019 and October 2019. The laboratory results are given in Table 14 and are compared to values from the ADWG.

Table 14 Groundwater chemistry results

Isaac River Sub-basin EVs		ADWG[1]					Bore number[2] (minimum-maximum (median))							
Analyte	**Unit**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**PPD01A**	**PPD01B**	**PPD02B**	**PPD02C**	**PPD03A**	**PPD03B**	**Bore11**	**WW04A**
Physico-chemical														
pH	pH unit	6.5-8.5	-	6.5-8.5	-	6.5-8.5	7.3-7.4 (7.4)	7.7-10.2 (8.2)	7.4-8.0 (7.5)	7.7-8.0 (8.0)	7.4-8.2 (8.0)	7.7-8.5 (8.4)	6.9-8.2 (7.0)	7.2-7.3 (7.2)
EC	µS/cm	130	-	2,985	-	-	9,000-9,180 (9,090)	8,170-8,930 (8,750)	12,100-12,500 (12,300)	13,000-14,100 (13,300)	9,110-10,100 (10,000)	8,300-9,250 (8,840)	679-1,530 (1,190)	8,510-9,000 (8,660)
Total alkalinity as $CaCO_3$	mg/L	-	-	-	-	-	512-589 (551)	48-182 (180)	266-385 (325)	124-232 (205)	457-507 (506)	235-256 (249)	206-344 (323)	722-840 (724)
Chloride	mg/L	-	-	-	-	250	2,770-2,830 (2,800)	2,630-3,090 (2,910)	3,920-4,140 (4,140)	4,210-4,900 (4,600)	2,980-3,280 (3,200)	2,720-3,080 (2,850)	91-291 (207)	2,370-2,480 (2,430)
Sulfate	mg/L	-	-	1,000	-	250	9-25 (17)	5-166 (9)	3	29-128 (53)	4-17 (8)	12-28 (27)	1-6 (1)	582-744 (729)
Ca	mg/L	-	-	1,000	-	-	167-204 (186)	117-125 (119)	298-341 (338)	355-506 (417)	254-290 (271)	131-155 (138)	46-73 (60)	254-323 (297)
Mg	mg/L	-	-	2,000	-	-	93-95 (94)	14-42 (34)	118-131 (126)	176-294 (202)	158-162 (161)	62-75 (62)	10-21 (15)	308-333 (310)
K	mg/L	-	-	-	-	-	10-13 (12)	10-80 (12)	11-12 (11)	20-49 (26)	12-16 (12)	16-26 (25)	5-7 (7)	5-7 (5)
Na	mg/L	-	-	-	-	180	1,610-1,690 (1,650)	1,520-1,640 (1,610)	2,080-2,290 (2,140)	2,060-2,130 (2,090)	1,480-1,620 (1,580)	1,400-1,750 (1,580)	66-172 (116)	1,190-1,220 (1,200)
Dissolved metals														
Al	µg/L	55	20,000	5,000	-	200	<10	<10-10 (<10)	<10	<10	<10	<10	<10-10 (10)	<10
As	µg/L	24	2,000	500	10	-	2	<1-4 (3)	<1-1 (<1)	<1-1 (1)	2-8 (6)	1-2 (1)	1-2 (2)	<1-1 (<1)
Cd	µg/L	0.2	50	10	2	-	<0.1	<0.1-0.2 (<0.1)	<0.1	<0.1-0.1 (<0.1)	<0.1	<0.1-0.1 (<0.1)	<0.1	<0.1
Cr	µg/L	1	1,000	1,000	50	-	<1-2 (<2)	<1-279 (141)	<1	<1-116 (<1)	<1	<1-12 (7)	<1	<1
Co	µg/L	-	100	1,000	-	-	2-4 (3)	<1-2 (<1)	1-3 (2)	<1-4 (3)	4-19 (14)	1-3 (1)	<1	<1-6 (<1)
Cu	µg/L	1.4	5,000	1,000	2,000	1,000	<1-3 (<3)	<1-3 (<1)	<1-1 (<1)	<1-2 (1)	<1-4 (3)	<1-1 (<1)	<1-2 (<1)	<1
Pb	µg/L	3.4	5,000	100	10	-	<1	<1	<1	<1	<1	<1	<1	<1
Mn	µg/L	1,900	10,000	-	500	100	203-472 (338)	<1-123 (102)	48-209 (96)	47-401 (354)	278-2,070 (1,650)	311-932 (378)	220-613 (422)	130-514 (168)
Hg	µg/L	0.6	2	2	1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ni	µg/L	11	2,000	1,000	20	-	23-30 (27)	<1-10 (8)	2-70 (8)	2-76 (10)	18-33 (26)	8-42 (10)	2-53 (4)	2-174 (8)
Se	µg/L	-	50	20	10	-	<10	<10	<10	<10	<10	<10	<10	<10-60 (<10)
Ag	µg/L	50	-	-	100	-	<1	<1	<1	<1	<1	<1	<1	<1

Isaac River Sub-basin EVs		ADWG[1]					Bore number[2] (minimum-maximum (median))							
Analyte	**Unit**	**95% protection[3]**	**Irrigation[4]**	**Stock[5]**	**Health**	**Aesthetic**	**PPD01A**	**PPD01B**	**PPD02B**	**PPD02C**	**PPD03A**	**PPD03B**	**Bore11**	**WW04A**
Zn	µg/L	8	5,000	20,000	-	3,000	85-244 (165)	<5-103 (72)	23-84 (46)	12-21 (21)	19-157 (43)	6-23 (16)	<5-25 (<5)	<5-98 (<5)

1. Table 4 of Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP 2011) and Australian Drinking Water Guidelines (NHMRC & NRMMC 2011).
2. Green = 95% protection exceedance, yellow = irrigation EV exceedance, orange = stock EV exceedance, red = ADWG health exceedance, blue = ADWG aesthetic exceedance.
3. Table 3.4.1 of Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000).
4. Table 9 of Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP 2011).
5. Table 11 of Isaac River Sub-basin Environmental Values and Water Quality Objectives (DEHP 2011).

Groundwater was found to be poor quality and not suitable for human consumption, irrigation, or stock watering and is typically brackish with a median EC ranging from 8,660 to 13,300 µS/cm. Groundwater was typically alkaline with the median pH ranging from 7.0 to 8.4. Some elevated metals were observed relative to the drinking and aquatic protection guidelines. The exception to these results was Bore 11, which showed generally potable physico-chemical and metal values.

e Modelling

Future numerical groundwater flow modelling will be done if new data becomes available that suggests EVs and sensitive receptors could be adversely impacted by groundwater drawdown. The Receiving Environment Management Plan (REMP) and Water Management Plan (WMP) may also need to be updated depending on any model predictions.

As mining progresses, a need for predictive groundwater modelling will be assessed every two years based on quarterly reviews and groundwater monitoring data.

Where additional management strategies are needed in response to environmental performance, the new model will be used to test the effectiveness of mitigation measures prior to starting (to improve outcomes of the proposed measures).

3.1.3.6 Soil types, properties and productivity

a Soil types

A desktop assessment of publicly available soil mapping data gave an indication of relevant soil types across and surrounding the Project. Results from the desktop assessment show most of the Project mapped as landscape unit MM7 which are moderate to gently undulating lowlands and plains with soil types characterised by moderately deep to deep clays. A small area on the southern side of the Project is mapped as landscape unit Ua6 which is moderate to strongly undulating lands with some marginal low hill areas and shallow duplex soils.

The desktop assessment was ground-truthed in the field by soil survey, the result of which are described in the following sections.

b Properties

Vertosols are mapped as the dominant soil type and was verified by soil survey which found both Brown and Grey Vertosols (Figure 6).

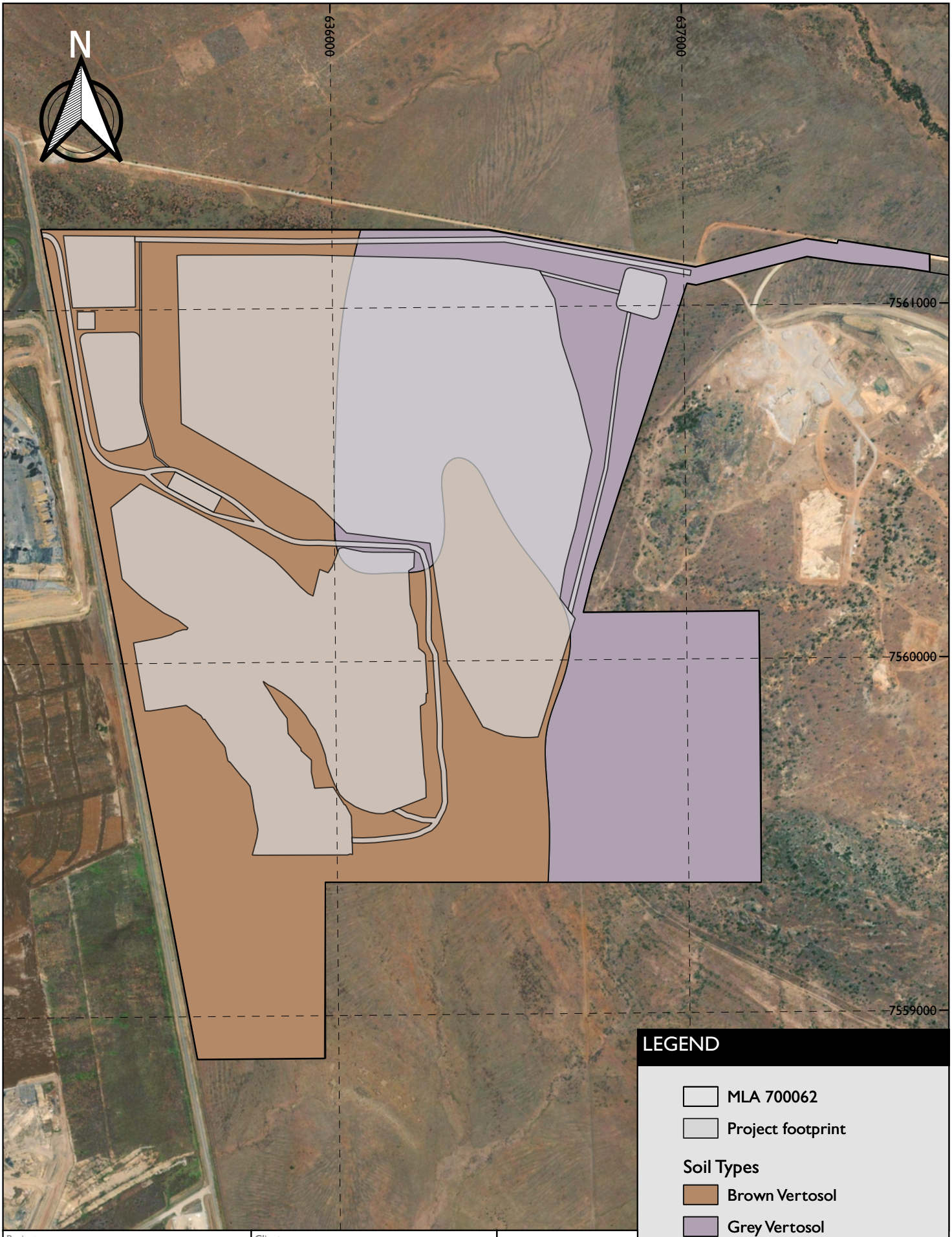
Vertosols generally have high clay contents (>35%) with uniform texture. They have the potential for strong cracking and slickensides. These soils have high agricultural potential with high fertility and water-holding capacity, but they require significant amounts of rain before water is available to vegetation. Gypsum may be needed to improve their structure and they can be difficult to cultivate when they are wet. Their primary limiting factor is the strongly seasonal climate of the region rather than the soil physical and / or chemical properties. The highly seasonal rainfall may present an erosion risk especially when groundcover is depleted in the winter, followed by high intensity rainfall during the remainder of the year.

Table 15 and Table 16 contain a summary of chemical properties for Brown and Grey Vertosols respectively.

Soil chemistry results have been compared to sufficiency values which are agricultural industry benchmarks:

- Rayment and Bruce (1984);
- Baker and Eldershaw (1993);
- DERM (2011); and
- Peverill et al. (1999).

Sufficiency values are used as a guide only and present ‘best case’ criteria, which may be overly conservative for the establishment of native vegetation.



LEGEND

- MLA 700062
- Project footprint

Soil Types

- Brown Vertosol
- Grey Vertosol

Scale 1 : 15 000

0 250 500 m

Project: Progressive Rehabilitation and Closure Plan		Client: Coking Coal One Pty Ltd	
Figure: 6	Title: Soil Map	Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 15,000 CRS: GDA94 / MGA zone 55	SGM environmental

Table 15 Brown Vertosols soil properties

			Soil horizons[1] (minimum-maximum (median))			
Constituents	**Unit**	**Soil sufficiency**	**A1**	**A2**	**B**	**Comments[2]**
pH	pH units	6.0-7.5	8.1-8.8 (8.6)	8.7-8.9 (8.9)	8.6-9.2 (9.1)	Strongly alkaline throughout profile. May lead to Fe, Zn, Cu and B deficiency.
EC saturated extract (ECe)	deciSiemens per metre (dS/m)	<2.00	0.72-0.90 (0.85)	0.89-1.66 (1.23)	2.04-6.00 (2.24)	Low to moderate salinity in A horizons. Moderate salinity in B horizon.
TKN	mg/kg	>1,500	1,060-1,720 (1,370)	1,030-1,350 (1,120)	500-800 (680)	Slightly deficient in A horizons but not to the point that it will restrict plant growth. Deficient in B horizon.
Reactive P	mg/kg	>10	<5-15 (8)	-	-	Deficient; however, may become more available to vegetation if pH is lowered to pH 6.5.
Cation exchange capacity (CEC)	Centimoles per kilogram (cmol/kg)	12.0-25.0	23.9-30.7 (26.0)	24.5-32.2 (27.4)	24.3-32.6 (26.7)	High throughout the profile indicating a large reserve of cations available for mineralisation and buffering capacity to acidification.
Exchangeable Ca	cmol/kg	>5.0	18.8-24.6 (22.4)	18.8-25.4 (20.7)	13.8-22.4 (17.3)	Sufficient, will not limit vegetation growth.
Exchangeable Mg	cmol/kg	>1.0	2.7-4.2 (3.8)	4.2-5.6 (5.2)	6.5-9.3 (7.1)	Sufficient, will not limit vegetation growth.
Exchangeable K	cmol/kg	>0.3	0.4-1.9 (1.0)	0.3-0.6 (0.4)	<0.2-0.4 (0.3)	Sufficient, will not limit vegetation growth.
Exchangeable sodium percentage (ESP)	%	<6.0	<0.2-1.0 (<0.2)	1.7 – 3.5 (2.7)	7.1-10.4 (10.2)	Non-sodic A horizons. Moderately sodic B horizon.
Organic carbon (OC)	%	1.0-1.8	1.3-1.8 (1.5)	-	-	Sufficient, will not limit vegetation growth. Average structural stability.

			Soil horizons[1] (minimum-maximum (median))			
Constituents	**Unit**	**Soil sufficiency**	**A1**	**A2**	**B**	**Comments[2]**
Electrochemical stability index (ESI)		>0.05	0.08-1.05 (0.97)	0.05-0.06 (0.05)	0.02-0.07 (0.03)	Negligibly dispersible A horizons. Slightly dispersible B horizon.

1. Green = soil sufficiency exceedance.
2. Based on median.

Table 16 Grey Vertosols soil properties

			Soil horizons[1] (minimum-maximum (median))			
Constituents	**Unit**	**Soil sufficiency**	**A1**	**A2**	**B**	**Comments[2]**
pH	pH units	6.0-7.5	7.9-8.7 (8.6)	8.9-9.0 (8.9)	8.8-9.2 (8.9)	Strongly alkaline throughout profile. May lead to Fe, Zn, Cu and B deficiency.
ECe	dS/m	<2.00	0.37-1.01 (0.90)	1.42-5.78 (3.13)	1.57-6.93 (4.66)	Low salinity in A1 horizon. Moderate salinity in the A2 horizon and high salinity in the B horizon.
TKN	mg/kg	>1,500	1,050-2,100 (1,545)	480-1140 (715)	370-860 (700)	Sufficient in A1 horizon. Deficient in A2 and B horizons.
P	mg/kg	>10	<5-9 (<5)	-	-	Deficient; however, may become more available to vegetation if pH is lowered to pH 6.5.
CEC	cmol/kg	12.0-25.0	20.3-35.2 (34.2)	28.0-38.8 (32.9)	23.5-38.1 (28.8)	High throughout the profile indicating a large reserve of cations available for mineralisation and buffering capacity to acidification.
Exchangeable Ca	cmol/kg	>5.0	13.9-29.6 (28.5)	16.3-24.5 (20.6)	11.3-23.4 (16.0)	Sufficient, will not limit vegetation growth.

			Soil horizons[1] (minimum-maximum (median))			
Constituents	**Unit**	**Soil sufficiency**	**A1**	**A2**	**B**	**Comments[2]**
Exchangeable Mg	cmol/kg	>1.0	3.7-5.9 (4.5)	8.5-9.4 (8.9)	7.3-10.2 (8.6)	Sufficient, will not limit vegetation growth.
Exchangeable K	cmol/kg	>0.3	0.5-2.0 (0.8)	0.4-0.5 (0.5)	<0.2-0.4 (0.4)	Sufficient, will not limit vegetation growth.
ESP	%	<6.0	<0.2-1.7 (1.0)	3.6-13.5 (10.5)	4.9-18.2 (14.4)	Non-sodic A1 horizon. Moderately sodic A2 and B horizons.
OC	%	1.0-1.8	1.2-1.9 (1.7)	-	-	Sufficient, will not limit vegetation growth. Average structural stability.
ESI		>0.05	0.04-1.09 (0.11)	0.03-0.05 (0.05)	0.03-0.05 (0.04)	Negligible dispersible A horizons. Slightly dispersible B horizon.

1. Green = soil sufficiency exceedance.
2. Based on median.

c Productivity

Agricultural land classification

The *Guidelines for Agricultural Land Evaluation in Queensland* (DSITI & DNRM 2015) gives agricultural land classification (ALC) classes based on soil and landscape characteristics.

ALC mapping indicates the Project only has limited capacity for cropping purposes. The land within the MLAs and MLT are considered suitable as pasture, supporting stock pasture grazing on sown and native pastures. Native pasture grazing occurs across 100% of the MLAs and MLT, with 60% (218.45 ha) being suitable for sown pastures due to higher fertility. No land is mapped as non-agricultural land.

Areas of regional interest

Under the *Regional Planning Interests Act 2014* (RPI Act), an approval is needed when a resource activity or regulated activity is proposed in a zone of regional interest. Zones of regional interest are:

- priority living areas (PLAs);
- priority agricultural areas (PAAs);
- strategic cropping areas (SCAs); and
- strategic environmental areas (SEAs).

There are no mapped PLAs, PAAs, SCAs or SEAs within or adjacent to the Project and no further assessment for these regional interests is needed.

Good quality agricultural land

The *Broadsound Shire Planning Scheme* (BSC 2005) has mapped good quality agricultural land (GQAL) across the region. GQAL is land that is classified as ALC classes A to C1. The map prepared by the Broadsound Shire Council indicates that there is no GQAL.

3.1.3.7 Land stability

a Pre-existing land degradation and erosion

The pre-mining erosion rate has been calculated using the revised universal soil loss equation (RUSLE). RUSLE is a calculation used to estimate average annual soil loss caused by sheet and rill erosion. The equation is limited to making precautions for long-term annual soil loss.

The RUSLE equation is:

$$A = R \times K \times LS \times C \times P$$

Where:

- A = the estimated average annual soil in tonnes per hectare (t/ha);
- R = the rainfall and runoff erosivity factor. This describes intensity and duration of rainfall in a given geographical area;
- K = the soil erodibility factor. K is related to soil physical and chemical properties that determine how easily soil particles can be dislodged;
- LS = a dimensionless topography factor determined by length and steepness of a slope. The LS factor is related to the velocity of runoff;
- C = the cover and management factor. Cover of any kind can help protect the soil from raindrop impact, can slow runoff and reduce and reduce its kinetic energy; and
- P = the factor for supporting practices. This factor considers specific erosion control measures.

Values for R, S, L and K have been taken from a Qspatial data series given by DES which is based on the Australian Soil Resource Information System (ASRIS). Results have been calculated for a pasture system since this matches the pre-mining land-use. A C factor of 0.02 has been chosen assuming total pasture coverage and a P factor of 0.5 has been adopted assuming minimal land management. The resulting pre-mining erosion rates are shown in tonnes per hectare per year (t/ha/yr) in Table 17.

Table 17 Pre-mining erosion rates

Statistic	Erosion rate (t/ha/yr)
Minimum	0.1
Maximum	13.4
Median	1.1

It should be noted that the high maximum rate was only measured in the south eastern corner, which is characterised by steep slopes, causing a disproportionately high LS factor. This is supported by the relatively low median rate.

There are few Australian studies that have attempted to quantify erosion rates. The prediction of *Sheet and Rill Erosion Over the Australian Continent, Incorporating Monthly Soil Loss Distribution* (Lu et al. 2001) is one such study. The study relied upon remote sensing technology to determine national and state averages of erosion and found:

- the average Australian rate of erosion is 6.3 t/ha/yr;
- a low rate of erosion is defined as less than (<) 0.5 t/ha/yr;
- a medium rate of erosion is defined as 0.5-10 t/ha/yr; and
- a high rate of erosion is defined as greater than (>) 10 t/ha/yr.

The pre-mining erosion indicates the Project currently has a medium rate of erosion.

b Predisposition to ongoing stability issues

An assessment of soil erosion susceptibility is given in Table 18, which lists influencing factors for both soil types that have been identified.

Table 18 Soil erosion susceptibility

Soil type	Sodicity	Texture	Landform	Vegetation cover	Erosion susceptibility
Brown Vertosol	Sodic	Clay loam	Flat to gently undulating.	Buffel Grass dominated grassland on clay soils (land zone 9). Occasional regrowth Brigalow and semi-evergreen vine thicket species.	Low to medium susceptibility due to clay texture and flat terrain.
Grey Vertosol	Sodic	Clay loam	Flat to gently undulating.	Buffel Grass dominated grassland on clay soils (land zone 9). Occasional regrowth Brigalow and semi-evergreen vine thicket species.	Low to medium susceptibility due to clay texture and flat terrain.

As the Project is in a sub-tropical climate, soil erosion management shall be done in a two-season approach — wet season (December to March) and dry season (April to November). The erosion hazard based on average monthly rainfall depth recorded for the weather station located at the Moranbah Water Treatment Plant (station

034028) and referenced from the International Erosion Control Association's (IECA) *Best Practice Erosion and Sediment Control Guidelines* (IECA 2008) is described in Table 19.

Table 19 Erosion hazard based on average monthly rainfall

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	High	Moderate	Low	Low	V Low	V Low	V Low	V Low	Low	Moderate	High

Source: IECA 2008 *Table 4.4.2*.

3.1.3.8 Vegetation communities and ecological data

a Matters of environmental significance

The protected matters search tool identified the following matters of national environmental significance (MNES) (as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) as occurring in the Project or surrounds (within a 5 km radius of the Project):

- three threatened ecological communities (TECs);
- 23 threatened flora or fauna species; and
- 12 migratory bird species.

Current mapping of the Project indicates the only matters of state environmental significance (MSES) occurring within the MLAs is remnant vegetation mapped as 'essential habitat' (under the *Vegetation Management Act 1999* (VM Act)). 75.38 ha of habitat for the Ornamental Snake (*Denisonia maculata*) is mapped along the eastern portion of the Project. Of this, the Project will disturb ~24 ha.

No matters of local environmental significance (MLES) were identified in the Broadsound Shire Planning Scheme (BSC 2005) as being affected by the Project.

b Environmentally sensitive areas

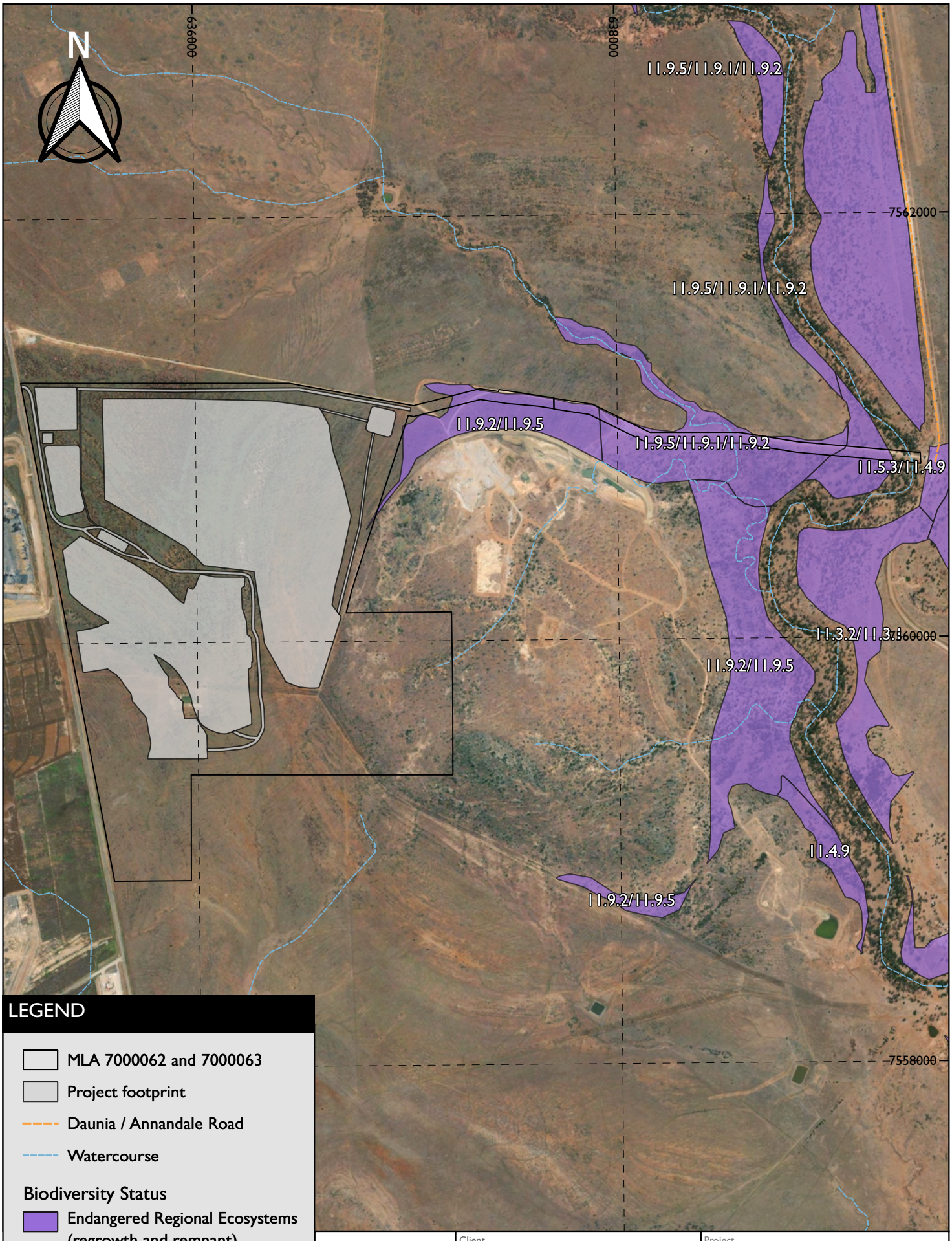
Environmentally sensitive areas (ESAs) mapping identified a single Category C ESA present within the Project, but external to the MLAs (Figure 7). This Category C ESA is associated with remnant vegetation listed as endangered under the *Environmental Protection Act 1994* (EP Act). Ground-truthing was done to confirm the status of the vegetation. No other ESAs are mapped in or near the Project.

c REs

Assessment of RE mapping identified three REs occurring within the Project. Table 20 gives a brief description on each of these ecosystems, along with their VM Act and EPBC Act status.

Table 20 RE descriptions

RE Code	Description	VM Act status	EPBC Act status
11.9.2	*Eucalyptus melanophloia* and / or *E. orgadophila* woodland on fine-grained sedimentary rocks	Least concern	No concern
11.9.5	*Acacia harpophylla* and / or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	Least concern	No concern



LEGEND

- MLA 7000062 and 7000063
- Project footprint
- Daunia / Annandale Road
- Watercourse

Biodiversity Status

- Endangered Regional Ecosystems (regrowth and remnant)

Scale 1 : 25 000

0 0.5 1 km

SGM environmental

Client: Coking Coal One Pty Ltd		Project: Progressive Rehabilitation and Closure Plan	
Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 25,000 CRS: GDA94 / MGA zone 55		Title: Environmentally Sensitive Areas	Figure: 7

d Significant flora

A summary of the significant flora that could occur, based on desktop research and the field surveys, is given in Table 21.

Table 21 Significant flora that could occur

Species	Common name	EPBC Status	Presence
Capparis humistrata	Caperbush	-	Potential
Cerbera dumicola	-	-	Potential
Acacia spania	Western Rosewood	-	Unlikely
Bertya pedicellata	-	-	Unlikely
Cycas ophiolitica	Marlborough Blue	Endangered	Unlikely
Dichanthium queenslandicum	King Blue-grass	Endangered	Unlikely
Dichanthium setosum	Bluegrass	Vulnerable	Unlikely
Eucalyptus raveretiana	Black Ironbox	Vulnerable	Unlikely
Samadera bidwillii	Quassia	Vulnerable	Unlikely

3.1.3.9 Fauna presence and populations

61 vertebrate fauna species were identified during dry and wet season surveys, comprising nine reptiles, 34 birds and 18 mammals.

The waterways are typical of smaller drainages in Central Queensland, being ephemeral and generally only flowing for short periods after rain. The aquatic flora and fauna are not considered to be diverse or unique. Although macro invertebrates and fish may opportunistically move into the upstream drainages of ephemeral creeks to forage, the drainage lines are considered poor habitat for macro invertebrates and are unlikely to harbour long-term fish populations.

a Significant fauna

A summary of the significant fauna that could occur, based on desktop research and the field surveys is given in Table 22.

Table 22 Significant fauna that could occur

Species	Common name	EPBC status	Presence
Petauroides armillatus	Greater Glider	Vulnerable	Observed
Denisonia maculata	Ornamental Snake	Vulnerable	Observed
Geophaps scripta	Squatter Pigeon	Vulnerable	Likely
Tachyglossus aculeatus	Short-beaked Echidna	Special least concern	Likely
Apus pacificus	Fork-tailed Swift	Migratory	Likely
Phascolarctos cinereus	Koala	Vulnerable	Unlikely

Species	Common name	EPBC status	Presence
Macroderma gigas	Ghost Bat	Vulnerable	Unlikely
Gallinago hardwickii	Latham's Snipe	Migratory	Unlikely

b Essential habitat

The extent of essential habitat mapped is restricted to the remnant vegetation described in Section 3.1.3.8a (MSES).

During a land survey, some gilgai were observed across the Project, which is regarded as habitat for Ornamental Snake (*Denisonia maculate*). CDM Smith Australia Pty Ltd (CDM Smith) identified two Ornamental Snakes on the Project during an ecological survey in 2020. The Ornamental Snake is listed as vulnerable under the Commonwealth EPBC Act and the State *Nature Conservation Act 1992* (NC Act). It is estimated that ~24 ha of habitat will be disturbed due to Project development, which will be offset.

3.1.3.10 Pre-mining land use

The Project is within the Bowen Basin and is close to current mining operations, for example, the BHP BMA Daunia Mine lies to the immediate west. Grazing and mining are the principal industries regionally. The Project is freehold land-used primarily for cattle breeding and pasture grazing. Quarrying activities operating under the registered name of Daunia Quarry (RQ421) are located to the immediate east.

The Project is in a rural setting typified by large holdings and agriculture and coal mining are established near the Project. The nearest township is Coppabella, located ~16 km to the north. Moranbah and Nebo are located 30 km and 56 km away from the Project respectively. Mackay (the regional centre) is 130 km to the north-east of the Project.

The Project will occupy land that is currently used for pasture grazing. There are no occupied homesteads within the proposed ML and no National Parks, nature refuges or declared catchments.

3.1.3.11 Identification of underlying landholders

The underlying landholders are summarised in Table 23.

Table 23 Lot and plan numbers

MLA	Lot	Plan	Property description	Ownership
700062	4	RP894192	Daunia Station	David Joseph Deguara and Joy Elizabeth Deguara
700063	4	RP866478	Mavis Downs	Josephine Louise and John David Lloyd

3.1.3.12 Native title

The Project is located on freehold land and therefore does not need a native title agreement.

A search of the National Native Title Tribunal (NNTT) database for the current native title status of the region identified the Project is located within the Barada Barna People's native title determination area (QCD2016/007). No areas where native title exists within the native title determination area are impacted.

3.1.4 Design for closure

This section describes how ERAs are carried out in a way that maximises the progressive rehabilitation of the land to a stable condition.

3.1.4.1 Location of mine features

a Protection of EVs

The Project has been developed to avoid major disruptions to most of the identified REs, which is found in the south-eastern corner of the MLAs:

- the MIA is in the north-western corner; and
- OC1 is in the south-western corner.

b Surrounding land uses and proximity to sensitive receptors

The region outside of the MLAs includes MDL 495 held by Peabody Moorvale West Pty Ltd and MDL 3034 held by Peabody Coppabella Pty Ltd. ~1,118 ha of EPC 830 is overlain by two active MLs, ML 1781 (Daunia) and ML 70115 (Daunia East), both of which are held by BHP Coal Pty Ltd (Figure 2).

MDL 444 and a northerly section of EPC 830 are overlain by potential commercial area (PCA) 152 held by CH4 Pty Ltd (Arrow Energy). The PCA falls within Arrow Energy's petroleum lease authority to prospect (ATP) 1103 (Figure 2).

Using aerial imagery and on ground assessments, three sensitive receptors were identified within a 10 km buffer of the MLAs. All identified receptors are isolated homesteads. The location and distance of each receptor from the Project is given in Table 24.

Table 24 Sensitive receptors

Receptor ID	Receptor	Easting	Northing	Distance (km)	Direction
R1	Daunia Homestead	639655.13	7558578.12	3.8	Southeast
R2	Mavis Downs Homestead	639041.22	7563825.44	4.6	East-northeast
R3	Olive Downs Homestead	633905.60	7553015.71	7.5	Southwest

c Proximity to the open-pit exit

The MIA, ROM coal stockpile and WRD1 are all near the open-pit exit. This will limit the distance required to haul overburden and ROM coal and decrease the potential risk for contamination and excess disturbance.

d Gradient of the footprint area

The Project footprint will be graded so that overland flow is directed toward OC1 or the water management system. The water management system will be partly gravity fed which will reduce construction, management, and closure costs. Everything to the east of the granitoid intrusion naturally flows towards North Creek and will assist in keeping clean water away from the MIA and OC1.

e Local and regional topography

The topography of the Project is relatively flat with gently undulating areas. Therefore, local topography is of little concern with respect to location of features and achieving the PMLU.

f Surface and ground water features

Because the Project features alter the natural flow paths, some increases in water levels might occur. Water levels might increase because natural drainage patterns have been disrupted causing some concentrated flow. For a 0.1% AEP design flood, water levels are predicted to increase:

- 0.02-0.1 m in the south-western corner, caused by OC1;
- 0.02-0.1 m in the eastern and north-western corner, caused by WRD1; and
- more than or equal to (≥) 0.2 m around the perimeter of OC1 and WRD1 caused by stormwater drainage design.

