Central Queensland Coal Project

Chapter 16 – MNES

Environmental Impact Statement

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Central Queensland Coal Project

Chapter 16 – Matters of National Environmental Significance

24 October 2017

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16 Matters of National Environmental Significance

Central Queensland Coal Pty Ltd (Central Queensland Coal) and Fairway Coal Proprietary Limited (Fairway Coal) (the joint Proponents), both wholly owned subsidiaries of Mineralogy Proprietary Limited (Pty Ltd) propose to develop the Central Queensland Coal Project (the Project). As Central Queensland Coal is the senior proponent, Central Queensland Coal is referred to throughout this Environmental Impact Statement (EIS). The Project comprises the Central Queensland Mine where coal mining and processing activities will occur along with a train loadout facility (TLF). It is intended that all aspects of the Project will occur as a single resource activity, authorised by mining leases and a site-specific Environmental Authority (EA).

The Project is located near the Central Queensland Coast approximately 130 kilometres (km) northwest of Rockhampton. The Project will be located within Mining Lease (ML) 80187 and ML 700022, which are adjacent to Mineral Development Licence (MDL) 468 and Exploration Permit for Coal (EPC) 1029, both of which are held by the Proponent.

The Project will involve mining a maximum combined tonnage of up to 10 million tonnes per annum (Mtpa) of semi-soft coking coal (SSCC) and high grade thermal coal (HGTC). Development of the Project is expected to commence in 2018 and extend for approximately 20 years until the current reserve is depleted.

Access to the Project will be via the Bruce Highway. The Project will require the hiring of 200 employees during construction and 250 employees during operations with an option to increase to 500 employees should operations increase to maximum throughput tonnages. The Project labour resources will be sourced from within the general local area (Marlborough, St Lawrence, Sarina, Mackay and Rockhampton) as a drive-in drive-out workforce. Central Queensland Coal and Fairway Coal will manage the Project construction and operations with the assistance of contractors.

This chapter of the EIS describes the potential impacts associated with the Project on Matters of National Environmental Significance (MNES) as set out under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The referral for this Project was submitted to the Department of Environment and Energy (DotEE) on 22 December 2016 (EPBC 2016/7851). This chapter of the EIS has been prepared in response to a decision made under section 75 of the EPBC Act by DotEE on 3 February 2017 to declare the Project a controlled action. Controlling provisions include:

- World Heritage properties (sections 12 and 15A);
- National Heritage places (sections 15B and 15C);
- Listed threatened species and communities (sections 18 and 18A);
- Listed migratory species (sections 20 and 20A);
- Great Barrier Reef Marine Park (sections 24B and 24C); and
- Water resources in relation to large coal mining development (sections 24D and 24E).

The EPBC Act provides for the protection of the environment, in particular MNES. Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on any MNES without approval from the Australian Government Environment Minister or the

Minister's delegate. A proposed action likely to significantly impact MNES should be referred, to obtain a decision on whether a proposed action will need formal assessment and approval under the EPBC Act.

For this Project, the EIS process is accredited under the bilateral assessment between the Commonwealth and Queensland Governments. As such, the EIS process under the EPBC Act will run concurrently with the Queensland EIS process.

The following information in this chapter addresses the requirement for a stand-alone MNES assessment as detailed in the Project's Terms of Reference (ToR) published by the Queensland Department of Environment and Heritage Protection (EHP) in April 2017. The chapter summarises the results of desktop and field-based assessments of the Project area as part of terrestrial and aquatic ecology, and surface and groundwater assessments using the results to define the potential impacts to the MNES of concern.

16.1 Title of the Action

The title of the action is the Central Queensland Coal Project (EPBC ref 2016/7851).

16.2 Proponent

The Project will be developed and operated by Central Queensland Coal and Fairway Coal. Both companies are private companies and subsidiaries of Waratah Coal Pty Ltd (Waratah Coal), a fully owned subsidiary of Mineralogy Pty Ltd. Mineralogy Pty Ltd and its associated entities have over 25 years' experience developing, funding and managing a range of major resource projects.

Waratah Coal is an Australian coal exploration and coal development company. Waratah Coal holds extensive mining concessions within the rich mineral basins of Laura, Bowen, Galilee, Surat, Moreton, Maryborough, Nymboida and the Northern Territory, in addition to the Styx Basin. Waratah Coal has been operating for over 10 years and has formed major international alliances in China and domestically during this time. From 2005 to 2009, Waratah Coal was dual-listed on the Toronto Stock Exchange and Australian Stock Exchange. In 2009, Waratah Coal was privatised and incorporated into Mineralogy Pty Ltd. Waratah Coal is committed to the economic development of regional growth in Queensland through the growth of mineral wealth while operating with an excellent record in the area. Waratah Coal aims to be a valued member of the local community and to openly engage and build trust and respect in Queensland over time.

Fairway Coal owns mineral development licence (MDL) 468 which will form the Project. Both Fairway Coal and Central Queensland Coal are registered as suitable operators with EHP (#701901 and #686364, respectively), meaning the company is registered as being suitable to carry out industrial activities requiring an EA.

The contact details for Central Queensland Coal are:

Address:	Level 17, 240 Queen Street Brisbane Qld 4001
Postal Address:	GPO Box 1538 Brisbane Qld 4001
Telephone:	0418872181
Email:	nharris@waratahcoal.com

Further information regarding the overarching company, Waratah Coal, can be obtained from the following website: http://waratahcoal.com/

16.3 Environmental Health and Safety Policy

Central Queensland Coal recognises its responsibility for implementing sound environmental stewardship of the environment in which it works. We will care for and manage the environment to deliver better environmental practice outcomes. Our commitment extends to all of those who work with and for Central Queensland Coal.

Central Queensland Coal recognise that operational success depends heavily on a shared commitment to setting and maintaining a high standard of cultural heritage, community, environment and safety performance. Central Queensland Coal is committed to supporting and strengthening local community relations with landowners and interested parties who have interests within or surrounding the Project. This will be achieved by managing the correct balance between pursuing the company's mining interests and preserving the interests of existing landholders as outlined in their Environmental Management System (EMS) which is being developed and is consistent with ISO14001 principles.

In executing our environmental policy, we will:

- Comply with all legislation and regulations;
- Incorporate environmental better practice into our core business plans and management processes;
- Provide adequate resources to meet our commitments;
- Train our workforce and contractors to meet our standards;
- Communicate our planned actions, targets and results to all stakeholders;
- Identify, minimize and mitigate environmental disturbance throughout our business;
- Measure our performance;
- Enforce our standards with partners and contractors; and
- Improve our performance through continuous planning.

This environmental policy confirms the company's intent towards creating and implementing sound environmental management practices. All management, employees and contractors of Fairway Coal will uphold and implement this policy.

The EMS will include specific operating procedures that incorporate organisational structures, planning activities, responsibilities, site practices, procedures, processes, and identify resources required for the development, implementation, review and maintenance of the safety and health policy.

As part of this process Central Queensland Coal is nominated as responsible for endorsing and approving all mitigation measures and environmental monitoring programs outlined in this document.

Neither Fairway Coal or Central Queensland Coal have proceedings against them under any law of the Commonwealth or State relating to the protection of the environment or the conservation and sustainable use of natural resources.

