Appendix 9

Environmental Management Plan

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1. INTRODUCTION

1.1 Purpose of the Environmental Management Plan

The Environmental Management Plan (EM Plan) has been prepared by Byerwen Coal Pty Ltd (Byerwen Coal) to address the legislative requirements and procedures set out in the *Environmental Protection Act* 1994 (EP Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EM Plan addresses the requirements of the Byerwen Coal Project (the project) Terms of Reference (ToR) for an Environmental Impact Statement (EIS), Queensland Government (July 2011).

An EM Plan is required under Section 201 of the EP Act as part of the application for an Environmental Authority (EA). Section 202 of the EP Act states that the purpose of an EM Plan is to propose environmental protection commitments to assist the administering authority in the preparation of the EA.

The EM Plan is intended to be a stand-alone document that details the environmental management requirements of the project. This EM Plan provides the framework for environmental management of project activities during construction and operation. Where required, plans for environmental management during construction and operation activities will be developed prior to those activities commencing, and will be based on this EM Plan.

1.2 EM Plan Structure

In accordance with Section 203 of the *EP Act,* the EM Plan covers:

- introduction
- project description - description of mining lease(s), description of mining activities, description of the land on which the mining activities are to be carried out
- environmental management systems – describes environmental auditing, monitoring, reporting, management of corrective action, staff training
- environmental values likely to be affected by the mining activities
- potential adverse and beneficial impacts of the mining activities on the environmental values
- state any codes of environmental compliance and standard environmental conditions that are to apply to the relevant mining activities
- environmental protection commitments to protect or enhance the environmental values under best practice measures
- environmental protection objectives, standards and measurable indicators
- environmental control strategies
- rehabilitation objectives, indicators and completion criteria
- draft Environmental Authority (EA) conditions.

1.3 Project Proponent

The proponent of the project is Byerwen Coal. The proponent is a joint venture between QCoal Pty Ltd and JFE Steel.

QCoal is a privately owned Queensland company based in Brisbane. QCoal has been active in the Queensland coal exploration and mining industry for over 17 years.

JFE Steel is a subsidiary of the JFE Group of Japan. JFE Steel and associated companies already have direct equity investments in a number of Queensland coal mines.

1.4 Project Location

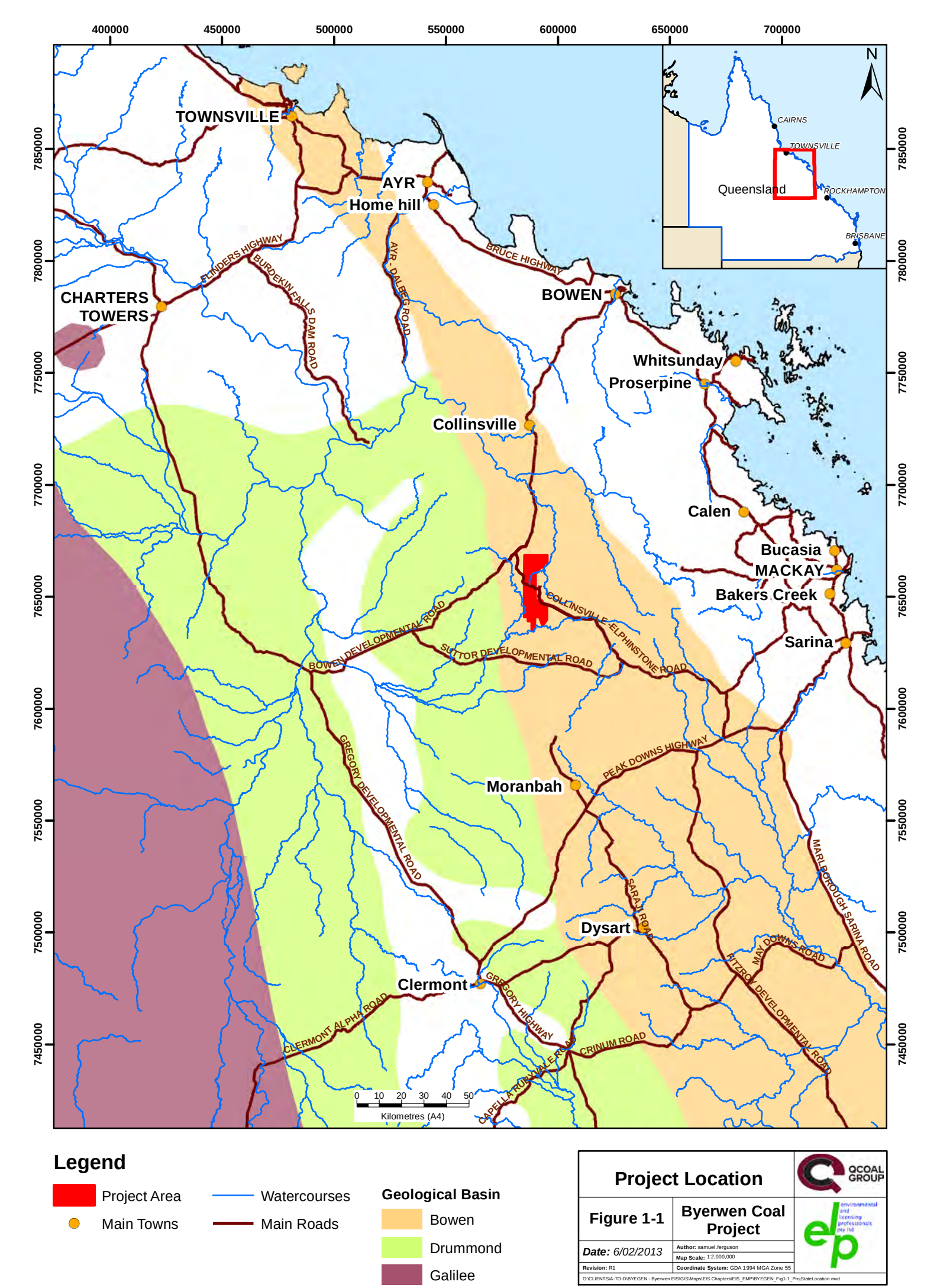
The project area comprises the project's six mining lease application (MLA) areas defined as the area of land contained within MLA 10355, MLA 10356, MLA 10357, MLA 70434, MLA 70435 and MLA 70436. Collectively, the six MLAs cover an area of approximately 22,697 hectares.

The project is located in the Whitsunday Regional Council and Isaac Regional Council government areas (in the north and south respectively). It is located approximately 20 km west of the mining township of Glenden and lies approximately 140 km west of the regional centre of Mackay.

The project is situated immediately to the west of the Xstrata Coal's Newlands Mine complex and to the north of the Xstrata Coal's Suttor Creek mine (which contains the Suttor Creek and Wollombi Pits).

The project area is traversed by the Collinsville-Elphinstone Road and the existing Goonyella to Abbot Point (GAP) rail line.

The project's location and regional context is shown in **Figure 1-1**. Local government boundaries in relation to the mining leases and nearby projects are shown in **Figure 1-2**.



Legend

- Project Area
- Main Towns
- Watercourses
- Main Roads

Geological Basin

- Bowen
- Drummond
- Galilee

Project Location	
Figure 1-1	**Byerwen Coal Project**
Date: *6/02/2013*	**Author:** samuel.ferguson
	Map Scale: 1:2,000,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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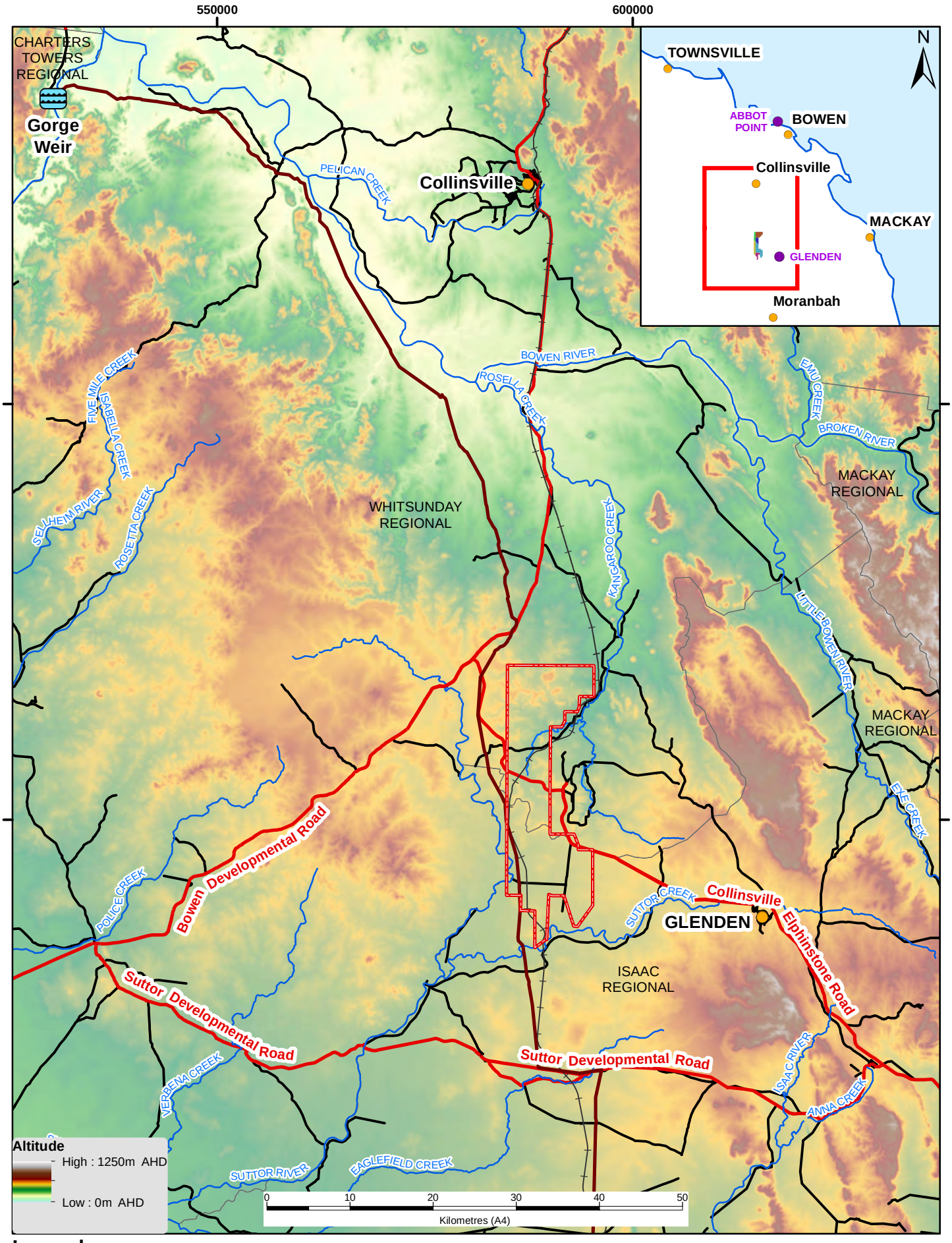

Legend

- Project Area
- Main Towns
- LGA Boundaries
- Watercourses
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Highway
- Main Road
- Local Roads (formed & unformed)

Local Context	
Figure 1-2	**Byerwen Coal Project**
Date: *15/04/2013*	**Author:** emma.lewis
	Map Scale: 1:600,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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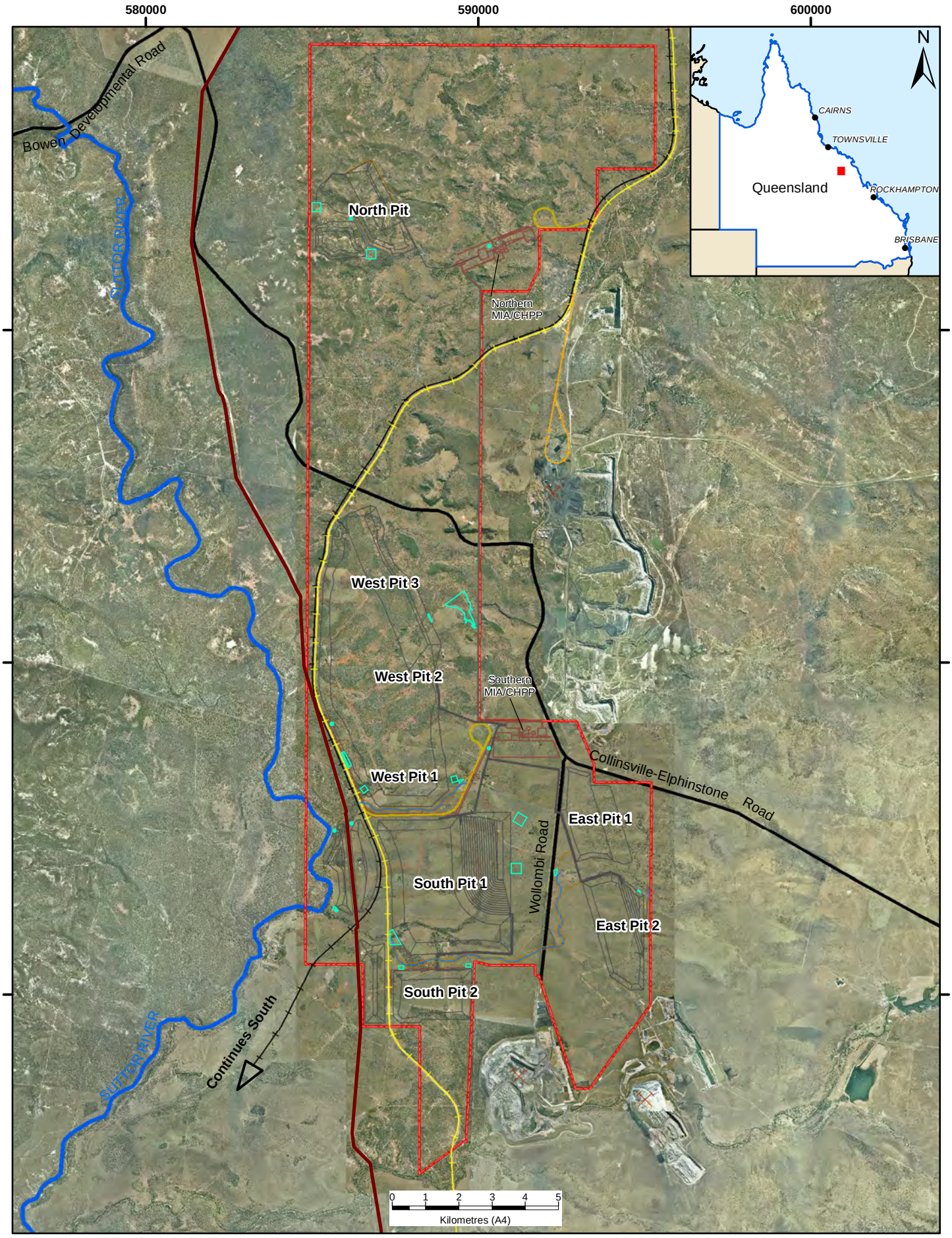

Legend

- Project Area
- Waste Rock Dumps and Pits
- Existing Mine Site
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Newlands Mine Rail Loop
- Alpha Coal Project Rail Line
- Train Loading Facilities
- Central Infrastructure Corridor
- Mine Infrastructure
- Suttor River
- Formed Road
- Drainage Bund
- Drainage Diversion
- Dam (mine affected, sediment affected, clean water)

Proposed Project Layout

Figure 1-3 — **Byerwen Coal Project**

Date: *1/03/2013*

Author: samuel.ferguson

Map Scale: 1:150,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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1.5 Land Use and Tenure

There are 7 leasehold (lands lease) properties that are either within or intersected by the project MLAs, as shown in **Figure 1-4**. Within the former Nebo Shire and Bowen Shire greater than 95% of land is zoned as rural or open space and recreation. This reflects the land use within the region surrounding the project, which is a mix of large-scale grazing, cropping, and mining activity. The project tenements are within land zoned as rural under local planning schemes.

The only off tenement infrastructure that will be constructed for the project is accommodation in Glenden. This will be the subject of a separate approvals process for development approval under the *Sustainable Planning Act 2009*. Nevertheless, social and economic impacts associated with accommodation in Glenden and transport of workers to and from Glenden are assessed in this EM Plan and the Social Impact Management Plan (SIMP).

The Birriah People currently have a registered Native Title Claim which overlaps part of the project area, being MLAs 10355, 10356, and 10357. The rights and interests claimed by the Birriah People are as set out in the Form 1 filed in the Federal Court of Australia. Under the *Aboriginal Cultural Heritage Act 2003 (Qld)* (ACH Act), the Birriah People are also the relevant Aboriginal party for that part of the project area. The Federal Court made a Native Title Consent Determination recognising the Jangga People's largely non-exclusive native title rights over the Determination Area. This area also overlaps part of the project area, located in an area where non-exclusive rights and interests have been recognised. The Jangga People are also the relevant Aboriginal party for that part of the project area.

There is one stock route which is designated as unused or inactive by the Queensland Government that intersects South Pit 1 in the southern tenement areas of the project.

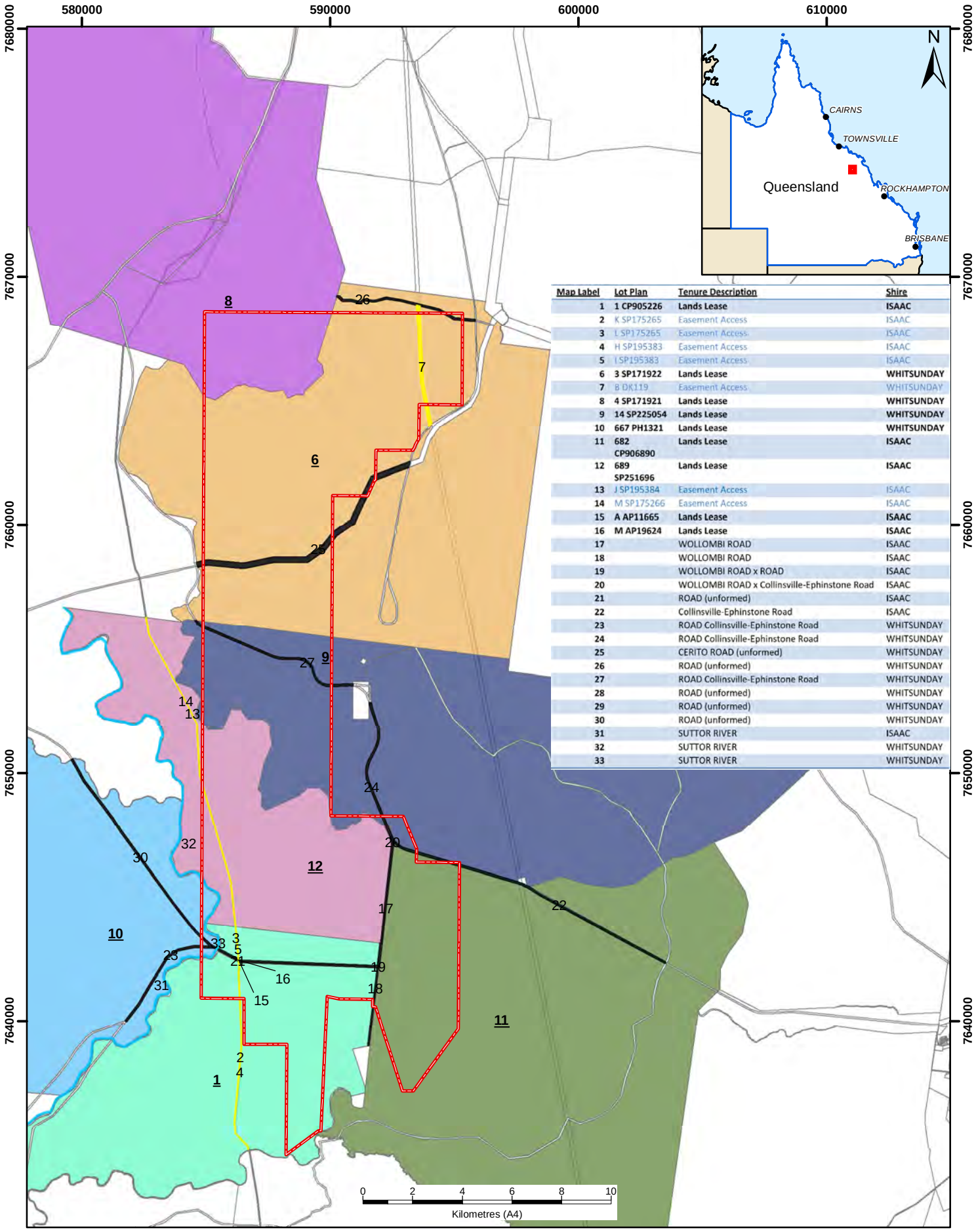
The identified existing third party infrastructure in the project area is:

- North Queensland Gas Pipeline - North Queensland Pipeline No 1 Pty Ltd
- Burdekin to Moranbah Pipeline (water) – SunWater
- Newlands Pipeline - SunWater
- GAP rail line – QR National (now Aurizon)
- Various powerlines – Ergon
- Wollombi Road – gazetted and formed road within the Isaac Regional Council
- Gazetted but unformed roads – Isaac Regional Council and Whitsunday Regional Council.

Connections to some of this third party infrastructure are necessary for the operations of the project.

There are overlapping mining and petroleum tenures (granted and under application) in the project area other than tenures held by the proponent or related companies, as follows:

- EPP 688, BNG (Surat) Pty Ltd, granted 26/02/2003
- EPP 742, CH4 Pty Ltd, application made 19/06/2002, not granted
- MLA 70460 for a transport corridor, Xstrata Coal Queensland Pty Ltd, application 05/10/2011
- EPM 18297, Navaho Gold Ltd, granted 30/01/2012
- EPM 18336, Navaho Gold Ltd, granted 06/02/2012
- PPL 89, North Queensland Pipeline No 1 Pty Ltd, granted 06/03/2003.



Map Label	Lot Plan	Tenure Description	Shire
1	1 CP905226	Lands Lease	ISAAC
2	K SP175265	Easement Access	ISAAC
3	L SP175265	Easement Access	ISAAC
4	H SP195383	Easement Access	ISAAC
5	I SP195383	Easement Access	ISAAC
6	3 SP171922	Lands Lease	WHITSUNDAY
7	B DK119	Easement Access	WHITSUNDAY
8	4 SP171921	Lands Lease	WHITSUNDAY
9	14 SP225054	Lands Lease	WHITSUNDAY
10	667 PH1321	Lands Lease	WHITSUNDAY
11	682 CP906890	Lands Lease	ISAAC
12	689 SP251696	Lands Lease	ISAAC
13	J SP195384	Easement Access	ISAAC
14	M SP175266	Easement Access	ISAAC
15	A AP11665	Lands Lease	ISAAC
16	M AP19624	Lands Lease	ISAAC
17		WOLLOMBI ROAD	ISAAC
18		WOLLOMBI ROAD	ISAAC
19		WOLLOMBI ROAD x ROAD	ISAAC
20		WOLLOMBI ROAD x Collinsville-Ephinstone Road	ISAAC
21		ROAD (unformed)	ISAAC
22		Collinsville-Ephinstone Road	ISAAC
23		ROAD Collinsville-Ephinstone Road	WHITSUNDAY
24		ROAD Collinsville-Ephinstone Road	WHITSUNDAY
25		CERITO ROAD (unformed)	WHITSUNDAY
26		ROAD (unformed)	WHITSUNDAY
27		ROAD Collinsville-Ephinstone Road	WHITSUNDAY
28		ROAD (unformed)	WHITSUNDAY
29		ROAD (unformed)	WHITSUNDAY
30		ROAD (unformed)	WHITSUNDAY
31		SUTTOR RIVER	ISAAC
32		SUTTOR RIVER	WHITSUNDAY
33		SUTTOR RIVER	WHITSUNDAY

Legend

Parcel Type

- Project Area
- Road
- Water
- Easement

Lands Lease

- 14SP225054
- 1CP905226
- 3SP171922
- 4SP171921
- 667PH1321
- 682CP906890
- 689SP251696

Real Property

QCOAL GROUP

Figure 1-4	Byerwen Coal Project
Date: 22/02/2013	**Author:** samuel.ferguson
	Map Scale: 1:200,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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elp environmental and licensing professionals pty ltd

1.6 Environmentally Relevant Activities

Pursuant to the EP Act, activities that will, or will have the potential to, release contaminants into the environment and which may cause environmental harm, are referred to as Environmentally Relevant Activities (ERAs).

Schedule 2 of the EP Regulation contains the ERAs regulated under the EP Act. The following ERAs may occur within the project area and will require approval as part of the EA application[1]:

- ERA 8 Chemical storage – storing more than 10m^3 of combustible or flammable liquids such as unleaded petrol, diesel fuel or lubricating oil.
- ERA 15 Fuel burning – any process involving the use of fuel burning equipment (including, for example, a standby power generator) that is capable of burning (whether alone or in total) 500 kg or more of fuel in one hour.
- ERA 43 Concrete batching – producing 200t or more of concrete or concrete products per year, by mixing cement with sand, rock, aggregate or other similar materials.
- ERA 56 Regulated waste storage – operating a facility for receiving and storing regulated waste for more than 24 hours.
- ERA 57 Regulated waste transport – transporting, on a non-commercial basis, 250kg or more of regulated waste in a vehicle.
- ERA 58 Regulated waste treatment – operating a facility for receiving and treating regulated waste.
- ERA 60 Waste disposal – operating a facility for disposing of regulated waste.
- ERA 63 Sewage treatment – operating sewage treatment works at a site that have a total daily peak design capacity of at least 21 EP; or operating a sewage pumping station with a total design capacity of more than 40KL in an hour.

1.7 Notifiable Activities

Under section 371 of the EP Act, an owner or occupier of land must notify the Department of Environment and Heritage Protection (DEHP) if a 'notifiable activity' is being carried out on the land. A list of notifiable activities is provided in Schedule 3 to the EP Act and includes activities such as storing mine wastes, mineral processing and fuel storage.

The effect of this notification is that information about the activity will be made publicly available on DEHP's Environmental Management Register.

The following notifiable activities are expected to occur within the project area (i.e. the project's mining leases):

- 7 Chemical Storage (other than petroleum products or oil) – storing more than 10t of chemicals that are dangerous goods.
- 23 Metal treatment or coating – treating or coating metal including, for example, anodising, galvanising, pickling, electroplating, heat treatment using cyanide compounds and spray painting using more than 5L of paint per week.

[1] The list may change depending on the State government's reassessment of the list of ERAs requiring approval resulting from *Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012*

- 24 Mine wastes – storing hazardous mine wastes including tailings dams, overburden or waste rock dumps containing hazardous contaminants.
- 29 Petroleum product or oil storage – storing petroleum or oil products that are class C1 or C2 combustible liquids in above ground tanks with more than 25,000L capacity.
- 37 Waste storage, treatment or disposal – storing or disposing of regulated waste.

2. PROJECT DESCRIPTION

2.1 Overview

The proponent proposes to develop open cut coal mines with a Run of Mine (ROM) rate of 15 Mtpa. Production from the project will primarily be high quality coking coal with some thermal coal.

Four mining zones have been identified for the project (north, south, east and west), comprising eight open pits. The south phase comprises mining zones in the south, east and west. The north phase comprises mining zones in the north. Mining will be via open cut using a combination of dragline, large excavator, truck and dozer equipment.

The mine will produce approximately 10 Mtpa of product coal for the export market over the 50 year project life (two years for construction, 46 years of mining operation and 2 years for decommissioning and rehabilitation).

Construction in the southern tenement area for the south phase will occur prior to any operations and include the southern coal handling and preparation plant (CHPP), mine infrastructure area (MIA) water management infrastructure, and southern train loading facility (TLF). In approximately Year 15 of mining operations, construction in the northern tenement area for the north phase will commence to coincide with the planned commencement of operations of the open pit, including the northern CHPP, MIA, water management infrastructure and northern TLF.

Underground mining is not being considered as part of the project. Accordingly the potential issue of subsidence associated with underground mining is not relevant to the project. However a qualitative engineering review was undertaken by the proponent to ascertain if any other project aspects pose potential subsidence risks, including, open cut mining, water infrastructure, MIA, CHPP and linear infrastructure. No subsidence related impacts are expected to arise as a result of the project and therefore subsidence is not considered further.

When fully developed to the planned production rate of approximately 10 Mtpa it is expected that the project CHPPs will require approximately 4,500 ML of water a year (of a total operational demand maximum of 6,180 ML a year required for the CHPP, dust suppression and potable water.).

Raw water will be imported to site from SunWater's Burdekin to Moranbah water pipeline system and along with decant water from the co-disposal facilities can be recycled to the process plants for coal washing. Process water associated with the CHPPs and co-disposal facilities will be managed in a closed circuit not connected to the mine water management system, such that there are no planned releases of process water. Product coal will be loaded onto trains via two TLFs, wholly within the project tenement area, located adjacent to the two CHPP areas. The TLF rail spur will be connected to the GAP rail line at their respective points. Product coal will be railed to the Port of Abbot Point coal terminal for distribution to international markets.

It is anticipated that a construction workforce of approximately 350 and 265 personnel will be required to construct the south phase and the north phase of the project respectively. The operational workforce will progressively ramp up to a peak once both the south phase and the north phase are operational.

An overview of the project layout is shown in **Figure 2-1** to **Figure 2-2.** The key elements of the project are outlined below:

- Open cut coal mines will be developed in the project area. Mining will occur 7 days per week and excavate to depths of up to 350 m (South Pit 1). The project will generate approximately 15 Mtpa of ROM coal to produce approximately 10 Mtpa of product coal for the export market.

- Out of pit waste rock dumps will be created adjacent to the coal mining areas within the project area. Once there is sufficient space for in-pit dumping, pits will be progressively backfilled with waste rock. Out of pit and in pit final landform will be to a maximum height of 60 m above the natural ground level.
- A water management system will be constructed that diverts clean water, captures and manages mine area runoff and pit water for reuse or release subject to release criteria. This will include water storage infrastructure for mine affected water and sediment control ponds for sediment laden runoff.
- ROM coal haul roads will connect open cut pits to the northern and southern CHPP's and associated loading facilities for ROM coal.
- Conveyors will be constructed to connect product coal pads adjacent to the northern and southern CHPPs to the respective TLFs.
- Southern and northern TLFs will comprise train loading bin, rail loop and rail spur.
- Heavy vehicle and light vehicle overpass crossings will be required for the GAP rail line.
- Light vehicle access roads will be constructed in and around the two CHPP plants and the MIAs and wherever possible it will be intended to separate the light vehicle traffic from any heavy mining or earthmoving equipment roads.
- Southern CHPP and MIA and northern CHPP and MIA, with the MIAs including office and administration facilities, worker amenities, workshops and fuel and oil storage.
- Process water comprising both coal rejects and dewatered fines from the CHPPs will be pumped to co-disposal facilities. Co-disposal dams will be situated adjacent to each CHPP for placement and water reuse.
- Power to infrastructure in the southern and northern tenement areas will be supplied by a connection to an existing 66 kV power line that originates from the Newlands substation and which intersects the tenements adjacent to the Collinsville-Elphinstone Road. All additional power lines will be located within the mining lease boundaries. Power line corridors will be approximately 20 m wide.
- Water pipelines will be constructed to connect the SunWater pipeline system to raw water storage facilities adjacent to the northern and southern CHPPs. These will be wholly within the project area.
- The project (construction and operation) will be accessed via the Collinsville-Elphinstone Road, at two points, one for the northern MIA and CHPP, and one for the southern MIA and CHPP.
- A sewage treatment plant (STP) with bunded storage will be situated on site. Treated effluent will be reused (for irrigation), with sludge material to be disposed of by a certified third party contractor at an appropriately licensed regional waste disposal facility.
- Provision will be made for diesel storage, portable back-up power generators and storage for tyres and other materials.

2.2 Construction

There will be two periods of construction, in the south and north tenement areas.

1. **South -** Construction in the southern tenement area (ML 70435, ML 70434 and ML 70436) will occur prior to any operations and includes construction of the south coal handling and preparation plant (CHPP), MIA, water management infrastructure, and south TLF.

2. **North -** Construction in the northern tenement area (ML 10355, ML 10356 and ML 10357) will commence in approximately Year 15 of south phase mining operations, to coincide with the planned commencement of operations of the open pit in the north in Year 17. Construction in the north tenement area will include the north CHPP, MIA, water management infrastructure and TLF.

Site preparation activities at both the south and north include the following:

- site security – (it is likely that fencing will be developed adjacent to the main access road security gate, and other strategic areas across the construction site, including the MIAs)
- site clearance
- civil works:
  - environmental protection measures
  - washdown facilities
  - erosion and sediment controls
  - quarry materials – where required will be sourced from onsite deposits within the mine footprint
  - concrete batch plant - concrete will be batched on site
- mobilisation to site:
  - accommodation (in Glenden)
  - crib huts
  - fencing
  - amenities
- access road establishment and upgrade
- establishment of yards:
  - installation of temporary water supply
  - sewerage management infrastructure
  - demountable offices
  - car park
- establishment of laydown and storage areas.

Construction phase activities at both the south and north can be broadly described as:

- earthworks
- civil works including temporary and permanent drainage works
- rail construction
- structure and plant erection and installation
- commissioning and testing of plant and equipment
- construction site demobilisation.

Infrastructure that will be constructed in the south (noting that some construction works will continue into operation) includes:

- the south CHPP and product coal stockpile area
- the south MIA, including administration facilities, workshops, servicing facilities, fuel storage and environmental control pond
- south ROM coal stockpile area and ROM dump station

- south train loading facility
- ROM coal haul roads and waste rock haul roads and / or conveyor
- sewage and waste management facilities
- raw water supply pipeline, storage and a treatment plant
- south co-disposal dam
- mine affected water dams, sediment affected water dams and clean water dams (further described in **Section 3**)
- drainage line diversion for the tributary of the Suttor River (further described in **Section 3**)
- light and heavy vehicle internal roads
- main gate and security building
- explosives storage and preparation facilities
- power lines and substation
- transmission line relocation and new transmission lines
- bridges and underpasses, where required for crossing of third party infrastructure.

Electricity requirements for the south phase of construction will be supplied via diesel generators for construction power requirements, until such time as a connection to the electricity transmission grid is established. Diesel will be used for all major mobile plant, equipment and vehicles during the construction period and will be stored in self-bunded tanks.

Infrastructure to be constructed during the north construction phase includes:

- the north CHPP and product stockpile area
- the north MIA, including administration facilities, workshops, servicing facilities, fuel storage and environmental control pond
- north ROM coal stockpile area and ROM dump station
- north train loading facility
- ROM coal and waste rock haul roads
- light and heavy vehicle internal roads
- power lines and substation
- water supply and management facilities, including raw water supply and storage
- north co-disposal dam
- mine affected water dams, sediment affected water dams and clean water (further described in **Section 3**)
- drainage line diversion for the tributary of the Kangaroo Creek (further described in **Section 3**)
- explosives storage and preparation facilities.

Electricity requirements for the north stage of construction will be supplied by either diesel generators or power lines connecting the electricity transmission grid to the project. Substations will be installed adjacent the north and south MIA.

There are two infrastructure corridors which will connect the south CHPP to the GAP rail line:

- southern infrastructure corridor
  - south rail spur
  - drainage diversions to divert water flowing between West Pit 1 and South Pit 1

- raw water supply pipeline
- existing powerline re-alignment.

- central infrastructure corridor which will connect the north CHPP to the GAP rail line:
  - road for light and heavy mine site vehicles
  - power lines
  - raw water supply pipeline
  - communications.

The central infrastructure corridor will be used for the transfer of mining equipment between the various pits in the project so as to limit the use of public roads.

2.3 Mine Sequencing Methods and Equipment

Four mining zones have been identified for the project, comprising eight open pits. The tenement area in which the zones are located and the pit areas within in each zone are described in **Table 2-1**.

Table 2-1 Mining Zones and Pits

Tenement area	Zone	Open Pit
Southern	South	South Pit 1
		South Pit 2
	East	East Pit 1
		East Pit 2
	West	West Pit 1
		West Pit 2
		West Pit 3
Northern	North	North Pit

The years of mining for each of the open pits are provided in **Table 2-2**.

Table 2-2 Mining Schedule for Open Pits

Open Pit	Years of Mining
South Pit 1	6 - 46
South Pit 2	6 - 30
East Pit 1	26 - 40
East Pit 2	31 - 46
West Pit 1	1 - 15
West Pit 2	11 - 25
West Pit 3	21 - 46
North Pit 1	16 - 30

The broad mining methodology for each open pit is:

- vegetation clearing (where required)
- soil stripping and storage or direct spreading
- blasting of the waste rock (where required)
- removal of waste rock by truck, excavator and drag line in box-cuts, creating new mining strips and filling in old/previously mined voids
- possible blasting of coal and the excavation of ROM coal by excavator and/or drag line
- hauling of ROM coal to the ROM pad by off-road trucks and then to the CHPPs for washing and processing and train load out
- final landform re-profiling, topsoiling and revegetation activities by earthmoving equipment.

Waste rock is scheduled to be placed back into each pit once the initial mining strips are established, however out of pit dumping will continue sporadically over the life of mine. During the initial years of pit operations, waste rock will either be trucked or crushed (in-pit) and conveyed to out of pit dumps. In-pit crushing and conveying may only occur when waste rock is required to cross the GAP rail line and potentially the proposed Alpha Coal Project rail line to reach the out of pit waste rock dump.

There will be a single out of pit dump for waste rock from West Pit 1, West Pit 2 and West Pit 3, which will merge with the in pit dump to create a final landform approximately 60 m above the natural ground level.

There will be two out of pit waste rock dumps for South Pit 1, which are separated by the SunWater Burdekin to Moranbah pipeline corridor. Both waste rock dumps are separated from the open pit by the GAP rail line and potentially the proposed Alpha Coal Project rail line and hence waste rock will either be trucked, using suitably engineered bridges, or crushed and conveyed to the dumps. Out of pit dumps will not merge with in-pit dumps as they are separated by third party linear infrastructure. Out of pit waste rock dumps will be up to 60 m above ground level.

There will be two out of pit waste rock dumps for South Pit 2. The out of pit dump to the east of the rail line will merge with the in pit dump to form a final landform.

East Pit 1, East Pit 2 and North Pit will each have a single out of pit waste rock dump, which will merge with the in-pit dump to form a final landform up to 60 m above ground level.

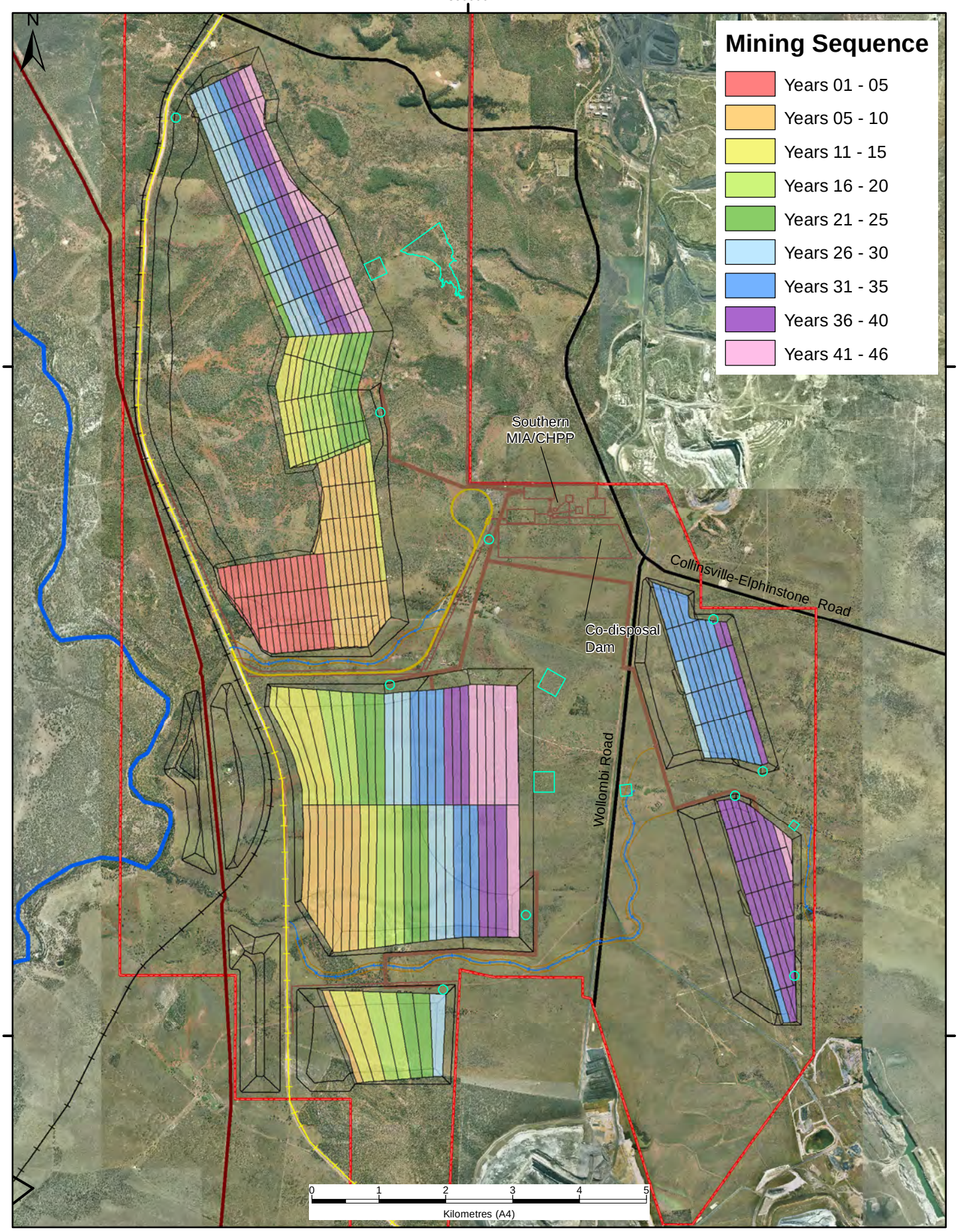
ROM coal will be transported to one of the onsite CHPP facilities and either directly tipped into the crushing and screening system or stockpiled on the ROM pad for future reclaim. From there it will be processed, blended and transported to one of the two TLFs for transfer to the Port of Abbot Point for export.

The southern ROM stockpile area will be capable of stockpiling approximately 400,000 tonnes. The northern ROM stockpile area will be capable of stockpiling approximately 200,000 tonnes.

2.4 Mine Site Layout and Project Footprint over the Mine Life

The mine layout is shown:

- for the life of mine mining sequence (south) in **Figure 2-1**
- for the life of mine mining sequence (north) in **Figure 2-2**
- at the end of mine life final landform (south) in **Figure 2-3**
- at the end of mine life final landform (north) in **Figure 2-4.**



Legend

- Project Area
- Waste Rock Dumps and Pits
- GAP Rail line
- Suttor River
- Formed Roads
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Dam (mine affected, sediment affected, clean water)
- Train Loading Facilities
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

Life of Mine Mining Sequence (South)	
Figure 2-1	**Byerwen Coal Project**
Date: *19/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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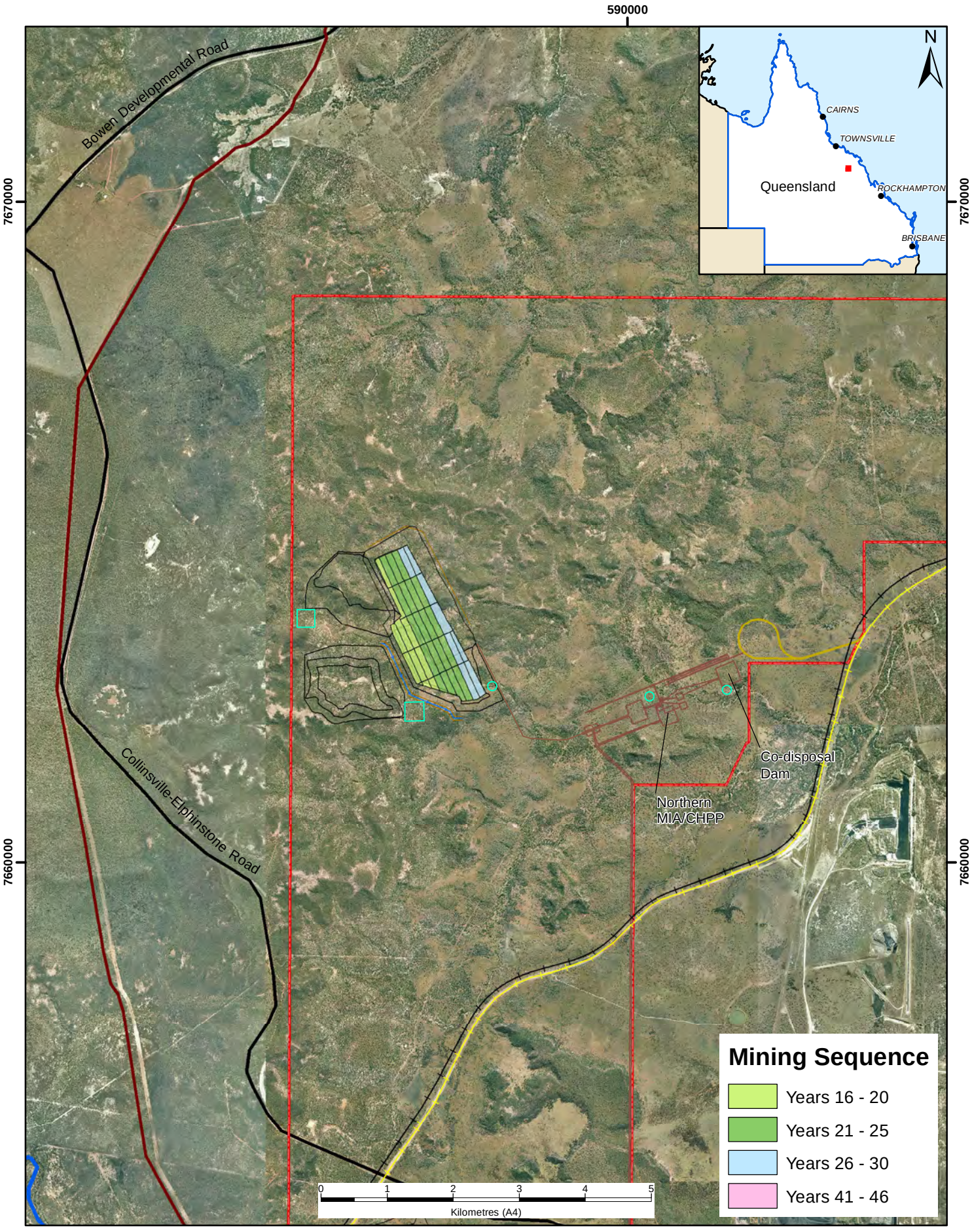

Legend

- Project Area
- Waste Rock Dumps and Pits
- GAP Rail line
- Suttor River
- Formed Roads
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Train Loading Facilities
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Dam (mine affected, sediment affected, clean water)

Life of Mine Mining Sequence (North)		QCOAL GROUP
Figure 2-2	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *19/03/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:75,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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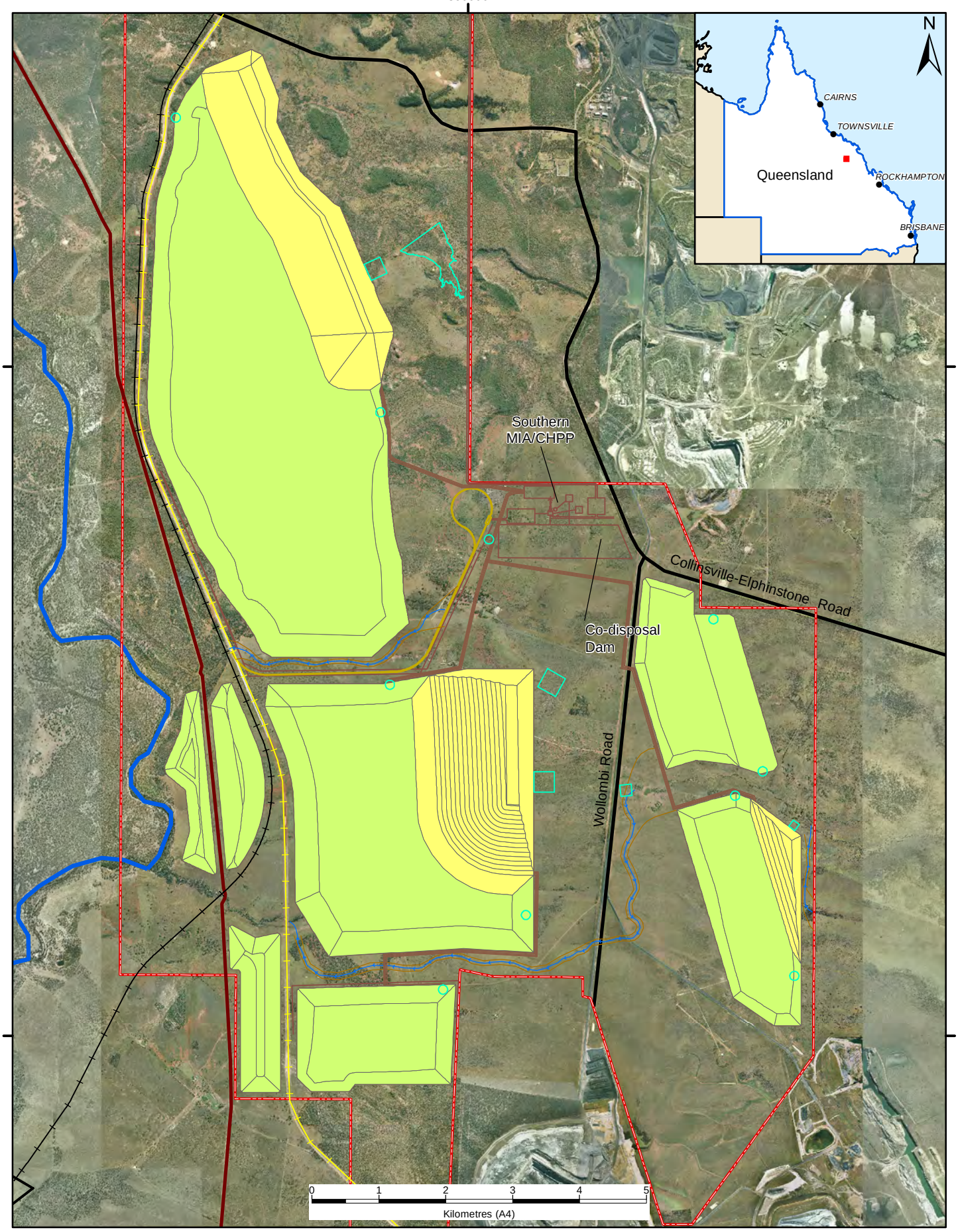

Legend

- Project Area
- Completed Rehab
- Final Void
- GAP Rail line
- Suttor River
- Formed Roads
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Dam (mine affected, sediment affected, clean water)
- Train Loading Facilities
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

End of Mine Life Final Landform (South)

QCOAL GROUP

Figure 2-3

Byerwen Coal Project

environmental and licensing professionals pty ltd

Date: *19/03/2013*

Author: samuel.ferguson

Map Scale: 1:75,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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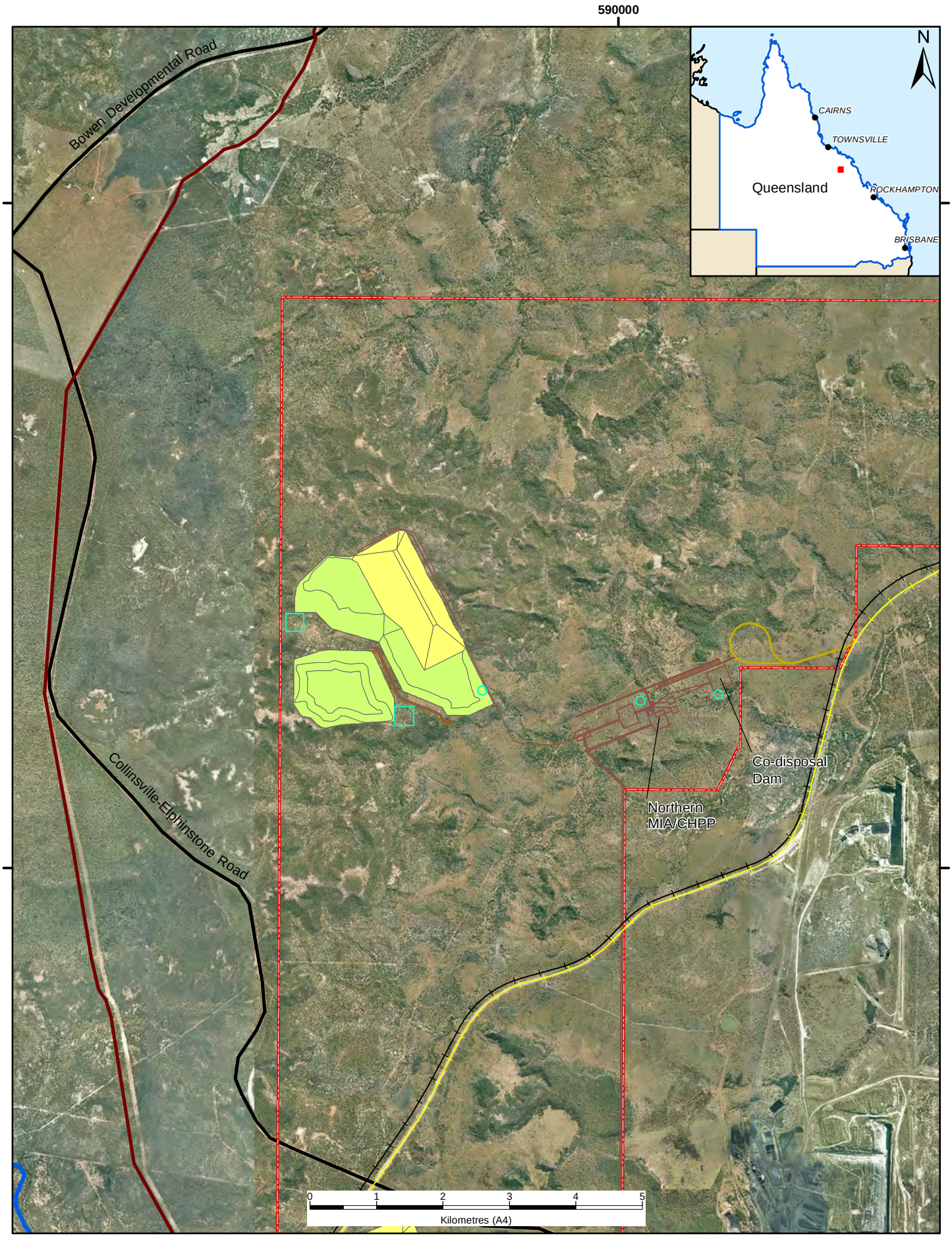

Legend

- Project Area
- Completed Rehab
- Final Void
- GAP Rail line
- Suttor River
- Formed Roads
- Mine Infrastructure
- Drainage Bund
- Drainage Diversion
- Dam (mine affected, sediment affected, clean water)
- Train Loading Facilities
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

End of Mine Life Final Landform (North)	QCOAL GROUP
Figure 2-4	**Byerwen Coal Project**
Date: *19/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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2.5 Processing and Products

There will be two CHPPs used for the project, the southern CHPP and the northern CHPP. The southern CHPP will be capable of processing 15 Mtpa ROM coal and the northern CHPP will be capable of processing 5 Mtpa ROM coal. The total amount of ROM coal that is processed at both CHPPs will be approximately 15 Mtpa.

Each CHPP is planned to comprise a two stage dense medium cyclone and spiral/reflux classifier and froth flotation operation with a co-disposal system for rejects management.

The approximate annual throughputs of the CHPP are shown in **Table 2-3**. It is not expected that any coal will bypass the CHPP.

Table 2-3 Indicative CHPP Outputs

Component	Indicative Tonnages (Mtpa)	
	Southern CHPP	Northern CHPP
ROM feed to CHPP	10 to 15.0	0 to 5.0
Washed product coal	6.7 to 10.0	0 to 3.3
CHPP coal rejects waste	3.3 to 5.0	0 to 1.7

2.6 Rejects Handling and Disposal

2.6.1 Disposal Alternatives

Two disposal methods, common to both the southern and northern CHPPs, were assessed for the project. The preferred option is to truck the coarse reject (greater than 12 mm) to mined waste rock dumps and co-dispose the mid-size reject (1 mm to 12 mm) and fine rejects material (less than 1 mm) to disposal cells in a co-disposal dam using gravel pumps and a combination of steel and poly pipework. Co-disposal of mid-size and fine rejects is a common practice successfully employed in many Australian mines.

The coarse rejects will be deposited by truck, initially in the voids between the waste rock stockpiles. The waste rock stockpile peaks will then be dozed to cover the rejects, and subsequently overlain by soil as part of rehabilitation.

2.6.2 Rejects Disposal

During Year 1 to 10 of mining, fine and mid-size rejects from the southern CHPP will be deposited into an external co-disposal facility located adjacent to the CHPP. From Year 10 rejects from the southern CHPP will be deposited into in-pit disposal facilities. During the initial years of operation of the northern CHPP, fine and mid-size rejects will be deposited in a co-disposal facility located adjacent to the CHPP. In later years, fine and mid-size rejects will be deposited into in-pit disposal facilities. These facilities will be designed, constructed and operated to minimise discharges to surface waters and groundwater. Supernatant from the pit disposal facilities will be returned the CHPP's.

The location and design of the in-pit rejects disposal facilities will be selected based on mining engineering, geotechnical, hydrogeological, safety and other studies.

As mining will be advanced as a series of pits, the progressive filling of mined-out pits with coal processing wastes is an effective long term rejects storage option.

Within the voids, fine and mid-size reject will be placed within cells, allowing rotation between cells and promoting desiccation and drying. Once rejects have dried, they will be capped with benign waste rock to achieve the final landform for rehabilitation (refer to **Section 9**).

Based on the mine schedule it is likely that the sequence of voids, in the southern tenement area, in which in-pit rejects' disposal facilities will be constructed is West Pit 1, West Pit 2 and then West Pit 3. In the northern tenement area, North Pit will be used for in-pit reject disposal.

2.6.3 Co-Disposal Dams

Co-disposal dams will be constructed at each of the CHPPs. The southern co-disposal dam will hold approximately 10,000 ML and be 2,000 m by 500 m by 10 m deep. The northern co-disposal dam will hold approximately 900 ML and be 300 m by 300 m by 10 m deep.

It is expected that the co-disposal dams will be regulated dams and will be designed in accordance with the Queensland Government Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (2012), (the Manual) and any other relevant codes and guidelines. **Section 3** contains a dam hazard assessment for the co-disposal dams.

Co-disposal dams will be designed by a Registered Professional Engineer of Queensland (RPEQ) and will involve site specific geotechnical and hydraulic investigations.

Co-disposal dam design will be based on a turkey's nest configuration with no external catchment reporting to the cells within the dams. With further geotechnical assessment the batter slope will be determined to take into account embankment fill properties and the aim of minimising dam footprint where possible.

Further investigation into the permeability of the materials to be used in the wall and floor of co-disposal facilities will be undertaken to determine the requirements to limit seepage.

The freeboard height, to allow for storm water catchment in the facility, will be determined during detailed design. Crests for the co-disposal dams will be approximately 4 m wide to allow for access and for pipe work associated with rejects disposal and rejects water recycling.

2.7 Product Coal Handling

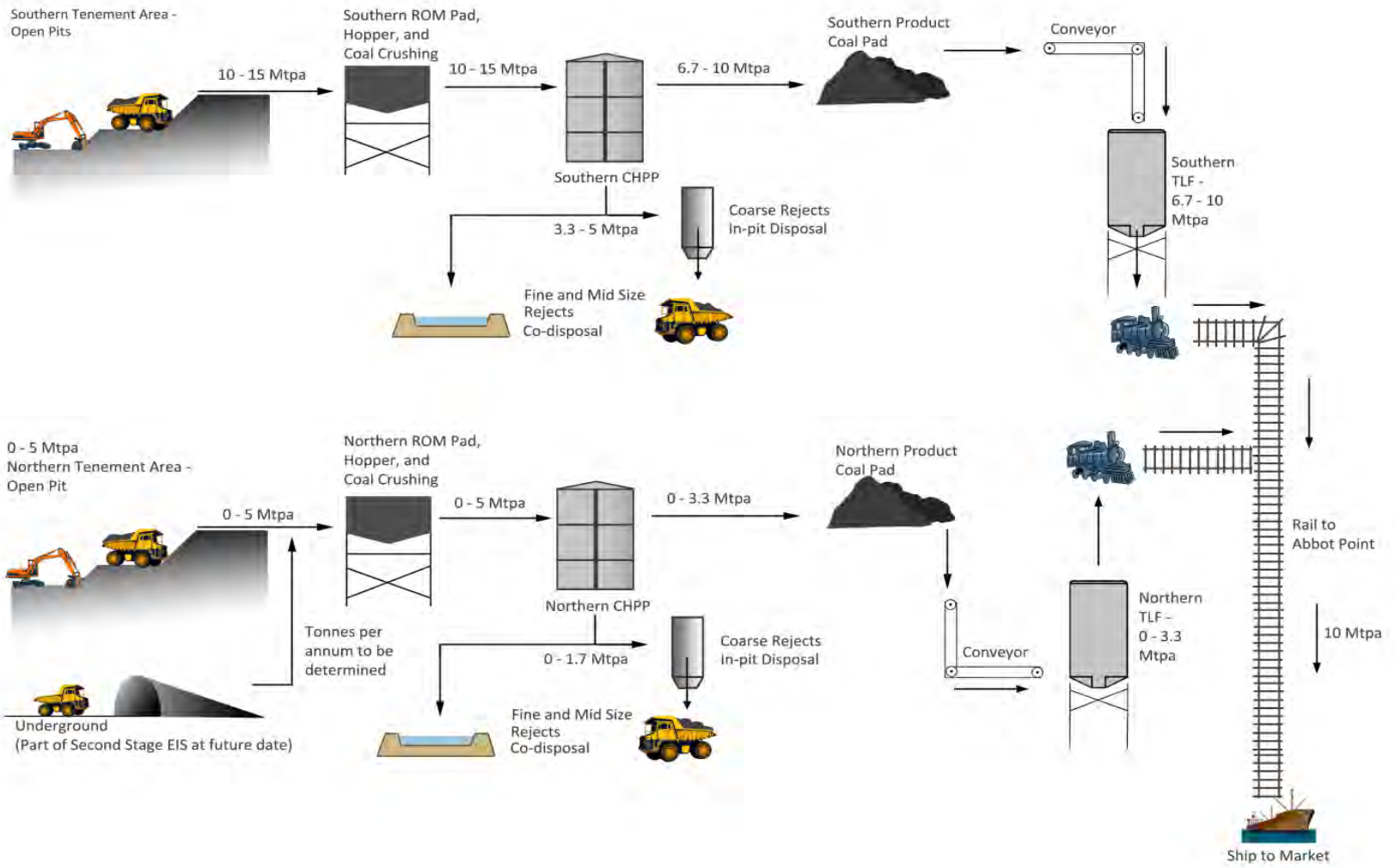
Figure 2-5 shows the processing, handling and transfer of coal from the mine and ROM stockpile to the Port of Abbot Point.

Product conveyors will deliver product coal from the southern and northern CHPPs to nearby product coal stockpiles. There will be a primary product conveyor for transfer of coking coal from the coarse, small and fine coal circuits and a secondary conveyor for transfer of non-coking coal by-products. There will be a single product coal stockpile pad in the north and the south, with separate sections for the primary and secondary product. Coal product will be discharged onto the product stockpiles via a 1,000 tph skyline stacker.

The southern primary and secondary stockpiles will have capacities of 300,000 t each with push out capacity of a further 600,000 t (across both) for a total of 1,200,000 t. The northern product stockpiles will each have a capacity of around 125,000 t each with an additional 150,000 t of push out capacity (across both) for a total of 400,000 t.

Product coal will be reclaimed from the stockpile by in-ground coal valves feeding an underground conveyor for transfer to adjacent train loading facilities.

Figure 2-5 Product Processing, Handling and Transfer



2.7.1 Product Coal Transport to Train Loading Facilities

The GAP rail line traverses the project tenements from south to north. A northern and a southern TLF are planned adjacent the respective CHPPs, to connect to the GAP at two respective points, to transport product coal from stockpiles adjacent the CHPPs. The TLFs will comprise rail loop, train loading bin and rail spur, connected to the GAP rail line. The southern rail spur and rail loop will be approximately 7 km in length and the northern rail spur and rail loop will be approximately 3.5 km in length.

2.8 Mine Infrastructure Area Requirements

There will be two MIAs, one in the southern tenement area adjacent to the southern CHPP and one in the northern tenement area adjacent to the northern CHPP. Both MIAs will contain similar facilities with the main points of difference being sizing, with the northern MIA to be smaller than the southern MIA, as infrastructure will be required to support production of 5 Mtpa ROM, compared to 15 Mtpa ROM.

The MIAs will include the following:

- site offices and administration facilities
- hardstands and laydowns
- workshop, heavy vehicle servicing facility, stores, tyre change and tyre storage facility
- heavy vehicle and light vehicle fuel, lube and oil facilities
- heavy vehicle and light vehicle wash down facilities
- generator (if required)
- reticulated services, including for fire fighting
- potable water treatment, potable water storage tanks and sewage treatment plants
- external area lighting.

Areas storing fuels or oils and washdown areas will be bunded and runoff from these areas will be directed to a sump to separate oils and water prior to releasing water to the environment control pond. Oils and fuel will be collected and disposed of by a licensed waste disposal contractor. It is anticipated that approximately 800 kL of fuel storage will be stored on site. Diesel will be reticulated to heavy vehicle service bays, and heavy and light vehicle bowsers. The fuel facility will be located at a safe operating distance from other MIA and surrounding facilities in accordance with *Australian Standard AS1940 - The storage and handling of flammable and combustible liquids.*

2.8.1 Explosives Magazine and Storage

An explosives magazine to house detonating explosives, bulk storage and all associated materials will be designed and constructed to *Australian Standard (AS) 2187 Explosives — Storage, Transport and Use*, and any other applicable standards and industry best practice. The magazine will be located in an isolated area for safety and security purposes.