Increases in water levels is likely to only have a minor impact on the Project and surrounding waterways. The short-life of the Project and its location in the upper reaches of the catchment, further decreases the potential impacts from increased water levels.

g Geotechnical conditions

The post Permian intrusive granite body to the east of the Project functions as a barrier to stop groundwater flow and seepage from OC1 and WRD1.

h Competing water and land uses

Four water licences were identified near the Project. Two were attached to a property to the southeast, with the purpose of water harvesting, and two were attached to the BHP MBA Daunia Mine, with the purpose of mining and diverting the course of flow. All four licences permit the extraction of water from the Isaac River.

The pre-mining land use is primarily cattle breeding and grazing suggesting North Creek located to the east and the dam located in the south are used for cattle watering.

i Visual impact

The Project is in a well-established mining zone and surrounded by large mining operations. Due to the other mines, along with the lack of public viewing points and the distance from public transport routes, the visual impact is a minor concern. Further, the Project will only be operated for a very short time before progressive rehabilitation begins.

3.1.4.2 Size, shape and design of mine features

a OC1

OC1 has been designed to provide favourable environmental outcomes while being financially viable and will include:

- rehabilitation to create a PMLU of pasture grazing;
- VEM overburden will be dumped into the LHD open-cut pit to mitigate costs of final landform reshaping; and
- backfilling LHD pit to 200RL to avoid long-term ponding of runoff water and reduce the size of WRD1.

b WRD1

WRD1 has been designed to provide favourable environmental outcomes while being financially viable and will include:

- avoiding the disturbance of ESAs;
- managing the direction of surface water runoff and separating mine affected and clean water;

- maintaining geotechnical stability of the planned highwall mining panels until highwall mining has been finished;
- providing a stable final landform with a favourable PMLU of pasture grazing; and
- minimising the overall disturbance.

3.1.4.3 Mining method

Several mining method options were investigated by Xenith Consulting Pty Ltd (Xenith) and were developed having regard for the value of the VEM seam, the value of incorporating highwall mining and maximising productivity. The chosen mining plan was for the initial open-cut mining of the LHD seam, followed by open-cut mining of the VEM seam, with highwall mining of both seams occurring in one campaign with a one-month relocation time. A terrace mining approach was selected due to the coal being steeply dipping and the relatively small size of the pits.

This mining method was selected by BCC, on the advice of Xenith because it gave the best balance of financial and environmental outcomes and overall risk management.

3.1.5 Rehabilitation and improvement planning

Progressive rehabilitation must be maximised by starting and finishing rehabilitation as soon as practicable after land becomes available. Land will become progressively available for rehabilitation throughout the life of the Project. Land is considered available for rehabilitation when (Section 126D (5) of the EP Act):

- the land is no longer being mined;
- the land is no longer being used for operating infrastructure or machinery for mining including dams or water storages;
- the land is not needed for mining of a probable or proved ore reserve; or
- the land contains permanent infrastructure remaining for a PMLU.

It is expected that all disturbed land, which is available for rehabilitation, is progressively rehabilitated. This section describes how and when to carry out rehabilitation and closure activities and identifies and justifies when land will become available for rehabilitation.

3.1.5.1 Identification of relevant activities

The relevant activities identified reflect the relevant activities in the PRC plan Schedule (Appendix A):

- OC1;
- ROM coal stockpile;
- WRD1;
- MIA;
- roads;
- water storage, supply and distribution; and
- exploration.

3.1.5.2 Size and extent of relevant activities

The proposed size and extent of relevant activities are given in Table 25 and Figure 3. Development of the Project is expected to commence in 2021 with initial early construction works and extend operationally for approximately five years until the depletion of the current reserve, and an additional two years for rehabilitation activities to be done. Additional time will be required after rehabilitation is finished to monitor success and do maintenance work when required.

Table 25 Size and extent of relevant activities

Relevant activities	Total rehabilitation area (ha)[1]
OC1	56.00
ROM coal stockpile	1.00
WRD1	100.00
MIA	4.00
Roads	7.00
Water storage, supply and distribution	7.00
Exploration	64.00

1. Approximate area in accordance with the EA application.

The Project is an open-cut mine that will be mined using a truck and shovel method before moving onto highwall mining to maximise coal extraction. Both the open-cut and highwall mining will target the VEM and LHD seams. Highwall mining will be done in the final years of the Project and will overlap with open-cut mining.

The water management system for the Project includes the following:

- collection of mine affected water in water storages for reuse;
- collection of sediment laden runoff from the MIA and waste rock stockpile, for treatment and reuse and / or discharge;
- use of water by the workforce, industrial processes, dust suppression and for firefighting (if required); and
- managed release of mine affected water to the receiving environment, governed by flow conditions, and water quality objectives.

Coal will be transported to an onsite ROM coal stockpile prior to being transported to the RM CHPP where it will be processed to high value metallurgical coal products at a yield of approximately 75%.

Coarse and fine rejects will be dewatered at the RM CHPP before being taken back to the Project for ex-pit or in-pit disposal, dependent on the stage of the Project development.

About 28.2 million loose cubic meters of overburden will be excavated during mining. Initially it will be taken to WRD. However, as the open-cut develops, overburden will be put back into OC1. Further, there may be potential for overburden from WRD1 to be transferred to OC1 as part of rehabilitation.

To minimise disturbance, soil stockpiles will be placed within the maximum disturbance footprint of WRD1 and OC1 in accordance with the development sequence of the Project. Direct placement of topsoil may also be done opportunistically when stripping and placement schedules align.

Rehabilitation works are expected to commence in year two and will continue progressively.

Project mine stage plans are given in Figure 8-Figure 11.

3.1.5.3 Likely duration of relevant activities

The purpose of this section is to describe when land is available for rehabilitation and when it is practical to start the first milestone for a feature.

Development of the Project is expected to start in 2024 and will operate until depletion of the current reserve; that is end of operation is expected in year 5 (ie 2028). Open-cut mining targeting the LHD and VEM seams will

begin with traditional open-cut mining before transitioning to high wall mining. It is expected that by the end of 2029 the total area of OC1 (~55.7 ha) will be available for rehabilitation. Installation of cover, surface preparation and revegetation (ie seeding) will occur ~12 months after major earthworks are completed.

It is expected that for the 12 months after mining has finished there will be major earthworks, surface preparation and some seeding of WRD1. The schedule of land availability is given in Table 26 and community consultation that has been done is given in Table 27.

It is expected that one wet season will be needed to establish vegetation (ie achieve surface requirements for pasture grazing). As such each campaign of rehabilitation works will be finished by early September each year to allow sufficient time for appropriate levels of vegetation cover to establish before the period of high erosion hazard rainfall (October to February). A further five years is needed before land will achieve a stable condition.

Table 26 Schedule of land availability

Relevant activities	**Cumulative area available (ha)**					
Year land becomes available	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
OC1	0	0	0	0	55.7	0
ROM coal stockpile	0	0	0	0	0	0.8
WRD1	24.3	49.8	76.7	97.9	0	0
MIA	0	0	0	0	0	3.9
Roads	0	0	0	0	0	7.3
Water storage, supply and distribution	0	0	0	0	0	7.8
Exploration	0	0	0	0	63.8	0

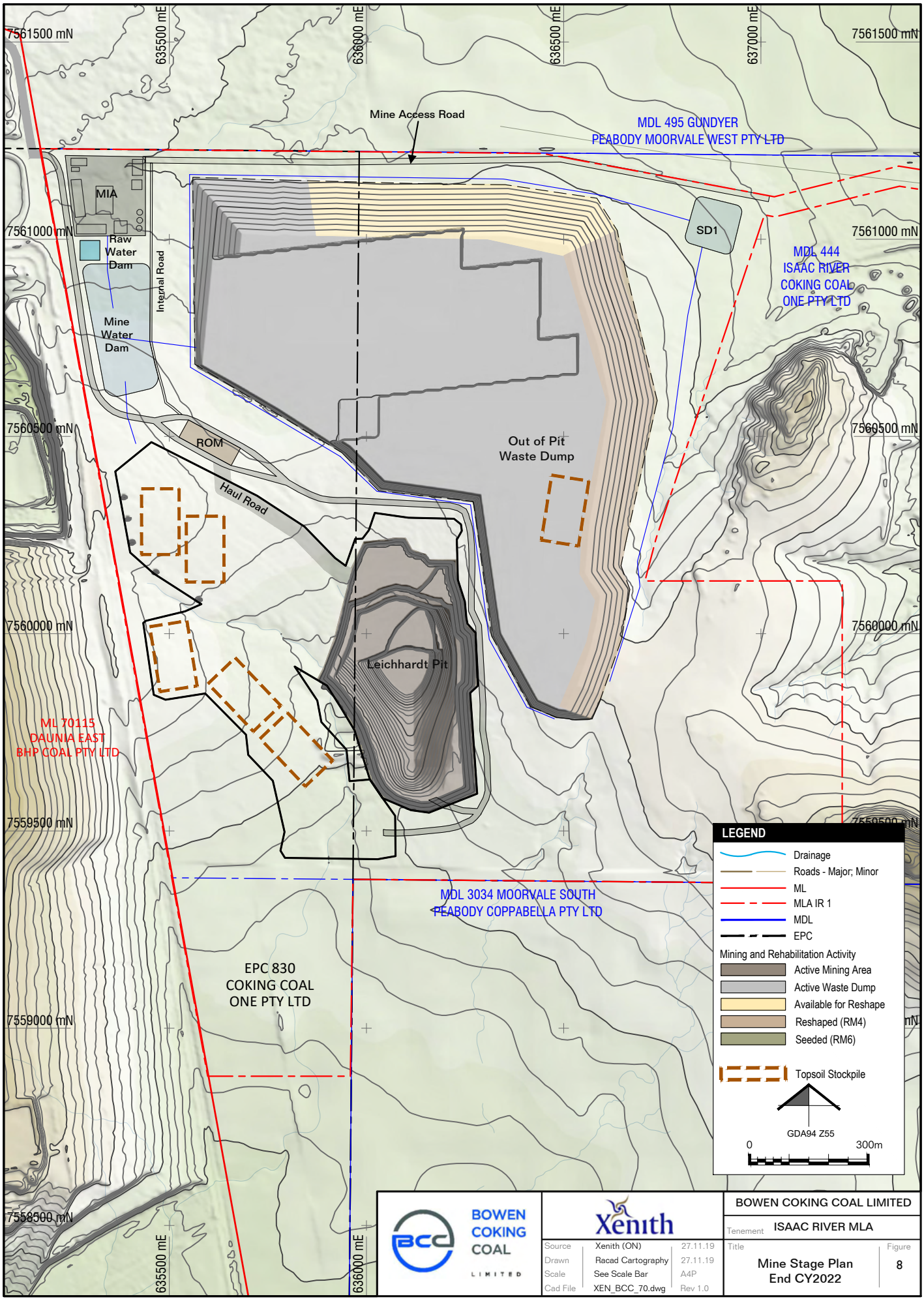
3.1.5.4 Progressive rehabilitation of relevant activities

WRD1 will progressively become available for rehabilitation and will be re-contoured during operation. All other relevant activities are needed until mining operations have ended.

Soil stockpiles can only be rehabilitated, ripped and seeded after all soil is used. OC1 will become available ~12 months after the end of mining (ie end of 2029).

The ROM coal stockpile is not available for rehabilitation until mining operations have ended. Any identified contamination will be removed and disposed of according to licence conditions. Once contamination has been removed the ROM coal stockpile will be ripped, soiled and seeded. The MIA is needed until mining operations end. Remaining infrastructure will be removed as recyclable scrap and the remaining unrecyclable components will be disposed of according to licence conditions.

Roads are needed during operation of the Project and for some rehabilitation activities; therefore, they are not available for rehabilitation until 2030. Water storage, supply and distribution is needed until potential contamination is removed to limit impact to EVs.


7561500 mN
635500 mE
636000 mE
636500 mE
637000 mE
Mine Access Road
MDL 495 GUNDYER
PEABODY MOORVALE WEST PTY LTD
MIA
Raw Water Dam
Internal Road
Mine Water Dam
SD1
7561000 mN
MDL 444
ISAAC RIVER
COKING COAL
ONE PTY LTD
7560500 mN
ROM
Haul Road
Out of Pit Waste Dump
7560000 mN
Leichhardt Pit
ML 70115
DAUNIA EAST
BHP COAL PTY LTD
7559500 mN
MDL 3034 MOORVALE SOUTH
PEABODY COPPABELLA PTY LTD
EPC 830
COKING COAL
ONE PTY LTD
7559000 mN
7558500 mN
LEGEND
Drainage
Roads - Major; Minor
ML
MLA IR 1
MDL
EPC
Mining and Rehabilitation Activity
Active Mining Area
Active Waste Dump
Available for Reshape
Reshaped (RM4)
Seeded (RM6)
Topsoil Stockpile
GDA94 Z55
0
300m
BOWEN COKING COAL LIMITED
Xenith
BOWEN COKING COAL LIMITED
Tenement
ISAAC RIVER MLA
Source
Xenith (ON)
27.11.19
Drawn
Racad Cartography
27.11.19
Scale
See Scale Bar
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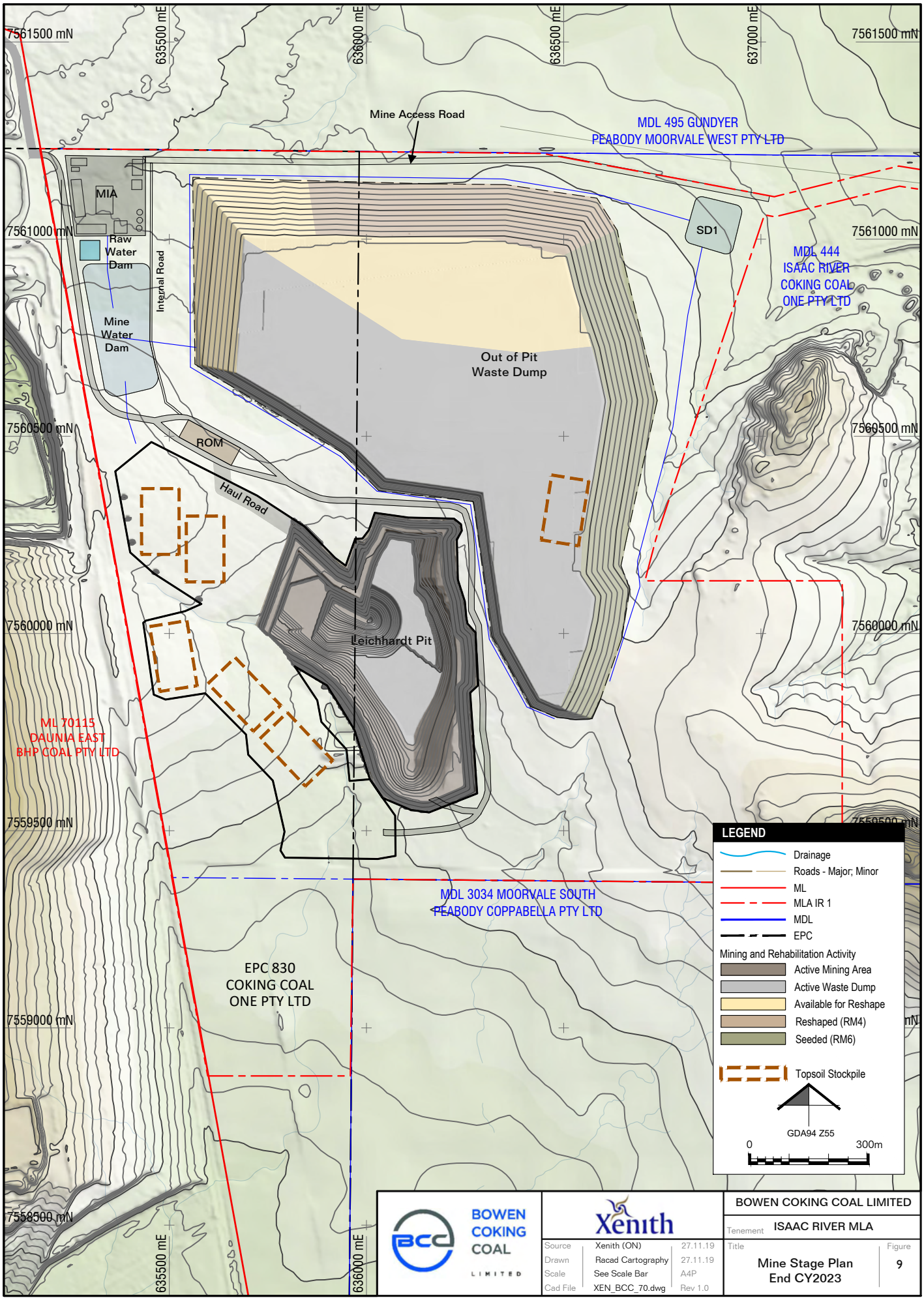
Cad File
XEN_BCC_70.dwg
Rev 1.0
Title
Mine Stage Plan
End CY2022
Figure
8


7561500 mN
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PEABODY MOORVALE WEST PTY LTD
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Raw Water Dam
Internal Road
Mine Water Dam
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ISAAC RIVER
COKING COAL
ONE PTY LTD
Out of Pit Waste Dump
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Haul Road
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LEGEND
Drainage
Roads - Major; Minor
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MLA IR 1
MDL
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Mining and Rehabilitation Activity
Active Mining Area
Active Waste Dump
Available for Reshape
Reshaped (RM4)
Seeded (RM6)
Topsoil Stockpile
GDA94 Z55
0
300m
BOWEN COKING COAL LIMITED
Xenith
Tenement
ISAAC RIVER MLA
Source
Xenith (ON)
27.11.19
Drawn
Racad Cartography
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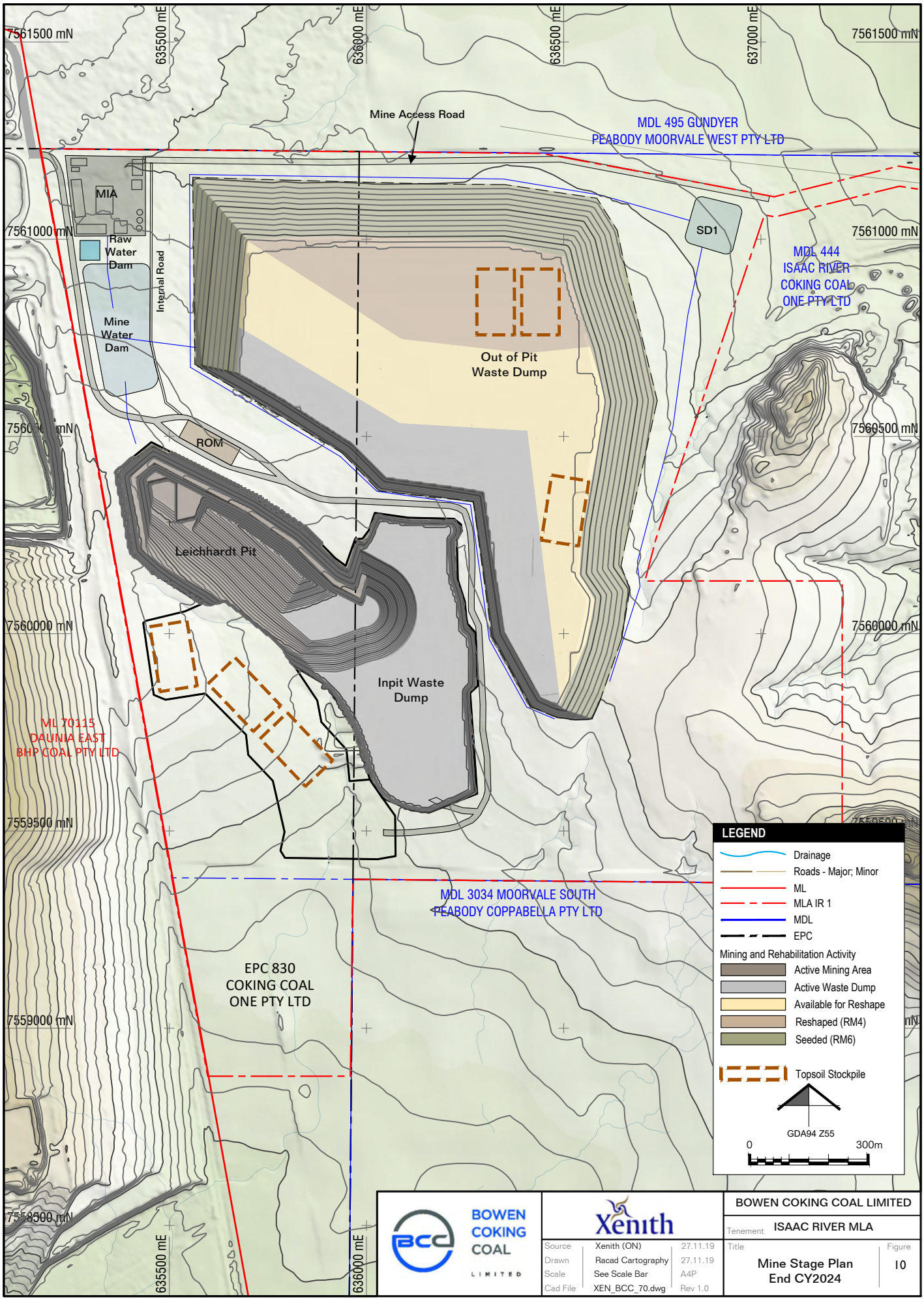
Title
Mine Stage Plan
End CY2023
Figure
9



BOWEN COKING COAL LIMITED

Xenith

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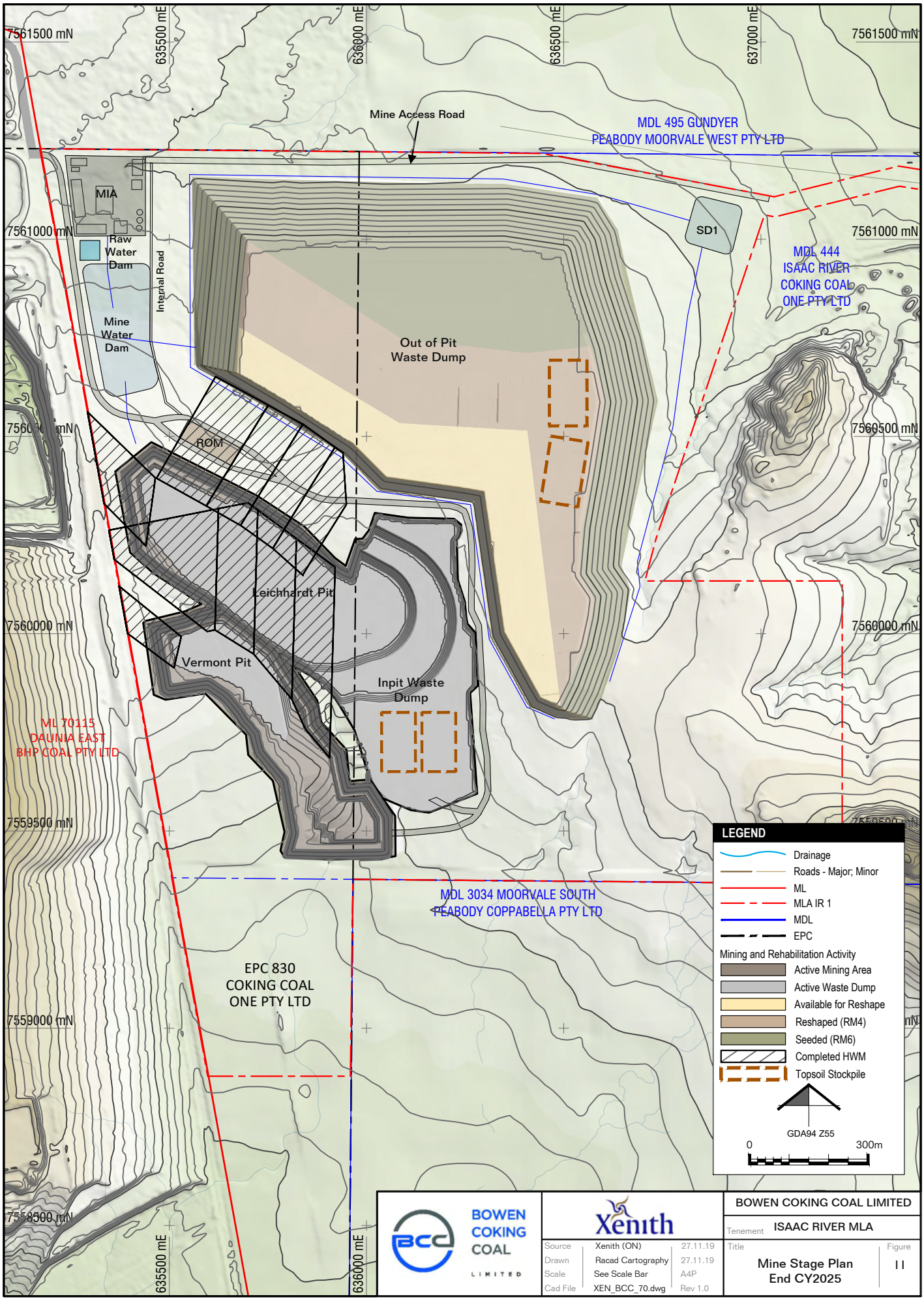
Tenement: ISAAC RIVER MLA

Title: Mine Stage Plan End CY2024

Figure: 10


7561500 mN
635500 mE
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636500 mE
637000 mE
Mine Access Road
MDL 495 GUNDYER
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SD1
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MDL 444
ISAAC RIVER
COKING COAL
ONE PTY LTD
Out of Pit Waste Dump
ROM
7560500 mN
Leichhardt Pit
7560000 mN
Vermont Pit
Inpit Waste Dump
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DAUNIA EAST
BHP COAL PTY LTD
7559500 mN
MDL 3034 MOORVALE SOUTH
PEABODY COPPABELLA PTY LTD
EPC 830
COKING COAL
ONE PTY LTD
7559000 mN
7558500 mN
LEGEND
Drainage
Roads - Major; Minor
ML
MLA IR 1
MDL
EPC
Mining and Rehabilitation Activity
Active Mining Area
Active Waste Dump
Available for Reshape
Reshaped (RM4)
Seeded (RM6)
Completed HWM
Topsoil Stockpile
GDA94 Z55
0
300m
BOWEN COKING COAL LIMITED
Xenith
Tenement
ISAAC RIVER MLA
Source
Xenith (ON)
27.11.19
Drawn
Racad Cartography
27.11.19
Scale
See Scale Bar
A4P
Cad File
XEN_BCC_70.dwg
Rev 1.0
Title
Mine Stage Plan
End CY2025
Figure
11

3.2 Community consultation

3.2.1 Community consultation register

Consultation between BCC and key Queensland and Commonwealth governments and landholders has started.

The land on which the Project will be developed is a greenfield site; however, coal exploration has been on-going since the mid 1960's. Prior consultation has not been recorded or is unknown. A renewed community consultation effort has been initiated in 2020; however, to date the underlying landholders have not formerly engaged with BCC. Community consultation that has been done to date is given in Table 27 and complies with 126C(1)(c)(iii) of the EP Act.

Table 27 Community consultation register

Consultation date(s)	Community member(s)	Description of consultation type (workshop, quarterly meetings, etc)	Information provided to the community	Issues raised / discussed by the community	How the issues have been considered	Decisions / outcomes of engagement	Commitments made by BCC
19 Nov 2019	Deguara Family (Daunia Station property owner)	Face to face meeting — Mackay	Seeking input on post mining land uses	Water storage / grazing uses preferred	Size of open cut void lends to water storage / grazing	Cost concept of partial backfill	Continue to engage
10 Dec 2019	John David Lloyd (Mavis Downs property owner)	Phone call	Described project / potential uses	Nil interest	No action	No action	Continue to keep informed
13 Feb 2020	Deguara Family (Daunia Station property owner)	Face to face meeting — Mackay	Proposed post mining landform as per meeting 19 Nov	Can cattle graze on slopes?	Would prefer proponent buys entire property	Supported concept of partial backfill	Continue to engage / check slope angles
31 Aug 2020	Isaac Regional Council	Email	Described project and requested meeting	No meeting	No action	No action	Follow up email

Consultation date(s)	Community member(s)	Description of consultation type (workshop, quarterly meetings, etc)	Information provided to the community	Issues raised / discussed by the community	How the issues have been considered	Decisions / outcomes of engagement	Commitments made by BCC
6 Sept 2020	Darren King	Face to face	Seeking input on post mining land uses	Preferred cattle uses / did not think eco-system would be sustainable as area is non-contiguous to other	Appeared to be consistent with other community member views	Continue with partial backfill approach	Continue to keep informed
2 Nov 2020	John David Lloyd (Mavis Downs property owner)	Letter mail out	Reason for consultation, reasons for proposed landform, tenement location and plans showing post mining landform visualisation	None to date	No action	No action	No action
2 Nov 2020	Eva Marie Small	Letter mail out	Reason for consultation, reasons for proposed landform, tenement location and plans showing post mining landform visualisation	None to date	No action	No action	No action

Consultation date(s)	Community member(s)	Description of consultation type (workshop, quarterly meetings, etc)	Information provided to the community	Issues raised / discussed by the community	How the issues have been considered	Decisions / outcomes of engagement	Commitments made by BCC
5 Nov 2020	BHP MBA Daunia Mine (adjoining)	Email	Reason for consultation, reasons for proposed landform, tenement location and plans showing post mining landform visualisation	Will circulate within organisation for commentary	No issues yet	Will revert asap	Continue to engage
5 Nov 2020	Peabody Millennium (adjoining)	Email	Reason for consultation, reasons for proposed landform, tenement location and plans showing post mining landform visualisation	Will circulate within organisation for commentary	No issues yet	Will revert asap	Continue to engage
5 Nov 2020	Barada Barna People	Email	Reason for consultation, reasons for proposed landform, tenement location and plans showing post mining	Awaiting response	Awaiting Response	Awaiting response	Continue to engage

Consultation date(s)	Community member(s)	Description of consultation type (workshop, quarterly meetings, etc)	Information provided to the community	Issues raised / discussed by the community	How the issues have been considered	Decisions / outcomes of engagement	Commitments made by BCC
			landform visualisation				
5 Nov 2020	Isaac Regional Council	Email	Reason for consultation, reasons for proposed landform, tenement location and plans showing post mining landform visualisation	Awaiting response	Awaiting response	Awaiting response	Continue to engage
21 May 2021	Williams family (Olive Downs Homestead property owner)	Email	Reason for consultation, tenement, location, opportunity to raise concerns	Awaiting response	Awaiting response	Awaiting response	Continue to engage

How views of the underlying landholders and other stakeholders have been addressed in the development of the rehabilitation strategy is described in Section 3.3.5.

3.2.2 Community consultation plan

The community consultation plan has been prepared in accordance with Section 126C(1)(c)(iv) of the EP Act and includes details of how BCC will carry out ongoing consultation.

The approach taken is based on locally-accepted standards of leading practice, international and Australian leading practices, particularly methods given in two publications by the *International Council on Mining and Metals — Planning for Integrated Closure Toolkit* (ICMM 2008) and the *ICMM Community Development Toolkit* (ICMM 2006). The specific methods follow those given in the *International Association for Impact Assessment* (IAIA) and the *International Principles for Social Impact Assessment* (Vanclay 2003). These methods have been adopted due to the IAIA's role in developing leading practices in community consultation. The community consultation plan also takes into consideration the *IAP2 Spectrum of Public Participation* (IAP2 Spectrum) (IAP2 2014) which defines five tiers for community consultation. Noting that only three tiers of community consultation will be used by BCC.

3.2.2.1 Objectives

The purpose of the community consultation plan is to identify, notify and engage community members who may be affected by the closure of the Project or by rehabilitation activities. Through the community consultation process, BCC will achieve the following objectives:

- identify community members, their interests and concerns about the closure and rehabilitation of the Project;
- inform identified community members of relevant activities and progress;
- establish and maintain community relationships;
- consider and address community concerns where possible, as they arise;
- develop practical mitigation strategies for unavoidable impacts; and
- provide timely, accurate and credible information to the community until relinquishment is achieved.

This community consultation plan forms part of the PRC plan and will be applied by BCC. This community consultation plan identifies activities to be done. The activities will be reviewed regularly to confirm their effectiveness and that the community consultation register is kept current.

3.2.2.2 Community profile

The Project is located within the IRC LGA, 900 km south of Cairns in Central Queensland. The region is strategically placed to capitalise on economic opportunities in Asia with world class export infrastructure.

The estimated resident population as of 30 June 2019 was 20,935 with an average annual growth rate of -1.7% (IRC 2020; QGSO 2020). It is estimated that there are an additional 12,130 resource sector workers housed in temporary accommodation (non-resident population) (IRC 2020). The median age is 33.0 years as of 30 June 2018.

Mining is the region's largest employer with 27 operating coal mines producing ~54% of Queensland's saleable coal (IRC 2019). According to the 2016 Census of Population and Housing data, 37.7% of the workforce worked in the mining industry while 10.4% worked in agriculture, forestry and fishing. 23.7% of the workforce were machinery operators and drivers and 20.7% were technician and trades workers. The unemployment rate in the March quarter 2020 was 2.1% compared to 6.1% in Queensland.

The Project is expected to start in 2021 and continue for five years providing significant direct and indirect employment opportunities through suppliers, contractors, service providers and local business. Given the nature and duration of the Project, this community consultation plan combines targeted and broader communication regarding its closure and rehabilitation.

3.2.2.3 How the community will be engaged / information released for community consultation

Community members will have varying levels of interest in and influence over the Project closure and rehabilitation activities. Consequently, different communication approaches will be employed for each community member (Table 28).

Community members associated with the Project include the Commonwealth, State and local government, landholders, community groups, non-government organisations, suppliers and internal community members. The methods and level of consultation will vary for each of these groups. Over time, the level of consultation of a community member may also vary. These concepts are demonstrated in the following sections including categorising community members into different tiers of consultation.

Table 28 Community member interest levels and communication method

Tier	Level of influence	Communication method
1 — Inform	Low	Media articles
2 — Consult	Medium	Newsletters and media articles
3 — Collaborate	High	Face to face meetings / dialogue, internal workshops and supplementary email updates / broadcasts

a Inform

The first tier of community members is those who should be 'informed'. These community members are typically local individuals or groups with a broader and more general interest in the future of the Project. These community members only want to know 'what is going on' and newsletters and updates are suitable communications media. BCC will provide objective and balanced information to inform community members on what is planned, and the progress being made with these plans.

b Consult

The second tier of community members is those who should be 'consulted'. They will have a direct interest and will want to both be informed and to provide feedback. This tier includes selected internal business units, neighbouring operators, and most government agencies (excluding key regulators). Meetings will be held with these community members so that concerns and issues can be identified, and practical solutions or actions imposed. Targeted supplementary email updates / broadcasts might also be used.

c Collaborate

The third tier is community members who need to be 'engaged' and who have the potential to be directly impacted. This tier is those who have a direct and influential role in local government, key State government agencies, Members of Parliament, cultural heritage groups, landholders, adjacent landholders and selected internal business units. The best method of consultation for this tier is regular, face to face meetings enabling candid discussions to occur. With some internal business units, meetings or workshops could be followed by regular targeted supplementary internal email updates / broadcasts.

