GEMINI PROJECT
Site-Specific EA Application: Supporting Information

PREPARED FOR
MAGNETIC SOUTH PTY LTD

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LIST OF ABBREVIATIONS

<	less than
>	more than
AARC	AARC Environmental Solutions Pty Ltd
AEP	annual exceedance probability
AHD	Australian Height Datum
AMD	acid mine drainage
ANC	acid neutralising capacity
ANFO	ammonium nitrate fuel oil
AQMP	*Air Quality Management Plan*
AS	Australian Standards
ATP	authority to prospect
AUL	auxiliary left turn treatment
AusRIVAS	Australian River Assessment System
Biosecurity Act	*Biosecurity Act 2014*
BMA	BHP Billiton Mitsubishi Alliance
BOD	biochemical oxygen demand
BoM	Bureau of Meteorology
CALMET	California Meteorological Model (version 6.5.0)
CALPUFF	California Puff Model (version 7.2.1)
CEC	cation exchange capacity
CH_4	methane
CHMP	*Cultural Heritage Management Plan*
CHPP	coal handling and preparation plant
CHR	channelised right turn treatment
CHRC	Central Highlands Regional Council
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DES	Department of Environment and Science
DNRM	former Department of Natural Resources and Mines
DNRME	Department of Natural Resources, Mines and Energy

DO	dissolved oxygen
DSA	Design Storage Allowance
E	east
e.g.	for example
EA Application	"*Site-specific application for a new environmental authority for a resource activity"*
EA	environmental authority
EC	electrical conductivity
EHP	former Department of Environment and Heritage Protection
EIS	Environmental Impact Statement
EP Act	*Environmental Protection Act 1994*
EP Regulation	*Environmental Protection Regulation 2019*
EP	equivalent person
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPC	exploration permit for coal
EPP (Air)	*Environmental Protection (Air) Policy 2019*
EPP (Noise)	*Environmental Protection (Noise) Policy 2019*
EPP (WWB)	*Environmental Protection Policy (Water and Wetland Biodiversity) 2019*
ERA	environmentally relevant activity
ERC	estimated rehabilitation cost
ESCP	*Erosion and Sediment Control Plan*
ESP	exchangeable sodium percentage
etc.	*"and other similar things"*
EVNT	Endangered, Vulnerable, Near Threatened
EV	environmental value
GAI	geochemical abundance index
GDE	Groundwater Dependent Ecosystem
GHG	greenhouse gas
GLC	ground-level concentrations
GWP	Global Warming Potential
HES	high ecological significance
i.e.	in other words
ICPMS	Inductively coupled plasma mass spectrometry
ILUA	Indigenous Land Use Agreement

JBT	JBT Consulting Pty Ltd
K	site and rock constant
KLC	kinetic leach column
L_{90}	'A' weighted sound pressure level equalled or exceeded 90% of the time
$L_{Aeq,adj,T}$	the L_{eq} adjusted for tonal or impulsive noise characteristics and with a measurement interval of 'T' duration (e.g. 15 minutes, 1 hour).
LC	least concern
LDP	land disturbance permit
L_{eq}	equivalent continuous sound level
LFA	Landscape Function Analysis
LGA	local government area
LOR	limit of reporting
Magnetic South	Magnetic South Pty Ltd (the Proponent)
MAW	mine affected water
MDL	Mineral Development Licence
MERFP Act	*Mineral and Energy Resources (Financial Provisioning) Act 2018*
MGA	Map Grid of Australia
MIA	mine infrastructure area
ML	mining lease
MLA	mining lease application
MRL	Mandatory Reporting Level
MSES	Matters of State Environmental Significance
N	north
n/a	not applicable
N_2O	nitrous oxide
NAF	non-acid forming
NATA	National Association of Testing Authorities
NBMP	*Noise and Blast Management Plan*
NC Act	*Nature Conservation Act 1992*
NC	no concern at present
NE	northeast
NGER Act	*National Greenhouse and Energy Reporting Act 2007*

NGER Determination	*National Greenhouse and Energy Reporting (Measurement) Determination 2008*
NGER Guidelines	*National Greenhouse and Energy Reporting Guidelines*
NGER Scheme	*National Greenhouse and Energy Reporting Scheme*
NNTT	National Native Title Tribunal
no.	number
NPI	National Pollution Inventory
NT	Near Threatened
NUMA	non-use management area
OC	of concern
OME	OME Resources Australia Pty Ltd
OPSIM	operational simulation model
PAF	potentially acid forming
PCA	potential commercial area
PCI	pulverised coal injection
PET	Plecoptera, Ephemeroptera, Trichoptera
pH	*"scale used to specify how acidic or basic a water-based solution is"*
PM_{10}	particulate matter with equivalent aerodynamic diameters of 10 µm or less
$PM_{2.5}$	particulate matter with equivalent aerodynamic diameters of 2.5 µm or less
PMF	probable maximum flood
PMLU	post-mining land use
PPE	personal protective equipment
PPV	peak particle velocity
PRCP	progressive rehabilitation and closure plan
QGC	Queensland Gas Company
RE	regional ecosystem
REMP	Receiving Environment Monitoring Program
RFFE	Regional Flood Frequency Estimation
RGS	RGS Environmental Pty Ltd
RGTCT	RG Tanna Coal Terminal
RIS	restricted invasive species
RN	registration number
ROM	run-of-mine

Rv,Max	Mean Max Reflectance
SE	southeast
SILO	Scientific Information for Land Owners
SISD	safe intersection sight distance
SLC	special least concern
SMD	slightly to moderately disturbed
SMU	soil management unit
SO_4^{2}	sulphate
SQG	sediment quality guideline
STP	sewage treatment plant
SWL	surface water level
SWMS	Site Water Management System
TAPM	The Air Pollution Model (version 4.0.5)
TBA	to be announced
TDS	total dissolved solids
TEC	threatened ecological community
the Project	Gemini Project
TLO	train load out
TSP	total suspended particulate matter
TSS	total suspended solids
UWIR	*Underground Water Impact Report*
V	vulnerable
V:H	vertical to horizontal
VC	vegetation community
VM Act	*Vegetation Management Act 1999*
VWP	vibrating wire piezometer
W	west
Water Act	*Water Act 2000*
WICET	Wiggins Island Export Coal Terminal
WoNS	Weeds of National Significance
WQO	water quality objective
WRM	WRM Water and Environment Pty Ltd
WRR Act	*Waste Reduction and Recycling Act 2011*

UNITS OF MEASUREMENT

%	percent
°	degree(s)
°C	degree(s) Celsius
cm	centimetre(s)
dB	decibel(s)
dBA	'A' weighted decibel
dBZ	decibel relative to 'Z'
dS/m	deciSiemens per metre
ha	hectare(s)
Hz	Hertz
kg/ha	kilogram(s) per hectare
kL	kilolitre(s)
km	kilometre(s)
km^2	square kilometre(s)
kt CO_2-e	kilotonne(s) of carbon dioxide equivalent
kt	kilotonne(s)
kV	kilovolt(s)
L	litre(s)
L/s	litre(s) per second
m	metre(s)
m/day	metre(s) per day
m/s	metre(s) per second
m^2	square metre(s)
m^3	cubic metre(s)
m^3/day	cubic metre(s) per day
mAHD	metre(s) Australian Height Datum
Mbcm	million bank cubic metre(s)
mbgl	metre(s) below ground level
meq/100g	milliequivalent per 100 grams
mg/kg	milligram(s) per kilogram

mg/L	milligram(s) per litre
mg/m^2/day	milligram(s) per square metre per day
Ml	megalitre(s)
ml	millilitre(s)
Ml/a	megalitre(s) per annum
mm	millimetre(s)
mm/s	millimetre(s) per second
Mt	million tonne(s)
Mtpa	million tonne(s) per annum
NTU	Nephelometric Turbidity Unit
t	tonne(s)
t/a	tonne(s) per annum
TJ	terajoule(s)
µg/L	microgram(s) per litre
µg/m^3	microgram(s) per cubic metre
µm	micrometre(s)
µS/cm	microSiemens per centimetre

EXECUTIVE SUMMARY

1.0 INTRODUCTION

AARC Environmental Solutions (AARC) was commissioned by Magnetic South Pty Ltd (Magnetic South; the Proponent) to prepare an environmental authority (EA) application for the Gemini Project (the Project). This report provides the supporting information to be considered as part of the EA Application to the Department of Environment and Science (DES) in consideration of Sections 125 and 126A of the *Environmental Protection Act 1994* (EP Act).

This report provides a description of the Project, environmentally relevant activities (ERAs), environmental values, potential impacts of the ERAs on the identified environmental values, and mitigation measures and management commitments.

1.1 THE PROPONENT

The Proponent for the Gemini Project is:

Magnetic South Pty Ltd

Suite 302, Level 3, 102 Adelaide Street, Brisbane, Queensland, 4000

ABN: 95 122 465 749

ACN: 122 465 749

Magnetic South is a private Australian based company which was founded in 2006. The executive team of Magnetic South has some 60 years' experience in the development and operation of metallurgical coal assets and agribusiness in central Queensland.

Magnetic South is the registered entity proposing to carry out the Project, and all permits and licences are held and will be issued to that entity.

1.2 CONTENT OF SUPPORTING INFORMATION

In accordance with Section 125 and 126A of the EP Act, this document includes the information described in Table 1.

1.3 ENVIRONMENTALLY RELEVANT ACTIVITIES

ERAs include resource activities or specific agricultural activities or other activities as defined by the EP Act. Current prescribed ERAs and resource activities are specified in Schedules 2 and 3, respectively, of the *Environmental Protection Regulation 2019* (EP Regulation). The Project will include the resource activity of "mining black coal" as well as the ancillary activities outlined in Table 2 which require approval as part of the EA application.

1.4 NOTIFIABLE ACTIVITIES

Notifiable activities are activities that have the potential to cause land contamination. The notifiable activities listed under Schedule 3 of the EP Act relevant to the Project are provided in Table 3.

Table 1 EP Act requirements for supporting information

Component	Relevant Section
Section 125 – Requirements for applications generally	
Description of all environmentally relevant activities for the application.	Section 1.3 and Table 2
Description of any development permit under the Planning Act, or State Development Area approval under the State Development Act required for carrying out the environmentally relevant activities for the application.	No approvals are required under the *Planning Act 2016* or *State Development and Public Works Organisation Act 1971*.
Description of the land on which each activity will be carried out.	Section 5.0
Assessment of the likely impact of each relevant activity on environmental values, including: • A description of the environmental values likely to be affected by each relevant activity; • Details of any emissions or releases likely to be generated by each relevant activity; • A description of the risk and likely magnitude of impacts on the environmental values; • Details of the management practices proposed to be implemented to prevent or minimise adverse impacts; and • Details of how the land, the subject of the application will be rehabilitated after each relevant activity ceases.	Environmental values, emissions or releases, risk and magnitude of impacts, and proposed management practices are detailed within each 'environmental' section. This constitutes Section 5.0 through to Section 13.0. Section 4.0
Description of the proposed measures for minimising and managing waste generated by each relevant activity.	Section 12.5 and Section 12.6
Details of any site management plan that relates to the application.	Details of relevant management plans are covered in the *Mitigation Measures, Management and Monitoring* subsection of each 'environmental' section (Section 5.0 through to Section 13.0).
Section 126A – Requirements for site-specific applications – particular resource projects and resource activities	
Any proposed exercise of underground water rights during the period in which resource activities will be carried out under the relevant tenure.	Section 8.3
The areas in which underground water rights are proposed to be exercised.	Pit AB and Pit C mining areas as specified in the conceptual layout (Figure 7) and mine stage plans (Figure 17 through to Figure 26).
For each aquifer affected, or likely to be affected, by the exercise of underground water rights: • A description of the aquifer; • An analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers and surface water; • A description of the area of the aquifer where the water level is predicted to decline because of the exercise of underground water rights; and • The predicted quantities of water to be taken or interfered with because of the exercise of underground water rights during the period in which resource activities are carried out.	Section 8.2.1 Section 8.2.4 and Figure 55 Section 6.3.1 and Section 6.4.1 Section 8.3.3, Figure 57 and Figure 58 Table 8 and Table 9.
The environmental values that will, or may, be affected by the exercise of underground water rights and the nature and extent of the impacts on the environmental values.	Section 8.2 Section 8.3.3 and Section 8.3.4
Any impacts on the quality of groundwater that will, or may, happen because of the exercise of underground water rights during or after the period in which resource activities are carried out.	Section 8.3.3
Strategies for avoiding, mitigating or managing the predicted impacts on the environmental values or the impacts on the quality of groundwater.	Section 8.4

Table 2 Applicable ERAs for the Project

Environmentally Relevant Activity	Description
Schedule 2	
8 (1) (c) Chemical storage	Chemical storage (the relevant activity) consists of storing more than 500 m^3 of class C1 or C2 combustible liquids under AS1940 or dangerous goods class 3.
31 (2) 2(b) Mineral processing	Processing, in a year, the following quantities of mineral products, other than coke (b) more than 100,000 t.
33 (1) Crushing, milling, grinding or screening	Crushing, milling, grinding or screening (the relevant activity) consists of crushing, grinding, milling or screening more than 5,000 t of material in a year.
63 1(b)(i) Sewage Treatment	Operating sewage treatment works, other than no-release works, with a total daily peak design capacity of more than 100 but not more than 1500 equivalent persons – if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme.

Table 3 Notifiable Activities for the Project

Notifiable Activities	Description
Schedule 3	
1 Abrasive Blasting	Carrying out abrasive blast cleaning (other than cleaning carried out in fully enclosed booths) or disposing of abrasive blasting material.
7 Chemical Storage	Storing more than 10 t of chemicals (other than compressed or liquefied gases) that are dangerous goods under the dangerous goods code.
15 Explosives production or storage	Operating an explosives factory under the *Explosives Act 1999.*
24 Mine Wastes	a) Storing hazardous mine or exploration wastes, including, for example, tailing dams, overburden or waste rock dumps containing hazardous contaminants; or b) Exploring for, or mining or process, minerals in a way that exposes faces, or releases groundwater, containing hazardous contaminants.
29 Petroleum Product or Oil Storage	Storing petroleum products or oil: a) In underground tanks with more than 200 Litre (L) capacity; or b) In above ground tanks with: I. For petroleum products or oil in class 3 in packaging groups 1 and 2 of the dangerous goods code – more than 2,500 L capacity; or II. For petroleum products or oil in class 3 in packaging groups 3 of the dangerous goods code – more than 5,000 L capacity; or III. For petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS 1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia – more than 25,000 L capacity.
37 Waste Storage, treatment of disposal	Storing, treating, reprocessing or disposing of waste prescribed under a regulation to be regulated waste for this item (other than at the place it is generated), including operating a nightsoil disposal site or sewage treatment plant where the site or plant has a design capacity that is more than the equivalent of 50,000 persons having sludge drying beds or on-site disposal facilities.

2.0 PROJECT LOCATION, SETTING AND TENURE

2.1 LOCATION AND SETTING

The Project is situated within the Bowen Basin, approximately 110 km east of Emerald and 125 km southwest of Rockhampton, in central Queensland (Figure 1). Blackwater, a larger town serving mines in the region, is located approximately 34 km to the west (Figure 1). The small rural townships of Bluff and Dingo are located approximately 15 km west and 3 km east of the Project, respectively (Figure 1).

The Project is located within the Central Highlands Regional Council (CHRC) local government area (LGA), which covers approximately 60,000 km^2 and supports a population of more than 30,000 residents living in Arcadia Valley, Bauhinia, Blackwater, Bluff, Capella, Comet, Dingo, Duaringa, Emerald, Rolleston, Sapphire Gemfields, Springsure and Tieri.

Nearby mining operations include Bluff PCI Project (approximately 12 km to the west), Yarrabee Coal Mine (approximately 34 km to the northwest), Jellinbah Mine (approximately 32 km to the northwest), Curragh Coal Mine (approximately 33 km to the northwest), and the Blackwater Mine (approximately 36 km to the southwest) (Figure 2).

Taunton National Park is situated to the north of the Project's mining lease application (MLA) area, whilst Walton State Forest is approximately 6 km to the west and Blackdown Tablelands National Park is located approximately 9 km to the southwest of the MLA (Figure 2).

The Capricorn Highway, which is a state-controlled road, links Rockhampton with western Queensland (Figure 1). Capricorn Highway traverses the MLA and links the townships of Bluff and Dingo (Figure 2). The Aurizon Blackwater Rail System (Blackwater Railway) tracks along the northern side of the Capricorn Highway (Figure 1 and Figure 2). A stock route (ID: 413CENT) tracks alongside the Capricorn Highway and is currently open but classified as minor and unused.

Publicly gazetted roads including Sanders, Namoi, Charlevue, Cooinda, Red Hill, Normanby and Ellesmere roads provide local access (Figure 2).

The topography of the MLA varies from flat to gently undulating, with elevations ranging between approximately 120 m to 150 m Australian Height Datum (AHD). The MLA and surrounds is currently used for low intensity cattle grazing and resource exploration activities. Land ownership in the vicinity of the Project is described in Section 2.3.2 (Land Ownership). It is Magnetic South's intention that the land continue to be used for agricultural purposes until such time that it is required for Project construction and/or operation. Land not required for mining activities will continue to be utilised for agricultural purposes throughout the life of the Project.

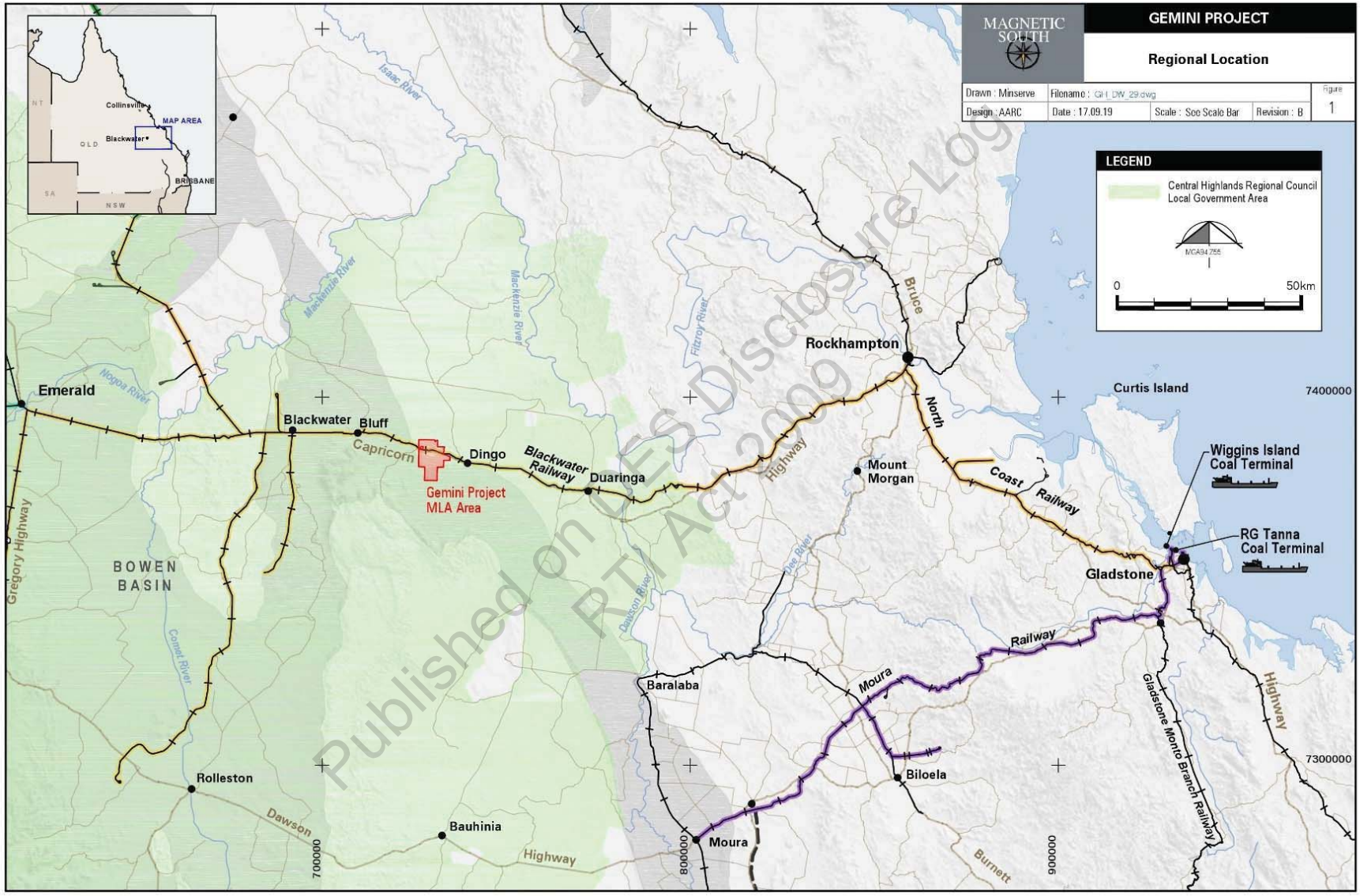


Figure 1 Regional location

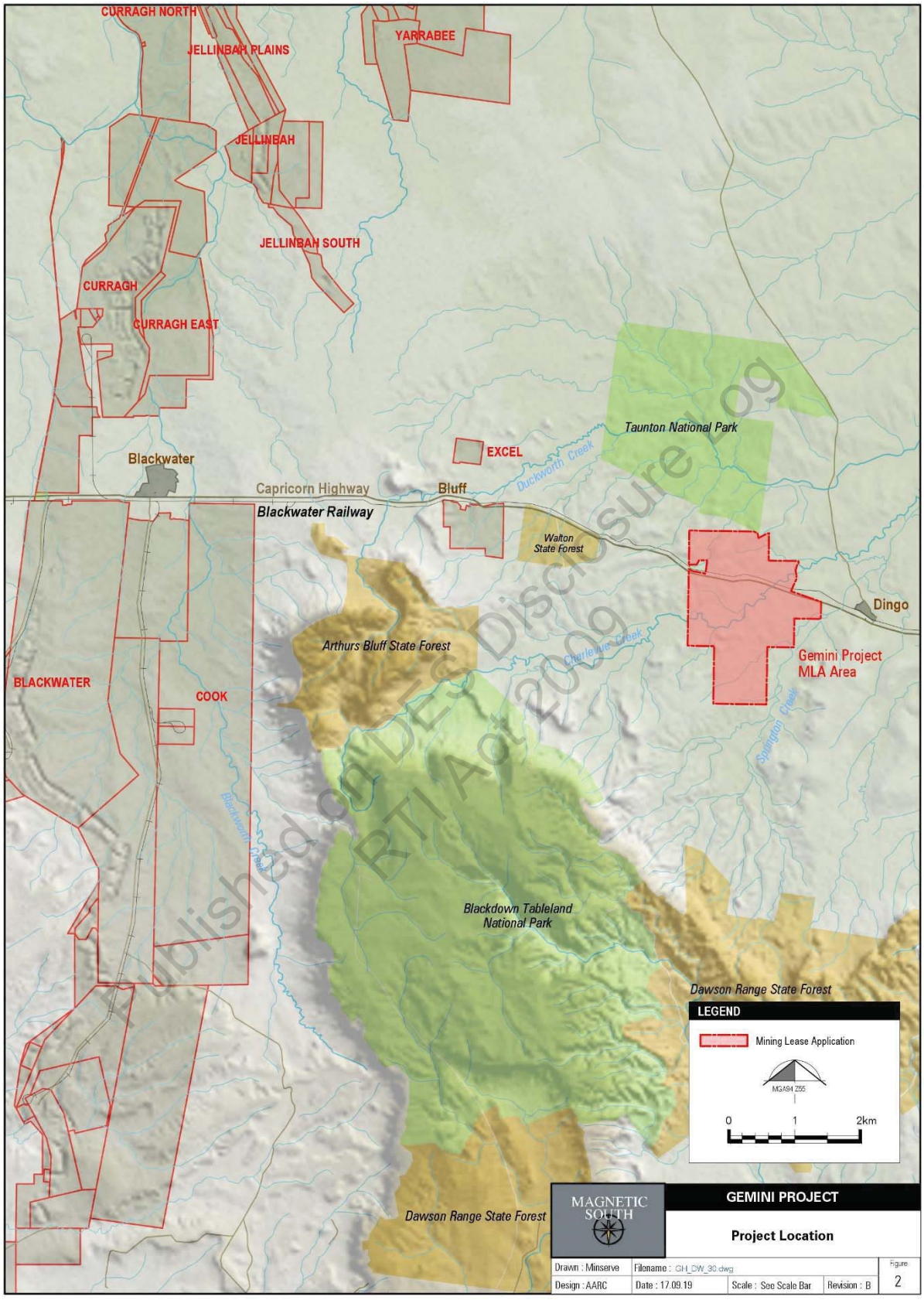


Figure 2 Project location

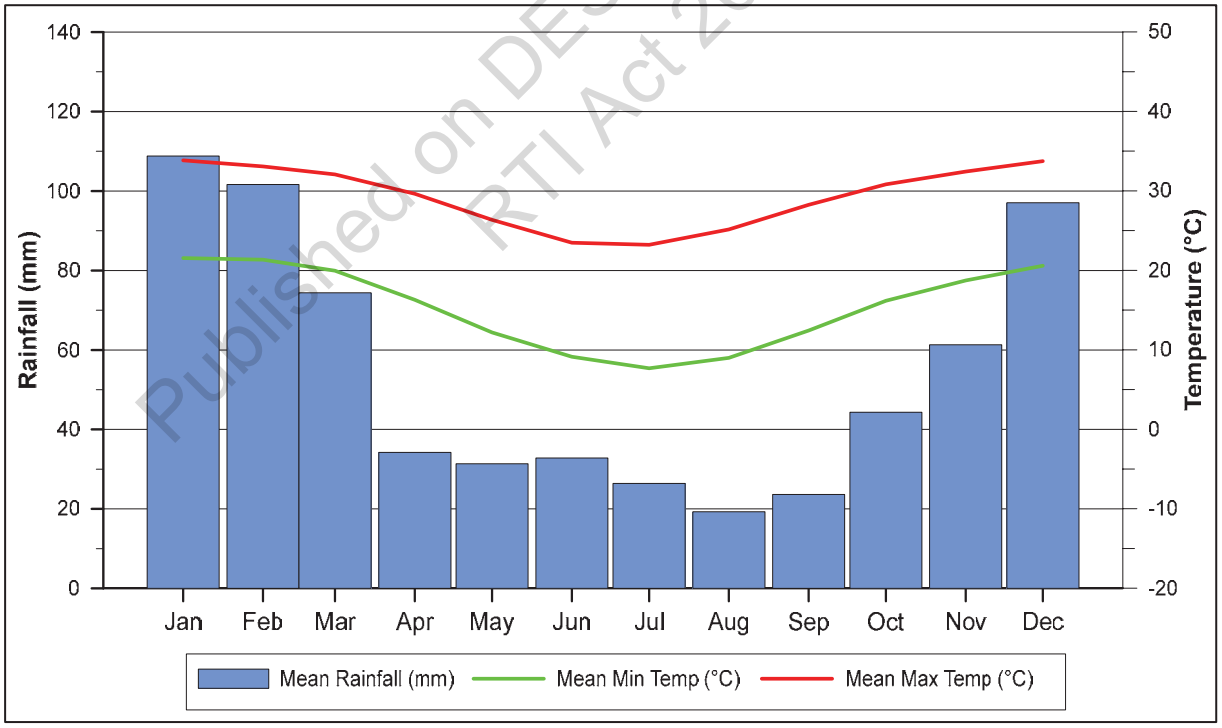
2.2 LOCAL METEROLOGICAL CONDITIONS

The Project area has a climate classification of 'subtropical' (moderately dry winter) using the Bureau of Meteorology's (BoM) modified Köppen climate classification system. The local region experiences a subtropical climate characterised by high variability seasonal rainfall subject to cyclic wet summer and dry winter seasons, with variable temperature and evaporation. Predominantly wind blows from the southeast and east in the region.

Local meteorological conditions have been compiled using data from the Scientific Information for Land Owners (SILO) Data Drill. The Data Drill accesses grids of climate data available from surrounding BoM point observations and then creates interpolated climate values for the requested location. The SILO climate data was obtained for coordinates that correspond to the approximate centre of the Gemini Project MLA. The data has been utilised to produce a climatograph for the Project (Figure 3).

The mean annual rainfall for the Project region is approximately 655 mm with average annual (pan) evaporation of 2,024 mm which exceeds rainfall for every month of the year (Table 4). Rainfall is highly seasonal, with November to March generally accepted as the 'wet season' and rainfall during this time accounting for approximately 68% of the region's total yearly rainfall. The 'dry season' usually occurs from April through to October with monthly rainfall totals below 45 mm consistently throughout this period. The rainfall data for this region is consistent with the Köppen classification of 'subtropical' (moderately dry winter).

The hottest months typically occur between October and March while the coolest months occur between May and September. The highest mean maximum temperature typically occurs in January (33.8°C) and the lowest mean minimum temperature in July (7.7°C).



Source: JBT (2019)

Figure 3 Climatograph for the Gemini Project

Table 4 Average monthly rainfall and evaporation

Month	Average Rainfall (mm)	Average Evaporation (mm)
January	108.8	229.6
February	101.6	186.4
March	74.4	185.1
April	34.2	150.8
May	31.3	117.7
June	32.8	93.5
July	26.4	101.2
August	19.3	129.9
September	23.6	164.2
October	44.3	207.6
November	61.3	220.2
December	97	237.8
Total	**655.2**	**2,024.1**

Source: JBT (2019)

2.3 TENURE AND LAND OWNERSHIP

2.3.1 Tenure

The Project is located entirely within the MLA, which is within exploration permit for coal (EPC) 881 held by Magnetic South (Figure 4). The surface rights held by Magnetic South within the MLA are also shown on Figure 4.

Petroleum tenements overlapping the MLA and surrounds include authority to prospect (ATP) 758, ATP 806 and potential commercial area (PCA) 163, PCA 165, and PCA 166 (Figure 5). All of the petroleum tenements are held by OME Resources Australia Pty Ltd, a subsidiary of Queensland Gas Company (QGC). Magnetic South and OME Resources Australia are parties to a co-development agreement.

Other tenements proximal to the MLA include EPC 960 and mineral development licence (MDL) 505 held by Walton Coal Pty Ltd, EPC 769 held by Peabody Capricorn Pty Ltd, and EPC 1859 held by Area Coal Pty Ltd (Figure 4).

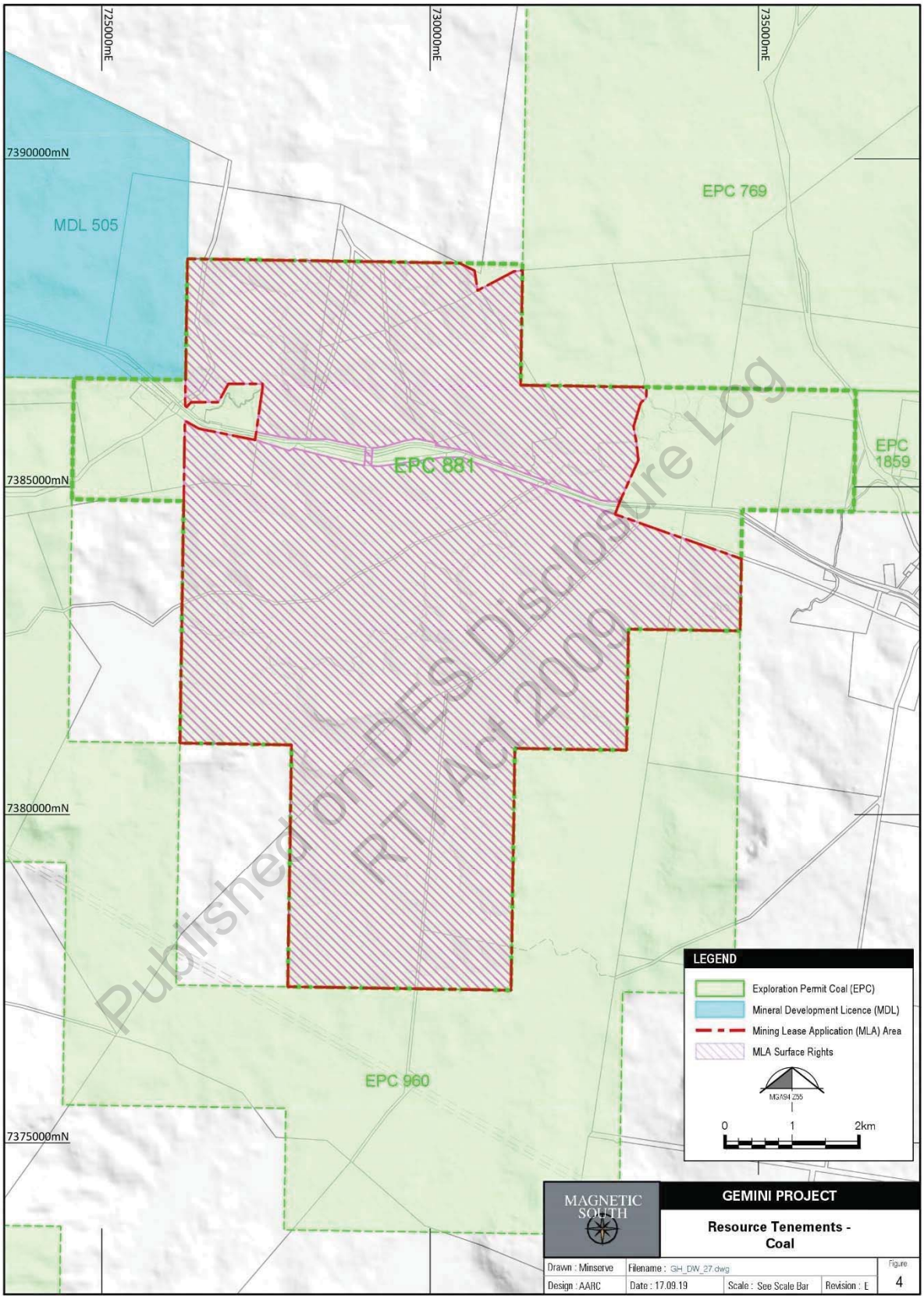


Figure 4 Resource tenements – coal

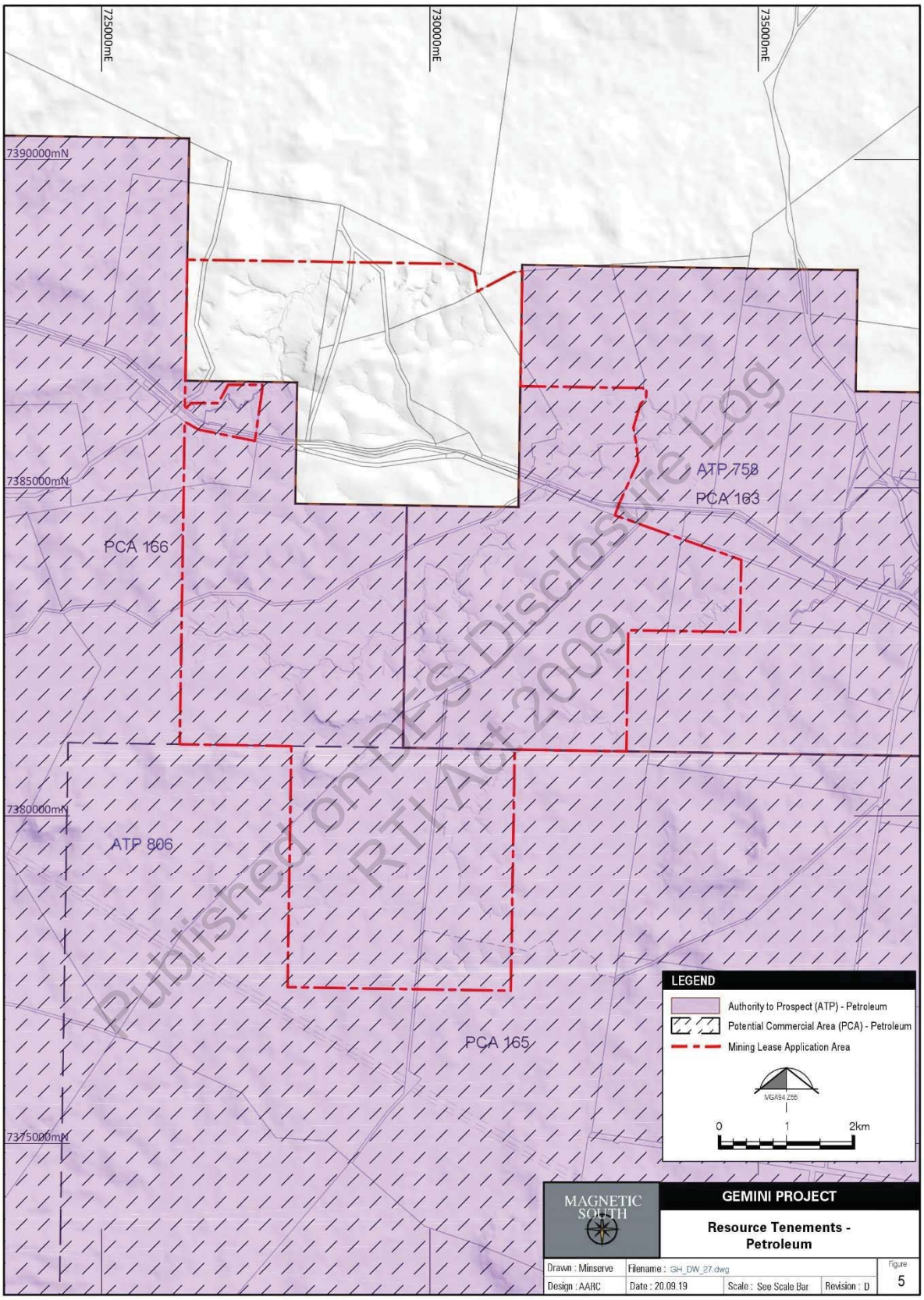


Figure 5 Resource tenements – petroleum

2.3.2 Land Ownership

The subject land within the MLA is held as freehold, leasehold or road reserve. Land ownership within the MLA is outlined in Table 5 and shown in Figure 6.

The Project's infrastructure is located on Lot 1 on Plan HT424 (freehold), Lot 2 on Plan HT138 (leasehold), Lot 100 on Plan RP882349 (freehold), and Lot 1 on Plan RP904099.

A number of publicly gazetted road reserves occur within the MLA; including the Capricorn Highway. The Blackwater Railway occurs within leasehold land along the northern side of the Capricorn Highway.

Consultation with private landholders within the MLA has been conducted by Magnetic South and discussions continue in relation to consent.

Table 5 Land ownership

Registered Owner/s	Lot / Plan	Tenure	Property Name
sch4p4(6) Personal information	100 / RP882349	Freehold	sch4p4(6) Personal information
	1 / RP904099	Freehold	
	4 / HT165	Freehold	
	2 / RP904099	Freehold	
	4 / RP801280	Freehold	
	1 / HT424	Freehold	
	47 / H406	Freehold	
Magnetic South Pty Ltd	2 / HT138	Lands Lease	-
The State of Queensland (Department of Transport and Main Roads)	643 / SP260475	Lands Lease	Rail corridor
	624 / SP260477	Lands Lease	
	25 / HT655	Lands Lease	-

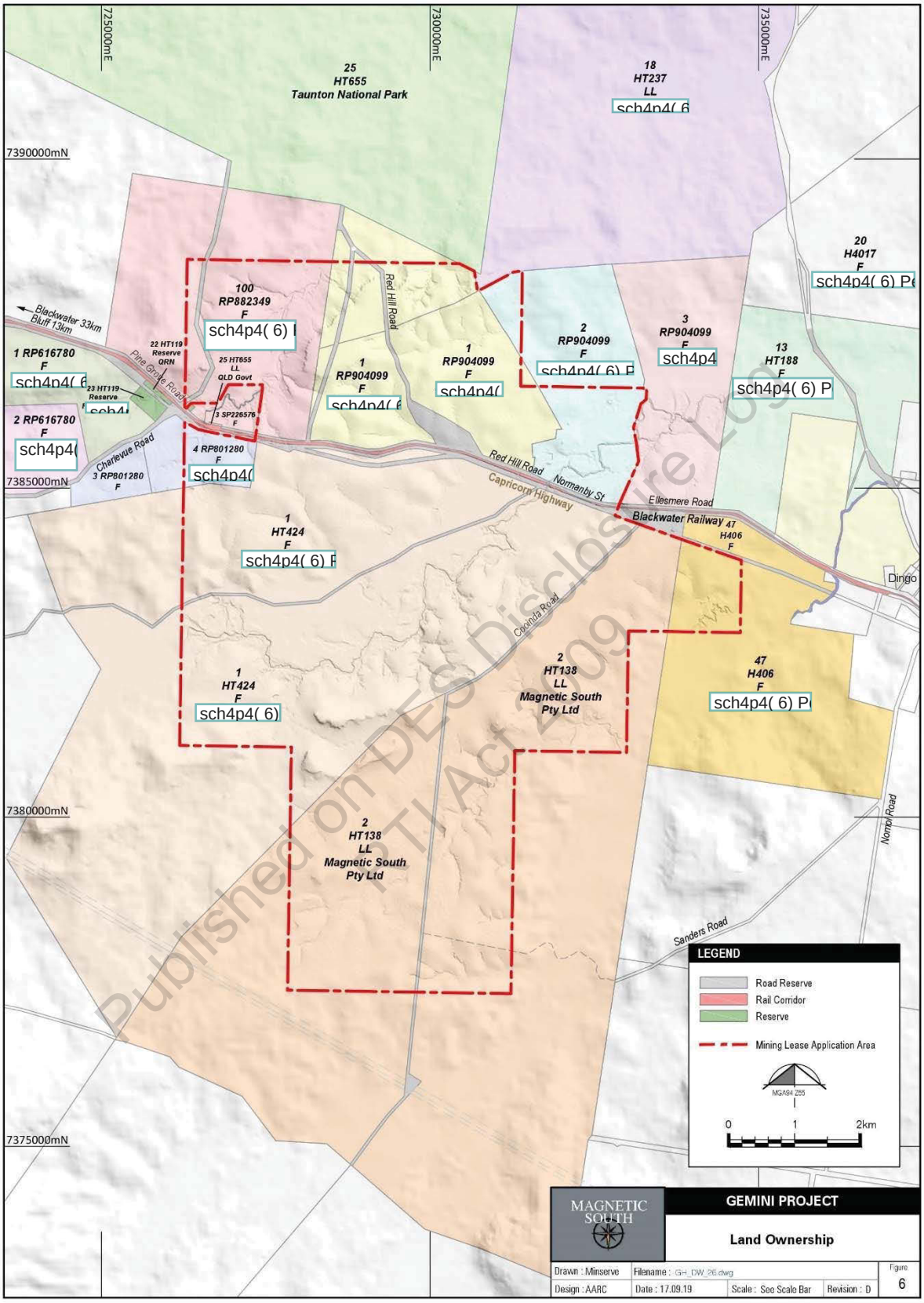


Figure 6 Land ownership

3.0 PROJECT DESCRIPTION

3.1 PROJECT OVERVIEW

The Gemini Project is a greenfield, open-cut metallurgical coal mine producing pulverised coal injection (PCI) coal and coking coal for export to the international steel making industry.

The Project is located in the Bowen Basin, a well-established coal mining area with existing transport infrastructure. The Project will bring benefits to the local community, region, Queensland and the Commonwealth through direct employment opportunities, royalties and taxes. The Project will also utilise the services of regional suppliers of rail, power, water, communications, contractors, service providers and local businesses, which will have a positive economic impact beyond direct employment.

The Project term is anticipated to be 25 years from grant of the mining lease (ML); with this term including initial construction, mine operation and rehabilitation activities.

Mine construction activities are scheduled to commence in July 2021; subject to granting of the Project ML and EA. It is anticipated that it will take approximately six months to establish the necessary infrastructure to commence overburden removal and 18 months to commence coal production.

The main activities associated with the Project include:

- Exploration activities continuing in order to support mine planning.
- Development of a mine infrastructure area (MIA) including mine offices, bathhouse, crib rooms, warehouse/stores, workshop, fuel storage, refuelling facilities, wash bay, laydown area, sewage, effluent and liquid waste storage, and a helipad.
- Construction and operation of a coal handling preparation plant (CHPP) and coal handling facilities adjacent to the MIA; including run-of-mine (ROM) coal and product coal stockpiles and rejects bin/overflow (coarse and fine rejects).
- Construction and operation of a surface conveyor from the product stockpiles to a train load out (TLO) facility and rail loop connecting to the Blackwater Railway to transport product coal to coal terminals at Gladstone for export.
- Construction of an accommodation facility within the bounds of the MLA.
- Construction of access roads from the Capricorn Highway to the MIA, and from the Capricorn Highway to the TLO facility.
- Installation of a raw water supply pipeline to connect to the Blackwater Pipeline network.
- Construction of a 66 kV transmission line and switching/substation to connect to the existing regional network.
- Other associated minor infrastructure, plant, equipment and activities.
- Development of mine areas (open-cut pits) and out-of-pit waste rock emplacements.
- Drilling and blasting of competent waste material.

- Mine operations using conventional surface mining equipment (excavators, front end loaders, rear dump trucks, dozers).
- Mining up to 1.9 Mtpa ROM coal (average of 1.8 Mtpa) for a construction/production period of approximately 20 years.
- Progressive placement of waste rock in:
    - Emplacements, adjacent to and near the open-cut voids; and
    - Mine voids, behind the advancing open-cut mining operations.
- Progressive rehabilitation of waste rock emplacement areas and mined voids.
- Progressive establishment of soil stockpiles, laydown area and borrow pits (for road base and civil works; material will be sourced from local quarries where required).
- Disposal of CHPP rejects (coarse and fine rejects) in out-of-pit spoil dumps, and in-pit behind the mining void.
- Progressive development of internal roads and haul roads including a causeway over Charlevue Creek to enable coal haulage and pit access.
- Development of water storage dams and sediment dams, and the installation of pumps, pipelines, and other water management equipment and structures including temporary levees, diversions and drains.

Existing local and regional infrastructure, facilities and services would be used to support Project activities. These include the SunWater water distribution network, the Aurizon rail network, Ergon's electricity network, the Capricorn Highway, and Gladstone export coal terminals.

3.2 PROJECT DISTURBANCE AREA

A conceptual Project layout is provided in Figure 7 which represents the total area disturbed by mine operations only and does not equate to the disturbance footprint at any one point in time. Open-cut mining areas will be developed and rehabilitated progressively. The total disturbance footprint for the Project is 1,961.2 ha which incorporates all mining and infrastructure components as described in Table 6.

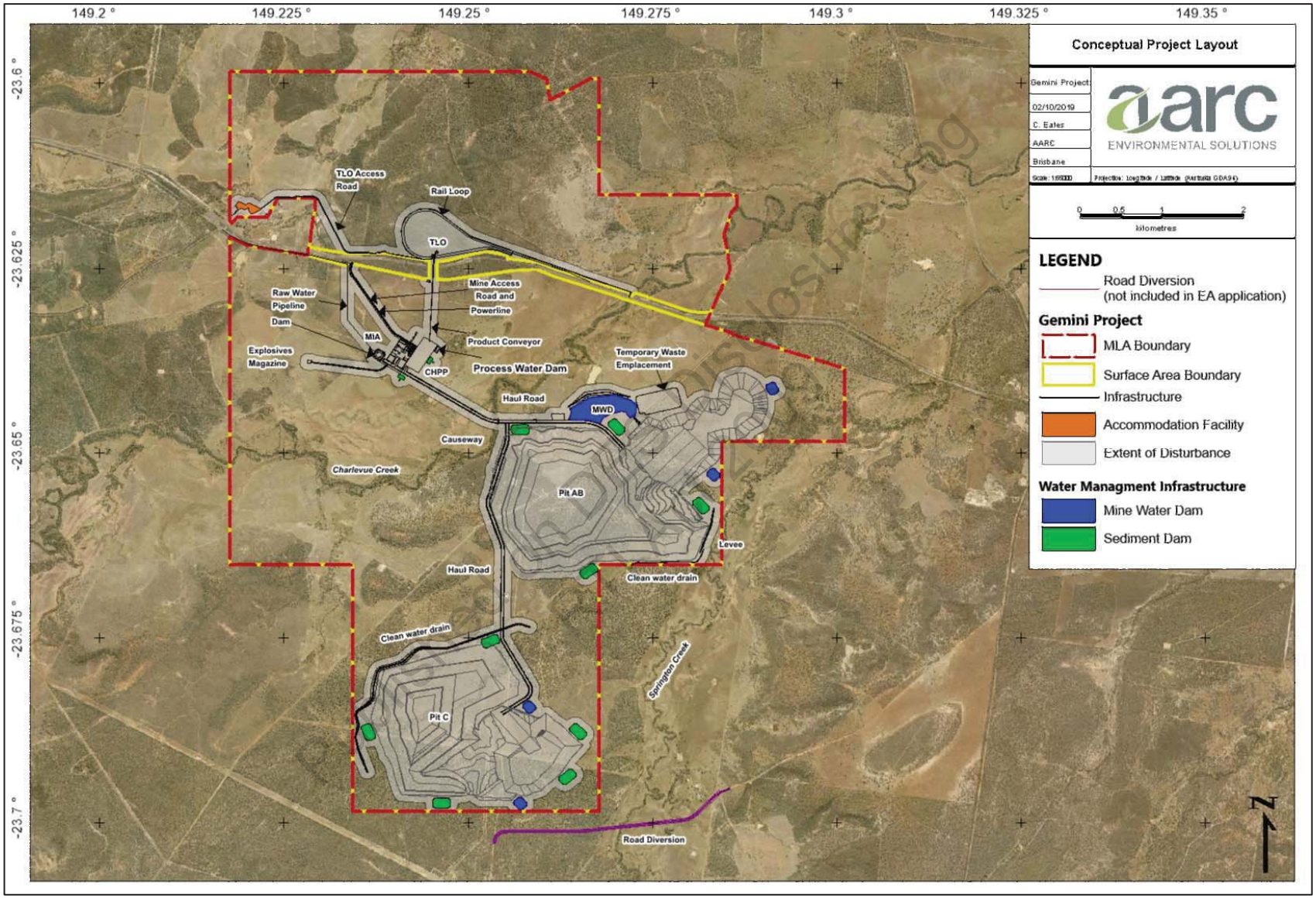


Figure 7 Conceptual Project layout

Table 6 Project disturbance area

Proposed Disturbance	Approximate Area (ha)
Pit AB open-pit and out-of-pit waste emplacement area.	704.8
Pit AB out-of-pit temporary waste emplacement.	33.2
Pit C open-pit and out-of-pit waste emplacement area.	500.6
MIA, CHPP, ROM and product stockpiles, explosives storage, mine access road and power supply corridor, water supply corridor, and raw water dam.	139.1
TLO facility, rail loop, overhead conveyor and TLO access road.	176.7
Haul roads.	143.4
Clean water drains, temporary flood protection levee, and water storages (mine affected water dams, sediment dams and process water dam).	249.3
Accommodation facility	14.2
Total	**1,961.2**

3.3 CONSTRUCTION

Proposed infrastructure and other development activities for the Project during the construction phase will include:

- Mine access road from the Capricorn Highway to the MIA, associated Capricorn Highway intersection, site access security infrastructure and car parking at the MIA;
- MIA;
- Explosives magazine;
- CHPP and associated coal handling infrastructure;
- TLO facility and access road;
- Haul road to Pit AB including a low level causeway across Charlevue Creek; and

  Construction of the haul road to Pit C is anticipated to commence in Year 11 of the Project.

- Accommodation facility.

These infrastructure components are described in Section 3.3.1 through to Section 3.3.3.

Water management infrastructure for the Project will include a temporary flood protection levee, clean water diversions for drainage features, mine affected water (MAW) dams, sediment dams, raw water dam and process water dam. The water management components are described in Section 3.4.3 (Water Management Infrastructure).

Supporting infrastructure required for the Project includes an electrical power transmission line (refer Section 3.5.1 (Power Supply)) and raw water supply pipeline (refer Section 3.5.2 (Water Supply)).

Site preparation will include the clearance of vegetation, topsoil removal and stockpiling, bulk earthworks and temporary drainage works. Initial site preparation works will be focused on the rail infrastructure, mine access road, MIA, CHPP and haul road. Site clearance will be staged throughout the construction phases on an "as needs" basis to coincide with infrastructure installation and development to minimise the extent and duration of disturbance.

Quarry materials will be sourced from onsite deposits, where available, for use as road base, select fill, rail ballast, rock protection, and other construction materials. It is expected that waste rock from pit excavation will provide the majority of construction and bulk fill materials, however, some material may also be sourced from the onsite Project disturbance footprint or from quarries in the region.

The majority of infrastructure components (e.g. CHPP, buildings, pipelines, etc.) will be manufactured offsite and transported to site for assembly and installation.

3.3.1 Mine Access Road

Vehicle access for mine personnel, contractors, suppliers and deliveries to the Project will be via a new mine access road from the Capricorn Highway. The concept design of the mine access road is shown in Figure 8. The proposed mine access road intersection will be located approximately 2.7 km east of the Capricorn Highway/Charlevue Road intersection. The concept design of the proposed intersection is shown in Figure 9. The design includes an auxiliary left turn treatment (AUL) – short turn lane and a channelised right turn treatment (CHR) with reduced length of right turn slots, which has been designed in accordance with the *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Austroads 2017).

The mine access road intersection will be sealed, while the remainder of the mine access road to the MIA will be unsealed. A *Traffic Impact Assessment* (Cardno 2019) has been prepared for the Project and is included as Appendix A.

A MIA will be constructed in the northwest of the MLA (Figure 7). An indicative layout of the MIA is shown in Figure 10. A security gate will be established at the entrance to the mine on the mine access road (Figure 10) to prevent inadvertent access to the mine site operations. The security gate will be positioned to direct visitors to the MIA and associated car park (Figure 10).

The MIA will include the mine offices, bathhouse, crib rooms, warehouses and storage areas, workshops, potable water storage, fuel storage and refuelling facilities, sewage, effluent and liquid waste storage, tyre bay, laydown area, Go-line, wash bay, and other associated amenities (Figure 10).

Personnel, visitors and deliveries will access the MIA and associated mine offices via the mine access road. Access from the MIA to the mining operations is via internal light vehicle access roads and the mine haul roads.

3.3.2 Explosives Storage

An explosives compound will be established to the west of the MIA (Figure 7 and Figure 11). Explosives magazines will be fenced, signed and maintained in accordance with *AS 2187.2-2006: Explosives – Storage and use (Part 2: Use of explosives).*

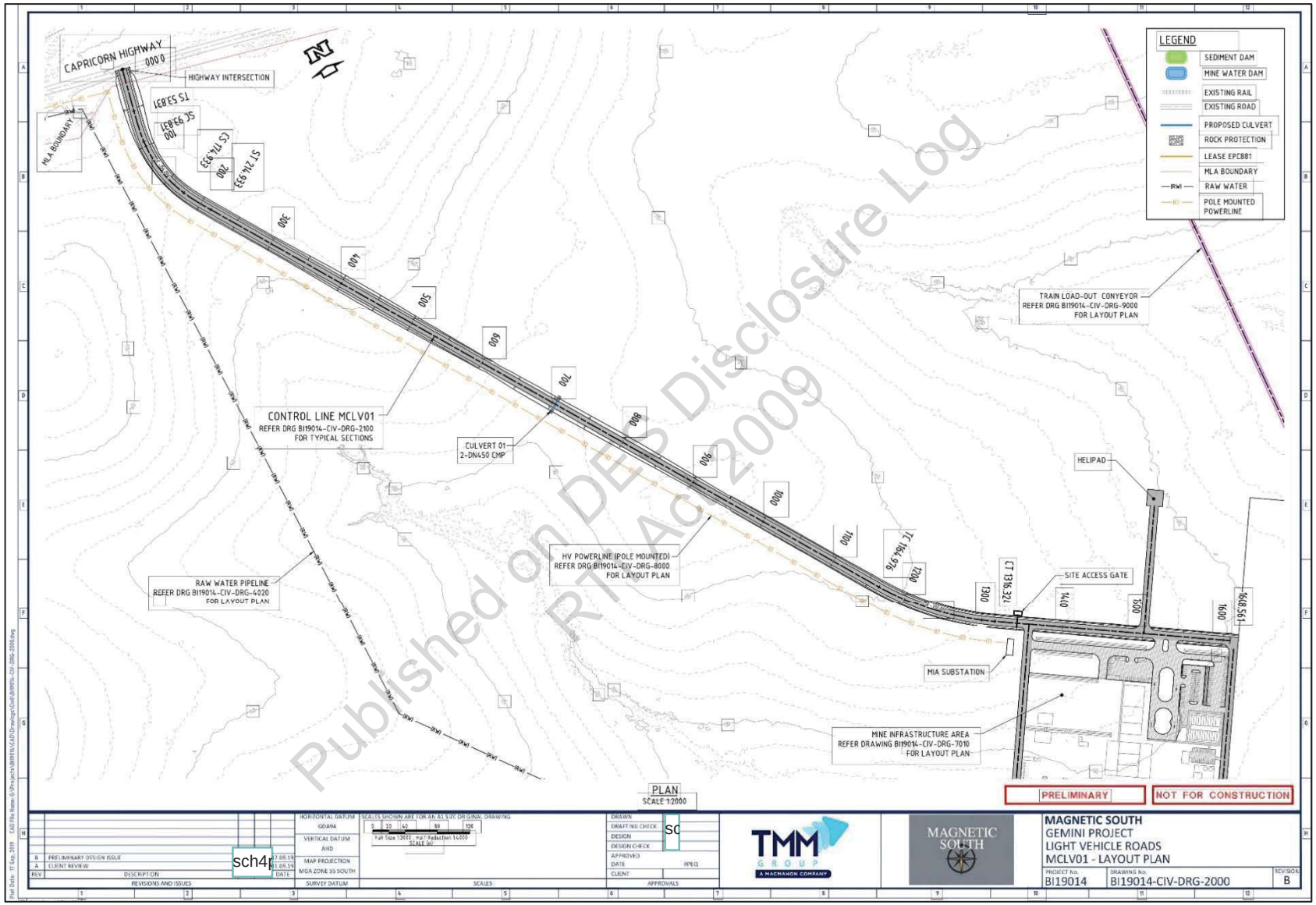
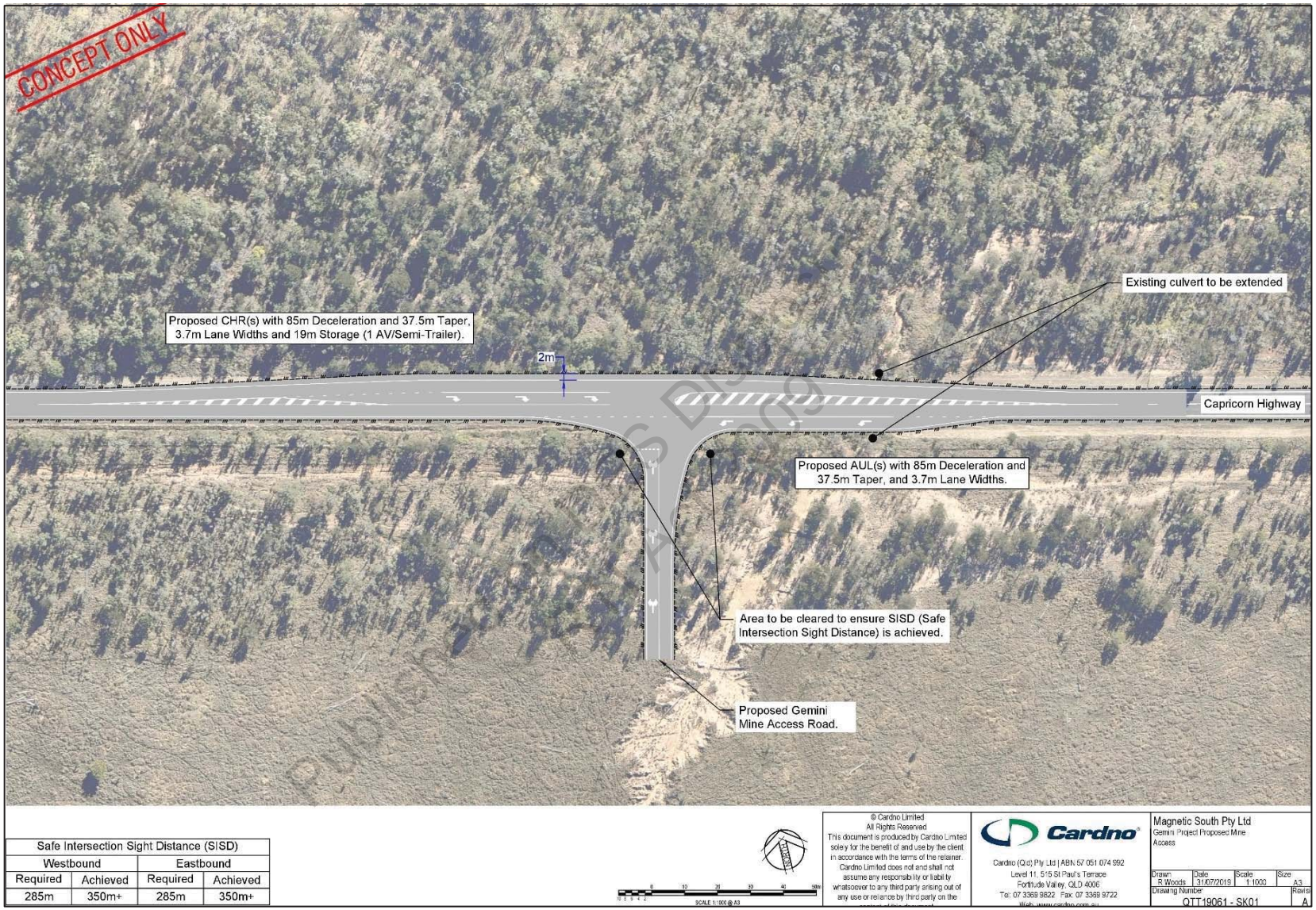


Figure 8 Mine access road conceptual design



Source: Cardno (2019) (Appendix A)

Figure 9 Mine access road intersection conceptual design

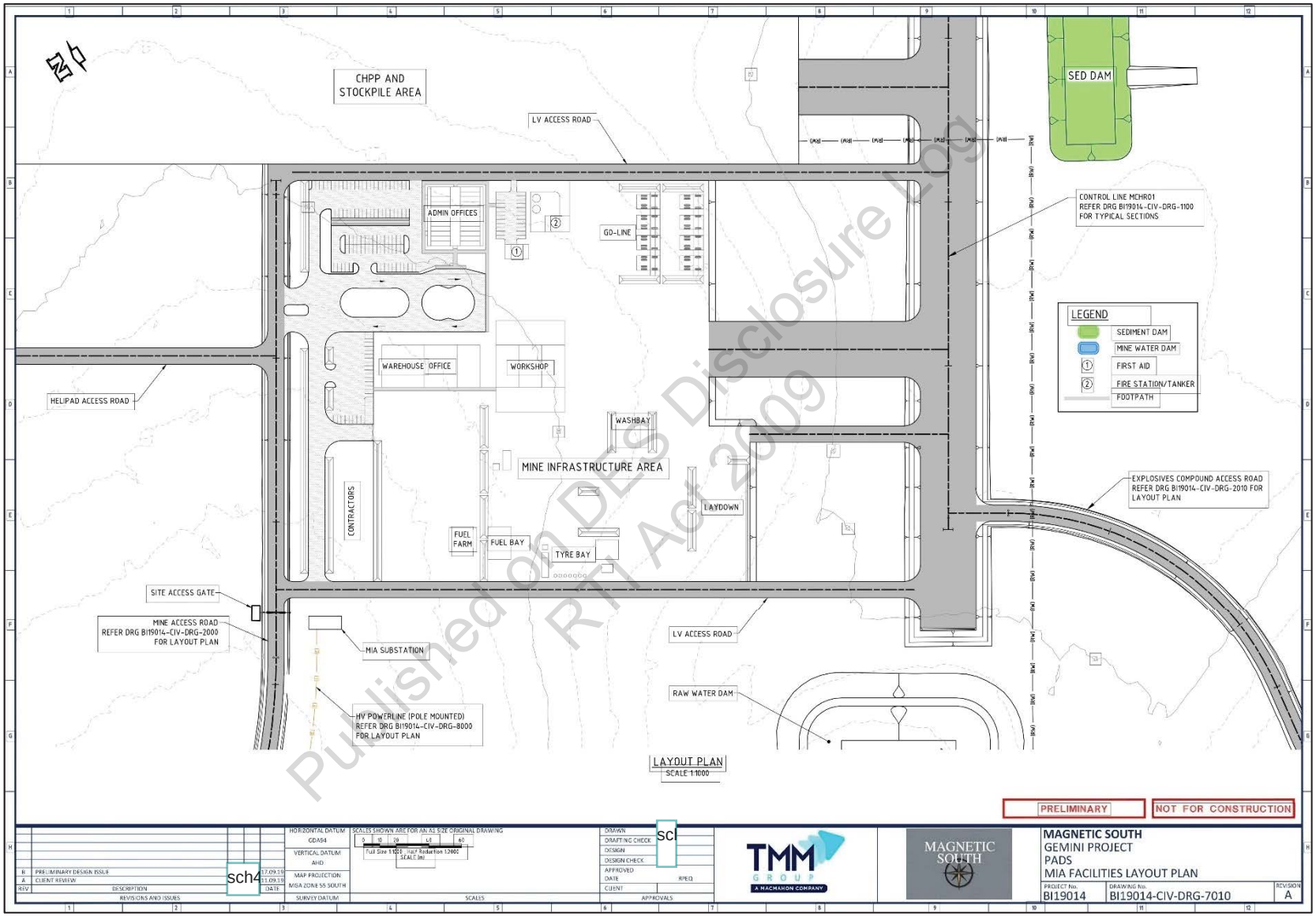


Figure 10 Mine infrastructure area conceptual layout

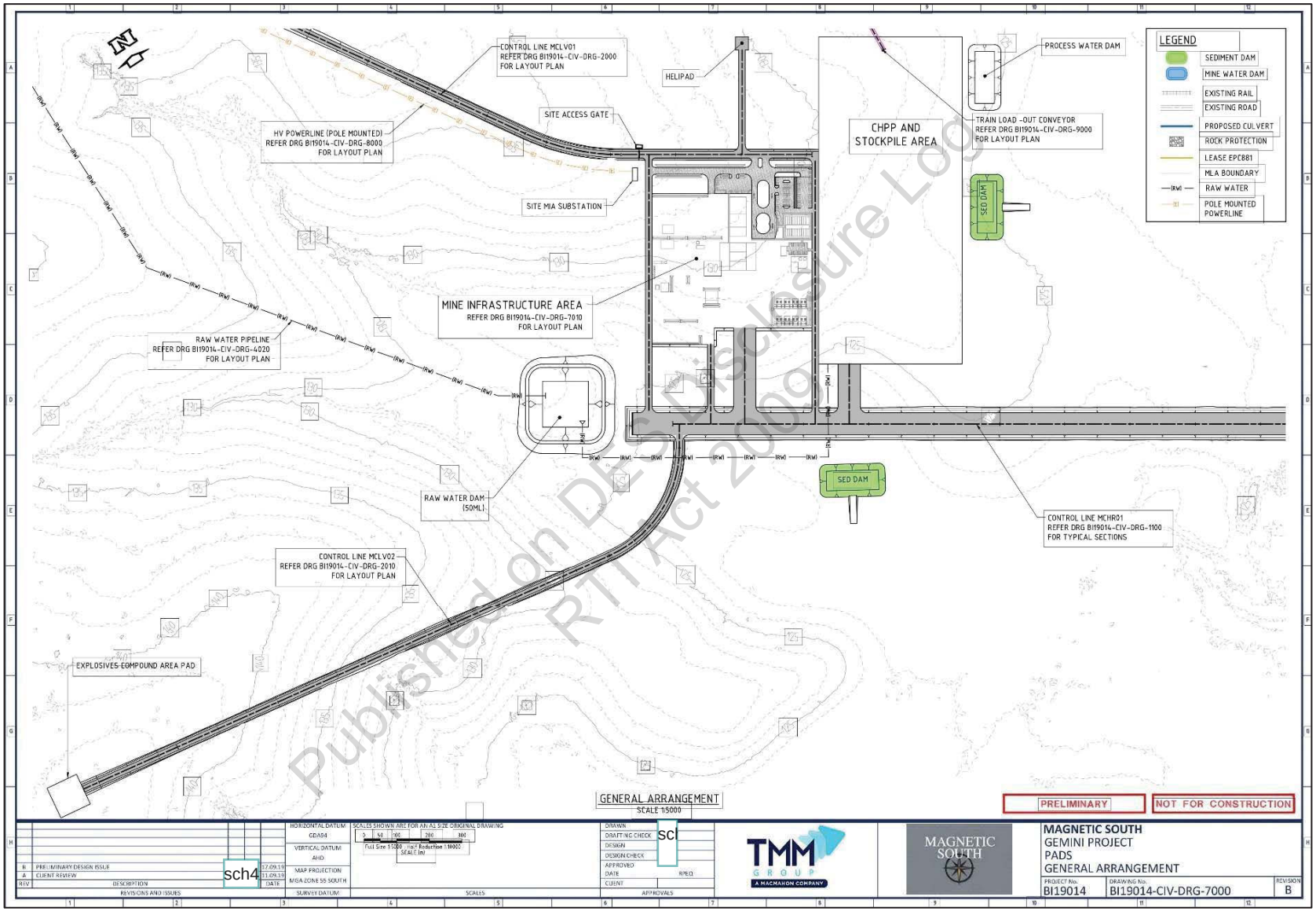


Figure 11 Mine infrastructure area and associated infrastructure general layout

3.3.3 CHPP, Stockpiles and Overland Conveyor

A CHPP and associated coal handling facilities will be constructed adjacent to the MIA (Figure 7 and Figure 11) and will include:

- CHPP;
- ROM coal stockpile;
- Product stockpile;
- Rejects bin and overflow (coarse and fine rejects); and
- Coal handling facilities including an overland conveyor to transport product coal to the TLO.

It is anticipated that construction of the CHPP and associated coal handling facilities will take approximately 18 months. The CHPP will operate 24 hours per day, 7 days a week.

Product coal will be direct fed to the train loading bin by conveyor from the product coal stockpile adjacent to the CHPP. The conveyor will be constructed to pass over both the Capricorn Highway and the Blackwater Railway (Figure 12). Concept design of the Capricorn Highway conveyor crossing is shown in Figure 13, and the Blackwater Railway conveyor crossing in Figure 14.

3.3.4 Train Load Out Facility and Access Road

A TLO facility comprising a rail spur, rail loop and train loading bin will be constructed adjacent to the Blackwater Railway (Figure 7).The rail spur and loop will be approximately 6 km in length and will connect to the Blackwater Railway west of the existing Charlevue Creek rail bridge.

Access to the TLO facility will be provided by an access road to be constructed on Lot 100 on Plan RP882349 (Figure 7). The TLO access road will utilise the existing level crossing on Pine Grove Road, be unsealed and will include a dry-weather creek crossing over Stanley Creek. This access road will be used for TLO construction activities and for operations.

An existing access track from the Capricorn Highway that runs beneath the rail bridge proximal to Charlevue Creek provides alternative access to the TLO, however, is suitable for light vehicles only.

3.3.5 Haul Roads

The alignment of the haul roads from the MIA to Pit AB and Pit C is shown in Figure 7. Construction of the haul road to Pit C is anticipated to commence in Year 11 of the Project.

The haul road to Pit AB will include a causeway to cross Charlevue Creek. The causeway will be designed for a 1 in 2 year rainfall event, with the capacity to carry a 500 t excavator on a float.

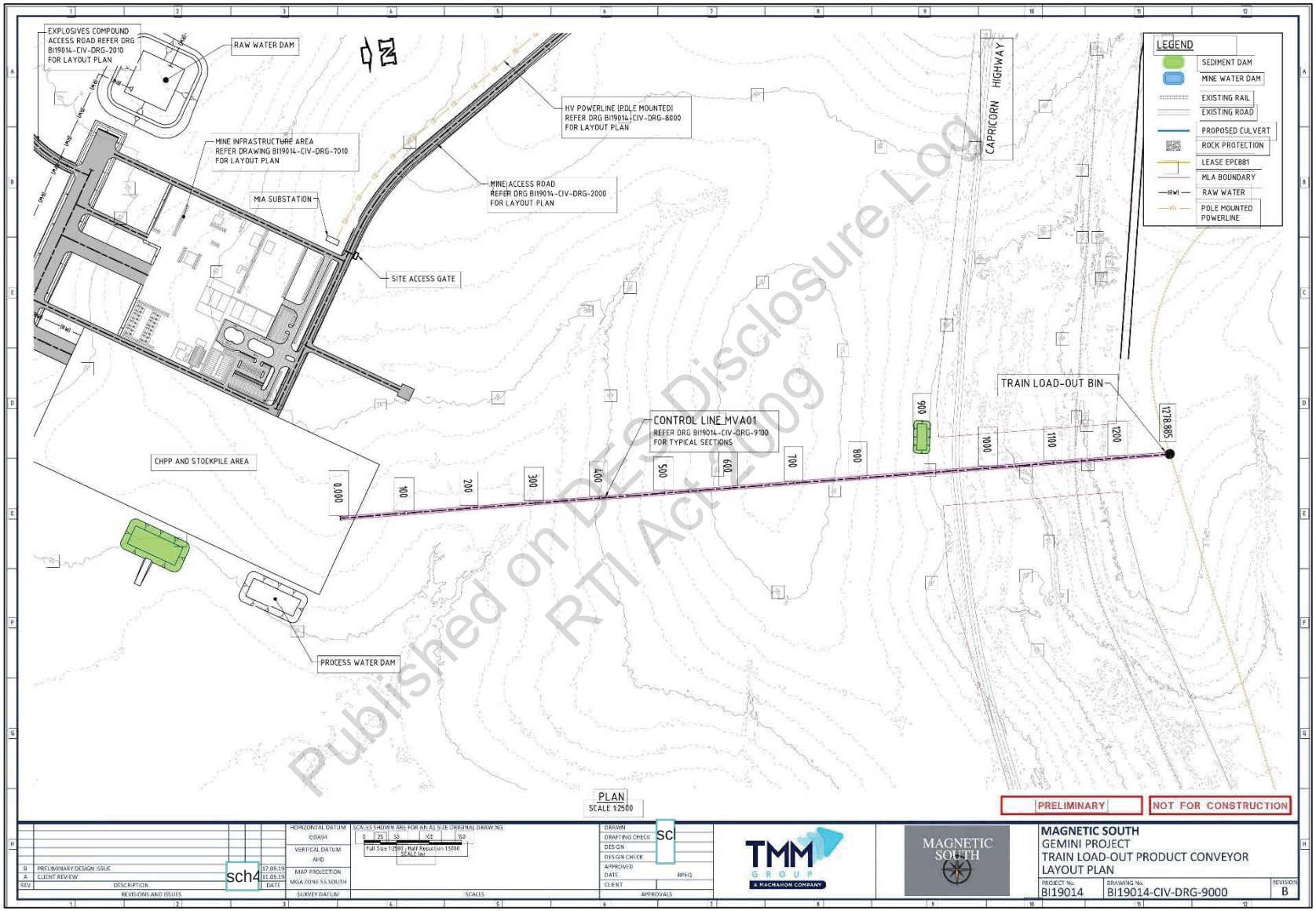


Figure 12 Product coal overland conveyor layout plan

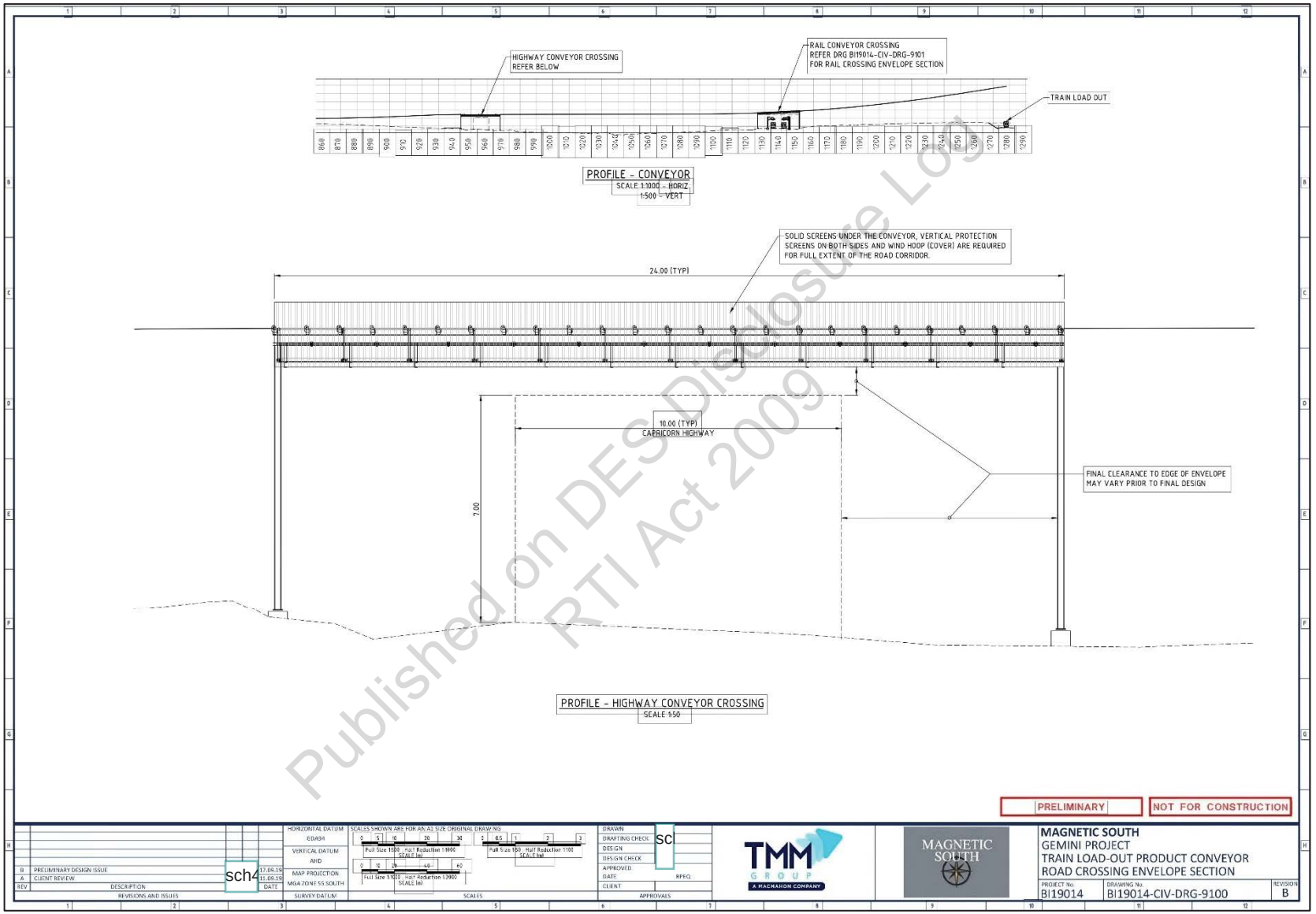


Figure 13 Capricorn Highway conveyor crossing conceptual design

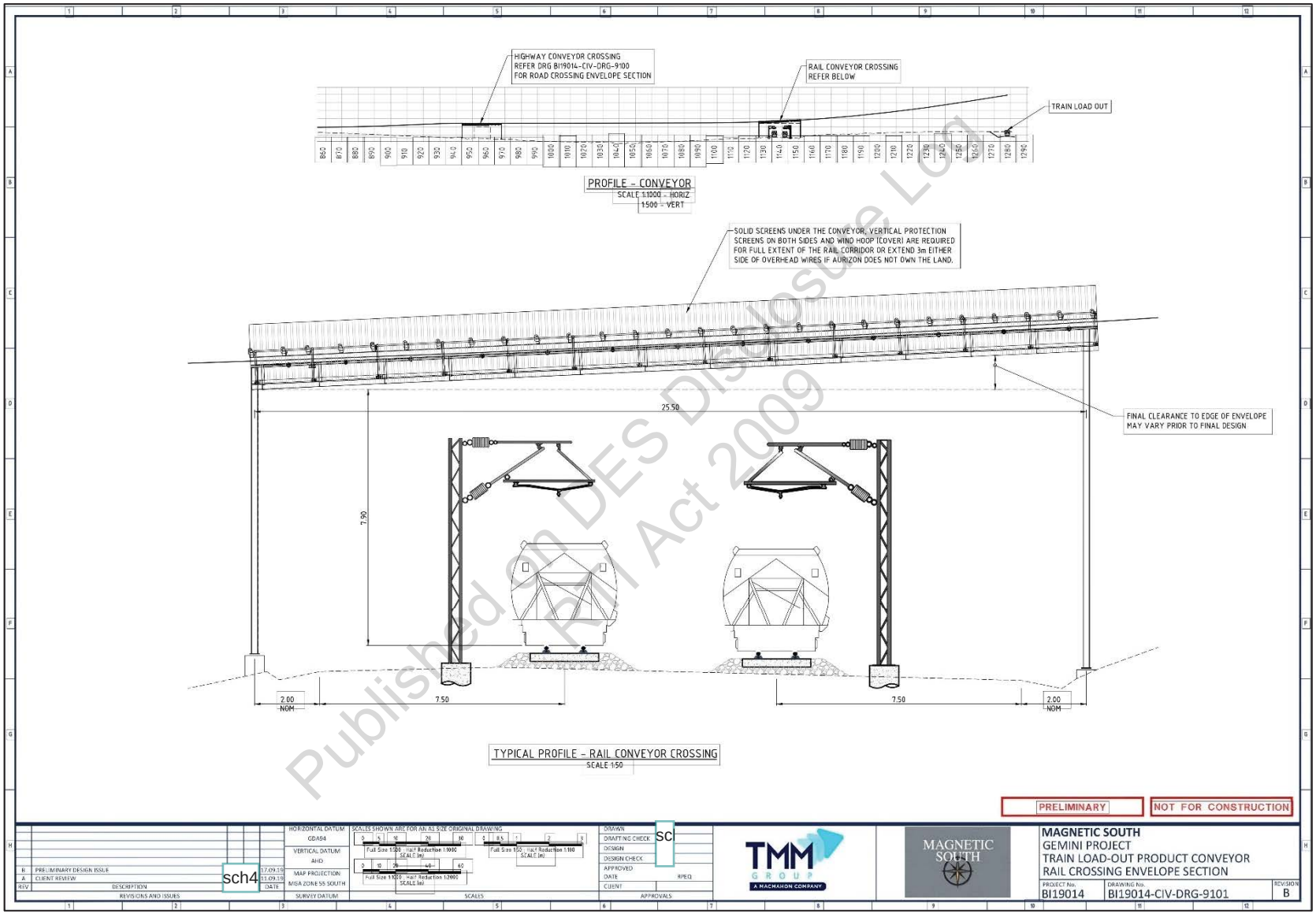


Figure 14 Blackwater Railway conveyor crossing conceptual design

3.4 SITE WATER MANAGEMENT

3.4.1 Water Management Principles

The 'Site Water Management System' (SWMS) for the Gemini Project is based on the following key principles:

- Divert clean catchment water around mining works to the extent practicable;
- Use/recycle lesser quality water in preference to higher quality water;
- Use potentially contaminated water in preference to imported raw water or uncontaminated water;
- Release water from site only in accordance with the conditions of the EA, such that the released water will not significantly impact on the values of the receiving waters or downstream properties;
- Manage water storages and transfers within the site in order to:
    - Maximise onsite storage to meet reasonably anticipated periods of wet and dry weather; and
    - Minimise disruption to mining operations.