2.9 Road Transport

Roads associated with the mine are divided into the following categories:

- ROM coal haul roads and waste rock haul roads within the mine site
- site access roads and internal roads for light and heavy vehicles, including the infrastructure corridor
- public access roads to the mine site
- closures and relocations of public roads and stock routes.

Crossing points are required to be established where roads cross the Collinsville-Elphinstone Road, the GAP rail line and potentially the proposed Alpha Coal Project rail line which will run parallel to the GAP rail line. Additional crossing points will also be required to allow waste rock haul truck traffic to cross the GAP rail line and proposed Alpha Coal Project rail line in the southern portion of the project area to access out of pit dump locations and to facilitate equipment movement.

Where light and heavy vehicles utilise the same routes, separation will be achieved as per standard industry practice.

Where required, crossings of the infrastructure corridors will be provided to allow landholders access from one side of the property to the other for the movement of stock and vehicles. The design and location of crossings will be determined in conjunction with landholders.

A haul road for ROM coal is required from all mine pits to the ROM coal stockpiles at CHPPs. Temporary haul roads will also be constructed to the out-of-pit waste rock dumps and will be extended / relocated as required.

There will be two site access roads which connect the Collinsville-Elphinstone Road to the southern and northern MIA and CHPP.

Approvals will be sought for all works associated with temporary road and stock route closures and relocations. All road and stock route closures or relocations will be communicated to the public.

2.10 Energy

Power demand at the mine is characterised by a base load component of approximately 23 MW originating from steady loads such as the CHPPs, conveyor belts and MIA facilities. In addition, 8 MW will be required for the dragline.

Power supply to the southern and northern tenement areas will be via spurs to an existing 66 kV line that originates from the Newlands substation and traverses the project area. The existing 66 kV power line, will be relocated to avoid West Pit 1, with the most likely route following the southern infrastructure corridor.

The existing local electrical infrastructure is a combination of 22 kV overhead power lines and single-wire earth return (SWER) lines across the project area. These lines supply the properties within and adjacent the project area.

Relocation of the existing electricity infrastructure within the project area will be timed to co-ordinate with the proposed mining schedule and in conjunction with the relevant energy provider.

2.11 Workforce

Accommodation for up to 780 workers is required for the project's peak (year 16) for the combined construction and operation workforce. The proponent's preference is for accommodation to be provided in Glenden, however should this option be rejected by the local authorities, the proponent will seek the necessary approvals to accommodate all workers in alternative accommodation, including in a camp on the project mining leases.

Accommodation in Glenden is off tenement and will require development approval under the *Sustainable Planning Act 2009 (SP Act)*. The proponent has an arrangement with a third party who will develop the accommodation facilities in Glenden and seek all relevant approvals for the construction and operation of the facilities.

3. WATER MANAGEMENT SYSTEM

3.1 Water Management System

The objective of the project water management strategy is to manage water generated within the project area in a manner that does not cause adverse impacts to surface water quality, or stream hydrology. Therefore the strategy aims to:

- release to the environment only when the receiving waterway is flowing or has recently flowed
- contain sediment within the mining area
- maintain water quality in the receiving environment within the ranges established as criteria.

Water within the project area will be segregated based on quality to allow for various management approaches. Three water classifications have been nominated for the project:

- mine affected water - from disturbed catchments or groundwater inflow into open pits
- sediment affected water - from disturbed catchments suitable for discharge after sediment removal
- clean water - from undisturbed areas, bypassing mine affected areas, suitable for natural discharge.

There would be a need to move water around the site, which would be achieved using gravity open channels or pipes, or pumping. Process water associated with the CHPPs and co-disposal facilities will be managed in a closed circuit such that there are no releases. The process water system is therefore not connected to the mine water management system.

Runoff from the MIA, CHPPs, coal stockpiles and other infrastructure areas, that is potentially contaminated (e.g. with oils), will be directed to other structures designed to improve the quality of the water such as an oily water separator or environmental control dam. It will then be released into the mine water system as mine affected water or sediment affected water, depending on water quality.

3.1.1 Mine Affected Water

Water that accumulates in pits as a result of groundwater inflow and surface water runoff will be collected and pumped to mine affected water dams at the surface. Construction of levees and drainage diversions will ensure pit workings and mine infrastructure are protected from surface runoff. Mine affected water will be contained in dams until flow rate criteria in receiving waters are met and waters can be released within water quality objectives (which may also be met either by dilution and/or blending). Mine affected water will be available for general site uses such as in dust suppression or coal washing (CHPP) if quality is deemed adequate at the time.

3.1.2 Sediment Affected Water

Areas that drain disturbed areas such as the MIA, coal stockpiles, recently rehabilitated waste rock dumps, access roads and laydown areas have the potential to generate sediment laden runoff. Sediment affected water would pass through sedimentation dams prior to release to the environment, once the water quality objectives are met. If these sediment affected waters also contain elevated salinity, then they would be reclassified as mine affected water and included in that water circuit. Sedimentation basins would likely be required until the disturbed areas are sufficiently rehabilitated and stabilised. Sediment affected water will be available for general site uses such as in dust suppression or coal washing (CHPP) if quality is deemed adequate at the time.

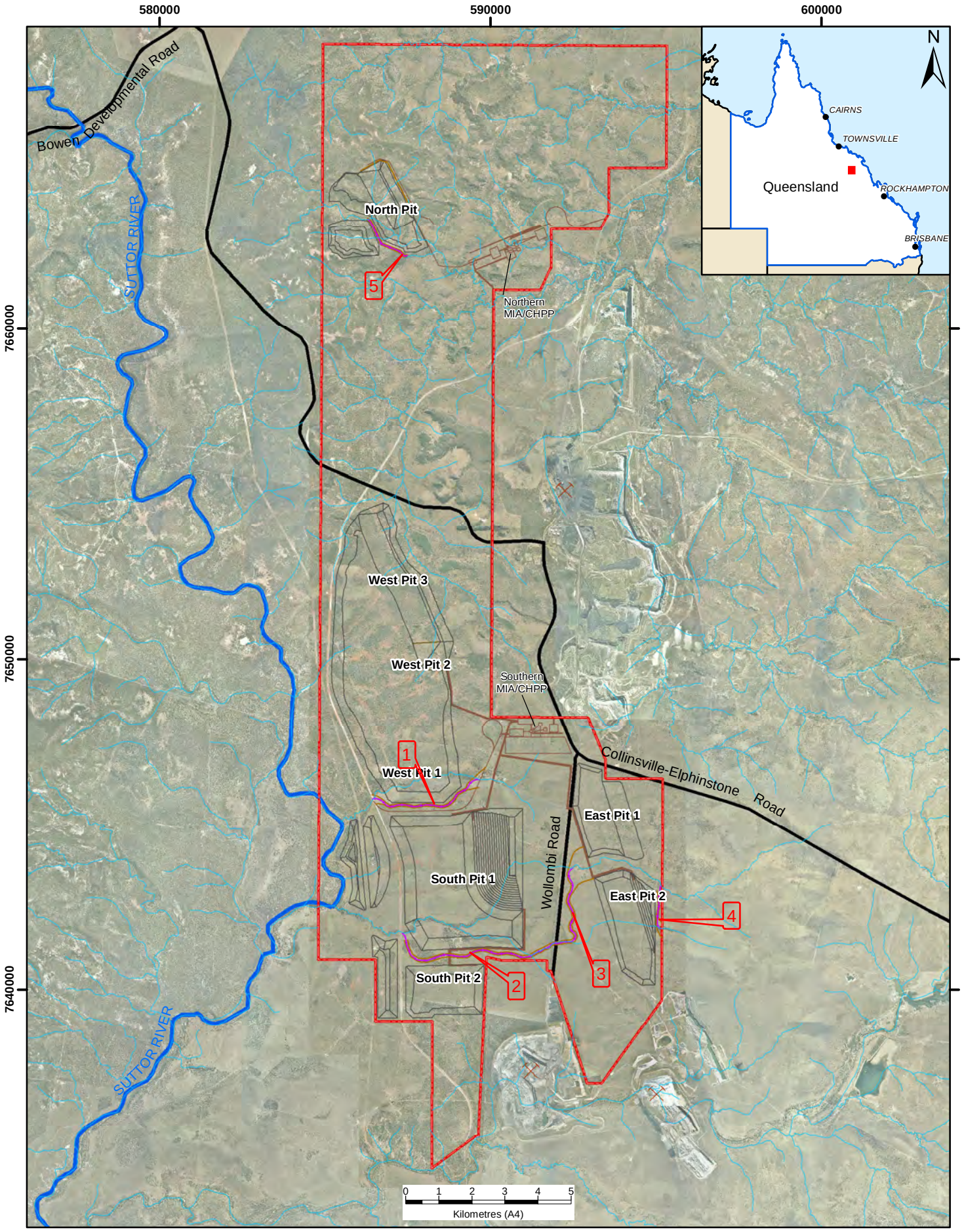
3.1.3 Clean Water

In most cases runoff from undisturbed catchments upstream of the mining area would be diverted around the disturbed area back into natural drainage features and the environment. Where this is not the case a clean water dam is proposed either to facilitate the diversion, or to provide a source of clean water that can be used to blend with mine affected water (if required) to facilitate release.

3.1.4 Drainage Diversions

The project will involve five drainage diversions (**Figure 3-1**) where existing watercourses or drainage lines are located within the footprint of open pits or waste rock dumps, as per the below:

- Diversion 1 – a drainage line that intersects West Pit 1 will be diverted between West Pit1 and South Pit 1. The tributary of the Suttor River that flows through West Pit 1 is not a defined watercourse. The natural topography for the initial 1,200 m of the proposed diversion channel rises approximately 4 m to 300 m Australian Height Datum (AHD) before falling 14.5 m to 285.5 mAHD over the remaining 2,500 m. levee banks have been included in the diversion channel feasibility design to contain the 0.1% AEP design discharge.
- Diversion 2 – a drainage line / watercourse that intersects South Pit 1 will be diverted between South Pit 1 and South Pit 2. The western section of the tributary which intersects South Pit 1 is a defined watercourse. The natural topography along the proposed diversion starts at chainage 5,750 m with a fall in elevation of 6.1 m from 301.6 to 295.5 mAHD for the initial 1,330 m (CH 5,750 to CH 4,420). Surface topography between CH 4,420 and CH 1,100 undulates between 294 and 297 mAHD before falling 11 m over the remaining 1,100 m to an elevation of 283 mAHD at the diversion channel outlet at the GAP rail crossing. Levee banks are included in the feasibility design to encompass varying topography where flood flows would otherwise spill from the design channel.
- Diversion 3 – connected to, and upstream of, diversion 2, which will divert a drainage line upstream of South Pit 1 into Diversion 2. Flows from the tributary between East Pit 1 and East Pit 2 are prevented from entering South Pit 1 by Diversion 3 which redirects flow into Diversion 2. Diversion 3 is approximately 2,630 m in length and runs in a southerly direction, diverting the drainage line upstream of South Pit 1 into Diversion 2. It has an upstream elevation of 302 mAHD and remains reasonably flat at 302 to 303 mAHD for the first 1,600 m of channel length (CH 6,750 to CH 8,500), climbing to a maximum elevation of 305 mAHD at CH6 250. From this location, the terrain begins a gradual decline in elevation from 305 to 301.6 mAHD at CH 5,750, where is joins Diversion 2.
- Diversion 4 – a drainage line that flows through East Pit 2 will be diverted north until it reaches another existing drainage line. The tributary that intersects East Pit 2 is not a defined watercourse. The diversion is located between East Pit 2 and the mine lease boundary and conveys a small drainage line in a northerly direction to a natural tributary which flows through a corridor between East Pit 1 and East Pit 2. The natural topography along the route of the diversion has an upstream elevation of 312 mAHD for the first 200 m before gradually increasing in elevation to 317 mAHD over the next 600 m (CH 1,200 to CH 600). From CH 600 the topography gradually falls over the remaining 600 m of the diversion channel to an elevation of 310 mAHD at CH 0.
- Diversion 5 – a drainage line that intersects North Pit will be diverted between North Pit and the out of pit waste rock dump. A small drainage line diversion is planned to allow water to bypass the North Pit and flow to Kangaroo Creek. This drainage diversion will be in place before mining operations commence at the North Pit. The drainage diversion put in place will remain as a permanent structure to divert water around the North Pit and its final void.



Legend

- Project Area
- Waste Rock Dumps and Pits
- Mine Infrastructure
- Formed Roads
- Existing Mine Site
- Drainage Line
- Drainage Bund
- Drainage Diversion

Diversions	
Figure 3-1	**Byerwen Coal Project**
Date: *1/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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3.2 Process Water, Water Demand and Water Supply

Process water will be imported to site from an external supply source (SunWater's Burdekin to Moranbah pipeline system) and reused on site where possible.

The process water circuit, of which the CHPP is part, is a closed system. Supernatant or decant water from the co-disposal facilities will be recycled to the process plants; however some water will be lost through evaporation, in coal processing or as part of the coal moisture content, and as such the make-up water will be from the external source. This provides a consistent and reliable water source and is therefore not included in the mine site water balance. The estimated average and maximum water demands for the project is summarised in **Table 3-1**. Water for potable water will be supplied by SunWater and treated to potable standard on site.

Table 3-1 Estimated Water Demand

Activity	Demand (MLpa)	
	Average	Maximum
Dust suppression	1,300	1,600
Vehicle washdown	70	70
Potable water	9	10
Northern CHPP raw water	1,000	3,400
Southern CHPP raw water	3,100	1,100
Total	5,479	6,180

3.3 Release Strategy

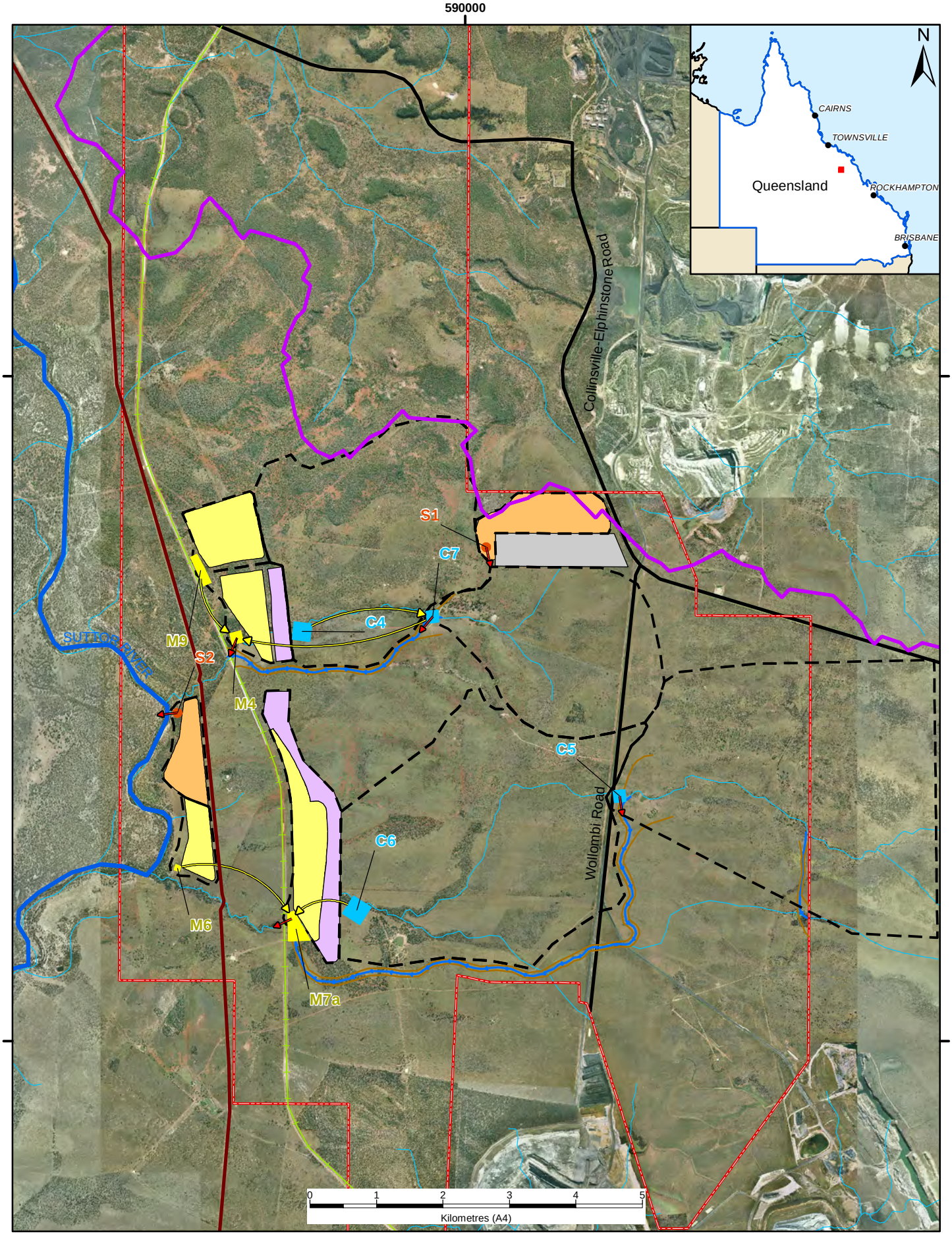
It will be necessary for the project to release water to the environment to balance the mine water inventory. This will be achieved through a controlled release strategy that allows discharge into the environment when water quality and flow conditions are within acceptable limits. All releases for all waters would be made in accordance with a water management plan, specifying flow and quality criteria. See **Section 6.3.3**.

3.4 Water Management Infrastructure

3.4.1 Overview and Staging

The mine water infrastructure requirements include six clean water dams, 14 mine affected water dams, 17 in-pit sumps and 27 sediment affected water dams. The conceptual layout of the dams (other than in-pit sumps) over various mine stages of mine life in the southern and northern areas is shown in **Figure 3-2** to **Figure 3-8**. Certain dams will require progressive relocation in line with the progression of mining activities and the expansion of the pits. The figures present water management features in this south at years 3, 10, 25 and 46, and the north at years 16, 25 and 46.

Mine affected water dams are denoted with an 'M', clean water dams with a 'C' and sediment affected water dams with an 'S'. Also shown on the figures are the catchment areas draining to the dams, the water transfer between dams and to the environment and the release points for water from dams. The indicative size of mine affected water dams and clean water dams is shown, but, sediment affected water dams are scaled for conceptual purposes only.



Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam
- Formed Roads
- Release to Environment
- Water Transfer

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 3 Southern Area

QCOAL GROUP

Figure 3-2 Byerwen Coal Project

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Date: *20/03/2013*

Author: samuel.ferguson

Map Scale: 1:75,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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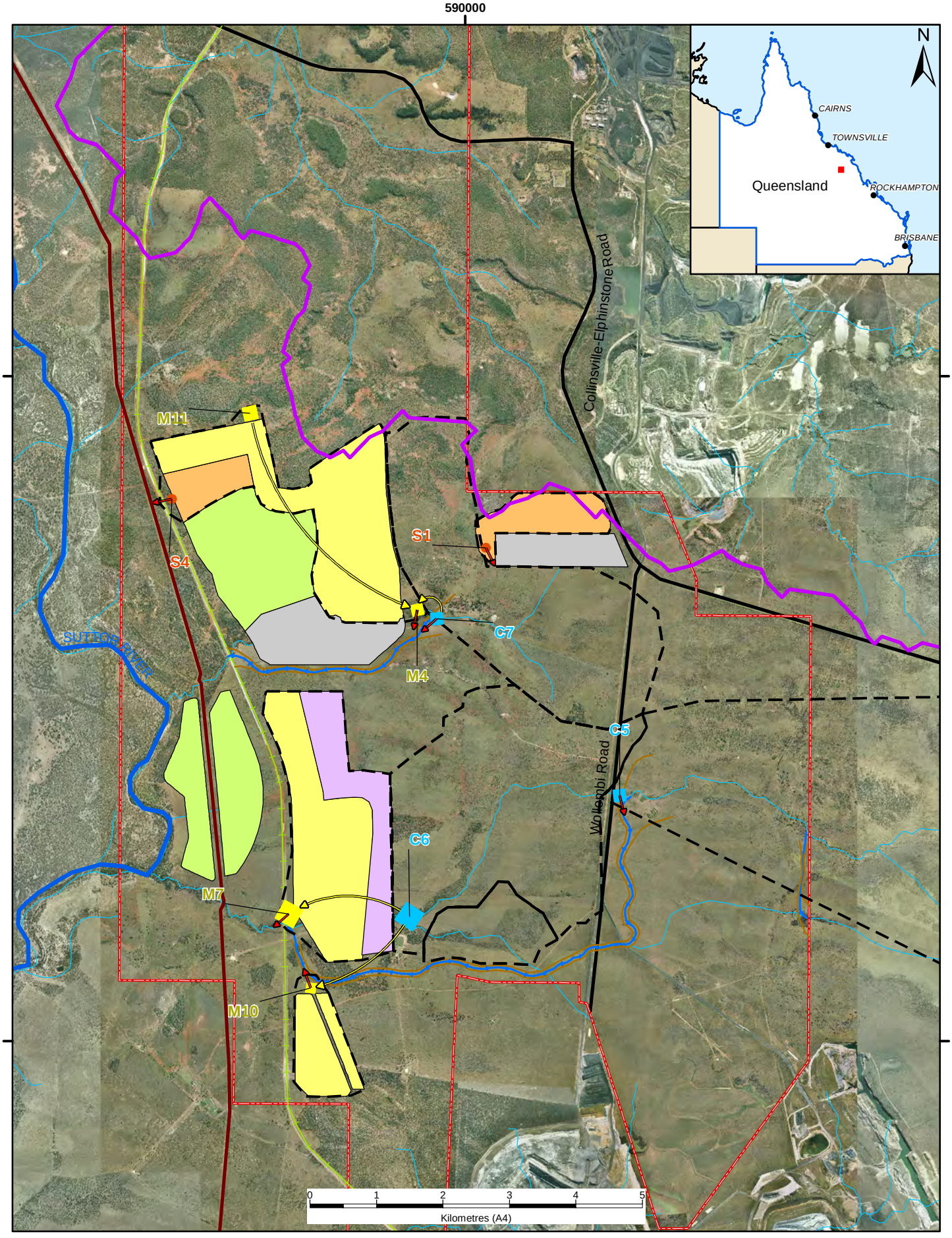

Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Release to Environment
- Water Transfer
- Formed Roads
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 10 Southern Area	QCOAL GROUP
Figure 3-3	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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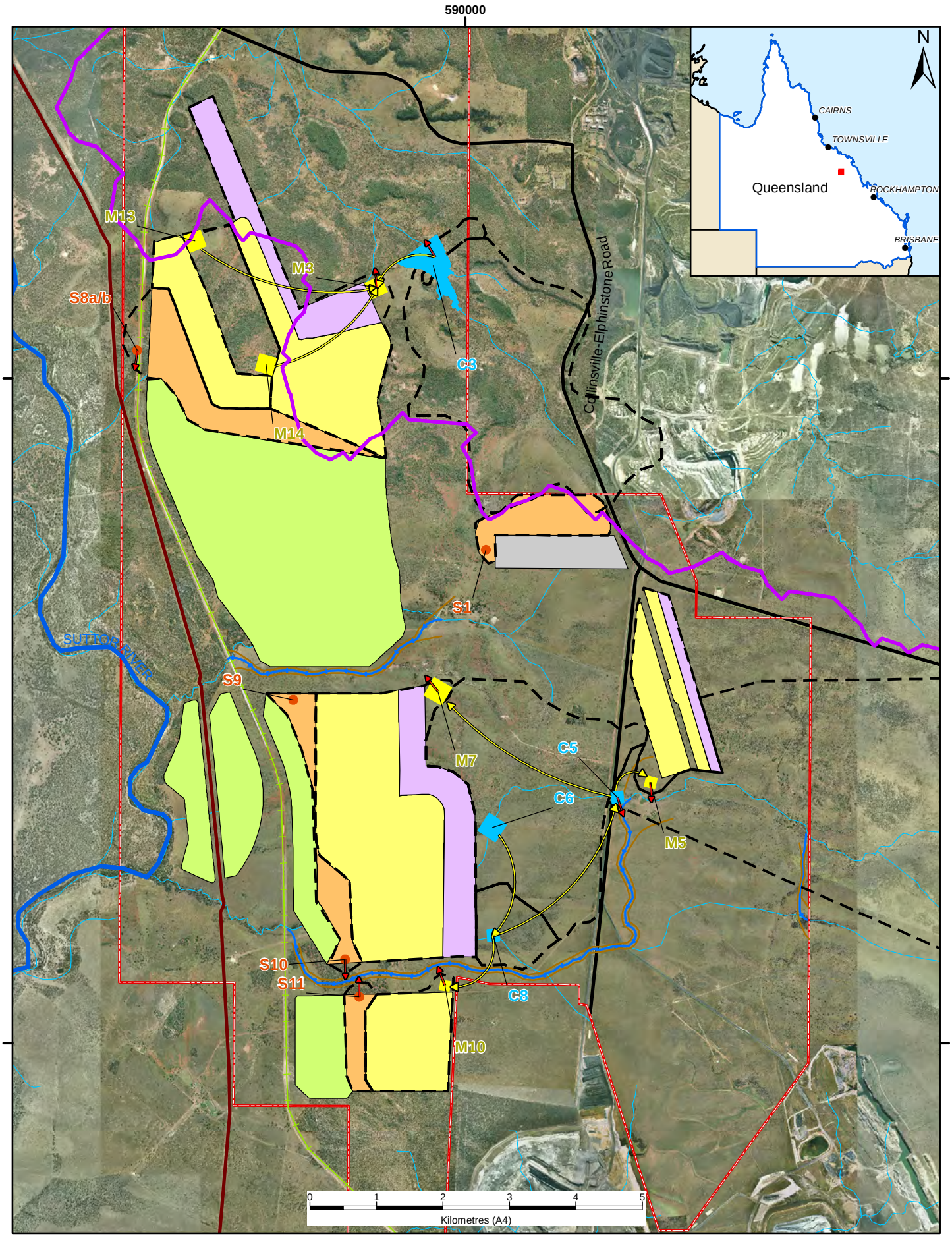

Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Formed Roads
- Release to Environment
- Water Transfer
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 25 Southern Area

QCOAL GROUP

Figure 3-4 Byerwen Coal Project

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Date: 20/03/2013	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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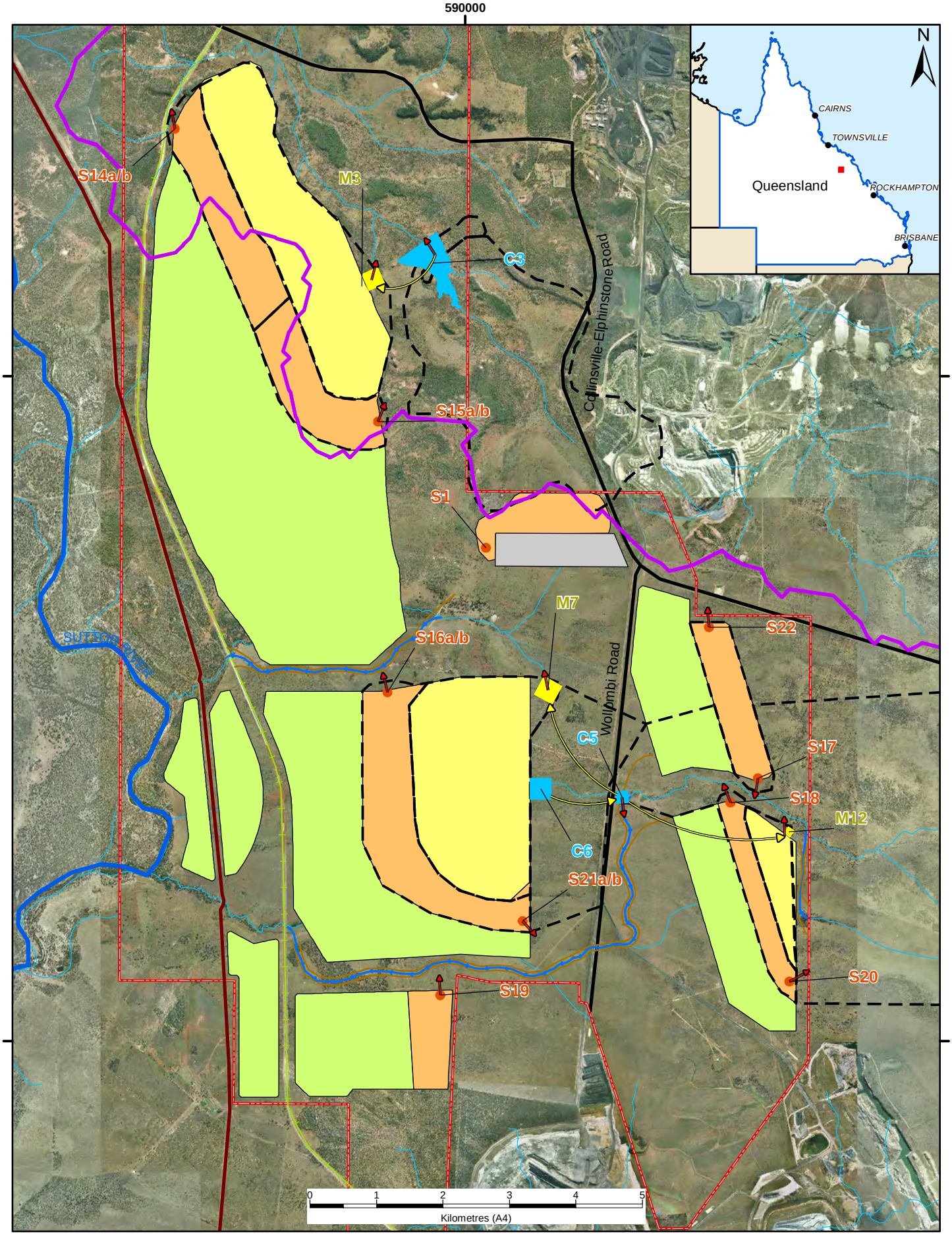

Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Formed Roads
- Release to Environment
- Water Transfer
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 46 Southern Area

QCOAL GROUP

Figure 3-5 | **Byerwen Coal Project**

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Author: samuel.ferguson

Map Scale: 1:75,000

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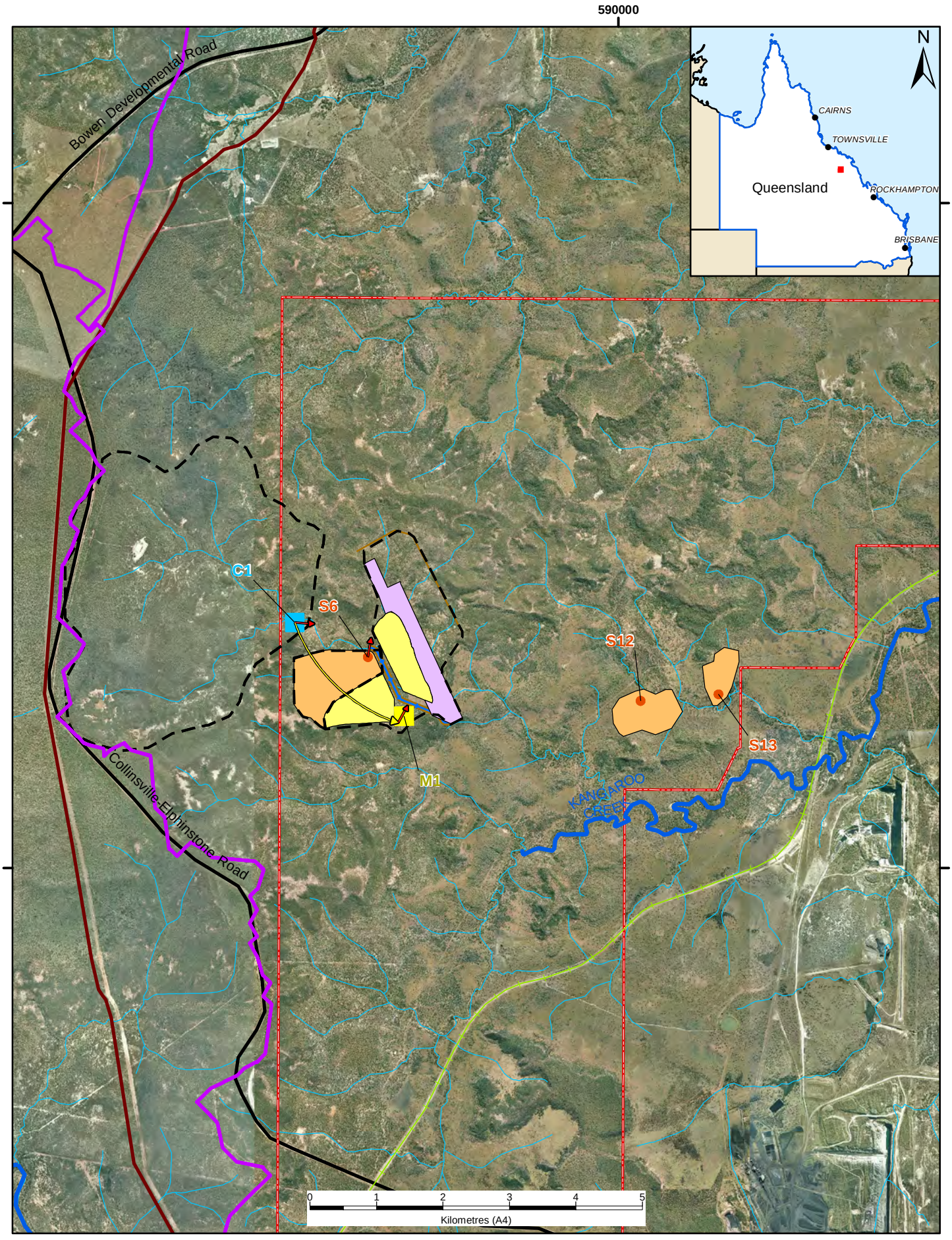

Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Formed Roads
- Release to Environment
- Water Transfer
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 16 Northern Area	QCOAL GROUP
Figure 3-6	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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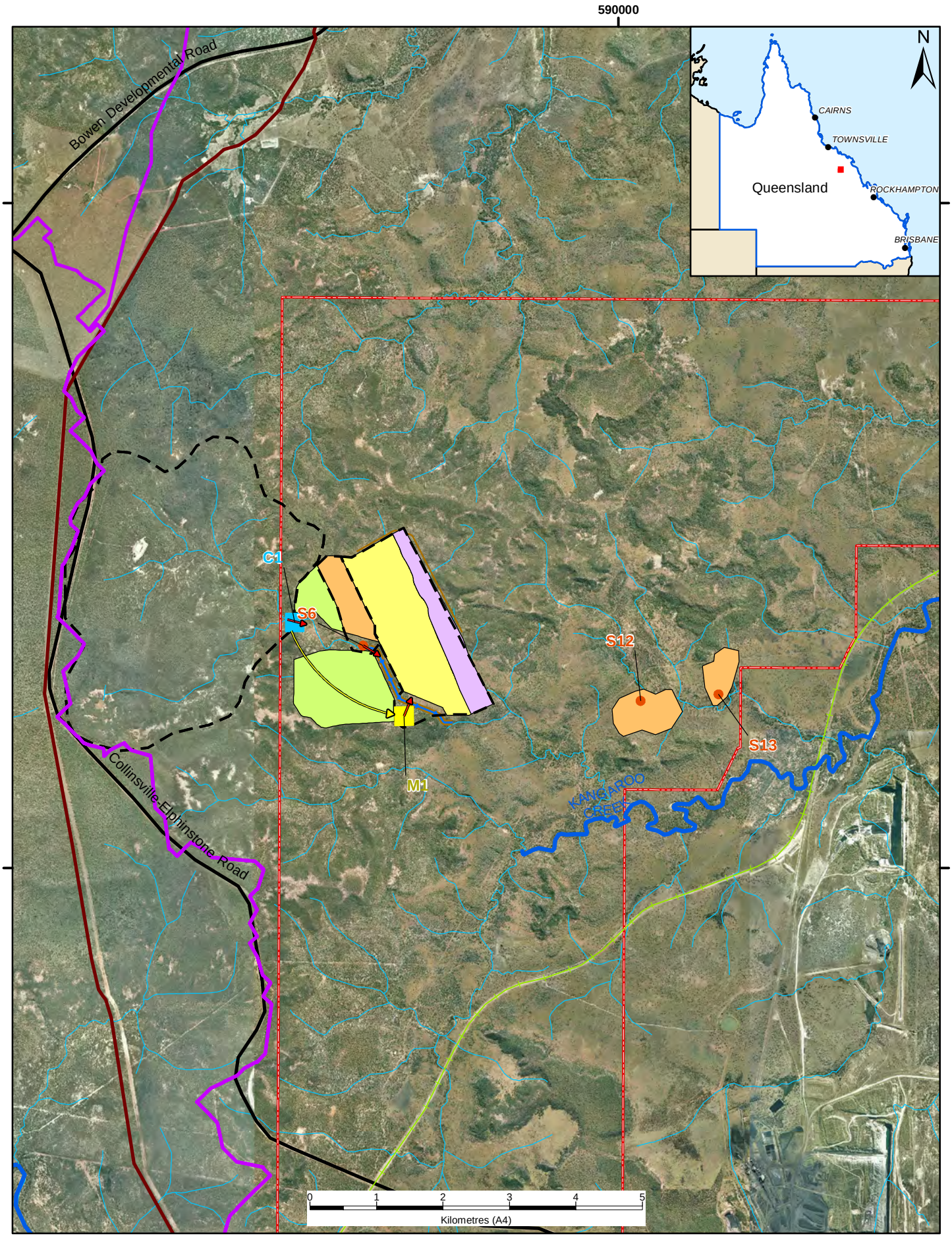

Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Formed Roads
- Release to Environment
- Water Transfer
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 25 Northern Area	QCOAL GROUP
Figure 3-7	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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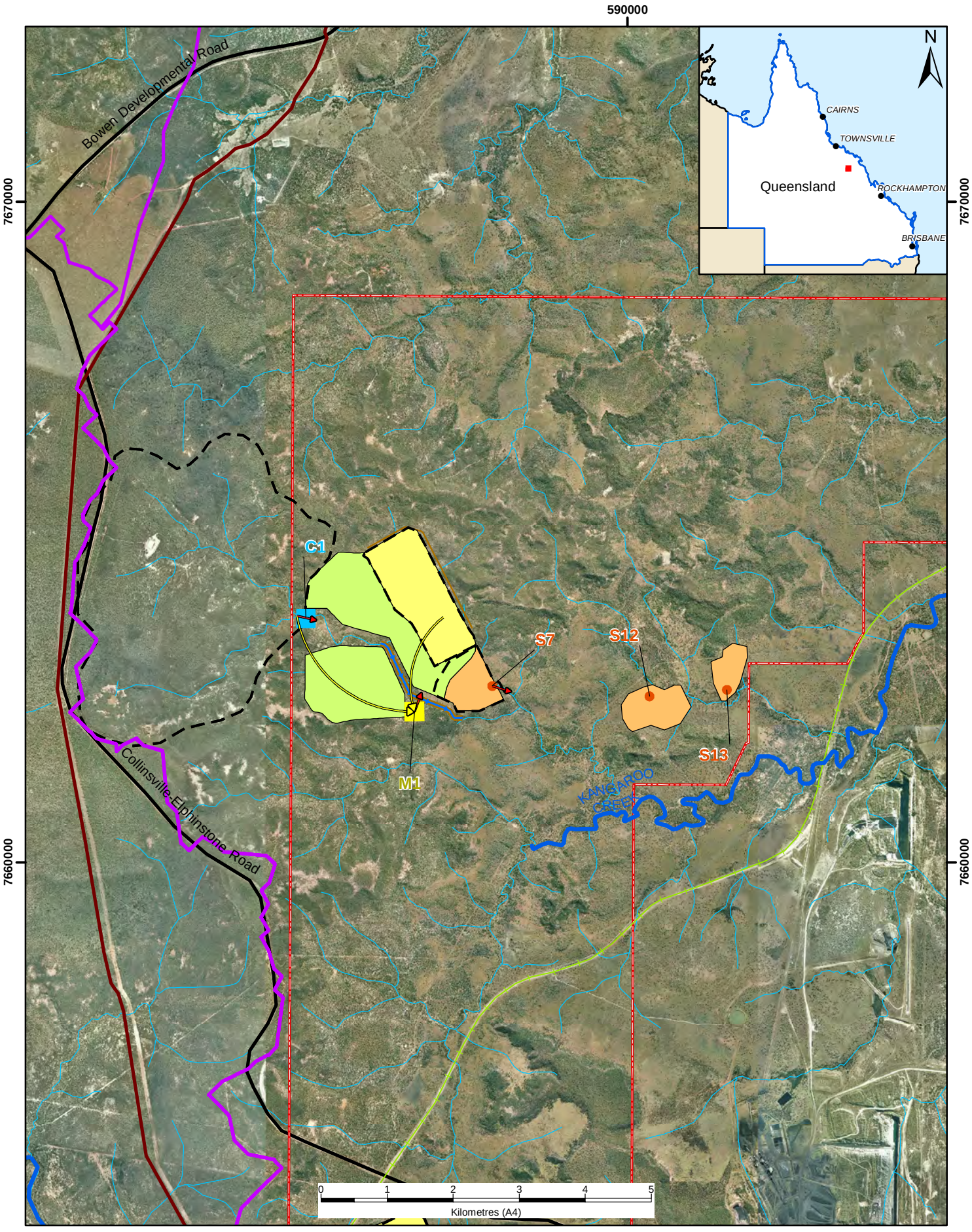

Legend

- Project Area
- Main Catchment Divide
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Drainage Bund
- Drainage Diversion
- Drainage Lines
- Subcatchments
- Formed Roads
- Release to Environment
- Water Transfer
- Clean Water Dam
- Mine Affected Water Dam
- Sediment Affected Water Dam

Area Type

- Mine Affected Water Catchment
- Rehabilitated Waste Rock Dump
- Sediment Affected Water Catchment
- Pre Strip
- Co-disposal Area

Mine Water Management Year 46 Northern Area	QCOAL GROUP
Figure 3-8	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:75,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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The majority of water transfer would be done through open channel or with the use of polypipe or layflat hose. Release to the environment would be accomplished using a combination of weirs, sluice gates and pumping to allow for all high and low capacity discharge occurrences. Smaller mixing dams will also be required at release points. These will allow controlled mixing of clean and dirty water before release. Mixing is predominately done during periods of recessional flow and therefore large amounts of mixing is not required and dam sizes would be small (i.e. <5 ML).

Release points of mine affected water dams will be on drainage lines to minimise the risk of scour with the exception of M3a, M3b and M5. Scour protection may be required at the latter's release point.

3.4.2 Dam Design and Sizing

3.4.2.1 Mine Affected Water Dams

The proposed water management system for mine affected catchments has been designed such that there are no unplanned releases to the environment. This has been achieved by:

- dams meeting the DSA criteria as per the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM, 2012), with a 5% or less probability that pits will be required to hold water
- viable contingency measures that may be used for extreme climate scenarios.

The DSA is the minimum storage allowance provided by a dam for the wet season. The adopted design criteria meets the standards required for the corresponding hazard rating of the containment structures (refer **Section 3.4.3**). Consideration was also given to the fact that the project will operate several open cut mining pits for the majority of the mine life, providing an opportunity for emergency storage in one pit while still being able to maintain mining operations in the remaining pits.

3.4.2.2 Sediment Affected Water Dams

Sediment dams were designed based on containment of a 10 year ARI 24 hour design storm event.

3.4.2.3 Clean Water Dams

Clean water dams serve two purpose, to protect the mining areas from catchment runoff and to provide a clean water supply for use in dilution to achieve end-of-pipe and downstream water quality objectives.

Dams protecting the mining areas from catchment runoff are designed to have a very low risk of exceeding capacity, as the consequence of overtopping may result in flooding of the pit. Preliminary sizing is based on a 1% AEP and considers pipe and pump out capacity, with a balance between storage volume and pump capacity. However this will be further analysed during detailed design.

Clean water dams providing a clean water supply have been sized based on the reliability of supply to meet site requirements. Preliminary designs ensure natural catchment flows will continue.

3.4.2.4 Dam Sizing

Mine water infrastructure requirements satisfy the design criteria of the DSA (DERM, 2012) and meet the acceptable level of risk of utilising an emergency contingency measure. Mine affected water and clean water dams are proposed as 'turkey's nest' type dams with the exception of C3 which is proposed as a valley dam with stage storage relationship has been extracted from survey data. The proposed mine affected water and clean water dam capacities are provided in **Table 3-2**.

Sediment affected water dams range in size between 15 and 54 ML (approximately 1 ha per dam) while in-pit sumps range in size between 173 and 362 ML, other than the East Pits which are 29 to 37 ML.

Table 3-2 Maximum Mine Affected Water and Clean Water Dam Sizing

	Dam	Volume (ML)	Height (m)	Footprint (ha)*
Mine Affected	M1	571	7.0	8.2
	M3a	475	7.0	6.8
	M3b	476	7.0	6.8
	M4	183	7.0	2.6
	M5	137	7.0	2.0
	M6	29	4.0	0.7
	M7	588	7.0	8.4
	M8	127	7.0	1.8
	M9	392	7.0	5.6
	M10	130	7.0	1.9
	M11	392	7.0	4.3
	M12	60	5.0	1.2
	M13	484	7.0	6.9
	M14	484	7.0	6.9
Clean Water	C1	100	7.0	7.1
	C3	250	3.2	20.2
	C4	469	7.0	6.7
	C5	100	7.0	2.9
	C6	651	7.0	9.3
	C7	100	7.0	2.9
	C8	150	7.0	2.1

3.4.3 Dam Hazard Assessment

The Manual sets out the requirements for hazard category assessment and certification of the design of 'regulated structures'. A dam hazard assessment was conducted for all mine affected water dams, co-disposal dams, sediment affected water dams and clean water dams. All clean water dams and sediment affected water dams were classified as low hazard and are therefore not regulated dams. **Table 3-3** provides a summary of the dam hazard assessment for mine affected water dams and the north and south co-disposal dams.

The DSA for the site requires containment of the 1% and 5% AEP for high and significant hazard rating respectively. This was used to determine the DSA with a safety factor or design simulation margin (DSM) of 50% in accordance with the Manual. Structures requiring a DSA will be brought down to this level by the 1 November each year in preparedness for the upcoming wet season. Regulated structures will be subject to the normal obligations for regulated structures, as shown below:

- submission of detailed designs and documentation by a person suitably qualified and experienced in dam engineering (RPEQ)[2]
- annual inspections by a person suitably qualified and experienced in dam engineering (RPEQ)
- design of a spillway to cater for a specific ARI based on the hazard category assigned to the dams

[2] See definition provided in **Section 19**

- inclusion of a suitable DSA and Mandatory Reporting Limits (MRL)
- assessment of the potential impacts of any failure of the dam embankments.

Table 3-3 Dam Hazard Assessment

Dam	Volume (ML)	Failure to contain scenario	Dam break scenario	Containment scenario	Hazard category	Regulated structure?
M1	571	Significant	Significant	Significant	Significant	Regulated
M3a	475	Significant	Significant	Significant	Significant	Regulated
M3b	476	Significant	Significant	Significant	Significant	Regulated
M4	183	Significant	Significant	Significant	Significant	Regulated
M5	137	Significant	Significant	Significant	Significant	Regulated
M6	29	Significant	Low	Significant	Significant	Regulated
M7	588	Significant	High	Significant	High	Regulated
M8	127	Significant	Low	Significant	Significant	Regulated
M9	392	Significant	Low	Significant	Significant	Regulated
M10	130	Significant	Significant	Significant	Significant	Regulated
M11	392	Significant	Significant	Significant	Significant	Regulated
M12	60	Significant	Low	Significant	Significant	Regulated
M13	484	Significant	Significant	Significant	Significant	Regulated
M14	484	Significant	Significant	Significant	Significant	Regulated
South Co-disposal	10 000	High	High	Significant	High	Regulated
North Co-disposal	900	High	High	Significant	High	Regulated

Potential evaporative contaminant increases in mine affected water dams will be mitigated by regular releases of mine affected water in accordance with the release criteria and direct rainfall.

3.4.3.1 Referable Dams

Under the *Water Supply (Safety and Reliability) Act 2008* (Qld), dam assessments must include a Failure Impact Assessment in accordance with Guidelines for Failure Impact Assessment of Water Dams (DERM, June 2010), if the dam being considered meets certain design parameters. The southern co-disposal dam is the only dam within the project's water management system that may be considered a referable dam. A Failure Impact Assessment will be completed by the proponent, if required, when detailed designs of the southern co-disposal dam are available.

3.4.4 Design of Diversions

The project diversion channel designs are based on the DEHP guideline on Watercourse Diversions – Central Queensland Mining Industry (DERM, 2011[3]), which provides advice on stream powers, velocities

[3] Department of Environment and Resource Management (2011), Watercourse Diversions – Central Queensland Mining Industry, Central West Region, Queensland

and shear stresses that are considered to be the upper range for natural Bowen Basin watercourses. The Manual also outlines hydrological design criteria for regulated structures including levees and specifies that the crest level for levee embankments should contain a 0.1% AEP with 0.5 m additional freeboard.

The conceptual design of diversion channels was based on the following key principles:

- A slope similar to the natural watercourse conditions.
- A 10 m width for construction and additional 30 m either side to allow for contingencies
- A design allowing for meandering to match the diverted channel length to the natural creek.
- A 1:5 bank slope, however this is dependent on specific soil characteristics and a geotechnical study of the area is required to confirm the design parameters.
- A trapezoidal cross sectional design, with channel features to be considered during detailed design.
- Stable, self sustaining and require no ongoing monitoring or management.

Table 3-4 summarises the diversion design parameters. A small diversion (Diversion 5) is planned to bypass the North Pit and flow to Kangaroo Creek; however this is not required until later in the mine life (approximately Year 15) and will be designed once further detailed surveys have been completed.

Table 3-4 Summary Details of Diversions

Detail	Diversion 1	Diversion 2	Diversion 3	Diversion 4
Minimum depth (m)	3.6	4.2	4.4	2.4
Minimum top width (m)	56	62	64	40
Bottom width (m)	20	20	20	20
Corridor length (m)	3,700	5,750	2,580	1,700
Corridor width (m)[1]	215	325	355	130
Deepest cut (m)	7	9	7.5	6.5
Highest levee bank (m)	1.5	2	2	2
Grade (%)	0.30	0.22	0.23	0.20
Bank slope	1:5	1:5	1:5	1:5

Note 1: Includes allowance for any meanders and levees

3.5 Proposed EA Conditions

Schedule X – Regulated Structures

Assessment of hazard category

X1 The hazard category of any structure must be assessed by a suitably qualified and experienced person:

a) in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM365)*; and

b) in any of the following situations:

i. prior to the design and construction of the structure; or

ii. prior to any change in its purpose or the nature of its stored contents; and

iii. in accordance with the *Manual for assessing Hazard Categories and H ydraulic Performance of Dams.*

X2 A hazard assessment report and certification must be prepared for any structure assessed and the report may include a hazard assessment for more than one structure.

X3 The holder must, on receipt of a hazard assessment report and certification, provide to the administering authority one paper copy and one electronic copy of the hazard assessment report and certification.

X4 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 Hazard Categories and Hydraulic Performance of Dams* (EM635).

X5 The holder must take reasonable and practical measures so that each dam associated with the mining activity is designed, constructed, operated and maintained in accordance with accepted engineering standards and is fit for the purpose for which it is intended.

Design and construction of a regulated structure

X6 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 Hazard Categories and Hydraulic Performance of Dams (EM635)*.

X7 Construction of a regulated structure is prohibited unless the holder has:

a) submitted a hazard category assessment report and certification to the administering authority;
b) commissioned a suitably qualified and experienced person to prepare a design plan for the structure; and
c) received the certification from a suitably qualified and experienced person for the design and design plan and the associated operating procedures in compliance with the relevant condition of this authority.

X8 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 Hazard Categories and Hydraulic Performance of Dams (EM635)*.

X9 Regulated structures must:

a) be designed and constructed in accordance with and conform to the requirements of the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams;
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.

X10 The design plan for a regulated structure must include, but is not limited to:

a) certification that the design plan:
    i. is in accordance with the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, including subsidiary certifications if necessary; and
    ii. addresses the requirements in **Condition X10(b) to (h)**
b) A design report which provides:
    i. a description of all the documents which constitute the design plan;
    ii. a statement of:

a) the applicable standards including engineering criteria, industry guidelines, relevant legislation and regulatory documents, relied upon in preparing the design plan; and
b) all relevant facts and data used in preparing the design plan, including any efforts made to obtain necessary facts and data, and any limitations or assumptions to facts and data used in preparing the design plan;
c) the hazard category of the regulated structure; and
d) setting out the reasoning of the suitably qualified and experienced person who has certified the design plan, as to how the design plan provides the necessary required performance;

iii. documentation of hydrological analyses and estimates required to determine all elements of the design including volumes and flow capacities;
iv. detailed criteria for the design, operation, maintenance and decommissioning of the regulated structure, including any assumptions;
v. design, specification and operational rules for any related structures and systems used to prevent failure scenarios;

c) drawings showing the lines and dimensions, and locations of built structures and land forms associated with the regulated structure;
d) consideration of the interaction of the pit design with the levee or regulated dam design;
e) an operational plan that includes:
i. normal operating procedures and rules (including clear documentation and definition of process inputs in the DSA allowance);
ii. contingency and emergency action plans including operating procedures designed to avoid and/or minimise environmental impacts including threats to human life resulting from any overtopping or loss of structural integrity of the regulated structure;
f) a plan for the decommissioning and rehabilitation of the regulated structure at the end of its operational life;
g) details of reports on investigations and studies done in support of the design plan;
h) any other matter required by the suitably qualified and experienced person.

X11 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;
b) construction of the regulated structure is in accordance with the design plan;

X12 Where a regulated dam is to be managed as part of an integrated containment system and the DSA volume is to be shared across the integrated containment system, the design and operating rules for the system as a whole must be documented in a system design plan that is certified by a suitably qualified and experienced person.

X13 The system design plan must contain:

a) the design plans, and
b) the ‘as constructed’ plans, and
c) the operational rules for each individual regulated dam that forms part of the integrated system, and
d) the standards of serviceability and accessibility of water transfer equipment or structures, and

e) the operational rules for the system as a whole.

Operation of a regulated structure

X14 Operation of a regulated structure is prohibited unless:

a) the holder has submitted to the administering authority:
   i. one paper copy and one electronic copy of the design plan and certification of the 'design plan' in accordance with **Condition X3**, and
   ii. a set of 'as constructed' drawings and specifications, and
   iii. certification of those 'as constructed drawings and specifications' in accordance with **Condition X11**, and
   iv. 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.
b) the requirements of this authority relating to the construction of the regulated structure have been met; and
c) Relevant details for the dam have been included in **Schedule X Table 1 and Table 2**.

X15 Each regulated structure must be maintained and operated in a manner that is consistent with the current design plan, the current operational plan, and the associated certified 'as constructed' drawings for the duration of its operational life until decommissioned and rehabilitated.

X16 The holder must take reasonable and practicable control measures to prevent the causing of harm to persons, livestock or wildlife through the construction and operation of a regulated structure. Reasonable and practicable control measures may include, but are not limited to:

a) the secure use of fencing, bunding or screening; and
b) escape arrangements for trapped livestock and fauna.

Mandatory reporting level

X17 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.

X18 The holder must, as soon as practical and 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.

X19 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.

Annual inspection report

X20 Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person.

X21 At each annual inspection, the condition and adequacy of all components of the regulated structure must be assessed:

a) against the most recent hazard assessment report and design plan (or system design plan);
b) against recommendations contained in previous annual inspections reports;
c) against recognised dam safety deficiency indicators;
d) for changes in circumstances potentially leading to a change in hazard category;
e) for conformance with the conditions of this authority;
f) for conformance with the 'as constructed' drawings;

g) for the adequacy of the available storage in each regulated dam, based on an actual observation or observations taken after 31 May each year but prior to 1 November of that year, of accumulated sediment, state of the containment barrier and the level of liquids in the dam (or network of linked containment systems);
h) for evidence of conformance with the current operational plan.

X22 A suitably qualified and experienced person must prepare an annual inspection report containing details of the assessment and including recommended actions to ensure the integrity of the regulated structure.

X23 The suitably qualified and experienced person who prepared the annual inspection report must certify the report in accordance with the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (EM635)*.

X24 The holder must:

a) upon receipt of the annual inspection report, consider the report and its recommendations and take action to ensure that the regulated structure will safely perform its intended function; and
b) within twenty (20) business days of receipt of the annual inspection report, notify the administering authority in writing, of the recommendations of the inspection report and the actions being taken to ensure the integrity of each regulated structure.

X25 A copy of the annual inspection report must be provided to the administering authority upon request and within ten (10) business days.

Design storage allowance

X26 On 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).

X27 The holder must, as soon as possible and 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.

X28 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.

Performance review

X29 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.

X30 The holder must take action to modify its water management or linked containment system so as to ensure that the regulated dam or linked containment system will perform in accordance with the requirements of this authority, for the subsequent November to May period.

Note: Action may include seeking the necessary approvals for physical modification of a regulated dam.

Transfer arrangements

X31 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, hazard

assessment, design plan and other supporting documentation, to a new holder and the administering authority on transfer of this authority.

Decommissioning and rehabilitation

X32 Prior to the cessation of the environmentally relevant activity, each regulated structure must be decommissioned such that:

a) ongoing environmental harm is minimised by the regulated structure:
   i. becoming a safe site for humans and animals at the completion of rehabilitation; or
   ii. becoming a stable landform, that no longer contains flowable substances and minimises erosion impacts; or
   iii. not allowing for acid mine drainage; or
   iv. being approved or authorised under relevant legislation for a beneficial use; or
   v. being a void authorised by the administering authority to remain after decommissioning; and

b) the regulated structure is compliant with all other relevant rehabilitation requirements of this authority.

Regulated structures location and performance

X33 Each regulated structure named in column 1, of **Schedule X Table 1** must be wholly located within the control points noted in columns 2 and 3 of **Schedule X Table 1**, for that structure.

Schedule X Table 1 – Location of regulated structures

Column 1	Column 2	Column 3	Column 4 Levees Only
Name of Regulated Structure[1]	Latitude[2] (GDA 94)	Longitude[2] (GDA 94)	Unique Location ID[3]
Mine affected water dam M1	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M3a	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M3b	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M4	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M5	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M6	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M7	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M8	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M9	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M10	To be confirmed on completion of final design	To be confirmed on completion of final design	

Column 1	Column 2	Column 3	Column 4 Levees Only
Name of Regulated Structure[1]	Latitude[2] (GDA 94)	Longitude[2] (GDA 94)	Unique Location ID[3]
Mine affected water dam M11	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M12	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M13	To be confirmed on completion of final design	To be confirmed on completion of final design	
Mine affected water dam M14	To be confirmed on completion of final design	To be confirmed on completion of final design	
South Co-disposal	To be confirmed on completion of final design	To be confirmed on completion of final design	
North Co-disposal	To be confirmed on completion of final design	To be confirmed on completion of final design	
Diversion 1			To be confirmed on completion of final design
Diversion 2			To be confirmed on completion of final design
Diversion 3			To be confirmed on completion of final design
Diversion 4			To be confirmed on completion of final design
Diversion 5			To be confirmed on completion of final design

1 The 'name of the regulated structure' should refer to the name for example, process residue facility and decant dam.
2 A minimum of three control points is required to constrain the location of all activities associated with the regulated structure. Additional infrastructure which forms part of any regulated dam may include appurtenant works consisting of seepage collections systems, runoff diversion bunds, containment systems, pressure relief wells, decant and recycle water systems. Note that details on tailing discharge pipelines would be included in this table only if they have not been included in the design plan required in **Condition X10**.
3 This location reference is the reference for **Schedule X Table 4** flood level and crest level.

X34 Each regulated dam named in column 1 of **Schedule X Table 2**, must be consistent with the details noted in columns 2 to 7 of **Schedule X Table 2**, for that dam.

Schedule X Table 2 – Basic details of regulated dams

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Name of Regulated dam[1]	Hazard Category	Surface area of dam at spillway (ha)	Max. volume of dam at spillway (ML)	Max. depth of dam[2] at spillway (m)	Spillway Level (mAHD)	Use of dam[3]
Mine affected water dam M1	Significant	8.2	571	7.0	To be confirmed on completion of final design	To be confirmed on completion of final design
Mine affected water dam M3a	Significant	6.8	475	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M3b	Significant	6.8	476	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M4	Significant	2.6	183	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M5	Significant	2.0	137	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M6	Significant	0.7	29	4.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M7	High	8.4	588	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M8	Significant	1.8	127	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M9	Significant	5.6	392	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam	Significant	1.9	130	7.0	To be confirmed on completion of final design	Storage of mine affected water

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Name of Regulated dam[1]	Hazard Category	Surface area of dam at spillway (ha)	Max. volume of dam at spillway (ML)	Max. depth of dam[2] at spillway (m)	Spillway Level (mAHD)	Use of dam[3]
M10						
Mine affected water dam M11	Significant	4.3	392	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M12	Significant	1.2	60	5.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M13	Significant	6.9	484	7.0	To be confirmed on completion of final design	Storage of mine affected water
Mine affected water dam M14	Significant	6.9	484	7.0	To be confirmed on completion of final design	Storage of mine affected water
South Co-disposal	High		10,000	10	To be confirmed on completion of final design	Storage of process water and rejects from process plant
North Co-disposal	High		900	10	To be confirmed on completion of final design	Storage of process water and rejects from process plant

1 The name of the regulated dam should refer to the name of the dam, for example, process residue facility and decant dam and should be the same name used in **Schedule X Table 1** for the dam.
2 For regulated dams which do not require a dam wall, input the maximum void depth, for example, where dams are formed by excavating below the land surface or backfilling a residual void.
3 The use or purpose of the regulated dam should outline the designed function, for example, 'the permanent containment of tailings resulting from the extraction of nickel, cobalt and other metals at the XYZ refinery'.

X35 Each regulated dam named in column 1 of **Schedule X Table 1**, must meet the hydraulic performance criteria noted in columns 2 to 4 of **Schedule X Table 3**, for that dam.

Schedule X Table 3 – Hydraulic performance of regulated dams

Column 1	Column 2	Column 3	Column 4
Name of Regulated dam	Spillway Capacity AEP	Design Storage Allowance AEP	Mandatory Reporting Level AEP
Mine affected water dam M1	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M3a	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M3b	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M4	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M5	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M6	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M7	1:10,000 To 1:100,000 AEP	1:100 AEP	1:100 AEP 72 hour duration
Mine affected water dam M8	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M9	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M10	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M11	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M12	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M13	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
Mine affected water dam M14	1:100 AEP To 1:1000 AEP	1:20 AEP	1:10 AEP 72 hour duration
South Co-disposal	1:10,000 To 1:100,000 AEP	1:100 AEP	1:100 AEP 72 hour duration
North Co-disposal	1:10,000 To 1:100,000 AEP	1:100 AEP	1:100 AEP 72 hour duration

X36 Each regulated levee named in column 1 of **Schedule X Table 1**, must be consistent with the details noted in columns 2 to 6 of **Schedule X Table 4**, for that levee.

Schedule X Table 4 – Basic details of regulated levees

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Name of Regulated Levee	Design AEP	Design Flood Level[1] (mAHD)	Minimum Levee Level[1] (mAHD)	Schedule D Table 1 Location ID[1]	Use of levee
Diversion 1	0.1% AEP event with a minimum freeboard of 0.5 m	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Diversion of drainage line.
Diversion 2	0.1% AEP event with a minimum freeboard of 0.5 m	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Diversion of drainage line.
Diversion 3	0.1% AEP event with a minimum freeboard of 0.5 m	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Diversion of drainage line.
Diversion 4	0.1% AEP event with a minimum freeboard of 0.5 m	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Diversion of drainage line.
Diversion 5	0.1% AEP event with a minimum freeboard of 0.5 m	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Diversion of drainage line.

1 Design flood levels, and hence regulated levee levels, are expected to vary along the length of that levee. The location IDs listed (Column 5) must correspond with location IDs listed in **Schedule X Table 1** and, together with columns 3 and 4, define the minimum design level envelope for the longitudinal crest of the structure.

4. ENVIRONMENTAL MANAGEMENT

4.1 Environmental Policy

The proponent operates under the Safety, Health and Environment Policy.

4.2 Environmental Risk Identification and Assessment

As part of a risk management system, internal reviews will be conducted prior to construction for activities deemed to have high risk for potential environmental harm, to identify all environmental hazards and risks to determine those that are significant. Appropriate control strategies will be documented, implemented and monitored for effectiveness, including audits, to address the significant risks.

4.3 Environmental Legal Obligations

Documents pertaining to environmental legal obligations (i.e. approvals, licences and conditions) will be managed by the proponent to maintain, update, implement and review all legal environmental conditions and obligations, for compliance and effectiveness.

4.4 Environmental Objectives, Targets and Management Plans

Environmental objectives, targets and management plans are contained within the EM Plan. As part of the requirement for continual improvement, these will be reviewed. Progress towards and compliance with the objectives and targets will be monitored and reviewed on a regular basis.

4.5 Roles, Responsibilities and Authorities

Roles, responsibilities and authorities will be assigned to ensure effective environmental management. A representative will be nominated who be responsible for the effective development, implementation, maintenance and improvement of environmental management.

4.6 Training, Awareness and Competence

Appropriate environmental awareness training, including information on the EM Plan and EA, will be provided where required to employees, contractors and visitors. The training program will include identifying needs, developing training programs as well as requirements to maintain training records and documentation.

4.7 Communications

Mechanisms to manage all internal and external environmentally related communications will be developed.

4.8 Documentation and Document Control

Methods by which environmental management is undertaken shall be documented and implemented, including controls for key environmental documentation. Where required, controls shall be developed,

documented and implemented in relation to operational processes to address significant environmental risks (identified in the environmental risk assessment), to ensure compliance with legal obligations and the EM Plan, including objectives and targets.

4.9 Emergency Response Plan

A site specific emergency response plan will be developed for the project site and kept up to date. Management of the potential for environmental harm shall be included in the plan.