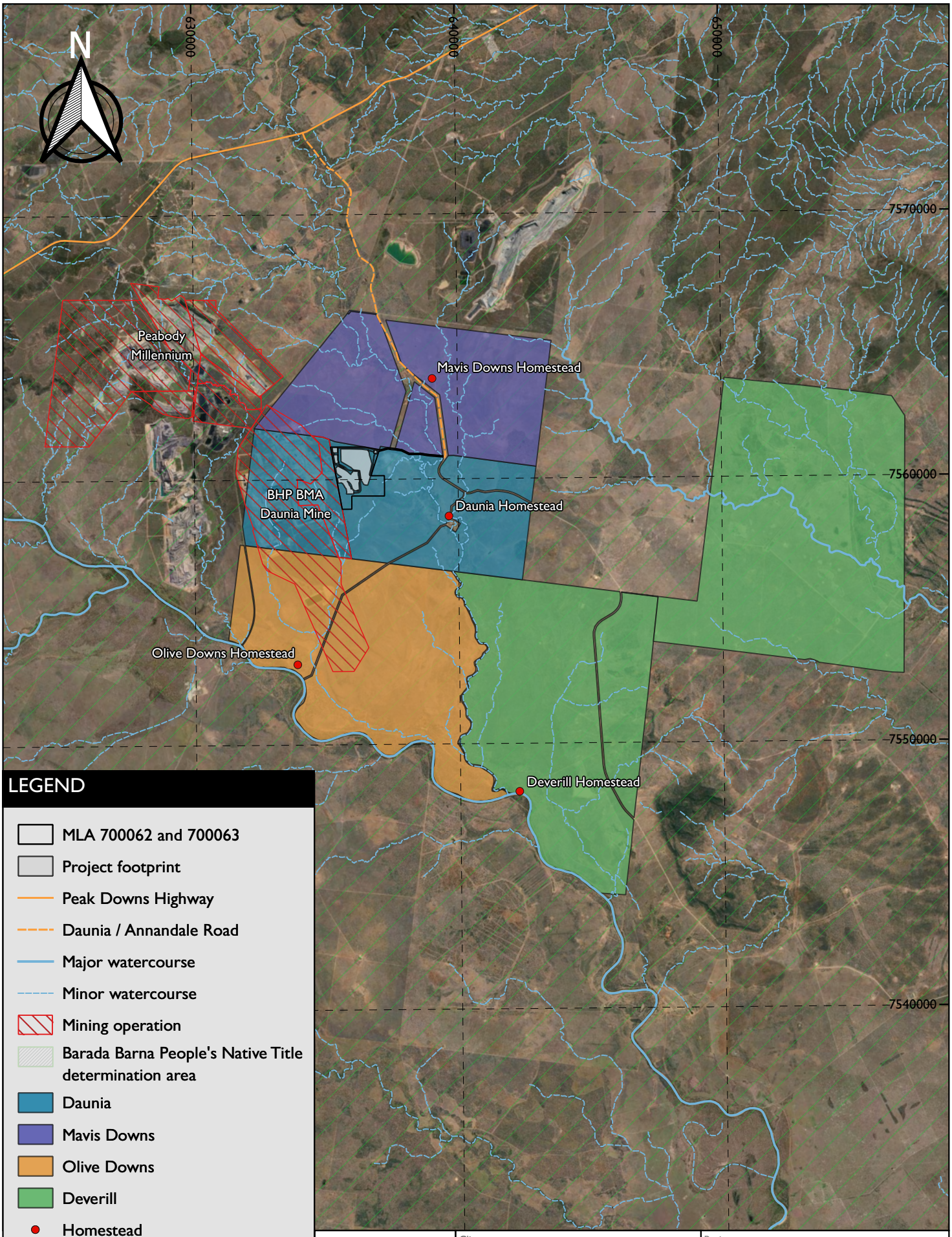
An initial listing of general internal and external community members and their suggested tier of consultation are given in Table 29.

Table 29 Community members and tiers of consultation

Key community members	Tier of consultation
Internal	
Senior management • Chief Operating Officer	Collaborate
Other business units • Site team	Collaborate
External	
Commonwealth Members	Inform
State Members	Consult
Mayor	Consult
Councillors	Inform
Government agencies (regulators)	Collaborate
Neighbours	Collaborate
Media	Inform
Investors	Inform
Queensland Resources Council	Inform
Service providers	Inform
Landholders	Collaborate

3.2.2.4 Identified community members

An initial listing of all potential community members that have an interest in, or may be affected by the Project, is given in Figure 12 and Table 30. These community members and their relationship to the Project are also given in Table 30.



LEGEND

- MLA 700062 and 700063
- Project footprint
- Peak Downs Highway
- Daunia / Annandale Road
- Major watercourse
- Minor watercourse
- Mining operation
- Barada Barna People's Native Title determination area
- Daunia
- Mavis Downs
- Olive Downs
- Deverill
- Homestead

Scale 1 : 200 000

0 4 8 km

SGMenvironmental

Client: Coking Coal One Pty Ltd		Project: Progressive Rehabilitation and Closure Plan	
Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 20,000 CRS: GDA94 / MGA zone 55		Title: Key Community Members	Figure: 12

Table 30 Key community members

Key community member(s)	Relationship to Project
David Joseph Deguara and Joy Elizabeth Deguara (Daunia Station property owner)	Holder of land directly under the Project tenement MLA 700062
Josephine Louise and John David Lloyd (Mavis Downs property owner)	Holder of land directly under the Project tenement MLA 700063
Isaac Regional Council	Local government in jurisdiction over the Project
Darren King	Local community member
Eve Marie Small (Deverill Creek Station)	Property south-east of the Project
Williams family (Olive Downs Homestead property owners)	Sensitive receptor located ~7.5 km south-west of the Project; however, given the relatively small Project footprint and the existence of BHP BMA Daunia Mine in between the property and the Project, it is unlikely the Project will have any impact on the homestead.
BHP BMA Daunia Mine (adjoining)	Mining operation that lies to the immediate west of the Project
Peabody Millennium (adjoining)	Mining operation ~ 10 km north-west of the Project
Barada Brarna People	Project is located within the Barada Barna People's native title determination area (QCD2016/007)

3.2.2.5 Proposed consultation frequency

Consultation should occur prior to any PRC plan schedule amendments that are likely to impact the community and the register should be updated when this consultation is finished. The proposed frequency of consultation is given in Table 31.

Ongoing community consultation will continue throughout the stages of the mine life so that progressive rehabilitation and the socio-economic and environmental impacts related to mine closure can be discussed with the community.

3.2.2.6 How feedback / comments will be considered

Once feedback / comments have been received and logged, BCC will make an initial assessment to identify, classify and / or investigate the root cause and identify any actions needed to address it. The community member will be asked about their expectations and suggestions for resolution. BCC will report back to community members on how feedback is received and addressed.

BCC will continue to carry out consultation in relation to the activities carried out under the PRC plan. BCC will regularly review and revise the community consultation plan and community consultation register as needed.

3.2.2.7 Planned future community consultation

Table 31 outlines planned future community consultation including how and when community members will be informed and what information will be released.

Table 31 Planned future community consultation

Community member(s)	How	When	What information will be released
David Joseph Deguara and Joy Elizabeth Deguara (Daunia Station property owners)	Phone call / face to face meeting	Annually, or prior to any amendments to the PRC plan schedule	Update landholders on the Project and seek input on any proposed changes to the PMLU
Josephine Louise and John David Lloyd (Mavis Downs property owners)	Phone call / face to face meeting	Annually, or prior to any amendments to the PRC plan schedule	Update landholders on Project and inform if there are any changes
Isaac Regional Council	Email	Annually, or prior to any amendments to the PRC plan schedule	Update local government on the Project and inform if there are any changes
Darren King	Phone call	Annually, or prior to any amendments to the PRC plan schedule	Provide an update on the Project and inform if there are any changes
Eve Marie Small (Deverill Creek Station)	Letter / phone call	Annually, or prior to any amendments to the PRC plan schedule	Provide an update on the Project and inform if there are any changes
Williams family (Olive Downs Homestead property owners)	Letter / phone call	Annually, or prior to any amendments to the PRC plan schedule	Provide an update on the Project and inform if there are any changes
BHP BMA Daunia Mine (adjoining)	Email	Annually, or prior to any amendments to the PRC plan schedule	Provide an update on the Project and inform if there are any changes and continue to engage
Peabody Millennium (adjoining)	Email	Annually, or prior to any amendments to the PRC plan schedule	Provide an update on the Project and inform if there are any changes and continue to engage
Barada Brarna People	Email	Annually, or prior to any amendments to the PRC plan schedule	Provide an update on the Project and inform if there are any changes and continue to engage

3.3 Post-mining land use

3.3.1 Options review

3.3.1.1 OC1

The PMLU options for OC1 are broadly grouped as:

- using the water for ecological purposes including aquaculture;
- using the open-cut pit as a high-wall habitat;
- atypical uses including industrial, commercial (pumped hydro-electricity, solar farm, and landfill) and recreational land uses such as dams; and
- pasture grazing.

a Ecological uses

Surface water in OC1 has the potential to be useful for a range of ecological purposes including non-commercial (habitat) and commercial enterprises. The presence of surface water in OC1 relies on rainfall directly into the footprint given it is disconnected from groundwater and overland flows will be diverted from OC1. Salt is expected to accumulate over time due to evapo-concentration during short periods prior to drying out.

Studies have shown that pit waterbodies with a salinity concentration of less than 4,000 mg/L can support a variety of freshwater plants and invertebrates in shallow water (Hart et al. 1991; Proctor & Grigg 2006; Richardson 2012). Brackish water is potable to most (if not all) terrestrial wildlife (Griffiths et al. 2014).

The air space above the final void water body can be used by native insectivorous microbats for foraging on aerial flying insects. Studies have found multiple bat species foraging over man made saline and hypersaline environments at mine sties (Griffiths et al. 2014; Griffiths 2013). It is also possible that some bats drink brackish water (Griffiths et al. 2014).

It should also be noted that OC1 water would likely have reduced recruitment, not necessarily aligning with surrounding water ecology as the recruited biodiversity would be adapt to the homogenous environment. Comparably, recruitment in the surrounding undisturbed environment is likely reliant upon a mosaic of temporary waters that provide crucial habitat during dry periods.

Aquaculture

Commercial ecological use of OC1 could include aquaculture. Using an open-cut pit for aquaculture is not new, in Malaysia, for example, open-cut pits have been used for aquaculture production (Arumugam 1994). Similarly, in the USA, open-cut pits have been used for fish production (Axler et al. 1996; Pierce & Tomcko 1989).

In Australia, the use of aquaculture as an alternative method for rehabilitation has also been explored (McCullough 2006) and used at the Ngalang Boodja Mine Lake Aquaculture project. However, both economic factors and water quality may prohibit / limit potential for aquaculture.

Factors that limit economic potential for aquaculture may include elevation, clay %, overburden pH, overburden permeability and potential for bio-accumulation.

Environmental limitations are largely a function of water quality. That is, aquaculture involving feeding and / or nutrient addition can potentially impact water quality:

- Organic enrichment comes primarily from uneaten food and fish faeces, with as much as 30% of dry feed unconsumed (Rosenthal et al. 1988) and 30% of the consumed food becoming faeces (NCC 1990).
- Hypo limnetic and sediment anoxia may also result (Axler et al. 1992; Brown et al. 1987; Enell 1982 & NCC 1990). Further, oxygen depletion may result in an accumulation of ammonium, methane, hydrogen

sulfide, and ferrous and manganous ions and increased rates of phosphorus release from sediments (Bergheim et al. 1991; Gowen & Bradbury 1987).
- Sediment dispersion and resuspension from faeces and food waste may decrease water clarity, interfere with invertebrate and vertebrate feeding, and potentially increase the cost of water treatment.
- Wasted nitrogen and phosphorus from feed and faeces may also contribute to eutrophication in nutrient-limited waters (Phillips et al. 1985). Nitrogen is excreted primarily as unionised ammonia, which is potentially toxic to aquatic organisms. Ammonium is also readily available to algae and could increase algal growth in a nitrogen deficient system.

Aquaculture is a feasible option for OC1; however, for the option to remain feasible into the future it would require that the base of the open-cut pit promotes shallow zones, and the commercial feasibility of the Project is attractive to investors.

Highwall habitat

Post-mining use of the high wall may be achieved through habitat creation. There is potential for the high wall to be used by some microbats and bird species. The following microbat species have been recorded regionally and are known to utilise caves and may make use of the high wall if, for example, artificial structures were retained that replicated caves, holes or cracks:

- Northern Freetail Bat (*Chaerephon jobensis*);
- Hoary Wattle Bat (*Chalinolobus nigrogriseus*);
- Little Pied Bat (*Chalinolobus picatus*);
- Little Bent-wing Bat (*Miniopterus australis*);
- Troughton's Sheathtail Bat (*Taphozous troughtoni*); and
- Eastern Cave Bat (*Vespadelus troughtoni*).

The most likely species of birds to utilise the high wall are the Peregrine Falcon (*Falco peregrinus*) and Welcome Swallow (*Hirundo neoxena*). The Project is within the known distribution for both species.

Leaving the highwall in place is not considered the best PMLU outcome for the Project and does not align with how the land is currently used. Notwithstanding, creating a highwall habitat may be a viable land use option.

b Commercial uses

Pumped-hydro electrical

BCC considered the feasibility of a pumped hydro-electrical project. A pumped hydroelectrical project is not feasible for the Project because:

- a second open-cut pit / reservoir / void is not available and building a reservoir would require an approval;
- there is unlikely to be enough vertical height difference to make power generation cost-efficient;
- pumped hydro would be uneconomic (ie will not generate a positive net present value) because of the likely fluctuations in the electricity price and the need for a battery to smooth out peaks and troughs in electricity supply and demand;
- pumped hydro would require significant capital expenditure and expertise, and therefore is likely to require investment from a third party; and
- pumped hydro would be made less efficient by any backfilling of OC1.

Landfill

Regionally, there are no plans to convert any open-cut pits to waste service facilities. Notwithstanding, the region has several waste service facilities and future requirement for extra waste facilities would require assessment before BCC could commit to this PMLU.

The IRC operates nine waste service facilities in the LGA. These facilities include six resource recovery centres at Moranbah, Clermont, Dysart, Middlemount, Glenden and St Lawrence. IRC operates a further three refuse transfer stations and are proposing to convert the Middlemount and St Lawrence resource transfer stations to resource recovery centres (IRC 2016).

In 2016 IRC identified that the Dysart resource recovery centre had significant unused capacity and has upgraded the transfer station and weighbridge infrastructure (IRC 2016).

In 2017 IRC upgraded the Moranbah resource recovery centre by developing a new landfill cell and there is also opportunity to expand the Clermont resource recovery centre. Further, IRC has acknowledged that the Clermont resource recovery centre may require expansion to accommodate waste from the Carmichael Coal Mine (IRC 2016).

Further afield within the Mackay Regional Council waste disposal from IRC may also be accommodated at the Hogan's Pocket Landfill. The Hogan's Pocket Landfill is estimated to have capacity until ~2050 (Mackay Regional Council 2014).

For OC1 to be used as a waste service facility an additional approval would be needed under the EP Act and a development approval may also be needed under the *Planning Act 2016*. Further, a financial assurance would be needed to provide a guarantee that the costs of remediation, closure and post closure liabilities are not left to the State / community should the landfill be abandoned, or the operator becomes insolvent.

Landfill remains a feasible option for OC1. However, for the option to remain feasible into the future it would require minimal or no backfilling of OC1, the commercial feasibility is attractive to investors, and potential environmental impacts from the landfill can be managed.

Water storage for irrigation

Irrigation could be for either crops / fodder in adjoining land (undisturbed by the Project) or for stock watering. Stock watering would use significantly less water than irrigation and therefore would have an insignificant impact on salinity of OC1.

Salt is expected to accumulate over time due to evapo-concentration for short periods before the landform completely dries out. Therefore, the use of stored water for irrigation is limited and not considered a feasible option.

Pasture grazing

Grazing trials have been conducted at several coal mines on the east coast of Australia including, Hunter Valley Operations (NSW), Mt Arthur (NSW), Liddell (NSW), New Acland (Qld), Wilkie Creek (Qld) and Burton (Qld). The studies have shown through a variety of methods including blood testing, cattle health indices such as weight gain and pasture monitoring that properly managed rehabilitated land has the potential to perform at least as good, and in some cases better than undisturbed pasture grazing.

The use of rehabilitated land for pasture grazing requires minimum soil, typically 0.2-0.5 m, but may be up to 1 m eg New Acland. The rehabilitated land can be sown with either native pasture or improved pasture species so long as the grasses are palatable and nutritious to cattle.

The use of rehabilitated land for pasture grazing is less constrained by slope angle compared to active cropping.

c Recreational uses

Recreational water use

There are two well regarded recreational water bodies near the Project. The Theresa Creek Dam located 22 km south of Clermont is fully stocked with Barramundi, Golden Perch, Eel-Tailed Catfish, Sleepy Cod, Silver Perch and Bony Bream. Another popular fishing location is Bundoora Dam which is stocked with Golden Perch, Eel-Tailed Catfish, Sleepy Cod and Spangled Perch. Redclaw Crayfish are also abundant at both dams.

The Project is located about 130 km from Mackay which is a gateway to many coastal recreational water use areas.

There are several human-water interaction risks that require consideration before OC1 can be transitioned to a recreational dam:

- water quality may prevent recreational use, particularly as water quality changes with time;
- catchment shaping, bank instability and fluctuating water levels may create physical hazards;
- stratification can be caused by thermal or salinity differences in water;
- density resulting in non-mixing layers; however, if stratification does break and separated layers mix then this can lead to incompatible water quality for recreational use; and
- the recreational dam water may provide an opportunity for growth of disease vectors (eg mosquitoes), and protozoan disease such as avian botulism and Salmonella bought to the lake by birds.

Therefore, the use of OC1 as a recreation dam is unlikely to be a suitable PMLU.

3.3.1.2 WRD1 and other features

a Grazing

The proposed final landform for WRD1 will be shaped to ~15% slope angle (and lower for other features) with up to 0.4 m of soil cover (typically ~0.2 m). The proposed final landform will lend itself to pasture grazing.

Grazing is a feasible option for WRD1 and the other features. However, for the option to remain feasible into the future it would require that land be manageable for a future landholder and that any land use practices are not cost prohibitive.

Grazing is the preferred option of the underlying landholders (see Section 3.2.1).

b Cropping

The main pre-mining land use is non-cropping agriculture. The land is currently covered in a mix of pasture grazing and pockets of sparsely vegetated open eucalypt woodland on low hills to the east.

The pre-mining land has been assessed using the *Technical Guidelines for Environmental Management of Exploration and Mining in Queensland* (DME 1995c). The assessment found that the Project is not suitable for cropping or has limited cropping potential. The land within MLA 700062 and the undisturbed section at the western end of MLA 700063 are suitable for pasture grazing on sown and native pastures. Native pasture grazing occurs across 40% of MLA 700062, with the remaining 60% being mapped as suitable for pasture grazing on sown pastures. Further, the land is not considered to be high value cropping land with no mapped strategic cropping land (SCL) occurring.

The proposed final landform for WRD1 will be shaped to ~15% slope angle (and lower for other features) with up to 0.4 m of soil cover (typically ~0.2 m). Whilst the proposed slope angles could be ploughed along the contour it is unlikely that the soil profile will be deep enough for ploughing without mixing the underlying overburden into the soil layer. Mixing of soil and overburden would increase soil sodicity and EC resulting in poor crop growth and yields. Further, it is unlikely that the soil will be able to hold enough rainfall in storage to sustain crops which will also result in poor crop growth and yield. Plant available water could be overcome by irrigation; however, water is unlikely to be of a quality that can sustain long-term use (Section 3.1.3.4c).

Therefore, the use of WRD1 and the other features for cropping is unlikely to be a good PMLU.

c Native habitat

Prior to historical land clearing for agriculture much of the vegetation in the region would have been dominated by Brigalow trees (*Acacia harpophylla*). However, much of the region was cleared for pasture following the *Brigalow and Other Lands Development Act 1962* (Nix 1994). Techniques for removing Brigalow trees included repeated 'pulling' with bulldozers and chains, followed by hot fires which resulted in little or no remnant

vegetation surviving. The success of the *Brigalow and Other Lands Development Act 1962* means that all Brigalow dominated ecosystems in Queensland are listed as endangered under the VM Act. After the clearing of Brigalow trees, buffel grass (*Cenchrus ciliaris*) varieties were introduced to improve pasture yields and this invasive grass species is now a common feature in the landscape (Marshall et al. 2012).

Therefore, the objective of returning native habitat is to establish groundcover quickly using introduced pasture and fast-growing annual species (millett and sorgum). This strategy provides early-stage succession of the landform providing surface cover and quickly introduces organic matter to assist with plant available water capacity. Native and other slower growing grasses do not provide the same initial stabilisation and organic matter introduction and can lead to landform instability. Native grasses and legumes will be included in the seed mix to increase diversity and contribute to a sustainable land use and habitat post-mining.

Native habitat remains a viable land use option for WRD1 and the other features. However, the choice of this land use over pasture grazing would likely be limited to land that can be used to connect remnant vegetation with other habitat corridors. Currently, the Project if returned to native habitat would form an isolated island and therefore returning the Project to its pre-mining land use is considered a better option.

d Solar farm

A solar farm using fixed arrays may be a viable option for the Project like the proposed Kidston 270 megawatt (MW) solar project. If a solar farm were developed, then ~2-3 ha of land would be needed to produce each megawatt of power.

Ideally the fixed arrays require relatively flat topography, suitable geological conditions, a low risk of flooding, and lower quality ecological and agricultural land. Therefore, construction of fixed arrays on WRD1 and the other features maybe feasible given the landform can be made as flat as possible.

The solar farm would require a connection to the grid, which may be possible by repurposing nearby transmission lines, however; a local substation would also be needed.

A solar farm constitutes a material change of use and a development approval would be needed before it could be built. In most cases, the local council is the planning authority responsible for assessing the development application using the assessment benchmarks in the local Planning Scheme and the *Planning Act 2016*.

The operational lifespan of a solar farm typically ranges from 20-30 years depending on the climatic conditions and the maintenance regime. Therefore, after 20-30 years the solar farm would need to be refurbished or decommissioned.

A solar farm remains a feasible option for the Project. However, for the option to remain feasible into the future it would require that the final landform be as flat as possible, and the commercial feasibility of the Project is attractive to investors.

3.3.2 Assessment of PMLU options

3.3.2.1 Limiting factors

a OC1

From the options review (Section 3.3.1) the following most limiting factors have been found (Table 32), noting that returning OC1 to pasture grazing is considered the best option because it will maximise land use post-mining.

Table 32 OC1 most limiting factors for PMLUs

Options	Most limiting factors
Ecological (non-commercial)	Would require shallow reaches and therefore re-grading of OC1 to facilitate this option. The quality of the water may be suitable for some aquatic species depending on wetting and drying cycles.
Ecological (commercial / aquaculture)	Both economic factors and water quality may prohibit potential for aquaculture for commercial use. The nature of aquaculture feeding and / or nutrient addition can potentially impact water quality. The economic potential for aquaculture is limited by the following factors: elevation, clay %, overburden pH, overburden permeability and potential for bio-accumulation of metals.
Pumped hydro	Unaffected by water quality but requires a large head pressure and therefore minimal or no backfilling of OC1. Requires investment from a third party, and significant capital expenditure and expertise. Pumped hydro is dependent on fluctuations of supply and demand in the electricity market.
Landfill	Would require OC1 de-watering and disposal. Additional approvals are needed before OC1 can be used as a waste service facility including an EA. It would need to be demonstrated that the landfill is not connected to any regional aquifer to avoid groundwater contamination. There needs to be enough demand from the LGA or region.
Grazing	Requires minimum soil cover. Consideration should be given to landform design to make sure that the backfilled OC1 is above the groundwater table.

b OC1 landform analysis to achieve pasture grazing

Options analysis

Five rehabilitation options were modelled by Xenith (2020) (Appendix B). The options were focussed on the dozing of OC1 crests and backfilling from WRD1 to bring the bottom of OC1 up to an acceptable level (195-200 RL) ie above the water table after mining has stopped and groundwater has equalised so that pasture grazing can be established.

The five options were:

- Option 1 — do-nothing;
- Option 2 — western ramp rehabilitated (LHD pit);
- Option 3 — LHD pit rehabilitated and VEM pit backfilled;
- Option 4 — both LHD and VEM pits rehabilitated; and
- Option 5 — both LHD and VEM pits backfilled.

Preferred option

Whilst not the cheapest of the five options that were modelled, Option 4 was selected as the go-forward plan for the final landform. Reshaping of both the LHD and the VEM pits will occur to build a final landform that provides stable slopes and a favourable land-use outcome (pasture grazing), while managing the financial impacts of overburden movement necessary to achieve the landform. The partial backfilling of OC1 will also aid in pit stability as all excavated slopes would be buttressed by reprofiled in-pit spoil material. It is important to note,

however, that this is not specifically a requirement to achieve geotechnical stability (Appendix H) and does not require any extra material in addition to the calculated backfill volumes.

The resulting final landform will be below natural ground level and will act as a temporary water storage after rainfall. It is anticipated that the landform will intermittently act as a cattle watering point and be available for pasture grazing once the temporarily stored water evaporates.

The backfilled open-cut pit is above the water table and will not retain a permanent waterbody. Pre-mining groundwater level and quality data is given in Section 3.1.3.5. The predicted groundwater level and quality of the backfilled OC1 is further described in Section 3.5.4.1 and demonstrated in the final void modelling, which is given in *Section 6* of the *Mine Water Balance Technical Report* (see Appendix D).

Aside from OC1, all other features will be returned to pasture grazing which directly matches pre-mining conditions. Returning the land to pasture grazing also provides specific financial, environmental, and community benefits to the region.

Financial benefits

Establishing pasture grazing will result in a lower cost of direct seeding and vegetation establishment, leading to an efficient relinquishment of the Project.

In addition, the future landholder for the Project will likely be pastoralists. Returning as much of the Project to pasture grazing will maximise useable pastoral land, resulting in economic benefits to the landholder.

Environmental benefits

Grazing pastures will have a lower biodiversity than native habitat; however, this will result in a reduced fuel load and improved fire management of the land.

The introduction of stock may also positively impact soil and vegetation. For example, it may control invasive species, improve nutrient cycling from manure, and distribute seed by cattle movement. Some negative impacts may also occur and may include soil compaction, erosion, and reduced groundcover. Potential negative impacts can be managed through best-practice land management.

Social benefits

As the future land tenures will likely be pastoral holdings, returning the land to pasture grazing will be preferred. Most of the land underlying the Project tenures was originally pasture grazing, as is most of the land in the surrounding region. This will result in a PMLU which is close to regional land-uses.

c WRD1 and other features

From the options review (Section 3.3.1) the following most limiting factors have been found for WRD1 and other features (Table 33).

Table 33 WRD1 and other features limiting factors for PMLUs

Options	Most limiting factors
Grazing	Requires minimum soil cover. Consideration should be given to slope angle, land access and management (eg weeds). May require land management.
Cropping	Requires a minimum soil depth for ploughing. The land is not considered high value cropping land and has restricting limitations including nutrient deficiencies.

Options	Most limiting factors
Native habitat	Requires long-term management of the land for weeds and feral animals. Native and other slower growing grasses do not provide the same initial stabilisation and organic matter introduction and can lead to landform instability. The instability of land is a major limiting factor for this option as is the ability to achieve a successful outcome.

3.3.2.2 Assessment method and result

The assessment method and outcome used to assess each PMLU against the others is given in Appendix C.

3.3.2.3 Assessment summary

a OC1

The analysis given in Appendix C —Table 72 suggests that the order of preference is:

- pasture grazing;
- ecological (non-commercial);
- ecological (commercial / aquaculture)
- dams (recreational);
- landfill;
- pumped-hydro; and
- dams (water storages) for irrigation; and

Dams (recreational), landfill, pumped hydro and dams (water storages for irrigation) are unlikely to be viable options unless there is a market need for these potential land uses.

b WRD1 and other features

The analysis given in Appendix C —Table 73 suggests that the order of preference is:

- pasture grazing;
- native habitat;
- cropping; and
- solar farm.

Cropping, solar farm and native habitat have a lower feasibility than pasture grazing due to issues with soils suitability, disturbance area and stability.

3.3.3 Relevant legislation, plans and strategies

3.3.3.1 Local government

The following review of the *Mackay, Isaac and Whitsunday Regional Plan* (DLGP 2012) and the *IRC 2035, our Community Strategic Plan* (IRC 2015) demonstrate that pasture grazing is consistent with the strategies and plan outlined herein.

a Mackay, Isaac and Whitsunday Regional Plan

The *Mackay, Isaac and Whitsunday Regional Plan* (DLGP 2012) includes the following specific policies for PMLUs:

- identified valuable mineral and extractive resource areas within the region are protected from development that might adversely affect current or future extraction;

- the operation of extraction and processing activities does not compromise:
  - human health;
  - current and future resource use opportunities;
  - regional landscape values; or
  - ecosystem function and services; and
  - must minimise its impact on primary production.
- once extraction ceases, former resource areas are rehabilitated to facilitate multiple end-uses, ensuring continuing contribution to the economic, community and EVs of the region; and
- innovative practices are encouraged, including local processing and value-adding activities, to maximise eco-efficiencies.

The *Mackay, Isaac and Whitsunday Regional Plan* is consistent with a PMLU of pasture grazing because:

- the mine plan maximises the extraction of economic coal and therefore no potential resource will be sterilised from rehabilitation;
- the PMLU aligns with the regional landscape and will be returned to pasture grazing ie rehabilitation minimises the impact to primary production;
- rehabilitation of the land to pasture grazing does not exclude other potential land uses such as solar farms or native habitat; and
- the rehabilitation option chosen is innovative because OC1 will be backfilled to above the permanent groundwater level resulting in a rehabilitated landform that is entirely useable.

b 2035 Community Strategic Plan

Isaac 2035, our *2035 Community Strategic Plan* (the strategic plan), IRCs commitment to the long-term future of the region. It is the blueprint for the future, which outlines how IRC will work towards enabling strong, vibrant, diverse, and sustainable communities for our people over the next 20 years.

Inevitable social, economic and political changes mean that IRC to explore new ways of capitalising on opportunities and addressing challenges, to make sure the region reaches its full potential.

The aim of the strategic plan is to provide clear goals and direction towards improving the future of the Isaac region through growth in four key themes:

- community — strong and diverse communities that support all to live, work and raise families;
- economy — continue to be Queensland's number one performing regional economy based upon a thriving, resilient and diverse mix of industry sectors;
- infrastructure — effective and sustainable infrastructure that supports the needs of the region's communities and its economic sectors; and
- environment — appropriate and sustainable balance between environment, economy and community to make sure our natural resources are sustainably managed and protected.

The strategic plan is consistent with a PMLU of pasture grazing because:

- the Project will attract a range of semi-skilled and skilled workers to the region who may choose to live and work locally, adding to community diversity;
- the Project will add to the industries that consistently place IRC in the top GDP performing LGA's in Queensland, whilst allowing for transition to a future land use that will retain community employment;
- when rehabilitated the Project will transition to pasture grazing and continue to support the region's communities and its economic sectors as an agribusiness; and
- the rehabilitation option chosen is innovative because OC1 will be backfilled to above the permanent groundwater level resulting in a rehabilitated landform that is entirely useable and reduces potential future harm to EV's.

3.3.3.2 State and Commonwealth legislation

State and Commonwealth legislation that may be relevant to the PMLU and region is summarised in Table 34 including how the legislation relates to the Project.

Table 34 State and Commonwealth legislation

Legislation	Objective	General application	How it relates to the Project
Planning Act 2016	The principal objective of this Act is to achieve ecological sustainability.	Where land is included on a mining lease (ML) pursuant to the *Mineral Resources Act 1989*, closure and rehabilitation activities done under an EA do not require a planning approval from the local government.	The PMLU does not require local government approval; however, the review of other potential PMLUs did identify the potential for local government approvals (Section 3.3.1).
Local Government Act 2009	The purpose of this Act is to provide for the way a Local government is constituted and the nature and extent of its responsibilities and powers. Local laws are made under the Act.	Local laws may apply to the owner of land as defined under the *Mineral Resources Act 1989*.	The *Planning Act 2016* only applies if a built structure that is entered onto the *Queensland Heritage Register* is found. Therefore, the Planning Act does not apply to development in the ML authorised under the *Mineral Resources Act 1989*.
EP Act 1994	To protect the environment while allowing development that improves the total quality of life and ecologically sustainable development.	General environmental 'duty of care' to be observed to guarantee that any potential environmental impact from the Project is minimised.	The potential impacts to EVs have been assessed as part of the EA amendment application. Duty of care is demonstrated for rehabilitation by preparing the PRC plan in accordance with the PRC plan guideline.
State Development and Public Works Organisation Act 1971	To provide state planning and organisational legislation that aids in the delivery of ecologically sustainable development.	Commitments during the environmental impact statement (EIS) phase may impact on closure and rehabilitation of the Project.	The potential impacts to EVs have been assessed as part of the EA amendment application. Duty of care is demonstrated for rehabilitation by preparing the PRC plan in accordance with the PRC plan guideline.

Legislation	Objective	General application	How it relates to the Project
Transport Infrastructure Act 1994	The overall objective of the Act is to provide a regime that allows for and encourages effective integrated planning and efficient management of a system of transport infrastructure.	Approval from the Department of Transport and Main Roads (DTMR) is needed under the Act if the Project interferes with a State Controlled Road.	The Project does not propose any modification to State Controlled Roads. Consequently, approvals for works under s33 of the Act is not needed.
Aboriginal Cultural Heritage Act 2003 which give rise to *Duty of Care Guidelines, 2004*	Provide effective recognition, protection and conservation of Aboriginal cultural heritage.	All practical measures need to be taken to make sure closure activities do not harm Aboriginal cultural heritage, ie demonstrate 'cultural heritage duty of care'.	The *Aboriginal Cultural Heritage Act 2003* (ACH Act) requires that, when carrying out an activity, all reasonable and practicable measures are taken to make sure that the activity does not harm Aboriginal cultural heritage. This is referred to as the cultural heritage duty of care. BCC is in the process of negotiating a cultural heritage management plan (CHMP) with the Barada Barna People to manage the risk of harm to Aboriginal cultural heritage by activities associated with the Project.
Land Act 1994	Relates to the administration and management of non-freehold land and deeds of grant in trust and the creation of freehold land, for related purposes.	Regulates the opening and closing of road reserves and land dealings relating to changes in land tenure.	The *Land Act 1994* provides a framework for the allocation of State land as leasehold, freehold or other tenure and provides for its management. The Act further regulates the grant, lease and permitting of Unallocated State Land and reserves and roads. No action is needed to satisfy this Act.
Stock Route Management Act 2002	The main purpose of this Act is to provide for stock route network management.	Regulates the management and use of stock routes.	The Project will not intersect existing stock routes. Consequently, no agreements to alter stock routes or reserves are needed.

Legislation	Objective	General application	How it relates to the Project
Water Act 2000 (and Water Resource (Fitzroy Basin) Plan, 2011 Fitzroy Basin Resource Operations Plan, 2011)	Provide for the sustainable management of water and other resources and the establishment and operation of water authorities and for other purposes.	Utilisation of groundwater and rehabilitation of bore holes.	No make-good agreements associated with disturbance to water quality, volume or water supply infrastructure are anticipated and therefore do not impact on the proposed PMLU. No creek diversions or off-lease works are proposed; therefore, no action is needed.
Nature Conservation Act 1992	To provide a framework for the protection of state listed threatened species	Rehabilitation strategies may need to include any State listed threatened species or communities that occur in the ML.	A single Ornamental Snake was found in 24 ha of degraded gilgai within non-remnant vegetation in the north western corner of MLA 700062. *The EA amendment application found that the reduction in available habitat may lead to a minor localized decrease in the local population; however, due to the amount of available habitat, both remnant and non-remnant within the region and the number of records within the broader region it is considered to be unlikely that this decrease would be significant at a regional scale.* Therefore, no specific measures for Ornamental Snakes have been included in the PRC plan.
VM Act	Regulates clearing of vegetation to guarantee appropriate management and conservation.	Project to comply with State and regional vegetation management plans and policies and comply with vegetation management practices on leased and freehold land.	Clearing native vegetation is exempt from requiring a clearing permit when it is conducted within a ML. No works are proposed outside of the ML. As such no development approvals are needed.