16.4 The Central Queensland Coal Project

16.4.1 Project Justification

The Project will produce both coking (SSCC) and thermal (HGTC) coal for export. Coking and thermal coals are in demand globally to generate steel and electricity, respectively. Recent demand for both coking and thermal coal has increased significantly with spot prices reaching US$300 and US$100 free on board (FOB), respectively. Quarterly contract sale prices have also significantly increased with the next quarter contracts for coking and thermal coal reaching US$300 and US$100/tonne, FOB respectively. As an indication of the extent to which global demand has changed, coking coal spot price (daily market price), was $US73.40/tonne in November 2015 and in November 2016 prices reached $US289.30/tonne; a four year high (~400% increase) (Office of the Chief Economist 2017). The demand for thermal and coking coal, and subsequent coal spot prices makes this Project economically viable.

With respect to thermal coal, the United States (US) International Energy Agency (IEA) predicts global energy consumption to grow by 37 per cent (%) by 2040 (US IEA 2014). This is taking in to account existing and planned government policies regarding climate change. In 2040, natural gas, oil and coal will each account for roughly one-quarter of the world's energy needs (US IEA 2014).

Among these fossil fuels, coal demand is predicted to grow most rapidly, driven largely by growth in non-Organisation for Economic Co-operation and Development (OECD) countries. Asia accounts for 60% of the growth of energy demand and it is predicted that by 2025, China will make up 24% of the global energy demand. From 2025 to 2040, India is likely to take over China as the main source of global demand growth (US IEA 2014). Increases in demand are predicted to continue for approximately the next ten years (US IEA 2014).

Australia exported 201.3 million tonnes (Mt) of thermal coal during the 2015 – 2016 financial year, valued at over $14.7 billion, and is expected to increase to 202.2 Mt with a revenue of $18.9 billion this financial year (2016 – 2017) (DFAT 2017). Southeast Asian thermal coal demand is expected to triple in the next 25 years (IEA 2015). This Project will help supply the demand growth.

As with thermal coal, non-OECD countries are also predicted to drive global growth in coking coal consumption and production over the medium term as steel is required to support growing infrastructure needs (Office of the Chief Economist 2017). Australia exported 188 Mt of coking coal during 2015 – 2016 financial year, valued at over $19.7 billion, and this is expected to increase to 191.7 Mt this financial year (2016-2017) at a relative value of $36.6 billion (Office of the Chief Economist 2017). Importantly, about $1.59 billion (80%) of the royalties paid to the Queensland Government in 2015–16 were attributed to coal sales (Queensland Treasury 2017). With increased pricing in both thermal and coking coal it is expected that the royalty contribution will increase.

Australian production rates of coking coal are expected to increase at a rate of 2.1% per year until 2020. This growth will be supported by new developments such as this Project. The current increases in global demand for coal and forecast increases in production support the justification for the Project.

It is anticipated that the Project will contribute to Queensland's important coal export industry in meeting world demand for coal. This offers long-term economic benefits to the Australian,

Queensland and local communities. Further detail justifying the Project is provided in Chapter 2 – Project Needs and Alternatives.

16.4.2 Project Benefits

Coal is Queensland's second largest export commodity and provides significant benefits to the State and Federal governments through strong financial returns and significant employment opportunities. In the 2015/2016 financial year coal contributed to the Queensland economy by:

- Contributing $32.7 billion gross regional product (equating to 11% of Queensland's total gross regional product);
- Employing 183,554 full time employees (equating to 8% of Queensland total employment);
- Paying $2.7 billion in wages to 19,072 direct full-time employees;
- Paying $1.6 billion in royalties (out of a Queensland total of $2.2 billion) to State governments which was then distributed across Queensland; and
- Spending $11.3 billion within Queensland on locally purchased goods and services, benefitting 10,727 local Queensland businesses, and community contributions benefitting 469 Queensland community organisations (QRC, 2016).

The Project is predicted to provide a significant contribution to these economic benefits, including employment and a boost to the townships of Ogmore, St Lawrence and Marlborough, as described in detail within Chapter 19 – Social and Economics.

The Project will provide a boost to the Livingstone Shire and Queensland's and Australia's economy. Capital expenditure for the Project is anticipated to total $242.68 million. Operational expenditure will be approximately $8,250 million once the Project is operational (see Chapter 19 – Social and Economics). The Project will provide key social and economic benefits to the locality, region and state including flow on business, employment skills and training programs, and royalties and taxes.

If the Project does not proceed, then the benefits of the Project would not be realised.

16.4.3 Project Description

Central Queensland Coal and Fairway Coal (the joint Proponents), both wholly owned subsidiaries of Mineralogy Proprietary Limited, propose to develop the Project, located 130 km northwest of Rockhampton in the Styx Coal Basin in Central Queensland (Figure 16-1). As Central Queensland Coal is the senior proponent, Central Queensland Coal is referred to throughout this EIS. The Project will be located within Mining Lease (ML) 80187 and ML700022, which is adjacent to MDL 468 and Exploration Permit for Coal (EPC) 1029, both of which are held by the Proponent.

The Project will initially involve the mining of an approximately 1 million tonnes per annum (Mtpa) with options of increasing to 5 or 10 Mtpa of semi-soft coking coal (SSCC) and high grade thermal coal (HGTC). Development of the Project is expected to commence in 2018 and extend for approximately 20 years until the current reserve is depleted.

The Project consists of three open cut pit operations that will be mined using a truck and shovel methodology (Figure 16-2). The run-of-mine (ROM) coal will ramp up to approximately 2 Mtpa during Stage 1 (Year 1-4), where coal will be crushed, screened and washed to SSCC grade with an estimate 80% yield. Stage 2 of the Project (Year 4-20) will include further processing of up to an additional 4 Mtpa ROM coal within another coal handling and preparation plant (CHPP) to SSCC and

up to 4 Mtpa of HGTC with an estimated 95% yield. At full production two CHPPs, one servicing Open Cut 1 and the other servicing Open Cut 2 and 4, will be in operation.

A new TLF will be developed to connect into the existing North Coast Rail Line (Figure 16-2). The TLF will require all new infrastructure when connecting to the North Coast Rail network which will allow transport of the product coal to the established coal loading infrastructure at the Dalrymple Bay Coal Terminal (DBCT).

The Project is located within the Livingstone Shire Council (LSC) Local Government Area (LGA). The nearest major regional centre is Rockhampton, located approximately 130 km to the south of the Project. Apart from the TLF, the Project is located on the Mamelon property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. The TLF is located on Strathmuir property, described as real property Lot 9 on MC230. A small section of the haul road to the TLF is located on the "Brussels" property described as real property Lot 85 on SP164785.

Access to the Project will be via the sealed Bruce Highway and the Mount Bison Road, Central Queensland Coal will manage the Project construction and subsequent mining operation with the assistance of contractors. Throughout the three phases of the Project (construction, operation and decommission) the Project will provide potential employment opportunities in Ogmore, St Lawrence, Clairview and Marlborough, in addition to the broader regional area.

The Project will directly create a total demand of approximately 200 full-time equivalent (FTE) positions in Queensland for the construction period. At full operating capacity, the Project will directly employ between 250 to 500. The Project workforce, comprising all staff and contractors throughout the life of the Project, will be required to follow Project specific Workforce Management Plans and Strategies to ensure social and environmental impacts are minimised. A detailed description of the Project, as assessed within this EIS, is provided in Chapter 3 – Description of the Project.