3.4.2 Site Water Management System

For the purpose of site water management, site water has been classified into the types shown in Table 7 on the basis of the likely water quality characteristics.

The proposed strategy for the management of surface water at the Project is based on the separation of water from different sources based on anticipated water quality.

A conceptual SWMS was developed for the Gemini Project by WRM Water and Environment Pty Ltd (WRM) as a part of the *Surface Water Assessment* (Appendix B). On the basis of the expected runoff and groundwater inflow quality, the SWMS separates water into two segregated management systems:

1. **Mine affected water system:** will manage runoff and seepage from the mine pits, CHPP, coal stockpiles, and MIA. This is a closed system designed to prevent releases of MAW to the environment.
2. **Sediment water system:** runoff from overburden dumps will be managed under an *Erosion and Sediment Control Plan* which is to be implemented throughout the Project, such that sediment generated and transported by runoff will be settled in a sediment dam. As overburden runoff quality is expected to be relatively benign (refer Section 13.0 (Waste Rock and Coal Reject Geochemistry)), the sediment dams will potentially discharge directly into the environment (after the settlement of suspended sediment), and as such, will not affect the mine water balance. However, the water balance assessment has assumed sediment dams will be pumped back to the CHPP for reuse.

Clean water flows from undisturbed areas are generally diverted around the areas of disturbance. A raw water supply pipeline is proposed to supply all site water requirements prior to dam construction, and supplement site water supplies throughout the life of the Project. Raw water will be delivered to a

dedicated raw water dam (located adjacent to the MIA), which will also intercept clean water from its local upstream catchment.

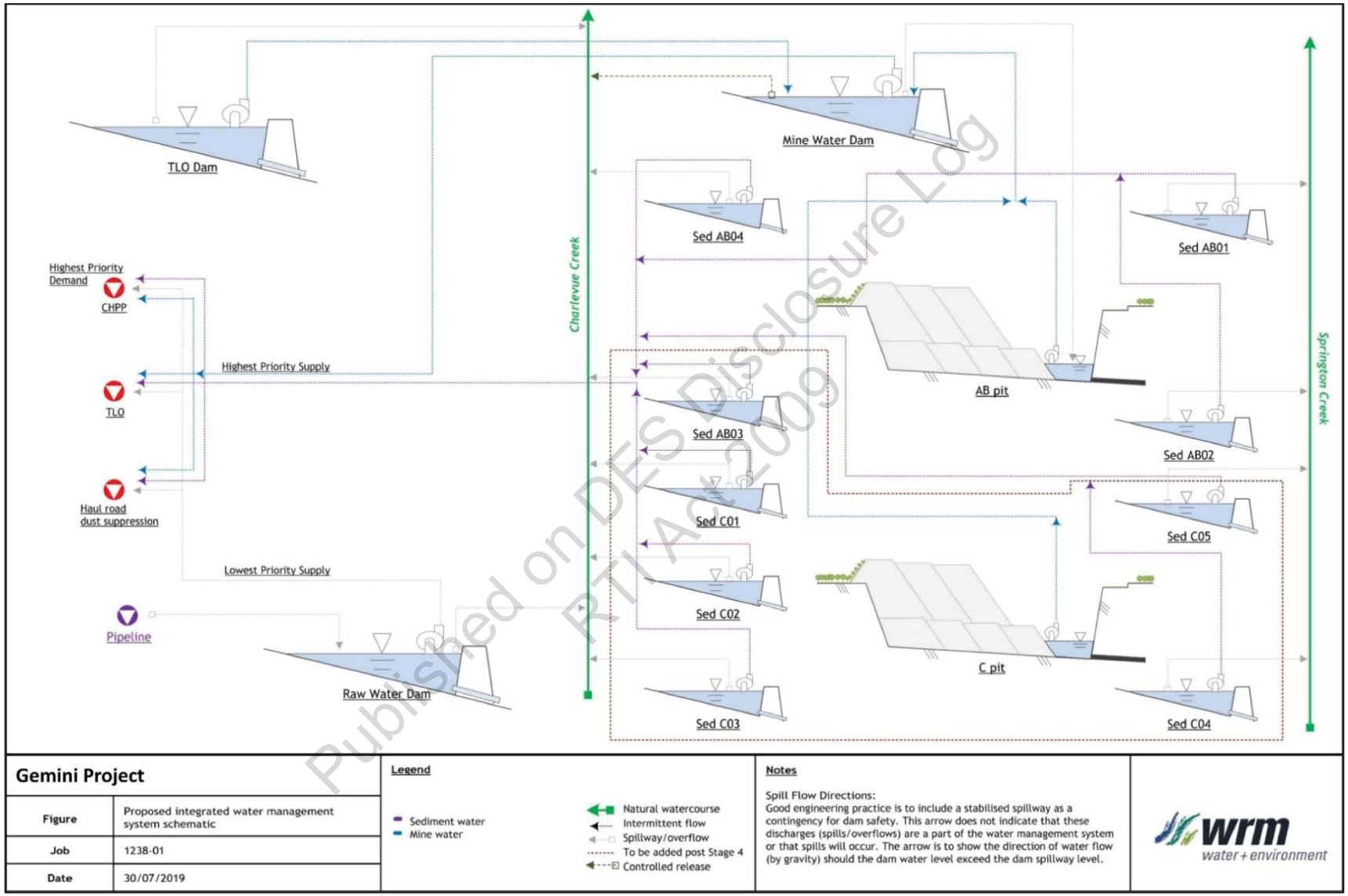
A site water balance model has been developed by WRM (2019b) to determine the most appropriate design of the SWMS. The site water balance forms the basis of impact assessment and infrastructure design for the site. Details of the site water balance are provided in Section 3.4.4 (Site Water Balance Model).

A schematic of the integrated SWMS configuration for the Project is shown in Figure 15.

Table 7 Site water types

Water Type	Definition
Mine affected water	In accordance with the *Model mining conditions* (DES 2017e), MAW means the following types of water: i) pit water, tailings dam water, processing plant water; ii) water contaminated by a mining activity which would have been an ERA under Schedule 2 of the EP Regulation if it had not formed part of the mining activity; iii) rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated, excluding rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed in accordance with the standards and requirements of an *Erosion and Sediment Control Plan* to manage such runoff, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water; iv) groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated; v) groundwater from the mine dewatering activities; vi) a mix of MAW (under any of paragraphs i to v) and other water.
Sediment water	Surface water runoff from areas that are disturbed by mining operations (including out-of-pit waste rock emplacements). This runoff does not come into contact with coal or other carbonaceous material and may contain high sediment loads but does not contain elevated level of other water quality parameters (e.g. electrical conductivity, pH, metals, metalloids, non-metals). This runoff must be managed to ensure adequate sediment removal prior to release to receiving waters.
Clean catchment water	Surface runoff from areas unaffected by mining operations. Clean catchment water includes runoff from undisturbed areas and fully rehabilitated areas.
Raw water	Untreated water, generally from an external water supply, that has not been contaminated by mining activities.
Potable water	Treated water suitable for human consumption.

Source: WRM (2019b) (Appendix B)



Source: WRM (2019b) (Appendix B)

Figure 15 Proposed integrated site water management system schematic

3.4.3 Water Management Infrastructure

The SWMS consists of infrastructure to provide catchment separation and manage water quality and quantity onsite. Infrastructure for the Project's SWMS includes:

- Temporary flood protection levee to protect Pit AB from potential flood waters;
- Clean water drains to divert runoff from undisturbed catchments around areas disturbed by mining activities;
- Sediment water drains to divert water from overburden emplacement areas, and areas yet to be rehabilitated;
- Sediment water dams to store water from overburden emplacement areas and allow settlement of sediment loads before discharging treated water or recycling back to the CHPP;
- Mine water drains to divert water from MIA, CHPP and coal stockpile areas into the MAW system; and
- Mine water dams to store water pumped out of the pit, and collect water from the MIA, CHPP and coal stockpile areas.

Figure 7 provides a schematic layout of proposed water management infrastructure for the Project.

3.4.3.1 Temporary Flood Protection Levee

A temporary flood levee designed to provide protection from a 0.1% annual exceedance probability (AEP) flood event will be constructed adjacent to Pit AB (Figure 7). The levee will be constructed prior to the commencement of waste stripping within Pit AB.

The design height of the levee ranges from 1.21 m to 2.37 m, determined by the modelled flood height, plus 0.5 m freeboard. The levee will be reinforced by in-pit rock dumps as mining progresses. The levee will be reshaped during rehabilitation of the waste rock emplacements and final backfill of Pit AB and be subject to rehabilitation.

3.4.3.2 Clean Water Drains

The Project will require two sections of a 'drainage feature' (as determined under the *Water Act 2000* (Water Act) to be diverted around surface disturbance areas associated with Pit AB and Pit C (Figure 7). This will allow the runoff from undisturbed upslope catchments to flow around the operations, minimising the impact on the downstream environment, while also minimising the potential volume of water captured into the MAW system. The drainage feature is a tributary of Springton Creek and is not considered to be a 'watercourse' as defined by the Water Act.

3.4.3.3 Water Storages

Water storages will include MAW dams, sediment dams, raw water dam, and process water dam. All storages will be located such that they are above the 0.1% AEP flood level.

All water storage dams, structures and facilities will be designed, constructed and managed in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016).

Water collected in sediment dams will be captured and retained for reuse on-site and/or controlled release off-site to the receiving environment in accordance with *Model water conditions for coal mines in the Fitzroy basin [ESR/2015/1561]* (EHP 2013a).

Process Water Dam

Water is used in the CHPP for the sizing and removal of waste material. Water recovered from the CHPP during processing will be recycled through a closed loop circuit whereby any wastewater from the CHPP is temporarily stored in the process water dam and reused in the CHPP.

Mine Water Dams

Water that accumulates in the pits will be transferred to contained water storages (i.e. mine water dams) for beneficial use (i.e. dust suppression and/or CHPP water supply). Pit AB will be used as a supplementary mine water storage after commencement of mining in Pit C. A number of small staging dams may be used to collect water pumped from the mine pits before transferring to the mine water dam. These ancillary dams are designed to overtop back into the pits. The main mine water dam is located to the north of Pit AB and offsite discharge of mine water will be avoided by operating below a maximum operating level and directing emergency overflows from the mine water dam via a spillway to the Pit AB.

MIA dams will capture and contain runoff from the MIA and coal stockpiles. Oil/water separators are proposed for vehicle wash and workshop areas to treat hydrocarbon contaminated runoff prior to capture. These dams will be sized to ensure full containment of MIA and coal stockpile runoff.

A series of sediment traps and small drainage dams will be used to capture washdown and overflow from trains and sumps before it is directed to the TLO dam. Water collected in this small dam will be pumped to the mine water dam.

Sediment Dams

Sediment dams will be constructed to contain runoff from the waste rock emplacements and haul roads. The sediment dams allow for gravity settling of sediment prior to re-use of the water onsite or release offsite. The sediment dams will be designed in accordance with *Best Practice Erosion and Sediment Control* (IECA Australasia 2008) and the guideline for *Stormwater and environmentally relevant activities [ESR/2015/1653]* (EHP 2017).

The sediment dams have therefore been sized as follows:

- Water storage capacity 0.1% AEP 24-hour storm event with an adopted volumetric event runoff coefficient for disturbed catchments of 0.5;
- *Total sediment basin volume = settling zone capacity + sediment storage volume.*
  The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted; and
- *Solids storage volume = 25% of water storage volume.*

If required, water captured in sediment dams will be pumped back into the MAW system.

The sediment dams will be maintained until such time as vegetation within the catchment of the sediment dams successfully establishes and where runoff has similar water quality characteristics to areas that are undisturbed by mining activities. Sediment dams may be maintained during rehabilitation to augment site water requirements.

Raw Water Dam

A raw water dam will be located adjacent to the MIA (Figure 7 and Figure 11) and will be sized to hold approximately 100 megalitres (Ml). The raw water dam will store water transported to site via the raw water pipeline from Blackwater, described in Section 3.5.2 (Water Supply).

3.4.4 Site Water Balance Model

The operating life mine stage plans were used to determine progressive catchment areas and land use types for each mine water storage. These 'snapshots' of mine operations were adopted for the site water balance modelling. A computer-based operational simulation model (OPSIM) was used to assess the dynamics of the mine water balance under conditions of varying rainfall and catchment conditions throughout the development of the Project, based on the SWMS described in Section 3.4.2 (Site Water Management System). The model was configured to simulate the operations of all major components of the water management system. Detailed water balance modelling methodology is provided in Appendix B.

Water Demand

Water demands calculated for the operational life include CHPP coal washing and conveyor dust suppression, haul road dust suppression, and TLO dust suppression demands. The estimated annual demands for the operational Project are summarised in Table 8.

Table 8 Summary of site water demands and expected groundwater inflows

Year	Demand (Ml/a)				Net Groundwater Inflow (Ml/a)
	CHPP	Haul Road	TLO	Total	
1	162.0	314.6	0.72	477.3	**31.5**
2	162.0	314.6	0.73	477.3	**31.5**
3	162.0	314.6	0.73	477.3	**31.5**
4	162.0	314.6	0.73	477.3	**31.5**
5	162.0	333.4	0.73	496.1	**31.5**
6	162.0	333.4	0.72	496.1	**31.5**
7	162.0	333.4	0.72	496.1	**31.5**
8	162.0	333.4	0.71	496.1	**31.5**
9	162.0	333.4	0.72	496.1	**31.5**
10	162.0	333.4	0.72	496.1	**31.5**
11	162.0	401.5	0.70	564.2	**220.8**
12	162.0	401.5	0.74	564.2	**220.8**
13	162.0	401.5	0.74	564.2	**189.2**
14	162.0	464.9	0.74	627.6	**205.0**
15	162.0	464.9	0.74	627.6	**31.5**
16	162.0	511.8	0.72	674.5	**31.5**
17	162.0	511.8	0.74	674.5	**31.5**
18	143.4	511.8	0.65	655.9	**47.3**
Total	**2,897.4**	**6,928.5**	**13.00**	**9,838.9**	**1,292.6**

Source: WRM (2019b) (Appendix B)

Groundwater Inflows

A indicated that there will be small 'pumpable' inflows of groundwater to mining pits at the end of operations. Current active pits do not indicate any groundwater inflows. Groundwater inflows to the pits have been assumed to increase in a linear manner over time.

Groundwater inflows were estimated in the *Groundwater Impact Assessment* (JBT 2019), which is discussed further in Section 8.0 (Groundwater) and attached as Appendix C. The estimates provided by JBT (2019) are net inflows to the pit after evaporation losses from the pit faces and the entrained moisture losses due to mining. The net inflow rates adopted for the site waster balance model are provided in Table 8.

Overall Water Balance

The overall average annual site water balance is summarised in Table 9. The results demonstrate the adaptive capacity of the SWMS to changing mine stages and climatic variability.

Over the life of the Project, the results of the site water balance indicate that small volumes of external water supply will be required at each stage of the Project, with the exception of Stage 1 (first four years of Project). Haul road dust suppression forms the greatest demand for water on the site, while the greatest loss of water is caused by evaporation.

Total average inflows increase steadily during the first three stages (13 years) of the Project from approximately 1,000 Ml/a to approximately 1,500 Ml/a. A larger increase is evident in Stages 4 and 5, with the commencement of Pit C adding a greater runoff catchment area which increases total average inflows to around 2,300 Ml/a over the final five years of the Project.

Total average outflows, steadily increase over the operational life of the Project from approximately 1,000 Ml/a to approximately 2,000 Ml/a.

The model of the SWMS has been configured to ensure MAW is contained within the system. Hence, the modelled results show no spills of MAW from the mine water dams (not including sediment dams).

When the sediment dams exceeds their maximum operating volumes, sediment dams are allowed to discharge offsite. Note that sizing of the proposed sediment dams is in accordance with *Best Practice Erosion and Sediment Control* (IECA Australasia 2008).

External Water Supply

Site water requirements are preferentially sourced from the MAW system and supplemented as required by the sediment water system. However, in the event that both systems are not sufficient to meet operational water requirements, external raw water will be supplied by a spur pipeline from the Blackwater Pipeline (refer Section 3.5.2 (Water Supply)) and transferred to the raw water dam.

'External supply pipeline' refers to the quantity of raw water imported from external sources (i.e. SunWater) which is then transferred to the raw water dam.

Potential imported water requirements have been assessed using forecast simulation. The results show that:

1. Imported water requirements from the external pipeline are highest in the early Project stages.

2. Under very dry conditions, the demand could reach 500 Ml/a, but median Year 1 demand is less than 100 Ml/a.

3. During later years, accumulated stored water in the MAW system and sediment water system is sufficient to supply demands in all but the driest years.

Table 9 Average annual site water balance

Process	Stage 1 Y1-Y4	Stage 2 Y5-Y10	Stage 3 Y11-Y13	Stage 4 Y14-Y15	Stage 5 Y16-Y18	Total
Inflows (Ml/a)						
Rainfall and runoff	973	1,052	1,215	2,148	2,214	7,602
Net groundwater inflow	32	32	210	118	37	428
External supply pipeline	89	51	29	17	11	196
Total Inflows	**1,093**	**1,135**	**1,454**	**2,283**	**2,261**	**8,226**
Outflows (Ml/a)						
Evaporation	250	317	386	629	762	2,344
Haul road dust suppression	315	336	405	469	515	2,040
CHPP Usage	162	162	162	162	162	810
Spill from Raw Water Dam	37	41	41	43	44	206
Spill from Sediment Dams	223	245	398	669	652	2,187
Spill from MAW Dams	0	0	0	0	0	0
Total Outflows	**988**	**1,102**	**1,392**	**1,972**	**2,135**	**7,587**
Change in Site Water Inventory (Ml/a)	**102**	**29**	**59**	**308**	**122**	**619**

Source: WRM (2019b) (Appendix B)

3.5 SUPPORTING INFRASTRUCTURE

3.5.1 Power Supply

Electricity supply to the region is provided by a Powerlink 275 kV/132 kV substation at Blackwater (Rangal Substation). Electricity is currently supplied to properties within the local area from a 132 kV/66 kV substation at Blackwater, as well as Ergon substations at Dingo and Bluff. Ergon Energy distributes electricity from these substations to local customers.

Power to the mine will be supplied by the construction of a 66 kV transmission line and an onsite switching/substation located adjacent to the MIA. The transmission line will be connected to the regional network and be installed along the alignment of the mine access road to the MIA (Figure 8). Diesel power generation will be used for construction activities and until the transmission line is completed.

3.5.2 Water Supply

SunWater operates the Blackwater Pipeline network, which supplies water from the Bedford Weir (part of the Nogoa-Mackenzie River pipeline network) to the town of Blackwater and a number of nearby coal mines.

A spur pipeline from the Blackwater Pipeline will be constructed for the Project by SunWater with the take-off point located near the Blackwater Treatment Plant. SunWater has advised there is sufficient availability of water within the Mackenzie Nogoa River network to provide the Project's estimated water requirements. Within the MLA the water supply pipeline will be installed proximal to the mine access road corridor and connect to the raw water dam near the MIA (Figure 16).

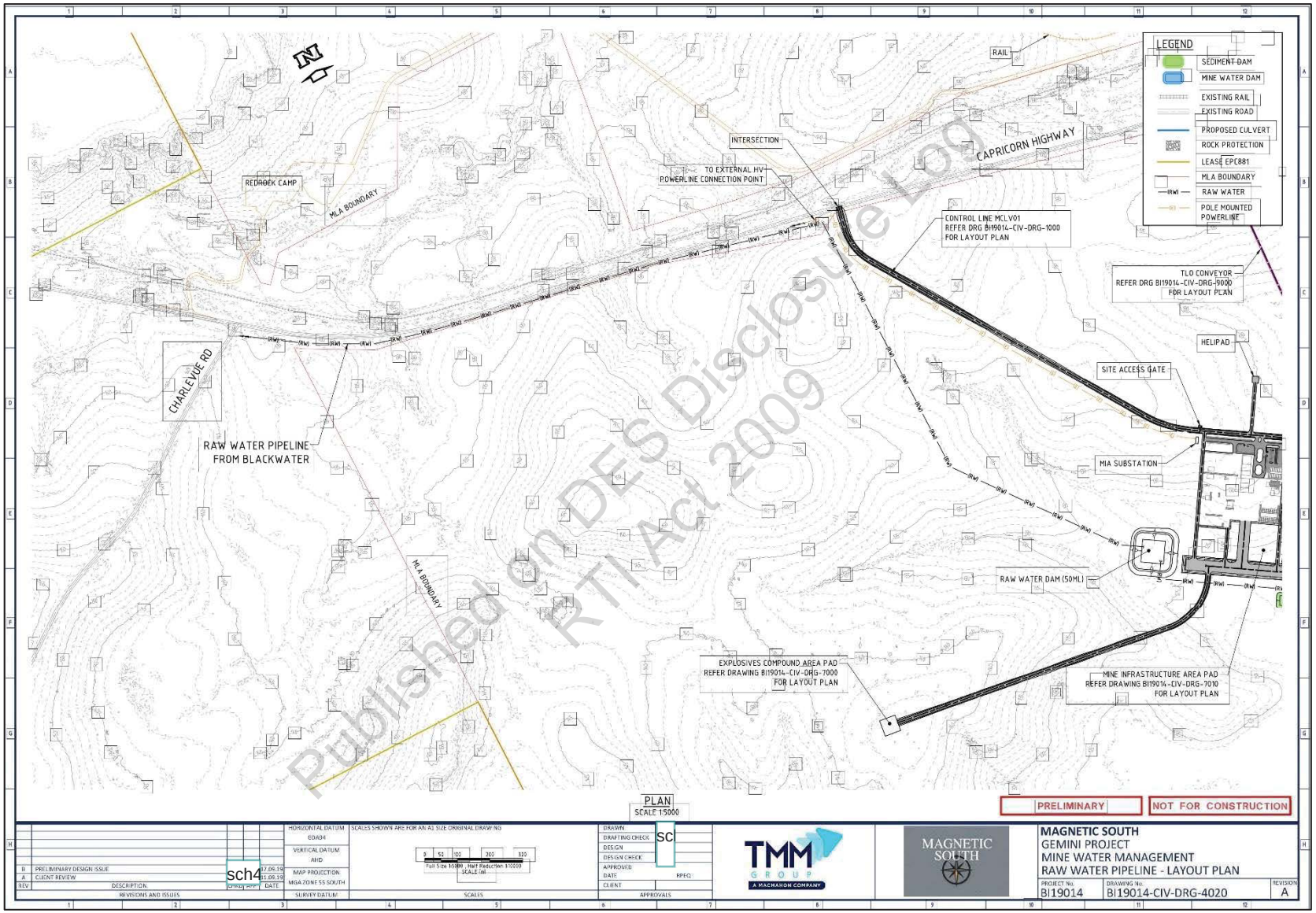


Figure 16 Raw water supply pipeline layout plan

During construction water will be required for dust suppression and civil works, as well as potable water for drinking. Water will be sourced from regional suppliers and transported to site by tanker and stored at the MIA until the permanent supply is established. Potable water may also be supplied by truck from Blackwater.

3.5.3 Sewerage

The Proponent will operate and manage an onsite septic system, which will be located at the MIA to service the office area. Waste from the septic system will be regularly pumped out and removed by a regulated waste contractor for disposal as required. Servicing or maintenance of the system, will be contracted to a licensed plumber to undertake the works, as required.

The Proponent will also operate and manage a sewage treatment plant (STP) located at the accommodation facility. The likely STP is a membrane bioreactor, with an appropriately sized pump station to minimise the retention of raw sewage to less than eight hours. This will mitigate the potential for production of odour and volatile organic compounds. The STP will have a maximum capacity of 140 equivalent persons (EP).

Treated wastewater from the STP will be disposed of using low height sprays in a designated irrigation area while the remaining sewage sludge will be removed by a licensed regulated waste contractor for offsite disposal. An effluent disposal system will be implemented to ensure that spray drift does not occur to any sensitive or commercial places. This will be achieved by using low pressure sprays with a greater number of spray nozzles for the required disposal area. Additionally, the design of the system will ensure no runoff from the disposal area occurs.

Treated effluent will be irrigated to a designated area on dry days in accordance with EA conditions. All effluent released will be monitored for pH and faecal coliforms and comply with the appropriate limits prescribed by the EA for the Project.

During the initial site preparation phase, prior to installation of the STP, all sewage will be contained at the MIA and transferred by a certified third-party contractor to an appropriately licensed regional waste disposal facility.

Specific details and requirements regarding the sewage management system will be addressed in a *Waste Management Plan* (WMP) for the Project.

3.5.4 Telecommunications

High speed telecommunication services are available in the region via an existing fibre optic network. Connection to this network will be undertaken utilising either microwave or fibre optic cable. A cable connection will be established in the mine access road and power supply corridor.

3.5.5 Fuel Supply

Fuels will be stored within the MIA. Fuels (including diesel) will be delivered to the Project by contractors. The transport, storage and handling of fuels (including diesel) will be undertaken in accordance with relevant legislation and guidelines.

All equipment and vehicle operators will be trained in the safe operation of the equipment (including operating procedures for the refilling and maintenance of fuel storage tanks and mine vehicles) and the relevant emergency response procedures in the event of an incident.

Regular inspection programs will be undertaken to monitor the structural integrity of fuel tanks and bunds.

3.6 MINING OPERATIONS

3.6.1 Open-Cut Mining Method and Activities

The Project includes two mining areas referred to as Pit AB and Pit C. The open-cut mining areas will be mined using a conventional truck and shovel mining method with excavators and haul trucks.

Mining of Pit AB will be undertaken over a period of approximately 12 years. Out-of-pit waste rock emplacements are required until mine operations advance sufficiently to allow backfilling of the mine void. Out-of-pit waste rock emplacement for Pit AB will be conducted over a period of approximately eight years. In-pit waste rock emplacement will occur from Year 5. Following the completion of coal extraction from Pit AB, final backfilling of the Pit AB void will occur through the rehandling of out-of-pit waste rock emplacements from Year 12.

The development of Pit C is scheduled to commence in Year 12 (one year prior to the completion of mining in Pit AB) and mining will be undertaken over a period of approximately seven years. Out-of-pit waste rock emplacement will be undertaken for Pit C over a period of approximately four years. Once operations have advanced sufficiently, backfilling of the mine void will commence and continue as the mining face advances. Following the completion of coal extraction from Pit C in Year 18, final backfilling of the Pit C void will occur through the rehandling of the out-of-pit waste rock emplacement.

A summary of the open-cut mining activities is provided below.

Vegetation Clearing and Topsoil Stripping and Handling

Vegetation will be progressively cleared over the life of the Project ahead of the active mining and waste rock emplacement areas. Specific vegetation clearance procedures will be developed for the Project as described in Section 5.0 (Land).

Topsoil from disturbed areas will be stripped and stockpiled for use in rehabilitation of the final landform. Where stripped topsoils cannot be used directly for progressive rehabilitation, the topsoil will be stockpiled separately. Specific soil management, stockpiling and re-application procedures will be developed for the Project as described in Section 4.0 (Rehabilitation and Closure).

Waste Rock Management

Some weathered or friable overburden (e.g. clays and alluvium) will be pre-stripped using excavators and haul trucks, with supporting dozers.

Drilling and blasting of competent overburden and interburden material (waste rock) will be undertaken within the open-cut pit areas. Standard commercial products will be used, with the principal blasting agent being ammonium nitrate fuel oil (ANFO).

The removal of waste rock will be undertaken by excavator and haul truck, with supporting dozers to expose the underlying coal seams. The waste rock will be placed in out-of-pit waste rock emplacements, or as infill in the mine void, behind the advancing mining operations.

The permanent waste rock emplacements are located to the west of Pit AB and Pit C. The emplacements will be developed progressively during the operational life of each pit and will be approximately 45 m high. As mining advances, sufficient void space will be created within the mined out areas to enable waste rock to be placed in the in-pit waste rock emplacements.

A small temporary waste rock emplacement will also be established to the north of Pit AB. Waste material will be re-handled from each emplacement and from the temporary emplacement to backfill the final voids of each of the respective pits following the completion of coal mining activities.

ROM Coal Handling

Excavators will load the ROM coal into haul trucks for haulage to the ROM stockpile area located at the MIA. Haulage of ROM coal from Pit AB and Pit C will be conducted during the hours of 7 am to 10 pm only, to minimise air quality and noise impacts at sensitive receptors.

Landform Profiling and Rehabilitation

Re-shaping of the waste rock emplacements, re-application of topsoil and revegetation of the final landform surfaces will be undertaken progressively over the life of the Project. The rehabilitation strategy for the Project is described in Section 4.0 (Rehabilitation and Closure).

3.6.2 Mine Schedule

The total quantity of coal to be mined is approximately 32 Mt ROM. The indicative mine schedule is provided in Table 10. The life of mine waste rock material handled is estimated to be approximately 475 Mbcm for the Project. The annual volumes of waste rock handled during the various mining stages of the Project are provided in Table 10.

Subject to granting of the Project ML and EA, mine construction activities are scheduled to commence in July 2021. It is anticipated that it will take approximately six months to establish the necessary infrastructure to commence overburden removal and 18 months to commence coal production.

Indicative general arrangements for various stages of the Project are shown in Figure 17 to Figure 26. The stage plans show the mine's progression over time and are based on the present schedules and production plans. The layout and mining sequence may vary from that shown to account for localised geological features, detailed engineering design, mining economics and variations in market tonnages and quality requirements.

3.6.3 ROM Coal Processing

ROM coal from the ROM stockpile area will be crushed and screened and conveyed to the CHPP for beneficiation. A portion of mined coal may be screened and crushed and bypass the CHPP, direct to the product stockpiles.

Primary sizing will break the coal down to a maximum of 250 mm diameter. Secondary and tertiary sizing will then reduce the top size coal below 50 mm diameter.

The coarse coal circuit will comprise dense medium cyclones and centrifuges to separate the coarse rejects from the washed product coal. The fine coal circuit will comprise cyclones and sieve bends, flotation cells and thickeners, and reflux classifier and screens. Product coal will be conveyed to the product stockpiles for blending to meet customer specifications. The product coal will be conveyed to the TLO facility to be loaded onto trains.

Coarse rejects will be conveyed to the rejects bin. Fine rejects and slimes will be dewatered and conveyed to the rejects bin to be combined with the coarse reject material. The combined rejects will be loaded onto trucks for placement in out of pit spoil dumps, or in-pit behind the mining void.

The conceptual materials handling flowsheet is shown in Figure 27.

Table 10 Indicative mine schedule

Year	Waste Rock (Mbcm)	ROM Coal Mined (Mtpa)	Coal Rejects (Mtpa)	Product Coal (Mtpa)
Y1	13.0	0	0	0
Y2	26.1	0.9	0.83	0.07
Y3	22.1	1.9	0.54	1.36
Y4	24.4	1.9	0.53	1.37
Y5	27.8	1.9	0.54	1.36
Y6	22.5	1.9	0.54	1.36
Y7	26.8	1.9	0.56	1.34
Y8	29.9	1.9	0.55	1.35
Y9	24.0	1.9	0.57	1.33
Y10	24.2	1.9	0.55	1.35
Y11	23.4	1.9	0.56	1.34
Y12	26.2	1.9	0.60	1.30
Y13	27.5	1.8	0.41	1.39
Y14	28.2	1.8	0.41	1.39
Y15	28.7	1.8	0.42	1.38
Y16	28.1	1.8	0.41	1.39
Y17	27.4	1.8	0.45	1.35
Y18	28.9	1.8	0.42	1.38
Y19	14.3	1.6	0.38	1.22
Total	**473.4 Mbcm**	**32.3 Mt**	**9.27 Mt**	**23.03 Mt**

Notes: Mbcm million bank cubic metres
Mtpa million tonnes per annum

3.6.4 Rail Transport and Port Operations

The PCI coal or coking coal from the Project will be transported via the Blackwater Railway to the RG Tanna Coal Terminal (RGTCT) or Wiggins Island Export Coal (WICET) in Gladstone (Figure 1) for export to the international steel making market. Both of these terminals form part of the existing Port of Gladstone.

There will be approximately four train movements per week on average, subject to train and shipping schedules.

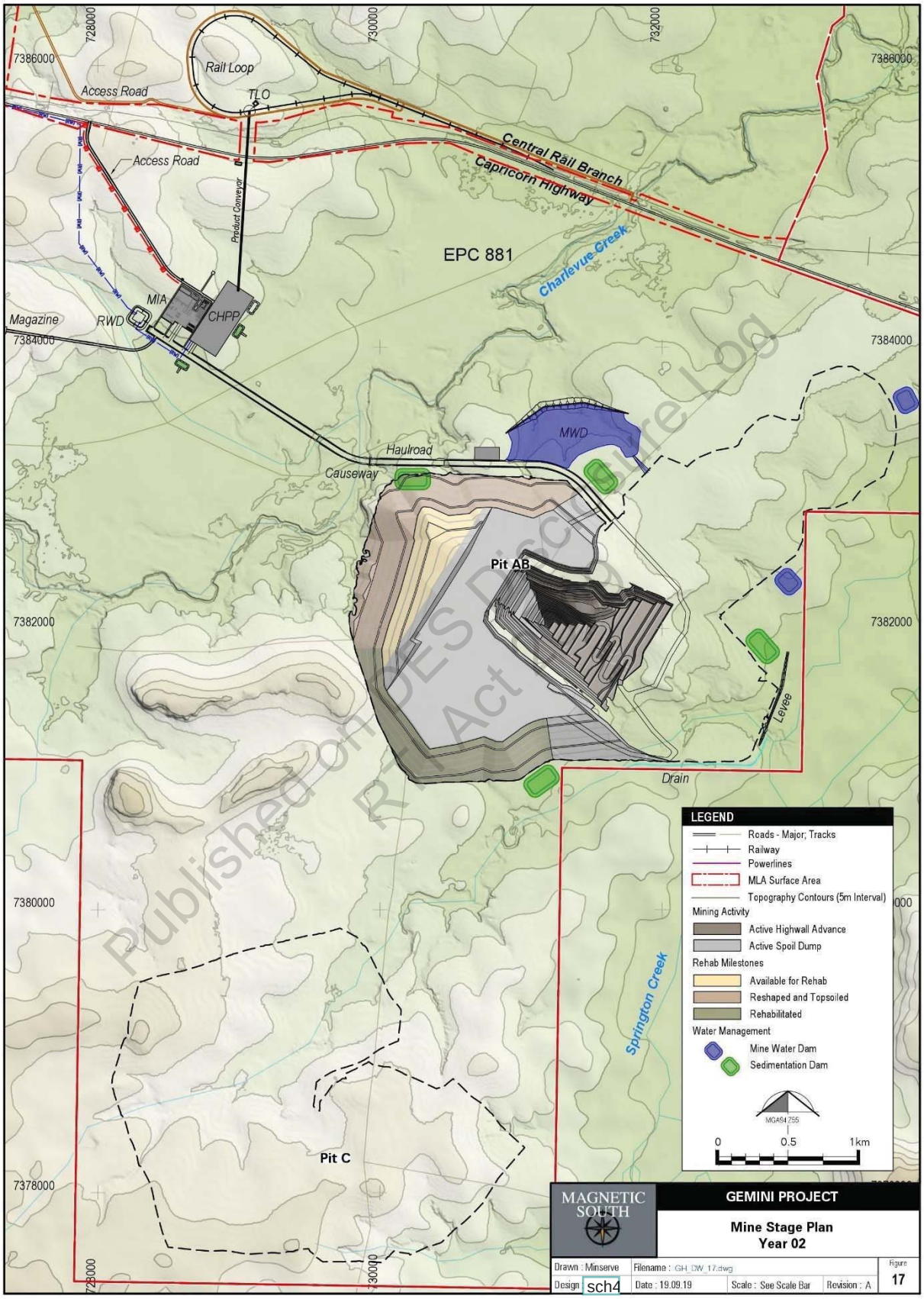


Figure 17 Mine stage plan – Year 02

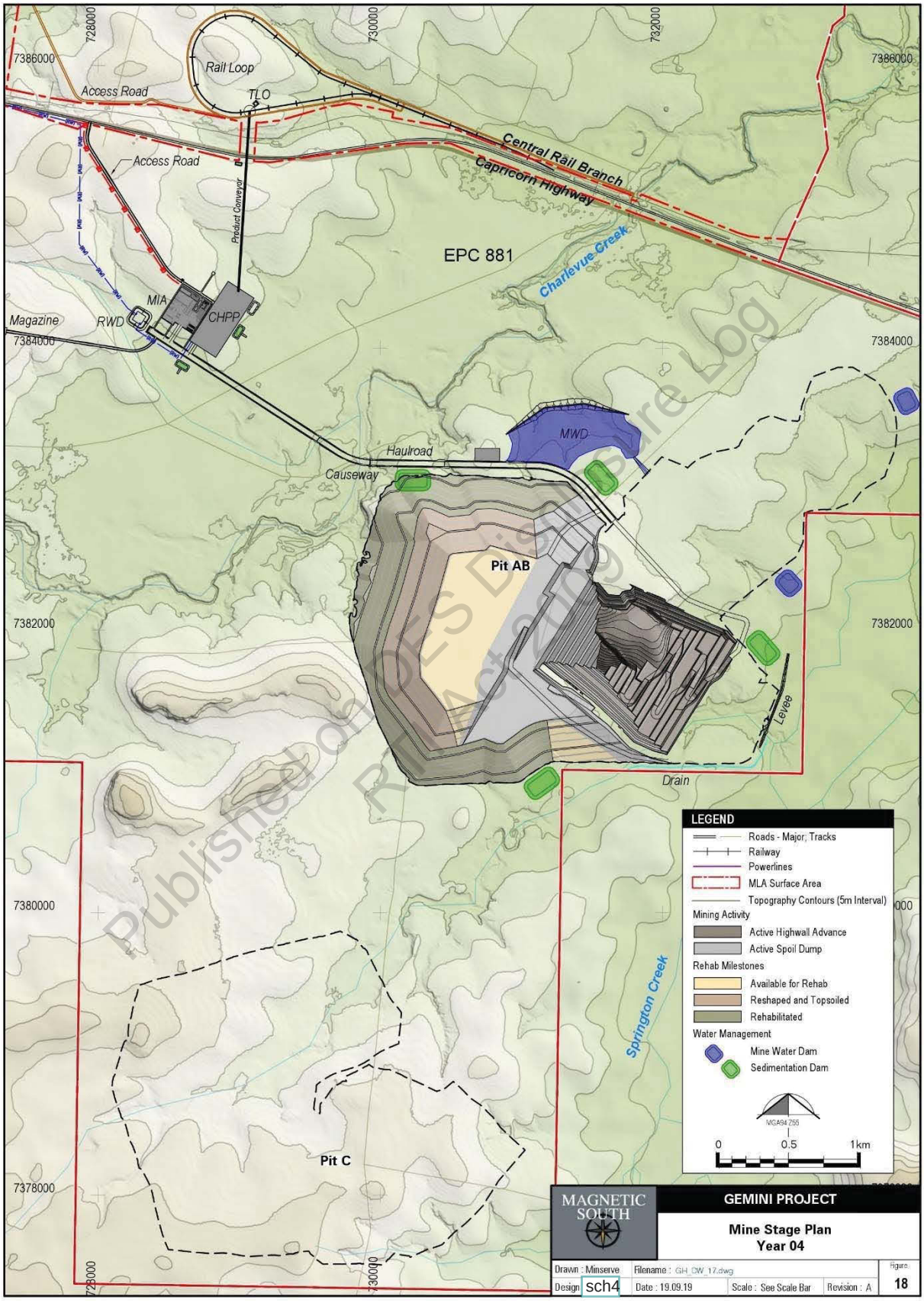


Figure 18 Mine stage plan – Year 04

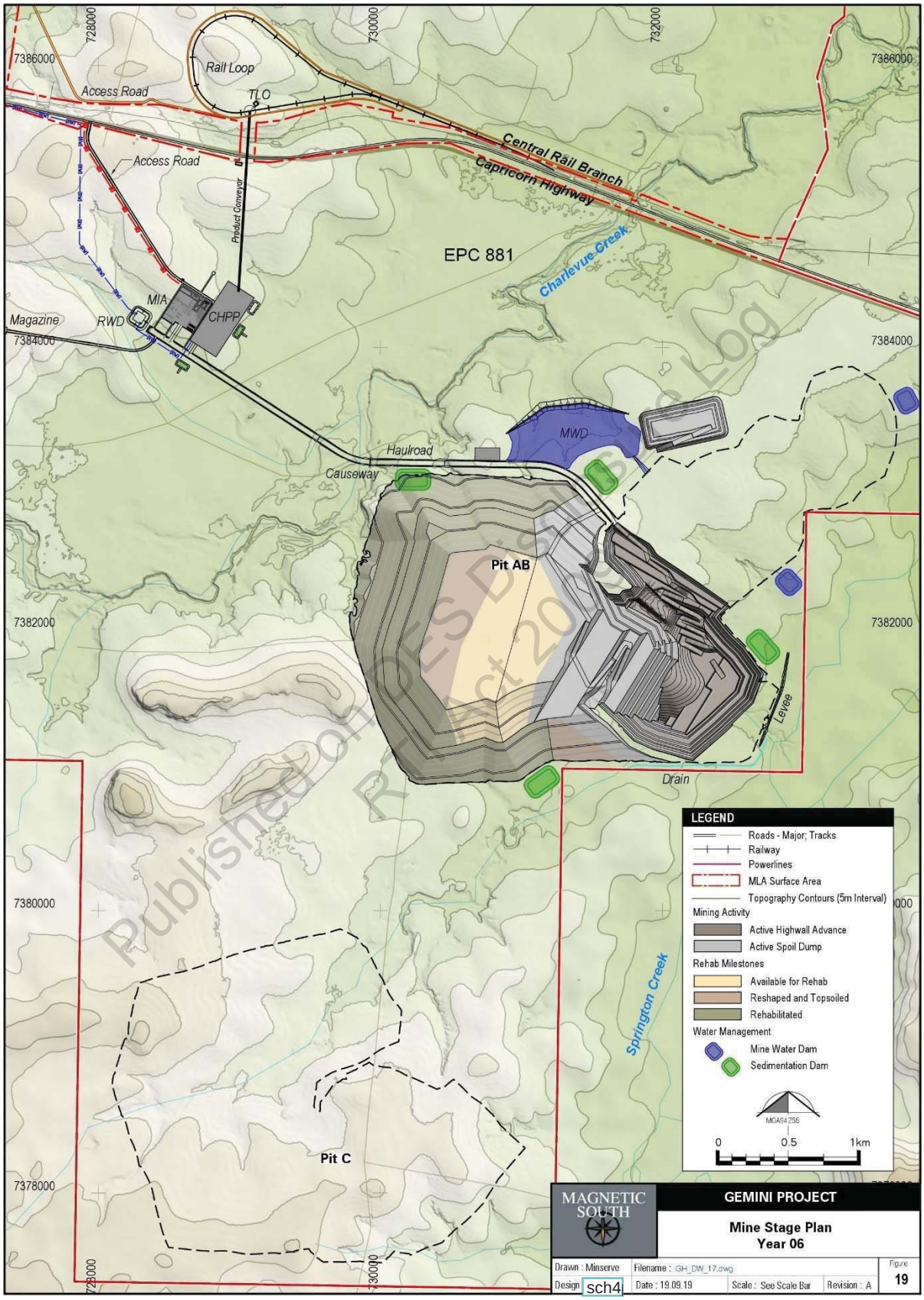


Figure 19 Mine stage plan – Year 06

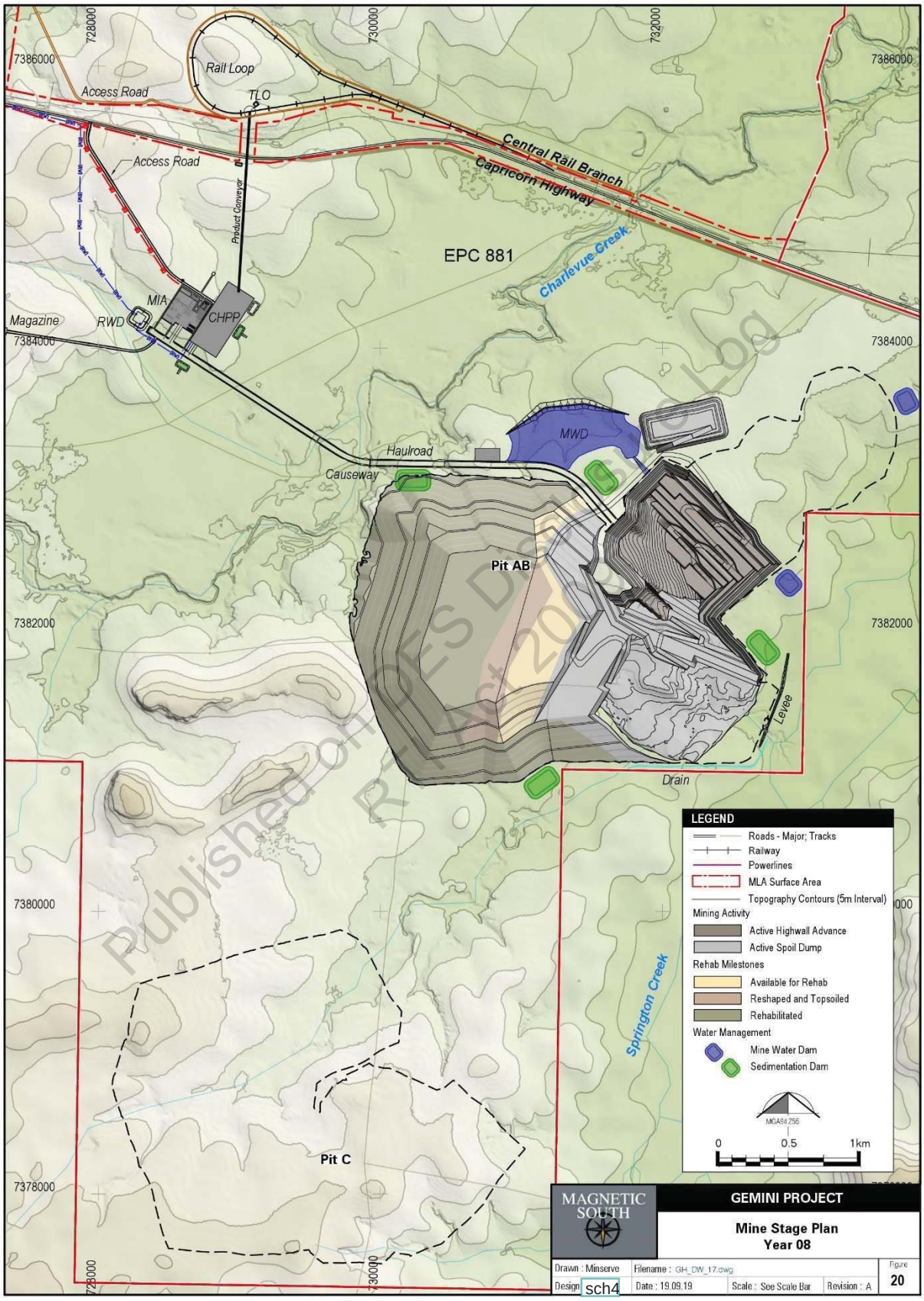


Figure 20 Mine stage plan – Year 08

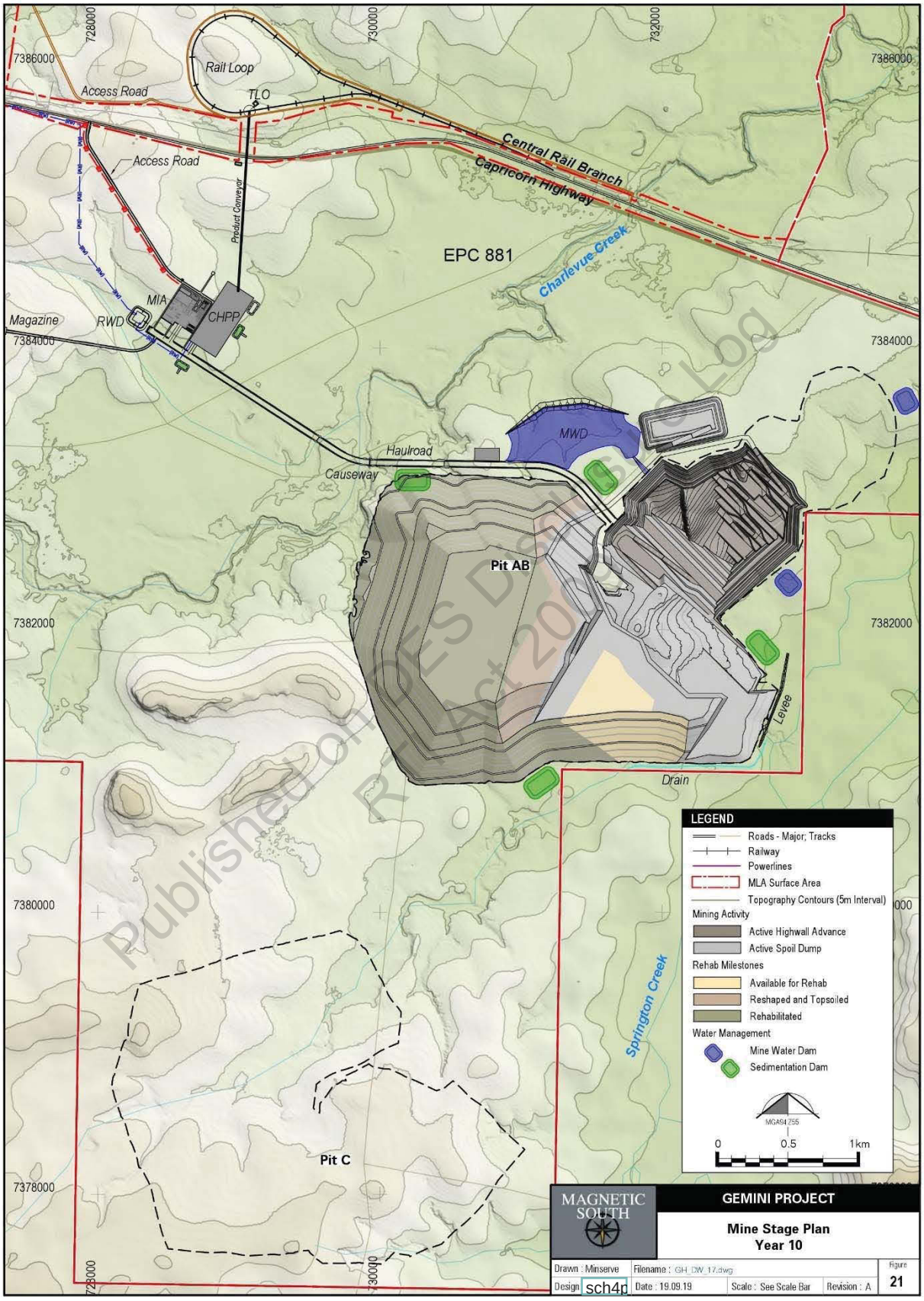


Figure 21 Mine stage plan – Year 10

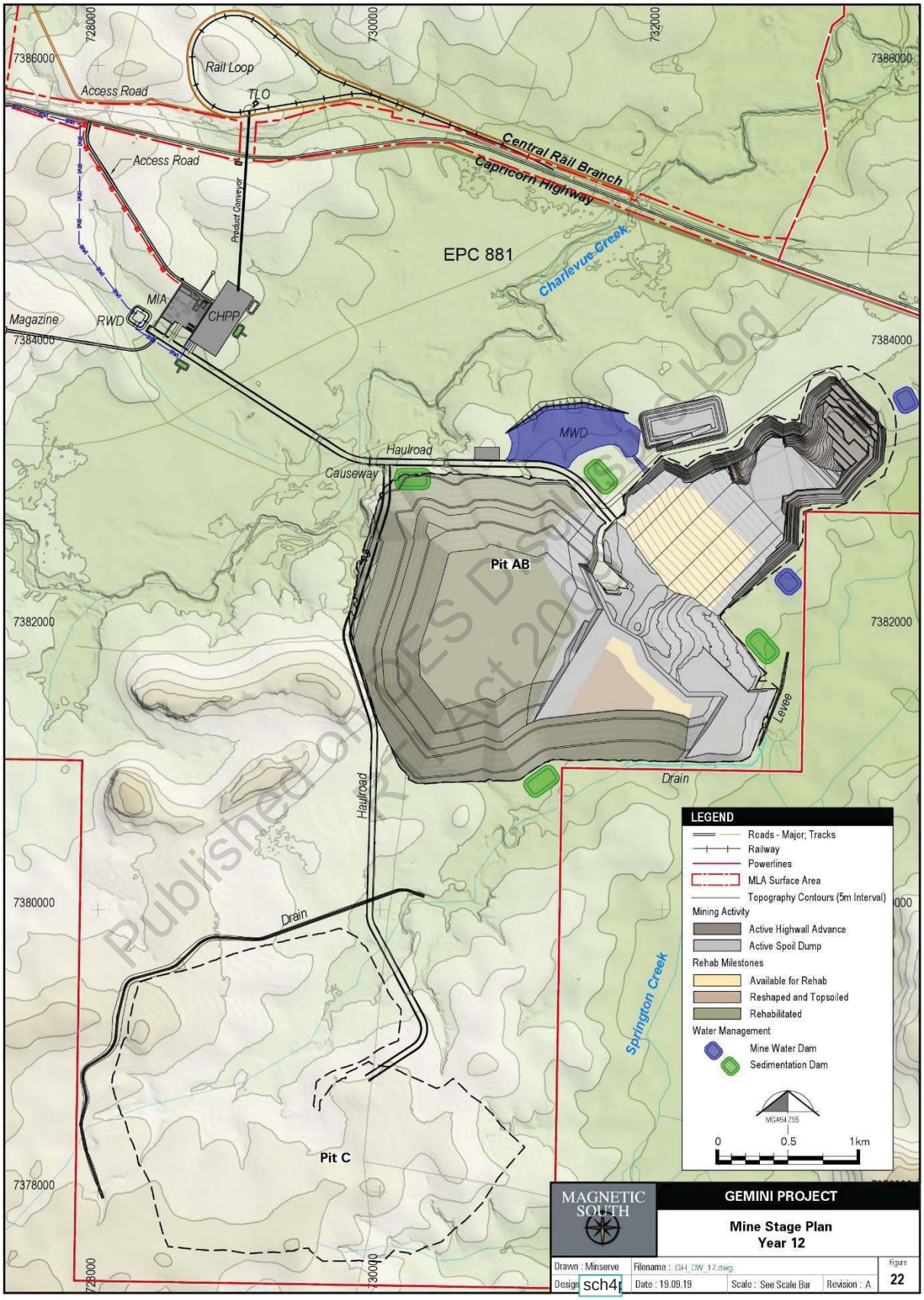


Figure 22 Mine stage plan – Year 12

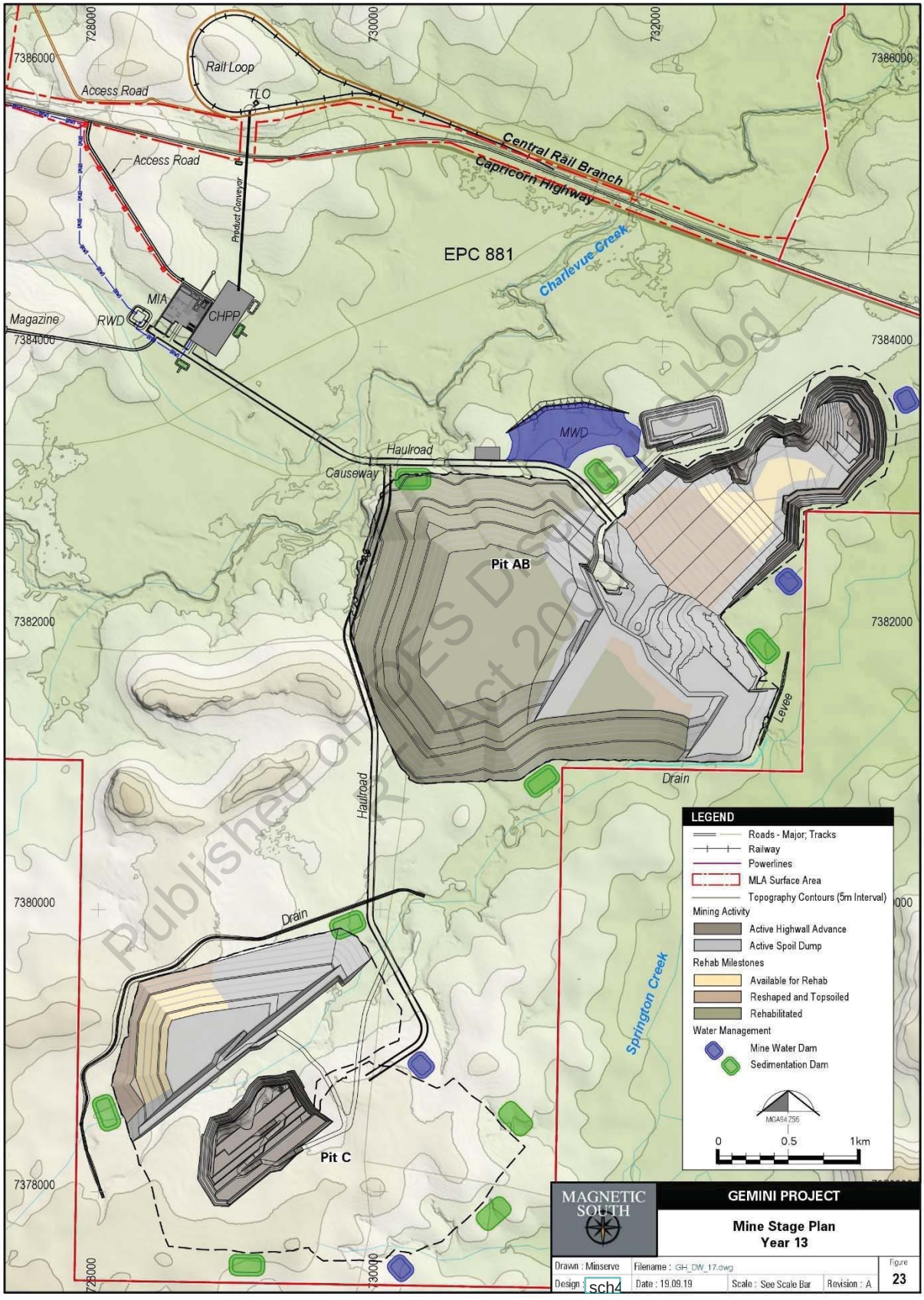


Figure 23 Mine stage plan – Year 13

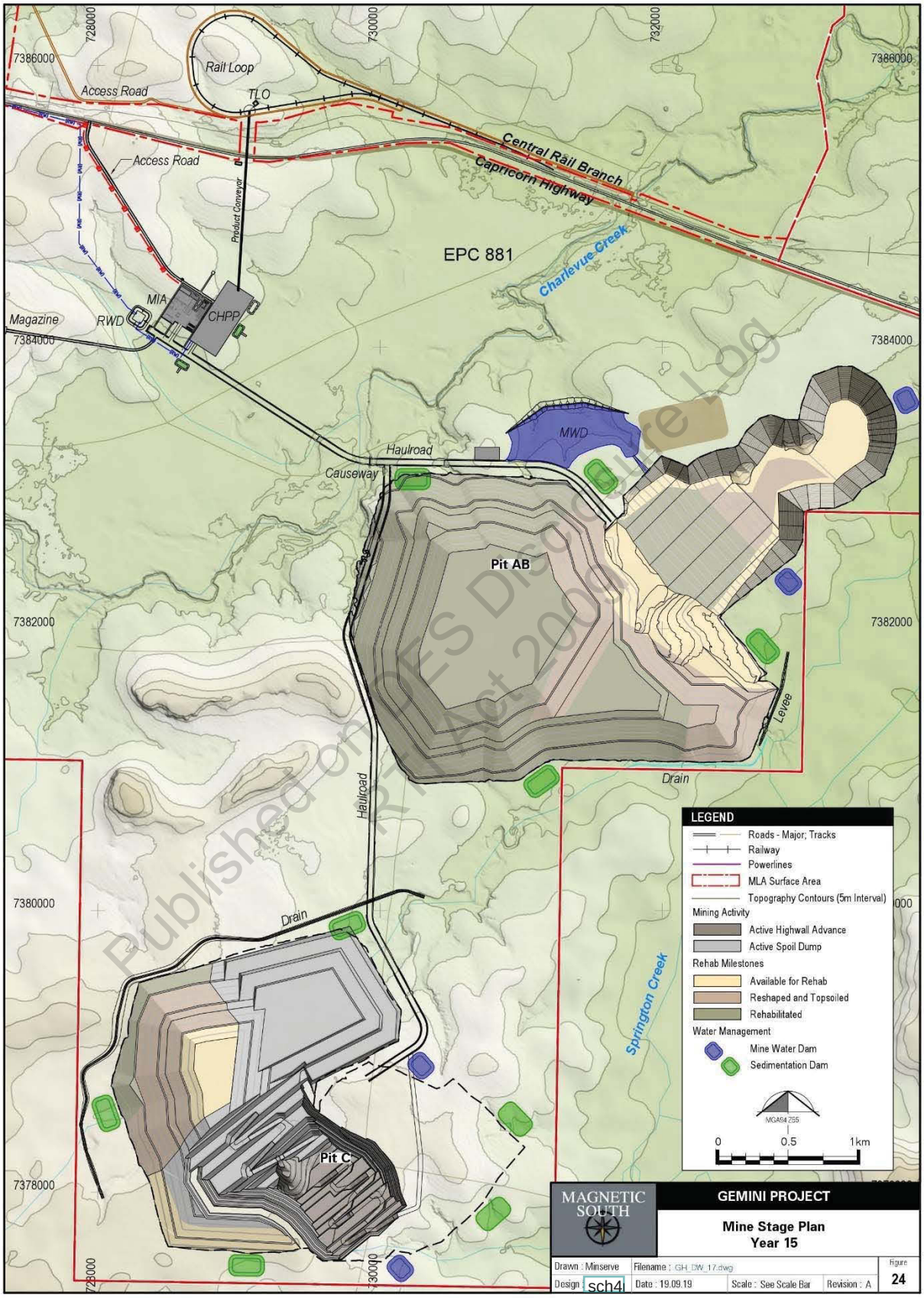


Figure 24 Mine stage plan – Year 15

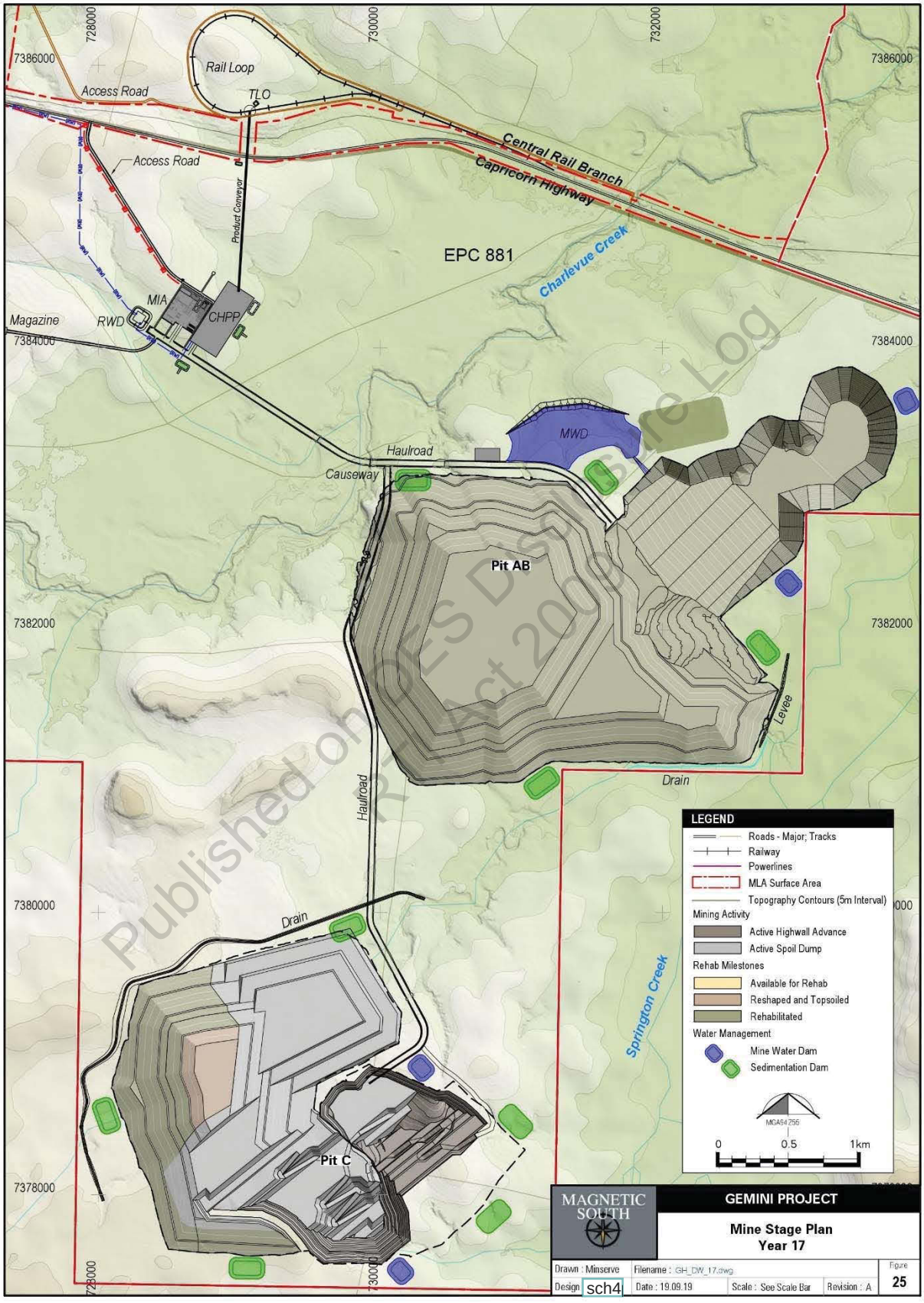


Figure 25 Mine stage plan – Year 17

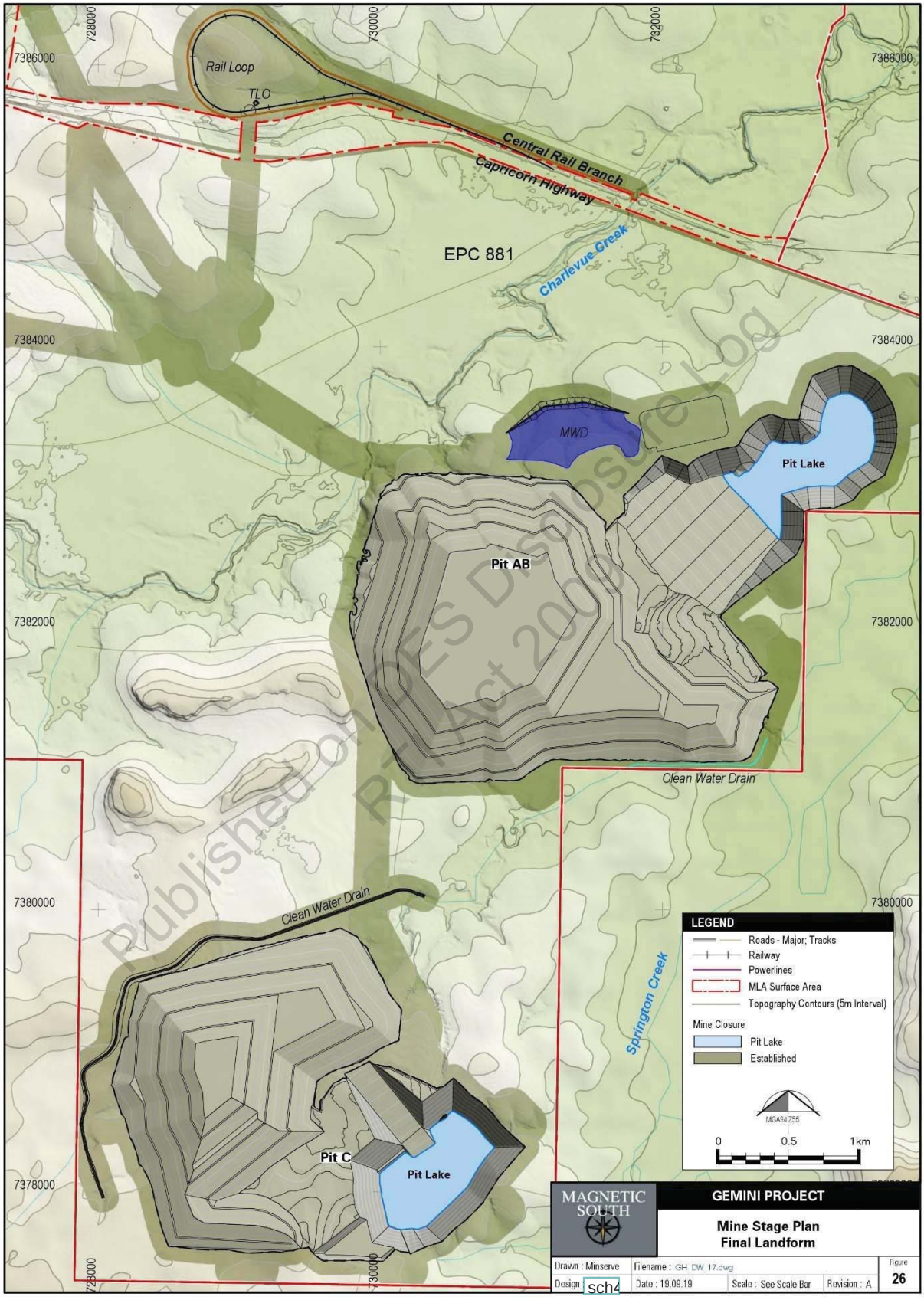


Figure 26 Mine stage plan – final landform

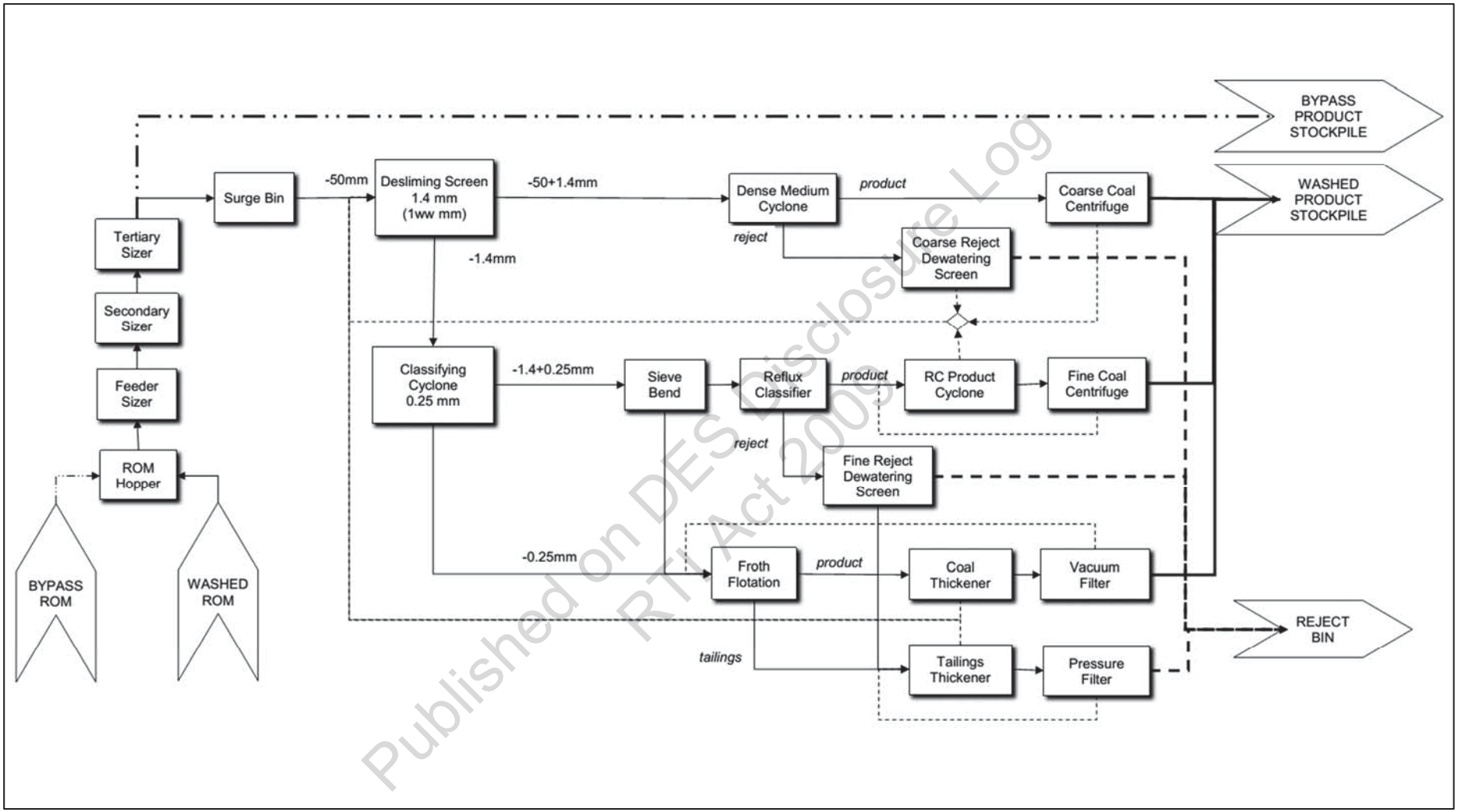


Figure 27 Conceptual materials handling flowchart

3.7 EQUIPMENT FLEET

Equipment used to construct the Project will include excavators, haul trucks, dozers, drills, graders, front end loaders, cranes and water trucks. The mine fleet for the Project is forecast to vary according to the production rates and equipment requirements associated with the open-cut mining operations.

The mining equipment required for the Project includes large (540 t class) hydraulic excavators to remove the bulk of the waste rock material, supplemented by smaller 350 t and 200 t class hydraulic excavators and front end loaders to remove interburden and partings, and to mine coal. Haul trucks will transport coal (100 t class) and waste rock (240 t class).

A fleet of ancillary equipment will be used to support the mining equipment, including dozers, graders and water trucks. Rotary drills will also be used to drill the waste rock material and coal as required.

The forecast equipment list at full development will include:

- up to four excavators;
- up to 20 haul trucks;
- up to nine dozers;
- up to two graders;
- up to four front end loaders; and
- up to two water trucks.

A small fleet of ancillary equipment will be used to service and maintain mine equipment and infrastructure and CHPP, ROM and product coal stockpiles and manage warehouse storage. This will include fuel trucks, service trucks tyre changer, forklift, mobile cranes, light trucks, loaders and light vehicles.

3.8 ROAD TRANSPORT

The Capricorn Highway traverses the MLA, providing a convenient regional link to Blackwater, Emerald and Rockhampton. As described in Section 3.3.1 (Mine Access Road), an intersection with the Capricorn Highway will be constructed for the mine access road.

A number of local Council roads traverse the MLA and are located to the north and south of the Capricorn Highway. Local roads to the north of the Capricorn Highway within the MLA include Red Hill Road and Ellesmere Road.

Local roads within the MLA to the south of the Capricorn Highway include Cooinda Road and an un-named road. Cooinda Road traverses the MLA from the south and connects to the Capricorn Highway. The un-named road traverses the centre of the MLA through Lot 1 on Plan HT424 (Figure 6) and connects to the Capricorn Highway. To the east of the MLA, Sanders Road originates from Namoi Road and extends to the property boundary of Lot 2 on Plan HT138. From the property boundary, Sanders Road becomes an access track within the property and connects to Cooinda Road within the MLA. These local roads and tracks will be temporarily closed to the public for the Project.

To maintain the connection of Cooinda Road to the Capricorn Highway (via Sanders Road and Namoi Road), the access track extending from Sanders Road is proposed to be diverted. The diversion will be approximately 2 km in length and will connect onto Cooinda Road approximately 1.0-1.2 km south of its

current connection. The diversion works are located outside of the MLA and will be subject to a separate approval from the Central Highlands Regional Council (i.e. approval is not being sought by this EA application). Notwithstanding, the approximate location of the proposed diversion is shown on Figure 7.

A *Traffic Impact Assessment* (Cardno 2019) for the Project's roads and intersections is attached as Appendix A. This assessment concluded that all proposed intersections including the mine access intersection successfully meet the safe intersection sight distance (SISD) requirements. Modelling and analysis of the mine access intersection and the Pine Grove Road intersection (TLO access route) was conducted for a three-way priority-controlled arrangement showing that these intersections can accommodate the anticipated traffic network.

A link capacity assessment was developed for the worst case traffic scenario anticipated in 2040. This assessment concluded that the Project's road network operates at the highest level of service under baseline traffic conditions. The status of the traffic environment with additional Project related traffic is described as "*stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream*".

The overall impacts to the existing traffic network are not expected to be significant based on an increase in mobilisation of Project vehicles on local and State roads.

3.9 WORKFORCE

Employment opportunities that will be generated by the Project include:

- Peak construction workforce of up to 260 personnel; including approximately 230 persons servicing the mine development and 30 persons servicing the rail development; and
- Peak operations workforce of up to 330 personnel.

The construction workforce roster will typically be 12-hour day shifts, on a 10 days on and four days off rotation. The majority of work will be conducted during the day; however some construction activities may require night work. For these activities continuous 24-hour activities may be undertaken, scheduled over two 12-hour shifts in a 24-hour cycle.

The operational workforce roster will be 12-hour day/night shifts, on a seven days on and seven days off rotation. The senior management and technical staff roster will be 10-hour day shifts, on a five days on and two days off rotation.

3.10 WORKFORCE ACCOMMODATION

During site preparation and construction, temporary accommodation would be available for non-resident workers within the local region in towns such as Blackwater, Dingo and Bluff and in the accommodation facility, once constructed. The accommodation facility will be constructed to accommodate up to 280 persons, but under normal conditions will only be occupied by up to 140 persons. There will be a local access road from the Capricorn Highway connecting to the accommodation facility.

It is anticipated that 80% of the operational workforce will be drive-in-drive-out from the surrounding region, staying at the accommodation facility and bussed to site daily. The remaining 20% of the workforce would reside locally in Dingo, Bluff or Blackwater, with daily light vehicle travel to site and carpooling where practicable.

4.0 REHABILITATION AND CLOSURE

4.1 LEGISLATIVE FRAMEWORK

4.1.1 Environmental Protection Act 1994

In Queensland, mine rehabilitation is required under the EP Act. Amendments to the EP Act in late 2018 implemented key elements of the State Government's *Mined Land Rehabilitation Policy* (State of Queensland 2018) which intends to ensure that land disturbed by mining activities is rehabilitated to a safe and stable landform that does not cause environmental harm and is able to sustain an approved post-mining land use (PMLU).

A key component of the amended Act is the requirement (clause 125 (1)(n)) for a site-specific application for a mining activity related to a mining lease to be accompanied by a proposed progressive rehabilitation and closure plan (PRCP) complying with Division 3 of Part 2 of Chapter 5. Under this Division, a PRCP must include a PRCP schedule providing rehabilitation milestones for each proposed PMLU, and management milestones for each non-use management area (NUMA) proposed; as well as stating when each milestone is to be achieved. In accordance with the *Environmental Protection (Rehabilitation Reform) Amendment Regulation 2019*, the PRCP start date is 1 November 2019.

4.1.2 Mineral and Energy Resources (Financial Provisioning) Act 2018

The *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act) was assented to on 30th November 2018 and, apart from amending the EP Act to implement key elements of the *Mined Land Rehabilitation Policy* (State of Queensland 2018), introduces a new financial provisioning scheme, and changes the method for estimating the rehabilitation cost for a resource activity. The new financial provisioning scheme:

- Provides for holders of an EA for a resource activity, to pay financial provision contributions to a scheme fund, or provide a surety;
- Provides a way to manage the financial risk to the State, as well as the State's costs and expenses, where a resource activity EA holder does not comply with their obligations in relation to rehabilitation; and
- Provides a source of funds to the State, for the rehabilitation and/or remediation of lands impacted by abandoned mines, as well as for research contributing to the rehabilitation of land on which resource activities have been carried out.

In accordance with Section 297 of the EP Act, it will be a condition of a resource activity EA that the holder must not carry out a resource activity unless an estimated rehabilitation cost (ERC) decision is in effect and the holder has made the relevant contribution to the scheme fund. Given this, it is anticipated that at the time of issue of an EA for the Project, the proponent will determine the ERC and apply to DES for an ERC decision for the resource activity in accordance with Section 298 of the EP Act.

4.1.3 Policies, Subordinate Legislation and Guidelines

As outlined at Section 4.1.1, the *Mined Land Rehabilitation Policy* (State of Queensland 2018) is the principal and current policy relevant to mine land rehabilitation.

At the time of writing, the following relevant subordinate legislation and guidelines were available:

- *Guideline (Resource Activities): Rehabilitation requirements for mining resource activities [ESR/2016/1875]* (DES 2014a)

The EP Act is supported by the EP Regulation.

4.2 KEY INFLUENCING ECOSYSTEM PROCESSES AND FUNCTIONS

4.2.1 Climate

Rehabilitation methods, particularly surface preparation activities, revegetation species selection, and revegetation timing need to consider the climatic aspects of the region.

The climate of the Project area is characterised as semi-arid with hot humid summers and dry mild winters. Temperatures range between 15°C and 30°C, with mean daily maximum temperatures ranging between 24°C in June and 34°C in January; and mean minimum temperatures ranging between 8°C in July and 22°C in January. The average annual rainfall is 559 mm and evaporation typically exceeds 2,000 mm per annum.