3.3.4 Statutory constraints

There are no statutory constraints that would limit the ability for the Project to be transitioned to pasture grazing when mining ends.

A post closure land management plan may be needed to make sure that the land is managed properly by the future landowner.

3.3.5 Community consultation

The PMLU is consistent with the outcome of community consultation because it:

- established that native habitat is not considered a good use of the land because it will be expensive to establish and will not be contiguous with any other native habitat; and
- there is a preference for pasture grazing including that community members have expressed a desire for OC1 to be backfilled above the final groundwater level and that pasture grazing must be supported on slopes of WRD1.

How underlying landholders and other stakeholders views have been addressed:

- all embankments / slopes will be battered to 15% or less and is considered suitable for ingress and egress of grazing animals (see Section 3.5.1.5a);
- OC1 will be backfilled with the lowest level 195 m AHD in the south and the floor level in the northern section to be backfilled to 200 m AHD;
- due to the relatively small catchment area and loss to groundwater, any ponding in the backfilled OC1 will be temporary and has potential to occur only under wet conditions; and
- salts are expected to accumulate over time due to evapo-concentration, however, this only occurs for short periods prior to completely drying out (salt levels reduce when new inflows occur).

3.3.6 Description of the PMLU

The Project will have a PMLU of pasture grazing (Table 35). Pasture grazing is defined as cultivation of native and introduced grass species that are palatable and nutritious to livestock.

Table 35 Feature PMLU

Relevant activities / features	PMLU
OC1	Pasture grazing
ROM	Pasture grazing
WRD1	Pasture grazing
MIA	Pasture grazing
Roads	Pasture grazing
Water storage, supply and distribution	Pasture grazing
Exploration	Pasture grazing

3.3.7 Completion criteria

Completion criteria are used to measure whether the PMLU has been successfully achieved. That is, the completion criteria show achievement of the PMLU to a stable condition at surrender. The completion criteria and justification for each criterion is given in Table 36. The completion criteria are used as milestone criteria in the PRC plan schedule (Appendix A).

Table 36 PMLU completion criteria and justification for each criterion

Rehabilitation milestone	Completion criteria	Justification of completion criteria
Infrastructure decommissioning and removal	All site services disconnected.	All services must be disconnected before infrastructure is decommissioned and removed.
	All road materials (bitumen and gravel) removed.	No roads are to remain as a PMLU.
	All pipelines drained and removed.	All pipelines must be drained and removed.
	All fencing is removed.	No fencing is to remain as a PMLU.
	All buildings demolished and removed.	No buildings are to remain as a PMLU.
	All drill holes, sumps, exploration tracks and gridlines decommissioned.	Any remaining drill holes, sumps, exploration tracks and gridlines decommissioned.
Remediation of contaminated land	A site investigation report is prepared by an AQP.	A site investigation report under the EP Act must be prepared to identify any further work that is required in relation to contaminated land to make sure that the land is suitable for the PMLU.
	Certification from an AQP that all contaminated land has been remediated or removed and disposed of according to licence conditions.	Certification must be given to make sure that all contaminated land has been remediated or removed and disposed of according to licence conditions.
Remediation of contaminated sediment	A contaminated sediment assessment is prepared by an AQP.	A contaminated sediment assessment should be undertaken to identify contaminated sediment that must be remediated or removed and disposed of according to licence conditions.

Rehabilitation milestone	Completion criteria	Justification of completion criteria
	Certification from an AQP that all contaminated sediment, along with any synthetic liners, is remediated or removed and disposed of according to licence conditions.	Certification must be given to make sure that all contaminated sediment and synthetic liners have been remediated or removed and disposed of according to licence conditions.
Landform development and reshaping / re-profiling	All major earthworks completed.	Landform development and reshaping / re-profiling involves major earthworks.
	OC1 is backfilled to 200 m AHD in the LHD void and 195 m AHD in the VEM void as verified by an AQP.	Backfilling brings the surface above the water table after mining has stopped and groundwater has equalised so that pasture grazing can be established. The final surface height will vary across the void from 200 m AHD in the LHD (north) void to 195m AHD in the VEM void (south).
	Highwall portals have been sealed and are not accessible from the final landform surface and verified by an AQP.	Sealing highwall portals ensures stability of the area and removes a safety risk for future landholders, cattle and fauna.
	Sediment and mine water dams will be desilted and backfilled using their embankments.	The removal of silt allows for a consolidated base for backfilling of dams. The use of the embankments for backfilling the dams is a cost-effective rehabilitation method.
	Slope of constructed landform is ≤15% and verified by an AQP.	The final landform will be shaped to ~15% slope angle (and lower for other features). The final landform was selected based on its ability to provide stable slopes, a favourable land us outcome and management of potential impacts on environmental values.
	Landform is assessed as geotechnically stable by an appropriately qualified geotechnical engineer.	Certification must be given by a suitably qualified geotechnical engineer that the final landform is geotechnically stable.

Rehabilitation milestone	Completion criteria	Justification of completion criteria
	Surface water runoff meets site drainage specifications as assessed by an AQP.	An assessment of surface water runoff will minimise areas of concentrated flow and better manage surface water runoff.
Installation of cover	Certification by an AQP that fine rejects are buried under waste rock with a minimum of 5 m cover thickness.	The risk of acid generation is low with all samples classified as NAF or NAF-barren (except for some PAF fine rejects), suggesting that a complex cover system will be not be needed. Rejects will be buried by overburden with at least 5 m cover.
Surface preparation	An assessment of soil health and suitability has been completed by an AQP to confirm soil is suitable for target vegetation establishment.	A soil health and suitability assessment should be completed by an AQP to make sure soil is suitable for target vegetation establishment and specify any requirements for amelioration.
	Application of ameliorants as per requirements of the soil health and suitability assessment.	Ameliorants may be required because of the soil health and suitability assessment.
	Deep ripping of surfaces has been completed.	Surfaces need to be deep ripped prior to seeding.
	Placement of 0.2 metres (m) of soil.	Soil will be applied with a thickness of 0.2 m to provide enough depth for ripping and vegetation growth.
	Light scarification on the contour of the topsoiled surface has been completed.	Scarifying on the contour will help to alleviate compaction, encourage rainfall infiltration and minimise runoff.
	Appropriate erosion and sediment control systems have been installed and verified by an AQP.	Appropriate erosion and sediment control systems will help protect the topsoiled surface from erosion and contain any sediment runoff prior to vegetation establishment
Revegetation (pasture grazing)	Completed seeding as per the site *Revegetation Plan*.	Recommended seeding rates are given the *Revegetation Plan*.

Rehabilitation milestone	Completion criteria	Justification of completion criteria
Achievement of surface requirements (pasture grazing)	Groundcover ≥80%.	Groundcover must be at least 80% to ensure stability of the landform in accordance with the Water Erosion Prediction Protection (WEPP) modelling.
	No active areas of gully erosion and drainage follows appropriate drainage paths.	There should be no active areas of gully erosion and drainage follows appropriate drainage paths.
	Erosion gullies are less than or equal to 0.3 m deep.	Erosion gullies must be less than or equal to 0.3 m and are considered stable ie is not active erosion.
	Certification from an AQP that rehabilitation is resilient to fire.	A Project specific fire protection plan may be needed to protect rehabilitation for several years until vegetation is able to survive fire or have set seed so they can re-establish. Certification should be gained to establish that rehabilitation is resilient to fire.
	Certification by an AQP that weeds and pest species are in densities no greater than at analogue sites.	Weeds and pest species can compromise revegetation. Weeds and pest species should be in densities no greater than at analogue sites.
Achievement of PMLU to a **stable** condition (pasture grazing)	Certification from an AQP that the area has achieved stable condition.	Leaving the Project in an unstable condition that has the potential to cause harm is unacceptable. Certification must be given to make sure that land is in stable condition. That is, the land is safe and structurally stable, the land can sustain the PMLU and there is no environmental harm being caused by anything on or in the land.
	Certification from an AQP that the landform achieved a factor of safety ≥1.5.	The landform must be geotechnically stable. A landform is considered geotechnically stable when it achieves a factor of safety of a least 1.5.
	Maximum erosion rate of <10 t/ha/yr.	The landform will have an acceptable erosion rate when the maximum erosion rate is less than 10 t/ha/yr.

Rehabilitation milestone	Completion criteria	Justification of completion criteria
	Average erosion rate of ≤5 t/ha/yr.	The landform will have an acceptable erosion rate relative to the surrounding land when the average erosion is less than 5 t/ha/yr.
	Groundcover ≥80%.	Groundcover should be a least 80% to reach acceptable limits of erosion and stability and make sure that it is able to sustain the PMLU.
	Certification from an AQP that weed and pest species are no greater than at analogue sites.	Weeds and pest species may compromise revegetation and the PMLU. The landform must be able to sustain the PMLU and be of quality that can be used for pasture grazing.
	Surface water runoff quality from the area complies with the following: • pH is between 6.5 and 9.0; • EC is 20th of downstream monitoring points and 80th percentile of upstream monitoring points; • aluminium is <100 µg/ L; • arsenic is <13 µg/L; • cadmium is <0.2 µg/L; • chromium is <1 µg/L; • copper is <2 µg/L; • iron is <300 µg/L; • lead is <10 µg/L; • mercury is <0.2 µg/L; • nickel is <11 µg/L; • zinc is <8 µg/L; • boron is <370 µg/L; • cobalt is <90 µg/L • manganese is <1,900 µg/L;	Rainfall runoff / or seepage must be of acceptable characteristics for the receiving environment that does not cause environmental harm. Discharge contaminant triggers are based on a range of default or model criteria including: • *Model water conditions for coal mines in the Fitzroy basin (version 3); and* • *Isaac River Sub Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), Including all waters of the Isaac River Sub-Basin (including Conners River) 2011.*

Rehabilitation milestone	Completion criteria	Justification of completion criteria
	• molybdenum is <34 µg/L; • selenium is <10 µg/L; • silver is <1 µg/L; • uranium is <1 µg/L; • ammonia is <1,000 µg/L; • nitrate is <1,100 µg/L; • petroleum hydrocarbons (C6-C9) is <20 µg/L; • petroleum hydrocarbons (C10-C36) is <100 µg/L; • fluoride (total) is <2,000 µg/L.	
	Groundwater level is below RL 195 m AHD.	Groundwater is expected to rebound to 185 RL. Xenith have conservatively assumed 195-200 RL for backfill to make sure the base of the final landform is above the groundwater table.
	Groundwater quality complies with the following (median concentration from the most recent eight consecutive samples from a compliance bore): • pH range is 7.40/7.1 (shallow/deep) or 20th percentile of reference, whichever is lower and 8.30/8.10 (shallow/deep) or 80th percentile of reference, whichever is higher; • EC is 16,000/8,910 µS/cm (deep/shallow) or 80th percentile of reference, whichever is higher; • aluminium is 5 mg/L or 80th percentile of reference, whichever is higher; • arsenic is 0.5 mg/L or 80th percentile of reference, whichever is higher; • boron is 5 mg/L or 80th percentile of reference, whichever is higher; • cadmium is 0.01 mg/L or 80th percentile of reference, whichever is higher; • chromium is 1 mg/L or 80th percentile of reference, whichever is higher;	Groundwater must be of acceptable quality that is like pre-mining conditions. The trigger limits have been determined from baseline groundwater monitoring and follow the Proposed Draft Environmental Authority Conditions.

Rehabilitation milestone	Completion criteria	Justification of completion criteria
	• copper is 1 mg/L or 80th percentile of reference, whichever is higher; • mercury is 0.002 mg/L or 80th percentile of reference, whichever is higher; • lead is 0.1 mg/L or 80th percentile of reference, whichever is higher; • molybdenum is 0.05 mg/L or 80th percentile of reference, whichever is higher; • nickel is 1 mg/L or 80th percentile of reference, whichever is higher; • selenium is 0.02 mg/L or 80th percentile of reference, whichever is higher; • uranium is 0.2 mg/L or 80th percentile of reference, whichever is higher; and • zinc is 0.317 mg/L/0.060 mg/L (shallow/deep) or 80th percentile of reference, whichever is higher.	

3.4 Non-use management areas

There are no non-use management areas (NUMAs).

3.5 Rehabilitation management methodology

3.5.1 General rehabilitation practices

The following sections present information deemed necessary to underpin the development of rehabilitation and management methodologies.

3.5.1.1 Hydrogeology

During mine operations, groundwater in the Permian strata (rock and coal seams) is expected to be diverted to the open-cut pit by dewatering / depressurisation. There will also be additional seepage from the overburden stored in OC1.

There is a potential for groundwater diversion towards OC1 along north north-west to south south-east trending faults west of the Project. Notwithstanding, it is at least 10 km south of the Project before the fault intersects alluvial sediments associated with either the Isaac River or North Creek. The transmissivity of the fault is not known, but it is unlikely to be enough to impact the groundwater within the alluvium aquifer of either watercourse. Groundwater discharged into OC1 during operation will either be removed by pumping or will evaporate. After OC1 is rehabilitated the pit floor will be above the water table which would make it unlikely that OC1 will receive groundwater.

Monitoring of the hydraulic head at groundwater bores which are closely located (~200 m) to the BHP BMA Daunia Mine indicates a low potential for groundwater drawdown within the seams of the Rangal Coal Measures.

The conceptual hydrogeological model for the Project is shown in Figure 13.

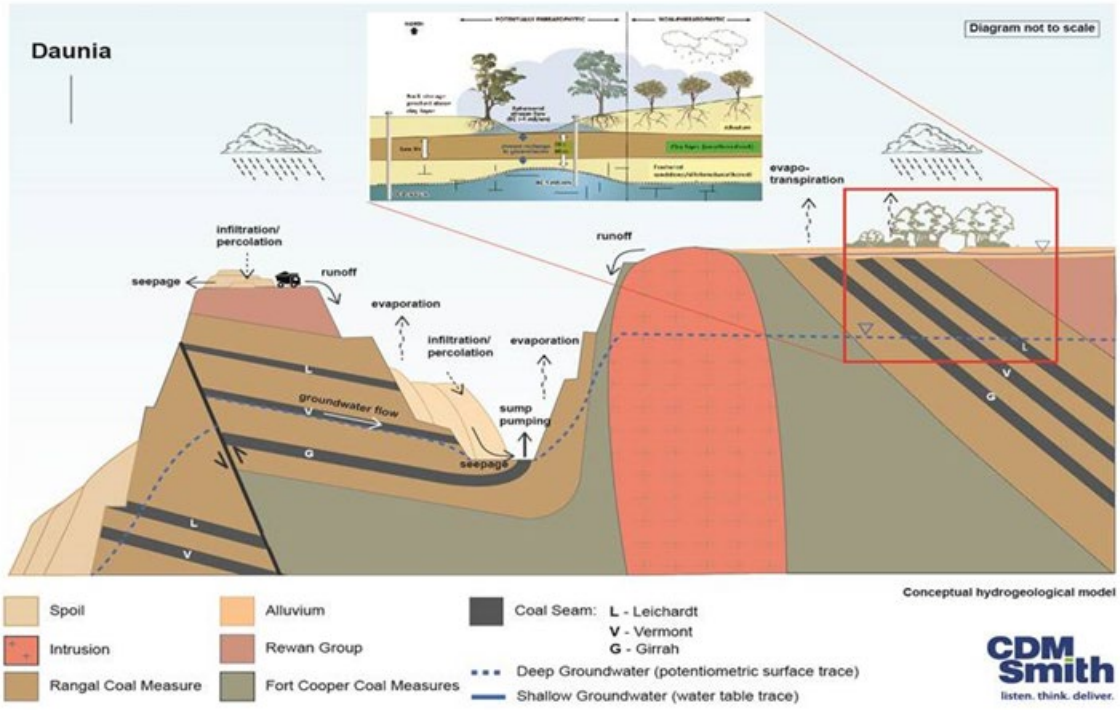


Figure 13 Conceptual hydrogeological model

3.5.1.2 Flooding

A *Flooding and Stormwater Drainage Assessment* has been prepared in accordance with Sections 124, 125 and 126A-126D of the EP Act and complies with Section 3.4 of the PRC plan guideline (Appendix E).

Following the industry approach, including the *Australian Rainfall and Runoff A Guide to Flood Estimation* (Ball et al. 2019), catchment topography and feature characterisation was combined with long-term rainfall statistical representation for select event probabilities (the comparative assessment) to compare the:

- existing case — the modelled terrain without any modifications; and
- developed case — the modelled terrain was modified to reflect the Project as it is expected to be in the year 2026.

Design storms ranging in duration from 45 minutes to three hours were tested in the model to find the critical duration for the local catchment. Flows were observed to leave the model along parts of the northern, eastern, and southern boundaries. A review of water level hydrographs at these locations showed a 120 minute duration design storm produced the highest flood level in each case, and accordingly this was selected as the critical storm duration for the purposes of the comparative assessment.

Design flood events at annual exceedance probabilities, including 10%, 1% and 0.1% were then simulated in the model. Flood modelling of rare events, of less than 0.1% AEP, were not modelled due to the small catchment size and lack of infrastructure assessed from a risk basis. The results of the model have been processed to developed maps showing peak depth, peak velocity, and peak water surface elevation (nine maps in total). The maps are presented in Figure 4-7-Figure 4-15 of *Flooding and Stormwater Drainage Assessment* (Appendix E). Broadly, the results can be characterised as follows:

- Flood depths are generally quite shallow, with concentrated overland flow only observed in the bottoms of gullies. Indicative peak depths in the 0.1% AEP case are in the order of 0.5-1.0 m, with these depths confined to gullies. Note that although the direct rainfall methodology results in some inundation of every model cell, most of these depths are very shallow. For visualisation purposes a threshold depth of 0.2 m has been used to highlight the areas where flow concentration occurs.
- Ponding is limited to the existing farm dam and quarry storages, but runoff otherwise drains freely away from the site to the north, east, and south.
- Peak velocities mirror the peak depth profiles. As flow concentration occurs, so does velocity increase. In areas of shallow or sheet flow, 0.1% AEP peak velocities are less than 0.5 m/s. This increases towards a maximum of about 2 m/s in the gullies on the eastern side of the Project (these being the steepest). Elsewhere peak velocities are constrained in the range of ~0.5-1.5 m/s.

Both the Isaac River and broader Fitzroy River basins contain gauges that record river heights, and thus the record of historic flooding. However, these gauges are typically located in the lower and flatter reaches of the much larger contributing catchments, where flooding may occur. In contrast, the Project is in the very upper reaches, along a ridge line, where the small contributing catchment area means that large scale flooding is typically not experienced. Changes in water depths and velocities are only noticeable in the concentrated flow of gullies leading off the Project. Modelling shows that flooding in North Creek or the Isaac River will not affect the Project.

Peak flood depth modelling suggests no impact to OC1 or WRD1. The key change to surface water quantity arising from the Project is the creation of internally-draining areas (ie OC1, WRD1) that reduce the total area that would otherwise drain freely to North Creek or the Isaac River. With the use of sediment controls and site design, no impact is anticipated to watercourses within and surrounding the Project during construction.

3.5.1.3 Soil and capping material assessment

a Soil types disturbed

Geographic information system (GIS) software has been used to match the features (disturbance) with soil mapping to find areas of soil that will be disturbed. Most of the disturbed soil is Brown Vertosols (Table 37).

Table 37 Disturbed soil

Soil type	ha	%
Brown Vertosols	116.59	67.5
Grey Vertosols	56.26	32.5
Total	**172.85**	**100**

b Soil stripping

Topsoil and subsoil will be stripped and stockpiled. The soil stripping procedure will be designed to maximise the salvage of soil so pastures can be grown. The soil stripping method will be like leading practice and incorporate the full range of reasonable and feasible mitigation methods, with the goal of minimising the degradation of nutrients and micro-organisms.

If the total disturbance area of ~173 ha requires soil to be spread to 0.2 m, then a total soil volume of 346,000 m^3 is needed.

Table 38 gives the recommended soil stripping depths for the features and the resulting volume of soil. The depths of stripping have been separated into soil and subsoil based on horizons with similar properties and rehabilitation value, as per the field assessment (CDM Smith 2020) The Grey Vertosol subsoil (0.3-0.85 m) should not be stripped due to the chemical properties (high ECe). The results show that there are enough soil resources available for use in rehabilitation. A swell factor was used to calculate the volume of freshly stripped soil for stockpiling purposes. It should be noted that due to consolidation, the amount of soil available for rehabilitation will be the stripping area multiplied by the pre-disturbed soil depth.

The overall volume of soil needed for rehabilitation should be checked prior to construction to make sure that adequate soil is available. If any soil shortages emerge, due to factors like unanticipated shallowness, waterlogging or soil loss, subsoil should be ameliorated with the measures given in Section 3.5.1.3e and used in place of soil.

Table 38 Stripping depths and soil volumes

Soil type	Topsoil (m)	Subsoil (m)	Total soil depth (m)	Total soil volume (m^3)	Swell factor	Total stockpiled volume (m^3)
Brown Vertosols	0.30	0.25	0.55	641,269	1.2	769,523
Grey Vertosols	0.30	-	0.30	168,784	1.2	202,541
Total	**-**	**-**	**-**	**810,053**		**972,064**

1. Based on depths identified during soil field assessment

d Stockpile management

Stockpiles for topsoil and subsoil will be formed in low structures with the intention to minimise height (3 m maximum) and maximise the surface area (dependant on available area). Stockpiling using a greater number of low stockpiles, rather than a few large stockpiles, is preferable to reduce soil degradation and retain its value for vegetation growth. Revegetating stockpiles will minimise weed infestation and maintain organic matter, soil structure and microbial activity.

Stockpiles of soil will be kept for the shortest possible period. Where it is necessary to store material over more than one growing season, some form of protective surface cover will be established. Stockpiles to be retained for a period longer than six months will be sown with a cover crop if vegetation does not volunteer. Declared plants on the stockpiles will be monitored and control programs applied.

e Amelioration

Soil amelioration is used where fertility maybe low or to assist management of other soil characteristics that may impact rehabilitation success. Soil amelioration typically involves the application of soil conditioners, such as fertilisers or gypsum, onto the features after soil has been spread and before revegetation occurs.

Fertiliser

Fertiliser is used to provide a readily available source of nutrients to supplement fertility, maximise the growth of seeded areas and establish vegetation on rehabilitated land. Sampling may be done of stockpiled soil and other growth mediums prior to rehabilitation work to confirm the amelioration requirements.

If fertiliser is needed, ammonium phosphate sulfate fertiliser can be applied to increase the sulfur and ammonia content of the soil which will lower the pH (from the sulfur and ammonia — 12-17% and 14-18% by weight respectively) and will add 7-12% P. It should be noted that because of the high CEC, it is expected that the soil will acidify slowly due to the inherent buffering capacity. The ammonium phosphate sulfate fertiliser P should be applied at a nominal rate of 100 kilograms per hectare (kg/ha).

It should be noted that while macronutrients vary across the Project, it is likely that these would be sufficient for pasture grazing; therefore, fertiliser is not required.

Elemental sulfur and iron sulfate

Elemental sulfur or iron sulfate are used if alkaline soil conditions are impacting vegetation growth. Bacteria in the soil will oxidise the sulfur, forming sulfuric acid, which will then lower pH. It is assumed that pasture species will be able to tolerate the alkaline soils. Therefore, elemental sulfur and iron sulfate are unlikely to be necessary.

Gypsum

Gypsum application rates have been based on achieving a soil ESI of >0.05 for soils that are to be stripped and stockpiled (Table 39) as Australian soils with an ESI <0.05 tend to disperse. The ESI incorporates the dispersive effect of exchangeable Na as well as the coagulating impact of increased soil EC. Emerson aggregate dispersion tests more closely aligned with ESI results compared to solely ESP indicating that it is a more reliable predictor of dispersion potential.

Gypsum application rate has been determined using BP SodiCalc (the program) (BP Company 2018). The program determines the gypsum application rate from the observed pH, EC and exchangeable cations and is adjusted for a target ESP, exchangeable Mg potential and exchangeable K potential. The program assumes a gypsum efficiency rate of 65% and assumes that only the top 0.2 m of the rehabilitated profile will require treatment.

As given in Table 38, enough soil will be stockpiled so that no subsoil will need to be used for rehabilitation. Should subsoil be required amelioration application rates are given in Table 39.

Table 39 Recommended gypsum application rates

Soil type	Soil layer	Gypsum application rate (t/ha)
Brown Vertosols	Topsoil	Nil
	Subsoil	3.6
Grey Vertosols	Topsoil	Nil
	Subsoil	9.0

f Soil application

Soil will be applied to landforms once they are re-contoured and any compacted zones (infrastructure and other hardstand areas) have been deep ripped. The soil application procedure will be designed to minimise any degradation of soil properties, aligning with industry leading practice.

Generally, soil will be applied with a minimum thickness of 0.2 m to the features to provide enough depth for ripping and vegetation growth.

The following measures are proposed to minimise the loss of soil during respreading and promote successful vegetation:

- a soil management strategy will be prepared before soil is spread, which confirms the depths and volume of soils to be reapplied to each feature;
- features will be re-contoured and deep ripped before any soil is spread;
- soil will be spread in even layers 0.2 m across the feature;
- soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise runoff.
- pasture will be seeded as soon as practicable after respreading; and
- erosion and sediment controls will be used where necessary before establishing vegetation.

g Erosion and sediment control

Progressive rehabilitation will support the stabilisation of the features as quickly as practicable and to limit erosion. In addition to this, specific erosion and sediment control measures will be used, aligning with best practice guidelines (DME 1995a; DME 1995b). A *Conceptual Erosion and Sediment Control Plan* (Appendix F) has been developed for the construction and operational phases of the Project. The *Conceptual Erosion and Sediment Control Plan* will be adapted for the post operational monitoring phase of the Project and incorporate site-specific learnings gained during operation. The construction of control measures will consider several variables such as rainfall intensity, erosivity, gradient and flow estimates.

The erosion control options that might be used are given in Table 40.

Table 40 Recommended erosion and sediment controls

Area	Control measures
Erosion control and cleared land	• restrict clearing to land essential for the works; • windrow vegetation debris along the contour; • minimise length of time soil is exposed; and • divert runoff from the features away from the works.
Exposed subsoils	• minimise length of time subsoil is exposed; • direct runoff from exposed land to sediment dams; and • use erosion control structures such as:

Area	Control measures
	– bonded fibre matrix; – composite blankets; – erosion control blankets; – mulching; – revegetation; – soil binders and surface stabilisers; – surface roughening; – sediment fences; – check dams; – grass filter traps; – compost / mulch berms; – drop inlet protection; and – gypsum application.
Contour cultivation	All cultivation used to prepare the rehabilitation area should be on the contour. On steep slopes, this approach requires the land to be terraced or benched.
Contour deep ripping or contour furrowing	These procedures should be used to relieve soil compaction and improve water infiltration on exposed sodic subsoils and the Vertosol soil stockpile. These actions may be done in conjunction with gypsum application.
Contour or levee banks	Earth stockpiles or similar structures are the most common physical control measures. The size of these structures is determined by the size of their catchment. These structures should not be constructed out of dispersive or highly erodible materials.
Absorption and pondage banks	These banks are similar in design to contour banks but laid out such that they pond water — thereby causing greater infiltration and less runoff. They are applicable only to low slopes (less than 1%) and should be avoided in materials which become dispersive when saturated. They should not be used on WRD1.
Diversion banks	These banks are commonly used to reduce or eliminate the catchment to the heads of gullies. They need to be located such that they spill water to stable land — preferably away from the rehabilitation area.
Spillways / grassed waterways	These structures are used to confine runoff from all the above structures into a stable vegetated flow path. Because these structures effectively take all excess runoff from a rehabilitation area, they should be installed first and well vegetated prior to the actual construction of the diversion structures. Supplementary irrigation water may be needed to sustain the vegetation.
Sedimentation dams — gully trap dams	These structures are an interim measure to confine the movement of soil to the rehabilitated area. In effect they act as settling areas to make sure that soil eroded from the rehabilitated area does not pass beyond that area. Ideally their role in erosion control should diminish over time as the rehabilitated area is stabilised by other measures.

Area	Control measures
Vertosol erosion control	Where needed, Gypsum should be applied to Vertosols to improve aggregate stability (gypsum displaces sodium ions with calcium ions). Where practical, half the recommended dosing rate will be applied to the surface of the soil material prior to stripping. The other half should be applied to the top-dressed material immediately after spreading. Alternatively, gypsum may be applied to the soil surface after its spreading and incorporated into the soil by ripping. The use and quantities of gypsum will be determined on a site by site basis prior to soil stripping.

h Contaminated land management

The risk of disturbing existing contaminated land is negligible given no records of contaminated land exist. Similarly, no potential for acid-sulfate soils has been found. However, the construction and operation phases of the Project has potential to cause contamination.

Contamination may occur due to activities related to the ROM coal stockpile, MW1 and the MIA. Storage of hazardous and other chemicals also present a contamination risk from spills.

The contamination management measures are:

- the provision of appropriate spill control equipment including booms and absorbent materials at refuelling facilities;
- making sure all refuelling facilities and the storage and handling of oil and chemicals comply with relevant Australian standards; and
- creating procedures to make sure fuel, oil and chemical storage and handling is safe. This includes storing these materials in bunds to contain spills and prevent uncontrolled discharge.

3.5.1.4 Waste characterisation

The following sections provide a summary of the *Waste Characterisation* report prepared by CDM Smith in 2020 (Appendix G).

a Mineral waste volumes

A breakdown of overburden and coal rejects accumulated over the life of the Project is given in Table 41.

Table 41 Annual volumes of overburden and coal rejects

Project year	Overburden million bank cubic metres (mbc)	Coal rejects (t)
1	7,000,528	125,000
2	5,391,584	130,000
3	5,424,939	125,000
4	5,041,422	282,500
5	-	500
Total	**22,858,472**	**663,000**

b Overburden and interburden characterisation

Geochemistry

12 samples had their geochemistry assessed and are representative of the lithologies given in Table 42. In the absence of coal rejects, interburden located immediately above and below the coal were analysed as coal rejects.

Table 42 Geochemistry samples and lithologies

Sample number	Drill hole number	Sample interval (m)	Lithology
PPD002GC_59-60	PPD002	59-60	Coal
PPD002GC_65-67	PPD002	65-67	Sandstone
PPD002GC_108-109	PPD002	108-109	Siltstone
PPD002GC_111-112	PPD002	111-112	Siltstone
PPD003GC_39-40	PPD003	39-40	Sandstone
PPD003GC_65-66	PPD003	65-66	Siltstone
PPD003GC_72-73	PPD003	72-73	Coal
PPD003GC_109-110	PPD003	109-110	Siltstone
PPD004GC_16-17	PPD004	16-17	Siltstone
PPD004GC_22-23	PPD004	22-23	Siltstone
PPD004GC_91-92	PPD004	91-92	Coal
PPD004GC_116-117	PPD004	116-117	Coal

Geochemical abundance indices (GAIs) were calculated for the 12 samples to give an indication of the elemental enrichment found in the overburden and interburden. Across the 12 samples GAI values greater than zero, but less than three, were identified for As, Cu, Hg and Zn. The result shows minor enrichment for these elements. The generally accepted method is that only samples that have a GAI of three or higher need further evaluation. All remaining elements had GAI values less than zero.

Acid generation potential

Characterisation of the overburden and interburden was done in accordance with the *Assessment and Management of Acid Drainage guideline* (DME 1995a). The acid base accounting and net acid generation (NAG) methods were used for characterisation of the samples. The main components of the methods are the net acid production potential (NAPP) and the NAG tests. The sample classification criteria are given in Table 43.

Table 43 Sample classification criteria

Classification	NAPP (kilograms of sulfuric acid per tonne of spoil (kg H_2SO_4/t))	NAGpH	Total S (%)
PAF	>10	<4.5	-
PAF-low capacity (PAF-LC)	0-10	<4.5	-
NAF	Negative	≥4.5	-
NAF-barren	Negative	≥4.5	<0.05

Classification	NAPP (kilograms of sulfuric acid per tonne of spoil (kg H_2SO_4/t))	NAGpH	Total S (%)
Acid-consuming (AC)	Less than -100	≥4.5	-
Uncertain (UC)	Positive	≥4.5	-
	Negative	≤4.5	-

To assess the potential for acid generation the samples of overburden and interburden were tested and classified using the criteria in Table 43. A summary of the assessment is given in Table 44.

Table 44 Acid base accounting and NAGpH summary

Sample number	pH	Total S (%)	Maximum Potential Acidity (MPA) (kg H_2SO_4/t)	ANC (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)	NAGpH	Classification
PPD002GC	8.3	0.02	0.6	12.3	-11.7	7.5	NAF-barren
PPD002GC	9.1	0.08	2.5	13.0	-10.6	7.1	NAF
PPD002GC	9.5	0.09	2.8	78.0	-75.2	9.3	NAF
PPD002GC	9.3	0.08	2.5	40.3	-37.9	8.8	NAF
PPD003GC	9.5	0.06	1.8	62.1	-60.3	8.4	NAF
PPD003GC	9.6	0.07	2.1	45.7	-43.6	9.0	NAF
PPD003GC	9.3	0.05	1.5	24.3	-22.8	8.4	NAF
PPD003GC	9.6	0.08	2.5	122.0	-119.6	9.4	NAF
PPD004GC	8.1	0.01	0.3	10.7	-10.4	7.8	NAF-barren
PPD004GC	7.4	0.01	0.3	10.6	-10.3	7.5	NAF-barren
PPD004GC	9.4	0.04	1.2	51.9	-50.7	8.9	NAF-barren
PPD004GC	9.6	0.03	0.9	107.0	-106.1	8.6	NAF-barren

The results show that the samples were slightly (pH 7.4) to highly (pH 9.4) alkaline and contain little to no sulfur (<0.01-0.09%). The risk of acid generation is low, with 100% of the samples classified as NAF or NAF-barren.

BHP BMA Daunia Mine is located immediately west of the Project on ML1781 and ML70115. The Olive Downs Project is located ~20 km south of the Project. Geological units and lithology are similar and therefore it is expected that the geochemical characterisations will also be similar.

Geochemical characterisation for overburden and interburden was done at the adjacent BHP BMA Daunia Mine (BHP BMA 2008). Only two samples out of 199, both interburden, had a NAPP greater than 10 kg H_2SO_4/t (BHP BMA 2008). The mean interburden and overburden NAPP was -38.5 and -25.0 kg H_2SO_4/t respectively and is likely suitable for revegetation (BHP BMA 2008). A summary acid base account is given in Table 45. The geochemical assessment found that overburden and interburden materials at BHP BMA Daunia Mine pose a low to negligible risk of acid generation ie there is high degree of neutralising capacity that would counter any acid generation from the oxidation of sulfide material.

Table 45 BHP BMA Daunia Mine acid base account (BHP BMA 2008)

Acid base account	Number of samples	Minimum	Median	Maximum
Total S (%)	199	<0.01	0.02	0.9
MPA (kg H_2SO_4/t)	-	<0.3	0.61	27.5
ANC (kg H_2SO_4/t)	58	1.9	33	214
NAPP (kg H_2SO_4/t)	58	-212	-32	15

Where, MPA (kg H_2SO_4/t) is total S (%) multiplied by 30.6.