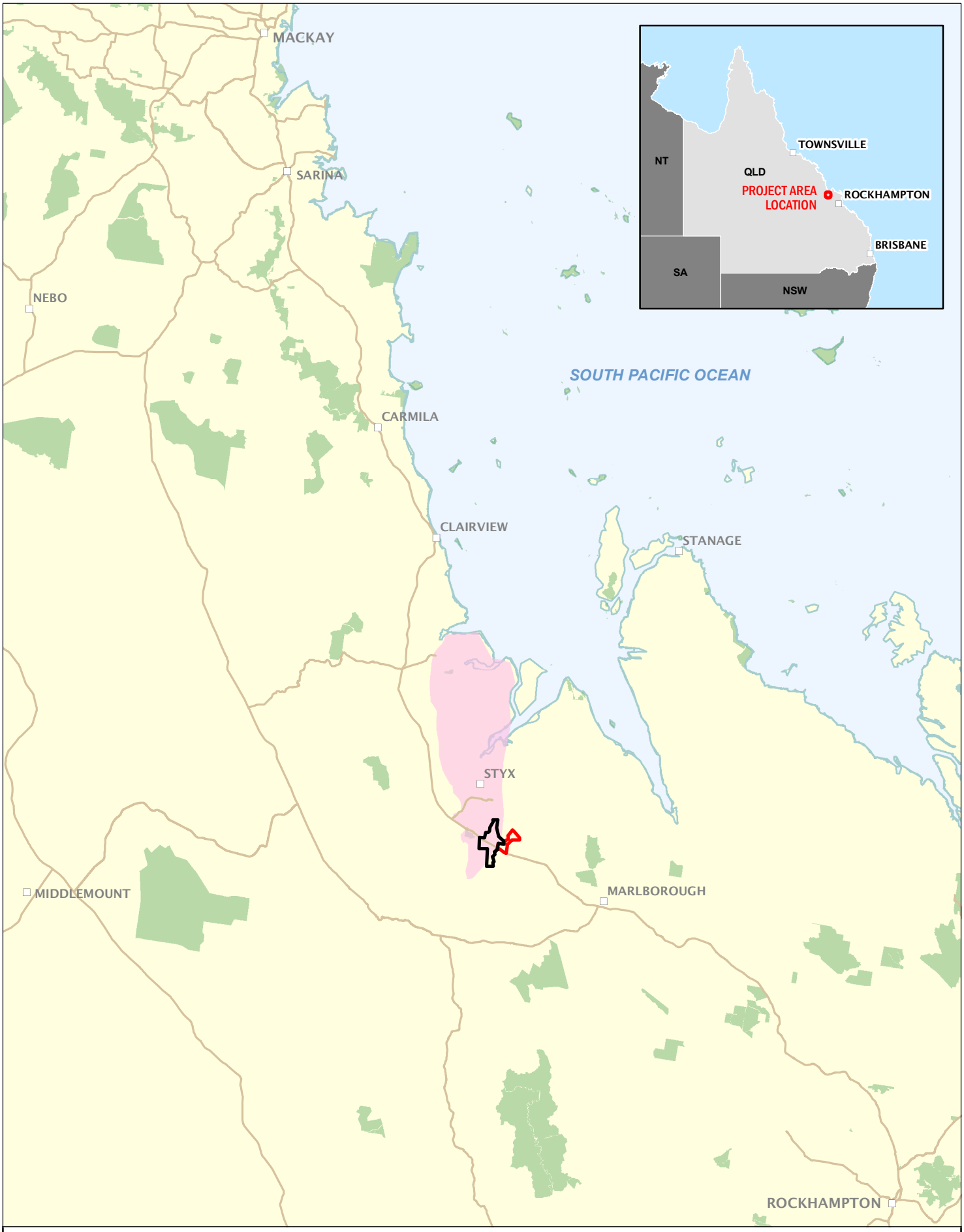

Figure 16-1
Regional Project location

Scale @ A4 1:1,050,000
Date: 21/07/17
Drawn: Gayle B.

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017
Geoscience Australia, 2017

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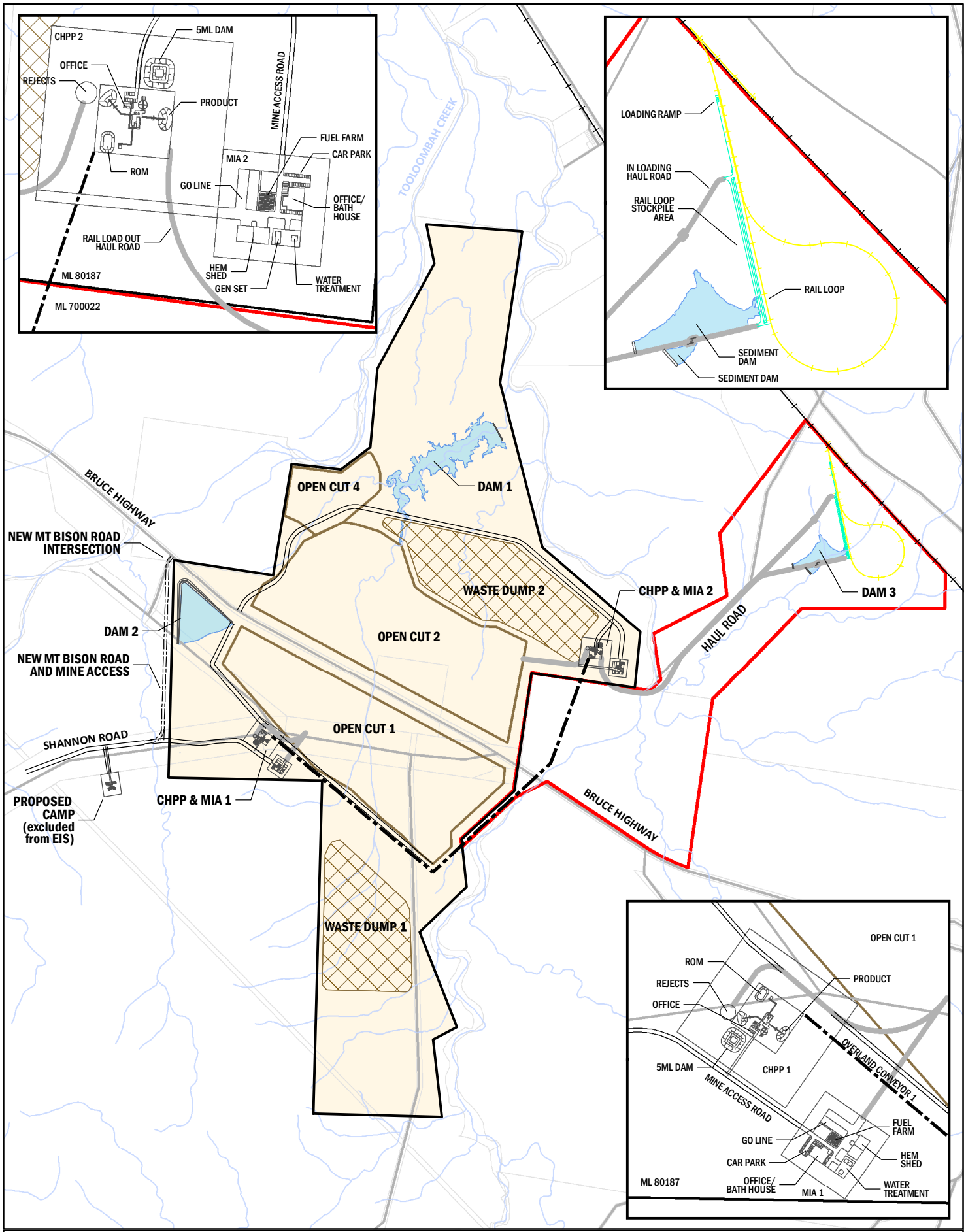

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Scale @ A4 1:55,000
Date: 21/07/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Open-cut Mine Pit
- Dam Catchment
- Waste Dump Area
- Overland Conveyor
- Haul roads
- Rail Loadout Facility
- Rail Loop
- Proposed mine infrastructure
- Watercourse
- North Coast Rail Line
- Main road
- Cadastral boundary

Figure 16-2
Project layout

DATA SOURCE
QLD Open Source Data, 2017
Esri Basemaps

CDM Smith

BRUGGEMANNGD B:\BES150160 Styx Coal\GIS\DATA\MXD\FINAL\03 EIS Preparation\BES150160.03-054 R1 project components.mxd 7/21/2017

16.4.4 Relationships to Other Projects

The Project is interrelated with other external infrastructure projects which are not encompassed in this EIS assessment or approval process. The potentially interrelated projects below may be undertaken as part of supporting and servicing the Project following further design and consultation with stakeholders. Should these projects be required they will be subject to separate assessment and approvals undertaken by the respective service providers. They are provided here for the sake of completeness and include:

- Accommodation camp; and
- Alternative access road to Mount Bison Road.