In accordance with the requirements of the ToR for the project's EIS, consultation will be undertaken with government agencies including the Queensland Fire and Rescue Service, Emergency Management Queensland and Queensland Ambulance Service.

4.10 Monitoring and Measurement

The basis of the monitoring plan for each environmental value is contained within this EM Plan, including dust deposition and concentration, surface water quality, groundwater quality, noise and rehabilitation success. Environmental monitoring will address meeting the EA conditions, environmental legal obligations, implementation of the EM Plan, implementation of the operational controls developed, as well as progress towards objectives and targets. The monitoring plan will outline the environmental monitoring to be undertaken, including monitoring sites, parameters, frequency, procedures or methods, and records to be kept. Monitoring records shall be kept and results reviewed on an as required basis to determine ongoing compliance.

4.11 Records Management

Records shall be kept to demonstrate compliance with the EA and other identified environmental legal obligations.

4.12 Reporting, Corrective and Preventive Action

Statutory reporting requirements will be identified as part of the environmental legal obligations and undertaken as per the reporting requirements. To ensure continual improvement, any non-conformance with the EA Conditions will be investigated and reported as per the EA requirements, including corrective and/or preventative actions. Where identified amendments will be made to the EM Plan, EA or operational procedures or plans, based on the outcomes of investigations.

4.13 Audits

An audit schedule will be developed to ensure the effective implementation of the EM Plan and compliance with the EA and other legal obligations. Internal audits will be conducted at regular intervals to cover the scope of all environmental requirements and shall be planned based on environmental risk and previous performance.

4.14 Management Review

A management review will occur on at least an annual basis to determine the suitability, adequacy and effectiveness of environmental management. Audit results, evaluations of environmental legal compliance and compliance with the environmental objectives will be taken into consideration. The output of the management review will include changes to environmental objectives and targets and the environmental policy consistent with the commitment to continual improvement.

5. OVERVIEW OF THE EM PLAN

For each identified environmental value and environmental protection objective, a control strategy and EA conditions containing measurable standards and indicators are proposed. The objectives detail what should be achieved, the indicator is the measure used to assess whether the objectives have been met, the standards are the levels, limits or targets to achieve the objective and the control strategies are the methods for achieving those.

Indicators, standards and control strategies have been determined from existing legislation, Environmental Protection Policies (EPPs), results of the EIS, industry standards, and the administering authority's technical guidelines. The EM Plan identifies the key control strategies and limits, as related to the protection of the environmental values for the project and provides the framework for the proposed EA conditions.

There are a number of general conditions that do not relate to environmental values or control strategies but are to be included in the EA. Conditions proposed for the Schedule of General Conditions are provided in **Section 5.1**.

5.1 Proposed EA 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 authorised by this environmental authority, the holder of this environmental authority must comply with this environmental authority.

A3 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
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

A4 Except where specified otherwise in another condition of this authority, all monitoring records or reports required by this environmental authority must be kept for a period of not less than 5 years.

Financial assurance

A5 Provide to the administering authority financial assurance for the amount and in the form acceptable to the administering authority in accordance with the most recent edition of the administering authority's: Guideline—Calculating financial assurance for mining projects, before the proposed mining activities can commence.

A6 The amount of financial assurance must be reviewed by the holder of this environmental authority when a plan of operations is amended or replaced or the authority is amended.

Risk management

A7 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, within 3 months of the issue of this environmental authority.

Notification of emergencies, incidents and exceptions

A8 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.

A9 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
c) proposed actions to prevent a recurrence of the emergency or incident.

Complaints

A10 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
h) person responsible for resolving the complaint.

A11 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

A12 The holder of this environmental authority must:

a) within 1 year of the commencement of this authority, obtain from a suitably qualified and experienced third party a report on compliance with the conditions of this environmental authority,

b) obtain further such reports at regular intervals not exceeding 3 years from the completion of the report referred to above,
c) provide each report to the administering authority within 90 days of its completion.

A13 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 2 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 **Condition X33** the time specified in that condition
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.

6. SURFACE WATER MANAGEMENT

6.1 Environmental Values

6.1.1 Hydrology

The project straddles the Suttor River and Bowen River catchment boundary, which are both part of the headwaters of the Burdekin River catchment (**Figure 6-1**), with a relationship as follows:

- Burdekin River catchment:
  - Bowen River catchment:
    - Rosella Creek sub-catchment 1,473 km^2: northern project area including Kangaroo Creek (**Figure 6-2**).
  - Suttor River catchment:
    - Upper Suttor River sub-catchment 5,155 km^2: southern project area including Suttor River and Suttor Creek (**Figure 6-3**).

6.1.1.1 Rosella Creek Sub-catchment

Within the Rosella Creek sub-catchment the project area encompasses ninety five riverine systems or drainage lines mapped by DEHP, comprising:

- One 4th order stream (Kangaroo Creek)
- Five 3rd order streams
- Sixteen 2nd order streams
- Seventy three 1st order streams.

Kangaroo Creek is located in the upper reaches of the Rosella Creek sub-catchment and becomes Rosella Creek downstream of the project boundary (refer **Figure 6-4**). Within the project area, Kangaroo Creek consists of a largely sandy, ephemeral watercourse with sections of cobbles in the upper reaches.

Rosella Creek is a largely sandy, dry seasonal creek system with limited habitat availability, although waterholes are present that create aquatic habitat in places (Dight, 2009). Rosella Creek flows generally north and discharges into the Bowen River.

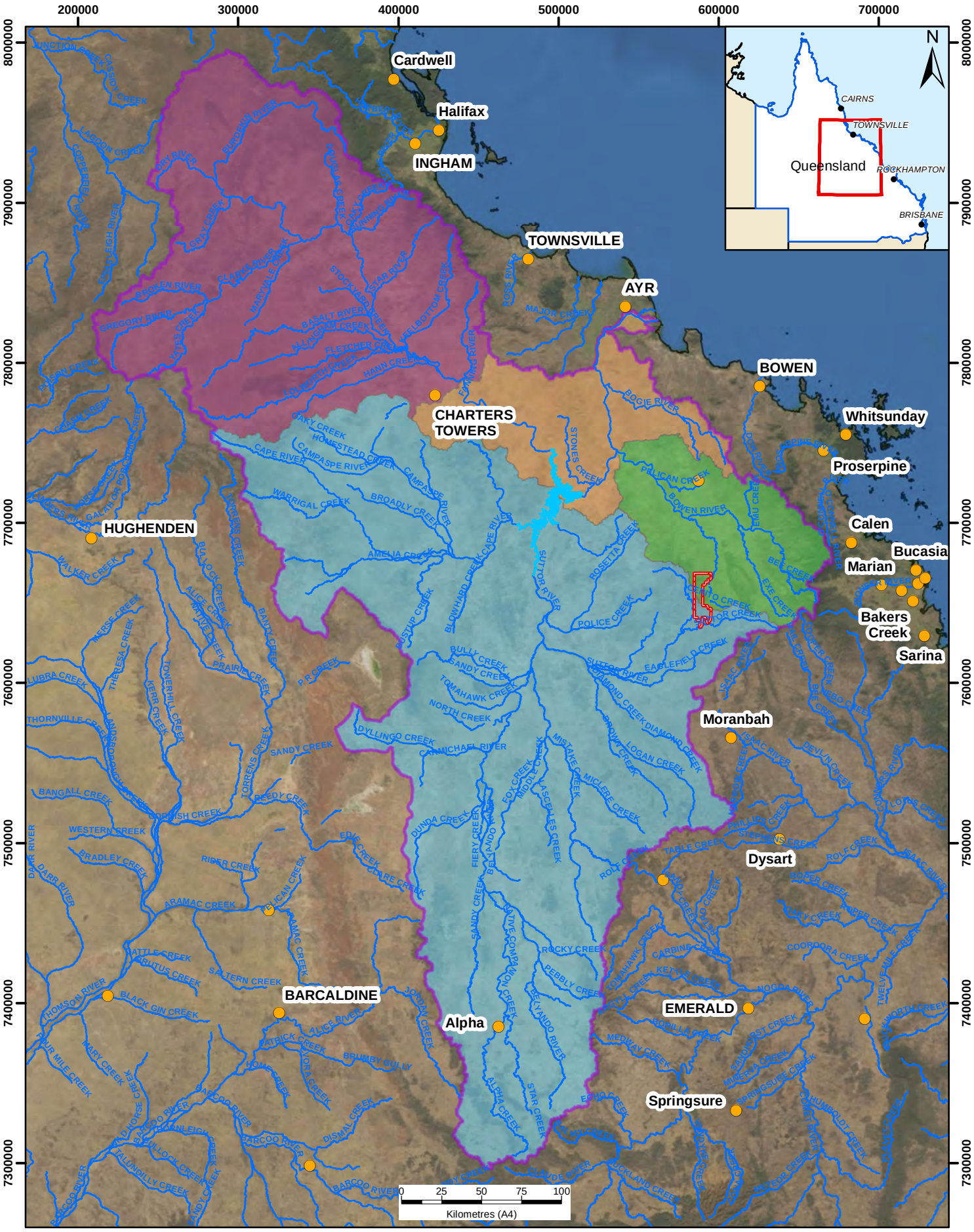
6.1.1.2 Upper Suttor River Sub-catchment

Within the Upper Suttor River sub-catchment, the project area encompasses 15 riverine systems or drainage lines comprising:

- One 5th order stream (the Suttor River)
- One 3rd order stream
- Three 2nd order streams
- Ten 1st order streams.

Within and immediately upstream and downstream of the project area, the Suttor River (refer to **Figure 6-5)** consists of a large sandy, meandering watercourse. The river is ephemeral, with flow recorded at Eaglefield gauging station (25 km downstream of the project area) less than 40% of the time.

The Suttor River discharges into the Belyando River which ultimately drains to the Burdekin Falls Dam.



Legend

- Project Area
- Burdekin Falls Dam
- Burdekin Basin Catchment
- Major Watercourses
- Towns
- Bowen River Basin
- Lower Burdekin River Basin
- Suttor River Basin
- Upper Burdekin River Basin

Burdekin Basin Catchment		QCOAL GROUP
Figure 6-1	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *6/02/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:3,100,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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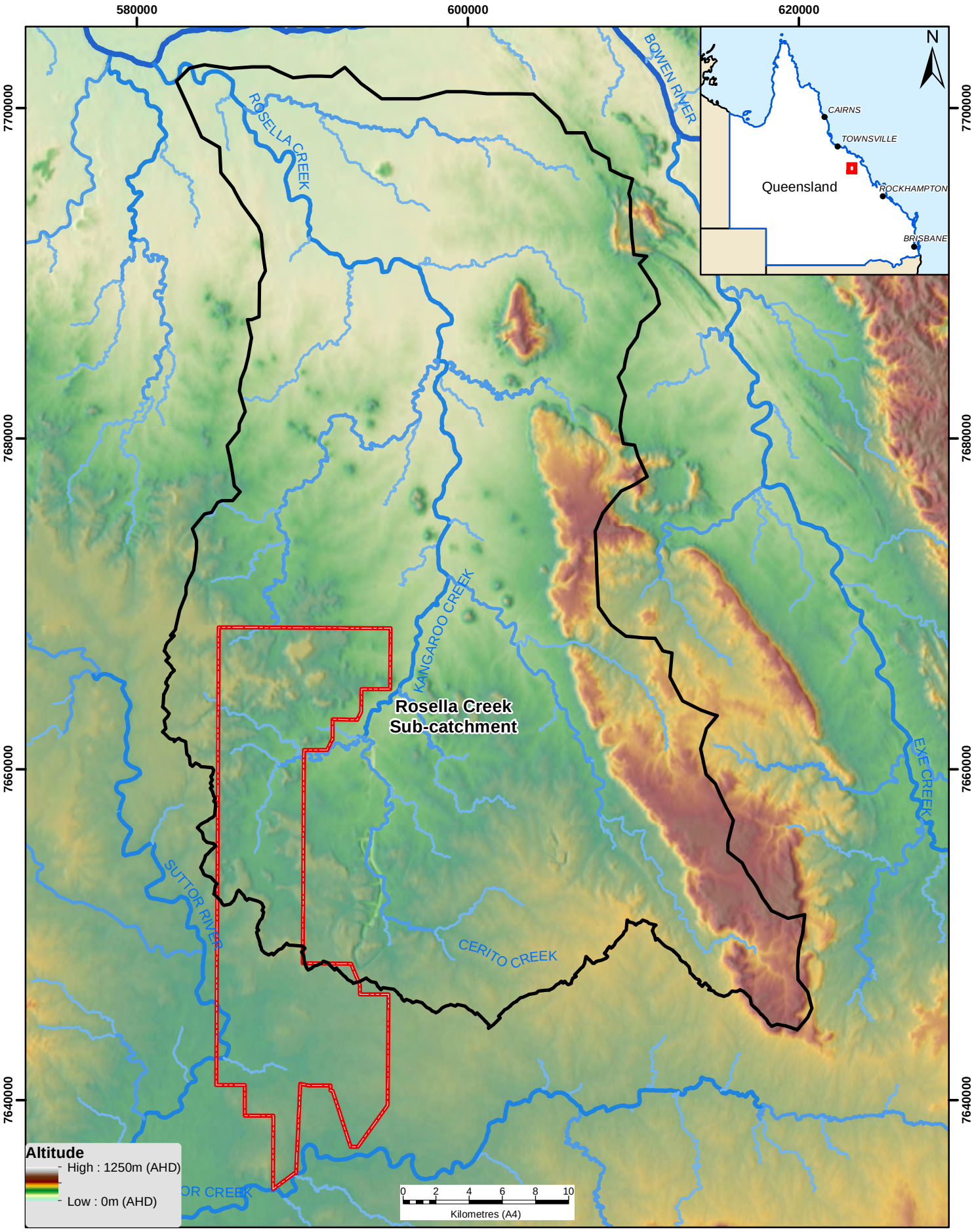

Legend

- Project Area
- River Subcatchments

Drainage (Stream Order)

3 4 5 6

Rosella Creek Sub-Catchment		QCOAL GROUP
Figure 6-2	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *6/02/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:300,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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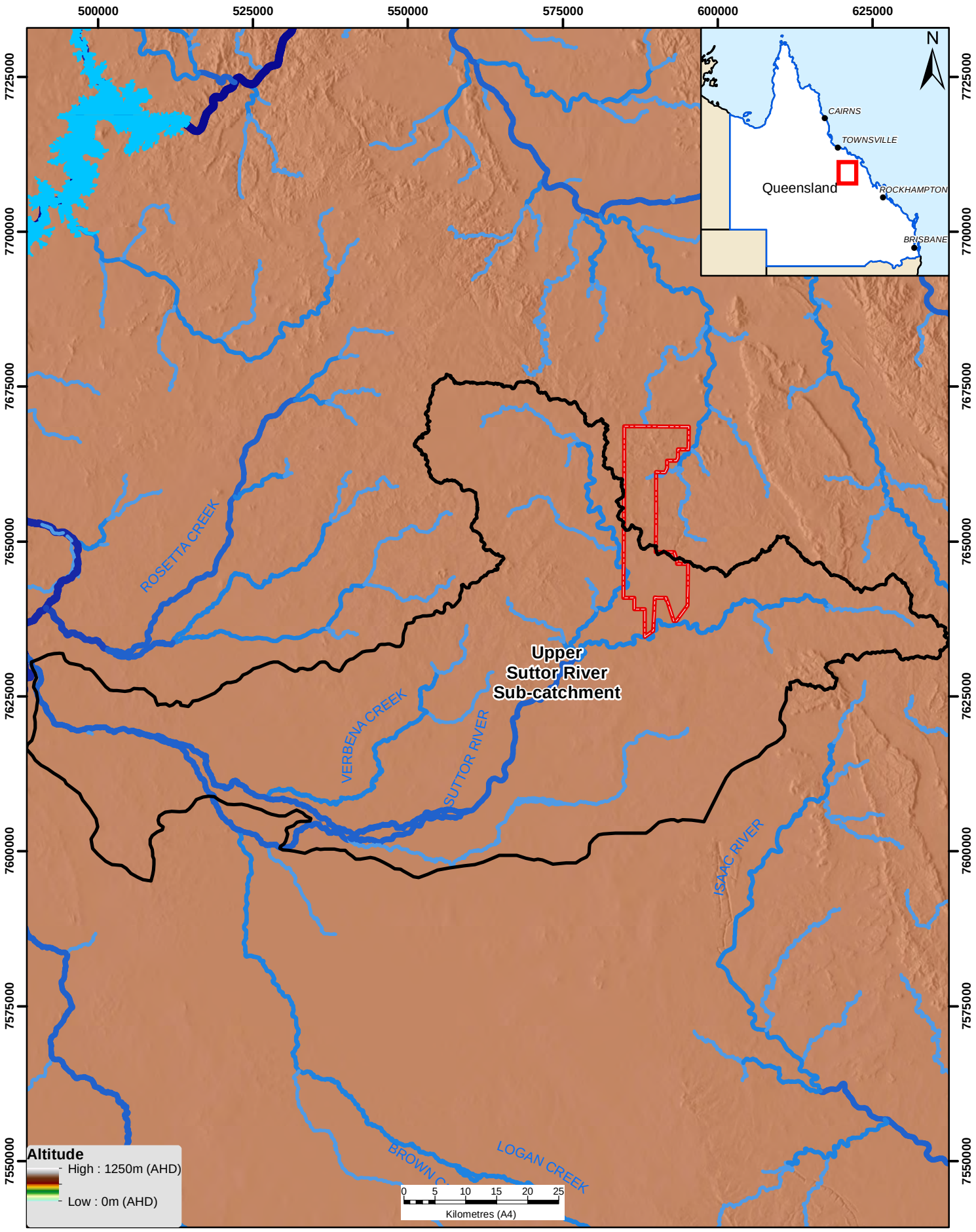

Legend

- Project Area
- River Subcatchments
- Burdekin Falls Dam

Drainage (Stream Order)

Upper Suttor River Sub-Catchment	QCOAL GROUP
Figure 6-3	**Byerwen Coal Project**
Date: *6/02/2013*	**Author:** samuel.ferguson
	Map Scale: 1:800,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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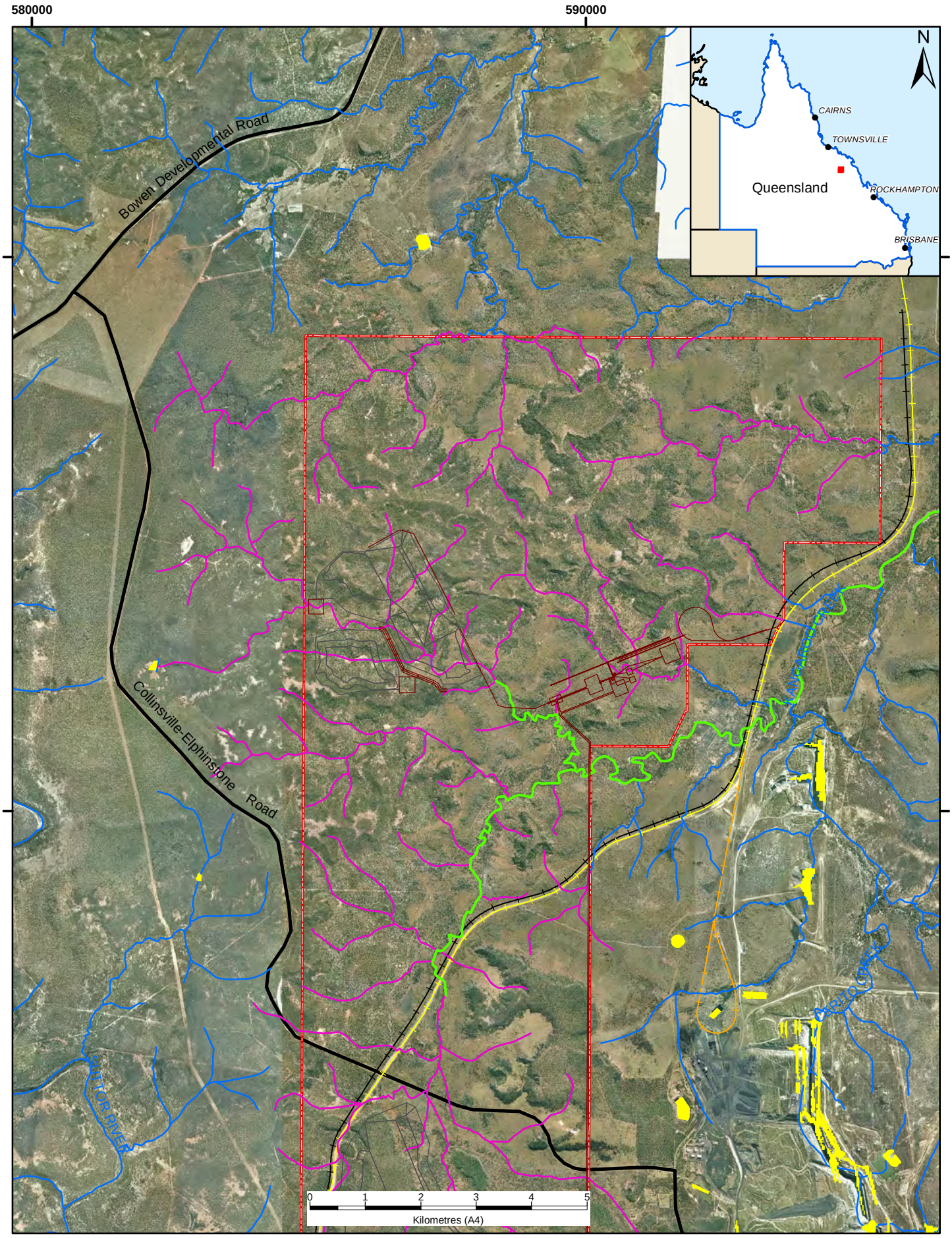

Legend

- Project Area
- Mine Infrastructure
- GAP Railway
- Newlands Mine Rail Loop
- Alpha Coal Project Rail Line
- Waste Rock Dumps and Pits
- Formed Roads
- Watercourse under Water Act 2000
- Not a Watercourse under Water Act 2000
- Waterway status not assessed
- Lacustrine Water Body
- Indicative extent gilgai wetland habitat

Deemed Watercourses within the Northern part of the Project Area		QCOAL GROUP
Figure 6-4	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *16/04/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:90,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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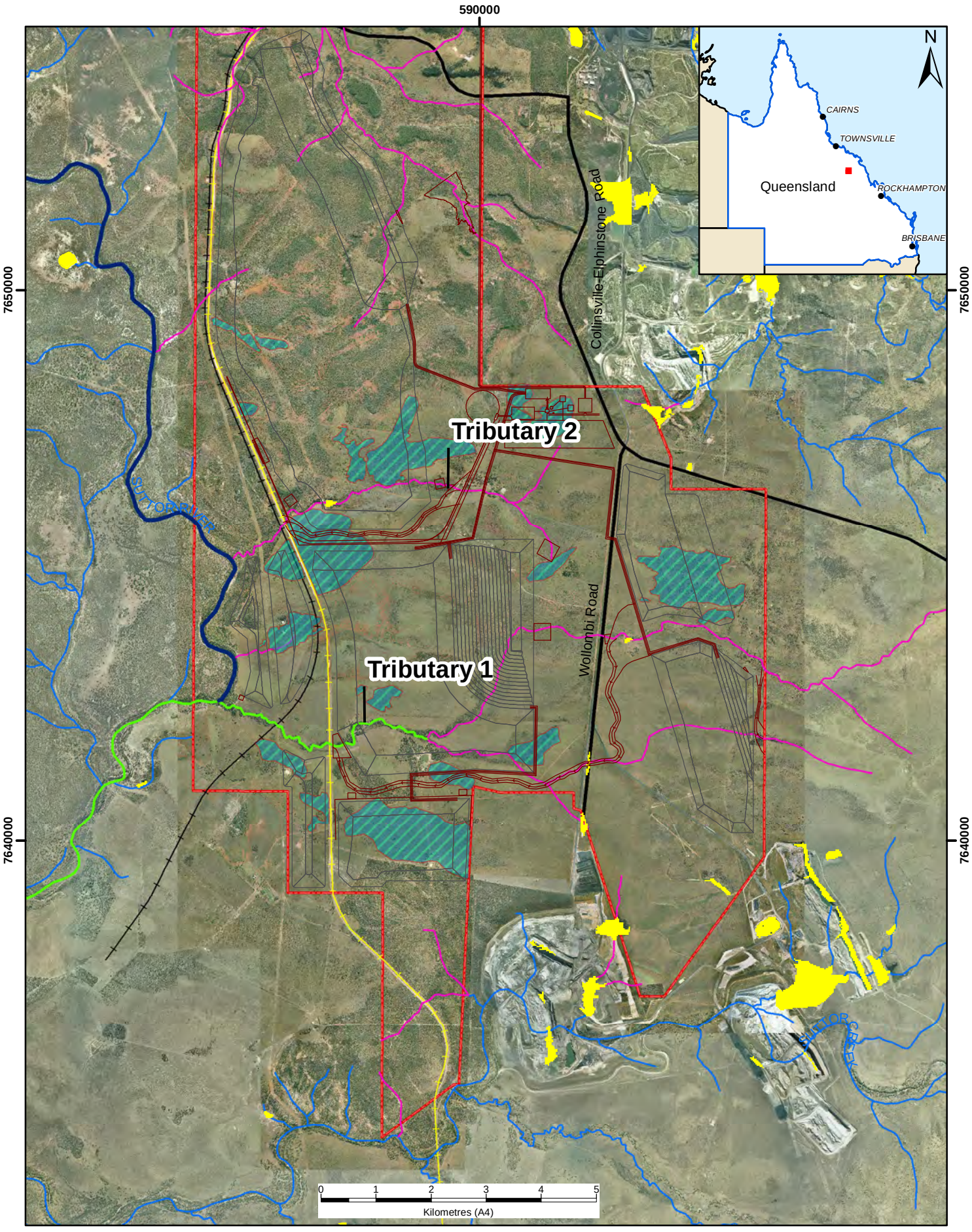

Legend

- Project Area
- Mine Infrastructure
- Waste Rock Dumps and Pits
- GAP Railway
- Newlands Mine Rail Loop
- Alpha Coal Project Rail Line
- Formed Roads
- Watercourse under Water Act 2000
- Not a Watercourse under Water Act 2000
- Suttor River
- Waterway status not assessed
- Lacustrine Water Body
- Indicative extent gilgai wetland habitat

Deemed Watercourses within the Southern part of the Project Area		QCOAL GROUP
Figure 6-5	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *16/04/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:90,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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6.1.2 Watercourse Determinations

A DEHP letter of advice (19 July 2012), advised that within the project boundary, two watercourses met the watercourse determination criteria of the *Water Act 2000*, one in Rosella Creek sub catchment and one in Upper Suttor River sub catchment, as shown on **Figure 6-4** and **Figure 6-5**.

6.1.3 Land Use

6.1.3.1 Rosella Creek Sub-catchment

The principal land use is grazing on native pastures. Due to long term grazing activities and extensive clearing of the floodplain, the condition of the waterways and riparian habitat has undergone major decline over the last 30 years (Dight, 2009).

Hill slope erosion is identified by the Burdekin WQIP technical panel as the major source of sediment and particulate nutrients affecting water quality in the Rosella Creek sub-catchment, while gully and streambank erosion are also predicted to make substantial contributions.

Water quality has been predicted by the Burdekin WQIP technical panel to be relatively poor, with elevated concentrations of sediment leaving the sub-catchment.

6.1.3.2 Upper Suttor River Sub-catchment

Land use consists almost exclusively of grazing on natural and modified pastures. The riparian habitat of the sub-catchment has deteriorated over the last 30 years, principally due to clearing along headwater streams and on the floodplains, and is currently assessed to be in poor condition. Watercourses in the catchment are highly ephemeral.

Water quality in the Upper Suttor River sub-catchment is predicted to be moderately impacted by suspended sediment during wet season event flows, with elevated concentrations in the lower reaches of the sub-catchment.

Hill slope erosion is identified as the major source of sediment and particulate nutrients affecting water quality within the Suttor Basin. Gully erosion is also identified as a significant contributor. Water quality in the Suttor Basin is predicted to have moderately elevated suspended sediment concentrations and loads at end-of-basin during wet season event flows (NQ Dry Tropics, 2009).

6.1.4 Wetlands

There are no wetlands of international significance (Ramsar Convention) in the project area or anywhere upstream of the Burdekin Falls Dam. The Burdekin Falls Dam is described in the Queensland Wetland Mapping data as a lacustrine wetland although it is an artificial and highly modified wetland. While recognised as a wetland by the DEHP, its ecosystem value is diminished because it is artificial and is operated for flood mitigation and irrigation/drinking water supply purposes.

Four lacustrine wetlands and a single palustrine wetland area are identified within or immediately adjacent to the project footprint, as well as number of gilgai wetlands occurring on untilled vertosol soils. Wetlands are addressed in **Section 11.1.2.**

6.1.4.1 Palustrine Wetland

The palustrine wetland is situated on a closed depression of the Suttor River floodplain, and is intersected by the western boundary of the project area (see **Figure 6-5**). At the time of surveys conducted as part of the aquatic ecology assessment in May 2012, this wetland was identified as a vegetated swamp covering approximately 60 ha (1 km x 0.6 km), with an average depth of 0.5 m. The palustrine wetland will be retained, and is not within the footprint of the project.

The pre-development inundation extents for the 1, 2 and 5 year Average Recurrence Interval (ARI) flood events show that the palustrine wetland is not inundated during these more frequent flood events. This indicates that flooding from the Suttor River is not the main source of water for the wetland.

6.1.4.2 Lacustrine Wetlands

The Queensland Wetlands Mapping identifies four mapped lacustrine wetlands within the project area. Three of these are dammed drainage channels, and the fourth is a topographic depression on the upslope of a constructed contour in the south-eastern section of the project area, (see **Figure 6-5).**

One of the dams is positioned within the footprint of West Pit 1, and would be dewatered as part of the project. At the time of the aquatic ecology assessment surveys, the wetted area of site was approximately 5 ha, being approximately 250 m wide at the dam wall, and extending approximately 400 m upstream.

The second dam is approximately 0.8 ha in area and is in the path of the drainage diversion between South Pit 1 and South Pit 2, and thus would need to be removed as part of diversion construction works.

6.1.4.3 Gilgai Wetlands

A number of gilgai wetlands exist in the project area, all occurring on untilled vertosol soils. The indicative extent of gilgai wetland habitat is shown in **Figure 6-5**. These gilgai wetlands are ephemeral and are expected to fill with water during and following periods of heavy and/or extended rain.

6.1.5 Local Water Quality Assessment

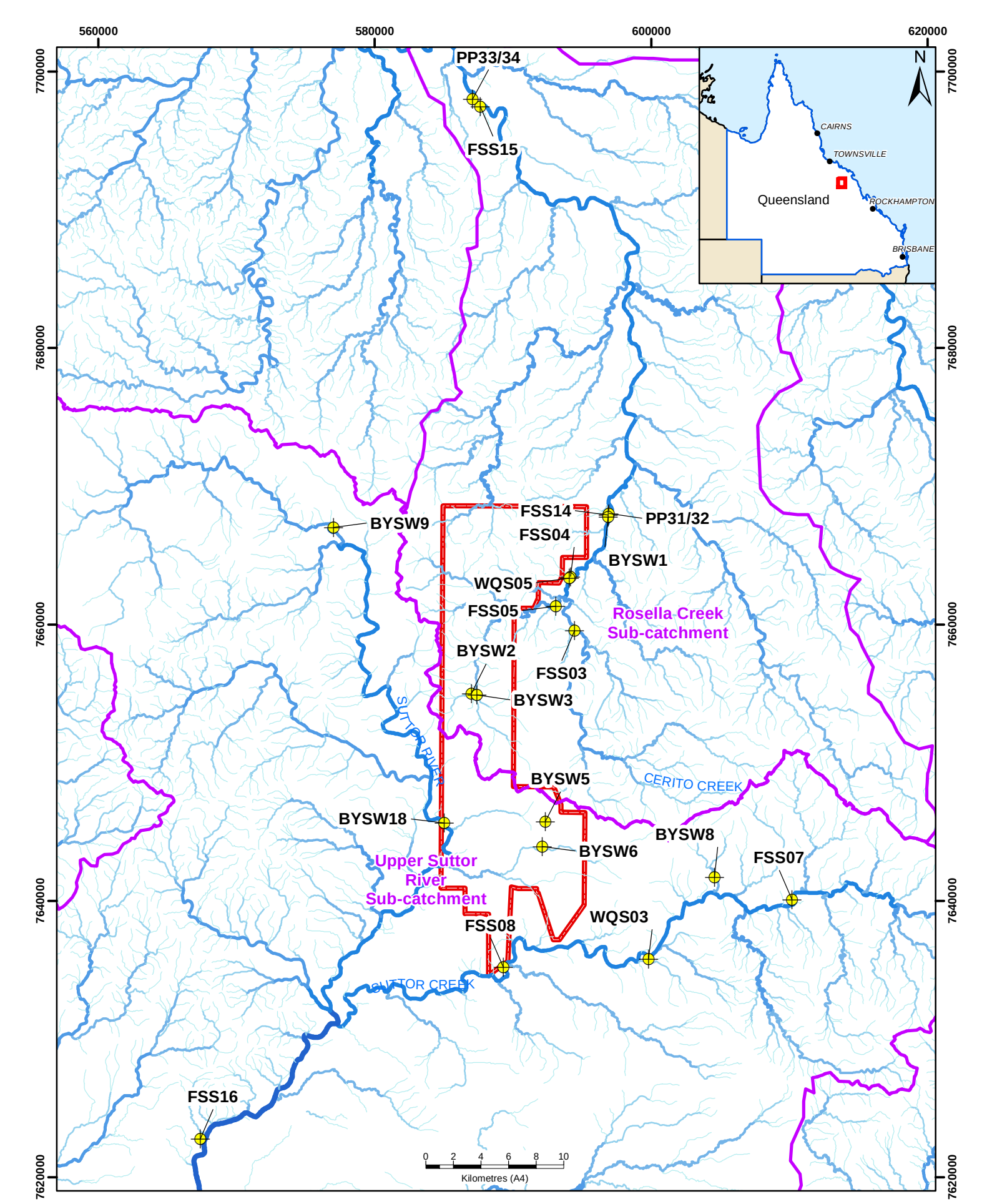
Water quality indicators have been used to establish the management measures to protect the identified Environmental Values (EVs). Data was sourced from surface water monitoring within the Rosella Creek and Upper Suttor River sub-catchments on and around the project from 2010 to 2012. The dataset was supplemented using similar data generated by Xstrata Coal Pty Ltd for the adjacent Newlands Coal mine between 2006 to 2011 via a data-share agreement between the proponent and Xstrata. Locations of monitoring sites are shown on **Figure 6-6**.

6.1.5.1 Rosella Sub-catchment

A summary of monitoring data for the Rosella sub-catchments (median values and 80th percentile) is presented in **Table 6-1** and **Table 6-2** respectively. **Table 6-1** and **Table 6-2** also provide the default water quality objectives (**Section 6.3.1**) for waterways in the project catchment area.

6.1.5.2 Upper Suttor River Sub-catchment

Baseline water quality monitoring data for the Upper Suttor River sub-catchments (median values and 80th percentile) is summarised in **Table 6-3** and **Table 6-4**, which also provide the default water quality objectives for waterways in the project catchment area.



Legend

- Project Area
- River Subcatchments
- Surface Water Sampling Sites

Drainage (Stream Order)

1 2 3 4 5 6

Surface Water Monitoring Locations	
Figure 6-6	**Byerwen Coal Project**
Date: *22/02/2013*	**Author:** samuel.ferguson
	Map Scale: 1:341,944
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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Table 6-1 Summary Median Water Quality Data for Rosella Creek Sub-catchment

Parameter	Units	(QWQG) Default Trigger Level* (lowland/upland)	BYSW1	BYSW2^	BYSW3^	PP32	PP33	PP34	FSS03^	FSS04	FSS05	FSS14	FSS15	WQS05
pH(field)	pH units	6.5-8.0 / 7.5	**8.6**	**8.2**	-	**8.2**	**8.4**	**8.5**	**8.2**	**8.3**	**8.3**	**8.3**	**8.3**	7.4
pH(lab)	pH units	6.5-8.0 / 7.5	**8.4**	**7.7**	**7.8**	**8.4**	**8.3**	**8.4**	**8.2**	**8.4**	**8.4**	**8.4**	**8.4**	7.8
EC (field)	µS/cm	271	**1150**	**350**	-	**522**	**465**	**393**	**1079**	**1653**	**1133**	**2071**	**1750**	**286**
EC (lab)	µS/cm	271	**1285**	177	179	**431**	**622**	**509**	**1200**	**1755**	**1185**	**1960**	**1595**	256
Turbidity (lab)	NTU	50 / 25	35	**280**	**340**	89	90	95	**45**	23	7	36	27	-
Oxidised Nitrogen	mg/L	0.06 / 0.015	**0.285**	**0.020**	**0.020**	-	-	-	-	-	-	-	-	-
Total Nitrogen	mg/L	0.5/ 0.25	**0.80**	**1.00**	**0.80**	0.01	0.010	0.01	0.04	0.12	0.08	0.19	0.03	0.04
Total Phosphorus	mg/L	0.05/ 0.03	-	**0.35**	**0.13**	-	-	-	-	-	-	-	-	-
Sulfate (dissolved)	mg/L	250	38	5	9	26	30	16	171	233	18	242	155	10
Dissolved Metals														
Aluminium	mg/L	0.055	0.01	**0.38**	**0.45**	**0.070**	0.01	0.010	0.010	0.010	0.020	0.010	0.010	**0.090**
Boron	mg/L	0.37	0.08	0.07	0.05	0.06	0.07	0.06	0.06	0.07	0.06	0.08	0.08	0.05
Copper	mg/L	0.0014	**0.002**	**0.003**	**0.003**	0.0010	**0.0020**	**0.0020**	**0.0020**	0.0010	0.0010	0.0010	**0.0020**	**0.0020**
Manganese	mg/L	1.9	0.00	0.00	0.00	-	-	-	0.00	0.00	0.00	0.00	0.0	-
Nickel	mg/L	0.011	0.003	0.005	0.004	0.002	0.001	0.001	0.004	0.003	0.002	0.003	0.002	0.004
Zinc	mg/L	0.008	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Total Metals														
Aluminium	mg/L	n/a	1.73	4.50	1.30	0.350	0.260	0.420	1.450	0.510	0.105	0.720	0.730	36.000
Boron	mg/L	n/a	0.08	0.07	0.08	0.06	0.07	0.06	0.06	0.07	0.06	0.08	0.08	0.05
Copper	mg/L	n/a	0.0020	0.0070	0.0062	0.0030	0.0020	0.0020	0.0030	0.0020	0.0020	0.0020	0.0025	0.0530
Manganese	mg/L	n/a	0.05	0.03	0.01	-	-	-	0.3	0.0	0.01	0.0	0.1	-
Nickel	mg/L	n/a	0.006	0.010	0.009	0.003	0.002	0.001	0.009	0.008	0.003	0.007	0.005	0.118
Zinc	mg/L	n/a	0.008	0.008	0.006	0.005	0.005	0.005	0.010	0.005	0.005	0.006	0.011	0.112

Values in **RED** indicates an exceedance of default trigger value

* See **Section 6.3.1**

^ Upland stream

Table 6-2 Summary 80th Percentile Water Quality Data for Rosella Creek Sub-catchment

Parameter	Units	(QWQG) Default Trigger Level* (lowland/upland)	BYSW1	BYSW2^	BYSW3^	PP32	PP33	PP34	FSS03^	FSS04	FSS05	FSS14	FSS15	WQS05
pH(field)	pH units	6.5-8.0 / 7.5	**8.6**	**8.4**		**8.4**	**8.6**	**8.67**	**8.5**	**8.4**	**8.4**	**8.5**	**8.5**	7.8
pH(lab)	pH units	6.5-8.0 / 7.5	**8.4**	**8.0**	**7.9**	**8.4**	**8.5**	**8.7**	**8.4**	**8.5**	**8.5**	**8.5**	**8.5**	7.9
EC (field)	µS/cm	271	**1240**	**440**	-	**887**	**962**	**477**	**3730**	**2817**	**1217**	**2702**	**2207**	**286**
EC (lab)	µS/cm	271	**1354**	**284**	251	**745**	**735**	**657**	**3714**	**2886**	**1270**	**2626**	**2108**	**316**
Turbidity (lab)	NTU	50/ 25	35	**460**	**440**	**113**	**137**	**145**	**615**	**96**	40	**136**	**550**	-
Oxidised Nitrogen	mg/L	0.06/ 0.015	**0.342**	**0.030**	**0.078**	-	-	-	-	-	-	-	-	-
Total Nitrogen	mg/L	0.5 / 0.25	**0.98**	**1.36**	**1.00**	0.16	0.04	0.01	0.14	**0.56**	0.23	**0.72**	0.1	0.08
Total Phosphorus	mg/L	0.05 / 0.03		**0.35**	0.18	-	-	-	-	-	-	-	-	-
Sulfate (dissolved)	mg/L	250	40	8	10	57	43	31	**467**	**456**	23	**408**	232	30
Dissolved Metals														
Aluminium	mg/L	0.055	0.010	**0.974**	**0.788**	**0.098**	0.040	0.020	**0.090**	**0.106**	0.050	**0.076**	**0.072**	**0.220**
Boron	mg/L	0.37	0.08	0.08	0.08	0.06	0.10	0.10	0.12	0.10	0.08	0.10	0.09	0.05
Copper	mg/L	0.0014	**0.0018**	**0.0040**	**0.0042**	**0.0020**	**0.0020**	**0.0020**	**0.0020**	**0.0020**	**0.0030**	**0.0020**	**0.0020**	**0.0020**
Manganese	mg/L	1.9	0.00	0.01	0.00	-	-	-	0.00	0.01	0.01	0.01	0.00	-
Nickel	mg/L	0.011	0.004	0.008	0.005	0.002	0.001	0.001	0.006	0.006	0.004	0.005	0.003	0.004
Zinc	mg/L	0.008	0.006	**0.008**	0.006	0.005	**0.009**	**0.005**	**0.010**	0.005	0.005	0.005	0.005	0.005
Total Metals														
Aluminium	mg/L	n/a	1.74	6.68	1.30	11.240	1.692	2.670	9.200	5.174	3.020	4.720	15.920	92.300
Boron	mg/L	n/a	0.08	0.08	0.08	0.06	0.10	0.10	0.12	0.10	0.08	0.12	0.10	0.05
Copper	mg/L	n/a	0.002	0.008	0.006	0.0090	0.0032	0.0030	0.0088	0.0070	0.0060	0.0078	0.0182	0.1000
Manganese	mg/L	n/a	0.05	0.05	0.01	-	-	-	0.3	0.1	0.01	0.2	0.6	-
Nickel	mg/L	n/a	0.007	0.013	0.009	0.015	0.004	0.005	0.022	0.015	0.013	0.014	0.025	0.232
Zinc	mg/L	n/a	0.010	0.011	0.006	0.019	0.009	0.006	0.045	0.020	0.016	0.019	0.038	0.186

Values in **RED** indicates an exceedance of default trigger value

* See **Section 6.3.1**

^ Upland stream

Table 6-3 Summary Median Water Quality Data for Upper Suttor River Sub-catchment

Parameter	Units	(QWQG) Default Trigger Level* (lowland/upland)	BYSW5^	BYSW6^	BYSW8^	BYSW9	BYSW18	FSS07	FSS08	FSS16	WQS03	WQS04
pH(field)	pH units	6.5-8.0 / 7.5	-	**8.1**	**8.1**	**8.8**	**8.1**	**8.0**	**8.3**	7.6	8.0	-
pH(lab)	pH units	6.5-8.0 / 7.5	**7.7**	**7.8**	**8.0**	7.2	7.5	**8.1**	**8.3**	8.00	**8.2**	7.7
EC (field)	µS/cm	168	-	100	**400**	**200**	95	**619**	**761**	**449**	152	-
EC (lab)	µS/cm	168	**206**	161	**335**	159	159	**551**	**882**	**684**	145	206
Turbidity (lab)	NTU	50 / 25	**80**	**45**	**55**	**266**	**584**	**87**	**70**	16	-	80
Oxidised Nitrogen	mg/L	0.06 / 0.015	**0.025**	0.010	0.010	**0.080**	0.05	-	-	-	-	0.025
Total Nitrogen	mg/L	0.5/ 0.25	**0.90**	**0.80**	**0.40**	**1.00**	**0.6**	0.15	0.26	0.09	0.01	0.90
Total Phosphorus	mg/L	0.05 / 0.03	**0.14**	**0.15**	**0.04**	-	-	-	-	-		0.14
Sulfate (dissolved)	mg/L	250	2	2	5	5	4	5	52	18	4	2
Dissolved Metals												
Aluminium	mg/L	0.055	**0.100**	**0.195**	0.010	**0.350**	**0.72**	0.025	0.020	**0.070**	**0.230**	0.100
Boron	mg/L	0.37	0.05	0.05	0.06	0.06	0.05	0.10	0.09	0.06	0.05	0.05
Copper	mg/L	0.0014	**0.0020**	**0.0030**	**0.0020**	**0.0020**	0.001	**0.0020**	**0.0020**	0.0010	**0.0020**	0.0020
Manganese	mg/L	1.9	0.00	0.00	0.01	0.08	0.055	-	0.0	0.0	-	0.00
Nickel	mg/L	0.011	0.006	0.006	0.002	0.001	0.002	0.001	0.002	0.002	0.001	0.006
Zinc	mg/L	0.008	0.005	**0.009**	0.005	**0.012**	0.006	0.005	0.005	0.005	0.005	0.005
Total Metals												
Aluminium	mg/L	n/a	1.90	0.79	0.83	9.51	8.93	0.695	1.890	1.660	2.980	1.90
Boron	mg/L	n/a	0.05	0.05	0.06	0.06	0.05	0.10	0.09	0.06	0.05	0.05
Copper	mg/L	n/a	0.007	0.003	0.002	0.001	0.004	0.0030	0.0040	0.0020	0.0080	0.007
Manganese	mg/L	n/a	0.14	0.02	0.04	0.14	0.160	-	0.1	0.3	-	0.14
Nickel	mg/L	n/a	0.014	0.008	0.003	0.003	0.005	0.003	0.005	0.003	0.007	0.014
Zinc	mg/L	n/a	0.009	0.015	0.006	0.006	0.014	0.009	0.006	0.007	0.011	0.009

Values in **RED** indicates an exceedance of default trigger value

* See **Section 6.3.1**

^ Upland stream

Table 6-4 Summary 80th Percentile Water Quality Data for Upper Suttor River Sub-Catchment

Parameter	Units	(QWQG) Default Trigger Level* (lowland/upland)	BYSW5^	BYSW6^	BYSW8^	BYSW9	BYSW18	FSS07	FSS08	FSS16	WQS03
pH(field)	pH units	6.5-8.0 / 7.5	-	**8.2**	**8.2**	**8.6**	**8.2**	**8.3**	**8.6**	8.0	8.0
pH(lab)	pH units	6.5-8.0/ 7.5	**7.9**	8.0	8.1	7.5	7.5	**8.2**	**8.6**	**8.1**	**8.3**
EC (field)	µS/cm	168	-	**420**	**460**	**200**	98	**1561**	**1462**	**857**	155
EC (lab)	µS/cm	168	**237**	**218**	**741**	**218**	**183**	**2040**	**1558**	**884**	149
Turbidity (lab)	NTU	50 / 25	178	107	140	305	606	151	203	198	
Oxidised Nitrogen	mg/L	0.06 / 0.015	0.054	0.020	0.020	0.082	0.05	-	-	-	-
Total Nitrogen	mg/L	0.5 / 0.25	1.20	1.16	0.60	1.30	0.64	0.28	0.68	0.16	0.03
Total Phosphorus	mg/L	0.05 / 0.03	0.14	0.15	0.04	0.00	-	-	-	-	-
Sulfate (dissolved)	mg/L	250	13	6	23	5	4	9	99	38	5
Dissolved Metals											
Aluminium	mg/L	0.055	**0.262**	**0.332**	**0.200**	**0.806**	**1.004**	**0.238**	**0.120**	**1.292**	**0.182**
Boron	mg/L	0.37	0.05	0.05	0.10	0.06	0.05	0.05	0.11	0.07	0.05
Copper	mg/L	0.0014	**0.0034**	**0.0030**	**0.0020**	**0.0020**	0.001	**0.0020**	**0.0020**	**0.0020**	**0.0030**
Manganese	mg/L	1.9	0.02	0.01	0.02	0.16	0.075	0.00	0.00	0.03	-
Nickel	mg/L	0.011	0.007	0.006	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Zinc	mg/L	0.008	0.007	**0.013**	0.006	**0.012**	0.006	0.005	0.005	0.005	0.006
Total Metals											
Aluminium	mg/L	n/a	1.90	1.65	0.92	9.700	9.510	5.140	5.502	5.890	71.240
Boron	mg/L	n/a	0.05	0.05	0.06	0.06	0.05	0.10	0.12	0.08	0.07
Copper	mg/L	n/a	0.007	0.004	0.002	0.003	0.0046	0.0108	0.0080	0.0070	0.0690
Manganese	mg/L	n/a	0.14	0.04	0.04	0.20	0.202	-	0.2	0.5	-
Nickel	mg/L	n/a	0.014	0.008	0.003	0.003	0.005	0.008	0.011	0.008	0.192
Zinc	mg/L	n/a	0.009	0.023	0.007	0.007	0.016	0.025	0.021	0.020	0.149

Values in **RED** indicates an exceedance of default trigger value

* See **Section 6.3.1**

^ Upland stream

6.1.6 EPP (Water)

Under the EPP (Water), the protection of the receiving environment is guided by the identification of EVs relating to those waters. EVs require protection from the effects of pollution, waste discharge and modified sediment processes. There are no EVs established for the Burdekin Basin Catchment, as per Schedule 1 of the EPP (Water). EVs adopted for the receiving waterways have therefore been identified based on a review of land uses and downstream water usage within the relevant sub catchments.

The Burdekin WQIP presents a qualitative assessment of the sub-catchments which was also referenced. The EVs for each of the two sub-catchments are described within **Table 6-5** and discussed below.

6.1.7 Classification of Existing Aquatic Ecosystems

The ANZECC guidelines describe how aquatic ecosystems can be subdivided into three levels of protection based on their current condition as follows:

- High Ecological Value (HEV) ecosystems –essentially unmodified, highly valued aquatic ecosystems in which the ecological integrity is regarded as intact.
- Slightly to Moderately Disturbed (SMD) ecosystems – ecosystems in which aquatic biodiversity may have been diminished to a small but measurable degree by human activity, but where the biological communities remain in a healthy condition.
- Highly Disturbed (HD) ecosystems – degraded aquatic ecosystems with reduced and/or highly modified ecological values due to human activity.

The aquatic ecosystem values of the overall sub-catchment are considered to be SMD ecosystems as a consequence of the surrounding land use for cattle grazing.

Table 6-5 Environmental Values for the Burdekin Catchment

Draft Environmental Value	Rosella Creek Sub-catchment	Upper Suttor River Sub-catchment
Protection of aquatic ecosystems	Kangaroo and Rosella Creeks experience flow only after sustained or intense rainfall. Stream flows are highly variable with most channels drying out and aquatic fauna concentrating in senescing pools in the drier months. As a consequence, physical attributes, water quality and the composition of aquatic floral and faunal communities are also expected to be highly variable over time. The aquatic ecosystem values of the sub-catchment are considered to be slight to moderately disturbed as a consequence of the surrounding land use for cattle grazing.	The Suttor River and its tributaries are ephemeral streams which can occasionally contain large waterholes. The size and persistence of these waterholes is dependent on the substrate composition, season and climatic conditions. The sub-catchment's physical attributes, water quality and the composition of aquatic floral and faunal communities will therefore be highly variable over time. The catchment area shows pre-existing dry land salinity which is likely to result from erosion caused by a combination of natural and anthropogenic processes. This may cause a potential threat to aquatic ecosystems within the catchment. The Burdekin WQIP technical panel indicate that macroinvertebrates have experienced moderate change along the Suttor River. Fish and water quality are moderately affected below the junction with the Belyando River. Two lacustrine wetlands and one palustrine wetland area are located within or immediately adjacent to the project footprint. The project will remove two mapped lacustrine wetlands (dams), and some gilgai wetland. The palustrine wetland will be retained, and not physically disturbed by mining activities.
Suitability for stock watering	Land use in the area is dominated by grazing. Water supply for production of healthy livestock is commonly extracted from the surrounding water resources.	Land use is predominantly grazing on natural and modified pastures. Livestock water supply is commonly extracted from the surrounding water resources.
Suitability for industrial uses	Mining has a presence within this catchment and further development is planned. Specifically, Xstrata's Newlands, Newlands East, Northern Underground mines and Eastern Creek (North and South) mines are located immediately to the east of the project. It is likely that this area of mining activity will be extended within the life of the project.	Coal mining activities are undertaken within this catchment and further development is planned. Xstrata's Suttor Creek mine (containing the Wollombi and Suttor Creek Pits) exist adjacent to the southern boundary of the project.
Cultural and spiritual values	The Birriah and Jangga traditional owners have custodial use of water resources within the catchments. Environmental values: ▪ water access and use	

Draft Environmental Value	Rosella Creek Sub-catchment	Upper Suttor River Sub-catchment
	▪ water allocation for traditional owners ▪ water to camp near for traditional activities ▪ participation in the management of water.	
Suitability for primary, secondary and visual recreation	None identified	Swimming, fishing and camping along the Suttor River.
Suitability for drinking water and human consumption	None identified	Drinking water is cited as an environmental value in the Burdekin WQIP. There are no urban areas or towns located downstream of the project area within the sub-catchment and the very small population is widely scattered on pastoral holdings. The potential exists for river water to be used for drinking purposes.
Suitability for irrigation and protection of water harvesting entitlements	None identified	The predominant agricultural land use within the sub-catchment is grazing. The nearest property with a license to take water for crop irrigation purposes is located approximately 60 km downstream of the project area.

6.2 Potential Impacts

6.2.1 Hydrology

The operation of the water management system in accordance with the planned release strategy will have negligible impact on the hydrology of the Suttor River and Kangaroo Creek. Impacts will be minor in local tributaries in the project area as maximum release rates are well within the design capacities of diversion channels.

Flood waters from the 100 Year and 1,000 Year ARI events reach sections of the waste rock dump associated with the west pits complex and out of pit waste rock dumps associated with South Pit 1 and South Pit 2.; however, modelling shows negligible changes to flood depths and velocities. This will require armouring up to the 1,000 year ARI flood level such that it is non-erodible when in contact with flood waters, resulting in negligible impacts. Alternately the toe of the dump can be relocated outside the flood extent. It should be noted that the peak depth and velocities at the face of the WRD do not occur together and where the velocity is highest adjacent the waste rock dump the depth is 0.8 m.

The Probable Maximum Floods (PMF) flood event reaches the aforementioned waste rock dumps and the south western corner of South Pit 1. The levee of Diversion 2 is overtopped by the Suttor River PMF event, but not the 1,000 year ARI event.

There are no open pits or final voids that will be subject to flooding from the 1,000 year ARI flood event from regional flooding of the Suttor River.

The GAP rail line is not overtopped in the pre-development Suttor River 100 year ARI flood event and this flood immunity is not affected by the project development. There are negligible impacts at the proposed Alpha Coal Project rail line.

Diversion channels will be constructed prior to commencement of mining works at open pits from which they divert water. Therefore impacts from inflows from unnamed tributaries to the Suttor River are expected to be negligible. Additionally, the levees that form part of the water course diversions works will be extended to protect South Pit 1 and West Pit 1 from 1,000 year ARI regional flooding in the Suttor River at all intervals of the mine life.

North Pit and associated waste rock dump are situated in the upper catchment of Kangaroo Creek at an elevation above any floodplain and the small gullies in these areas are not of sufficient size to warrant flood modelling. A small drainage diversion is planned to allow water to bypass the North Pit and flow to Kangaroo Creek. This drainage diversion will be in place before mining operations commence at the North Pit. The northern MIA is located across a tributary of Kangaroo Creek and may require culverts or a bridge to provide access and protect the area. However this infrastructure is not required until approximately Year 15 in the mine life and localised water management measures will be determined during future detailed design work.

South Pit 2 and associated waste rock dump were determined to be beyond the extent of any flood flows from Suttor Creek.

6.2.2 Drainage Diversions

Realignment of drainage lines requires detailed hydrological and hydraulic assessment to enable management of downstream impacts. Conceptual diversions have been determined with lengths similar to the natural condition (where possible) to limit erosion potential. The hydraulic parameters in the diversion channel are all within the guideline values for natural watercourses in the Bowen Basin.

The preliminary design of the diversion channels will be reviewed during detailed design, based on geotechnical advice to confirm the design parameters. They will be designed as stable self sustaining system that promote nutrient processing, ecological connectivity and sediment storage and transport

and maintained over the life of the mine, with refinements made if needed, resulting in diversions and levees that require no maintenance post closure. With appropriate design and construction, impacts to catchment hydrology, localised flooding, geomorphology and ecological integrity from diversions are expected to be negligible to minor.

The diversion channels have been designed to cater for local catchment discharges up to and including the 0.1% AEP event discharge plus a 0.5 m freeboard to the top of the bank or levee (in accordance with the Manual). The diversion channel design includes levees to contain the 1,000 year ARI local catchment flows from the unnamed tributaries of the Suttor River. These levees have been included in the hydraulic modelling and extended to high ground at their downstream extent to completely protect the mine pits from backwater flooding in the Suttor River 1,000 year ARI event.

The proposed diversion channel (Diversion 2 and Diversion 3) will require part of the Wollombi Road to be removed. A causeway would be constructed to reconnect the road with flood immunity similar or greater than, the existing crossing, as required.

The drainage diversion channels 1, 2 and 3 will move the flow of water around the mining area, but still enter their receiving waterways at the same location; therefore negligible change in flow or velocity is expected to occur in the receiving waterways.

Diversion channel 4 redirects a small part of East Pit 2 upstream catchment upstream into the drainage line between East Pit 1 and East Pit 2. This increases the contributing catchment of the drainage line by less than 10% and is not expected to significantly alter the flow or velocity of the drainage line.

6.2.3 Palustrine Wetland

During mining, the upstream catchment of the wetland will be disrupted by construction of a waste rock dump associated with West Pit complex. In the first year of mining the catchment will reduce from 4.2 km^2 to 2.9 km^2, and then there will be a further reduction from 2.9 km^2 to 2.4 km^2 around year 5. However, the wetland catchment will be rehabilitated to a similar pre-development hydrological profile around year 16, allowing the pre-development hydrological processes currently in the catchment to be reinstated. The disruption to the wetland is therefore temporary.

The catchment of the wetland will be reduced for a period of around 16 years. In a median rainfall year the surface water flowing to the wetland would reduce from approximately 170 ML to 95 ML as a result of the catchment reduction, resulting in a shortfall of some 75 ML per annum over the 16 year disturbance period. The impacts on the hydrology of the wetland in the 16 years of reduced catchment will be moderate, however once the catchment is rehabilitated to a similar pre-development hydrological profile, impacts on the hydrology of the wetland will be negligible. The impacts of this change in hydrology on the wetland ecology are discussed in **Section 11**.

6.2.4 Erosion and Sediment Mobilisation

Sediment mobilised during construction and operations has the potential to discharge to waterways leading to deleterious effects on water quality and aquatic habitats.

6.2.5 Contaminant Mobilisation

Potential sources of onsite water contaminants during mining are predominately diesel and other petroleum based fuel and lubricants used by excavation and construction machinery. Spills will most likely occur in pits and be contained within the mine water management system.

6.2.6 Mine Water Discharges

The release conditions specify the maximum discharge rate and end-of-pipe EC that can occur, however the actual release rate and EC will depend on the flow in the receiving environment. The water balance model indicates that these maximum conditions are often not met because of downstream constraints.

Three flow regimes have been nominated for the receiving environment:

- low/recession flow: Representative of periods of baseflow after a runoff event occurs. This flow regime is triggered after a medium flow event ceases and continues for 42 days thereafter
- medium flow: Representative of surface runoff event and calculated to be 5 ML/d (0.06 m^3/s) in the Suttor River and 1 ML/d (0.01 m^3/s) in Kangaroo Creek, based on the 20th percentile during periods of flow and is reached approximately 30% of the time
- high flow: The high flow threshold trigger is 210 ML/d (2.4 m^3/s) in Suttor River and 100 ML/d (1.2 m^3/s) in Kangaroo Creek. This represents the 80th percentile during flow periods and is indicative of a substantial flow event which occurs approximately 8% of the time relative to the entire year.

Table 6-6 summarises the modelled mine water discharges into the Suttor River. The table indicates that releases most often occur during high flow conditions (75% of the time when releases occur it will be at times of high flow) and that most of the mine water gets released during high flow conditions (94% of the total volume of water released is at high flow conditions). This is because higher discharge rates and dilution ratios are possible during high flow events. The table also indicates that recession flow is not a major component of the mine water release strategy. Modelling suggests that only around 1% of the volume of water released occurs during recession flow.

Table 6-6 Suttor River Mine Water Discharge Analysis

	Recession/Low flow	Medium flow	High flow
% of time when releases occurring	7%	18%	75%
% of release water volume	1%	5%	94%
Mean rate of water discharged (ML/d)	7	11	54
Mean EC released (µS/cm)	950	950	930
Maximum EC released (µS/cm)	1,720	2,440	3,680

Table 6-7 below summarises the modelled mine water discharges into Kangaroo Creek. The table suggests that releases to Kangaroo Creek may occur more frequently in medium flow conditions than in Suttor River. However, the majority (approximately 70%) of water discharged from the mine (in terms of volume) would be associated with high flows in Kangaroo Creek.

Table 6-7 Kangaroo Creek Mine Water Discharge Analysis

	Recession/Low flow	Medium flow	High flow
% of time releases occurring	14%	52%	34%
% of release water volume	2%	30%	68%
Mean rate of water discharged (ML/d)	7	23	79
Mean EC released (µS/cm)	960	950	820
Maximum EC released (µS/cm)	1,300	2,100	2,200

6.2.6.1 Salinity

The salinity of water is the primary constraint to the release of water from the mine water management system. The mine water balance model comprises modelling of the mine water management system, of the volume of water and the salinity of water. By virtue of the release conditions, there is expected to be no change to the 80th percentile EC in the Suttor River. The water balance model suggests that there is a very slight increase in EC below the 80th percentile, reflecting the effect of the releases. However these are of a very low order (10s of µS/cm) and would not have measurable impact on the river water quality.

The water balance model suggests similar findings for Kangaroo Creek as described above for Suttor River.

6.3 Environmental Protection Objectives

WQO's are based on the most relevant water quality guidelines but are derived for specific water types based on long term monitoring of unimpacted 'reference' sites. Site-specific WQO's are preferred where sufficient information is available. Specific WQO for the protection of aquatic ecosystems within the Burdekin Basin are not included within Schedule 1 of the EPP (Water). Additionally, the Burdekin WQIP states that insufficient data is available from the Burdekin Dry Tropics NRM region to derive locally relevant WQO for freshwater ecosystems. Consequently draft WQO were derived based on the QWQG and ANZECC guidelines which includes derivation of site specific WQO's.

6.3.1 Default Water Quality Guidelines

Water quality guidelines form the basis for determining WQOs. There are three main references used to identify guideline values in Queensland:

- ANZECC Guidelines –provide values (numbers) or descriptive statements for different indicators to protect aquatic ecosystems and human uses of waters. For aquatic ecosystems, although the guidelines provide extensive default guideline values, they strongly emphasise the need to develop more locally relevant guidelines.
- QWQG – The QWQG are intended to address the need identified in the ANZECC guidelines by:
  - providing guideline values (numbers) tailored to Queensland regions and water types
  - providing a process for deriving and applying locally specific guidelines for waters.
- EPP (Water) – EVs and WQOs have been scheduled under the EPP (Water) for certain waters within Queensland.

The EPP (Water) states that the most locally relevant guideline will be used in preference to broader guidelines. Therefore, where the QWQG provides water quality guideline values for Queensland waters, it will take precedence over the ANZECC guidelines. For indicators such as toxicants and other industrial and agricultural uses, ANZECC guidelines remain the principal source of information.

Currently no EV's or WQO's have been scheduled under EPP (Water) for the Burdekin catchment. Therefore the Central Coast Queensland Regional Guideline Values for physico-chemical indicators for SMD waters have been adopted as default values for both the Rosella Creek and Upper Suttor River sub-catchments. These guidelines revert to the ANZECC guidelines for certain water quality parameters.

For freshwaters, the QWQG generally defaults to the ANZECC guidelines categories of upland and lowland freshwaters. The ANZECC Guidelines suggest a cut-off of 150 m elevation to differentiate between lowland and upland freshwaters but also acknowledges that this definition is not applicable in all instances and also broadly defines upland freshwaters as small (first or second order) upland streams

that are moderate to fast flowing due to steep gradients with substrates usually consisting of cobbles, gravel or sand.

Lowland streams are defined by the QWQG as larger (>3rd order streams), slow flowing and meandering streams with very slight gradients and substrates which are rarely comprised of cobble and gravel but more often of sand, silt or mud.

While all watercourses in the study area are located at elevations greater than 150 m, the broader QWQG definitions of freshwaters were considered to be more applicable. As such, the Suttor River, Suttor Creek and the majority of Kangaroo Creek have been considered to be lowland freshwaters with default trigger values assigned accordingly. Tributaries of these watercourses and the upper reaches of Kangaroo Creek were considered to be upland freshwater streams.

6.3.2 Site-Specific Water Quality Objectives

Many of the baseline water quality sampling locations show existing water quality indicators in excess of those stipulated in the relevant water quality guidelines (see **Table 6-1, Table 6-2, Table 6-3**, and **Table 6-4**). Therefore, a more appropriate set of WQO is required using guiding principles highlighted in the QWQG. WQO for physical and chemical indicators have been set in accordance with the recommended approach in the QWQG, for the receiving environment of the project using the following key steps:

1. Selecting suitable baseline reference sites
2. Defining the water type at the receiving environment
3. Calculating guideline values based on reference data sets.