Geochemical characterisation was done at Olive Downs Project for 42 weathered and 51 unweathered overburden and 73 interburden samples. The results show that the risk of acid generation is low, with 99% classified as NAF or NAF-barren, and less than 1% classified as UC or PAF. Any acid generation would be very limited and the risk removed by the overwhelming acid neutralising capacity of the overburden and interburden.

Saline and sodic drainage potential

Overburden and interburden samples were analysed and classified in accordance with the *Assessment and Management of Saline and Sodic Waste* (DME 1995b) (Table 46). Salinity and sodicity affect the erodibility, with salinity generally supressing the degree of dispersion and sodicity increasing the likelihood of clay dispersion when wet. Sodic overburden and interburden can also have extremely low permeability, impede drainage, be hard-setting and increase the potential for tunnel erosion.

Table 46 Summary of saline and sodic drainage potential

Parameter	Units	Range (minimum-maximum)	Median
EC (1:5)	dS/m	0.070-0.549	0.199
pH	pH units	7.4-9.6	9.4
ESP	%	9.8-61.2	40.1
CEC	meq/100g	8.9-14.9	10.8
Ca:Mg ratio	-	0.6-3.6	2.65

Salinity of overburden and interburden is generally low (0.070-0.549 dS/m); however, sodicity, in the form of ESP, ranged from medium to very high (9.8-61.2%) (Table 46). Strongly sodic overburden and interburden are likely to have structural stability problems related to dispersion. Noting that overburden will be covered with a minimum of 0.2 m of topsoil, therefore, amelioration is not required to address dispersion potential of overburden. Sufficient topsoil will be available for rehabilitation (see Section 3.5.1.3b). Measures to protect the final landform surfaces will be protected from erosion during the initial stages of plant growth and establishment to ensure a stable landform (Section 3.5.1.5d) is given in Section 3.5.1.8.

Overburden and interburden quantities

The volume of overburden and interburden is estimated to be 23 bcm. It will come from removing overburden and interburden from OC1 to access the economic coal seams and will be stored in OC1 or on WRD1.

c Fine reject characterisation

In addition to potential overburden and interburden samples, fine rejects were analysed to get a better understanding of composition and chemistry. Fourteen samples were tested for pH, salinity, acidity and elemental composition (metals and total S).

Geochemistry

GAIs were calculated for the 14 samples to give an indication of the elemental enrichment found in the fine rejects. In the 14 samples analysed, GAI values greater than zero and less than three were identified for As, Cu, Hg and Total S. One sample resulted in a GAI value for Total S greater than 3; however, the median GAI was calculated to be 0.7. The elemental composition of the fine rejects was like the overburden and interburden samples, except for slightly elevated total sulfur.

Salinity

Salinity of the fine rejects ranged from very low (0.043 dS/m) to moderate (0.647 dS/m), with a median EC of 0.249 dS/m. The fine rejects showed similar salinity to the overburden and interburden.

Acidity

The fine reject samples generally showed a low acid production potential; however, three samples had slightly elevated total S (0.61-0.98%). The buffering capacity for samples with elevated total sulfur were reported at or above the median for the fine reject samples. The buffering capacity was not sufficient to neutralise the acid potential, as the three samples reported positive NAPP.

Table 47 gives a summary of the acid base accounting of the fine rejects.

Table 47 Fine rejects acid base accounting summary

Parameter	pH	Total S (%)	MPA (kg H_2SO_4/t)	ANC (kg H_2SO_4/t)	NAPP (kg H_2SO_4/t)	Classification
Minimum	5.5	0.03	0.9	7.8	-20.6	NAF-barren
Maximum	9.7	0.98	30.0	23.6	12.0	PAF
Mean	6.6	0.29	8.9	14.5	-5.6	NAF
Median	8.8	0.17	5.2	13.6	-8.2	NAF

d Coarse and fine reject disposal

WRD1

Coal rejects will initially be contained and dewatered at the RM CHPP. The dewatered rejects will be trucked to the Project and placed in cells that will be formed in WRD1. The reject storage area will be bunded to divert stormwater runoff away from the cells with the leachate being collected and diverted to MW1. These dirty water drains will be sized to capture runoff generated from a 24 hour 1 in 10-year ARI event. Based on the indicative mine schedule there is adequate storage capacity at WRD1 to manage rejects until in-pit dumping starts. Potential for groundwater mounding below WRD1 is unlikely due to the low permeability of the foundation.

Weathered rock (ie oxide zone) will be placed on the base of the WRD and capped beneath unweathered materials (ie interburden and overburden from transition or primary zones) to limit dispersion and erosion potential. It is proposed that non-dispersive and non-sodic materials are used for the outer slopes of the WRD and sodic materials disposed of within the central (inner) zones of the dump.

OC1

Once in-pit dumping starts, coarse and fine rejects will be placed in in-pit disposal areas where it will be blended with the overburden. Rejects disposed into the open-cut pit would be placed below the expected final (post-closure) groundwater level and buried under overburden typically within six months of placement.

QA/QC

The following QA/QC and mitigation measures will be in place to make sure that the disposal of rejects is safe:

- an appropriate quantity of acid neutralising material (agricultural and / or hydrated lime) will be readily available at the rejects storage area;
- reject storage areas will be sprayed with water to control dust emissions; and
- further characterisation of PAF fine rejects will be done to inform placement strategy.

e Ongoing sampling during operations

BCC will develop and implement a Mineral Waste Management Plan (MWMP), prior to commencement of activities, that describes the management of mineral waste throughout the life of the Project. The objectives of the MWMP are to:

- inform placement and disposal strategy;
- determine the quality of run-off and seepage including salinity, acidity, alkalinity and dissolved metals, metalloids and non-metallic inorganic substances; and
- determine management and mitigation procedures to manage environmental risk and achieve proposed rehabilitation methods and objectives.

The MWMP will include, where relevant, at least:

- effective characterisation of waste rock and overburden to predict, under the proposed placement and disposal strategy, the quality of run-off and seepage generated concerning potentially environmentally significant effects including salinity, acidity, alkalinity and dissolved metals, metalloids and non-metallic organic substances;
- a program of progressive sampling and characterisation to identify dispersive and non-dispersive overburden and the salinity, acid and alkali producing potential and metal concentrations of waste rock;
- a MWMP demonstrating how PAF and acid forming waste rock will be selectively placed and / or covered to minimise the potential generation of AMD;
- where relevant, a sampling program to verify cover and / or placement of PAF waste rock;
- how often the performance of the MWMP will be assessed;
- the indicators or other criteria on which the performance of the MWMP will be assessed; and
- rehabilitation strategy.

The sampling and testing program will use drill chip samples of representative overburden / interburden for geochemical assessment during Project operation.

Field and laboratory testing will be done to characterise and validate that:

- non-dispersive and non-sodic material is used for the outer slopes of the WRD to limit dispersion and erosion potential of the rehabilitated landform;
- identified sodic material is disposed of within the central (inner) zones of the dump or in-pit; and
- further characterise fine rejects.

Results from field and laboratory testing will inform the management and mitigation procedures to manage environmental risk and achieve the proposed rehabilitation methods and objectives.

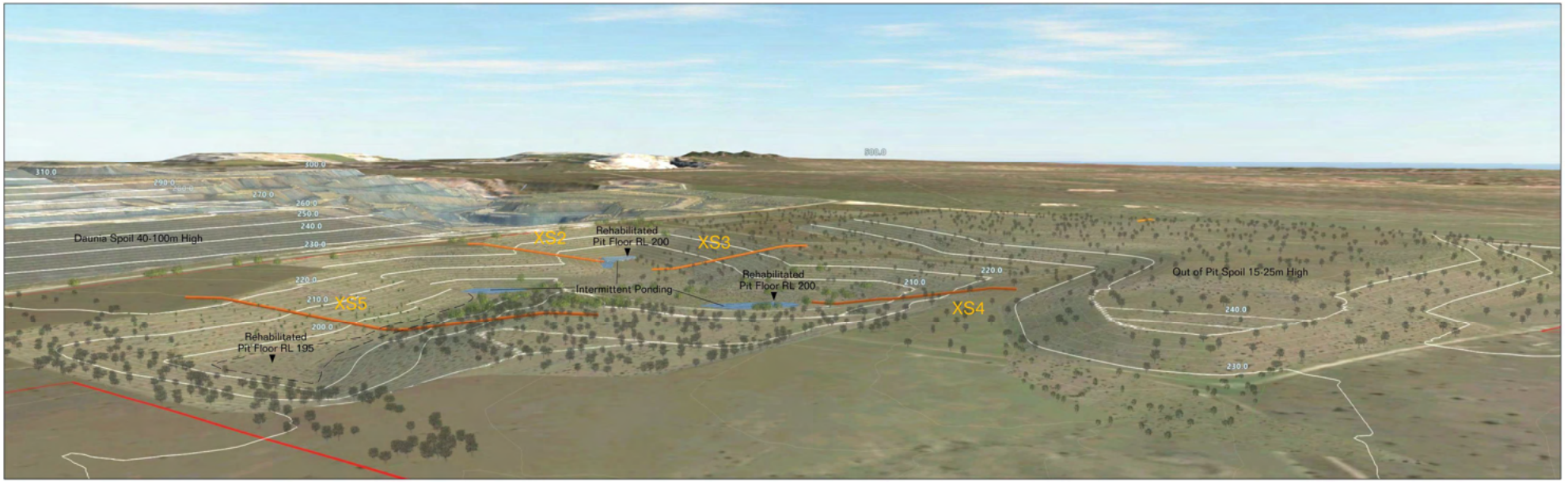
Surface run-off and seepage from the WRD and any rehabilitated areas will be monitored for a standard suite of water monitoring parameters in accordance with the MWMP.

3.5.1.5 Final landform design

The final landform design is a key component of rehabilitation and closure planning. This section describes how land will be rehabilitated for pasture grazing to a safe and structurally stable condition.

a Three-dimensional design plans for the final landform

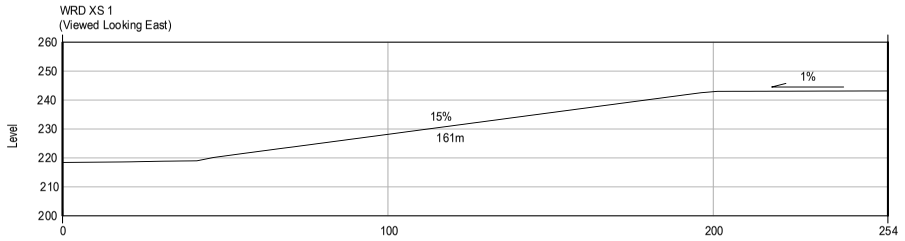
A three-dimensional (3D) design plan of the final landform is given in Figure 14. The intent of the final landform design is to create a gentle sloping landform suitable for pasture grazing which blends into the surrounding landscape. All embankments / slopes will be battered to 15% or less (see Figure 15 and Figure 17 in Appendix A). The *Guidelines for Agricultural Land Evaluation in Queensland* (DSITI & DNRM 2015) apply limitations to some land where the use of machinery is impeded or where access by grazing animals may be constrained (ie usually steep slopes). Slopes greater than 25% are typically considered as unsafe for general machinery use and are therefore regarded as unsuitable. While the DNRM guideline does not define a 'steep' slope, *Meat and Livestock Australia* defines sloping lands of 10-25% as being suitable for grazing (MLA 2019). A maximum slope of 15% is therefore not considered steep and should not provide any impediment to livestock movement. Given all sides of OC1 will be at a maximum slope of 15% or less, access and egress to all areas of the void will be possible for grazing animals.

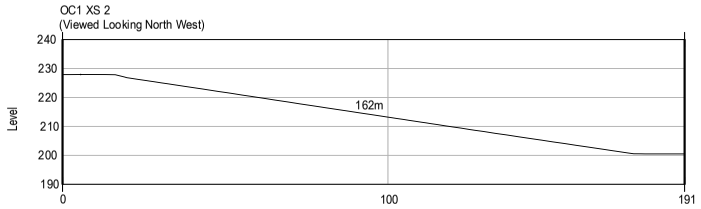


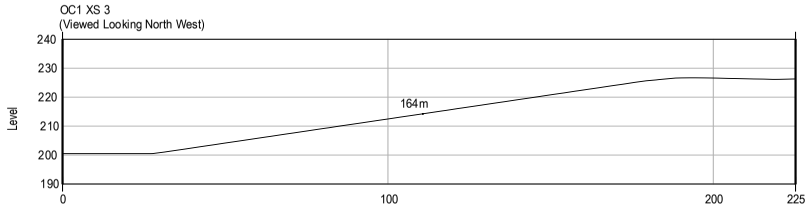
(a)

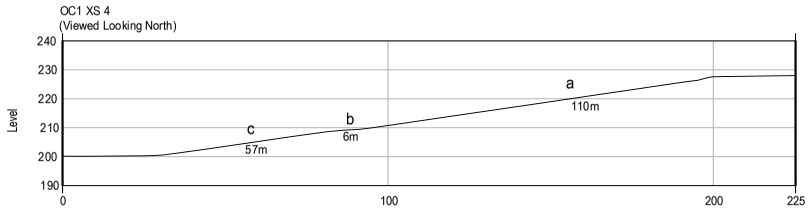
(b)

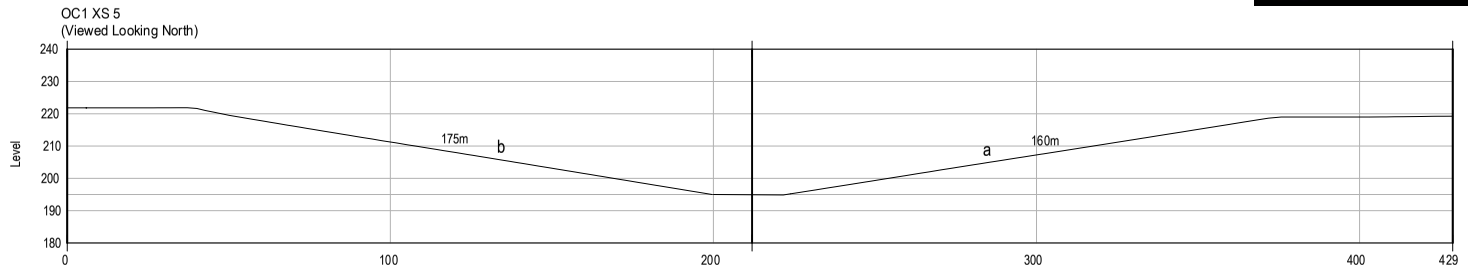
Figure 14 Final landform visualisation (a) Project looking north-west (b) Project looking south

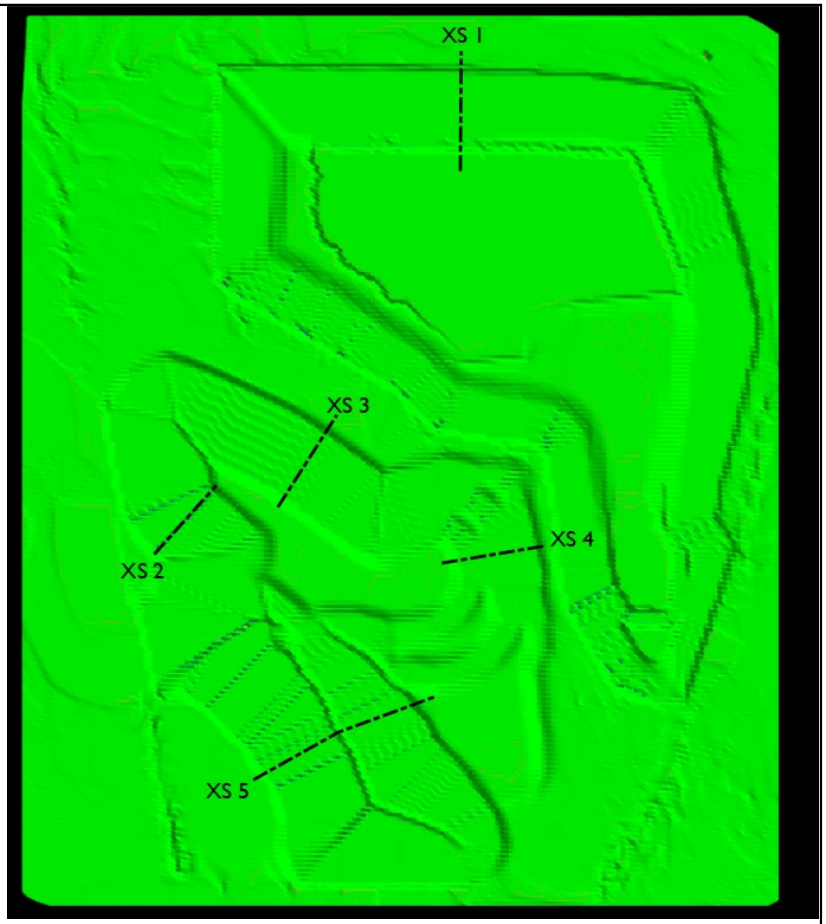












Slope %	Color
0 - 15	
15 - 16.7	
16.7 - 17	
17-18	
> 18	

0 50 100 m

SGM environmental

Client: Coking Coal One Pty Ltd

Project: Progressive Rehabilitation and Closure Plan

Design: SGM Environmental Pty Ltd 25.05.2021

Scale: X

CRS: X

Title: Final Landform Slopes

Figure: 15

b Method for determining final landform design

Xenith on behalf of BCC did a conceptual and detailed mining plan in 2019 and 2020. Four rehabilitation options were modelled based on the mining method. Options for dozing OC1 and backfilling from WRD1 has been modelled to bring the pit base of OC1 up to 195-200 RL. A 'do nothing' approach was not considered as this does not provide a satisfactory land use outcome (ie results in a NUMA). The potential final landform options are given in *Bowen Coking Coal: Development of Mining Plan: Isaac River Project* (Xenith 2020) (Appendix H).

The final landform was chosen based on its ability to provide stable slopes, a favourable land use outcome and management of potential impacts on EVs to achieve the final landform. Impacts of groundwater recharge from localised dewatering at closure is given in the following section.

c Key considerations

The location and footprint of the Project avoids groundtruthed REs and Ornamental Snake essential habitat near the eastern boundary of the MLA. Consideration of the final landform has regard for visual impact (eg view from road) and the final landform blends into the surrounding landscape. Hydrological and hydrogeological assessments were done to predict flood levels (Section 3.5.1.2). The final landform does not require an engineered cover to prevent water, air ingress or minimise the potential for seepage (Section 3.5.1.6).

Coal rejects will be disposed of in cells during the construction of WRD1 and OC1, described in Section 3.1.2.4 and Section 3.5.1.2. The material needed to cover coal rejects and rehabilitate the landform are adequate in quantity and support the PMLU (Section 3.5.1.4).

An assessment of erosion from the final landform were assessed as part of the WEPP assessment (Appendix I). The WEPP assessment showed acceptable rates of erosion for the slope parameters (eg height, length gradient) and material properties (eg soil erodibility). No underground mining will be performed therefore no subsidence is expected to occur. Some settling may occur in OC1 but the final landform will be internally draining and therefore the potential risk associated with settling is considered minor.

An additional seven groundwater monitoring bores were drilled and constructed at the Project between April and May 2019 to investigate groundwater levels, hydrochemistry and to be used for hydraulic testing of the HSUs (see Section 3.1.3.5c). Minor volumes of groundwater are encountered in the coal seams and in the weathered sandstone / siltstone units. A review of bore logs within the Project indicate groundwater was intercepted ~40 m below ground level but groundwater yields are low. Pre-mining groundwater quality is described is Section 3.1.3.5d. Assessment of the long-term behaviour of water in the backfilled OC1 is described in Section 3.5.4.1 and Appendix D.

Consideration has been given to groundwater depressurisation and drawdown of the water table. Once mining ends, there is potential for a small (up to 1 m) and short lived (~one year) drawdown in the alluvial aquifer in the vicinity of North Creek. This temporary drawdown is not likely to impact large riparian trees that occur in this area and for this reason no mitigation measures are proposed. A series of targeted observation bores will be established before this potential drawdown to ensure a robust monitoring dataset is available to monitor this prediction. Existing and proposed groundwater monitoring bores are given in Section 3.1.3.5c. Monitoring requirements are outlined in Section 3.5.1.5e and will be performed throughout the construction of the final landform.

The successful rehabilitation of the final landform will be assessed through the monitoring program described in Section 3.7. An erosion monitoring program is to be developed and conducted at several locations that pose the greatest erosion risk including OC1 internal batters (see Section 3.7.6.2). It is proposed that erosion / final landform stability monitoring will be done every two years then every five years post-closure for the following 20 years.

d Stability of final landform

The objective of final landform design is to achieve long-term stability. To demonstrate that the final landform design can achieve long-term stability, WEPP (Appendix I) and slope stability analysis was done.

A 100-year synthetic climate file was generated using the CLIGEN stochastic weather generator which was used in the WEPP. The WEPP rainfall / runoff model was run using desktop data and final landform designs, to estimate the potential annual erosion rate (t/ha/yr) for a variety of surface conditions, slope parameters and vegetation cover scenarios. WEPP indicated that once 80% groundcover was achieved, both WRD1 and OC1 showed average and maximum annual erosion rates that reached acceptable rates (<5 t/ha/y and <10 t/ha/y respectively). Landloch (2013) have shown that rehabilitated mine slopes have a low tendency to rill with an average erosion rate of <5 t/ha/yr. Avoiding rill formation will ensure landform stability and reduce the likelihood of excessive erosion. The elimination of rilling will also reduce the potential of channelised flow, which can result in gully erosion. Noting that erosion rates vary from year to year depending on climatic conditions so a maximum annual erosion rate will be examined as a secondary performance indicator. Given the desktop limitation of the WEPP model, rehabilitation trials will be done to confirm the landform design predictions from the WEPP modelling. The details of these trials are given in Section 3.6.5.

Two-dimensional limit equilibrium analyses were performed by Blackrock Mining Solutions Pty Ltd (2021) (Appendix H) to measure slope stability in terms of factor of safety (FOS). The limit equilibrium method is an accepted approach to analyse slope stability and derive a FOS. A FOS of 1 means there is 50% probability that failure will occur. FOS values >1 indicates that the system is considered geotechnically stable. A FOS ≥1.5 is an accepted FOS criterion for long-term slope stability analysis. The limit equilibrium analysis returned FOS values ranging between 3.77 and 4.50. The FOS values are greater than the minimum FOS requirement (≥1.5) for long-term geotechnical stability and are therefore acceptable.

e Quality assurance / quality control requirements

Key risks associated with final landform construction include a failure to follow the design, construction materials not conforming to specifications, poor or inadequate construction quality and the failure of quality assurance and quality control (QA/QC) to identify construction inadequacies. Final landform construction management, technical supervision and QA/QC will be done by an AQP who can make sure that construction is carried out in accordance with the design plan. GPS machine guidance will assist during landform constriction and reshaping while LiDAR, aerial or on-ground surveys will be used to periodically monitor construction against design. The use of appropriate construction materials will be determined by the MWMP requirements as outlined in Section 3.5.1.4e. Construction quality will be managed through effective mine planning and field supervision during construction.

A QA/QC document will be prepared by an AQP to verify final landform design has been done in accordance with the design plan and is stable.

f Methodology to verify the predicted success

The WEPP model has shown that slopes will achieve an acceptable erosion rate when groundcover reaches 80%. Measures to ensure stability of placed topsoil during vegetation establishment are given in the Section 3.5.1.3g and include:

- deep ripping of surface material prior to topsoiling to reduce compaction, encourage water infiltration and provide surface roughness for better adhesion of topsoil to the contoured surface;
- scarifying placed topsoil along the contour to reduce compaction, encourage water infiltration, create rills to slow water flow downslope and create furrows and depressions for water collection to enhance seed germination;
- appropriate scheduling of topsoil / seeding to ensure sufficient subsoil moisture levels and favourable weather conditions for germination; and
- selected cover crop species in seed mixes to provide fast vegetation cover for erosion protection.

The WEPP model will be calibrated through rehabilitation trials using laboratory flumes, rainfall simulator field plots and / or natural field plots which will be used to calculate rill and interrill erodibility, critical shear and effective hydraulic conductivity. Further details on rehabilitation trials are given in Section 3.6.5.

A geotechnical assessment will be prepared by an AQP to verify that the final landform is in a stable condition and has a FOS of at least 1.5 with no signs of significant erosion.

Successful rehabilitation of the final landform will be assessed through the completion criteria and monitored following the plan described in Section 3.7. DES must be satisfied with the rehabilitation before it will certify that the final landform is successfully rehabilitated and accept the surrender of the EA.

g Limitation and assumptions of the final landform design

The final landform design has the following limitations:

- the accuracy of soil availability and quality at closure;
- effects of climate change on future rainfall event intensities, durations and / or frequencies; and
- nature of the final waste material.

The final landform design has the following assumptions:

- there is sufficient cover material available;
- the nature of the cover and waste material is like the current assessments; and
- progressive rehabilitation will begin during operations as soon as land becomes available.

3.5.1.6 Cover design

Coal rejects will initially be placed in the reject storage area in WRD1 until in-pit dumping starts. Rejects will be buried by overburden (typically within six months of placement) with at least 5 m cover. The final landform will be sheeted with about 0.2 m of soil and sown with pasture seed.

The risk of acid-generation is low (Table 44) with all samples classified as NAF or NAF-barren (except for some PAF fine rejects), suggesting that a complex cover system will not be needed. However, the samples tested showed medium to high sodicity (Table 46) indicating the potential for dispersion which may affect stability and require treatment before landform rehabilitation.

The soil assessment (Section 3.5.1.3) has shown that adequate soil resources will be available to rehabilitate the final landform. The fertility and dispersibility of the soil were assessed as acceptable for rehabilitation without any amelioration being needed. However, if subsoil is needed due to a shortage of topsoil, then gypsum rates have been given to reduce sodicity (Table 39).

3.5.1.7 Water management

Water can be divided into four types:

- clean water — runoff that are undisturbed / relatively undisturbed by mining;
- sediment laden water — sediment laden runoff from disturbed catchments ie MIA and WRD1;
- mine affected water (dirty water) — water collected in OC1 from groundwater ingress or runoff, likely to contain elevated levels of salts and metals; and
- contaminated water — runoff and water which could potentially contain hydrocarbons, salts or other chemical contaminants.

Clean water will be diverted around mining activities and OC1 to prevent it from becoming mine affected or contaminated water.

Sediment laden water, contaminated water and mine affected water will be captured in one of the following water management structures (Figure 3):

- sediment laden water — SD1;
- mine affected water — MW1; and
- contaminated water — OC1.

After rehabilitation, all runoff will be clean water as it will come from rehabilitated land. No further water management / segregation will be needed at that time. Overall, the final landform will be water shedding.

a Contaminants that pose a risk to EVs

The following potential contaminates pose a risk to EVs after rehabilitation:

- WRD1 and OC1:
  - dissolved metals and salts (including aluminium, arsenic, selenium and vanadium); and
  - total dissolved solids (TDS) and sediment.
- MIA and other features:
  - hydrocarbons as total petroleum hydrocarbons, total recoverable hydrocarbons and benzene, toluene, ethylbenzene, p-xylene and naphthalene (TPH, TRH and BTEXN); and
  - TDS and sediment.

b Source, pathway and fate of contaminants

WRD1 and OC1

The potential exists for the groundwater quality to be altered by a release of contaminants to shallow groundwater. This may be caused by subsurface contaminants being released by infiltration and subsequent recharge from OC1 or WRD1.

The volume of stormwater entering OC1 and becoming mine affected water is limited to rain which falls directly over the OC1 area. Precipitation received in OC1 will be dewatered to the MW1 for reuse. Flood modelling has shown that the OC1 unlikely to be affected by flooding from North Creek and is not located in a flood plain.

Overburden in OC1 is unlikely to impact on groundwater. After the OC1 final landform is built the groundwater levels will return to pre-mining levels with groundwater flowing to the south-southeast. The overburden in OC1 is too separate from the Isaac River to the south and south-east and seepage flow will not reach the Isaac River. An area of topographic high and the underlain low permeability intrusive to the east of the Project function as a barrier to groundwater flow to the east towards North Creek, stopping seepage flow from OC1.

Dirty water drains are proposed to collect runoff from the rejects storage area in WRD1 and discharge to MW1. These dirty drains will be sized to capture runoff generated from a 1 in 10 year ARI event. SD1 will capture rainfall runoff from WRD1.

Rainwater can seep through WRD1 and reach the groundwater table as recharge. A conceptual hydrogeological model was developed by CDM Smith using the MODFLOW Recharge Package (described in the *Isaac River Groundwater Modelling Technical Appendix*). Seepage recharge rates were based on daily infiltration rates; where daily net infiltration rate equals daily rainfall rate minus daily pan evaporation rate multiplied by the pan reduction factor. The calculated WRD1 seepage recharge rates for operation and closure are given in Table 48.

Table 48 Calculated WRD1 seepage rates

Year	WRD1 seepage recharge (mm/yr)
1	4.5

Year	WRD1 seepage recharge (mm/yr)
2	22.7
3	38.2
4	45.8
5	68.3
Post- year 6	4.5

WRD1, immediately east and north-east of OC1, has some potential to affect groundwater quality through the leaching of contaminants, however, is unlikely to be significant. WRD1 will be placed on low permeability strata which will restrict infiltration rates (the Rewan formation). The Rewan formation is made up of lithic sandstone, pebbly lithic sandstone and green to reddish brown mudstone and is considered an aquitard. HSU's are described in Section 3.1.3.5b.

Model predictions of groundwater flow during operation indicate seepage through waste rock will drain back into OC1. Water from the rejects disposal area within WRD1 will be captured and report to the MW1 during operation. Hydraulic controls (bunds and drains) implemented around WRD1 will maintain separation of 'clean' and 'dirty' water. Sediment laden water from WRD1 will be maintained through sediment and erosion control structures given in the *Conceptual Erosion and Sediment Control Plan* (Appendix F). After closure and recovery, groundwater will ultimately be captured by the BHP MBA Daunia Mine pits.

The geochemistry (Section 3.5.1.4) indicates little potential for acid mine drainage from OC1 or WRD1 ie the leaching of metals / metalloids from OC1 or WRD1 will have minimal impact on groundwater quality.

Finally, whilst some recharge to shallow groundwater from OC1 and WRD1 will occur it is not expected that the impact to groundwater will be significant. Baseline groundwater salinity of the Rangal Coal Measures around the Project has shown it to be brackish to saline. Consequently, it is not expected that salts in the OC1 and WRD1 final landforms will cause a significant increase in the salinity of groundwater.

TDS and sediment are not expected to be a significant issue from the final landform at rehabilitation. The final landform will have established groundcover that will keep the ground surface stable and significant erosion is not expected.

MIA and other features

The main threat to groundwater quality during mining will be from any spills of potentially contaminated substances such as hydrocarbons. This will be addressed by good housekeeping practices and containment of hydrocarbons and other hazardous materials. Hydrocarbons will be collected in MW1 which may also collect water from reject disposal in WRD1 and dewatered rainfall from OC1. MW1 water may be used to meet operational water demands and if it becomes full it will overflow to OC1.

Erosion and sedimentation form surface runoff, if not appropriately managed, could impact local downstream water quality (ie North Creek) and on aquatic ecosystem EVs. Specifically, increased suspended sediments can reduce light penetration, decreasing photosynthesis of aquatic flora and lowering dissolved oxygen concentrations. Due to the ephemeral nature of the drainage features and watercourses together with the installation of erosion and sediment control structures, it is unlikely to impact North Creek. Erosion and sediment control will be managed and implemented through the *Conceptual Erosion and Sediment Control Plan* (Appendix F).

The accidental release of pollutants (ie storage failure) not captured by the Project's drainage network have potential to impact North Creek. The EVs for the receiving waters include irrigation, stock watering and potentially human consumption. Therefore, accidental release of pollutants may impact downstream agricultural operations and prevent use of water for human consumption. However, it is unlikely that drinking water EVs will be impacted given the distance between the Project and downstream extraction points.

SD1 will capture rainfall runoff from the MIA ie capture sediment laden runoff for sediment removal during construction and operation to allow for the capture, treatment and discharge of stormwater generated from the Project during a rainfall event.

At rehabilitation, MW1 will be decommissioned, desilted, and rehabilitated so that it follows the topography of the final landform. After rehabilitation, all runoff will be clean water as it will come from rehabilitated land. No further water management / segregation will be needed at that time.

Finally, whilst some recharge to shallow groundwater may occur it is not expected that the impact to groundwater will be significant and will be comparatively small compared to OC1 and WRD1. Baseline groundwater salinity of the Rangal Coal Measures has shown it to be brackish to saline. Consequently, it is not expected that residual salts will cause a significant increase in the salinity of groundwater.

c Infiltration and seepage intervention and collection controls

Operationally water will be captured by:

- sediment laden water — SD1:
- mine affected water — MW1;
- contaminated water — OC1; and
- dewatering of OC1 which will be stored in MW1 to meet operational water demand.

After rehabilitation, all runoff will be clean water as it will come from rehabilitated land. No further water management / segregation will be needed at that time.

Finally, after rehabilitation dewatering of OC1 will stop and the groundwater will be allowed to return to its pre-mining level within the backfilled landform. The final groundwater level will be below the backfilled open-cut pit floor.

d Long-term management requirements

There are no long-term water management requirements for the Project after rehabilitation is finished. Therefore, SD1, MW1 and all other water management structures will be removed.

e Dewatering requirements

Mining of OC1 will result is very local dewatering of the Rangal Coal Measures and Fort Copper Coal Measures strata immediately around the pit. Dewatering of the pit and highwall worked areas will be done through sump pumping and pit base drainage systems that will lead to a cone of depression being formed in the Rangal Coal Measures and underlying Fort Copper Coal Measures strata. Groundwater levels will decline ~100 m below their current position. Numerical groundwater modelling (MODFLOW USG) was done to simulate and predict groundwater system response to mine water affecting activities associated with the Project. The model predicted pre-mine, operational and post-mine groundwater levels and drawdown data. The model indicates that the dewatering rate will gradually increase from around 0 ML/d between 2021 (year 1) to reach a peak dewatering rate of 0.39 ML/d in 2024 (year 4); groundwater inflows to the pit during operation will be removed via sump pumping. Post-mining, the predicted drawdown is expected to recover by 2031 (six years after the end of mining). The groundwater level beneath the rehabilitation WRD1 maybe ~2 m higher than the pre-mining condition but will not rise to more than 10 m below the surface. The post-mining localised groundwater mound associated with the waste rock dump will not influence regional groundwater flow in the long-term with groundwater flows directed towards the existing BHP BMA Daunia Mine pits to the west and re-establishing toward Isaac River in the south.

Further, there is no predicted drawdown impact to riparian GDEs associated with the North Creek and Isaac River during operation.

3.5.1.8 Revegetation

A *Revegetation Plan* that meets the requirements given in the PRC plan guidelines is given as Appendix J.

Revegetation activities will typically start when land forming is finished, such as, re-contouring, soiling and drainage works. The timing of these works will ideally be scheduled for seasonal sowing of pasture seed. Where surfaces have been prepared, the rehabilitation seed mix will be sown and will align with the PMLU.

Seed will be collected from the Project where possible, and treated if necessary, to make sure it is adapted to environmental conditions in the region.

An initial pasture seed mix that could be used for rehabilitation is given in Table 49 and is based on the current suite of species found in the Bowen Basin. It is a combination of native and introduced pasture species that is suitable for local conditions and supports the proposed PMLU.