Any related developments will be constructed and owned by third party service providers who will obtain any necessary approvals (local, state or federal government approvals) to construct or maintain the infrastructure. As part of the design process for this infrastructure, Central Queensland Coal commits to avoid, minimise and manage any impacts on environmental values (EVs), including MNES, because of the development of any associated infrastructure.

16.4.5 Project Context and Areas

16.4.5.1 Regional Context

The Project is located within the LSC LGA which spans an area of approximately 11,770 km^2. It is located in the Capricornia region of central Queensland encompassing lands to the north and east of Rockhampton and is located 8 km south of the Great Barrier Reef World Heritage Area. The LSC area encompasses a variety of land uses and industries dominated by cattle grazing and tourism with an extensive urban conurbation in the Yeppoon area. Although relatively small the region has several national parks, state forests and important wetlands with significant EV.

16.4.5.2 Landscape Context

The Project is largely located within the Marlborough Plains subregion, one of the 13 subregions of the Brigalow Belt North bioregion. The southern portion of the Mine Lease (ML) occurs in the adjacent Nebo-Connors Ranges subregion. The Project area is located close to the boundary of the Brigalow Belt South bioregion located to the south. Vegetation within the Marlborough Plains subregion is dominated by alluvial plains and colluvial slopes, usually supporting woodlands characterised by Poplar Gum (*Eucalyptus platyphylla*), Ghost Gum (*Corymbia dallachiana*), Forest Red Gum (*E. tereticornis*) and paperbarks (*Melaleuca* spp.) with low rises supporting Narrow-Leaved Ironbark (*E. crebra*).

Large sections of the Brigalow Belt North bioregion have been cleared of remnant native vegetation for grazing, agriculture and mining. Remaining vegetation is generally confined to rockier hilly areas, linear strips of roadside vegetation, riparian vegetation and relatively small isolated remnants. Thus, clearing over the past 150 years has resulted in a highly fragmented landscape with remnant vegetation patches separated by large expanses of cleared land.

Areas to the north and east of the Project area have been substantially impacted by vegetation clearing associated with cattle grazing activity. Connectivity between remaining tracts of vegetation is tenuously maintained by thin strips of riparian vegetation along creek lines such as Tooloombah Creek and Deep Creek which border the Project. Nevertheless, woodland and open forest habitat remaining in the south and east of the site remains contiguous with an extensive tract of remnant

vegetation, which includes Tooloombah Creek Conservation Park. To the west of the Project remains extensive tracts of remnant forest associated with the nearby Broadsound Range.

The Project is located within the Styx River catchment whose main tributaries include Deep, Granite, Montrose, Stoodleigh, Tooloombah, Waverly and Wellington Creeks. The catchment is bordered by the Connors Ranges in the Northwest and the Broadsound Ranges to the Southwest and empties into the Coral Sea near Rosewood Island. The lower Styx River is part of Broad Sound, a large wetland listed in the Directory of Important Wetlands of Australia (DIWA).

Vegetation within the Project area and immediate surrounds comprises:

- Heavily disturbed habitats that have previously undergone significant clearing for cattle production;
- Substantial areas of less disturbed eucalypt woodland; and
- Linear remnants of open forest vegetation largely associated with the creek systems adjacent to the Project boundary.

16.4.5.3 Local Context

Elevations across the Styx catchment range from 0 to 540 m above sea level. The mine area and TLF area predominantly comprises flat or undulating lands, with sharper topographical relief restricted to the southern portion of ML 80187. The land within the Project disturbance area can be described as gently undulating.

The Project area drains via several smaller creeks and tributaries to the Styx River and estuary, and into the Coral Sea. ML 80187 is bordered by Deep Creek on the eastern boundary and Tooloombah Creek on the northeast boundary. The both creeks meet approximately 2 km north of the ML boundary, thereupon merging to become the Styx River. The haul route crosses Deep Creek to the immediate east. The TLF is located approximately 2 km to the northeast in cleared grazing lands.

Substantial portions of the Project area have previously been cleared for cattle grazing. The remaining remnant vegetation is largely located in the south and east remaining connected to a rocky tabletop area to the immediate south of the ML. There is also a largely thin strip of riparian vegetation associated with the creek lines lying adjacent to the ML.

16.4.5.4 Land Tenure

The mine area is located entirely within part of the Mamelon cattle property, situated on Lot 3 on HLN29 and Lot 4 on HLN225, both of which are freehold tenures. An east-west oriented, un-named road reserve also traverses the mine area, although no formed road exists there. the Project is located on the Mamelon property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. The TLF is located on Strathmuir property, described as real property Lot 9 on MC230. All infrastructure associated with the Project will be located within the LSC LGA.

Table 16-1 Land tenure

Property description	Property name	Tenure	Current use	Proposed use	Owner and occupier
Central Queensland Coal mine area					
Lot 9 MC496	Mamelon Station	Freehold	Grazing	Mining	QNI Metals Pty Ltd
Lot 10 MC493					
Lot 11 MC23					
Lot 1 on RL3001					
AAP16117	Mt Bison Road	Road Reserve	Grazing	Mining	Livingstone Shire Council
Haul road and TLF					
Lot 9 on MC230	Strathmuir	Freehold	Grazing	Transport Corridor	Russell Charles Smith, Elizabeth Joan Smith and Edward George Smith
Lot 85 on SP164785	Brussels	Freehold	Grazing	Transport Corridor	Scott Robert McCartney
Lot 9 on MC230	Strathmuir	Freehold	Grazing	TLF	Russell Charles Smith, Elizabeth Joan Smith and Edward George Smith

16.4.5.5 The Project Area

The overall Project area comprises the following:

- A mine area on the current ML 80187 (herein referred to as the Central Queensland Coal mine area) comprising 2,279 ha, of which 1,128 ha will be disturbed;
- A haul road approximately 4.5 km long and 20 m wide extending northeast from the Central Queensland Coal mine area to the TLF. The disturbance area will be 9 ha; and
- A TLF covering a proposed disturbance area of approximately 23 ha.

16.4.6 Project Consultation

The ToR was publicly advertised for comment by EHP from 10 April 2017 to close of business 8 June 2017. The extension of the public comment period was proposed by the proponent as the Project area was under the damaging influences of Cyclone Debbie during the public review period. A total of 23 submissions were received by EHP for consideration in finalising the ToR, most of which came from government agencies. The most common issues raised in these submissions included:

- Downstream greenhouse gas (GHG) emissions;
- Impacts to the Great Barrier Reef Marine Park;
- Offset package to compensate for significant residual impacts;
- Ongoing communications and liaison with stakeholders and the community;
- Aboriginal and Torres Strait Islander specific plans and strategies;
- Surface water and groundwater impacts;
- Groundwater dependent ecosystems (GDEs) and stygofauna impacts;
- Transport impacts;
- Local industry participation;

- Emergency and health services capacity;
- Impacts to arable land;
- Fish passage and connectivity for aquatic fauna;
- Impacts to the aquatic environment; and
- Potential for flooding.