6.3.2.1 Selected Reference Sites

Selected reference sites are as follows:

- Rosella Creek Sub-catchment Reference Site Selection: FSS05 was selected as the most representative site with 84 sampling events over full season's variability between February 2007 and September 2011.
- Upper Suttor River Sub-catchment Reference Site Selection: BYSW6, BYSW8 and FSS07 were considered as suitable reference sites. Of the three sites, the most comprehensive water quality monitoring dataset was available for FSS07 with 66 records spanning the period from November 2006 to September 2011. This site was therefore chosen as the reference site.

6.3.2.2 Determination of WQOs

The recommended approach for an SMD receiving environment is to base the guideline values on the 20th and 80th percentiles of the monitoring dataset. The dataset needs to contain more than 12 data points with 24 data points considered more appropriate. Where the 80th percentile values exceeded default trigger values, the 80th percentile values have been adopted as the draft WQOs, otherwise default trigger values have been adopted. Where there was considered to be insufficient data for a particular parameter at FSS05, data from BYSW2 were used instead. Similarly, where there was insufficient data for FSS07, data from BYSW6 was used.

A comparison of the default trigger values and the 80th percentile for ambient surface water quality was undertaken for the Rosella Creek and Upper Suttor River sub-catchments. Water at the reference sites was classified as 'hard', which is typical of the area. Guideline trigger values for copper, zinc and nickel were therefore corrected for respective levels of hardness prior to comparison.

For the majority of parameters for both sub-catchments, the WQO default trigger values have been retained as the draft WQOs. The exceptions to this are pH, EC, turbidity, total nitrogen and aluminium.

After reviewing the full set of baseline water quality data, as well as literature provided in the Burdekin WQIP, these parameters are confirmed as having an existing occurrence higher than published guidelines across both sub-catchments and therefore the upward revision of the guidelines is considered appropriate for future management of water quality for the project.

As such a draft set of WQOs (**Table 6-8),** have been established based on site specific baseline data and published guidelines. These form the basis for developing mine water release criteria and a customised approach to management of water quality within the sub-catchment areas.

Trigger investigation levels are identified for downstream compliance points. Trigger investigation values are values that if exceeded, trigger a requirement for further investigation and reporting processes. This normally includes comparing upstream and downstream water quality data and assessing the risk of causing environmental harm. Where it is not possible to assess upstream water quality data, a comparison to baseline data or an analogue catchment is undertaken.

Table 6-8 Draft Water Quality Objectives

Parameter	Units	Default Trigger Level		Draft WQO	
				Upper Suttor River Sub-Catchment	Rosella Creek Sub-Catchment
pH (flow)	pH units	Upper	8.0	8.3	8.5
	pH units	Lower	6.5	6.5	6.5
pH (nil flow or flood event)	pH units	Upper	9.0	9.0	9.0
	pH units	Lower	5.5	5.5	5.5
Electrical Conductivity	µS/cm		168/271*	2040	1270
Turbidity (lab)	NTU		50	151	50
Oxidised Nitrogen	mg/L		0.06	0.06	0.06
Total Nitrogen	mg/L		0.5	1.16	0.5
Total Phosphorus	mg/L		0.05	0.05	0.05
Dissolved Sulfate	mg/L		250	250	250
Dissolved Aluminium	mg/L		0.055	0.250	0.055
Dissolved Boron	mg/L		0.37	0.37	0.37
Dissolved Copper	mg/L		0.003^/0.007#	0.003	0.007
Dissolved Manganese	mg/L		1.9	1.9	1.9
Dissolved Nickel	mg/L		0.03^/0.06#	0.03	0.06
Dissolved Zinc	mg/L		0.02^/0.04#	0.02	0.04

* See **Section 6.3.1**
^ Hardness modified trigger value, Upper Suttor River sub-catchment
# Hardness modified trigger value, Rosella Creek sub-catchment

6.3.3 Release Criteria

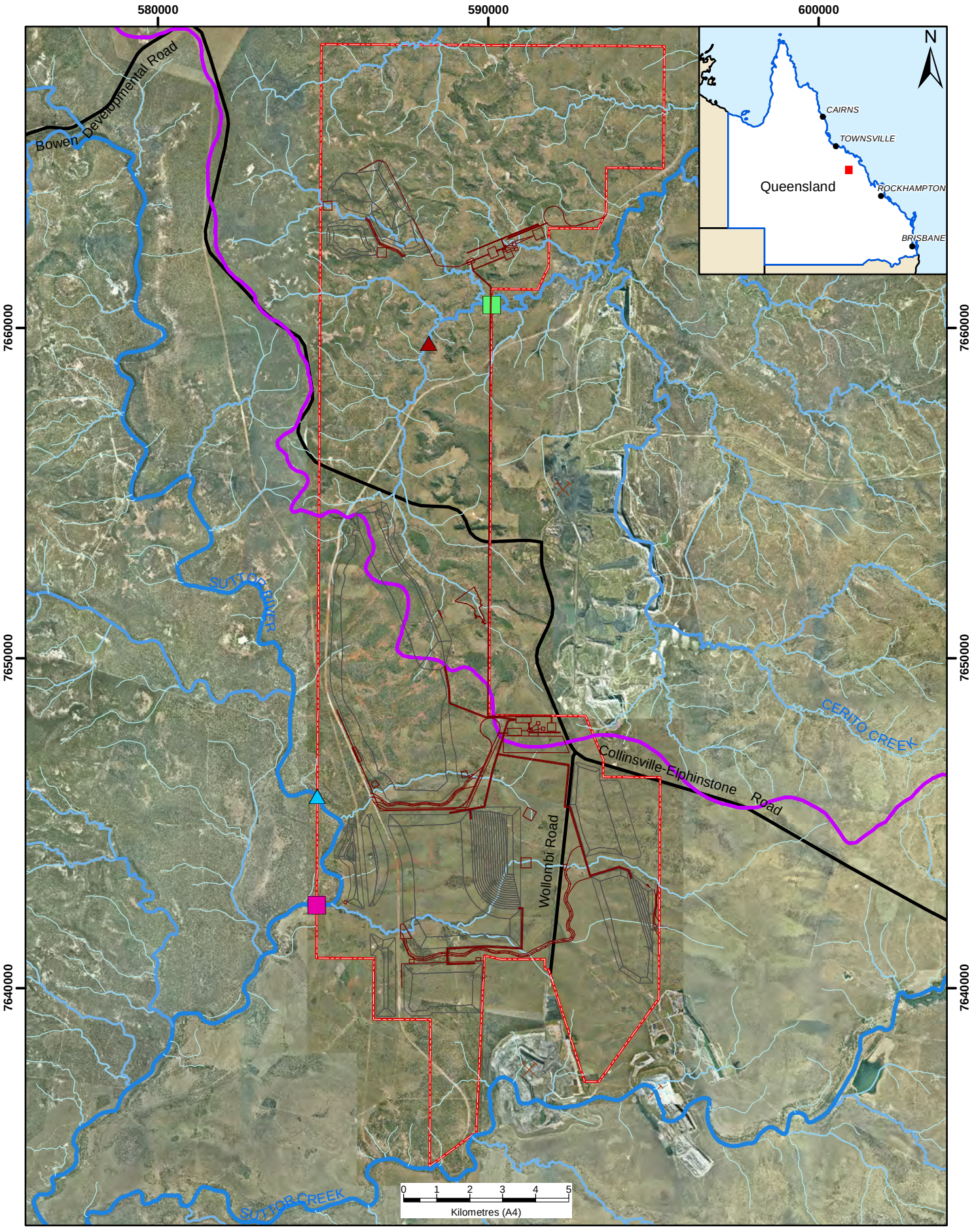
Discharge of mine affected water to the environment will be permitted on the basis of:

- **End-of-pipe water quality:** Water quality that enters the environment using a range of water quality indicators. The salinity limits (electrical conductivity) vary based on receiving waterway flows.

- **Flow in the receiving environment:** Discharges only during or immediately following flow in the receiving environment.
- **Receiving waterway (downstream) water quality:** Water quality in the receiving environment at a downstream location. This provides for dilution while ensuring that the water quality in the receiving waterway is maintained within a range experienced in the natural environment.

Flow in the receiving environment is ideally measured upstream of mine site discharges. This is possible in the Suttor River, but not in Kangaroo Creek since the discharge location from West Pit 3 is at the head of the catchment. In the absence of a non-mine affected analogue catchment with similar size, a flow gauging station is proposed downstream of the releases from West Pit 3, but upstream of releases from North Pit. Interpretation of the flow gauging data will need to consider the influence of any mine releases on the gauge.

Two receiving environment compliance locations are proposed as shown on **Figure 6-7**. The receiving environment flow gauging stations are also shown.



Legend

- Project Area
- Mine Infrastructure
- Waste Rock Dumps and Pits
- Drainage Basin Sub-Area
- Existing Mine Site
- Formed Roads

Compliance Points

- CP1
- CP2

Water Flow Monitoring Points

- MP1
- MP2

Drainage (Stream Order)

1 2 3 4 5

Proposed Compliance and Flow Monitoring Points	QCOAL GROUP
Figure 6-7	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
G:\CLIENT\SA-TO-D\BYEGEN - Byerwen EIS\GIS\Maps\EIS Chapters\EIS_EMP\BYEGEN_Fig6-7_compliancepoints.mxd	

6.3.4 Release Rules

Release rules have been developed with the objective of ensuring releases do not result in unacceptable water quality in the receiving environment, considering:

- receiving environment flow
- receiving environment water quality
- mine release rate
- mine release water quality.

6.3.4.1 Receiving Environment Flow

Mine discharges are permitted when flow conditions in the receiving environment are above a minimum level, and are derived from a runoff event as either surface runoff or baseflow.

The waterways in the region are highly ephemeral and have flow approximately 40% of the time. Of this, approximately 20% is baseflow. Release of water during periods of baseflow is proposed with water of higher quality (low EC) and at lower release rates than release of water during storm-related surface runoff events. Storm-related surface runoff events occur only around 30% of the time and it is during these windows that dilution of lower quality (high EC) mine water can occur. The higher the flow rate the more releases that can occur without compromising the river hydrology or water quality.

In summary, Suttor River and Kangaroo Creek have no flow around 60% of the time. When there is flow in these waterways that is not storm-event related (i.e. baseflow) discharge would not occur, except for the period immediately following a substantial flow event. 80% of the time when flow is present in the receiving waterway, controlled releases from the mine will be permitted to occur, if required.

6.3.4.2 Receiving Environment Water Quality

Water quality objectives have been derived to protect the environmental values in these waterways and have been developed based on a baseline monitoring program (see **Section 6.1**). While a range of parameters will be monitored, the critical water quality indicator that is likely to constrain releases to the environment is salinity (as electrical conductivity). The electrical conductivity trigger values are based on the 80th percentile electrical conductivity values observed in the baseline monitoring program within each catchment using a reference site.

6.3.4.3 Mine Release Flow Thresholds

Mine release flow thresholds have been derived to meet several objectives:

- maximise opportunities for release of mine water during flow event windows
- control the release rate into the river system, to limit adverse hydraulic issues (e.g. flooding, scour)
- ensure the river hydrology is not significantly altered by mine site releases.

Mine water releases will occur at a rate that ensures sufficient dilution is available in the receiving environment to meet water quality objectives. Therefore the mine water releases may not always occur at the maximum release rate. The release locations would be configured to enable the mine to respond to release opportunities as soon as possible. This is likely to involve gravity release systems (e.g. sluice gates or weirs) that are controlled by telemetry systems. This would allow releases to be made when access is difficult and not be constrained by pumping capacity during release windows.

6.3.4.4 Mine Release Water Quality

Maximum limits have been derived for end-of-pipe releases to the environment and will vary depending on the flow in the receiving environment.

6.3.5 Proposed Release Rules

The release rules modelled for Suttor River and Kangaroo Creek releases are presented in **Table 6-9 and Table 6-10** respectively. It should be noted that within the model all releases were stopped when the downstream compliance EC reached the compliance value (2,040 µS/cm in Suttor River and 1,270 µS/cm in Kangaroo Creek), including when the background levels were naturally outside this range.

Table 6-9 Release Conditions – Suttor River Catchment

Flow Regime	Suttor River Upstream	Mine Discharges		Suttor River Downstream
	Upstream Flow Trigger	Maximum Combined Discharge	End of Pipe EC Limit	Maximum EC During Release
Low/No flow	Recession flow*	0.3 m3/s	2,040 µS/cm	2,040 µS/cm
Medium	5–210 ML/d	2.9 m3/s	2,500 µS/cm	2,040 µS/cm
High	>210 ML/d	10 m3/s	6,500 µS/cm	2,040 µS/cm

** After a flow event exceeding 5 ML/d, release of high quality water (EC <2,040 µS/cm) is permitted for a period of up to 42 days after 'medium' flow ceases*

Table 6-10 Release Conditions – Kangaroo Creek Catchment

Flow Regime	Kangaroo Creek Upstream	Mine Discharges		Kangaroo Creek Downstream
	Upstream Flow Trigger	Maximum Combined Discharge	End of Pipe EC Limit	Maximum EC During Release
Low/No flow	Recession flow*	0.1 m^3/s	1,270 µS/cm	1,270 µS/cm
Medium	1–100 ML/d	1.0 m^3/s	2,500 µS/cm	1,270 µS/cm
High	>100 ML/d	2.3 m^3/s	6,500 µS/cm	1,270 µS/cm

** After a flow event exceeding 1 ML/d, release of high quality water (EC <1,270 µS/cm) is permitted for a period of up to 42 days after 'medium' flow ceases*

6.4 Performance Criteria

- Compliance with the requirements of the project's EA, demonstrated via surface water monitoring.
- Discharges met the established release criteria .
- Water management system and infrastructure function in accordance with design specifications.
- The number of complaints about water quality or flows from down gradient land users.

6.5 Control Strategies

Mitigation measures will be in alignment with the requirements and provisions of Queensland Government's NRM Guideline—*Activities in a watercourse, lake or spring associated with a resource activity or mining operations WAM/2008/3435,* (2012), where this is not practicable a riverine protection permit will be sought (in accordance with section 269 of the *Water Act* 2000).

Adherence to mitigation measures set out below is expected to protect the EV's and objectives identified for water quality within the sub-catchment areas.

6.5.1 Palustrine Wetland

The remediation strategy for wetland catchment reduction involves returning the land to a similar hydrological profile, creating a similar catchment for the wetland. The area would be rehabilitated by around year 16, allowing the hydrological processes currently feeding the wetland to be reinstated.

6.5.2 Erosion and Sediment Mobilisation

An Erosion and Sediment Control Plan will be developed for the project. The key features in the Erosion and Sediment Control Plan will involve:

- concentrating work to as small an area as practicable
- implementing sediment limitation devices to restrict sediment movement off site
- constructing bunds to restrict flow velocities and therefore reduce scour of waterway bed and banks
- limiting vegetation clearing work during heavy rainfall
- adopting stormwater controls and upstream treatment, e.g. infiltration devices or vegetation filters
- revegetating and/or use of other stabilisation techniques, considering seasonal influences
- minimising vegetation disturbance, especially riparian vegetation
- implementing dust suppression and scour protection measures.

Construction activities at or near drainage features can mobilise sediment and alter flow and quality characteristics. These potential impacts can be managed by:

- installing suitable stormwater management infrastructure prior to commencement
- minimising disturbance by earthmoving equipment in riparian areas.

6.5.3 Contaminant Mobilisation

The likelihood and the consequences of potential impacts from contaminant mobilisation will be mitigated by:

- the transfer of fuels and chemicals managed to prevent spills outside of bunded areas
- significant spillage or leakage to be immediately reported and an appropriate emergency clean-up operation implemented to prevent possible mobilisation of contaminants.

6.5.4 Mine Water Management System

The water management system for the project is discussed in detail in **Section 3**.

6.6 Monitoring and Auditing

A water quality monitoring program will be implemented within the project area for the life of the project. Monitoring is proposed for water storages, release points and the receiving environment. **Table 6-11** provides the water quality characteristics which will be assessed as part of the program.

Two receiving environment monitoring and compliance locations are shown in **Figure 6-7** and are:

- **MP1** – Suttor River Flow gauging station upstream of mine releases at the edge of ML. (Easting 584817: Northing 7645806).
- **CP1** – Suttor River downstream of mine releases at edge of ML (Easting 584806: Northing 7642521).
- **MP2** - Kangaroo Creek upstream of North Pit contribution (Easting 588199: Northing 7659529).
- **CP2** - Kangaroo Creek downstream of upstream of North Pit contribution at edge of ML (Easting 590101: Northing 7660695).

A Receiving Environment Monitoring Program (REMP) will be developed to assess the local receiving waters for the specified discharge locations. The purpose of the REMP is to assess the overall condition of the local receiving waters. **Table 6-11** provides an indication of the likely water quality characteristics which will be assessed as part of the program, and would be confirmed during development of the REMP. Biological indicators such as macroinvertebrate surveys will also be periodically undertaken. Refer to **Section 11**.

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 6.5** and compliance with the release rules and criteria outlined in **Sections 6.3** and **6.4** as applicable to surface water management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

6.6.1 Unplanned Discharges

The design of the water management strategy reduces the risk of unplanned discharges to the environment. However, events may occur which are outside of the normal water management system or accepted modelling parameters, and as such cannot be predicted. Such events could be reasonably anticipated to be associated with high rainfall periods when high flows in the receiving environment are likely.

In terms of water quality impacts, this means that any unplanned release is likely to be a small component of the existing flow. The main water quality concern associated with the project is salinity, and any salinity associated with unplanned releases would be quickly and widely diluted.

Contingency measures for water surplus and water deficit scenarios include:

- transfer of water between dams to balance storages
- use of mine affected water in the processing circuit
- emergency storage of surplus water in an open pit (this may temporarily suspend or slow mining)
- enhanced evaporation (e.g. mist irrigation over waste rock dumps)
- preferential use of surplus water for general site requirements (e.g. dust mitigation) where the quality is acceptable.

Table 6-11 Monitoring Program

Location	Number of Locations	Quality Characteristic	Monitoring Frequency
Water storages	Varies throughout mine life	pH	Quarterly
		Electrical conductivity	
		Sulfate	
		Aluminium (total)	
		Copper (total)	
		Lead (total)	
		Nickel (total)	
		Uranium (total)	
		Zinc (total)	
Release points	Varies throughout mine life	Aluminium (total and filtered)	Commencement of release and thereafter weekly during release
		Cadmium (total and filtered)	
		Chromium (total and filtered)	
		Copper (total and filtered)	
		Iron (total and filtered)	
		Lead (total and filtered)	
		Nickel (total and filtered)	
		Zinc (total and filtered)	
		Boron (total and filtered)	
		Manganese (total and filtered)	
		Molybdenum (total and filtered)	
		Selenium (total and filtered)	
		Silver (total and filtered)	
		Uranium (total and filtered)	
		Vanadium (total and filtered)	
		Ammonia	
		Nitrate	
		Petroleum hydrocarbons (C6–C9)	
		Petroleum hydrocarbons (C10–C36)	
		Sodium	
		Electrical conductivity	
		pH	
		Turbidity	
		Suspended solids	
		Sulfate	
Receiving environment	▪ 2 downstream compliance points, ▪ 2 upstream monitoring points) ▪ Palustrine wetland	pH	Daily (during the release of mine water) Monthly (during natural flow)
		Electrical conductivity	
		Turbidity	
		Suspended solids	
		Sulfate	
		Sodium	

6.7 Proposed EA Conditions

Schedule W - Water

Contaminant release

W1 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.

W2 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 **Schedule W Table 1** and depicted in **Figure 1**[4] of this environmental authority.

W3 The release of mine affected water to internal water management infrastructure installed and operated in accordance with a water management plan that complies with **Conditions W32 to W37** inclusive is permitted.

Schedule W Table 1 – Mine affected water release points, sources and receiving waters

Release Point	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Contaminant Source and Location	Monitoring Point	Receiving Water
M1	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (North Pit)	Spillway	Adjacent drainage line feeding Kangaroo Creek catchment
M3 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (West Pit 2 and 3)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
M4	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (West Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
M5	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (East Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
M7 (moves east with mining)	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (South Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
M10	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (South Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
M12	To be confirmed on completion of final design	To be confirmed on completion of final design	Mine affected water from activities (East Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S1	To be confirmed on completion of	To be confirmed on completion of	Sediment affected water from	Spillway	Adjacent drainage line feeding

[4] Figure 1 is to be generated as the project design is progressed and will be based on **Figure 3-2** to **Figure 3-8** of this EM Plan.

Release Point	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Contaminant Source and Location	Monitoring Point	Receiving Water
	final design	final design	activities (South MIA)		Upper Suttor catchment
S2	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (South Pit 1)	Spillway	Adjacent drainage line feeding Suttor Kangaroo Creek
S4	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (West Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S6	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (North Pit)	Spillway	Adjacent drainage line feeding Kangaroo Creek catchment
S7	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (North Pit)	Spillway	Adjacent drainage line feeding Kangaroo Creek catchment
S8 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (West Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S10	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (South Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S11	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (South Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S12	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (North MIA)	Spillway	Adjacent drainage line feeding Kangaroo Creek catchment
S13	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (North MIA)	Spillway	Adjacent drainage line feeding Kangaroo Creek catchment
S14 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (West Pits 2 and 3)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S15 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (West Pits 2 and 3)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S16 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (South Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S17	To be confirmed on completion of	To be confirmed on completion of	Sediment Affected water from	Spillway	Adjacent drainage line feeding

Release Point	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Contaminant Source and Location	Monitoring Point	Receiving Water
	final design	final design	activities (South Pit 1)		Upper Suttor catchment
S18	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (East Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S19	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (South Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S20	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (East Pit 2)	Spillway	Adjacent drainage line feeding Upper Suttor catchment
S22	To be confirmed on completion of final design	To be confirmed on completion of final design	Sediment Affected water from activities (South Pit 1)	Spillway	Adjacent drainage line feeding Upper Suttor catchment

M denotes Mine affected water dam
S denotes Sediment affected water dam
C denotes Clean water dam

W4 Release of mine affected water to waters in accordance with **Condition W2** must be as per the following:

a) release waters must not exceed the release water quality limits for the stated flow conditions in **Schedule W Table 2**
b) release waters are to be measured at the monitoring points specified in **Schedule W Table 1** for each quality characteristic and frequency stated in **Schedule W Table 2.**
c) release waters are to be released at the rates stated in **Schedule W Table 1** for each flow condition stated in **Schedule W Table 2.**
d) The stated release flow conditions stated in **Schedule W Table 2** are to be measured at the upstream location/s stated in **Schedule W Table 3**.
    i. The holder must ensure stream flow gauging station(s) is installed, operated and maintained to determine stream flows at the upstream locations stated in **Schedule W Table 3**.

Schedule W Table 2 – Mine affected water release limits for flow conditions

KANGAROO CREEK CATCHMENT					
Parameter	Units	Flow Regime	Limit	Maximum combined discharge	Monitoring Frequency
Electrical Conductivity	µS/cm	Low/No flow (Recession flow*)	1,270	0.1 m^3/s	Daily (during the release of mine water): Monthly (of natural flow).
		Medium (1–100 ML/d)	2,500	1.0 m^3/s	Daily (during the release of mine water): Monthly (of natural flow).
		High (>100 ML/d)	6,500	2.3 m^3/s	Daily (during the release of mine water): Monthly (of natural flow).
pH	pH units	Flow	6.5 - 8.5		Daily (during the release of mine water): Monthly (of natural flow).

KANGAROO CREEK CATCHMENT					
pH	pH units	No flow or flood event	5.5 – 9.0		Daily (during the release of mine water): Monthly (of natural flow).
Turbidity	NTU		50		Daily (during the release of mine water): Monthly (of natural flow).
Dissolved Sulfate	mg/L		250		Daily (during the release of mine water): Monthly (of natural flow).
SUTTOR RIVER CATCHMENT					
Parameter	**Units**	**Flow Regime**	**Limit**	**Maximum combined discharge**	**Monitoring Frequency**
Electrical Conductivity	µS/cm	Low/No flow (Recession flow^)	2,040	0.3 m^3/s	Daily (during the release of mine water): Monthly (of natural flow)
		Medium (5–210 ML/d)	2,500	2.9 m^3/s	Daily (during the release of mine water): Monthly (of natural flow)
		High (>210 ML/d)	6,500	10 m^3/s	Daily (during the release of mine water): Monthly (of natural flow)
pH	pH units	Flow	6.5 - 8.3		Daily (during the release of mine water): Monthly (of natural flow)
pH	pH units	No flow or flood event	5.5 – 9.0		Daily (during the release of mine water): Monthly (of natural flow)
Turbidity	NTU		151		Daily (during the release of mine water): Monthly (of natural flow)
Dissolved Sulfate	mg/L		250		Daily (during the release of mine water): Monthly (of natural flow)

Note:
This does not apply to dams containing hazardous waste
Flow to be estimated and measured respectively during each sampling event
* After a flow event exceeding 1 ML/d, release of high quality water (EC <1,270 µS/cm) is permitted for a period of up to 42 days after 'medium' flow ceases
^ After a flow event exceeding 5 ML/d, release of high quality water (EC <2,040 µS/cm) is permitted for a period of up to 42 days after 'medium' flow ceases

Schedule W Table 3 – Recieving water upstream and release event monitoring locations

Monitoring Point	Reference Upstream (Monitoring)	Easting	Northing
Monitoring Point MP1	Suttor River Flow gauging station upstream of mine releases at the edge of ML.	584817	7645806
Monitoring Point MP2	Kangaroo Creek upstream of North Pit contribution	588199	7659529

W5 The release of mine affected water to waters from the release points must be monitored at the locations specified in **Schedule W Table 1** for each quality characteristics and at the frequency specified in **Schedule W Table 4**.

Schedule W Table 4 – Release contaminant trigger investigation levels

Parameter	Units	Trigger Investigation Level		Monitoring Frequency
		Upper Suttor River Sub-Catchment	Rosella Creek Sub-Catchment	
Dissolved Aluminium	mg/L	0.250	0.055	Commencement of release and thereafter weekly during release
Dissolved Arsenic*	mg/L	0.013	0.013	
Dissolved Cadmium*	mg/L	0.0002	0.0002	
Dissolved Chromium *	mg/L	0.001	0.001	
Dissolved Copper	mg/L	0.003	0.007	
Dissolved Iron*	mg/L	0.3	0.3	
Dissolved Lead*	mg/L	0.004	0.004	
Dissolved Mercury*	mg/L	0.0002	0.0002	
Dissolved Nickel	mg/L	0.03	0.06	
Dissolved Zinc	mg/L	0.02	0.04	
Dissolved Boron	mg/L	0.37	0.37	
Dissolved Cobalt*	mg/L	0.09	0.09	
Dissolved Manganese	mg/L	1.9	1.9	
Dissolved Molybdenum*	mg/L	0.034	0.034	
Dissolved Selenium*	mg/L	0.01	0.01	
Dissolved Silver*	mg/L	0.001	0.001	
Dissolved Uranium*	mg/L	0.001	0.001	
Dissolved Vanadium*	mg/L	0.01	0.01	
Total Nitrogen	mg/L	1.16	0.5	
TPH C6-C9*	µg/L	20	20	
TPH C10-C35*	µg/L	100	100	
Sodium*	mg/L	tbc	tbc	

Note:
1. All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal/metalloids apply if dissolved results exceed trigger.
2. The quality characteristics required to be monitored as per **Schedule W Table 4** can be reviewed once the results of two years monitoring data is available, or if sufficient data is available to adequately demonstrate negligible environmental risk. It may be determined that a reduced monitoring frequency is appropriate or certain quality characteristics can be removed from **Schedule W Table 4** by amendment.
* From Model water conditions for coal mines in the Fitzroy basin

W6 If quality characteristics of the release exceed any of the trigger levels specified in **Schedule W Table 4** during a release event, the environmental authority holder must compare the down stream results in the receiving waters to the trigger values specified in **Schedule W Table 4** and:

a) where the trigger values are not exceeded then no action is to be taken; or

b) where the down stream results exceed the trigger values specified **Schedule W Table 4** for any quality characteristic, compare the results of the down stream site to the data from background monitoring sites and;
   ii. if the result is less than the background monitoring site data, then no action is to be taken; or
   iii. 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:
      a) details of the investigations carried out; and
      b) actions taken to prevent environmental harm.

Note: Where an exceedance of a trigger level has occurred and is being investigated, in accordance with **Condition W6 b(ii)**, no further reporting is required for subsequent trigger events for that quality characteristic.

W7 If an exceedance in accordance with **Condition W6 b(ii)** is identified, the holder of the authority must notify the administering authority within 14 days of receiving the result.

W8 The daily quantity of mine affected water released from each release point must be measured and recorded at the monitoring points in **Schedule W Table 1**.

W9 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

W10 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) expected release cessation date/time;
c) release point(s);
d) release volume (estimated);
e) receiving water(s) including the natural flow rate; and
f) any details (including available data) regarding likely impacts on the receiving water(s).

Note: Notification to the administering authority must be addressed to the Manager and Project Manager of the local administering authority via email or facsimile.

W11 The environmental authority holder must notify the administering authority as soon as practicable (nominally within 24 hours after cessation of a release event) of the cessation of a release notified under **Condition W10** and within 28 days provide the following information in writing:

a) release cessation date/time;
b) natural flow volume in receiving water;
c) volume of water released;
d) details regarding the compliance of the release with the conditions of agency interest—water of this environmental authority (i.e. contamination 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 W10 and W11**, provided the relevant details of the release are included within the notification provided in accordance with **Conditions W10 and W11**.

Notification of release event exceedance

W12 If the release limits defined in **Schedule W T able 2** are exceeded, the holder of the environmental authority must notify the administering authority within 24 hours of receiving the results.

W13 The authority holder must, within 28 days of a release that exceeds the conditions of this authority, provide a report to the administering authority detailing:

a) the reason for the release;
b) the location of the release;
c) all water quality monitoring results;
d) any general observations;
e) all calculations; and
f) any other matters pertinent to the water release event.

Monitoring of water storage quality

W14 Water storages stated in **Schedule W Table 5** which are associated with the release points must be monitored for the water quality characteristics specified in **Schedule W Table 6** at the monitoring locations and at the monitoring frequency specified in **Schedule W Table 5**.

Schedule W Table 5 – Water storage monitoring

Water storage description	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Monitoring location	Frequency of monitoring
M1	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
M3 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
M4	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
M5	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
M7 (moves east with mining)	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
M10	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
M12	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S1	To be confirmed on completion of final	To be confirmed on completion of final	To be confirmed on completion of final	Quarterly

Water storage description	Latitude (decimal degree, GDA94)	Longitude (decimal degree, GDA94)	Monitoring location	Frequency of monitoring
	design	design	design	
S2	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S4	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S6	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S7	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S8 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S10	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S11	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S12	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S13	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S14 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S15 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S16 (a and b)	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S17	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S18	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S19	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S20	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly
S22	To be confirmed on completion of final design	To be confirmed on completion of final design	To be confirmed on completion of final design	Quarterly

M denotes Mine affected water dam
S denotes Sediment affected water dam
C denotes Clean water dam

W15 In the event that waters storages defined in **Schedule W Table 5** exceed the contaminant limits defined in **Schedule W Table 6**, the holder of the environmental authority must implement measures, where practicable, to prevent access to waters by all livestock.

Schedule W Table 6 – Onsite water storage contaminant limits

Contaminant	Units	Contaminant Limit
pH	pH units	4 to 9 (range)
Electrical conductivity	□s/cm	5970
Sulphate	mg/L	1000
Fluoride	mg/L	2
Aluminium	mg/L	5
Arsenic	mg/L	1.0 mg/L
Cadmium	mg/L	0.01
Cobalt	mg/L	1
Copper	mg/L	1
Lead	mg/L	0.5
Nickel	mg/L	1
Zinc	mg/L	20

Note: Total measurements (unfiltered) must be taken and analysed

Receiving environment monitoring and contaminant trigger levels

W16 The quality of the receiving waters must be monitored at the locations specified in **Schedule W Table 8** for each quality characteristic and at the monitoring frequency stated in **Schedule W Table 7 and Schedule W Table 4**.

Schedule W Table 7 – Receiving waters contaminant trigger levels

Quality characteristic	Trigger level		Frequency
	Kangaroo Creek	Upper Suttor River	
pH (pH unit)*	6.5-8.5 / 5.5-9.0	6.5-8.3 / 5.5-9.0	Daily during release
Electrical conductivity (µS/cm)	1270	2040	
Tubdidity (ntu)	50	151	
Sulphate (SO42-) (mg/L)	250	250	

Note: * pH will vary as a WQO based on flow conditions

Schedule W Table 8 – Receiving water upstream background sites and downstream monitoring points

Monitoring Point	Reference Upstream (Monitoring)	Easting	Northing
Compliance Point CP1	Suttor River downstream of mine releases at edge of ML	584806	7642521
Compliance Point CP2	Kangaroo Creek downstream of upstream of North Pit contribution at edge of ML	590101	7660695

W17 If quality characteristics of the receiving water at the downstream monitoring points stated in **Schedule W Table 8** exceed any of the trigger levels specified in **Schedule W Table 7** during a release event the environmental authority holder must compare the down stream 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 down stream 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 W17 b**, no further reporting is required for subsequent trigger events for that quality characteristic.

Receiving environment monitoring program (REMP)

W18 The environmental authority holder must develop and implement a 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.

W19 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 **Schedule W Table 3 and 8**);
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 2006. 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 **Schedule W Table 2 and 4**);
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 Guidance on Sampling of Bottom Sediments);
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.

W20 A REMP Design Document that addresses each criterion presented in **Conditions W18 and W19** must be prepared and submitted to the administering authority no later than 3 months after the date of issue of this environmental authority. Due consideration must be given to any comments made by the administering authority on the REMP Design Document and subsequent implementation of the program.

W21 A report outlining the findings of the REMP, including all monitoring results and interpretations in accordance with **Conditions W18 and W19** 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

W22 Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as farm dams or tanks, or used directly at properties owned by the environmental authority holder or a third party for the purpose of:

a) supplying stock water subject to compliance with the quality release limits specified in **Schedule W Table 9**; or
b) supplying irrigation water subject to compliance with quality release limits in **Schedule W Table 10**; or
c) supplying water for construction and/or road maintenance in accordance with the conditions of this environmental authority.

Schedule W Table 9 – Stock water release limits

Quality characteristic	Units	Minimum	Maximum
pH (pH unit)	pH units	6.5	8.5
Electrical conductivity (µS/cm)	µS/cm	N/A	5000

Schedule W Table 10 – Irrigation water release limits

Quality characteristic	Units	Minimum	Maximum
pH (pH unit)	pH units	6.5	8.5
Electrical conductivity (µS/cm)	µS/cm	N/A	Site specific value to be determined in accordance with ANZECC & ARMCANZ (2000) Irrigation Guidelines

W23 Mine affected water may be piped or trucked or transferred by some other means that does not contravene the conditions of this environmental authority and deposited into artificial water storage structures, such as dams or tanks. The volume, pH and electrical conductivity of water transferred must be monitored and recorded.

W24 If the responsibility for mine affected water is given or transferred to another person in accordance with **Conditions W22 or W23:**

a) the responsibility for the mine affected water must only be given or transferred in accordance with a written agreement (the third party agreement); and
b) the third party agreement must include a commitment from the person utilising the mine affected water to use it in such a way as to prevent environmental harm or public health incidents and specifically make the persons aware of the General Environmental Duty (GED) under s. 319 of the Environmental Protection Act 1994, environmental sustainability of the water disposal and protection of environmental values of waters; and
c) the third party agreement must be signed by both parties to the agreement.

Water general

W25 All determinations of water quality and biological monitoring must be:

a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements;
b) made in accordance with methods prescribed in the latest edition of the Department of Environment and Heritage Protection's Monitoring and Sampling Manual;

Note: Condition W25 requires the Monitoring and Sampling Manual to be followed and where it is not followed because of exceptional circumstances this should be explained and reported with the results.

c) collected from the monitoring locations identified within this environmental authority, within 24h of each other where possible;
d) carried out on representative samples; and
e) analysed at a laboratory accredited (e.g. NATA) for the method of analysis being used.

W26 The release of any contaminants as permitted by this environmental authority, directly or indirectly to waters, other than internal water management infrastructure that is installed and operated in accordance with a water management plan that complies with **Conditions W29 to W34** inclusive:

a) must not produce any visible discolouration of receiving waters; and
b) must not produce any slick or other visible or odorous evidence of oil, grease or petrochemicals nor contain visible floating oil, grease, scum, litter or other objectionable matter.

Annual Water Monitoring Reporting

W27 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 with each annual return:

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.

Temporary interference with waterways

W28 Temporarily destroying native vegetation, excavating, or placing fill in a watercourse, lake or spring necessary for and associated with mining operations must be undertaken in accordance with the DEHP's guideline Activities in a Watercourse, Lake or Spring Associated with Mining Activities.

Water management plan

W29 A Water Management Plan must be developed by an appropriately qualified person and implemented within 3 months of the issue of this environmental authority.

W30 The Water Management Plan must:

a) provide for effective management of actual and potential environmental impacts resulting from water management associated with the mining activity carried out under this environmental authority; and
b) be developed in accordance with DEHP's guideline Preparation of Water Management Plans for Mining Activities (EM324) 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 saline drainage;
    v. measures to manage and prevent acid rock drainage ;
    vi. contingency procedures for emergencies; and
    vii. a program for monitoring and review of the effectiveness of the water management plan.

W31 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 W30**;
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.

W32 The holder of this environmental authority must attach to the review report required by **Condition W31**, a written response to the report and recommended actions, detailing the actions taken 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.

W33 The review report required by **Condition W31** and the written response to the review report required by **Condition W32** must be submitted to the administering authority with the subsequent annual return under the signature of the appointed signatory for the annual return.

W34 A copy of the water management plan must be provided to the administering authority on request.

Saline Drainage

W35 The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of saline drainage.

Acid Rock Drainage

W36 The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of acid rock drainage.

Stormwater and Water Sediment Controls

W37 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.

W38 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 W37**.

b) Water management infrastructure that is installed and operated, in accordance with a Water Management Plan that complies with **Conditions W29 to W34** inclusive, for the purpose of ensuring water does not become mine affected water.

W39 The maintenance and cleaning of any vehicles, plant or equipment must not be carried out in areas from which contaminants can be released into any receiving waters.

W40 Any spillage of wastes, contaminants or other materials must be cleaned up as quickly as practicable to minimise the release of wastes, contaminants or materials to any stormwater drainage system or receiving waters.

All dams

W41 The hazard category of each dam must be determined by a suitably qualified and experienced person at least once in each two year period.

W42 Dams having a hazard category determined to be significant or high must be specifically authorised by an environmental authority.

7. GROUNDWATER MANAGEMENT

7.1 Environmental Values

7.1.1 Geology

The stratigraphy of the project study area is shown in **Table 7-1**, of which the Suttor Formation, Tertiary, Sand beneath Basalt Flows, Rangal Coal Measures, Fort Cooper Coal Measures and Exmoor Formation, are considered hydrogeologically relevant to the project.

Table 7-1 Stratigraphy of the Project Area

Age	Unit		Lithology	Topography
Quaternary			Silt, sand, clay soil.	Occurs on floodplains of major watercourses and as outwash fan deposits.
Tertiary	**Suttor Formation**		Sandstone and conglomerate, locally silicified.	Breakaways: table-top mesas.
	Tertiary Basalt		Olivine basalt, fresh and vesicular in places.	Slightly elevated lands.
	Sand below Basalt		Unconsolidated sand and minor gravel: lag deposits from formerly exposed topography.	Not exposed at surface.
Triassic	Moolayember Formation		Micaceous and lithic sandstone and siltstone.	Recessive: flat areas on Clematis Group tablelands.
	Clematis Group		Medium–coarse quartz sandstone & pebble conglomerate.	Tablelands: steep scarps.
	Rewan Group		Green lithic sandstone: red, brown and green mottled mudstone.	Recessive.
Late Permian	Bowen Basin	Blackwater Group Includes: **Rangal Coal Measures** **Fort Cooper Coal Measures** Moranbah Coal Measures	Coal: grey, brown, green sandstone: siltstone: shale: chert: minor conglomerate: fossils.	Generally recessive, subdued.
Early Permian		Back Creek Group Includes: **Exmoor Formation** Lizzie Creek Volcanics	Grey to purple fine sandstone & siltstone: local coarse sandstone: grey carbonaceous shale: cocquinite lenses: fossils. Andesite: subordinate rhyolite and shale.	Generally recessive sandstone ridges. Not exposed in project area. Regarded as basement for the hydrogeological regime.

7.1.2 Hydrogeology

Eleven[5] dedicated groundwater bores are installed and located to characterise and monitor the hydrogeology of the project area, as shown in **Figure 7-1**, with data indicating the following:

- The depth of groundwater noted in the basalt and underlying Tertiary sand is relatively shallow.
- Air lift yield (ALY) from the intersected coal measures are so low as to be almost insignificant.
- The hydrostratigraphic units in which wells are screened generally comprise confined aquifers.
- Unconsolidated Quaternary sediments consisting predominantly of sand and gravel (colloquially referred to as 'alluvium') are associated with the Suttor River, to the west and southwest, and Kangaroo Creek to the north and northeast. The alluvium appears to be only a thin veneer (nominally 2 m thick), if present at all. Two bores (BYGW04 and BYGW08) are installed to specifically assess the alluvium, however, neither BYGW04 nor BYGW08 intersected any alluvium.

Groundwater studies on the project area indicate that the aquifer/s in the basalt and in the Tertiary sand below the basalt are not hydraulically continuous. Data indicates that there is a wide a wide range in the standing water level (SWL) in the coal seams and that ALYs in the coal seam aquifers are lower than those from the basalt aquifers. Bores in other lithological units indicate little groundwater of any significance in mudstone or siltstone, with the only significant groundwater associated with sandstone. The larger ALYs in the sandstone are very localised, indicating that fracture (secondary) porosity and not intergranular (primary) porosity is the dominant mechanism of groundwater accumulation and flow.

7.1.2.1 Aquifers and Aquifer Connectivity

Aquifers beneath the project area potentially occur in a number of stratigraphic units:

- Alluvium: The alluvium is not regarded as an aquifer on the project area.
- Suttor Formation: Poor aquifer, low yields and poor groundwater quality. Any aquifers in this formation would be unconfined or semi-confined.
- Basalt: Low to moderate yield and no reports of significant vesicles. Fracture porosity is the dominant mechanism for storage and flow. Aquifers would be unconfined or semi-confined.
- Tertiary Sand below the Basalt: The Tertiary sand aquifer at the base of the basalt is lensoid and discontinuous but locally high yielding. This aquifer is not used for stock water due to the random nature of occurrence of the basal sands, with landholders tending to rely more heavily on dams and piped water. Any aquifers in this formation would be confined.
- Coal Seams Potentially higher yielding aquifers in sandstone within the Bowen Basin coal measure sequence. Groundwater quality is generally very poor and may be unsuitable for stock. Waters are sodium chloride type with a high total dissolved salt (TDS) content; sulphate content is also high. The aquifers within the sandstone are discontinuous and would be confined.
- Basement (Lizzie Creek Volcanics): Aquifers not reported. Basement aquifers are not regarded as significant to the project, but where present would be confined.

There are no alluvial aquifers of any significance in the project area. Tertiary sequence aquifers do not appear to be in hydraulic connectivity with the deeper Permian sequence aquifers; however aquifers within the sandstones contained in the Permian coal seams are discontinuous and as such, hydraulic connectivity within the coal seam aquifers will be at best very limited (as evidenced by low hydraulic

[5] Note BYGW007A and BYGW007B both occur at position #16 on **Figure 7-1**.

conductivity values derived from the testing program). There are no aquifers of significance in the basement.

7.1.2.2 Depth to Water Table and Groundwater Flow Directions

The SWL is relatively shallow beneath the basalt and much deeper where there is no basalt cover. This suggests that the basalt is a storage mechanism for groundwater and that groundwater within the Tertiary sequences is perched above the underlying Permian sequences.

Both the SWL and thickness of aquifers show wide ranges, reinforcing that there is little hydraulic continuity in the aquifers beneath the project area. The regional potentiometric surface for the Permian sequences (groundwater levels from coal seam aquifers) provides an indication of groundwater flow directions. **Figure 7-2** shows a contour map of groundwater elevation.

The contours suggest groundwater flow in the Permian sequences both to the north east and to the south with a groundwater divide (mounding) between BYGW02 and BYGW03. It is noted that this groundwater divide correlates to the boundary between surface water drainage sub-catchments which straddle the site namely the Rosella Creek sub-catchment to the north and the Upper Suttor River sub-catchment to the south.

7.1.3 Groundwater to Surface Water Interactions and Groundwater Recharge

Groundwater studies indicate that there is little or no hydraulic connection between the Suttor Formation aquifers and the Suttor River. The groundwater level in this bore is generally well below the depth of incision of the river bed.

The SWL beneath the project area ranges from about 20 to 80 m below ground level (bgl). None of the drainage features that traverse the project area are incised to any more than about 5 m. Furthermore there is no alluvial development of significance.

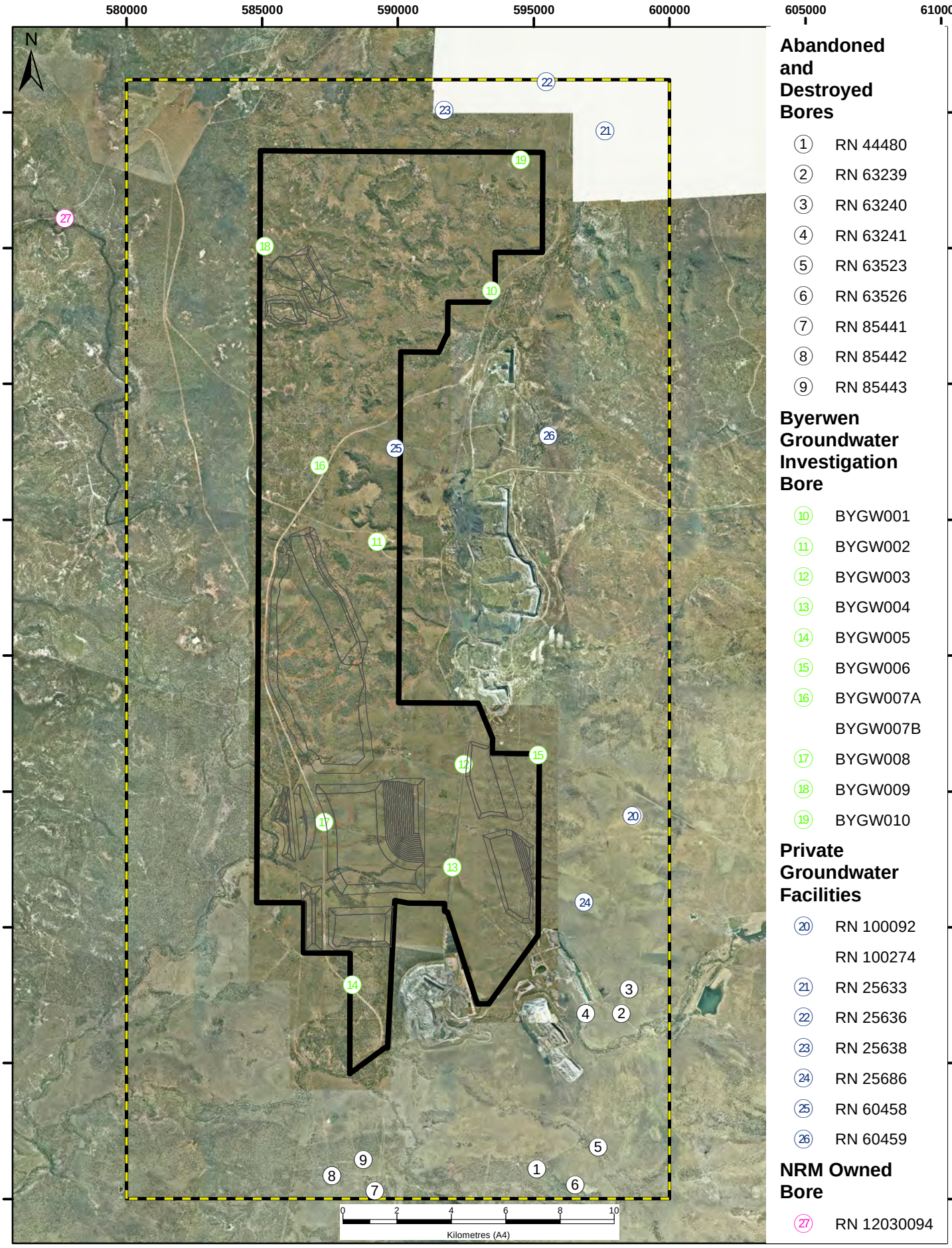
It is concluded that there is little or no groundwater - surface water interaction across the project area, as the standing water levels are deep and there is generally a significant thickness of low permeability material or aquitards above any aquifers that are encountered.

Recharge of the Tertiary aquifers occurs by direct infiltration of rainfall. As the Tertiary and Permian sequences are not hydraulically connected the Tertiary aquifers do not contribute recharge to the Permian aquifers. Recharge to the coal measure sandstone aquifers, also occurs via direct (but slow) infiltration of rainfall. The majority of the recharge to the Permian coal sequence aquifers probably derives from slow infiltration through the predominantly clayey Suttor Formation. There is no recharge from the alluvium to the Permian sequence aquifers as there are no significant alluvial aquifers on the project area. In other areas in the Bowen Basin it has been estimated that only about 3% of incident rainfall results in recharge to the consolidated aquifers. Given the lack of hydraulic connectivity between various aquifers or between aquifers and the quaternary alluvium, as well as the extremely slow recharge rates, any predicted localised drawdown within specific aquifers is considered unlikely to affect the hydrogeological recharge regime in any aquifer, outside the predicted drawdown.

7.1.4 Springs and Groundwater Dependent Ecosystems

No springs, seeps or swamps are known within the project study area and there is no groundwater - surface water interaction between the aquifer sequences beneath the project area and the watercourses that traverse the project area. Project mining activities will have no impact on river baseflow.

With the exception of stygofauna (refer **Section 11.2.3**) it is concluded that there are no GDE which can be impacted by the project's mining activities.



Abandoned and Destroyed Bores

1. RN 44480
2. RN 63239
3. RN 63240
4. RN 63241
5. RN 63523
6. RN 63526
7. RN 85441
8. RN 85442
9. RN 85443

Byerwen Groundwater Investigation Bore

10. BYGW001
11. BYGW002
12. BYGW003
13. BYGW004
14. BYGW005
15. BYGW006
16. BYGW007A
    BYGW007B
17. BYGW008
18. BYGW009
19. BYGW010

Private Groundwater Facilities

20. RN 100092
    RN 100274
21. RN 25633
22. RN 25636
23. RN 25638
24. RN 25686
25. RN 60458
26. RN 60459

NRM Owned Bore

27. RN 12030094

Legend

- Project Area
- Study Area
- Waste Rock Dumps and Pits

Private Groundwater Facilities, and Dedicated Groundwater Monitoring Bores		QCOAL GROUP
Figure 7-1	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *21/02/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:185,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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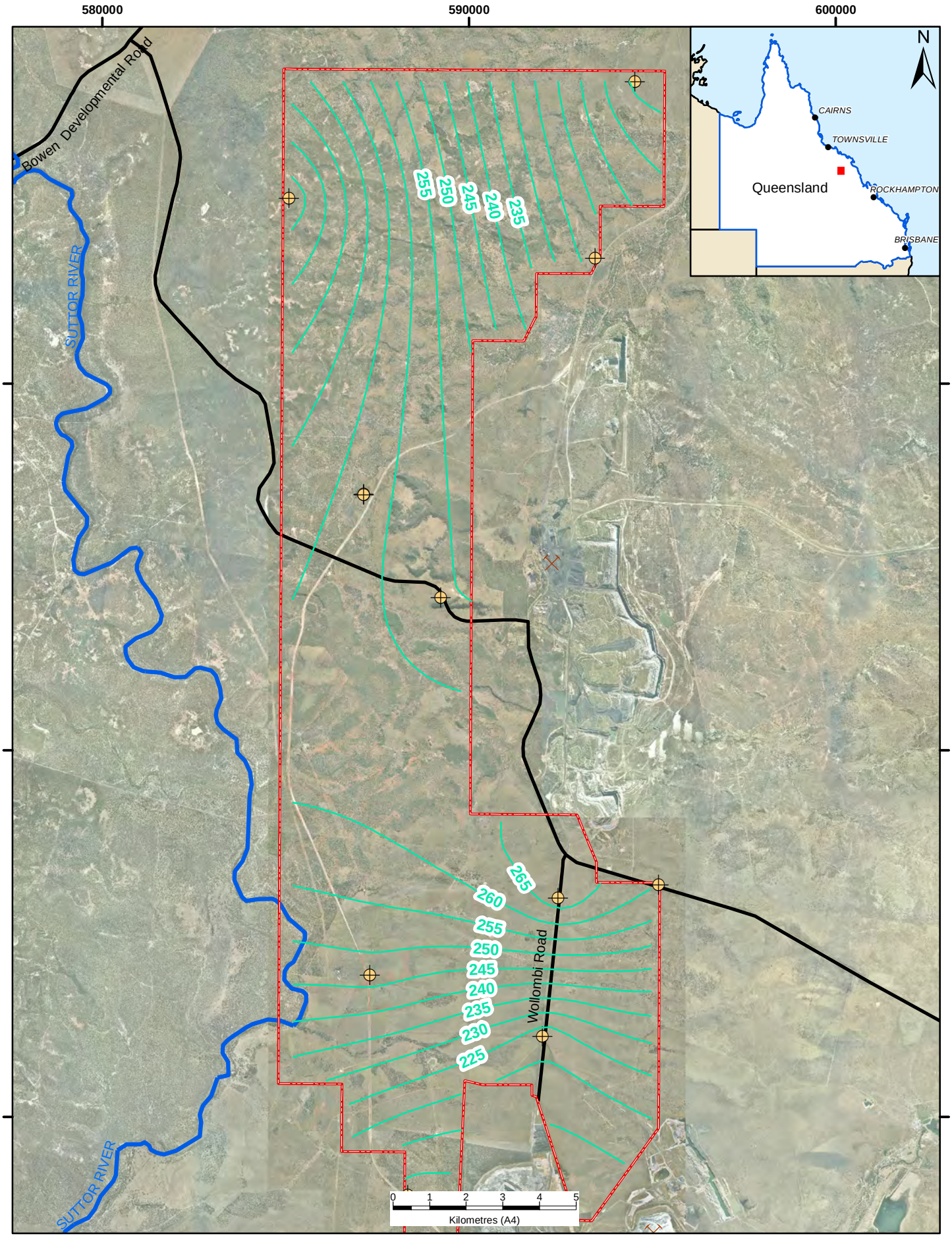


Legend

- Project Area
- Groundwater Monitoring Bore
- Groundwater Elevation Contours
- Existing Mine Site
- Formed Road

Groundwater Elevation Contours Permian Aquifer Sequences, October 2011	QCOAL GROUP
Figure 7-2	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:136,281
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
G:\CLIENT\SA-TO-D\BYEGEN - Byerwen EIS\GIS\Maps\EIS Chapters\EIS_EMP\BYEGEN_Fig7-2_grd_contours.mxd	

7.1.5 Location, Type and Status of Private Groundwater Facilities

A search of the Department of Natural Resources and Mines (NRM) groundwater database identified eight privately owned existing groundwater facilities as well as nine abandoned and destroyed bores within the project study area as shown on **Figure 7-1** and **Table 7-2.**

RN 60458, RN 60459, RN 100092 and RN 100274 were originally mining exploration holes that are now shown as 'existing' in the groundwater database. The bores are mostly used for stock watering and they are equipped with either windmills or low discharge diesel-powered pumps. Bores with this sort of equipment pump at low discharge rates, resulting in less drawdown. Apart from the discharge data shown in **Table 7-2**, which are noted as being low, there are no records of pumping rates, drawdown or recharge measurements from any private groundwater bores in the NRM groundwater database.

Table 7-2 Summary of Private Groundwater Bores

Registered Number	Property or Holding	Bore Name	Easting MGA94	Northing MGA94	Cased Depth (m)	Reported Discharge (L/s)	Pumping Equipment
RN 25633	Weetalaba	Rockhole	597618	7669314	18.3	1.25	Windmill
RN 25636	Weetalaba	3-ways	595464	7671126	37.2	0.88	Windmill
RN 25638	Weetalaba	Millers Well	591706	7670079	16.4	0.5	Windmill
RN 25686	Not stated	Not recorded	596844	7640920	6.4	0.32	Windmill
RN 60458	Byerwen	AGC26	589906	7657632	56	2.1	-
RN 60459	Byerwen	AGC35	595533	7658096	45	1.5	-
RN 100092	Not stated	MGC Suttor Creek No 2	598620	7644095	No strata log, no casing information	Not reported	-
RN 100274	Not stated	MGC Suttor Creek No 4	598678	7644094	No strata log, no casing information	Not reported	-

7.1.6 Groundwater Chemistry in Dedicated Groundwater Monitoring Bores

Groundwater from the dedicated groundwater bores is monitored in an ongoing programme. The groundwater in its natural state is generally brackish to saline and of poor quality. Groundwater from all formations beneath the project area is of the sodium chloride type. In summary chemical analysis of the groundwater monitoring bores data indicates that:

- Electrical conductivity (EC) and the TDS content of the groundwater ranges from moderate to high.
- Moderate to highly alkaline with pH in excess of 10.0 being measured in BYGW05, BYGW06, BYGW08 and BYGW10, while BYGW01 recorded a pH of 9.44. These bores are also high in EC, TDS and ammonia. This groundwater chemistry is invariably associated with the coal seams.
- Arsenic, cadmium copper and zinc were below the ANZECC/ARMCANZ 2000 stockwater guideline values.
- Dissolved lead is generally been below the ANZECC/ARMCANZ 2000 stockwater guideline value of 0.1 mg/L except for the water from bores BYGW07B and BYGW09 in December 2011.
- Nitrate and nitrite concentrations have been below the Australian Drinking Water Guideline values.
- Sulphate concentrations in the groundwater are within the generally accepted stock watering guideline value except for the groundwater from BYGW02.

No groundwater related industries other than extraction for mine dewatering or agricultural use exist in, or adjacent to, the project area within the coal measure aquifers. The presence of anthropogenic dissolved hydrocarbons within the groundwater in the area is considered extremely unlikely.

7.2 Potential Impacts

Potential project related impacts on groundwater environmental values are described below:

- Potential to drawdown regional groundwater levels by pit dewatering.
- Potential contamination of groundwater through seepage of waste rock dumps and in-pit rejects.
- If final void water levels exceed local groundwater levels, final void water may be released to groundwater.
- Pollution of groundwater from surface activities may occur from seepage from co-disposal facilities and accidental release of hydrocarbons (e.g. fuels and oils) or other contaminants.

Impacts on groundwater are associated with project operations, as construction activities are unlikely to impact groundwater as they are limited to surface or near surface works. No activity is anticipated to intercept groundwater bearing units and affect the gross porosity or permeability of those units, except for the pits themselves, which have been specifically modelled and addressed as final voids.

7.2.1 Pit Groundwater Inflow Estimates

Inflow estimates were assessed for the various pits according to their floor levels, for successive stages of development. Pit inflows are calculated using hydraulic conductivities (permeability) based on the South and East Pits, the West Pit and the North Pit. A low and high hydraulic conductivity case was assessed for the South, East and West Pits, while a single hydraulic conductivity was assessed for the North Pit, based on bore tests in those respective areas. It is considered that the low hydraulic conductivity case is more pertinent to the East, West and South Pits (inflows shown in **Table 7-3**), while the estimated pit flows for the North Pit are presented in **Table 7-4**.

Table 7-3 Pit Inflow Estimates for the Low Hydraulic Conductivity Case

Mine Year	Pit	Bottom level (m AHD)	Inflow m^3/day	Inflow L/s
Year 01	West Pit 1	240	4	0.04
Year 03	West Pit 1	230	6	0.07
Year 05	West Pit 1	185	24	0.28
Year 10	West Pit 1	90	90	1.04
Year 25	West Pit 2	50	14	0.16
Year 25	West Pit 3	220	9	0.10
Year 46	West Pit 3	82	96	1.12
Year 03	South Pit 1	205	9	0.10
Year 05	South Pit 1	135	44	0.51
Year 10	South Pit 1	80	84	0.97
Year 25	South Pit 1	25	135	1.57
Year 46	South Pit 1	-80	260	3.01
Year 10	South Pit 2	220	4	0.05
Year 25	South Pit 2	70	92	1.06
Year 25	East Pit 1	270*	0	0.00

Mine Year	Pit	Bottom level (m AHD)	Inflow m^3/day	Inflow L/s
Year 46	East Pit 2	191	13	0.15

*** Above water table**

Table 7-4 Pit Inflow Estimates North Pit

Mine Year	Pit	Bottom level (m), (Australian Height Datum)	Inflow m^3/day	Inflow L/s
Year 16	North Pit	175	70	0.81
Year 25	North Pit	100	256	2.97
Year 46	North Pit	80	320	3.70

7.2.2 Drawdown of Regional Groundwater Levels

The Marinelli and Niccoli method is considered a highly suitable analytical hydrogeological model for the estimation of potential drawdown associated with the project dewatering activities. Based on the mine planning calculations, South Pit 1 in Year 46 will have a maximum depth of 380 m bgl which is nominally 320 m below the existing water table. This is the deepest and most extensive of all of the project pits and as such is considered to be the 'worst-case scenario'. Given the highly conservative nature of this model as well as the previous conservative assumptions made, this assumed radial value is considered suitable.

South Pit 1 will induce drawdown to a distance of 2,300 m, which given the highly conservative assumptions made for other modelling parameters, represents a conservative maximum extent to all aquifers intercepted by the pits.

There are no groundwater users, GDE or hydraulic connections to the Suttor River within that radial distance of South Pit 1.

Ultimately the dedicated groundwater monitoring bores will be used to accurately measure any actual drawdown impacts of the pits as they are developed.

7.2.3 Private Boreholes

Other than bore RN 25686, none of the private boreholes is within 2,300 m of any of the project's open pits. RN 25686 is approximately 1,950 m east of East Pit 2 at Year 35 of mining operations; however, it generally only suitable for stock watering, being naturally too high in chloride and sulphate for human consumption. In addition RN25686 has a cased depth of 6.4 m and as such is also considered too shallow to experience any dewatering related impacts.

As groundwater use in the vicinity of the project is for stock water use only and the modelled drawdown extent does not predict drawdown of groundwater levels at private groundwater bores (other than potentially at RN 25686), dewatering from project mining activities is expected to have negligible or no impact on private groundwater bores.

However in the unlikely event of regional depressurisation of the water table, the dedicated project groundwater monitoring bores are well located to measure those impacts.

7.2.4 Waste Rock and Rejects

In summary waste rock and rejects characterisation indicates that:

- there is a low risk of acidity forming for waste rock or coal rejects

- there is low risk of salinity and dispersion from the weathered material if it is covered with unweathered material as final landform
- there are low concentrations of metals and metalloids.

With respect to in-pit rejects management facilities, whilst pits are being dewatered there will always be a hydraulic gradient into the pit where water is collected and managed, as such seepage into the groundwater around the pits is extremely unlikely.

7.2.5 Final Void Water Interaction with Groundwater

Final void water level modelling indicates an overwhelming likelihood (85-95% probability), that final void water levels in all pits will stabilise at levels below the surrounding water table, providing a permanent hydraulic gradient into the void, preventing excursions into the surrounding groundwater.

Salinity of final void water is expected to increase and range between 1,000 mg/L and 10,000 mg/L over time. Waste rock geochemistry testing suggests that there is a very low risk of acid generation, and the water quality entering the voids from the pit walls would not adversely affect void water quality. The salinity of near surface water is expected to be much lower that at depth, with high dissolved oxygen, neutral to slightly alkalinity, with low to very low dissolved metal concentrations.

Given that there is a minimal likelihood of final void water flowing into the surrounding groundwater (i.e. stabilising above the surrounding groundwater level), and the existing groundwater is generally brackish to saline and of poor quality, the potential for final void water to impact on the surrounding groundwater is expected to be minor. Furthermore any potential impacts to groundwater values which might occur would themselves be minor.

7.2.6 Groundwater Vulnerability to Pollution

In accordance with the EPP (Water), contamination of groundwater through construction, operation and decommissioning will be avoided through design of facilities to prevent release of contaminants. The proponent will adopt hydrocarbon and chemical handling, storage and spill response procedures for all phases of the project to minimise the risk of contaminant release and contain any accidental releases.

7.3 Environmental Protection Objectives

The objectives for groundwater are to:

- ensure the project does not adversely impact on the availability or quality of groundwater for existing uses
- prevent contamination of groundwater quality from surface infrastructure and in-pit structures
- establish a groundwater monitoring program to measure impacts to groundwater from the project and inform mitigation measures, if required.
- Minimise spills of contaminants with potential to impact groundwater.

7.4 Performance Criteria

The performance criteria for groundwater are to:

- Ensure groundwater monitoring demonstrates no significant changes in groundwater quality or quantity in existing working bores from project activities
- Corrective activities, if required, are undertaken promptly and result in acceptable water volumes and quality

- Ensure groundwater monitoring detects seepage (if any) from co-disposal dams and remediation measures are implemented.
- Compliance with the requirements of the project's EA, demonstrated via groundwater monitoring results.

7.5 Control Strategies

Mine water management systems will be designed in accordance with the descriptions in **Section 3**.

The co-disposal dams will be constructed on a prepared low-permeability base to minimise seepage from the base and basal edges of the facility. In order to prevent contamination of groundwater and to minimise seepage from the base and basal edges of the facility, the co-disposal dams will be constructed in accordance with the requirements of the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DEHP, 2012) (the Manual) by a Registered Professional Engineer Queensland (RPEQ). The construction of co-disposal dams will include seepage detection mechanisms systems based on the RPEQ design, which can include, regular surveyed level monitoring, dam specific water balances and monitoring bores installed near co-disposal dams to detect seepage and measure seepage quality, if any.