The climatic aspects of the Project site of most relevance to rehabilitation outcomes and erosional impacts can be summarised as:

- **Rainfall:** records depict a typical wet season between November and March of each year, approximately coinciding with the hotter summer months. Figure 28 highlights the significant variation of wet year average rainfall that exists in the region.

- **Evaporation:** average evaporation rates are typically three times greater than the average annual rainfall which, with the variation in annual rainfall commonly experienced is indicative that significant moisture stress can regularly occur, with a consequent potential impact on revegetation success rates and/or failure events.

- **Rainfall intensity:** the central Queensland area can experience high intensity rainfall events. Analysis of BoM 2016 Design Rainfall Data System indicates that short (less than five-minute) duration, high intensity storms of greater than 100 mm per hour would be expected in the Bluff area of central Queensland typically once or twice each year (BoM 2019a).

4.2.2 Landscape, Landform and Hydrology

The Project area is described as gently undulating with elevations ranging between 120-150 mAHD. The physiography of the area is characterised by a dissected tableland having a general relief variation of about 80 m with slopes within the MLA area well less than 5°. The topography of the Project is representative of the surrounding region. The viewscape, some 15-18 km distant to the southwest and west respectively is to the elevated Blackdown Tableland National Park and Arthurs Bluff State Forest which rise approximately 450 m above the elevation of the Project site. There is little relief to the north and east with the land falling gently toward the Mackenzie River valley.

The landscape is influenced by the presence of Charlevue Creek which bisects the MLA from west to east and Springton Creek which flows alongside the southeast boundary of the MLA. The associated floodplains of these two watercourses result in localised lower elevations within the surrounding landscape.

The Project lies within the Mackenzie River sub-catchment, which covers a total area of 12,985 km^2, and is situated in the centre of the Fitzroy River catchment. The major water body associated with the Project site is Charlevue Creek. This creek begins within the boundaries of Blackdown Tablelands

National Park, flowing to the northeast before joining Springton Creek. Springton Creek flows to the Fitzroy River eventually reaching the Pacific Ocean approximately 46 km north of Gladstone. A significantly smaller tributary, Stanley Creek crosses the northwest corner of the MLA boundary eventually converging with Springton Creek downstream of the MLA. Minor associated tributaries, dams and drainage features also exist across the site.

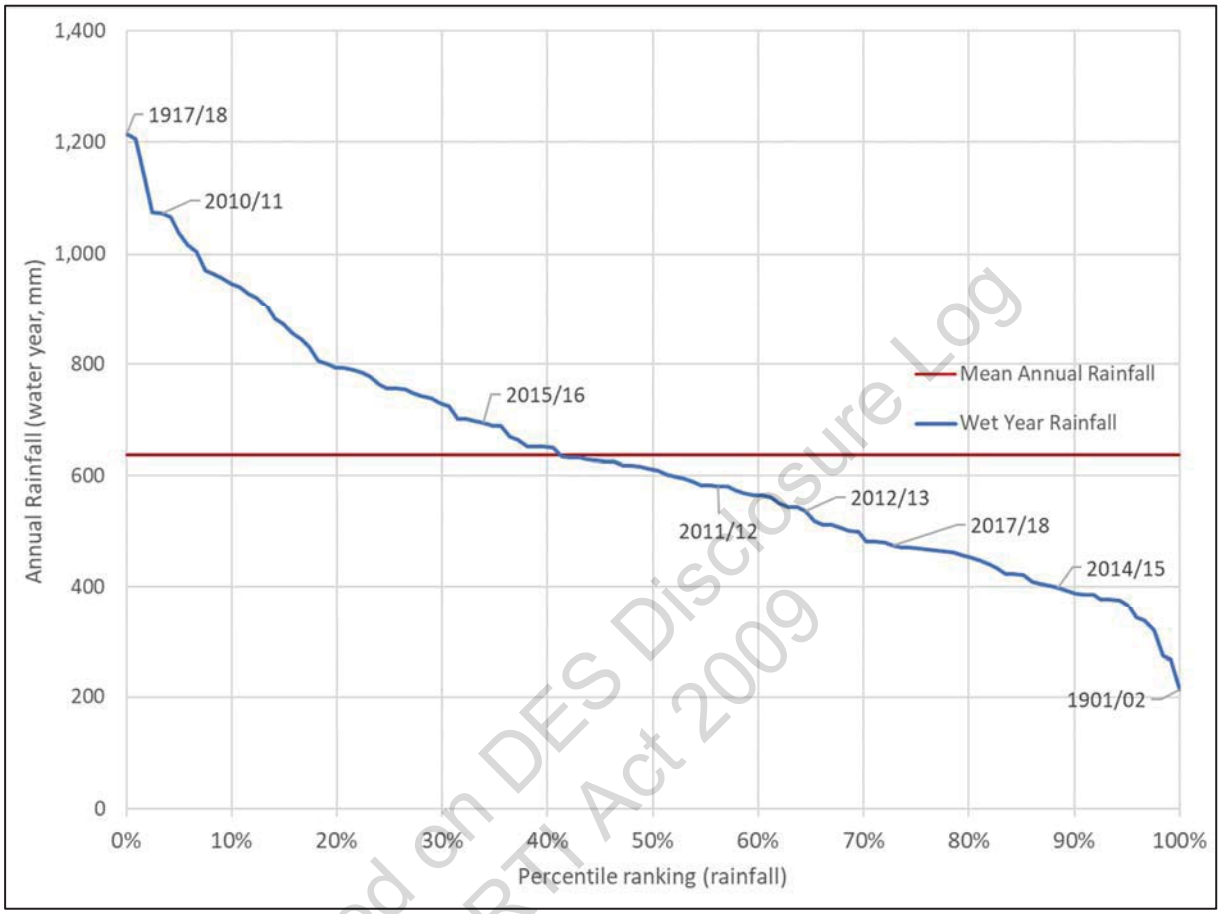


Figure 28 Percentile ranking of water years

4.2.3 Spoil Geochemistry

A detailed *Geochemical Assessment of Mining Waste Materials* associated with the Project was undertaken by RGS Environmental Pty Ltd (RGS 2019a) (Appendix D). Geochemical test work undertaken was based on industry recognised procedures for the geochemical characterisation and assessment of mine materials. Seventy samples representative of the main overburden, interburden and potential coal reject materials likely to be encountered during development of the Project were assessed.

Samples were subjected to a range of static and kinetic geochemical tests to assess the presence and degree of environmental risk from the oxidation of reactive sulphides, the potential for acid generation, and leaching of soluble metals/metalloids and salts. While these geochemical risks were determined to be low, the assessment recommended the placement of any carbonaceous mining waste material in locations not near the surface or outer batters of spoil emplacement areas.

The assessment identified that while most mining materials would be amenable to revegetation, they are likely to be susceptible to dispersion and erosion and may require amelioration for example, through the addition of gypsum and fertiliser. The assessment recommended additional testing of materials and

field trials to assist in determining the most appropriate management options to ensure effective rehabilitation.

Geochemistry is discussed in further detail in Section 13.0 (Waste Rock and Coal Reject Geochemistry).

4.2.4 Topsoil Resources

Soil management units (SMUs) are detailed within Section 5.2.5 (Soils). In general, the surface soils to be reclaimed for use in rehabilitation topsoiling activities are of variable pH (between 4.6 and 8), very low to medium salinity, non-sodic (with the exception of the Charlevue SMU), and of very low to high fertility (based on cation exchange capacity (CEC) analysis results). The majority of topsoil reclaimed will originate from the Geoffrey SMU which, while not dispersive in the A horizon, has a sandy texture and low nutrient status and may require amelioration to ensure successful revegetation.

Based on recommended stripping depths (refer Table 11), the volume of topsoil able to be reclaimed across the disturbance footprint of the Project site is approximately 8,804,397 m^3. If a 10% handling loss is assumed, approximately 7,923,957 m^3 of topsoil resource will be recoverable.

Based on a recommended minimum topsoil respreading depth of 0.3 m, approximately 5,641,800 m^3 of topsoil will be required for rehabilitation efforts over the life of the Project. The soil balance indicates that sufficient topsoil material will be available for rehabilitation efforts without the need to source additional material.

Soils are discussed in further detail in Section 5.0 (Land).

Table 11 Estimated topsoil volumes available for rehabilitation

Soil Management Unit	Surface Area to be Disturbed (ha)	Stripping Depth (m)	Estimated Volume of Recoverable Topsoil (m^3)
Anderson	-	-	-
Barry	7.9	0.90	70,900
Charlevue	218.3	-	-
Cooinda	34.9	0.60	209,640
Ellesmere	-	-	-
Geoffrey	1,489.3	0.50	7,446,500
James	11.7	0.60	70,320
Kosh	41.6	0.50	208,067
Namoi	131.4	0.60	788,400
Nigel	20.5	-	-
Normanby	-	0.90	-
Wallace	5.3	0.20	10,570
Total	**1,961**	-	**8,804,397**

4.2.5 Terrestrial Ecology

The Project area falls within the Brigalow Belt bioregion, characterised by brigalow (*Acacia harpophylla*) woodland but presenting other vegetation such as semi evergreen vine thickets, dry eucalypt woodlands

and native Bluegrass (*Dichanthium sp.*) grasslands. Due to the size of Brigalow Belt bioregion, it covers a broad climatic gradient as well as a diversity of soils and topography. As a result of agricultural and development activities, most of the relatively undisturbed areas are confined to the rugged parts of the landscape.

Consistent with the surrounding country, the MLA is predominantly non-remnant and subject to low intensity cattle grazing. Remnant vegetation includes patches of eucalypt woodland within riparian areas and on flat plains. These communities are mapped as riverine wetlands where they are associated with a major watercourse or floodplain. *Acacia sp.* closed woodlands are present on higher ground. The Project proposes clearing of 720 ha of remnant vegetation over the life of the Project.

Five weeds of national significance (WoNS) and/or restricted invasive species (RIS) under the *Biosecurity Act 2014* (Biosecurity Act) (DAF 2018) were identified on the MLA. The near threatened plant species *Cerbera dumicola* was identified in two rocky areas to the central west of the MLA. Impacts to these populations were avoided in the Project design.

Three fauna species of conservation significance; the southern squatter pigeon (*Geophaps scripta scripta*), the greater glider (*Petauroides volans*) and the short-beaked echidna (*Tachyglossus aculeatus*) were identified on the Project. The rufous fantail (*Rhipidura rufifrons*), a listed migratory bird species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was also identified within the study area. All fauna species are regionally abundant, having been recorded outside of the study area on numerous occasions. Ample equivalent or improved habitat is available for these species in the surrounding area. The Project proposes no significant impact to the species.

Flora, fauna and aquatic ecological systems are discussed in further detail in Section 6.0 (Flora and Fauna).

4.2.6 Current Land Use and Land Suitability

Under the CHRC 2016 planning scheme, the land within the Project boundary is mapped as ‘rural’. This zone provides for various rural uses, opportunities for non-rural uses compatible with agriculture and the environmental features and landscape of the areas, and the protection and/or management of significant natural resources and processes related to primary production. The current use is best described as low intensity cattle grazing and resource exploration activities.

SMUs are detailed at Section 5.2.5 (Soils) along with a determination of land suitability for cattle grazing (refer Section 5.2.6 (Land Suitability)). The land suitability assessment identified grazing land suitability within the Project area as being of Classes 2, 3 and 4 as detailed in Table 12.

Table 12 Land suitability assessment for the Project area

Land Suitability Class (Grazing - Agricultural Land Class)	Area Occupied	Description
Class 2	1,081 ha (17.6%)	Suitable land with minor limitations which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production.
Class 3	4,320 ha (70.2%)	Suitable land with moderate limitations which either further lower production or require more than those management practices of Class 2 land to maintain economic production.
Class 4	7,49 ha (12.2%)	Marginal land, which is presently considered unsuitable due to severe limitations. The long-term significance of these limitations on the proposed land use is unknown or not quantified. The use of this land is dependent upon undertaking additional studies to determine whether the effect of the limitations can be reduced to achieve sustained economic production.

4.3 REHABILITATION OBJECTIVES

The overarching objective of mined land rehabilitation for the Gemini Project is to conform to the State government policy of returning disturbed lands to a safe and stable landform that does not cause environmental harm and is able to sustain an approved post-mining land use.

4.3.1 Post-Mining Land Use

The PMLU for the Project is proposed to be primarily grazing, with the introduction of some areas of native ecosystem habitat suitable for native flora and fauna; specifically where the final landform is not suitable for a grazing land use. This PMLU has been determined on the basis of pre-mining land suitability, landholder/stakeholder preferences, and the existing use and environmental values of the surrounding land. The overarching objective is to return the majority of disturbed land to current and/or future landowners with a land use capacity conforming to existing local government planning instruments, and that enables a sustainable future value to be derived.

The development of the rehabilitation strategy for the Project has been informed by the rehabilitation hierarchy. Minimisation of disturbance has been a focus of design phase mine planning work, and a key land use objective being reinstatement of a land use at least equivalent or compatible to that existing previously.

Given the existing land use of the area, reinstatement of grazing as a PMLU will be adopted for all areas apart from the proposed residual voids and any retained water management or other infrastructure where the latter supports accepted PMLUs and/or adds to the economic value of the land to be relinquished. With appropriate management of the higher sodicity topsoils identified, it is anticipated that rehabilitated landforms will be capable of sustaining improved and native pastures equivalent to those currently existing.

Two residual voids will remain post-mining and are anticipated to accumulate water over time to an equilibrium water level. The pit lakes and surrounding highwalls are proposed to support a PMLU of fauna habitat comprised of the water body itself and its surrounding inwardly draining slopes which will be rehabilitated to sustain a native ecosystem able to support native fauna. The air/waterbody interface is expected to support a range of waterborne and flying insects, as well as avifauna and various bat and microbat species. The waterbody itself is expected to support a range of freshwater aquatic plants and

invertebrates in shallower edge areas and over time transition to brackish water species as water quality changes. Rehabilitated low wall slopes will be capable of supporting a grazing land use.

The proposed mining functional areas or 'domains' are summarised in Table 13 and illustrated in Figure 29. The following sections discuss the proposed PMLUs, any specific objectives and targets, environmental risks and the proposed implementation and management approach.

Table 13 Nominated post-mining land use

Rehabilitation Functional Area	Post-mining Land Use	Approximate Footprint Area (ha)	Approximate Proportion of Total Disturbance
Waste rock emplacements (in-pit and out-of-pit)	Grazing	908	46%
Final void waterbody	Fauna habitat	81	4%
Residual void highwalls/ Low walls	Native vegetation supporting fauna habitat	133	7%
Mine infrastructure areas[1]	Grazing	590	30%
Water management infrastructure[1]	Grazing/native vegetation	250	13%

Notes: 1 Where not retained under a landholder agreement allocating infrastructure responsibility.

4.3.2 Waste Rock Emplacements

The commencement of mining necessarily sees overburden being initially placed out-of-pit to provide sufficient working space for operations to proceed. A single out-of-pit waste rock emplacement is associated with each of Pit AB and Pit C. In-pit placement of overburden will occur in Year 2 for Pit AB and about year 15 for Pit C.

The out-of-pit waste rock emplacement for Pit AB is located to the west and south of the pit with construction coinciding with the commencement of mining. By Year 4, the full footprint of out-of-pit dumping will be reached with waste rock being placed both in-pit and within the extents of the out-of-pit emplacement. In Year 6, a small temporary out-of-pit emplacement will be constructed to the north of the pit for the purpose of providing additional pit backfilling later in the mine life.

Beyond Year 6, the majority of waste rock is placed in-pit, progressively refiling the pit from south to north as the pit progresses in the same direction. By about Year 12/13 the maximum extents of Pit AB are reached and the development of infrastructure to support Pit C commences.

Mining of Pit C commences in Year 12, again with waste rock being placed in an out-of-pit waste rock emplacement located to the west of the pit. By Year 15, waste rock from Pit C is being placed both in-pit and out-of-pit and the full disturbance footprint of the out-of-pit waste rock emplacement has been reached. Pit AB is continuing to be progressively rehabilitated, including the rehandling of spoil from the temporary out-of-pit waste rock emplacement back in-pit and all areas having been reshaped including the highwalls of Pit AB.

By Year 19, the rehabilitation of Pit AB has been completed and mining is at or near completion at Pit C, with progressive rehabilitation of the Pit C waste rock emplacements ongoing.

Figure 17 through to Figure 26 conceptually visualise the progression of the mine, including location and extent of waste rock emplacements. A preliminary schedule of disturbance and rehabilitation is discussed at Section 4.3.7 (Progressive Rehabilitation).

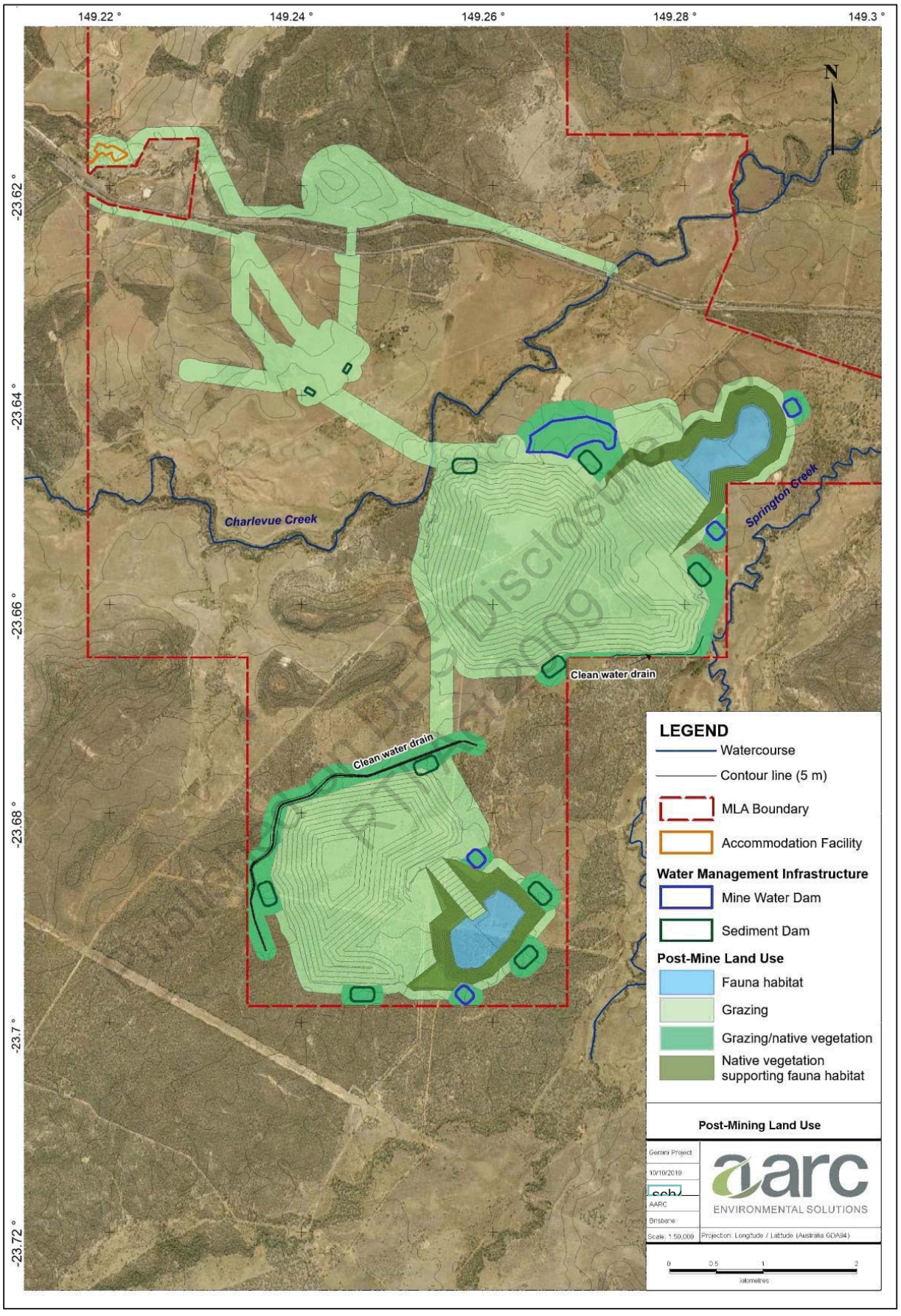


Figure 29 Conceptual post-mining land uses

Minor drainage works and a pit levee are required to the southeast of Pit AB to ensure high flows from an unnamed second order tributary of Springton Creek do not access the pit. In addition, a drain is required to divert clean runoff from the upper reaches of an unnamed second order tributary of Springton Creek around the out-of-pit emplacement associated with Pit C. Although neither of these tributaries are defined as watercourses under the Water Act, the drainage works will be designed and constructed generally in accordance with the design principles set out in the guideline; *Works that interfere with water in a watercourse for a resource activity – watercourse diversions authorised under the Water Act 2000 [OSW/2019/4599]* (DNRME 2019). Materials used for levee construction and other civil purposes will be subject to civil engineering testing to meet appropriate design requirements.

The *Geochemical Assessment of Mining Waste Materials* (RGS 2019a) (Appendix D) and *Geochemical Assessment of Coal Reject Material* (RGS 2019b) (Appendix E) for the Project identified that waste rock materials have a low risk of acid generation and a high factor of safety with respect to potential for acid mine drainage (AMD). Most coal reject materials have a relatively low risk of acid generation. While the risk of environmental harm arising from the geochemical characteristics of materials to be handled is low, it is proposed that coal reject materials or any potentially acid forming (PAF) waste rock materials identified will be selectively handled and encapsulated within waste rock emplacements and well away from the outside surface of rehabilitated landforms.

As indicated in Table 14, waste rock emplacements have been designed to have externally draining slopes up to 6° and constructed from rear dump truck-tipped dumps. While detailed geotechnical assessments are yet to be undertaken, the slopes proposed are at the lower end of typical design practice for waste rock emplacements in the Bowen Basin. Key overburden emplacement design parameters are provided at Table 14. The locations of overburden emplacements showing proposed PMLUs are illustrated at Figure 30.

Table 14 Waste Rock Emplacement Parameters

Emplacement	PMLU	Max. Elevation (mAHD)	Typical/ Max Slope	Approx. Max. Slope Length (m)
Pit AB overburden emplacement (in-pit and out-of-pit)	Grazing	175	6°	540
Pit AB temporary (out-of-pit)	Grazing	n/a	n/a	n/a
Pit C overburden emplacement (in-pit and out-of-pit	Grazing	190	6°	530

The top surfaces of both waste rock emplacements are limited in area and, given the relatively low geochemical risk currently identified, it is considered preferable to internally drain the upper surfaces of waste rock emplacements rather than increase flows down rehabilitated slopes. Additionally, rehabilitated slopes will be constructed to a relatively low 6° to reduce the risk of erosional instability. Given these mitigation measures, drainage from regraded rehabilitation slopes is intended to be managed with limited use of graded banks; principally by targeting sufficient surface roughness through contour cultivation and good revegetation rates. However, this approach will ultimately depend on the results of further topsoil testing and the performance of early rehabilitation works. If erosion is observed in early rehabilitation efforts, graded banks and spine drains will be incorporated into the rehabilitation design, as a temporary erosion control measure.

Revegetation of grazing PMLU areas will utilise a pasture mix appropriate to the local area.

Given the overburden and topsoil materials available, the rehabilitation design parameters to be observed, and the mitigation measures and actions nominated, no significant risks associated with the rehabilitation of overburden emplacements have been identified.

Rehabilitation performance indicators are discussed at Section 4.6 (Rehabilitation Indicators and Completion Criteria).

4.3.3 Tailings and Reject Management

Coal preparation processing is described in Section 3.6.3 (ROM Coal Processing). Coarse rejects will be conveyed to the rejects bin. Fine rejects and slimes will be dewatered and conveyed to the rejects bin to be combined with the coarse reject material. The combined rejects will be loaded onto trucks for placement in out-of-pit spoil dumps, or in-pit behind the mining void. Over the life of the mine, just over 9 Mt of rejects is estimated to be generated for disposal in-pit.

As such, no separate tailings disposal facility is proposed for the Project. Representative samples of coal reject materials will be further assessed at the operational stage to ensure that the findings of the geochemical assessment (RGS 2019b) (Appendix E) remain applicable.

4.3.4 Final Void

Mine planning for the Project results in the northeast end of Pit AB and the east end of Pit C remaining as residual voids. Both voids will be partially backfilled with waste rock to elevate the void floor above the level of significant groundwater inflows, and to limit the potential for pit water to recharge any aquifers.

The void low wall will be rehabilitated to a gradual slope, safe for access and grazing by cattle. Small pit lakes will form on the pit floor reaching a steady state level where water losses through evaporation are equal to water inputs from rainfall, runoff and groundwater inflows. While water levels in the voids will vary over time dependant on the prevailing climatic conditions, the results of modelling indicate that an equilibrium level of approximately 80 mAHD will be reached after 200 years. The steady state water level is well below the base of Tertiary aquifers negating any risk of contamination.

Perimeter drainage will be provided to limit the volume of surface water runoff, including modelled 1:1,000 storm event flows, from entering the void. The surface water assessment confirms that pit lake water levels will not exceed 50 m below ground level and that there is therefore no risk of overflow to surface waters.

With respect to proximity of the residual void to a floodplain, the second order streams located within the Project area do not meet the definition of a watercourse under the Water Act and therefore adjoining lands do not constitute a floodplain within the context of the *Mined Land Rehabilitation Policy* (State of Queensland 2018).

Physical void characteristics are summarised in Table 15.

Table 15 Final Voids

Mining Area	Approx. Footprint area[1] (ha)	Approx. Pit Depth (m)	Approx. Pit Lake Area (ha)
Pit AB	176	85	43
Pit C	122	80	37

Notes: 1 This figure includes in-pit areas rehabilitated to a grazing PMLU.

Alternatives Closure Options Analysed

Mine planning assessed a number of options to manage and reduce final landform residual risk including backfilling the pits to a modified pre-mining topography, backfill of pits to about 80 m below the pre-mining topography and no backfilling of pits. All options required the rehandle of spoil material, the reduction of remnant highwall angles by dozer push, the reshaping of waste emplacements, and normal rehabilitation techniques related to topsoiling, surface preparation and revegetation. Options were evaluated on the relative basis of cost, overall project value and relative reduction in environmental risk.

The modified pre-mining topography option was based on backfilling to a level slightly higher than the original topography to allow for settlement over time. Once a sufficient period has been allowed for settlement, the area would be shaped and drained to manage erosion and then topsoiled and revegetated. Advantages with this option include negation of the need to stabilise highwall slopes or make safe the final void itself. The primary disadvantages with this option are:

- The significant cost of rehandling extremely large volumes of spoil at the end of mine life resulting in the Project not being able to proceed;
- The significant limitation on being able to undertake progressive rehabilitation given the need to rehandle a majority of waste rock material at the end of mine life; and
- The ongoing settlement of the final landform surface potentially resulting in long term stability issues.

The modified pre-mining topography option resulted in the net present value (NPV) of the project being so low that the Project could not proceed. In consideration of the margins of error within the financial model assumptions, the risk of a negative return was far too high for development. This option was therefore not considered further.

The option to backfill to 80 m below topography is based on the findings of the groundwater assessment which indicated that, with controls to limit surface water draining to the pits, saline inflows would be significantly reduced if the pit was backfilled to about 80 m below ground level. For this option, in-pit backfill would be reshaped to a maximum of 6° in line with other slopes with a grazing land use. Highwall slope management requirements would be reduced and additional areas would be available for grazing. Only minor restrictions on progressive rehabilitation arise. While still resulting in a partially backfilled void at completion of mining, a key advantage is that water quality within the pit lakes will increase in salinity at a significantly lower rate than otherwise, as detailed below.

The residual void will comprise three principal ‘domains’ having differing landforms and characteristics and, as a result, differing post mining land uses. These domains are described as:

- Regraded, topsoiled and revegetated low wall slopes draining to the pit water lakes and able to support a grazing PMLU.
- Two water bodies with a surface level which has been modelled to gradually increase to an equilibrium level of between 70-80 mAHD; acting as a groundwater sink and having a gradually increasing salinity. A key rehabilitation objective for this domain is to reduce the rate of predicted water salinity present in the void primarily to allow the ecology of the residual void waterbody sufficient time to adapt to salinity changes. Final void modelling suggests that during the first 200 years after closure, lake salinities will be less than 10,000 mg/L. After 500 years salinity is conservatively modelled to increase to 30,000 mg/L. It should be noted that modelling inherently overestimates the rate of salinity increase in residual void water bodies by assuming that the source of mobile salts in overburden is infinite. Recent research is challenging this assumption,

but there is little currently available data on the long-term behaviour of water bodies resident in Bowen Basin coal mine overburdens, particularly the rate of approaching a long-term equilibrium salinity level. The backfilling option adopted is intended to seal the poorer quality remnant coal seam aquifers and limit salt inputs to the pit lake from groundwater.

The final voids will be able to support suitable native fauna habitat despite a gradually increasing salinity. The air/waterbody interface is expected to support a range of waterborne and flying insects, as well as avifauna and various bat and microbat species. The waterbody itself is expected to support a range of freshwater aquatic plants and invertebrates in shallower edge areas and over time transition to brackish water species as water quality changes. The groundwater assessment concluded that there is a low risk of the Project impacting on groundwater quality post-mining.

The material characteristics present some potential rehabilitation erosion issues to be managed by selective handling and rehabilitation processes. Given that low wall slope runoff will report to the void, this effectively negates any potential to cause environmental harm.

- Residual void high walls will be regraded to moderate slopes of approximately 22°, made safe and rehabilitated to a native ecosystem able to support native fauna as a PMLU.

Figure 30 provides a conceptual layout of the proposed domains.

4.3.5 Mine Infrastructure Areas

The majority of the MIA is proposed to be returned to a grazing PMLU. However, where ecosystem connectivity is identified to be advantageous for post-mining and neighbouring land uses, the option exists to re-establish native vegetation corridors. Monitoring and maintenance regimes will be implemented as per Section 4.4.5 (Revegetation) and Section 4.7 (Rehabilitation Monitoring and Measurement).

If consultation with neighbours or other potential post-mining land users identifies any infrastructure of value to the PMLU, a written agreement will be established that transfers liability in the structure and its use to the new owner.

4.3.6 Water Management Infrastructure

Unless water storage facilities are identified by the post-mining landholder as of value to their future use of the land, and an agreement is entered into, all water storages will be regraded to blend in with the surrounding landscape and revegetated to the determined PMLU.

Drainage works are to remain post-mining. The revegetation of permanent drainage structures will incorporate geomorphic and riparian vegetation features that are consistent with the pre-mining environment. A key objective of the revegetation of permanent drainage structures will be to ensure that self-sustaining vegetation communities are achieved. Additionally, revegetation along permanent drainage structures will aim to restore habitat connectivity within the remaining portions of Springton Creek.

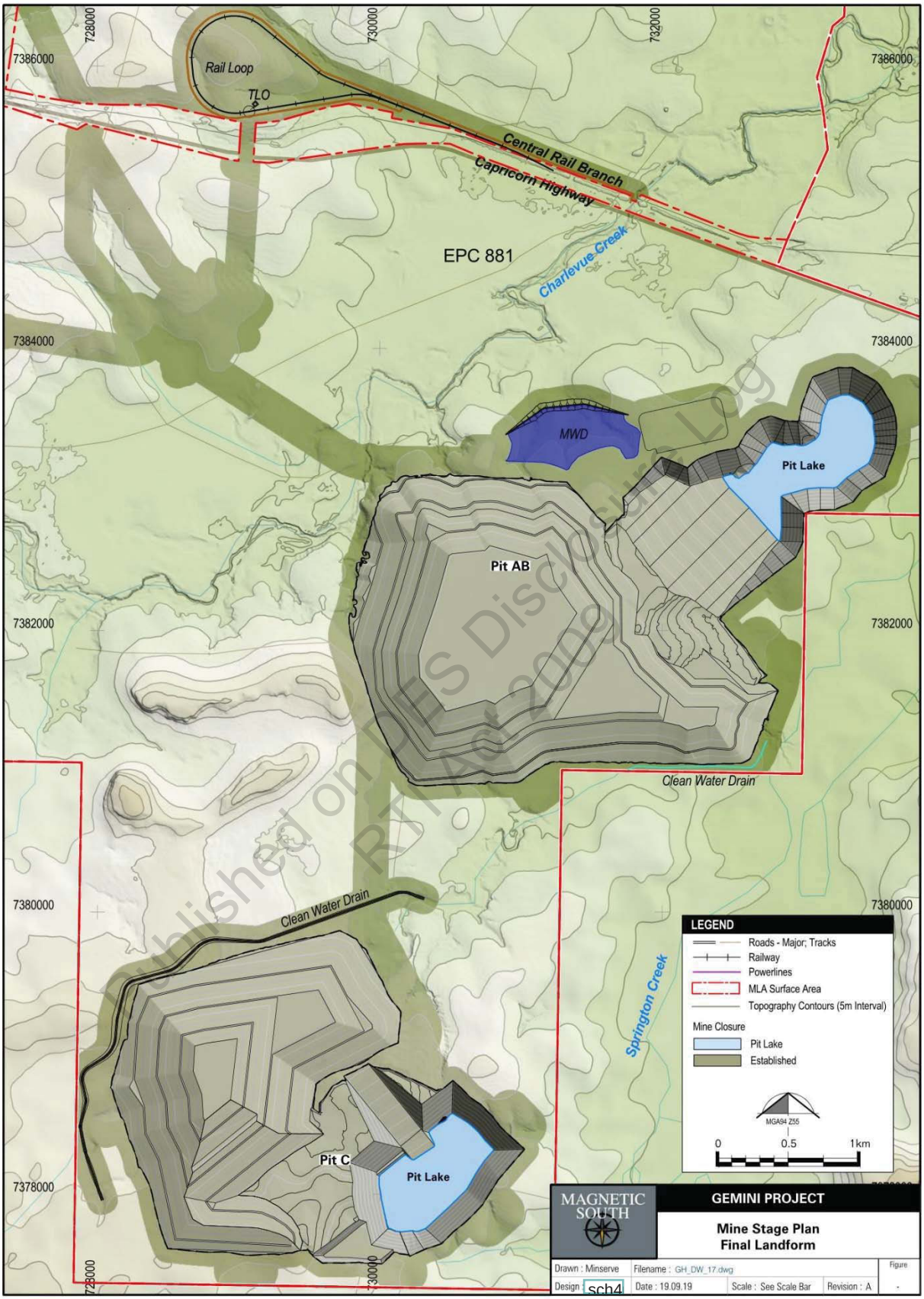


Figure 30 Conceptual Final Landform

4.3.7 Progressive Rehabilitation

Mine stage plans have been prepared for every second year from Year 2 to Year 12, and then from Year 13 to Year 17 and are included as Figure 17 to Figure 25. A conceptual post-mining landform has also been prepared and is shown at Figure 30. The stage plans indicate the conceptual sequence of mining and rehabilitation activities particularly with respect to the functional operational steps of waste rock emplacement construction, the point at which disturbed areas become available for rehabilitation, and then completion of the activities of reshaping/topsoiling and revegetation.

Areas from the stage plan figures provided above have been extracted and are presented in Table 16. This data excludes the rehabilitation of areas post-mining such as mine infrastructure areas and water management infrastructure.

Table 16 Indicative progressive rehabilitation schedule

Mine Stage	Area	Area Available for Rehabilitation (ha)	Total Area Reshaped and Topsoiled (ha)	Total Area Rehabilitated (ha)
Year 4	Pit AB	60	60	110
	Pit C	-	-	-
Year 8	Pit AB	36	25	225
	Pit C	-	-	-
Year 12	Pit AB	55	15	315
	Pit C	-	-	-
Year 15	Pit AB	82	112	380
	Pit C	40	50	17
Year 20*	Pit AB	-	-	659
	Pit C	-	-	465
	Water management infrastructure	-	-	250
	Mine infrastructure areas	-	-	590

Note: * Year 20 nominally provided as at completion of rehabilitation.

4.4 REHABILITATION METHODS AND CONTROLS

4.4.1 Defining Land Available for Rehabilitation

As a general guide, overburden emplacements are constructed as benches with external faces formed from upper benches set back sufficiently from the prior bench to facilitate regrading to the design final rehabilitation slope. For the Project, rehabilitated slopes will vary to up to a maximum of 6°.

For coal mining operations, it is not uncommon for changes to mine plans to occur as a result of factors including; increased resource knowledge, changed market conditions, geological factors, extreme weather or other external factors. For this reason the rehabilitation schedule should be treated as indicative. Mine planning changes are expected to result in regular updates to the schedule over the mine life.

On completion of dumping to design limits, emplacements will be available for rehabilitation with the single exception of where haul roads or services create an impediment to access areas for rehabilitation. With the planning arrangement of a single emplacement linked to each operational pit, such circumstances are considered to be relatively limited and are unlikely to result in any significant delay to the progressive rehabilitation schedule.

4.4.2 Reshaping/Landform Development

Overburden placement will be undertaken using rear dump trucks in accordance with mine planning schedules and as per dump designs informed by geotechnical assessments. Standard mine survey controls will be utilised to ensure that disturbance footprints are not exceeded and that design slopes will be attained.

Regrading to final landform will be undertaken using bulldozers to push to grade utilising standard survey controls.

Where proposed to be utilised, and in conformance with a master emplacement surface drainage plan, graded banks and rock-protected spine drains will be installed to allow drainage from long rehabilitated slopes to be conveyed to natural ground level. All surface runoff from newly rehabilitated slopes will be directed into sediment dams until revegetation uptake is stable and adequate to control soil erosion.

Final trimming of reshaped areas will be undertaken as required to remove excess rock and ensure correct graded bank slopes.

Topsoil spreading will then be undertaken to achieve the designated topsoil depth followed by surface preparation including at a minimum contour ripping to retain moisture and control erosion.

4.4.3 Topsoil Management

Topsoil is a key factor in achieving successful rehabilitation and a valuable resource for the Project. Topsoil management will be carried out in accordance with a *Topsoil Management Plan* addressing the following aspects:

- Identification and delineation of topsoil resources based on the soil assessments already undertaken (AARC 2019b) (Appendix F); including indicative stripping depths and topsoil qualities;
- Identification of amelioration requirements for topsoils to address identified deficiencies;
- A topsoil stockpiling plan that optimises the placement of topsoil stockpiles as much as practicable and sets stockpile design parameters including height (typically up to 3 m), and batter angles (no greater than 1:3); and describes applicable construction practices;
- A topsoil inventory which is to be maintained during the life of the Project and which accounts for the volumes and locations of topsoil as it is progressively stripped, stockpiled and reapplied. The inventory will also address the delineation of stockpiled topsoil, protection from unplanned use or disruption and prioritisation of re-use. The soil inventory will allow early identification of potential issues such as soil balance deficits or poorer quality soils; enabling remedial actions to be planned in advance of mining operations; and
- Erosion and sediment control methods applicable to areas stripped of topsoil, topsoil stockpiles (including revegetation where warranted) and areas where topsoil is being and has been re-applied.

4.4.4 Revegetation

Vegetation is generally established in rehabilitated areas through topsoil application, by direct seeding or by planting using nursery-raised tube-stock of target species. Initial revegetation efforts will be aimed at stabilising and establishing the building blocks for a self-sustaining system, in accordance with the defined land use.

Areas identified as returning to a grazing PMLU will likely utilise grass seed mixes for the Project area that include Rhodes grass (*Chloris gayana*), forest bluegrass (*Bothriochloa decipiens*), Queensland bluegrass (*Dichanthium sericeum*), barbed wire grass (*Cymbopogon refractus*), black speargrass (*Heteropogon contortus)* and curly windmill grass (*Enteropogon acicularis*) as well as other species native to the area. Application rates are anticipated to range between 6-10 kg/ha.

For areas to be restored to native vegetation, species will be based on the rehabilitation objectives and will generally target species relevant to nearby remnant vegetation associations, soil types, and site conditions. Revegetation of native woodland areas for example, will include the planting of endemic species which are characteristic of pre-mining conditions, as identified through flora assessments undertaken for the Project.

Seeding will typically be scheduled to occur prior to wet season to maximise the benefits of subsequent rainfall.

Topsoil stockpiles will be revegetated to assist in stabilisation and erosion control. Similarly, drainage lines, berms and other erosion control and stabilisation works will require revegetation with an appropriate seed mix. Application rates will vary depending on the circumstance as well as the rehabilitation species sensitivity, the growth media and the PMLU.

4.4.5 Rehabilitation Maintenance

Significant rainfall events, floods, fire, drought, pest species outbreaks or other factors may also result in a requirement to maintain rehabilitated areas. Maintenance of rehabilitated areas may also be required where visual observations of rehabilitation and or rehabilitation monitoring results (refer Section 4.7 (Rehabilitation Monitoring and Measurement)) indicate that the expected trajectory towards achieving completion criteria is not being met. These maintenance activities may include:

- Earthworks repair of erosion areas;
- Re-seeding;
- Supplementary planting of tube-stock;
- Additional fertiliser or other ameliorant application; and
- Repair or alteration of drainage structures.

In the event that maintenance is required, a maintenance plan will be developed that properly assesses the risks of re-entering a rehabilitated area with earthmoving equipment, the sourcing of soils and topsoil, impacts on planned drainage of the site, erosion controls and revegetation methods.

4.4.6 Mine Infrastructure Areas

Mine infrastructure areas will not be rehabilitated until mining operations have ceased. These areas will have all infrastructure removed and be regraded to their approximate original contour to ensure they are stable and sound. Footings will be either completely removed or removed to at least a depth of 1 m

below surface level. Where possible infrastructure will be on-sold or sold for scrap. Clean construction and demolition waste will either be removed from site or placed within one of the final waste rock emplacements and covered. Any land identified to be subject to contamination will be subject to notification and a site investigation and either excavated and contaminated material removed to a licensed facility or, or risk assessed and listed on the Environmental Management Register.

Once reshaped, mine infrastructure areas will be subjected to rehabilitation practices including topsoiling and revegetation as described in Section 4.4.3 (Topsoil Management) and Section 4.4.4 (Revegetation). The land disturbance and other controls detailed at Section 4.5 (Land Disturbance Management and Controls) will be implemented as appropriate. In addition, controls to address specific demolition and closure risks will be implemented.

If consultation with neighbours or other potential post-mining land users identifies any infrastructure of value to the PMLU, a written agreement will be established that transfers liability in the structure and its use to the new owner.

Haul roads will be constructed utilising spoil material sourced from initial mining operations. At closure, haul roads will have road base materials removed and be reshaped to create a stable landform that blends in with the surroundings. Minor site access roads and tracks will be rehabilitated where they are no longer required.

4.4.7 Water Management Infrastructure

Unless water storage facilities are identified by the post-mining landholder as of value to their future use of the land, and an agreement is entered into, all water storages will be drained and de-silted, and re-profiled to ensure the area is free-draining and blends in with the surrounding landscape. Disturbed areas will be seeded with a pasture seed mix suitable for grazing. Raw water dams, once no longer required, will be emptied by pumping to the final void. Dam liners will be removed and appropriately disposed of.

The installed clean water drains will remain post-mining. Revegetation works for these structures will be undertaken at time of construction with the objective of ensuring that self-sustaining vegetation communities are achieved. Where appropriate, revegetation along these drainage lines will incorporate an objective of restoring or maintaining habitat connectivity.

Revegetation activities will include:

- Planting an appropriate mix of native trees, shrubs and grasses;
- Reinstating woody debris in the diverted landscape;
- Weed and pest management;
- Ensuring revegetated areas are protected from the impacts of livestock grazing; and
- Monitoring diversion stability and revegetation success until a trajectory of achieving completion criteria can be demonstrated.

4.5 LAND DISTURBANCE MANAGEMENT AND CONTROLS

4.5.1 Land Disturbance Permit System

All construction, operational and decommissioning phase disturbances will be managed using a land disturbance permit (LDP) system. The LDP system will define, risk assess and approve all land disturbances before the activity can proceed.

4.5.2 Erosion and Sediment Control

An *Erosion and Sediment Control Plan* (ESCP) for the Project will be developed to address the construction, operational and rehabilitation/closure phases of the Project.

The ESCP will be developed as a technical supporting document for the LDP system. If any land disturbance triggers erosion and sediment control requirements, the ESCP will provide control options that can be nominated as conditions of land disturbance. Typical controls are likely to include:

- Silt fences, hay bales or other flow reduction and sediment entrapment devices;
- Sediment traps and dams; and
- Rapid revegetation methods.

Erosion and sediment control structures will be designed and installed in accordance with *Best Practice Erosion and Sediment Control* (IECA Australasia 2008) and *Soil Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites* (Witheridge & Robert 1996), as appropriate. Erosion and sediment control structures would not be removed until disturbed areas have been stabilised and the risk of erosion of sedimentation impacts have reached pre-disturbance levels.

4.5.3 Contaminated Land

The risk of land contamination will be similar to existing mining operations and is likely to be confined to instances of small diesel spills, and/or spills of chemicals likely to be onsite. Given the relatively small scale of the Project, it is likely that any inadvertent contamination will be cleaned up with contaminated material removed offsite.

4.5.4 Pest and Weed Management

The Project's *Weed and Pest Management Plan* will address weeds and pests across the Project as well as in rehabilitation areas. Regular monitoring will be undertaken specifically targeted at identified pest and weed species, and management plans implemented as appropriate to the findings of monitoring results.

4.6 REHABILITATION INDICATORS AND COMPLETION CRITERIA

The *Guideline (Resource Activities): Rehabilitation requirements for mining resource activities [ESR/2016/1875]* (DES 2014a) requires the nomination of rehabilitation performance indicators and completion criteria for mining resource activities. Rehabilitation performance indicators are intended to provide defensible measurements of progress towards rehabilitation targets – referred to as completion criteria.

Principles for the development of rehabilitation performance indicators are preferably specific, measurable, achievable, realistic and timely. They should be outcome-based (linked to the end land use); flexible to adapt to changing circumstances; able to evolve as the mine life progresses; subject to

periodic review; and include a measurement approach that details how the criterion will have been met (COA 2016b; ANZMEC and MCA 2000).

Completion criteria are the threshold values, which when met, are deemed to demonstrate that a given indicator requirement has been achieved. Completion criteria may be established through technical or engineering studies or by assessing analogue or comparative sites that are considered to represent the desired rehabilitation outcome. In many cases, completion criteria need to be developed on the basis of ongoing monitoring of analogue sites to determine seasonal behaviours or variation over time.

For the Geminin Project, completion criteria and indicators have been developed to demonstrate:

- Productivity of the land (for grazing land uses);
- Sufficiency of vegetation cover;
- Rates of erosion and sediment loss, and changes in rate over time;
- Land capability;
- Geotechnical stability of rehabilitated areas (e.g. slope length, slope angle, rate of sediment loss, factors determined through geotechnical studies);
- Quality of water runoff at various upstream and downstream monitoring locations;
- Efficacy of containment and treatment of sediment-laden runoff;
- Engineering standards and certifications for decommissioned and rehabilitated infrastructure; and
- Remediation of any contaminated land.

The proposed completion criteria for the Project are set out in Table 17.

Table 17 Rehabilitation Objectives, Performance Indicators and Completion Criteria by domain

Mine Domain	Rehabilitation Goal	Rehabilitation Objective	Performance Indicator	Completion Criteria
Final Voids	Safe	The final voids are safe for humans and animals.	Presence of safety barriers and signage around the final void.	• Provide evidence that signage and safety barriers have been installed to limit access to the final void. • All safety barriers and signage have been installed and tested as per the latest guidelines at the time rehabilitation is undertaken (currently *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland* (DME 1995) and *Coal Mining, Safety and Health Act 1999* (CMSH Act) for signage).
			Safety assessment of the final void highwalls and low walls.	• Geotechnical assessment certifying that the final void is safe and stable.
	Non-polluting	The final voids are isolated from local water resources.	Water quality monitoring: void water quality monitoring.	• Water quality within the final void water body maintains environmental values required for the defined land use(s).
			Water quality monitoring: surface waters and groundwater.	• Environmental values of adjacent/downstream surface waters are not impacted by pit water. • Water quality of surrounding groundwater resources remains consistent with baseline and reference data.
			Final void surface water levels.	• Evidence that final void water levels are behaving in accordance with predicted values.
	Stable	Very low probability of wall failure, slippage or rock falls that will cause significant environmental harm.	Geotechnical studies of the final void.	• Geotechnical evidence/report supporting a low probability of failure or slippage causing environmental harm.
			Past records of slope failure during mining.	• Evidence that appropriate control measures are in place to prevent any recurrence.
		Highwall and low wall construction meets geotechnical design criteria.	Geotechnical indicators as defined by closure geotechnical assessment.	• To be determined based on closure geotechnical assessment.
		Highwall/low wall erosion at assessed rates.	Highwall/low wall erosion rates.	• Evidence that erosion is being managed with the required berms/ graded banks, interceptor channels and drains etc.
	Sustainable land use	Pit lake able to support native fauna.	Ecosystem monitoring and analysis (e.g. erosion, sediment quality, organic matter and nutrient content and cycling, vegetation dynamics, habitat complexity and habitat quality) monitoring.	Monitoring demonstrates: • Sustainable fauna usage of the final void. • Weed diversity and abundance comparable to relevant rehabilitation monitoring reference sites. • Pest fauna and flora species are not on an increasing trajectory.

Mine Domain	Rehabilitation Goal	Rehabilitation Objective	Performance Indicator	Completion Criteria
Water Management Infrastructure	Safe	Site is safe for all humans and animals.	Dams are decommissioned and rehabilitated in full accordance with decommissioning requirements specified in the operational plan for the structure.	• Certification from a suitability qualified person that structures have been decommissioned and rehabilitated in full accordance with the decommissioning requirements specified in the operational plan for the structures.
			Contaminated land site investigations.	• The land has either been removed from the environmental management register or the land has a site management plan approved.
	Non-polluting	Hazardous material adequately managed, presenting a low risk of environmental harm.	Contaminated land site investigations.	• The land has either been removed from the environmental management register or the land has a site management plan approved.
			Water quality monitoring.	• For a period of 3 consecutive years post-mining, the water quality of any potentially impacted streams meets EA water quality limits or is consistent with upstream/reference site data. • For a period of 3 consecutive years post-mining, water quality of surrounding groundwater aquifers is consistent with baseline and/or reference data.
	Stable	Vegetative cover sufficient to minimise erosion.	Percentage ground cover.	• Evidence that the percentage ground cover of the rehabilitated areas is sufficient to limit erosion to rates similar to analogue sites.
	Sustainable land use	Vegetation and habitat established consistent with agreed post mine land use.	Monitoring of vegetation type, density and regeneration rates.	• Evidence that the vegetation species richness/composition and vegetation cover/density of the rehabilitated areas is statically equivalent to analogue sites and is self-sustaining over time.
		Soil properties support desired land use.	Soil nutrient testing.	• Evidence that soil nutrient levels are statistically equivalent to analogue sites.
		Establish self-sustaining natural vegetation.	Monitoring of species composition, species richness, and weed abundance.	• Evidence that vegetation species composition, richness and weed abundance of rehabilitated areas is statistically equivalent to analogue sites.

Mine Domain	Rehabilitation Goal	Rehabilitation Objective	Performance Indicator	Completion Criteria
Mining Infrastructure Areas	Safe	Site is safe for all humans and animals.	Infrastructure removed or retained by agreement.	• Evidence that residual risk is acceptable and risk liability transfer has occurred.
	Non-polluting	Hazardous material adequately managed, presenting a low risk of environmental harm.	Contaminated land site investigations.	• The land has either been removed from the environmental management register or the land has a site management plan approved.
			Water quality monitoring.	• For a period of 3 consecutive years post-mining, the water quality of any potentially impacted streams meets EA water quality limits or is consistent with upstream/reference site data. • For a period of 3 consecutive years post-mining, water quality of surrounding groundwater aquifers is consistent with baseline and/or reference data.
	Stable	Vegetative cover to minimise erosion.	Percentage ground cover.	• Evidence that the percentage ground cover of the rehabilitated areas is statistically equivalent to analogue sites.
	Sustainable land use	Vegetation and habitat established consistent with agreed PMLU.	Vegetation type and density.	• Evidence that the percentage ground cover of the rehabilitated areas is statistically equivalent to analogue sites.
		Soil properties support desired land use.	Soil nutrients.	• Evidence that soil nutrient levels are statistically equivalent to analogue sites.
		Establish self-sustaining vegetation.	Species composition, species richness, and weed abundance.	• Evidence that vegetation species composition, richness and weed abundance of rehabilitated areas is statistically equivalent to analogue sites.

Mine Domain	Rehabilitation Goal	Rehabilitation Objective	Performance Indicator	Completion Criteria
Waste Rock Emplacements	Safe	The spoil dumps will be safe for humans and animals.	Safety assessment of slopes that are >22° and >5 m in height.	• Certification in rehabilitation report that slopes have been assessed as safe and area expected to remain so. • Safety signage is consistent with the requirements of the CMSH Act or equivalent legislation at the time of mine rehabilitation.
	Non-polluting	Hazardous material adequately managed.	Engineering supervision and design.	• Certification in the rehabilitation report that the specified minimum cover thickness is in place.
		Waste emplacements are not a source of serious environmental harm to the receiving environment.	Water quality.	• For a period of 3 consecutive years post-mining, the water quality of any potentially impacted streams meets EA water quality limits or is consistent with upstream/reference site data. • For a period of 3 consecutive years post-mining, water quality of surrounding groundwater aquifers is consistent with baseline and/or reference data.
	Stable	Minimal probability of slope failure that will cause significant environmental harm.	Geotechnical studies of spoil dumps.	• Geotechnical evidence/report supporting a very low probability of failure or slippage causing environmental harm.
			Past record of slope failure during mining.	• Evidence in rehabilitation report that appropriate control measures are in place to prevent any recurrence.
		Landform designs meets criteria.	Slope angle and length.	• A maximum angle of 8° is achieved for all dump slopes above natural surface.
		Vegetative cover to minimise erosion.	Percentage ground cover.	• Evidence that the percentage ground cover of the rehabilitated areas is statistically equivalent to analogue sites.
		Low probability of significant erosion.	Visual observations of erosion.	• Evidence that the erosion rates of rehabilitated areas is statistically equivalent to analogue sites, or on a clear trajectory to determined acceptable rates.
	Sustainable land use	Vegetation and habitat established consistent with agreed PMLU.	Vegetation type and density.	• Evidence that vegetation species richness/composition and vegetation cover/density of the rehabilitated areas is statistically equivalent to analogue sites.
		Soil properties support desired land use.	Soil nutrients.	• Evidence that soil nutrient levels are statistically equivalent to analogue sites.
		Establish self-sustaining natural vegetation.	Species composition, species richness, and weed abundance.	• Evidence that vegetation species composition, richness and weed abundance of rehabilitated areas is statistically equivalent to analogue sites.

Mine Domain	Rehabilitation Goal	Rehabilitation Objective	Performance Indicator	Completion Criteria
Constructed Drainage Lines	Safe	Permanent drainage lines remain safe for humans and animals.	Safety barriers and signage assessed against requirements of the CMSH Act.	• Evidence that all safety precautions have been taken in accordance with the relevant legislation.
			Assessment of diversion by an appropriately qualified person.	• Evidence that safety precautions have been implemented in accordance with relevant legislation.
	Non-polluting	Discharge will be of good quality water that is unlikely to affect known environmental values.	Water quality.	• Evidence that monitoring data is meeting specified trigger levels that ensure environmental values are not being compromised.
	Stable	Minimal probability of instability that will cause significant environmental harm.	Geotechnical behaviour of final landforms.	• Geotechnical evidence/report supporting a very low probability of failure or slippage causing environmental harm.
			Risk assessment of final landform.	• Evidence that appropriate risk assessment and control measures have been undertaken.
		Vegetation cover to minimise erosion.	Percentage ground cover.	• Evidence that the percentage ground cover of the rehabilitated areas is statistically equivalent to analogue sites.
	Sustainable land use	Establish safe and stable waterway with a low risk of environmental harm.	Water quality established by monitoring or modelling validated by monitoring.	• Evidence that the watercourse function is on a trajectory equivalent to analogue watercourses.

4.7 REHABILITATION MONITORING AND MEASUREMENT

Rehabilitation monitoring for the Project has the goal of assessing compliance with the rehabilitation objectives and agreed completion criteria.

Rehabilitation monitoring will be used to track the progress of revegetated areas and determine requirements for intervention, such as weed control or supplementary planting. Additionally, rehabilitation monitoring will also:

- Evaluate coverage and application of topsoil prior to seeding;
- Monitor drains and assess water quality to determine whether substantial silting of inverts and/or any localised failure of drain embankments has occurred;
- Evaluate topsoiled areas following rainfall events (particularly on slopes) to assess whether significant rill development or loss of topsoil has occurred;
- Evaluate the behaviour of placed topsoil over time (erosion or dispersion, compaction, salting or hard setting);
- Assess the germination success in revegetated areas (including recording of diversity and abundance);
- Monitor revegetation success over time (e.g. survival rate, plant growth, species diversity, weed content, fauna usage);
- Evaluate potential threats to rehabilitated areas (e.g. weed invasion, pest species, dispersive soils or potentially acid forming-low capacity materials, erosion); and
- Record key rehabilitation information (e.g. photographic records, surveys, file notations).

Rehabilitation monitoring will be defined through a *Rehabilitation Monitoring Program*. To monitor the success of progressive rehabilitation, permanently marked transects will be established. These transects will generally be monitored for a minimum of five years. The results will then be used to continually inform and assess the effectiveness of rehabilitation strategies and methodologies, as well as enabling movement towards progressive certification. Where new monitoring techniques and technologies are identified, these will be adopted as appropriate.

4.7.1 Monitoring Methodology

A transect based approach (consistent with the BioCondition methodology) will be utilised for rehabilitation monitoring. This approach aims to provide a measure of the capacity of a terrestrial ecosystem to maintain biodiversity values at a local or property scale and allows a comparative assessment of pre- and post-mining ecosystems.

BioCondition monitoring assesses a suite of parameters at different landscape positions on each site, namely on flats, slopes and in troughs. Repeated edaphic (soil properties) and biological measurements are taken over time for various parameters that indicate changes in ecosystem function as rehabilitation proceeds. In general, the method involves monitoring two groups of sites:

- **Natural sites (analogue/reference):** are chosen to best reflect the pre-mining land use (i.e. cleared pasture for cattle grazing) to obtain relevant and realistic rehabilitation criteria for the matching PMLU. Analogue sites will be chosen as close as possible to the rehabilitated area so

that the same climatic and environmental conditions existed at both sites to the extent possible; and

- **Rehabilitated sites:** are monitored for rehabilitation performance, successful or otherwise.

Multiple analogue/reference sites will be established on and around the Project that best represent pre-mining ecosystems. For this Project, reference sites representative of the proposed PMLU of low intensity grazing on native and improved pastures will be established prior to the commencement of the Project.

Structured, periodic monitoring of reference sites will provide an understanding of the pre-mining landscape, assisting in the future planning and refinement of rehabilitation strategies, as well as providing data for determination of completion criteria when assessing rehabilitation success.

Rehabilitation transect sites will also be established within rehabilitated landforms post mining. At each site the following parameters will be monitored annually:

- Aspect and slope;
- Tree density (trees/ha);
- Shrub density (shrubs/ha);
- Herb/grass density (grasses/ha);
- Groundcover (%);
- Species composition;
- Chemical and physical indicators of soil;
- Erosion indicators (depth of rills or erosion lines, surface crusting, slopes); and
- Photographic records of the site.

In addition to rehabilitation transect monitoring, other related site environmental monitoring will continue throughout and following the life of the mine (e.g. surface water monitoring). These data sets will also work to further inform rehabilitation success.

In accordance with current standards, rehabilitation monitoring will ultimately aim to demonstrate that domain specific completion criteria have been continuously met for a period of three years or greater.

4.7.2 Review of Rehabilitation Monitoring Data

Rehabilitation monitoring data will be used to review rehabilitation success. This will occur through:

- Tracking revegetation and/or regeneration progress against performance indicators and completion criteria;
- Assessing the performance of landform designs and rehabilitation concept methods;
- Evaluating the effectiveness of environmental management measures/controls; and
- Identifying the requirement for intervention strategies or ameliorative/contingency measures.

The results of any industry rehabilitation trials and investigations will also continue to be used to inform and refine future rehabilitation concepts, practices and measures.

4.8 CLOSURE AND RELINQUISHMENT

4.8.1 Closure Planning

A *Closure Plan* will be developed for the Project during the first five years of the Project life. The C*losure Plan* will extend the preliminary rehabilitation requirements described in Table 17 (i.e. the rehabilitation goals, objectives, performance indicators and completion criteria), and develop detailed planning for the post-mining closure phase of the Project.

The *Closure Plan* will update and refine landform design criteria, particularly residual void slope highwall and low wall slope design and completion criteria on the basis of experience gained during mining operations. Any agreements in relation to retained infrastructure will also be addressed.

The *Closure Plan* will also refine rehabilitation maintenance requirements and provide an update on findings from rehabilitation monitoring undertaken.

4.8.2 Final Rehabilitation Report and EA Surrender

At the point in time that rehabilitation monitoring indicates that completion criteria are being achieved for all or part of the rehabilitation undertaken for the Project, either a final or progressive rehabilitation report will be compiled and submitted to the administering authority for consideration in accordance with Section 264 or Section 318ZF of the EP Act.

5.0 LAND

This section provides a description of the existing land values within and surrounding the Project. It aims to identify the Project's potential impacts on the existing values and propose mitigation measures and management strategies to prevent or minimise adverse environmental effects.

This section is informed by the *Soil and Land Suitability Assessment* (AARC 2019b) presented as Appendix F.

5.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objective relevant to potential impacts to land as described in the EA guideline for *Application requirements for activities with impacts to land [ESR/2015/1839]* (DES 2017b) is:

The activity is operated in a way that protects the environmental values of land including soils, subsoils, landforms and associated flora and fauna.

The Project would achieve all of the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

(a) Activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the environmental values of land;

(b) Areas disturbed will be rehabilitated or restored to achieve sites that are:

(i) safe to humans and wildlife;

(ii) non-polluting;

(iii) stable; and

(iv) able to sustain an appropriate land use after rehabilitation or restoration;

(c) The activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants; and

(d) The application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils.

5.2 DESCRIPTION OF ENVIRONMENTAL VALUES

5.2.1 Landform and Visual Amenity

Landform

The topography of the Project area varies from flat to undulating hills, with elevation ranging between 120-150 mAHD. The landscape is strongly influenced by the presence of Charlevue Creek and its associated floodplains, which have relatively lower elevations than the surrounding landscape of undulating hills. An elevated ridgeline is located 2-5 km east of the Project at an elevation of 170 mAHD.

The major water body associated with the Project is Charlevue Creek, which dissects the MLA, flowing in a northeast direction. This creek begins within the boundaries of Blackdown Tablelands National Park,

flowing northeast before joining with Springton Creek and the Fitzroy River, eventually reaching the Pacific Ocean approximately 46 km north of Gladstone. Two significantly smaller creeks, Stanley and Springton, cross the Project boundaries in the northwest and southeast respectively. These two creeks eventually converge with the Mackenzie River. Associated tributaries, agricultural dams and unnamed drainage features also appear across the site.

Visual Amenity

Visual amenity refers to the quality and appreciation of a geographical location in the context of valued features, characteristics and attributes. The existing visual environment of the Project and surrounding area is typical of the Bowen Basin; with predominant rural landscape character comprised primarily of grazing land and areas of bush reserve. The landscape amenity is dissected by major transport infrastructure including the Capricorn Highway and the Blackwater Railway. To the west of the Project, coal mines and associated infrastructure can occasionally be observed from public transport corridors. A number of small towns and rest stops are located along the Capricorn Highway serving the local residents and mining communities.

Some areas of the Project site may be visible to the public via main roads and local residential dwellings, as discussed in Section 5.3.2 (Visual Amenity).

5.2.2 Native Title and Cultural Heritage

Native title determination areas described by the National Native Title Tribunal (NNTT) is extinguished within the boundary of the ML. As such, a native title process is not required to be undertaken as part of the MLA process.

The Proponent will comply with the *Aboriginal Cultural Heritage Act 2003* and the supporting *Duty of Care Guidelines* (DATSIP 2004) when undertaking activities within the area of EPC 881 and the proposed ML.

A *Cultural Heritage Management Plan* (CHMP) will be developed and implemented for the Project in accordance with the *Aboriginal Cultural Heritage Act 2003*.

5.2.3 Geology

Regional Geology

The Gemini coal deposit is hosted within the Permian Rangal Coal Measures and the Yarrabee Structural Zone. Seven seams or seam groups have been identified at the Gemini Project site, which belong to either the Rangal Coal Measures or the underlying Burngrove Formation (BOYD 2019). In descending stratigraphic order, the seams include the Aries, Castor, Pollux, Orion, Pisces, Virgo and Leo seams. The seams contain several individual plies that have identified for mining at the site.

The site surface geology is shown in Figure 31. It predominantly comprises sediments of the Tertiary Duaringa Formation and Quaternary alluvium associated with ephemeral creeks including Charlevue Creek and Springton Creek.

Figure 32 shows the project location in relation to the underlying Bowen Basin solid geology (i.e. the surficial unconsolidated Quaternary and Tertiary units have been removed, revealing the relationship between the underlying Triassic and Permian sediments, as well as the prevalence of regional-scale faults). The two mining areas (Pit AB and Pit C) are in areas where folding has brought the coal seams close to surface at depths that can be economically mined.

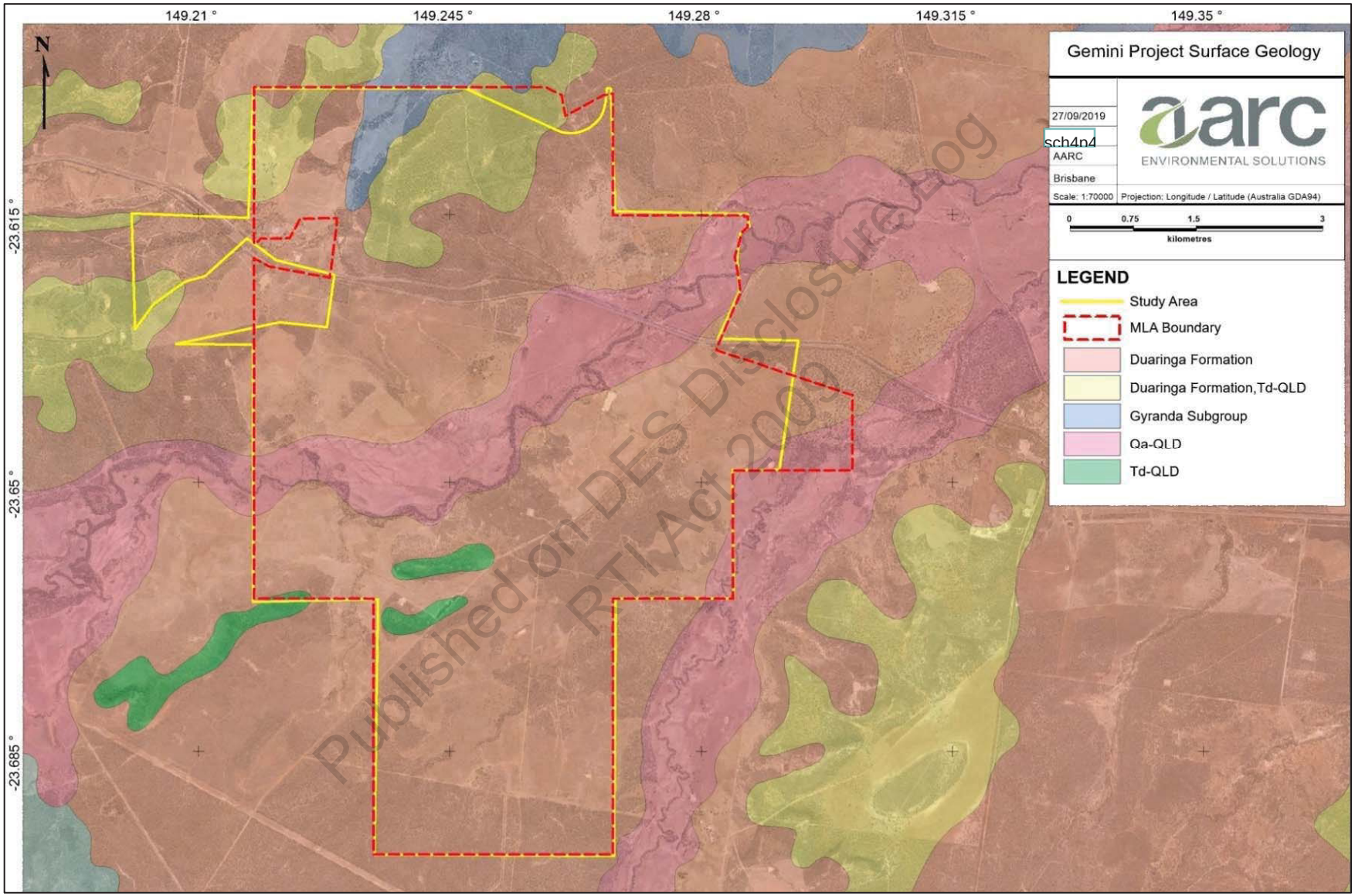


Figure 31 Surface geology

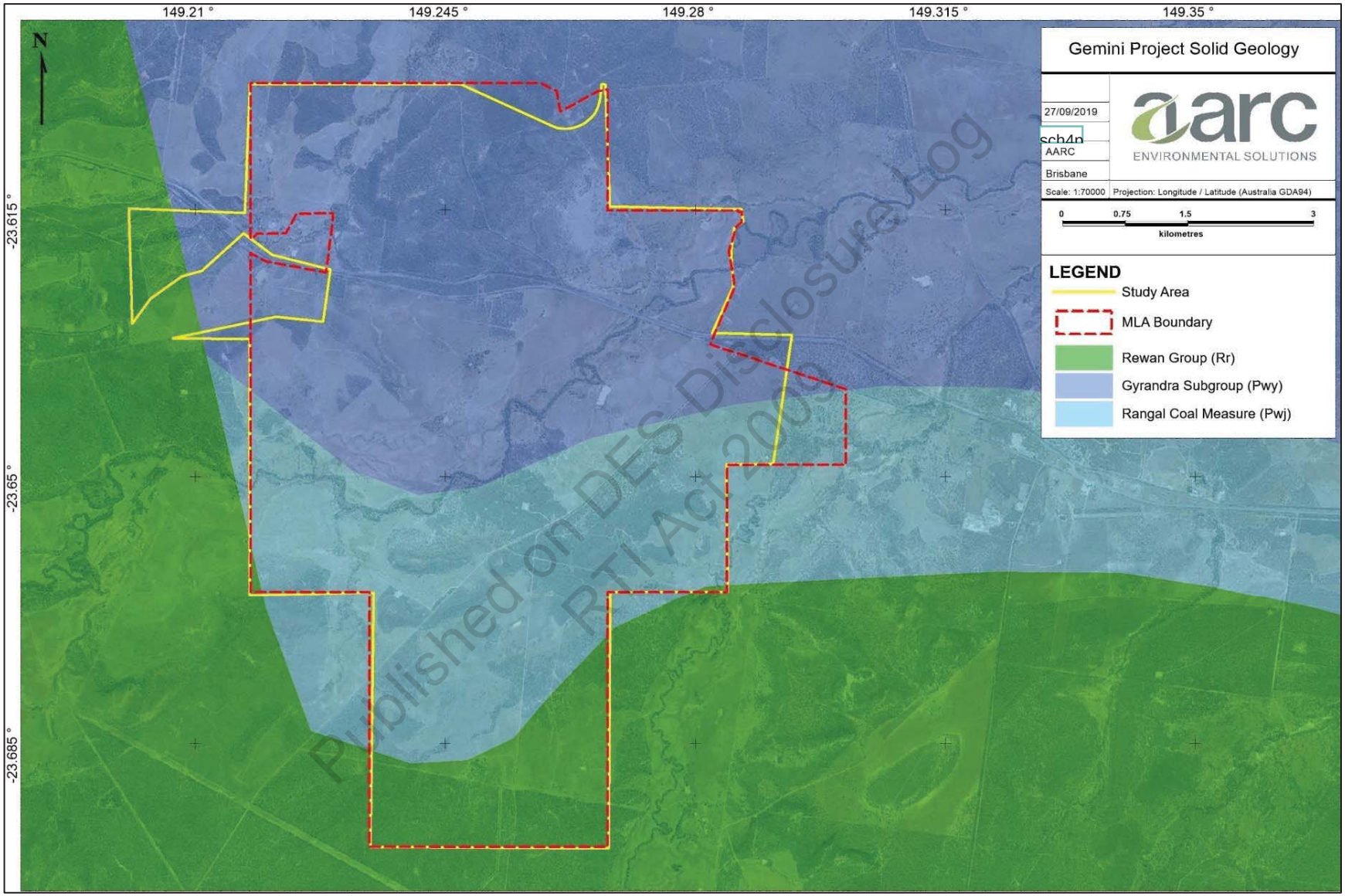


Figure 32 Solid geology

5.2.4 Land Systems

Two land systems are mapped within the Project area and are described as follows.

Dingo Land System

The Dingo land system is characterised by fluvial plains surrounding significant waterways. It is mostly composed of stable flood plains traversed by a branching pattern of drainage floors. The majority of deposits are weathered alluvium, with slopes of coarser or finer textured alluvium (depending on flow patterns). Channels can be up to 30 m wide and 3 m deep, with fringing riparian vegetation. Main drainage floors can then extend 800 m outwards, with deep texture contrast sandy loams over mottled clays, and open spaces of *Eucalyptus tereticornis* (blue gum) and *Eucalyptus crebra* (narrow-leaved ironbark) with sparse shrubs. Large plains surround drainage features (up to 3 km wide) which can contain either deep texture contrast soils with *Eucalyptus populnea* (poplar box) woodlands, or deep layered soils on alluvium with woodlands of blue gum and narrow-leaved ironbark. Slopes within this land unit are usually the result of strongly Gilgai shrink-swell clays, forming depressions of finer soil textures with *Acacia harpophylla* (brigalow) scrub.

Geology in this unit is comprised of weathered Quaternary alluvium.

Melbadale Land System

The Melbadale land system is characterised by the shallow dissection of weathered tertiary land surfaces, forming undulating plains dominated by complex depositional mid and lower slopes, with minor lateritic upper slopes in some places. This land system features moderately dense branching drainage patterns, with local relief usually less than 15 m. Depending on the steepness of terrain, upper slopes are often dominated by deep loamy red earths (gentle slopes) with narrow-leaved ironbark, or shallow fine sandy loams (steep terrain) with *Acacia shirleyi* (lancewood) forests. Mid to lower slopes are often associated with deep texture contrast soils of loamy sands overlying mottled sandy clays, with grassy woodlands of open-spaced narrow-leaved ironbark and shrubs. Lower slopes are often associated with deep light to medium clays, with tall forests of narrow-leaved ironbark. Tributaries have variable soil textures depending on slope, though stratified loams and texture contrast soils are common.

Geology in this land system is comprised of Quaternary to late Tertiary colluvial/alluvium, laterised tertiary sandstone, conglomerate, and shale.

5.2.5 Soils

A *Soil and Land Suitability Assessment* was undertaken within the MLA by AARC (2018) and attached as Appendix F.

Methodologies employed throughout this study are detailed in Appendix F and followed procedures in the *Australian Soil and Land Survey Field Handbook* (NCST 2009) and the *Guidelines for Surveying Soil and Land Resources* (McKenzie *et al.* 2008). The soil survey was based on a free-survey technique with soil profile and observation sites located to best represent all soil types present in the Project.

Within the Project, a total of 12 SMUs were described. Table 18 provides an overview of each SMU and its extent within the Project. The spatial distribution of the SMUs has been mapped at a scale of 1:70,000 and is depicted in Figure 33.

No acid sulphate soils have been identified within the Project area.

Table 18 Soil management units within the study area

SMU	Surface Area (ha)	Percent of Study Area (%)	General Description
Anderson	37.78	0.61	Hard setting soil unit associated with isolated hills. Soil textures grade from loams at the surface, to light medium clays with depth, sometimes exhibiting red mottling. Vegetation associated with this unit includes *Eucalyptus crebra*, *Corymbia clarksoniana*, and *Acacia rhodoxylon* with *Erythroxylon australe* in the shrub layer. The Anderson SMU has a very strongly acidic pH throughout the profile, ranging from 4.6 in the topsoil, to 4.8 in the lower subsoil. Electrical conductivity (EC) and chloride results indicate that at all depths, salinity is very low, with EC ranging from 0.064 deciSiemens per metre (dS/m) in the topsoil, to 0.02 dS/m in the subsoil layer. Chloride concentrations reflected this result, decreasing with depth from 30 mg/kg to 10 mg/kg, both well below toxic limits.
Barry	156.50	2.54	Hard setting soil associated with rivers, drainage lines and levees. Surface soils in this unit are comprised of clay loams to medium clays, grading into light or medium clays at variable depths. Dominant vegetation includes *Eucalyptus tessellaris*, *Eucalyptus populnea* and *Eucalyptus tereticornis*, with *Bauhinia hookeri, Cassia spinarum* and *Cassia brewsteri* in the shrub layer. The Barry SMU has a slightly acidic pH (6.5) which increases gradually with depth, becoming neutral at 0.2 m (6.8), and increasing to pH 7.2 with depth. EC is very low throughout the profile, ranging from 0.063 dS/m in the topsoil, to 0.012 dS/m in the lower subsoil. Chloride concentrations reflect this result, ranging from 20 mg/kg to <10 mg/kg with depth.
Charlevue	232.90	3.79	Hard setting soil associated with plains and rises. Textures within this unit grade from sandy clay loams or light clays in the surface soil, to medium heavy clays in the subsoil horizons. Dominant vegetation includes *Eucalyptus populnea* and *Eucalyptus crebra,* with *Flindersia dissosperma* (sometimes dominant) and *Cassia spinarum* in the shrub layer. The Charlevue SMU has a variable pH, ranging from 5.4 (strongly acid) in the topsoil to 7.9 (moderately alkaline) in the lower subsoil. EC is medium in the surface soil (0.28-0.43 dS/m) and increases to high in the subsoil (0.46 dS/m). Chloride is considered to be high from 0.2 m depth downwards (>600 mg/kg), which can cause toxicity by interfering with plants' osmotic capacity.
Cooinda	34.94	0.57	Hard setting soil associated with plains. Texture development within this unit is gradual, changing from a sandy clay loam in the topsoil, to a sandy light clay at mid-depth, and a medium heavy clay in the deeper subsoil. Dominant vegetation includes *Eucalyptus populnea* and *Flindersia dissosperma* (sometimes dominant), with *Cassia spinarum* in the shrub layer. The pH of the Cooinda SMU ranges from moderately acid (5.6) in the topsoil, to neutral (6.8) in the lower subsoil. EC is very low throughout the profile, with topsoil values of 0.015 dS/m, increasing to 0.043 dS/m in the subsoil. Chloride levels reflect EC, increasing from <10 mg/kg to 40 mg/kg with depth.

SMU	Surface Area (ha)	Percent of Study Area (%)	General Description
Ellesmere	14.59	0.24	Hard setting soil associated with isolated hills of weathered tertiary surfaces (laterite). Textures within this unit grade from fine sandy loams in the surface soil to medium clays in the subsoil horizons. Dominant vegetation is *Acacia shirleyi*, with *Erythroxylon australe* in the shrub layer. The Ellesmere SMU is a highly acidic soil unit, ranging from 4.6 (very strongly acid) in the topsoil to 5.5 (strongly acid) in the lower subsoil layer. EC is very low throughout the profile, changing from 0.02 dS/m in the topsoil, to 0.026 dS/m in the lower subsoil. Chloride concentrations are very low, consistently presenting at <10 mg/kg.
Geoffrey	4,061.00	66.0	This unit consists of texture contrast soils with soft surface conditions, associated with undulating plains and rises. Textures range from loamy sands to sandy light clays, overlying sandy medium clays with conspicuous orange or red mottling. Where these soils were exposed due to insufficient groundcover, extensive washouts and large erosion gullies were observed. In these areas, overland flow had removed coarse sandy material, leaving the easily eroded clays exposed to surface runoff. The Geoffrey SMU was often cleared, though when present dominant vegetation included *Eucalyptus crebra*, *Melaleuca leucadendra*, *Casuarina cunninghamiana* and *Corymbia clarksoniana*, with *Alphitonia excelsa*, *Petalostigma pubescens*, and *Acacia rhodoxylon* in the shrub layer. Due to the stark difference in textures between the topsoil and subsoil layers, pH for the Geoffrey SMU changes quite dramatically down the soil profile. Sandy, massive horizons (0.0-0.6 m) are moderately acidic, with pH gradually increasing with depth from 5.8 to 6.0. The clay B2 horizon has a pH value over two units higher (8.1) and is classified as 'moderately alkaline'. This is likely due to the increased CEC of the clay in the B2 horizon compared with the sand in the upper horizons.
James	145.20	2.36	Hard setting red soils associated with hills and rises. Textures within this unit vary depending on slope, with lesser developed soils found on crests (sandy clay loams to clay loams) and more developed/deeper soils found on mid slopes (clay loams to light medium clays). Dominant vegetation includes *Acacia rhodoxylon, Eucalyptus crebra,* and *Corymbia clarksoniana.* The pH in the James SMU is slightly acidic throughout the profile, with very little variation. It increases gradually with depth from 6.2 in the topsoil, to 6.4 in the lower subsoil. EC is very low at all depths, ranging from 0.013 dS/m in the topsoil to 0.015 dS/m in the subsoil. Chloride levels reflect this result, presenting at <10 mg/kg throughout the profile.