The final ToR was issued on 5 August 2017 and encompassed the relevant and applicable issues raised during the consultation.

Consultation was undertaken in 2015 with representatives from government agencies, service providers and businesses from the local community to inform the scope and assessment of the Project during the preparation of the EIS. Consultation and discussions with landowners near the Project area commenced in 2012. Meetings and discussions have been held with landholders regarding exploration activities. However, consultation regarding the impacts of the Project's development will begin formally with the publication of the EIS.

Discussions with the Traditional Owners occurred during 2017. The Barada Kabalbara Yetimarala People #1 have a current Native Title claim over the area where the mine pits and ancillary infrastructure are proposed (ML80187). A second Native claim held by the Barada Kabalbara Yetimarala People #2 exists over land where the TLF is proposed (ML700022). That claim is described as a shared country claim with the Darumbal People. Currently a Cultural Heritage Management Plan (CHMP) is under development with the Barada Kabalbara Yetimarala People. The CHMP will address the management of cultural heritage on land within the two MLs. Further detail regarding the Project consultation process and relevant stakeholders is discussed in Chapter 1 – Introduction.

16.4.6.1 Ongoing Consultation during EIS development

Targeted consultation was undertaken with meetings and discussions held with representatives from the following agencies and organisations:

- Livingstone Shire Council;
- Rockhampton Regional Council;
- Department of Environment and Heritage Protection;
- Department of Natural Resources and Mines;
- Department of State Development;
- Department of Infrastructure, Local Government and Planning;
- Department of Transport and Main Roads (DTMR);
- Department of National Parks, Recreations, Sport and Racing;
- Department of Agriculture and Fisheries;
- Department of Energy and Water Supply;
- Department of the Environment and Energy (Cth);

- Federal Member for Capricornia;
- State Member for Mirani;
- Aurizon;
- Queensland Rail;
- Pacific National;
- Ergon Energy;
- Powerlink;
- Telstra;
- Darumbal People;
- Barada Kabalbara Yetimarala People;
- Scorpion Energy Pty Ltd – EPC 2128;
- Waratah Coal Pty Ltd – EPC 2268; and
- Arrow Energy Pty Ltd – Authority to Prospect (ATP) 700.

The purpose of the meetings was to update and brief agencies and stakeholders on the status of the Project, along with identifying and discussing potential impacts and management options.

16.4.6.2 Consultation Beyond EIS Stage

Following the Project's EIS approval, engagement with Project stakeholders and the community will continue for the life of the Project and be delivered through a Stakeholder and Community Engagement Plan. The Plan will be designed to maximise community and stakeholder input into the Project's development and delivery (including mine decommissioning) through capacity building and two-way communication mechanisms which will be in place for the life of the Project.

16.4.6.3 Affected and Interested Persons

In addition to the individuals, groups and businesses mentioned above, there are a wider range of interested and affected persons that may be impacted by, or have interest in, the Project. The identified stakeholders are represented in Figure 16-3 and directly affected landowners and tenement holders are outlined in Chapter 3 – Description of the Project.

Where practicable, communication and engagement activities will be prioritised in the following order:

- Key stakeholders and directly affected landholders;
- Local communities, neighbouring landholders, and other stakeholders; and
- General public and wider regional community.

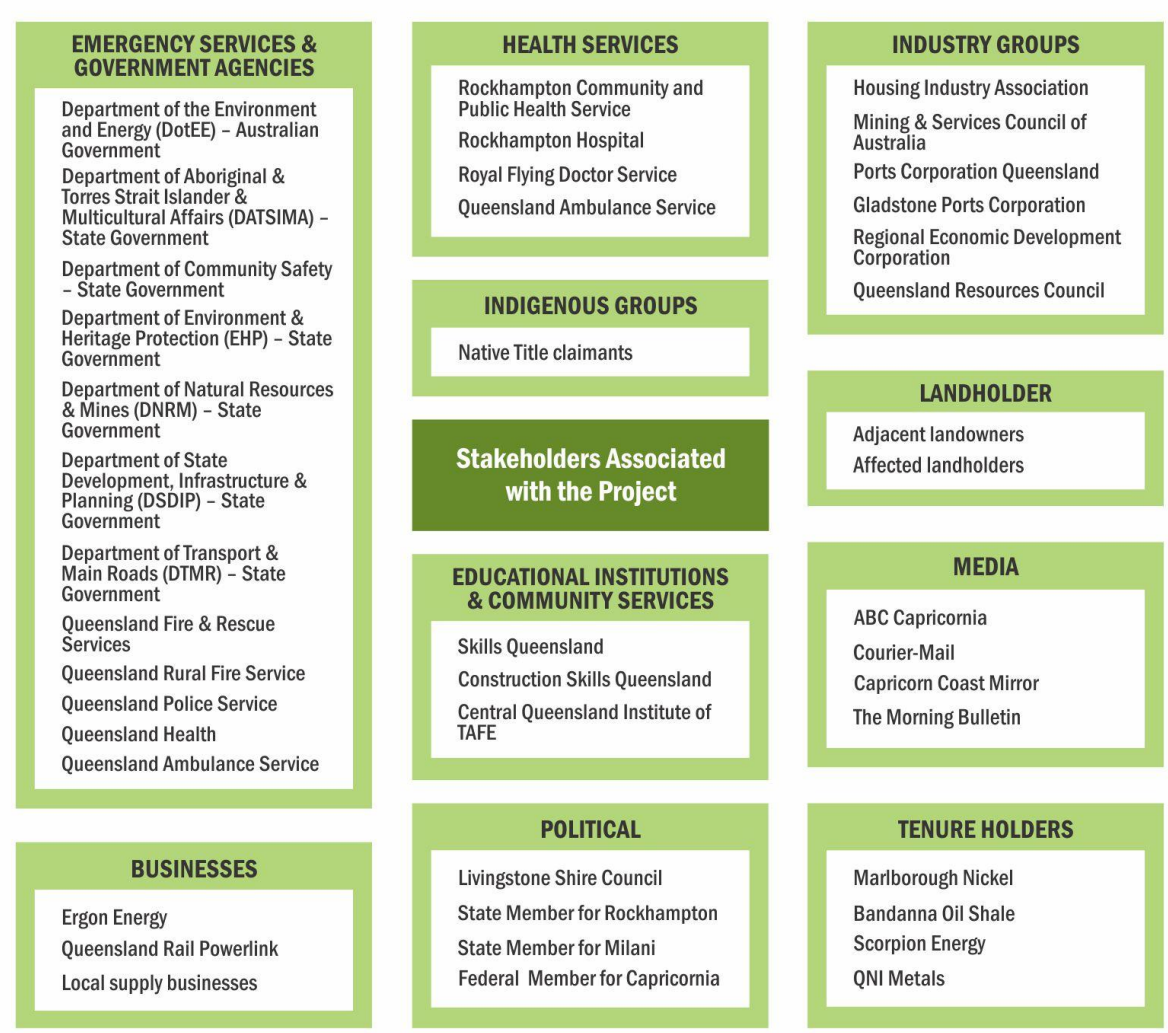


Figure 16-3 Project stakeholders

Key upcoming Project consultation activities include:

- Meetings with directly affected and neighbouring land owners to discuss the Project and the management of its impacts;
- Meetings with affected Native Title Claimants;
- Discussions with resource companies owning tenements that overlap the Project's ML application areas;
- Ongoing group meetings with representatives of the local community throughout 2017;
- Development of Project fact sheets for upload to the Project website as needs are identified;
- Consultation with the LSC and DTMR regarding affected roads and road reserves;
- Meetings to progress social impact management action plans including Department of State Development, LSC, Queensland Ambulance Service (QAS), Queensland Fire and Emergency Service (QFES) and Skills Queensland;
- Maintaining the Project website;

- Development of a Local Content Strategy and engagement with local businesses at one or more events to determine whether their capabilities can be drawn upon; and
- Planning for the implementation of a community advisory group or similar where interested members of the local community can meet and discuss the Project regularly.