Table 49 Potential pasture grazing seed mix

Scientific name	Common name	Recommended rate (kg/ha)
Native species		
Alloteropsis semialata	Cockatoo Grass	2-4
Arundinella nepalensis	Reedgrass	2-4
Bothriochloa bladhii	Forest Bluegrass	6-8
Bothriochloa decipiens	Pitted Bluegrass	2-4
Bothriochloa erianthoides	Forest Mitchel Grass	6-8
Chloris divaricata	Slender Chloris	2-4
Chloris ventricosa	Tall Windmill Grass	6-8
Cymbopogon refractus	Barbed Wire Grass	2-4
Dichanthium sericeum	Queensland Blue Grass	2-4
Enteropogon acicularis	Curly Windmill Grass	2-4
Heteropogon contortus	Black Speargrass	6-8
Imperata cylindrica	Cogon Grass	2-4
Themeda triandra	Kangaroo Grass	6-8
Introduced species		
Echinochloa sp.	Millet	10
Cenchrus ciliaris	Buffel Grass	2-5
Bothriochloa pertusa	Indian Blue Grass	2-5
Chloris gayana var. Katambora	Rhodes Grass	1-2

A cover crop has been included to encourage stabilisation as quickly as possible. This will help to minimise erosion and dust impacts, as well as inhibiting the establishment of weeds. The cover crop selected is an infertile annual species that will die off after one year and will not prevent land being returned to grazing pasture. Legumes may also be selected to assist in the supply of bio-available nitrogen to soil.

Some seed germination rates are dramatically improved if the seeds are treated prior to planting. A range of treatments are available and would be investigated with the seed suppliers as necessary to maximise revegetation success and cost effectiveness.

Livestock will be excluded from areas undergoing active revegetation.

3.5.2 Voids

OC1 sits within the ungauged North Creek tributary catchment within the Isaac basin. *IRC Planning Scheme Flood* overlay maps show areas of potential flooding to the east of MLA 700062, associated with North Creek. The overlay maps in the *IRC Planning Scheme* are not available for download; however, the *SPP Interactive Mapping Flood Hazard layer* has identical data and has been used to assess whether OC1 sits in a flood plain. The *SPP Interactive Mapping Flood Hazard* shows that flooding would be constrained to the main channels and valley floodplains. Where there is interaction with infrastructure, infrequent flooding would potentially result in disruption in transport routes and water pooling in topographic depressions. It is unlikely that flooding in the Isaac River would affect OC1 with the terrain of the lower north east corner of the site siting some 40 m above the North Creek confluence with the Isaac River (Refer to *Section 7.1.1.1* of the *Void Management Plan* — Appendix K).

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

Therefore, a *Void Closure Plan* that includes the following has been included as Appendix K:

- options available for minimising final void area and volume (where a final void is proposed) (refer *Section 4* of the *Void Closure Plan*);
- proposed final dimensions of the void (ie depth, length and width);
- pit wall geotechnical and geochemical stability, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events;
- proposed final slope angles of high wall, low wall and end walls of each final void;
- void hydrology, addressing the long-term water balance and water level in the voids, stratification connections to groundwater resources and potential for overflow;
- groundwater modelling to determine whether the void is acting as a sink or a source for groundwater;
- a water balance study including an assessment of void surface and groundwater interactions such as:
  - groundwater lowering / reduction in hydraulic head (from new voids eg caves / karst systems) cones of depression and associated impacts;
  - the drainage and flooding behaviours of surface waters in the vicinity of the void;
  - the potential extent of flooding and implications of interactions with the void;
  - a conceptual model that incorporates all projected inflows, outflows, and recharge rates water storage and long-term water balance
  - each of the major water fluxes into and out of the void; and
  - the sources of surface water within the mine catchment that are likely to influence the water quality in the void.
- predicted water quality in the long-term including potential stratification;
- a 3D void design plan; and
- rehabilitation strategies.

A geotechnical assessment of the final landform was done by Blackrock Mining Solutions Pty Ltd (Appendix H).

3.5.3 Built infrastructure

3.5.3.1 Site services

No infrastructure, roads or tracks will remain; therefore, the identification of on-going maintenance requirements post rehabilitation is not needed. The MIA will be decommissioned, demolished, salvaged and / or removed. The following section describes the method for removing site services.

a Site preparation

Prior to decommissioning, the following activities will be done:

- A site investigation report will be done by an AQP to identify contamination from the MIA (eg spills or accumulation of hazardous substances).
- Site services will be isolated, disconnected and terminated.

b Termination

All Project services will be isolated, disconnected and terminated to make them safe. Diesel generators will be decommissioned and removed. The switch room will be disconnected, and electrical power substations will be removed and sold or used on another project. Sewerage will be taken by licenced contractors to an offsite licensed facility for treatment. Telecommunications data services (ie connection the existing fibre optic network) will be disconnected, removed and recovered.

3.5.3.2 Infrastructure and buildings

The Project will establish a temporary bio-remediation pad within the ML for any hydrocarbon contaminated soils requiring remediation. A location for a bioremediation pad will be determined should the need for remediation arise. The remediation pad will be constructed with an impermeable base layer to prevent leaching and be suitably bunded to contain runoff and prevent ingress of clean water. Water from the bioremediation area will be captured and returned to a licenced facility for treatment.

Should onsite treatment of contaminated soil be necessary, BCC will consult with DES in regard to amending the EA to include *ERA 60(1)(a) Waste disposal — operating a facility for disposing of less than 50,000t per year of limited regulated waste and general waste.*

Should offsite treatment of contaminated materials be required, materials will be transferred to a licenced facility for appropriate treatment / disposal.

Should onsite disposal of inert waste be necessary during decommissioning, BCC will consult with DES in regard to amending the EA to include *ERA 60(1)(c) Waste disposal — operating a facility for disposing of less than 50,000t per year of inert waste.*

a Administration facilities and internal road and carparking

Infrastructure will be removed for their salvage and scrap value. Remaining infrastructure, including car parks and roads, will be demolished and disposed of according to licence conditions.

A contaminated land survey will be carried out by an AQP to check that contamination has been removed prior to the area being scraped, deep ripped, spread with soil and seeded

b Workshop and stores

All mining equipment will be de-oiled, depressurised and isolated. Infrastructure, materials and equipment will be removed for their salvage and scrap value. Remaining infrastructure will be demolished and disposed of according to licence conditions.

A contaminated land survey will be carried out by an AQP to check that contamination has been removed prior to the area being scraped, deep ripped, spread with soil and seeded

c Laydown and hardstands

All equipment and materials will be removed. Laydown and hardstands will be removed and disposed of according to licence conditions.

A contaminated land survey will be carried out by an AQP to verify contamination has been removed prior to being scraped, deep ripped, spread with soil and seeded

d Vehicle fuelling facility / petrol oil lubricant storage and handling facilities

All fuel, lubricants, chemicals and wastes will be removed for recycling or disposal. Infrastructure / equipment will be removed for their salvage and scrap material. Remaining infrastructure will be demolished and disposed of according to licence conditions. Concrete pads and internal roads will be demolished and disposed of according to licence conditions.

A contaminated land survey will be carried out by an AQP to check that contamination has been removed prior to being scraped, deep ripped, spread with soil and seeded

e Washdown facilities

All infrastructure and equipment will be removed for their salvage and scrap value. Remaining infrastructure and prewash bays will be demolished and ripped and deposed of according to licence conditions.

A contaminated land survey will be carried out by an AQP to check that contamination has been removed prior to being scraped, deep ripped, spread with soil and seeded

3.5.3.3 Heritage

The Project is located on freehold land, within the Barada Barna People's native title determination area (QCD2016/007). No areas where native title exist within the native title determination area will be impacted by the Project.

3.5.3.4 Health and safety

There are regulatory and community requirements and obligations relevant to the construction, operation and closure of the Project. A risk assessment was done to identify potential risks and define mitigation strategies. Any new activities will require a review of risk management to make sure the Project continues to meet its regulatory commitments.

Due to the separation distance between the Project, the nearest sensitive receptors and the communities of Moranbah and Coppabella, adverse health and safety impacts associated with operation and rehabilitation of the Project have generally been ranked as low.

Post-relinquishment health and safety will be addressed through achieving the rehabilitation requirements described in Section 3.4.

3.5.3.5 Rehabilitation maintenance

Maintenance of rehabilitation must take place and demonstrate:

- stability of landforms;
- erosion control measures remain effective;
- stormwater runoff and seepage from rehabilitation does not negatively affect the EVs of any waters; and
- vegetation shows healthy growth, recruitment is occurring, and rehabilitation are managed regarding declared plants.

Maintenance activities on rehabilitation will be guided by general site inspections and rehabilitation monitoring. Maintenance activities may include:

- maintenance of new vegetation, eg addition of fertiliser, re-planting of significant areas of failed vegetation, etc prior to its establishment within the ecosystem;
- repair of failed drainage or significantly eroded areas;
- modifications to landforms or structures to improve management of surface water runoff;
- upkeep of water management structures;
- removal of temporary drainage structures not needed for long-term stability; and
- replacement and probable repairs to fencing and signage.

The intent is to reduce the need for long-term maintenance to a level that aligns with the PMLUs and surrounding land-uses through establishing effective physical and chemical stability of the features. It is anticipated that maintenance activities are expected to be more substantial in the first few years post-closure, then will gradually diminish as stable conditions develop.

3.5.4 Methods to rehabilitate land to a stable condition

3.5.4.1 Voids

The options analysis in Section 3.3.1.1 describes the reasoning behind the final landform design and rehabilitation requirements of OC1.

Actions to rehabilitate OC1 are:

- partially backfilling the open-cut pit, from the collapse of internal batters, to minimise its volume;
- re-contouring of all slopes to create a PMLU; and
- diverting surface flows away from the re-contoured OC1 crest, where possible.

Backfilling OC1 will involve collapsing the internal batters through dozing or blasting, followed by re-contouring of the subsequent slopes to 15% (8.52 degrees) or less. All highwall portals will be sealed via backfilling / re-contouring of OC1 so that none are accessible from the final landform surface.

The re-contoured feature will be ripped, soiled and seeded.

During operation dewatering of OC1 has the potential to impact the local groundwater system by creating a new groundwater sink and developing a cone of depression around the dewatered open-cut pit. Due to the low hydraulic conductivity and transmissivity of the Rangal Coal Measures, the cone of depression is likely to be closely restricted to land surrounding the open-cut pit (no further than 500 m). Once OC1 is no longer dewatered, the depressed groundwater close to the open-cut pit will rebound towards its pre-mining level and the backfilled OC1 floor will remain above the rebounded groundwater level.

Groundwater bore levels are given in Section 3.1.3.5. While site monitoring bores have a short monitoring record, bore RN162470 has a longer monitoring record (2009-present) and has an average groundwater elevation of ~ 170 m AHD and shows no response to dewatering operations at the BHP MBA Daunia Mine with a slight groundwater level rise from 2017.

There is no timeseries groundwater level data for the North Creek alluvium, although RN182167 (south-east of the Project) records a single groundwater depth ~ 18 m bgl (November 2018).

The Goldsim model developed for the operational phase of the Project was used to assess the long-term behaviour (quantity and quality) of water in the backfilled OC1 (the conceptual water balance model) (see Appendix D).

The conceptual water balance model simulates the inflow and outflow on a daily time-step. The volume of water in the backfilled OC1 is calculated at each time step as the sum of direct rainfall to evaporation and infiltration

losses. The conceptual water balance model calculates salt concentration based on the volume of salt and water in the void.

The backfilled OC1 is at the top of the catchment and outside the probable maximum flood extent. Runoff from the rehabilitated WRD1 will be diverted and not drain into the backfilled OC1; that is, there will be minimal external catchment and runoff to the void. No groundwater inflow is assumed as the floor of the backfilled OC1 is above the groundwater table. Groundwater bore levels are given in Table 12 (see Section 3.1.3.5c). The key water input in direct rainfall. Key outflows include evaporation, infiltration into the porous backfill material and potential infiltration into groundwater. Consideration to WRD1 seepage is described in Section 3.5.1.7.

The conceptual water balance model showed:

- ponding will be temporary (ie only occurring under wet conditions);
- there is no expected risk of spill and discharge to the receiving environment given the small catchment area of OC1 and the relative volume of storage; and
- salt is expected to accumulate over time due to evapo-concentration for short periods prior to drying out and then subsequently reduce when new inflows occur.

a QA/QC methods

QA/QC methods that will be used to ensure the landform is constructed as designed are (Appendix H):

- GPS machine guidance;
- LiDAR; and / or
- aerial or on-ground surveys to periodically monitor construction against design.

An erosion monitoring program based on the *Conceptual Erosion and Sediment Control Plan* (Appendix F) is to be developed and conducted at several locations that pose the greatest erosion risk including OC1 internal batters (see Section 3.7.6.2). It is proposed that erosion / final landform stability monitoring will be done every two years then every five years post-closure for the following 20 years.

b Timeframes for reshaping OC1

The Project will operate until depletion of the current reserve; that is the end of operation is expected in year five. Open-cut mining targeting the LHD and VEM seams will begin with traditional open-cut mining operations before transitioning to high wall mining. OC1 will be available by the end of 2030 for rehabilitation. Landform development and reshaping is expected to take no longer than one year. The landform development and reshaping will be complete by the end of 2027.

The installation of the cover, surface preparation and revegetation of OC1 will be done by the end of 2031. It is expected that one wet season will be needed to establish vegetation to achieve surface requirements for pasture grazing. A further five years is required to achieve stable condition.

3.5.4.2 ROM coal stockpile

A potential contamination assessment will be done on the ROM coal stockpile to see if the feature has actual or potential contamination. Any identified contamination will be removed and disposed of to OC1. The feature will be ripped, soiled and seeded. After the feature is rehabilitated a clean-up validation assessment will be done having regard for NEPM.

3.5.4.3 WRD1

Most of WRD1 will be re-contoured during operation of the Project (Section 3.1.4.2b). All remaining faces will be re-contoured to a stable slope angle (15% (8.52 degrees) or less) which will resemble the surrounding landscape. Once re-contoured the feature will be ripped, soiled and seeded. All stockpiled soil will be removed

to be used in the rehabilitation of disturbed areas. Once all soil is removed, the stockpile footprints will be ripped and seeded.

3.5.4.4 MIA

Actions to rehabilitate the MIA are:

- do a potential contamination assessment to see if there is any actual contamination;
- remove any remaining infrastructure, materials or equipment for their salvage and scrap value;
- treat contaminated soils if required and dispose of any remaining infrastructure and contamination to a licensed off-site facility;
- do a clean-up validation assessment having regard for NEPM;
- scrape and deep rip the feature; and
- spread soil and seed.

Some of the feature will not require rehabilitation ie has not been disturbed by infrastructure.

3.5.4.5 Roads

All dirt roads will have gravel sheeting removed (if needed), followed by re-contouring to the surrounding gradient, ripped, soiled and seeded.

Bitumen roads will have the pavement removed and disposed of according to licence conditions prior to being rehabilitated in the same manner as dirt roads.

3.5.4.6 Water storage, supply and distribution

Before rehabilitation occurs, water storage structures will be tested for any contaminated sediment, which will be removed and disposed of according to licence conditions. The embankments, or other clean fill, will be dozed back into the water storages to natural ground level. All stored water will be removed by solar evaporation. The feature will be ripped, soiled and seeded.

Once the Project is rehabilitated there will be a potential for sediment to end up in the receiving environment from rainfall events. Sediment will likely discharge to North Creek which could impact the receiving environment; however, due to the ephemeral nature of the creek and the fact that discharged sediment will not be contaminated, the impact of any discharge is likely to be small. Notwithstanding, mitigation by erosion and sediment control (ESC) structures, may be needed prior to relinquishment to further reduce this potential risk.

3.5.4.7 Exploration

The closure and rehabilitation of all exploration activities including drill holes, sumps, exploration tracks, and gridlines will be done in accordance with Section 16 of the EP Act, provisions under the *Water Act 2000* and *Eligibility criteria and standard conditions for exploration and mineral development projects — Version 2*.

Due to a large percentage of exploration activities falling under the disturbance footprints of other Project features (mainly OC1 and WRD1), rehabilitation will only be needed for those remaining after mining has finished. These will be progressively rehabilitated where practicable.

3.5.4.8 How the rehabilitation method supports the rehabilitation milestones

This section presents the connection between the rehabilitation methods and milestones for a PMLU of pasture grazing (Table 50). The monitoring methods that will be implemented to ensure the landform will each milestone and milestone criteria is given in A schedule of monitoring, reporting and review for each milestone is given in Table 60-Table 68. Contingency strategies if rehabilitation monitoring indicates milestone criteria are not being met is given in Table 69. The rehabilitation monitoring program will help identify and quantify problems, risks and opportunities for corrective actions and adaptive management.

Table 60-Table 68 (see Section 3.7.8).

Table 50 Relationship between rehabilitation milestones and rehabilitation methods

Milestone	Relationship to method
Infrastructure decommissioning and removal	All site infrastructure including buildings, dams and roads will be decommissioned and removed: • buildings will be isolated and demolished; and • demolition materials will be preferentially recycled.
Remediation of contaminated land	• contaminated site assessment concentrating on the ROM coal stockpile, MW1, MIA, SD1 and hazardous material storage: – assessment having regard for NEPM, EP Act and *Waste Reduction and Recycling Act 2011*. • contamination clean-up and remediation or removal and disposal according to licence conditions; • water management system retained until the threat of potential contamination no longer exists; and • landfill PMLU excluded because of the potential contamination threat to groundwater.
Remediation of contaminated sediment	• contaminated sediment; • certification by an AQP that all contaminated sediment, including synthetic liners, is remediated or removed and disposed of according to licence conditions.
Landform development and reshaping / re-profiling	• modifications to landforms or structures to improve management of surface water runoff; • backfilling OC1 to design and re-contouring to 15% (8.52 degrees) or less (Section 3.5.1.5a): – after rehabilitation dewatering of OC1 will stop and the groundwater will be allowed to return to its pre-mining level within the backfilled landform; and – the final groundwater level will be below the backfilled open-cut pit floor. • re-contouring of WRD1 to 15% (8.52 degrees) or less (Section 3.5.1.5a); • assessment to check that the landform is geotechnically stable; • sealing of highwall portals; and • SD1 and MW1 will be desilted and backfilled using their embankments
Installation of cover	• rejects will be buried by overburden (typically within six months of placement) with at least 5 m cover; • the final landform will be sheeted with about 0.2 m of soil and sown with pasture seed; • the risk of acid-generation is low with all samples classified as NAF or NAF-barren (except for some PAF fine rejects), suggesting that a complex cover system will not be needed; • the soil assessment has shown that adequate soil resources will be available to rehabilitate the final landform;

Milestone	Relationship to method
	• the fertility and dispersibility of the topsoil were assessed as acceptable for rehabilitation without any amelioration being needed; and • if subsoil is needed due to a shortage of topsoil, then gypsum rates have been given to reduce sodicity.
Surface preparation	• an assessment of soil health; • application of ameliorants as per requirements of the soil health assessment; • deep ripping of surfaces; • apply 0.2 m soil cover; • light scarification on the contour; and • installation of appropriate erosion and sediment control structures
Revegetation (pasture grazing)	• seeding as per the *Revegetation Plan.*
Achievement of surface requirements (pasture grazing)	• assessment to check that groundcover ≥80%.
Achievement of PMLU to a stable condition (pasture grazing)	• certification from an AQP that the landform achieved a factor of safety ≥1.5; • assessment to check that the maximum erosion rate at any point on the landform is <10 t/ha/yr; • assessment to check that the average erosion rate is ≤5 t/ha/yr; • assessment to check that groundcover ≥80%; • assessment to check that weed and pest species are no greater than at analogue sites; • assessment of surface water runoff quality to make sure that it is not compromising EVs; and • assessment of groundwater quality to make sure that it is not compromising EVs.

3.6 Risk assessment

Identifying environmental, community, social and economic impacts and risks associated with closure and rehabilitation is critical for effective closure and rehabilitation planning. The overall objective of the closure and rehabilitation risk assessment (the risk assessment) is to identify risks of a stable condition for land not being achieved and how BCC intends to manage or mitigate the identified risks in accordance with Section 126C(1)(f) of the EP Act. The meaning of a 'stable condition' is given in Section 111A of the EP Act:

111A Meaning of a stable condition

Land is in a stable condition if —

a) the land is safe and structurally stable; and

b) there is no environmental harm being caused by anything on or in the land; and

c) the land can sustain a post-mining land use.

The risk assessment was developed considering the standard *AS ISO 31000:2018 Risk Management — Guidelines*. Risks and opportunities were identified for all decommissioning, demolition and closure and rehabilitation related activities that are yet to have occurred, or already have occurred at the Project. The post closure and rehabilitation monitoring periods were also included.

3.6.1 Risk identification

The risk identification step was used to:

- identify and define risks to land being safe and structurally stable;
- identify and define risks which have the potential to adversely affect EVs; and
- identify and define risks to land sustaining the PMLU.

3.6.2 Risk analysis

The risk analysis process considered the maximum probable outcome for each identified risk with the current control measures in place. Current control measures are minimal given the Project is still in the planning and approvals phase. As such most controls will be implemented during the operations phase and are listed in the risk treatment plan.

Each identified risk was then analysed using the consequence categories and associated criteria given in Table 51 and the likelihood categories in Table 52. This determined the risk rankings also given in Table 52.

The consequence table has been modified to consider environmental risks associated with land not achieving a stable condition only.

Table 51 Consequence table

Rating	Environment
6 — Catastrophic	• offsite impact requiring long-term remediation (years) with residual damage; • onsite species extinction or permanent impairment of ecosystem function; or • irreversible loss to site / item of cultural heritage value.
5 — Major	• offsite impact requiring long-term remediation (years); • onsite impact requiring long-term remediation (years) with residual damage; • onsite change to ecosystem function; or • irreversible damage to site / item of cultural heritage value.
4 — Significant	• offsite impact requiring medium-term remediation (months); • onsite impact requiring long-term remediation (years); • onsite temporary impairment to ecosystem function; or • repairable damage to site / item of cultural heritage value.
3 — Moderate	• offsite impact requiring short-term remediation (weeks); or • onsite impact requiring medium-term remediation (months).
2 — Minor	• onsite impact requiring short-term remediation (weeks).
1 — Low	• onsite impact confined to a small area with a prompt (within a day) clean-up.

Table 52 Likelihood table and risk matrix

Likelihood	Description	1	2	3	4	5	6
Almost Certain (A)	Likely to occur multiple times a year.	High	High	Very High	Very High	Very High	Very High
Likely (B)	Might occur once a year.	Medium	High	High	Very High	Very High	Very High
Possible (C)	Might occur multiple times during the Project.	Low	Medium	High	High	Very High	Very High
Unlikely (D)	Might occur once during the Project.	Low	Low	Medium	High	High	Very High
Rare (E)	Unlikely to occur during the Project.	Low	Low	Low	Medium	High	High

3.6.3 Risk evaluation

Risk evaluation involves comparing the results of the risk analysis with the establishment of risk criteria to determine where additional action is required. Additional actions may include:

- do nothing further;
- consider risk treatment options;
- undertake further analysis;
- maintain existing controls; or
- reconsider objectives.

For this Project, the risk criteria requires risks to be evaluated as very high, high or medium to have additional treatments introduced. However, risks evaluated as low may also have additional treatments applied.

Table 53 Risk identification, analysis and evaluation

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
1. Land instability caused by ineffective removal of subsurface infrastructure (eg pipelines, cabling etc.)	Safe and stable	Infrastructure may create erosion points causing instability	Current mine plans show locations of planned infrastructure PRC plan includes infrastructure removal	2	D	Low	Yes
2. Ineffective removal of ROM material prior to rehabilitation	Impact to EV's	Decreased visual amenity of rehabilitated land Impact to surface water runoff	PRC plan includes removal of ROM material	2	D	Low	Yes
3. Ineffective rehabilitation of exploration works	PMLU	Open boreholes, sumps etc. present a risk to cattle	Exploration rehabilitation planned in PRC	2	D	Low	Yes
4. Water quality in any retained dams does not support the PMLU	PMLU	Water not suitable for cattle or other uses	Assumed that all dams will be removed	2	C	Medium	Yes
5. Residual contamination of land	PMLU	Contamination impacts PMLU	PRC plans for identification, assessment and proper disposal of contaminated soil	3	D	Medium	Yes
	Impact to EV's	Contaminated soil and / or impacts to	PRC plans for identification, assessment and proper disposal of contaminated soil	3	D	Medium	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
		downstream water quality					
6. Previously unidentified contaminated land mistakenly identified as low risk / not requiring sampling	PMLU	Contaminated soil / water impacts vegetation cover / stock water supply	PRC plans for identification, assessment and proper disposal of contaminated soil	2	D	Low	Yes
	Impact to EV's	Contaminated soil and / or impacts to downstream water quality	PRC plans for identification, assessment and proper disposal of contaminated soil	3	D	Medium	Yes
7. Contaminated sediment not removed or remediated	Impact to EV's	Contaminates impact groundwater / surface water quality	PRC plans for identification, assessment and proper disposal of contaminated sediment Base of dams above groundwater table	2	D	Low	Yes
8. Open cut not backfilled to design level	Safe and stable	Geotechnical instability of pit walls due to absence of backfill	Current designs and modelling include backfill material Open cut area required for backfill placement	4	D	High	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
	PMLU	Backfill not above equilibrium groundwater level impacting inundated areas	Current surface design level above groundwater equilibrium level	4	D	High	Yes
9. Highwall portals not properly sealed and accessible from the final landform surface	Safe and stable	Area unsafe for vehicle or foot traffic due to unseen hazards Risk of injury to grazing cattle	PRC plan outlines sealing of portals	3	D	Medium	Yes
10. Excessive sediment remains in dams prior to backfilling	Safe and stable	Excessive sediment creates unstable base for backfilling leading to instability	PRC plans for identification, assessment and proper disposal of sediment	2	D	Low	Yes
11. Dams not properly backfilled impacting the PMLU	PMLU	Low lying areas become waterlogged Impact to vegetation Does not support PMLU	Current designs allow for settling of material after backfilling	3	D	Medium	Yes
	Safe and stable	Subsidence causing instability	Current designs allow for settling of material after backfilling	3	D	Medium	Yes
12. Landform slopes constructed steeper than design	Safe and stable	Increased erosion risk if slope exceeds material limits	Current final landform slope designs within material limitations	4	D	High	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
	PMLU	Excessive steep slopes not suitable for cattle and / or landholder access	Current design slope within accepted limits for grazing / landholder access	4	D	High	Yes
13. Structural stability of landform not achieved	Safe and stable	Constructed landforms not geotechnically stable	Current design assessed as geotechnically stable	4	D	High	Yes
14. Ineffective drainage on final landforms leads to excessive erosion	Safe and stable	Damage to previously completed rehabilitation Increased likelihood of instability	Effective drainage considered in final landform design	3	C	High	Yes
15. Topsoil not suitable for target vegetation	PMLU	Topsoil unable to support target rehabilitation species	Soil assessment shows topsoil suitable for establishment of grazing species without amelioration	3	D	Medium	Yes
16. Deep ripping not completed, downslope or insufficient depth	PMLU	Recontoured landform too compacted for moisture penetration	*Revegetation Plan* includes deep ripping of surfaces	2	C	Medium	Yes
	Impact to EV's	Impact to surface water runoff quality	*Revegetation Plan* includes deep ripping of surfaces	2	C	Medium	Yes
17. Degraded or poor quality topsoil impacts vegetation establishment	PMLU	Soil quality not sufficient to establish vegetation	Soil assessment shows fertility and dispersibility of	3	C	High	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
			topsoil suitable for vegetation growth without amelioration PRC plan outlines topsoil management practices				
18. Inadequate topsoil reserves	PMLU	Inadequate soil to establish vegetation and support PMLU	Soil assessment shows adequate soil available	3	C	High	Yes
	Safe and stable	Some rehabilitation areas receive less than 0.2 m of topsoil	Soil assessment shows adequate soil available	3	C	High	Yes
19. Soil not applied as per required specifications	PMLU	Vegetation does not adequately establish	PRC plan outlines topsoiling process and specifications	3	D	Medium	Yes
	Impact to EV's	Impact to surface water runoff quality	PRC plan outlines topsoiling process and specifications	2	D	Low	Yes
20. Inadequate erosion and sediment control leads to excessive erosion / land instability	Safe and stable	Excessive erosion causing land instability Post earthworks landform not suitable for surface preparation	*Conceptual Erosion and Sediment Control Plan* prepared	3	C	High	Yes
21. Seed quality or application not sufficient	PMLU	Vegetation does not adequately establish Does not support PMLU	*Revegetation Plan* has seeding rate and seed variety chosen based on AQP input	2	D	Low	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
for vegetation establishment							
22. Stock fencing not effective in protecting rehabilitated areas prior to stabilisation	PMLU	Vegetation does not adequately establish Does not support PMLU	No current controls	2	D	Low	Yes
23. Vegetation species not consistent with PMLU	PMLU	Does not support PMLU	*Revegetation Plan* has seeding rate and seed variety chosen based on AQP input	3	D	Medium	Yes
24. Groundcover not sufficient for surface stabilisation on OC1 and WRD1	Safe and stable	Inadequate cover establishment causes excessive erosion rates	*Revegetation Plan* tailored to site conditions	3	C	High	Yes
25. Inadequate vegetation cover on OC1 and WRD1	PMLU	Unable to support grazing	*Revegetation Plan* tailored to site conditions	3	C	High	Yes
	Impact to EV's	Impact to surface water runoff quality	*Revegetation Plan* tailored to site conditions	2	C	Medium	Yes
26. Inadequate vegetation cover on areas excluding OC1 and WRD1	PMLU	Unable to support grazing	*Revegetation Plan* tailored to site conditions	2	C	Medium	Yes
27. Tunnel erosion and / or subsidence causes	Safe and stable	Damage to previously completed rehabilitation	Soil assessment shows fertility and dispersibility of	3	D	Medium	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
instability in final landforms		Increased likelihood of erosion Area unsafe for vehicle or foot traffic due to unseen hazards Risk of injury to grazing cattle	topsoil suitable for vegetation growth without amelioration Soil assessment predicts acceptable rates of erosion Development and implementation of the MWMP				
28. Dispersive material placed on WRD1 or OC1 backfill surface leads to excessive erosion	Safe and stable	Excessive erosion damages stability of final landform Area unsafe for vehicle or foot traffic due to unseen hazards	Rehabilitation methodology recommends the placement of non-dispersive or non-erosive material on the surface of the dump Development and implementation of the MWMP	3	C	High	Yes
29. Impact of extreme weather events (eg flood, cyclone, drought etc) prior to vegetation establishment leads to instability	Safe and stable	Significant erosion undermines the stability of the landform	*Revegetation Plan* outlines optimal seeding conditions to establish vegetation	3	C	High	Yes
	PMLU	Inadequate vegetation cover to sustain grazing	*Revegetation Plan* outlines optimal seeding conditions to establish vegetation	2	C	Medium	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
	Impact to EV's	Risk of injury to fauna	Soil assessment predicts acceptable rates of erosion	2	D	Low	Yes
30. Rehabilitation vegetation lost or damaged due to bushfire	Impact to EV's	Loss of biodiversity Damage to previously completed rehabilitation	No current controls	2	C	Medium	Yes
31. Pastures dominated by weed species	PMLU	Pasture unable to support cattle grazing	*Revegetation Plan* outlines weed management	3	C	High	Yes
	Impact to EV's	Untreated weed outbreaks impact surrounding land	*Revegetation Plan* outlines weed management	2	D	Low	Yes
32. Introduction of pasture grazing onto slopes triggers significant erosion	Safe and stable	Significant erosion undermines the stability of the landform	Erosion modelling shows no excessive erosion with adequate vegetation cover	3	C	High	Yes
	PMLU	Diminished vegetation cover is unable to sustain grazing	*Revegetation Plan* tailored to site conditions	3	C	High	Yes
	Impact to EV's	Impact to surface water runoff quality	*Conceptual Erosion and Sediment Control Plan* prepared	2	C	Medium	Yes
33. Lack of rehabilitation maintenance ie repair of significant erosion	Safe and stable	Excessive erosion progressively impacts stability of final landform	*Revegetation Plan* outlines remediation program	2	D	Low	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
34. Differential settlement in backfilled OC1 results in undulating landscape	PMLU	Settlement creates areas not suitable for grazing	Progressive backfilling timeframe allows for settlement prior to rehabilitation	3	D	Medium	Yes
35. Intermittent water storages in OC1 not suitable for stock watering	PMLU	Small water storage areas do not support the PMLU	Current modelling shows intermittent water is suitable for stock in excess of 100 years	3	B	High	Yes
36. Surface water runoff causes environmental harm	Impact to EV's	Environmental harm from contaminated runoff	Surface water modelling included in PRC plan	3	D	Medium	Yes
37. Groundwater contamination from rehabilitated area	Impact to EV's	Contamination of groundwater	Groundwater monitoring shows negligible impact from the Project Groundwater generally of poor quality and not used for productive purposes	4	D	High	Yes
38. Schedule delays impact milestone completion	Safe and stable	Damage to recontoured landform prior to surface preparation	PRC plan includes schedule	3	D	Medium	Yes
39. Inappropriate PMLU	PMLU	PMLU not sustainable	Soils and rehabilitation design assessed as suitable for grazing	4	D	High	Yes

Risk identification	Risk analysis						Risk evaluation
Risk / threat (aspect)	**Impact category**	**Potential impact**	**Current control measures**	**Consequence (C)**	**Likelihood (L)**	**Current risk**	**Further treatment required?**
			PMLU in line with surrounding land uses				
40. In the future local weather patterns may change (ie rainfall and ambient temperature) resulting in weather patterns that are not compatible with a PMLU.	PMLU	PMLU not sustainable	PRC plan includes landforms and vegetation that is compatible to a PMLU of grazing and is compatible with current weather patterns.	2	D	Low	Yes

3.6.4 Risk treatment

Risk treatment involves evaluating options for the management or mitigation of identified risks. The most appropriate risk treatment options (proposed actions) have been selected based on multiple criteria including cost benefit, regulatory obligations, community responsibility and protection of EVs. Actions to apply these options have been allocated to the appropriate work parties, scheduled and performance measures and constraints identified. Given the Project has not yet started the most appropriate functional areas have been chosen for responsibility of action implementation. This allocation may be further refined and reviewed as organisational structures mature. The risk treatment plan is given in Table 54.

3.6.4.1 Residual risk

The nominated treatment options have been assessed as adequate in reducing the original risk ranking to an acceptable level. The risk treatments and the remaining risk should be monitored and reviewed regularly with any significant changes or emerging issues communicated with relevant parties. Treatments may be modified, replaced, or complemented with additional treatments as needed to make sure an acceptable level of risk is maintained.