SMU	Surface Area (ha)	Percent of Study Area (%)	General Description
Kosh	924.00	15.00	Hard setting soil associated with alluvial plains, plains and low rises. Textures within this unit are gradational, changing from sandy clay loams and light clays in the topsoil, to medium heavy clays in the lower subsoil. Commonly, this unit was cleared for grazing, with regrowth consisting of scrub species including *Vachellia nilotica*, *Cassia spinarum, Capparis lasiantha, Cassia brewsteri*, and *Eucalyptus spp.* shrubs. When present, vegetation included *Eucalyptus tereticornis, Acacia hemiglauca, Acacia salicina, Bauhinia hookeri, Eucalyptus crebra* and *Eucalyptus populnea*. Due to the stark difference in textures between the topsoil and subsoil layers, pH for the Kosh SMU changes quite dramatically down the soil profile. Sandy, massive horizons (0.0 to 0.6 m) are moderately acid, with pH gradually increasing with depth from 5.8 to 6.0. The low CEC calculated for this unit resulted in extremely low concentrations of exchangeable cations. In the surface soil, calcium and magnesium were relatively equally represented, though concentrations of these cations were extremely limited.
Namoi	177.60	2.89	Hard setting soil associated with hills and rises. Textures within this unit are gradational, changing from a sandy clay loam in the topsoil to a light medium clay in the subsoil. Dominant vegetation includes *Eucalyptus crebra,* with *Heteropogon contortus* and juvenile *Acacia spp.* The pH in the Namoi SMU is slightly acidic throughout the profile, with very little variation. It increases gradually with depth from 6.2 in the topsoil, to 6.4 in the lower subsoil. EC is very low at all depths, ranging from 0.013 dS/m in the topsoil to 0.015 dS/m in the subsoil. Chloride levels reflect this result, presenting at <10 mg/kg throughout the profile. CEC remains fairly consistent with depth, ranging from 4.3 meq/100g (very low) in the topsoil to 5.8 meq/100g (very low) in the subsoil.
Nigel	284.60	4.63	Hard setting soil associated with isolated high relief areas of tertiary land surface. Textures within this unit are rudimentary, grading from sands to sandy light clays. Vegetation is variable between sites, but includes *Acacia shirleyi, Acacia rhodoxylon, Eucalyptus crebra, Melaleuca leucadendra, Corymbia clarksoniana,* and *Eucalyptus tessellaris.* The pH within the Nigel SMU is highly variable, changing from 6.3 (slightly acid) in the topsoil to 8.5 (strongly alkaline) in the lower subsoil. EC follows a similar pattern, changing from very low between 0.0-0.3 m depth, to medium in the subsoil. CEC increases with depth from low (6.8 meq/100g) to moderate (17.4 meq/100g), likely due to the increased clay content in the subsoil layers.

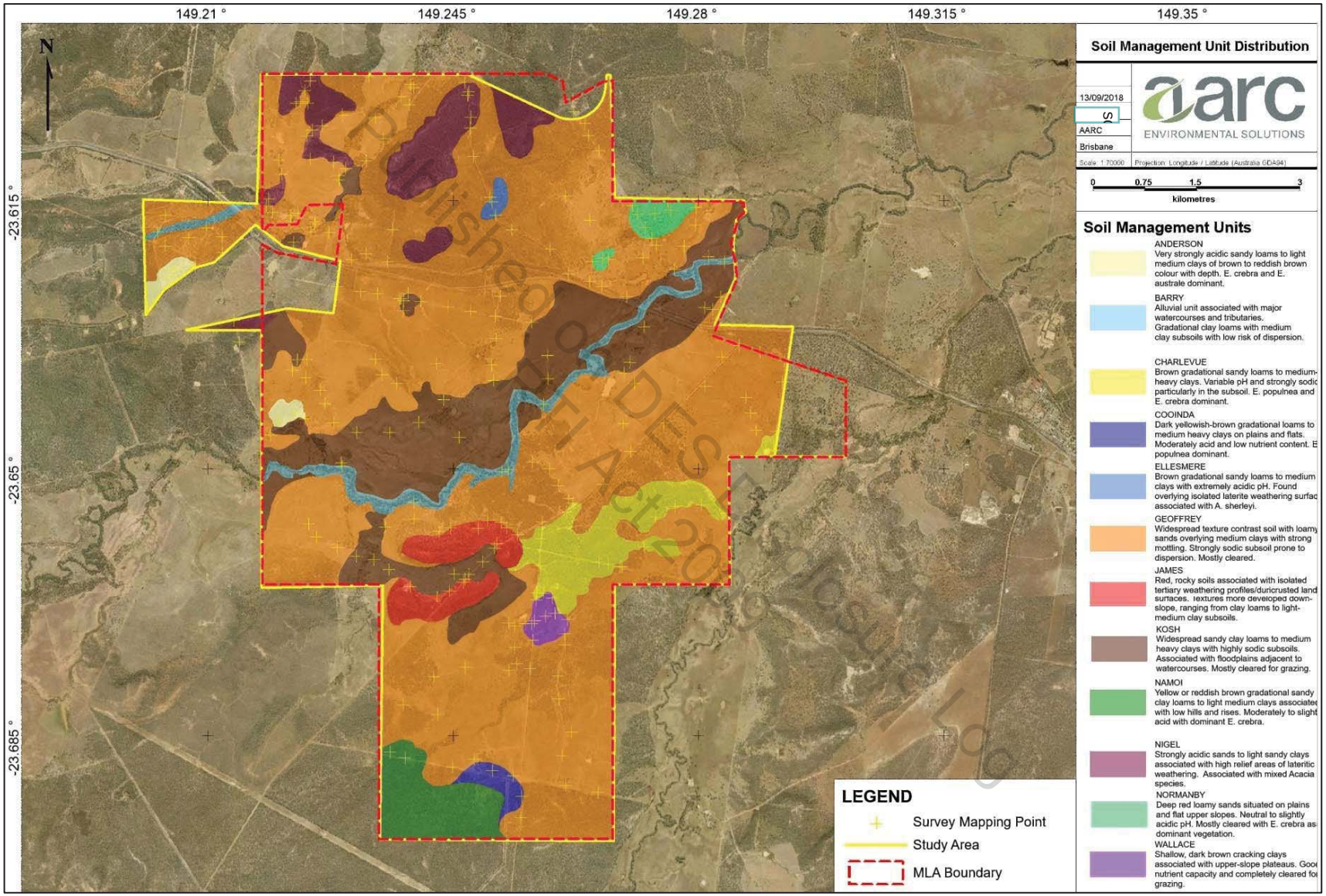


Figure 33 Distribution of Soil Management Units

5.2.6 Land Suitability

The *Soil and Land Suitability Assessment* (AARC 2019b) (Appendix F) considers environmental factors including climate, soils, geology, geomorphology, erosion, topography and the effects of pre-mine land use. The classification indicates the potential of the land to be used for a range of agricultural activities.

The assessment for land suitability (cattle grazing and dryland cropping) was carried out in accordance with the methodologies described in:

- *Guidelines for Agricultural Land Evaluation in Queensland* (DSITI & DNRM 2015); and
- Chapter 10 (Suitability framework for the inland Fitzroy and southern Burdekin area) of the *Regional Land Suitability Frameworks for Queensland* (DSITI & DNRM 2013).

An interpretation of the data collected on the physical, chemical and nutritional characteristics of the soil was made to rank the land according to the five-class land suitability system provided in the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland* (DME 1995). The five land suitability classes used for assessing the land are defined in Table 19.

Table 19 Agricultural and conservation land classes

Agricultural Land Class	Type	Description
Class 1	Agricultural	Suitable land with negligible limitations. This is highly productive land requiring only simple management practices to maintain economic production.
Class 2	Agricultural	Suitable land with minor limitations which either reduce production or require more than the simple management practices of class 1 land to maintain economic production.
Class 3	Agricultural	Suitable land with moderate limitations which either further lower production or require more than those management practices of class 2 land to maintain economic production.
Class 4	Agricultural	Marginal land, which is presently considered unsuitable due to severe limitations. The long-term significance of these limitations on the proposed land use is unknown or not quantified. The use of this land is dependent upon undertaking additional studies to determine whether the effect of the limitation(s) can be reduced to achieve sustained economic production.
Class 5	Agricultural	Unsuitable land with extreme limitations that preclude its use.

Notes: green shading suitable
red shading unsuitable

The land use of the Project area is more suitable for cattle grazing than dryland cropping based on the average land suitability class across the identified SMUs of the Project.

A summary of the land suitability classes for both dryland cropping and cattle grazing for each SMU identified within the study area is provided in Table 20.

Table 20 Land Suitability Classes for Project SMUs

SMU	Land Suitability Class (Grazing)	Land Suitability Class (Cropping)
Anderson	4	4
Barry	2	3
Charlevue	4	5
Cooinda	3	5
Ellesmere	3	5
Geoffrey	3	5
James	4	4
Kosh	2	5
Namoi	3	4
Nigel	4	5
Normanby	4	4
Wallace	3	5

Cattle Grazing Suitability

Within the study area, the suitability of land for cattle grazing is most limited by nutrient deficiency, exchangeable sodium percentage (ESP), and vegetation. Low nutrient levels and high sodicity in the soils may limit livestock production through a reduction in pasture growth and nutritive value of pasture species. Vegetation regrowth species can also impact the suitability of the land if they contain woody or poisonous species. In addition to this, high density regrowth and a woody shrub layer may reduce the carrying capacity of the land, making it unsuitable for grazing.

While no Class 1 land was identified within the study area, examination of the land suitability limitations for cattle grazing (Figure 34) indicate 1,080.5 ha of the study area is suitable for cattle grazing with minor limitations (Class 2), while 4,320.2 ha is suitable for cattle grazing with moderate limitations (Class 3). The remaining area (749.0 ha) was comprised of Class 4 land, with no Class 5 land identified.

Figure 34 shows the distribution of land suitability classes for cattle grazing across the Project.

Dryland Cropping

Land suitability for dryland cropping on the study area is most limited by soil water availability, soil wetness, erosion, and surface condition. Plants require suitable quantities of water to reach optimum production, and therefore maximum rooting depth, with the ability of the soil to take in water (wetness) playing a large part in crop survival. Topsoil and subsoil erosion also limit the ability of the soil to support crops. Soil preparation for sowing in the form of tillage may increase the risk of soil dispersion through slaking caused by the manipulation of soil aggregates by machinery. Surface condition also limits the soil classes, with hard setting soils found across most SMUs. Surface condition directly impacts seedling emergence and establishment by reducing seed-soil contact.

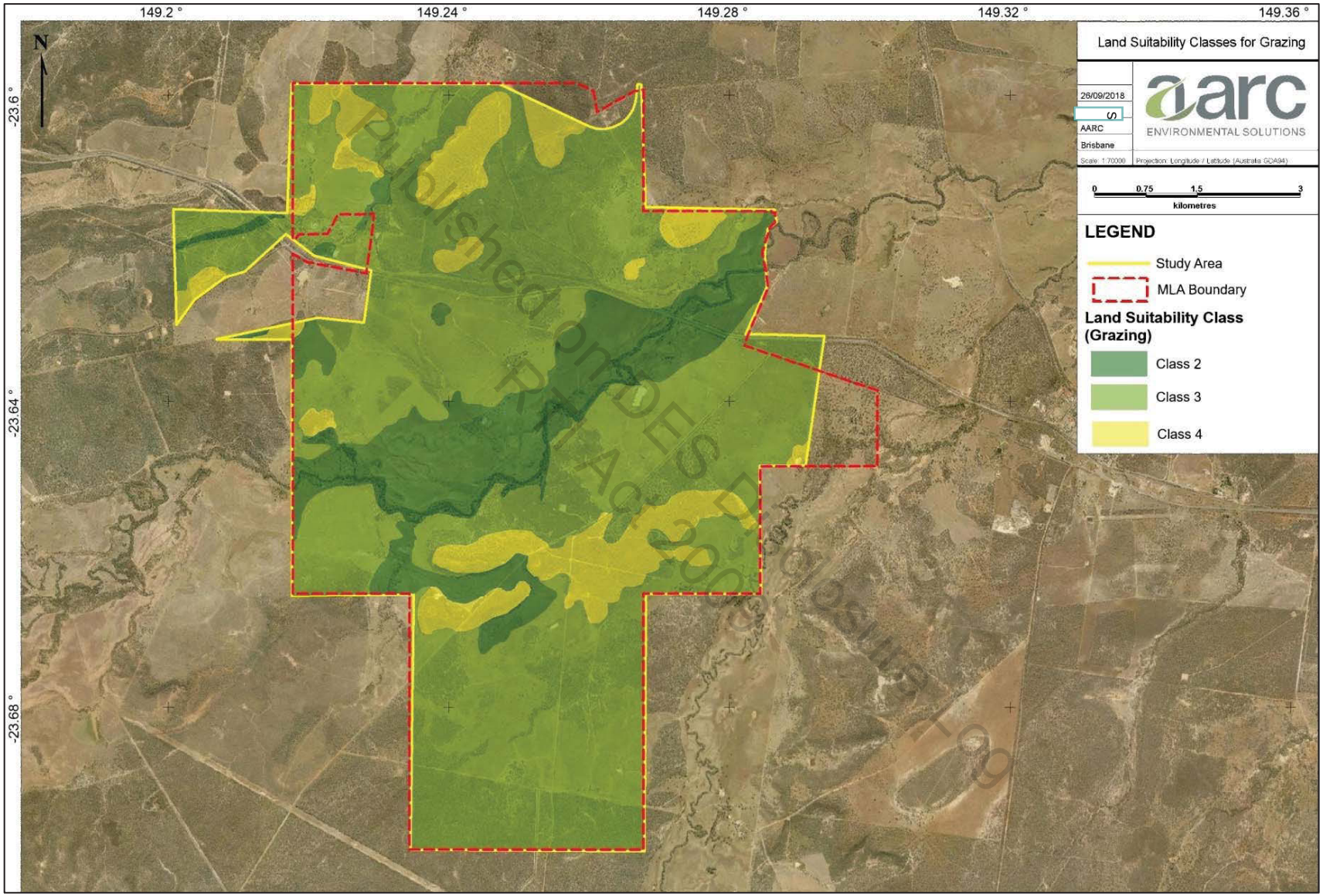


Figure 34 Land Suitability Classes for Cattle Grazing within the Study Area

In central Queensland, Class 1, 2 and 3 lands for dryland cropping are required to have the capacity to store sufficient levels of moisture to sustain a crop cycle from planting to harvesting with minimal rainfall. Class 4 lands are considered marginal for dryland cropping, requiring significant levels of rainfall for crop success. Class 5 lands are unsuitable for dryland cropping due to severe limitations.

Examination of the land suitability limitations for dryland cropping (Figure 35) indicates that 156.5 ha of the study area is suitable for cropping with moderate limitations (Class 3), and 409.1 ha of land is marginally suitable for cropping (Class 4). The remaining 5,584.1 ha of land is unsuitable (Class 5) due to land and soil limitations.

Figure 35 shows the distribution of land suitability classes for broadacre cropping across the Project.

5.2.7 Land Use

The Project is located within the 'Central Queensland Regional Plan' area. Queensland land use mapping classifies the Project area as 'grazing modified pastures'. Other minor land use classifications over the site include 'residential', 'reservoir/dam', 'marsh/wetland', and primarily in association with the Capricorn Highway; 'transport and communication', 'utilities', 'services', and 'other minimal use'.

Dominant land uses within the local region are:

- grazing modified pastures;
- mining;
- other minimal use;
- managed resource protection; and
- production forestry.

The land within the Project boundary is currently used for low intensity cattle grazing and resource exploration activities. Cattle grazing being the major land use within the Project reflects the land suitability assessment which describes the site as mostly Class 2 and 3, suitable for grazing with minor to moderate limitations. The majority of the area has been cleared for cattle grazing; however some patches of remnant vegetation remain, including riparian vegetation associated to Charlevue Creek.

The land in and around the Project is also used for purposes other than cattle grazing; including road transport, stock routes, protected areas, and coal mining. These land uses are discussed in Section 2.1 (Location and Setting).

5.2.8 Areas of Regional Interest

The Project activities are not in areas located within mapped areas of regional interest; however, a strategic cropping land trigger area exists northeast of the Project. The Project does not intersect any areas mapped as priority living areas, priority agricultural areas, strategic cropping land or strategic environmental areas.

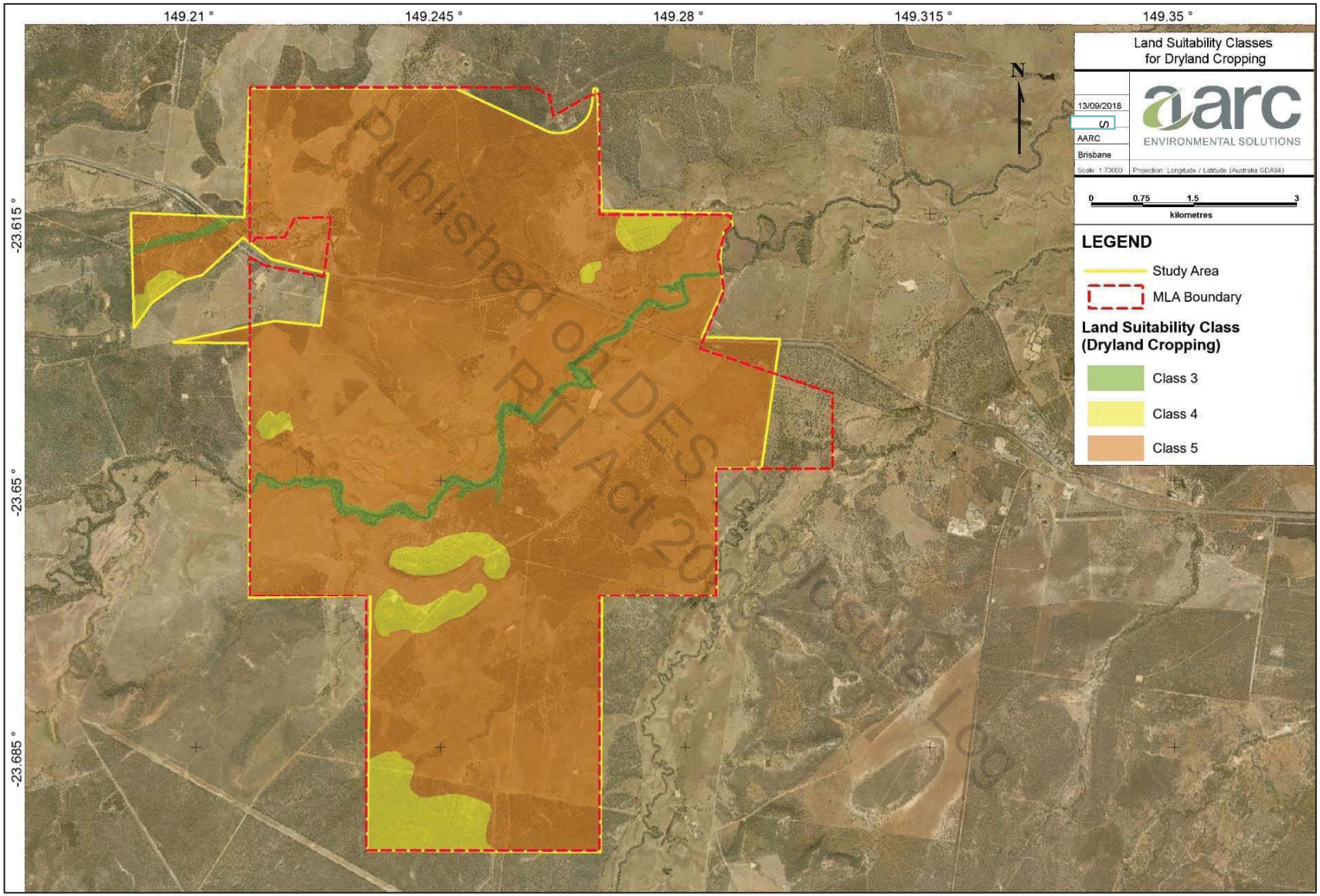


Figure 35 Land Suitability Classes for Dryland Cropping within the Study Area

5.3 POTENTIAL IMPACTS

5.3.1 Landform

Project activities involved in the construction of elevated landforms, open-cut pits and voids may impact land values by modifying the pre-mine topography. Some changes to the local topography will be temporary including the development of bunds and drains.

Waste rock emplacements associated with Pit AB and Pit C will be developed during operation. Where possible, spoil will be hauled and placed in-pit, behind the mining void. However, rehabilitated out-of-pit waste rock emplacement areas will remain as permanent features in the post-mining landform facilitating a maximum slope of 1:10 vertical to horizontal (V:H) and a maximum height of 190 m. Rehabilitated final void lakes are also proposed in the final landform, below the pre-mining topography.

Impacts from mining activities on the landform values of the Project may result in alteration to hydrological regimes within drainage features and an increase in Project landform exposure to erosion and instability.

Disturbance of vegetation and the topsoil layer can lead to the mobilisation of soil through the process of erosion, particularly water erosion through heavy rainfall or overland flow. The risk of erosion at the Project will be increased by the following activities:

- clearing of vegetation;
- topsoil stripping and stockpiling;
- construction of infrastructure; and
- exposure of slopes.

Erosion of rehabilitated landforms reduces the likelihood of revegetation success, and in extreme cases can compromise the structural integrity of the landform, making it unstable and unsafe. In addition, if not managed correctly, erosion can result in the release of suspended sediments and potential contaminants into the receiving environment. Soils and spoil within the Project have some dispersive characteristics, and will be potentially subject to erosion, particularly on artificial slopes.

5.3.2 Visual Amenity

The Project is located along the Capricorn Highway; the main road corridor from Rockhampton to Emerald.

The Pit AB out-of-pit waste rock emplacement is located approximately 2 km south of the Capricorn Highway. The topography between the Pit AB waste rock emplacement area and the Capricorn Highway is relatively flat with minimal obstruction by natural features. The final landform of the Pit AB waste rock emplacement will be progressively rehabilitated throughout the life of mine and will visually resemble the surrounding landscape of gently undulating hills. The Pit AB waste rock emplacement will have a maximum height of 190 mAHD. This elevated landform will likely be visible from the Capricorn Highway and from two sensitive receptors located 2 km northwest and 3 km northeast, respectively. The Pit AB void is a depression below natural ground surface and is not expected to be visible from public or private sensitive locations.

Construction of the Pit C waste rock emplacement will begin in Year 12 at which time it will be located approximately 500 m north of the Cooinda Road diversion. The closest residential dwelling associated with Pit C waste rock emplacement is located approximately 3 km east. Another residential dwelling is

located approximately 2.7 km south of the Pit C waste rock emplacement. Both of these dwellings are owned by Magnetic South. These dwellings are occupied at the discretion of Magnetic South, however, the gently undulating local topography and a strand of remnant vegetation will assist in reducing the visual impact of the Project for any prospective tenants.

The TLO will contain a rail spur, rail loop and train loading bin and will be located approximately 300 m north of the Capricorn Highway. The TLO will connect with the existing Blackwater Railway. Visual impacts of the TLO will be like those associated with the existing rail system and are not expected to be significant. The Blackwater Railway services coal export from the Bowen Basin and is a dominant visual feature along the length of the Capricorn Highway with rail infrastructure and trains frequently visible.

An overland conveyor will transport export material from the CHPP to the TLO, crossing over the Capricorn Highway. The overhead conveyor will be similar in design and impact as the existing Boonal conveyor located 28 km to the west, which crosses over the Capricorn Highway. The closest residential dwelling is located 700 m east of the overland conveyor; which will be less than 10 m high and is unlikely pose a visual impact to the residential dwelling.

All haul roads are internal to the MLA and are located 1 km, or more, away from the closest residential dwelling. Visual impacts from road infrastructure and vehicles are unlikely. Dust impacts and suppression is discussed in Section 9.0 (Air Quality).

The Project's MIA and CHPP will be located 700 m southwest of the closest residential dwelling and 1.1 km south of the Capricorn Highway. Topography between these infrastructure areas and the surrounding public viewpoints is relatively flat and has been predominantly cleared for cattle grazing. The MIA and CHPP will likely be visible in the distance from the Capricorn Highway and this residential dwelling.

Views of Project infrastructure and elevated landforms are not expected to be significant from local roads and residential dwellings due to the local topography and large separation distances between dwellings and mining activities. Visual amenity impacts to surrounding road users and residential dwellings will be similar to that seen from the surrounding coal mining projects discussed in Section 2.1 (Location and Setting).

5.3.3 Soils

Mining activities, including the stripping, stockpiling, handling, and compaction of soil, have the potential to impact its physical, chemical and biological properties. Potential impacts from mining activities on the existing soils within the Project area may include:

- Potential soil and land contamination through:
    - spills from mine-affected water storages or pipelines;
    - spillage of chemicals or fuel; and
    - effluent irrigation from the STP;
- Loss of soil physical structure due to excavation and handling;
- Loss of the soil seedbank; and
- Impacts on soil fertility due to mixing with subsoils or resulting from changes in chemistry when subsoils are exposed to oxygen.

5.3.4 Land Suitability and Land Use

Project activities will disturb and alter the current land use of low intensity cattle grazing in the short term. Cattle grazing within the Project area is categorised predominantly as land suitability class 3; suitable for cattle grazing with moderate limitations. A total area of 1,695 ha of class 3 land exists within the Project's disturbance footprint occupying 86% of this extent. The remaining disturbance footprint of the Project is categorised as class 2 (2.5%) and class 4 (11.5%).

The Project aims to achieve a PMLU for all areas of rehabilitation, with no proposed NUMAs. Primarily, the land will be returned to cattle grazing land use across flat and gentle slopes. Secondly, the proposed post-mining beneficial land use will allow for the establishment and support of native ecosystems on areas of steeper slopes (i.e. treated high walls). Establishment of native ecosystems is defined as the establishment of vegetation that allows colonisation by surrounding non-weed species such that vegetation will progress towards native bushland with no designated agricultural or grazing use.

The rehabilitated final voids will remain in the post mining landform in a safe, geotechnically stable and non-polluting condition. As described in Section 4.3.4 (Final Void), the void will contain a fresh to brackish pit lake that is expected to provide suitable habitat for fauna species, particularly migratory and marine bird species. The final voids will provide a reduced land suitability of class 5.

5.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

The Project will be managed to minimise the extent and severity of land disturbance.

Landform

Management practices to minimise impacts to landform values are provided below:

- Land clearing will be limited to the minimum area required for safe operation of the Project. An internal permit to disturb system is proposed to prevent unnecessary or unauthorised impacts to land values during construction and operation;
- Erosion and sediment control structures will be developed and implemented during operation in accordance with *Best Practice Erosion and Sediment Control* (IECA Australasia 2008);
- Spoil emplacements will be constructed to a maximum slope of 1V:10H (approximately 5.7%) and a maximum height of 190 mAHD;
- Construction of contour banks on slopes is proposed at a spacing of 80 m for slopes of 1V:10H to manage runoff and prevent erosion and associated landform instability;
- Highwalls within Pit AB and Pit C will be pushed back after mining to form a slope angle of approximately 22° to ensure stability of the final landform. Treated upper slopes will be rehabilitated to achieve a PMLU suitable for native ecosystems; and
- Erosion monitoring and maintenance is proposed throughout the mine life and during mine closure, until it can be demonstrated that final landforms are stable.

Visual Amenity

Impacts to visual values associated to the Project will be mitigated through the following practices:

- Where practicable, infrastructure has been located at greater distances from sensitive places such as residences and public transport corridors;

- The final landform design incorporates landform and land use characteristics of the pre-mining and surrounding landscape; and

- Progressive rehabilitation of elevated landforms such as the Pit AB and Pit C waste rock emplacements will begin as soon as land becomes available. Rehabilitation of the Project's waste rock emplacements will increase the visual appeal of the elevated landforms and conform their visual structure to the surrounding landscape.

Land Contamination

To mitigate impacts from land contamination from potentially hazardous spills of chemicals or mine affected water, the following strategies will be employed:

- Development of an *Emergency Response Plan* to inform staff and contractors of the procedure for responding to a spill or potentially hazardous release. This plan will also outline the relevant reporting requirements following a spill or potentially hazardous release;

- Investigation and notification of any contamination to land resulting from a spill or release event to the DES in accordance with the Project's Environmental Authority;

- All chemical and hydrocarbon storage and handling facilities will be appropriately bunded, with spill kits available, and spills cleaned up immediately;

- The STP will be surrounded by an earthen bund wall, so that if any overflows or spills do occur, they will be appropriately contained; and

- Spill kits will be made available from the MIA and any other hydrocarbon handling facility.

Soils

Impacts to soil will be mitigated to reduce the risk of soil degradation and improve the chances of rehabilitation success. Mitigation strategies for soil include:

- Progressive rehabilitation of landforms and direct placement of topsoil to help preserve the seed bank and reduce erosion; and

- Carrying out routine testing of soil properties prior to use in rehabilitation. If required, fertilizers, soil ameliorants, and application of a seed mix will be used to increase the likelihood of rehabilitation success.

Erosion Protection Measures

Erosion protection measures developed to reduce the risk and impacts of erosion include:

- Topsoiled areas will be deep ripped to reduce compaction from heavy machinery, encourage infiltration of water and prevent erosion. Areas will be ripped along the contour to reduce the velocity of runoff water down the slope. Ripping depths will vary depending on the type of spoil material, depth of topsoil and equipment used for rehabilitation operations;

- Ensuring that when required, stockpiles are generally less than 2 m high and contoured to encourage water to drain;

- Where required, seeding of topsoil as soon as possible after placement onto rehabilitated areas, to ensure root masses assist in preventing erosion;

- Topsoil stockpiles will be placed away from drainage areas, roads, machinery, transport corridors, and stock grazing areas;
- Topsoil stockpiles will be seeded or covered with a water-shedding lining to prevent unnecessary erosion of soil; and
- Seeding of topsoil as soon as possible after placement onto rehabilitated areas, to ensure root masses assist in preventing erosion.

Topsoil Handling Procedures

Within the Project's disturbance area, topsoil in each SMU will be stripped to the depths outlined in Table 21. The potential volume of topsoil available within the Project's disturbance has been calculated using the topsoil stripping depths and the SMU surface area. The potential volume for each SMU is outlined in Table 21.

Table 21 Potential topsoil volume within project disturbance footprint

SMU	Topsoil Stripping Depth (m)	SMU Area (m^2)	Potential Soil Volume (m^3)
Anderson*	0.0	0	0
Barry	0.9	78,770	70,893
Charlevue*	0.0	2182960	0
Cooinda	0.6	349,400	209,640
Ellesmere*	0.0	0	0
Geoffrey	0.5	14,853,460	7,426,730
James	0.6	117,200	70,320
Kosh	0.5	416,133	208,067
Namoi	0.6	1,314,000	788,400
Nigel*	0.0	205,230	0
Normanby*	0.9	0	0
Wallace	0.2	52,850	10,570
	Total	**19,570,003**	**8,784,619**

Notes: * Topsoil stripping not recommended (Appendix F).

Placement of topsoil will be at a thickness of approximately 0.3 m across the rehabilitated area to create a growth medium of sufficient depth to hold water and support revegetation. If available, subsoils that have been identified as having a high clay content with low erosivity risk will be returned first at a depth of up to 0.5 m, prior to the addition of sandier topsoil. This may assist in providing a more suitable growth medium that holds water for long periods of time.

Topsoil will be deep ripped into the underlying spoil surface, to encourage surface water infiltration and minimise soil loss due to erosion. On slopes of spoil dumps, ripping will be undertaken along the contour.

For the Geoffrey SMU, soil horizons in the natural landscape will be restored during rehabilitation. The clay rich subsoils will be placed first on the rehabilitated landform, followed by the sandy A horizon over the top to recreate the A and B horizons. Placement of the subsoil layer is expected to retain soil moisture necessary for successful revegetation.

Land Suitability and Land Use

Potential impacts on soil can be mitigated through:

- Determining PMLUs that align with pre-mining land use and the surrounding properties;
- A final landform design that aims to maximise PMLU areas;
- Progressive rehabilitation to return the land to a productive land use as soon as practicable; and
- Ongoing monitoring, maintenance and rehabilitation trials to ensure a safe, stable and non-polluting landform.

The majority of areas in the final landform will be restored to a PMLU of cattle grazing. The exceptions being water management features such as ponds and drains, which will be returned to a PMLU of native ecosystems or equivalent. This includes the final pit lake and high walls, that will be restored to achieve a fauna habitat land use. These areas are expected to be unsuitable for grazing and will achieve a reduced land suitability score of 5.

6.0 FLORA AND FAUNA

This section provides a description of the existing flora and fauna values within the Project. It aims to identify the Project's potential impacts on the existing values and propose mitigation measures and management strategies to prevent or minimise adverse environmental effects.

This section also discusses potential impacts to wetland values and groundwater dependant ecosystems (GDEs), however all other water values are discussed in Section 7.0 (Surface Water) and Section 8.0 (Groundwater).

This section is informed by:

- *Terrestrial Ecology Assessment* (AARC 2019c) (Appendix G);
- *Aquatic Ecology Assessment* (AARC 2019a) (Appendix H);
- *Surface Water Assessment* (WRM 2019b) (Appendix B); and
- *Groundwater Impact Assessment* (JBT 2019) (Appendix C).

6.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objective relevant to potential impacts to flora and fauna as described in the EA guideline for *Application requirements for activities with impacts to land [ESR/2015/1839]* (DES 2017b) is:

The activity is operated in a way that protects the environmental values of land including soils, subsoils, landforms and associated flora and fauna.

The Project would achieve all of the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

(a) Activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the environmental values of land;

(b) Areas disturbed will be rehabilitated or restored to achieve sites that are:

(i) safe to humans and wildlife;

(ii) non-polluting;

(iii) stable; and

(iv) able to sustain an appropriate land use after rehabilitation or restoration;

(c) The activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants; and

The environmental objective relevant to potential impacts to wetlands as described in the EA guideline for *Application requirements for activities with impacts to water* (DES 2017c) is:

The activity will be operated in a way that protects the environmental values of wetlands.

The Project would achieve the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

a) There will be no potential or actual adverse effect on a wetland as part of carrying out the activity; and

b) The activity will be managed in a way that prevents or minimises adverse effects on wetlands.

The environmental objective relevant to potential impacts to surface ecological systems (i.e. GDEs) as described in the EA guideline for *Application requirements for activities with impacts to water* (DES 2017c) is:

The activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems.

The Project would achieve the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

(a) There will be no direct or indirect release of contaminants to groundwater from the operation of the activity; and

(b) *There will be no actual or potential adverse effect on groundwater from the operation of the activity.*

Or, the activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.

6.2 DESCRIPTION OF ENVIRONMENTAL VALUES

6.2.1 Regional and Local Setting

The Project is located within the Brigalow Belt bioregion. This bioregion occupies over a fifth of Queensland; from Townsville in the north to near the border of New South Wales in the south. The Brigalow Belt bioregion is characterised by brigalow (*Acacia harpophylla*) woodland but presents other vegetation such as semi evergreen vine thickets, dry eucalypt woodlands and native bluegrass (*Dichanthium sp.*) grasslands. Due to the size of Brigalow Belt bioregion, it covers a broad climatic gradient as well as a diversity of soils and topography, the Brigalow Belt hosts a high diversity flora and fauna (Young *et al.* 1999; McFarland *et al.* 1999; DES 2018a).

As a result of agricultural and development activities, most of the relatively undisturbed areas are confined to the rugged parts of the landscape with less development value (DES 2018a), parks and reserve areas.

At a local level, the Project is positioned in a relatively flat landscape, dissected by Charlevue Creek, which has a lower elevation than the surrounding land. The Project is also crossed by Stanley Creek and Springton Creek, as well as small tributaries associated with the main waterways.

The area is currently used for low intensity cattle grazing and resource exploration activities and is dissected by the Capricorn Highway and several publicly gazetted roads.

6.2.2 Terrestrial Flora

An assessment of terrestrial flora ecological values was conducted within EPC 881 (herein referred to within Section 6.0 (Flora and Fauna) as the study area) (AARC 2019c) (Appendix G). Six field surveys

were undertaken between 2017 and 2019 covering a range of seasonal and climatic conditions to ensure temporal and seasonal survey requirements for the Brigalow Belt bioregion were met. The dates of these surveys were:

1) 4-12 May 2017;
2) 18-30 September 2017;
3) 16-23 February 2018;
4) 22-29 March 2018;
5) 1-2 August 2019; and
6) 19 August 2019.

The surveys were conducted in accordance with the following guidelines:

- *Site examination for threatened and endangered plant species* (Goff, Dawson & Rochow 1982);
- *Management of endangered plants* (Cropper 1993); and
- *Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (V5.0)* (Neldner *et al.* 2019).

Threatened Ecological Communities

Desktop assessments identified four threatened ecological communities (TECs) that could potentially occur within 10 km of the study area:

- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Weeping Myall Woodlands; and
- Poplar Box Grassy Woodland on Alluvial Plains.

Vegetation surveys over the Project determined that communities recorded within the study area do not meet the condition thresholds to constitute a TEC (Appendix G).

Regional Ecosystems

Flora surveys confirmed the presence of six vegetation communities classed as remnant vegetation within the study area. Table 22 outlines the regional ecosystems (REs) characteristic of each vegetation community, where applicable, as well as a short description of the vegetation present. Figure 36 displays the distribution of vegetation communities on the study area.

Flora Species of Conservation Significance

Field surveys included targeted searches for flora species of conservation significance. Surveys covered all potential habitat within the study area based on database searches and field observations. Targeted

searches across the study area detected the presence of one flora species of conservation significance; *Cerbera dumicola.*

Cerbera dumicola is a shrub or small tree growing to 4 m high (DES 2018d). The species occurs across a range of habitats in central and southern Queensland and is associated with a range of vegetation communities. The species is regionally abundant, having been recorded outside of the study area on multiple occasions (AVH 2019).

Cerbera dumicola was identified during the vegetation surveys in two very localised rocky areas associated with vegetation community (VC) 2 and VC1 (on an ecotone with VC2) (Figure 37). This species was not identified within similar habitat types elsewhere in the study area during targeted searches.

Table 22 Vegetation communities within the study area

Vegetation Community	Regional Ecosystem	VM Act Status	Biodiversity Status	Community Description
VC1	11.5.2	LC	NC	Narrow-leaved ironbark (*Eucalyptus crebra*) and Clarkson's bloodwood (*Corymbia clarksoniana*) woodland with a sparse shrub layer on sand plains.
VC2	11.7.2	LC	OC	Lancewood (*Acacia shirleyi*) and/or rosewood (*Acacia rhodoxylon*) woodland on lateritic duricrust.
VC3	11.3.25	LC	OC	Blue gum (*Eucalyptus tereticornis*) with *Bauhinia spp.* and *Casuarina cunninghamiana* fringing woodland on drainage features.
VC4	11.3.2	OC	OC	Poplar box (*Eucalyptus populnea*) woodland on alluvial plains.
VC5	11.5.2 / 11.3.25	LC	NC / OC	Mixed polygon where the dominant vegetation community was VC1 (*Eucalyptus crebra* and *Corymbia clarksoniana* woodland) but along ephemeral creeks and with an important presence of blue gums (*Eucalyptus tereticornis*).
VC6	11.3.25 / 11.3.2 / 11.5.2	LC / OC / LC	OC / OC / NC	Mixed polygon as a result of combination of VC3 with elements of VC4 and some elements of VC1 due to edge effect.

Notes: VM Act *Vegetation Management Act 1992*
LC Least concern
OC Of concern
NC No concern at present

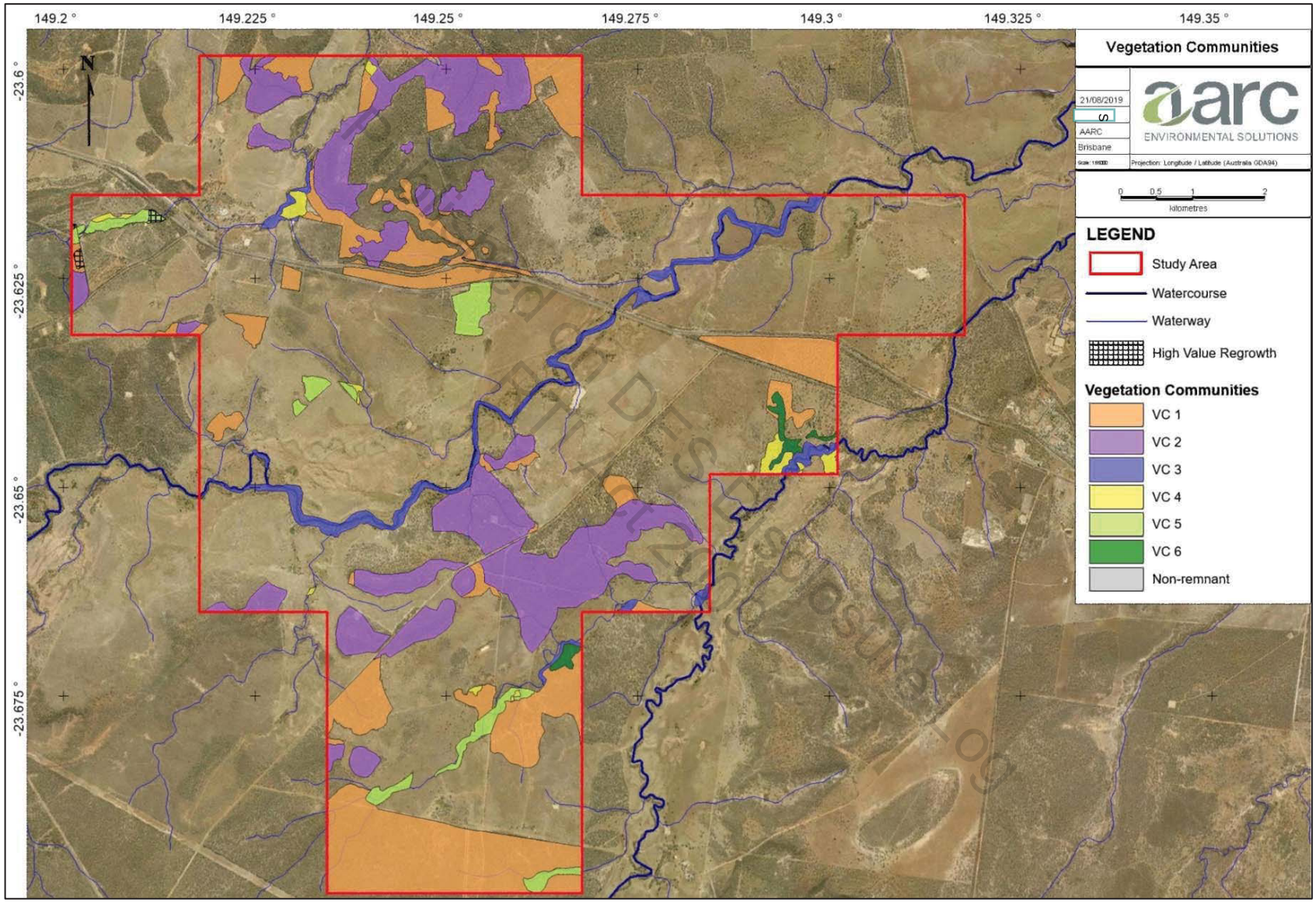


Figure 36 Vegetation communities within the study area

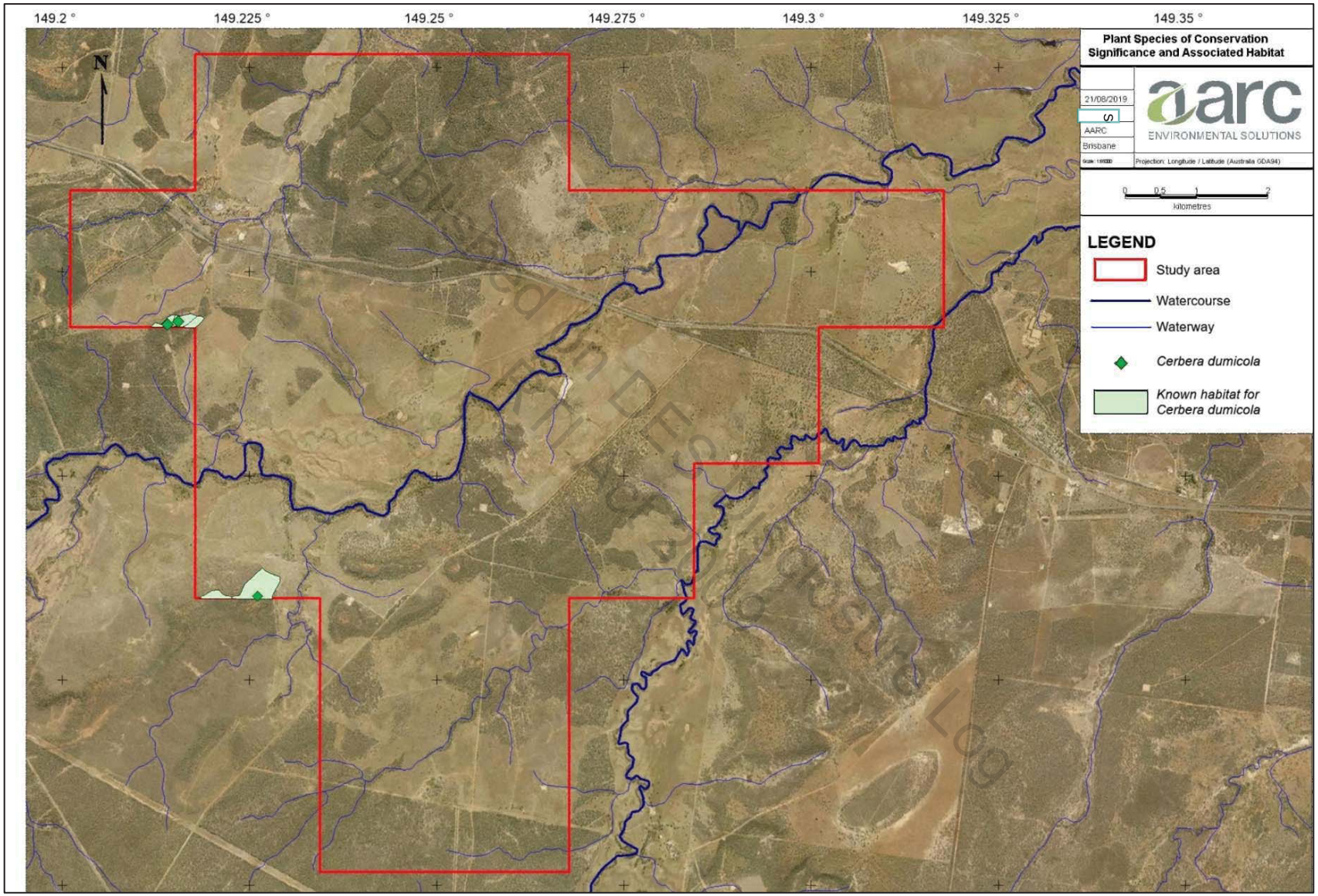


Figure 37 ***Cerbera dumicola*** **locations and known habitat**

Weed Species

A total of 33 introduced flora species were recorded on the study area. Five of which are classed as WoNS and/or as RIS under the Biosecurity Act (DAF 2018). Introduced plant species are classified as WoNS if they present a serious threat to industry, water supply, human health/safety, plant communities and/or cultural values.

Weeds of management concern (i.e. WoNS or Biosecurity Act RIS) identified within the study area are listed in Table 23. A full list of all introduced species can be found in Appendix G.

Table 23 Weed species of management concern identified in the study area

Scientific name	Common name	WoNS	Biosecurity Act RIS (Category 3)
Harrisia martinii	Harrisia cactus	-	X
Cryptostegia grandiflora	Rubber vine	Yes	X
Opuntia tomentosa	Velvety tree pear	Yes	X
Parthenium hysterophorus	Parthenium	Yes	X
Bryophyllum sp.	Mother of millions	-	X
*Vachellia farnesiana**	Mimosa bush	-	-

Notes: * Considered a noxious weed of management concern.
Category 3: A person must not distribute the invasive plant either by sale or gift, release it into the environment.

Wetlands

Field surveys concluded that all the potential lacustrine and palustrine wetlands identified within the study area from desktop searches (Appendix G) were either not present or were identified as artificial (farm) dams. The only natural wetlands within the study area are riverine wetlands associated with riparian and vegetation along Charlevue Creek, Springton Creek and some larger tributaries. These have been mapped as VC3, VC5 and VC6 (Figure 36). Wetland habitats identified within the study area are mapped in Figure 38.

Outside the study area, there is a large palustrine wetland (approximately 82 ha in area) located approximately 4 km east of the MLA boundary. This wetland, identified as of high ecological significance (HES) under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (WWB)), is not connected to the study area through any waterbodies or watercourses. Current government mapping and field inspections of the mapped wetlands identified the vegetation as non-remnant. Field assessment identified the presence of flora species known to inhabit wetland environments. No water was observed during the site inspection (Appendix H).

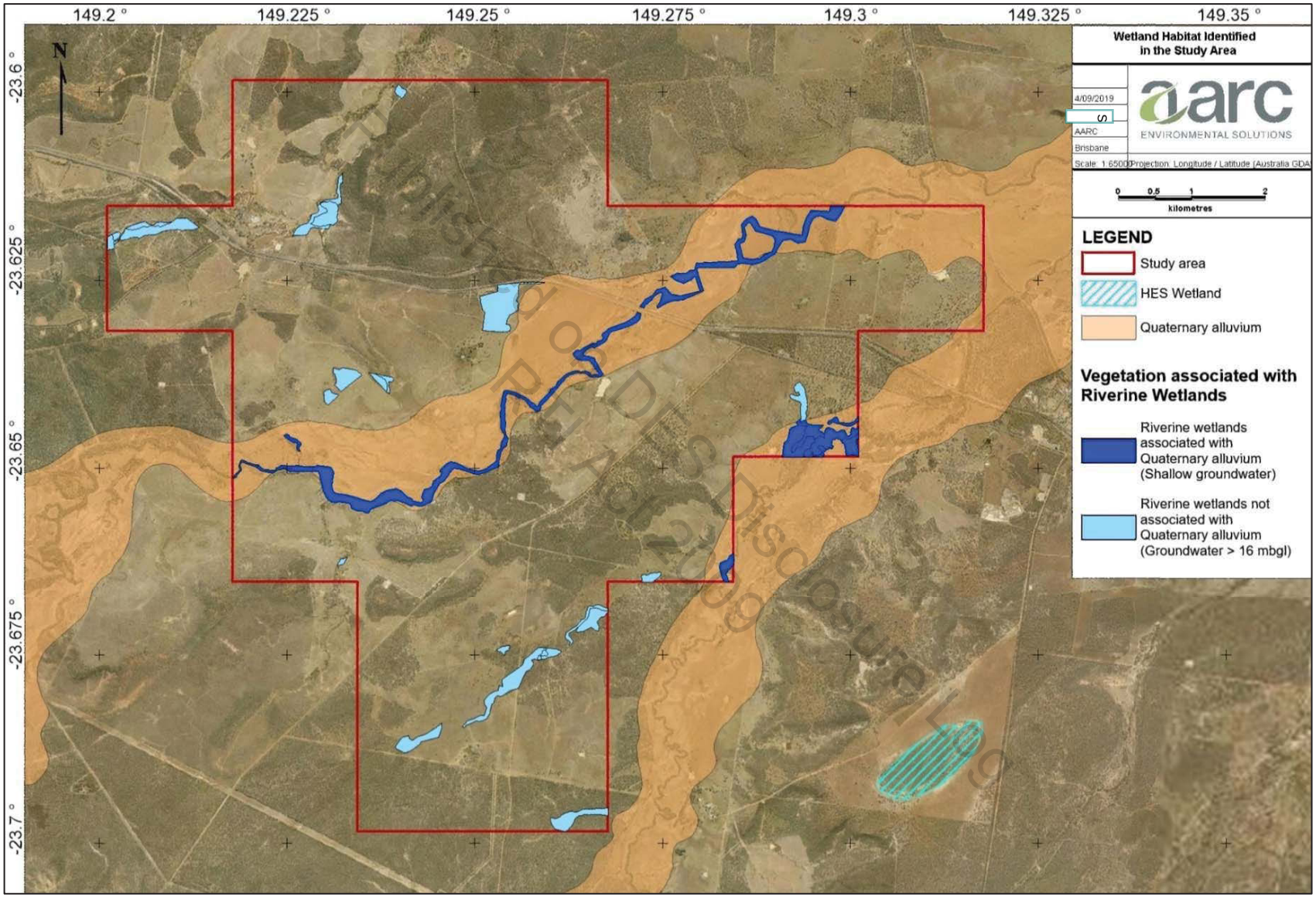


Figure 38 Wetland habitats identified in the study area

Groundwater Dependent Ecosystems

The above-mentioned wetlands have the potential to be partially dependent on groundwater (BoM 2019b). Within the study area high potential terrestrial GDEs and moderate potential aquatic GDEs were identified by database searches in association with Charlevue Creek and Springton Creek. Moderate potential terrestrial GDEs were also mapped in association with some of the smaller waterways.

The *Groundwater Impact Assessment* (Appendix C) concluded that shallow groundwater within the study area is limited to the extent of Quaternary alluvium associated with Charlevue Creek and Springton Creek. Within the Tertiary sediments, groundwater aquifers were greater than 16 m below ground level. Therefore, the potential for groundwater dependency was limited to only riverine wetlands overlying Quaternary alluvium (Figure 38).

The HES wetland located 4 km to the east of the study area is also potentially groundwater dependant; however, it is noted that this wetland is ephemeral and does not hold water throughout the year.

Assessment of impact to potential GDEs within the Project has been addressed in Section 6.3.1 (Terrestrial Flora) and Appendix C.

6.2.3 Terrestrial Fauna

An assessment of terrestrial fauna ecological values was conducted within the study area by AARC (2019c) (Appendix G). Four field surveys were undertaken between 2017 and 2018 covering a range of seasonal and climatic conditions to ensure temporal and seasonal survey requirements for the Brigalow Belt bioregion were met. The dates of these surveys were:

1) 4-12 May 2017;
2) 18-30 September 2017;
3) 16-23 February 2018; and
4) 22-29 March 2018.

The surveys were conducted in accordance with the guidelines:

- *Survey guidelines for Australia's threatened bats* (DEWHA 2010a);
- *Survey guidelines for Australia's threatened birds* (DEWHA 2010b);
- *Survey guidelines for Australia's threatened mammals* (DEWHA 2011a);
- *Survey guidelines for Australia's threatened reptiles* (DEWHA 2011b); and
- *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (V 3.0)* (Eyre *et al.* 2018).

Fauna Species of Conservation Significance

Field surveys across the study area detected the presence of three fauna species of conservation significance; the southern squatter pigeon (*Geophaps scripta scripta*), the greater glider (*Petauroides volans*) and the short-beaked echidna (*Tachyglossus aculeatus*). The southern squatter pigeon and the greater glider are listed as vulnerable under the EPBC Act and the *Nature Conservation Act 1992* (NC

Act). The short-beaked echidna was recorded across several sites over the survey seasons. This species is listed under the NC Act as special least concern and is not listed under the EPBC Act.

The observed locations of these species within the study across the field surveys are displayed in Figure 39.

Migratory Species

The rufous fantail (*Rhipidura rufifrons*) is a listed migratory bird species under the EPBC Act and was identified within the study area. Figure 39 displays the observed locations of the rufous fantail within the study area.

Pest Species

Four introduced and/or pest fauna species listed as RIS under the Biosecurity Act were identified within the study area (Table 24). A further two species; the cane toad (*Rhinella marina*) and the house mouse (*Mus musculus*), are not declared invasive species' under the Biosecurity Act, but are recognised as invasive pests in Queensland.

Table 24 Introduced species identified in the study area

Scientific name	Common name	Biosecurity Act RIS			
		Category 3	Category 4	Category 5	Category 6
Canis familiaris/ Canis lupus dingo	Wild dog/dingo	X	X	X	X
Oryctolagus cuniculus	Rabbit	X	X	X	X
Felis catus	Feral cat	X	X	-	X
Sus scrofa	Feral pig	X	X	-	X

Notes: Category 3: the invasive animal must not be distributed either by sale or gift or released into the environment.
Category 4: the invasive animal must not be moved.
Category 5: the invasive animal must not be kept.
Category 6: the invasive animal must not be fed.

6.2.4 Aquatic Ecology

To describe the aquatic ecology values of the Project, an assessment of aquatic ecological values was conducted within the study area by AARC (2019a) (Appendix H).

Three field surveys were undertaken between 2018 and 2019 covering a range of seasonal and climatic conditions to ensure temporal and seasonal variation. The dates of these surveys were:

1) 23-24 February 2018;

2) 3-7 April 2019; and

3) 1-2 August 2019.

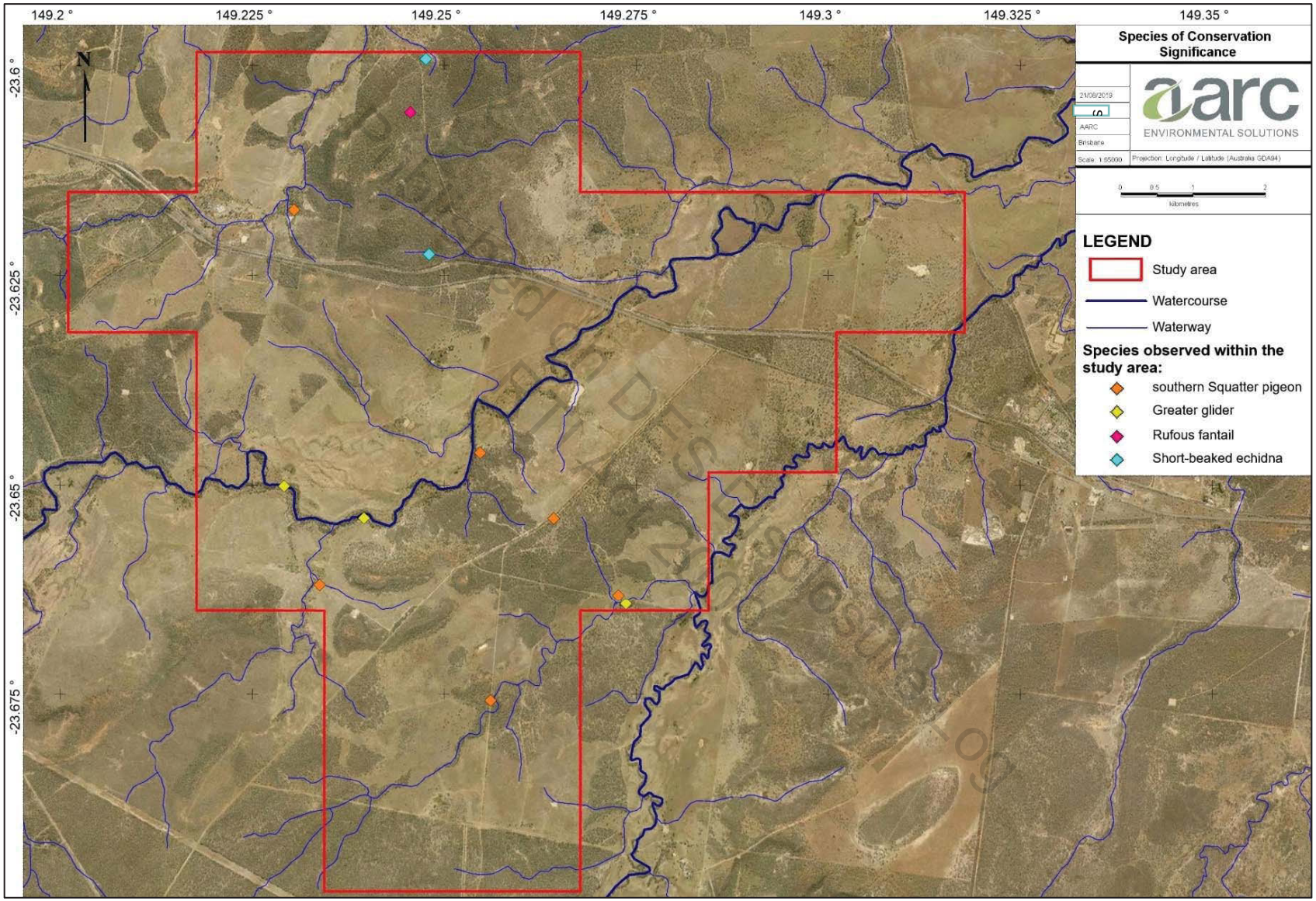


Figure 39 **Fauna species of conservation significance identified in the study area**

Field surveys employed standard methodologies derived from:

- *Australian River Assessment System (AusRivAS) Physical Assessment Protocol* (Parsons *et al.* 2002);
- *Queensland AusRivAS Sampling and Processing Manual* (DNRM 2001); and
- *Monitoring and Sampling Manual: Environmental Protection (Water) Policy 2009* (DES 2018c).

Aquatic ecology values pertaining to flora, fauna, wetlands and GDEs are discussed within this section. Refer to Section 7.0 (Surface Water) for discussion of values pertaining to water quality and hydrology.

Aquatic Ecosystems

The waterways of the study area are ephemeral, experiencing periodic flows. The aquatic setting of the Project is described in Section 5.2.1 (Landform and Visual Amenity).

Charlevue Creek and Springton Creek are determined watercourses under the Water Act, all other waterways crossing the Project are determined drainage features. Extensive clearing for agricultural purposes has been undertaken across much of the study area including the removal of riparian vegetation. The removal of riparian vegetation and direct stock access to the waterways has resulted in bank instability, erosion and occurrence of weeds.

Water Quality

Surface water quality was found to be generally poor. Results for physico-chemical parameters were outside the water quality objectives (WQO) guideline values for the protection of aquatic ecosystems at many sites including pH, dissolved oxygen, turbidity, ammonia, and sulphate (as SO_4^{2}). Petroleum hydrocarbons were found to exceed WQO guideline values at several sites, considered likely due to the highway and agricultural practices. Water quality is discussed in detail in Section 7.0 (Surface Water).

Stream Sediment Quality

Stream sediment quality was found to contain a high proportion of sand particles with some sites containing a mixture of silt and clay. Metal concentrations in stream sediment were generally low, except for nickel levels along a tributary of Springton Creek. Stream sediment quality is discussed in detail in Section 7.0 (Surface Water).

Biological Indicators

Macroinvertebrate diversity, abundance and Plecoptera, Ephemeroptera and Trichoptera (PET) taxa richness were generally low. SIGNAL scores were correspondingly low and consistent with the expected results for ephemeral streams in an agricultural setting. The AusRivAS predictive modelling assessed the aquatic environments at the sample sites as significantly impaired to highly degraded. While impaired habitats are common in ephemeral creeks, the extent and severity of the impairment indicates low waterway health within the Project.

Species of Conservation Significance

Database searches identified four fauna species of conservation significance with potential to occur within 50 km of the study area. No aquatic flora of conservation significant were identified by the desktop searches.

The *Aquatic Ecology Assessment* (AARC 2019a) confirmed the absence of threatened aquatic fauna or flora within the study area. This is consistent with the highly ephemeral nature of watercourses and the disturbed condition occurring as a result of past clearing and agricultural land use.

The Fitzroy River turtle was previously identified as potentially impacted by the 'Dingo West Project', subject to the particular manner in which the Project is undertaken (EPBC Referral Decision (2010/5775)). This was based on the likely habitat for the turtle occurring approximately 54 km downstream of the Project. The *Aquatic Ecology Assessment* (AARC 2019a) confirmed that the species did not inhabit watercourses within or immediately downstream of the Project and concluded that suitable habitat for the species was not present.

Fish Passage

The *Queensland Waterways for Waterway Barrier Works* (DAF 2013) identifies watercourses within the Project as providing value for fish passage. Despite watercourses within the study area only containing water for very short periods of the year (post rainfall), during a flow event Charlevue Creek and Springton Creek would be utilised by fish species. However, there are no known migratory aquatic species likely to rely on the watercourses for regular movement or as access to known breeding locations.

6.3 POTENTIAL IMPACTS

6.3.1 Terrestrial Flora

Vegetation Communities

The Project will include vegetation clearance and land disturbance during the construction and operation of the mine. The extent of land disturbance would be approximately 1,961 ha, of which, approximately 720 ha of is remnant vegetation.

Other potential impacts to vegetation communities include:

- Removal of habitat for terrestrial flora and fauna;
- Further habitat fragmentation and loss of connectivity. It is noted that existing vegetation clearing due to agricultural land use has already limited connectivity within this community; and
- Potential for reduced condition of neighbouring vegetation communities due to the introduction of weeds or the release of contaminants associated with mine operations.

Flora Species of Conservation Significance and Habitat

Cerbera dumicola has been identified during the vegetation surveys in two very localised rocky areas associated with vegetation community VC2 and VC1 (Figure 37). This species was not identified elsewhere in the study area.

The proposed mining activity proposes no impacts to populations of *Cerbera dumicola*. The nearest land disturbance is located 1.3 km to the east.

Weed Species

Project development has the potential to create or enhance conditions for invasive weed species, which may spread and out-compete native and pasture species. Weed species may be introduced via the spread of seed on persons, vehicles and equipment. Weed species may quickly colonise disturbed areas if left untreated.

The introduction of weed species can reduce native species abundance and diversity through competition. This can lead to the reduced condition of vegetation and native fauna habitat.

Wetlands

The Project has potential to impact on wetlands via:

- direct clearing;
- changes in hydrology;
- erosion and sedimentation; and
- contaminant release.

Groundwater Dependant Ecosystems

Where wetlands exhibit a degree of dependence on groundwater for survival, drawdown from the mine can result in a reduced ecosystem condition, changes to vegetation composition or die back.

Water quality data, groundwater level and groundwater drawdown estimation (JBT 2019) (Appendix C) were to assess GDEs and the associated impact of drawdown (AARC 2019a) (Appendix G).

GDEs within the study area

The potential GDEs within the study area are riverine type wetlands including riparian vegetation on watercourses and floodplains. The dominant species of this vegetation is blue gum (*Eucalyptus tereticornis*), with associated species; *Bauhinia* spp., river oak (*Casuarina cunninghamiana*), paperbark tea-tree (*Melaleuca* spp.) and poplar box (*Eucalyptus populnea)*. Published research has identified the rooting depth of the blue gum as 10 m (Boland et al. 2006).

Groundwater modelling estimated that the Project has the potential to cause a maximum drawdown of 5 m (steady-state post-mining drawdown) at some locations below the Charlevue and Springton creeks (Appendix C). The groundwater depth adjacent to Charlevue Creek has been recorded at 8.8 mbgl with an EC range from 15,200 µS/cm to 16,600 µS/cm, whilst groundwater below Springton Creek registered a depth of 11.2 mbgl with an EC of 5,948 µS/cm (Appendix C).

Considering blue gum and river oak have moderate salinity tolerance of 4,000 to 8,000 µS/cm (DA 2002), it is concluded that the groundwater within the Charlevue Creek alluvium is too saline to be useable by the vegetation along the Charlevue Creek.

The salinity recorded adjacent to Springton Creek alluvium is within the tolerance level of the dominant species (DA 2002). However, it is also noted that the depth to groundwater in that area (11.19 mbgl) is potentially beyond the depth that is accessible by vegetation.

Charlevue and Springton creeks are highly ephemeral watercourses subject to occasional flow events that replenish the alluvial aquifers. As a result, fluctuations in the groundwater level throughout the year are likely within these riverine ecosystems. Based on the existing condition of the riverine vegetation communities within the study area, it is highly likely that this vegetation has a very low reliance on groundwater aquifers for survival, if any at all. Rather the riverine communities represent facultative GDEs, capable of surviving on soil moisture present in unsaturated shallow soil layers.

It is therefore concluded that there is a very low risk that groundwater drawdown would result in a significant impact to these riverine communities.

HES wetland outside the study area

The *Groundwater Impact Assessment* (Appendix C) includes an assessment of the potential GDE wetland located to the southeast of study area. The groundwater study predicted a 2 m drawdown within the community, post mining.

The potential GDE is located on an elevated ridgeline and the feature is located within a shallow depression on the ridgeline that is surrounded to the south, west and east by elevation contours at 170 mAHD, with the centre of the depression falling below 165 mAHD. The feature is well above the natural ground surface within the MLA, which ranges from 125 to 135 mAHD, with the elevation of the Springton Creek floodplain dropping below 120 mAHD.

The potential GDE is therefore located within a shallow depression on the ridgeline that is likely to be internally draining under average rainfall conditions and that only discharges to the northeast under high rainfall conditions. It is interpreted that, under average rainfall conditions and at the tail end of high rainfall conditions, surface runoff within the relatively small catchment that reports to this area will pond in the area of the shallow depression and provide localised recharge to an underlying groundwater lens that is likely to be disconnected from the regional groundwater system.

Registered bores indicate the depth to water for bores constructed within Tertiary sediments and Permian coal measures ranges from approximately 26-32 mbgl in this area. This equates to a groundwater elevation of 108-110 mAHD for bores in topographically elevated areas. The water level in the site monitoring bores, which were assessed to be representative of the regional groundwater level, are therefore considerably lower than the elevation of the base of the potential GDE, which is at an elevation approximately 165 mAHD.

Based on the observations discussed above, it is concluded that:

- The potential GDE is located on an elevated ridgeline, but within a shallow depression that is likely to drain internally under average rainfall conditions but drains to the northeast under high rainfall conditions;
- The drainage of surface runoff to the shallow depression is likely to result in localised recharge to a perched lens of groundwater that is disconnected from the regional groundwater system; and
- It is probable that this perched groundwater lens provides water to vegetation within the depression during the dry season, but that the groundwater lens is an extremely localised system that relies on replenishment by seasonal rainfall rather than being maintained by the regional groundwater system.

It is noted the EC of site groundwater monitoring bores, which are interpreted to be within the regional groundwater system, is high (15,000-29,000 µS/cm). However, it is also noted that the EC of the registered bores to the north of the potential GDE is very low, with bore 111570 recording an EC of 240 µS/cm and bore 161093 recording an EC of 710 µS/cm. This provides further evidence that the groundwater system in this area is perched above the regional groundwater system, with the flowline from the area of the potential GDE (where recharge is interpreted to occur) to the area where these bores are located being very short.

It is concluded that the potential GDE is maintained by localised runoff and shallow recharge and that a reduction in the regional groundwater level of approximately 2 m, at a vertical distance of approximately 50 to 60 m below the base of the potential GDE, has a very low risk of impacting groundwater levels beneath the potential GDE.

6.3.2 Terrestrial Fauna

Fauna Species of Conservation Significance and Habitat

Field surveys across the study area detected the presence of three fauna species of conservation significance; the southern squatter pigeon (*Geophaps scripta scripta*), the greater glider (*Petauroides volans*) and the short-beaked echidna (*Tachyglossus aculeatus*).

Potential impacts of the Project to threatened fauna species include:

- Direct clearing of habitat within the Project defined impact areas;
- Further habitat fragmentation and loss of connectivity, particularly along Charlevue Creek which provides partial connectivity to larger downstream riparian communities. It is noted that existing vegetation clearing due to agricultural land use has already limited connectivity within this community;
- Potential for fauna mortality through interactions with vehicles on roads and/or heavy machinery used for land clearing;
- Potential for habitat degradation through increased risk of release of contaminants or sediments into receiving environments within and downstream of the Project; and
- Potential for increased invasive flora and fauna.

Southern squatter pigeon (Geophaps scripta scripta)

Suitable habitat for the southern squatter pigeon exists in open grassy woodland throughout the study area. Within this suitable habitat, fifteen birds were observed during the ecological surveys; the majority during spring 2017. The species is regionally abundant, having been observed outside of the study area on multiple occasions, with the species observed multiple times on local roads and elsewhere in the local area. No breeding activity was observed within the study area.

It is unlikely that the proposed Project will have a significant impact on the southern squatter pigeon; either the local population or the population in its entirety due to:

- The species being highly mobile;
- The abundance of equivalent and more suitable habitat outside of the study area in adjacent areas;
- The observed high local abundance of the southern squatter pigeon within and surrounding the study area; and
- The likely suitable habitat to be provided by rehabilitated land, post mining.

Greater glider (Petauroides volans)

The preferred habitat of the greater glider consists of tall, montane, moist eucalypt forests with relatively old trees and abundant hollows. It favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Critical microhabitat is an abundance of large hollows in large, old trees for daily denning shelters and breeding purposes. The species is absent from cleared areas and has little ability to disperse between fragments across cleared areas, with habitat connectivity critical to species survival (TSSC 2016).

Suitable habitat for the great glider within the study area is confined to the Eucalypt riparian woodlands such as along the Charlevue Creek; that features tall open woodland containing hollows and a sparse shrub layer.

It is unlikely that the proposed Project will have a significant impact on the greater glider; either the local population or the population in its entirety due to:

- No significant impact proposed to habitat within the study area, specifically Charlevue Creek. Proposed disturbance within this habitat is limited to the development of a small culvert crossing;
- The observed abundance of greater gliders within the study area and within the broader central Queensland region; and
- The abundance of equivalent and more suitable habitat outside of the study area in adjacent areas.

Short-beaked echidna (Tachyglossus aculeatus)

The short-beaked echidna is found in a variety of habitat types including open forests, grasslands and heavily vegetated woodlands. Suitable habitat for the species exists across the study area.

It is unlikely that the proposed Project will have a significant impact on the short-beaked echidna (*Tachyglossus aculeatus)*; either the local population or the population in its entirety due to:

- The known abundance and wide-ranging distribution of the species;
- The presence of ample equivalent or better suited habitat surrounding the Project;
- The relatively small extent of impact proposed by the Project; and
- The likely suitable habitat to be provided by rehabilitated land, post mining.

Migratory Fauna Species

The rufous fantail (*Rhipidura rufifrons*), a listed migratory bird species under the EPBC Act, was identified within the study area. The rufous fantail is generally found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats, such as those within the study area.

It is unlikely that the proposed Project will have a significant impact on the rufous fantail (*Rhipidura rufifrons*); either the local population or the population in its entirety due to:

- The rufous fantail is a common and secure species (Blakers *et al.* 1984);
- The study area does not contain the preferred habitat type for the species;
- The species is highly mobile and likely only passing through the Project on its migratory path;
- No known breeding sites or nesting habitat was identified on the study area; and
- Ample equivalent or higher quality habitat exists surrounding the study area.

Pest Species

Pest species compete with, and prey on native fauna. Construction and operation of the Project increases the risk of pest species on the study area through:

- Generation of food and other waste that may attract pests; and
- Creation of artificial ponding areas providing habitat for pest species such as cane toads.

6.3.3 Aquatic Ecology

The aquatic ecology values within the study area are limited to riverine ecosystems including Charlevue Creek, Springton Creek, and some tributaries. The creeks are highly ephemeral, experiencing periodic flows only following heavy or repeat rainfall events. Past clearing for agricultural purposes has been undertaken across much of the study area including the removal of riparian vegetation. The removal of riparian vegetation and direct stock access to the waterways has resulted in bank instability, erosion and occurrence of weeds.

The Project has potential to impact on aquatic ecology values through:

- The release of MAW to the receiving waterways and associated impacts to ecosystem health;
- Potential for spills and leaks from the mining operation to cause contamination in the receiving waterways;
- Direct impacts to riverine ecosystems via land disturbance for vehicle crossings or diversion of drainage features;
- Risk of increased erosion from cleared lands or mine infrastructure such as spoil dumps, resulting in increased sediment loads entering the aquatic ecosystems; and
- Impediments to fish or other aquatic fauna movements due to the construction of crossings or other infrastructure.

6.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

6.4.1 Terrestrial Flora

Vegetation Communities

To minimise and mitigate impacts to vegetation communities on the Project the following management strategies will be implemented:

- Clearing of land and vegetation will be limited to areas defined in the Project approval and required for safe operation; and managed through
    - An internal permit to disturb system will be implemented to minimise the chances of unauthorised clearing; and
    - Areas to be cleared will be clearly defined and demarked to equipment operators;
- Inductions and training materials provided to employees will identify the environmental values of the site as well as the company procedures for managing impacts within its authority;

- Rehabilitation will be undertaken progressively and will aim to return the land to the pre-mining land use where possible; and

- Where impact to Matters of State Environmental Significance (MSES) cannot be avoided and are authorised by the Project approval, environmental offsets will be provided.

Flora Species of Conservation Significance

Suitable habitat for the *Cerbera dumicola* exists to the west of the Project, within the MLA. The proposed mine construction and development will not impact on the populations. To ensure no inadvertent impacts to *Cerbera dumicola* the following management strategies will be implemented:

- An internal permit to disturb system will be implemented to minimise the chances of unauthorised clearing and impacts to the populations within the MLA;

- Inductions and training materials provided to employees will identify the environmental values of the site as well as the company procedures for managing impacts within its authority; and

- Existing populations will be monitored for abundance, distribution and health over the mine life.

Weed Species

To control the abundance and spread of weed species the following management strategies will be implemented:

- A *Pest and Weed Management Plan* will be prepared and implemented prior to construction;

- As required, weeds within the MLA will be controlled using herbicides and other recommended methods;

- Inductions and training materials provided to employees will assist the identification of common weeds and will include procedures for reporting; and

- Access to vehicle wash down facilities will be provided for vehicles at risk of spreading weeds.

Wetlands/GDEs

Wetlands/GDEs include riverine vegetation on the MLA, particularly riparian vegetation associated with Charlevue and Springton creeks. In addition, a HES wetland is located to the southeast of the Project. To manage potential impacts on wetlands, the following will be undertaken:

- Sediment and erosion control structures will be installed and maintained near all at risk areas to prevent sediment release to wetlands;

- A *Receiving Environment Monitoring Program* (REMP) will be implemented and include monitoring of water, sediments, riparian/riverine vegetation health and biological indicators in aquatic environments;

- The release of MAW will be in accordance with the quality controls provided in the *Model Mining Conditions* (DES 2017e); and

- Groundwater bores adjacent to Charlevue Creek (DW7076W) and Springton Creek (DW7292W1), will be fitted with dataloggers. This data will allow the assessment of the range

of water levels within the alluvium and the response of groundwater levels within the alluvium to rainfall recharge, stream flow events and mining activities.

6.4.2 Terrestrial Fauna

Fauna Species of Conservation Significance

Fauna species of conservation significance identified on the Project include; the southern squatter pigeon (*Geophaps scripta scripta*), the greater glider (*Petauroides volans*), the short-beaked echidna (*Tachyglossus aculeatus*) and the rufous fantail (*Rhipidura rufifrons*) (migratory). The proposed mine construction and development will not have a significant impact on these Species. To ensure no inadvertent impacts occur the following management strategies will be implemented:

- An internal permit to disturb system will be implemented to minimise the chances of unauthorised clearing and impacts to the threatened fauna within the MLA;
- Inductions and training materials provided to employees will identify the environmental values of the site as well as the company procedures for managing impacts within its authority;
- Vehicles speeds will be limited within the MLA, to minimise the risk of collision;
- Vegetation clearing will be done in a staged manner, allowing time for fauna to leave the area; and
- Pre-clearing inspections will be undertaken by qualified staff to minimise the risk of fauna mortality.

Pest Species

To prevent the introduction of pest species and to control their spread, the following management strategies will be implemented for the Project:

- A *Pest and Weed Management Plan* will be prepared and implemented prior to construction;
- Rubbish and food scraps will be managed so as not to encourage pest species;
- Inductions and training materials provided to employees will assist the identification of common pests and will include procedures for reporting; and
- Control of feral cats and other animals will be undertaken within the MLA.

Aquatic Ecology

Aquatic ecology values are primarily attributed to Charlevue Creek and Springton Creek within the MLA. The following mitigation measures will be implemented to protect existing values:

- Sediment and erosion control structures will be installed and maintained near all at risk areas to prevent sediment release to wetlands;
- Crossing design should provide for the fish passage during low and high flow events;
- The release of MAW, will be in accordance with the quality controls provided by the *Model Mining Conditions* (DES 2017e);
- Fuel and hazardous liquids will be stored in a bunded facility, in accordance with relevant Australian Standards;
- A *Spill and Emergency Management Plan* will be implemented during construction and operation to minimise the risk of contaminant release to aquatic ecosystems;
- Open-cut pits will be appropriately bunded or located in a manner that prevents surface water from entering the voids during a 1:1000 year flood event and dams will be appropriately bunded or located in a manner that prevents surface water from entering or damaging the dams during a 1:1000 year flood event; and
  This is consistent with the EPBC Referral Decision: not a controlled action if undertaken in a particular manner.
- A *Receiving Environment Monitoring Program* (REMP) will be implemented and will include monitoring of water, sediments, riparian/riverine vegetation health and biological indicators in aquatic environments.

6.5 ENVIRONMENTAL OFFSETS

The offsets framework requires environmental offsets to be delivered where an activity is likely to result in a significant residual impact on a prescribed environmental matter. The *Queensland Environmental Offset Policy Significant Residual Impact Guideline* (EHP 2014) was used to determine whether Project impacts are considered to be significant. This guideline outlines the criteria for identifying when an impact on a prescribed environmental matter (i.e. MSES) may be significant. The significant impact criteria provide a trigger for consideration of offsets (EHP 2014).

As part of the ecological assessments (AARC 2019a; AARC 2019c), significant impact assessments were conducted for all prescribed environmental matters identified in the study area. A summary of results from the assessment is provided in Table 25, whilst the full assessments can be found in Appendix G and Appendix H.

Of the prescribed matters that will be significantly impacted by the proposed disturbance further details of the impact assessment and offset requirements are summarised in Table 26.

Magnetic South is committed to delivering environmental offset requirements for matters with a significant residual impact at a result of the Project. Offsets will be delivered as either a financial settlement or proponent-driven offset (i.e. a land-based offset or Direct Benefit Management Plan), or a combination of both.

Table 25 Summary of Project MSES and likelihood of significant residual impact

Protected Matter		NC Act Status	VM Act Status	Likelihood of occurrence within study area	Likelihood of significant impact
Of Concern RE 11.3.2		n/a	OC	Present	Yes
REs located within the defined distance from the defining banks of a VM Act watercourse		n/a	n/a	Present	Yes
Connectivity Area		n/a	n/a	Present	Yes
Wildlife Habitat and Essential Habitat	*Cerbera dumicola*	n/a	n/a	Present	No
	Southern squatter pigeon	V	n/a	Present	No
	Greater glider	V	n/a	Present	No
	Short-beaked echidna	SLC	n/a	Present	No
Waterways providing for Fish Passage		n/a	n/a	Present	No
HES Wetlands		n/a	n/a	Not present	No

Notes: n/a not applicable
OC of concern
V vulnerable
SLC special least concern

Table 26 Summary of MSES impact assessment and offset requirements

MSES	Total Impact Area (ha)	Impact Assessment	Offset Requirement	Habitat Description
Of Concern RE11.3.2	7.53	Clearing is non-linear and exceeds the clearing threshold.	Offset Required	This vegetation community was characterised by *Eucalyptus populnea* (poplar box) woodland on alluvial plains. It was represented in several small to moderate patches within the study area and is subject to pressures from grazing, exotic species invasion.
REs located within the defined distance from the defining banks of a VM Act watercourse	59.79	Clearing of watercourse vegetation is required. The clearing widths and areas exceed significant impact guidelines. REs supporting watercourse vegetation includes RE 11.3.25, RE 11.5.2, RE 11.3.2 and RE 11.7.2.	Offset Required	A number of VM Act watercourses traverse the MLA. Impacts will occur to watercourse vegetation that is associated with RE 11.3.25, RE 11.5.2, RE 11.3.2 and RE 11.7.2.
Connectivity area*	720.74	The *Landscape Fragmentation and Connectivity Tool** was applied to the proposed extent of disturbance area. The results found that significant impact would occur to connectivity at both local scale and to core remnant areas.	Offset Required	The *Landscape Fragmentation and Connectivity Tool* determined that there is significant impact to the connectivity of the remnant vegetation within the Project.