If installed monitoring bores indicate seepage the proponent will take the appropriate remedial action. This will be determined at the time and will be based on the advice of an RPEQ to address seepage. If contamination from seepage has occurred, as with contamination on any area of the project, an investigation will be undertaken, with management or remediation as required. This may involve engaging a suitably qualified person (SQP) approved by DEHP as a contaminated land specialist[6], where required, and will fully depend on the nature and extent of contamination.

The proponent will adopt hydrocarbon and chemical handling, storage and spill clean-up procedures that will minimise the risk of contaminant release or contain any accidental releases. Fuel and chemical storages will be constructed and bunded to the relevant Australian Standard. Re-fuelling areas will incorporate oil-water separators.

A groundwater monitoring strategy will be implemented, comprising the existing dedicated groundwater monitoring bores.

7.6 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 7.5** and compliance with the criteria outlined in **Section 7.4** as applicable to groundwater management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling

[6] For the purposes of preparing site investigation and validation reports and draft site management plans, an SQP is defined in the *Environmental Protection Regulation 2008*.

- management review.

The project bores are well located to delineate any project related groundwater impacts (changes in quality and level) between the project and private groundwater bores and will therefore detect any project related changes in groundwater prior to private bores.

The following groundwater monitoring strategy will be implemented by the proponent during construction, operations and decommissioning:

- RNs 25633, 25636, 25638, 25686, 60458, 60459, 100092 and 100274 will be measured for their groundwater level and groundwater quality before mining commences to establish their groundwater status at that time. Regular or as required measurements of groundwater level and quality in these bores after nearby mining commences will be undertaken to assess whether the groundwater in these private groundwater facilities is impacted and establish if ongoing monitoring in those wells is required.
- Monitoring of dedicated project groundwater monitoring bores will be undertaken in accordance with the Water Quality Sampling Manual produced by the former DERM and all analytical samples for compliance monitoring will be submitted to a NATA accredited laboratory.
- Monitoring of dedicated project groundwater monitoring bores will be undertaken quarterly for level and quality, to monitor potential operational impacts and allow a more robust statistical analysis of contaminant trigger limits.
  - BYGW01
  - BYGW02
  - BYGW03
  - BYGW04
  - BYGW05
  - BYGW06
  - BYGW07A
  - BYGW07B
  - BYGW08
  - BYGW09
  - BYGW10.
- Automatic water level data loggers will remain in BYGWB05, BYGW07A and BYGW09 to capture daily groundwater levels which will enable sufficient temporal resolution for trend analysis on groundwater level fluctuations.
- The data from the groundwater monitoring bores will be reviewed at minimum six-monthly intervals.

The proponent will develop a groundwater monitoring plan, incorporating the strategies described above and incorporating standards and indicators against which groundwater impacts can be measured.

Specifically if monitoring indicates a change in groundwater elevation > 2m compared to the previous quarterly monitoring event, results will be reported to the regulatory authority, which will include an investigation into the cause, potential short, medium or long term impacts and any required management or mitigations.

Water quality criteria will also be monitored for change and compared against a range of investigation level criteria based on baseline data. This will include physiochemical parameters, metals and hydrocarbons. Groundwater contaminant parameters and trigger levels (i.e. indicators) will be finalised based on a background groundwater monitoring program and be submitted to the administering authority by commencement of mining operations.

If groundwater contaminant trigger levels are exceeded then the proponent will complete an investigation into the potential for environmental harm and notify the administering authority within 30 business days of receiving the analysis results. Any required remedial action will be agreed upon with the relevant regulator and would be undertaken within an agreed timeframe.

In addition bore performance will be reviewed annually for function and suitability, and recommendations made for maintenance or replacement of bores where required.

7.7 Proposed EA Conditions

Schedule W – Groundwater

W43 Groundwater, affected by mining activities must be monitored for water level and quality, at the locations and frequencies defined in **Schedule W Table 11**, in accordance with the latest edition of the administering authroties Water Quality Samping Manual.

Schedule W Table 11 – Groundwater Monitoring Locations and Frequency

Monitoring Point	Easting MGA94	Northing MGA94	Monitoring Frequency
RN 25633	597618	7669314	Prior to commencement of operational mining activities in close proximity to these bores and then quarterly for 12 months after operational mining acitiviy commences.
RN 25636	595464	7671126	
RN 25638	591706	7670079	
RN 25686	596844	7640920	
RN 60458	589906	7657632	
RN 60459	595533	7658096	
RN 100092	598620	7644095	
RN 100274	598678	7644094	
BYGW01	593438	7663430	Quarterly
BYGW02	589229	7654175	Quarterly
BYGW03	592422	7645985	Quarterly
BYGW04	591997	7642215	Quarterly
BYGW05	588323	7637881	Quarterly
BYGW06	595167	7646339	Quarterly
BYGW07A	587122	7656990	Quarterly
BYGW07B	587115	7656973	Quarterly
BYGW08	587279	7643867	Quarterly
BYGW09	585089	7665060	Quarterly
BYGW10	594512	7668243	Quarterly

W44 Groundwater level measurements must record standing groundwater levels in metres accurate to 0.01 m. The elevation of the reference point, (relative to AHD), for use in any groundwater level measurement must be determined to an accuracy of 0.01 m.

W46 If a change of >2 m (higher or lower than the previous quarterly monitoring event) is detected to the standing water level in the bore, monitoring data will be reported to the relevant authority on a quarterly basis.

W47 Groundwater quality monitoring must include parameters in **Schedule W Table 12**.

W48 Groundwater contaminant parameters and trigger levels as per **Schedule W Table 12**, must be finalised based on a background groundwater monitoring program and be submitted to the administering authority prior to the commencement of operational mining activities.

Schedule W Table 12 – Groundwater Contaminant Trigger Levels

Parameter	Units	Contaminant Trigger Levels
pH Value	pH Unit	To be determined as per Condition W50
Electrical Conductivity @ 25°C	µS/cm	To be determined as per Condition W50
Total Dissolved Solids	mg/L	To be determined as per Condition W50
Total Hardness as $CaCO_3$	mg/L	To be determined as per Condition W50
Hydroxide Alkalinity as $CaCO_3$	mg/L	To be determined as per Condition W50
Carbonate Alkalinity as $CaCO_3$	mg/L	To be determined as per Condition W50
Bicarbonate Alkalinity as $CaCO_3$	mg/L	To be determined as per Condition W50
Total Alkalinity as $CaCO_3$	mg/L	To be determined as per Condition W50
Sulfate as SO_4^{2-}	mg/L	To be determined as per Condition W50
Chloride	mg/L	To be determined as per Condition W50
Calcium	mg/L	To be determined as per Condition W50
Magnesium	mg/L	To be determined as per Condition W50
Sodium	mg/L	To be determined as per Condition W50
Potassium	mg/L	To be determined as per Condition W50
Fluoride	mg/L	To be determined as per Condition W50
Dissolved Aluminium	mg/L	To be determined as per Condition W50
Dissolved Arsenic	mg/L	To be determined as per Condition W50
Dissolved Cadmium	mg/L	To be determined as per Condition W50
Dissolved Copper	mg/L	To be determined as per Condition W50
Dissolved Lead	mg/L	To be determined as per Condition W50
Dissolved Manganese	mg/L	To be determined as per Condition W50
Dissolved Zinc	mg/L	To be determined as per Condition W50
Dissolved Iron	mg/L	To be determined as per Condition W50
TPH C6-C9	µg/L	To be determined as per Condition W50
TPH C10-C36	µg/L	To be determined as per Condition W50

W49 If groundwater contaminant trigger levels defined in **Schedule W Table 12** are exceeded then the environmental authority holder must complete an investigation into the potential for environmental harm and notify the administering authority of the exceedence and the results of the investigation, within 30 business days of receiving the analysis results. If remedial actions are required they must be agreed upon with the administering authority and implemented within agreed timeframes.

8. LAND MANAGEMENT

8.1 Environmental Values

8.1.1 Property Tenures in the Project Area

Table 8-2 (overleaf) identifies the tenure property type, regional council, details of the ownership, property size and extent of property within the project footprint. The cadastral boundaries of these properties are shown in **Figure 8-1.** The proponent will negotiate compensation arrangements with landholders that are impacted. Lot 689 SP251696 is owned by a wholly owned subsidiary of Byerwen Coal Pty Ltd.

8.1.2 Sensitive Receptors and Dwellings

The potentially sensitive locations in the vicinity of the project comprise the homesteads of grazing properties and Glenden township. The closest potentially sensitive locations are shown on **Figure 8-2** along with the mine site. The locations and separation distances to the project area and nearest project activities are contained in **Table 8-1**. Several sensitive receptors are either not occupied for the duration of the project or are occupied on a part-time basis. Dwelling R1 is on Lot 689 SP251696 and will be vacated prior to any construction for the project and as such is not a receptor. Dwelling R4 on Lot 1 CP905226 is unoccupied and will remain unoccupied for the life of the project and is not considered as a receptor. Dwelling R9 has been identified as an abandoned homestead and is not considered as a receptor. These sites have been identified for completeness but were not considered as sensitive receptors for the purposes of impact assessment.

Table 8-1 Potentially Sensitive Receptors

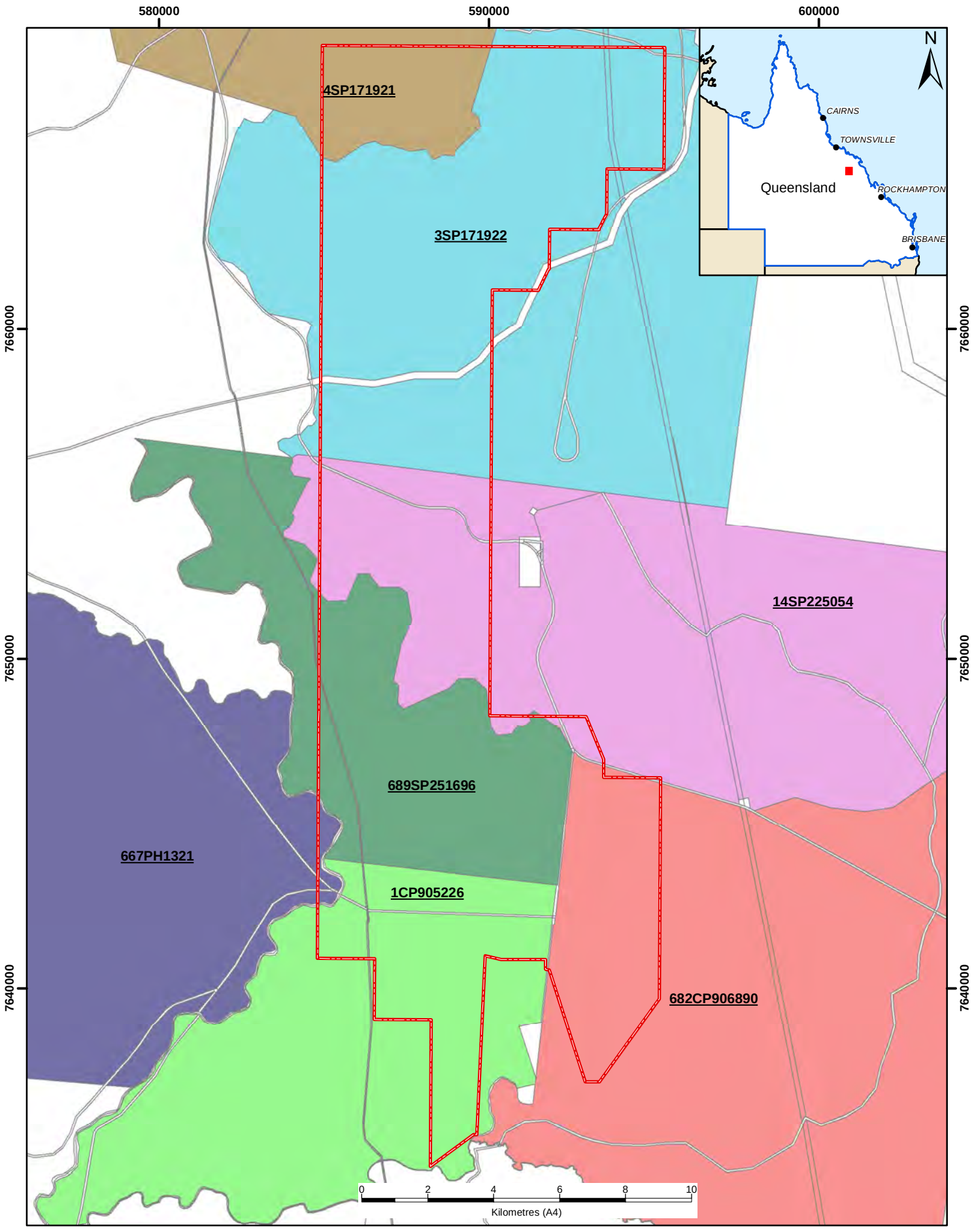
Sensitive Receptor	Considered as a Receptor	Permanently Occupied for Duration of Project	Separation Distance (km) and Direction to Sensitive Receptor from (A, B, C)		
			A) Project Area Boundary	B) Project Footprint	C) Train Loading Facilities
Glenden Township	Yes	Yes	19.4 km E	20.0 km E	25.7 km NE
R1 Suttor North Station Homestead (not occupied for duration of project)	No	No	(on lease)	-	-
R2 Suttor Creek Station Homestead	Yes	Yes	6.8 km E	7.3 km NW	14.2 km NW
R3 Lancewood Station Homestead	Yes	Yes	9.7 km SE	13.3 km NW	19.5 km NW
R4 Wollombi Station Homestead (not occupied for duration of project)	No	No	0.5 km E	0.6 km E	1.4 km E

Sensitive Receptor	Considered as a Receptor	Permanently Occupied for Duration of Project	Separation Distance (km) and Direction to Sensitive Receptor from (A, B, C)		
			A) Project Area Boundary	B) Project Footprint	C) Train Loading Facilities
R5 Cerito Station Homestead (occasional occupancy)	Yes	No	5.8 km W	7.0 km SE	12.7 km SE
R6 Byerwen Station Homestead	Yes	Yes	1.5 km E	7.9 km SW	5.5 km SW
R7 Weetalaba Station Homestead	Yes	Yes	4.9 km NE	12.4 km SW	10.7 km SW
R8 Glenden Station Homestead	Yes	Yes	18.2 km E	18.5 km E	24.0 km NE
R9 Two Sheds	No	No	3.7 km N	8.3 km N	14.6 km N
R10 Fig Tree Station Homestead	Yes	Yes	13.2 km SE	17.2 km SE	20.8 km SE

Figure 8-2 shows the dwellings on the properties identified within a 10 km buffer zone of the project MLAs and within a 5 km buffer zone of the transport route between Glenden and the MLAs. Residences which will remain permanently occupied during the project are considered to be receptors for the purpose of assessing impacts in this EM Plan.

Table 8-2 Real Property Tenure – Byerwen Project

Lot	Plan	Tenure	Description and Land Use	Council	Property Size (ha)	Extent of Property Within MLAs (ha)	Percentage of Property Within MLAs	Extent Within the Project Footprint (ha)	Percentage within the Project Footprint
1	CP905226	Lands Lease	Tenure: Grazing Homestead Perpetual Lease (GHPL) 30/4120. Lessees: Private individuals. – Grazing.	Isaac Regional	9,846	2,947	29.9%	1,429	14.5%
3	SP171922	Lands Lease	Tenure: Term Lease (TL) 0/235865. Lessee: Collinta Holdings. Pty. Ltd. - Grazing	Whitsunday Regional	17,576	7,846	44.6%	813	4.6%
4	SP171921	Lands Lease	Tenure: GHPL 5/2123. Lessee: Private Individual - Grazing	Whitsunday Regional	43,947	1,514	3.4%	0	0.0%
14	SP225054	Lands Lease	Tenure: TL 0/35642. Lessee: Collinta Holdings Pty. Ltd. - Grazing	Whitsunday Regional	16,946	2,863	16.9%	992	5.9%
667	PH1321	Lands Lease	Tenure: Lands Lease (Mount Lookout Holding) Lessees: Private individuals. – Grazing. Tenure Reference Pastoral Holding (PH) 5/667.	Whitsunday Regional	35,467	120	0.3%	0	0.0%
682	CP906890	Lands Lease	Tenure: Lands Lease (Suttor Creek Holding). Lessees: Private individuals – Grazing. Tenure Reference TL 0/235783.	Isaac Regional	19,453	2,536	13.0%	958	4.9%
689	SP251696	Lands Lease	Tenure: Lands Lease. Lessee: Leichhardt Pastoral Pty. Ltd. – Grazing. Tenure Reference TL 0/235359	Isaac Regional	6,786	4,563	67.2%	2,777	40.9%
		Roads and Watercourses	Wollombi Road, Collinsville-Elphinstone Road, unnamed roads, Cerito Road, Suttor River			304		28	
Total					**150,021**	**22,693**		**6,997**	



Legend

- Project Area
- 4SP171921
- 14SP225054
- 667PH1321
- 1CP905226
- 682CP906890
- 3SP171922
- 689SP251696

Properties Intersected by the Project Area MLAs		
Figure 8-1	**Byerwen Coal Project**	
Date: *22/02/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:150,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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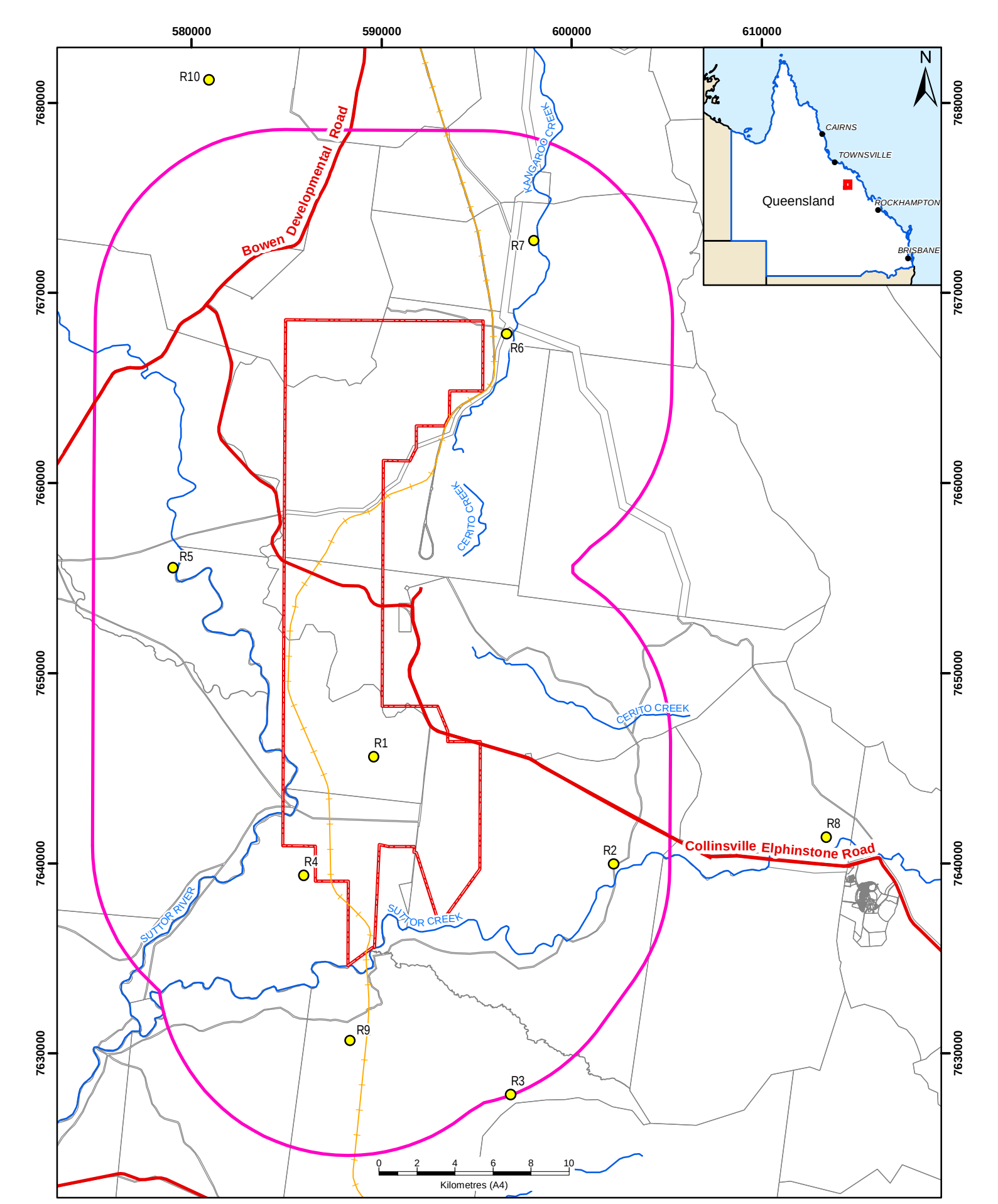

Legend

- Project Area
- Cadastre
- 10km Buffer
- Potenially Sensitive Receptors
- GAP Rail line
- Major Watercourses
- Main Road

Potenially Sensitive Receptors and Dwellings	QCOAL GROUP
Figure 8-2	**Byerwen Coal Project**
Date: *19/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:250,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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8.1.3 Land Suitability

The surrounding land use is generally extractive industries (coal mining), beef cattle grazing (the existing land use) and rain-fed broadacre cropping.

A land suitability assessment was conducted which demonstrated that 88% of the project area is unsuitable for rain-fed broadacre cropping, 58% is unsuitable for beef cattle grazing and a further 15% requires significant inputs for suitability as beef cattle grazing.

8.1.4 Good Quality Agricultural Land

GQAL was classified on the basis of land suitability mapping. GQAL per the site investigation indicates that agricultural land quality is lower than mapped by publically available datasets, with 2,666 ha of Class A, 6,887 ha of Class C and 13,144 ha of Class D GQAL.

8.1.5 Strategic Cropping Land

An 'on-ground' Strategic Cropping Land (SCL) assessment was conducted in June 2011 as per the SCL requirements at that time. Areas of land that met all of the SCL assessment criteria at that time were identified within the project area. Within the project area there are:

- 4,128 ha of potential SCL
- 1,902 ha of SCL per the preliminary site investigation in June 2011.

8.1.6 Stock Routes

There is one stock route which is designated as unused or inactive by the Queensland Government that intersects South Pit 1 in the southern tenement areas of the project.

8.1.7 Third Party Infrastructure and Overlapping Tenure

Third Party Infrastructure and overlapping tenure in the project area are described in **Section 1.5**.

8.1.8 Existing Contaminated Land

A preliminary site investigation was conducted to determine existing contaminated or potentially contaminated sites within and surrounding the project area and assess the potential impacts, if any. No sites of concern were identified. If existing contaminated sites are identified during activities, then measures will be implemented to investigate and, if required, manage contaminated materials.

8.2 Potential Impacts

8.2.1 Properties, Residences and Receptors

The following potential impacts to properties and residences (dwellings) have been identified:

- loss of land area used to support agricultural activities within the footprint of project activities or area where access is limited
- disruption of agricultural activities through construction of linear infrastructure across properties or loss of agricultural infrastructure such as fences, dams and tracks
- noise, vibration and dust impacts on receptors and livestock from mining operations
- social and economic impacts (positive and negative).

8.2.2 Land Suitability, Good Quality Agricultural Land and Strategic Cropping Land

Table 8-3 provides the area of GQAL (as mapped by site inspection) by class, land suitability for beef cattle grazing, land suitability broad-acre rain-fed cropping and potential SCL within the project footprint (approximately 7,000 ha within the project area).

Table 8-3 Extent of Agricultural Land Category within Project Footprint

Agricultural Land Category	Class of Land Category	Subclass	Area within Project Footprint (ha)
GQAL per site inspection	A		1,638
	B		0
	C		2,615
	D		2,771
Land Suitability	Beef Cattle Grazing	1	0
		2	3,308
		3	950
		4	2,719
		5	51
	Broad-acre rain-fed cropping	1	0
		2	1,636
		3	0
		4	2,986
		5	2,402
SCL	Potential SCL		1,435

8.2.3 Third Party Infrastructure and Overlapping Tenure

Impacts to third party infrastructure and overlapping tenure, may result from project construction and operation activities, for example, crossings of linear infrastructure, proximity to project operations or blasting and vibration.

8.2.4 Waste Rock and Rejects Characterisation

Weathered waste rock, particularly Quaternary and Tertiary material, is likely to generate alkaline, medium to high salinity run-off and seepage. Unweathered rock, primarily from the Moranbah Coal Measures is expected to generate alkaline and low salinity run-off and seepage. Weathered materials comprise about half of all waste rock expected to be mined. The salinity of the waste rock is considered unlikely to significantly impact local groundwater resources. The groundwater in the local area is naturally highly saline.

The total sulfur and sulphide-sulfur concentrations of the majority of waste rock samples were low (almost negligible). The majority (97%) of waste rock samples were classified as non-acid forming (NAF).

Total metal and metalloid concentrations were generally low and below the adopted health based guideline levels for soil. Some waste rock material may produce leachate containing slightly elevated concentrations of some soluble elements including molybdenum, selenium and vanadium. However, these concentrations are common for rock material in the Bowen Basin.

Weathered materials (primarily Quaternary and Tertiary) are expected to have a greater potential for dispersion (erosion) than unweathered materials, which are mostly Permian. Waste rock used for final landform covering will primarily comprise unweathered material, which has a relatively low salinity and low potential for dispersion.

It is estimated that the two CHPPs will produce around 3 to 5 Mtpa of coal reject, which is expected to comprise about 2.5% of the average annual mine waste. Potential coal reject is likely to generate alkaline, low to medium salinity surface runoff and seepage, following surface exposure.

The total sulfur concentration of the samples was generally low, however some coal reject materials contained sulphide concentrations, which may be sufficient to generate acid (in the absence of any neutralising materials).

Approximately 22% of potential coal reject samples have been classified as PAF, 73% of samples as NAF and 5% as Uncertain. However, the PAF and Uncertain samples have low sulfur concentrations and therefore a low capacity to generate acid.

Total metal and metalloid concentrations in coal reject samples were low and below adopted health based guidelines for soil. Some coal reject materials may have the potential to produce leachate containing slightly elevated concentrations of soluble elements, including molybdenum, selenium and vanadium. However, these concentrations are common for coal reject material in the Bowen Basin.

8.3 Environmental Protection Objectives

- As far as reasonably practicable and safe, allow for ongoing use of the land for agricultural purposes.
- Following rehabilitation, to provide a stable, non-polluting landform (refer **Section 9**).
- To provide beneficial post-mining land use in accordance with the Rehabilitation Management Plan (refer **Section 9**).
- To minimise the extent and degree of disturbance on land as mining is occurring.
- Progressively rehabilitate land disturbed by mining (refer **Section 9**).
- Maximise recovery and reuse of suitable soil resources.
- Minimise land contamination and remediate areas of contamination, as appropriate.

8.4 Performance Criteria

- Compliance with established rehabilitation and decommissioning criteria.
- Compliance with the requirements of the Project's EA.
- Soils managed in accordance with the Soil Management Plan requirements.
- Waste rock managed in accordance with Mine Waste Management Plan requirements.

8.5 Control Strategies

8.5.1 Properties, Residences and Receptors

The proponent will negotiate with landholders for ongoing use of land within the project area that is not subject to disturbance, for the continuation of existing land practices such as grazing. Access to land will be limited where there are safety concerns for landholders or livestock, including areas subject to mining or containing mine infrastructure.

Where linear infrastructure intersects landholder properties, crossing points will be established to allow landholders continued access for movement of livestock, people and equipment on landholder properties.

Clean water dams constructed as part of the mine water management system, may provide alternative water supplies by agreement with future landholders.

8.5.2 Land Suitability, Good Quality Agricultural Land and Strategic Cropping Land

The proponent will undertake the necessary process under the *Strategic Cropping Land Act 2011* (*SCL Act*) to validate SCL. Depending on the findings of the validation assessment, the proponent may apply for a protection decision for a temporary or permanent impact to SCL in the SCMA, with associated mitigation measures to be determined. The mitigation measures may include avoidance, rehabilitation or, where SCL is permanently lost, payment of 'mitigation costs'.

The post mine land use is likely to include land suitable for cattle grazing at the same or lower land suitability class. There will be some areas, such as the final voids, where the post mine land use will not be similar to the pre-mining land use.

8.5.3 Third Party Infrastructure and Overlapping Tenure

Potential mitigations for impacts to third party infrastructure and overlapping tenure include:

- buffers between project operations and third party infrastructure or overlapping tenure activities
- design and construct of crossing points to prevent impacts to linear infrastructure resulting in failure
- diverting or realigning third party infrastructure without affecting existing users
- consulting infrastructure owners and overlapping tenure holders in order to minimize hazards and risks to people, property and the environment from potential interactions.

8.5.4 Post Operations Land Use

Section 9 describes rehabilitation and decommissioning of project activities, including potential post mine land uses. The primary rehabilitation objective will be to return the site to a stable self-sustaining landform requiring no ongoing management or monitoring, in line with a defined final land use.

8.5.5 Management Measures for Existing Contaminated Land

In the unlikely event that contaminants do exist within the project area, they will be contained within the surface layer or the soils immediately below this layer. Any soils that are suspected to be contaminated from visual/odour indications will be captured and contained pending further investigation. If suspect sites are located, these should be inspected for visual evidence of contamination. Some examples of these visual indicators include soil staining, un-natural or chemical odours and vegetation die-off.

If evidence of significant contamination is observed during soil stripping activities, this material should be stockpiled and managed separately. An investigation will be undertaken, with management or remediation as required. This may involve engaging an SQP approved by DEHP as a contaminated land specialist where required, and will fully depend on the nature and extent of contamination.

8.5.6 Waste Rock and Rejects Management

8.5.6.1 Mine Waste Management Plan

The waste rock characterisation described in **Section 8.2.4** focused on waste rock in the first 10 to 15 years of mining. A Mine Waste Management Plan (MWMP) will be developed prior to project operations

at each of the eight open pits. Waste rock throughout the entire project area is expected to be benign with a negligible risk of acid generation (and low metals concentrations). The MWMP will address the following:

- Classification of waste rock zones (on the basis of acid forming potential, salinity and sodicity), placement and use of waste rock materials and appropriate disposal of PAF waste or waste designated as not suitable for use on final surfaces.
- Uneconomic coal seams mined as waste rock will not report to final surfaces, as these 'carbonaceous' zones can be associated with sulfide minerals.
- Coal reject disposed directly into waste rock will be covered by waste rock such that coal reject does not report to final surfaces.
- A program of progressive sampling and characterisation and evaluation of mining waste from areas of operations beyond Year 10 to confirm the expected geochemical properties of these materials
- Verify encapsulation and/or placement of PAF and acid-forming (if any) mining waste.
- Regular review of the MWMP and criteria to assesses the performance of plan implementation.
- Monitoring and rehabilitation in accordance with the Rehabilitation Management Plan (refer **Section 9**).

8.5.6.2 Waste Rock Disposal Method and Dump Design

Waste rock used for final landform covering will primarily comprise unweathered material, which has a relatively low salinity, lower potential for dispersion and low risk of developing acid conditions.

In an open pit mining operation, the weathered waste rock will typically be placed at the base of the waste rock dumps, beneath the unweathered materials. The weathered rock is therefore not considered to pose significant management issues to the project as it will be covered by unweathered material.

Permian materials are generally more amenable to amelioration for sodicity and vegetation growth, through the addition of fertilizer, than Tertiary materials. Slopes should be well stabilised against erosion to reduce the risk of significant erosion of potentially dispersive sodic Permian materials. It is proposed that Permian materials are used for the outer slopes of waste rock dumps to limit dispersion and erosion, with Tertiary materials disposed of within the central (inner) zones of waste rock dumps.

The management of seepage from waste rock dumps is included in the mine affected water management system described in **Section 6**. This system will be designed to limit release of seepage from waste rock dumps to the environment, other than in accordance with the release criteria described. Potential impacts from discharge of seepage from waste rocks on groundwater are described in **Section 7**.

Where waste rock is proposed to be used for construction activities, testing will be undertaken as required to determine the geotechnical suitability of the material for use.

8.5.6.3 Rejects Disposal Method and Containment Design

Coal reject, whether disposed in-pit or amongst out-of-pit waste rock, will not report to final landform surfaces.

Rejects management, is described in **Section 2.6** and **Section 3.4.2**. The large majority of potential coal reject materials will not pose a risk of developing acid conditions. Based on sample numbers, about 20% of potential coal reject materials may have a low capacity to generate acidity. However, when managed as a bulk material at the reject co-disposal facility this small proportion of PAF waste would be expected to pose a low environmental risk. Furthermore, bulk coal reject is expected to be alkaline, which assists with neutralising any acid generated.

Coal reject disposed into a pit, will be progressively covered (buried) with waste rock. Coarse reject may be disposed initially into out of pit waste rock dumps. The management of coarse reject disposed under this scenario is essentially the same as for in-pit disposal (i.e. progressive burial by waste rock).

Co-disposed reject managed under an in-pit disposal strategy will likely be disposed into cells in a nominated area of the pit, which will be progressively buried by backfilled waste rock.

The following general principles will be adopted to minimise potential environmental impacts from co-disposal dams:

- The co-disposal dams will be constructed on a prepared low-permeability base.
- The co-disposal dams will be operated to minimise the level (volume) of decant water in the facility and maintain a safe water depth (low hydrostatic pressure) at dam walls.
- Decant water will be reused, as much as practical, in the CHPPs.
- Design and operation will include inspection and monitoring of integrity and seepage loss.
- Surface run-off and seepage from co-disposal dams will be monitored for 'standard' water quality parameters, including pH, EC, sulfate (and other major ions) and a broad suite of soluble.

8.6 Monitoring and Auditing

Monitoring will comprise:

- Ongoing operational geochemical characterisation of mine waste materials to confirm expected geochemical characteristics of these materials.
- Continued characterisation of reject materials from the CHPP to verify the expected geochemical data of rejects.
- Leachate and site water derived from, or in contact with, waste rock dumps, reject materials or other mineral waste will be monitored.
- A co-disposal dam inspection program (which may include seepage detection piezometers) will be implemented to ensure that the performance and structural integrity of the co-disposal dams is maintained and to monitor the quality of any seepage. The location of monitoring locations will be developed in consultation with the DEHP as detailed design of the mine layout is advanced prior to the commencement of mining operations.
- Monitoring of the stability of waste rock dumps.

Monitoring of potential seepage from the co-disposal dams may include:

- Visual inspection of the walls on a regular basis.
- Seepage detection piezometers.
- Drainage incorporated into the design of the floor of the TSF.

Site supervisors will be responsible for modifying or stopping non-conformances until corrective actions are determined. Corrective actions will be implemented and monitored on site to ensure they are effective under the provisions of the project RMP, SMP and MWMP respectively.

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 8.5** and compliance with the criteria outlined in **Section 8.4** as applicable to land management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities

- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

8.7 Proposed EA Conditions

Schedule C - Land and Rehabilitation

C1 Land disturbed by mining must be rehabilitated in accordance with **Schedule C Table 1**.

Schedule C Table 1 — Rehabilitation requirements

Mine Domain / Feature Name	Mine Tenure	Post-mine land use goals and objective	Indicators	Projective Vegetation Cover Range (%)
Waste rock dumps	ML 10355, 10357, 70434, 70435, 70436	Safe, non-polluting, stable and self-sustaining for grazing and remnant vegetation	Leachate monitoring	50% analogue
Final voids	ML 10355, 10357, 70434, 70435, 70436	Safe, non-polluting, stable and self-sustaining final voids	Water monitoring	n/a
Mine infrastructure areas and CHPPs	ML 10355, 70434	Safe, non-polluting, stable and self-sustaining for grazing and remnant vegetation	Vegetation cover, geotechnical stability	50% analogue
Co-disposal dams	ML 10355, 70434	Safe, non-polluting, stable and self-sustaining for grazing and remnant vegetation	Structural, geotechnical and hydraulic adequacy. Seepage monitoring	50% analogue
Mine water management infrastructure	ML 10355, 10356, 10357, 70434, 70435, 70436	Safe, non-polluting, stable and self-sustaining for grazing, remnant vegetation and water storages	Structural, geotechnical and hydraulic adequacy. Water monitoring	50% analogue
Creek diversions	ML 10355, 10357, 70434, 70435, 70436	Safe, non-polluting, stable and self-sustaining for grazing and remnant vegetation	Vegetation cover, hydraulic performance	50% analogue
Haul roads and access roads	ML 10355, 10356, 10357, 70434, 70435, 70436	Safe, non-polluting, stable and self-sustaining for grazing, remnant vegetation and roads for future use	Vegetation cover, geotechnical stability	50% analogue
Train loading facilities	ML10355, 70434, 70436	Safe, non-polluting, stable and self-sustaining for grazing and	Vegetation cover, geotechnical	50% analogue

Mine Domain / Feature Name	Mine Tenure	Post-mine land use goals and objective	Indicators	Projective Vegetation Cover Range (%)
		remnant vegetation	stability	
Linear infrastructure	ML 10355, 10356, 70434, 70435, 70436	Safe, non-polluting, stable and self-sustaining for grazing and remnant vegetation	Vegetation cover, geotechnical stability	50% analogue

Rehabilitation landform criteria

C2 Rehabilitation must commence progressively as areas become available and in accordance with the plan of operations[7].

Infrastructure

C3 All buildings, structures, mining equipment and plant erected and/or used for the mining activities must be removed from the site prior to surrender, except where agreed in writing by the administering authority and the landowner.

General

C4 Complete an assessment report, to be undertaken by a Registered Professional Engineer of Queensland (RPEQ), of geotechnical issues and erosivity of the proposed final landforms, including final voids, to demonstrate long-term landform stability. Reference is to be made to the Queensland Mining Guidelines (or subsequent reprints) in making this assessment.

Mine Closure Plan

C5 A Mine Closure Plan for the site must be developed and implemented for a nominal period of:

a) At least thirty (30) years following final ore processing on site: or
b) A shorter period if the site is proven to be geotechnically and geochemically stable and it can be demonstrated to the satisfaction of the administering authority that no release of contaminants from the site will result in environmental harm and be prepared at least 18 months prior to final ore processing on-site.

C5 The Mine Closure Plan must include the following elements:

a) Operation and maintenance of:
   i. Wastewater collection and reticulation systems
   ii. Wastewater treatment systems
   iii. The groundwater monitoring network:
   iv. Final cover systems
   v. Vegetative cover.
b) Monitoring of:
   i. Surface water quality
   ii. Groundwater quality
   iii. Seepage rates
   iv. Erosion rates
   v. The integrity and effectiveness of final cover systems
   vi. The health and resilience of vegetative cover.

[7] A Plan of Operations will be generated in accordance with the requirements of the EP Act.

9. REHABILITATION AND DECOMMISSIONING

9.1 Rehabilitation Hierarchy and Goals

The DEHP guideline – 'Rehabilitation requirements for mining projects'[8] (the DEHP Guideline) describes the preferred rehabilitation hierarchy which, in order of decreasing capacity to prevent or minimise environmental harm, is:

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

Rehabilitation goals as described in the DEHP guideline require rehabilitated areas to be

- safe to humans and wildlife
- non-polluting
- stable
- able to sustain an agreed post mining land use.

9.2 Decommissioning and Rehabilitation Objectives

In accordance with the DEHP guideline the following objectives have been derived for decommissioning and rehabilitation of areas disturbed by the project:

- The mine site will be safe to humans and fauna.
- Stable landform with land use capabilities and/or suitabilities as determined in the Rehabilitation Management Plan (RMP).
- Mine wastes and disturbed land will be rehabilitated so that they are non-polluting and self-sustaining or to a condition where the maintenance requirements are consistent with an agreed post-mining land use.
- Surface and ground waters that leave the project area will be within defined water quality criteria.
- Hazardous materials will be identified and adequately managed to ensure the site is non-polluting.
- Potential for acid mine drainage will be determined and will be adequately managed to ensure the site is non-polluting.
- Vegetation cover will be established to reduce rates of erosion and sediment loss.
- Final rehabilitation will be designed as permanent self sustaining landforms requiring no ongoing maintenance or management.

[8] DEHP, Rehabilitation requirements for mining projects, EM1122, 120822

Specific rehabilitation objectives are described below for each mine domain. The mine domains are:

- waste rock dumps
- final voids
- mine infrastructure areas, including CHPPs
- co-disposal dams
- mine water management infrastructure (e.g. mine affected water dams)
- drainage diversions
- haul roads and other roads
- train loading facility
- linear infrastructure (e.g. power lines and water pipelines).

9.3 Land Use

9.3.1 Pre Mine Land Use and Land Suitability

The dominant land use within the project site is beef cattle grazing on areas cleared of remnant vegetation. Approximately 68% of the land within the project footprint is land that has been previously disturbed and modified to allow grazing of cattle. The remaining 32% comprises remnant vegetation, of which approximately 33% is Endangered or Of Concern Regional Ecosystem.

9.3.2 Potential Post-mine Land Uses

Rehabilitation objectives include returning the site to a stable and self-sustaining landform with a productivity level that conforms to a defined final land use, through effective mine closure planning, establishment of key performance indicators, stabilisation of landforms and revegetation with suitable species.

Mine closure planning will consider the choice of post-mining land use. This final land use may not necessarily be the original use. The final land use will largely be dependent on pre-mining land suitability, landholder preferences for land use, the potential uses of likely rehabilitated landforms, and the existing use or environmental values of surrounding land. Determination of post-mining land use will be made in consideration of the rehabilitation hierarchy, as outlined in **Section 9.1**.

There will be some areas of the mine site, such as the final voids, that are not returned to their previous land use. These areas will be developed to a lower value land use, but will be left in a stable condition that minimises the potential to generate future pollution or adversely affect environmental values.

Considerations and final determination of post-mine land use for the project site will be documented in the RMP, which will be developed by the proponent. The RMP describes the post mine land uses and will be developed within two years of the effective date of the environmental authority for the project, based on the following considerations:

- An inventory of existing land uses. Further analysis of specific areas may be required to establish criteria for rehabilitation success.
- A description of the location and extent of land proposed to be disturbed by mining activities.
- An assessment of post-mining land suitability and options, and their community benefits.
- An assessment of the feasibility to achieve the various options including any ongoing maintenance or management needs.

Table 9-1 describes for each mine domain identified the pre-mine land use, the post-mine land use objective and suitability classification, and the projective cover range percentage compared to an analogue site for rehabilitation. The RMP will confirm post-mine land uses for each domain.

Table 9-1 Draft Final Land Use and Rehabilitation Schedule

Mine Domain	Mine Tenure	Pre-mine Land Use	Post-mine Land Use Objective	Mine Land Suitability Classification	Projective Vegetation Cover Range (%)
Waste rock dumps	ML 10355, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Final voids	ML 10355, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Final Void	n/a	n/a
Mine infrastructure areas and CHPPs	ML 10355, 70434	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Co-disposal dams	ML 10355, 70434	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Mine water management infrastructure	ML 10355, 10356, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation, water storages	Class IV, water storages	50% analogue
Creek diversions	ML 10355, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Haul roads and access roads	ML 10355, 10356, 10357, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation, roads for future use	Class IV, roads for future use	50% analogue
Train loading facilities	ML 10355, 70434, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue
Linear infrastructure	ML 10355, 10356, 70434, 70435, 70436	Grazing, remnant vegetation	Grazing, remnant vegetation	Class IV	50% analogue

Table 9-2 provides the surface area and indicative maximum slope ranges for various mining landforms. The maximum slope ranges will be determined in the RMP.

Table 9-2 Landform Design Criteria

Disturbance Type	Indicative Grade Range (%) or Maximum Slope (°)	Projective Surface Area (ha)
Final voids – high wall	0-214% or 65°	1,342 ha across four final voids
Final voids – low wall	0-100% or 45°	
Co-disposal facilities	0-20% or 11.5°	104
Waste rock dumps	0-20% or 11.5°	4,749
MIA, ROM pad	0-18% or 10°	255

9.4 Progressive Rehabilitation

The main features of the progressive rehabilitation process are:

- constructing a stable land form consisting of out of pit and in pit waste rock dumps
- progressively construct dumps to final landform design, to minimise reshaping post mining
- respreading of topsoil across available reshaped areas
- contour ripping immediately after topsoil placement to control erosion
- seeding with appropriate seed mix prior to the wet season to maximise the benefits of rainfall
- managing direct rainfall and runoff from the rehabilitated landform in sediment dams.

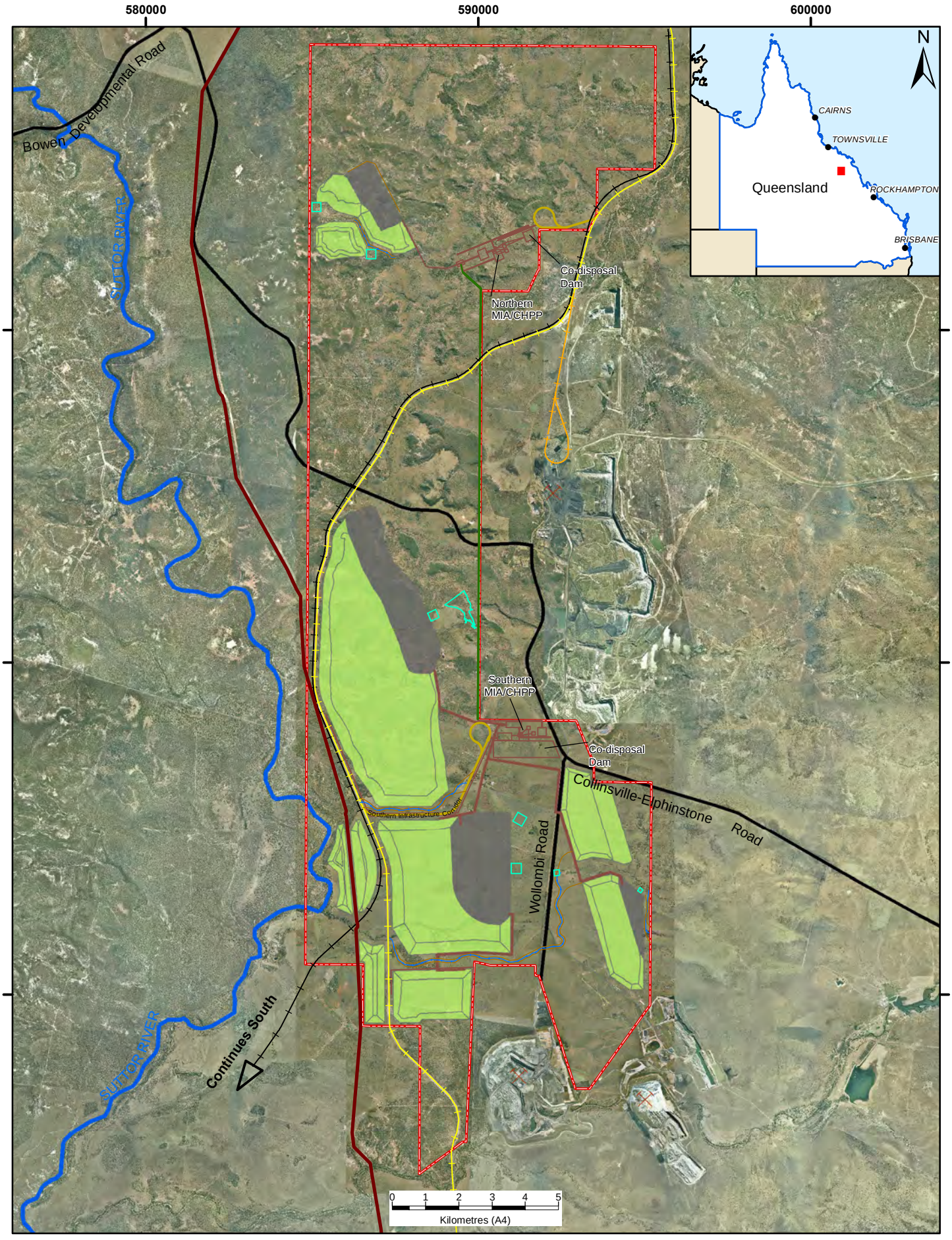
Progressive rehabilitation will minimise the amount of land disturbed at any one time and will be scheduled as part of day to day mining operations. Indicative schedules for progressive rehabilitation have been developed and will be finalised as part of the RMP. The final rehabilitated landform design is presented in **Figure 9-1**.

Progressive rehabilitation will also include the rehabilitation of any areas disturbed during construction that are not required for ongoing operations.

The following decommissioning strategies are proposed for various remaining structures post-mine closure:

- Conduct of a contaminated land assessment of relevant locations. This may involve engaging a suitably qualified person (SQP) approved by DEHP as a contaminated land specialist[9].
- Remediation or ongoing management of contaminated land as required. Ongoing management may include retaining parcels of the land on DEHP's Environmental Management Register.
- Removal (or sale and removal if appropriate) of all items of the mine infrastructure area, and any temporary buildings and facilities, unless agreed with the post-mining landowner.
- Ripping, application of topsoil, and seeding of land.
- Establishment of safety bunds and fencing for final void areas.

[9] For the purposes of preparing site investigation and validation reports and draft site management plans, an SQP is defined in the *Environmental Protection Regulation 2008*.



Legend

- Project Area
- Completed Rehab
- Final Void
- Existing Mine Site
- Burdekin to Moranbah Pipeline
- GAP Rail line
- Newlands Mine Rail Loop
- Alpha Coal Project Rail Line
- Mine Infrastructure
- Train Loading Facilities
- Suttor River
- Drainage Bund
- Drainage Diversion
- Formed Road
- Dam (mine affected, sediment affected, clean water)
- Central Infrastructure Corridor

Progressive Rehabilitation – Final Landform	QCOAL GROUP
Figure 9-1	**Byerwen Coal Project**
Date: *20/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
G:\CLIENT\SA-TO-D\BYEGEN - Byerwen EIS\GIS\Maps\EIS Chapters\EIS_EMP\BYEGEN_Fig9-1_FinalLandform.mxd	

9.5 Rehabilitation and Decommissioning by Mine Domain

9.5.1 Waste Rock Dumps

The rehabilitation objectives for waste rock dumps are:

- Establishment of a post-mine land use in accordance with the RMP.
- Dump slopes are geotechnically stable.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Surface and near surface soil properties will support the proposed land use.
- Vegetation cover is established to minimise erosions rates.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Landform does not present a risk to people and stock.
- Ongoing management requirements are similar to non-mined land.

For final rehabilitation of waste rock dumps, it is proposed that Permian waste rock be used for the outer slopes to limit potential for dispersion and erosion, with Tertiary waste rock preferentially disposed into the central (inner) zones of waste rock piles. Where this strategy cannot be fully achieved (due to mine waste scheduling) and Tertiary waste rock is required to report to outer surfaces, there are two proposed options:

- establish a slope gradient of less than 10% with a cover of non-dispersive Permian material
- if steep outer slopes are required, a thick cover of durable rock will be placed, which may or may not be Permian material.

Waste rock dumps will be designed, shaped, capped with topsoil and revegetated in accordance with a Mine Waste Management Plan. The design of dumps is an important part of the rehabilitation process. Dumps will be designed and engineered to be geotechnically stable and safe. Final landforms are anticipated to be 60 m increased elevation compared to existing landform.

Irrespective of the waste rock reporting to the exterior of waste rock dumps, suitable topsoil and subsoils that have been stripped prior to mining will be applied to the surface of the dumps. A Soil Management Plan will be developed prior to commencement of mining activities to identify the soils best suited to rehabilitation at the recommended depth (300 mm) from the potentially available surface and subsurface materials. **Section 10** identifies that there is suitable surface and subsurface materials to achieve this depth of cover for rehabilitation.

The rehabilitation strategy for establishing geotechnically stable and formed waste rock dumps is to:

- rip waste rock material to between 0.5-1 m
- apply stripped subsoils and topsoil material (minimum of 100 mm)
- scarify the surface (immediately before seeding)
- seed with an appropriate seed mix
- control weed species.

Ongoing monitoring of the success of rehabilitation will be undertaken in accordance with the RMP.

Surface run-off and seepage from waste rock dumps, including any rehabilitated areas, will be monitored for ‘standard’ water quality parameters.

9.5.2 Final Voids

The rehabilitation objectives for the final voids are:

- Post-mine land use is a void containing water that has little or no risk of overtopping.
- Voids are isolated from surface water flows.
- Water quality does not present a risk of environmental harm to surface waters or groundwater.
- Voids are stable over the long term.
- Safety risk to people, fauna and stock is managed and access to void water is limited.
- Future potential use of the voids is maximised (where practicable).

The final landform will include four final voids: SP1, WP3, EP2, NP. The risk of discharge from final voids and predicted water quality, is summarised below:

- Water inflow from groundwater, surface water runoff and direct rainfall will result in pit lakes which will reach a steady state condition, where water loss (evaporation) is grossly equivalent to water input.
- Under no conditions will water from within the void rise to the final void rim; discharges to the surface water system are not expected to occur.
- The steady state water level of all pits is predicted to lie below the regional groundwater level, causing a permanent groundwater gradient into the pits. As such discharge to surrounding groundwater is expected.
- Groundwater from the coal measures is expected to be the primary source of void water inflow. This groundwater is slightly alkaline and brackish and generally contains low concentrations of nutrients and metals. As the pit lakes mature, the salinity is expected to gradually increase causing stratification. Salinity of near surface water is expected to be much lower than at depth, with high dissolved oxygen, neutral to slightly alkaline, with low to very low dissolved metal concentrations.

Final void water depth is unlikely to be at a depth where it can be accessed safely by fauna or livestock. Water quality is unlikely to be suitable for stock use or as a source of aquatic ecosystem habitat. Therefore the primary objectives of final void design will be to:

- isolate the void from surface water and groundwater systems by minimising the catchment extent, diverting potential surface inflows and creating a permanent groundwater sink
- exclude humans, fauna and stock from the final voids.
- Configure the void for overflow immunity.

These objectives can be achieved by:

- Constructing permanent self sustaining bunds around final voids (nominally minimum 2 m high with 4 m base and located 10 m beyond the areas potentially affected by pit highwall instability)
- limiting access to the final void through bund walls, tree planting, fencing, signage and landholder and community awareness.

Final void design will address the geotechnical stability of high and low walls through all relevant variables (e.g. shear strength, number of benches, water inflows, fractures, faults, slopes, settlement, weathering and material) into engineering design. Drainage will be generally directed away from the highwall to limit slope deterioration.

9.5.3 Mine Infrastructure Areas and CHPPs

Rehabilitation objectives for the mine infrastructure areas (including product and ROM coal stockpile, administration, workshop, maintenance, fuel storage and waste management areas) and CHPPs are:

- Establishment of post-mine land use in accordance with the RMP.
- Hazardous or contaminated material or areas are identified and managed.
- Infrastructure is dismantled and removed.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

The CHPP and mining support infrastructure will be dismantled and removed upon completion of the mining operations. The plant concrete bases and footings will be removed and the area ripped, reshaped and topsoil applied before revegetation. Drainage control through ripping, profiling or the provision of erosion control structures will also be undertaken. Any infrastructure that is considered to be of beneficial use to the subsequent landholder will be retained, if requested.

A contaminated land assessment of the coal stockpile areas, fuel storage area, chemical storage areas, waste storage/transfer areas, effluent treatment plant area, treated effluent irrigation area and any other potentially contaminated sites will be undertaken to identify any potential contamination.

Any metals or materials that may contaminate the site (e.g. batteries, waste oils) will be removed from site and disposed of at an appropriately licensed waste disposal facility. Some wastes may be buried on site in the in-pit waste rock dumps, including tyres and construction waste. The majority of wastes will have low potential to cause contamination through seepage. Those wastes that have to the potential to cause contamination through seepage will be disposed of in cells within the waste rock dump that will contain any contaminated seepage. Any metal with the potential to react with waste rock and result in contamination of groundwater will not be disposed of in the in-pit waste rock dumps.

Drainage control through ripping, profiling or the provision of erosion control structures will also be undertaken. Any infrastructure that is considered to be of beneficial use to the subsequent landholder will be retained, if requested.

Once decommissioned, the rehabilitation strategy for infrastructure areas will be to:

- rip compacted areas to between 0.5-1 m
- apply stripped subsoils and topsoil material (average between 100-150 mm)
- scarify the surface (immediately before seeding)
- seed with appropriate seed mix
- control weed species.

9.5.4 Co-disposal Dams

The rehabilitation objectives for co-disposal dams are:

- Establishment of a post-mine land use in accordance with the RMP.
- Final landform is geotechnically stable.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Potentially contaminated materials are adequately managed.
- Vegetation cover is established to minimise erosions rates.
- Run-off or seepage water quality does not present a risk of environmental harm.

- Landform does not present a risk to people and stock.
- No ongoing specific management requirements.

Two co-disposal dams, one near the southern CHPP and one near the northern CHPP, are proposed. These will be used for storing reject material during the initial years of operation of each CHPP (nominally the first 10 years of operations of each CHPP). In subsequent years, all reject material will be disposed of in-pit. The strategy for disposing of coarse and fine waste reject into pit voids will reduce the area of land required for the management of rejects.

During operations, the characteristics of the co-disposed coal rejects will be further assessed to inform the RMP. The decommissioning, closure and post-closure aspects of coal reject co-disposal dams will also be addressed as part of the RMP.

The following general principles will be adopted for the closure of co-disposal dams:

- Co-disposal dam rehabilitation will be undertaken after drying of the dams.
- The surface will be covered with a soil cover system and capped with a layer including clay and benign overburden material, and will be topsoiled and vegetated.
- The design of the soil cover system will be documented in the RMP, but will principally comprise a cover of suitable waste rock and topsoil to a final nominal re-profiled thickness of 3 m.
- Rejects will be covered with a capillary break if required to prevent the vertical movement of salts.
- The cover will be designed to provide a low gradient final landform.
- The rehabilitated co-disposal dams will be vegetated with an appropriate seed mix.
- If required, co-disposal dams will be placed on the DEHP's Environmental Management Register.
- The catchment of dams will be limited to the area within the embankments with clean water flows diverted around dams.
- Any installed seepage detection monitoring will continue until the soil cover system is installed and the out of pit co-disposal facility is 'closed'.

Waste rock will be suitable to use as a soil cover, as it is alkaline, has low sulfur, is likely to have a high factor of safety and very low probability of acid generation, and will have excess capacity to neutralise any acidity generated by coal reject materials. A topsoils cap will be required as a growth medium.

9.5.5 Mine Water Management Infrastructure

The rehabilitation objectives for mine water management infrastructure (mine affected water dams, sediment dams, clean water dams and associated pipes and pumps) are the same as those for the co-disposal dams. There is potential for beneficial use of some mine water management infrastructure by landholders. Mine water management infrastructure will be retained where agreed by the post-mining landowner.

Any plan to retain water storage facilities post mining will consider the water quality and quantity requirements. These requirements will vary depending on whether the site is to be used for stock, wildlife, or human consumption, irrigation or recreational uses. Such a land use option may need separate hydrological and/or hydrogeological assessments. Criteria of achievement will show that all environmental and water quality requirements consistent with the use have been met and that the intended users of the water have a need for the facility. Responsibility for ongoing operation and management of dams, that will benefit the landholder, will be transferred to the landholder following mine closure.

Water storage dams will either be retained as water storages for the post-mining land use or rehabilitated. Rehabilitation will vary depending on the storage history. Dams that contained saline

water or other contaminants may require further remediation. The general principles that will be adopted for closure of dams that contained saline water or other contaminants are the same as those for the co-disposal dams.

If not retained as water storages, water storage dams will be returned to grazing land as occurred pre-mining, and will generally be able to be used for beef cattle grazing. Dams that have contained saline water are likely to only be returned to cattle grazing land.

9.5.6 Creek Diversions

The design of creek diversions is described in **Section 3**. The objectives for creek diversion are to:

- create a creek that operates as part of a self-sustaining stream system and promotes nutrient processing, ecological connectivity and natural sediment storage or transport
- whenever practical, avoid the use of artificial grade control structures or other structures that are likely to require maintenance beyond life of mine
- include natural, locally and regionally occurring geomorphic and habitat features
- create a creek where the diversion and adjoining reaches establish a state of dynamic equilibrium (equal rates of sediment erosion and deposition).

Creek diversions will be retained following mine closure, as they will have been designed though best-practice measures to provide stable landform and by mine closure, would be established with long-term riparian vegetation and aquatic habitat. At the conclusion of mining, the creek diversions will be left in a stable and sustainable condition in line with the RMP. There should be no requirement for ongoing maintenance and management of diversions and levee banks following mine closure.

9.5.7 Haul Roads and Access Roads

The rehabilitation objectives for haul roads and access roads are:

- Establishment of post-mine land use in accordance with the RMP.
- Hazardous or contaminated material or areas are identified and managed.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

A number of the roads may be retained for use by future landowners post-mine closure and rehabilitation. Responsibility for ongoing operation and management of roads and road related infrastructure retained by the landholder will be transferred to the landholder following mine closure.

Some roads will also be temporarily retained following rehabilitation as access roads for rehabilitation monitoring purposes. This will be determined in consultation with stakeholders.

Management of any contaminated areas may include on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants.

The majority of roads across in the project area will be highly compacted. Rehabilitation, where undertaken, will require deep ripping, profiling, application of topsoil and seeding. Drainage construction will be applied where necessary. Roads which are selected to remain at the project site post-mine closure may require ongoing management of sediment containment measures to minimise potential erosion and sediment entering into waterways.

9.5.8 Train Loading Facilities

The rehabilitation objectives for TLFs are:

- Establishment of post-mine land use in accordance with the RMP.
- Removal of infrastructure, unless approved for use by another party.
- Hazardous or contaminated material or areas are identified and managed.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

At the end of mine life, the TLFs (incorporating rail loop and rail spur) will be decommissioned, including removal of all infrastructure (rails, sleepers) and rail ballast material except if the infrastructure is approved for use by another party.

Management of any contaminated areas may include on-site remediation, removal to an appropriately licensed waste disposal facility or encapsulation on-site to prevent the release of contaminants.

Following decommissioning, the TLFs will require deep ripping, profiling, application of topsoil and seeding.

9.5.9 Linear Infrastructure

The rehabilitation objectives for linear infrastructure (power lines and water pipelines) are:

- Establishment of a post-mine land use in accordance with the RMP.
- Removal of infrastructure, unless approved for use by another party or where removal of buried infrastructure would create more environmental damage than leaving in-situ.
- Erosion rates are managed to levels that do not compromise post-mine land use.
- Run-off or seepage water quality does not present a risk of environmental harm.
- Ongoing management requirements are similar to non-mined land.

The power lines/power poles and water pipelines may be retained, by agreement, for future use by landholders, local government or another project. If they are not retained, infrastructure will be removed from site and disturbance corridors will undergo deep ripping, profiling, application of topsoil and seeding. Buried water pipelines will be left in-situ as the pipeline rights of way will be progressively rehabilitated following construction and installation. This will avoid creating additional disturbance and rehabilitation requirements associated with removal of pipelines.

9.6 Rehabilitation Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 9.5** and compliance with the criteria outlined in **Section 9.7** and **9.7** as applicable to the management of rehabilitation and decommissioning activities.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management

- reporting, corrective and preventative actions
- audit scheduling
- management review.

Progressive rehabilitation will only commence once out of pit waste rock dumps are stabilised. Monitoring and assessment of progressive rehabilitation processes will be undertaken throughout the project life. Assessment involves measuring indicators of rehabilitation success against established criteria.

In the initial years of revegetation, monitoring will occur a number of times per year, but once vegetation is established monitoring may occur as required until completion criteria indicate successful revegetation. From this point monitoring may occur as required until the surrender of the mining lease.

Monitoring of rehabilitation success, including survival of regrowth and return of fauna species, will be conducted at locations representative of the range of conditions impacting the rehabilitating areas. Reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness.

Monitoring of soil erosion in rehabilitated areas will be included as part of the rehabilitation program.

If monitoring and assessment results indicate that the rehabilitation objectives may not be achieved, then the rehabilitation strategy will be modified. Non-compliance with the established criteria and indicators will trigger a review of processes such as planning and design, and/or repair and maintenance of failed rehabilitation work.

As rehabilitation technologies, strategies and monitoring techniques change and/or are improved over time, the proponent will review and update the project's rehabilitation and monitoring procedures to include the most effective processes and strategies.

9.7 Completion Criteria and Indicators

A RMP will be developed for the project within two years of the effective date of the environmental authority. In accordance with the Strategic Framework for Mine Closure[10], the RMP will describe completion criteria and establish a set of indicators which will demonstrate the successful completion of the closure process.

In order to establish standards, completion criteria and indicators, the proponent will review all relevant legislation and industry codes of practice, and consult all stakeholders. Completion criteria will be developed that provide a clear definition of successful rehabilitation for each domain at the mine site.

For all indicators that are selected, the RMP will:

- state what objective(s) the indicator relates to
- justify selection of the indicator, including the relationship between the indicator and the objective
- state how the indicator is to be measured
- state how the results will be reported and interpreted.

Completion criteria and indicators will be developed for:

- agricultural productivity
- vegetation cover
- erosion and sediment loss

[10] Australia and New Zealand Minerals and Energy Council and Minerals Council of Australia, Strategic Framework for Mine Closure 2000

- soil quality
- geotechnical stability of rehabilitated areas
- quality of water runoff
- engineering standards and certifications for decommissioned and rehabilitated infrastructure
- remediation of any contaminated land.

Indicators of rehabilitation success that are applicable to revegetation include plant and litter cover, plant density and species composition, plant yields, presence and content of weeds, soil erosion, soil nutrient status, soil salinity and microbial population.

Where the intention is to reinstate the previous grazing land use the success of pasture species planting may be gauged by the whether the area can support the intended stocking rates.

Where the intention is reinstate a natural ecosystem, nearby undisturbed vegetation communities can be used as a reference to assess the success of rehabilitation. It is not intended, nor is it reasonably practicable, to create native vegetation communities with the same abundance and distribution of undisturbed native vegetation. Completion criteria will be nominated to represent rather than recreate exactly representative native vegetation communities. If areas are to be revegetated with native species, completion criteria and indicators may include a comparison relative to a representative site.

In addition completion criteria and indicators will be developed for the final void (and any other areas that are potentially not returned to grazing land) which include:

- geotechnical stability of the final void
- security and access to the final void.

Where dams are retained for the future benefit of landholders, completion criteria and indicators will be developed to establish the quality of the water and the risk posed by future changes in water quality.