Table 54 Risk treatment plan

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
1. Land instability caused by ineffective removal of subsurface infrastructure (eg pipelines, cabling etc)	• Ensure infrastructure mapping is kept up to date	• Infrastructure can be easily removed if locations are known	• Environment • Technical services	• ERC tool • Survey support	• ERC auditing	• ERC reportable to regulator	• Ongoing	1 + E = Low
2. Ineffective removal of ROM material prior to rehabilitation	• Ensure adequate supervision and monitoring of rehabilitation activities • Implement rehabilitation monitoring program	• Supervision to confirm effective removal • Monitoring to inform effectiveness	• Operations • Environment	• Final landform design including WRD1 location for ROM material. • Survey support	• Hold points during rehabilitation works • Rehabilitation monitoring • Inspections and auditing	• Hold point inspections reported to environment team • Rehabilitation monitoring reports	• Prior to rehabilitation of ROM area and ongoing	2 + E = Low
3. Ineffective rehabilitation of exploration works	• Review and validate database of all historic and current drill holes to determine how many remain unrehabilitated • Develop program to progressively rehabilitate drill holes and pads	• Database review provides accurate data for rehabilitation works scope.	• Environment • Technical services	• Exploration drill data • Equipment for rehabilitation	• Rehabilitation monitoring to include exploration areas	• Rehabilitation monitoring reports	• As per exploration code of practice or as dictated in EA	2 + D = Low
4. Water quality in any retained dams does not meet the PMLU	• Include dam removal in ERC • Incorporate actions in response to water quality monitoring	• Inclusion in ERC allows budget for 'worst case scenario' of full removal • Intervention based on monitoring may be able to improve water quality outcomes.	• Environment / commercial and procurement • Environment	• Data from water quality monitoring	• Water quality data results	• Water quality data to be reported to environment team and communicated internally	• At start of water quality monitoring	2 + E = Low
5. Residual contamination of land	• Allow for contaminated soil disposal in ERC • Monitor incidents involving hydrocarbon or chemical spills • Develop site Spill Response Plan and implement • AS1940 audits and inspections	• Inclusion in ERC provides budget and time allocation for completion • Monitor incidents to ensure recording of spill locations • Site spill response should include proper disposal • Allows monitoring of hydrocarbon handling and informs level of risk	• Environment / commercial and procurement • Environment • Environment • Environment	• IEM software module • IEM software module • Spill response procedure • Audit and inspection tools	• Performance measured by inspections and auditing	• Regular review of event and incident system • Audit and inspection reports reported internally	• Regular audits, inspections and review of register to start at start of operations	3 + D = Medium
6. Previously unidentified contaminated land mistakenly identified as low risk / not requiring sampling	• Record incidents and events with potential to cause contamination • Contaminated land assessment by an AQP at closure	• Properly kept records allow for potential contamination to be identified during contaminated land assessments • Contaminated land assessment / sampling to	• Environment • Environment	• IEM software module • AQP	• Performance may be measured by inspections and auditing	• Regular review of event and incident system • AQP assessment forms part of	• Regular audits, inspections and review of register to start at start of operations.	2 + D = Low

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
		confirm areas requiring treatment			• Assessment results	relinquishment documentation	• At closure	
7. Contaminated sediment not removed or remediated	• Water Management Plan (WMP) to identify dams with potential contamination • Contaminated land (including sediment) assessment by an AQP at closure	• WMP outlines what dams may receive or store potentially contaminated water • Contaminated land assessment and sampling to confirm locations / existence of contaminated sediment	• Environment • Environment	• WMP • AQP	• Performance may be measured by inspections and auditing • Assessment results	• Regular review of WMP • AQP assessment forms part of relinquishment documentation	• Regular audits, inspections and review of register to start at start of operations • At closure	1 + D = Low
8. Open cut not backfilled to design level	• Ensure adequate supervision and monitoring of backfilling • Regular review of mine plan to ensure adequate backfill volumes	• Supervision and monitoring to ensure mine plan is followed • Current mine plan allows enough material for backfilling	• Operations / environment • Technical services	• Survey support • Mine planning support	• Survey data review against mine plan schedule	• Changes to final landform will require update and resubmission of the PRC plan	• Quarterly monitoring at commencement of backfilling	3 + D = Medium
9. Highwall portals not properly sealed and accessible from the final landform surface	• Ensure locations of portals are accurately recorded • Develop process for sealing of portals including appropriate timing • AQP inspection and review of sealing process and records	• Accurate record keeping will ensure all portals are properly sealed • Documented process to assist effective sealing of portals • Ensures sealing process is effective	• Technical services / environment • Technical services / environment • Technical services / environment	• Survey support and mine planning support • AQP and technical support • AQP support	• Review of survey data • Performance may be measured by inspections and auditing • Results of AQP inspection and review	• Regular review of documented portal locations reported internally • Regular review of documented sealed portals reported internally • AQP assessment forms part of relinquishment documentation	• Review and auditing to start immediately following first portal install • Develop process following first portal install • At closure	2 + D = Low
10. Excessive sediment remains in dams prior to backfilling	• Erosion controls to limit sediment load levels • Inspection of dewatered dams prior to backfilling	• Minimising sediment creation limits build up • Ideal timing for inspection is following water removal for accurate assessment	• Environment • Operations / environment	• Erosion and sediment control plan (ESCP) • Operations support for dewatering	• Erosion and sediment control inspections and audits • Dam inspection results • Constraint – weather or operational constraints may impact dewatering timing	• Regular monitoring of ESCP controls and internal reporting • Excessive levels of sediment may require design or rehabilitation process changes which requires communication to technical	• At start of operations • Following dewatering of dams	1 + D = Low

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
						services and operations		
11. Dams not properly backfilled impacting PMLU	• Ensure adequate supervision and monitoring of backfilling	• Monitoring and supervision to ensure dams are backfilled to design level	• Operations / environment	• Survey support	• Review of survey data versus design	• Review of completed backfill to highlight deviations from design and reported internally	• During backfilling of dams	1 + D = Low
12. Landform slopes constructed steeper than design	• GPS guidance on machines constructing landform • GPS guidance on machines reshaping landform • Survey control during landform construction • Survey control during landform reshaping	• GPS guidance allows material to be placed in correct locations during operations • GPS guidance allows for reshaping to be completed as per design • Survey checks allow regular review that material is being placed in desired locations • Survey checks allow for review of reshaping versus design	• Operations / environment • Operations / environment • Technical services / environment • Technical services / environment	• GPS guidance systems • GPS guidance systems • Survey support • Survey support	• Constraints — not all equipment may be suitable or feasible for GPS guidance • Constraints — not all equipment may be suitable or feasible for GPS guidance • Review of survey data versus design • Review of survey data versus design	• Monitor GPS systems to ensure designs are current • Monitor GPS systems to ensure designs are current • Monitor construction versus the mine plan • Monitor reshaping versus design • All monitoring requires internal reporting only	• Regularly during operations • Regularly during landform reshaping • Regularly during operations • Regularly during landform reshaping	3 + D = Medium
13. Structural stability of landform not achieved	• Geotechnical monitoring during operations • Ensure backfilling is completed as per design, mine plan and geotechnical assessment • Ensure final landform is consistent with geotechnically assessed landform • Ensure deviations from design are reassessed by a geotechnical engineer (AQP)	• Monitoring will identify areas of instability • Backfilling is assessed as providing additional support (buttressing) to OC1 walls • Final landform assessed as well above required FOS • Changes to design may not impact stability but require reassessment to confirm	• Technical services / operations • Technical services / environment • Technical services / environment • Technical services / environment	• Geotechnical engineer / AQP • Geotechnical engineer, survey support, mine planning resources • Geotechnical engineer and survey support • Geotechnical engineer, survey support, mine planning resources	• Geotechnical assessments / inspections • Review of survey data versus design • Review of survey data versus design • Review of mine plan versus design	• Monitoring reported to geotechnical engineer, mine planning and technical services • Monitoring reported to geotechnical engineer, mine planning and technical services • Monitoring reported to geotechnical engineer, mine planning and	• At the start of pit excavation • During backfilling / in-pit dumping • At completion of reshaping • Regular review from start of pit excavation	3 + D = Medium

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
						technical services • Monitoring reported to geotechnical engineer, mine planning and technical services		
14. Ineffective drainage on final landform leads to instability	• Develop and start ESC monitoring and management program • Finalise and start a closure and rehabilitation monitoring program	• ESC monitoring will provide evidence of drainage effectiveness • Rehabilitation monitoring performance will t inform success	• Environment • Environment •	• ESC monitoring program • Rehabilitation monitoring program •	• Data from rehabilitation monitoring • Data from ESC monitoring •	• Monitoring reported in ESC and rehabilitation reporting	• Following start of WRD construction and ongoing	2 + C = Medium
15. Topsoil not suitable for target vegetation	• Monitor completed rehabilitation for success	• Monitoring provides evidence of suitability	• Environment	• Rehabilitation monitoring program	• Data from rehabilitation monitoring	• Performance reported in rehabilitation monitoring	• Following completion of first rehabilitation	2 + D = Low
16. Deep ripping not completed, downslope or insufficient depth	• Regular supervision and inspections during rehabilitation works	• Inspections provide visual evidence of effective ripping	• Operations / environment	• Adequate supervision	• Visual inspection results	• Monitoring by visual inspection and reported internally	• Regularly during all rehabilitation works	2 + D = Low
17. Degraded or poor quality topsoil impacts vegetation establishment	• Assess topsoil health ahead of rehabilitation if required eg poorly vegetated stockpiles • Monitor completed rehabilitation for success	• Ability to identify treatment requirements prior to topsoiling • Monitoring provides evidence of good topsoil health	• Operations / environment • Environment	• Soil inventory tool • Rehabilitation monitoring program	• Visual inspection results • Data from rehabilitation monitoring	• Review rehabilitation monitoring versus topsoil visually identified as poor • Performance reported in rehabilitation monitoring	• Prior to topsoiling • Following completion of first rehabilitation	2 + D = Low
18. Inadequate topsoil reserves	• Assess soil inventory ahead of rehabilitation • Maintain record of soil inventory	• Quantifying and monitoring of soil inventory aids in planning of rehabilitation. • Suitable alternate growth mediums may supplement supply if needed.	• Technical services / environment • Environment	• Survey support • Soil inventory tool	• Assess soil inventory against rehabilitation requirements regularly	• Soil inventory included in ERC supporting information • Internal reporting of topsoil deficiencies	• Prior to any site clearing	2 + D = Low

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
19. Topsoil not applied as per required specifications	• Regular supervision and inspections during topsoiling • Survey confirmation of topsoiled surface prior to seeding	• Provides confirmation topsoiling process is being followed • Provides confirmation topsoil application specifications have been met	• Operations / environment • Technical services / environment	• Adequate supervision • Survey support	• Topsoil depths and visual inspection results • Review of survey data	• Check inspection documentation • Review survey data versus inventory	• During topsoiling works • Immediately following topsoiling works and prior to seeding	2 + D = Low
20. Inadequate erosion and sediment control leads to excessive erosion / land instability	• Ensure finalisation and implementation of ESCP	• ESCP measures and controls apply to all stages of landform development	• Environment	• ESCP inspection program • Surface water monitoring program	• ESCP inspection results • Surface water monitoring data	• Monitor controls as per ESCP and reported internally • Surface water data may be reported externally as per the EA	• At start of operations and ongoing • At start of operations and ongoing	2 + D = Low
21. Seed quality or application not sufficient for vegetation establishment	• Ensure seed supplier provides quality and viability testing of seed • Monitor vegetation establishment through rehabilitation monitoring	• Seed viability testing confirms seed quality • Vegetation monitoring provides evidence of effective seeding	• Environment / procurement • Environment	• Seed quality and viability test • Rehabilitation monitoring program	• Test results • Data from rehabilitation monitoring	• Review vegetation monitoring versus seed test results • Performance reported in rehabilitation monitoring	• During seeding procurement • Following completion of first rehabilitation and ongoing	1 + D = Low
22. Stock fencing not effective in protecting rehabilitated areas prior to stabilisation	• Inspect rehabilitation areas for stock presence	• Excluding stock from establishing areas will allow for quicker stabilisation of rehabilitation area	• Environment	• Budget provision for fencing • Landholder co-operation	• Inspection results • Rehabilitation monitoring results	• Internal reporting • Communication with landholders	• Following completion of first rehabilitation and ongoing	1 + D = Low
23. Vegetation species not consistent with PMLU	• Review rehabilitation monitoring data	• Data will confirm species present	• Environment	• Rehabilitation monitoring program	• Data from rehabilitation monitoring	• Internal reporting • Communication with landholders	• Following completion of first rehabilitation and ongoing	2 + E = Low
24. Groundcover not sufficient for surface stabilisation on OC1 and WRD1	• Review rehabilitation monitoring data and implement remediation where required • ESCP inspections	• Data will provide targets for remediation • ESCP inspections to identify areas of insufficient surface stabilisation	• Environment • Environment	• Rehabilitation monitoring program • ESCP monitoring program •	• Data from rehabilitation monitoring • Data from ESCP inspections	• Internal reporting • Internal reporting	• Following completion of first rehabilitation and ongoing • Following completion of first	3 + D = Medium

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
							rehabilitation and ongoing	
25. Inadequate vegetation cover on OC1 and WRD1	• Start rehabilitation monitoring program	• Monitoring to provide evidence of adequate cover	• Environment	• Rehabilitation monitoring program	• Data from rehabilitation monitoring assessed against completion criteria	• Performance against completion criteria communicated to environment team and community	• At start of rehabilitation monitoring / ongoing	3 + D = Medium
26. Inadequate vegetation cover on areas excluding OC1 and WRD1	• Start rehabilitation monitoring program	• Monitoring to provide evidence of adequate cover	• Environment	• Rehabilitation monitoring program	• Data from rehabilitation monitoring assessed against completion criteria	• Performance against completion criteria communicated to environment team and community	• At start of rehabilitation monitoring / ongoing	2 + D = Low
27. Tunnel erosion and / or subsidence causes instability in final landform	• Implement rehabilitation monitoring program • Finalisation and implementation of ESCP • Develop closure and rehabilitation maintenance plan and schedule based on monitoring • Develop and implement a MWMP	• Ongoing monitoring for evaluation of effectiveness • ESCP monitoring to assist in identifying areas for remediation • Early intervention by inspection and remediation will help counter potential instability • MWMP will ensure potentially dispersive material is placed in the bottom of the pit of dump and not on the surface	• Environment • Environment • Environment • Environment / operations	• Rehabilitation monitoring program • ESCP monitoring program • Equipment for remediation • MWMP	• Data from rehabilitation monitoring • Data from ESC monitoring • Results of visual inspections of rehabilitated areas • Data from MWMP	• Performance reported in rehabilitation and ESCP monitoring • Internal reporting to environment and production team	• Following start of WRD1 construction and OC1 backfilling / ongoing • At start of operation and ongoing	2 + D = Low
28. Dispersive material placed on WRD1 or OC1 backfill surface leads to excessive erosion	• Operational monitoring to categorise potentially dispersive material for proper disposal • Ensure adequate supervision and monitoring of rehabilitation activities • Develop and start ESC monitoring and management program • Implement rehabilitation monitoring program • Develop and implement a MWMP	• Dispersive material can be identified and buried in dumps or backfilled void • Supervision of works may identify dispersive material during landform shaping • Monitoring to inform effectiveness • Monitoring to inform effectiveness • MWMP will ensure potentially dispersive material is placed in the bottom of the	• Operations / environment • Operations / environment • Environment • Environment • Environment / operations	• Materials characterisation during operations • Adequate supervision • ESC monitoring program • Rehabilitation monitoring program • MWMP	• Data from materials characterisation • Results of visual inspection • Data from ESC monitoring • Data from rehabilitation monitoring • Data from MWMP	• Internal reporting to environment and production team • Internal reporting to environment and production team • Performance reported in rehabilitation and ESC monitoring	• At start of mining operations / WRD1 construction / OC1 backfilling and ongoing • Ongoing during landform reshaping / backfilling • At start of mining operations / WRD1	2 + D = Low

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
		pit of dump and not on the surface				• Internal reporting to environment and production team	construction / OC1 backfilling and ongoing • At start of mining operations / WRD1 construction / OC1 backfilling and ongoing • At start of operation and ongoing	
29. Impact of extreme weather events (eg flood, cyclone, drought etc) prior to vegetation establishment leads to instability	• Seeding works scheduled outside of high erosion risk periods (ie December-February) • Implement rehabilitation monitoring program • Develop and start ESC monitoring and management program	• Schedule of works outside of high rainfall periods reduces risk of negative impacts • Monitoring will inform effectiveness • Monitoring will inform effectiveness	• Operations / environment • Environment • Environment	• PRC plan schedule • Rehabilitation monitoring program ESC monitoring program	• PRC schedule audits • Data from rehabilitation monitoring • Data from ESC monitoring •	• Results of PRC schedule audits reported to DES • Performance reported in ESC and rehabilitation monitoring	• Start with planning of first rehabilitation works • Following completion of first rehabilitation and ongoing • Following completion of first rehabilitation and ongoing	3 + D = Medium
30. Rehabilitation vegetation lost or damaged due to bushfire	• Implement rehabilitation monitoring program • AQP certification of fire resilience	• Monitoring of rehabilitated areas will give best indication of possible fire management practices • AQP review in preference to actual burn offs	• Environment • Environment	• Rehabilitation monitoring program • AQP support •	• Data from rehabilitation monitoring • AQP review	• Rehabilitation monitoring reports communicated internally • AQP assessment forms part of relinquishment documentation	• Following first site rehabilitation / ongoing • Following first site rehabilitation / ongoing	2 + D = Low
31. Pastures dominated by weed species	• Consider including weed declarations during seed procurement • Implement rehabilitation monitoring program including weed survey • Implement inspection of all mobile and stationary plant for seeds	• Source weed free seed where feasible to remove a source of weed seed • Monitoring will confirm early outbreaks can be treated • Inspection of equipment will help to manage another source of weed seed	• Commercial and procurement • Environment • Site maintenance	• Seed testing and validation • Rehabilitation monitoring program • Equipment inspection standard / program	• Data from seed testing and validation • Data from rehabilitation monitoring • Review completed inspections	• Seed test results reported internally and to supplier if necessary • Rehabilitation monitoring reports	• Following first site rehabilitation / ongoing • Following first site rehabilitation / ongoing • Prior to any disturbance	2 + D = Low

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
						communicated internally • Inspection checks reported internally		
32. Introduction of pasture grazing onto slopes triggers significant erosion.	• Implement rehabilitation monitoring program • Develop and start ESC monitoring and management program • Develop post-closure land management plan using rehabilitation monitoring results and stakeholder engagement	• Monitoring (rehabilitation and ESC) is the best methodology for identifying erosion issues • Post-closure land management plan to determine suitable stocking rates	• Environment • Environment • Environment	• Rehabilitation monitoring program • ESC monitoring program • Data from rehabilitation monitoring and stakeholder input	• Data from rehabilitation monitoring assessed against completion criteria • Data from ESC monitoring • Stakeholder feedback and rehabilitation monitoring data	• Performance reported in ESC and rehabilitation monitoring and communicated internally • Performance communicated to environment team and landholder	• Following first site rehabilitation / ongoing • Following first site rehabilitation / ongoing • Following start of pasture grazing on rehabilitated land	3 + D = Medium
33. Lack of closure and rehabilitation maintenance ie repair of significant erosion	• Implement rehabilitation monitoring program • Develop and start ESC monitoring and management program • Budget for closure and rehabilitation maintenance works and include in ERC • Develop closure and rehabilitation maintenance plan and schedule based on monitoring	• Rehabilitation monitoring allows for detection of rehabilitation maintenance needs • ESC monitoring allows for detection of rehabilitation maintenance needs • Budget allocation is essential for works to be carried out • Rehabilitation maintenance plan and schedule helps mitigate erosion impact	• Environment • Environment • Senior management / site management / commercial and procurement • Environment	• Rehabilitation monitoring program • ESC monitoring program • ERC calculator • Equipment for remediation	• Follow up monitoring and inspection of remediated areas • Data from ESC monitoring • ERC review • Rehabilitation monitoring results	• Rehabilitation monitoring results and maintenance needs will be communicated internally • ESC monitoring results and maintenance needs will be communicated internally • ERC amount or changes reportable to DES • Included in rehabilitation monitoring reports	• Following first round of rehabilitation / ongoing • Following first round of rehabilitation / ongoing • At start of operations • Following first round of rehabilitation / ongoing	1 + D = Low
34. Differential settlement in backfilled OC1 results in undulating landscape.	• Settlement to be monitored during backfilling • Implement rehabilitation monitoring program	• Monitoring to inform potential areas of excessive settlement • Monitoring to determine impact of any settlement	• Operations • Environment	• Survey support • Rehabilitation monitoring program	• Visual inspection results • Data from rehabilitation monitoring	• Internal reporting to environment and technical services • Internal reporting	• During backfilling works • Following first round of OC1 rehabilitation / ongoing	2 + E = Low

Risk	Treatment	Justification for risk treatment	Responsibility	Resource requirements	Performance measures and constraints	Reporting and monitoring	Timing and scheduling	Residual risk (C+L)
35. Intermittent water storages in OC1 not suitable for stock watering	• Monitor surface water storages in base of OC1 • Include in post-closure land management plan using rehabilitation monitoring results and stakeholder engagement	• Monitoring to inform cattle suitability • Post-closure management plan to inform maintenance and management (if required)	• Environment • Environment	• Water monitoring program • Stakeholder input	• Data from water monitoring • Stakeholder feedback	• Performance communicated to environment team and landholder • Communicated to landholder	• Following completion of OC1 rehabilitation • Following completion of OC1 rehabilitation	1 + B = Medium
36. Surface water runoff causes environmental harm	• Monitor surface water runoff	• Monitoring to detail risk of impact	• Environment	• Water monitoring program	• Data from surface water monitoring	• Some water monitoring, including exceedances, externally reportable as per EA conditions	• At start of operations	2 + D = Low
37. Groundwater contamination from rehabilitated area	• Ongoing monitoring of groundwater	• Monitoring to confirm modelling predictions of low risk to groundwater or to provide an early indication of potential issues	• Environment	• Water monitoring program	• Data from groundwater monitoring	• Some water monitoring, including exceedances, externally reportable as per EA conditions	• At start of operations	2 + D = Low
38. Schedule delays impact milestone completion	• Regular review of PRC schedule	• Schedule will highlight delays and risk to completion	• Environment	• PRC schedule	• Compare PRC schedule versus actual completed works	• PRC audit results reportable to DES	• At start of operations	2 + D = Low
39. Inappropriate PMLU	• Implement rehabilitation monitoring program	• Field testing of rehabilitation approach and PMLU (rehabilitation monitoring).	• Environment	• Rehabilitation monitoring program	• Data from rehabilitation monitoring assessed against completion criteria	• Performance against completion criteria communicated to environment team and community	• At start of rehabilitation monitoring / ongoing	4 + E = Medium
40. In the future local weather patterns may change (ie rainfall and ambient temperature) resulting in weather patterns that are not compatible with the PMLU	• Implement rehabilitation monitoring program	• Monitoring will inform changes to rehabilitation over time	• Environment	• Rehabilitation monitoring program	• Data from rehabilitation monitoring assessed against completion criteria	• Performance against completion criteria communicated to environment team and community	• At start of rehabilitation monitoring / ongoing	1 + D = low

3.6.5 Rehabilitation trials

There is a limited rehabilitation trial planned for the Project. The relatively short duration and small footprint ie lack of suitable locations to do rehabilitation trials means it is not a useful tool to inform most aspects of the rehabilitation methodology. The proposed methodology (seed mix and seed application rate) follows tried and established rehabilitation methods already in use in the Bowen Basin. It is an established fact that mined land can be rehabilitated and transitioned to pasture grazing.

Grazing trials (the studies) have already been done at several coal mines in Queensland including New Acland, Wilkie Creek and Burton Coal mines. The studies have shown through a variety of methods including blood testing, cattle health indices such as weight gain and pasture monitoring that properly managed rehabilitated pasture grazing land can perform comparably, and in some cases, better than undisturbed pasture grazing land.

A combination of native and introduced pasture species will be used to establish pasture and reduce the likelihood of erosion; and are based on the current species typically used for rehabilitation in the Bowen Basin. Monitoring data from analogue sites will be used to assess the performance of rehabilitated land with adaptations made if the rehabilitated land does not perform as anticipated (Refer to Section 4.2.6.1 in the *Revegetation Plan* — Appendix J).

A soil monitoring program will be started to monitor stockpile condition and reuse. Based on the soil monitoring program and vegetation health and establishment soil may require amendment before it is applied to the final landform.

One aspect requiring rehabilitation trials will be calibration of the WEPP model.

3.6.5.1 Objectives

The primary objective of the rehabilitation trial will be to calibrate the WEPP modelling outputs and validate the proposed rehabilitation methodology.

3.6.5.2 Design

The trial will involve laboratory flumes, rainfall simulator field plots and / or natural field plots which will be used to calculate rill and interrill erodibility, critical shear and effective hydraulic conductivity. The trial will be conducted on WRD1 once sufficient material has been dumped to allow for the trial to be completed. Adequate room will be required to ensure the trial can be conducted safely and without interruption from ongoing operations.

Once a preferred location has been selected the dumped material will be reshaped to 15% as per final landform specifications. The location should allow for the establishment of two plots on the recontoured slope. A rainfall simulator will be installed on one plot while the other will rely on natural rainfall. Sensors to measure matric suction, temperature, volumetric water content, bulk EC and pore water EC will also be installed on the plots.

One plot will receive pre-determined amounts of simulated rainfall while the other plot will receive natural rainfall only. The installed sensors will gather data required for analysis.

Field samples of dump material will also be taken for laboratory analysis.

3.6.5.3 Timing and duration

The rehabilitation trials should start within the first 12 months of operation and as soon as a suitable location is available. The current mine plan projects land within the WRD1 to be available at the end of 2022. This means sufficient area should be available to commence the trial within this time frame.

The trial simulation should run for a minimum of 12 months (one wet and dry season for the natural rainfall area) to ensure sufficient data is collected. No previous trials have been conducted at the site.

3.6.5.4 Monitoring and evaluation

The data collected from the trial will allow calibration and adjustment (if required) of the WEPP model. Should the data suggest that the current proposed rehabilitation methodology is not effective adjustments may be made to the process. The criteria for rehabilitation milestones may also be updated should trial data indicate chosen criteria is not achievable or not consistent with the proposed PMLU.

3.7 Monitoring and maintenance

3.7.1 Analogue sites

In accordance with best practice, several analogue sites that resemble the pre-mining landform will be chosen for monitoring. Three analogue sites have been chosen (so far) and are described in the *Revegetation Plan* (Appendix J).

3.7.2 Milestone monitoring

The following sections of the PRC plan describe monitoring and maintenance activities that will be done post-rehabilitation. Information collected during monitoring will demonstrate that the rehabilitation criteria have been met and contribute to satisfying DES's decision to progress surrender of the EA.

The post-rehabilitation phase will start when all the activities specified in this PRC plan are finished. Post-rehabilitation monitoring will be conducted to assess whether the closure objectives and rehabilitation criteria are being met, while maintenance will be done to address where the objectives and rehabilitation criteria remain incomplete or unsatisfactory. At this stage, the identified monitoring and maintenance activities are conceptual and will need to be refined as the strategy develops in the future. Operational monitoring will start as disturbance occurs and will continue up until closure. Data collected during this time will enhance monitoring data requirements for the post-closure monitoring period.

3.7.3 Biodiversity monitoring

~24 ha of Ornamental Snake (*Denisonia maculata*) habitat will be lost because of the Project. Consequently, the Project will identify and secure a biodiversity offset for the loss of the 24 ha. This offset will likely be located within proximity to the Project, which will assist in the ease of monitoring.

Once the offset has been approved, an offset area management plan will be developed. This management plan will likely include the use of BioCondition and photo-monitoring techniques to monitor the following attributes:

- ecological condition;
- pasture grazing;
- fire;
- weeds; and
- pest animals.

3.7.4 Surface water

3.7.4.1 Monitoring for seepage

The detailed design of the sediment and mine water dams will make provision for the detection and management of seepage where it may result in safety and / or water quality impacts to the receiving environment. The largest amount of seepage is likely to occur within the floor of the sediment dams. In general, the site water management strategy indicates that mine affected water will be of good to moderate quality.

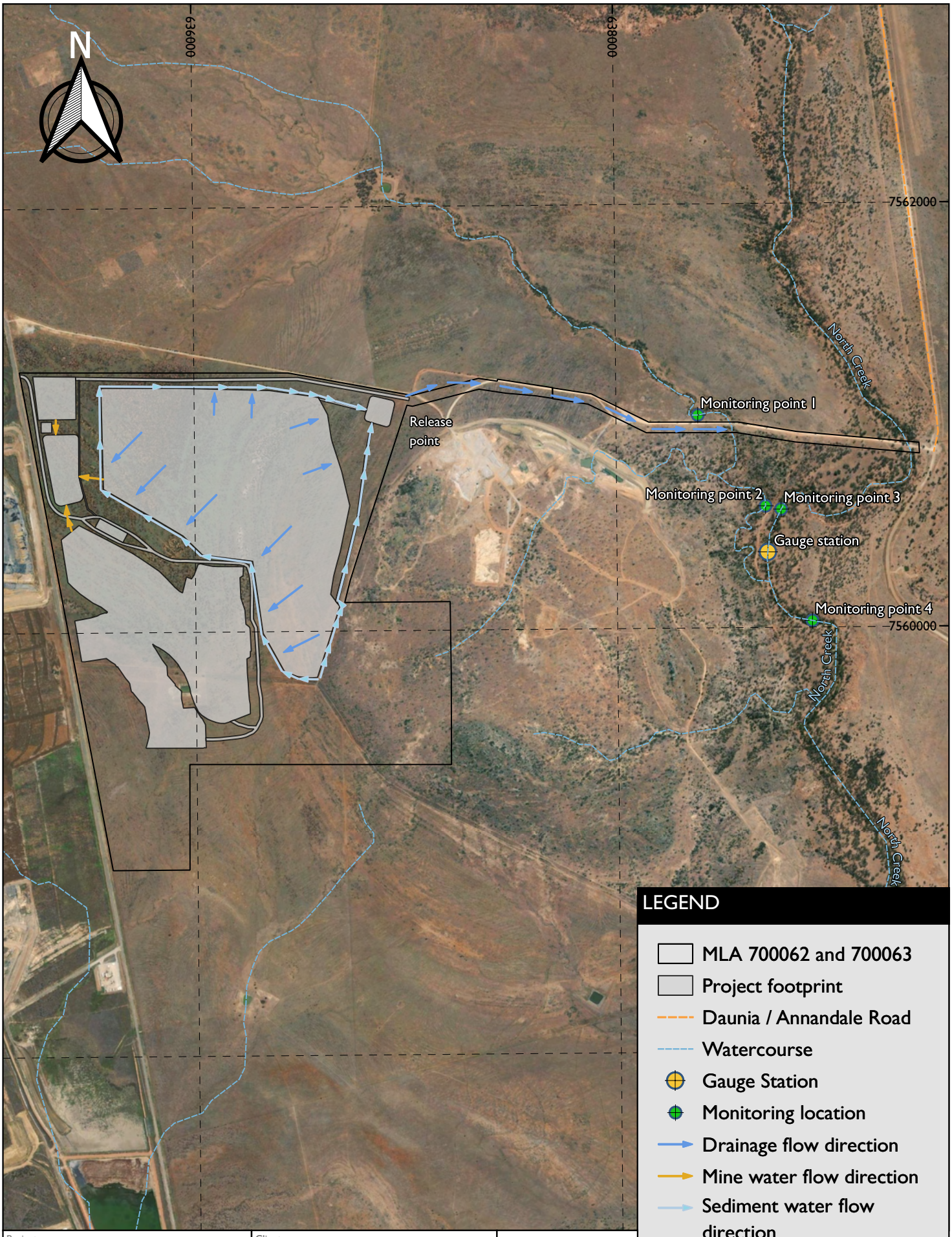
3.7.4.2 Ongoing water quality management and monitoring

Mine affected water will be retained on-site for reuse or released under mine affected water release conditions to North Creek via a pump and pipeline via the site access road as per EA conditions. North Creek provides sufficient opportunity to release and dilute due to a large upstream catchment area which is considered to be a Zone 2 catchment. Discharges of treated stormwater as per the Project *Conceptual Erosion and Sediment Control Plan* will be conveyed to an existing minor tributary to North Creek via a drain along the northern edge of the access road, and within the access road easement. Water monitoring will be done at the SD1 discharge location, and locations upstream and downstream of the Project's discharge point. The proposed upstream and downstream monitoring points are given in Table 55 and Figure 16.

Table 55 Proposed monitoring points and receiving waters

Monitoring points	Purpose	Easting	Northing	Receiving waters location description
Upstream monitoring points				
Monitoring point 1 (MP1)	Reference	638390	7561042	Tributary of North Creek located upstream of mine discharges.
Downstream monitoring points				
Monitoring point 2 (MP2)	Monitoring	638706	7560574	Tributary of North Creek located outside the proposed ML boundary downstream of mine discharges.
Monitoring point 3 (MP3)	Reference	638789	7560573	North Creek located outside the proposed ML boundary upstream of mine discharges.
Monitoring point 4 (MP4)	Monitoring	638939	7560029	North Creek located outside the proposed ML boundary downstream of mine discharges.
Gauging stations				
Gauging station 1	For monitoring streamflow	638714	7560330	North Creek located outside the proposed ML boundary upstream of mine discharges.

A REMP will be developed and will be periodically updated as needed throughout the life of the Project. The incident reporting processes to DES will be done as per the EA conditions.



Project: Progressive Rehabilitation and Closure Plan		Client: Coking Coal One Pty Ltd	
Figure: 16	Title: Proposed Monitoring Points and Receiving Waters	Design: SGM Environmental Pty Ltd 25.05.2021 Scale: 1 : 25,000 CRS: GDA94 / MGA zone 55	SGM environmental

a Discharge contaminant trigger levels

Discharge contaminant triggers levels have been established based on *Model water condition for coal mines in the Fitzroy basin* (DES 2013). For metals and metalloids, trigger levels apply if dissolved results exceed trigger levels. However, total (unfiltered) results for metals and metalloids can be used to disregard a parameter. These trigger values may be revised in the future based on further assessment of site-specific data. The potential contaminants and discharge trigger levels are given in Table 56.

Table 56 Discharge contaminant trigger levels

Potential contaminant	Trigger level (µg/L)	Comments
Al	100	For aquatic ecosystem protection, based on LOR for ICPMS
As	13	For aquatic ecosystem protection, based on SMD guideline[1]
Cd	0.2	For aquatic ecosystem protection, based on SMD guideline
Cr	1	For aquatic ecosystem protection, based on SMD guideline
Cu	2	For aquatic ecosystem protection, based on LOR for ICPMS
Fe	300	For aquatic ecosystem protection, based on low reliability guideline
Pb	10	For aquatic ecosystem protection, based on LOR for ICPMS
Hg	0.2	For aquatic ecosystem protection, based on LOR for CV FIMS
Ni	11	For aquatic ecosystem protection, based on SMD guideline
Zn	8	For aquatic ecosystem protection, based on SMD guideline
B	370	For aquatic ecosystem protection, based on SMD guideline
Co	90	For aquatic ecosystem protection, based on low reliability guideline
Mn	1,900	For aquatic ecosystem protection, based on SMD guideline
Mo	34	For aquatic ecosystem protection, based on low reliability guideline
Se	10	For aquatic ecosystem protection, based on LOR for ICPMS
Au	1	For aquatic ecosystem protection, based on LOR for ICPMS
U	1	For aquatic ecosystem protection, based on LOR for ICPMS
V	10	For aquatic ecosystem protection, based on LOR for ICPMS
Ammonia	1,000	For aquatic ecosystem protection, based on SMD guideline
Nitrate	1,100	For aquatic ecosystem protection, based on ambient *Queensland Water Quality Guidelines 2009* for TN
Petroleum hydrocarbons (C6-C9)	20	-
Petroleum hydrocarbons (C10-C36)	100	-

Potential contaminant	Trigger level (µg/L)	Comments
Fl (total)	2,000	Protection of livestock and short-term irrigation guideline

1. SMD — slightly moderately disturbed level of protection; guideline refers to ANZECC & ARMCANZ (2000).

The Project design avoids the release of mine affected water. This does not include the discharge for stormwater runoff contaminated only by sediment which is associated with ESC structures. The proposed stormwater discharge limits for pH and turbidity are given in Table 57.