Notes: * *Landscape Fragmentation and Connectivity Tool* is based on current government mapping.

7.0 SURFACE WATER

This section provides a description of the existing surface water values within and surrounding the Project. It aims to identify the Project's potential impacts on the existing values and propose mitigation measures and management strategies to prevent or minimise adverse environmental effects.

This section is informed by the *Surface Water Assessment* (WRM 2019b) presented in Appendix B. A *Flood Impact Assessment* (WRM 2019a) was also conducted to inform the *Surface Water Assessment* (WRM 2019b).

Surface water values pertaining to flora, fauna and wetlands are addressed in Section 6.0 (Flora and Fauna).

7.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objective relevant to potential impacts to surface water as described in the EA guideline for *Application requirements for activities with impacts to water [ESR/2015/1837]* (DES 2017c) is:

The activity will be operated in a way that protects the environmental values of waters.

The Project would achieve all of the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

a) *The storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks;*

b) *Contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water;*

c) *The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment;*

d) *The disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values;*

e) *Acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered;*

f) *Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland; and*

g) *The activity will be managed so that adverse effects on environmental values are prevented or minimised.*

Of the performance outcomes described above, (d) assessment of acid sulphate soils is addressed in Section 5.0 (Land), (e) assessment of acid producing rock is addressed in Section 13.0 (Waste Rock and Coal Reject Geochemistry), and (f) assessment of impacts to wetlands are addressed in Section 6.0 (Flora and Fauna).

7.2 DESCRIPTION OF ENVIRONMENTAL VALUES

The following documents were consulted to assist in identification of the surface water environmental values (EVs) for the Project:

- *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*;
- *Environmental Protection (Water) Policy 2009 Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (EHP 2011a); and
- *Water Resource (Fitzroy Basin) Plan 2011*.

The EPP (WWB) is the primary instrument for surface water management under the EP Act; it governs discharge to land, surface water and groundwater, aims to protect EVs and sets water quality guidelines and objectives.

Schedule 1 of the EPP (WWB) outlines the *Environmental Protection (Water) Policy 2009 Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (EHP 2011a) as the relevant document for defining EVs and WQOs for the Project region, as described in Section 7.2.3 (Surface Water Quality).

The *Water Resource (Fitzroy Basin) Plan 2011* sets out the allocation and sustainable management of water resources in the Fitzroy Basin. The plan also identifies outcomes for sustainable management of water, the water plan area, general and specific surface water and groundwater outcomes, as well as general and specific ecological outcomes.

7.2.1 Drainage Network

The Project area lies within the Fitzroy River Basin, which encompasses an area of 142,545 km^2 and contains the Comet, Connors, Dawson, Don, Nogoa and Mackenzie Rivers, which make up its six sub-catchment areas (BoM 2018; DES 2018b). The study area lies within the Mackenzie River catchment, which covers a total area of 12,985 km^2, and is situated in the centre of the Fitzroy River Basin (Figure 40).

The Project area also lies within the local site catchments of Springton Creek and Charlevue Creek (Figure 41). Charlevue Creek flows through the Project area in a northeast direction. This watercourse begins within the boundaries of Blackdown Tablelands National Park, flowing northeast before joining with Springton Creek and the Fitzroy River, and eventually flows into the Pacific Ocean approximately 46 km north of Gladstone. Springton Creek flows though the Project area in a north-northeast direction. These two creeks eventually converge with the Mackenzie River. First and second order streams associated with Charlevue Creek and Springton Creek also occur in the study area.

Stanley Creek traverses the northwest corner of the Project area and flows in a northeast direction to join with Duckworth Creek (offsite), which then joins with Springton Creek further downstream of the Charlevue - Springton Creek confluence (Figure 42).

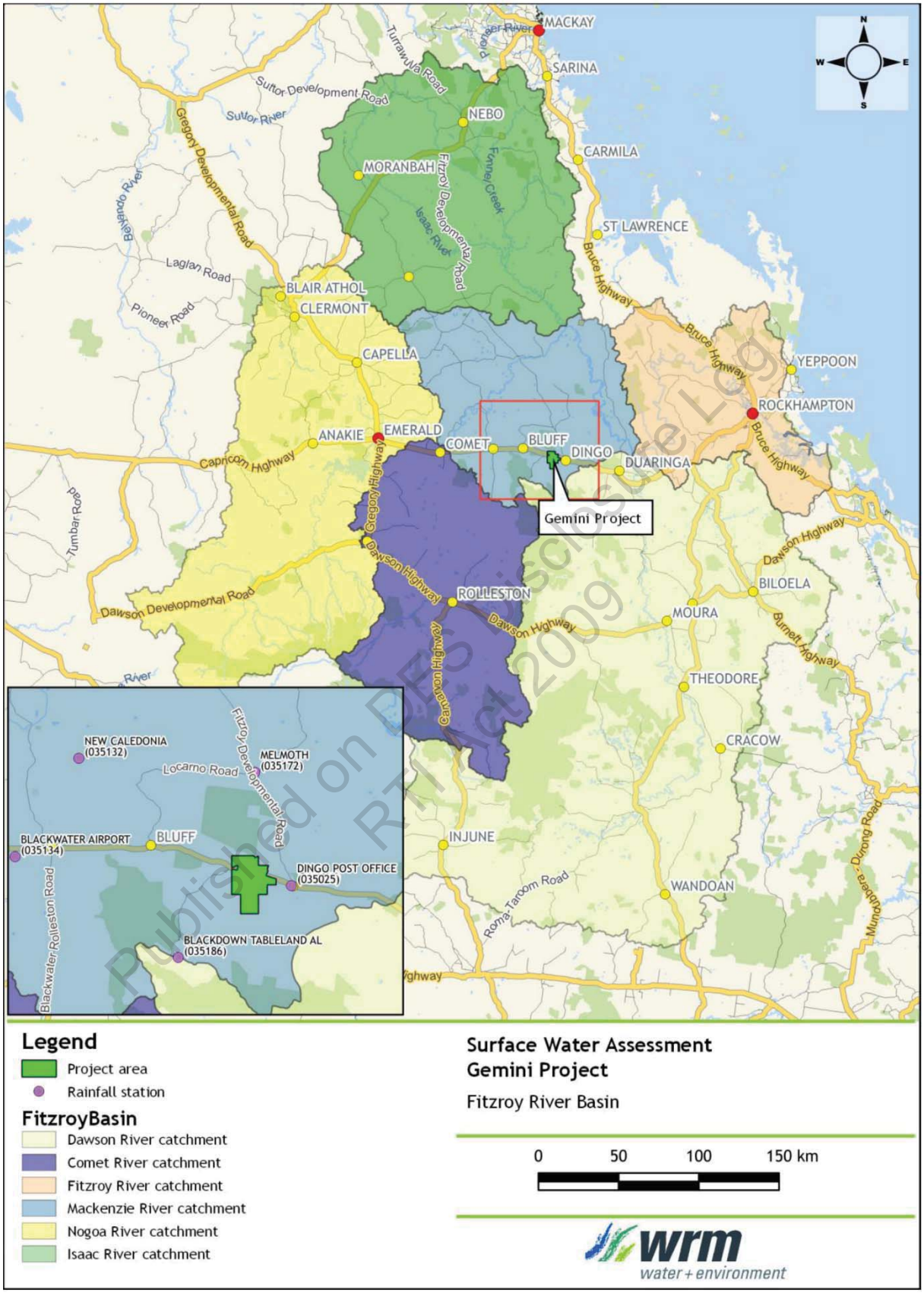


Figure 40 Fitzroy River Basin

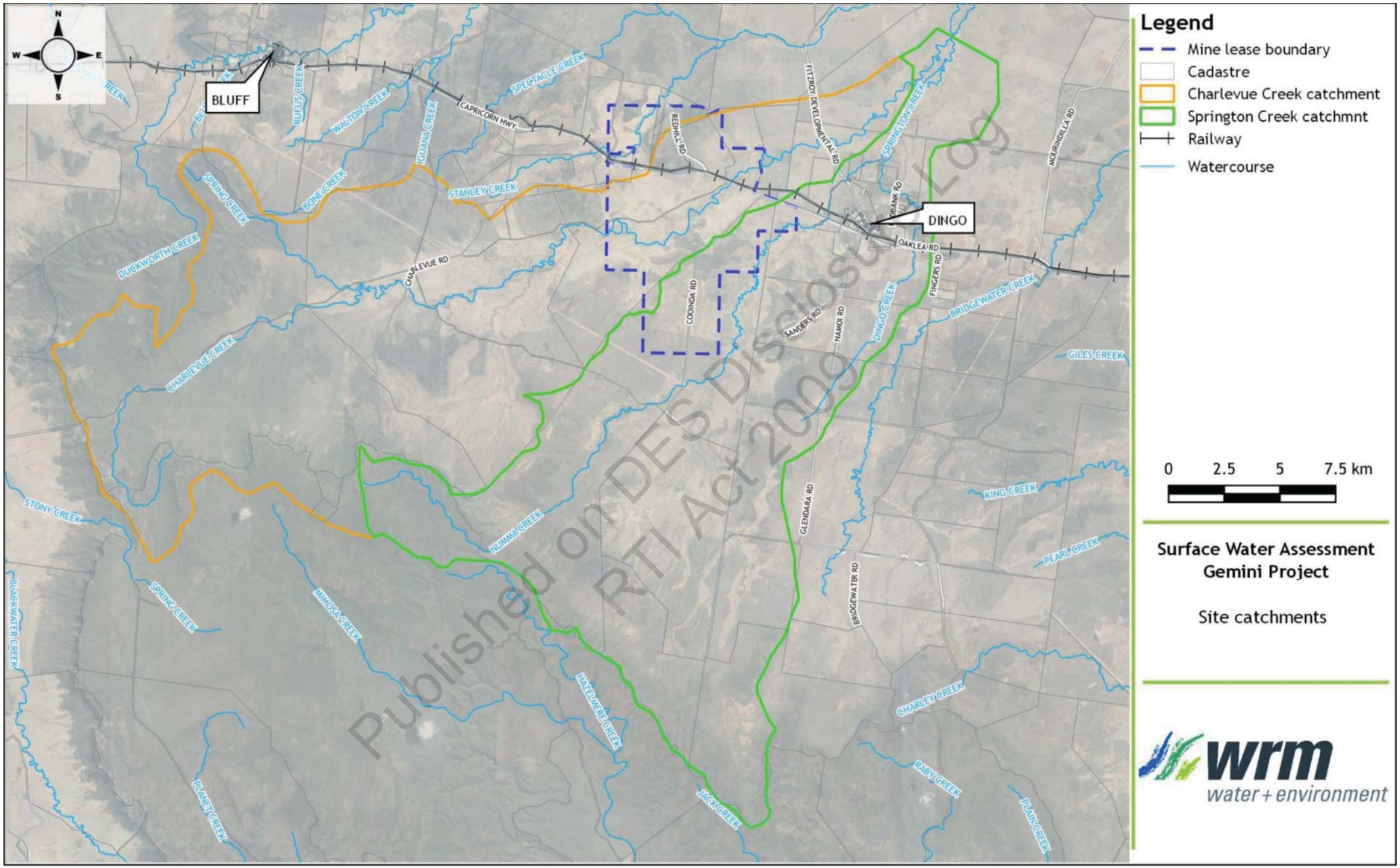


Figure 41 Project Area Catchments

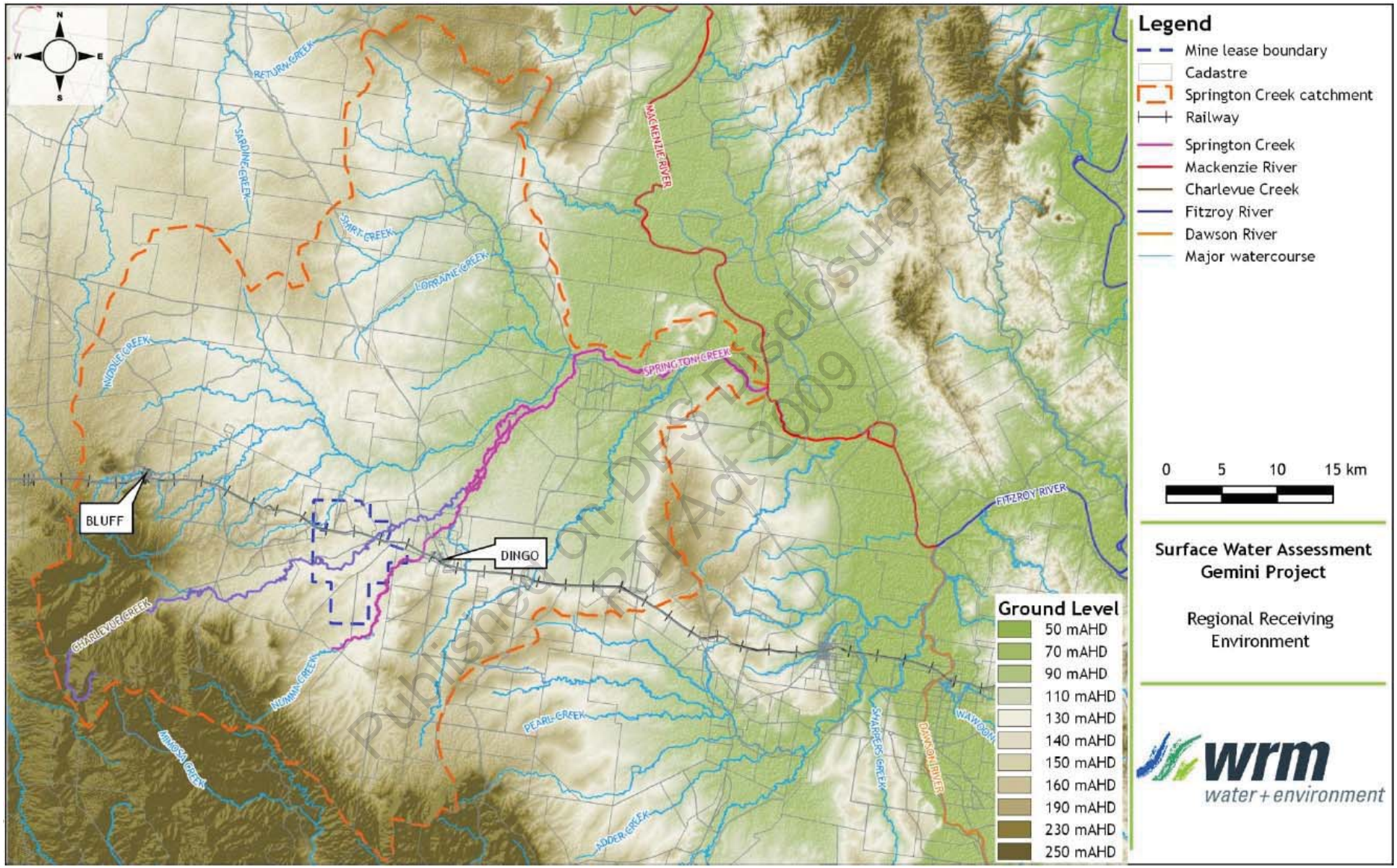


Figure 42 Regional Receiving Environment

Local Stream Morphology

All local waterways are ephemeral, with streamflow mostly occurring shortly after rainfall between September and April. Stream flows are highly variable, with most channels remaining dry during winter to early spring when rainfall and runoff is low, although some pools hold water for extended periods. Typical depth of channels reaches up to 0.8 m and a channel widths range between 1.2 and 3.5 m.

Within the Project, Springton Creek and Charlevue Creek cross alluvial floodplains. The reaches of Springton Creek and Charlevue Creek in the proposed mining area have well-defined channels, typically characterised of predominant sandy beds with a mixture of silt and clay at varying proportions, and well established riparian vegetation.

The riparian vegetation constituted a mixture of low to moderate disturbance and were located within remnant and non-remnant environs. Disturbance of clearing for agricultural purposes and direct stock access to waterways have contributed to bank instability, erosion and occurrence of weeds. Further details are addressed in Section 6.0 (Flora and Fauna).

Topography of the surrounding land varies from flat to undulating, with elevation within the Project ranging from 120-150 m. The landscape is influenced by Charlevue Creek, which has a lower elevation than the surrounding landscape.

7.2.2 Wetlands

The assessment of wetlands within and outside of the Project area is provided in Section 6.0 (Flora and Fauna), along with the description of potential impacts and mitigation measures proposed. To avoid duplication, no further discussion of wetlands is included in this section.

7.2.3 Surface Water Quality

Regional Water Quality Objectives

The document *Environmental Protection (Water) Policy 2009 for the Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (EHP 2011a) provides WQOs to support and protect the different EVs identified for waters within the Mackenzie River southern tributaries of the Mackenzie River sub-basin. Ten EVs are nominated broadly to the mapped areas of this zone, of which the following are relevant to the Project and its receiving waters:

- Aquatic ecosystems (slightly to moderately disturbed); and
- Water suitable for stock watering.

The guideline WQOs for the protection of aquatic ecosystems and for stock watering are provided in Table 27. Collected water samples in February 2018 and April 2019 have been compared to these WQO values to characterise the existing water quality of the site-specific waterways and drainage features.

Table 27 Water quality objective guideline values

Mackenzie River Sub-basin EVs and WQO Basin No. 130 (part)		
Management Intent (Level of Protection)	**WQOs to protect EV**	
	Parameter	**Water Quality Objective**
Aquatic ecosystem *(moderately disturbed)*	**Water**	
	Ammonia N	<20 µg/L
	Oxidised N	<60 µg/L
	Organic N	<420 µg/L
	Total nitrogen	<7 µg/L
	Filterable reactive phosphorus	<20 µg/L
	Total phosphorus	<160 µg/L
	Chlorophyll a	<5.0 µg/L
	Dissolved oxygen	85-110% saturation
	Turbidity	<50 NTU
	Suspended solids	<110 mg/L
	pH	6.5-8.5
	Conductivity (EC) baseflow	<310 µS/cm
	Conductivity (EC) high flow	<210 µS/cm
	Sulphate	<10 mg/L
	Macroinvertebrates	
	Taxa richness (composite)	12-21
	Taxa richness (edge habitat)	23-33
	PET taxa richness (composite)	2-5
	PET taxa richness (edge habitat)	2-5
	SIGNAL index (composite)	3.33-3.85
	SIGNAL index (edge habitat)	3.31-4.20
	% tolerant taxa (composite)	25-50%
	% tolerant taxa (edge habitat)	44-56%
Stock watering	**Water**	
	Total Dissolved Solids	3000 mg/L
	Aluminium	5 mg/L
	Arsenic	0.5 (up to 5) mg/L
	Beryllium	*not determined**
	Boron	5 mg/L
	Cadmium	0.01 mg/L
	Chromium	1 mg/L
	Cobalt	1 mg/L
Stock watering (cont.)	Copper	0.4 mg/L (sheep)

Mackenzie River Sub-basin EVs and WQO Basin No. 130 (part)		
Management Intent (Level of Protection)	**WQOs to protect EV**	
		1 mg/L (cattle) 5 mg/L (pigs) 5 mg/L (poultry)
	Fluoride	2 mg/L
	Iron	*not sufficiently toxic*
	Lead	0.1 mg/L
	Manganese	*not sufficiently toxic*
	Mercury	0.002 mg/L
	Molybdenum	0.15 mg/L
	Nickel	1 mg/L
	Selenium	0.02 mg/L
	Uranium	0.2 mg/L
	Vanadium	*not determined**
	Zinc	20 mg/L

Notes: N nitrogen
EC electrical conductivity
NTU Nephelometric Turbidity Units
* insufficient background data to calculate

Local Surface Water Quality Assessment

As part of an ongoing surface water monitoring program implemented at the site in 2018, water quality sampling across Charlevue Creek, Springton Creek and Stanley Creek included field readings of pH, EC and temperature and has occurred following two flow events to date. Surface water samples were also collected at each waterway that contained standing or flowing water. Location of the survey sites are displayed in Figure 43.

Samples were analysed at a NATA accredited laboratory for various physico-chemical parameters, metals, nutrients, hydrocarbons and pesticides and assessed against WQOs. Exceedances of WQOs are highlighted orange in Table 28 and Table 29.

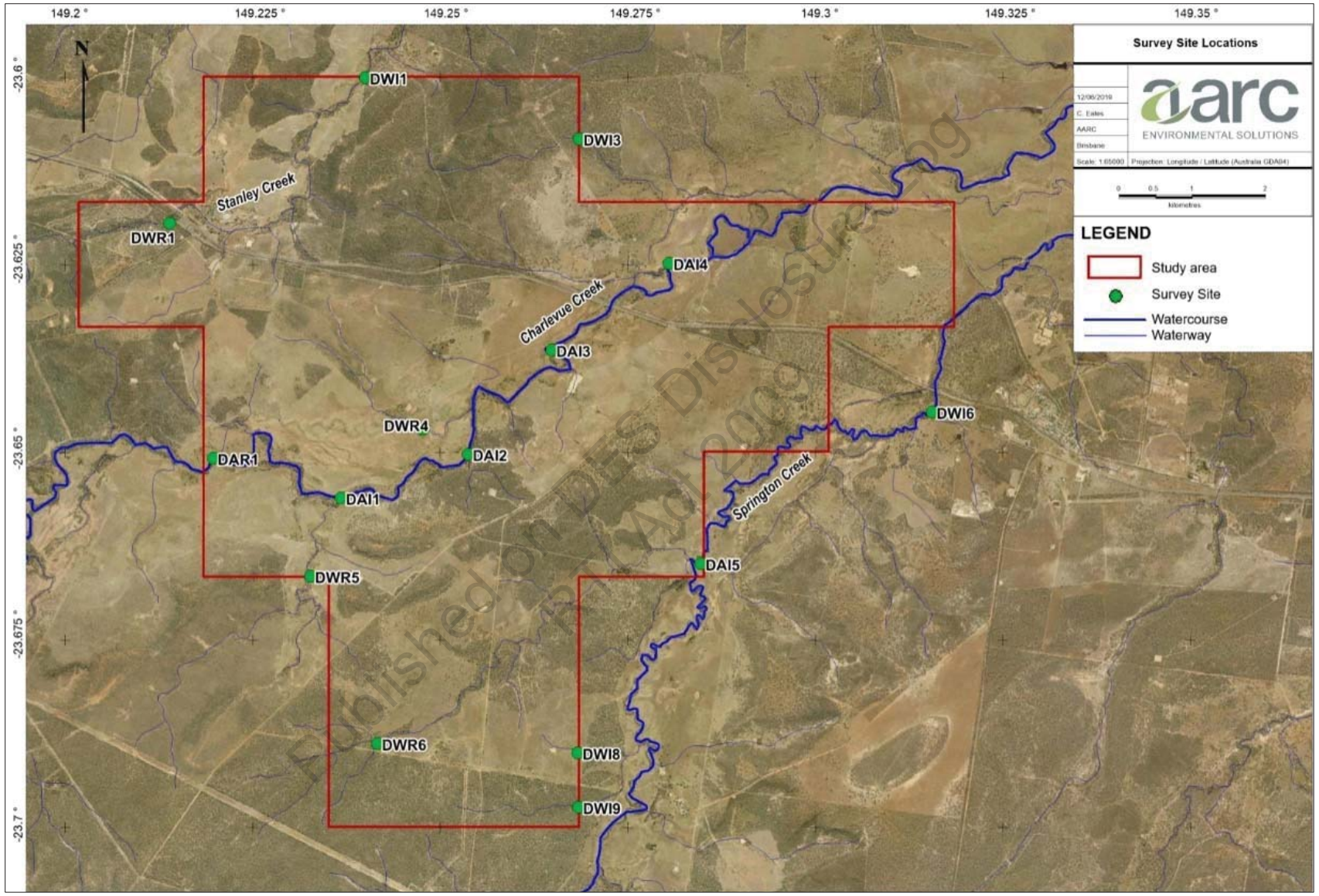


Figure 43 Location of surface water sampling sites

Table 28 Physico-chemical parameters (Charlevue Creek)

Parameter	WQO	DAR1		DWR5		DAI1		DAI2		DAI3		DAI4	
		2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
pH	6.5-8.5[a]	7.27	7.12	7.28	6.27	6.63	6.24	6.91	6.37	6.92	6.78	6.87	6.58
Temperature (°C)	n/a	27.1	20.5	29.5	21.2	30.8	20.7	26	21	26.8	20.1	26.3	21.2
EC (µS/cm)	<310[a]	73.1	120.6	209.5	211.2	74.1	113.9	67	128.1	83.6	124.4	70.3	105.4
Suspended Solids (mg/L)	n/a.	58	172	8660	43	2080	131	880	228	6170	103	168	152
Total Dissolved Solids (mg/L)	3000[b]	45.6	85.8	125.3	147.9	43.5	80.6	42.8	90.1	51.9	89.3	44.6	73.8
Dissolved Oxygen (DO) (%)	85-110[a]	87	28	88	61	67	58	80	15	80	46	81	56
Oxygen Reduction Potential (millivolts)	n/a.	140.5	179.8	205.4	203.8	228.7	197.8	269.3	160.6	198.3	184	137.4	210.8
Turbidity (NTU)	<50[a]	387	12154.4	1231.6	23199	2050.3	13046.2	831.2	13896.6	2582.6	16031.5	506.3	13455.6
Sulphate as SO_4 - Turbidimetric (mg/L)	<10[a]	2	<1	5	15	2	<1	<1	<1	2	<1	<1	1
Fluoride (mg/L)	2[ab]	0.1	0.2	0.1	0.1	0.1	0.3	0.1	0.3	0.2	0.2	0.1	0.2
Ammonia (mg/L)	<0.02[a]	0.02	0.1	0.28	0.43	0.04	0.23	0.09	0.07	0.08	0.14	0.14	0.13

Notes: a aquatic ecosystem WQO
b livestock drinking WQO

Table 29 Physico-Chemical Parameters (Stanley Creek and Springton Creek)

Parameter	WQO	Stanley Creek		Springton Creek				
		DWR1 - 2018		DWI9	DAI5		DWI6	
		South	North	2019	2018	2019	2018	2019
pH	6.5 - 8.5[a]	6.61	7.61	6.11	6.84	6.28	7.34	5.95
Temperature (°C)	n/a	28.1	31.4	22.9	27.8	21	24.6	23.2
EC (µS/cm)	< 310[a]	113.8	0.4	140.7	121.2	137.2	0.3	65
Suspended Solids (mg/L)	n/a	106	145	238	852	68	215	86
Total Dissolved Solids (mg/L)	3000[b]	69.9	0.25	95.4	74.8	96.6	0.197	43.8
Dissolved Oxygen (DO) (%)	85 - 110[a]	4	98	17.1	53	46	95	50
Oxygen Reduction Potential (millivolts)	n/a	98.2	147.1	116.5	242.5	220.9	158.6	222.8
Turbidity (NTU)	< 50[a]	155.3	4.1	44098.4	3734.08	30580.5	21.4	10730.4
Sulphate as SO_4 - Turbidimetric (mg/L)	< 10[a]	10	2	4	7	4	<1	2
Fluoride (mg/L)	2[ab]	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Ammonia (mg/L)	< 0.02[a]	0.12	0.13	0.9	<0.01	0.2	0.02	0.12

Notes: a aquatic ecosystem WQO
b livestock drinking WQO

Exceedances of WQOs for turbidity across all sites and years were observed, which can be attributable to soil erosion, runoff, pollution and algal blooms; however, some waterways can have naturally high levels of suspended solids and turbidity (Fondriest Environmental Inc. 2014).

Low levels of dissolved oxygen (DO) were observed across most sampling sites in 2018 and 2019. The low levels of DO were recorded in stagnant pools along ephemeral waterways, which naturally experiences DO values below 50% saturation (EHP 2011a). Therefore, these exceedances are not a reliable indicator of the long-term health of the system.

Petroleum hydrocarbons across sampling sites at the three waterways exceeded WQO values during the 2018 survey. Site DWR5, which is located upstream of Charlevue Creek, recorded the highest exceedance of petroleum hydrocarbons, which is mostly likely attributable to the agricultural and pastoral land uses close to or at this site. Although there were no recorded exceedances during the 2019 survey, it will continue to be closely monitored due to the existing and consistent local source of petroleum hydrocarbons.

Given the higher carbon chain fractions being reported, possible sources include; crude oil, heavy fuel oils, lubricating oils, asphalts and pitch and even waxes and other related products. Sites DWR1 (Stanley Creek) and DWI6 (Springton Creek) occur along the Capricorn Highway, which is a possible point source for the petroleum hydrocarbons observed at these locations.

Macroinvertebrate diversity, abundance and PET richness were generally low, which is reflective of the system's low waterway health at time of sampling.

All laboratory analysis results for dissolved metals, total metals, and petroleum hydrocarbons are presented in Appendix H.

7.2.4 Stream Sediment Quality

Stream Sediment Quality Objectives

Baseline levels of metals in stream sediments provide an additional indication of waterway health. Stream sediment quality sampling was carried out at all sites in 2018 and 2019. Samples were tested for various contaminants and results were compared to the sediment quality guideline (SQG) values listed in *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ 2000) (Table 30).

Table 30 Stream sediment quality objective values

Contaminant	Sediment Quality Guideline Value (mg/kg)	
	Low Value	High Value
Arsenic	20	70
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Nickel	21	52
Mercury	0.15	1
Zinc	200	410

7.2.4.1 Stream Sediment Characteristics

Stream sediment quality was well below the relevant SQG low and high trigger values for all parameters except nickel, which exceeded the SQG low trigger value at DWR6 during both years. This site is located along an unnamed waterway which feeds into Springton Creek at DAI5.

Particle size analysis and particle size classification demonstrated that Stanley Creek (DWR1) the stream sediment is predominantly sand with small amounts of clay and silt. However, further downstream along Stanley Creek (DWI1), sediment is characterised as sand (92-96%) with negligible presence of gravel, silt or clay.

Charlevue Creek stream sediment is characterised by high percentages of sand (56-94%) at the majority of sites with variable levels of clay (1-24%) and silt (1-17%). Though minor, the presence of gravel was recorded across the sites along Charlevue Creek. Sites DWR4, DAI2, and DAI5 presented lower levels of sand (9-45%), and higher percentages of clay (25-41%) and silt (17-66%). Of these sites only DWR4 had higher levels of fine particles during both the 2018 and 2019 sampling periods. This site was located along a natural depression which flows into Charlevue Creek.

Along Springton Creek stream sediment levels vary between sites but remain consistent across sample years. Springton Creek itself is characterised by predominantly sand, with consistent levels of clay and silt.

Particle size analysis is presented graphically in Figure 44 and all stream sediment laboratory analyses are provided in Appendix H.

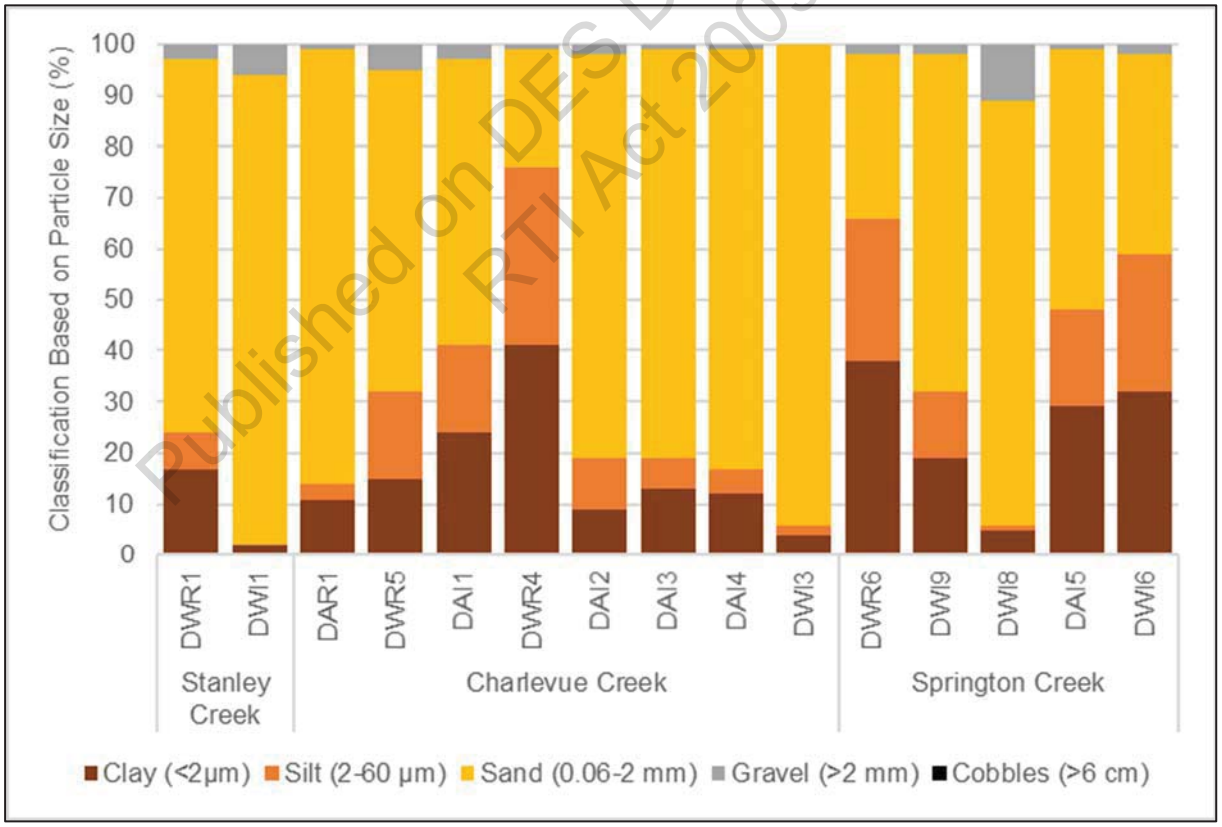


Figure 44 Stream sediment particle size analysis

7.2.5 Existing Flood Conditions

The *Flood Impact Assessment* (WRM 2019a) attached to Appendix B; defines existing flood conditions across the Project area for a range of design events, in terms of peak water level, peak velocity and water depth.

The XP-RAFTS flood model was used to estimate design discharges for the 50%, 10%, 2%, 1% and 0.1% AEP as well as the probably maximum flood (PMF) design discharge using an ensemble of design temporal patterns. In absence of gauged streamflow data, the resulting peak discharges were validated against the 'rational method and regional flood frequency estimation' (RFFE) estimates (refer to Appendix B).

The XP-RAFTS modelling was then adopted as inflows to the TUFLOW hydraulic model to estimate flood extents and depths along the channel and floodplain of Charlevue Creek and Springton Creek for the nominated design events.

Under existing conditions, all flow generally remains contained within the Charlevue Creek and Springton Creek floodplain channels during a 50% AEP flood event with water depth of <1.5 m. The extent of flooding is more widespread during a 10% AEP event along the drainage features, with small areas of localised inundation with depth of up to 2.5 m along Charlevue Creek floodplains. This flood extent is generally consistent for the 2%, 1% and 0.1% AEP and PMF events, however, flood depth can increase up to 4 m in some areas along the floodplains and reaches up to more than 5 m in the main channels. This predicted flooding regime is mainly attributable to the flat and undulating topography of the area.

Flood extent along the unnamed tributary of Springton Creek throughout all modelled AEP events are not widespread and are contained within close proximity to the main channel with shallow depths of up to 1.5 m. Peak flood depth reaches up to 2.5 m during the PMF event.

The general flooding patterns along the two drainage features indicate that flood velocity increases (up to 3.0 m/s) respective to decreasing AEP. Flood modelling also indicate lower flood velocity (less than 1.0 m/s) with further distance from the main creek channels.

Flood velocity during PMF event can reach a maximum of 4.0 m/s across most of the predicted flooding areas.

Figure 45 and Figure 46 illustrate the flooding extents, depths and velocity for 1% AEP event.

Graphical representation of all modelled existing flood conditions, showing extent, depth and velocity are provided in Appendix B.

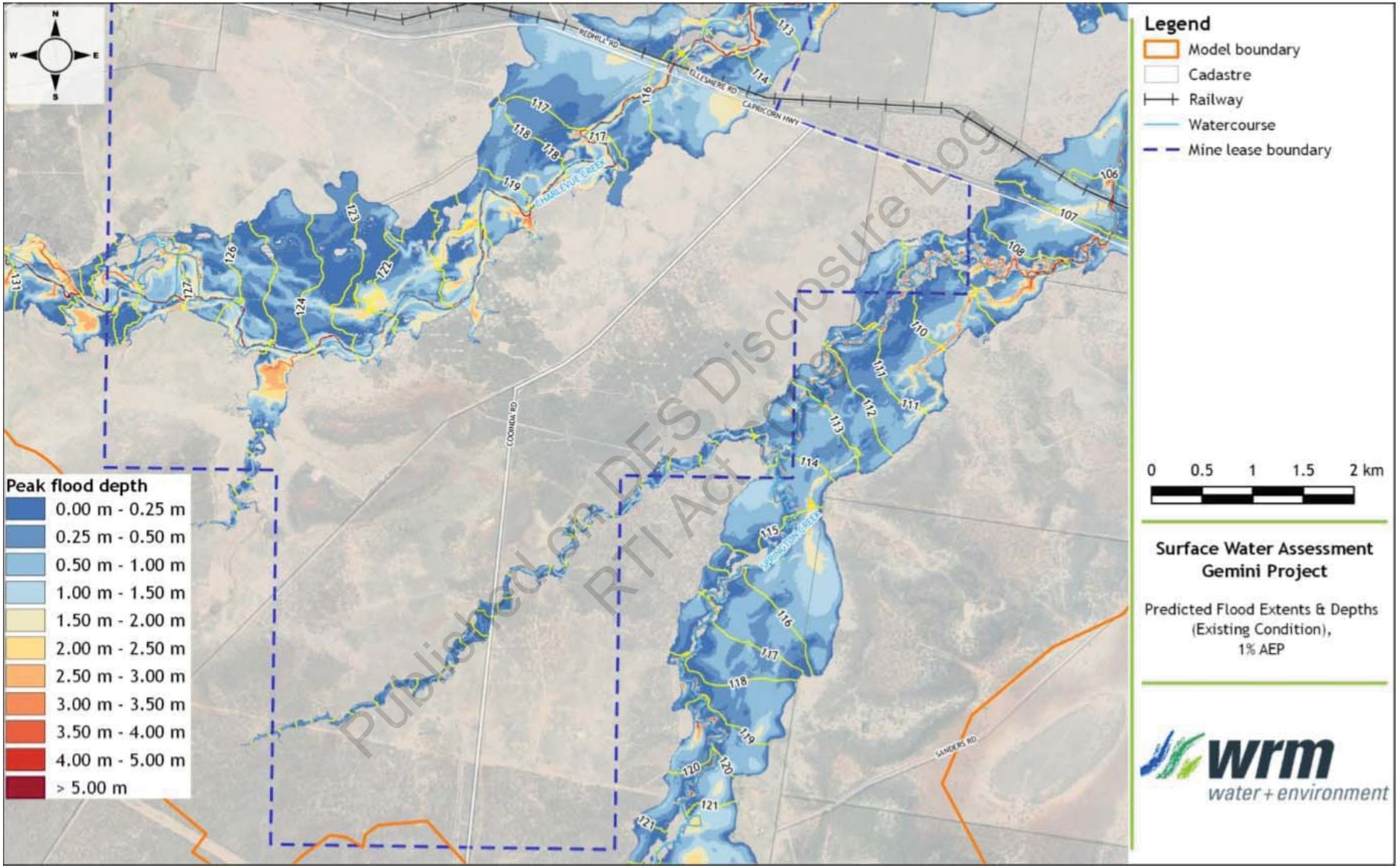


Figure 45 Predicted flood extent and depth for existing conditions (1% AEP)

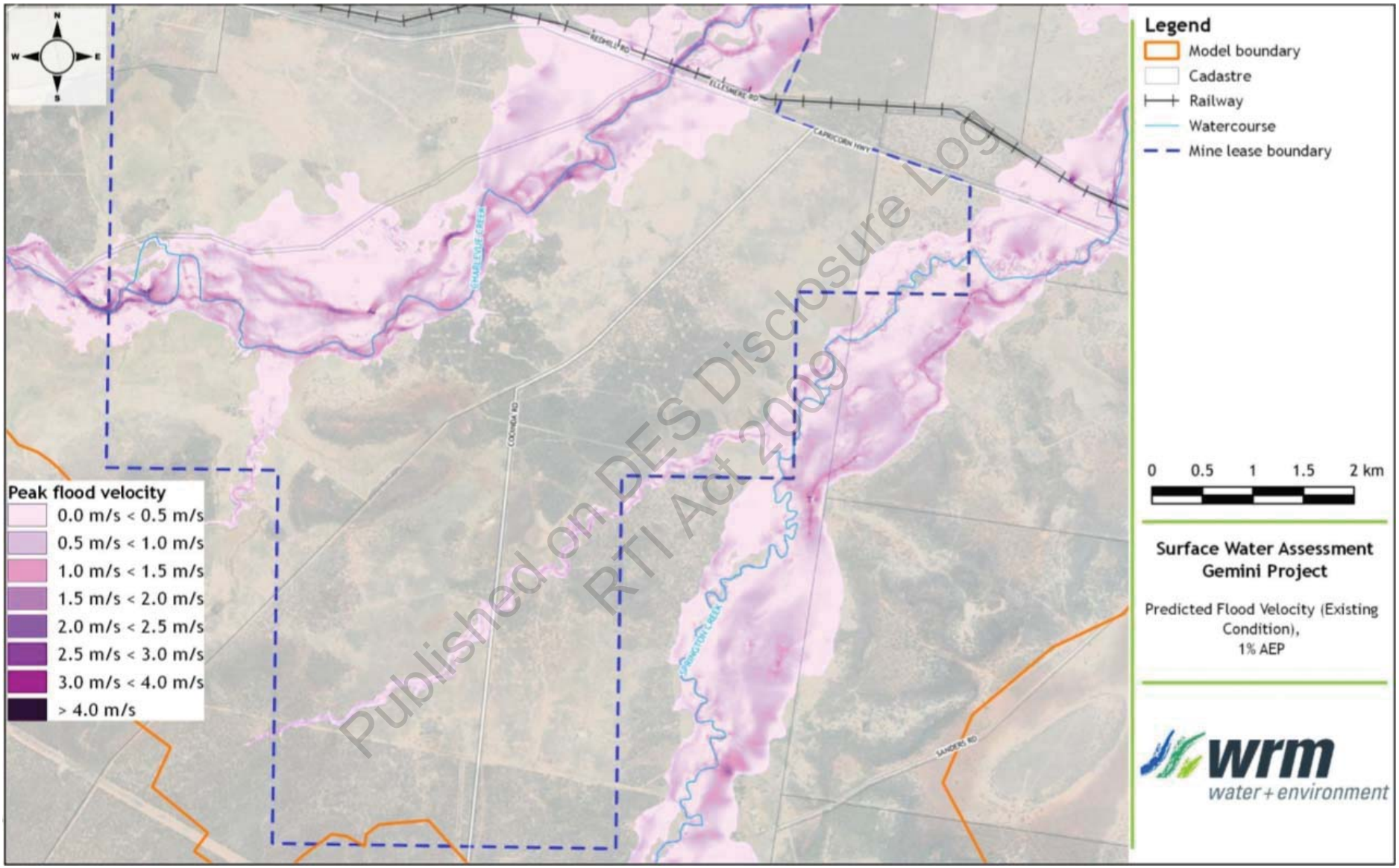


Figure 46 Predicted flood velocity for existing conditions (1% AEP)

7.3 POTENTIAL IMPACTS

The potential impacts of the Project on the surface water EVs include:

- Impacts on regional water availability due to the potential need to obtain water from external sources to meet operational water requirements of mining operations;
- Short-term and/or long-term loss of catchment area draining to local drainage paths due to capture of runoff within the SWMS and the open-cut pits;
- Adverse impacts on the quality of surface runoff draining from the disturbed areas to the various receiving waters surrounding the Project;
- Adverse impacts associated with the release of contaminants in MAW;
- Impacts on flood levels at the Capricorn Highway and the Blackwater Railway upstream of the proposed rail loop and TLO facility; and
- Potential impacts of the Project on flood levels and flood velocities of Charlevue Creek and Springton Creek.

7.3.1 Project Water Availability

Raw water for the Project will be sourced from the Bedford Weir, which is part of the Nogoa-Mackenzie River pipeline network, via a spur pipeline from the Blackwater Pipeline (see Section 3.5.2 (Water Supply)). The site water balance model indicates that due to the relatively low water requirements of the CHPP, the mine site water requirements of the Project can largely be sourced from water collected within the SWMS under average rainfall conditions. During low rainfall periods, the reliance of water supply from the external pipeline is expected to increase.

Figure 47 demonstrates the raw water requirements from the pipeline based on the median model performance. Water requirements from the external pipeline are highest in the early Project stages. Under very dry conditions, the demand could reach 500 Ml/a, however, median demand for Year 1 is less than 100 Ml/a. During later years, accumulated stored pit and sediment dam water is sufficient to supply demands in all but the driest years.

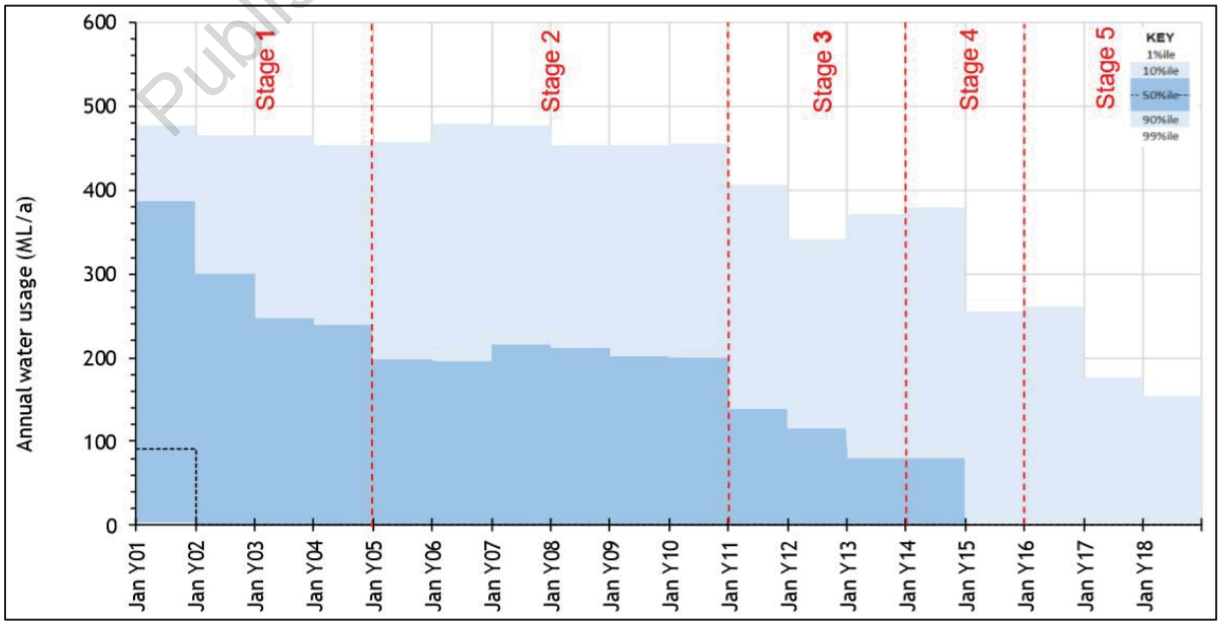


Figure 47 Raw water pipeline usage

7.3.2 Loss of Catchment Area

During operations, the Project will intercept runoff from disturbed areas of the mine site. The SWMS will capture runoff from areas that previously would have flowed to receiving waters of Springton Creek and Charlevue Creek, and therefore, the catchment areas will change with the development of the Project (Table 31). The maximum captured catchment areas at Year 18 represent:

- 1.0% of Charlevue Creek catchment upstream of the confluence with Springton Creek;
- 3.6% of Springton Creek catchment upstream of the confluence Charlevue Creek; and
- 2.3% of the total combined Springton Creek catchment area, downstream of the confluence with Charlevue Creek.

Table 31 Catchment intercepted by SWMS at Year 18

	Charlevue Creek Catchment	Springton Creek Catchment	Total Combined Catchment
	Upstream of Confluence		*Downstream of Confluence*
Total area intercepted by SWMS	336.9 ha	1,174.9 ha	1,511.8 ha
Total catchment area	32,243 ha	32,497 ha	64,740 ha
Proportion of catchment area intercepted by SWMS	1%	3.6%	2.3%

After mine closure, the SWMS will be decommissioned with some residual impact on streamflow due to surface water runoff to the final voids from some areas (Table 32). The maximum captured catchment area at mine closure consists of approximately:

- 0.03% of Charlevue Creek catchment upstream of the confluence with Springton Creek;
- 1.1% of Springton Creek catchment upstream of the confluence Charlevue Creek; and
- 0.6% of the total combined Springton Creek catchment area, downstream of the confluence with Charlevue Creek.

Table 32 Catchment intercepted by final void at mine closure

	Charlevue Creek Catchment	Springton Creek Catchment	Total Combined Catchment
	Upstream of Confluence		*Downstream of Confluence*
Total area intercepted by final void	10.0 ha	345.0 ha	355.0 ha
Total catchment area	32,243 ha	32,497 ha	64,740 ha
Proportion of catchment area intercepted by final void	0.03%	1.1%	0.6%

7.3.3 Impacts on Surface Water Quality

Land disturbance associated with mining has the potential to adversely affect the quality of surface runoff by increasing sediment loads and transporting contaminants from spoil and coal seams. However, with implementation of the SWMS, environmental risks resulting from disturbed area runoff are expected to be low.

MAW includes runoff from processing and coal stockpile areas, groundwater, and wastewater from the CHPP. This water will be contained in designated mine water dams onsite and will only be released in accordance with EA conditions.

Other runoff from disturbed areas, such spoil dumps, will be intercepted by sediment dams designed in accordance with the SWMS. Discharge from sediment dams directly into the receiving environment (after settlement of suspended sediments) would only occur during rainfall events. The discharge is expected to have insignificant impacts on water quality, as overburden runoff quality is expected to be relatively benign.

7.3.4 Mine Affected Water Releases

The results of the water balance modelling show no uncontrolled spills from the MAW system to receiving waters; as any unplanned overflows from mine water dams would overtop back into the pit. Additionally, the model results also show that the maximum modelled water level for both voids is well below the surface overflow level.

The release of MAW from the Project will occur in accordance with the *Model Mining Conditions* (DES 2017e) only; as set out in the EA. Relatively small volumes of water are expected to be released to Charlevue Creek, primarily due to the relatively low and infrequent flows in this waterway. Such release events would likely only occur post significant rainfall and flow within local catchments. Such conditions present opportunity for release without environmental harm, while reducing the risk of accumulating legacy water in the void.

The proposed EA conditions for water release are provided in Section 14.0 (Draft EA Conditions).

7.3.5 Post-mining Final Void Lakes

Pit AB and Pit C is proposed to be backfilled progressively during mining, with two final voids at the end of mining which will meet the rehabilitation objectives addressed in Section 4.3 (Rehabilitation Objectives). Key water inputs in the voids include rainfall on pit lake water surfaces, runoff from pit faces and rehabilitated upstream catchment areas and groundwater interception. Further information regarding the final void configuration will be addressed in Section 4.3.4 (Final Void) and Table 17.

The voids are intended to be partially backfilled to a level that prevents the interchange of water between the coal seams and the lakes, resulting in lower water levels and salinities than would otherwise be the case. Backfilling with waste rock material will elevate the void floor above the level of groundwater flows to prevent pit water transiting into any aquifers.

The final pit floor of Pit AB will be at an elevation of approximately 40 mAHD, which is 72 m below the natural surface elevation. Pit C final pit floor will be at an elevation of approximately 60 mAHD or approximately 60 m below the natural surface elevation. Final void modelling suggests that during the first 200 years after closure, lake salinities will be less than 10,000 mg/L. After 500 years salinity is conservatively modelled to increase to 30,000 mg/L, however, modelling is based on an assumption that salt levels in spoil leachate do not decline over time.

Final voids were modelled to remain as a groundwater sink and do not present a risk of overtopping. The maximum modelled water level for Pit AB is 57.6 mAHD, which is approximately 54 m below the void overflow level/natural surface elevation (112 mAHD). Similarly, the maximum modelled water level for Pit C is around 54.4 m below the void surface overflow level/natural surface elevation of approximately 128 mAHD.

7.3.6 Impacts on Flooding

As part of the *Flood Impact Assessment* (WRM 2019a), modelling was undertaken to determine the change in flood behaviour in Charlevue Creek, Springton Creek and its unnamed tributary during developed conditions. The results are as follows:

- The Project will temporarily increase Charlevue Creek flood levels immediately upstream of the proposed haul road crossing. In a 1% AEP flood event, these impacts are contained within the MLA (Figure 48).
- The works at Pit AB will increase flood levels in Springton Creek by up to 0.22 m in a 1% AEP flood (Figure 49). These impacts would extend off-lease onto land owned by Magnetic South, and reduce with distance downstream of the boundary;
- There will be localised off-lease impacts on flood levels in the unnamed tributary of Springton Creek immediately upstream of Pit AB and Pit C;
- The proposed rail loop will not have an impact on Charlevue Creek or Springton Creek flooding; and
- There will be no impact on flood levels at these waterways at Capricorn Highway, Blackwater Railway, or downstream of the Project.

Graphical representation of all modelled developed flood conditions, showing extent, depth and velocity are provided in Appendix B.

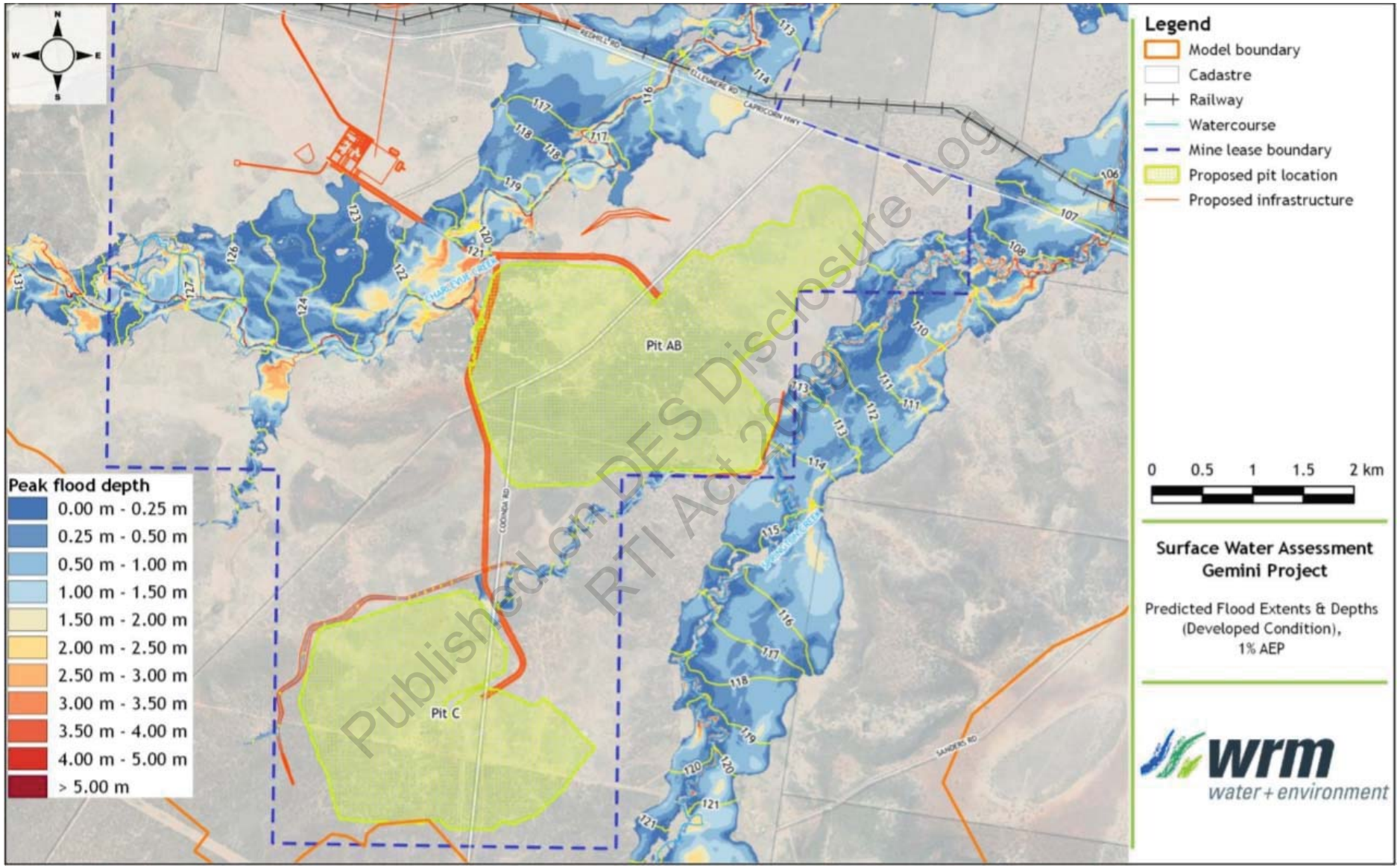


Figure 48 Predicted flood extent and depth for developed conditions (1% AEP)

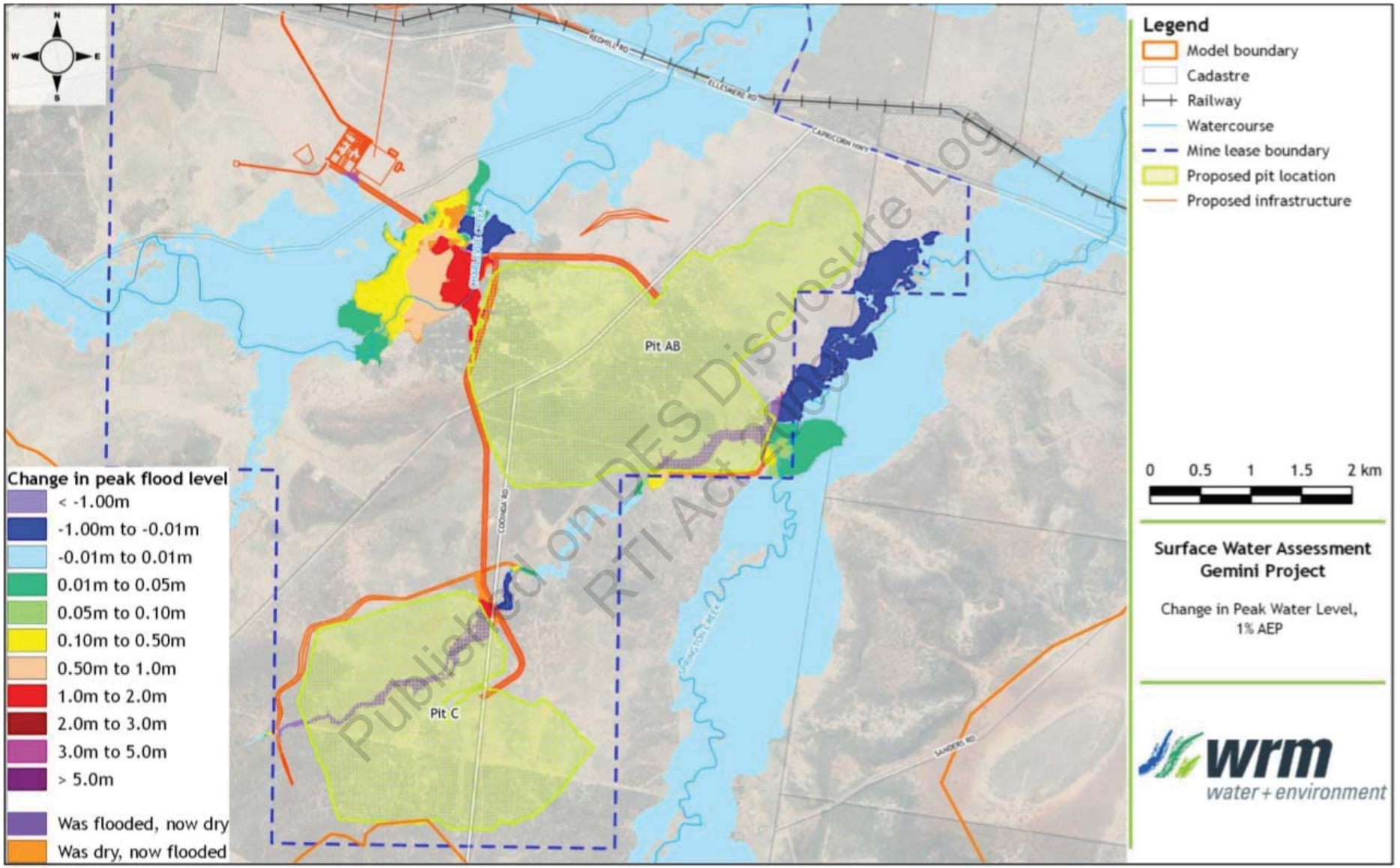


Figure 49 Change in peak flood level from the Project (1% AEP)

7.3.7 Cumulative Impacts

Bluff PCI Project, located approximately 12 km west of the Project, is the nearest operation to the Gemini Project, and also contributes to the Springton Creek catchment, downstream of both Projects (Figure 42). The Walton Coal Project is proposed within the same catchment. The Bluff PCI Project and Walton Coal Project are of relatively small scale and short mine life.

Water supply for the Bluff PCI Project and Walton Coal Project are to be partially sourced from the Jellinbah Mine. Therefore, the potential cumulative impacts of these projects on flows in Springton Creek will be minimal.

Waterways that traverse the Gemini Project eventually flow into the Mackenzie River, which is a major tributary within the Fitzroy River basin. The Fitzroy River basin is the largest catchment in Queensland; draining into the Pacific Ocean and also the largest catchment draining into the Great Barrier Reef. However, it does not contribute significant freshwater flows to the coastal environment when compared to river systems further north.

Potential impacts (increased sediment load and salinity) on the water quality of the Fitzroy River basin and the connecting tributaries in the catchment will be mitigated through the use of the SWMS, including sediment basins, progressive rehabilitation, spill controls, release controls and water quality monitoring.

Provided that uncontrolled and controlled releases from the three Projects are managed in accordance with respective EA conditions, the proposed management approach for mine water from the Gemini Project is expected to have negligible cumulative impact on surface water quality and associated environmental values.

Given the scale and nature of the three projects, cumulative impacts on flooding are not expected to lead to any adverse impacts on human populations, property or other environmental or social values.

7.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

The Proponent will establish a *Site Water Management Plan* (SWMP) in accordance with the EA conditions, with the objectives to develop a site water balance model and SWMS (detailed in Section 3.4.2 (Site Water Management System)), determine the source and nature of potential contaminants, and its potential impacts to the receiving environment. The SWMP will also define management actions to minimise the risks of environmental harm to receiving environment and outline contingency procedures for emergencies.

7.4.1 Site Water Management

The potential impacts on receiving water quality and downstream flow are to be managed by the SWMS, which are discussed in Section 3.4 (Site Water Management). This includes:

- Clean water drains to divert two sections of the unnamed tributary of Springton Creek around disturbed areas;
- Sediment water drains to divert water from overburden emplacement areas, and areas yet to be rehabilitated;
- Sediment water dams to store water from overburden emplacement areas and allow settlement of sediment loads before discharging treated water or recycling back to the CHPP;
- Mine water drains to divert water from MIA, CHPP and coal stockpile areas into the MAW system; and

- Mine water dams to store water pumped out of the pit, and capture water from the MIA, CHPP and coal stockpile areas.

7.4.2 Mine Affected Water Release

If any controlled releases are to occur, it would be in accordance with the EA conditions; consistent with the *Model water conditions for coal mines in the Fitzroy basin [ESR/2015/1561]* (DES 2013). The model conditions provided in this document are used as a basis for proposing specific water related protection commitments of EVs in the application documentation. The conditions include minimum flow and quality criteria and include commitments for monitoring during release events.

7.4.3 Flood Mitigation

The proposed mine operations and associated infrastructure are largely located outside of Charlevue Creek and Springton Creek flood inundation areas, as illustrated in Figure 48.

Flood management controls for the Project include construction of a temporary flood protection levee for Pit AB. The flood levee design will ensure that the mine void is outside the 0.1% AEP flood event as well as the PMF event during operations and at final landform. Design of the flood level is provided in Section 3.4.3.1 (Temporary Flood Protection Levee).

Clean water drains are also designed to divert clean water from the unnamed tributary of Springton Creek around disturbed areas; largely Pit AB and Pit C. The design of the drains will consider the principles set out in *Works that interfere with water in a watercourse for a resource activity – watercourse diversions authorised under the Water Act 2000 [OSW/2019/4599]* (DNRME 2019) guideline, despite the tributary not defined as a 'watercourse' under Water Act.

7.4.4 Receiving Water Monitoring

The *Aquatic Ecology Assessment* (AARC 2019a) (Appendix H) identified high turbidity and suspended solids in the existing receiving waters, therefore, the regional WQOs are not a reliable indicator of the local system's long-term health. Site-specific reference/baseline values will be developed after a period of monitoring to assess future local water quality data.

A REMP will be developed for the Project in accordance with the *Model Mining Conditions* (DES 2017e) to demonstrate compliance with the EA release conditions. The REMP will include collecting samples at downstream sites of the Project to compare to background data from upstream sites (Table 33).

The REMP will include a standard suite of water quality parameters including but not limited to; pH, EC, major anions (sulphate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids (TDS), and a broad suite of soluble metals/metalloids. Sediment and macroinvertebrate samples will also be collected along with visual records of vegetation and stream morphology.

Table 33 Receiving water monitoring points

Description	Location in relation to the Project	Latitude	Longitude
Springton Creek US	Upstream	-23.6976	149.2738
Springton Creek DS	Downstream	-23.6434	149.3145
Charlevue Creek US	Upstream	-23.6305	149.2715
Charlevue Creek DS	Downstream	-23.6469	149.2104

Notes: Coordinates relevant to GDA94.

7.4.5 Site Water Management System Monitoring

Onsite SWMS monitoring will be implemented to validate the SWMS performance against the design assumptions regarding water quality and water quantity. Monitoring will be specifically undertaken at the mine water dams and sediment dams. If required, adaptive management decisions will be undertaken where necessary to ensure protection of the surface water environment.

Mine Water Dam Monitoring

Any surface runoff and seepage water collected in mine water dams and the process water dam will be monitored for 'standard' water quality parameters including, but not limited to; pH, EC, major anions (sulphate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), TDS and a broad suite of soluble metals/metalloids.

Sediment Dam Monitoring

Monitoring of sediment dams will be used to validate the anticipated runoff quality reporting to sediment dams and haul road runoff dams. Initial monitoring will occur on a regular (e.g. monthly) basis to demonstrate the water quality of stored waters is consistent with the relevant operating parameters to allow releases from sediment dams to occur when required. Subject to demonstrating water quality is in accordance with the WQOs, the frequency of monitoring and suite of parameters for the sediment dam monitoring will be reviewed and updated accordingly when a release occurs.

8.0 GROUNDWATER

This section provides a description of the existing groundwater values within and surrounding the Project. It aims to identify the Project's potential impacts on the existing values and propose mitigation measures and management strategies to prevent or minimise adverse environmental effects.

This section is informed by the *Groundwater Impact Assessment* (JBT 2019) presented as Appendix C.

Surface water values has been discussed in Section 7.0 (Surface Water), and GDEs within Section 6.0 (Flora and Fauna), whilst groundwater inflows is discussed in Section 3.4.4 (Site Water Balance Model) and Section 4.0 (Rehabilitation and Closure).

8.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objective relevant to potential impacts to groundwater as described in the EA guideline for *Application requirements for activities with impacts to water [ESR/2015/1837]* (DES 2017c) is:

The activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems.

The Project would achieve one of the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation whereby:

1. *Both of the following apply:*

    (a) there will be no direct or indirect release of contaminants to groundwater from the operation of the activity; and

    (b) there will be no actual or potential adverse effect on groundwater from the operation of the activity; or

2. *The activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.*

8.2 DESCRIPTION OF ENVIRONMENTAL VALUES

The EPP (WWB) describes environmental values to be protected or enhanced in Queensland. The Project is located within the 'Mackenzie Groundwaters' region within the broader Fitzroy Basin. The environmental values identified on the *WQ1310 – Fitzroy Basin Groundwater Zones map* (EHP 2011b) for this region and their relevance to the Project are:

- **Aquatic ecosystems:** values that are potentially associated with groundwater include those that support GDEs and are discussed in Section 6.0 (Flora and Fauna).
- **Cultural & spiritual:** the groundwater that may be impacted by the Project is not known to have any cultural and spiritual value.
- **Industrial use:** the groundwater that may be impacted by the Project may be suitable for industrial purposes, however, other than coal mining, there is no known industrial users of groundwater.
- **Agricultural purposes:** groundwater use for agricultural purposes is limited to livestock and is discussed in Section 8.2.2 (Groundwater Quality).

- **Drinking water:** the groundwater that may be impacted by the Project is not known to be used as a drinking water supply due to its poor quality, as discussed in Section 8.2.2 (Groundwater Quality).

The values relevant to the MLA and surrounding area include

- Agricultural uses, where groundwater is extracted from surrounding agricultural bores; and
- Aquatic ecosystems, where shallow groundwater may support groundwater dependant ecosystems in some capacity.

The *Groundwater Impact Assessment* (JBT 2019) (Appendix C) describes site specific environmental values in detail. The following sections provide a summary.

8.2.1 Geology & Hydrogeology

The surface geology of the Project predominantly comprises sediments of the Tertiary Duaringa Formation and Quaternary alluvium associated with ephemeral creeks. The underlying Bowen Basin solid geology is illustrated in Figure 50, showing the Project location in relation to the underlying Triassic and Permian sediments, as well as the prevalence of regional-scale faults. The target mining areas are located where folding has brought the coal seams closer to the surface at economically mineable depths.

There are 48 registered bores (listed as 'existing' or 'abandoned but useable') within 10 km of the MLA, with the majority of bores screened within Tertiary units (26 bores) or the Permian coal measures (15 bores). Aquifer data and groundwater EC data from the Department of Natural Resources, Mines and Energy (DNRME) groundwater database is displayed in Figure 51, and detailed in Table 4-5 of Appendix C.

The Project comprises a groundwater monitoring bore network of 38 bores at 17 sites (Figure 52), with locations detailed in Table 4-1 of Appendix C.

Analysis of available monitoring data from these regional and local bore networks concludes that groundwater occurs within three main groundwater units at site, including:

- Quaternary alluvium associated with Charlevue Creek and Springton Creek;
- Tertiary sediments of the Duaringa Formation; and
- The Permian Rangal Coal Measures, where groundwater occurs preferentially within the coal seams.

A minor occurrence of Tertiary basalt has been identified from geological drilling to the north of Pit C. The area of basalt is approximately 600 m long, 200 m wide and 20 m thick and has been interpreted as a localised basalt paleochannel (JBT 2019). One groundwater monitoring bore has been located within the basalt (bore DW7105W1); the bore is 23 m deep and the basalt is dry at the bore location. The basalt flow is interpreted to be dry (as it is above the regional groundwater level) and of limited extent and is therefore not an important groundwater feature within the project area. Extensive geological drilling across the project area has shown no other evidence of basaltic flows or intrusions (JBT 2019).

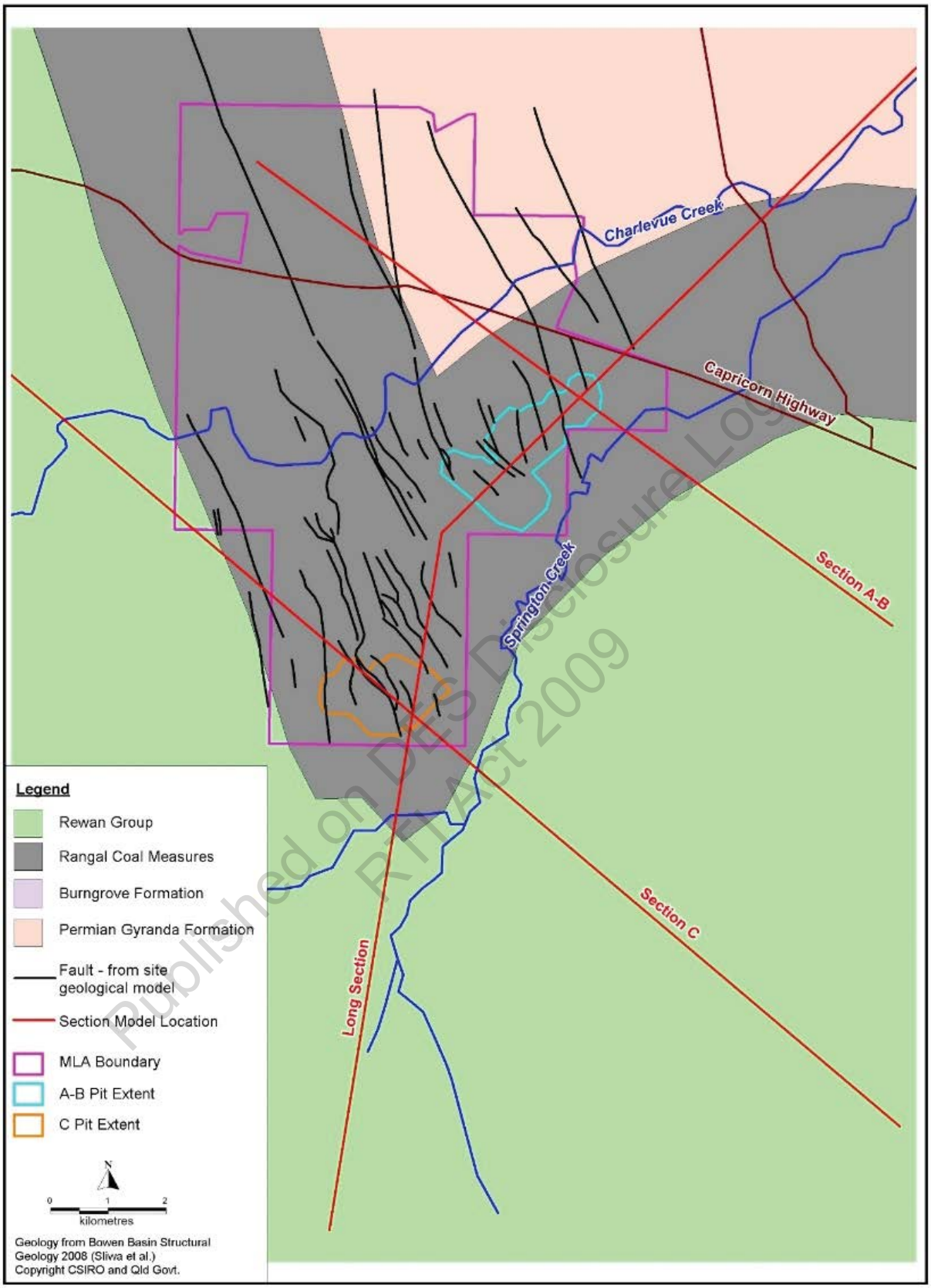


Figure 50 Project location and Bowen Basin solid geology

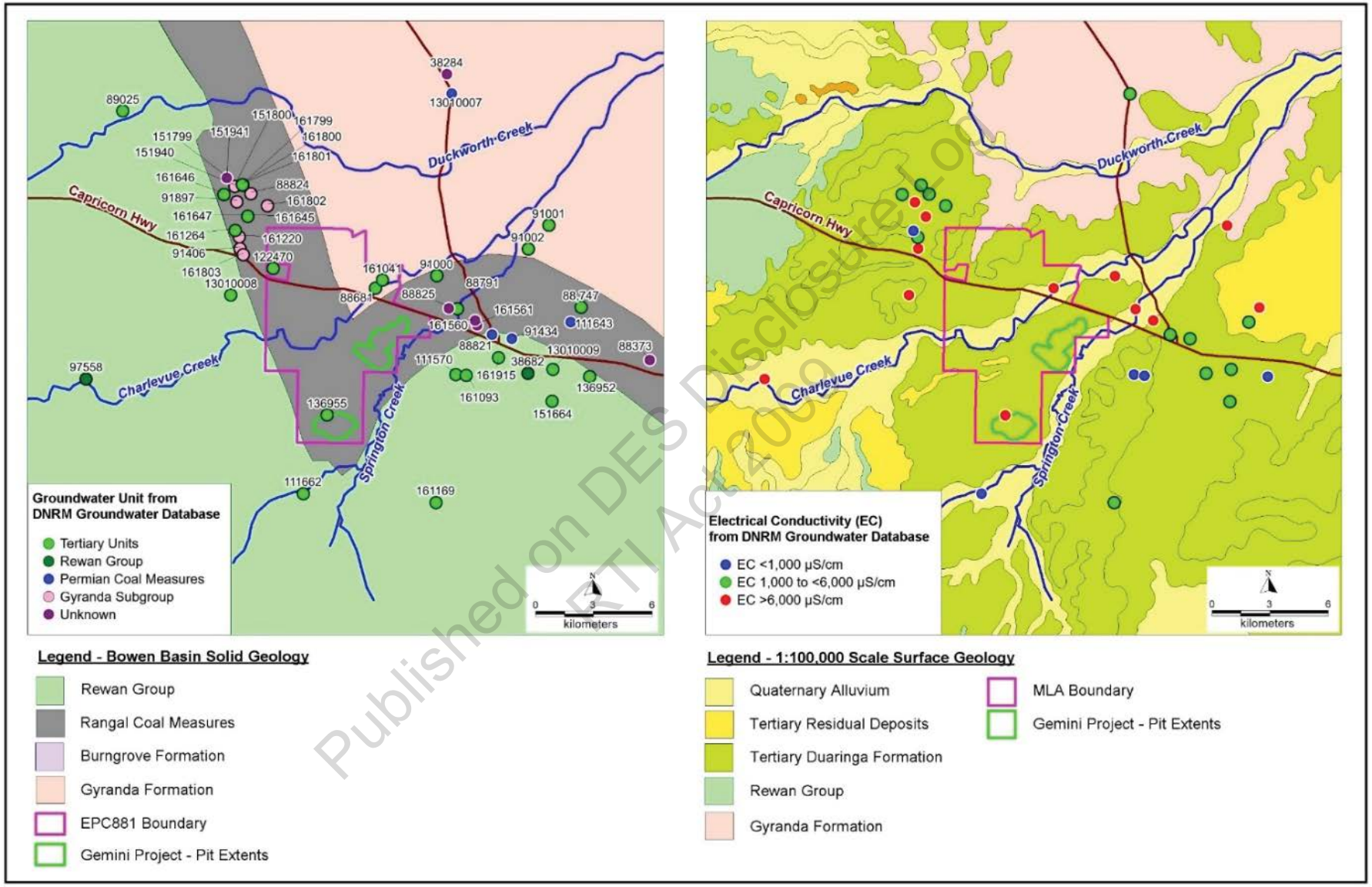


Figure 51 Aquifer data and groundwater EC data from DNRME groundwater database

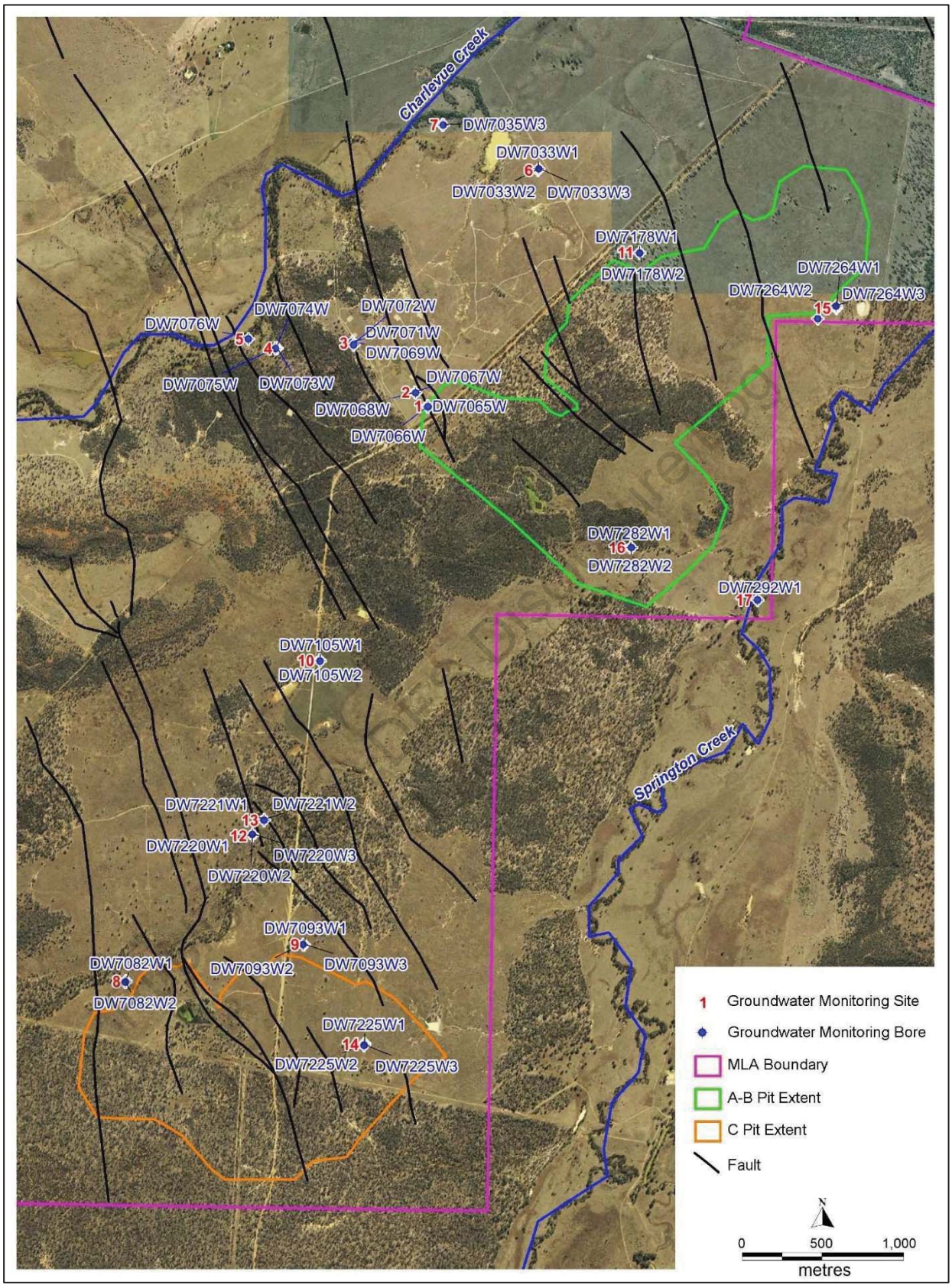


Figure 52 Gemini Project groundwater monitoring bore network

Detailed discussion of the installation and monitoring of the Project groundwater monitoring network can be found within Section 4.0 of Appendix C. Utilising data from the local and regional bore networks, an overview of the site-specific groundwater aquifers as described as follows. Characteristics of the aquifers are discussed in further detail in Section 8.2.2 (Groundwater Quality), Section 8.2.3 (Hydraulic Conductivity), and Section 8.2.4 (Groundwater Level).