Completion criteria to determine success of final rehabilitation and hence surrender of the mining lease will be developed in conjunction with the administering authority.

9.8 Mine Closure Planning

The proponent will develop a Mine Closure Plan (MCP) four years prior to final coal processing to achieve ecologically sustainable development (ESD) as required by the *EP Act,* the fundamental objective of which is to attain operationally and economically feasible closure while taking into account community priorities, environmental requirements and sustainability of the rehabilitation and the final land use. Rehabilitation and decommissioning strategies will be implemented to meet the criteria agreed upon as part of the RMP.

The proponent will prepare a MCP which will list the specific operational activities required to be undertaken in order to complete rehabilitation and decommissioning of the project. The criteria for achieving self-sustaining final landforms will be developed as part of the Mine Closure Plan calling upon site specific rehabilitation trials, monitoring and research programs.

The Mine Closure Plan will:

- identify stakeholders and interested parties, enabling them to have their interests considered
  - may include employees, management, shareholders, local businesses and services providers, landholders, neighbours and nearby residents, local government, NGOs and community groups, conservation organisations, regulators and other government agencies.
- ensure the process of closure occurs in an orderly, cost-effective and timely manner

- ensure that cost of closure is allowed for by the company
- ensure there is clear accountability and adequate resources to implement the closure plan
- establish a set of indicators which will demonstrate the successful completion of the closure process
- achieve agreed completion criteria to the satisfaction of the Responsible Authority.

9.8.1 Closure Planning

Mine closure planning will adopt a risk based approach and will incorporate technical, economic social and long term considerations. The MCP will include a number of subsidiary plans which typically include a final rehabilitation plan and a decommissioning plan.

The RMP is considered as the first stage of planning for land use post mining activities, requiring consideration of longer term objectives during operation. The RMP is intended to be a "living" document that will be reviewed and updated during mining operations and will be part of the MCP.

Adequate financial provision will be made for the cost of mine closure.

9.8.2 Implementation

The accountability for resourcing and implementing the MCP will be clearly identified. Adequate resources will be provided to assure conformance with the MCP.

9.8.3 Standards and Completion Criteria

Completion criteria are an agreed set of environmental indicators which, upon being met, will demonstrate successful rehabilitation of the site. Completion criteria will be developed that are specific to the mine, and reflect the unique set of environmental, social and economic circumstances of the site. Standards and completion criteria will recognise the legislative framework and consider all relevant industry codes of practice existing at the time of closure. Completion criteria are the basis on which successful rehabilitation is determined and will be developed in consultation with stakeholders.

Specific performance indicators will be developed to measure progress in meeting the completion criteria. The environmental indicators are intended to demonstrate whether the ecological processes which will lead to successful rehabilitation are trending in the right direction. This will enable early intervention and remedial actions where trends are not positive.

9.8.4 Relinquishment

The proponent will provide financial assurance for the decommissioning and rehabilitation costs associated with disturbances during the operational period. Relinquishment of this financial assurance will only occur once the regulator is satisfied that decommissioning and rehabilitation is successful.

9.9 Proposed EA Conditions

Reference **Section 8.7 Schedule C.**

10. SOILS, EROSION AND SEDIMENT MANAGEMENT

10.1 Environmental Values

The following environmental values may be impacted by erosion and sedimentation:

- The integrity of undisturbed land and ecosystems on the project site
- The integrity of topsoil as a resource to be used in rehabilitation
- The stability of disturbed land and ensuring it is non-polluting
- The suitability of land to support beneficial post mining land uses such as agriculture.

Table 10-1 summarises the main properties for the ten identified soil types within the project area.

10.2 Potential Impacts

Approximately 6,100 ha (87%) of the total project footprint of 7,000 ha will comprise waste rock dumps and open pit excavations / final voids, these areas will be disturbed sequentially over the mine life and not simultaneously. Unless salvaged prior to disturbance, soils can be physically degraded in-situ without alterations to landform, particularly where heavy machinery is used such as haul roads. This degradation can limit revegetation, decrease water infiltration, increase run-off and cause accelerated erosion.

Once soil is salvaged for rehabilitation the soil quality can be affected by mixing of poor and good quality soils, poor topsoil stripping and handling, length of time stockpiled, location of stockpile and by contamination. Poor quality soils (e.g. highly erodible, low fertility soils) may not be salvaged due to their potential detrimental impacts on rehabilitation success.

Soil erosion may result in the following:

- potential loss of agricultural productivity
- decrease in rehabilitation potential or increase in management effort required for successful rehabilitation particularly where infertile subsoils are exposed
- decreased capacity for soils to intercept and store rainfall resulting in decreased soil water storage and increased run-off potentially affecting downstream hydrology
- decrease in ecosystem services
- decrease in visual amenity.

The movement of eroded soil into waterways can result in degradation of water quality with respect to suspended solids/turbidity, nutrients, and metals / metalloids associated with mineralised soils.

10.3 Environmental Protection Objectives

- Salvage suitable soils resources for use in progressive rehabilitation
- To minimise impacts to the quality of soils, including soils to be used in rehabilitation
- To prevent or minimise erosion and sedimentation of water bodies such that water quality objectives (refer **Section 6.3**) are achieved

Table 10-1 Summary of Soil Properties and Management Issues

Soil Type	Description	Erosion Potential	Soil Acidity	Salinity Class	Sodicity	Dispersibility	Inherent Fertility
Rudosols	Poorly developed soils (alluvium)	Moderate gully erosion observed	Non acidic	Very low to low	Sodic below 0.3 m	Near complete to complete dispersion at all depths	Fertility issues below 0.6 m
Sodosols	Texture contrast soils	Moderate sheet to moderate severe gully erosion	Non acidic	Medium salinity below 0.9 m	Magnesium enhanced sodicity below 0.3 m, sodic below 0.6 m	Slight to moderate dispersion below 0.7m	Fertility issues below 0.3 m
Northern Kandosols	Deep unstructured soils	No significant accelerated erosion observed	Surface material is acidic	Very low	Non-sodic	No dispersion	Fertility issues below 0.6 m
Central Kandosols	Deep unstructured clayey soils	No significant accelerated erosion observed	Non acidic	Very low	Magnesium enhanced sodicity may be an issue below 0.9 m	Slight dispersion in surface soils	Fertility issues below 0.6 m
Central Dermosols	Red form	No significant accelerated erosion observed	Non acidic	Very low to low	Sodic below 0.3 m	Near complete to complete dispersion below 0.4 m	Fertility issues below 0.3 m
Southern Dermosols	Brown form	No significant accelerated erosion observed	Non acidic	Medium to high salinity below 0.3 m	The soils are sodic (including Mg enhanced sodicity) below 0.3 m	Moderate to near complete dispersion	Fertility issues below 0.3 m
Brown Vertosols	Deep structure brown soils	No significant accelerated erosion observed	Non acidic	Medium to extreme salinity below 0.3 m	Strongly sodic with magnesium enhanced sodicity below 0.3m	Moderate dispersion in surface soils	Fertility issues below 0.9 m
Northern Dark Vertosols	Deep structured brown soils	Active minor gully erosion observed	Non acidic	Medium salinity below 0.6 m	These soils are sodic (with magnesium enhanced sodicity) below 0.3 m	Unknown	Fertility issues throughout the profile
Central Dark Vertosols	Deep cracking soils in areas of gilgai	No significant accelerated erosion observed	Non acidic	Very low to low	Non sodic	No dispersion	Fertility issues below 0.3 m
Southern Dark Vertosols	Deep cracking soils	No significant accelerated erosion observed	Non acidic	Very low to low	magnesium enhanced sodicity may be an issue in this soil	No dispersion	Fertility issues below 0.9 m

10.4 Performance Criteria

- Land use capabilities described in the Rehabilitation Management Plan are achieved.
- Reinstatement of landform in line with project scope requirements.
- Water quality objectives are achieved.
- No increase in erosion during construction or operation, on land adjacent to project activities as specified in the erosion and sediment control plan (ESCP) monitoring provisions.
- Compliance with the requirements of the project's EA.

10.5 Control Strategies

10.5.1 Soils Management

Sodic soils prone to erosion will require management to minimise erosion or amelioration if used in rehabilitation. Saline soils may restrict the growth of moderately sensitive crops and grasses if respread on the surface. Careful separation of topsoil and subsoil will avoid exposure of these sodic/saline layers from occurring following reinstatement of the final rehabilitated landform. Varying levels of dispersion were evident in surface and subsoils with the exception of central kandosols, northern kandosols, central dark vertosols and southern dark vertosols. This has implications for subsoil management and associated erosion with subsequent potential impacts such as water quality as discussed in **Section 6**.

A Soil Management Plan (SMP) will be developed prior to commencement of mining activities to identify the soils best suited to rehabilitation at the recommended depth of cover (300 mm) from the potentially available surface and subsurface materials**.** A depth of 300 mm of soil has been found to produce a high revegetation performance. There are approximately 47 million m^3 of suitable surface and subsurface material, which provides sufficient volume to select the optimal soils for rehabilitation to a depth of cover of 300 mm. These soils will be stripped and stockpiled or used directly in rehabilitation.

Where possible areas where soils have saline and/or sodic properties should be avoided (i.e. areas of sodosols, southern dermosols and brown vertosols). Where it is impracticable to avoid these areas then the management approach will need to consider the following:

- Surface material is generally of greater agronomic value than mining overburden and therefore as a general rule should be salvaged (to a nominal depth of 300 mm) for use in rehabilitation activities.
- Where disturbance activity is temporary such as roads, tracks or infrastructure areas, the decision to salvage must consider the limitation of subsurface soils, as exposure of problematic subsurface soils may present a greater environmental risk than not salvaging surface material prior to disturbance.
- For all other soils, in the circumstance where suitable soil material extends to depth and the mining activity represents a permanent loss of such soils material (i.e. waste rock dumps, co-disposal dams and open pits), soil material recovery to the depth specified in the SMP should occur. Surface soil material (nominally 300 mm) should be salvaged and stored separately. Any suitable soil below this may also be harvested and stockpiled.
- Wherever practicable, salvaged soil material will be directly placed on areas to be rehabilitated. Typically, it is not possible to operate a salvage and direct placement approach from the outset; however, soils will be used directly in rehabilitation once waste rock dumps are stabilised as final landform. It is also preferable that minimal quantities of soil be stockpiled, to the extent that salvageable soils available for direct placement are used preferentially to previously stockpiled soils.

The selection of locations for soil stockpiles will be incorporated into mine planning and drainage design, with tracking of soils volumes undertaken as part of the SMP. In order to maximise the value of topsoil resources on-site. The SMP will include consideration of the following precautions:

- Mining activities to be planned to minimise soil disturbance.
- Appropriate drainage to avoid high water velocities or concentration of drainage.
- An ESCP will be prepared for the site, which may include installation of diversion banks or drains upslope of stockpiles to minimise stockpile erosion.
- Where possible, soil disturbance will occur during the dry season.
- Surface and sub-soils will be stripped, handled and stockpiled separately.
- Where stripped soils cannot be directly placed, they will be stockpiled in a suitable area e.g. away from drainage lines.
- Where possible, soils should not be stripped, handled or re-spread when they are wet and prone to damage through smearing and compaction or when they are dry and powdery.
- Equipment movements on the unstripped topsoil will be minimised. If excavators are used, equipment will preferentially work on the exposed subsoil or overburden so as to minimise the compaction of the topsoil being stripped. Haulage routes will be located on the subsoil or overburden, not the unstripped topsoil.
- Soil stockpiles will be allowed to self-seed with existing species and/or stockpiles will be seeded with plant species selected for rehabilitation.

10.5.2 Erosion and Sediment Control

The water management strategy is presented in **Section 6**. This strategy involves activities that are a mitigation measure for impacts to soils, namely:

- the use of sediment dams to capture sediment affected waters from waste rock dumps
- separation of clean water from water from areas of disturbance.

An ESCP will be developed for the project prior to commencement of mining activities in accordance with the *Soil Erosion and Sediment Control-Engineering Guidelines for Queensland Construction Sites* and the *EPA Best Practice Urban Stormwater Management-Erosion and S ediment Control* guideline. Additional guidance will be obtained from IECA (2008) *Best Practice Erosion and Sediment Control*. The ESCP will be approved by a suitably qualified person (such as a Certified Professional in Erosion and Sediment Control). The ESCP will be amended as the mine develops to account for changes in final landform design and infrastructure locations. The most critical aspects of the ESCP are set out below.

- Development of the ESCP will be integrated into the mine planning process.
- Sensitive areas that may require specific measures will be identified.
- The period of maximum disturbance will be planned to occur in the dry season where possible.
- The extent and duration of disturbance (topsoil and subsoil exposure) will be minimised.
- Boundaries of areas to be cleared will be delineated and clearing will be authorised by use of a ‘permit to clear’ system.
- Grubbing out and removal of ground cover should be carried out as close to the time of earthworks as possible.

- Erosion potential and run-on water will be controlled to minimise the amount of sediment affected water released by diverting upslope clean water around the disturbed areas in a controlled manner (or passing it through the site in a manner that separates it from dirty site water).
- All drainage structures and sediment controls will have design specifications appropriate to the rainfall regime and design life.
- Erosion controls will be used to minimise sediment generation and transport.
- Sediment controls will be used to treat run-off from disturbed areas prior to leaving the site.
- Sediment controls will be located as close to the source as possible.
- Erosion and sediment control structures will be installed as required, prior to disturbance in that area of site.
- Disturbed areas will be stabilised as soon as possible (progressively).
- Control structures will be inspected regularly.

Details of the rehabilitation of the site, including final landform design is provided in **Section 9.** Rehabilitated mine landforms will be designed to minimise slope angle and length. Low erosion risk soil will be preferentially used on areas with longer and/or steeper slopes.

Erosion loss decreases exponentially with percentage ground cover and is greatly reduced when cover exceeds 50%. For long-term stabilisation in tropical climates, IECA (2008)[11] recommends a minimum ground cover of 80% which will considered as the target for this project.

Temporary surface protection may be provided by trash blanketing or other measures such as hydromulching, bonded fibre matrix (BFM) or erosion control matting, but vegetation establishment will be required for long-term soil stabilisation. All revegetated areas will be monitored to ensure the desired ground cover is achieved and further seeding or planting is conducted in areas that do not meet the desired target.

Erosion mitigation measures specifically relevant to waterways include the following:

- Where earthworks are carried out in proximity to a watercourse, disturbance will be stabilised.
- Felled timber will be removed from the area and stockpiled away from the watercourse.
- Where required temporary controls will be installed along cleared slopes approaching watercourses, to divert dirty water away from the watercourse.
- Clean rock and culverts will be used for temporary watercourse crossings
- Where buried infrastructure crosses a drainage line, work will be preferentially scheduled for the dry season.
- The discharge of diverted water (piped or pumped) will not cause stream bed or bank erosion downstream of the works.
- Water discharged to a waterway will meet project water quality objectives.

10.6 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 10.5** and compliance with the criteria outlined in **Section 10.4** as applicable to soils, erosion and sediment management.

[11] IECA 2008. Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia Chapter), Picton NSW.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

Monitoring of erosion and sediment control structures will be carried out both pre- and post-wet season and following any significant events. Monitoring may be done using visual methods (such as those for recording erosion features) and/or more quantitative methods such as those using erosion monitoring pins, or measuring sediment loads from monitored catchments.

Monitoring of erosion and sediment controls may include:

- visual inspections undertaken regularly and following significant rainfall e.g. 20 mm in 24 hours
- daily inspections of erosion and sediment control measures during any wet season construction
- daily monitoring of weather predictions to manage clearing and construction activities.
- completion of site inspection checklist
- supervisors to visually monitor all operations and identify where correct procedures are not being followed
- contractors to monitor works and should they become aware of improper management practices, to report the issue to their supervisor.
- site supervisors will be responsible for modifying or stopping non-conforming management practices until corrective actions are determined
- corrective and preventive actions to be implemented and monitored visually on site to ensure they are effective.

10.7 Proposed EA Conditions

Reference **Section 6.7 Schedule W.**

11. FLORA AND FAUNA MANAGEMENT

11.1 Environmental Values

11.1.1 Terrestrial Ecology

11.1.1.1 Regional Ecosystems

Based on EIS field surveys, revised Regional Ecosystem (RE) mapping shows that 50% of the project area (approximately 11,411 ha) supports remnant vegetation. The balance of the project area (approximately 11,211 ha) is non-remnant or regrowth vegetation, comprising cleared grazing land and regrowth vegetation.

11.1.1.2 Connectivity and Wildlife Corridors

Habitat connectivity within the project area is linked to riparian corridors associated with the Suttor River and Kangaroo Creek and contiguous areas of terrestrial vegetation in the central and northern parts of the project area.

11.1.1.3 Endangered and Of Concern Regional Ecosystems

The revised RE mapping shows that six endangered REs (Biodiversity Status) occur within the project area and comprise 1,457 ha of the project area. It is important to note that the project area includes some areas of regrowth brigalow vegetation that meets Threatened Ecological Communities (TEC) listing, however does not meet requirements to be considered remnant vegetation protected under the *Vegetation Management Act 1999* (*VM Act*) or classified as an ESA. Rather, these areas are considered to qualify as brigalow high value regrowth (HVR). The revised RE mapping shows that seven of concern REs (Biodiversity Status) occur within the project area and comprise 1,766 ha of the project area.

11.1.1.4 High Value Regrowth Vegetation

Within the project area, HVR occurs as advanced brigalow regrowth with small areas of HVR 11.8.5 and HVR 11.8.13 mapped for the project area. A total of 71 ha of high value regrowth vegetation (comprising 68 ha of endangered RE and 3 ha of least concern RE) is included in the revised RE map.

11.1.1.5 Threatened Ecological Communities

Three of the Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act)* listed TEC identified by the desktop assessment as potentially occurring were confirmed as present within the project area as follows:

- Brigalow (*Acacia harpophylla*) dominant and co-dominant
- Semi-evergreen vine thickets (SEVT) of the Brigalow Belt (north and south) and Nandewar Bioregions
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin

11.1.1.6 Terrestrial Flora Species

A total of 436 terrestrial flora species were recorded from the project area, including two threatened flora species listed under the Nature Conservation Act *1992 (NC Act*). One previously undescribed flora species, *Kelita uncinella* was also recorded from the project area. *Kelita uncinella* has not been assessed by any scientific committee and has no legislative status at present.

Desktop assessments identified 11 threatened flora species either known, or with the potential to occur in the project area, including one threatened flora species listed under the *EPBC Act*, *Dichanthium queenslandicum*. A single HERBRECS record of this species occurs just outside the eastern boundary of the project area in non-remnant grassland immediately west of the Newlands Coal Mine. Detailed survey of the species' primary habitat (RE 11.8.1) was undertaken without additional specimens being located and was considered sufficient to exclude *D. queenslandicum* as a known or likely occurrence. Of the remaining species identified in the desktop assessment, only two species are known occurrences. No other threatened flora species are considered likely to occur in the project area. Those threatened flora species known to occur in the project area are:

- *Bertya pedicellata*
- *Cerbera dumicola*

Analysis of HERBRECS data and field assessment indicates three regionally significant species occurring in the project area and two species located in close proximity to the project area, including:

- *Diospyros geminata*
- *Melaleuca fluviatilis*
- *Pleiogynium timorense* (Burdekin plum)
- *Acacia bancroftiorum*
- *Phyllanthus maderaspatensis.*

Species recorded within the project area that may have been utilised by Aboriginal people include:

- Food: wattles (*Acacia* sp.), split jack (*Capparis lasiantha*), wild orange (*Capparis canescens*), current bush (*Carissa ovata*), ruby saltbush (*Enchylaena tomentosa*), and narrow-leaved bottle tree (*Brachychiton rupestris*), Kurrajong (*Brachychiton populneus*) and Burdekin plum (*Pleiogynium timorense*).
- Medicinal use: wattles, soap tree (*Alphitonia excelsa*), native quinine (*Petalostigma pubescens*), flax lilies (*Dianella* spp.), cockatoo apple (*Planchonia careya*), Kurrajong (*Brachychiton populneus*) and hop bush (*Dodonaea viscosa*).
- Material use: eucalypts (*Eucalyptus* and *Corymbia* spp.), paperbarks (*Melaleuca* spp.), native quinine, flax lilies, cockatoo apple and Casuarina species.

The following tree species of commercial significance were observed in the project area:

- Lemon-scented spotted gum (*Corymbia citriodora)*
- Narrow-leaved red ironbark (*Eucalyptus crebra)*
- Queensland blue gum (*Eucalyptus tereticornis)*
- Burdekin plum (*Pleiogynium timorense*).

Other species of commercial significance which were recorded within the project area correspond with the Type A plants. Horticultural species recorded as growing in the project area included four species classified as Type A flora species:

- broad-leaved bottle tree (*Brachychiton australis)*
- kurrajong (*Brachychiton populneus)*
- narrow-leaved bottle tree (*Brachychiton rupestris)*
- black orchid (*Cymbidium canaliculatum).*

11.1.1.7 Terrestrial Fauna Species

Six threatened fauna species listed under the *EPBC Act* and/or *NC Act* were recorded from the project area during fauna surveys, with a further three threatened fauna species considered likely to occur in the project area, as follows:

- **Known to Occur**
  - ornamental snake (*Denisonia maculate*)
  - cotton pygmy- goose (*Nettapus coromandelianus*)
  - black-necked stork (*Ephippiorhynchus asiaticus*)
  - square-tailed kite (*Lophoictinia isura*)
  - squatter pigeon (*Geophaps scripta scripta*)
  - little pied bat (*Chalinolobus picatus*)
- **Likely to Occur**
  - black-throated finch (southern) (*Poephila cincta cincta*)
  - common death adder (*Acanthophis antarcticus*)
  - Australian painted snipe (*Rostratula australis*).

Habitat within the project area was found to support several fauna species of bioregional and cultural significance, as follows:

- grey-crowned babbler (*Pomatostomus temporalis temporalis)*
- Australian bustard (*Ardeotis australis)*
- short-beaked echidna (*Tachyglossus aculeatus)* – a special least concern species as per the *NC Act.*

The following migratory fauna species listed under the *EPBC Act* were recorded from the project area during fauna surveys:

- eastern great egret (*Ardea modesta)*
- white-bellied sea-eagle (*Haliaeetus leucogaster)*
- Latham's snipe (*Gallinago hardwickii)*
- rainbow bee-eater (*Merops ornatus)*
- rufous fantail (*Rhipidura rufifrons).*

A further six migatory species are likely to occur in the project area, including:

- cattle egret (*Apus pacificus)*
- fork-tailed swift (*Ardea ibis)*
- white-throated needletail (*Hirundapus caudacutus)*
- Australian painted snipe (*Rostratula australis)*
- satin flycatcher (*Myiagra cyanoleuca).*

A number of these migratory species were recorded from farm dams and wetland areas in the project area, which are considered to provide the most suitable habitat. Inundated gilgai areas are also expected to provide temporary wetland habitats for migratory species. However the overall habitat values for migratory species are limited and of low value.

Wetlands within the project area provide potential breeding habitat for wetland bird species. Tree hollows also represent important breeding habitat for a range of arboreal species including birds,

possums and bat species. Hollows were generally found to be most common within eucalypt forests on undulating sandy plains and the alluvial floodplains within poplar box/blue gum. Hollows are generally restricted to large mature trees within the landscape and would not be expected to occur in areas that have been previously cleared.

11.1.2 Aquatic Ecology

11.1.2.1 Riverine Systems and Wetlands

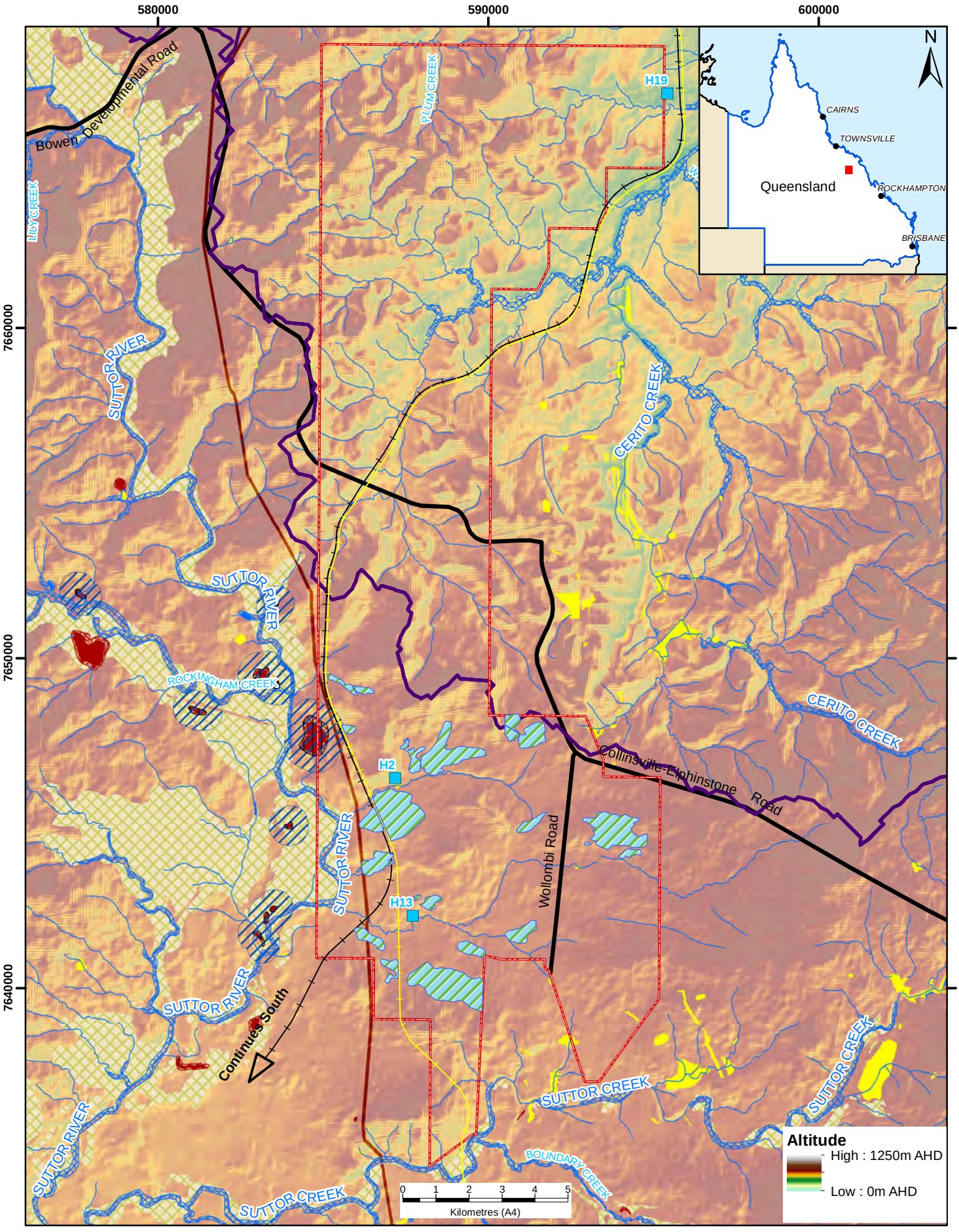
The project area encompasses the Upper Suttor River sub-catchment in the south and the Rosella Creek sub-catchment (containing the Kangaroo Creek catchment) in the north.

Stream flows are highly variable, with most channels expected to dry out during the months of August and September, when rainfall and runoff is historically low. During these times, aquatic fauna are concentrated in senescing pools. As a consequence, physical attributes, water quality, and the composition of aquatic floral and faunal communities, are expected to be highly variable over time.

A High Ecological Significance (HES) palustrine wetland is situated on a closed depression of the Suttor River floodplain, and is intersected by the western boundary of the project area, but is not within the project footprint (refer **Section 6.1.4**). The wetland is likely to be semi-permanent in nature.

The Queensland Wetlands mapping (DEHP 2012) identifies seven mapped lacustrine wetlands within the project area (refer **Figure 11-1**). Six of these are dammed drainage channels, and the seventh is a topographic depression upslope of a constructed contour in the south-eastern section of the project area. The dam to the west of East Pit 1 and 2 would remain undeveloped, as would the topographic depression. The dam near the south-east corner of South Pit 1 would be incorporated into the drainage diversion: however would remain largely unchanged. One of the dams (site S2) is positioned within the proposed West Pit 1 and would be dewatered as part of the project. Two dams located to the north of East Pit 1 would remain unaffected by the project, as would the dam located on a tributary to Suttor Creek in the far southeast of the project area.

A number of gilgai wetlands were observed across the project area. These gilgai wetlands are ephemeral and are expected to fill with water during and following periods of heavy and/or extended rain.



Legend

- Project Area
- Main Catchement Divide
- Formed Roads
- Burdekin Moranbah Pipeline
- Drainage Lines
- Indicative extent of gilgai wetland habitat

GBR Wetland Protection Area

- Wetland
- Trigger Area

Areas that may include wetlands

- Remnant regional ecosystem 1-50% wetland (mosaic units)

Water Bodies

- Riverine
- Lacustrine
- Palustrine

Wetland Regional Ecosystem

- Riverine
- Palustrine

Drainage Features, Wetlands, Gilgais

Figure 11-1 | **Byerwen Coal Project**

Date: 23/04/2013 | **Author:** samuel.ferguson | **Map Scale:** 1:150,000 | **Revision:** R1 | **Coordinate System:** GDA 1994 MGA Zone 55

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11.1.2.2 Aquatic Flora Species

A total of 13 genera of aquatic plants (macrophytes) were recorded during the survey including three Aquatic Conservation Assessment (ACA) Priority species being:

- Water chestnut (*Eleocharis dulcis)*
- Swamp ricegrass *(Leersia hexandra)*
- Nardoo *(Marsilea drummondii).*

The palustrine wetland and gilgai wetland had higher diversity of macrophytes, while the lacustrine wetland and the stream survey sites all had low macrophyte diversity and abundance. The lack of both diversity and abundance in macrophyte cover at the stream survey sites may also be due to seasonal variation or may be associated with the flood events that occurred in the region in early 2012.

Two threatened aquatic flora species were identified in database searches as occurring in the broader Burdekin basin: the salt pipewort (*Eriocaulon carsonii*), which is 'Endangered' under the *EPBC Act* and *NC Act*, and the frogbit (*Hydrocharis dubia*), which is 'Vulnerable' under the *EPBC Act*. Both of these listed threatened species are also identified as Priority 'Back on Track' species for the Burdekin NRM region (DERM 2010[12]). These threatened species were not identified within the project area during the May 2012 survey and were assessed as unlikely to occur in the project area.

In addition, 13 aquatic flora species are listed as Priority species under the ACAs for riverine and non-riverine wetlands of the Great Barrier Reef Catchment (Inglis and Howell 2009a[13], 2009b[14]). Of these species three were detected within the palustrine wetland.

11.1.2.3 Aquatic Fauna Species

A total of 1,342 macroinvertebrate individuals, representing 57 taxa, were retrieved from the 18 samples collected during field surveys. Edge habitat at all surveys sites had higher taxa richness than bed habitats.

SIGNAL 2 results suggest that most of the sites where samples were collected have been under long-term stress from decreased water quality (possibly natural or from past and present land uses), harsh physical conditions (intense seasonal runoff and erosion and deposition and fine sediments) or other anthropogenic effects. AUSRIVAS scores indicate that most sites surveyed within the project area is significantly impaired and lacking in some species that would be expected to occur at the site.

A vertebrate fauna species list generated from Wetland Info (DERM 2012a) identified 49 native fishes, two alien fishes, three semi-aquatic mammals, five turtles, and the saltwater crocodile, *Crocodylus porosus*, as having been recorded in the broader Burdekin Basin.

Two species are listed as threatened ('Endangered' or 'Vulnerable') under the *NC Act* and/or the *EPBC Act*: the Australian lungfish (*Neoceratodus forsteri*), which is listed as 'Vulnerable' under the *EPBC Act*, and the estuarine crocodile, which is listed as 'Vulnerable' under the *NC Act*. No species are listed as Near Threatened. The platypus (*Ornithorhynchus anatinus*) is listed as 'Special Least Concern' under the *NC Act*. In addition, 11 aquatic fauna species are listed as 'Priority' species under the ACA's for riverine and/or non-riverine wetlands of the Great Barrier Reef Catchments. One of these species, Irwin's turtle (*Elseya irwini*), is also listed as a 'High Priority' Back on Track species for the Burdekin NRM region. Of

[12] Department of Environment and Resource Management (DERM) (2010). Burdekin Natural Resource Management Region 'Back on Track' Actions for Biodiversity, Department of Environment and Resource Management, Brisbane.
[13] Inglis S. N. and Howell S. (2009a). Aquatic Conservation Assessments (ACA), Using AquaBAMM, for the riverine wetlands of the Great Barrier Reef catchment: Burdekin region, Department of Environment and Resource Management, Brisbane.
[14] Inglis S. N. and Howell S. (2009b). Aquatic Conservation Assessments (ACA), Using AquaBAMM, for the non-riverine wetlands of the Great Barrier Reef catchment: Burdekin region, Department of Environment and Resource Management, Brisbane.

those Priority species identified as having being recorded in the broader Burdekin Basin, only one Priority species, the southern purple-spotted gudgeon (*Mogurnda adspersa*) was recorded during the fauna survey, at sites S1, S3, and S4 in the Suttor River sub-catchment. All other Priority species identified as having been recorded in the broader Burdekin Basin were not assessed as likely to occur in the project area.

Eight species of fish were recorded, of which all eight have previously been recorded in the broader Burdekin basin as per database records. All eight species were recorded in the Suttor River sub-catchment, but only two of these species, the eastern rainbowfish (*Melanotaenia splendida*), and spangled perch (*Leiopotherapon unicolor*), were recorded in the Kangaroo Creek sub-catchment.

No threatened (or near threatened) species listed under Commonwealth or State legislation, including the Australian lungish, were recorded in the project area or are considered likely to occur. No turtles were observed or caught, during field surveys in May 2012.

11.1.3 Stygofauna

A pilot study, conducted in accordance with WA Guidelines 54 and 54a (2003 & 2007) identified the presence of stygofauna in groundwater associated with the Byerwen project.

Two adjoining mining leases (the project site and Newlands Mine) share the same hydrogeology, with common aquifers hydraulically connected with sufficient conductivity to allow the movement of stygofauna within the aquifers. The project site and Newlands Mine stygofauna datasets were combined to generate a comprehensive stygofauna dataset encompassing 75 individual samples collected from 28 bores over a 4 year timeframe (2008 to 2011).

Only two stygofaunal taxa were recovered from one of 20 Newlands Mine bores sampled annually for four years. It is evident from the Newlands Mine data that stygofauna are low in diversity and abundance from this locality. The pilot study also failed to identify significant stygofaunal communities. Collectively, these data suggest that stygofauna (i.e. stygophiles, stygobites and phreatobites) are poorly represented within the Byerwen and Newlands Mine mining lease areas.

Further stygofauna survey or mitigation of potential impacts is only required if endemism is demonstrated at the Family or Order level for stygofauna. The obligate stygofauna collected from both the Newlands Mine and the project specific surveys are not endemic, because the Order/Family they belong to occur in all Australian States (Serov, 2002). Any proposed mining activities associated with the project will not threaten or put at risk the survival of the amphipod and copepod taxa at the Order/Family level of taxonomic resolution (i.e. impacts will be negligible). Therefore no mitigations or further survey work is proposed for stygofauna.

11.2 Potential Impacts

11.2.1 Terrestrial Ecology Impacts

11.2.1.1 Project Footprint

The direct footprint of all mining and infrastructure areas as described in **Section 2.4** totals approximately 7,000 ha. The total impact footprint including buffers considered for the terrestrial ecology impact assessment (the 'project ecological footprint') is approximately 7,480 ha. The buffered ecological footprint area adopted for the terrestrial ecology impact assessment in terms of REs, RE category and TECs is provided in **Table 11-1**, **Table 11-2** and **Table 11-3** respectively.

Table 11-1 Project Footprint RE Breakdown

RE	Direct Footprint (a)	Footprint Adopted for Terrestrial Ecology Impact Assessment (b)	Difference (b-a)
11.3.1	8	9	1
11.3.25	9	9	0
11.3.4	1	2	1
11.4.2	126	156	30
11.4.8	33	35	2
11.4.9	61	62	1
11.5.1	20	20	0
11.5.16	186	190	4
11.5.3	31	31	0
11.7.1	20	20	0
11.7.1x1	194	194	0
11.7.2	217	241	24
11.7.3	40	40	0
11.7.4	172	175	3
11.7.6	791	842	51
11.8.11	79	84	5
11.8.13	15	18	3
11.8.4	59	75	16
11.8.5	177	188	11
HVR 11.3.1	11	11	0
HVR 11.4.9	6	7	1
HVR 11.8.13	0	0	0
HVR 11.8.5	1	1	0
HVR 11.9.5	2	2	0
Non-remnant	4,751	5,069	318
Total	**7,010***	**7,481**	**471**

***** Comparable to the total footprint area described in **Section 2.4** (7,000 ha) with the discrepancy an artefact of GIS mapping
Note: Impact calculations rounded to the nearest whole number

Table 11-2 Project Footprint Breakdown by RE Category

RE	Direct Footprint (a)	Footprint Adopted for Terrestrial Ecology Impact Assessment (b)	Difference (b-a)
Endangered RE	303	314	11
Of concern RE	429	465	36
No concern at present RE	1,507	1612	105
HVR	20	21	1
Non-remnant	4,751	5,069	318
Total	**7,010***	**7,481**	**471**

***** comparable to the total footprint area described in **Section 2.4** (7,000 ha) with the discrepancy an artefact of GIS mapping
Note: Impact calculations rounded to the nearest whole number

Table 11-3 Project Footprint TEC Breakdown

RE	Direct Footprint (a)	Footprint Adopted for Terrestrial Ecology Impact Assessment (b)	Difference (b-a)
TEC Brigalow	307	316	9
TEC SEVT	15	18	3
TEC Natural Grasslands	79	84	5
Not TEC	6,609	7,063	454
Total	**7,010***	**7,481**	**471**

***** comparable to the total footprint area described in **Section 2.4** (7,000 ha) with the discrepancy an artefact of GIS mapping
Note: Impact calculations rounded to the nearest whole number

11.2.1.2 Direct Impacts

Direct impacts are considered as being land clearance, habitat loss, fragmentation and loss of connectivity.

The total project clearance requirements are 2,391.1 ha of remnant native vegetation and 21.4 ha high value regrowth. The majority of this vegetation would be cleared from the West Pit, North Pit and northern MIA with smaller areas of clearing associated with the other pits as well as the central infrastructure corridor connecting the northern and southern MIAs.

The majority of the remnant vegetation to be cleared (1,612.8 ha) is classified as no concern at present (by biodiversity status), with the remaining area comprised of endangered (313.9 ha) and of concern (465.2 ha) RE types. The effects of land clearance may include:

- loss of vegetation communities or individual threatened species
- reduced species abundance and biodiversity
- loss of habitat, loss of connectivity and associated diminished fauna movement
- loss of land stabilisation and riparian filtration functions.

A summary of total clearing areas by RE type is provided in **Table 11-4**. Clearing of vegetation will occur in stages as mining progresses. The location of areas to be cleared over the entire mine life in relation to the project footprint is shown in **Figure 11-2** and **Figure 11-3**.

It is important to note that the overall habitat value of the project area has been significantly affected by historical clearing and the ongoing effects of grazing. The project will cause further impact on these (already highly compromised) habitats, within the project footprint as a result of:

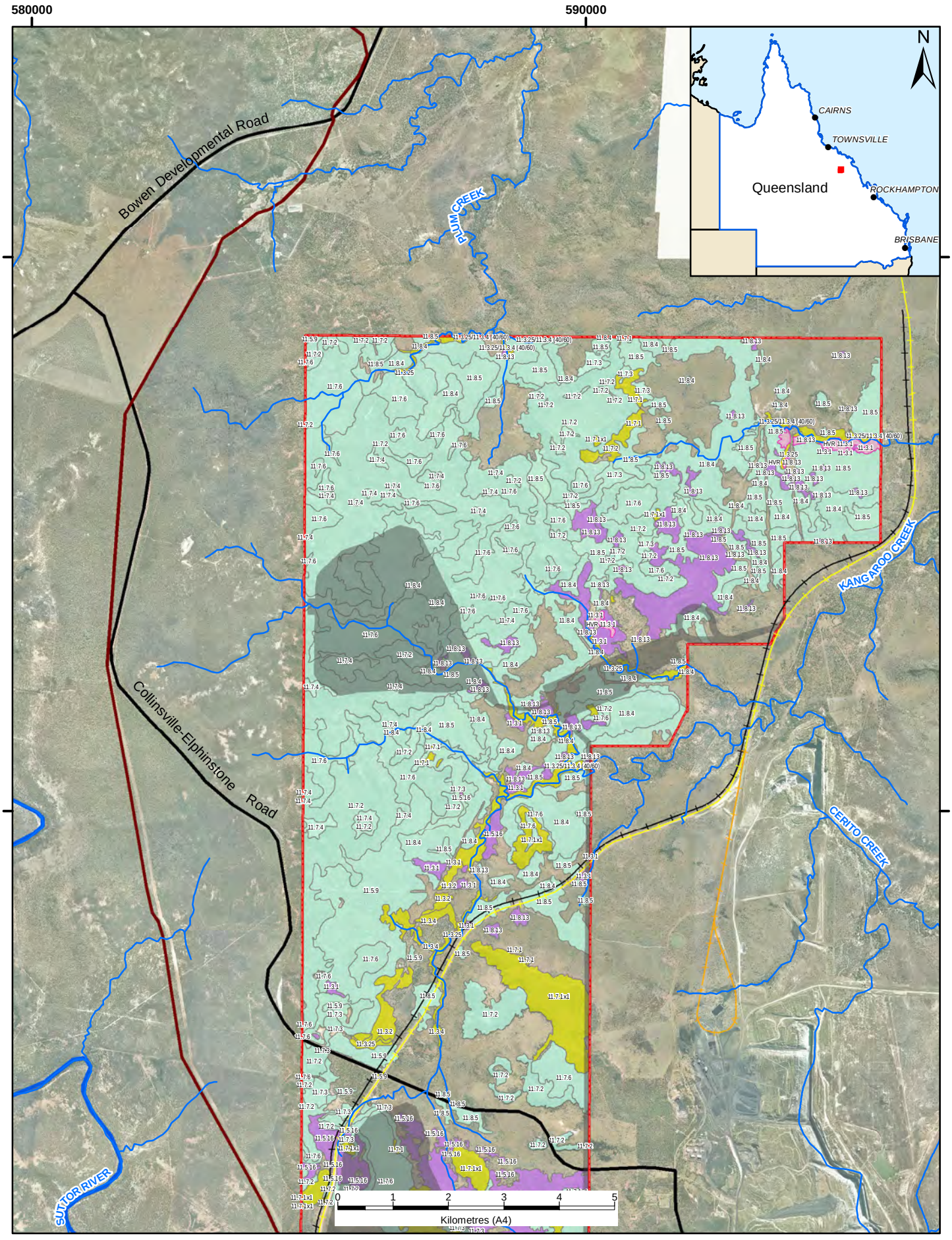
- Removal of permanent, yet artificial, water sources associated with the dams at H2 and H13.
- Removal of gilgai wetland habitat from the southern part of the project area. Historic clearing has previously reduced the habitat value of these wetlands.
- Encroachment on riparian vegetation associated with Suttor Creek by the spoil dumps associated with South Pit 1.
- Removal of riparian vegetation associated with the North Pit footprint.
- Removal of habitat, such as tree hollows and coarse woody debris.
- Reducing the catchment area of the palustrine wetland on the south-west boundary of the project area. Further discussion is provided in **Section 6.2.3**.

There are three primary areas of impact on connectivity from project activities:

- Loss of connectivity within the band of terrestrial vegetation in the central part of the project area associated with the establishment of the West Pits.
- Removal of riparian corridors along the tributary of Kangaroo Creek and excise of remnant vegetation from the contiguous band in the northern part of the project area associated with the establishment of the North Pit.
- Reduced connectivity of riparian corridors along Kangaroo Creek associated with the construction of the central infrastructure corridor.

Table 11-4 Area of Impact by RE

RE	Biodiversity Status	VM Act Status	TEC	Impact Area (ha)
11.3.1	Endangered	Endangered	Brigalow	8.7
11.3.4	Of concern	Of concern	–	1.6
11.3.25	Of concern	Least concern	–	8.7
11.4.2	Of concern	Of concern	–	156.4
11.4.8	Endangered	Endangered	Brigalow	34.6
11.4.9	Endangered	Endangered	Brigalow	62.2
11.5.1	No concern at present	Least concern	–	20.2
11.5.3	No concern at present	Least concern	–	31.0
11.5.16	Endangered	Endangered	Brigalow	190.4
11.7.1	Of concern	Least concern	–	214.1
11.7.2	No concern at present	Least concern	–	240.7
11.7.3	No concern at present	Least concern	–	40.3
11.7.4	No concern at present	Least concern	–	175.0
11.7.6	No concern at present	Least concern	–	841.9
11.8.4	No concern at present	Least concern	–	74.8
11.8.5	No concern at present	Least concern	–	188.1
11.8.11	Of concern	Of concern	Natural grasslands	84.4
11.8.13	Endangered	Endangered	SEVT	18.0
Total Remnant				2,391.1
HVR 11.3.1	Endangered	Endangered	Brigalow	11.0
HVR 11.4.9	Endangered	Endangered	Brigalow	7.6
HVR 11.8.5	No concern at present	Least concern	-	0.6
HVR 11.8.13	Endangered	Endangered	-	0.4
HVR 11.9.5	Endangered	Endangered	Brigalow	1.8
Total HVR				**21.4**
Non-Remnant				**5,070.2**
Total				**7,482.7**



Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems

- Endangered
- Of Concern
- No Concern
- HVR containing E; HVR containing LC

Vegetation Community Impacts (North)

Figure 11-2	**Byerwen Coal Project**
Date: *22/02/2013*	**Author:** samuel.ferguson
	Map Scale: 1:90,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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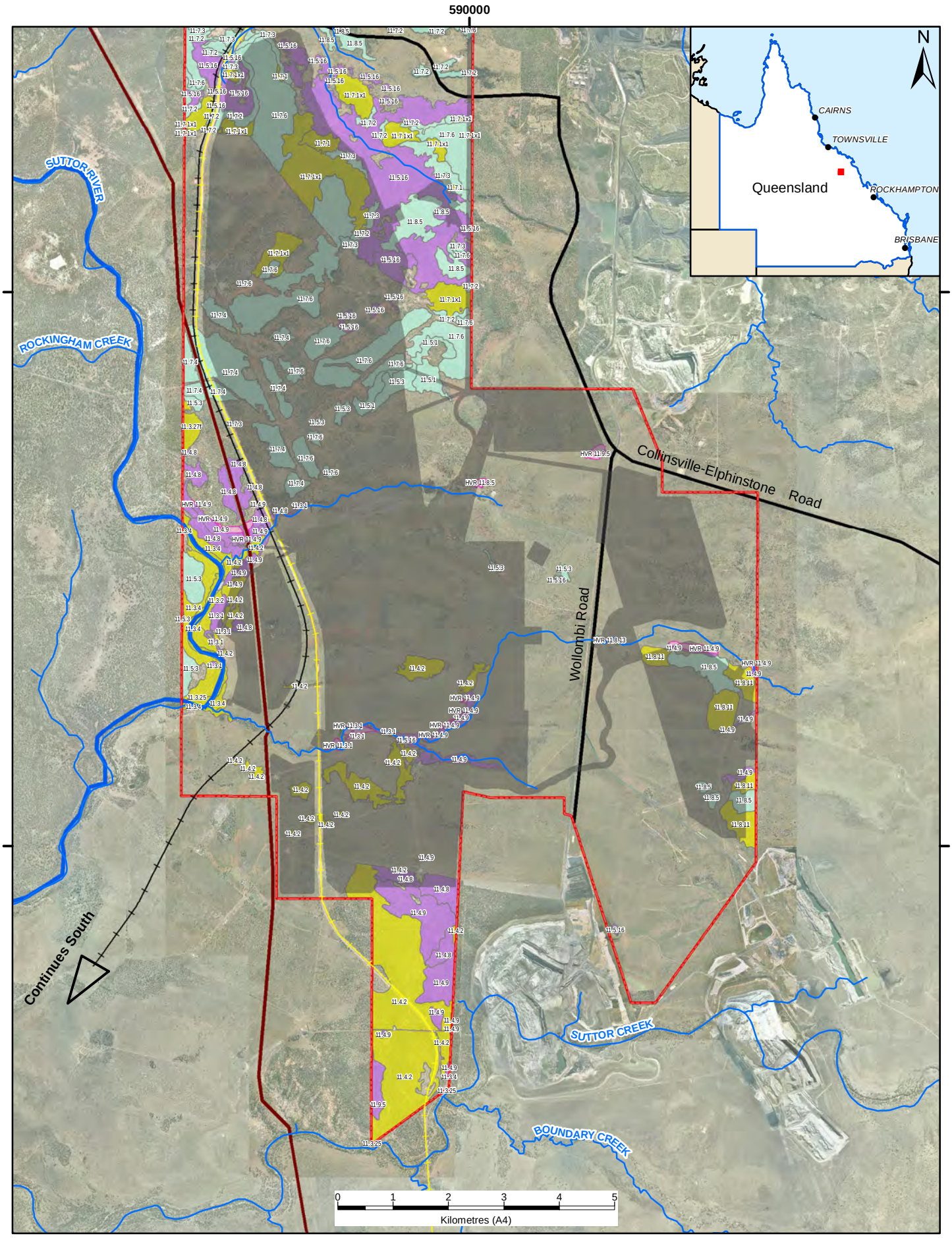

Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems

- Endangered
- Of Concern
- No Concern
- HVR containing E; HVR containing LC

Vegetation Community Impacts (South)

QCOAL GROUP

Figure 11-3	**Byerwen Coal Project**
Date: *22/02/2013*	**Author:** samuel.ferguson
	Map Scale: 1:90,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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elp environmental and licensing professionals pty ltd

11.2.1.3 Additional Impacts

In addition the removal of habitat and the associated impacts of land clearing, other potential impacts can include:

- Weeds and Pest Animals: Impacts of terrestrial weed species likely to occur within the project area are discussed in **Section 12**.
- Edge Effects: Potential impacts associated with the clearing of vegetation is the creation of smaller patches of vegetation, with a greater edge to surface area ratio. Impacts associated with this increase in edge area are known as 'edge effects' and include increased exposure to weed invasion, light and wind penetration (which can alter microclimate features). Plant communities may become susceptible to disease and an overall decrease in health. The impacts of edge effects are difficult to quantify as these effects occur gradually over time; therefore, direct impacts such as vegetation loss and fragmentation are used to determine impacts.
- Indirect Impacts: Includes downstream impacts on surface water and impacts related to noise, dust and light generation.
  - Subject to management of mine-affected water and sediment-affected water, no downstream impacts on surface water resources would be expected.
  - Dust: Dust generation has the potential to smother plants. Dust deposition contours from air modelling and vegetation dust criteria are discussed in **Section 13**. As limited vegetation will be retained within the project footprint, dust effects on plant health would be minor.
  - Noise: Increased noise has the potential to disturb terrestrial fauna and impact on feeding and breeding behaviour.
  - Light: Key sources of light generation in the project area will be the open cut pits, the CHPPs and the mine infrastructure areas, associated access roads and rail facilities. This has the potential to impact on nocturnal species by disrupting feeding behaviour and reducing effective home ranges. Conversely, increased light will attract insects which may be beneficial for some insectivorous nocturnal feeders, such as some bird and bat species.
  - Impacts on terrestrial flora and fauna values outside the boundaries of the project area related to dust, noise and light generated by the project are expected to be negligible to minor.

11.2.1.4 Impacts on Terrestrial Flora Values

The establishment of open cut pits and surface infrastructure for the project will result in the loss of:

- 313.9 ha of remnant endangered RE and 465.2 ha of remnant of concern RE
- 20.8 ha of endangered HVR RE
- an overall reduction in the extent of TECs in the project area.
- The extent of watercourse vegetation clearance has been calculated in accordance with the Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands bioregions (DERM 2009a) which specifies buffer distances from the high bank of watercourses. Based on these definitions a total of 247.3 ha of remnant watercourse vegetation would be removed from the project area.

A number of threatened flora species, and the previously undescribed species *Kelita uncinella* are either known, considered likely to occur or have the potential to occur in the project area as follows:

- *Bertya pedicellata* - Known to occur in the project area: Threats to this species are unknown but are likely to include habitat loss, inappropriate fire regimes, mining and construction activities. Approximately 240.7 ha of potential habitat for this species will be cleared from the North Pit footprint, West Pit footprint and northern MIA.
- *Cerbera dumicola* - Known to occur in the project area: The ecology of this species is not well understood but threats are likely to include habitat loss, inappropriate fire regimes, mining and construction activities. Approximately 1,257.7 ha of potential habitat for this species will be cleared from the North Pit footprint and the northern extent of the West Pit (i.e. West Pit 3). If present, mining in these areas would result in the loss of *C. dumicola* plants from the pit footprints.
- *Kelita uncinella* - Known to occur in the project area: No known populations will be impacted as a result of the project. Indirect impacts could arise from alterations to fire regimes within the species' habitat or through actions that increase the incursion of buffel grass.

11.2.1.5 Impacts on Terrestrial Fauna Values

Table 11-5 provides a summary of impacts on potential habitat for threatened and migratory fauna species known or likely to occur in the project area based on RE associations within the project area. These calculations provide an estimate of habitat loss based on broadly suitable habitat only. As such, areas of broadly suitable habitat which have been identified may not actually be of significance, or therefore require mitigation, when determining impacts on the species in question.

Table 11-5 Impacts on Potential Habitat for Threatened and Migratory Fauna Species

Species		Status		RE Associations within the Project Area	Area (ha) of Remnant Vegetation Impacted within The Project Area[c]
Common Name	Scientific Name	*EPBC Act*[a]	*NC Act*[b]		
Known to Occur					
ornamental snake	*Denisonia maculata*	V	V	11.3.1, 11.3.25, 11.3.4, 11.4.2, 11.4.8, 11.4.9, 11.8.11, 11.8.13, 11.8.4, 11.8.5	E – 123.5 OC – 251.1 NC – 262.9
cotton pygmy-goose	*Nettapus coromandelianus*	–	NT	11.3.1, 11.3.2, 11.3.25,11.3.4, 11.3.27	E - 8.7 OC -10.3
black-necked stork	*Ephippiorhynchus asiaticus*	–	NT	11.3.1, 11.3.25, 11.3.4, 11.3.27	E - 8.7 OC -10.3
square-tailed kite	*Lophoictinia isura*	–	NT	11.3.25, 11.3.2, 11.3.4, 11.5.1, 11.7.1, 11.7.4 11.7.6	OC – 224.4 NC - 1037.1
squatter pigeon	*Geophaps scripta scripta*	V	V	11.3.2, 11.3.4, 11.3.25, 11.5.1, 11.7.4, 11.7.6,	OC -10.3 NC - 1037.1
little pied bat	*Chalinolobus picatus*	–	NT	11.3.1, 11.3.2, 11.3.4, 11.3.25, 11.5.1, 11.7.1, 11.7.2, 11.7.4, 11.7.6,	E – 8.7 OC – 224.4

Species		Status		RE Associations within the Project Area	Area (ha) of Remnant Vegetation Impacted within The Project Area[c]
Common Name	Scientific Name	*EPBC Act*[a]	*NC Act*[b]		
				11.9.5	NC – 1277.8
eastern great egret	*Ardea modesta*	M	-	11.3.2, 11.3.25, 11.3.27	OC – 8.7
white-bellied sea-eagle	*Haliaeetus leucogaster*	M	-	11.3.25, 11.3.27,	OC – 8.7
Latham's snipe	*Gallinago hardwickii*	M	-	11.3.25, 11.3.27	OC – 8.7
rainbow bee-eater	*Merops ornatus*	M	-	Aerial foraging over all RE types	E – 313.9 OC – 465.2 NC – 1,612.0
rufous fantail	*Rhipidura rufifrons*	M	-	11.3.25, 11.3.27, 11.9.5	OC – 8.7
Likely to Occur					
black-throated finch (southern)	*Poephila cincta cincta*	E	E	11.3.1, 11.3.2, 11.3.25, 11.3.4, 11.3.27, 11.4.2, 11.4.8, 11.4.9, 11.5.1, 11.5.16, 11.5.3, 11.5.9, 11.8.11, 11.8.13, 11.8.4, 11.8.5	E – 207.9 OC – 160.0 NC – 238.3[d]
common death adder	*Acanthophis antarcticus*	–	NT	11.3.1, 11.7.4, 11.7.6, 11.7.1x1, 11.9.5	E – 8.7 OC – 214.1 NC – 1,016.9
Australian painted snipe	*Rostratula australis*	V, M	V	11.3.25, 11.3.2, 11.3.27, 11.9.5	OC – 8.7
cattle egret	*Ardea ibis*	M	-	11.3.2, 11.3.25, 11.3.27,	OC – 8.7
fork-tailed swift	*Apus pacificus*	M	-	Aerial foraging over all RE types	E – 313.9 OC – 465.2 NC – 1,612.0
white-throated needletail	*Hirundapus caudacutus*	M	-	Aerial foraging over all RE types	E – 313.9 OC – 465.2 NC – 1,612.0
satin flycatcher	*Myiagra cyanoleuca*	M	-	Riparian forest on adjoining the Suttor River	0

a *EPBC Act* Status: V – Vulnerable, E – Endangered, M - Migratory
b *NC Act* Status: NT – Near Threatened, V – Vulnerable, E - Endangered
c Area calculation based on RE biodiversity status: E - Endangered, OC - Of concern, NC - No concern at present
d The quantum of impact was determined by buffering potential watering sites for this species by a distance of 1 km and determining the extent of remnant grassy woodland within this area.

The following sections provide an assessment of impacts on terrestrial fauna values known or likely to occur within the project area.

11.2.1.6 Threatened Fauna

Ornamental snake – Known to occur

The loss or degradation of riparian habitat surrounding drainage features, dams, wetlands and particularly gilgai is expected to have the largest impact on the ornamental snake. The main area of high value habitat are the lower areas of the clay floodplains containing regenerating brigalow stands and gilgai located within the footprint of South Pit 2 as well as DEHP-mapped essential habitat within the waste rock footprint associated with the West Pits.

The drainage features within the project area, particularly in the southern half, are also habitat of value for the ornamental snake. The relocation of the watercourse between West Pit 1 and South Pit 1 and the intersection of creek crossing by the central infrastructure corridor is also expected to impact ornamental snake habitat.

Cotton pygmy-goose – Known to occur

The greatest impact on the cotton pygmy goose is expected to be the removal or degradation of permanent and/or ephemeral wetlands as well as the surrounding riparian habitat, as this species is almost entirely aquatic and utilises these water bodies and nearby stags as foraging and breeding habitat. The cotton pygmy-goose was observed within the southern dam at H2 located within the footprint of West Pit 1. The cotton pygmy-goose is likely to use both farm dams in the southern section of the disturbance footprint and the nearby section of Suttor River (in times of inundation). While the two farm farms (H2 and H13) are within the disturbance footprint, the project is not expected to impact the Suttor River with the appropriate management of the adjacent waste rock dumps.

The removal of the dams and wetland areas at H2 and H13 will incur a loss of foraging and breeding habitat for this species, however as the cotton pygmy-goose is highly mobile it is expected that this species can migrate to adjacent water bodies with suitable fringing vegetation. Disturbance to other drainage features such as the creek diversion between South Pit 1 and 2 and the central infrastructure corridor creek crossings which approach the northern MIA are not expected to affect the cotton pygmy-goose as this species is likely to use a variety of wetlands and dam areas seasonally and is capable of relocating with changes in the availability of suitable wetland habitat.

Black-necked stork – Known to occur

The black-necked stork is expected to be most affected by the loss of foraging and breeding habitat within the project area. This species forages and nests adjacent to permanent or ephemeral wetlands and was detected foraging in the wetland associated with the dam at H2. Dams in the southern half of the disturbance footprint, particularly those within the West Pit 1 and South Pit 1 footprint provide high value breeding and foraging habitat for the black-necked stork.

While other suitable foraging and nest sites occur outside of the project area, this species is secretive and nests in isolated pairs in wetlands with low levels of disturbance (Dorfman et al 2001).

Square-tailed kite – Known to occur

The removal or degradation of vegetation along drainage features, such as the Suttor River and permanent water sources are expected to have the largest effect on square-tailed kite breeding and foraging habitat. This species constructs nests in the fork or on a large limb of mature eucalypts within 1 km of water (Aumann and Baker-Gabb 1991). Based on RE associations, approximately 10 ha of breeding habitat occur in the project area while foraging habitat would also include areas of non-remnant vegetation. This figure does not account for the availability of microhabitat features with the

REs, therefore the affected high value breeding habitat may be more constrained within the project area and disturbance footprint.

Squatter pigeon – Known to occur

Threats to the squatter pigeon population include loss of habitat due to clearing for agricultural or industrial purposes, habitat degradation by grazing herbivores (e.g. sheep, cattle, rabbits) and excessive predation, particularly by cats and foxes.

Grassy woodland habitat would be removed from the project area as a result of the establishment of the West Pits and South Pit 1 footprints. However, this area is likely to represent an overestimate of impacts on habitat for this species, as squatter pigeon typically occurs in proximity to water. Clearing would result in a localised reduction of breeding and foraging habitat in the southern part of the project area however, this habitat type is widespread in the region and impacts on the species as a whole would be minor.

Little pied bat – Known to occur

The little pied bat was detected at five sites (T1 to T5) within the southern section of the disturbance footprint and will be directly impacted by the loss of vegetation during the development of South Pit 2 and East Pit 2. This species roosts in tree hollows of mature trees, such as eucalypts and can forage up to 17 km from a roost site (Churchill 2008). The highest density of hollow-bearing trees in the project area would be expected to occur along the Suttor River and within poplar box woodlands (RE 11.4.2) around site H15.

Remnant vegetation associated with little pied bat habitat within the project area may be affected through the phases of the project. Mature hollow-bearing trees would be lost from the poplar box woodlands near site H15 and also in other areas of remnant vegetation within North Pit , the northern MIA, West Pit 1, 2 and 3, South Pit 1 and 2, and East Pit 2.

Habitat fragmentation and loss of connectivity may also affect the little pied bat. Little pied bats appear to be most scarce in highly fragmented landscapes: however the habitats where they do persist are well-connected, small patches of native vegetation (IUCN 2012). The habitat loss within the footprint of West Pit 3 and the associated waste rock dump will fragment high value habitat resulting in an isolated stand of remnant vegetation.

Black-throated finch (southern) – Likely to occur

The main impact on the black-throated finch is potentially the removal or degradation of riparian habitat. While the black-throated finch inhabits open woodlands and forest with a grassy understorey, almost all recent records, south of the tropics, have been in riparian habitat (BTF Recovery Team 2004). The foraging habitat of the black-throated finches requires access to water and grass seeds while breeding habitat is variable. Nesting may occur in a fork of a tree, shrub, sapling or hollow of a native or non-native species in remnant or non-remnant vegetation (DSEWPaC 2012c). The relatively broad breeding microhabitat suggests that distance to a suitable water source may be a limiting habitat factor. The dams located at H2 and H13 within the footprint of West Pit 1 and South Pit 1, respectively, is expected to have the largest effect on black-throated finch in terms of habitat loss as the sites afford high value wetlands fringed by eucalypt species and Brigalow adjacent to pastoral grasslands. The Suttor River riparian corridor is also considered to afford breeding and foraging habitat for the black-throated finch.

Common death adder – Likely to occur

The main effect on the death adder as a result of project development will be the loss of habitat within shrubby remnant or mature eucalypt or acacia woodland (particularly in Brigalow). Potential habitat occurs throughout the project area but specifically areas within the footprint of South Pit 2, West Pit 3

and the northern section of the central infrastructure corridor and the northern MIA were identified as high value areas for this species.

Australian Painted Snipe – Likely to Occur

Impacts specific to the Australian Painted Snipe are outlined in the section below under migratory fauna.

11.2.1.6.1 Migratory Fauna

The potential impacts to migratory species in the project area are predicted to be minor or negligible as many of the species are highly mobile and capable of relocating with changes in the availability of suitable wetland habitat. Potential impacts specific to migratory species known or likely to occur in the project area are discussed below.

Eastern great egret – Known to occur

The removal or degradation of permanent and/or ephemeral wetlands is likely to have the largest effect on the eastern great egret. Gilgais, inundated flood plains, dam sites and water courses, particularly those concentrated in the south-western section of the project area, afford foraging habitat for this species. The large wetland associated with the dam at H2 and the dam at H13 are located within the footprints of West Pit 1 and South Pit 1, however the dam at H19 and the riparian areas along the Suttor River are located outside the development footprint and are likely to experience little disturbance.

White-bellied sea-eagle – Known to occur

The white-bellied sea-eagle is generally associated with coastal environments and large, inland bodies of water or major drainages. It is a highly mobile species that is likely to use suitable habitat in the project area as a flyover resting site or potentially to forage. Project activities are expected to have a minor or negligible effect on the white-bellied sea-eagle.

Latham's snipe and Australian painted snipe – Known/Likely to occur

The removal or degradation of ephemeral water bodies is likely to have the largest effect on Latham's snipe and the Australian painted snipe. High value habitat includes the large wetland associated with the dam at H2 and the dam at H13 which are both located within the footprints of West Pit 1 and South Pit 1. The creek diversion and crossings between South Pit 1 and South Pit 2 and south of the Northern Infrastructure Area are also likely to affect the habitat for these species.

Rainbow bee-eater – Known to occur

The excavation of open pits and the stocking of waste rock may increase the availability of nesting sites for the rainbow bee-eater, while conversely create susceptibly of nest disturbance through ongoing project activities.

Rufous fantail – Known to occur

High value habitat for the species is located at the farm dam at site H2 and the riparian corridor of waterways in the southern section of the project area. The removal of the dam and diversion of the creek located between South Pit 1 and South Pit 2 is likely to impact foraging habitat however, this species typically breeds in moister vegetation types.

Cattle egret – Likely to occur

Suitable habitat for this species is more prevalent within the southern half of the project area, largely within the footprint of the West and South pits, within non-remnant vegetation in proximity to water.