Table 57 Proposed stormwater discharge limits

Potential contaminant	Discharge limits	Monitoring frequency
pH	6.5 (minimum) 9.0 (maximum)	Daily during discharge — the first sample taken within two hours of start of discharge (if practicable and safe)
Turbidity	Discharge must not exceed background level	Daily during discharge — the first sample taken within two hours of start of discharge (if practicable and safe)

b Discharge strategy

Due to the Project topography and short mine life, mine affected water will be contained within the ML boundaries. However, a discharge strategy will be developed to minimise the risk of non-compliant sediment discharges through effective balance of the water inventory, water reuse and by discharging better quality water, when possible, instead of allowing sediment to concentrate in storages.

Discharges of treated stormwater may occur to an existing minor tributary of North Creek, in accordance with EA conditions or as an uncontrolled release, via flow over a designated spillway during extreme wet weather events. Water quality monitoring will be done at locations both upstream and downstream of the proposed discharge point. Water quality monitoring will include assessment of pH, EC, turbidity, sulfate and total suspended solids.

A Trigger Action Response Plan (TARP) will be developed which will give actions and responses necessary should monitoring identify exceedances in the water discharge criteria (trigger levels). In addition, the TARP will give the criteria, monitoring and reporting measures for environmental incidents, unplanned events or cases of unauthorised discharge.

3.7.5 Groundwater

Groundwater monitoring will occur on the ML and off-lease (where practicable) prior to mining and during the operational and post-closure phase of the Project. The monitoring program will be designed to take into consideration the EA conditions, as well as Queensland and Commonwealth groundwater monitoring guidelines and will be used to assess the environmental performance of the adopted groundwater management measures.

The proposed monitoring program will include two reference bores, along with eight compliance bores. Monitoring will involve quarterly measurements of standing water levels and key field measurements (EC and pH), along with twice-yearly sampling and analysis for selected analytes. Automated pressure transducers will be installed at selected monitoring bores to provide daily observations that can be used to distinguish short-term changes, such as seasonal recharge, from potential long-term effects of the Project (dewatering and backfilling).

Groundwater quality will be measured by laboratory analysis. Groundwater must comply with the following (median concentration from the most recent eight consecutive samples from a compliance bore):

- pH range is 7.40/7.1 (shallow/deep) or 20th percentile of reference, whichever is lower and 8.30/8.10 (shallow/deep) or 80th percentile of reference, whichever is higher;
- EC is 16,000/8,910 µS/cm (deep/shallow) or 80th percentile of reference, whichever is higher;
- aluminium is 5 mg/L or 80th percentile of reference, whichever is higher;
- arsenic is 0.5 mg/L or 80th percentile of reference, whichever is higher;
- boron is 5 mg/L or 80th percentile of reference, whichever is higher;
- cadmium is 0.01 mg/L or 80th percentile of reference, whichever is higher;
- chromium is 1 mg/L or 80th percentile of reference, whichever is higher;
- copper is 1 mg/L or 80th percentile of reference, whichever is higher;
- mercury is 0.002 mg/L or 80th percentile of reference, whichever is higher;
- lead is 0.1 mg/L or 80th percentile of reference, whichever is higher;
- molybdenum is 0.05 mg/L or 80th percentile of reference, whichever is higher;
- nickel is 1 mg/L or 80th percentile of reference, whichever is higher;
- selenium is 0.02 mg/L or 80th percentile of reference, whichever is higher;
- uranium is 0.2 mg/L or 80th percentile of reference, whichever is higher; and
- zinc is 0.317 mg/L/0.060 mg/L (shallow/deep) or 80th percentile of reference, whichever is higher.

The proposed locations for the monitoring bores and the proposed monitoring program is given in Table 58.

Table 58 Proposed groundwater monitoring bores

Monitoring bore	Status	Easting	North	Screened depth (m bgl)	GCZ	HSU	Receptor monitored	Purpose
RB01	Proposed	636135	7561335	30 to 70	Zone 34 (deep)	Rangal Coal Measure	Terrestrial ecosystems to the north of MDL 444	Drawdown and groundwater quality
RB02	Proposed	638864	7561470	10 to 30	Zone 34 (shallow)	North Creek Alluvium	Aquatic and terrestrial ecosystems to the northeast of MDL 444, stock water	Drawdown and groundwater quality
Compliance bores								
CB01	Proposed	636135	7561335	30 to 60	Zone 34 (deep)	Granitoid	Terrestrial ecosystems to the east of MDL 444	Drawdown and groundwater quality
CB02 (MB03)	Proposed	638709	7560060	10 to 30	Zone 34 (shallow)	North Creek Alluvium	Aquatic and Terrestrial ecosystems to the east of MDL 444, stock water	Drawdown and groundwater quality
CB03 (MB04)	Proposed	638748	7559377	10 to 30	Zone 34 (shallow)	North Creek Alluvium	Aquatic and Terrestrial ecosystems to the southeast of MDL 444, stock water	Drawdown and groundwater quality
CB04 (MB06)	Proposed	635300	7560935	20 to 40	Zone 34 (shallow)	Rangal Coal Measure	Groundwater	Groundwater quality
CB05 (MB07)	Proposed	636973	7561046	20 to 40	Zone 34 (shallow)	Rangal Coal Measure	Groundwater	Drawdown and groundwater quality
CB06 (MB08)	Proposed	636508	7559654	20 to 40	Zone 34 (shallow)	Rangal Coal Measure	Groundwater	Drawdown and groundwater quality
CB07 (MB09)	Operational (PPD001A)	653970	7559367	45 to 51	Zone 34 (deep)	Rangal Coal Measure	Terrestrial ecosystems	Drawdown and groundwater quality
CB08 (MB10)	Operational (PPD001B)	653970	7559367	73 to 79	Zone 34 (deep)	Granitoid	Terrestrial ecosystems	Drawdown and groundwater quality

3.7.6 Soil and erosion

3.7.6.1 Soil

The objectives of soil monitoring are to:

- guarantee maximum value to the rehabilitation process;
- measure the performance of stockpile storage and soil reuse; and
- improve the management and reuse of stockpiled soils.

A soil monitoring program will be developed to monitor stockpile condition and reuse activities. The program will include the following:

- review the current knowledge and experience of staff in the management and reuse of soils;
- monitor stockpiles for stability, floristic diversity, and seed viability quarterly (3-monthly) or at another agreed interval;
- use the outcomes of the monitoring program to determine the stockpile maintenance strategy;
- develop and apply success criteria for stockpile management performance to guarantee maximum value to rehabilitation;
- develop and enhance the knowledge of soil stockpile management and reuse through the guided application of experimental management techniques; and
- measure the performance of stockpile storage and reuse activities, using indicators such as soil and stockpile stability, establishing vegetation, and invasive species establishment.

3.7.6.2 Erosion

The *Conceptual Erosion and Sediment Control Plan* (Appendix F) will be adapted to produce an erosion monitoring program suitable for post rehabilitation monitoring. Monitoring will be done at several locations, focusing on final landforms with steep batter slopes, which provide the greatest erosion risk. Permanent photographic points will be set up to monitor slopes of the following features on an annual basis. Alternatively, a novel technology such as light detection and ranging (LiDAR) may be used:

- WRD1;
- OC1 internal batters and any in-pit WRDs; and
- ROM coal stockpiles and soil stockpiles.

Photographs will be taken following each wet season to capture the potential erosion caused by runoff. These will be compared to the previous years to determine any erosion that may require remedial works.

Physical examination of erosion will be conducted together with the photographic monitoring. Examination will be done by traversing the features on foot at mid-slope and recording any significant erosion or rill lines (deeper than 10 cm). The data to be collected at each rill line should include the following:

- GPS reading of location;
- general description of type of erosion (gully, rill, tunnel etc) and possible cause;
- depth, width and length of erosion;
- location of sediment deposition; and
- suggested remedial works.

Remedial works will generally be needed for any erosion that is increasing in size.

All drainage, erosion and sediment control measures will be maintained until their function is no longer needed and adequate surface stabilisation is achieved.

All control measures should be maintained to confirm they:

- are in accordance with the specified operational standard for each measure; and
- prevent any unacceptable risk to safety.

3.7.7 Vegetation

Vegetation monitoring will be done on all re-contoured surfaces. The sampling density will be determined by BCC closer to the date of closure, based on what is practical to achieve and what DES will accept. To confirm consistency and repeatability of the vegetation monitoring, permanent sites will be established on the rehabilitated features. Vegetation monitoring methods will be refined closer to the date of closure, but should involve:

- photographing;
- recording general site notes;
- identifying presence of invasive species;
- measuring soil loss;
- measuring ground cover and species diversity; and
- measuring biomass.

The method will have regard for the BioCondition monitoring methodology described by the Queensland Herbarium (DSITIA 2015).

3.7.8 Schedule

In accordance with legal obligations and best practice, rehabilitation monitoring will be done following the schedule given in Table 59.

Table 59 Proposed monitoring schedule

Name	Frequency	Duration (post-closure)
Analogue sites	Annually	Five years
Surface water / receiving environment	Twice yearly	10 years (then every five years for the following 20 years)
Groundwater	Annually	10 years (then every five years for the following 20 years)
Soil	Every two years	10 years (then every five years for the following 20 years)
Erosion / final landform stability	Every two years	10 years (then every five years for the following 20 years)
Vegetation	Annually	10 years (then every five years for the following 20 years)

3.7.9 Schedule of monitoring, reporting and review of each milestone

An annual report will be done and will present a review of all rehabilitation monitoring done to the end of each annual period. The purpose of the report will be to provide an assessment of whether rehabilitation is trending towards the PMLU. If the data trend indicates a deviation from the completion criteria, then corrective actions will be recommended in the report. Corrective actions will be carried out and their success examined in the next annual report.

A schedule of monitoring, reporting and review for each milestone is given in Table 60-Table 68. Contingency strategies if rehabilitation monitoring indicates milestone criteria are not being met is given in Table 69. The rehabilitation monitoring program will help identify and quantify problems, risks and opportunities for corrective actions and adaptive management.

Table 60 RM1 (infrastructure decommissioning and removal) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
All site services disconnected	Review infrastructure mapping for currency Review legal agreements for retention of infrastructure	Document review	Annually	Internal	Update mapping and records as required	At completion of works	Visual inspection and review of termination documentation	Organise disconnection
All road materials (bitumen and gravel) removed	Review infrastructure mapping for currency Review legal agreements for retention of infrastructure	Document review and site inspection	Annually	Internal	Update mapping as required	At completion of works	Visual inspection	Organise removal
All pipelines drained and removed	Review infrastructure mapping for currency Review legal agreements for retention of infrastructure	Document review and site inspection	Annually	Internal	Update mapping as required	At completion of works	Visual inspection	Organise removal
All fencing is removed	Review infrastructure mapping for currency Review legal agreements for retention of infrastructure	Document review and site inspection	Annually	Internal	Update mapping as required	At completion of works	Visual inspection	Organise removal
All buildings demolished and removed	Review infrastructure mapping for currency Review legal agreements for retention of infrastructure	Document review and site inspection	Annually	Internal	Update mapping as required	At completion of works	Visual inspection	Organise removal
All drill holes, sumps, exploration tracks and gridlines decommissioned	Monitor documentation of exploration works	Document review and site inspection	Annually	Internal	Update documentation as required	At completion of works	Site inspection Rehabilitation monitoring BioCondition monitoring	Review rehabilitation processes if criteria not being met

Table 61 RM2 (remediation of contaminated land) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
A site investigation report is prepared by an AQP	Review infrastructure mapping for inclusion of potentially contaminated land sites Review incident reports for hydrocarbon and other spills	Document review and site inspection	Annually	Internal	Update mapping as required Consider training on spill procedure as required Consider training on incident reporting	Following removal of contaminated material	Investigation as per NEPM legislation and sampling and analysis verification (SAP) standards	Prepare remediation plan for any remaining areas of contamination

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
	Review adequacy of incident report actions and location details Identify high risk / regularly affected areas and proximity to sensitive receptors				(environment) as required Consider containment or mitigation strategies for identified areas			
Certification from an AQP that all contaminated land has been remediated or removed and disposed of according to licence conditions.	Review records / register / map files of potential contaminated areas Review incident reports for evidence of significant spill events	Document review and site inspection	Annually	Internal	Update register / records / mapping as required	Following removal / treatment of contaminated material	Investigation as per NEPM legislation and SAP standards	Start remediation of failed areas

Table 62 RM3 (remediation of contaminated sediment) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
A contaminated sediment assessment is prepared by an AQP	Review water quality monitoring for identification of potentially contaminated sediment Review procedures relating to dam maintenance to make sure contaminated sediment is handled and remediated or removed and disposed of appropriately	Data review Document review and site inspection	Annually	Internal	Update register / mapping files as required Update procedures and communicate to workforce if required	Following removal of sediment	Investigation as per NEPM legislation and SAP standards	Prepare remediation plan for areas with contaminated material remaining
Certification from an AQP that all contaminated sediment, including any synthetic liners, is remediated or removed and disposed according to licence conditions	Review records / register of any sediment removal	Document review and site inspection	Annually	Internal	Inappropriate disposal of contaminated material or inadequate record keeping being raised as an incident and investigated	Following removal of sediment	Investigation as per NEPM legislation and SAP standards	Prepare remediation plan for areas with contaminated material remaining

Table 63 RM4 (landform development and reshaping / reprofiling) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
All major earthworks completed	Monitor against PRCP schedule and milestones	Ground survey and LiDAR	Annually	Internal	Update schedule if required	Following completion of works	Ground survey and LiDAR	Update schedule or accelerate works

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
OC1 is backfilled to 200 m AHD in the LHD void and 195 m AHD in the VEM void as verified by an AQP	Review mine plans to ensure sufficient material is assigned for backfill	Document / design review	Quarterly	Internal	Update plan if required	Following completion of backfilling	Ground survey and LiDAR	Remediate areas as required
Highwall portals have been sealed and are not accessible from the final landform surface and verified by an AQP	Review mapping / register of highwall portals	Document review and site inspection	Annually	Internal	Update register / records / mapping as required	Following completion of sealing	Ground survey, LiDAR and site inspection	Seal / reseal documented areas as required
Sediment and mine water dams desilted and backfilled using their embankments	Review rehabilitation records for documentation of desilting and embankment removal	Document review and site inspection	Annually	Internal	Review and update design plans if required	At completion of works	Visual inspection	Assess impact of changed methodology on rehabilitation area
Slope of constructed landform is ≤ 15 % and verified by an AQP	Review landform designs to make sure slopes are planned as ≤ 15 % Review survey / LiDAR data for compliance with maximum slope angle	Document / design review Ground survey and LiDAR	Annually Monthly during reshaping works	Internal Internal	Update designs if required Remediate areas as required	Following completion of works	Ground survey and LiDAR	Remediate areas as required
Landform is assessed as geotechnically stable by an appropriately qualified geotechnical engineer	Monitoring of landform stability by geotechnical engineer Analysis of survey data by geotechnical engineer	Geotechnical inspections Ground survey / LiDAR	Quarterly Quarterly	Internal Internal	Remediate areas of instability Review and update design plans if required	Following completion of works	Geotechnical assessment	Remediate as advised or start redesign process
Surface water runoff meets site drainage specifications as assessed by an AQP	Review landform designs to make sure effective drainage has been considered	Document / design review	Annually	Internal	Update designs if required	Following completion of works	Ground survey and LiDAR	Remediate areas as required

Table 64 RM5 (installation of cover) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
Certification by an AQP that fine rejects are buried under waste rock with a minimum of 5 m cover thickness	Inspect in-pit areas for existence of fine rejects	Visual inspections, ground survey	Annually	Internal	Survey locations of fine material for cover by waste rock	Following placement of cover material at final RL	Visual inspections, ground survey, test pitting and laboratory analysis (as required)	Remove material if feasible or determine appropriate in situ treatment

Table 65 RM6 (surface preparation) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
An assessment of soil health and suitability has been completed by an AQP to confirm soil is suitable for target vegetation establishment	Not applicable (N/A) — assessment completed prior to works starting	N/A	N/A	N/A	N/A	Prior to placement of soil	Soil sampling, laboratory analysis and results interpretation	Treat soil as required
Application of ameliorants as per requirements of the soil health and suitability assessment.	Review rehabilitation records for evidence of amelioration application Review effectiveness of amelioration on rehabilitation	Visual inspection and document review Rehabilitation monitoring	Annually (document review) Ongoing during application works Annually (rehabilitation monitoring)	Internal Internal Internal	Update rehabilitation records as required Review rehabilitation methodology if amelioration not appearing to be effective	Prior to seeding	Visual inspection Test pitting, sampling and laboratory analysis if required	Complete amelioration
Deep ripping completed	Review rehabilitation records for evidence of deep ripping Inspect rehabilitation areas during ripping	Visual inspection and document review	Annually Ongoing during works	Internal	Update rehabilitation records as required	Prior to seeding	Visual inspection	Remediate areas not adequately ripped
Soil placement (0.2 m)	Review rehabilitation records for evidence of topsoil placement depth Inspect areas of topsoil placement during works	Visual inspection and document review Test pitting	Annually Ongoing during works	Internal	Review methodology if topsoil is too shallow in multiple areas Remediate isolated areas as required i.e especially on slopes or in high-risk areas	Prior to seeding	Visual inspection Test pitting	Remediate areas as required
Light scarification on the contour of the topsoiled surface has been completed	Review rehabilitation records for evidence of scarification	Visual inspection and document review	Annually	Internal	Update rehabilitation records as required	Prior to seeding	Visual inspection	Remediate areas as required
Appropriate erosion and sediment control systems have been installed and verified by an AQP	Inspect erosion and sediment control installations	Visual inspection	Annually	Internal	Review appropriateness / effectiveness of controls	Pre and post wet season	Visual inspection	Remediate areas as required Alter control types as required

Table 66 RM7 (revegetation — pasture grazing) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
Completed seeding as per the *Revegetation Plan.*	Review rehabilitation records for evidence of seed application rates Visual inspection during seeding works	Visual inspection and document review	Annually Ongoing during works	Internal Internal	Update records as required	Annually	Rehabilitation monitoring BioCondition monitoring	Reseed as required Review seeding methodology, seeding rate, seed species, seed viability etc

Table 67 RM8 (achieve surface requirements — pasture grazing) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
Groundcover ≥80%.	Inspection of rehabilitation areas	Visual inspections	Bi-annually	Internal	Remediate areas where minimal cover may pose a risk ie erosion, stability, sediment runoff etc	Annually	Rehabilitation monitoring BioCondition monitoring	Plan and execute remediation program
No active areas of gully erosion and drainage follows appropriate drainage paths	Inspect areas of active erosion Inspect drainage lines following rain events	Visual inspection LiDAR	Bi-annually or following rain events	Internal	Identify root cause of erosion Remediate where necessary	Annually	Rehabilitation monitoring	Investigate underlying cause of drainage issues eg design, construction, material types, ineffective maintenance etc Develop maintenance program for remediation Carry out remediation program
Erosion gullies are less than or equal to 0.3 m deep	Inspect areas of active erosion	Visual inspection LiDAR	Bi-annually	Internal	Identify root cause of erosion Remediate where necessary	Annually	Rehabilitation monitoring	Investigate underlying cause of drainage issues eg design, construction, material types, ineffective maintenance etc Develop maintenance program for remediation Carry out remediation program
Certification by AQP that rehabilitation is resilient to fire	Inspection of regrowth following fire events	Visual inspection	As required	Internal	Review seed mix if regrowth is insufficient Reseed if required	Annually	Rehabilitation monitoring	Review seed mix if regrowth is insufficient Reseed as required
Certification by AQP that weed are in densities no greater than analogue sites	Inspect rehabilitation and undisturbed areas for presence of weeds	Visual inspection	Bi-annually	Internal and neighbouring landholders as required	Targeted treatment of weed outbreaks	Annually	Rehabilitation monitoring	Plan and execute weed treatment program

Table 68 RM9 (achievement of PMLU to a stable condition — pasture grazing) milestone monitoring

Milestone criteria	Periodic monitoring	Monitoring methodology	Frequency	Reporting	Contingency strategy	Review timing	Review methodology	Contingency strategy
Certification from an AQP that the area has achieved a stable condition	Monitoring of landform stability by geotechnical engineer Analysis of survey data by geotechnical engineer	Geotechnical inspections Ground survey / LiDAR	Annually Annually	Internal Internal	Remediate areas of instability Review and update design plans if required	Following completion of works	Geotechnical assessment	Remediate as advised or start redesign process
Certification by an AQP that the landform achieved a FOS ≥ 1.5	Monitoring of landform stability by geotechnical engineer Analysis of survey data by geotechnical engineer	Geotechnical inspections Ground survey / LiDAR	Annually Annually	Internal Internal	Remediate areas of instability Review and update design plans if required	Following completion of works	Geotechnical assessment	Remediate as advised or start redesign process
Maximum erosion rate of <10 t/ha/yr	Inspect areas of active erosion	Visual inspection LiDAR	Bi-annually	Internal	Identify root cause of erosion Remediate where necessary	Annually	Rehabilitation monitoring	Develop maintenance program for remediation Carry out remediation program
Average erosion rate of ≤5 t/ha/yr	Inspect areas of active erosion	Visual inspection LiDAR Calculation of average erosion rate	Annually	Internal	Identify root cause of erosion Remediate where necessary	Annually	Rehabilitation monitoring	Develop maintenance program for remediation Carry out remediation program
Groundcover ≥ 80%.	Inspection of rehabilitation areas	Visual inspections	Bi-annually	Internal	Remediate areas where minimal cover may pose a risk ie erosion, stability, sediment runoff etc	Annually	Rehabilitation monitoring BioCondition monitoring	Plan and execute remediation program
Certification by AQP that weeds, and pests are in densities no greater than analogue sites	Inspect rehabilitation and undisturbed areas for presence of weeds and pests	Visual inspection	Bi-annually	Internal and neighbouring landholders as required	Targeted treatment of weed outbreaks Targeted eradication of pests	Annually	Rehabilitation monitoring	Plan and execute weed treatment program Plan and execute pest eradication program
Surface water runoff quality from the area complies with proposed EA conditions	Monitoring as per EA requirements	Sampling and laboratory analysis	As per EA	As per EA	Investigate non-compliant results as required	Annually	Sampling and laboratory analysis	Investigate cause of non-compliant results
Groundwater level is below RL 195 m	Monitoring as per EA requirements	Levels, sampling and laboratory analysis	As per EA	As per EA	Investigate non-compliant results as required	Annually	Sampling and laboratory analysis	Investigate cause of non-compliant results
Groundwater quality complies with proposed EA conditions	Monitoring as per EA requirements	Sampling and laboratory analysis	As per EA	As per EA	Investigate non-compliant results as required	Annually	Sampling and laboratory analysis	Investigate cause of non-compliant results

Table 69 Milestone review and contingency planning

Milestone reference	Description	Milestone criteria	Monitoring methodology	Reported to:	Intervention trigger	Action	Response	Review schedule
RM1	Infrastructure decommissioning and removal	1. All site services disconnected 2. All road materials (bitumen and gravel) removed 3. All pipelines drained and removed 4. All fencing is removed 5. All buildings demolished and removed 6. All drill holes, sumps, exploration tracks and gridlines decommissioned	1. Visual inspection and review of termination documentation 2. Visual inspection 3. Visual inspection 4. Visual inspection 5. Visual inspection 6. Visual inspection, rehabilitation monitoring	1. Environment and service providers 2. Environment 3. Environment 4. Environment 5. Environment 6. Environment	1. Services still connected 2. Road materials not removed 3. Pipelines not removed 4. Fence lines not removed 5. Buildings not removed 6. Works not completed	1. Investigate why services remain connected 2. Organise removal 3. Organise removal 4. Engage with landholder 5. Engage with landholder 6. Audit completed and outstanding works	1. Organise disconnection 2. Organise removal 3. Organise removal 4. Organise removal or add to retention agreement 5. Organise removal or add to retention agreement 6. Start remediation works	1. Following infrastructure removal 2. Following infrastructure removal 3. Following infrastructure removal 4. Following infrastructure removal 5. Following infrastructure removal 6. Following infrastructure removal
RM2	Remediation of contaminated land	1. A site investigation report is prepared by an AQP. 2. Certification from an AQP that all contaminated land has been remediated or removed and disposed of according to licence conditions	1. Investigation as per NEPM legislation and sampling and analysis verification (SAP) standards 2. Certification of assessment report by an AQP	1. Environment 2. Environment	1. Assessment identifies additional areas of contamination 2. Certification not received	1. Identify all contamination areas 2. Identify failed areas	1. Prepare remediation plan for additional areas of contamination 2. Start remediation of failed areas	1. Following removal of contaminated material 2. Following removal of contaminated material
RM3	Remediation of contaminated sediment	1. Contaminated sediment assessment prepared by an AQP 2. Certification from an AQP that all contaminated sediment is remediated or removed and disposed of according to licence conditions	1. Assessment as per NEPM legislation 2. Visual assessment and sampling and analysis (SAP) verification	-	1. Failed assessment 2. Sediment not removed or dumped elsewhere on site	1. Identify areas of failure 2. Identify areas of failure	1. Prepare remediation plan for areas of failure 2. Prepare remediation plan for areas of failure	1. Following removal of contaminated material 2. Following removal of contaminated material
RM4	Landform development and reshaping / reprofiling	1. Major earthworks completed (except soil placement) 2. OC1 is backfilled to 200 m AHD in the LHD void and 195 m AHD in the VEM void as verified by an AQP 3. Highwall portals have been sealed and are not accessible from the final landform surface and verified by an AQP 4. Sediment and mine water dams will be desilted	1. Ground survey and LiDAR 2. Ground survey, LiDAR and AQP visual inspection 3. Ground survey, LiDAR and AQP visual inspection 4. Visual inspection 5. Ground survey and LiDAR 6. Geotechnical assessment 7. Ground survey, LiDAR and rehabilitation monitoring	1. Works supervisor / environment 2. Works supervisor / environment 3. Works supervisor / environment 4. Environment 5. Works supervisor / environment 6. Environment 7. Works supervisor / environment	1. Earthworks not completed 2. OC1 backfilled below 200 m RL 3. Portals not sealed to final landform surface 4. Works not completed 5. Slope exceeds 15%6. Landform not assessed as stable 7. Surface water runoff does not meet site drainage specifications or	1. Investigate schedule delay 2. Investigate shortfall of fill material 3. Identify impacted portals 4. Audit completed and outstanding works 5. Assess the scale of the issue ie how many areas outside of specification 6. Determine mechanism for instability 7. Determine cause of variation from specification	1. Update schedule or accelerate works 2. Backfill void to required RL 3. Start sealing of identified portals 4. Organise sediment removal and earthworks 5. Analyse impact of areas outside specification on overall stability and start remediation if required 6. Remediate areas not assessed as stable	1. Upon completion 2. Following completion of backfill 3. Periodically during sealing 4. Following infrastructure removal 5. Periodically during reprofiling 6. Upon completion 7. Following completion of major earthworks

Milestone reference	Description	Milestone criteria	Monitoring methodology	Reported to:	Intervention trigger	Action	Response	Review schedule
		and backfilled using their embankments 5. Slope of constructed landform is ≤15% (verified by an AQP) 6. Landform is assessed as geotechnically stable by an appropriately qualified geotechnical engineer 7. Surface water runoff meets site drainage specifications as assessed by an AQP			areas of concentrated runoff impact land stability		7. Remediate impacted areas where required	
RM5	Installation of cover	1. Fine rejects buried under a minimum of 5m of waste rock as certified by a AQP	1. Visual inspections, ground survey, test pitting and lab analysis	1. Works supervisor / environment	1. Fine reject material identified on surface or during test pitting	1. Assess quantity of material present and other potential locations	1. Remove material if feasible or determine appropriate in situ treatment	1. Following placement of material to final RL
RM6	Surface preparation	1. An assessment of soil health and suitability has been completed by an AQP to confirm soil is suitable for target vegetation establishment 2. Application of ameliorants as per requirements of the soil health and suitability assessment. 3. Deep ripping completed 4. Soil placement (0.2m) 5. Light scarification on the contour of the topsoiled surface has been completed 6. Appropriate erosion and sediment control systems have been installed and verified by an AQP	1. Sampling, lab testing and results analysis of soil 2. Visual inspection and application record keeping 3. Visual inspection 4. Visual inspection. test pitting of selected areas 5. Visual inspection 6. Visual inspection	1. Environment 2. Environment 3. Environment 4. Environment 5. Environment 6. Environment	1. Soil not suitable for target vegetation 2. Amelioration not completed 3. Ripping not completed or not to adequate depth 4. Topsoil not to adequate depth 5. Scarification not completed or not on contour 6. Appropriate controls not installed effectively	1. Determine treatment options 2. Complete amelioration 3. Determine extent of areas not adequately ripped 4. Complete additional test holes to determine extent of issue 5. Organise scarification to be carried out and remediation if required 6. Determine impact of missing control systems	1. Treat soil as required 2. Complete amelioration 3. Deep rip areas not adequately treated 4. Consider placement of additional topsoil in high-risk areas or areas of concern 5. Complete scarification or remediation as required 6. Install appropriate controls	1. Prior to placement of soil 2. Prior to seeding works 3. Prior to seeding works 4. Prior to seeding works 5. Prior to seeding works 6. Prior to seeding works
RM7	Revegetation (pasture grazing)	1. Seeding completed as per *Revegetation Plan*	1. Visual inspection, review records	1. Environment	1. Seeding not completed or inadequate	1. Determine extent of inadequacy	1. Start reseeding works	1. Immediately following seeding
RM8	Achieve surface requirements	1. Groundcover ≥ 80% 2. No active areas of gully erosion and drainage follows appropriate drainage paths.	1. Rehabilitation monitoring, BioCondition monitoring 2. Rehabilitation monitoring, ground survey and LiDAR	1. Environment 2. Environment 3. Environment 4. Environment 5. Environment	1. Groundcover less than 80% 2. Active erosion present and / or evidence of ineffective drainage	1. Investigate cause of inadequate cover (soil quality, seed quality, seed variety, weather patterns etc)	1. Plan remediation program based on investigation i.e soil treatment, reseeding etc 2. Start remediation works as required	1. Immediately following first seeding 2. Immediately following first rehabilitation

Milestone reference	Description	Milestone criteria	Monitoring methodology	Reported to:	Intervention trigger	Action	Response	Review schedule
		3. Erosion gullies are less than or equal to 0.3m deep. 4. Certification by AQP that rehabilitation is resilient to fire 5. Certification by AQP that weeds are in densities no greater than analogue sites	3. Rehabilitation monitoring, ground survey and LiDAR 4. Rehabilitation monitoring 5. Rehabilitation monitoring, BioCondition monitoring		3. Identification of gullies greater than 0.3m 4. Species composition of rehabilitation not assessed as suitable for fire resilience or observed lack of recovery from actual fire 5. Weeds identified in densities greater than analogue sites	2. Determine underlying cause of drainage issues (design, construction, material types, ineffective maintenance etc) and / or source erosion scour 3. Undertake an investigation as per the *Revegetation Plan* 4. Review adopted seed mix 5. Investigate potential weed source and impact on proposed PMLU	3. Start remediation program as per the *Revegetation Plan* 4. Alter seed mix and start reseeding as required 5. Plan and execute weed treatment program	3. Immediately following first rehabilitation 4. Assessment to follow first round of rehabilitation monitoring 5. Assessment to follow first round of rehabilitation monitoring
RM9	Achievement of PMLU to a stable condition (pasture grazing)	1. AQP certification of a stable condition 2. Certification by AQP that landform has achieved a factor of safety (FOS) ≥1.5 3. Maximum erosion rate of <10 t/ha/yr at any point on the landform 4. Average erosion rate of ≤5 t/ha/yr 5. Groundcover ≥ 80% 6. Certification by AQP that weeds and pests are in densities no greater than analogue sites 7. Surface water runoff quality from the area complies with proposed EA limits 8. Groundwater is below RL 195 m 9. Groundwater quality complies with proposed EA limits	1. Certification assessment by AQP based on achievement of safe, stable, non-polluting and self-sustaining 2. Geotechnical assessment by qualified geotechnical engineer 3. Survey and LiDAR monitoring 4. Survey and LiDAR monitoring 5. Rehabilitation monitoring, BioCondition monitoring 6. Rehabilitation monitoring, BioCondition monitoring 7. Surface water sampling and laboratory analysis 8. Groundwater level monitoring 9. Groundwater sampling and laboratory analysis	1. Environment 2. Environment and technical services 3. Environment 4. Environment 5. Environment 6. Environment 7. Environment 8. Environment 9. Environment	1. Area does not receive certification 2. FOS < 1.5 3. Erosion rate exceeds 10 t/ha/yr at any point (calculated) 4. Average erosion rate exceeds 5 t/ha/yr (calculated) 5. Groundcover less than 80% 6. Weeds and pests identified in densities greater than analogue sites 7. Surface water runoff quality exceeds limits 8. Groundwater level exceeds RL 200m 9. Groundwater quality exceeds EA limits	1. Investigate failed criteria and assess underlying causes 2. Complete geotechnical assessment 3. Identify potential sources of erosion 4. Identify potential sources of erosion 5. Investigate cause of inadequate cover (soil quality, seed quality, seed variety, weather patterns etc) 6. Investigate impact on proposed PMLU 7. Investigate cause of surface water runoff quality exceedances 8. Investigate cause of elevated groundwater level 9. Investigate cause of Groundwater quality exceedances	1. Develop remediation program to address deficiencies 2. Implement recommendations from geotechnical assessment 3. Start remediation / soil stabilisation 4. Start remediation / soil stabilisation 5. Plan remediation program based on investigation ie soil treatment, reseeding etc 6. Plan and execute weed and pest treatment program 7. Response based on investigation results 8. Response based on investigation results 9. Response based on investigation results	1. Immediately following last rehabilitation 2. Immediately following last rehabilitation 3. Immediately following first rehabilitation 4. Immediately following first rehabilitation 5. Immediately following first seeding 6. Immediately following first rehabilitation 7. Following first round of surface water sampling from rehabilitated area 8. Start following first groundwater sampling 9. Start following first groundwater sampling

3.7.10 QA/QC

Monitoring, data assessment and reporting will be done by an AQP. This could be staff (eg environment officer) or an external consultant. All monitoring data files will be stored onsite. Mine staff will be responsible for reviewing monitoring data, analysis, reports and managing consultants.

Aspects to consider when reviewing the data, analysis and reports include QA/QC of data, methodologies used, fluctuating trends in data from previous years, accuracy of figures and graphs and general conclusions made about rehabilitation progress.

3.7.11 Review

This monitoring plan will be reviewed by if circumstances change. The review will consider:

- evaluation of rehabilitation objectives and indictors;
- opportunities for improvement identified in inspection checklist records;
- reports of environmental incidents;
- any amendments to relevant legislation, policy and guidelines;
- any changes to Project plans, mining activities or construction / mining / rehabilitation works contractors at the Project; and
- rehabilitation completion criteria based on the above items.

3.7.12 EA surrender

DES must be satisfied with the rehabilitation before it can certify progressive rehabilitation for part of the Project or accept the surrender of the EA for the whole or part of the Project tenure. DES's decision is based on an assessment of either a progressive rehabilitation report for part of the Project (refer to section 318Z of the EP Act) or a final rehabilitation report (refer to section 264 of the EP Act) for the whole Project tenure or a singular part being surrendered.

The Proponent is required to prepare a progressive / final rehabilitation report, including a compliance statement and submit it to DES for assessment. DES will consider the relevant rehabilitation requirements (refer to section 318ZI or section 268 of the EP Act) when deciding whether to certify progressive rehabilitation or whether to approve a surrender application. The Proponent is also required to develop a post-relinquishment management plan to assist ongoing land management beyond surrender of the Project tenure.

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