For further information, please refer to Chapter 1 – Introduction.

16.5 Alternatives to the Project

During the Project design process, a number of alternative scenarios were considered to evaluate the relative social, economic and environmental advantages and disadvantages of different Project alternatives. Results from this analysis were used to select the final Project scope in the context of fixed locations for the coal resource and ML areas. This process ensures the Project design has been underpinned by relevant environmental, social and economic drivers.

Alternative scenarios considered were those that are practicable, feasible and available to Central Queensland Coal. These included locality, technological and conceptual alternatives. The particular scenarios assessed as part of the EIS included the following alternative actions:

- No development scenario;
- Locality alternatives;
  - MIA
  - Transport corridor
  - TLF
  - Mine access road for the workforce
- Technological alternatives;
  - Mining methods
  - Rejects and tailings management
- Conceptual alternatives;
  - Open cut pit configurations
  - Water supply
  - Energy supply
- Alternative accommodation during the construction and operational phases.

The following subsections discuss each of the alternative scenarios. A more detailed discussion including analysis against the principles of Ecologically Sustainable Development is provided in Chapter 2 – Project Needs and Alternatives.

16.5.1 No Development Scenario

The no development scenario predicts the future scenario which would exist in the absence of any Project. The no development scenario would avoid the potential impacts of the Project on the existing environment including MNES and cattle grazing would likely continue to be the primary land use.

This scenario would also have a significant impact socially and economically as between 475 to 4,600 direct and indirect jobs and business expansion opportunities would not be realised. The region will not benefit from employee opportunities, financial donations to community groups, training programs or receive local business support. With the significant reduction in the resource industry workforce within central Queensland the broader region will continue to experience social and economic stress.

In economic terms, the no development scenario would result in a loss to the Queensland Government in approximately $525.26 million in royalties over the life of the mine.

16.5.2 Locality Alternatives

16.5.2.1 Mine Location

The mine location is determined by the targeted coal deposit and ML 80187, held by Central Queensland Coal and Fairway Coal. The proposed ML boundaries are defined by existing geological conditions which are suitable to mining based on the results of exploration studies undertaken within the MLs. As such alternative mine locations are not available to Central Queensland Coal. The existing location is suitable for development of a mine as the proposed location:

- Is in the Styx Coal Basin which has previously supported coal mining;
- Is not within any Environmentally Sensitive Areas (although a small section of the Project does lie within an area shown as Strategic Cropping Land (SCL) on the SCL trigger map (see Chapter 5 – Land for more information);
- Is within close proximity to the existing North Coast Rail Line which connects to the existing Goonyella rail and port infrastructure system, or alternatively, use of the North Coast Rail Line to connect into the existing Blackwater Rail Line and port infrastructure at Gladstone;
- Has direct access to the area off the Bruce Highway; and
- The rail distance between the Project and Port of Hay Point and the DBCT is 190 km.

16.5.2.2 Mine Infrastructure Area

Two options were considered for the operation of the MIA and CHPP. The original concept was for a single MIA and CHPP servicing all three open cut pits. This concept was optimised to allow for the future extraction of SSCC. Further assessment of the mine operability resulted in decision to move towards two smaller MIA and CHPPs. One MIA and CHPP will be located on the south-western side of the Bruce Highway and will service Open Cut 1. The second MIA and CHPP will be located on the north-eastern side of the Bruce Highway servicing Open Cut 2 and Open Cut 4. The use and development of two MIAs and CHPPs concept was adopted, as a balance between the long term haulage of ROM coal, reject material and product coal while allowing for the economic extremities of the mine area. A further key reason was to significantly reduce the interaction and volume of traffic crossing the Bruce Highway moving to and from the single MIA / CHPP as originally proposed.

16.5.2.3 Transport Corridor Locations

A preliminary study of five options was undertaken by Central Queensland Coal to identify potential haul road and TLF locations. Two options were ruled out as a feasible alternative because of the relatively longer haulage distances required (approximately 20 km and 42 km) and the need to use public roads (i.e. Ogmore and Kootandra roads and the Bruce Highway) to haul coal to the respective TLFs.

Three options were selected for detailed consideration. This assessment considered a number of economic, environmental and social criteria including: earthwork volumes, capital expenditure (CAPEX) and operating expenses (OPEX), impacted areas of mapped EVs (Threatened Ecological Communities (TECs), Regional Ecosystems (REs), SCL and watercourses), and impacted landholdings and roads. The three options evaluated were:

- Option 1 – the haul road is approximately 3 km in length, heading north from the MIA and adjacent to Deep Creek for approximately 2.5 km before crossing Deep Creek and running approximately 0.5 km to the northeast to connect to the TLF. The rail connection is approximately 1.5 km in length in a northeast direction to the North Coast Rail Line;
- Option 2 – the haul road is approximately 2.5 km in length, heading north from the MIA and adjacent to Deep Creek for approximately 2 km before crossing Deep Creek and running approximately 0.5 km to the northeast to connect to the TLF. The rail connection is approximately 1.5 km in length in a northeast direction to the North Coast Rail Line; and
- Option 3 - the haul road is approximately 4.5 km in length, initially heading southeast from the MIA for approximately 2 km before crossing Deep Creek and running approximately 0.1 km to the east and then heading approximately 2.4 km to the east to connect to the TLF. The rail connection is approximately 3.5 km in length in a northeast direction to the North Coast Rail Line.

The assessment identified all three options as being suitable for the Project. The amount of disturbance to REs were similar between the three options assuming the design of the haul road and TLF for Option 1 avoids Endangered TEC. Options 1 and 2 both affect areas of mapped SCL noting; however, that no cropping has occurred in the area. All three routes affect two landholders, with one being a related party to the Project and consents to the land being used for the haul road. All three options were located on land held under freehold title although Options 1 and 2 both had uncertainty associated with a potential boundary waterway crossing whereas Option 3 has a road easement through Deep Creek which will be utilised as the haul road crossing and thereby avoids impacts to Native Title. Following this assessment, a ground-truthing exercise was carried out to confirm the vegetation types within the disturbance footprints of the three options.

Following this, Option 3 was considered the best option notwithstanding it required the longest haul road and civil works associated with the creek crossing. No SCL or TEC areas were mapped along this haul road corridor, the TLF or rail connection. Similar to Options 1 and 2, Option 3 impacts two landholders, with one of the two land holders already consenting to the haul road development. One MDL is affected by the haul road and TLF; however, this MDL is held by Central Queensland Coal. Option 3 does not traverse land with Native Title whereas Options 1 and 2 cross a potential boundary waterway crossing and for Option 2 the TLF and haul road to the east of Deep Creek are on land held under Pastoral Lease within the Darumbal Native Title Claim area.