As the cattle egret appears tolerant of some level of ground disturbance, the largest effect as a result of project activities is expected to be displacement during the construction phase.

Fork-tailed swift and white-throated needletail – Likely to occur

The fork-tailed swift and white-throated needletail are highly mobile, aerial species which adapt to many habitat types. Breeding and foraging habitat are considered unlikely to be affected by the project.

Satin flycatcher – Likely to occur

Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The satin flycatcher is considered likely to occur in riparian vegetation adjoining the Suttor River (outside of the project area).

11.2.1.7 Bioregional and Culturally Significant Fauna

Road mortality resulting from increased traffic, particularly along the central infrastructure corridor, is likely to have the largest impact on ground dwelling short-beaked echidna.

The bioregional significant Australian bustard (*Ardeotis australis*) and grey-crowned babbler (eastern) (*Pomatostomus temporalis temporalis*) also have large distributions and habitat loss expected to only have a minor impact these species.

11.2.2 Aquatic Ecology Impacts

11.2.2.1 Removal and Diversion of Waterways

Within the project area, approximately 36.2 km of mapped streams will be directly impacted by clearing activities and stream diversions. In the Upper Suttor River sub-catchment (southern project area), this includes direct impacts on the following streams mapped by DEHP:

- 6.2 km of 1st order streams
- 9.2 km of 2nd order streams
- 2.2 km of a 3rd order stream.

In the Rosella Creek sub-catchment (northern project area), the following streams mapped by DEHP will be directly impacted:

- 11.6 km of 1st order streams
- 1.9 km of 2nd order streams
- 5.1 km of 3rd order streams
- 50 m of 4th order streams.

Five stream diversion channels are proposed (refer **Section 3.1.4**): four in the Suttor Creek sub-catchment and one in the Kangaroo Creek sub-catchment.

Macrophyte communities will be impacted during establishment of stream diversion channels, but are expected to rapidly colonise the constructed diversion channels; therefore, impacts to macrophytes during establishment of stream diversion channels are expected to be minor, and short in duration. It is expected that the diversion channels would be colonised by macroinvertebrate species via mobile adult migration. As a result, the impact on aquatic fauna is unlikely to be significant in the longer term.

11.2.2.2 Removal of Dams

Two lacustrine water bodies (dams) are likely to be removed as part of the Project. One of the dams (Site S2) is approximately 5 ha in area and is located within the proposed West Pit 1. The other dam is approximately 0.8 ha in area and is in the path of the proposed southern-most diversion, and thus would need to be modified as part of diversion's construction. The removal of these lacustrine water

bodies will potentially have a direct impact on individual fauna, as well as an indirect impact through reduction of potential breeding habitat.

11.2.2.1 Indirect Impacts on a Wetland of High Ecological Significance

The HES wetland on the western boundary of the project area is not within the footprint of project activities. Impacts on this wetland may result from:

- development in the catchment of this wetland resulting in detrimental impacts on the hydrological regime of this wetland
- mine affected water or sediment affected water run-off from disturbed areas, entering the wetland, although this will be controlled through the mine water management system described in **Section 3.**

There is likely to be a temporary change in plant species composition as hydrological regimes change over time. Provided that a core area of wetland remains seasonally inundated, a representative suite of plants should persist and enable recolonisation over time as the wetland expands in area.

11.2.2.2 Vegetation Clearing, Earthmoving, and Control of Stormwater Runoff

The establishment of project infrastructure would potentially impact surface water quality through increased erosion of sediments that are exposed after vegetation clearing. If not appropriately controlled, erosion of sediments can lead to increased suspended sediment loads to waterways, which can reduce light penetration and visibility, limiting plant growth, and impeding fish movement. Increased sedimentation can also reduce waterway depths, change drainage patterns, and smother benthic flora and fauna.

Aquatic ecosystems within the project area also have the potential to be impacted by nutrients, salts, metals, or other contaminants that are adsorbed onto sediments washed into the waterways. Increased nutrient loads can promote excessive growth of aquatic flora (algae and macrophytes), provided environmental conditions also favour photosynthesis (i.e., light availability). Excessive growth of aquatic flora can reduce oxygen concentrations. Excessive growth of surface aquatic flora can block sunlight for submerged flora, limiting their photosynthetic activity.

Hydrocarbon based leaks or spills from construction equipment represents a potential risk, as most are toxic to aquatic flora and fauna at relatively low concentrations. Runoff of spilt fuels and oils into waterways is only likely to occur if spills occur in close proximity to waterways (natural stormwater channels and constructed diversion channels), or if the spill or leak is left uncontrolled. The risk of impacts to aquatic flora and fauna from a fuel or oil spill is lower during the dry season (when watercourses are dry) as spills are likely to be contained before they disperse throughout the waterway.

11.2.2.3 Vehicle Stream Crossings and Obstruction of Fauna Passage

The project requires approximately 16 vehicle stream crossings including:

- 6 crossings of 1st order streams
- 2 crossings of 2nd order streams
- 3 crossings of 3rd order streams
- 1 crossing of a 4th order stream (Kangaroo Creek)
- 4 crossings of stream diversions.

Construction of stream crossings can cause both direct and indirect impacts. Direct impacts include a loss of riparian and aquatic habitat due to disturbance of the bed and banks, increased sunlight exposure, and accelerated sedimentation and impeding fish movement. Indirect impacts include long-term barriers to fish movement, alteration of habitats, and increased pollution.

11.2.2.4 Operational Impacts

Without appropriate mitigation measures in place the mine operation has potential to impact on aquatic ecological values in the project area and broader catchment through:

- uncontrolled discharge of mine affected water into waterways
- uncontrolled stormwater runoff from disturbed areas entering waterways or wetlands
- uncontrolled dust emissions and deposition into waterways or catchment areas
- altering the geomorphology and ecology of a waterway through changes in flow and water quality.

The water management system, including capture storage and release of mine-affected water is described in **Section 3**. Given that site releases will be strictly regulated and there is no significant change expected to key physico-chemical attributes in the receiving environment, adverse impacts on aquatic ecosystems are not expected.

Areas that drain disturbed areas such as the MIA, coal stockpiles, recently rehabilitated waste rock dumps, access roads and laydown areas have the potential to generate sediment laden runoff.

The geomorphology and ecology of natural streams within the project area may be altered by changes in flow and water quality. The project has the potential to alter the hydrology of surface water systems by capturing water in dams, losing water in the form of dust suppression or pond evaporation, and releasing water during flow events.

The palustrine wetland (a HES wetland) and its catchment would be temporarily affected during mining.

11.2.3 Stygofauna

Consideration of impacts not required (refer **Section 11.1.3**).

11.3 Environmental Protection Objectives

Environmental protection objectives for the project are identified as follows:

- Protection of conservation significant species, communities and habitat.
- Minimal disturbance to flora and fauna during construction and operation.
- No unplanned or unapproved disturbance/clearing of flora and fauna.
- Effective rehabilitation of post-mining landscape to ensure suitable habitat for recolonisation.
- No long term loss in bioregional extent and ensure no degradation of retained communities in the disturbance area.
- Offsets provided in accordance with requirements of the Offsets Strategy.
- No long term reduction in known habitat and local population viability and minimise degradation to retained, potential habitat in the disturbance areas.
- No introduction of new weed species or spread of existing weed species
- No introduction of new pest species or spread of existing pest species.
- Containment and control of identified priority weed infestations.

11.4 Performance Criteria

In meeting the objectives identified above, performance criteria are identified as follows:

- Compliance with the requirements of the project's environmental authority.

- Compliance with the Rehabilitation Management Plan (refer **Section 9**).
- Compliance with the REMP (to be prepared).
- Compliance with the requirements of the water management system, including release criteria for mine affected and sediment affected water (refer **Section 6**).
- Compliance with the requirements of an approved Pest Mangement Plan (PMP).
- Flora and fauna managed in accordance with the requirements of permits and species plans.
- No unplanned or unapproved disturbance/clearing of flora and fauna.
- Successful creation of offsets in accordance with success criteria in the Offsets Strategy.

11.5 Control Strategies

11.5.1 Terrestrial Ecology

11.5.1.1 Control Strategies for Direct Impacts

Strategies to control impacts of land clearance, habitat loss, fragmentation and loss of connectivity may include:

- Clear delineation of areas of vegetation requiring removal to ensure disturbance is minimised.
- Maintenance of retained areas of vegetation to provide a source of seed for mine rehabilitation.
- Preparation of a RMP and Mine Closure Plan (MCP) incorporating rehabilitation monitoring and trials.
- Use of native species for rehabilitation wherever possible. If native species are unsuccessful, introduced stoloniferous grasses may be to achieve rapid surface coverage.
- Minimising vegetation clearance along drainage features in order to maintain bank stability, habitat connectivity and movement corridors for terrestrial fauna species.
- Clearing riparian vegetation in a staged manner to allow fauna to migrate to adjacent habitats.
- Having a suitably qualified spotter-catcher available when clearing in habitat areas.
- Progressive rehabilitation of mined areas to incorporate the provision of microhabitat features such as trees and logs.
- Habitat Fragmentation/Loss of Connectivity: Placement of waste rock at the out of pit waste rock dumps associated with South Pit 1 will be closely supervised to ensure no unnecessary clearing occurs and that water and sediment are managed to avoid impacts on vegetation and water quality within and adjacent to the Suttor River.

11.5.1.2 Control Strategies for Indirect Impacts

Control strategies for other potential terrestrial impacts include the following:

- Edge Effects: Rehabilitation of disturbed areas and the provision of buffers around undisturbed areas of remnant vegetation will help to minimise edge effects.
- Watercourse Diversion: Subject to re-establishment of ‘natural’ channels which include riparian vegetation and appropriate management to prevent erosion, only minor impacts on terrestrial flora and fauna values are expected as a result of watercourse diversions.

- Waterway Crossing: Impacts associated with waterway crossings will be reduced by minimising the number of crossings required, designing to prevent scour and implementing appropriate sediment and erosion controls at crossing points.
- Noise mitigation: High intensity activities such as blasting will be generally restricted to daylight hours which will minimise impacts on the breeding and feeding behaviour of nocturnal animals.
- Vehicle Strike Risk: The highest risk of direct fauna mortality is likely to be associated with vehicles travelling along the central infrastructure corridor. These crossings will be designed to minimise the potential for interaction with fauna. Reduced speed limits will also be adopted along the infrastructure corridor to minimise the risk for interaction with fauna by vehicle collision. In addition, lighting may also be provided at major intersections and points of major infrastructure along the corridor.
- Fauna Injury: Native fauna injured during construction and operational phases of the project would be taken to a vet or wildlife carer. In the event of injuries to domestic fauna or livestock, personnel would call for veterinary assistance and notify the appropriate landholder.

11.5.1.3 Control Strategies for Remnant Watercourse Vegetation, Threatened REs and TECs

Impacts on endangered and of concern REs will be minimised by marking the areas to be cleared to avoid unnecessary loss of these communities. Progressive rehabilitation of mined areas will also be undertaken in accordance with a Rehabilitation Management Plan which may include using species characteristic of the original ecosystems wherever possible.

Impacts on remnant watercourse vegetation will be mitigated by:

- minimise the number of waterway crossings for Kangaroo Creek and tributaries
- maintaining adequate buffers from the Suttor River riparian corridor
- providing appropriate scour and erosion protection to maintain vegetation and ecological function
- restricting disturbance of watercourse vegetation to that necessary for the works
- maintaining adequate buffer distances from watercourses not directly impacted by mining
- emulating natural vegetation communities along realigned watercourses through planting endemic species characteristic of the original vegetation communities impacted.

11.5.1.4 Control Strategies for Significant Flora

Appropriate fire management regimes will be implemented to minimise the potential for adverse impacts on *Cerbera dumicola*.

11.5.1.5 Control Strategies for Fauna Species

Control strategies for threatened species may include the following:

- Ornamental snake: Management measures will focus on minimising the impact on riparian vegetation associated with the location of the waste rock dumps within the Suttor River floodplain. Adequate buffers will be maintained from retained vegetation and scour protection provided for the dump to minimise the potential for erosion, sedimentation and associated impacts on water quality, particularly during larger flood events. Vehicle movements around the dump will be minimised, particularly at night, to reduce the risk of vehicle strike and the disruption associated with lighting in this habitat.

- Black-necked stork: The use of plain wire, opposed to barbed wire will be considered to reduce juvenile black-necked storks (as well as other species prone to collision (e.g. kangaroos, emus)) collision and probably mortality. A strategy to reduce vehicle collisions will also be developed.
- Squatter pigeon: Where possible, clearing in proximity to water will be undertaken outside breeding times (September through October), with fauna spotter-catchers employed to search for nests and/or stir up birds ahead of clearing works outside these times. Reduced speed limits will be imposed on haul roads close to watering points during the construction and early operational phases of the project prior to the removal of suitable habitat from within the project footprint.
- Little pied bat: Consideration will be given to the maintenance and/or re-establishment of connectivity in habitat through the central part of the project area.
- Black-throated finch (southern): Impacts on this species will be mitigated by conducting detailed searches of nesting habitat within proximity to important water sources (i.e. transects along the Suttor River riparian corridor and dam at H2) and replicating suitable habitats where possible.
- Common death adder: Impacts on this species will be managed by employing fauna spotter-catchers to flush out individual animals prior to clearing in remnant areas and implementing appropriate weed, pest and fire management protocols and measures to reduce vehicle strike. This species is venomous and personnel interacting with this species will be trained in the management and handling of venomous snakes.

Control strategies for migratory species may include the following:

- Eastern great egret: The waste rock dump, located west of South Pit 1 will be managed to reduce the probability of habitat degradation within the Suttor River riparian areas.
- Latham's snipe and Australian painted snipe: Impacts on these species will be mitigated by having a suitably qualified spotter-catcher available when clearing in habitat areas and the provision of suitable habitat associated with offset benefits for the species.
- Rainbow bee-eater: Impacts on this species will be mitigated by timing works in and around watercourses to avoid breeding times (September to February) and to deploy fauna spotter-catchers to search for nest burrows in stream banks when works during this period cannot be avoided.
- Rufous fantail: Impacts on breeding habitat for this species will be mitigated by minimising impacts on the Suttor River riparian corridor.

Control strategies for Bioregional and Culturally Significant Fauna:

- Ground dwelling short-beaked echidna: Road mortality resulting from increased traffic, particularly along the central infrastructure corridor, is likely to have the largest impact. Measures to avoid vehicle strike will be applied.

11.5.2 Aquatic Ecology

11.5.2.1 Control Strategies for Diversion of Waterways

Diversions will be designed to limit impacts on hydrology and control measures to mitigate impacts may include:

- Construction would occur during the dry season,

- Disturbance to breeding places would be undertaken in accordance with an approved species management program (SMP), damage mitigation permit (DMP), or other relevant authorisation, to ensure compliance with the *NC Act*.
- A General Fisheries Permit under the *Fisheries Act 1994* would be obtained to take, remove, or relocate fish during site establishment.
- Revegetated according to the RMP, which should minimise erosion by stabilising channel banks and beds, thus reducing sediment loads.
- Establish riparian corridors to achieve riparian vegetation continuity along diversion channels, allowing biogeochemical processes to continue and to assist in regulating water quality.

Monitoring of the diversion channels would include the physical condition (e.g., bank stability, erosion, and physico-chemical water quality), and biological condition (e.g., vegetation cover, health, and utilisation by aquatic fauna).

11.5.2.2 Control Strategies for Indirect Impacts on a Wetland of High Ecological Significance

During mining, the West Pit complex, including waste rock dump, will be developed in this catchment, reducing flow to the wetland. The mine will reduce the catchment area by approximately 43%, to 2.4 km^2 for a period of approximately 16 years, until such time as the West Pit complex waste rock dump is rehabilitated and the wetland catchment reinstated.

Reinstatement of the current hydrological regimes (through rehabilitation of the West Pit complex waste rock dump) is considered likely to see the return of the wetland to its current state over time.

A culling program will be considered for feral pigs to minimise damage to the wetland areas which are intended to be a seed source for the broader wetland upon its reinstatement.

The remediation strategy for the area will include returning the land to a similar hydrological profile, creating a similar catchment for the wetland.

Sediment and erosion control structures will be installed upslope of this wetland prior to the commencement of works to negate sediment laden runoff entering this wetland. These sediment and erosion control structures (described in **Section 10**) will be monitored and maintained throughout the site establishment works.

11.5.2.3 Control Strategies for Vegetation Clearing, Earthmoving, and Control of Stormwater Runoff

Impacts from potential increased nutrient loads to waterways are, however, expected to be minimal, providing that adequate sediment and erosion controls are established prior to site clearing, and are maintained throughout the site establishment works. Sediment and erosion controls are described in **Section 10**. The mine water management system, including capture of sediment-affected water is described in **Section 3**.

11.5.2.4 Control Strategies Vehicle Stream Crossings and Obstruction of Fauna Passage

Stream crossings will be designed in a way that maintains or enhances water flows, water quality, stream ecology and existing riparian vegetation. Impacts to the hydrologic, hydraulic, and geomorphic functions of the stream will be minimised. Stream crossings should be designed in accordance with Queensland Fisheries guidelines for design of stream crossings (FHG 001, Cotterell 1998[15]) and the NSW

[15] Cotterell, E. (1998). Fish Habitat Guideline FHG 001 – Fish Passage in Streams: Fisheries guidelines for design of stream crossings. Department of Primary Industries, Brisbane.

Office of Water (2010[16]) guidelines for watercourse crossings, which include a range of guidelines for design and construction mitigation.

11.5.2.5 Control Strategies for Operational Impacts

- Mine-affected water: Mine affected water will be released to the environment when it meets the release criteria for water quality and receiving water flow rates. The water management system, including capture storage and release of mine-affected water is described in **Section 3**. Release criteria have been established in accordance with the QWQG, as described in **Section 6.3.3** and are designed to protect existing environmental values including aquatic ecology in receiving waters and have been developed based on a baseline monitoring program. Scour protection will be provided at discharge points, where required.
- Control of runoff: The mine water management system describing separation of clean water from undisturbed areas and sediment-affected waters is described in **Section 3.1**. Runoff from undisturbed catchments upstream of the mining area would be diverted around the disturbed area and released directly to the environment. Sediment-affected water would pass through sediment dams prior to release to the environment. Sedimentation dams will be utilised until disturbed areas are sufficiently rehabilitated and stabilised.
- Stream Hydrology and Geomorphology: The remediation strategy for the palustrine wetland (a HES wetland area) will include returning the land to a similar hydrological profile, creating a similar catchment for the wetland. Following remediation it is considered likely that the wetland would be restored to its current condition.

11.5.2.6 Decommissioning Phase

The areas disturbed by mining will be rehabilitated as per a Rehabilitation Management Plan (to be developed). Four final voids will remain, but these voids are not predicted to overtop and there should be no impacts to aquatic ecology in surrounding waterways and wetlands.

11.5.3 Stygofauna

No control strategies are proposed in relation to stygofauna (refer **Section 11.1.3**).

11.6 Residual Impacts

11.6.1 Terrestrial Ecology

Land clearance and habitat loss associated with the establishment of open cut pits and supporting infrastructure are the main impacts on the terrestrial flora and fauna values of the project area.

The project will result in the loss of approximately 2,391.1 ha of remnant native vegetation from within the footprint. This will result in an overall reduction in the extent of endangered (313.9 ha) and of concern (465.2 ha) vegetation communities in the project area.

Removal of permanent water sources associated with farm dams may also result in the loss of a habitat resource for some threatened and migratory species.

[16] NSW Office of Water (2010). Controlled activities – Guidelines for watercourse crossings. NSW Department of Environment, Climate Change and Water

11.6.1.1 Terrestrial Ecology Residual Impact Offsets Control Strategy

The proponent will mitigate residual impacts on endangered and of concern vegetation communities through an approved offsets strategy, subject to approval by the regulatory body responsible for offset assessments.

11.6.2 Aquatic Ecology

No residual impacts are anticipated once control strategies are implemented.

11.6.3 Stygofauna

No residual impacts are anticipated (refer **Section 11.1.3**).

11.7 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 11.5** and compliance with the criteria outlined in **Section 11.4** as applicable to flora and fauna management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

Ecological monitoring will include the following:

- A Rehabilitation Management Plan and Mine Closure Plan will be developed which incorporate rehabilitation monitoring and trials.
- Monitoring of rehabilitation success will be conducted at locations representative of the range of conditions impacting the rehabilitating areas. Monitoring data will be reviewed to assess trends and monitoring program effectiveness.
- As part of weed management, known populations of *Kelita uncinella* occurring on the project area may be monitored during construction and operation.
- Diversion channels will be monitored and will include the physical condition (e.g., bank stability, erosion, and physico-chemical water quality), and biological condition (e.g. vegetation cover, health, and utilisation by aquatic fauna).
- A suitable baseline assessment and ongoing monitoring will be undertaken to monitor the status of the palustrine wetland, including seasonal variation. These monitoring requirements will be included in the REMP.
- A monitoring program will be established to monitor water quality in the mine water management system and in the receiving environment.

- Sediment and erosion control structures will be monitored and maintained throughout the site establishment works.
- Regular monitoring and reporting on the progress of the offset will be provided to the regulator. These monitoring actions will provide a record of comparability over the term of the offset and the overall progress of the offset.
- Weed monitoring will be conducted annually at offset sites by the land manager and recorded. These records will be incorporated into reports to the regulator.

11.8 Proposed EA Conditions

Schedule Y - Ecology

Y1 Cleared vegetation from the site must be managed in accordance with the following hierarchy:

a) Reuse, e.g. use of logs and tree stumps as shelter for fauna in rehabilitated areas
b) Recycle, e.g. mulching of vegetation and use in rehabilitation on the site
c) Other alternative management options implemented in a way that causes the least amount of environmental harm.

Y2 A detailed weed and pest management plan will be developed prior to the commencement of construction activities. The weed management plan will describe how the weeds and pests are to be managed in accordance with the LP Act 2002 and/or local government requirements for weeds not declared under state legislation.

12. WEED AND PEST MANAGEMENT

12.1 Environmental Values

The environmental values to be protected or enhanced are the terrestrial and aquatic flora and fauna of the ecosystems in the vicinity of the project.

12.2 Potential Impacts

12.2.1 Terrestrial Weeds

Site surveys identified 56 introduced flora occurring within the project area of which the following are weeds of National Significance (WONS), and/or declared as Class 2 pests under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), and/or Whitsundays Regional Council Pest Management Plan (WRC 2009) regionally significant weed:

- rubber vine (*Cryptostegia grandiflora*) – (WONS and LP Act)
- velvet pear (*Opuntia stricta*) – (WONS and LP Act)
- prickly pear (*Opuntia tomentose*) – (WONS and LP Act)
- parthenium (*Parthenium hysterophorus)* – (WONS and LP Act)
- harrisa cactus (*Harrisia martinii*) – (LP Act)
- fireweed (*Senecio madagascariensis*) – (LP Act)
- Noogoora burr (Xanthium *pungens*) – (WRC 2009).

The most widespread environmental weed encountered was buffel grass (*Cenchrus ciliaris*). Other common environmental weed species include a large number of grasses and scattered occurrences of sensitive weed (*Mimosa pudica*). Weed cover generally reflects site history and disturbance with areas intensively utilised for grazing typically devoid of native ground covers.

An increase in bare ground and open areas, associated with project related land clearance, will favour weedy species, particularly parthenium, which can suppress the regeneration of native species and reduce the available habitat for native species. Vehicles, machinery and material movement has the potential to introduce new terrestrial weed into the area, and/or facilitate the spread of weeds.

12.2.2 Aquatic Weeds

Only one aquatic weed, Awnless barnyard grass (*Echinochloa colona*), was detected during field surveys. This species is a native of tropical Africa and Asia and is a weed of irrigated areas and soils prone to flooding. It is not listed as a WONS in Australia, nor is it declared under the LP Act. The presence of aquatic weed species may have the following impacts:

- exclusion of native aquatic vegetation by out competing these species
- reduction in dissolved oxygen levels, reduction in water temperature and effects on breeding habitat through the prevention of light penetration, as well as physical smothering of native plants
- restriction of access to river bank nesting habitat for turtle species.

Vehicles, machinery and material movement associated with the project will have the potential to introduce new aquatic weeds into the area, and/or facilitate the spread of weeds.

12.2.3 Pest Animals

The following feral animals declared as pests under the LP Act were observed or are considered likely to occur within the project area:

- feral dog (*Canis lupus familiaris*)
- dingo (*Canis lupus dingo*)
- feral cat (*Felis catus*)
- feral pig (*Sus scrofa*)
- rabbit (*Oryctolagus cuniculus*)
- goat (*Capra hircus*)
- cane toad (*Bufo marinus*)
- house mouse (*Mus musculus*)
- house gecko (*Hemidactylus frenatus*).

The impacts of these species are likely to include the following:

- predation on or toxicity to native species
- competition for food resources, which may decrease abundance of prey for native predator species
- habitat changes due to destruction of plants, changed floristic composition, reduced regeneration of plants, alteration of soil structure, increased invasion and spread of weeds
- increased access for non-native predator species
- reduced water quality and availability
- spread of exotic invertebrates and creation of habitats suitable for disease, including the spread of root-rot fungus, *Phytophthora cinnamomi*
- Cane toads are considered to pose a threat to the ornamental snake, common death adder, northern quoll and rainbow bee-eater (through usurping of nesting burrows).

12.3 Environmental Protection Objectives

The following protection objectives for the project site are identified:

- Prevent the introduction and/or spread of significant weed species and plant diseases into areas presently unaffected
- Contain and control identified priority weed infestations
- Monitor the effectiveness of weed and plant disease prevention and containment strategies to reduce the introduction and/or spread of significant weed species and plant diseases
- Avoid or manage potential threats that particular terrestrial animal pest species pose to biosecurity.

12.4 Performance Criteria

In meeting the objectives set out above, the following performance criteria is identified:

- Compliance with the requirements of the project's PMP (to be developed, based on control strategies presented below).

12.5 Control Strategies

12.5.1 Weed Management

12.5.1.1 Prevention

- Workers and contractors will be made aware of the significant weed species of the region, the potential impact on the project site and surrounding lands and their responsibilities as per a weed and pest management plan to minimise introduction and/or spread of weeds.
- Vehicles, machinery, plant equipment and materials imported from overseas will be inspected by quarantine and customs in accordance with the requirement and protocols of Australian Quarantine and Inspection Service (AQIS).
- Vehicles, machinery, plant equipment and materials will be certified weed free. A weed hygiene declaration form and/or a vehicle washdown register will be maintained.
- Drivers will be advised to keep vehicles to roads or compacted surfaces (preventative) and reduce vehicle movements in wetted soil where avoidance is not possible.
- Wash down facilities will be constructed for vehicles arriving and departing from the project. These facilities will be confined to one area, bunded and located away from drainage lines.
- During site clearing operations in areas known to have weed infestations, vegetation will be disposed of at a designated disposal sites or otherwise managed to avoid weed spread.
- Disturbance will be minimised and management measures implemented to prevent the spread and establishment of parthenium and buffel grass into adjacent habitat for this species.
- Soil known to contain parthenium or other declared weeds will not be moved into weed free areas. Where this is unavoidable, plants will be treated and soil placed in soil dump footprints or co-disposal pit.
- Where soil or material is known to contain weeds it may be necessary to cover truckloads.
- Seeds brought onto the project area must comply with the relevant seed Acts.

12.5.1.2 Treatment and Control

Vegetation areas to be retained and cleared areas to be revegetated, will be identified prior to the commencement of construction.

Treatment plans will be implemented for major weed infestations (i.e. Weed Control Sites) and will be designed considering optimal treatment times and methods to maximise effectiveness for control. Treatment applications will be selected on a species-by species basis depending on the effectiveness of the application to control each species. Identified weeds of management concern, including declared and environmental weeds, will be controlled in accordance with local best practice management as described in the pest fact sheets published by Biosecurity Queensland and the Department of Agriculture, Fisheries and Forestry. Treatment applications may employ mechanical, chemical, biological and cultural methods.

Physical/mechanical control methods can be highly effective for small infestations, may help to retain ground cover and can discourage germination of weed seeds. Because this method can disturb the soil, its use is often discouraged in areas with poor soil stability. Physical/mechanical methods may include:

- hand-pulling
- grubbing

- slashing/mowing/mulching/netting
- cultivation (ripping/rotary hoeing/stick raking) or bulldozing.

Chemical treatment methods would be undertaken by licensed operators as per the Queensland *Agricultural Chemicals Distribution Control Act 1966* (*ACDC Act*). Operator licences are issued by the Department of Agriculture, Forestry and Fisheries (DAFF). The type and method of application will vary depending on the targeted species, location, size of infestation and age of growth (refer to the Material Safety Data Sheet [MSDS] for individual herbicides). Applications may include:

- foliar spray
- wick application
- basal bark
- cut stump
- stem injection
- soil or root application.

Cultural control refers to land management and better management practices in order to reduce weed infestations and prevent weed spread. These methods are most effective when used in conjunction with other physical/mechanical, chemical and biological control applications and may include:

- revegetation
- quarantine
- fire
- hygiene.

12.5.2 Plant Disease Management

Plants and seeds must be examined before entering the project site to ensure that plant diseases are not introduced or spread on-site and to surrounding lands. Where necessary quarantine bins will be provided for the receipt of quarantine waste which may include plants and/or plant materials. This material would be collected and treated or disposed of only by qualified personnel in accordance with AQIS requirements. Contact details for quarantine personnel will be made readily available to site personnel. Plants and plant materials suspected of being affected by an Alert plant disease will be immediately reported to DAFF so they may provide instruction on further action to be taken such as diagnosis, containment and treatment.

12.5.3 Pest Species Management

Pest species management will include:

- appropriate disposal and management of wastes on site
- waste, including food scraps, should not be left uncovered to avoid attracting feral animals
- where feral animals are identified, appropriate strategies are to be developed in consultation with the local government and/or Biosecurity Queensland
- where the introduction of any new feral animal species or spread of existing feral species has resulted from project activities, the project activities will be reviewed taking into account the likely sources of the introduction and including procedures to prevent re-occurrence
- no feeding or handling of animals.

12.5.4 Animal Disease Management

There will be no live animal imports directly to the site.

12.6 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 12.5** and compliance with the criteria outlined in **Section 12.4** as applicable to weed and pest management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

Monitoring establishes benchmarks for assessing the extent and distribution of significant weed species within the project site over time, and the effectiveness of management strategies. The management strategy can be altered based on monitoring results as needed, to improve results and respond to changes in the environment, such as seasonal conditions or changes that may compromise existing priorities and previously set goals.

Monitoring activities will focus on:

- Extent and distribution of weed populations including new infestations with more frequent monitoring during construction.
- Following construction, surveys will be undertaken on a regular basis to assess the extent and distribution of significant weed species within the project site. This survey will include previously disturbed areas, retained vegetation, buffer areas and monitoring for plant disease.
- Treatment applications - Photographs will be taken prior to and after treatment applications to provide a visual assessment of the effectiveness of methods to reduce weed density.
- Monitoring in response to outbreaks or spreading of declared weeds particularly parthenium.
- Monitoring disturbed and non-disturbed project areas to inform adaptive management approaches.
- Information gathered during the monitoring process will enable informed decisions to be made and allow for the alteration and tailoring of the weed management strategy to suit priorities.

12.7 Proposed EA Conditions

Reference **Section 11.8 Schedule Y.**

13. AIR QUALITY AND GREENHOUSE GAS MANAGEMENT

13.1 Environmental Values

13.1.1 Environmental Protection (Air) Policy 2008

The Queensland Environmental Protection (Air) Policy 2008 (EPP (Air)) aims to achieve the object of the *Environmental Protection Act 1994* (EP Act) in relation to Queensland's air environment. Schedule 1 of the EPP (Air) nominates relevant air quality indicators and goals for any sensitive or commercial place, which have been adopted as the air quality objectives for the project, as follows:

a) Total suspended particulate 90 µg/m^3 averaged over a year.

b) $PM_{2.5}$ 8 µg/m^3 averaged over one year.

c) $PM_{2.5}$ 25 µg/m^3 averaged over 24 hours.

d) no greater than 5 days per year where the dust concentration of PM_{10} averaged over 24 hours, or PM_{10}(24 hour), is greater than 50 µg/m^3 (i.e. the 5th highest).

13.1.2 DEHP – Guidelines

The EPP(Air) 2008 does not address dust deposition. The relevant guideline for the assessment of air quality in relation to the project is the DEHP's (formerly EPA), "*Preparing an E nvironmental Management Overview Strategy (EMOS) for Non-standard Mining Projects*". This guideline requires that the release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance at any sensitive or commercial place. According to the guideline, the maximum permissible measured dust levels, which have been adopted as the air quality objective for the project:

(a) Dust deposition of 120 mg/m^2/day, averaged over one month

(b) PM_{10} 150 µg/m^3 averaged over 24 hours, at a sensitive or commercial place downwind of the operational land.

In the case of the latter, the 150 µg/m^3 (24 hour) PM_{10} criterion has been superseded by the more recent and more stringent provision of Schedule 1 of EPP(Air) 2008, i.e. PM_{10}(24 hour) (5th highest) is to be no greater than 50 µg/m^3.

13.1.3 National Environmental Protection Measure Air

The National Environmental Protection Measure (NEPM) (Air) 1998 was developed by the National Environment Protection Council for ambient air quality allowing for the adequate protection of human health and well-being. This PM_{10} goal is the same as that contained in Schedule 1 of the EPP (Air).

13.1.4 Vegetation

The direct physical and chemical effects of dusts on vegetation became apparent only at relatively high surface loads. Doley (2006) examined the physical effects of dust on vegetation and suggested that the most sensitive plant functions may be altered with monthly dust loads (deposition) of about 8 g/m^2 (266 mg/m^2/day) for dust with medium diameters of 50 µm.

The potential impacts of dust deposition on terrestrial ecology are included in **Section 11** .

13.1.5 Sensitive Receptors

Potentially sensitive receptors, for the purposes of assessing project impacts on air quality, are defined in **Section 8.1.2**.

13.1.6 Climate

Climate data from Moranbah and Collinsville Bureau of Meteorology (BOM) weather monitoring stations was used for modelling purposes. The region has a warm climate with two distinct seasons, a dry winter season and a wet summer season. Dry season temperatures generally range between 9°C to 30°C, while wet season temperatures range from 20°C to 33°C. Rainfall is seasonal mostly between November and April and highly variable ranging from around 200 mm to above 1,200 mm each year.

13.1.7 Dust

During the wet summer season the dust emissions from most activities are less than during the dry season. The dry winter season is also the period when grass fires are likely to occur.

13.1.8 Greenhouse Gas

In December 2007, the Australian government ratified the Kyoto Protocol, an international agreement designed to restrict growth in the emission of greenhouse gases in developing countries to the quantity being emitted in 1990. This target was expected to be met over the five year period from 2008 to 2012. Australia committed to monitor and report greenhouse gas emissions and has set a target level for emissions of 108% of estimated emissions for 1990 or 591.5 million tonnes (Mt) CO_2-e.

13.2 Potential Impacts

13.2.1 Development of the Emissions Database

Construction will involve vegetation clearance and some earthworks but will be at a level of activity less than the operational coal mine. Decommissioning activities will involve infrastructure removal and final rehabilitation activities. Dust emissions will occur during construction and decommissioning at levels below the operational mine; hence operational conditions are applicable to all phases of the project.

The development of an operational emissions database has been based on the National Pollution Inventory Emission Estimation Technique Manual for Mining Version 2.3 (NPI 2012) as well as US-EPA AP-42 (2003) 5th Update. The main mining activities that produce, were identified for the project.

The NPI 2012 describes standard (level 1) and enhanced (level 2) watering rates for dust control. Modelling assumes that enhanced (level 2) watering provides 75% dust control efficiency and standard (level 1) watering provides 50% dust control efficiency compared to no watering. Level 2 controls may also comprise more specific methods for loading of haul trucks (to avoid spillage) and timely spillage control or spot watering rather than general increase in the watering rate for all hours and roads.

Three main cases (modelling scenarios) were addressed representing Year 5, Year 17 and Year 36 from commencement. All aspects of the modelling (meteorological, scheduling and operational) have been designed to achieve realistic worst-case down-wind atmospheric dust concentrations for modelling dust emissions from project activities.

13.2.2 Results of Dispersion Modelling – Dust Emissions

The modelling of dust concentration and deposition levels at each nearby sensitive receptor, was undertaken for several operational stages of the mine as follows:

- Year 5 with standard dust controls
- Year 5 with enhanced dust control
- Year 17 with enhanced dust control
- Year 36 with enhanced dust control.

Standard dust controls were modelled for Year 5 only, to provide a starting point of reference to guide the control levels that would be most relevant for subsequent modelling runs. Results showed that for Years 17 and 36, modelling runs using enhanced dust control would be more relevant. The predicted dust concentration/deposition includes the assumed background level.

Modelling results showed that air quality parameters $PM_{2.5}$ (24 hour), $PM_{2.5}$ (annual average), TSP, and dust deposition, were within the respective air quality objectives at all relevant receptors, for all years modelled, with the application of standard or enhanced dust controls.

However, the PM_{10}(24 hour) air quality objective of no more than 5 days per year where the dust concentration of PM_{10}(24 hour) was greater than 50 µg/m^3 (5^{th} highest) at R5 for all years modelled, but is met at all other locations for all years modelled. As such industry accepted mitigations were modelled to achieve 5^{th} highest PM_{10} (24 hour) compliance. Modelling showed that with specific mitigations (**Section 13.5**) dust emissions can be reduced to achieve compliance at R5 for all modelled years.

Dust deposition contours for the project area generated from air quality modelling indicate a 266 mg/m^2/day deposition rate may be exceeded in the immediate vicinity of mining operations (i.e. the project footprint). As limited vegetation will be retained within the project footprint, detrimental dust effects on plant health would be minor.

13.2.3 Train Loading Facility Modelling

Dust emissions for the entire rail line route were assessed as part of the GAP rail line expansion. QR (now Aurizon) has in place a Coal Dust Management Plan (CDMP). The proponent is fully committed to compliance with Aurizon's CDMP. This EM Plan considers air emissions from the operation of the two TLFs (north and south) between the CHPPs and the GAP rail line.

Dust from the TLF's can be emitted from the coal surface of loaded wagons, coal leakage from doors of loaded wagons, wind erosion of spilled coal in corridors, residual coal in unloaded wagons and leakage of residual coal from doors, as well as parasitic load on sills, shear plates and bogies of wagons.

A model has been developed assuming a coal train travelling at high speed and various setback distances incorporating the site meteorology. Modelling considered both the 4 km (north) and the 7 km (south) rail spurs and loops and the dust concentration at setbacks between 100 m and 2 km from the TLFs. The closest sensitive receptor to either of the spur lines is at least 5 km. The modelled dust levels at 2 km from the rail line are extremely low and at 5 km the dusts would be imperceptible. Modelled dusts from the rail line were seen to be very low and have a negligible impact on any sensitive receptor.

13.2.4 Greenhouse Gas

Based on the GHG emissions assumptions, the projected annual emissions by emissions type (Scope 1 and Scope 2) are presented in **Table 13-1**. Other than vegetation clearing, for which GHG emissions are presented over the life of the project, emissions estimates are on an average annual basis. Total estimated Scope 1 and Scope 2 GHG emissions over the life of the project are provided in **Table 13-2**.

Table 13-1 GHG Emissions Estimates

Emissions Source	Quantity	Units	GHG	Emissions Factor	EF unit	GHG ($ktCO_2$-e)
Blasting	55,000	tpa	N_2O	180	kg CO_2-e/ t ANFO	9.9
Fuel	20	MLpa	CO_2	2.67112	kg CO_2-e/L	53.4
			CH_4	0.00772	kg CO_2-e/L	0.2
			N_2O	0.0193	kg CO_2-e/L	0.4
Fugitive from coal mining	15	Mtpa	CH_4	17	kg CO_2-e/t raw coal	255.0
Purchased electricity	271,560	MWh/a	CO_2	0.89	kg CO_2-e/kWh	241.7
Estimated total annual emissions (excluding vegetation clearing)						**560.6**
Clearing vegetation	2,500	ha (life of project)#	CO_2	132,120	kg CO_2-e/ha	330.3

Vegetation clearing will not occur evenly on a per annum person and hence is only estimated for the life of project.

Table 13-2 Life of Project GHG Emissions

Emissions type	Annual GHG (kt CO_2-e)	Project phase in which emissions occur	Duration (years)	Total GHG (kt CO_2-e)
Blasting	9.9	Operations	46	455.4
Fuel	54.0	Construction, operations, decommissioning	47#	2,538.0
Fugitive from coal mining	255.0	Operations	46	11,730.0
Clearing Vegetation	Refer life of project estimate in **Table 13-1**.	Construction and operations	48	330.3
Total Scope 1 emissions				**15,053.7**
Purchased electricity	241.7	Construction operations, decommissioning	49*	11,843.3
Total Scope 2 emissions				**11,843.3**
Total emissions				**26,897.0**

Annual fuel usage during construction and decommissioning will be significantly less than during operations (1 MLpa compared to 20 MLpa) and hence an extra one year has been added to the 46 year period of operations as a conservative estimate of the fuel used during the 4 years of construction and decommissioning.
* The first year of construction is assumed to be powered by diesel generators.

13.3 Environmental Protection Objectives

Air Quality

- Compliance with air quality criteria at sensitive receptors.
- Respond to all non-vexatious complaints on air quality upon instruction from the regulatory authority.

GHG

- Minimise impacts from GHGs arising as a result of project activities, by minimising the emission of GHGs from project sources.
- Procurement of energy efficient equipment and plant where practicable.
- Effective mine planning and optimisation of schedules and routes
- Management and continuous improvement toward GHG reduction.

13.4 Performance Criteria

The following criteria have been adopted to minimise impacts of dust on identified sensitive receptors:

- dust concentration of $PM_{2.5}$ 25 µg/m^3 averaged over 24 hours
- dust concentration of $PM_{2.5}$ 8 µg/m^3 averaged over a year
- no greater than 5 days per year where the dust concentration of PM_{10} (24 hours) is greater than 50 µg/m^3 (5^{th} highest)
- TSP 90 µg/m^3 averaged over a year
- dust deposition of 120 mg/m^2/day
- for vegetation a maximum month dust deposition 266 mg/m^2/day is proposed.

All these criteria (except deposition) are qualities of the air environment that are important to protect human health and wellbeing. The deposition goal (or dust fallout) is for assessing dust nuisance. The indicators apply at any sensitive or commercial place, such as residences, parks, gardens, schools, shopping precincts, etc.

GHG will be measured and / or estimated annually.

13.5 Control Strategies

13.5.1 Dust Mitigation Measures

The dust emission database has been based on standard emission factors from the NPI 2012. There are a host of dust control measures, in addition to those standard and enhanced controls described in **Section 13.2.1,** that are available to significantly mitigate dust emissions. Examples of these are provided in **Table 13-3**.

Table 13-3 Dust Mitigation Measures

Source	Mitigation Measure
Mining Areas	Disturb the minimum area necessary for mining and rehabilitate promptly.
Coal Handling Area	Use water sprays and water trucks to suppress dust in coal handling areas.
Stockpiles	Maintain water sprays on raw and product coal stockpile and transfer points. Topsoil stockpiles should be sown with an appropriate plant mix and managed to ensure adequate ground cover is maintained.
Loading Haul Trucks	Prevent overloading to avoid spillage in transit.
Draglines	Reduce the drop height.
Haul Roads	Maintain haul roads in good condition and use water trucks regularly to suppress dust. Investigate use of chemical suppressants if haul roads become too slippery.

Source	Mitigation Measure
Other Roads	Keep usage to a minimum and maintain in good condition. Use water trucks regularly to suppress dust.
Waste Rock Emplacements	Keep these areas moist, particularly if used by dump trucks. Keep the recently spread material moist to encourage crusting of surface. Use sprays or water cannon during dumping to control dust from dumping. Up to 70% control is possible for water sprays.

13.5.1.1 Haul Roads

The modelling of dusts from haul roads (refer **Section 13.2**) is based on either standard or enhanced water application. For this model, the adoption of enhanced water control effectively provided a maximum of 75% control with an average of 50% control. The use of chemical dust suppressants would increase effectiveness to 95%.

13.5.1.2 Draglines

The default emission rate adopted in NPI 2012 includes results of testing carried out in the Hunter Valley, which showed that approximately 43% of TSP particles will be in the PM_{10} range compared with 18% for the strict application of the equations. However, the default emission rate is based on a drop height of 12 m and 2% moisture content. Thus reducing the drop height from 12 m to 6 m would result in a reduction in PM_{10} emissions from the dragline of approximately 53% (including maintaining the Hunter Valley correction) or a reduction of 88% based on the equation.

13.5.1.3 Loading Haul trucks

There is the potential for spillage to occur from haul trucks in transit. This spillage would fall on haul roads and would potentially become dust by the action of subsequent vehicles. Maintaining a suitable profile on the upper surface of the load of haul trucks would avoid spillage in transit.

13.5.2 Mitigation Measures for Adverse Meteorology

A series of sequentially applied dust mitigation measures were modelled specifically for receptor R5, to ensure that the project can achieve compliance with 5th highest PM_{10}(24 hour) at that receptor.

Modelling was conducted in a staged approach to sequentially include additional mitigation measures until compliance with the 5th highest PM_{10} (24 hour) objective was demonstrated. This approach corresponds with the real world sequential implementation of practical mitigations. The following is a summary of the results of modelling of the mitigation investigations:

- Replacing enhanced watering with chemical dust suppressants of haul roads.
- Reducing the drop height for the dragline from the modelled 12 m to 6 m, as well as using chemical dust suppression on the haul roads.
- Reducing the activity rate in the West Pits to 50% as well as reducing dragline drop height and using chemical dust suppressants on the haul roads.
- Reducing the activity rate in both the West and East Pits to 50% as well as reducing dragline drop height and using chemical dust suppressants on the haul roads. With these measures the air quality objective of 5th highest PM_{10} (24 hour) is achieved for all meteorological conditions at all years modelled.

The modelling has demonstrated that the air quality objectives can be met for all sensitive receptors with the application of suitable mitigation measures as required based on meteorological conditions at

the time. Furthermore the modelling has included a 9% contingency factor (i.e. production and movement of waste rock increased by 9%). Operating at normal activity levels will result in a reduction in the maximum dust exposures and fewer days when disrupted operations are likely to occur.

13.5.3 Dust Management Plan

A Dust Management Plan will be developed and include an action response plan to mitigate adverse air quality impacts. The dust management plan should investigate optimal application of water.

The modelling has indicated that enhanced dust control for haul roads is required to achieve compliance with air quality objectives at all receptors other than R5.

The Dust Management Plan will address the sequential and incremental adoption of dust mitigation measures in response to adverse meteorological conditions, seasonal effects and monitored dust levels, to enable compliance with air quality objectives at all receptors.

The dust monitoring at R5, when correlated with the real time prevailing wind direction measurements, will be used to make decisions regarding specific mining operational changes, to reduce dust exposure at R5.

13.5.4 Greenhouse Gas

The 'liable entity' under the *Clean Energy Act 2011* will comply with the requirements and intent of this Act, including requirement to purchase carbon permits. This is the primary legislative mechanism in Australia to reduce GHG emissions as it creates an economic incentive to reduce emissions.

The proponent is committed to sustainable development and reducing the GHG emissions of its operations, accelerating the uptake of energy efficiency, integrating GHG issues into business decision making and providing more consistent reporting of GHG emissions.

13.6 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 13.5** and compliance with the criteria outlined in **Section 13.4** as applicable to air quality and greenhouse gas management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

13.6.1 Long-term Dust Monitoring

A network of dust deposition gauges will be installed at sensitive receptors surrounding the project.

In addition to monitoring dust, local meteorological data will be collected from a monitoring station installed on the project area and situated close to the administration area. This station will collect temperature, relative humidity, rainfall and wind data over the life of the project.

13.6.1.1 Receptor 5 Dust Monitoring

More frequent monitoring of dust will be undertaken at R5 with a monitoring station permanently installed close to the homestead. To assist with identifying weather conditions that lead to high dust events data correlations will be drawn between meteorological conditions and dust monitoring results at R5 to enable prediction of high dust scenarios based on weather conditions and to pre-emptively implement dust controls where required.

13.6.2 Greenhouse Gas Monitoring

The proponent is committed to monitor, audit and report on GHG emissions as per the requirements of the *National Greenhouse and Energy Reporting Act 2007* (NGER Act).

13.7 Proposed EA Conditions

Schedule B - Air

Dust Nuisance

B1 Subject to **Conditions B2 and B3** the release of dust or particulate matter or both resulting from the mining activity must not cause an environmental nuisance, at any sensitive receptors.

B2 When requested by the administering authority, dust and particulate monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive receptors, and the results must be notified within 14 business days to the administering authority following completion of monitoring.

B3 If the environmental authority holder can provide evidence through monitoring that the following limits are not being exceeded then the holder is not in breach of **Condition B1**:

a) Dust deposition of 120 milligrams per square metre per day, averaged over one month, monitored in accordance with AS 3580.10.1 Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method of 1991 (or more recent additions)

b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 50 micrograms per cubic metre over a 24 hour averaging time (can be exceeded no more than five (5) times per year), at a sensitive receptor downwind of the operational mine, when monitored in accordance with:

   i. Particulate matter - Determination of suspended particulate PM10 high-volume sampler with size-selective inlet - Gravimetric Method, when monitored in accordance with AS 3580.9.6 Methods for Sampling and Analysis of Ambient Air - Determination of Suspended Particulate Matter - PM (sub) 10 high volume sampler with size-selective inlet – Gravimetric Method of 1990 (or more recent additions): or

   ii. Any alternative method of sampling PM10, which may be permitted by the 'Air Quality Sampling Manual' as published from time to time by the administering authority.

B4 If monitoring indicates exceedence of the relevant limits in **Condition B3**, and the exceedance is shown to be due to the mining activity, then the environmental authority holder must:

a) Address the complaint including the use of appropriate dispute resolution if required: or

b) Implement dust abatement measures so that dust emissions from the activity do not result in further environmental nuisance.

Odour Nuisance

B5 The release of noxious or offensive odours or any other noxious or offensive airborne contaminants resulting from the mining activity must not cause an environmental nuisance at any sensitive receptor.

B6 When requested by the administering authority, odour monitoring must be undertaken in accordance with the latest version of the DERM's (now DEHP) guideline Odour Impact Assessment from Developments within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 business days to the administering authority following receipt of monitoring results.

B7 If the cause is shown to be non project related, then the holder is not in breach of **Condition B5**, if the cause is shown to be project related, the holder must:

a) Address the complaint including the use of appropriate dispute resolution if required: or
b) Immediately implement odour abatement measures so that emissions of odour from the activity do not result in further environmental nuisance.

14. NOISE AND VIBRATION MANAGEMENT

14.1 Environmental Values

14.1.1 Existing Noise Environment

The project is situated in a relatively flat, established grazing and mining region comprising open farmlands and native scrublands. Existing noise sources primarily comprise farming and grazing activities, existing mining, existing commercial activities, road-based traffic and existing rail.

14.1.2 Background Noise Levels

A baseline noise profile is represented by four survey locations described in **Table 14-1** (which also shows the potential sensitive receptors as discussed in **Section 14.1.3**). The resulting Rating Background Levels (RBL) for the survey locations are shown in **Table 14-1**.

Table 14-1 Rating Background Levels for Measured Existing Noise Levels [dB(A)]

RBL / Median	Background Noise Level $L_{A90(10\ minute)}$			Noise Level $L_{Aeq\ (10\ minute)}$				Noise Level $L_{A10(10\ minute)}$		
	Day	Evening	Night	24 hr	Day	Evening	Night	Day	Evening	Night
R4	27.8	28.6	24.4	39.6	42.0	37.3	32.5	42.3	38.8	34.5
R5	30.9	21.5	18.9	44.5	47.8	36.6	25.0	48.9	36.1	23.8
R6	18.0	17.6	16.7	31.6	33.1	31.5	21.9	34.4	33.4	22.5
Subject site (near R1)	25.5	26.0	26.7	32.0	33.6	28.4	29.4	34.4	28.8	30.7

The existing noise levels are considered to be due to noise associated with residential activity, farming, birds, wind (e.g. rustling of leaves) and/or traffic. Mining-related or industrial noise was not a notable feature of the measurements at any monitoring locations.

14.1.3 Sensitive Receptors

Potentially sensitive receptors, for the purposes of assessing project noise and vibration impacts, are defined in **Section 8.1.2**. Baseline noise monitoring was undertaken at locations R1, R4, R5 and R6.

14.2 Potential Impacts

14.2.1 Noise Modelling

Modelling was undertaken at three operational periods representing local maxima in relation to overall waste rock and ROM coal production. They also represent the early phases of most of the pits when operations are expected to lead to higher environmental noise levels.

In summary, the noise modelling methodology included development of a digital terrain noise model of the site and surroundings using PEN3D software incorporating a 3D terrain model allowing accurate representation of the ground, ground cover, tree zones, mounds, barriers and weather conditions based on detailed equipment lists. The model is corrected for meteorology conditions. Thus, at night or during downwind predictions, the PEN calculations are likely to result in conservatively high results (i.e. the modelled noise levels are likely to be higher than the measured levels).

There are no modelled scenarios where the calculated noise levels at sensitive receptors exceed the acoustic quality and background creep objectives.

14.2.2 Low Frequency Noise

Night time low frequency noise modelling indicates that criteria levels are met at all sensitive receptors.

14.2.3 Blast Overpressure and Vibration – Sensitive Receptors

The blast overpressure and vibrations modelling indicated that for a charge weight of 500 kg, the blast overpressure and vibration levels are well below the objectives at all sensitive receptors.

14.2.4 Railway Noise

Two proposed TLFs (including rail spur and balloon loop) will be constructed off the GAP rail line which intersects the project. The noise levels from diesel electric comprise: L_{Amax} of 117 dB(A) (sound power level) and L_{Aeq} of 72 dB(A) per lineal metre for 15 Mtpa. Due to the large separation distances between the TLFs and sensitive receptors, all sensitive receptors readily comply with the QR noise level goals.

14.2.5 Road Traffic Noise

The maximum increase in traffic is 10.5% for the route between site and Glenden Collinsville-Elphinstone road (south of development). A 10.5% increase in traffic will lead to a 0.6 dB(A) or lower increase in traffic noise along the route, which is considered negligible (5 times less) in comparison to the 3 dB(A) increase which would require further investigation (as stated in **Section 14.4.7**).

14.2.6 Blasting Vibration and Overpressure – Buildings and Infrastructure

Buildings and infrastructure with the potential to be impacted by vibration include homesteads of sensitive receptors, historical cultural heritage sites and third party linear infrastructure (GAP rail line, Alpha Coal Project rail line, SunWater Burdekin to Moranbah pipeline and North Queensland Gas Pipeline). Modelling shows that there are no buildings and infrastructure that are expected to experience vibration levels in excess of the criteria. The GAP rail line and Alpha Coal Project rail line are within the zone that may marginally exceed vibration greater than 5 mm/s; however it is inferred that

the criteria of 40 mm/s will not be exceeded. As a conservative measure to protect linear infrastructure, if blasting encroaches within 1 km of the infrastructure, vibration monitoring will be undertaken.

14.3 Environmental Protection Objectives

Objectives for the protection of the identified noise environmental values are:

- Noise and vibration levels from project activities at sensitive receptors comply with the pertinent noise and vibration criteria.
- Where compliance is not achieved investigations will be undertaken to determine the cause and possible preventative actions.

14.4 Performance Criteria

Noise and vibration criteria apply to construction, decommissioning and operations. The following were considered in establishing acoustic quality and background creep objectives:

- *(EP Act) 1994*
- *Environmental Protection (Noise) Policy 2008 (EPP (Noise)) 2008*
- DERM (now DEHP) Ecoaccess Guideline "Planning for Noise Control"
- Ecoaccess Guideline "Noise and Vibration from Blasting"
- Ecoaccess Guideline “Assessment of Low Frequency Noise”
- British Standard 7385:Part 2-1993 *Evaluation and Measurement for Vibration in Buildings*
- German Standard DIN 4150.3-1999 Structural Vibration – Part 3: *Effects of Vibration on Structures.*

14.4.1 Acoustic Quality Criteria

The EPP (Noise) identifies acoustic quality criteria as - maintenance of noise levels at or below those that are conducive to human health and wellbeing, enabling individuals to sleep, study, learn, relax, converse and partake in recreation activities. The noise objectives for the project are provided below.

Table 14-2 Summary of Noise Acoustic Criteria

Location	Time Period	Acoustic Quality Criteria dB(A)		
		$L_{Aeq, adj, 1 hr}$	$L_{A10, adj, 1 hr}$	$L_{A1, adj, 1 hr}$
All Residential Receptors	Day	40	45	50
	Evening	40	45	50
	Night	35	40	45

14.4.2 Controlling Background Creep

The controlling background creep criteria seek to prevent deterioration of the acoustic environment through limiting continuous and variable noise sources including individual or collective sources. DERM (now DEHP) Ecoaccess Guideline "Planning for Noise Control" provides methods and procedures for setting conditions. Recommended Outdoor Background Noise Planning Levels (min$L_{A90,1hour}$) for ‘Very Rural’ receiver areas have been used as the basis for setting the maximum planning noise objective levels. The Recommended Outdoor Background Noise Planning Levels were moderated using the

guideline Recommended Noise Emission Planning Levels for Developments (min$L_{A90,1hour}$) guidelines table where the RBL values are higher or lower than the Outdoor Background Noise Planning Levels.

The resulting noise level criteria to avoid background creep (**Table 14-3**) are lower than the acoustic quality objectives **Table 14-2** during all time periods. This indicates the existing noise levels are relatively low and generally unaffected by industrial or traffic noise.

Table 14-3 Summary of Noise Level Criteria to Avoid Background Creep based on LAeq,adj,T = LA90,T + 3 dB(A).

Location	Modelled Noise Criteria to Avoid Background Creep $_{LAeq, adj, 1 hr}$ [dB(A)]		
	Daytime	Evening	Night
R-5 Cerito Station Homestead	36	30	28
R-6 Byerwen Station Homestead and all other sensitive receptors	28	28	28

14.4.3 DERM Ecoaccess Guideline – Low Frequency Noise

The DERM Ecoaccess Guideline "Assessment of Low Frequency Noise" identifies a number of industrial sources and processes having high noise levels and frequency content less than 200 Hz. It is possible that, due to the propagation of noise over the large separation distances between the source of noise and the receiver, a loss of high frequency components may occur. Thus the low frequency noise objective of 50 dB(Linear) applies at noise sensitive receptors.

14.4.4 Blasting Criteria – Sensitive Receptors

DEHP's Ecoaccess Guideline "Noise and Vibration From Blasting" indicates that blasting should be limited to the hours of 09:00 to 15:00, Monday to Friday, and from 09:00 to 13:00 on Saturdays. Blasting should not generally take place on Sundays or public holidays.

Blasting outside these recommended times should be approved only where:

a) blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter airblast overpressure and ground vibration limits should apply): or
b) there is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

Blasting activities are such that if noise should propagate to a noise-sensitive place:

a) the airblast overpressure must be not more than 115 dB(linear) peak for 9 out of any 10 consecutive blasts initiated, regardless of the interval between blasts
b) the airblast overpressure must not exceed 120 dB(linear) peak for any blast.

Blasting operations are such that if ground vibration should propagate to a vibration-sensitive place:

a) the ground-borne vibration must not exceed a peak particle velocity of 5 mm per second for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts
b) the ground-borne vibration must not exceed a peak particle velocity of 10 mm per second for any blast.

14.4.5 Blasting Criteria – Buildings and Infrastructure

Most commonly specified "safe" structural vibration levels are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have the potential to cause

damage to the main structure. Reinforced and heavy framed commercial structures and less likely to be the subject of cosmetic damage from vibration and as a consequence have higher vibration limits than unreinforced or light frames buildings. Thus the criteria presented in this section are for the light-frames dwellings typical of central Queensland.

14.4.5.1 BS 7385: Part 2-1993 Vibration in Buildings

British Standard (BS) 7385: Part 2-1993 Evaluation and Measurement for Vibration in Buildings provides limits to avoid the likelihood of cosmetic building damage from ground vibration. The guide values for transient vibration judged to give minimal risk of cosmetic damage to residential buildings are 3.7 mm/s at 1 Hz, rising to 15 mm/s at a frequency of 4 Hz, increasing to 20 mm/s at a frequency of 15 Hz, then to 50 mm/s at a frequency of 40 Hz and above.

Typically the dominant frequencies associated with blasting are between 5 Hz and 30 Hz. Thus the vibration limits are effectively between about 15 mm/s and almost 40 mm/s peak particle velocity (PPV).

14.4.5.2 DIN 4150.3 - Buried Pipework and Telecommunication Cables

The German Standard, DIN 4150.3-1999 Structural Vibration – Part 3: Effects of vibration on structures, provides guideline values to avoid damage to underground pipe work. The limits for buried pipe work are provided in **Table 14-4**.

Table 14-4 Vibration Limits for Buried Pipework from DIN 4150.3-1999

Pipe Material	Peak Wall Vibration Velocity (mm/s)	
	Short Term	**Long Term**
Steel (including welded pipes)	100	50
Clay, concrete, reinforced concrete, pre-stressed concrete, metal with or without flange (other than steel)	80	40
Masonry, Plastic	50	25

14.4.6 Railway Noise Criteria

QR National (now Aurizon) sets noise level limits from railways in Queensland. The planning levels for a railway, assessed 1 m in front of the most exposed part of an affected noise sensitive place are:

a) 65 dB(A), assessed as 24 hour average equivalent continuous A-weighted sound pressure level: and
b) 87 dB(A), assessed as a single event maximum sound pressure level.

Typically the planning objectives for coal train operations are met close to the railway (i.e. at distances up to approximately 50 m). Both the $L_{Aeq\ 24\ hour}$ noise level and the single event maximum sound pressure level of 87 dB(A) have been adopted as the objectives for railway noise level.

14.4.7 Road Traffic Noise Criteria

The Department of Transport and Main Roads (DTMR) sets noise level limits from road traffic on public roads in Queensland. There are no noise sensitive receptors close to the Collinsville-Elphinstone Road between Glenden and the project site or any local roads which may be used for the project. There are no criteria in Queensland to assess the impact of noise from a road traffic-generating development; however an increase of 3dB(A) over a short period of time is considered to be a significant increase in traffic noise and an increase which justifies consideration of noise control.

A 3 decibel or more increase in the $L_{Aeq\ 24\ hour}$ noise levels over existing noise levels has been adopted as a measure of a significant change in the road traffic noise levels.

14.5 Control Strategies

The modelled noise levels generated by the project comply with the acoustic quality criteria during the day, evening and night at all sensitive receptors. The noise modelling shows that at all times the indoor noise level criteria to protect sleep disturbance are met at all sensitive receptors.

The modelling shows that the calculated noise levels at the identified sensitive receptors are expected to comply with the identified criteria to avoid background creep for all time periods.

The low-frequency noise level criteria are expected to be met at all sensitive receptors.

The blasting vibration levels are expected to be met at all sensitive receptors. The blast overpressure criteria are readily met at all sensitive receptors. The project will limit blasting to the hours of 9 am to 3 pm, Monday to Friday, and from 9 am to 1 pm on Saturdays unless there is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

Modelling shows that there are no buildings and infrastructure that are expected to experience vibration levels in excess of the criteria. The GAP rail line and Alpha Coal Project rail line are within the zone that may marginally exceed vibration greater than 5 mm/s; however it is inferred that the criteria of 40 mm/s will not be exceeded. As a conservative measure to protect linear infrastructure, if blasting encroaches within 1 km of the infrastructure, the blast vibrations will be monitored to demonstrate compliance.

Due to the large separation distances between the TLFs and sensitive receptors, all sensitive receptors readily comply with the QR noise level goals.

The generation of road traffic by the site is minor leading to a maximum increase of less than 1 dB(A) along the most adversely affected road. This is considered a minor increase in traffic noise in comparison to the 3dB(A) increase which would require further investigation (as stated in **Section 14.4.7**) and complies with the project noise level goals for road traffic noise.

14.6 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 14.5** and compliance with the criteria outlined in **Section 14.4** as applicable to noise and vibration management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

If required, noise monitoring program will be developed and subsequent investigations will be undertaken in the event that there are complaints regarding noise.

14.7 Proposed EA Conditions

Schedule D - Noise and Vibration

Noise nuisance

D1 Subject to **Conditions D2 and D3** noise from the mining activity must not cause an environmental nuisance, at any noise sensitive place.

D2 When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

Noise monitoring

D3 If the environmental authority holder can provide evidence through monitoring that at the positions defined in **Schedule D Table 1**, the limits defined in **Schedule D Table 2** and **Schedule D Table 3** (where applicable) are not the result of project activities, then the holder is not in breach of **Condition D1**. Monitoring must include:

a) LAmax, adj, T
b) The level and frequency of occurrence of impulsive or tonal noise
c) Atmospheric conditions including wind speed and direction
d) Location, date and time of recording.

Schedule D Table 1 – Sensitive Receptors

Noise Receptors	Latitude	Longitude
Glenden Township	-	-
R2 - Suttor Creek Station Homestead	-21.339656	147.985655
R3 - Lancewood Station Homestead	-21.449417	147.934265
R5 - Cerito Station Homestead	-21.199866	147.761538
R6 - Byerwen Station Homestead	-21.088022	147.929896
R7 - Weetalaba Station Homestead	-21.043569	147.943465
R8 - Glenden Station Homestead	-21.326228	148.093654
R10 - Fig Tree Station Homestead	-20.968	147.778574

Schedule D Table 2 – Noise Criteria

Location	Time Period	Acoustic Quality Objectives (Measured at the Receptors and to Protect Health and Wellbeing) [dB(A)]			Low Frequency Noise Limit [dB]
		$L_{Aeq, adj, 1 hr}$	$L_{A10, adj, 1 hr}$	$L_{A1, adj, 1 hr}$	
All Residential Receptors	Day	40	45	50	50
	Evening	40	45	50	50
	Night	35	40	45	50

Schedule D Table 3 – Background Creep Criteria

Location	Modelled Noise Goals to Avoid Background Creep LAeq, adj, 1 hr [dB(A)]		
	Daytime	Evening	Night
R5- Cerito Station Homestead	36	30	28
All other sensitive receptors in Schedule D - Table 1	28	28	28

Based on LAeq,adj,T = LA90,T + 3 dB(A)

D4 If monitoring indicates exceedence of the limits in **Schedule D Table 2** and/or **Schedule D Table 3** (where applicable), then the environmental authority holder must investigate the causee of the exceedence and determine if the cause is project related:

a) If the cause is shown to be non project related, then the holder is not in breach of **Condition D1**
b) If the casue is shown to be project related, then the holder must:
   i. address the complaint including the use of appropriate dispute resolution if required
   ii. Immediately implement abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.