Quaternary Alluvium

The Project has two monitoring bores within the Quaternary alluvium which is present within ephemeral waterways to the east and west of the mining areas (Springton Creek and Charlevue Creek, respectively). Recharge to alluvium is via direct rainfall recharge and occurs at a low rate. This is consistent with the observation of elevated salinity in the shallow sediments, likely due to the low rate of recharge, as well as high residence times for groundwater.

Tertiary Sediments

There are 26 registered bores in the region screened within Tertiary units and ten Project monitoring bores (one within Tertiary basalt); five of which are dry (including the Tertiary basalt bore). The presence of dry bores within the Tertiary, as well as a variation in water level between the topographically elevated base of Tertiary and topographically lower base of Tertiary, suggest that a continuous water surface does not exist in the Tertiary sediments and that the elevation of the base of Tertiary will be a control on the presence of groundwater within the sediments. From review of available data it is assessed that it is probable that the Tertiary sediments are dry above 120 mAHD and likely dry above 110 mAHD. The Tertiary sediments exhibit similar recharge and salinity characteristics to the Quaternary alluvium.

Permian Rangal Coal Measures

There are 15 registered bores in the region screened within Permian coal seams and 26 Project monitoring bores (including three within the overburden/interburden sediments); only one of which is dry (Aries seam). Within the Permian coal measures the coal seams are the primary conduits for groundwater flow with no significant trend for upward or downward movement of groundwater between the coal seams. However, a trend occurs for groundwater movement through the coal seams from the southwest to the northeast, and also from the northwest to the southeast, towards a depression that is centred on the area where Pit AB is proposed to be developed. The coal seams are recharged in subcrop areas where the coal seams directly underlay Tertiary and/or Quaternary sediments. The extremely high salinity of groundwater within the coal measures supports an interpretation of a low rate of recharge to these units.

8.2.2 Groundwater Quality

Regional Groundwater Quality

ANZECC and ARMCANZ (2000) outline a livestock drinking limit for salinity for beef cattle of 4,000 mg/L (equates to an approximate EC of 6,000 µS/cm). Bores that recorded a salinity in excess of this were assessed to be of limited or no use for stock watering.

The majority of bores within or close to the MLA recorded EC in excess of 6,000 µS/cm (refer to Table 4-5 in Appendix C). JBT (2019) noted that the EC of groundwater within the Tertiary sediments was often in excess of 10,000 µS/cm and at some sites in excess of 20,000 µS/cm (highly saline); which was consistent with groundwater quality data from the Project bore network. The majority of Tertiary bores outside the tenement area recorded an EC of < 6,000 µS/cm, with four bores in Tertiary sediments to the east or south of the project area recording an EC <1000 µS/cm (mostly fresh). There is potential these bores may be used for stock-watering purposes.

Local Groundwater Quality

Groundwater quality data is available for eight sampling events that occurred at approximately monthly intervals between December 2018 and August 2019. The results are presented in Appendix B of the *Groundwater Impact Assessment* (Appendix C) and have been summarised in Table 34.

Table 34 Summary of groundwater quality results from monitored bores

Groundwater unit		Field pH	EC (µS/cm)	Sulphate (mg/L)	Boron (mg/L)	Copper (mg/L)	Zinc (mg/L)
Quaternary alluvium	Range	7.05-7.49	15,200-6,600	204-249	0.56-4.56	0.002-0.023	0.007-0.028
	Mean	7.3	15,788	217	3.50	0.013	0.014
	Median	7.33	15,700	212	3.81	0.011	0.011
Tertiary sediments	Range	6.78-7.06	20,200-21,900	291-635	1.14-1.52	0.001-0.014	0.017-0.096
	Mean	6.93	20,843	367	1.28	0.004	0.049
	Median	6.94	20,800	334	1.26	0.003	0.035
Coal seams	Range	6.21-6.84	22,100-28,500	341-841	0.88-1.49	0.001-0.081	0.025-0.21
	Mean	6.44	25,693	622	1.23	0.011	0.086
	Median	6.42	25,600	642	1.25	0.003	0.075

All groundwater units (Quaternary alluvium, Tertiary sediments and Permian coal measures) recorded very high EC above the ANZECC and ARMCANZ (2000) livestock drinking limit for beef cattle of approximately 6,000 µS/cm. Salinity increases with aquifer depth, and it is unlikely that groundwater units within the Project are used for stock watering. A single field value from bore DW7292W1 (Springton Creek alluvium) recorded an EC of 5,948 µS/cm. Due to the high salinity of the groundwater, samples were also relatively high in sulphate, especially for the coal seams.

Groundwater quality was typically above the ANZECC and ARMCANZ (2000) freshwater ecosystem protection trigger value (95% species protection) for boron (all samples), copper and zinc (majority of samples) as well as aluminium, arsenic, lead and nickel (a number of samples for each analyte).

The pH (field testing) of groundwater within the Project area was mostly neutral, with the Quaternary alluvium ranging from 7.05 to 7.49; the Tertiary sediments ranging from 6.78 to 7.06; and the Permian coal seams ranging from 6.21 to 6.84.

8.2.3 Hydraulic Conductivity

Falling head tests were undertaken on 25 bores from the Project bore network to obtain site-specific hydraulic conductivity data from all Project groundwater units. Hydraulic conductivity and air-lift yield data for each monitoring bore is in Table 4-2 of Appendix C (JBT 2019) and summarised for each groundwater unit in Table 35.

A total of 17 slug tests were performed on bores that are screened within the coal seams. The hydraulic conductivity decreased with depth with the difference evident when comparing coal seam bores screened at a depth of less than 80 mbgl to bores screened at a depth greater than 80 mbgl.

Table 35 Hydraulic conductivity and air-lift yield data per groundwater unit

Groundwater Unit	No. of Tests	Hydraulic Conductivity (m/day)			Average Air-lift Yield (L/s)
		Min	Max	Geometric Mean	
Quaternary Alluvium	1	0.097	-	-	-
Tertiary	5	0.027	3.805	0.27	0.548
Permian Coal Seams	17	0.002	5.387	0.13	1.185
Coal Seams <80 mbgl	11	0.012	5.387	0.37	1.578
Coal Seams >80 mbgl	6	0.002	0.245	0.02	0.320
Permian Interburden	2	0.001	0.002	-	-

The relationship between hydraulic conductivity and depth is shown graphically in Figure 53. Of particular interest is the data for the coal seam bores, where the trend for lower hydraulic conductivity with increasing depth is illustrated via the trend line and the 95% confidence interval that has been applied to the data.

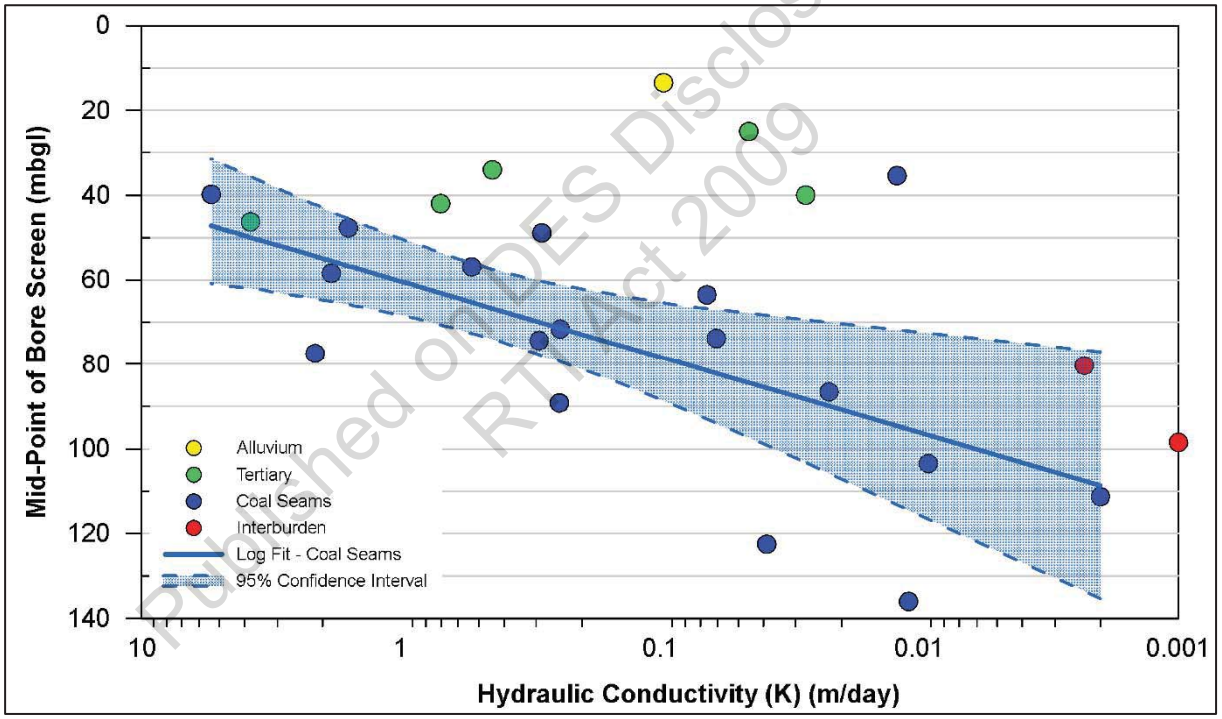


Figure 53 Relationship between hydraulic conductivity and depth

8.2.4 Groundwater Level

The most recent groundwater level data for the Project monitoring network bores is detailed in Table 4-1 of Appendix C. Figure 54 and Figure 55 illustrate water level data for Tertiary and coal seam groundwater units, respectively.

Six of the monitoring bores were dry; five within Tertiary sediments (depth: 14 m to 23 m) and one within the Aries seam (depth: 31.6 m).

Of the five dry sites; two were drilled to base of Tertiary, indicating that the Tertiary is dry at these locations, whilst the other three were not constructed to the full depth of Tertiary sediments. There was a significant reduction in depth to base of Tertiary to the west and north-west of Pit AB, where the base of Tertiary lowers from approximately 100 mAHD to 70-80 mAHD. The bores within the lower elevation area of base of Tertiary tended to record water levels in the order of 90 to 95 mAHD, whereas the bores in the higher elevation area tended to range between 105 to 113 mAHD.

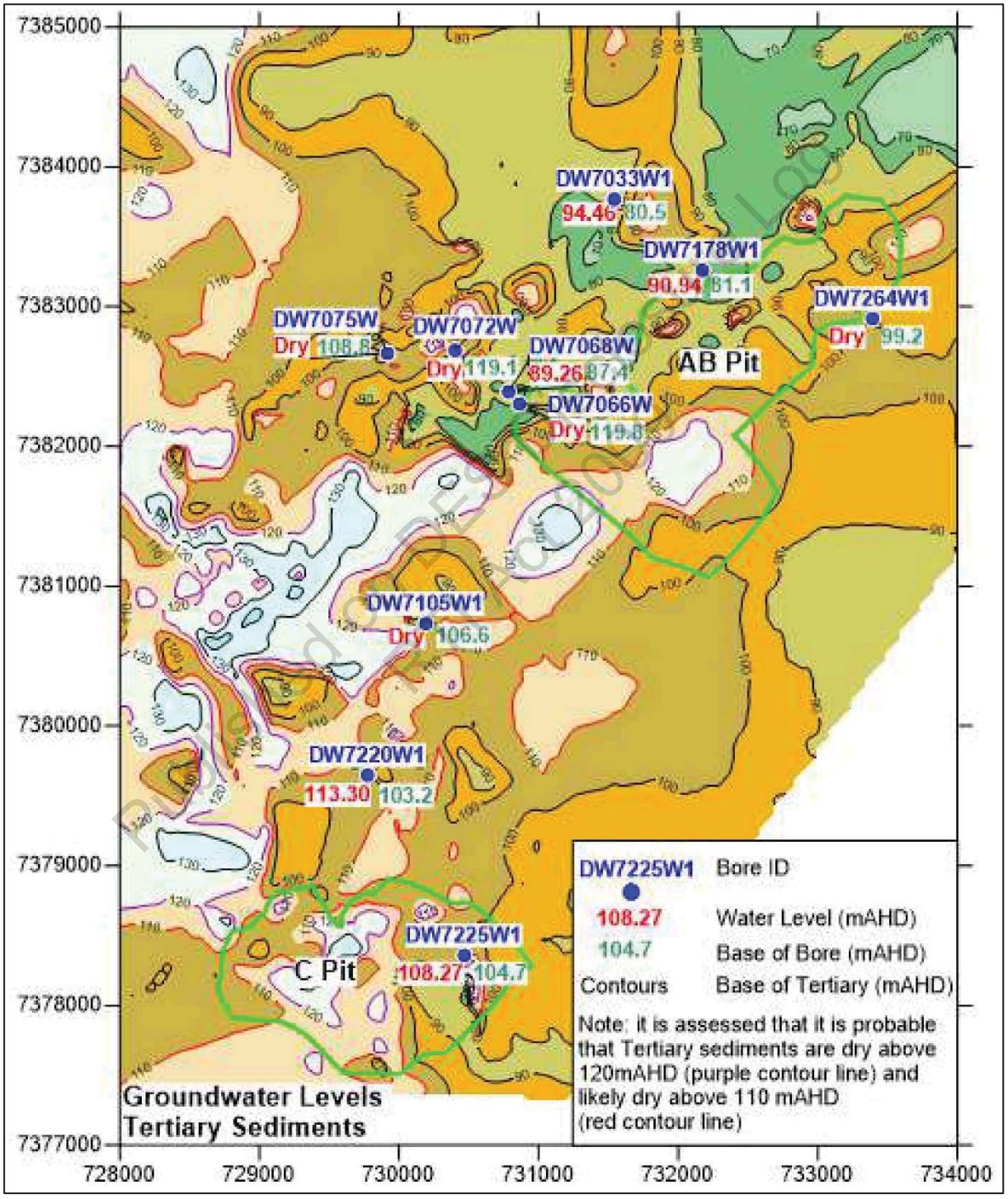


Figure 54 Water level data for Tertiary groundwater units

The data for bores within the coal seams suggest that the coal measures are continuously saturated and that there is no significant trend for upward or downward movement of groundwater between the coal seams. Figure 55 shows the pre-mining groundwater level contours for the coal measures; indicating a trend for groundwater movement within the coal seams from the southwest to the northeast, and also from the northwest to the southeast, towards a depression that is centred on the area where Pit AB is proposed to be developed.

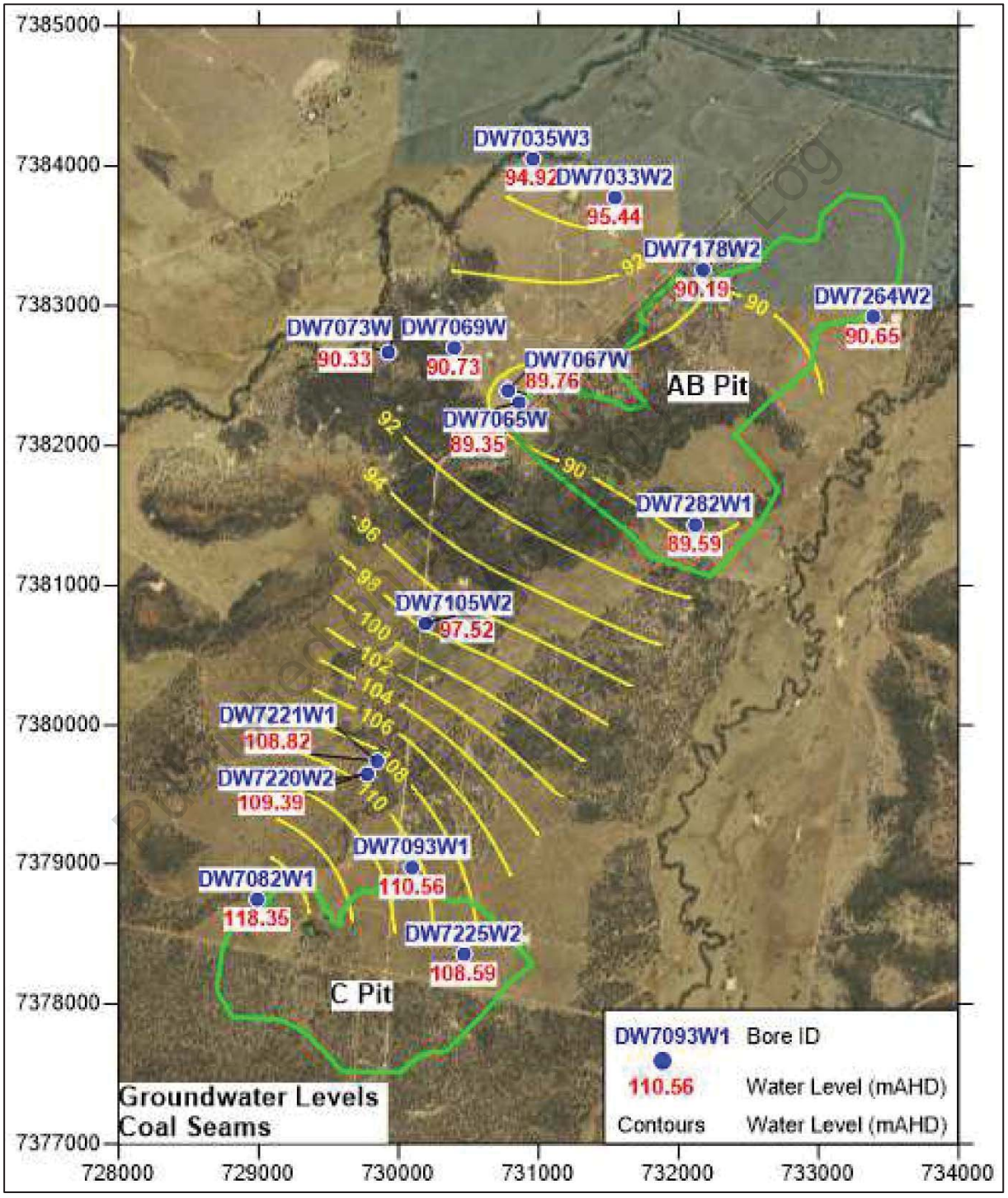


Figure 55 Water level data for coal seam groundwater units

Bore DW7076W is located adjacent to Charlevue Creek (refer Figure 52) and screened in the Quaternary alluvium. The bore has been fitted with a data logger that records water level at 3-hourly intervals which will allow the relationship between creek flow and water level to be established over time. To date, the water level has been relatively stable, displaying a slight downward water level trend between 9-10 mbgl. It is currently uncertain whether the reduction in water level is related to the ongoing removal of groundwater from the bore during sampling events, with the downward spike in water level following sampling being evident in the bore hydrograph (Figure 56). Further data will continue to be collected to establish the long-term water level trend.

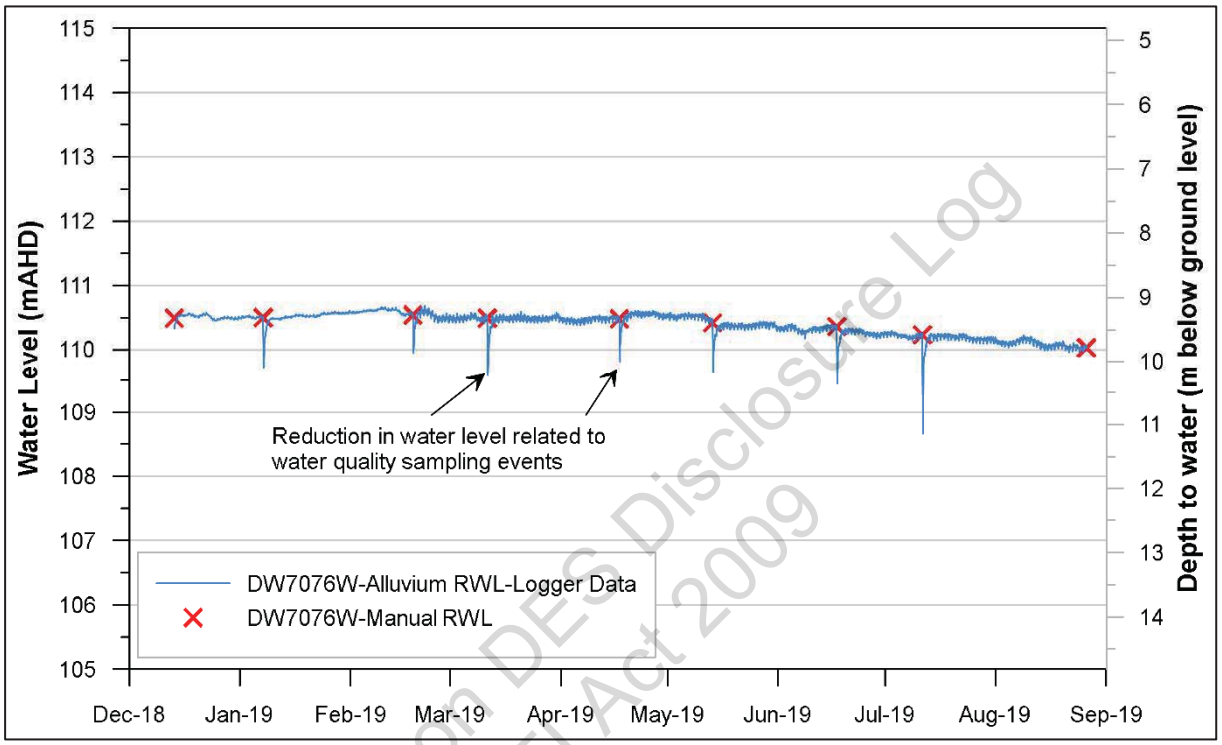


Figure 56 Water level data for Quaternary alluvium (Bore DW7076W)

8.3 POTENTIAL IMPACTS

The proposed mining activity has potential to impact groundwater values of the Project via either:

- A drop in surrounding groundwater level occurring as a result of drawdown from the mining activity. The change in water level has potential to reduce the availability of water in existing groundwater bores. In addition, the drop in groundwater level may also reduce available supply for potential groundwater dependant ecosystems, where they exist within the zone of influence.

- The mining activity presents an increased risk of groundwater contamination either via spills or leaks that might occur during the operation and have potential to seep to shallow aquifers, or in the post mining landform, subject to the final void equilibrium level and the associated risk of water in the void seeping in surrounding aquifers.

It is noted that the risk of groundwater drawdown from the project is limited to the take of Associated Water only. Groundwater is not proposed to be extracted as a source of water for any other related activity. The total predicted take of associated water is detailed in Table 36 (JBT 2019; JBT 2019, pers. comm., 8 October). For the purpose of future associated water reporting, JBT (2019) concluded that it

would be more reasonable to assume the rate of inflow prior to development of the spoil aquifer, (approximately ~500 m^3/day) as the water that is developed from the spoil is derived mainly from rainfall recharge to the spoil and does not represent water from the natural formation. It is estimated that annual take of associated will range from 150 Ml/a to 345 Ml/a.

Table 36 Estimated take of associated water

Year	Pit AB		Pit C		Total
	m^3/day	Ml/a	m^3/day	Ml/a	Ml/a
1	626	228	0	0	228
2	626	228	0	0	228
3	433	158	0	0	158
4	433	158	0	0	158
5	508	185	0	0	185
6	508	185	0	0	185
7	946	345	0	0	345
8	946	345	0	0	345
9	493	180	0	0	180
10	493	180	0	0	180
11	493	180	0	0	180
12	493	180	121	44	224
13	493	180	121	44	224
14	493	180	241	88	268
15	453	165	241	88	253
16	453	165	239	87	253
17	248	91	239	87	178
18	248	91	163	59	150

The *Groundwater Impact Assessment* (JBT 2019; Appendix C) was undertaken to assess the impacts of the Project. The following sections provide a summary of impacts relating to groundwater drawdown and the risk of contamination.

The potential for impacts of the Project on GDEs is described within Section 6.0 (Flora and Fauna). The potential impacts associated with final void water levels are described in more detail within Section 4.0 (Rehabilitation and Closure).

8.3.1 Groundwater Model

To estimate the extent of water level impact from the proposed project, the *Groundwater Impact Assessment* (JBT 2019) (Appendix C) utilised 2-dimensional seepage modelling using the program Seep/W.

Section 5.0 of Appendix C details the essential elements of the conceptual model used to inform the Seep/W numerical model. The choice of the numerical model code was based on an assessment of the model platform and appropriate to the study requirements (assessment details in Section 6.1 of Appendix C). Sections 6.2 through to 6.5 (of Appendix C) present technical details of model inputs, whilst Section 6.7 details the uncertainty analysis.

8.3.2 Assessment Criteria

Criteria against which groundwater drawdown was assessed is based on the 'bore trigger thresholds' for the Queensland Water Act. A 'bore trigger threshold' as defined under section 362 of the Act; is a decline in the water level in the aquifer that is:

(a) the prescribed threshold for the area (if a regulation prescribes the bore trigger threshold for an area in which the aquifer is situated); or

(b) otherwise:

(i) for a consolidated aquifer – 5 m; or

(ii) for an unconsolidated aquifer – 2 m.

The potential for impact on existing groundwater users is discussed in Section 8.3.4 (Impacts on Existing Groundwater Users), whilst the potential for water level impact on GDEs is discussed in Section 6.0 (Flora and Fauna).

8.3.3 Modelling Results

Water Quality

Modelling predicted that a permanent cone of depression will develop, directing groundwater flow towards the final voids. Therefore, the risk of the Project impacting on water quality (via outflow to the groundwater system) was assessed to be low.

It was, however, assessed that the Project could impact groundwater quality if the water within the final void were able to exit the void via unconsolidated sediments (i.e. the base of Tertiary) and flow via the groundwater system towards sensitive environmental receptors such as Springton Creek. For this reason, an assessment of the potential for water within the final voids to exit the void via the base of Tertiary sediments was undertaken. This assessment concluded that there is no outlet via the base of Tertiary for water within the final void of either Pit AB or Pit C, for either the maximum 'base case' water level or the maximum 'high inflow case' water level. It is concluded that there is a low risk of the Project impacting on groundwater quality.

Groundwater Level

The modelled drawdown extent at the end of mining is shown in Figure 57, and at post-mining equilibrium (i.e. steady-state post-mining drawdown) in Figure 58. The contours are shown as drawdown extent based on extrapolation of data points from each of the cross-section models (as depicted on Figure 57 and Figure 58).

At the end of mining, the 5 m drawdown extent is approximately 2 km from Pit AB and 1.8 km from Pit C, on the western side of the mining areas. On the eastern side, the 5 m extent is approximately 2 km from both Pit AB and Pit C. The 5 m extent of drawdown is approximately 1 km from Pit C at the southern end of the mining area, and approximately 2 km from Pit AB at the northern end. The 2 m drawdown contour extends approximately a further 1 km, than the 5 m drawdown extent.

At post-mining equilibrium, the 5 m drawdown extent is approximately 2 km further from Pit C at the southern side and 2 km further from Pit AB at the northern end of the mining area, than at end of mining. The drawdown contours also extend further to the east and west another approximately 2.5 km.

There are no mining operations within the zone of predicted drawdown from mining at the Gemini Project; therefore there are no cumulative impacts to assess.

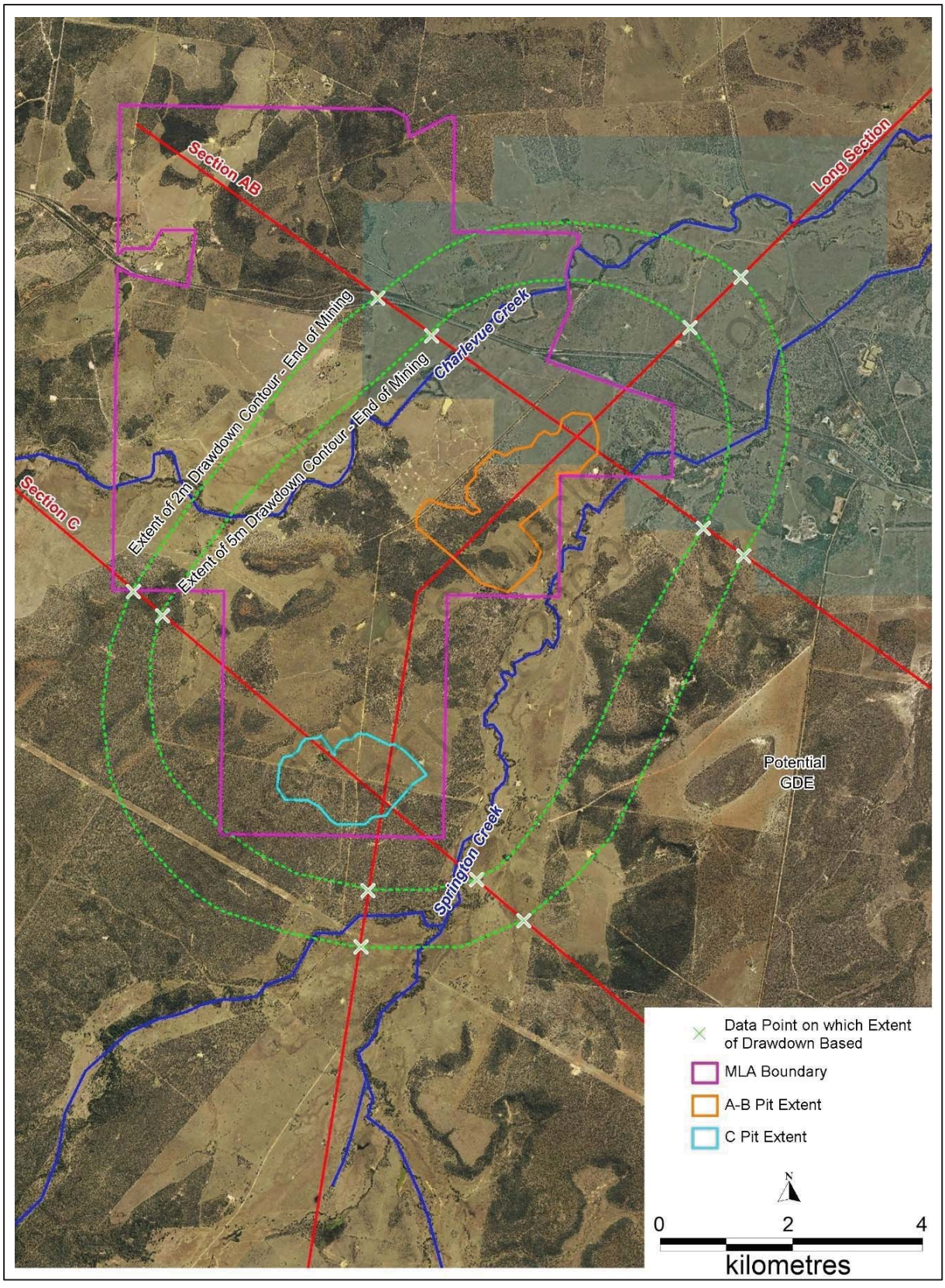


Figure 57 Water level drawdown contours (2m and 5m) at end of mining

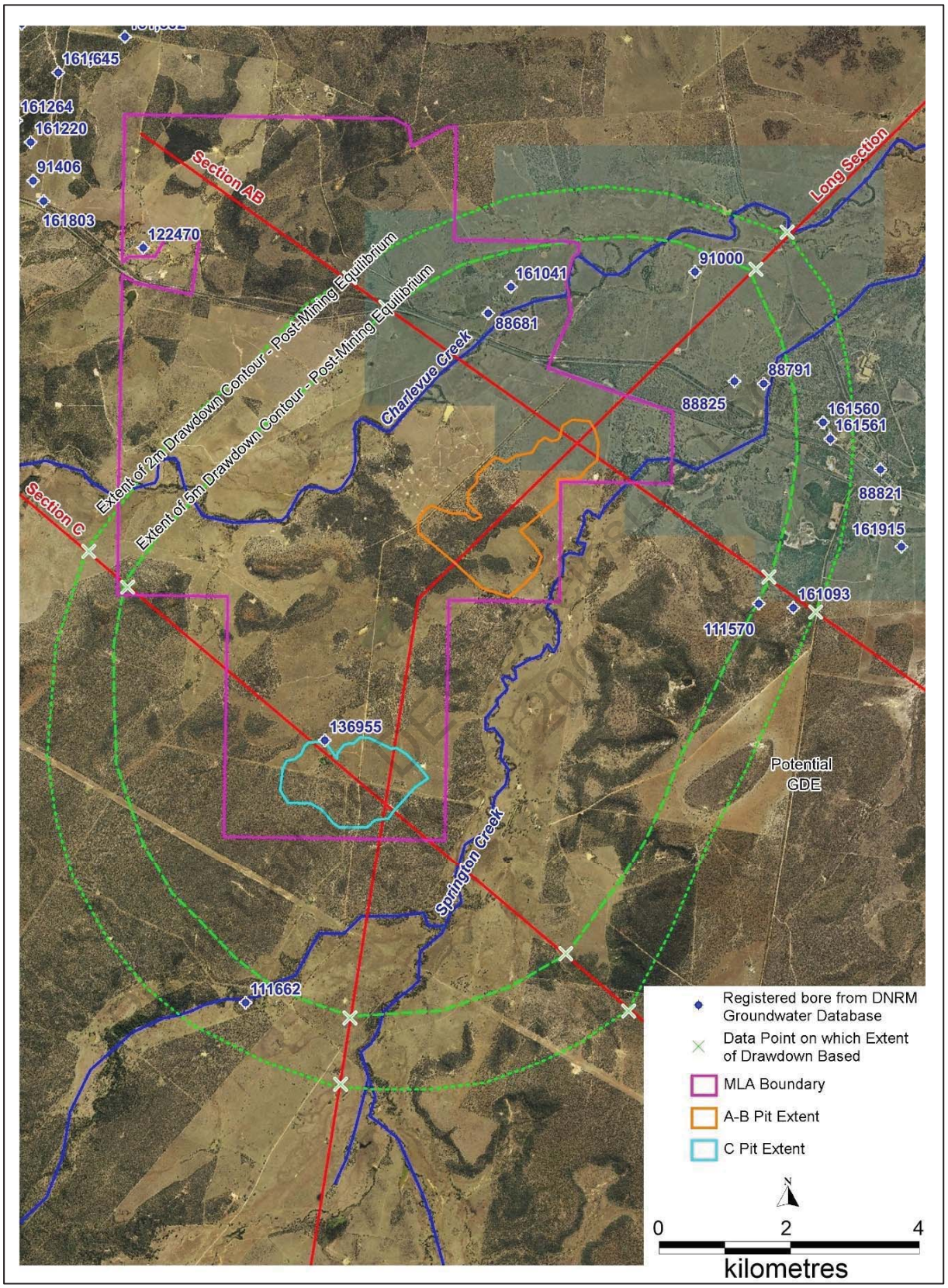


Figure 58 Water level drawdown contours (2m and 5m) at post-mining equilibrium

8.3.4 Impacts on Existing Groundwater Users

Groundwater Level

Figure 57 (end of mining) and Figure 58 (post-mining equilibrium) show 11 registered groundwater bores (from the DNRME groundwater database) within the 2 m drawdown zone. Summary data for the bores within this zone are shown in Table 37 and summarised as follows:

- Two bores (111662 and 136955) are located on land that is owned by Magnetic South;
- Two bores (161560 and 161561) appear to be monitoring bores for the Dingo Landfill;
- Three bores record groundwater that is highly saline and assessed to be of no beneficial use (in excess of the upper limit of salinity tolerance for beef cattle, sheep, horses and pigs with no loss of production, with a decline in animal health at progressively higher salinity values (ANZECC and ARMCANZ 2000). These bores recorded EC values of 10,000 µS/cm (88681), 19,200 µS/cm (88791) and 14,660 µS/cm (91000);
- Two bores (88825 and 161041) are sites with relatively little available data, but which are located within the zone of potential impact to the northeast and west-northwest of AB Pit respectively; and
- Two bores (111570 and 161093) recorded relatively fresh groundwater (<1,000 µS/cm) at shallow depth. While these bores are located within the extent of 2 m drawdown, they were assessed to be isolated from the regional groundwater system as discussed in detail with relation to GDEs in Section 7.2.1 of Appendix C. At these sites it is noted that they are not located within the zone of potential impact at end of mining but are within the zone of potential impact at post-mining equilibrium.

Based on the assessment of bores within the zone of influence, it is unlikely that the Project will significantly impact on the availability of groundwater for agricultural land use.

Where there is remaining uncertainty over the presence, or the productive use of bores within the zone of influence, further assessment in the form of a bore plan and assessment will be undertaken prior to development. It is further noted that make-good agreements will be put in place where it is determined that drawdown affects the utility of the bore.

Water Quality

Considering the mining activity is predicted to result in a permanent cone of depression, and the lack of an outlet via the base of Tertiary for water within the final void of either Pit AB or Pit C, it was concluded that the risk of significant groundwater contamination was very low.

The risk of spills or leaks causing contamination is assessed to be manageable and unlikely to result in environmental harm.

Table 37 Bores from DNRME groundwater database within 2 m drawdown zone

RN	Aquifer	EC (µS/cm)	SWL (mbgl)	Original Bore Name	Comment
88681	Duaringa Formation	10,000	-	-	Extremely saline - no beneficial use based on water quality.
88791	Duaringa Formation	19,200	-20	New Bore	Extremely saline - no beneficial use based on water quality.
88825	Unknown	-	-	Windmill	-
91000	Duaringa Formation	14,660	-20	Mackenzie OLO	Extremely saline - no beneficial use based on water quality.
111570	Tertiary-Undefined	240	-16	Ward	Refer to Appendix C (Section 7.2.1) for discussion.
111662	Tertiary-Undefined	750	-17	Smith	Located on land owned by Magnetic South.
136955	Tertiary-Undefined	10,300	-21	-	Located within MLA on land owned by Magnetic South.
161041	Duaringa Formation	-	-29	-	-
161093	Tertiary Mafic Volcanics	710	-19.5	-	Refer to Appendix C (Section 7.2.1) for discussion.
161560	Unknown	28,102	-	Dingo Landfill MW2	Assumed to be a monitoring bore at Dingo Landfill.
161561	Unknown	-	-	Dingo Landfill MW1	Assumed to be a monitoring bore at Dingo Landfill.

Notes: RN registration number
SWL surface water level

8.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

Overall, the *Groundwater Impact Assessment* (JBT 2019) concluded that there is a low risk the Project would impact on groundwater quality, groundwater level or potential GDEs. The management and monitoring strategies, will ensure groundwater resources are managed and risk remains low. Magnetic South is committed to implementing procedures for monitoring and complaints resolution to control magnitude of risk.

Impacts and mitigation measures for protection of potential GDEs is discussed in detail within Section 6.0 (Flora and Fauna).

Associated Water Take

Monitoring and annual reporting of associated water take will be in accordance with the requirements of the MR Act.

Landholder Bores

Magnetic South will prepare an *Underground Water Impact Report* (UWIR) for submission and approval in accordance with the Water Act. The report will identify aquifers that are predicted to be impacted by the exercise of underground water rights; establish obligations to monitor impacts on aquifers and springs; impose a strategy to mitigate impacts on any spring of interest; assist with management of impacts of the exercise of water rights by resource tenure holders; and establish underground water obligations (make good obligations of the resource tenure holder for private water bores.

Where it has been determined that an impact on landholder bores exists, a *Baseline Assessment Plan* will be prepared (as required by the Water Act) identifying water bores located on a holder's tenure and setting out a timetable for undertaking baseline assessments of those bores.

If required, bore assessments and 'make good agreements' will be established (in accordance with the Water Act) with any relevant stakeholders.

Groundwater Monitoring and Evaluation Program

The Project groundwater monitoring bore network established for the baseline studies will continue to be monitored throughout operation and decommissioning.

This program will record groundwater levels and water quality from existing monitoring bores to provide long term groundwater level data from the Project area, and to detect and quantify potential drawdown occurring during and post mining.

Bores within the alluvium are targeted for monitoring via water level dataloggers to allow assessment of the range of seasonal water level variation at these sites. It is noted that a data logger is already fitted to bore DW7076W and that it is planned to install a logger in bore DW7292W1.

A summary of the groundwater monitoring bores to be included in the monitoring program is provided in Table 38.

Table 38 Groundwater monitoring bores

Site	Bore ID	Easting	Northing	Bore Depth (m)	Unit Monitored
1	DW7065W	730860	7382307	77.27	Permian Coal Seams (Aries 3)
	DW7066W	730863	7382304	17.35	Tertiary sediments
2	DW7067W	730781	7382394	100.14	Permian Coal Seams (Aries 3)
	DW7068W	730785	7382391	47.5	Tertiary sediments
3	DW7069W	730397	7382699	71.38	Permian Coal Seams (Pollux Upper Seam)
	DW7071W	730394	7382703	31.59	Permian Coal Seams (Aries 3)
	DW7072W	730403	7382687	14.01	Tertiary sediments
4	DW7073W	729926	7382666	82.1	Permian Coal Seams (Castor/Pollux Seams)
	DW7074W	729922	7382666	55.78	Permian Coal Seams (Castor Upper Seams)
	DW7075W	729918	7382666	14.03	Tertiary sediments
5	DW7076W	729750	7382723	12	Quaternary alluvium
6	DW7033W1	731543	7383768	45.23	Tertiary sediments
	DW7033W2	731546	7383773	74.77	Permian Coal Seams (Orion 5)

Site	Bore ID	Easting	Northing	Bore Depth (m)	Unit Monitored
	DW7033W3	731548	7383777	81	Permian Coal Seams (Interburden)
7	DW7035W3	730957	7384050	48.47	Permian Coal Seams (Orion 1)
8	DW7082W1	728989	7378746	40.58	Permian Coal Seams (Castor Lower Seam)
	DW7082W2	728986	7378742	59.17	Permian Coal Seams (Pollux Upper Seam)
9	DW7093W1	730096	7378974	87.3	Permian Coal Seams (Pollux Lower Upper Seam)
	DW7093W2	730092	7378973	99.2	Permian Coal Seams (Interburden)
	DW7093W3	730088	7378974	123.25	Permian Coal Seams (Pollux Lower Lower Seam)
10	DW7105W1	730192	7380733	23.04	Tertiary sediments (Basalt)
	DW7105W2	730193	7380729	69.25	Permian Coal Seams (Pollux Lower Upper Seam)
11	DW7178W1	732174	7383260	51.15	Tertiary sediments
	DW7178W2	732174	7383256	58.69	Permian Coal Seams (Pollux Lower Upper Seam)
12	DW7220W1	729775	7379648	26.5	Tertiary sediments
	DW7220W2	729775	7379651	38.4	Permian Coal Seams (Castor Seam)
	DW7220W3	729774	7379655	75.08	Permian Coal Seams (Pollux Lower Upper Seam)
13	DW7221W1	729846	7379745	50.43	Permian Coal Seams (Aries 3)
	DW7221W2	729845	7379742	72.36	Permian Coal Seams (Castor Seam)
14	DW7225W1	730467	7378359	37	Tertiary sediments
	DW7225W2	730466	7378355	78.9	Permian Coal Seams (Aries 3)
	DW7225W3	730465	7378351	112.8	Permian Coal Seams (Castor Seam)
15	DW7264W1	733392	7382915	14	Tertiary sediments
	DW7264W2	733391	7382921	104.21	Permian Coal Seams (Aries 1)
	DW7264W3	733391	7382925	136.7	Permian Coal Seams (Aries 3)
16	DW7282W1	732119	7381433	43.03	Permian Coal Seams (Overburden)
	DW7282W2	732123	7381433	89.91	Permian Coal Seams (Aries 3)
17	DW7292W1	732905	7381108	15	Quaternary alluvium

9.0 AIR QUALITY

This section provides a description of existing air quality within and surrounding the Gemini Project. It aims to predict any changes in air quality as a result of the Project and propose mitigation measures and management strategies.

The *Air Quality and Greenhouse Gas Assessment* (Katestone 2019) provided in Appendix I has been conducted to determine the likely impacts of the Gemini Project on airborne concentrations and dust deposition rates. Particulates considered in this assessment are:

- Total suspended particulate matter (TSP);
- Particulate matter with equivalent aerodynamic diameters of 10 µm or less (PM_{10}); and
- Particulate matter with equivalent aerodynamic diameters of 2.5 µm or less ($PM_{2.5}$).

9.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objective relevant to potential impacts to air, as described in the EA guideline for *Application requirements for activities with impacts to air [ESR/2015/1840]* (DES 2017a) is:

The activity will be operated in a way that protects the environmental values of air.

The Project would achieve all of the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

(a) Fugitive emissions of contaminants from storage, handling and processing of materials and transporting materials within the site are prevented or minimised;

(b) Contingency measures will prevent or minimise adverse effects on the environment from unplanned emissions and shut down and start up emissions of contaminants to air; and

(c) Releases of contaminants to the atmosphere for dispersion will be managed to prevent or minimise adverse effects on environmental values.

9.2 DESCRIPTION OF ENVIRONMENTAL VALUES

In accordance with the *Environmental Protection (Air) Policy 2019* (EPP (Air)) the environmental values pursuant to air quality to be enhanced or protected include:

- The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems;
- The qualities of the air environment that are conducive to human health and wellbeing;
- The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and
- The qualities of the air environment that are conducive to protecting agricultural use of the environment.

9.2.1 Land Use

The Project and surrounding area is currently used predominately for cattle grazing with most of the area cleared of remnant vegetation for agricultural purposes.

To the east of the Project lies Dingo, a small town of approximately 450 people, and includes residences, sporting facilities (sports oval, tennis courts), a primary school, and local businesses (Post Office, hotel, shops, etc.).

Figure 59 illustrates the area considered in the air quality assessment of the Project with context through contours in AHD. The study area covers approximately 400 km^2 and extends beyond the borders of the MLA in order to assess the potential impact of the Project on the air quality of the wider community.

9.2.2 Sensitive Receptors

A desktop assessment identified potential sensitive receptors within and surrounding MLA. Sensitive receptors considered in the assessment are presented in Figure 60 and Table 39, encompassing residences, businesses, and recreational areas within 5 km of the MLA boundary.

At the time of submission, Magnetic South was the landowner of Lot 2 on Plan HT138, on which sensitive receivers SR19, SR20 and SR21 are located, and Lot 3 on Plan HT139, on which SR14 is located. Discussions between Magnetic South and landowners of other properties located within and adjacent to the MLA are ongoing.

9.2.3 Climate and Wind Characteristics

Meteorological modelling was used to generate wind speed and direction inputs for the impact assessment as described in Appendix A of the *Air Quality and Greenhouse Gas Assessment* (Katestone 2019) (refer Appendix I). The local meteorological conditions relating to the Project are described in Section 2.2 of this document.

9.2.4 Existing Air Quality

Existing Sources of Emissions

Ambient dust levels across the area will be influenced by natural sources of dust such as wind erosion and fires, as well as dust emissions from existing anthropogenic sources in the area, possibly including local agriculture or horticulture, and existing mines.

The National Pollution Inventory (NPI) is a public database of annual emissions of 93 substances reported by industries across Australia. Within the study domain (approximately 20 km radius) there are no facilities currently reporting to the NPI program. There are five NPI reporting facilities within a 50 km radius of the Project including four mines and one quarry. These existing facilities are sufficiently far from the Gemini Project to have a minimal impact on the local dust levels near the Project.

Ambient Air Quality

The *Air Quality and Greenhouse Gas Assessment* (Katestone 2019) (Appendix I) estimates the expected background concentrations of relevant air contaminants (Table 40).

The nearest available monitoring site for particulates is located at Blackwater township, approximately 35 km west of the Project. Background particulate values based on the Blackwater monitoring site are conservative considering its close proximity to the existing mines in the Blackwater region.

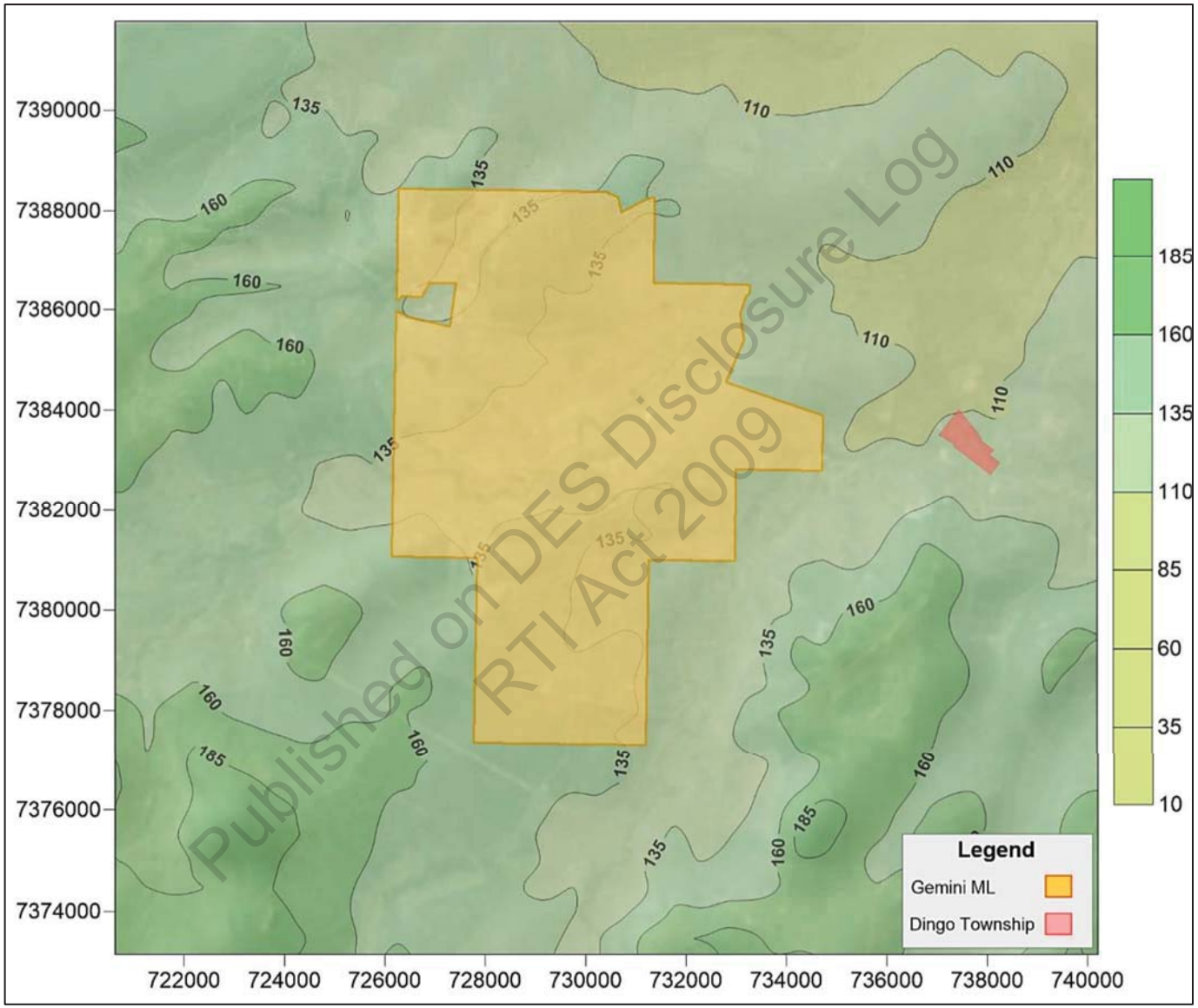


Figure 59 Local terrain

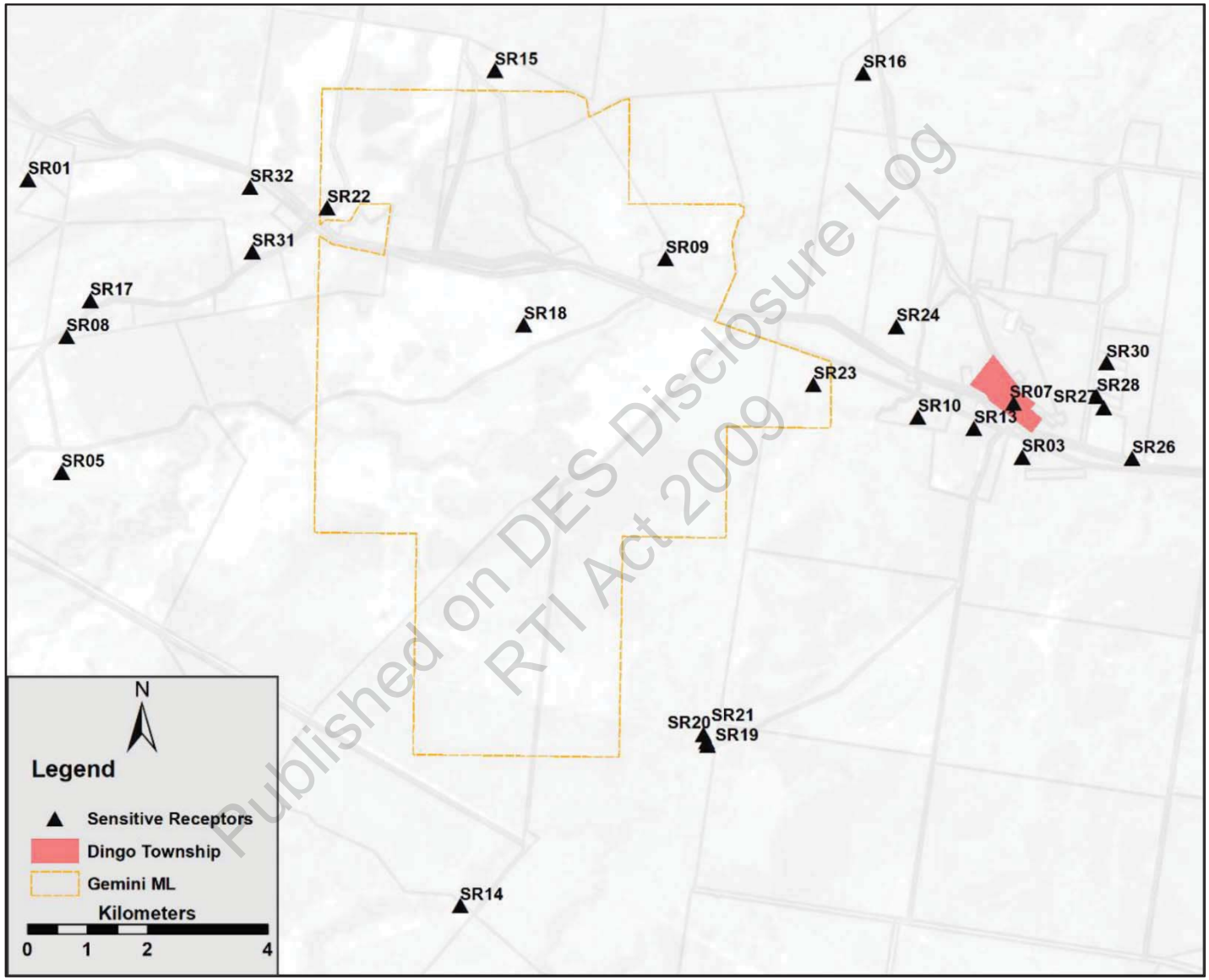


Figure 60 Location of sensitive receptors and Project activities

Table 39 Sensitive receptors within 10 km of the Project

Receptor ID	Receptor type	Easting	Northing	Location
SR01	Residential	721380	7386940	4.8 km W
SR03	Residential	737915	7382328	3.2 km E
SR05	Residential	721937	7382077	4.2 km W
SR07	Dingo Township *(residential, businesses & facilities)*	737777 (town centre)	7383220 (town centre)	2.3 km E
SR08	Residential	722022	7384327	4.2 km W
SR09	Residential	731988	7385624	Within MLA
SR10	Residential	736181	7382995	1.4 km E
SR13	Residential	737113	7382802	2.3 km E
SR14^	Residential^	728569	7374873	2.5 km S
SR15	Residential	729144	7388750	0.3 km N
SR16	Residential	735273	7388705	3 km NE
SR17	Residential	722415	7384928	3.9 km W
SR18	Residential	729626	7384531	Within MLA
SR19^	Residential^	732684	7377515	1.5 km SE
SR20^	Residential^	732671	7377581	1.5 km SE
SR21^	Residential^	732614	7377700	1.5 km SE
SR22	Residential and Accommodation	726358	7386469	Within MLA
SR23	Residential	734446	7383534	Within MLA
SR24	Residential	735824	7384500	1.2 km NE
SR26	Residential	739747	7382306	5 km E
SR27	Residential	739278	7383145	4.5 km E
SR28	Residential	739157	7383337	4.4 km E
SR30	Residential	739319	7383894	4.6 km E
SR31	Residential	725109	7385743	1.1 km NW
SR32	Residential	725075	7386813	1.2 km NW

Notes: Datum: Map Grid of Australia (MGA) Zone 55.
^ denotes a sensitive receptor located on property owned by Magnetic South Pty Ltd.

For the purposes of the cumulative impact assessment, the ambient background concentrations of PM_{10} and $PM_{2.5}$ were taken as the 70th percentile 24-hour average from the Blackwater monitoring site. Use of the 70th percentile value was based on the methodology published by EPA Victoria (EPA Victoria 2007) and is accepted in Queensland.

DES does not conduct monitoring for TSP and dust deposition at its Blackwater site and publicly available data for the region is limited. Therefore, background levels of TSP were derived from the measured PM_{10} data at Blackwater. Dust deposition rates were based on typical dust deposition rates for rural areas.

Table 40 Ambient background concentrations used to assess cumulative impacts

Pollutant	Averaging Period	Concentration	Source
TSP	Annual	32.8 µg/m3	Calculated from the average PM_{10} data measured at Blackwater using PM_{10}/TSP ratio of 0.5.
PM10	24-hour	18.2 µg/m3	70th percentile of monitoring data at Blackwater.
	Annual	16.4 µg/m3	Average of monitoring data at Blackwater.
PM2.5	24-hour	4.7 µg/m3	70th percentile of monitoring data at Blackwater.
	Annual	4.2 µg/m3	Average of monitoring data at Blackwater.
Dust Deposition	Monthly	30 mg/m²/day	Typical value.

9.3 POTENTIAL IMPACTS

Katestone (2019) used standard industry dispersion models suitable for use in Australia and regulatory approved assessment techniques to predict ground-level concentrations (GLC) of air pollutants in the areas surrounding the Project. Technical details of the methodology and models are provided in Appendix A of the *Air Quality and Greenhouse Gas Assessment* (Katestone 2019) (Appendix I).

9.3.1 Air Quality Objectives and Criteria

The EP Act provides for the management of the air environment in Queensland. The EPP (Air) was made under the EP Act with the objective "*to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the EP Act (i.e. ecologically sustainable development)*". The EPP (Air) air quality objectives relevant to the key air pollutants that may be generated from the Project are presented in Table 41.

Table 41 Relevant Air Quality Objectives EPP (Air)

Pollutant	Environmental Value	Averaging Period	Air Quality Objective	Number exceedances allowed per year
TSP	Health and Wellbeing	1 year	90 µg/m^3	None
PM_{10}		24 hours	50 µg/m^3	None
		1 year	25 µg/m^3	None
$PM_{2.5}$		24 hours	25 µg/m^3	None
		1 year	8 µg/m^3	None
Dust Deposition	Amenity	1 month	120 mg/m²/day	None

Notes: Dust deposition value is a DES recommended design objective rather than EPP (Air) objective and applies to total insoluble solids.

9.3.2 Emissions

Dust emissions will be generated over the life of the Project as a result of material extraction, handling, haulage and wind erosion of exposed mine areas. Emissions of oxides of nitrogen, sulphur dioxide and carbon dioxide would also occur due to blasting activities and combustion of fuels onsite. However, these emissions are transient (contained within the haul road corridor and open-cut pits) and low in magnitude compared with dust emissions. For these reasons, dust is the sole pollutant of interest for this assessment.

Key dust-generating activities associated with the Project include:

- Drilling and blasting;
- Material extraction and handling (overburden and ROM coal);
- Bulldozer activity;
- Material haulage (overburden and ROM coal);
- Road grading; and
- Wind erosion of exposed mine areas.

The three operational modelling scenarios represent the worst-case potential for dust emissions over the life of the Project, given the proposed mining schedule and proximity of sensitive receptors. These are:

- Year 2;
- Year 8; and
- Year 15.

The emissions estimation techniques applied in this assessment were based on standard methods that are applied throughout Australia and in the United States. These methods are consistent with those adopted for other air quality assessments conducted for other coal mines in Australia. Emissions of TSP, PM_{10} and $PM_{2.5}$ from mining activities were estimated using approximation of emission rates from NPI emissions estimation technique handbook (DSEWPAC 2012) and the United States Environmental Protection Agency AP42 emission handbooks (EPA 1998; EPA 2006).

Dust emissions from individual mining activities for the modelling scenarios were accounted for and have been explicitly modelled using Project specific activity information. The size distribution of dust particles was derived from the emission rates estimated for TSP, PM_{10} and $PM_{2.5}$.

Emissions have been presented inclusive of standard mitigation control factors to minimise dust emissions from mining activities. Standard efficiency factors for these control measures are presented in Table 42. Schematics and a breakdown of dust emission rates estimated for the three assessment scenarios is presented in Appendix I (refer to Table 6, and Figures 7 to 9).

9.3.3 Modelling Results

The dispersion modelling assessment has erred on the side of caution and selected conservative inputs; therefore, the predicted concentrations of dust are conservative estimates. Results have been presented as GLCs or deposition rates at the sensitive receptors as well as contours across the modelling domain. These results are subject to the standard mitigation measures outlined in Table 42.

Background dust levels have been added to the incremental model predictions in order to estimate the potential cumulative impacts of the Project with existing sources of dust in the region. Results have been assessed by comparing the cumulative concentrations and dust deposition rates with the air quality objectives described in Table 41.

Table 42 Dust control measures and relative reduction in emissions

Activity	Control measure	Reduction
ROM coal haulage	Watering	85%
Overburden haulage	Watering	85%
Drilling	Drill dust suppression sprays	70%
ROM unloading at CHPP	Water sprays	70%
Crushing	Enclosure	70%
Product stockpile	Wet from CHPP	50%
Train loading	Telescopic chute with water spray	85%
Conveyor	Enclosure	70%
Conveyor	Uncovered	0%

When interpreting the results, it is important to note that the predictions are not contemporaneous. The values presented are the maximum concentration predicted independently at each sensitive receptor or grid point for the entire modelling period and thus constitute a worst-case or near worst-case result. These values do not necessarily occur at the same time or under the same meteorological conditions.

Suspended Particulate Matter (TSP)

Annual average TSP modelling results, inclusive of the estimated annual average background level, show concentrations of TSP comply with the relevant air quality objective at all sensitive receptors using the standard mitigation measures.

The maximum cumulative annual average TSP concentration predicted at any sensitive receptor over the three scenarios modelled is 61.4 µg/m^3, at SR18 in Year 2. This equates to 68% of the relevant objective value of 90 µg/m^3.

Complete TSP modelling results are included in Appendix I as well as contour plots for the three model runs. The worst-case impact contour plot showing the predicted cumulative annual average TSP concentrations for Year 2 is reproduced as shown in Figure 61, where the TSP air quality objective is represented by the red contour line.

Suspended Particulate Matter (PM_{10})

Modelling results for PM_{10} predicted exceedances of the 24-hour average objective value of 50 µg/m^3 at 11, 16, and 8 receptors in modelling Years 2, 8, and 15, respectively. Minor exceedances of the annual average PM_{10} objective guideline are predicted for one receptor in each modelling year. SR18 exceeds the 25 µg/m^3 objective value by 8.8 µg/m^3 and 4 µg/m^3 in Years 2 and 8, respectively. SR09 exceeds the objective value by 4.2 µg/m^3 in Year 8, whilst SR22 exceeds by 2.5 µg/m^3 in Year 15.

For the Project, there will be ongoing implementation of the standard dust control measures. Application of additional mitigation measures will occur under adverse meteorological conditions that are conducive to dust impacts, when necessary. Various mitigation measures available are discussed in Section 9.4 (Mitigation Measures, Management and Monitoring), however for the purposes of the model; additional mitigation measures included restricting overburden and ROM haul to between 7am and 6pm, when necessary.

Using standard and, when necessary, additional mitigation measures predicted 24-hour average and annual average concentrations of PM_{10} were modelled and determined to comply with the relevant air quality objective at all sensitive receptors.

Complete PM_{10} modelling results are included in Appendix I as well as contour plots for the 12 model runs using standard mitigation measures for 24-hour average and annual average PM_{10} concentrations for each modelling year, and further model runs using the additional mitigation measures, when necessary, for each modelling scenario.

The worst-case impact contour plot for the predicted 24-hour average PM_{10} concentrations with standard mitigation measures and additional measures, when necessary, is shown in Figure 62 (Year 2), where the 24-hour average PM_{10} air quality objective is represented by the red contour line.

The worst-case impact contour plot for the predicted annual average PM_{10} concentrations with standard mitigation measures and additional measures, when necessary, is shown in Figure 63 (Year 8), where the annual average PM_{10} air quality objective is represented by the red contour line.

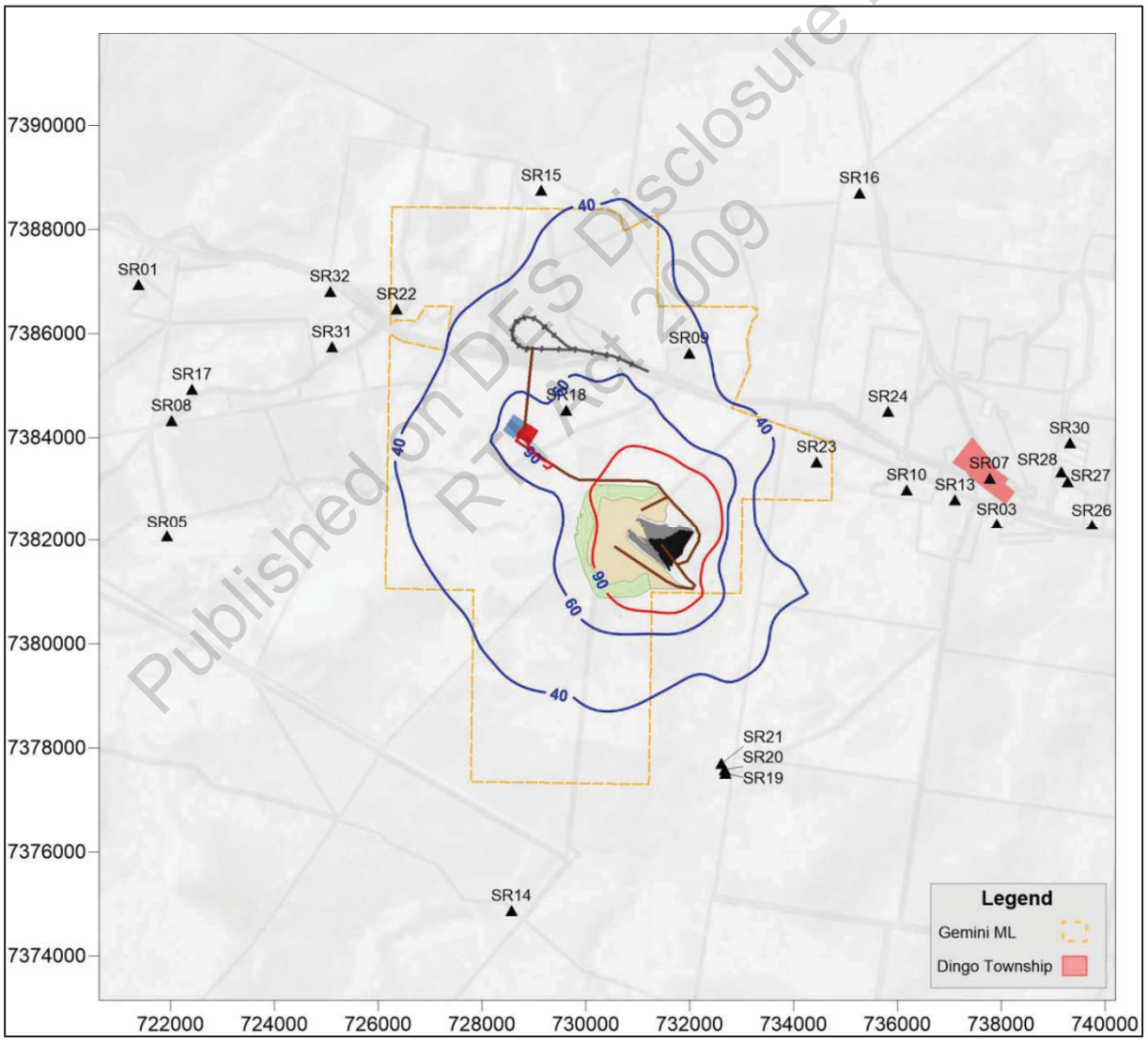


Figure 61 Worst-case predicted cumulative annual average TSP concentrations (Year 2)

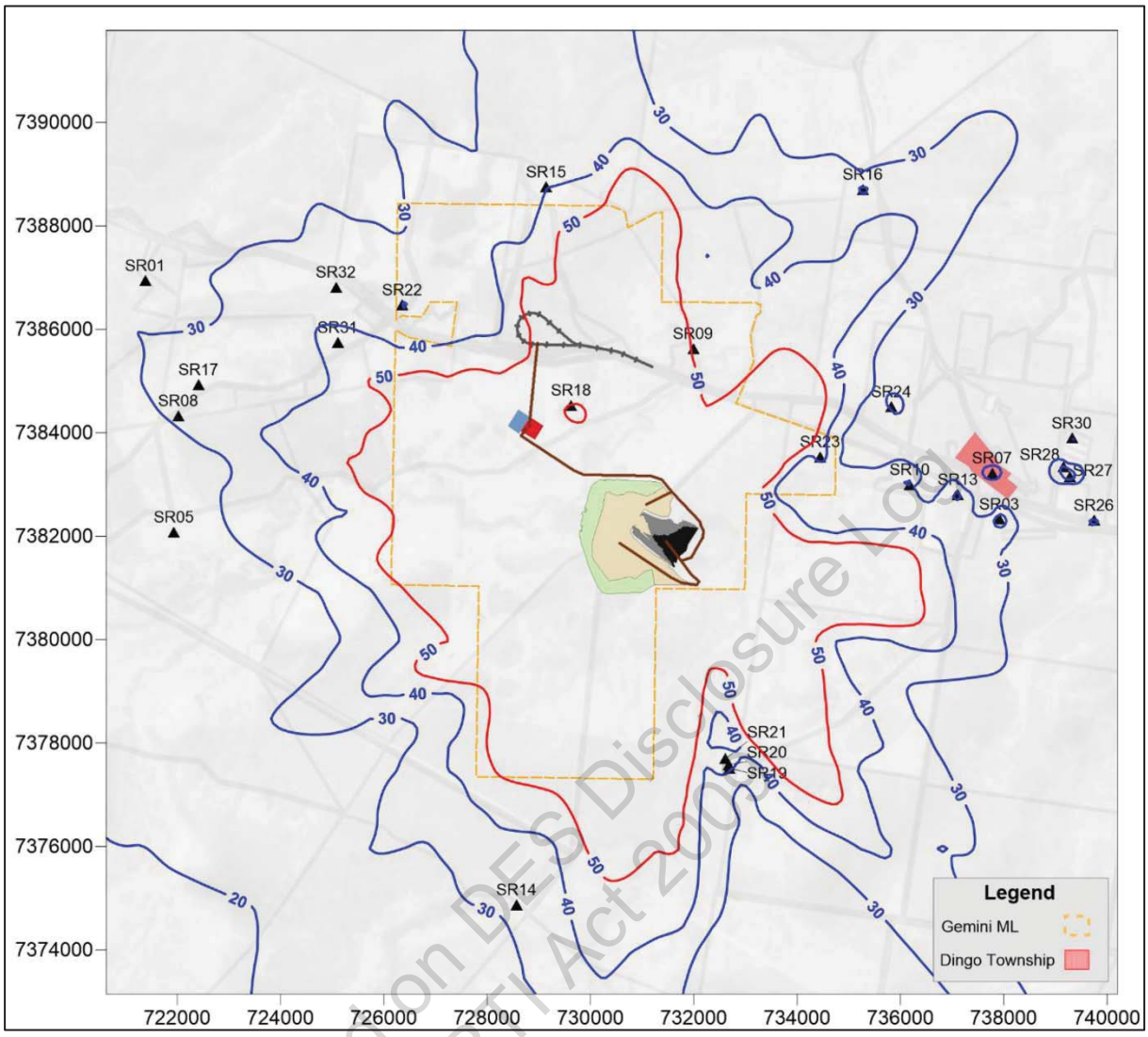


Figure 62 Worst-case predicted cumulative 24-hour average PM_{10} concentrations (Year 2) with additional mitigation measures

Suspended Particulate Matter ($PM_{2.5}$)

Annual average and 24-hour average $PM_{2.5}$ modelling results, inclusive of the estimated background levels, show concentrations of $PM_{2.5}$ comply with the relevant air quality objective at all sensitive receptors using the standard mitigation measures.

The maximum cumulative 24-hour average $PM_{2.5}$ concentration predicted at any sensitive receptor over the three scenarios modelled is 18.8 µg/m^3, at SR09 in Year 8. This equates to 75% of the relevant objective value of 25 µg/m^3. The maximum cumulative annual average $PM_{2.5}$ concentration predicted at any sensitive receptor over the three scenarios modelled is 6.8 µg/m^3, at SR18 in Year 2. This equates to 85% of the relevant objective value of 8 µg/m^3.

Complete $PM_{2.5}$ modelling results are included in Appendix I as well as contour plots for the six model runs. The worst-case impact contour plot showing the predicted cumulative 24-hour average $PM_{2.5}$ concentrations for Year 8 is reproduced as shown in Figure 64. The worst-case impact contour plot showing the predicted cumulative annual average $PM_{2.5}$ concentrations for Year 2 is reproduced as

shown in Figure 65. Relevant $PM_{2.5}$ air quality objective is represented in each figure by the red contour line.

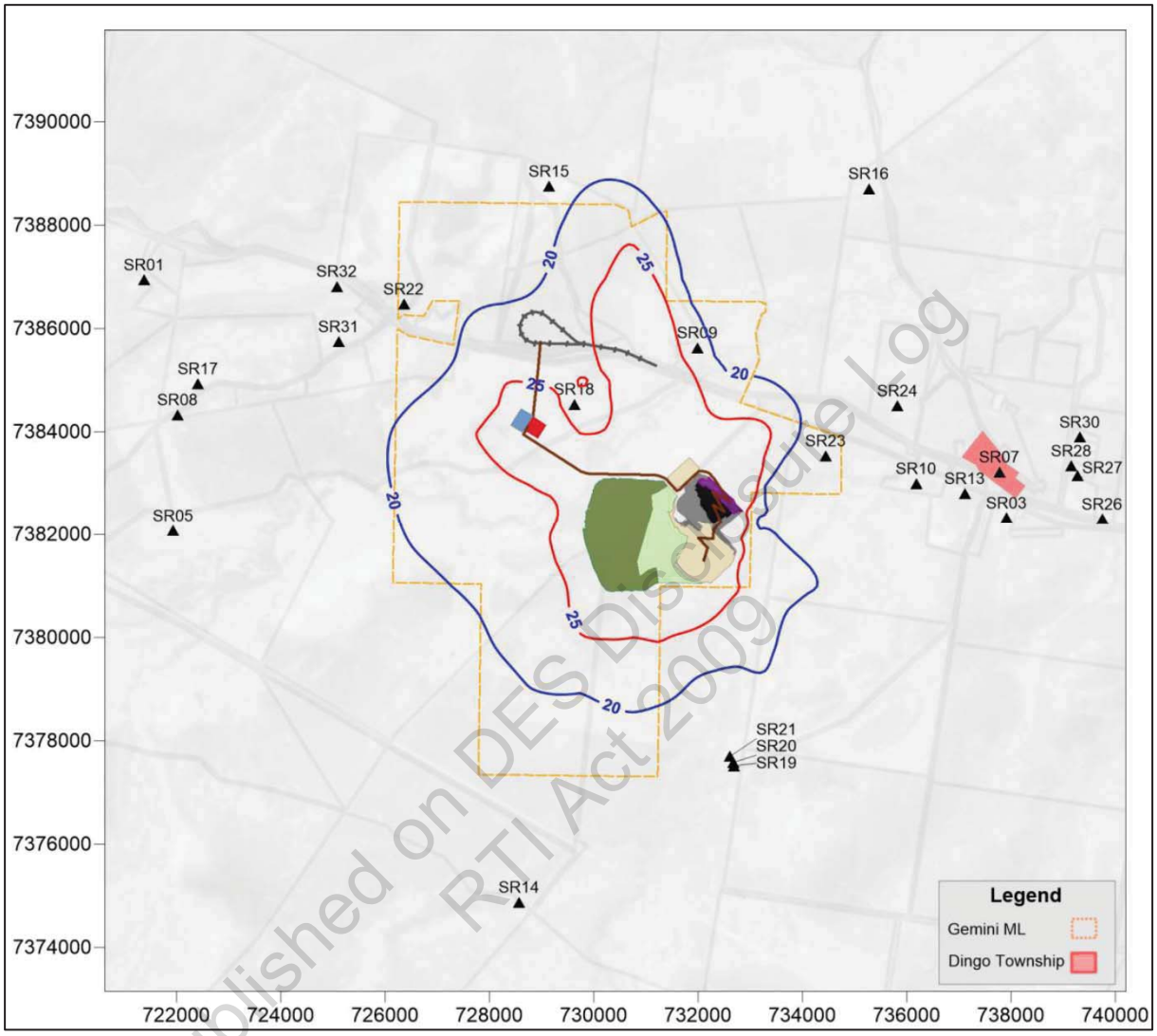


Figure 63 Worst-case predicted cumulative annual average PM_{10} concentrations (Year 8) with additional mitigation measures

Dust Deposition

Monthly dust deposition modelling results, inclusive of the estimated background level, show dust deposition rates comply with the relevant air quality objective at all sensitive receptors using the standard mitigation measures.

The maximum cumulative monthly dust deposition rates predicted at any sensitive receptor over the three scenarios modelled is 80.9 mg/m^2/day, at SR18 in Year 2. This equates to 67% of the relevant objective value of 120 mg/m^2/day.

Complete dust deposition modelling results are included in Appendix I as well as contour plots for the three model runs. The worst-case impact contour plot showing the predicted cumulative monthly dust deposition rates for Year 2 is reproduced as shown in Figure 66, where the dust deposition air quality objective is represented by the red contour line.

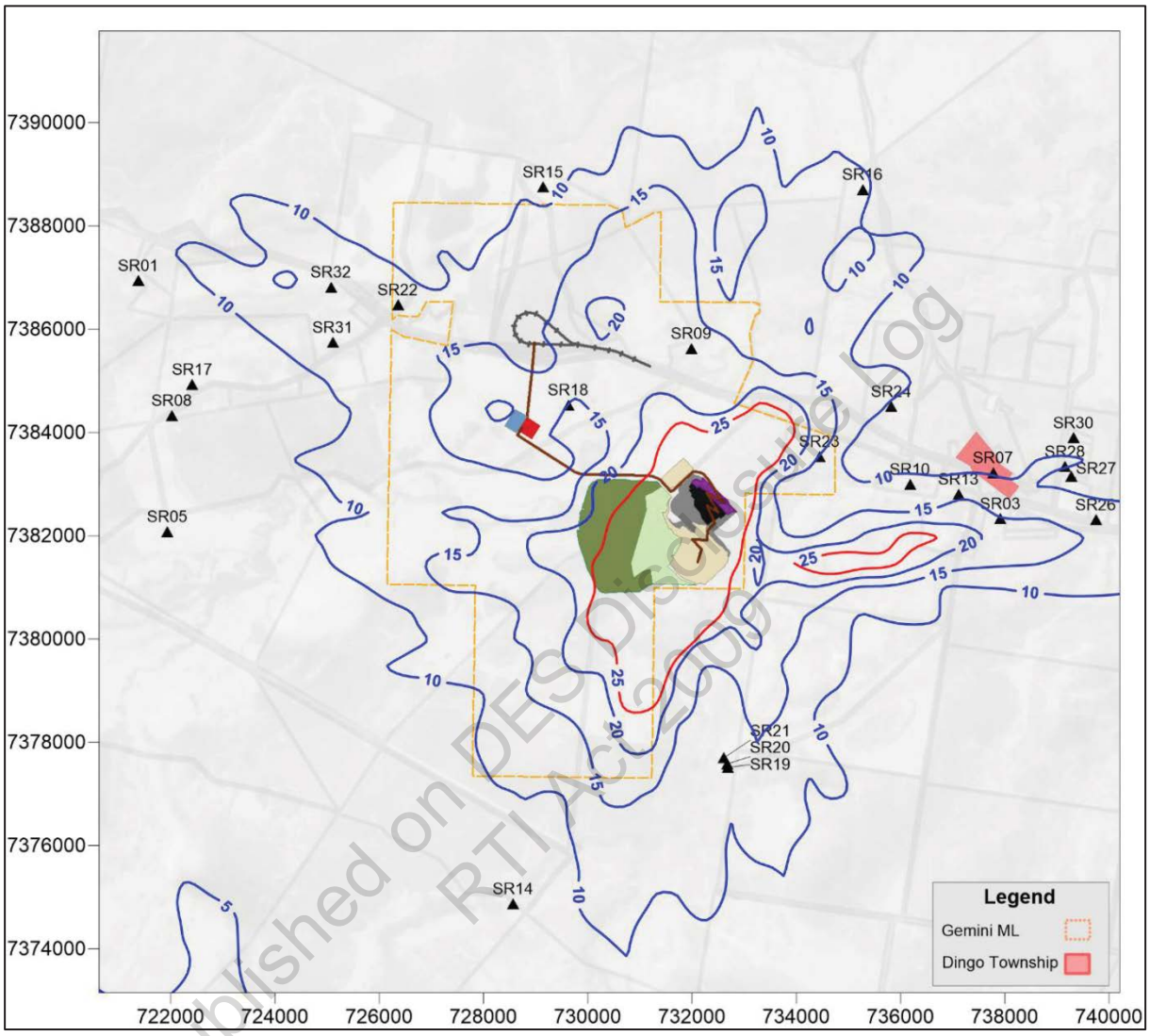


Figure 64 Worst-case predicted cumulative 24-hour average $PM_{2.5}$ concentrations (Year 8)

9.3.4 Impacts and Risks

Modelling shows that with the inclusion of standard and additional mitigation measures, the Project can be operated in accordance with the EPP (Air) objectives at all sensitive places. As the modelling assessed potential worst case conditions with conservative assumptions, it is likely that the additional mitigation measures will only be employed on an as required basis during operations.