16.5.3 Technological Alternatives

The technology used in processes can greatly influence the level of environmental impact of an activity. Advancements in technology allow us to conduct operations far more efficiently than historically. This efficiency can translate to a smaller footprint (the amount of surface area disturbed), less waste generated, cleaner and safer operations, and greater compatibility with the environment. Various technologies were considered for transferring coal from Open Cut 1 to the MIA and reject and tailings management during concept development of the mine. These considerations are discussed in the following sections.

16.5.3.1 Assessment of Alternative Mining Methodologies

A conceptual study to determine the most appropriate mining methodologies was carried out by Central Queensland Coal. The study examined key mine design parameters to the application of various mining technologies. Those considered included:

- Open cut pit mining; and
- Underground longwall mining.

The key mine design parameters included: percentage recovery, annual production volumes, value per tonne of ROM and the mining design limitations of each mining method. These were compared using a margin ranking process to identify the most suitable method for the site.

The Project mining operation will target up to 10 seams of coal in a relatively shallow environment, necessitating the use of an open cut mining method to an economical cut-off depth. The open cut will utilise a truck and shovel operation to extract both overburden and coal in a strip / terrace mine configuration. In most cases the excavated void will be back-filled and rehabilitated as soon as possible after the coal reserves have been extracted. Small final voids will be left in Open Cut 1 and Open Cut 4 to improve water storage capacity, as a defence against future droughts, to enhance ongoing grazing activities.

16.5.3.2 Assessment of Alternative Rejects and Tailings Management Technologies

The Project mine will utilise an in-pit disposal methodology for tailings material created from the raw coal beneficiating process undertaken by the CHPP. All reject material will be dewatered and transferred to the in-pit overburden waste. Fine and ultra-fine tailings will be dewatered and transferred to overburden waste areas and mixed with the overburden waste material.

The preferred method is to truck all coarse reject and dewatered fine reject material to in-pit and out of pit overburden waste areas. With regards to MNES this method will minimise the overall disturbance footprint of the Project and eliminate the potential for MNES fauna species to access standing water created by the wet tailings storage method.

16.5.3.3 Open Cut Pit Configuration and Optimisation

The mining method considered was based on the occurrence of multiple gently dipping thin coal seams and some surface constraints. As a result, a strip / terrace mining method was selected.

The nature of the thin coal seams lends itself to a coal seam aggregation process which was conducted to develop proper coal working sections. The coal working sections were used in the determination of the economic pit limits through a margin ranking process. Alpha Mine Planning 4U

conducted a margin ranking exercise and typical industry costs were used (all-inclusive cost – from pit to port).

Various washability data sets were available for the ranking exercise but to deliver the anticipated product coal qualities, a sink float setting of 1.5 was used. The net outcome of the margin rank resulted in various cut-off margins for the associated basal coal seam. These were used to ultimately determine the final pit limits and preferred basal coal seam.

This exercise further identifies the sequence and mining direction of the various pits, which resulted in a generalised direction from south to north. This mining direction had a significant impact on reducing the size of the final pit voids, in-pit dumps and potential impact on the environment (no final void for Cut-2).

The use of this optimisation process incorporated both the economic and environmental Ecologically Sustainable Development (ESD) concepts into the decision making criteria to find the optimal pit layout which minimise over burden and waste rock removal.

16.5.3.4 Water Supply

The overall water demand is 1.9 ML (including fire water) per day. The water balance for the Project indicates that there will be a slight water deficit for the operations phase of the Project (see Chapter 9 – Surface Water). A reliable source of water is required for years 10 – 12 of the construction and operation of the Project. The total water requirement from offsite supplies will vary in relation to water use and the availability of onsite supplies. Water supply options investigated for supplying raw water to the mine have included:

- Onsite capture (mine dewatering and rainfall harvesting);
- External supply; and
- Onsite reuse.

Following ESD analysis no one option is considered solely suitable for the Project. Water will be sourced using all available options, onsite and offsite water supplies and onsite reuse of water to have the most sustainable outcome available.

During construction and the establishment of the external water supply, water will be required to be trucked in and stored onsite.

16.5.3.5 Alternative Energy Sources

The average expected energy demand for the Project during operations will be in the order of 3 to 5 megawatt (MW) with an estimated annual usage of 35 Gigawatt hour (GWh) based on 365 days, 24 hours per day operation. An assessment was undertaken during the feasibility studies to determine the most cost-effective method for power supply.

Powerlink and Ergon Energy were consulted regarding connections into their existing networks. There is also a regional 275 kilovolt (kV) line which crosses the southwest MLs boundary. From discussions with Powerlink it is not feasible to connect to this power supply. Currently there is no transformer in the area to step down the high voltage for mine supply. Consequently, this option is no longer under consideration.

A separate option to connect into the existing 11 kV transmission line maintained by Ergon Energy which provides power to the nearby township of Ogmore is under consideration. From discussion

with Ergon this 11 kV line has limited capacity to support the Project; however, depending on the final power demand needed to support the CHPP operations an opportunity to connect to the Ogmore substation may still be possible.

As there is currently no firm opportunity for a secure supply through connection into the existing Powerlink or Ergon network, the decision was taken to utilise 415 volt (V), three-phase dual fuel generators to provide power onsite. These generators will be installed at the MIA and the CHPP with the likely configuration for the MIA being two 300 kilovolt ampere (kVA) 415 V dual fuel generator sets mounted in a fully bunded area adjacent to the MIA 415 V Switchroom. The configuration for the CHPP would likely be one 500 kVA 415 V dual fuel generator set mounted in a fully bunded area adjacent to the raw coal 415 V Switchroom. The CHPP substation will have three 500 kVA 415 V dual fuel generator sets mounted in a fully bunded area adjacent to the CHPP 415 V Switchroom.

16.5.3.6 Alternative Accommodation

Accommodation options for workers both during the construction and operation phase have been assessed. As the Project will be predominantly drive-in drive-out from local towns, Central Queensland Coal considered offsite accommodation at regional towns (i.e. Ogmore, Marlborough, St Lawrence and Rockhampton) as well as developing a new onsite accommodation village in the ML. The ESD decision considerations when assessing these alternative options are discussed in Chapter 3 – Description of the Project.

Central Queensland Coal intends to staff the Project as a drive-in drive-out operation using a local work force to the extent possible and encouraging personnel to live in the local area thereby decreasing the Project footprint and potential impacts to MNES. There may be a need for some drive-in drive-out from further afield and the proximity to regional towns supports this approach. Consequently, the use of existing accommodation at nearby townships is the preferred option. The Project will investigate establishing a bus service to transport staff to and from local townships when the annual production exceeds 5 Mtpa.

The focus on using a local workforce to the extent possible enables the workforce to stay connected with family and the community when compared to utilising an accommodation camp. This is being in-line with extant best practice in the resource sector. Where these local and regional towns are not able to service the personnel, an accommodation camp will be developed outside the ML. The potential accommodation camp is outside the scope of this EIS.

16.6 Assessment of Project Against ESD Principles

Ecologically Sustainable Development as defined in the National Strategy for Ecologically Sustainable Development (NSESD) is development which aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations. The NSESD was adopted by all levels of Australian Government in 1992 and provides broad strategic directions and framework for governments to direct policy and decision-making. The key objectives of the NSESD are:

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

While planning and designing the Project, Central Queensland Coal has considered the guiding principles of ESD as outlined in the NSESD. The guiding principles of ESD and how they are addressed in the EIS are outlined in the following table.