D5 The method of measurement and reporting of noise and/or vibration and/or airblast overpressure levels must comply with the latest edition of the administering authority's 'Noise Measurement Manual'.

Vibration and Overpressure Nuisance

D6 Subject to **Conditions D7 and D8**, vibration and/or airblast overpressure from the mining activity must not cause an environmental nuisance, at any vibration and/or airblast overpressure sensitive places.

D7 When requested by the administering authority, vibration and/or airblast overpressure monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any vibration and/or airblast overpressure sensitive place, and the results must be notified within 14 business days to the administering authority following completion of monitoring.

D8 If the environmental authority holder can provide evidence through monitoring that at the positions defined in **Schedule D Table 1**, the limits defined in **Schedule D Table 4** are not the result of project activities then the holder is not in breach of **Condition D6**. Monitoring must include:

a) location of the blast(s) within the mining area (including which bench level)
b) atmospheric conditions including temperature, relative humidity and wind speed and direction
c) location, date and time of recording.

Schedule D Table 4 – Vibration and Overpressure Criteria

Location	Monday to Friday 09:00 to 15:00, Saturdays 09:00 to 13:00	Other Days and Times
Sensitive receptors – airblast overpressure	Not more than 115 dB(linear) peak for 9 out of any 10 consecutive blasts initiated andnot exceed 120 dB(linear) peak for any blast	Condition as defined by the location of the activity and negotiated with the proponent and receptor
Sensitive receptors – vibration	Must not exceed a peak particle velocity of 5 mm per second for nine out of any 10 consecutive blasts initiated and must not exceed a peak particle velocity of 10 mm per second for any blast	Condition as defined by the location of the activity and negotiated with the proponent and receptor

D9 If monitoring indicates exceedence of the relevant limits in **Schedule D Table 4**, then the environmental authority holder must investigate the casue of the exceedence and determine if the cause is project related:

a) If the cause is shown to be non project related, then the holder is not in breach of **Condition D6**
b) If the cause is shown to be project related, then the holder must:
    i. address the complaint including the use of appropriate dispute resolution if required
    i. Immediately implement abatement measures so that vibration and/or airblast overpressure from the activity does result in further environmental nuisance.

D10 Every explosive blast for the mining activity shall be designed by a competent person to achieve the criteria specified in **Schedule D Table 4**.

D11 All relevant information pertaining to the design of every explosive blast for the mining activity in relation to the criteria specified in **Schedule D Table 4** shall be kept in written and diagrammatic form.

15. VISUAL MANAGEMENT

15.1 Environmental Values

Landscape character is described as the integrity of the landscape character of the project site at local and regional levels. Visual amenity is described as the amenity value of the landscape as experienced by residents and visitors from viewpoints at surrounding properties, public roads and other receptors.

15.1.1 Landscape Character

The landscape character assessment area has been categorised into three landscape units:

- Unit 1 Southern Flat Rural Landscape: assessed as a low visual sensitivity
- Unit 2 Central Moderately Hilly, Forested/Rural Landscape: assessed as a low visual sensitivity
- Unit 3 Northern Hilly Forested/Rural Landscape: assessed as a moderate visual sensitivity.

15.1.2 Visual Amenity– Sensitive Receptors and Viewpoints

All potential sensitive receptors (permanent residents and other potentially sensitive land use viewers) in the vicinity of the project area are identified in **Figure 8-2**. Sensitive receptors situated 5 km or more from the project area are assumed to be outside the area for which visual change can reasonably be considered to be of significant concern. No occupied houses within 5 km are within the area of the project's visibility and as such no further assessment has been undertaken for any sensitive receptors.

15.2 Potential Impacts

15.2.1 Landscape Character

The landscape character impact assessment is based on landscape units in the context of 'visual sensitivity' and 'magnitude of visual change', resulting in 'impact level' rankings as shown in **Table 15-1**.

Table 15-1 Landscape Character Impact Assessment Summary Table

Landscape Unit	Magnitude of Visual Change		Sensitivity	Level of Impact	
	During Operations	End of Mine Life (Following Successful Rehabilitation)		During Operations	End of Mine Life
1	High	Moderate	Low	Moderate	Low
2	High	High (becoming moderate)	Low	Moderate	Low
3	High (mining area) Low (other areas)	Moderate (mining area) Low (other areas)	Moderate	High (mining area) Low (other areas)	Moderate (mining area) Low (other areas)

Units 1 and 2 would experience more landscape and landform change, while Unit 3 would experience far less, due to the extent of activities in those respective areas. Impact would be reduced in the longer term by mitigation measures. Hence, the residual landscape character impact at the end of the mine would be low across most of the project area. A smaller area of moderate impact associated with the disturbed area of the former North Pit due to the higher sensitivity on this landscape unit.

15.2.2 Visual Amenity

There are no identified sensitive receptors within a 5 km radius of the project and within the viewshed, as there are no occupied houses within this zone. Visual amenity assessments of the five public viewpoints from surrounding roads within 5 km of project activities is summarised in **Table 15-2**. Overall the visual amenity impact to any viewpoint in the long term would be no greater than a low to moderate impact following rehabilitation measures.

Table 15-2 Visual Amenity Impact Summary Table

Viewpoint	Magnitude of Visual Change		Sensitivity	Level of Impact	
	During Operations	End of Mine (post rehabilitation)		During Operations	End of Mine Life
A: Collinsville-Elphinstone Road (from the railway bridge)	Low (except during final years when moderate)	Low	Moderate	Low (except during final years when moderate)	Low
B: Wollombi Road	Moderate	Low	Insignificant	Low	Insignificant
C: Collinsville-Elphinstone Road (north of Wollombi Road)	Moderate	Insignificant	Moderate	Moderate	Insignificant
D: Collinsville-Elphinstone Road (south East of Wollombi Road)	Moderate	Low	Moderate	Moderate	Low
E: Collinsville-Elphinstone Road (central infrastructure corridor)	Low	Low / Insignificant	Moderate	Moderate	Low / Insignificant

Viewpoints C and D can be mitigated further through retention of existing vegetated buffers. Screening of viewpoint A (from the railway bridge at Collinsville-Elphinstone Road) is not possible due to the elevation of that viewpoint. However, the impact on this viewpoint would be low following rehabilitation.

15.2.3 Lighting Impacts

The existing night-time visual environment of this region is one already affected by mines. It is anticipated that all viewpoints within a 5km radius of the active mine area, even where direct views are not possible, will notice a sky glow. There are no sensitive receptors of any concern within this 5km area, although beyond this distance it may still be possible to see a sky glow. It is anticipated that at some locations along the Collinsville-Elphinstone Road lights would be seen, particularly those of the southern MIA and CHPP, which are located approximately 1 km from that road.

15.3 Environmental Protection Objectives

The project landscape character and visual amenity objectives are identified as follows:

- Minimise long term changes to landscape character through progressive and final decommissioning and rehabilitation of mining activities.
- Minimise visual amenity impacts from mining activities on sensitive receptors or other public viewpoints.
- Minimise of light from the project so that it does not cause a nuisance to any sensitive receptors.

15.4 Performance Criteria

The project landscape character and visual amenity objectives are identified as follows:

- Progressive rehabilitation undertaken in accordance with the Rehabilitation Management Plan.
- Final decommissioning and rehabilitation undertaken in accordance with the Mine Closure Plan.
- Receptors with potential visual impacts identified and applicable mitigation measures implemented.
- Visual amenity or light nuisance complaints investigated and actions implemented as necessary.

15.5 Control Strategies

Mitigation measures that will occur during the life of the project, and at its closure include:

- progressive rehabilitation of disturbed mine areas
- decommissioning of infrastructure at the end of operations and rehabilitation of disturbed areas
- lighting designed to minimise impact to surrounding sensitive receptors and roads.

Mitigation to address the specific visual impact to viewpoints C and D from public roads, includes retention where practicable of a vegetated buffer of at least 25m wide at the following places:

- North of the Wollombi Road intersection with Collinsville-Elphinstone Road until at least 250m past the MIA (i.e. viewpoint C).
- South of Wollombi Road where project activities at East pit 1 are directly alongside Collinsville-Elphinstone Road (i.e. viewpoint D).

Rehabilitation will occur along the central infrastructure corridor (i.e. as seen from viewpoint E).

15.6 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 15.5** and compliance with the criteria outlined in **Section 15.4** above.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions

- audit scheduling
- management review.

Monitoring of the effectiveness of the proposed visual impact mitigation measures carried out regularly over the period of the mining operations, would include site inspections at the identified public viewpoints and sensitive receptors, as appropriate.

15.7 Proposed EA Conditions

No conditions proposed.

16. WASTE MANAGEMENT

This section of the EM Plan described management of other wastes associated with the project. A number of council waste facilities exist in the region which are able to service the proposed project, including the Glenden Waste Facility.

Management of waste material specifically from the mining activity and coal processing operations, including subsoils, waste rock, tailings and coal reject material is described in **Section 8**. Management of stormwater runoff from disturbed areas, including from the waste rock dumps and mine infrastructure areas is described in **Section 6**. Management of groundwater inflows into the open pit is detailed in **Section 7**. The management of airborne wastes, including greenhouse gases is described in **Section 13**.

16.1 Environmental Values

The environmental values related to waste management include:

- soil quality and land use
- surface water and aquatic ecology
- groundwater
- air quality
- terrestrial ecology
- visual amenity
- health and safety.

16.2 Potential Impacts

Waste streams, other than excavated waste and rejects, that may be produced by the project include:

- general waste, typically consisting of putrescible wastes and other general wastes, primarily generated at warehousing, workshop, office and crib room facilities
- general recyclable wastes, consisting of paper, cardboard, recyclable plastics, glass, aluminium, and steel cans, primarily generated at warehousing, workshop, office and crib room facilities
- scrap steel, primarily generated during workshop activities
- waste hydrocarbons, including oils, greases, oily water, oil and fuel filters, and oily rags, generated primarily from workshop and field service activities
- waste chemicals, other than waste hydrocarbon fluids, generated primarily from the workshop and field service activities
- waste tyres, generated from vehicle maintenance
- waste batteries, from vehicle maintenance
- sewage generated at workshop, office and crib room facilities.

Potential impacts of waste generated by the project, other than waste rock and rejects, include:

- water pollution caused by release or spills of solid or liquid waste either directly to receiving waters or indirectly via run-off from waste contaminated sites
- land contamination caused by spills or inappropriate waste disposal to soil

- groundwater contamination caused by spills of solid or liquid waste
- littering due to unsuitable storage and containment measures for general waste
- odour caused by inappropriate storage and/or treatment of putrescible waste
- increased vermin and potential spread of disease due to inappropriate storage of waste
- reduced visual amenity due to improper storage of waste
- waste of raw materials
- waste of embedded energy and greenhouse gas emissions
- consumption of landfill space , for example, Glenden Waste Facility
- risks to human health and safety through poor management of hazardous materials.

16.3 Environmental Protection Objectives

Environmental protection objectives for the project in relation to waste are summarised as:

- To comply with the *Environmental Protection (Waste Management) Regulation 2000* (EPP Waste), *Waste Reduction and Recycling Act 2011* and other relevant legislation.
- Avoid contaminating land, surface water or groundwater through poor waste management practices.
- Minimise the total generation of waste and the quantity of waste produced per tonne of production, in accordance with the EPP Waste waste management hierarchy, which involves:
  - waste avoidance
  - waste re-use
  - waste recycling
  - waste disposal in accordance with legislative requirements, as a last option.

16.4 Performance Criteria

- No contamination of land or waters from waste management beyond the footprint of waste management facilities.
- If land or groundwater contamination as a result of waste management activities has occurred, an investigation will be undertaken, with management or remediation as required. This may involve engaging an SQP approved by DEHP as a contaminated land specialist where required, and will fully depend on the nature and extent of contamination.
- Waste monitoring data demonstrates reduction in waste produced (per tonne of production).
- Adherence to waste management plan indicating minimisation of waste generated, maximise reuse and recycling, and the safe treatment and disposal of all non-reusable and non-recyclable materials in compliance with legislation.

16.5 Control Strategies

A detailed Waste Management Plan will be developed for the project that defines and describes the objectives and measures for protecting or enhancing environmental values from impacts by waste. The management measures will consider the waste hierarchy and describe how standards will be achieved, as well as set the objectives that will be monitored, audited and managed.

The scope of the Waste Management Plan will address the management of construction and operational wastes including storage, transport and disposal. The plan will include proposed methods for waste management at each stage of the project to achieve the highest possible level on the waste management hierarchy taking into consideration the EPP Waste.

Implementation of the Waste Management Plan will be monitored on a regular basis via the project site inspection and auditing requirements. The purpose of the Waste Management Plan is to detail how the project will:

- comply with all relevant environmental legislation
- minimise the amount of waste created during the project, including during construction
- recycle waste materials where practicable
- minimise the impacts of construction and operational activities
- minimise the storage volumes kept on site, and ensure segregation where appropriate
- ensure that there are systems in place to demonstrate compliance with environmental legislation
- implement waste control measures that avoid environmental harm
- implement waste control measures to minimise odour, minimise loss of visual amenity and litter
- minimise impacts to human health
- ensure and promote sustainable practices for waste management for both on-site and off-site.

During the project, the following principles for waste minimisation and management will apply:

- compliance with waste management legislation
- implementation of the waste minimisation hierarchy - waste avoidance, re-use, recycling
- water conservation, treatment and reuse
- efficient energy usage
- effective waste disposal – as the final option.

16.5.1 Summary of Key Environmental Design Features

Environmental design criteria will be utilised to ensure that any potential impact of waste is minimised.

16.5.1.1 Liquid Waste

The project will utilise a variety of technologies and practices to control, minimise and re-use liquid wastes. Where practicable, these measures will include:

- segregation and treatment of potentially contaminated runoff from mine infrastructure areas prior to release to mine affected water dams
- removal of waste oil from site for re-use
- segregation of water from areas of disturbance from clean water
- maximizing the area of successfully completed progressive rehabilitation
- reuse of rejects decant water in the CHPP
- reuse of treated effluent for onsite irrigation or dust suppression
- use of secondary containment structures (bunding) for storage of hazardous liquid wastes
- design of facilities to Australian Standards for the storage and handling.

Management of liquid waste associated with rejects is described in **Section 3**. Mine affected water will be released from the site subject the quality and volume criteria described in **Section 6**.

A number of options are being considered for management of treated effluent, including irrigation to land as part of rehabilitation or to a separate area. At this stage of planning, discharge criteria have not been established. These will be based on discharge rates of nutrients and other water quality parameters that do not result in long term impacts to soil quality or runoff to watercourses.

16.5.1.2 Solid Waste

The project will utilise a variety of technologies and practices to control, minimise and re-use solid wastes. Where practicable, these measures will include:

- maximise recycling and re-use opportunities
- re-use of cleared site vegetation (including mulching) to aid site rehabilitation
- erosion and sediment control following site earthworks
- develop contract conditions with suppliers to minimise waste entering the site
- topsoil and some subsoils will be reused in rehabilitation.

Management of solid wastes associated with waste rock and rejects is described in **Section 8.**

16.5.1.3 Air Emissions

The project will utilise a variety of technologies and practices to control and minimise air emission wastes. Where practicable, these measures will include the following:

- vehicles and machinery used will be fitted with appropriate emission control equipment and maintained in a proper and efficient manner in accordance with the manufacturer's specifications
- low emission technologies will be investigated as appropriate
- efficient blast design
- management of waste rock dump activities during high wind conditions
- dust suppression measures will be implemented, including watering haul roads.

Management and reduction of air emissions is described in **Section 13.**

16.5.2 Waste Management Hierarchy

The waste management hierarchy, considering the principles in EPP Waste will be the primary mechanism to ensure sustainable waste management.

16.5.2.1 Waste Avoidance

Waste avoidance will be achieved through the consideration of alternative products, implementation of appropriate technology and procurement processes.

16.5.2.2 Waste Re-use

The re-use of waste will be achieved through identifying opportunities onsite and subsequently identifying market demands for waste items (e.g. timber pallets and scrap metal). Wastes will be segregated and stored in designated areas on site. Investigations regarding waste re-use will be ongoing throughout the project life. This will include the regular review of marketability of wastes to ensure that potential new and emerging opportunities for waste re-use are realised.

Table 16-1 summarises current market demand for recyclable waste.

Table 16-1 Market Demand for Recyclable Waste

Recyclable Product	Potential Use	Marketability
Scrap metal	Managed by a licensed waste contractor. Taken from site, shredded or crushed and re-smelted.	High marketability. Ongoing demand from local and global market.
Lead acid batteries	Managed by a licensed waste contractor. Taken from site, batteries are stripped and parts are made into new batteries.	High marketability including within Queensland markets.
Paper, cardboard, glass, cans	Managed by a licensed waste contractor. Taken from site to an appropriate materials recycling facility. Will be re-sold, dependent on product.	Low – medium marketability as markets tend to fluctuate.
Waste oils	Managed by a licensed waste contractor. Taken from site. Oils will be filtered and de-mineralised and distilled to produce oil, or recycled for use as fuel oil.	High marketability including within Queensland markets.
Decommissioned equipment	Decommissioning plan to be developed. Metals to be managed as above and plant and equipment to be sold.	Medium to high marketability due to high value recyclable materials generated.

16.5.2.3 Waste Recycling

Waste recycling will be used on-site wherever practicable. Waste generated through the project that can be recycled includes waste oils, construction materials, scrap metal, paper and cardboard, glass, some plastics, tins and cans, as well as waste water.

16.5.2.4 Waste Disposal

Disposal of wastes will be used where there is no other reasonably viable option available. General waste will be transported to a local landfill for disposal in accordance with regulatory requirements. Regulated waste that cannot be recycled will be transported off-site by a licensed contractor to an appropriate regulated waste facility. Transport of hazardous waste is discussed in **Section 17**.

The proponent does not intend to develop a landfill on site. This does not preclude the disposal of certain wastes (e.g. tyres and decommissioning waste as described in **Section 9.5**) into cells within the open pits. The potential impacts of waste disposal in the open pits will be further analysed as the requirements are better defined as required. Waste will not be disposed of in the open pit where there is a risk of ongoing contamination of groundwater.

16.5.3 Cleaner Production

Cleaner production techniques applicable to the project include the following:

- Improve operation and maintenance practices to reduce the quantity of resources used and minimise the amount of waste generated (e.g. reuse wastewater).
- Select technology and practices considering environmental, waste reduction as well as economic factors.
- Site extraction design to minimise the volume of waste rock in relation to coal to be removed.
- Segregate waste to enable recovery and re-use.
- Closed-loop recycling where a product is recycled and used again in the same form.

16.5.4 Natural Resource Use Efficiency

The water management strategy for the project is described in **Section 6** and it is proposed that the mine is a release site, subject to approved volume and quality discharge criteria.

Power will be supplied by connection to an existing supply line that intersects the project area, taking advantage of existing supply capacity without compromising the energy supply to other users. In addition, resources will not be unnecessarily expended on developing alternative energy supplies.

Treated water from sewage treatment systems may be reused in the CHPP or in irrigation of rehabilitation areas. Biosolids from sewage treatment will be preferentially used on site, with appropriate treatment and management, as a means to increase nutrient levels in soils to be used for rehabilitation.

16.5.5 Council Waste Facilities

The project proposes to use the IRC Glenden Waste Facility, located on Ewan Drive, Glenden, for disposal of general wastes other than:

- wastes that are reused or recycled, either on-site or at a designated facility
- wastes planned for on-site disposal
- regulated wastes or other wastes that cannot be accepted by the Glenden Waste Facility.

16.6 Waste Treatment, Handling and Storage

16.6.1 Waste Treatment

The treatment of sewage and runoff from mine infrastructure areas will be the only waste treatment to occur on-site. Sewage effluent managed on-site will be treated to a standard suitable for irrigation or reuse. Runoff from mine infrastructure areas will, if required, pass through an oily water separator before release to the mine water dams.

16.6.2 Waste Handling and Storage

Designated waste storage areas will be planned and constructed across the site in accordance with the Waste Management Plan. The waste storage areas will consist of labelled colour coded bins for different wastes such as metals, paper, oils, batteries, general waste.

Waste storage areas will have a suitable containment system in place, to ensure wastes are contained and do not cause environmental harm. A separate hazardous waste storage area will be available to ensure that any hazardous waste is managed to prevent environmental harm.

Measures to be implemented include the following:

- bunds will be in accordance with Australian Standard AS 1940 – The storage and handling of flammable and combustible liquids, where applicable for the type of waste being stored
- regular inspections will be undertaken and spills will be pumped out and disposed of appropriately
- roofs will be installed where required over bunded areas
- hazardous waste containers will have lids and be kept closed
- all containers will be clearly labelled as per the legislative requirements
- absorbent material and spill kits will be located in the hazardous waste management area
- where practicable, all loading and unloading will take place within the containment area
- material safety data sheets will be available, to provide storage and handling information.

16.6.3 Spill Containment and Remediation

Hazardous materials will be stored in appropriate bunding in accordance with Australian Standard AS 1940 and other relevant standards. Spill containment material and spill kits will be located in areas where liquid waste is stored and handled and training in spill response will be conducted for all relevant employees.

If land or groundwater contamination as a result of waste management activities has occurred, an investigation will be undertaken, with management or remediation as required. This may involve engaging an SQP approved by DEHP as a contaminated land specialist where required, and will fully depend on the nature and extent of contamination. Remediation can include bioremediation measures on-site to effect the remediation of any incident involving specific wastes.

16.6.4 Regulated Waste Tracking

The Waste Management Plan will require the tracking of "Trackable Wastes" listed in Schedule 1 of the EPP Waste. The predominant types of trackable waste produced by the project are:

- oil and water mixtures or emulsions, or hydrocarbons and water mixtures or emulsions
- grease trap waste
- sewage sludge and residues including night soil and septic tank sludge
- tyres.

All identified trackable wastes are required to be accompanied by a Waste Transport Certificate and there is a requirement for a licensed waste transporter to collect and dispose of the waste utilising the appropriate DEHP procedures. A register will be developed and maintained for all regulated wastes generated on site. It will include the following details:

- source of waste
- type of waste
- quantity of waste
- storage location and details
- dates of collection
- date of disposal/recycling
- name and details (including licencing details) of transporter and facility used to dispose the waste.

The relevant DEHP forms are to be completed in line with the requirement under the *Environmental Protection (Waste Management) Regulation 2000*.

16.7 Waste Management Disposal and Controls

The waste streams generated during the construction and operation phases of the project were identified based on mine design and similar coal mines generating similar types of waste. Quantities of waste were estimated based on similar projects, with project specific adjustments.

16.7.1 Construction Waste

The wastes generated, anticipated volumes and management considerations for construction activities during the first (south) construction phase of the project are shown in **Table 16-2**. The second (north) construction phase will generate approximately half of the waste generated during the south construction phase, unless otherwise noted in **Table 16-2**.

Table 16-2 Waste Inventory – First Stage of Construction

Waste Type	Source(s)	Disposal Method (Waste Hierarchy)	Controls	Estimated Total Quantity
Vegetation	Clearing for infrastructure construction (excludes clearing for open pit excavations which is covered in operations)	Recycle	Where required, re-use on site as fencing, fauna habitat. Otherwise, mulch and stockpile for use in revegetation works.	Approximately 300 ha of clearing of which less than 50 ha contains remnant vegetation. For the second construction phase, approximately 300 ha of clearing of which greater than 200 ha is remnant vegetation.
Sediment	Sediment Ponds	Recycle	If emptying of sediment ponds is required during construction then sediment will be dried and reused in construction activities.	Not anticipated.
Sediment affected water	Runoff from construction areas and activities, including MIA, spoil stockpiles, access roads, (including dust suppression) and laydown areas.	Disposal/Recycled (water quality dependant)	Water collected in sumps and reused (such as in dust suppression) or released subject to water quality requirements.	Volumes are dependent on seasonality, rainfall and year of mine life.
Topsoil and some subsoils	During stripping	Recycle	Placed in windrow (stockpiles) for re-use in rehabilitation until such time as it can be used directly in progressive rehabilitation of waste rock dumps.	Approximately 300,000 m^3 of top soil stripped in each of the first and second construction phases, all to be used in rehabilitation over the life of the mine.
Excess spoil from construction of TLFs (excluding topsoil)	During earthworks at the TLFs	Recycle	Design aim to balance cut / fill volumes. Refill excavations and use to construct haul roads, pads etc. If necessary, stockpile or spread for use in revegetation works.	<500,000 m^3 in each of the first and second construction phases
Scrap metal	Off cuts for construction activities	Avoidance / minimise / recycle	Minimise waste by ordering what is required. Store in designated area for collection by a waste contractor for off-site recycling.	< 100 tpa
Concrete	Construction of infrastructure	Avoidance / minimise / recycle	Minimise waste by producing only the amount necessary. Prepare alternative pour areas for surplus quantities. If possible crush and re-use for road base etc. or dispose in waste rock dump.	<10 t

Waste Type	Source(s)	Disposal Method (Waste Hierarchy)	Controls	Estimated Total Quantity
Timber	Pallets and off cuts from construction activities	Avoidance / minimise / recycle	Minimise waste by ordering what is required. If possible, return good pallets to sender. Chip and reuse on site as mulch for landscaping.	<10 t
Building and construction waste	Scrap plasterboard, bricks, tiles, electrical off-cuts	Avoidance / minimise	Minimise waste by ordering what is required. Return to supplier what is not needed where possible. Store in a designated area for collection by a licensed waste contractor, to be recycled where commercially viable or disposed of at a licensed waste facility.	Unknown
Paints and resins, chemicals such as herbicides, chemical containers	Mining infrastructure area	Avoidance / minimise / disposal	Minimise waste by ordering what is required. Store in designated area for collection by a licensed waste contractor and disposal off site by a licensed waste receiver. Comply with requirements of MSDS.	<2 t
General waste including putrescibles, some plastics	Construction offices, workshop	Avoidance / minimise / disposal	Taken off-site for disposal at licensed waste facility.	<500 tpa during construction
Paper, cardboard, plastics, glass, aluminium cans	Construction offices	Avoidance / minimise / recycle / disposal	Collect and store in a designated area for collection by a licensed waste contractor, to be recycled where commercially viable or disposed of at a licensed waste facility.	<10 t
Sewage	Construction offices, workshop	Treat / recycle / disposal	Sewage conveyed to on-site sewage treatment plant for treatment. After treatment will be pumped to a holding dam or tank and then re-used on site or used for irrigation. Biosolids transferred by truck to a local Waste Water Treatment Plant for treatment or disposal on site in a controlled effluent management system.	20 ML
Waste oil and containers	Workshop	Recycled	Collected on site and stored in a designated bunded facility. Transported off site by a licensed waste contractor to a facility licensed to accept regulated waste for either recycling or disposal.	<50 t
Oil from oily water	Workshop / MIA contaminated stormwater	Recycled / disposal	Oil will be separated from the water and the oil will be collected as per waste oil (above). The separated water will be directed to the mine affected water dams possible reuse on site for dust suppression.	<5 t

Waste Type	Source(s)	Disposal Method (Waste Hierarchy)	Controls	Estimated Total Quantity
Air filters, oil filters, batteries	Workshop	Recycled	Stored in a designated area on site until there are sufficient to be collected by a licensed waste contractor for recycling off - site.	<2 t
Tyres	Light and heavy vehicles	Reuse	Collected and stored in designated area as per the DERM (now DEHP) Operational Policy – Disposal and storage of scrap tyres at mine sites. Tyres will be repaired and re-used where possible. Where possible, negotiate take-back agreement with tyre supplier. Any on-site disposal of tyres will follow the operational policy after considering any recycling options.	50 t (200 tyres per annum)

16.7.2 Operations Waste

The estimated volumes of each waste type (apart from waste rock and coal processing and washing wastes) likely to be generated during mine operation and their management are detailed in **Table 16-3**.

Table 16-3 Waste Inventory – Operations

Waste Type	Source(s)	Disposal Method (Waste Hierarchy)	Controls	Estimated Quantity per Annum
Vegetation	Progressive removal of vegetation will occur as areas are prepared for mining.	Recycle	Where required, re-use on site as fencing, fauna habitat. Otherwise, mulch and stockpile for use in ground stabilisation and revegetation works.	Approximately 7,000 ha of clearing over the life of the project, of which approximately 2,000 ha is remnant vegetation.
Sediment	Sediment ponds	Recycle	If emptying of sediment ponds is required then sediment will be dried and reused on site.	Not anticipated
Topsoil and some subsoils	During stripping	Recycle	Placed in windrow (stockpiles) for re-use in rehabilitation until such time as it can be used directly in progressive rehabilitation of waste rock dumps.	Approximately 18 million m^3 of top soil and sub soils stripped during the life of the mine, all to be used in rehabilitation over the life of the mine.
Scrap metal	workshop	Avoidance / minimise / recycle	Minimise waste by ordering what is required. Store in designated area for collection by a waste contractor for off-site recycling.	100 tpa

Waste Type	Source(s)	Disposal Method (Waste Hierarchy)	Controls	Estimated Quantity per Annum
Timber	Pallets and off cuts	Avoidance / minimise / recycle	Minimise waste by ordering what is required. If possible, return good pallets to sender. Chip and reuse on site as mulch for landscaping. If not suitable, dump on site.	<3 tpa
Paints and resins, chemicals such as herbicides, chemical containers	Mining Infrastructure Area	Avoidance / minimise / disposal	Minimise waste by ordering what is required. Store in designated area for collection by a licensed waste contractor and disposal off site by a licensed waste receiver. Comply with requirements of MSDS.	<10 tpa
General waste including putrescibles, some plastics	Offices, workshop	Avoidance / minimise / disposal	Taken off-site for disposal at licensed waste facility.	170 tpa
Paper, cardboard, plastics, glass, aluminium cans	Offices, workshop	Avoidance / minimise / recycle / disposal	Collect and store in a designated area for collection by a licensed waste contractor, to be recycled where commercially viable or disposed of at a licensed waste facility.	150 tpa
Sewage	Offices, workshop	Treat / recycle / disposal	Sewage conveyed to on-site sewage treatment plant for treatment. After treatment will be pumped to a holding dam or tank and then re-used on site or used for irrigation. Biosolids transferred by truck to a local waste water treatment plant for treatment and disposal on site in a controlled effluent management system.	<20 ML
Waste oil, oil filter, oily rags and containers	Workshop	Recycled	Collected on site and stored in a designated bunded facility. Transported off site by a licensed waste contractor to a facility licensed to accept regulated waste for either recycling or disposal.	350 tpa oil 200 container units 0.75 t per Mt coal (filters). 25,000 L / annum (rags).
Oil from oily water	Workshop / MIA contaminated stormwater	Recycled / disposal	Oil will be separated from the water and the oil will be collected as per waste oil (above). The separated water will be directed to the mine affected water dams for possible reuse on site for dust suppression.	3 t per Mt of coal (average of 30 Mt per annum)

Waste Type	Source(s)	Disposal Method (Waste Hierarchy)	Controls	Estimated Quantity per Annum
Air filters, batteries	Workshop	Recycled	Stored in a designated area on site until there are sufficient to be collected by a licensed waste contractor for recycling off -site.	150 tpa
Tyres	Light and heavy vehicles, including mining vehicles	Reuse	Collected and stored in designated area as per the DERM Operational Policy – Disposal and storage of scrap tyres at mine sites. Tyres will be repaired and re-used where possible. Where possible, negotiate take-back agreement with tyre supplier. Any on-site disposal (e.g. within the open pit) of tyres will follow the operational policy after considering any recycling options.	50 t (200 tyres per annum)
Mine affected water and sediment affected water	Groundwater ingress to open cut pits as well as runoff from pit walls, waste rock dumps, the MIA, coal stockpiles, access roads, (including dust suppression)and laydown areas.	Disposal / Recycled (water quality dependant)	Mine affected water collected in dams for release within water quality criteria. Mine affected water and sediment affected water will be available for general site uses such as in dust suppression or coal washing (CHPP) subject to water quality requirements.	Volumes are dependent on seasonality, rainfall and year of mine life. The mine affected water release strategy is presented in **Appendix 9**.
Process Water	CHPPs	60% of the CHPP plant flow-through is recycled co-disposal supernatant water.	Process water associated with the CHPPs and co-disposal facilities will be managed in a closed circuit such that there are no planned releases. Supernatant or decant water from the co-disposal facilities, will be recycled to the process plants for coal washing.	Supernatant return water from the southern co-disposal dam is approximately 4,650 ML per annum. Supernatant return water from the northern co-disposal dam is approximately 1,500 ML per annum.

16.7.3 Decommissioning Wastes

At the decommissioning phase of the project, a comprehensive assessment of waste will be undertaken in accordance with the waste management hierarchy in order to identify the most appropriate measures to manage the remaining waste on the project site. Site infrastructure will generally be decommissioned and demolished in line with the post mine land use. Further detail on decommissioning wastes and potential management of these wastes is provided in **Section 8** and **Section 9**. The potential for the site to be included on the Environmental Management Register or the Contaminated Land Register is described in **Section 8** and **Section 9**, along with measures to remediate or manage any potentially contaminated land.

Any construction facilities that are decommissioned following construction phases will be managed in accordance with the waste management hierarchy and the controls described above for construction wastes. Areas of potential contamination will be investigated and managed / remediated if required.

16.8 Monitoring and Auditing

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Sections 16.5, 16.6** and **16.7** and compliance with the criteria outlined in **Section 16.4** as applicable to waste management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

Waste streams, quantities and management practices will be monitored during construction and operation, including inspections of the waste management areas.

The objectives of monitoring waste management practices include:

- assessment of the actual wastes compared to predicted waste streams and quantities
- monitor potential impacts from wastes
- review the waste transportation records to ensure compliance
- identify improvement in waste management practices
- establishment of waste reduction targets, where possible
- monitor the implementation of the Waste Management Plan.

16.9 Proposed EA Conditions

Schedule E - Waste Management

E1 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.

E2 The holder of this environmental authority may burn vegetation cleared in the course of carrying out extraction activities provided the activity does not cause environmental harm at any sensitive place or commercial place.

Tailings

E3 Tailings must be managed in accordance with procedures contained within the current plan of operations. These procedures must include provisions 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 identify acid producing potential and metal concentrations of tailings
e) Maintaining records of the relative locations of any other waste stored within the tailings
f) Rehabilitation strategy
g) Monitoring of rehabilitation, research and/or trials to verify the requirements and methods for decommissioning and final rehabilitation of tailings, including the prevention and management of acid mine drainage, erosion minimisation and establishment of vegetation cover.

Schedule J - Sewage treatment

J1 Treated sewage effluent is permitted to be released to land when in compliance with the release limits stated in **Schedule J Table 1.**

Schedule J Table 1 – Contaminant release limits to land

Quality Characteristics/ Contaminant	Sampling and In-situ Measurement Point Location	Unit	Limit Type	Release Limit	Monitoring Frequency
5 day Biochecmical Oxygen Demand	At the outlet of the sewage treatment plant	mg/L	Maximum	20	Monthly
Total Dissolved Solids (TDS)		mg/L	Maximum	1,000	Monthly
Electrical Conductivity (EC)		uS/cm	Maximum	1,600	Monthly
pH		pH units	Range	6.0 to 9.0	Monthly
Total Nitrogen (TN)		mg/L	Maximum	30	Monthly
Total Phosphorus (TP)		mg/L	Maximum	10	Monthly
E. coli		CFU/100 mL	Maximum	10,000	Monthly

J2 Treated effluent may only be released to land within the mining lease areas at a designated, fenced and delineated area(s).

J3 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
c) there is no run-off of effluent.

J4 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.

J5 All sewage effluent released to land must be monitored at the frequency and for the parameters specified in **Schedule J Table 1**.

J6 The daily volume of effluent release to land must be measured and records kept of the volumes of effluent released.

J7 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.

J8 A minimum area of 1ha of land, excluding any necessary buffer zones, must be utilised for the irrigation and/or beneficial reuse of treated sewage effluent.

J9 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.

17. TRAFFIC AND TRANSPORT MANAGEMENT

17.1 Environmental Values

The values to be protected are the health, safety and amenity of project employees, visitors and the community using State, local and mine-site road networks.

The transport of goods and personnel will, for the major part, be moved on the State controlled road network. The project site access roads can be accessed from the Collinsville-Elphinstone Road without utilising local roads. It is expected there may be very small sections of the local council road network that may be used by vehicles (e.g. in and around Glenden and the project area), though these impacts would be considered insignificant due to the low number of movements. The local road network would only be used occasionally to provide a connection to the State controlled road network.

Project impacts on the capacity and operation of Mackay Airport from personnel movements, and the Ports of Brisbane, Mackay and Gladstone from imports of material and equipment, have been assessed as negligible in the context of current throughput quantities at these locations and are not considered further in this EM Plan.

17.2 Potential Impacts

The potential impacts on environmental and social values caused by project generated traffic include:

- pavement impacts
- dust, noise and vibration generated by vehicles that are travelling to the site and by vehicles moving around the project site
- contamination caused by accidental release of dangerous goods and hazardous materials
- changes to the level of service and safety of road uses.

The only link in the road network that meets the TMR criterion for significant traffic volume impact of "equal to or greater than 5% of the average annual daily traffic (AADT)" is Collinsville-Elphinstone Road south of the project to Glenden.

There are four sections of road where the project equivalent standard axels (ESAs) increased the expected background traffic ESAs by more than the TMR criterion for impact of 5% criteria:

- Collinsville-Elphinstone Road north of the project site to Bowen Developmental Road
- Collinsville Elphinstone Road between the project site and Glenden
- Collinsville-Elphinstone Road between Glenden and Suttor Developmental Road
- Suttor Developmental Road between Elphinstone and the Peak Down Highway.

17.3 Environmental Protection Objectives

- Protect the health and safety of employees and community with respect to road transport (including minimising road incidents and accidents in which project related vehicles are involved).
- Minimise impact on amenity to the local community from road transport.
- Minimise community complaints about road impacts.

17.4 Performance Criteria

- Number of road incidents and accidents in which project related vehicles are involved, with a target of zero incidents.
- Number of community complaints about road impacts with a target of zero complaints.
- Compliance with the Road Use Management Plan (to be developed).

17.5 Control Strategies

- Minimising Project Traffic
  - Bus transport provided for workers between Glenden accommodation and the mine site (other than administration workers) and approximately half of non-resident workers between Glenden and Mackay.
- Mine Access Intersection Upgrades
  - There are two proposed project access intersection locations from Collinsville-Elphinstone Road, one to service the southern tenement area and a second for the northern tenement area.
  - Location of intersections will be selected based on minimising the impact on the safety, operation, and efficiency of the road network, to optimise the sight distance provision in accordance with the Austroads, *Guide to Design – Part 4A*.
  - Wollombi Road will be affected by drainage diversions for the project. These will be designed to mimic overland flow to their pre-development conditions.
- Interaction of Project Roads with Rail Lines
  - The crossing of the GAP rail line will be designed in accordance with the relevant standards and guidelines as part of the permit requirements for the level crossings through QR (now Aurizon).
  - The intersection of the haul roads with Xstrata's mining lease for transport will be designed in accordance with the relevant design guidelines and standards including turn paths/swept path of the appropriate vehicles and ensure that appropriate sight lines and distances are provided to ensure safe operation of the intersection.
- Pavement Contributions
  - A maintenance contribution is applicable across the life of the mine for the four road sections described in **Section 17.2**. As the pavement life for each section of road will be reduced by less than 1 year across the remaining life, no rehabilitation contribution is required.
- Dust and Noise Management
  - Measures to mitigate dust emissions are described in **Section 13**. Load covers will be required on any heavy vehicles carrying material that has the potential to generate dust along public roads to or from the project site.
- Driver Fatigue Management
  - Adequate standard operating procedures, roster control and fatigue management guidelines will be developed in accordance with the *Coal Mine Safety and Health Act 1999* and assist in minimising and reducing the risk of driver fatigue. These will be in addition to the statutory guidelines set by TMR for Queensland.

- Driver fatigue management procedures will be implemented for all workers traveling to and from regional centres. In order to minimise the number of project personnel driving to and from regional centres, the proponent will provide bus transport.

- Transport of Dangerous Good and Hazardous Materials
  - Comply with requirements for transporting dangerous goods and hazardous materials, including requirements under the *Transport Operations (Road Use Management – Dangerous Goods) Regulation 2008* and the *Transport Infrastructure (Dangerous Goods by Rail) Regulation 2008*.
- Over Dimensional Loads
  - Requirements for overdimensional loads are provided in the Minimum Guide for Over Dimensional Vehicles, available from the Queensland Police. DTMR also maintains a "Conditions of Operation Database" for over dimensional operation. Permits will be obtained from DTMR for the operation of over dimensional vehicles.
- Safety and Security
  - Security controls will be installed on the site access roads to the northern and southern project areas and fencing will be provided at necessary locations adjacent to roadways and rail corridors. There is existing fencing along Collinsville-Elphinstone Road that will be maintained. In addition, signage will be installed to discourage access from public roads to the project area.
  - Car parking within the site will be designed to accommodate parking for cars/private vehicles, buses and commercial vehicles.

17.5.1 Road Use Management Plan

The road use management plan will be formulated in the later stages of the development process to minimise the impacts of the mine on the State-controlled road network. It is expected that this document will be dynamic and continually updated during stages such as, detailed design, construction and operation. This document will include:

- objectives
- strategies (e.g. dangerous goods or over dimension vehicle transportation)
- monitoring required throughout the project life
- corrective actions required
- continual report and updating.

Heavy loads, wide loads and over-dimensional/indivisible loads will be identified during construction and operations and all required traffic controls will be implemented for these traffic movements.

17.6 Monitoring and Auditing

Monitoring will include the following:

- Incident reporting will be completed for all road incidents and accidents. Incidents will be reported to the Site Senior Executive and corrective actions will be implemented.
- A complaints register will be maintained and this will be monitored on a regular basis to by site management to ensure that complaints are addressed.
- The RUMP will describe a monitoring programme which may include:
  - recording personnel patronage of bus transport

- monitoring hours worked by individuals to avoid driving while fatigued
- inspecting permits and authorisation for over-dimensional loads or transport of hazardous materials
- regular inspection of security infrastructure.

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 17.5** and compliance with the criteria outlined in **Section 17.4** as applicable to traffic and transport management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

Auditing will confirm the implementation of the Road Use Management Plan.

17.7 Proposed EA Conditions

No conditions proposed.

18. CULTURAL HERITAGE MANAGEMENT

18.1 Environmental Values

The environmental values to be protected or enhanced are the cultural heritage interest and significance relating to the historical use of the site. Historical cultural heritage is taken to include specifically non-Indigenous and shared Indigenous and non-Indigenous cultural heritage values.

18.1.1 Indigenous Cultural Heritage

The Birriah People currently have a registered Native Title Claim which overlaps part of the project area, being MLAs 10355, 10356, and 10357. The rights and interests claimed by the Birriah People are as set out in the Form 1 filed in the Federal Court of Australia. Under the *Aboriginal Cultural Heritage Act 2003 (Qld)* (ACH Act), the Birriah People are also the relevant Aboriginal party for that part of the project area. The Federal Court made a Native Title Consent Determination recognising the Jangga People's largely non-exclusive native title rights over the Determination Area. This area also overlaps part of the project area, located in an area where non-exclusive rights and interests have been recognised. The Jangga People are also the relevant Aboriginal party for that part of the project area.

18.1.2 Historical Cultural Heritage

Two sites of historical non-indigenous significance fell within the project area, being the old drover's and ringers' camps. These were approximately 300 m from the out of pit waste rock dump associated with South Pit 1 and approximately 800 m from the northern MIA and 2 km from the northern rail loop.

The Wollombi homestead complex is the only homestead complex falling within 1 km of the project footprint (this site is approximately 850 m from the out of pit waste rock dump associated with South Pit 2). In addition the grave on the Byerwen homestead complex and the Mount Lookout homestead complex have potential regional significance.

18.2 Potential Impacts

Impacts associated with ground disturbance (project footprint) are referred to as direct impacts. Impacts associated with vibration, air blast overpressure and traffic have the potential to impact cultural heritage sites within and outside the project area; these are referred to as indirect impacts.

There are no cultural heritage sites within the project area that are within the project footprint and as such direct impacts are limited.

The old drovers' and ringers' camp has potential for minor impacts from project activities due to the proximity to out of pit waste rock dump associated with South Pit 1. This site may be susceptible to impact due to their proximity to the waste rock dump and due to its current state of repair. A further archaeological assessment will be conducted if this site falls within 300 m of the project footprint to determine if a site-specific management plan will be required.

Without some management strategy, impacts may include the degradation or destruction of cultural heritage values.

18.3 Environmental Protection Objectives

18.3.1 Indigenous Cultural Heritage

- To protect heritage values within the project area from adverse impacts caused by project activities.

18.3.2 Historical Cultural Heritage

- To protect cultural heritage values of the site by avoiding or minimizing the impact of project activities on any discovered historical cultural heritage site.

18.4 Performance Criteria

Indicators to demonstrate the successful management of cultural heritage values include:

- the item, place or area receiving no significant damage due to project activities
- the item, place or area being successfully relocated (where applicable)
- the item, place or area being successfully rehabilitated (where applicable) to levels established in the management plan
- the item, place or area being successfully excluded from development activities (where applicable).

The following criteria are applicable to the protection and management of indigenous and historical cultural heritage values

18.4.1 Indigenous Cultural Heritage

The following criteria are applicable to the protection and management of indigenous cultural heritage values

- To avoid disturbance of known cultural heritage values caused by project activities, or, where this is not possible, to manage disturbances in accordance with the relevant CHMP.
- To ensure full compliance with the requirements of the ACH Act and CHMPs.

18.4.2 Historical Cultural Heritage

The following criteria are applicable to the protection and management of historical cultural heritage values

- Where required, to ensure management of historical cultural heritage occurs in accordance with a site-specific management plan.
- To ensure full compliance with the requirements of the *QH Act*.

18.5 Control Strategies

18.5.1 Indigenous Cultural Heritage

The proponent's preference for the management and protection of cultural heritage is avoidance in the first instance and collaboration with relevant Aboriginal Parties to ensure participation in the identification and protection of cultural heritage and to help specify impact mitigation measures.

The CHMPs executed (approved under the ACH Act) between the proponent and both the Birriah People and the Jangga People provide a protocol for conducting inspections and for management by way of recommended management strategies for indigenous cultural heritage, agreed on by all parties.

A management strategy has been developed in the CHMP that provides an inspection regime and discovery process that complies with the ACH Act and other relevant legislation.

18.5.2 Historical Cultural Heritage

The final rehabilitation of the project will return the area to primarily pastoral land use and therefore the likely impact on the cultural landscape is anticipated to be low.

Avoidance is the preferred management strategy for heritage values. As such, project works will avoid the known heritage values wherever possible. Known heritage values will be included in exclusion-zone mapping with fencing or pegging of the area if required.

Prior to any ground disturbing activities occurring in the immediate vicinity (within 300 m) of known heritage values, an archaeological assessment will be undertaken and a management plan or strategy specific to the item or place will be developed where required for each heritage value (identified or potential) likely to be impacted by project activities at the construction, operation and mine closure stages. At time of writing, the drovers' and ringers' camp is currently outside the project footprint. In the event project activity is anticipated to occur within 300 m of this site a management plan will be prepared for this site.

Under s.89 of the *QH Act*, it is a requirement to report the discovery of any archaeological artefact not previously identified in the historical cultural heritage study if the find should be of a scale to fulfil one of the significance criteria described in s.89 of the *QH Act*.

In the event heritage values are discovered during project activities, an assessment by a suitably qualified person (for the purpose of investigating, recording or conserving archaeological artefacts) will be conducted to determine the best management strategy for the site and to prepare a site-specific management plan if required. The best management option can differ greatly depending on the nature of the discovery. Any site-specific management plan will, as a minimum, include:

- a clear procedure
- designated contacts and contact details
- resource allocation measures
- monitoring programs (including essential parameters and indicators specific to the heritage value, frequency of monitoring and reporting methodology)
- management actions (including corrective actions (e.g. repairs and/or reconstruction requirements)), reporting, monitoring, staff training
- any emergency or safety procedures relevant to the management options being applied.

A plain English training manual on managing cultural heritage will be developed and provided to all site workers for their reference.

18.6 Monitoring and Auditing

Monitoring will include the following:

- Indigenous Cultural Heritage
  - Monitoring of sites of indigenous cultural heritage and measures to mitigate impacts will be conducted in accordance with the approved CHMPs.

- Historical Cultural Heritage
  - Specific inspection and/or monitoring regimes will be prescribed within any site-specific management plan to ensure the best management strategy tailored to the individual heritage value(s) is applied.

Auditing will be undertaken to assess the effectiveness of the control strategies identified in **Section 18.5** and compliance with the criteria outlined in **Section 18.4** as applicable to Indigenous and Historical Cultural management.

The auditing will include aspects of:

- roles, responsibilities and assigned authorities
- training, awareness and competence requirements
- documentation and document control provisions
- monitoring and measurement requirements
- records management
- reporting, corrective and preventative actions
- audit scheduling
- management review.

18.7 Proposed EA Conditions

No environmental authority conditions proposed.

19. DEFINITIONS

This section provides the definitions of terms used in the proposed environmental authority conditions in this EM Plan.

Schedule of Definitions

Note: Where a term is not defined in this environmental authority the definition in the *Environmental Protection Act 1994*, its regulations and Environmental Protection Policies, or the *Acts Interpretation Act 1954*, or the Macquarie Dictionary or the *Mining Resource Act 1989* or its regulation must be used in that order.

"accepted engineering standards", in relation to dams, means those standards of design construction, operation and maintenance that are broadly accepted within the profession of engineering as being good practice for the purpose and application being considered. In the case of dams, the most relevant documents would be publications of the Australian National Committee on Large Dams (ANCOLD). guidelines published by Queensland government departments and relevant Australian and New Zealand Standards.

“acceptance criteria” means the measures by which the actions implemented to rehabilitate the land are deemed to be complete. The acceptance criteria indicate the success of the rehabilitation outcome or remediation of areas which have been significantly been disturbed by the mining activities. Acceptance criteria may include information regarding:

a. vegetation establishment, survival and succession
b. vegetation productivity, sustained growth and structure development
c. fauna colonisation and habitat development
d. ecosystem processes such as soil development and nutrient cycling, and the recolonisation of specific fauna groups such as collembola, mites and termites which are involved in these processes
e. microbiological studies including recolonisation by mycorrhizal fungi, microbial biomass and respiration
f. effects of various establishment treatments such as deep ripping, topsoil handling, seeding and fertiliser application on vegetation growth and development
g. resilience of vegetation to disease, insect attack, drought and fire
h. vegetation water use and effects on ground water levels and catchment yields.

“acid rock drainage” means any contaminated discharge emanating from a mining activity formed through a series of chemical and biological reactions, when geological strata is disturbed and exposed to oxygen and moisture as a result of mining activity.

“administering authority” means the Department of Environment and Heritage Protection or its successor.

“aggregation dam” means a regulated dam that receives and contains coal seam gas water or coal seam gas concentrate. The primary purpose of the dam must not be to evaporate the water even though this will naturally occur.

"air blast over pressure level" means energy transmitted from the blast site with the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dBL).

"analogue site" – (or reference site) may reflect the original location, adjacent area or another area where rehabilitation success has been completed for a similar biodiversity. Details of the reference site may be as photographs, computer generated images and vegetation models etc.

"assessed" or "assess" by a suitably qualified and experienced person in relation to a hazard assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time:

a) exactly what has been assessed and the precise nature of that assessment

b) the relevant legislative, regulatory and technical criteria on which the assessment has been based

c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts

d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.

"associated works" in relation to a dam, means:

a) operations of any kind and all things constructed, erected or installed for that dam

b) any land used for those operations.

"authority" means an environmental authority or a development approval.

"blasting" means the use of explosive material to fracture:

a) rock, coal and other minerals in the later recover, or

b) structural components or other items to facilitate removal from a site for re-use.

"bunded" means within bunding consistent with Australian Standard 1940.

"brine dam" means a regulated dam that is designed to receive, contain or evaporate brine.

"Certification" means assessment and approval must be undertaken by a suitably qualified and experienced person in relation to any assessment or documentation required by this manual, including design plans, 'as constructed' drawings and specifications, construction, operation or an annual report regarding regulated structures, undertaken in accordance with the Board of Professional Engineers of Queensland Policy Certification by RPEQs (ID: 1.4 (2A)).

"Certifying, certify or certified" have a corresponding meaning as 'certification'.

"chemical" means:

a) An agricultural chemical product or veterinary chemical product within the meaning of the *Agricultural and Veterinary Chemicals Code Act 1994* (Cth)

b) A dangerous good under the dangerous goods code

c) A lead hazardous substance within the meaning of the Workplace Health and Safety Regulation 1997

d) A drug or poison in the Standard for the Uniform Scheduling of Drugs and Poisons prepared by the Australian Health Ministers' Advisory Council and published by the Commonwealth.

e) any substance used as, or intended to be used as:

i) a pesticide, insecticide, fungicide, herbicide, rodenticide, nematocide, miticide, fumigant or related product

ii) a surface active agent, including, for example, soap or related detergent

iii) a paint solvent, pigment, dye, printing ink, industrial polish, adhesive, sealant, food additive, bleach, sanitiser, disinfectant, or biocide

iv) a fertiliser for agricultural, horticultural or garden use. f) a substance used for, or intended for use for:

i) mineral processing or treatment of metal, pulp and paper, textile, timber, water or wastewater

ii) manufacture of plastic or synthetic rubber

"commercial place" means a place used as an office or for business or commercial purpose.

"component person" means a person with the demonstrated skill and knowledge required to carry out the task to a standard necessary for the reliance upon collected data or protection of the environment.

"construction" includes building a new dam and modifying or lifting an existing dam.

"contaminate" means to render impure by contact or mixture.

"contaminant" a contaminant can be:

a) a gas, liquid or solid

b) an odour

c) an organism (whether alive or dead), including a virus

d) energy, including noise, heat, radioactivity and electromagnetic radiation e) a combination of contaminants.

"dam" means a land-based structure or a void that is designated to contain, divert or control flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works. However, a dam does not mean a fabricated or manufactured tank or container designed to a recognised standard, nor does a dam mean a land-based structure where that structure is designed to an Australian Standard. In case there is any doubt, a levee (dyke or bund) is a dam, but (for example) a bund designed for spill containment to AS 1940 is not a dam.

"dam crest volume" means the volume of material (liquids and/or solids) that could be within the walls of a dam at any time when the upper level of that material is at the crest level of that dam. That is, the instantaneous maximum volume within the walls, without regard to flows entering or leaving (e.g. via spillway).

"dB" Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.

"dB(A)" Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.

"density of cover" In reference to trees and/or shrubs, it means the number of trees or shrubs in a specified area (e.g. 50 trees per square kilometre). With reference to understory plant species (e.g. grass and forbs), it means the percentage of surface area covered by a particular species.

"design storage allowance" or "DSA" means the minimum storage required in a dam at the first of November each year in order to meet the hydraulic performance requirements.

"domestic waste" means waste, other than domestic clean-up waste, green waste, recyclable waste, interceptor waste or waste discharged to a sewer, produced as a result of the ordinary use or occupation of domestic premises.

"effluent" means treated water discharged from sewage treatment plants.

"emergency action plan" means documentation forming part of the operational plan held by the holder or a nominated responsible officer, that identifies emergency conditions that sets out procedures and actions that will be followed and taken by the dam owner and operating personnel in the event of an emergency. The actions are to minimise the risk and consequences of failure, and ensure timely warning to downstream communities and the implementation of protection measures. The plan must require dam owners to annually update contact details that are part of the plan, and to comprehensively review the plan at least every five years.

"end of pipe" means the location at which water is released to waters or land.

"environmental authority" means an environmental authority granted in relation to an environmentally relevant activity under the *Environmental Protection Act 1994*.

"environmental authority holder" means the holder of this environmental authority.

"environmentally relevant activity" means an environmentally relevant activity as defined under Section 18 of the *Environmental Protection Act 1994* and listed under Schedule 2 of the *Environmental Protection Regulation 2008*.

"financial assurance" means a security required under the *Environmental Protection Act 1994* by the administering authority to cover the cost of rehabilitation or remediation of disturbed land or to secure compliance with the environmental authority.

"general waste" means waste other than regulated waste.

"hazard" in relation to a dam as defined, means the potential for environmental harm resulting from the collapse or failure of the dam to perform its primary purpose of containing, diverting or controlling flowable substances.

"hazard category" means a category, either low, significant or high, into which a dam is assessed as a result of the application of tables and other criteria in the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams*.

"hazardous waste" means a substance, whether liquid, solid or gaseous that, if improperly treated, stored, disposed of or otherwise managed, is likely to cause environmental harm.

"Holder" means:

a) where this document is an environmental authority, any person who is the holder of, or is acting under, that environmental authority: or

b) where this document is a development approval, any person who is the registered operator for that development approval.

"$L_{A10,\ adj,\ 15\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 15-minute period, using Fast response.

"$L_{A1,\ adj,\ 15\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 15-minute measurement period, using Fast response.

"$L_{Amax,\ adj,\ T}$" means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

"$L_{Aeq(period)}$" Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.

"$L_{A10(period)}$" The sound pressure level that is exceeded for 10% of the measurement period.

"$L_{A90(period)"}$ The sound pressure level that is exceeded for 90% of the measurement period.

"land" in the "land schedule" of this document means land excluding waters and the atmosphere.

"land capability" as defined in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME 1995).

"land suitability" as defined in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME 1995).

"land use" term to describe the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

"landfill" means land used as a waste disposal site for lawfully putting solid waste on the land.

"levee" means an embankment that only provides for the containment and diversion of stormwater or flood flows from a contributing catchment, or containment and diversion of flowable materials resulting from releases from other works, during the progress of those stormwater or flood flows or those releases: and does not store any significant volume of water or flowable substances at any other times.

"mandatory reporting level" or "MRL" means a warning and reporting level determined in accordance with:

a) the *Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland* (DME 1995), or
b) the criteria in the *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* published by the administering authority.

"mature trees" means any tree relevant to the tenure that is classified as a commercial sized tree by the Code of Practice for Native Forest Timber Production 2002.

"mg/L" means milligrams per litre.

"µg/L" means micrograms per litre.

"mineral" means a substance which normally occurs naturally as part of the earth's crust or is dissolved or suspended in water within or upon the earth's crust and includes a substance which may be extracted from such a substance, and includes:

a) clay if mined for use for its ceramic properties, kaolin and bentonite

b) foundry sand

c) hydrocarbons and other substances or matter occurring in association with shale of coal and necessarily mined, extracted, produced or released by or in connection with mining for shale or coal or for the purpose of enhancing the safety of current or future mining operations for coal or the extraction or production of mineral oil therefrom

d) limestone if mined for use for its chemical properties

e) marble

f) mineral oil or gas extracted or produced from shale or coal by in situ processes

g) peat

h) sat including brine

i) shale from which mineral oil may be extracted or produced

j) silica, including silica sand, if mined for use for its chemical properties

k) rock mined in block or slab form for building or monumental purposes.

But does not include:

a) living matter

b) petroleum within the meaning of the *Petroleum Act 1923*

c) soil, sand, gravel or rock (other than rock mined in block or slab form for building or monumental purpose) to be used or to be supplied for use as such, whether intact or in broken form

d) water.

“mine water” means process water and contaminated stormwater.

“natural flow” means the flow of water through waters caused by nature.

“native vegetation” means vegetation that occurs naturally in a certain area.

“nature” includes:

a) ecosystems and their constituent parts

b) all natural and physical resources

c) natural dynamic processes.

"noise sensitive place" means any of the following:

a) a dwelling

b) a library, childcare centre, kindergarten, school, university or other educational institution

c) a hospital, surgery or other medical institution

d) a protected area, or an area identified under a conservation plan as a critical habitat or an area of major interest, under the *Nature Conservation Act 1992*

e) a marine park under the *Marine Parks Act 1982*

f) a park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment.

“noxious” means harmful or injurious to health or physical wellbeing.

"NTU" means nephelometric turbidity units.

“offensive” means causing reasonable offence or displeasure: is disagreeable to the sense: disgusting, nauseous or repulsive, other than trivial harm.

"operational land" means the land associated with the project for which this environmental authority has been issued.

"operational plan" means a document that amongst other things sets out procedures and criteria to be used for operating a dam during a particular time period. The operational plan as defined herein may form part of a plan of operations or plan otherwise required in legislation.

"palletised" means stored on a movable platform on which batteries are placed for storage or transportation.

"particulate matter" or "(PM)" means dust particulate matter.

"$PM_{2.5}$" Dust particulate matter with an aerodynamic diameter less than 2.5 micron (millionth of a metre).

"PM_{10}" Dust particulate matter with an aerodynamic diameter less than 10 micron (millionth of a metre).

"peak particle velocity (ppv)" means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mms-1).

"person suitably qualified" in relation to a hazard assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time:

a) exactly what has been assessed and the precise nature of that assessment

b) the relevant legislative, regulatory and technical criteria on which the assessment has been based

c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts

d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.

"process water" means water used or produced during the mineral development activities.

"progressive rehabilitation" means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining operations are ongoing.

"protected area" means:

a) a protected area under the *Nature Conservation Act 1992*

b) a marine park under the *Marine Parks Act 2004*

c) a World Heritage Area.

"receiving environment" means all groundwater, surface water, land, and sediments that are not disturbed areas authorised by this environmental authority.

"receiving waters" means all groundwater and surface water that are not disturbed areas authorised by this environmental authority.

"recycled water" means appropriately treated effluent and urban stormwater suitable for further use.

"reference site" - see analogue site.

"regulated dam" means any dam in the significant or high hazard category as assessed using the *Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland* (DME 1995).

"regulated waste" means non-domestic waste mentioned in schedule 7 of the *Environmental Protection Regulation 2008* (whether or not it has been treated or immobilised), and includes:

a) for an element – any chemical compound containing the element

b) anything that has contained the waste.

"rehabilitation" the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

"representative" means a sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the mining activities.

"residual void" means an open pit resulting from the removal of ore and/or waste rock which will remain following the cessation of all mining activities and completion of rehabilitation processes.

"saline drainage" the movement of waters, contaminated with salt(s), as a result of the mining activity.

"self-sustaining" means an area of land which has been rehabilitated and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.

"sensitive place or receptors" means:

a) a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises

b) a motel, hotel or hostel

c) an educational institution

d) a medical centre or hospital

e) a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 2004* or a World Heritage Area

f) a public park or gardens.

"sewage" is defined under the *Plumbing and D rainage Act 2002* as household and commercial wastewater that contains, or may contain, faecal, urinary or other human waste.

"sewage treatment facility" is a process plant that removes contaminants from wastewater and household sewage, including physical, chemical, and biological processes to remove physical, chemical and biological contaminants.

"spillway" means a weir, channel, conduit, tunnel, gate or other structure designed to permit discharges from the dam, normally under flood conditions or in anticipation of flood conditions.

"stable" in relation to land, means land form dimensions are or will be stable within tolerable limits now and in the foreseeable future. Stability includes consideration of geotechnical stability, settlement and consolidation allowances, bearing capacity (trafficability), erosion resistance and geochemical stability with respect to seepage, leachate and related contaminant generation.

"storm water" means all surface water runoff from rainfall.

"suitably qualified and experienced person" in relation to dams means one who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the *Professional Engineers Act*

2002, OR registered as a National Professional Engineer (NPER) with the Institution of Engineers Australia, OR holds equivalent professional qualifications to the satisfaction of the administering authority for the Act: AND the administering authority for the Act is satisfied that person has knowledge, suitable experience and demonstrated expertise in relevant fields, as set out below:

a) knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impact of dams

b) A total of five years of suitable experience and demonstrated expertise in at least four of the following categories, with the 'geomechanics of dams' category being compulsory:

   i. geomechanics of dams with particular emphasis on stability, geology and geochemistry

   ii. investigation, design or construction of dams

   iii. operation and maintenance of dams

   iv. hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology

   v. hydraulics with particular reference to sediment transport and deposition, erosion control, beach processes

   vi. hydrogeology with particular reference to seepage, groundwater vii. solute transport processes and monitoring thereof

   viii. dam safety.

"system design plan" means a plan that manages an integrated containment system that shares the required DSA volume across the integrated containment system.

"tolerable limits" means a range of parameters regarded as being sufficient to meet the objective of protecting relevant environmental values. For example, a range of settlement for a tailings capping, rather than a single value, could still meet the objective of draining the cap quickly, preventing pondage and limiting infiltration and percolation.

"total suspended particulates" or "TSP" means dust particulate matter with an aerodynamic greater than 10 micron (millionth of a metre).

"trackable waste" means a waste or combination of waste stated in Schedule 1 of the *Environmental Protection (Waste Management) Regulation 2000.*

"trivial harm" means environmental harm which is not material or serious environmental harm and will not cause actual or potential loss or damage to property of an amount of, or amounts totalling more than $5,000.

"void" means any man-made, open excavation in the ground.

"waste" as defined in section 13 of the *Environmental Protection Act 1994*.

"waste management hierarchy" has the meaning given by the *Environmental Protection (Waste Management) Policy 2000*.

"waste water" means used water from the activity, process water or contaminated storm water.

"water" means:

a) water in waters or spring

b) underground water

c) overland flow water

d) water that has been collected in a dam.

“water quality” means the chemical, physical and biological condition of water.

"waters" includes all or any part of a creek, river, stream, lake, lagoon, swamp, wetland, spring, unconfined surface water, unconfined water in natural or artificial watercourses, bed and bank of any waters, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and underground water.

"watercourse" has the meaning provided in section 5 of the *Water Act 2000* and includes the bed and banks and any other element of a river, creek or stream confining or containing water.

“µg/L” means micrograms per litre.

“µS/cm-1” means microsiemens per centimetre.