There is a low risk that the Project would exceed the modelled scenarios. The management strategies discussed in Section 9.4 (Mitigation Measures, Management and Monitoring), will ensure risk remains low throughout the life of the Project, and provides for implementing procedures for monitoring and complaints resolution to control magnitude of risk.

The Project is unlikely to result in impacts to air quality that could adversely affect:

- Human health and wellbeing;
- Health and biodiversity of ecosystems including Taunton National Park;
- Agriculture activities including crop production; or
- Aesthetics of the environment including odour, dust, visibility reducing particles or light.

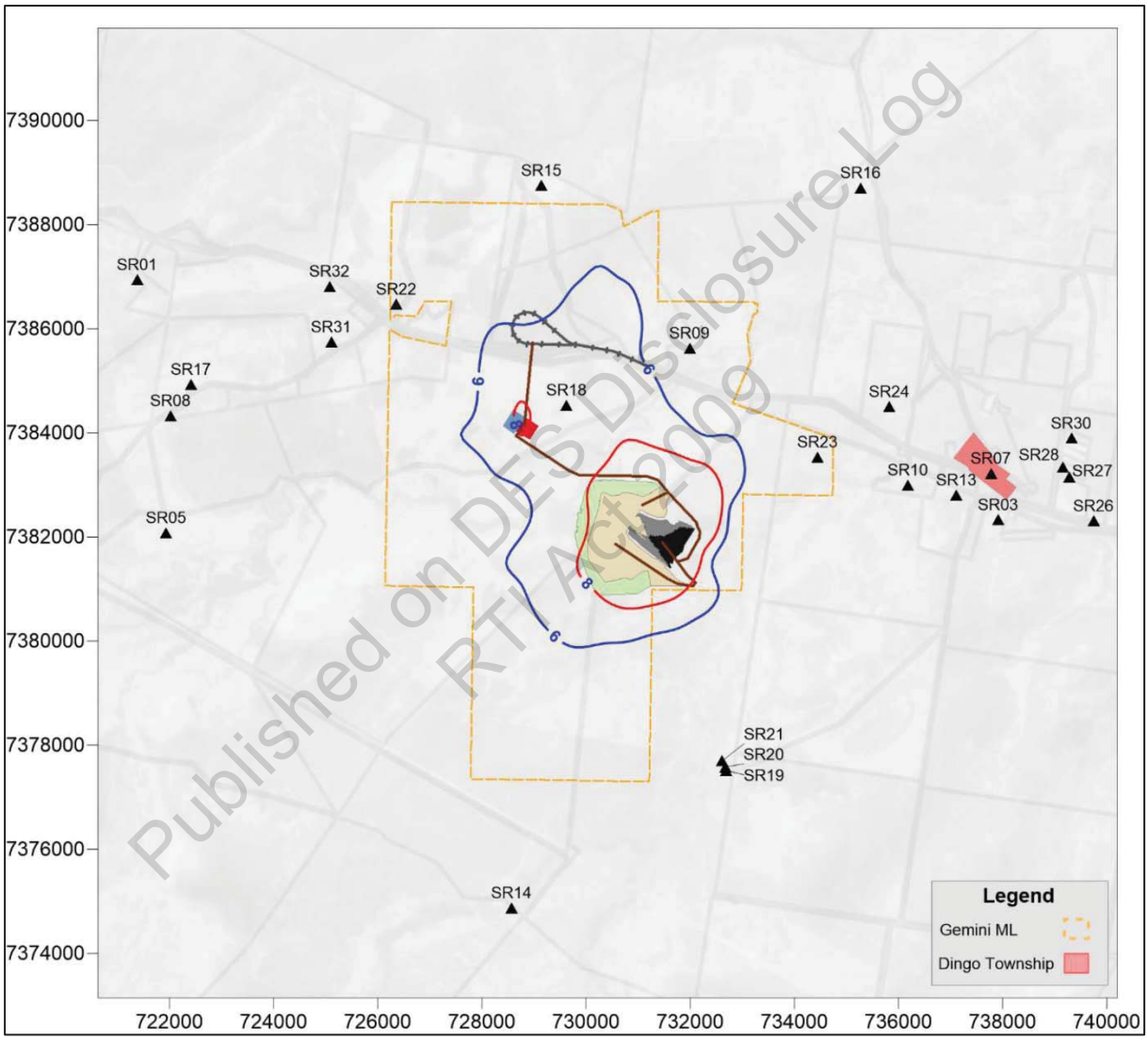


Figure 65 Worst-case predicted cumulative annual average $PM_{2.5}$ concentrations (Year 2)

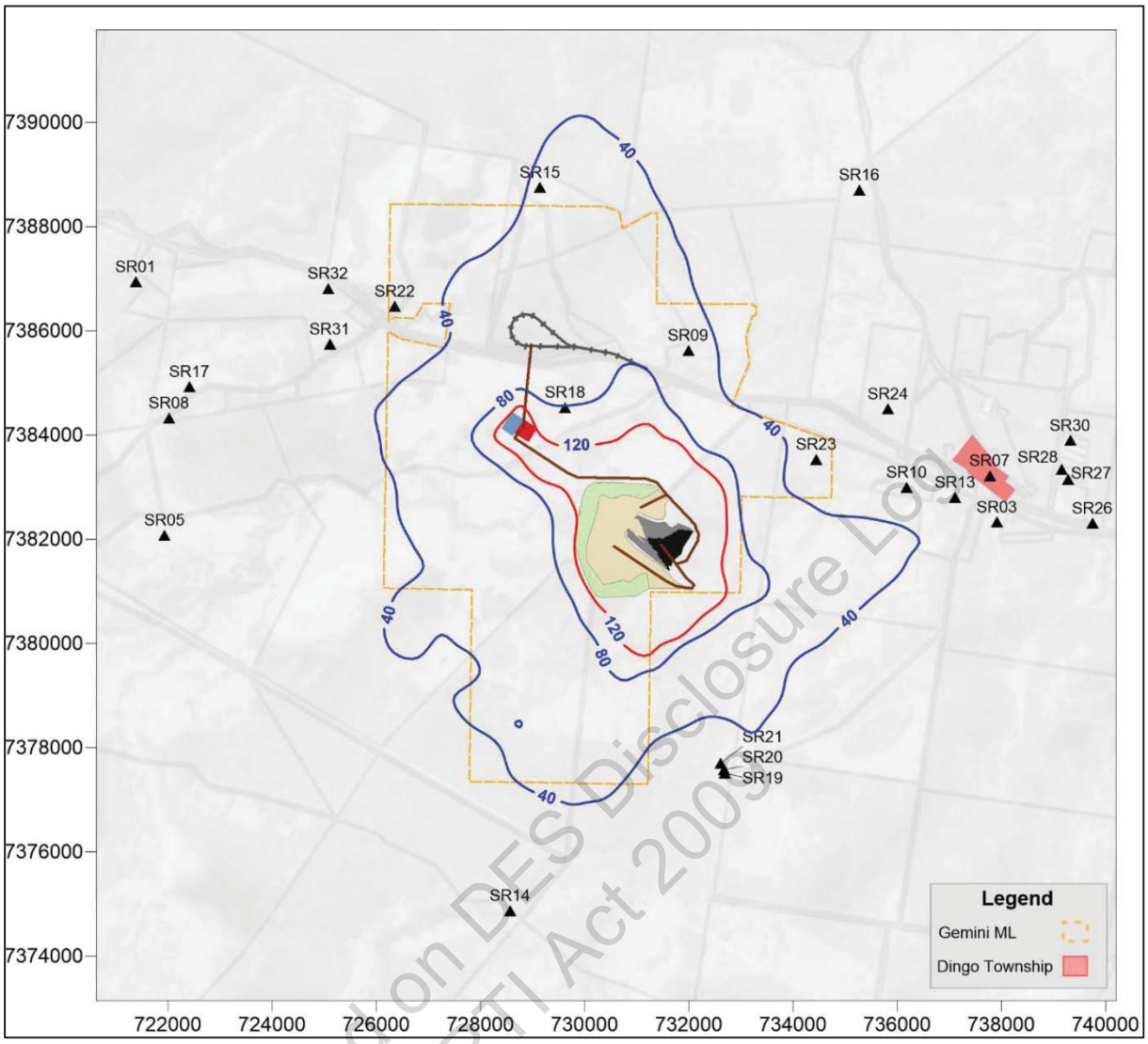


Figure 66 Worst-case predicted cumulative monthly dust deposition rate (Year 2)

9.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

The management hierarchy for air emissions as set out in the EPP (Air) requires that, to the extent that it is reasonable to do so, air emissions must be dealt with in the following order of preference:

1. Avoid (e.g. using technology that avoids air emissions);
2. Recycle (e.g. re-using air emissions in another industrial process);
3. Minimise (e.g. treating air emissions before release); and
4. Manage.

Dust management and mitigation measures will be implemented for the Project. Magnetic South is committed to implementing the following measures:

1. Develop and implement an ambient air quality monitoring program at sites representative of surrounding sensitive receptors for early detection of elevated PM_{10} concentrations;

2. Ensure mitigation measures are put in place where the ambient dust monitoring program indicates a potential exceedance. This may include, increased watering of haul roads and other dust sources, and if required, timing blasts or other high risk activities to occur outside of high risk weather conditions;

3. Develop an *Air Quality Management Plan* (AQMP) that will include a range of available measures to be implemented as necessary to ensure compliance with approval conditions. Measures that would be considered for inclusion in the AQMP include:

    a. Details of the of mitigation and management measures that are to be implemented at the site to minimise dust and other air emissions from the mine;

    b. Requirements for monitoring the impacts of mine operations on ambient air quality including the use of real-time measurement of dust levels and meteorological conditions;

    c. Additional remedial actions for air emissions control in the event of complaints being received, exceedances of criteria being recorded, or other trigger levels being breached; for example:

        i. Applying additional at-source and/or at-receptor dust controls;

        ii. Increasing the intensity of dust controls; and/or

        iii. Modifying certain operations;

    d. The requirement that Magnetic South will investigate, if monitoring indicates unexpected exceedances of air quality objectives; and

    e. Roles and responsibilities for implementation, monitoring and review of the AQMP.

4. Enter into discussions and, as appropriate, commercial arrangements with affected surrounding landholders which could include:

    a. Measures (e.g. purchase or relocation) which result in homesteads no longer being considered a sensitive receptor

    b. Installation of receptor-side mitigation (e.g. air conditioners / purifiers in affected residences).

10.0 GREENHOUSE GAS

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of the Earth's climate system. The Earth naturally absorbs and reflects incoming solar radiation and emits longer wavelength terrestrial (thermal) radiation back into space. A portion of this terrestrial radiation is absorbed by gases, known as greenhouse gasses (GHGs) in the atmosphere. Changes in the atmospheric concentrations of these GHGs can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. The major GHGs which make the largest contribution to global warming are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

The main GHG associated with the Project is CO_2, with smaller contributions from CH_4 and N_2O. These gases vary in effect and longevity in the atmosphere, however a system named Global Warming Potential (GWP) allows them to be described in terms of CO_2 (the most prevalent greenhouse gas); called carbon dioxide equivalents (CO_2-e). A unit of one tonne of CO_2-e is the basic unit used in carbon accounting.

The *Air Quality and Greenhouse Gas Assessment* (Katestone 2019) (refer Appendix I) identifies the potential sources of GHG emissions associated with the Project and quantifies the emissions from each source over the life of the Project. The estimated emissions have then been compared to State and National GHG emission inventory totals to provide an assessment of the potential significance of the Project in relation to Australia's GHG emission inventory.

10.1 NATIONAL GREENHOUSE AND ENERGY REPORTING ACT 2007

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes a mandatory scheme, the *National Greenhouse and Energy Reporting Scheme* (NGER Scheme) for the reporting of company GHG emissions and energy production and consumption.

The supporting *National Greenhouse and Energy Reporting Technical Guidelines* (NGER Guidelines) (DoEE 2017) are applicable across all industry sectors and cover important concepts under the NGER Act and supporting regulations, including scheme participation, and the determination of corporate, facility and operational control, and registration and reporting obligations. The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER Determination) provides methods and criteria for calculating GHG emissions and energy data under the NGER Act.

The range of emission sources covered in the NGER Determination includes:

- The combustion of fuels for energy;
- Fugitive emissions from the extraction of coal;
- Oil and gas;
- Industrial processes (such as producing cement and steel); and
- Waste management.

Registration and reporting is mandatory for corporations that has energy consumption or GHG emissions that exceed specified thresholds. GHG emission thresholds include Scope 1 and Scope 2 emissions. NGER reporting thresholds are summarised in Table 43. Reporting under the NGER Act is required for Scope 1 and Scope 2 emissions exceedances.

Table 43 Reporting thresholds for greenhouse gas emissions and energy use

Threshold Level	Threshold Type	
	GHG Emissions (kt CO2-e per year)	Energy Consumption (TJ per year)
Facility	25	100
Corporate	50	200

Notes: kt CO_2-e kilotonnes of carbon dioxide equivalent
TJ terajoules

10.2 EMISSIONS SOURCES

Scope 1, 2 and 3 GHG emissions were estimated on an annual basis for the Project. This included emissions from:

Scope 1: In relation to a facility, means the release of GHG into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.

Gemini Project Scope 1 emission sources include diesel combustion from heavy machinery and equipment and haulage vehicles; fugitive emissions of methane from mining of coal deposits (i.e. waste mine gas); and use of explosives.

Scope 2: In relation to a facility, means the release of GHG into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.

Gemini Project Scope 2 emission sources include electricity usage for conveyors, CHPP and other amenities.

A complete summary of emission sources associated with Project is documented in Table 14 of Appendix I.

10.3 EMISSIONS ESTIMATION

The estimated GHG emissions associated with the Project are summarised in Table 44. A complete breakdown of emissions are presented in Appendix I.

The relative influence of the emissions sources on total GHG emissions is summarised in Figure 67. A similar proportion of GHG emissions when broken down by scope and emissions sources is observed in individual years. Over half of the GHG emissions associated with the Project are associated with diesel combustion for heavy machinery, mining equipment, haulage and other onsite vehicles. Fugitive methane and electricity usage have also been identified as significant sources of GHG emissions.

The approximate reportable annual GHG emissions of the Project range from:

Scope 1: 16.8-186.9 kt CO_2-e per year

Scope 2: 1.6-18.2 kt CO_2-e per year

Total: 18.4-205.1 – kt CO_2-e per year

Table 44 Estimated annual greenhouse gas emissions

Year	GHG Emissions (kt CO_2-e per year)			Energy use (TJ per year)
	Scope 1	Scope 2	Total	Total
Year 1	16.8	1.6	18.4	247
Year 2	175.6	18.2	193.8	2,326
Year 3	141.6	18.2	159.9	1,557
Year 4	151.2	18.2	169.4	1,693
Year 5	163.5	18.2	181.7	1,868
Year 6	143.3	18.2	161.6	1,581
Year 7	172.5	18.2	190.7	1,997
Year 8	179.1	18.2	197.3	2,091
Year 9	145.3	18.2	163.6	1,610
Year 10	143.1	18.2	161.4	1,579
Year 11	140.2	18.2	158.4	1,536
Year 12	149.0	18.2	167.3	1,663
Year 13	158.6	18.2	176.8	1,799
Year 14	163.7	18.2	181.9	1,900
Year 15	161.2	18.2	179.4	1,864
Year 16	186.9	18.2	205.1	2,230
Year 17	159.6	18.2	177.9	1,842
Year 18	186.7	18.2	205.0	2,228
Year 19	103.4	18.2	121.6	1,100
Total	**2,841.2**	**330.1**	**3,171.3**	**32,711**

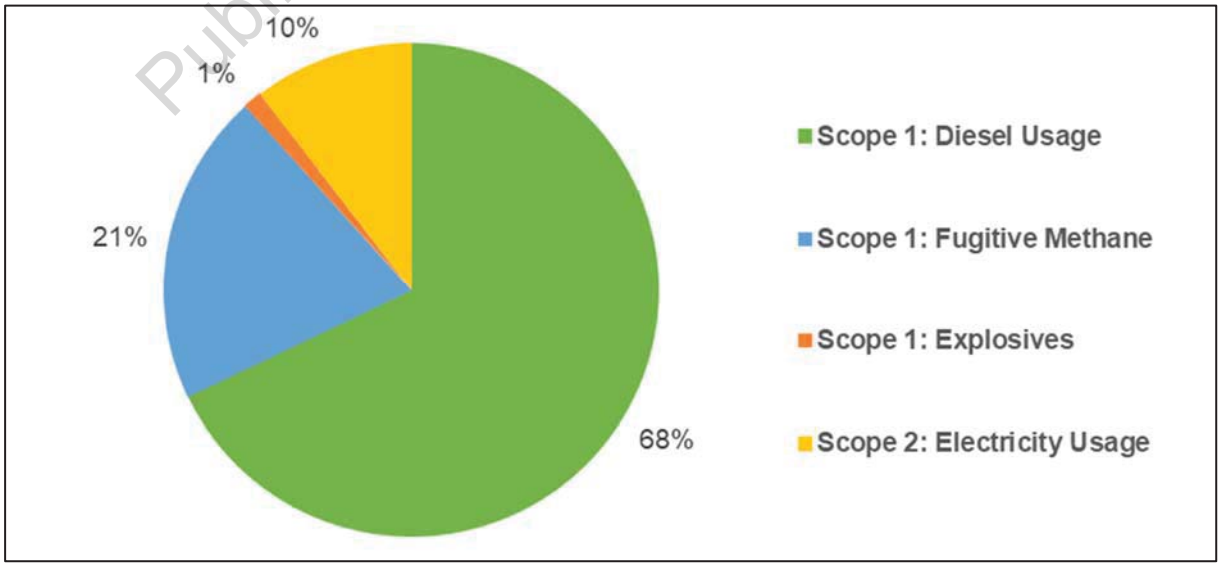


Figure 67 Total greenhouse gas emissions by scope

For comparative purposes; the latest GHG inventory estimates (excluding emissions from land use, land use change and forestry) is 538 Mt CO_2-e per year for Australia and 162 Mt CO_2-e per year for Queensland (DoEE 2019a; DoEE 2019b).

Accounting for the estimated maximum year of annual GHG emissions of 205.1 kt CO2-e (Year 2), the Project could contribute up to 0.04% of Australia's emissions and 0.13% of Queensland's emissions.

Based on the NGER Act reporting thresholds detailed in Table 43, the Gemini Project will have ongoing reporting obligations including annual assessment of GHG emissions as set out by the NGER Act and the NGER Determination.

10.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

The following management measures are proposed to minimise GHG emissions from the Project during operation:

- Minimise vegetation clearing at the Project to the authorised areas, required for Project development;
- Consideration of renewable energy options for initial design or future improvements, such as solar powered lighting;
- Consideration of the fuel efficiency of mining equipment during procurement;
- Logistical planning to improve efficiency and minimise energy use, including route and load optimisation of mining equipment and production scheduling to reduce idle time;
- Maintenance of mining equipment to maximise fuel efficiency;
- Using appropriately sized equipment; and
- Ongoing monitoring and reporting of GHG emissions including an annual review of energy use to identify potential energy efficiency opportunities on a regular and ongoing basis.

11.0 NOISE AND VIBRATION

This section describes the assessment of potential noise, vibration and blasting impacts from the construction, operation, and closure of the Gemini Project.

This section is informed by the *Noise Impact Assessment* (ASK 2019) presented as Appendix J.

11.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objectives relevant to potential noise impacts as described in the EA guideline for *Application requirements for activities with noise impacts [ESR/2015/1838]* (DES 2017d) is:

The activity will be operated in a way that protects the environmental values of the acoustic environment.

The Project would achieve either one of the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

1 *Sound from the activity is not audible at a sensitive receptor.*

2 *The release of sound to the environment from the activity is managed so that adverse effects on environmental values including health and wellbeing and sensitive ecosystems are prevented or minimised.*

11.2 DESCRIPTION OF ENVIRONMENTAL VALUES

11.2.1 Land Use

The Project site and surrounding area is currently used predominately for cattle grazing with most of the area cleared for agricultural purposes. To the east of the Project lies Dingo, a small town of approximately 450 people, and includes residences, sporting facilities (sports oval, tennis courts), a primary school, and local businesses (Post Office, hotel, shops, etc.).

11.2.2 Sensitive Receptors

Sensitive receptors, based on the definition from the *Environmental Protection (Noise) Policy 2019* (EPP (Noise)), were identified in parallel with the *Air Quality and Greenhouse Gas Assessment* (Katestone 2019) and the same suite of receptors was used for both assessments. Sensitive receptors considered in the assessment are presented in Figure 60 and Table 39, encompassing residences, businesses, and recreational areas within 5 km of the Project (refer Section Table 39).

A total of 25 sensitive receptors were identified, including the Dingo township (SR07), that consists of multiple dwellings, businesses, and facilities. Four sensitive receptors (SR09, SR18, SR22 and SR23) are located within the MLA. Four sensitive receptors (SR14, SR19, SR20 and SR21) are located on land owned by Magnetic South. There is a minimum distance of approximately 550 m between the Project components and nearest sensitive receptor (SR18).

The Capricorn Highway and the Blackwater Railway extend through the northern section of the MLA. A number of the sensitive receptors are located within 1 km of the highway and rail line.

The nearest mining operation to the Gemini Project is Bluff PCI Project, located approximately 14 km west of the Gemini Project's proposed ROM pad.

11.2.3 Climate and Wind Characteristics

The propagation of noise in the outdoor environment can be influenced by the local meteorological conditions. Air temperature, humidity, wind speed, wind direction and stability of the atmosphere can all influence noise either in isolation or as a combined weather condition. Computer modelling was used to input specific meteorological conditions relevant to a 'neutral' and an 'adverse' scenario (refer Section 6.2 of Appendix J). The local meteorological conditions relating to the Project are described in Section 2.2 of this document.

11.2.4 Background Noise Levels

The Project is located in a rural area with influences from transport and the agricultural industry. Specifically, the existing acoustic environment is affected by:

- Traffic on the Capricorn Highway and other local roads;
- Coal trains;
- Native birdlife;
- Insect noise;
- Agricultural equipment; and
- Cattle.

A baseline noise monitoring study was conducted to determine baseline background noise prior to the commencement of the Project (as detailed in Appendix J). Noise monitoring was undertaken in general accordance with *Australian Standard AS1055: Acoustics – Description and measurement of environmental noise* and the *Noise Measurement Manual* (EHP 2013b).

Noise levels were continuously monitored with noise loggers for up to 13 consecutive days in June 2019, and attended logging was undertaken of two nights for separate 15-minute periods. Noise logging was undertaken at three locations representative of nearby sensitive receptors:

Location A: Accommodation facility (the same location as SR22). Located in an open-field, approximately 360 m northeast of the railway line and 440 m northeast of the Capricorn Highway.

Location B: Dingo Roadhouse (approximately the same location as SR03). Located in an open-field location, approximately 220 m southwest of the Capricorn Highway.

Location C: Rural residence (approximately the same location as SR19, SR20 and SR21). Located in an open-field position, approximately 200 m northeast of the homestead.

The background noise levels were affected by insect noise at Locations A and C, however, insect noise was minimal at Location B. As insect noise is likely a seasonal influence, the noise level data was filtered to remove the insect noise from Locations A and C. The resulting background noise levels, calculated using the lowest 10th percentile method, are shown in Table 45. Whilst the existing background noise environment were influenced by a variety of natural sources (birdsong, windblown vegetation, cattle) at all locations; Locations A and B were also influenced by transport related sources of background noise including the Capricorn Highway and Blackwater Railway.

Table 45 Background noise level

Period	Background Noise Level (L_{90} dBA)		
	Location A	Location B	Location C
Day (7am to 6pm)	33	35	25
Evening (6pm to 10pm)	23	37	29
Night (10pm to 7am)	20	27	22

Notes: dBA 'A' weighted decibel.
L_{90} 'A' weighted sound pressure level equalled or exceeded 90% of the time.

11.3 POTENTIAL IMPACTS

To assess impacts and risks of the Project to the existing noise environment, ASK (2019) undertook a noise and vibration assessment. A summary of the impact assessment and results is provided below.

11.3.1 Noise Quality Objectives and Criteria

ASK (2019) consulted several sources of information in order to propose relevant noise and vibration objectives for the Project:

- *Environmental Protection Act 1994;*
- *Environmental Protection (Noise) Policy 2019;*
- *Guideline (Noise): Planning for noise control* (EHP 2004);
- *Guideline (Noise): Noise and vibration from blasting [EM2402]* (EHP 2016);
- *Guideline (Mining): Model mining conditions [ESR/2016/1936]* (DES 2017e).

In accordance with Note 6 of the *Model Mining Conditions* (DES 2017e), ASK (2019) proposed to adopt criteria in accordance with the EPP (Noise) and the *Planning For Noise Control* guideline (EHP 2004).

Based on the *Planning For Noise Control* (EHP 2004) the noise reduction provided by a typical residential building façade is 7 dBA with windows open. Based on a façade reduction of 7 dBA (i.e. 7 dBA reduction in noise levels from outside a house to inside a house when windows are fully open), the EPP (Noise) indoor noise objectives could be converted to the proposed noise limits (with windows open) presented in Table 46.

Table 46 Proposed noise limits

Period	Noise Limit ($L_{Aeq,adj,1hr}$ dBA)
Day (7am to 6pm)	42
Evening (6pm to 10pm)	42
Night (10pm to 7am)	37

Notes: $L_{Aeq,adj,1hr}$ means an 'A' weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 1-hour period has the same mean square sound pressure of a sound that varies with time.

The *Noise and vibration from blasting* and the *Model Mining Conditions* (DES 2017e) contain the same criteria for blasting. ASK (2019) propose that these criteria are adopted for the Gemini Project, as outlined in Table 47.

Table 47 Proposed blasting vibration and airblast criteria

Issue	Criteria
Airblast overpressure	115 dB (linear) peak for nine out of ten consecutive blasts initiated and not greater than 120 dB (linear) peak at any time.
Ground vibration peak particle velocity	5 mm/s PPV for nine out of ten consecutive blasts and not greater than 10 mm/s PPV at any time.

PPV peak particle velocity

11.3.2 Noise Prediction Model

Mining noise emissions from the Gemini Project have been predicted for the three mine year scenarios; Year 2, Year 8, and Year 15. These years were selected to give a representation of mine noise levels near the beginning, middle and end of the project. Modelling of the scenarios has incorporated mine ground elevations, equipment numbers and equipment locations for each mine year.

The *Noise Impact Assessment* (ASK 2019) (Appendix J) contains detailed information regarding model inputs including noise source emissions (refer to report Section 6.3), noise source locations (refer to report Appendix D), mobile equipment numbers (refer to report Table 6.3), and total scenario power levels (refer to report Table 6.4).

A SoundPLAN (Version 8.1) computer noise model was used to predict noise levels at sensitive receptors. The computer model calculated the noise levels at sensitive receptors, accounting for noise propagation variables such as distance attenuation, ground absorption, air absorption and shielding attenuation from topography, buildings or barriers.

The CONCAWE industrial noise prediction methodology was utilised within SoundPLAN, which is specially designed for large facilities and incorporates the influence of wind effects and stability of the atmosphere. The SoundPLAN model was setup to predict noise levels under neutral and adverse meteorological conditions (refer Section 6.2 of Appendix J).

11.3.3 Noise Modelling Results

The predicted noise levels at nearby sensitive receptors for the three mining year scenarios are presented in Table 48 for the night 'adverse' scenario, and in Table 49 for the day 'neutral' scenario. The results are compared against the proposed noise limits of 37 dBA $L_{Aeq,adj,1hr}$ (night) and 42 dBA $L_{Aeq,adj,1hr}$ (day/evening). Where the result exceeds the limit, the cell is shaded pink. Where the result exceeds the limit, but the sensitive receptor is owned by Magnetic South, the cell is shaded in blue, Where the result does not exceed, the level below the criterion is included in brackets.

The predicted noise levels are displayed graphically as noise contours in Figure 68 through to Figure 73.

Table 48 Predicted Night 'Adverse' Noise Levels

Receptor	Predicted Noise Emission Levels ($L_{Aeq,adj,1hr}$ dBA)								
	Year 2			Year 8			Year 15		
	Mine Only	Mine & Rail Loadout	Night Criterion Exceedance (37 dBA)	Mine Only	Mine & Rail Loadout	Night Criterion Exceedance (37 dBA)	Mine Only	Mine & Rail Loadout	Night Criterion Exceedance (37 dBA)
SR01	24	24	(-13)	22	22	(-15)	23	23	(-14)
SR03	32	32	(-5)	33	33	(-4)	25	25	(-12)
SR05	26	26	(-11)	25	25	(-12)	28	28	(-9)
SR07	32	32	(-5)	33	33	(-4)	24	25	(-13)
SR08	25	25	(-12)	23	24	(-13)	25	25	(-12)
SR09	43	43	6	40	41	4	32	34	(-3)
SR10	37	37	(0)	38	38	1	28	28	(-9)
SR13	34	34	(-3)	35	35	(-2)	26	26	(-11)
SR14	29	29	(-8)	28	28	(-9)	42	42	5
SR15	31	33	(-4)	30	32	(-6)	27	30	(-7)
SR16	30	30	(-7)	29	29	(-8)	21	21	(-16)
SR17	27	27	(-10)	25	25	(-12)	27	27	(-10)
SR18	49	50	13	48	49	12	47	48	11
SR19	38	38	1	39	39	2	43	43	6
SR20	39	39	2	39	39	2	43	43	6
SR21	39	39	2	40	40	3	43	43	6
SR22	35	36	(-1)	33	35	(-2)	33	35	(-2)
SR23	43	43	6	44	44	7	30	30	(-7)
SR24	37	37	(0)	37	37	(0)	26	26	(-11)
SR26	27	27	(-10)	28	28	(-7)	21	22	(-16)
SR27	28	28	(-9)	29	29	(-6)	22	22	(-15)
SR28	28	28	(-9)	29	29	(-6)	22	22	(-15)
SR30	28	28	(-9)	28	28	(-7)	22	22	(-15)
SR31	32	33	(-4)	30	31	(-4)	31	32	(-5)
SR32	30	31	(-6)	27	29	(-6)	29	30	(-7)

Table 49 Predicted Day 'Neutral' Noise Levels

Receptor	Predicted Noise Emission Levels ($L_{Aeq,adj,1hr}$ dBA)								
	Year 2			Year 8			Year 15		
	Mine Only	Mine & Rail Loadout	Day/Evening Criterion Exceedance (42 dBA)	Mine Only	Mine & Rail Loadout	Day/Evening Criterion Exceedance (42 dBA)	Mine Only	Mine & Rail Loadout	Day/Evening Criterion Exceedance (42 dBA)
SR01	18	18	(-24)	15	16	(-26)	17	17	(-25)
SR03	25	25	(-17)	26	26	(-16)	18	18	(-24)
SR05	20	20	(-22)	18	18	(-24)	22	22	(-20)
SR07	25	25	(-17)	25	25	(-17)	18	18	(-24)
SR08	19	19	(-23)	17	17	(-25)	18	18	(-24)
SR09	35	35	(-7)	33	33	(-9)	25	27	(-15)
SR10	30	30	(-12)	31	31	(-11)	21	21	(-21)
SR13	27	27	(-15)	28	28	(-14)	20	20	(-22)
SR14	22	22	(-20)	21	21	(-21)	34	34	(-8)
SR15	24	25	(-17)	22	24	(-18)	20	23	(-19)
SR16	23	23	(-19)	22	22	(-20)	14	15	(-27)
SR17	20	21	(-21)	18	18	(-24)	20	20	(-22)
SR18	43	44	2	43	44	2	42	43	1
SR19	31	31	(-11)	31	31	(-11)	35	35	(-7)
SR20	31	31	(-11)	32	32	(-10)	35	35	(-7)
SR21	32	32	(-10)	32	32	(-10)	36	36	(-6)
SR22	28	29	(-13)	26	28	(-14)	26	28	(-14)
SR23	36	36	(-6)	37	37	(-5)	23	23	(-19)
SR24	29	29	(-13)	30	30	(-12)	20	20	(-22)
SR26	20	20	(-22)	20	21	(-21)	15	15	(-27)
SR27	21	21	(-21)	22	22	(-20)	16	16	(-26)
SR28	21	21	(-21)	22	22	(-20)	16	16	(-26)
SR30	21	21	(-21)	21	21	(-21)	16	16	(-26)
SR31	25	25	(-17)	23	24	(-18)	24	24	(-18)
SR32	23	24	(-18)	21	22	(-20)	22	23	(-19)

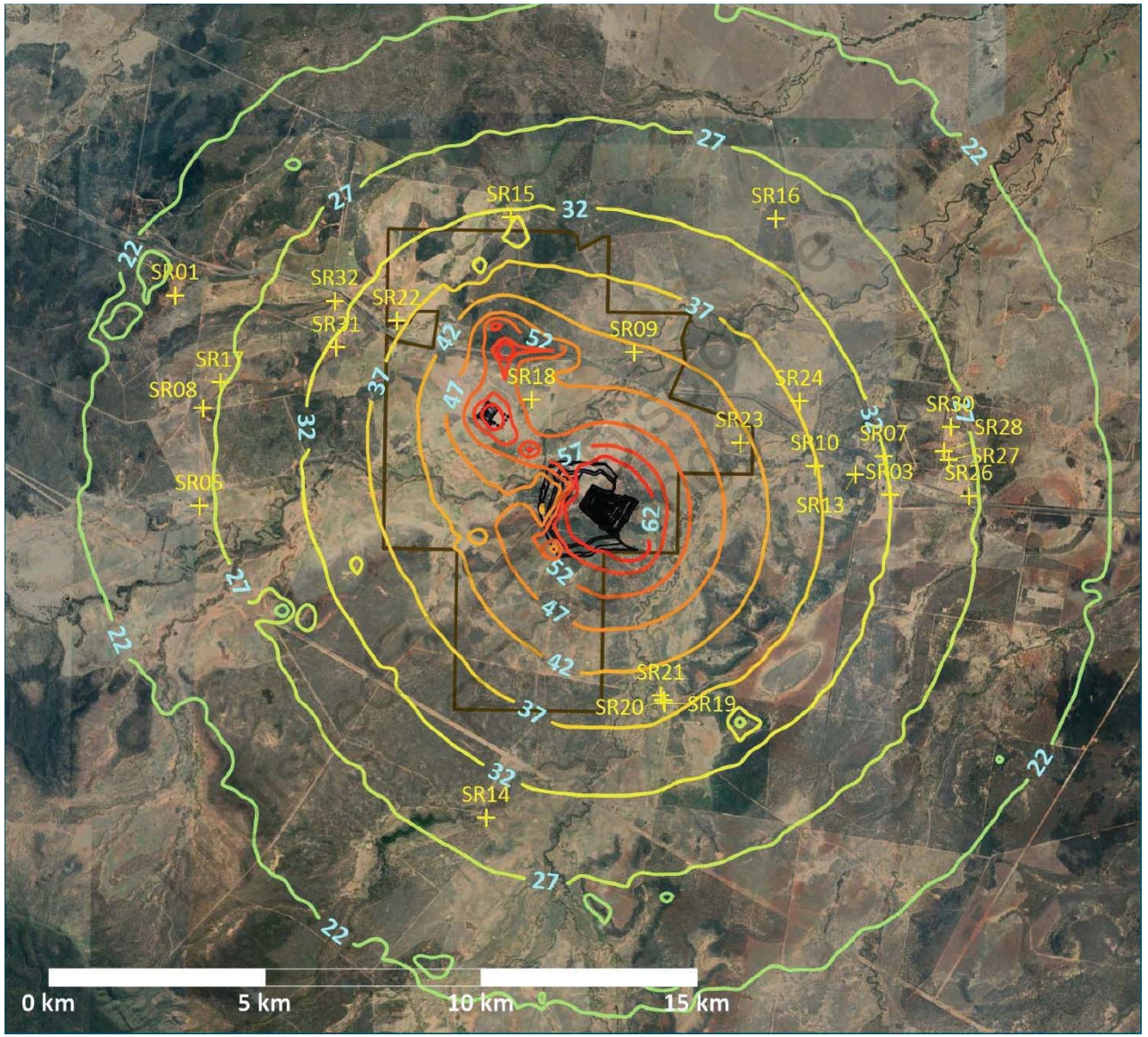


Figure 68 Year 2 - Night Adverse Scenario (Mine and Rail Loadout)

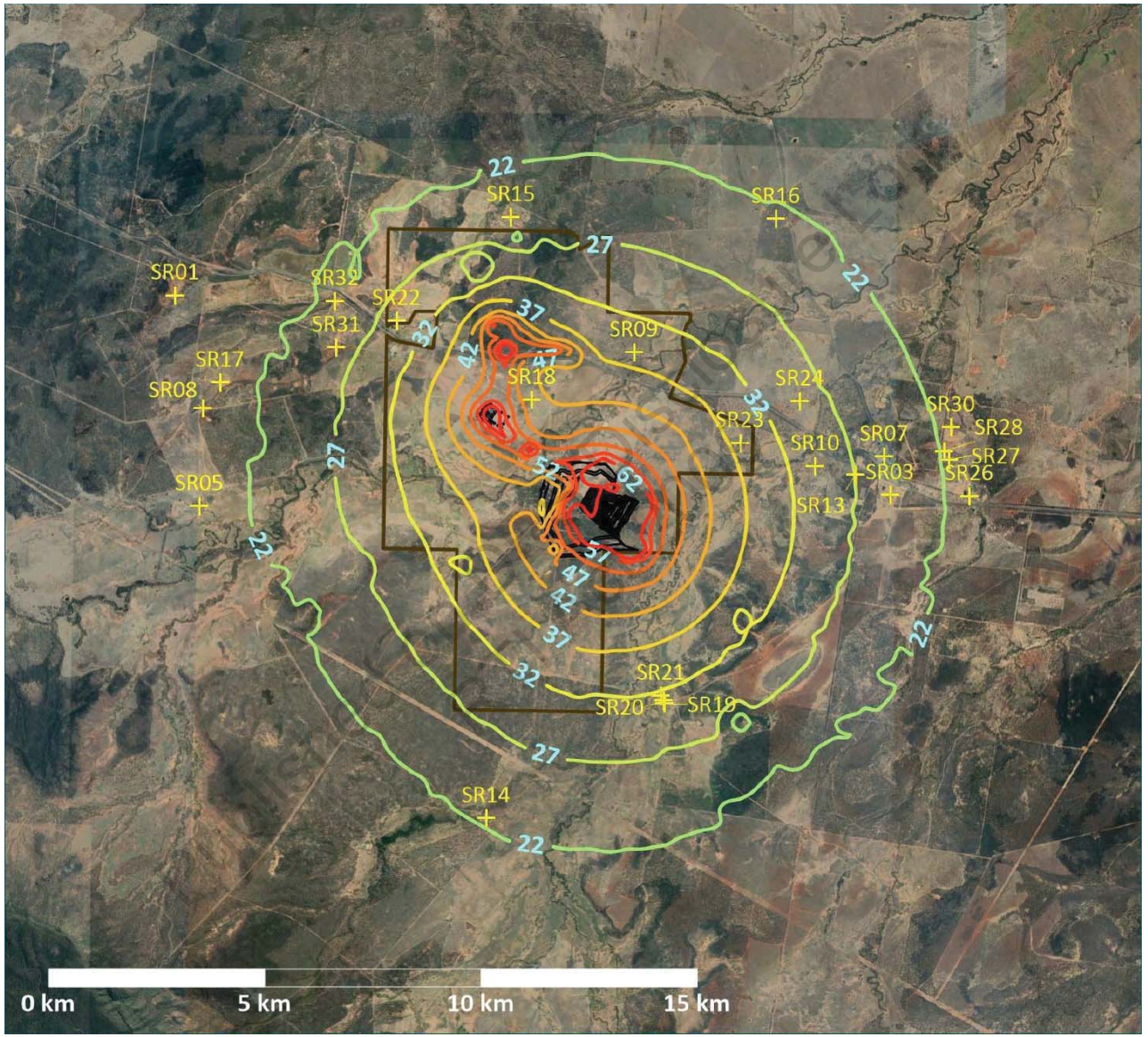


Figure 69 Year 2 - Day Neutral Scenario (Mine and Rail Loadout)

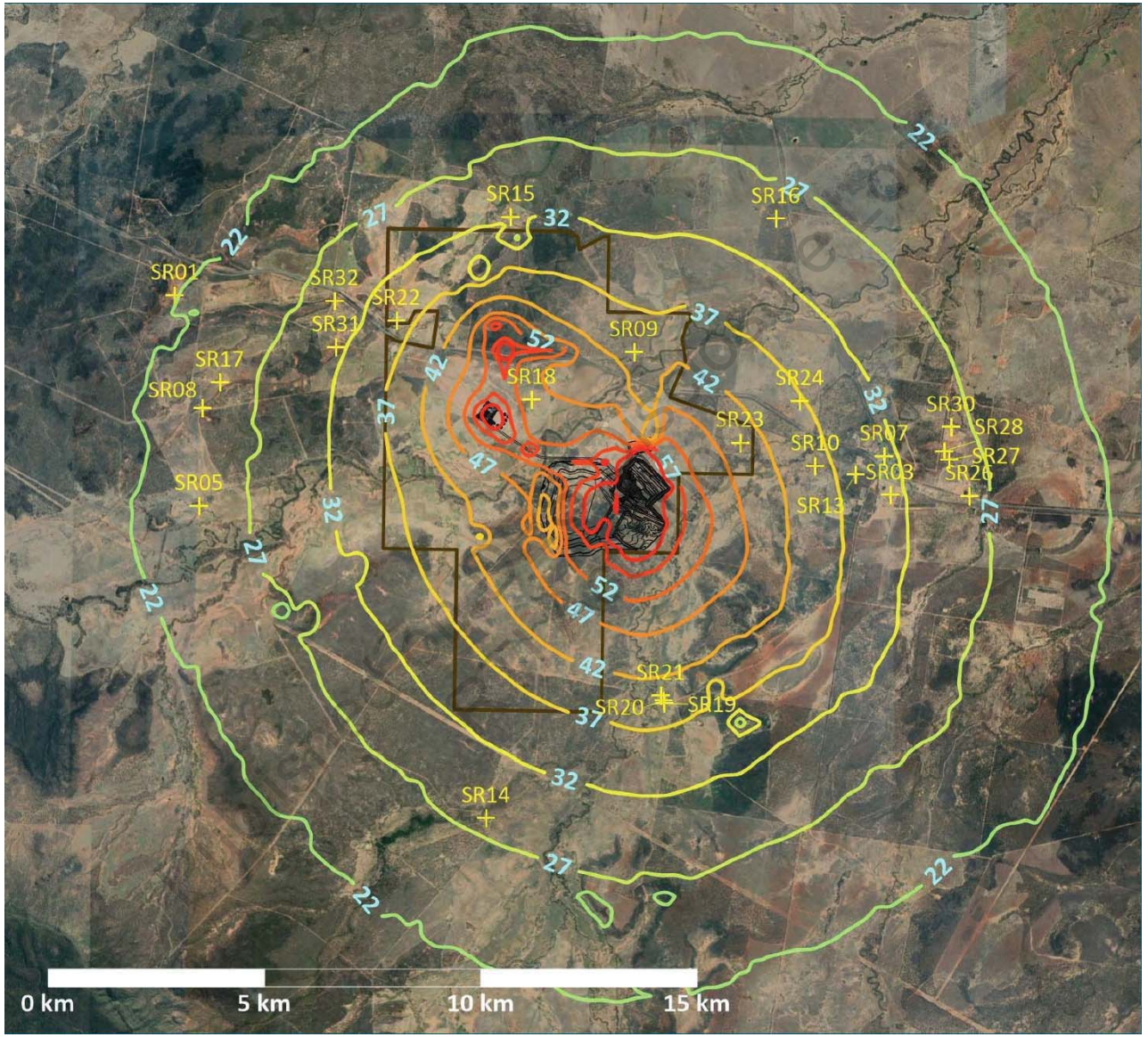


Figure 70 Year 8 - Night Adverse Scenario (Mine and Rail Loadout)

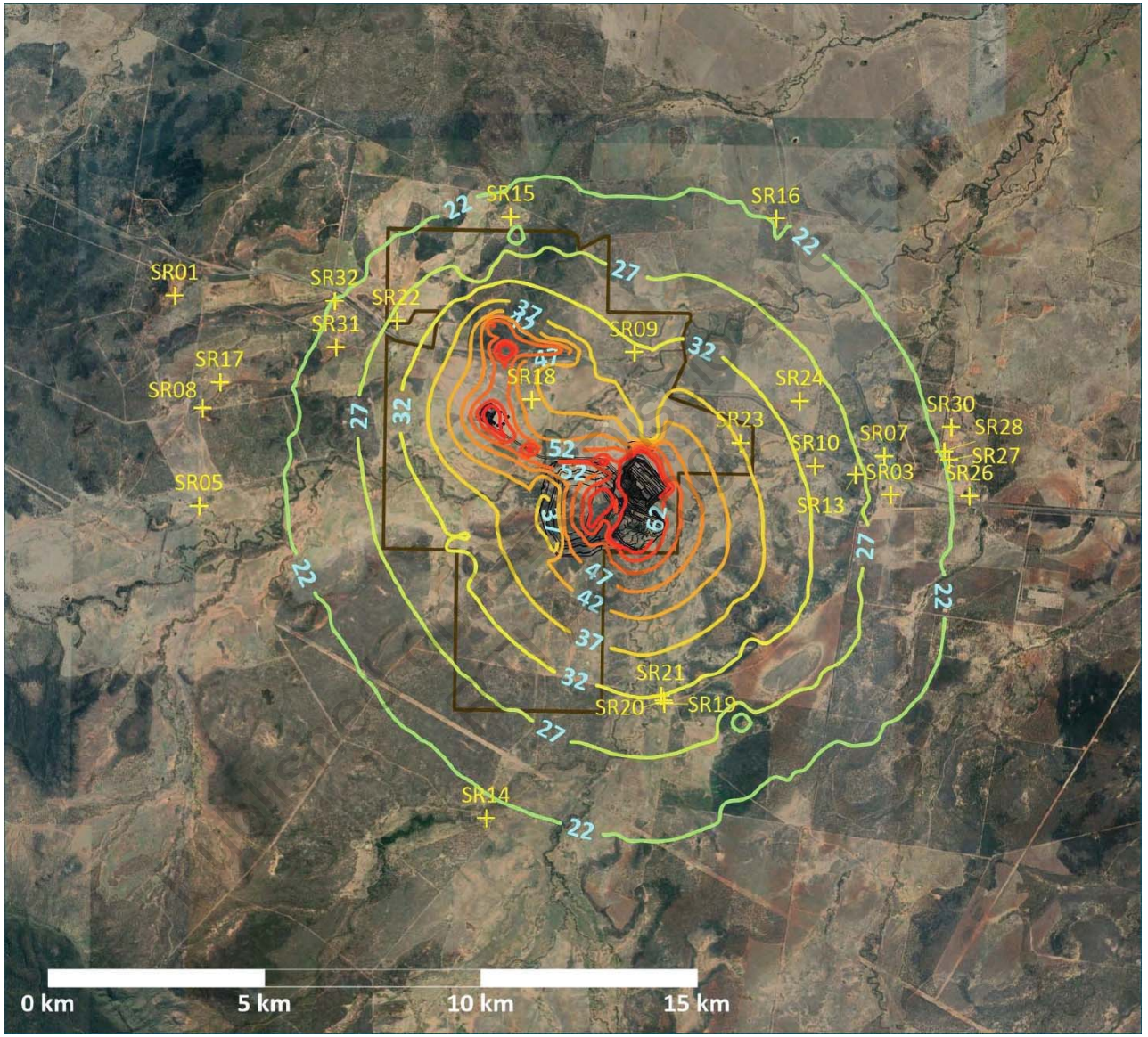


Figure 71 Year 8 - Day Neutral Scenario (Mine and Rail Loadout)

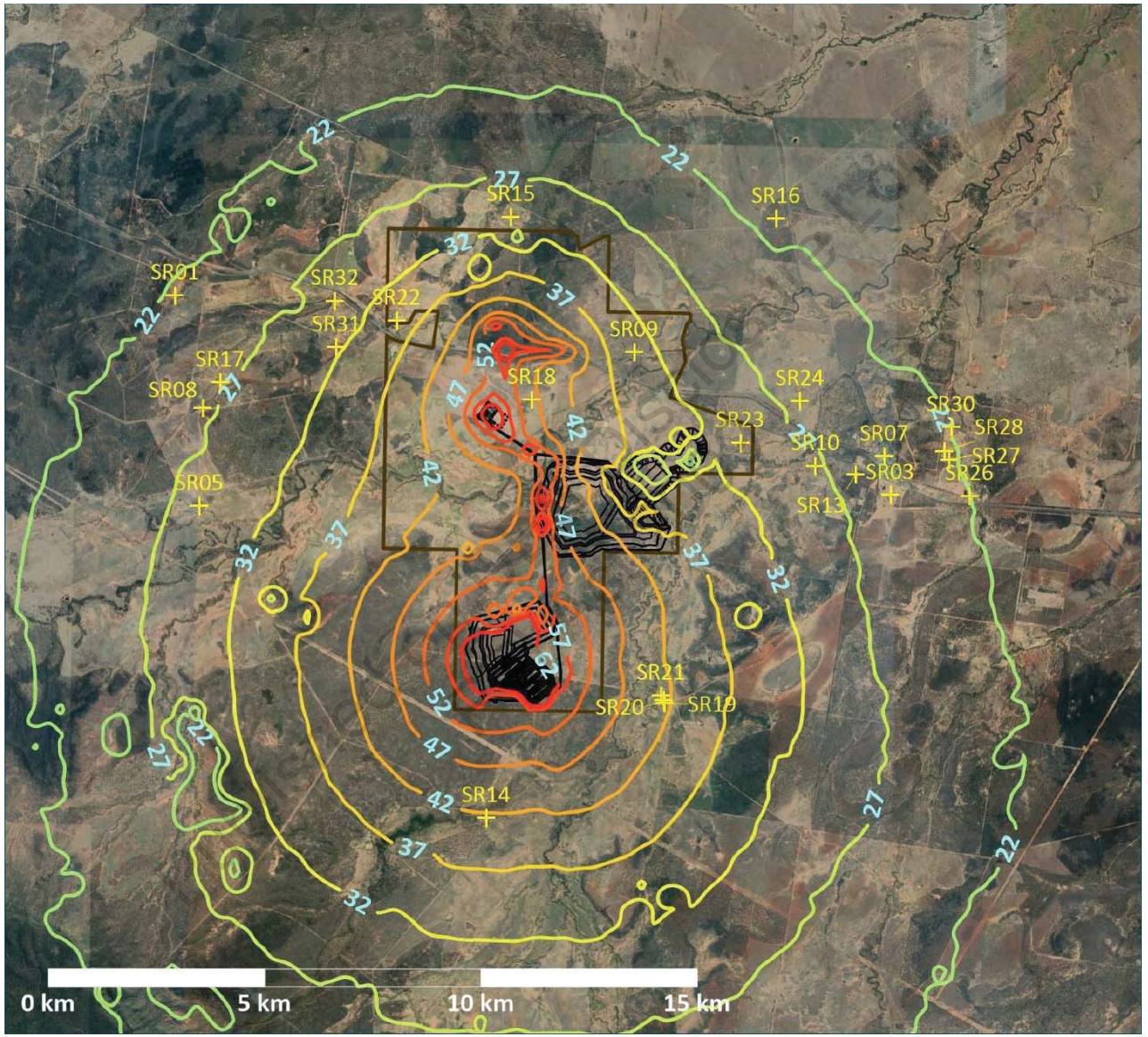


Figure 72 Year 15 - Night Adverse Scenario (Mine and Rail Loadout)

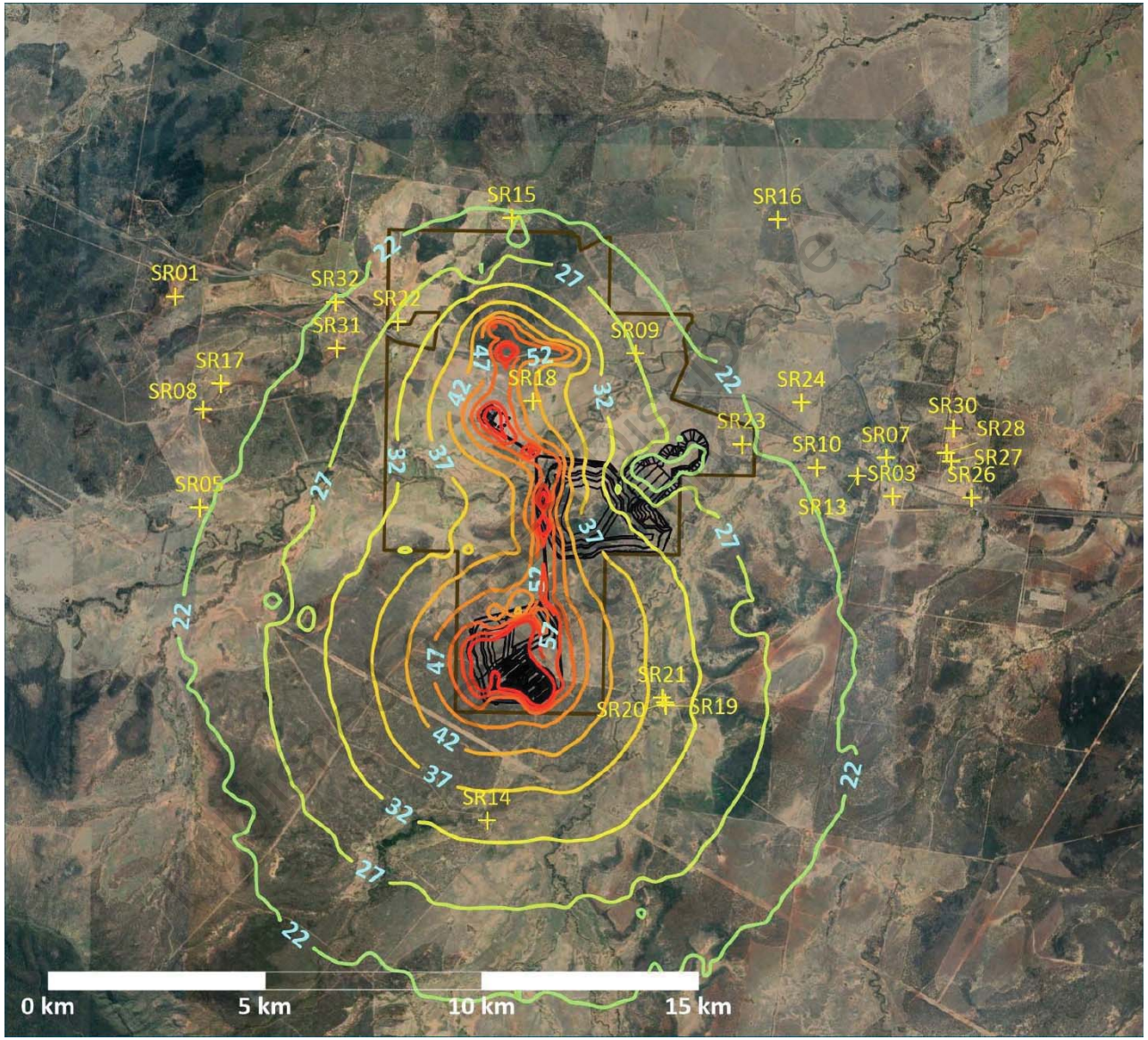


Figure 73 Year 15 Mine & Rail Loadout Day Neutral

For the night 'adverse' scenarios (Table 48), the highest exceedance is at SR18 (13 dBA in Year 2, 12 dBA in Year 8, and 11 dBA in Year 15). This sensitive receptor occurs within the MLA and is close to the ROM pad. From the day 'neutral' results in Table 49, the only exceedance is at SR18 (2 dBA in Years 2 and 8, and 1 dBA in Year 15).

Excluding SR18, for which Magnetic South is seeking an alternate commercial arrangement, and sensitive receptors located on property owned by Magnetic South at the time of submission (SR14, SR19, SR20 and SR21), the additional exceedances are listed as follows:

- SR09: Year 2 (6 dBA) and Year 8 (4 dBA);
- SR23: Year 2 (6 dBA) and Year 8 (7 dBA); and
- SR10: Year 8 (1 dBA).

SR09 and SR23 are located within the MLA and Magnetic South is progressing compensation agreements that will consider non-residency agreements. SR10 is located to the east of the MLA and Magnetic South is also in discussion with this landholder. Compliance is predicted at all other sensitive receptors.

11.3.4 Background Creep

The EPP (Noise) no longer contains criteria for background creep, but states that background creep should be prevented or minimised, to the extent that it is reasonable to do so.

Background creep can be defined as where noise levels increase over time with establishment of new development in, or near, an area. This is understood to require consideration of cumulative impacts, including other developments.

The nearest existing mine is Bluff PCI Project to the west of the Gemini Project. The sensitive receptors that have the most potential to be impacted by the Gemini Project to the west are SR22, SR31 and SR32, whilst the Bluff PCI Project is over 10 km from these receptors. Given this distance, and consideration that adverse wind conditions cannot occur for both mines simultaneously at these receptors since they are in opposite directions, it is unlikely that cumulative noise impacts from both mines would be an issue.

At locations close to the Capricorn Highway and Backwater Railway, road and rail traffic are significant noise sources. The background noise level monitoring identified $L_{Aeq,adj,15\ min}$ noise levels of 51 dBA and 49 dBA on average during the night at Locations A and B, respectively. These noise levels are well above the predicted mine noise levels at night, consequently the Gemini Project would have negligible impact relative to the noise levels from road and rail. The road and rail noise sources are also relatively intermittent, whilst the mining noise would typically be relatively steady. As such, additional assessment of the cumulative effects of the Gemini Project with existing road and rail noise is not warranted.

11.3.5 Vibration Assessment

It is anticipated that the existing vibration levels around the Project and at the location of sensitive receptors will generally be negligible, except at locations which are close to roads, rail lines or near major items of fixed plant. The only vibration source of significance from the mining of the Gemini Project would be blasting. Blasting activities within the pits have been assessed for both ground vibration and airblast.

Ground vibration and airblast levels caused by blasting activities were predicted based on the formulas and methodology of *Australian Standard AS2187.2: Explosives - Storage Transport and Use - Use of*

Explosives, which predicts the PPV in mm/s and the airblast over pressure (peak pressure) in dB. Technical details of assessment methodology and inputs for ground vibration and airblast can be found in Section 7 of the *Noise Impact Assessment* (ASK 2019) (Appendix J).

Based on the ASK (2019) blasting calculations, the ground vibration and airblast levels from the Gemini Project are predicted to be acceptable at the nearest sensitive receptors based on the nominated criteria (Table 47).

Table 50 shows that the 10 mm/s PPV criterion would not be exceeded at distances greater than 1.0 km from the blast, whilst the 5 mm/s PPV criterion would not be exceeded at distances greater than 1.5 km from the blast. The nearest sensitive receptor is approximately 1.9 km away from the nearest pit shell area where blasting would occur. Therefore, ground vibration due to blasting is predicted to be compliant with the nominated criteria at all sensitive receptors.

Table 50 Ground vibration levels at various distances from the blast

Distance from Blast (km)	Vibration Level (mm/s)	
	K = 800	K = 1600
1.0	2.9	5.9
1.5	1.5	3.1
2.0	1.0	1.9
2.5	0.7	1.4
3.0	0.5	1.0
3.5	0.4	0.8
4.0	0.3	0.6
4.5	0.3	0.5
5.0	0.2	0.4
5.5	0.2	0.4
6.0	0.2	0.3
6.5	0.1	0.3
7.0	0.1	0.3
7.5	0.1	0.2
8.0	0.1	0.2
8.5	0.1	0.2
9.0	0.1	0.2
9.5	0.1	0.2
10.0	0.1	0.1

Notes: K site and rock constant. Assumed to be in the range of 800 to 1600 for the Gemini Project (ASK 2019).

Table 51 contains the separation distances and the reduction of airblast noise levels due to distance. The distance to the airblast criterion contour line of 120 dB (linear) was calculated to be 880 m. The distance to the 115 dB (linear) contour line is calculated to be 1,290 m. Based on these calculations and blast parameters, the airblast criteria would not be exceeded at any sensitive receptors.

Table 51 Airblast noise levels at various distances from the blast

Distance from Blast (km)	Airblast Level (dB (linear))
1.0	118.3
1.5	113.0
2.0	109.3
2.5	106.4
3.0	104.0
3.5	102.0
4.0	100.3
4.5	98.8
5.0	97.4
5.5	96.2
6.0	95.0
6.5	94.0
7.0	93.0
7.5	92.2
8.0	91.3
8.5	90.5
9.0	89.8
9.5	89.1
10.0	88.4

11.3.6 Impacts and Risks

The Project has potential to impact on environmental values as a result of Project related noise impacts. Noise criteria was proposed (Table 46) in line with current policy.

From the predicted noise levels in Section 11.3.3 (Noise Modelling Results), of the properties that are not owned by Magnetic South at the time of submission, exceedances of the 37 dBA night objective is predicted at four receptors:

- SR09 (Year 2 and Year 8);
- SR10 (Year 8);
- SR18 (Year 2, Year 8 and Year 15);
- SR23 (Year 2 and Year 8).

The only exceedance of the 42 dBA day/evening objective occurred at SR18 (all modelling years), which is located close to the ROM pad. Compliance is predicted at all other sensitive receptors.

Of these potentially impact receptors; three are located within the MLA (SR09, SR18, and SR23) and Magnetic South is progressing compensation agreements that will consider non-residency agreements,

or a suitable property acquisition agreement. Discussions with landowners of properties within the MLA and surrounds are ongoing. Furthermore, a range of additional measures will be implemented, as necessary, to achieve compliance for residual sensitive receptors in the area.

Given there is a potential for exceedances, a noise monitoring program will be established. Where exceedances are measured at sensitive receivers, amelioration treatments to reduce noise levels may include:

- Management of mining equipment locations, such as operating at lower elevation or shielded areas during the night. Noise modelling with equipment relocated to shielded locations at lower elevation (e.g. in-pit) indicates that a 1 to 3 dBA reduction could be achieved;
- Reducing the number of equipment in operation during the night, such as reducing the haul truck fleet by 50% at night and removing at least two dozers is calculated to reduce noise levels by 3 dBA;
- Attenuation of equipment; such as packages for the major mobile equipment items, including haul trucks, dozers and excavators. It is expected that a reduction in the order of 5 dBA could be achieved; or
- Construction of a bund wall of sufficient height and in a location, which provides a high level of shielding to the loudest equipment (waste haul trucks and dozers), could be considered.

As discussed in further in Section 11.4 (Mitigation Measures, Management and Monitoring), based on the modelling and estimated noise reductions, it is expected that compliance can be achieved with noise management and/or attenuation measures.

Cumulative impacts (Section 11.3.4 (Mitigation Measures, Management and Monitoring)) from other mines are not expected to be an issue. Noise from road and rail are considerable at sensitive receptors near the Capricorn Highway and rail line, but since these sources are intermittent and will generally result in higher noise levels than those predicted for the mine, additional assessment of the cumulative effects of the Gemini Project with existing road and rail noise was not warranted.

Based on the blasting parameters and calculations (Section 11.3.5 (Vibration Assessment)), the ground vibration and airblast levels from blasting are predicted to be compliant at all sensitive receptors.

The impact assessment modelled scenarios representing the Project years with the worst-case scenarios for noise impacts. There is a low risk that the Project would exceed the modelled scenarios. The management strategies discussed in Section 11.4 (Mitigation Measures, Management and Monitoring), will ensure noise is managed and risk remains low throughout the life of the Project. Magnetic South is committed to implementing procedures for monitoring and complaints resolution to control magnitude of risk.

Ongoing discussions with landholders, as well as provision for and commitment to noise monitoring and management will result in a low risk of noise impacts to human health and wellbeing.

11.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

The management hierarchy for noise as set out in the EPP (Noise) requires that for an activity involving noise that affects, or may affect, an environmental value, to the extent that it is reasonable to do so, noise must be dealt with in the following order of preference:

1. Avoid the noise (e.g. locating an activity in an area that is not near a sensitive receptor);
2. Minimise the noise by preferably:
    a. Orientating an activity to minimise the noise (e.g. facing a part of an activity that makes noise away from a sensitive receptor); or alternatively
    b. Using the best available technology to minimise the noise; or
3. Manage the noise (e.g. using heavy machinery only during business hours).

The potential requirements for noise mitigation at this time are based solely on noise modelling for the Project. Magnetic South will monitor and verify noise levels before considering implementation of mitigation measures discussed.

During the commencement of mining operations, a noise monitoring survey will be conducted to verify the noise emissions within the Project and the level of noise impact at sensitive receptors. The verified noise levels will direct auditing compliance to noise limits that will be administered under the Environmental Authority and inform the ongoing design of operations and any noise mitigation requirements.

Noise and vibration management and mitigation measures will be implemented for the Project. Magnetic South is committed to implementing the following measures:

1. Develop and implement a noise monitoring program at sites representative of surrounding sensitive receptors for verification of modelling results. All noise monitoring will be conducted in accordance with *Australian Standard AS1055: Acoustics – Description and measurement of environmental noise* and the *Noise Measurement Manual* (EHP 2013b).

A blast monitoring program will be developed to monitor the airblast overpressure and blast vibration levels during all blast events. The blast design details will be the responsibility of the blast contractor and observations before and after blasting will also be recorded;

2. Ensure mitigation measures are put in place where the monitoring program indicates a potential exceedance. This may include amelioration treatments to reduce noise levels such as management of mining equipment locations, reducing the number of equipment in operation during the night, attenuation of equipment and/or construction of bund walls;
3. Develop a *Noise and Blast Management Plan* (NBMP) that will include a range of available measures to be implemented as necessary to ensure compliance with approval conditions. Measures that would be considered for inclusion in the NBMP include:
    a. Details of the of mitigation and management measures that are to be implemented at the site to minimise noise and vibration from the mine;
    b. Requirements for monitoring the impacts of mine operations on sensitive receptors;

c. Additional remedial actions for noise control in the event of complaints being received, exceedances of criteria being recorded, or other trigger levels being breached; for example:

    i. Management of mining equipment locations;

    ii. Reducing the number of equipment in operation during the night;

    iii. Attenuation of equipment; and/or

    iv. Construction of bund walls;

d. The requirement that Magnetic South will investigate, if monitoring indicates unexpected exceedances of noise or blast objectives; and

e. Roles and responsibilities for implementation, monitoring and review of the NBMP.

4. Enter into discussions and, as appropriate, commercial arrangements with affected surrounding landholders which could include:

    a. Measures (e.g. purchase or relocation) which result in homesteads no longer being considered a sensitive receptor; or

    b. Installation of receptor-side mitigation (e.g. air conditioners and glazed windows in affected residences to allow for closed windows).

12.0 WASTE GENERATION

This section provides a description of the waste streams that are likely to be produced over the life of the Project and describes the proposed measures for minimising and managing waste generated.

This section refers to general and regulated waste streams to be managed at the Project. Other waste products not addressed here include water, air, greenhouse gas and waste rock. These are addressed in the relevant technical sections:

- Surface water runoff and wastewater is addressed in Section 7.0 (Surface Water);
- Groundwater inflows into the open pits is addressed in Section 8.0 (Groundwater);
- Airborne wastes excluding greenhouse gases is addressed in Section 9.0 (Air Quality);
- Greenhouse gases and fugitive emissions is addressed in Section 10.0 (Greenhouse Gas); and
- Excavated waste rock and coal rejects is addressed in Section 13.0 (Waste Rock and Coal Reject Geochemistry).

12.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

The environmental objective relevant to waste, as described in the EA guideline for *Application requirements for activities with waste impacts [ESR/2015/1836]* (DES 2019), is:

Any waste generated, transported, or received as part of carrying out the activity is managed in a way that protects all environmental values.

The Project would achieve the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

a) *Waste generated, transported, or received, is managed in accordance with the waste and resource management hierarchy in the Waste Reduction and Recycling Act 2011; and*

b) *If waste is disposed of, it is disposed of in a way that prevents or minimises adverse effects on environmental values.*

12.2 DEFINITION OF WASTE

The EP Act defines ‘waste’ as anything that is:

a) *left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity; or*

b) *surplus to the industrial, commercial, domestic or other activity generating the waste.*

Section 42 of the EP Regulation defines ‘regulated waste’ as waste that is:

a) *commercial waste or industrial waste; and*

b) *a type, or contains a constituent of a type, mentioned in schedule 9, part 1, column 1.*

12.3 IDENTIFIED WASTE TYPES

The primary source of waste from mining operations is excavated waste (overburden and interburden), coarse rejects and fine rejects (tailings) from the CHPP. Other wastes (regulated and non-regulated) expected to be produced from activities pertaining to the Project include:

- general waste;
- recyclable waste;
- refurbishable items;
- green waste;
- scrap metal;
- personal protective equipment (PPE);
- air filters;
- timber and reusable pallets;
- waste oils;
- engine oil/fuel filters;
- waste greases;
- sewage effluent;
- empty waste oil containers;
- paints;
- hydrocarbon contaminated material;
- miscellaneous chemicals;
- batteries;
- ozone depleting substances; and
- tyres.

Table 52 describes the expected quantity of each generated waste type and disposal locations during the construction and operational phases of the Project.

Table 52 Anticipated waste generation from the construction and operation of the Project

Waste Type/ Waste Category	Form	Source	Approximate Quantity (per annum)		Management Strategies	Waste Management Hierarchy	Proposed Disposal Location
			Construction	Operation			
Non-regulated							
Excavated waste *(i.e. overburden, interburden)*	Solid	Mining activities	n/a	Up to 473.4 Mbcm	Excavated waste rock will be placed in an out-of-pit waste rock emplacement and in-pit waste rock emplacements of Pit AB and Pit C when space becomes available behind the advancing mining operations.	Waste disposal	Excavated waste rock will be disposed of within Pit AB and Pit C and out-of-pit waste rock emplacements.
Coal rejects *(i.e. coarse and fine rejects)*	Solid	Mining activities	n/a	Up to 8 Mtpa	Coal rejects will be disposed of in out-of-pit waste rock emplacements and in-pit waste rock emplacements of Pit AB and Pit C when space becomes available behind the advancing mining operations.	Waste disposal	Coal rejects will be disposed of within Pit AB and Pit C and out-of-pit waste rock emplacements.
General waste *(i.e. food scraps, non-Class 1, 2 and 5 plastics)*	Solid	Kitchenettes, crib rooms, administration areas, workshop, etc.	<130 t/a	<170 t/a	General waste will be stored onsite in bins for regular transport offsite by a licensed waste transport contractor to a licensed landfill.	Waste disposal	General waste will be transported offsite by a licenced waste contractor to an approved landfill.
Recyclable waste *(i.e. aluminium, steel cans, Class 1, 2 and 5 plastics, paper towels, paper and cardboard)*	Solid	Kitchenettes, crib rooms, administration areas, workshop, etc.	<40 t/a	<70 t/a	Recyclable waste will be stored onsite in bins for regular transport offsite by a licensed waste transport contractor for recycling.	Waste recycling	Recyclable waste will be transported offsite by a licenced recycling contractor to an approved recycling facility.

Waste Type/ Waste Category	Form	Source	Approximate Quantity (per annum)		Management Strategies	Waste Management Hierarchy	Proposed Disposal Location
			Construction	Operation			
Refurbishable items *(i.e. pipe work and associated components and fittings, wing nuts, conveyor rollers and belt)*	Solid	CHPP and workshops	<10 t	<10 t	Refurbishable items will be stockpiled within a designated area. If condition is acceptable, items will be reused directly.	Waste reuse	Reuse onsite.
					Where items are unable to be reused, they will be collected and disposed by a licensed waste contractor. Where items are contaminated with hydrocarbons, they will be managed as regulated waste.	Waste disposal	Refurbishable items will be disposed of offsite by a licenced waste contractor to an approved waste facility.
Green waste *(i.e. grass, cleared timber and weeds)*	Solid	Clearing of vegetation	As per schedule	As per schedule	Green waste will be mulched and/or placed in timber stacks for reuse onsite during rehabilitation.	Waste reuse	Reuse onsite.
Scrap metal *(i.e. stainless steel, aluminium and any item considered to be metal [ferrous or non-ferrous] including machine and vehicle parts)*	Solid	Construction activities, infrastructure maintenance and workshops	<50 t	<100 t	Small scrap metals will be placed in scrap metal skips. All grease and oils will be removed prior to placement in skips. Specific arrangements will be made for the collection of larger scrap metals. A licensed contractor will remove all scrap metals for segregation at a licensed recycling facility.	Waste recycling	Scrap metal will be transported offsite by a licensed contractor to an approved recycling facility.
PPE and other small items *(i.e. gloves, hard hats, safety glasses and face masks)*	Solid	Bathhouse and contractor facilities	<100 kg	<200 kg	Equipment that is not damaged will be reused onsite.	Waste reuse	Reuse onsite.
					Equipment that is sufficiently used and/or damaged will be disposed.	Waste disposal	PPE will be transported offsite by a licenced waste contractor to an approved landfill.
Air filters *(i.e. engine air filters)*	Solid	Vehicle and machinery maintenance at workshops	<1 t	<7 t	Air filters will be temporarily stored in the appropriate air filter skip and will be disposed of offsite by a licensed waste contractor.	Waste disposal	Air filters will be transported offsite by a licenced waste contractor to an approved landfill.

Waste Type/ Waste Category	Form	Source	Approximate Quantity (per annum)		Management Strategies	Waste Management Hierarchy	Proposed Disposal Location
			Construction	Operation			
Timber/reusable pallets	Solid	Workshop and administration areas	<20 t	<20 t	Reusable pallets will be returned to the supplier.	Waste reuse	Return to supplier for reuse.
					Where pallets are unable to be reused, they will be sent to general waste.	Waste disposal	Pallets that are not reusable will be transported offsite by a licenced waste contractor to an approved landfill.
Regulated							
Waste oils	Liquid	Machinery and vehicle maintenance and workshop	30 kL	199 kL	Waste oils will be transported offsite by a licensed regulated waste contractor and will be reused or recycled by a licensed regulated waste receiver.	Waste reuse or recycling	Waste oils will be recycled by a licenced regulated waste contractor.
Engine oil/fuel filters	Solid/ Liquid	Vehicle and machinery maintenance at workshop	50 each	780 each	Engine oil filters will be collected and stored in sealed oil filter disposal pod. They will be transported by a licensed regulated waste contractor to a licensed regulated waste receiver for treatment to recover oil for reuse.	Waste reuse	Re-use onsite.
					If filters are unable to be recovered, they will be recycled by a licensed regulated waste contractor.	Waste recycling	Engine oil/fuel filters will be recycled by a licenced regulated waste receiver at an approved recycling facility.
Waste grease *(i.e. from machinery)*	Liquid	Workshop, large machinery maintenance	<0 kL	<0.5 kL	Waste grease will be stored in sealed containers or tanks in a designated bunded area, which will then be transported offsite by a licensed regulated waste contractor. Waste grease will be recycled at a licensed waste facility.	Waste recycling	Waste grease will be recycled at an approved offsite facility by a licenced regulated waste contractor.

Waste Type/ Waste Category	Form	Source	Approximate Quantity (per annum)		Management Strategies	Waste Management Hierarchy	Proposed Disposal Location
			Construction	Operation			
Sewage	Liquid	Offices, workshops and accommodation camp	<7,665 kL	<7,665 kL	Sewage generated onsite will be pumped to the STP located proximate to the accommodation facility. Treated effluent will be irrigated with sprinklers to a designated area located at a distance of at least 500 m away from site offices and residences.	Treat waste before disposal	Treated effluent will be irrigated with sprinklers to a designated area.
			Low	Low	Sewage sludge will be directed to the septic systems and will be removed every 12-18 months for disposal by a certified regulated waste contractor for offsite disposal.	Disposal	Waste sludge will be disposed of by a regulated waste contractor
Empty waste oil containers	Solid	Workshop	<1 t	<1 t	All drums will be segregated and sealed prior to collection by a licensed regulated waste contractor and transported to a licensed waste receiver for recycling.	Waste recycling	Empty waste oil containers will be recycled offsite by a licenced regulated waste receiver.
Paints *(i.e. general paint, air dried insulating varnish)*	Liquid /Gas	Industrial area infrastructure and workshop	<1 t	<1 t	Paints will be transported to a designated sealed and bunded area to be collected by a licensed regulated waste contractor and transported to a licensed regulated waste receiver for treatment before disposal.	Treat waste before disposal	Empty waste oil containers will be recycled by a licenced regulated waste contractor.
Hydrocarbon contaminated material *(i.e. oily rags)*	Solid/ Liquid	Workshop servicing trucks and light/heavy vehicles	<1 t	<5 t	Hydrocarbon contaminated material will be stored in temporary storage facilities in the MIA, which will then be collected for offsite disposal.	Waste disposal	Hydrocarbon contaminated material will be disposed of by licenced waste transport operators at an appropriately licensed waste disposal facility.

Waste Type/ Waste Category	Form	Source	Approximate Quantity (per annum)		Management Strategies	Waste Management Hierarchy	Proposed Disposal Location
			Construction	Operation			
Miscellaneous chemicals *(i.e. engine coolant, solvents, sealants, etc.)*	Liquid / Gas	Workshop and administration	<1 kL	40 kL	Miscellaneous chemicals will be transported to a designated sealed and bunded area for collection by a licensed regulated waste contractor and transported to a licensed regulated waste receiver for treatment and disposal.	Treat waste before disposal	Miscellaneous chemicals will be disposed offsite by a licenced regulated waste contractor at an approved licenced facility.
Batteries *(i.e. dry cell, gel cell, lead acid)*	Solid	Operation of portable electrical equipment (radios, phones, etc.) within the workshop and other areas	<1 t	<2 t	Batteries will be segregated and stored within dedicated containers in the battery storage area, which will then be collected and transported by a licensed regulated waste contractor to a licensed regulated waste facility for recycling.	Waste recycling	Batteries will be recycled by a licensed regulated waste contractor at a licensed regulated waste facility.
					Remaining batteries that are not recyclable will be disposed of by a licensed regulated waste contractor.	Waste disposal	Batteries will be disposed offsite by a licenced regulated waste contractor at a licensed regulated waste facility.
Ozone depleting substance *(i.e. refrigerants and air conditioning substances)*	Liquid / Gas	Air conditioning units, fridges and cars throughout site	<1 kg	<1 kg	Ozone depleting substances will be stored at the source in cylinders and returned to the supplier for reuse and recycling.	Waste reuse and recycling	Ozone depleting substances will be recycled by a licenced regulated waste contractor.

Waste Type/ Waste Category	Form	Source	Approximate Quantity (per annum)		Management Strategies	Waste Management Hierarchy	Proposed Disposal Location
			Construction	Operation			
Tyres *(i.e. light and heavy vehicle tyres)*	Solid	Tyres from light and heavy vehicles	20	50	Tyres will be segregated and re-purposed onsite in a designated area where there will be no flammable materials within a 10 m radius. Tyres will then be transported offsite to a supplier for re-treading.	Waste reuse	Reuse onsite for alternate purposes.
					The remainder of tyres that will not be re-purposed will be disposed onsite in a designated tyre disposal area of the backfilled Pit AB and/or Pit C.	Waste disposal	Tyres will be disposed onsite within a designated tyre disposal area of the backfilled Pit AB and/or Pit C.

12.4 REGIONAL WASTE MANAGEMENT FACILITIES

The CHRC provides a network of 18 waste management facilities available for communities and businesses to dispose waste materials (CHRC 2016). The waste management facilities comprise eight small facilities (<2,000 t/a), three with a landfill capacity of 2,000-5,000 t/a, one large facility with a capacity of 10,000-20,000 t/a located in Emerald, and six bulk bin/transfer stations.

CHRC is currently progressing through an infrastructure rationalisation program in order to ensure environmental and licence compliance with DES requirements, while increasing opportunities for recycling, and ultimately, reducing the amount of waste sent to landfill (CHRC 2016).

Regional and local industry in general and the regional coal industry in particular, has created sufficient demand for waste management services such that the region is well serviced by all major waste service providers. Access to these services has resulted in a relatively mature approach by businesses in the area to waste sorting and recycling.

Current bulk bin, landfill and transfer station facilities are indicated in Figure 74.

12.5 WASTE MANAGEMENT

Waste from the Project will be managed in accordance with the waste and resource management hierarchy from the *Waste Reduction and Recycling Act 2011* (WRR Act), which lists waste and resource management strategies in the order of most to least preferred option:

(a) ***Avoid*** *unnecessary resource consumption;*

(b) ***Reduce*** *waste generation and disposal;*

(c) ***Re-use*** *waste resources without further manufacturing;*

(d) ***Recycle*** *waste resources to make the same or different products;*

(e) ***Recover*** *waste resources, including the recovery of energy;*

(f) ***Treat*** *waste before disposal, including reducing the hazardous nature of waste; and*

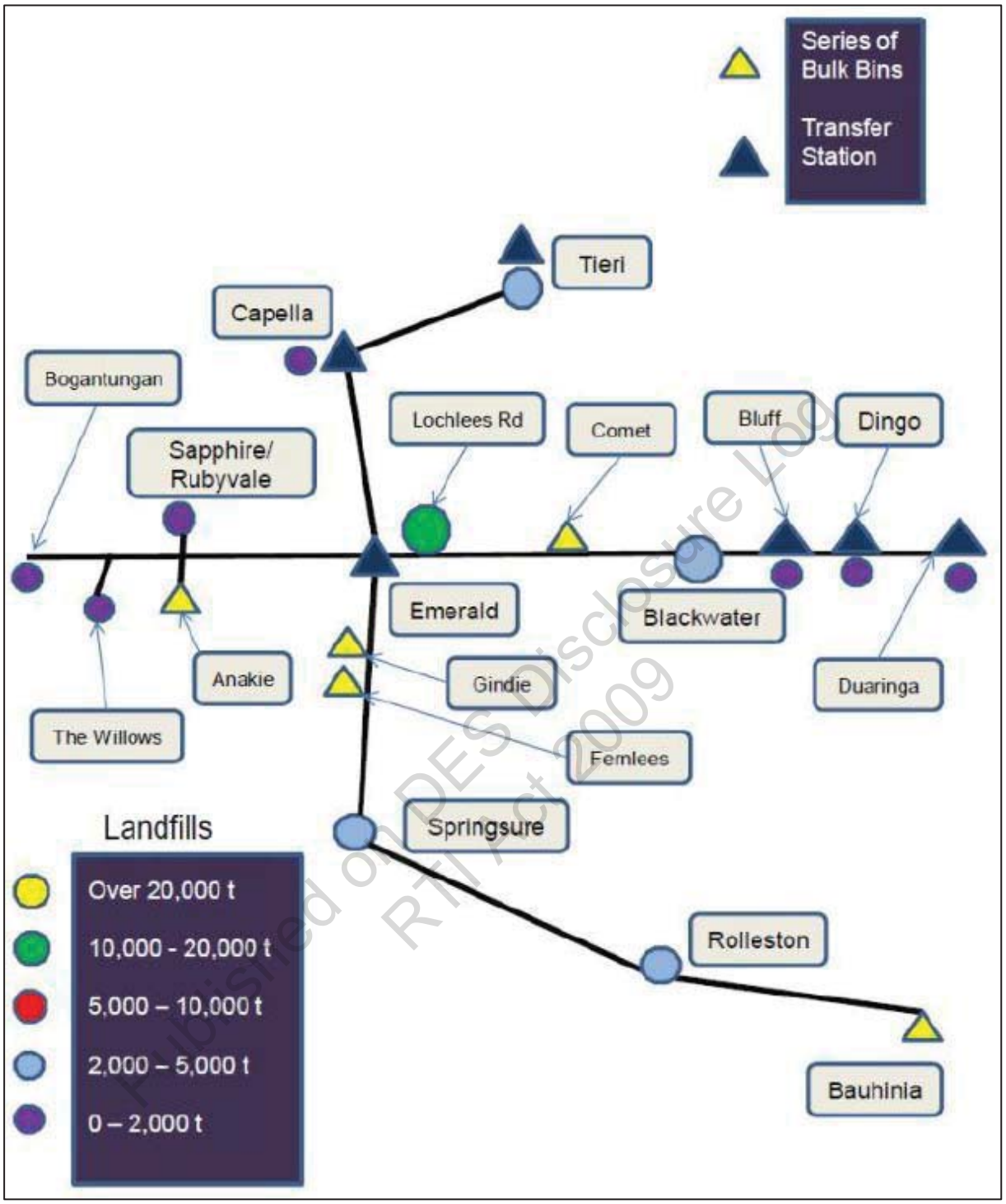
(g) ***Dispose*** *of waste only if there is no viable alternative.*

Appropriate waste management strategy for each waste stream in accordance with the hierarchy is addressed in Table 52.

Avoid or Reduce

Avoiding the production of waste is predominantly achieved through procurement practices, where the expected life and disposal requirements of materials or products are considered during the purchasing process.

Raw materials would be delivered in bulk where feasible. Otherwise, material that is not purchased in bulk will be determined based on minimal packaging and use of biodegradable materials. Magnetic South will also consider the use of alternative products, implementation of appropriate technology and procurement processes to ensure that unnecessary waste is not produced.



Source: CHRC 2016

Figure 74 Current CHRC waste infrastructure plan

Magnetic South will aim to reduce the amount of waste produced by limiting the amount of materials being transported to and stored onsite. Waste reduction efforts will also be towards reducing unnecessary consumption of electricity and water resources, along with the use of materials and products such as paper.

Reuse

Waste streams will be reused wherever ongoing health, safety and reliability can be ensured. Where possible, waste will be reused onsite or will be returned to the suppliers to enable reuse.

Recycle

The Project will generate a number of waste materials that can be recycled to generate products for a beneficial reuse.

Wastes that are recyclable will be collected and stored in designated bins, sealed containers or bunded areas, which will then be taken offsite by a licensed waste contractor and recycled at a licensed recycling facility.

Recover

Waste recovery is not proposed to be undertaken at the Project.

Treatment

Treatment of waste before disposal can minimise the environmental impact of waste disposal.

Paints and miscellaneous chemicals will be transported offsite by a licensed regulated waste contractor and treated at a licensed waste facility before disposal.

Sewage onsite will be treated in a STP located at the on-site accommodation facility. Treated effluent will be released for irrigation in accordance with the EA conditions.

Dispose

Disposal of waste is to be considered when no other economically feasible option for reuse or treatment exists. The disposal method will seek to minimise environmental effects and the potential for land contamination.

In most instances, where waste is proposed to be transported to a licenced landfill facility, Magnetic South will arrange for the waste to be transported offsite. This commitment will form part of the contractual arrangements which will be developed with licenced contractors.

Waste that will be disposed of offsite include general waste, air filters, hydrocarbon contaminated materials, sewage sludge and wastes that are no longer in reusable or recyclable conditions such as wooden pallets, refurbishable items and PPE. Sewage sludge will be collected and stored in a septic system onsite which will also be collected for disposal by a licensed waste contractor.

Scrap tyres that cannot be re-used will be stockpiled onsite in a designated area in Pit AB and Pit C in accordance with *Operational Policy (Mining): Disposal and storage of scrap tyres at mine sites [ESR/2016/2380]* (DES 2014b).

12.6 REGULATED WASTE MANAGEMENT

The EP Regulation requires that the administering authority is provided with appropriate information to manage the associated environmental risks of 'trackable wastes' listed in Schedule 11 of the EP Regulation.

Trackable waste will only be transported offsite by a licensed transporter (section 96 of the EP Regulation). The Proponent will also be required to provide information to the waste transporter in accordance to Schedule 12 of the EP Regulation.

'Waste transport certificates', along with other prescribed forms, are required to be submitted to DES as part of the process for tracking wastes in Queensland.

A register will be developed and maintained for all regulated wastes generated on-site, which will include the following details:

- Source, type and quantity of waste;
- Storage location;
- Dates of collection and recycling/disposal; and
- Name and details (including licencing details) of transporter and waste disposal facility.

12.7 WASTE AUDITING, MONITORING AND REPORTING

The waste streams and quantities produced would be recorded by Magnetic South over the life of the Project. Audits of the waste management activities will include:

- Assessing actual generated wastes against the predicted waste quantities;
- Monitoring the actual and potential impacts from wastes;
- Reviewing the waste transportation records to ensure compliance; and
- Identifying potential improvements in waste management practices, including establishment of waste reduction targets, where practicable.

Magnetic South will also monitor the implementation and effectiveness of the *Waste Management Plan* and its compliance with relevant Commonwealth and Queensland legislation.

13.0 WASTE ROCK AND COAL REJECT GEOCHEMISTRY

This section discusses the characterisation of waste rock and coal rejects for the Gemini Project. The *Geochemical Assessments of Mining Waste Materials* (RGS 2019a) (Appendix D) and *Geochemical Assessments of Coal Reject Material* (RGS 2019b) (Appendix E) were undertaken with the aim of understanding any potential geochemical risks. The assessments provide a geochemical characterisation of samples representative of the mining wastes (overburden and interburden materials) and coal reject materials.

Both static and kinetic testing methods were utilised to indicate the presence and degree of risk from the oxidation of reactive sulfides, and the potential for acid generation and leaching of soluble metals/metalloids and salts. The assessments also included characterisation of chemical parameters related to sodicity and material stability. The assessments were completed in accordance with relevant industry guidelines:

- *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland* (DME 1995);
- *Application requirements for activities with impacts to water [ESR/2015/1837]* (DES 2017c);
- *Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure* (COA 2016a);
- *Leading Practice Sustainable Development Program for the Mining Industry – Mine Rehabilitation* (COA 2016b);
- *Leading Practice Sustainable Development Program for the Mining Industry – Preventing Acid and Metalliferous Drainage* (COA 2016c); and
- *Global Acid Rock Drainage Guide (GARD Guide)* (INAP 2009).

13.1 ENVIRONMENTAL OBJECTIVES AND PERFORMANCE OUTCOMES

Surface waters and groundwaters could potentially be impacted from any adverse geochemical by-product associated with waste rock and coal rejects. The environmental values have been determined given that waste rock is being disturbed, placed and rehabilitated, and that coal rejects are a waste stream from coal processing that need to be managed. The relevant environmental objectives were therefore determined to be associated with potential impacts to water.

The environmental objective relevant to water, as described in the EA guideline for *Application requirements for activities with impacts to water [ESR/2015/1837]* (DES 2017c); are:

- *The activity will be operated in a way that protects environmental values of waters.*
- *The activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems.*

The Project would generally achieve these performance outcomes through implementation of the following measures as outlined in Part 3, Schedule 8, Division 1 of the EP Regulation:

a) *The storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks.*

b) *Contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water.*

c) *The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment.*

d) *The disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values.*

e) *Acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered.*

f) *Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland.*

g) *The activity will be managed so that adverse effects on environmental values are prevented or minimised.*

With respect to the groundwater-related objective, the following measures apply (DES 2017c):

a) *There will be no direct or indirect release of contaminants to groundwater from the operation of the activity.*

b) *There will be no actual or potential adverse effect on groundwater from the operation of the activity.*

In addition, the activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.

13.2 DESCRIPTION OF ENVIRONMENTAL VALUES

From a geochemical perspective, the EPP (WWB) is the primary instrument for protecting Queensland waters to achieve the object of the EP Act in relation to water. The EPP Water establishes EVs and management goals for waters and wetlands.

A key relevant document for the Project is the *Mackenzie River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Mackenzie River Sub-basin* (EHP 2011a). The document is made pursuant to the provisions of the EPP Water. It contains EVs and WQOs for waters in the Mackenzie River sub-basin. The WQOs and EVs are detailed Section 7.0 (Surface Water) and Section 8.0 (Groundwater).

13.2.1 Surface Water and Groundwater Resources

A description of surface water resources is provided in Section 7.2.1 (Drainage Network) including several illustrative figures.

All waterways of the Project area are ephemeral and experience flow only after sustained or intense rainfall in the catchment. Stream flows are highly variable, with most channels drying out during winter to early spring when rainfall and runoff is historically low, although some pools hold water for extended periods. Therefore, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

The land within the Project boundary is currently used for low intensity cattle grazing and resource exploration activities. The reaches of Springton Creek and Charlevue Creek in the proposed mining area have well-defined channels, typically with alluvial clay beds and well established in-channel vegetation.

Further details regarding the surface water management of the Project have been included in Section 3.4 (Site Water Management) and surface water Section 7.4 (Mitigation Measures, Management and Monitoring).

Groundwater resources are described in detail in Section 8.2.1 (Geology & Hydrogeology) and Section 8.2.2 (Groundwater Quality) including several illustrative figures.

13.3 POTENTIAL IMPACTS

Detailed geochemical assessments were undertaken of waste rock material (RGS 2019a) (Appendix D) and coal reject material (RGS 2019b) (Appendix E) associated with the Project. Geochemical test work undertaken was based on industry recognised procedures for the geochemical characterisation and assessment of mine materials. Refer to the relevant appendix report for technical details of the methodology and results of each assessment.

13.3.1 Coal Reject Geochemistry

A total of 80 coal reject samples from coal quality washability tests were provided from 14 different drill holes, comprising 52 coarse reject and 28 fine reject samples.

The $pH_{(1:5)}$ of the 22 composite coal reject samples from the Project ranged from 5.1 to 8.3 with a median value of 7.4 indicating that coal reject materials are typically in the pH neutral range. There does not appear to be any significant correlation between pH and reject type or coal seam.

$EC_{(1:5)}$ ranges from 398 to 1,062 µS/cm (median 774 µS/cm), with no apparent correlation between EC and reject type or coal seam. Based on the median pH and EC values, the coal reject samples tested are generally regarded as having 'high' soil pH and 'medium' salinity values with respect to the criteria for mining waste materials as defined by the *Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland* (DME 1995).

The total sulphur content (measure as total sulphur concentration - %S) of the samples ranges from 0.23-4.20 %S with a median value of 1.03 %S. This compares to a median crustal abundance value of 0.07 %S in unmineralised soils (Bowen 1979; INAP 2009). Materials with a total sulphur content less than or equal to 0.1 %S have negligible capacity to generate acidity. The reject samples used in the kinetic leach column (KLC) tests retained at least about 95.6% of their inherent total sulphur content after three months of exposure to idealised oxidising conditions. This reflects a relatively slow rate of sulfide oxidation (and potential acid generation) for these materials.

The results of the multi-element analysis were assessed against the geochemical abundance index (GAI) in accordance with relevant guidelines and practices (Bowen 1979; INAP 2009). The GAI results indicate that of the metals/metalloids measured, none are significantly enriched compared to median crustal abundance. The main findings of the coal reject geochemical assessment (Appendix E) are:

- The coal reject samples represent materials with a variety of geochemical characteristics ranging from non-acid forming (NAF) to PAF. As a bulk material, coal reject is expected to be NAF with excess acid neutralising capacity (ANC). Overall, most coal reject materials have a relatively low risk of acid generation and an increased factor of safety with respect to potential for AMD.

- Initial and ongoing surface runoff and seepage from coal reject materials is expected to be pH neutral and have a moderate level of salinity. The salinity of leachate from higher sulphur coal reject materials could increase over time if exposed to atmospheric conditions, due to the release of sulfate through sulphide oxidation.

- Comparison with guideline values and median crustal abundance in unmineralised soils indicates that the coal reject materials are not significantly enriched with metals/metalloids.

- Most metals/metalloids are sparingly soluble at the current pH of the leachate from coal reject materials. Dissolved metal/metalloid concentrations in surface runoff and leachate from bulk coal reject materials are expected to be relatively low and unlikely to pose a significant risk to the quality of surface and groundwater resources at relevant storage facilities.

13.3.2 Waste Rock Geochemistry

A total of 70 waste samples were collected from three drill holes within the Project area; representative of the main overburden, interburden and potential coal reject materials likely to be encountered during development of the Project. Samples were collected from the surface down through the stratigraphic profile (including economic and uneconomic coal seams) to the base of the open pit. The number of samples was selected to provide a good statistical representation of the amount and types of mining waste materials expected to be generated at the Project.

The $pH_{(1:5)}$ of samples across all sample types, ranged from 5.0 to 9.7 with a median value of 9.2. The samples with the lowest pH values (pH 5.0 to 5.5) represent clay and soil materials.

$EC_{(1:5)}$ ranges from 270 to 1,440 µS/cm with a median of 646 µS/cm, considered to be moderate. The weathered material tends to have a higher EC value than the fresh material.

Total sulphur content ranges from less than 0.01-0.60 %S (median 0.06 %S). Compared to the median crustal abundance of sulphur (0.07%) (INAP 2009), the median value of the mining waste materials is relatively low. The sulphur content of carbonaceous siltstone and coal are both higher than natural background values and both lithologies show greater variation in sulphur content than the weathered material, sandstone and siltstone.

The results of the multi-element analysis were assessed against the GAI in accordance with relevant guidelines and practices (Bowen 1979; INAP 2009). The GAI results indicate that, compared to median crustal abundance, only one of the 10 selected samples was enriched and then only with respect to cobalt. It should be noted that the nature of a coal deposit means some metals/metalloids are expected to be slightly elevated in various minerals.

Sample analysis indicated that the CEC of the materials varies between 4.2-18 meq/100g with a mean value of 10 meq/100g. The resulting effective CEC rating for the materials is from very low to moderate.

The ESP of the 10 selected samples ranged from low (4.5%) to very high (31.5%) with a median of 19.3%, indicating that some of the sample materials are likely to be sodic.

The findings of the geochemical assessment of waste rock samples (Appendix D) can be summarised as follows:

- All of the mining waste samples tested are NAF, have excess ANC and typically have low sulphur content. The sulphur content of coal and carbonaceous siltstone can be elevated compared to typical background concentrations, but is mainly present in a non-sulfidic form,

which does not contribute to acid generation. Overall, these materials have a low risk of acid generation and a high factor of safety with respect to potential for AMD.

- Initial and ongoing surface runoff and seepage from mining waste materials is expected to be moderately alkaline and have a moderate level of salinity.

- KLC test results indicate that mining waste materials are unlikely to generate acid conditions and more likely to generate pH neutral to alkaline conditions.

- Metal/metalloid enrichment in mining wastes, compared to median crustal abundance in unmineralised soils, is limited to cobalt in a single carbonaceous siltstone sample.

- Most metals/metalloids are sparingly soluble at the neutral to alkaline pH of leachate expected from bulk mining waste materials. Dissolved metal/metalloid concentrations in surface runoff and leachate from bulk mining waste materials are therefore expected to be low and unlikely to pose a significant risk to the quality of surface and groundwater resources at relevant storage facilities.

- Mining waste materials should be amenable to revegetation as part of rehabilitation activities, although, gypsum and fertiliser addition may need to be considered for sodic materials to limit dispersion and erosion and to provide a reasonable growth medium for revegetation and rehabilitation.

- As most mining materials appear to be susceptible to dispersion and erosion, additional testing including field trials, may be needed when the mine is operational and bulk materials are being generated. Such tests would help to determine the most appropriate management option for progressive rehabilitation of these materials during operations at mine closure.

13.3.3 Potential Impacts on Surface and Groundwater Resources

The potential impacts which may arise as a result of adverse mineral waste characteristics are primarily related to acid and saline leachate production and landform stability. With respect to acid and saline leachate potential, the majority of both the coal reject and waste rock material to be produced is classified as NAF, with excess ANC, and essentially devoid of sulphur. These materials have a very low risk of acid generation and a high factor of safety with respect to potential acid generation in leachate from waste dumps and storage facilities.

The static and kinetic geochemical test results indicate that surface runoff and seepage from both coal reject and waste rock materials is likely to be pH neutral and have a moderate salinity value. The pH of surface runoff and seepage from these materials is likely to fall within the range for 95% species protection in freshwater aquatic ecosystems as set out in ANZECC and ARMCANZ (2000).

The major ion concentrations in surface runoff and seepage from both coal reject and the leachate from NAF mining materials are relatively low. The major ions from coal reject are dominated by calcium, magnesium, sodium, sulfate, chloride (and bicarbonate), and the leachate from NAF mining waste materials are dominated by bicarbonate, sodium, chloride and to a lesser extent sulfate. The sulfate concentration in leachate from all mining waste samples tested is well below the applied ANZECC and ARMCANZ (2000) livestock water quality guideline criterion (1,000 mg/L).

The concentration of most trace metals/metalloids tested for water in contact with both coal reject and mining waste materials is low, typically below the limit of reporting for the laboratory analysis, and below the applied water quality guideline criteria. These trace metals/metalloids are sparingly soluble at the

expected pH of coal reject materials. All of the metals/metalloid concentrations are less than the applied livestock drinking water guideline trigger values.

For water in contact with mining waste materials, the static water extract results for a few samples. suggest that the concentrations of arsenic and selenium can be above applied aquatic freshwater ecosystem water quality guideline concentrations for 95 % species protection (ANZECC & ARMCANZ 2000). However, the concentration of these metals/metalloids in surface runoff and seepage from bulk mining waste materials is likely to be much lower and within the applied guideline concentrations described. Whilst one carbonaceous siltstone water extract sample had a selenium concentration marginally above the applied livestock drinking water guideline value, all other water extract samples displayed trace metal/metalloid concentrations at or below the applied livestock drinking water guideline values.

Overall, the static geochemical test results indicate that dissolved metal/metalloid concentrations in initial surface runoff and seepage from coal reject materials are unlikely to significantly impact upon the quality of surface and groundwater resources. However, some coal reject materials, if left exposed to oxidising conditions, may have the potential to generate brackish leachate containing elevated concentrations of sulfate and some metals/metalloids, in comparison to applied water quality guideline values. Therefore, coal reject materials should be encapsulated within spoil storage areas, well away from the outside surface of the final rehabilitated landforms. If coal reject materials are left exposed to oxidising conditions for an extended period of time prior to encapsulation, dosing with agricultural limestone (e.g. fine limestone) could be considered as a contingency measure.

In addition, the results of the CEC and ESP tests on the selected mining waste samples indicate that most of the materials represented by these samples are likely to have elevated sodicity levels and may be susceptible to dispersion and erosion, although these characteristics may be improved to some extent by the addition of gypsum. In addition, fertiliser addition will need to be considered for some mining waste materials to provide a reasonable growth medium for revegetation and rehabilitation.

The management strategies discussed in Section 13.4 (Mitigation Measures, Management and Monitoring), will ensure the risk of impact to waters remains low throughout the life of the Project, and will provide for water monitoring activities appropriate to assess any potential adverse effects.

13.4 MITIGATION MEASURES, MANAGEMENT AND MONITORING

13.4.1 Coal Reject Materials

As a result of the geochemical assessment work completed on coal reject materials (Appendix E) at the Project, the following management strategies are proposed for these materials to minimise the risk of any significant environmental harm to the immediate and downstream environment:

- Sampling and geochemical testing of representative samples of coal reject material will be undertaken during the operational mining phase on an as needed basis to confirm and extend the findings of the assessment;
- Coal reject materials will be encapsulated in spoil storage areas well away from the outside surface of the final rehabilitated landforms, where there is a lower risk of connectivity to surface water or groundwater resources;
- If coal reject materials are left exposed to oxidising conditions for an extended period of time prior to encapsulation, dosing with agricultural limestone would be considered as a contingency measure; and

- Surface water and seepage from the coal reject storage areas will be monitored to ensure that key water quality parameters remain within appropriate criteria.

13.4.2 Mining Waste Materials

As a result of the geochemical assessment work completed on mining waste materials (Appendix D) at the Project, a number of management strategies are proposed for these materials to minimise the risk of any significant environmental harm to the immediate and downstream environment.

- Placement of any carbonaceous mining waste material encountered during mining at the surface and outer batters of spoil emplacement areas will be avoided;

- Additional overburden/interburden testing and rehabilitation field trials will be completed during operations when bulk materials become available on an as needed basis to confirm the most appropriate management option for progressive rehabilitation of these materials during operations and at mine closure; and

- Surface water and seepage from the proposed mining and mining waste storage areas will be monitored to ensure that key water quality parameters remain within appropriate criteria. Water quality monitoring parameters will include pH, EC, total suspended solids on a quarterly basis and the suite of water quality analyses described in Appendix D (refer to Table B4 - Multi-Element Test results for water extracts from mining waste from the Gemini Project).

13.4.3 Monitoring Program

Environmental monitoring to identify and assess any impacts arising from seepage or contamination associated with the geochemistry of waste rock and coal rejects will comprise the following components:

- Ongoing groundwater monitoring to verify baseline groundwater information. It should be noted that groundwater data collected to date has indicated high EC groundwater associated with all groundwater units (refer to Section 8.0 (Groundwater)).

- Ongoing surface water monitoring will be undertaken principally to validate water management system performance against the design assumptions, both in terms of water quality and water quantity, so that adaptive management decisions can be undertaken where necessary to protect the surface water environment. Surface runoff and seepage water collection in the mine water dams and process water dam will be monitored for standard water quality parameters including, but not limited to pH, EC, major anions (sulphate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids and a broad suite of soluble metals/metalloids.

- Validation test work will be undertaken on potential spoil materials as the Project develops to enable appropriate spoil management measures to be planned and implemented as required. Where highly sodic and/or dispersive spoil is identified, this material would not be placed in final landform surfaces and would not be used in construction activities. Regardless of the spoil type, especially where engineering or geotechnical stability is required, testing would be undertaken during construction to determine the propensity of such materials to erode. Surface runoff and seepage from spoil piles, including any rehabilitated areas, would be monitored for ‘standard’ water quality parameters including, but not limited to, pH, EC, major anions (sulfate, chloride and alkalinity), major cations (sodium, calcium, magnesium and potassium), total dissolved solids and a broad suite of soluble metals/metalloids.

- A REMP will also be developed and implemented in accordance with the *Model Mining Conditions* (DES 2017e). The REMP would be implemented to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. Water quality monitoring will be undertaken upstream and downstream of the Project to detect downstream water quality impacts and to demonstrate compliance with the EA release conditions. Location details of the proposed receiving water monitoring points are provided in Section Table 33 (Receiving water monitoring points).

14.0 DRAFT EA CONDITIONS

The presentation of the following EA conditions is intended to assist with the process of developing appropriate EA conditions for the Project in consultation with DES. This section does not intend to replace or replicate the Notice of Decision stage of the EA application process under Chapter 5, Division 3, subdivision 2 of the EP Act.

The *Guideline (Mining): Model mining conditions [ESR/2016/1936]* (DES 2017e) provide a basis for proposing environmental protection commitments in EA application documents. The guideline allows for modification of the *Model Mining Conditions* to address the site-specific conditions and circumstances of the Project.

The conditions proposed within this Section have been developed to address the anticipated impacts of the Project as described within the EA application, and to be measurable and auditable. Where alternative conditioning has been proposed, an explanatory box is provided beneath the condition. For ease of application and review, the proposed EA conditions have been structured as per the guidelines.

14.1 ENVIRONMENTALLY RELEVANT ACTIVITIES

Environmentally relevant activities include resource activities or specific agricultural activities, or other activities prescribed by the EP Act. Current prescribed ERAs and resource activities are defined in Schedules 2 and 3 respectively of the EP Regulation. The Project will include the resource activity of 'Mining Black Coal' as well as the ancillary activities outlined in Table 53.

Table 53 Environmentally Relevant Activities

Environmentally Relevant Activity	Description
Schedule 2 (Ancillary Activities)	
8 (1) (c) Chemical storage	Chemical storage (the relevant activity) consists of storing more than 500 m^3 of class C1 or C2 combustible liquids under AS1940 or dangerous goods class 3.
31 (2) 2(b) Mineral processing	Processing, in a year, the following quantities of mineral products, other than coke (b) more than 100,000 t.
33 (1) Crushing, milling, grinding or screening	Crushing, milling, grinding or screening (the relevant activity) consists of crushing, grinding, milling or screening more than 5,000 t of material in a year.
63 1(b)(i) Sewage Treatment	Operating sewage treatment works, other than no-release works, with a total daily peak design capacity of more than 100 but not more than 1500 equivalent persons – if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme.
Schedule 3 (Resource Activity)	
8 (1) (c) Chemical storage	Chemical storage (the relevant activity) consists of storing more than 500 m^3 of class C1 or C2 combustible liquids under AS1940 or dangerous goods class 3.

14.2 PROPOSED CONDITIONS

Schedule A – General Conditions

General

A1 This environmental authority authorises environmental harm referred to in the conditions. Where there is no condition or this environmental authority is silent on a matter, the lack of a condition or silence does not authorise environmental harm.

A2 In carrying out the mining activity, the holder of this EA must not exceed the allowed disturbance area as detailed in **Schedule 1 – Figure A2 (Approved Plan)**.

A3 This environmental authority authorises the mining of 1.9 million tonnes per annum (Mtpa) ROM (run of mine) coal.

A4 The holder of this environmental authority must:

a) Install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority;

b) Maintain such measures, plant and equipment in a proper and efficient condition;

c) Operate such measures, plant and equipment in a proper and efficient manner; and

d) Ensure all instruments and devices used for the measurement or monitoring of any parameter under any condition of this environmental authority are properly calibrated.

Monitoring and Records

A5 Except where specified otherwise in another condition of this environmental authority, all monitoring records or reports required by this environmental authority must be kept for a period of no less than five years.

A6 Where monitoring is a requirement of this environmental authority, ensure that a competent person conducts all monitoring in accordance with:

a) The most recent *Monitoring and Sampling Manual* released by the administering authority, or

b) An appropriate method described in Australian Standards (AS), or;

c) Any other document approved by the administering authority.

A7 All analyses and tests required to be conducted under this environmental authority must be carried out by a laboratory that has National Association of Testing Authorities (NATA) certification for such analyses and tests, expect as otherwise authorised by the administering authority.

A8 All instruments, equipment and measuring devices used for measuring or monitoring in accordance with any condition of this authority must be:

a) Appropriately and competently calibrated, operated and maintained, and

b) Calibration reports must be supplied upon request to the administering authority, in accordance with Condition A19.

Estimated Rehabilitation Calculation

A9 The activity must not be carried out until the environmental authority holder has given surety or paid a contribution to the scheme fund, as required by section 297 of the Act.

Risk Management

A10 The holder of this environmental authority must develop and implement a risk management system for mining activities which mirrors the content requirement of the *Standard for Risk Management (ISO31000:2009),* or the latest edition of an Australian standard for risk management, to the extent relevant to environmental management, by 3 months from date of issue.

Notification of Emergencies, Incidents and Exceptions

A11 The holder of this environmental authority must notify the administering authority by written notification within 24 hours, after becoming aware of any emergency or incident which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with, the conditions of this environmental authority.

A12 Within 10 business days following the initial notification of an emergency or incident, or receipt of monitoring results, whichever is the latter, further written advice must be provided to the administering authority, including the following:

a) Results and interpretation of any samples taken and analysed;

b) Outcomes of actions taken at the time to prevent or minimise unlawful environmental harm; and

c) Proposed actions to prevent a recurrence of the emergency or incident.

Complaints

A13 The holder of this environmental authority must record all environmental complaints received about the mining activities including:

a) Name, address and contact number for of the complainant;

b) Time and date of complaint;

c) Reasons for the complaint;

d) Investigations undertaken;

e) Conclusions formed;

f) Actions taken to resolve the complaint;

g) Any abatement measures implemented; and

h) Person responsible for resolving the complaint.

A14 The holder of this environmental authority must, when requested by the administering authority, undertake relevant specified monitoring within a reasonable timeframe nominated or agreed to by the administering authority to investigate any complaint of environmental harm. The results of the investigation (including an analysis and interpretation of the monitoring results) and abatement measures, where implemented, must be provided to the administering authority within 10 business days of completion of the investigation, or no later than 10 business days after the end of the timeframe nominated by the administering authority to undertake the investigation.

Third-Party Reporting

A15 The holder of this environmental authority must:

a) Within one year of the commencement of this environmental authority, obtain from an appropriately qualified person a report on compliance with the conditions of this environmental authority;

b) Obtain further such reports at regular intervals, not exceeding three-yearly intervals, from the completion of the report referred to above; and

c) Provide each report to the administering authority within 90 days of its completion.

A16 Where a condition of this environmental authority requires compliance with a standard, policy or guideline published externally to this environmental authority and the standard is amended or changed subsequent to the issue of this environmental authority, the holder of this environmental authority must:

a) Comply with the amended or changed standard, policy or guideline within two years of the amendment or change being made, unless a different period is specified in the amended standard or relevant legislation, or where the amendment or change relates specifically to regulated structures referred to in a condition, the time specified in that condition; and

b) Until compliance with the amended or changed standard, policy or guideline is achieved, continue to remain in compliance with the corresponding provision that was current immediately prior to the relevant amendment or change.

Schedule B – Air

Dust and Particulate Matter Monitoring

B1 The environmental authority holder shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that the dust and particulate matter emissions generated by the mining activities do not cause exceedances of the following levels when measured at any sensitive or commercial place:

a) Dust deposition of 120 milligrams per square metre per day (mg/m²/day), averaged over one month, when monitored in accordance with the most recent version of *AS3580.10.1: Methods for sampling and analysis of ambient air - Method 10.1: Determination of particulate matter - Deposited matter - Gravimetric method*;

b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometres (PM_{10}) suspended in the atmosphere of 50 micrograms per cubic metre over a 24-hour averaging time, for no more than five exceedances recorded each year, when monitored in accordance with the most recent version of either:

i) *AS3580.9.6 Methods for sampling and analysis of ambient air Part 9.6: Determination of suspended particulate matter - PM_{10} high volume sampler with size-selective inlet - Gravimetric method;* or

ii) *AS3580.9.9 Methods for sampling and analysis of ambient air Part 9.9: Determination of suspended particulate matter - PM_{10} low volume sampler - Gravimetric method.*

c) A concentration of particulate matter with an aerodynamic diameter of less than 2.5 micrometres ($PM_{2.5}$) suspended in the atmosphere of 25 micrograms per cubic metre over a 24-hour averaging time, when monitored in accordance with the most recent version of *AS3580.9.10 Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - $PM_{2.5}$ low volume sampler—Gravimetric method*; and

d) A concentration of particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a 1 year averaging time, when monitored in accordance with the most recent version of *AS3580.9.3 Methods for sampling and analysis of ambient air - Method 9.3: Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method*.

B2 When requested by the administering authority or as a result of a complaint, dust and particulate monitoring (including dust deposition, TSP, PM_{10} and $PM_{2.5}$) must be undertaken, and the results thereof notified to the administering authority within 14 days following completion of monitoring.

B3 If the monitoring, which is carried out in accordance with Condition B2, indicates an exceedance of the relevant limits in Condition B1, then the environmental authority holder must investigate whether the exceedance is due to emissions from the activity. If the mining activity is found to be the cause of the exceedance, then the environmental authority holder must:

a) Notify the administering authority within seven days of an exceedance of the relevant limits in Condition B2.

b) Address the complaint including the use of appropriate dispute resolution if required; and

c) Implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance.

Schedule C – Waste Management

C1 All general and regulated waste (except tyres) must be removed from site to a facility that is lawfully able to accept the waste under the *Environmental Protection Act 1994*.

C2 An effective firebreak must be installed and maintained around all waste laydown and tyre storage areas.

C3 Subject to demonstrating to the administering authority that no other use higher in the waste management hierarchy can be practicably implemented, waste tyres generated from mining activities may be disposed of onsite in spoil emplacements.

C4 Scrap tyres resulting from mining activities disposed within the operational land must not impede saturated aquifers, cause contamination or compromise the stability of the consolidated landform.

C5 Unless otherwise permitted by the conditions of this environmental authority or with prior approval from the administering authority and in accordance with a relevant standard operating procedure, waste must not be burnt.

C6 Coarse and fine rejects from the CHPP must be managed in accordance with management plan that provides for:

a) Containment of tailings;

b) The management of seepage and leachates both during operation and the foreseeable future;

c) The control of fugitive emissions to air;

d) A program of progressive sampling and characterisation to verify the effective containment of rejects within spoil; and

e) Maintaining records of the relative locations of rejects disposed of in spoil.

Schedule D – Noise

D1 The holder of this environmental authority must ensure that noise generated by the mining activities does not cause the criteria in **Table D1 – Noise Limits** to be exceeded at a sensitive place or commercial place.

Table D1 – Noise Limits

Noise Level dB(A) Measured as:	Sensitive or Commercial Place		
	7am to 6pm	6pm to 10pm	10pm to 7am
L_{Aeq}, adj, 1 hour	42	42	37

In accordance with Note 6 of the Model Mining Conditions, criteria were developed in accordance with the EPP (Noise) and the Planning For Noise Control guideline (EHP 2004).

Airblast Overpressure Nuisance

D2 The holder of this environmental authority must ensure that blasting does not cause the limits for peak particle velocity and air blast overpressure in Table D2 – Blasting Limits to be exceeded at a sensitive place or commercial place.

Table D2 – Blasting Limits

Blasting Parameter	Sensitive or Commercial Place Limits	
	7:00 am to 6:00 pm	6:00 pm to 7:00 am
Airblast overpressure	115 dBZ peak for 4 out of 5 consecutive blasts initiated; or Not greater than 120 dBZ peak at any time.	No blasting is allowed during these times.
Ground vibration peak particle velocity	For vibrations of more than 35 Hz – more than 25 mm a second ground vibration, peak particle velocity, or For vibrations of no more than 35 Hz – more than 10 mm of second peak particle velocity.	No blasting is allowed during these times.

D3 Every explosive blast for the mining activity shall be designed by a competent person and be in accordance with a blast monitoring and management program, to achieve the criteria specified in Table D2 – Blasting Limits.

Monitoring and Reporting

D4 Noise monitoring and recording must include the following descriptor characteristics and matters:

a) The level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to statistical levels;

b) Atmospheric conditions including temperature, relative humidity and wind speed and directions;

c) Effects due to any extraneous factors such as traffic noise; and

d) Location, date and time of monitoring.

D5 The holder of this environmental authority must develop and implement a blast monitoring and management program to monitor compliance with Table D2 – Blasting Limits for:

a) At least 50% of all blasts undertaken on this site in each month at the nearest sensitive place or commercial place; and

b) All blasts conducted during any time period specified by the administering authority at the nearest and most affected sensitive place(s) or commercial place(s) or another such place to investigate an allegation of environmental nuisance caused by blasting.

Schedule E – Groundwater

E1 The holder of this environmental authority must not release contaminants to groundwater.

E2 All determinations of groundwater quality must be performed by an appropriately qualified person.

E3 Groundwater quality and levels must be monitored at the locations and frequencies defined in Table E3 – Groundwater Monitoring Locations and Frequency.

Bore Construction and Maintenance and Decommissioning

E4 The construction, maintenance and management of groundwater bores (including groundwater monitoring bores) must be undertaken in a manner that prevents or minimises impacts to the environment and ensures the integrity of the bores to obtain accurate monitoring.

Table E3 – Groundwater Monitoring Locations and Frequency

Site	Bore ID	Easting	Northing	Type	Bore Depth (m)	Unit Monitored	Monitoring Frequency
1	DW7065W	730860	7382307	SP	77.27	Permian Coal Seams (Aries 3)	Quarterly
	DW7066W	730863	7382304	SP	17.35	Tertiary sediments	Quarterly
3	DW7069W	730397	7382699	SP	71.38	Permian Coal Seams (Pollux Upper Seam)	Quarterly
	DW7071W	730394	7382703	SP	31.59	Permian Coal Seams (Aries 3)	Quarterly
	DW7072W	730403	7382687	SP	14.01	Tertiary sediments	Quarterly
4	DW7073W	729926	7382666	SP	82.1	Permian Coal Seams (Castor/Pollux Seams)	Quarterly
	DW7074W	729922	7382666	SP	55.78	Permian Coal Seams (Castor Upper Seams)	Quarterly
	DW7075W	729918	7382666	SP	14.03	Tertiary sediments	Quarterly
5	DW7076W	729750	7382723	SP	12	Quaternary alluvium	Quarterly
6	DW7033W1	731543	7383768	SP	45.23	Tertiary sediments	Quarterly
	DW7033W2	731546	7383773	SP	74.77	Permian Coal Seams (Orion 5)	Quarterly
	DW7033W3	731548	7383777	SP	81	Permian Coal Seams (Interburden)	Quarterly
10	DW7105W1	730192	7380733	SP	23.04	Tertiary sediments (Basalt)	Quarterly
	DW7105W2	730193	7380729	SP	69.25	Permian Coal Seams (Pollux Lower Upper Seam)	Quarterly
14	DW7225W1	730467	7378359	SP	37	Tertiary sediments	Quarterly
	DW7225W2	730466	7378355	SP	78.9	Permian Coal Seams (Aries 3)	Quarterly
	DW7225W3	730465	7378351	SP	112.8	Permian Coal Seams (Castor Seam)	Quarterly
17	DW7292W1	732905	7381108	SP	15	Quaternary alluvium	Quarterly

Notes: SP Stand pipe

Schedule F – Water (Fitzroy Model Conditions)

F1 A *Water Management Plan* must be developed by an appropriately qualified person and implemented for all stages of mining activities on the site.

F2 The Water Management Plan must:

a) Provide for the effective management of actual and potential environmental impacts result from water management associated with the mining activities carried out under this environmental authority.

b) Be developed by an appropriately qualified person and in accordance with administering authority's current guideline for preparation of a water management plan for mining activities, and include:

i) a study of the source of contaminants;

ii) a water balance model for the site;

iii) a water management system for the site;

iv) measures to manage and prevent and/or minimise saline drainage;

v) measures to manage and prevent and/or minimise acid mine drainage; and

vi) contingency procedures for emergencies.

F3 The *Water Management Plan* must be reviewed each calendar year and a report prepared by an appropriately qualified person. The report must:

a) Assess the plan against the requirements under Condition F2;

b) Include recommended actions to ensure actual and potential environmental impacts are effectively managed for the coming year; and

c) Identify any amendments made to the water management plan following the review.

F4 The holder of this environmental authority must attach to the review a report required by Condition F3, a written response to the report and recommended actions, detailing the actions take or to be taken by the environmental authority holder on stated dates:

a) to ensure compliance with this environmental authority; and

b) to prevent a recurrence of any non-compliance issues identified.

F5 A copy of the *Water Management Plan* must be provided to the administering authority on request.

Contamination Release

F6 Contaminants that will, or have the potential to, cause environmental harm must not be released directly or indirectly to any waters as a result of the authorised mining activities, except as permitted under the conditions of this environmental authority.

F7 Unless otherwise permitted under the conditions of this environmental authority, the release of mine affected water to waters must only occur from the release points specified in Table F1 – Mine Affected Water Release Points and Sources and depicted in **Schedule 2 – Figure H1 (Post-mining Land Use Areas)** attached to this environmental authority.

F8 The release of mine affected water to internal water management infrastructure installed and operated in accordance with a water management plan that complies with Condition F1 - F4 is permitted.

Table F1 – Mine Affected Water Release Points and Sources

Release Point	Easting (MGA94 Zone 55)	Northing (MGA94 Zone 55)	Mine Affected Water Source and Location
Mine Water Dam	731,377	7,383,379	Mine affected water system

F9 The release of mine affected water to waters in accordance with Condition F7 must not exceed the release limits stated in **Table F2 – Mine Affected Water Release Limits** when measured at the monitoring points specified in **Table F1 – Mine Affected Water Release Points and Sources** for each quality characteristic.

Table F2 – Mine Affected Water Release Limits

Quality Characteristic	Release Limits	Monitoring Frequency
Electrical conductivity (µS/cm)	Release limits specified in Table F4 – Mine Affected Water Release during Flow Events.	Daily during release (the first sample must be taken within two hours of commencement of release).
pH (pH Unit)	6.5 (minimum) 9.0 (maximum)	Daily during release (the first sample must be taken within two hours of commencement of release).
Turbidity (NTU)	TBA	Daily during release (first sample within two hours of commencement of release).

F10 The release of mine affected water to waters from the release points must be monitored at the locations specified in **Table F1 – Mine Affected Water Release Points and Sources** for each quality characteristic and at the frequency specified in **Table F2 – Mine Affected Water Release Limits** and **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants**.

Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants

Quality Characteristic	Trigger Levels (µg/L)	Comment on Trigger Level	Monitoring Frequency
Aluminium	55	For aquatic ecosystem protection, based on SMD guideline.	Commencement of release and thereafter weekly during release.
Arsenic	13	For aquatic ecosystem protection, based on SMD guideline.	
Cadmium	0.2	For aquatic ecosystem protection, based on SMD guideline.	
Chromium	1	For aquatic ecosystem protection, based on SMD guideline.	
Copper	2	For aquatic ecosystem protection, based on LOR for ICPMS.	
Iron	300	For aquatic ecosystem protection, based on low reliability guideline.	
Lead	4	For aquatic ecosystem protection, based on SMD guideline.	
Mercury	0.2	For aquatic ecosystem protection, based on LOR for ICPMS.	
Nickel	11	For aquatic ecosystem protection, based on SMD guideline.	
Zinc	8	For aquatic ecosystem protection, based on SMD guideline.	
Boron	370	For aquatic ecosystem protection, based on SMD guideline.	
Cobalt	90	For aquatic ecosystem protection, based on low reliability guideline.	
Manganese	1,900	For aquatic ecosystem protection, based on SMD guideline.	
Molybdenum	34	For aquatic ecosystem protection, based on low reliability guideline.	
Selenium	10	For aquatic ecosystem protection, based on LOR for ICPMS.	
Silver	1	For aquatic ecosystem protection, based on LOR for ICPMS.	
Uranium	1	For aquatic ecosystem protection, based on LOR for ICPMS.	
Vanadium	10	For aquatic ecosystem protection, based on LOR for ICPMS.	
Ammonia	900	For aquatic ecosystem protection, based on SMD guideline.	
Nitrate	1,100	For aquatic ecosystem protection, based on ambient Qld WQ Guidelines (2006) for TN.	
Petroleum Hydrocarbon (C6 – C9)	20		

Quality Characteristic	Trigger Levels (µg/L)	Comment on Trigger Level	Monitoring Frequency
Petroleum Hydrocarbon (C10 – C36)	100		
Fluoride (total)	2,000	Protection of livestock and short-term irrigation guideline.	

*The quality characteristics required to be monitored as per **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants** can be reviewed once the results of two years monitoring data is available, or if sufficient data is available adequately demonstrate negligible risk, and it may be determined that a reduced monitoring frequency is appropriate or that certain quality characteristics can be removed from **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants** by amendment.*

F11 If quality characteristics of the release exceed any of the trigger levels specified in **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants** during a release event, the environmental authority holder must compare the downstream results in the receiving waters to the trigger values specified in **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants** and:

a) Where the trigger values are not exceeded then no action is to be taken; or

b) Where the downstream results exceed the trigger, values specified **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants** for any quality characteristic, compare the results of the downstream site to the data from background monitoring sites and:

i) If the result is less than the background monitoring site data, then no action is to be taken; or

ii) If the result is greater than the background monitoring site data, complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining:

1. Details of the investigations carried out; and

2. Actions taken to prevent environmental harm.

Note: *Where an exceedance of a trigger level has occurred and is being investigated, in accordance with Condition F11 (b)(i) of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.*

F12 If an exceedance in accordance with Condition F11 (b)(ii) is identified, the holder of the environmental authority must notify the administering authority in writing within 24 hours of receiving the result.

Mine Affected Water Release Events

F13 The holder must ensure a stream flow gauging station/s is installed, operated and maintained to determine and record stream flows at the locations and flow recording frequency specified in **Table F4 – Mine Affected Water Release during Flow Events**.

F14 Notwithstanding any other condition of this environmental authority, the release of mine affected water to waters in accordance with Condition F7 must only take place during periods of natural flow in accordance with the receiving water flow criteria for discharge specified in **Table F4 –**

Mine Affected Water Release during Flow Events for the release point(s) specified in **Table F1 – Mine Affected Water Release Points and Sources**.

F15 The 80th percentile of electrical conductivity (EC) values recorded at the downstream monitoring points listed in **Table F4 – Mine Affected Water Release during Flow Events** must not exceed 310 µS/cm over the duration of the release influence period and have a maximum value of no greater than 20 per cent of 310 µS/cm. The 80th percentile must be calculated using all EC values recorded by the monitoring station during the release influence period.

Table F4 – Mine Affected Water Release during Flow Events

Receiving Water	Release Points	Gauging Station	Easting	Northing	Minimum flow
Charlevue Creek	Mine Water Dam	Downstream Charlevue Creek	TBA	TBA	TBA

*No mine affected waters will be released from site until a stream flow gauging, station as required under **Table F4 – Mine Affected Water Release during Flow Events.***

F16 The daily quantity of mine affected water released from each release point must be measured and recorded.

F17 Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters or cause a material build-up of sediment in such waters.

Notification of Release Event

F18 The environmental authority holder must notify the administering authority as soon as practicable and no later than 24 hours after commencing to release mine affected water to the receiving environment. Notification must include the submission of written advice to the administering authority of the following information:

a) Release commencement date / time;

b) Details regarding the compliance of the release with the conditions of department interest: water of this environmental authority (that is, contaminant limits, natural flow, discharge volume);

c) Release point/s;

d) Release rate;

e) Release salinity; and

f) Receiving water/s including the natural flow rate.

***Note**: Notification to the administering authority must be addressed to the Manager and Project Manager of the local Administering Authority via email or facsimile.*

F19 The environmental authority holder must notify the administering authority as soon as practicable and nominally no later than 24 hours after cessation of a release event of the cessation of a release notified under Condition F13 and within 28 days provide the following information in writing:

a) Release cessation date/time;

b) Natural flow rate in receiving water;

c) Volume of water released;

d) Details regarding the compliance of the release with the conditions of department interest; water of this environmental authority (i.e. contaminant limits, natural flow, discharge volume);

e) All in-situ water quality monitoring results; and

f) Any other matters pertinent to the water release event.

***Note**: Successive or intermittent releases occurring within 24 hours of the cessation of any individual release can be considered part of a single release event and do not require individual notification for the purpose of compliance with Conditions F14 and F15, provided the relevant details of the release are included within the notification provided in accordance with Conditions F14 and F15.*

Notification of Release Event Exceedance

F20 If the release limits defined in **Table F2 – Mine Affected Water Release Limits** are exceeded, the holder of the environmental authority must notify the administering authority within 24 hours of receiving the results.

F21 The environmental authority holder must, within 28 days of a release that is not compliant with the conditions of this environmental authority, provide a report to the administering authority detailing:

a) The reason for the release;

b) The location of the release;

c) The total volume of the release and which (if any) part of this volume was non-compliant;

d) The total duration of the release and which (if any) part of this period was non-compliant;

e) All water quality monitoring results (including all laboratory analyses);

f) Identification of any environmental harm as a result of the non-compliance;

g) All calculations; and

h) Any other matters pertinent to the water release event.

Receiving Environment Monitoring and Contaminant Trigger Levels

F22 The quality of the receiving waters must be monitored at the locations specified in **Table F6 – Receiving Water Upstream Background Sites and Downstream Monitoring Sites** for each quality characteristic and at the monitoring frequency stated in **Table F5 – Receiving Waters Contaminant Trigger Levels**.

Table F5 – Receiving Waters Contaminant Trigger Levels

Quality Characteristic	Trigger Level	Monitoring Frequency
pH (pH Units)	6.5-8.5	Daily during the release
Electrical Conductivity (EC) (µS/cm)	310	
Sulphate (SO_4^{-2}) (mg/L)	10	

Table F6 – Receiving Water Upstream Background Sites and Downstream Monitoring Sites

Description	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)
Upstream Background Monitoring Points		
Springton Ck Upstream (SC1)	-23.6976	149.2738
Charlevue Ck Upstream (CC1)	-23.6305	149.2715
Downstream Monitoring Points		
Springton Ck Downstream (SC2)	-23.6434	149.3145
Charlevue Ck Downstream (CC2)	-23.6469	149.2104

F23 If quality characteristics of the receiving water at the downstream monitoring points exceed any of the trigger levels specified in **Table F5 – Receiving Waters Contaminant Trigger Levels** during a release event the environmental authority holder must compare the downstream results to the upstream results in the receiving waters and:

a) Where the downstream result is the same or a lower value than the upstream value for the quality characteristic, then no action is to be taken; or

b) Where the downstream results exceed the upstream results, complete an investigation into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining:

i) Details of the investigations carried out; and

ii) Actions taken to prevent environmental harm.

Note: *Where an exceedance of a trigger level has occurred and is being investigated, in accordance with Condition F18 (b) of this condition, no further reporting is required for subsequent trigger events for that quality characteristic.*

F24 All determinations of water quality monitoring must be performed by suitably experienced and qualified person.

Receiving Environment Monitoring Program (REMP)

F25 The environmental authority holder must develop and implement a Receiving Environment Monitoring Program (REMP) to monitor, identify and describe any adverse impacts to surface water environmental values, quality and flows due to the authorised mining activity. This must include monitoring the effects of the mine on the receiving environment periodically (under natural flow conditions) and while mine affected water is being discharged from the site.

For the purposes of the REMP, the receiving environment is the waters of Duckworth Creek and connected or surrounding waterways within 15 km downstream of the release. The REMP should encompass any sensitive receiving waters or environmental values downstream of the authorised mining activity that will potentially be directly affected by an authorised release of mine affected water.

F26 The REMP must:

a) Assess the condition or state of receiving waters, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality);

b) Be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected;

c) Include monitoring from background reference sites (e.g. upstream or background) and downstream sites from the release (as a minimum, the locations specified in **Table F6 – Receiving Water Upstream Background Sites and Downstream Monitoring Sites**);

d) Specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the *Queensland Water Quality Guidelines 2009*. This should include monitoring during periods of natural flow irrespective of mine or other discharges;

e) Include monitoring and assessment of dissolved oxygen saturation, temperature and all water quality parameters listed in **Table F5 – Receiving Waters Contaminant Trigger Levels** and **Table F3 - Release Contaminant Trigger Investigation Levels, Potential Contaminants**;

f) Include, where appropriate, monitoring of metals/metalloids in sediments (in accordance with ANZECC & ARMCANZ (2000), BATLEY and/or the most recent version of *AS5667.1 Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*);

g) Include, where appropriate, monitoring of macroinvertebrates in accordance with the AusRivAS methodology;

h) Apply procedures and/or guidelines from ANZECC and ARMCANZ (2000) and other relevant guideline documents;

i) Describe sampling and analysis methods and quality assurance and control; and

j) Incorporate stream flow and hydrological information in the interpretations of water quality and biological data.

F27 A REMP Design Document that addresses the requirements of the REMP must be prepared and made available to the administrating authority upon request.

F28 A report outlining the findings of the REMP, including all monitoring results and interpretations must be prepared annually and made available on request to the administrating authority. This must include an assessment of background reference water quality, the condition of downstream water quality compared against water quality objectives, and the suitability of current discharge limits to protect downstream environmental values.

Water Reuse

F29 Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as farm dams or tanks, or used directly at properties owned by the environmental authority holder or a third party (with the consent of the third party).

Annual Water Monitoring Report

F30 The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format:

a) The date on which the sample was taken;

b) The time at which the sample was taken;

c) The monitoring point at which the sample was taken;

d) The measured or estimated daily quantity of mine affected water released from all release points;

e) The release flow rate at the time of sampling for each release point;

f) The results of all monitoring and details of any exceedances of the conditions of this environmental authority; and

g) Water quality monitoring data must be provided to the administering authority in the specified electronic format upon request.

Stormwater and Water Sediment Controls

F31 An *Erosion and Sediment Control Plan* must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.

F32 Stormwater, other than mine affected water, is permitted to be released to waters from:

a) Erosion and sediment control structures that are installed and operated in accordance with the *Erosion and Sediment Control Plan* required by Condition F31; and

b) Water management infrastructure that is installed and operated, in accordance with a *Water Management Plan* that complies with Conditions F2-F4 for the purpose of ensuring water does not become mine affected water.

Schedule G – Sewage Treatment

G1 The only contaminant permitted to be released to land is treated sewage effluent in compliance with the release limits stated in **Table G1 – Contaminant Release Limits to Land**.

Table G1 – Contaminant Release Limits to Land

Contaminant	Unit	Release Limit	Limit Type	Frequency
5-day biochemical oxygen demand (BOD)	mg/L	20	Maximum	Monthly
TSS	mg/L	30	Maximum	Monthly
Nitrogen	mg/L	30	Maximum	Monthly
Phosphorus	mg/L	15	Maximum	Monthly
E-coli	Organisms/100ml	1,000	Maximum	Monthly
pH	pH units	6.0 – 9.0	Range	Monthly

G2 Treated sewage effluent may only be released to land in accordance with the conditions of this approval.

G3 The application of treated effluent to land must be carried out in a manner such that:

a) Vegetation is not damaged;

b) There is no surface ponding of effluent; and

c) There is no run-off of effluent.

G4 If areas irrigated with effluent are accessible to employees or the general public, prominent signage must be provided advising that effluent is present, and care should be taken to avoid consuming or otherwise coming into unprotected contact with the effluent.

G5 All sewage effluent released to land must be monitored at the frequency and for the parameters specified in **Table G1 – Contaminant Release Limits to Land**.

G6 The daily volume of effluent release to land must be measured and records kept of the volumes of effluent released.

G7 When circumstances prevent the irrigation or beneficial reuse of treated sewage effluent such as during or following rain events, waters must be directed to a wet weather storage or alternative measures must be taken to store/lawfully dispose of effluent.

G8 Treated sewage effluent must only be supplied to another person or organisation that has a written plan detailing how the user of the treated sewage effluent will comply with their general environmental duty under section 319 of the *Environmental Protection Act 1994* whilst using the treated sewage effluent.

Schedule H – Land and Rehabilitation

H1 Land disturbed by mining must be rehabilitated in accordance with **Table H1 – Rehabilitation Domains and Post-Mining Land Use** and **Schedule 2 – Figure H1 (Post-mining Land Use Areas)**.

Table H1 – Rehabilitation Domains and Post-Mining Land Use

Rehabilitation Functional Area	Post-mining Land Use	Approximate Footprint Area (ha)	Approximate Proportion of Total Disturbance
Waste rock emplacements (in-pit and out-of-pit)	Grazing	908	46%
Final void waterbody	Fauna habitat	81	4%
Residual void highwalls/ Low walls	Fauna habitat	133	7%
Mine infrastructure areas	Grazing	590	30%
Water management infrastructure	Grazing/ Native vegetation	250	13%

Impacts to Prescribed Environmental Matters

H2 The significant residual impacts to prescribed environmental matters are not authorised under this environmental authority or the *Environmental Offsets Act 2014* unless the impact(s) is specified in **Table H2 – Significant Residual Impacts to Prescribed Environmental Matters**.

Table H2 – Significant Residual Impacts to Prescribed Environmental Matters

Prescribed Environmental Matter	Description		Maximum Extent of Impact
Regulated Vegetation	Of concern regional ecosystem	RE 11.3.2	7.5 ha
	Regional ecosystems within a defined distance of a vegetation management watercourse (RE 11.3.25, 11.5.2, 11.3.2 and 11.7.2)		60.0 ha
Connectivity Areas			720.7

H3 Records demonstrating that each impact to a prescribed environmental matter not listed in **Table H2 – Significant Residual Impacts to Prescribed Environmental Matters** did not, or is not likely to, result in a significant residual impact to that matter must be:

a) Completed by an appropriately qualified person; and

b) Kept for the life of the environmental authority.

H4 An environmental offset made in accordance with the *Environmental Offsets Act 2014* and the *Queensland Environmental Offsets Policy*, as amended from time to time, must be undertaken for the maximum extent of impact to each prescribed environmental matter authorised in **Table H2 – Significant Residual Impacts to Prescribed Environmental Matters**, unless a lesser extent of the impact has been approved in accordance with Condition H8.

H5 The significant residual impacts to a prescribed environmental matter authorised in Condition H2 for which an environmental offset is required by Condition H2 may be carried out in stages. An environmental offset can be delivered for each stage of the impacts to prescribed environmental matters.

Staged Impacts

H6 The significant residual impacts to a prescribed environmental matter authorised in Condition H2 for which an environmental offset is required by Condition H11 may be carried out in stages. An environmental offset can be delivered for each stage of the impacts to prescribed environmental matters.

H7 Prior to the commencement of each stage, a report completed by an appropriately qualified person, that includes an analysis of the following must be provided to the administering authority:

a) For the forthcoming stage—the estimated significant residual impacts to each prescribed environmental matter; and

b) For the previous stage, if applicable—the actual significant residual impacts to each prescribed environmental matter, to date.

H8 The report required by Condition H7 must be approved by the administering authority before a notice of election for the forthcoming stage, if applicable, is given to the administering authority.

H9 A notice of election for the staged environmental offset referred to in Condition H8, if applicable, must be provided to the administering authority no less than three months before the proposed commencement of that stage, unless a lesser timeframe has been agreed to by the administering authority.

H10 Within six months from the completion of the final stage of the project, a report completed by an appropriately qualified person, that includes the following matters must be provided to the administering authority:

a) An analysis of the actual impacts on prescribed environmental matters resulting from the final stage; and

b) If applicable, a notice of election to address any outstanding offset debits for the authorised impacts.

Chemical and Flammable or Combustible Liquids

H11 All flammable and combustible liquids must be contained within an onsite containment system and controlled in a manner that prevents environmental harm and maintained in accordance with the current edition of *AS1940 The storage and handling of flammable and combustible liquids*.

H12 All explosive, corrosive substances, toxic substances, gases and dangerous goods must be stored and handled in accordance with the relevant Australian Standards.

H13 All chemicals and flammable or combustible liquids stored onsite that have the potential to cause environmental harm must be stored in, or serviced by, an effective containment system that is impervious to the materials stored and managed to prevent the release of liquids to water or land. Where no relevant Australian Standard is available, the following must be applied:

a) Storage tanks must be bunded so that the capacity and construction of the bund is sufficient to contain at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas; and

b) Drum storage must be bunded so that the capacity and construction of the bund is sufficient to contain at least 25% of the maximum design storage volume within the bund.

Spills

H14 Any spills or release of flammable and combustible liquids; or chemicals, must be controlled in a manner that prevents environmental harm.

H15 An appropriate spill kit, personal protective equipment and relevant operator instructions/emergency procedure guides for the management of wastes, chemicals and flammable and combustible liquids associated with the activity must be kept at the site.

H16 Anyone operating with wastes, chemicals or flammable and combustible liquids under this approval must be trained in the use of the spill kit.

Infrastructure

H17 All infrastructure constructed by, or for, the environmental authority holder during the licensed activities include water storages, must be removed from the site prior to surrender, except where agreed in writing by the post mining landowner.

Note: *This is not applicable where the landowner/holder is also the environmental authority holder.*

Schedule I - Regulated Structures

Assessment of consequence category

I1 The consequence category of any structure must be assessed by a suitably qualified and experienced person in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016) at the following times:

a) prior to the design and construction of the structure, if it is not an existing structure; or

b) prior to any change in its purpose or the nature of its stored contents.

I2 A consequence assessment report and certification must be prepared for each structure assessed and the report may include a consequence assessment for more than one structure.

I3 Certification must be provided by the suitably qualified and experienced person who undertook the assessment, in the form set out in the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016).

I4 Conditions I5 to I9 inclusive do not apply to existing structures.

I5 All regulated structures must be designed by, and constructed under the supervision of, a suitably qualified and experienced person in accordance with the requirements of the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016).

I6 Construction of a regulated structure is prohibited unless:

a) the holder has submitted a consequence category assessment report and certification to the administering authority; and

b) certification for the design, design plan and the associated operating procedures has been certified by a suitably qualified and experienced person in compliance with the relevant condition of this authority.

I7 Certification must be provided by the suitably qualified and experienced person who oversees the preparation of the design plan in the form set out in the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016) and must be recorded in the Register of Regulated Structures.

I8 Regulated structures must:

a) be designed and constructed in compliance with the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016).

b) be designed and constructed with due consideration given to ensuring that the design integrity would not be compromised on account of:

i) floodwaters from entering the regulated dam from any watercourse or drainage line; and

ii) wall failure due to erosion by floodwaters arising from any watercourse or drainage line.

I9 Certification by the suitably qualified and experienced person who supervises the construction must be submitted to the administering authority on the completion of construction of the regulated structure, and state that:

a) the 'as constructed' drawings and specifications meet the original intent of the design plan for that regulated structure; and

b) construction of the regulated structure is in accordance with the design plan.

Notification of affected persons

I10 All affected persons must be provided with a copy of the emergency action plan in place for each regulated structure:

a) for existing structures that are regulated structures, within 10 business days of this condition taking effect;

b) prior to the operation of the new regulated structure; and

c) if the emergency action plan is amended, within 5 business days of it being amended.

Operation of a regulated structure

I11 Operation of a regulated structure, except for an existing structure, is prohibited unless the holder has submitted to the administering authority in respect of regulated structure, all of the following:

a) one paper copy and one electronic copy of the design plan and certification of the 'design plan' in accordance with Condition I6;

b) a set of 'as constructed' drawings and specifications;

c) certification of the 'as constructed drawings and specifications' in accordance with Condition I9;

d) where the regulated structure is to be managed as part of an integrated containment system for the purpose of sharing the DSA volume across the system, a copy of the certified system design plan;

e) the requirements of this authority relating to the construction of the regulated structure have been met;

f) the holder has entered the details required under this authority, into a Register of Regulated Structures; and

g) there is a current operational plan for the regulated structure.

Mandatory reporting level

I12 Conditions I13 to I16 inclusive only apply to Regulated Structures which have not been certified as low consequence category for 'failure to contain – overtopping'.

I13 The Mandatory Reporting Level (the MRL) must be marked on a regulated dam in such a way that during routine inspections of that dam, it is clearly observable.

I14 The holder must, as soon as practicable but within forty-eight (48) hours of becoming aware, notify the administering authority when the level of the contents of a regulated dam reaches the MRL.

I15 The holder must, immediately on becoming aware that the MRL has been reached, act to prevent the occurrence of any unauthorised discharge from the regulated dam.

I16 The holder must record any changes to the MRL in the Register of Regulated Structures.

Design storage allowance

I17 The holder must assess the performance of each regulated dam or linked containment system over the preceding November to May period based on actual observations of the available storage in each regulated dam or linked containment system taken prior to 1 July of each year.

I18 By 1 November of each year, storage capacity must be available in each regulated dam (or network of linked containment systems with a shared DSA volume), to meet the Design Storage Allowance (DSA) volume for the dam (or network of linked containment systems).

I19 The holder must, as soon as practicable but within forty-eight (48) hours of becoming aware that the regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on 1 November of any year, notify the administering authority.

I20 The holder must, immediately on becoming aware that a regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on 1 November of any year, act to prevent the occurrence of any unauthorised discharge from the regulated dam or linked containment systems.

Annual inspection report

I21 Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person.

I22 At each annual inspection, the condition and adequacy of all components of the regulated structure must be assessed and a suitably qualified and experienced person must prepare an annual inspection report containing details of the assessment and include a recommendations section, with any recommended actions to ensure the integrity of the regulated structure or a positive statement that no recommendations are required**.**

I23 The suitably qualified and experienced person who prepared the annual inspection report must certify the report in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures [ESR/2016/1933]* (DES 2016).

I24 The holder must within 20 business days of receipt of the annual inspection report, provide to the administering authority:

a) The recommendations section of the annual inspection report;

b) If applicable, any actions being taken in response to those recommendations; and

c) If, following receipt of the recommendations and (if applicable) recommended actions, the administering authority requests a copy of the annual inspection report from the holder, provide this to the administering authority within 10 business days11 of receipt of the request.

Transfer arrangements

I25 The holder must provide a copy of any reports, documentation and certifications prepared under this authority, including but not limited to any Register of Regulated Structures, consequence assessment, design plan and other supporting documentation, to a new holder on transfer of this authority.

Decommissioning and rehabilitation

I26 Regulated structures must not be abandoned but be either:

a) decommissioned and rehabilitated to achieve compliance with Condition I27; or

b) be left in-situ for a use by the landholder provided that:

i) it no longer contains contaminants that will migrate into the environment; and

ii) it contains water of a quality that is demonstrated to be suitable for its intended use(s); and

c) the holder of the environmental authority and the landholder agree in writing that the;

i) dam will be used by the landholder following the cessation of the environmentally relevant activity(ies); and

ii) landholder is responsible for the dam, on and from an agreed date.

I27 Before surrendering this environmental authority the site must be rehabilitated to achieve a safe, stable, non-polluting landform and grazing.

Register of Regulated Structures

I28 A Register of Regulated Structures must be established and maintained by the holder for each regulated structure:

I29 The holder must provisionally enter the required information in the Register of Regulated Structures when a design plan for a regulated dam is submitted to the administering authority.

I30 The holder must make a final entry of the required information in the Register of Regulated Structures once compliance with Condition I11 and I12 has been achieved.

I31 The holder must ensure that the information contained in the Register of Regulated Structures is current and complete on any given day.

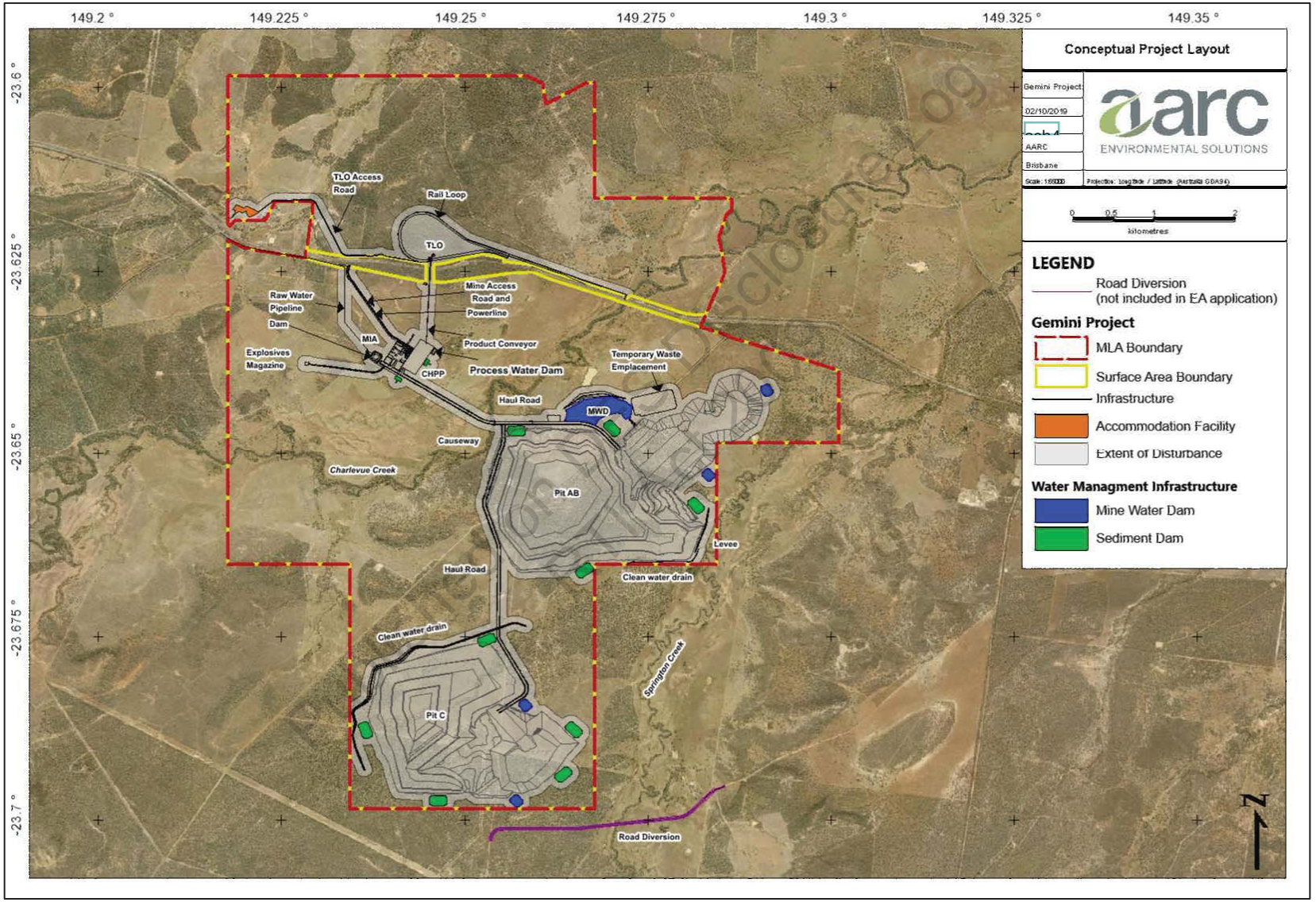
I32 All entries in the Register of Regulated Structures must be approved by the chief executive officer for the holder of this authority, or their delegate, as being accurate and correct.

I33 The holder must, at the same time as providing the annual return, supply to the administering authority a copy of the records contained in the Register of Regulated Structures, in the electronic format required by the administering authority.

Definitions

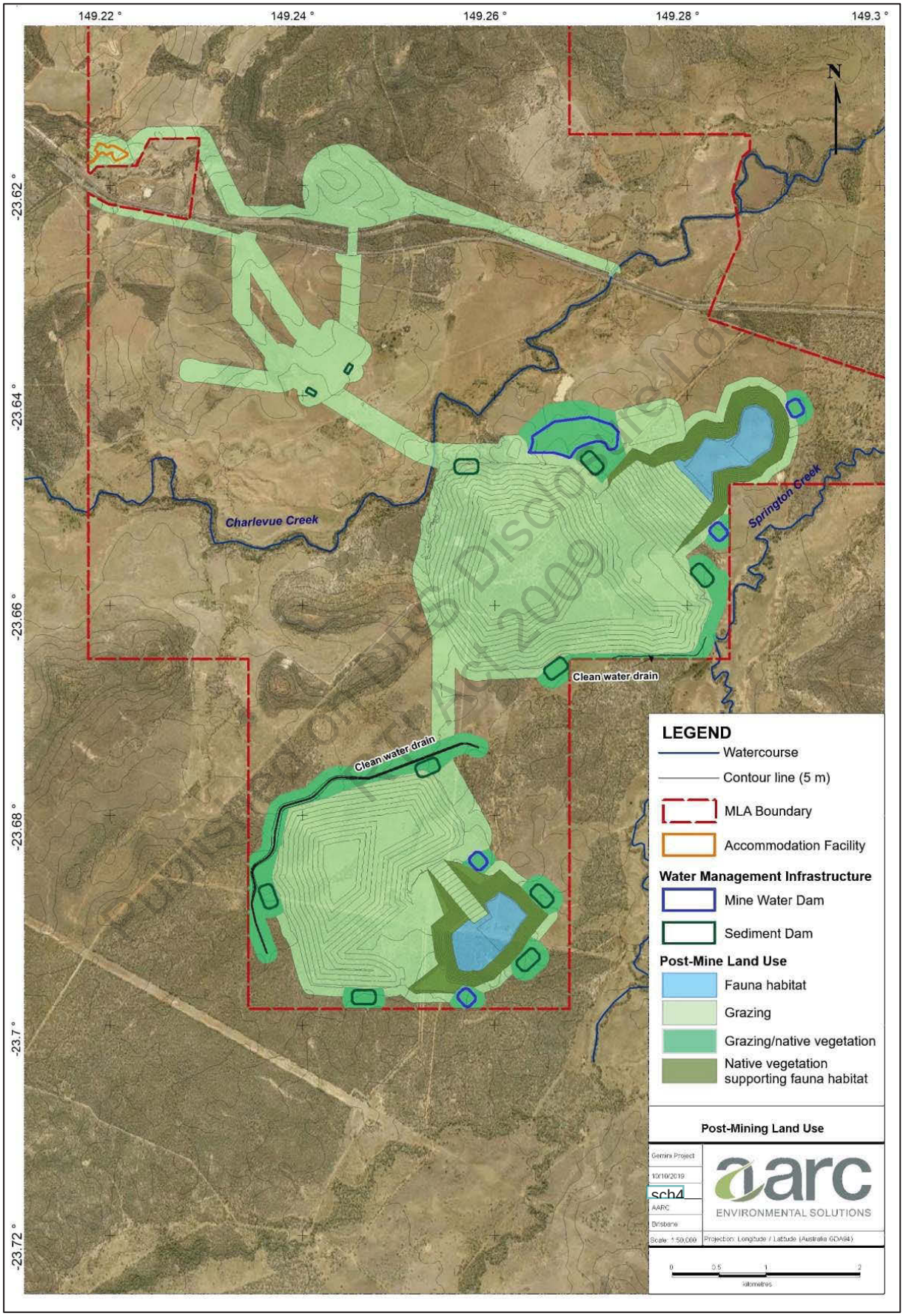
The words and phrases used throughout this proposed EA are as per the *Model Mining Conditions* (DES 2017e). Where a definition for a term used in this environmental authority is not provided by the *Model Mining Conditions* but is provided in the EP Act 1994 or subordinate legislation, the definition in the EP Act or subordinate legislation must be used.

Schedule 1 – Figure A2 (Approved Plan)



249

Schedule 2 – Figure H1 (Post-mining Land Use Areas)



250

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Appendix A Traffic Impact Assessment

Appendix B Surface Water Assessment

Appendix C Groundwater Impact Assessment

Appendix D Geochemical Assessment of Mining Waste Materials

Appendix E Geochemical Assessment of Coal Reject Material

Appendix F Soil and Land Suitability Assessment

Appendix G Terrestrial Ecology Assessment

Appendix H Aquatic Ecology Assessment

Appendix I Air Quality and Greenhouse Gas Assessment

Appendix J Noise Impact Assessment

K

Gemini Project Pre-lodgement – New site-specific EA application

ERA60?? – disposal of tailings in out of pit dumps and in pit

ERA50 – TLO? There will be a TLO and rail spur

Temp levee to protect Pit AB? It says it will be reinforced by in pit rock dumps, will be reshaped during rehab of waste rock and final backfill of Pit AB

Freshwater diversion or is this just diversion drains? Correct. Not a watercourse under Water Act

Mine water RPs – runoff from overburden will enter sediment dams and discharge direct to environment as material is benign?? (depends on definition of mine affected water) – what about emplacements with tailings?

STP is for camp, irrigated effluent

Details:

Total coal is 32Mt ROM. Due to commence in 2021.

Located within the floodplains of Charlevue Creek and Springton Creek in sub-catchment of Mackenzie River. This is not a floodplain by policy definition. No voids in floodplain.

Open cut, truck shovel, 2 pits – Pit AB (12 years) and Pit C (7 years).

Pit AB will be backfilled from year 12 by rehandling waste rock

Backfilling of Pit C will commence once mining has advanced, and will be completed in year 18.

There will be permanent wast rock placements to the west of each pit that will be 45m high.

Rehabilitation:

PMLU is grazing (majority of land) and native habitat (voids). Two residual voids will remain that will accumulate water (81ha or 4% of total disturbance). These will be rehabilitated to ensure they are able to provide suitable habitat.

SINCLAIR Alison

From: NIELSEN Tenille
Sent: Tuesday, 23 February 2021 7:51 AM
To: SINCLAIR Alison
Subject: FW: Gemini Project - EA Application - Supporting Information (Draft)

Follow Up Flag: Follow up
Flag Status: Completed

Queensland Government Queensland Government

Tenille Nielsen
Principal Environmental Officer
Business Centre (Coal) | Coal and Central QLD Compliance
Department of Environment and Science
P 07 4987 9341 **M** sch4p4(6) Pers

99 Hospital Road, Emerald QLD 4720
PO Box 3028, Emerald QLD 4720

From: sch4p4(6) Personal information @aarc.net.au>
Sent: Monday, 21 October 2019 2:02 PM
To: NIELSEN Tenille
Subject: RE: Gemini Project - EA Application - Supporting Information (Draft)

Awesome thanks.

A good idea to justify this. I think we can put a strong argument together as only a very small area of the resource intersects a potential flood plain

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From: NIELSEN Tenille <Tenille.Nielsen@des.qld.gov.au>
Sent: Monday, 21 October 2019 1:53 PM
To: sch4p4(6) Personal information @aarc.net.au>
Subject: RE: Gemini Project - EA Application - Supporting Information (Draft)

Hi sch4p4(6 nothing has changed since our pre-lodgement discussion about the EIS requirement. It will just make it easier for me as an assessing officer to recommend that an EIS is not required in the CAC report if you can provide the justification in the application supporting document. The document did not mention anything about not requiring an EIS. Cheers.

Tenille Nielsen
Team Leader
Business Centre (Coal) | Coal and Central QLD Compliance
Department of Environment and Science
P 07 4987 9341
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PO Box 3028, Emerald QLD 4720

From: sch4p4(6) Personal information @aarc.net.au>
Sent: Monday, 21 October 2019 1:03 PM
To: NIELSEN Tenille
Subject: RE: Gemini Project - EA Application - Supporting Information (Draft)

HI Tenille,

Can you please give me a call about the EIS trigger when you get a minute? I just want to hear your opinion on it. I didn't think it was a significant risk after our pre-lodgement but hoping something hasn't changed.

We will start working on a clear justification

Thanks

sch4p4(6)

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From: NIELSEN Tenille <Tenille.Nielsen@des.qld.gov.au>
Sent: Monday, 21 October 2019 12:43 PM
To: sch4p4(6) Personal informatic@aarc.net.au>
Cc: sch4p4(6) Personal information @aarc.net.au>; sch4p4(6) P bigpond.com; sch4p4(6) Personal @magnetic-south.com.au>; ENGEL Chelsea <Chelsea.Engel@des.qld.gov.au>
Subject: RE: Gemini Project - EA Application - Supporting Information (Draft)

Hi sch4p4(I have reviewed the draft supporting information document for the Gemini Coal Project EA application. I can advise that the submitted draft would likely meet the properly made requirements under s125 and s126A of the current EP Act for a new site specific EA application for a resource activity. This is providing the appropriate fee is paid and the applicant has applied to become a registered suitable operator.

In relation to the ERAs listed, I would recommend including ERA 60 for Waste disposal, for the disposal of tailings and rejects in out-of-pit spoil dumps or pit, and potentially limited regulated waste such as tyres.

Also, it would be highly beneficial to include a table in the introduction to justify why the project would not trigger an EIS under the EP Act based on the EIS trigger criteria (refer to https://www.qld.gov.au/environment/pollution/management/eis-process/about-the-eis-process/does-my-project-need-an-eis), one of which includes mining in a floodplain. The EIS decision is made by the Coordinated Assessment Committee (includes Director – EIS and Director – Coal) as part of the information stage based on the submitted application documents.

Let me know if you have any further questions.

Cheers.

Tenille Nielsen
Team Leader
Business Centre (Coal) | Coal and Central QLD Compliance
Department of Environment and Science

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99 Hospital Road, Emerald QLD 4720
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From: sch4p4(6) Personal informatic@aarc.net.au>
Sent: Monday, 14 October 2019 6:26 PM
To: NIELSEN Tenille
Cc: sch4p4(6) Personal information @bigpond.com; sch4p4(
Subject: Gemini Project - EA Application - Supporting Information (Draft)

Hi Tenille,

On behalf of Magnetic South; please find a link below to access the Gemini Project - EA Application - Supporting Information (Draft) and technical appendices.
https://australasianresource-my.sharepoint.com/:f:/g/personal/cphillips_aarc_net_au/Ehl0dyGiB0ZHsee3JaEECCwBcTyaaWPpLyWCZPwNSM8JXg?e=KCizea

This is a complete content draft, however I am still performing a few minor editing tweaks, so please excuse any formatting that isn't yet perfect.

We are extremely appreciative of the time you are granting us to read the draft document and provide any feedback prior to submission.

Kind regards,

sch4p4(6) Personal inf **SENIOR ENVIRONMENTAL SCIENTIST**
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SINCLAIR Alison

From: NIELSEN Tenille
Sent: Tuesday, 23 February 2021 7:44 AM
To: SINCLAIR Alison
Subject: FW: Gemini Project - EA Application - Supporting Information (Draft)

Follow Up Flag: Follow up
Flag Status: Completed

Queensland Government Queensland Government

Tenille Nielsen
Principal Environmental Officer
Business Centre (Coal) | Coal and Central QLD Compliance
Department of Environment and Science

P 07 4987 9341 **M** sch4p4(6) Pers

99 Hospital Road, Emerald QLD 4720
PO Box 3028, Emerald QLD 4720

From: NIELSEN Tenille
Sent: Monday, 21 October 2019 12:43 PM
To: sch4p4(6) Personal information
Cc: @bigpond.com; sch4p4(ENGEL Chelsea
Subject: RE: Gemini Project - EA Application - Supporting Information (Draft)

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Let me know if you have any further questions.

Cheers.

Tenille Nielsen
Team Leader
Business Centre (Coal) | Coal and Central QLD Compliance
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99 Hospital Road, Emerald QLD 4720
PO Box 3028, Emerald QLD 4720

From: sch4p4(6) Personal informati@aarc.net.au>
Sent: Monday, 14 October 2019 6:26 PM
To: NIELSEN Tenille
Cc: sch4p4(6) Personal information @bigpond.com; sch4p4(
Subject: Gemini Project - EA Application - Supporting Information (Draft)

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This is a complete content draft, however I am still performing a few minor editing tweaks, so please excuse any formatting that isn't yet perfect.

We are extremely appreciative of the time you are granting us to read the draft document and provide any feedback prior to submission.

Kind regards,

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