Table 16-2 Guiding principles of ESD addressed in the EIS

Guiding principle of ESD	EIS section
Enhance individual and community well-being and welfare	The Project is anticipated to provide significant benefits to the wider community in terms of employment opportunities and increased government revenues as outlined in Chapter 19 - Social and Economics. The Project has been designed such that the mining operations proposed can coexist with existing agricultural land uses and EVs within the region. These elements ensure that the Project will result in an enhancement of individual and community well-being in the region.
Intergenerational equity	Prepare and implement management plans for waste rock, general waste, soils, land, water and rehabilitation to minimise the legacy risks of the Project.
Protect biological diversity and maintain essential ecological processes	The Project has been designed to minimise impacts to ecological and EVs throughout the Project area. This is demonstrated by the Projects water management strategy, coal handling strategy and the size and placement of the MIA which means there will be limited direct impacts on remnant vegetation. The haul road and TLF options underwent assessment which considered RE's and TEC's as key criteria in the decision. Mitigation measures to protect biological diversity during the construction and operation phase are outlined in Chapter 9 – Surface Water and Chapter 14 – Terrestrial Ecology. Water and land use management plans will be prepared to protect ecological processes. Offsets and methods for developing offsets are discussed in Chapter 14 – Terrestrial Ecology.
Decision making based on long and short term considerations	Chapter 5 – Land, Chapter 9 – Surface Water, Chapter 10 – Groundwater, Chapter 14 – Terrestrial Ecology, Chapter 19 – Social and Economic, present the long-term and short-term economic, environmental, social and equity impacts of the Project to enable informed decision making. The EIS demonstrates that the Project has been designed, sited and will be constructed and operated considering the short and long-term potential impacts. This ensures potential impacts are identified and managed adequately and sustainably.
The precautionary principle	An assessment of the level of risk of environmental harm from the Project, consistent with the precautionary principle has been undertaken by Central Queensland Coal. Findings are detailed throughout the EIS. Mitigation measures proposed have also been developed based on the precautionary principle ensuring that Project's environmental management criteria and objectives are best practice, notwithstanding any uncertainty of impacts occurring. This includes, for example, the requirement of the Project to pay financial assurance ahead of construction and offsetting potential ecological impacts.
Global environmental impact	Greenhouse gas emissions, mitigation, and reduction options from Project construction and operation are discussed in Chapter 12 – Air Quality (although individually the Project will have a negligible impact on the global environment). The Project has been designed and will be constructed and operated such that GHG emissions are minimised and mitigated where practicable. The Project will be a very small contributor to Australia's national GHG inventory. The Project will have no impact on any internationally protected species or sites.
Development of a strong, growing and diversified economy which can enhance the capacity for environmental protection	Economic impacts of the Project and mitigation measures for potential adverse impacts are considered in Chapter 19 – Social and Economic. The Project will contribute significantly to local, State and Commonwealth revenues. The Project will also result in approximately 174 direct jobs during construction, between 90 and 1,900 direct jobs during operations and up to 1,425 indirect jobs.
Enhancing international competitiveness in an environmentally sound manner	With the adoption of the latest mining methods and good practice environmental management, environmental impacts will be minimised and the Project will enhance international competitiveness in the coal mining industry. Mining methods are detailed in Chapter 3 – Description of the Project. As outlined above the design of the Project is such that minimal direct environmental impacts are anticipated and mitigation measures to manage impacts have been proposed which will ensure the Project is undertaken in an environmentally sound manner.
Cost effective and flexible policy instruments	The design of the Project has considered current Queensland and Commonwealth Government policy.

Guiding principle of ESD	EIS section
Community involvement in decisions and actions	The EIS process includes a number of opportunities for public comment, during the development of the ToR, public exhibition of the EIS and targeted consultation of the draft EA and ML. Chapter 1 – Introduction describes the stakeholder consultation program that was undertaken for the Project. Chapter 19 – Social and Economic outlines Central Queensland Coal's ongoing commitments to the local community.

16.7 Project Construction and Operation

This section provides an overview of the various activities and their expected timing for the construction and operation phases of the Project. For a more detailed description refer to Chapter 3 – Description of the Project.

16.7.1 Construction

The commencement date for construction is dependent upon the timing of the Project approvals process. Year one should be understood to be the period following receipt of the ML and EA for the Project (2018).

The construction of the Open Cut 2, the initial CHPP, the haul road and TLF and associated mine infrastructure located on the north-eastern side of the Bruce Highway is planned to commence simultaneously in Year one. Open Cut 1 will commence development at approximately Year 10 coinciding with the construction of the second CHPP and MIA. Open Cut 4 will be developed in Year 12.

Key infrastructure to be constructed for the Project includes:

- Three open cut pits;
- Two CHPPs and product coal stockpiles;
- Two ROM coal stockpile areas and ROM dump stations (comprising dump hopper, product conveyor, crushers and surge bin);
- ROM coal haul roads and waste rock haul roads;
- Product stockpile and conveyor from Open Cut 1 to the product coal stockpile east;
- Waste management facilities;
- Water supply pipeline and management facilities, including raw water supply, storage and a WTP to treat water to potable quality;
- Mine affected water dams, sediment affected water dams and clean water dams;
- Light and heavy vehicle internal roads;
- Main gate and security building;
- Power distribution lines and substation; and
- Product Coal Haul Road from the CHPP 2 to the TLF, TLF product coal stockpile area, rail loop and rail spur.

16.7.1.1 Site Preparation

The initial site clearance works will be focused on the site access road, internal access roads, dams and laydown areas for construction, the MIA, CHPP and TLF. Site clearance will include clearance of vegetation, soil removal and storage, bulk earthworks and temporary drainage works. These works will be conducted in accordance with the Project's vegetation and soil management measures.

Site clearance activities will be staged during the construction phase on an as needed basis to coincide with construction requirements and to minimise the extent and duration of cleared areas at any one time. Suitable soil resources for use in rehabilitation will be stripped from areas where construction and mining operations will occur. Topsoils and subsoils will be stripped, handled and stored in a manner in line with industry best practice to prevent the deterioration of soil quality (refer to Chapter 11 – Rehabilitation and Decommissioning).

Site preparation activities will include the following:

- Construction of the mine access points on the Bruce Highway;
- Site security;
- Site clearance;
- Civil works;
- Environmental protection measures;
- Washdown facilities;
- Erosion and sediment controls;
- Concrete batch plant (concrete will be batched onsite, with suitable batching materials delivered to site by contracted supplier);
- Mobilisation to site;
- Utilisation of existing accommodation at Ogmore, Marlborough and St Lawrence, where possible, and / or develop an accommodation camp in close proximity to the ML;
- Crib hut;
- Fencing;
- Amenities;
- Access road / haul road establishment;
- Establishment of yards;
- Installation of temporary water supply with potable water trucked to the site until a water treatment plant (WTP) is installed;
- Sewerage management infrastructure with effluent trucked from site by a licensed contractor to a licensed waste disposal facility;
- Demountable offices;
- Car park; and
- Establishment of laydown and storage areas.

16.7.1.2 Civil Works

Civil works including construction of structure foundations, permanent laydown areas and hardstands will commence following grant of the ML and EA. It is expected that civil works required during the construction phase will be completed within Year 1; however, there may be requirements for further civil works during the operations and decommissioning phases. Typical civil works that will be undertaken as part of the Project include, but are not limited to:

- Civil earthworks, including foundation construction;
- Installation of permanent and temporary drainage;
- Trenching and laying of reticulated services and any other underground pipelines and services;
- Installation of powerlines and substations;
- Road formation construction, surfacing and finishing required for unsealed roads;
- Conveyor footings;
- Earthworks for the establishment of drainage diversions;
- Dams, including raw water dams, sediment affected water dams, mine affected water dams and clean water; and
- TLF, rail loop and rail spur formation construction, track laying and finishing for TLF.

Installation of permanent drainage will be undertaken to accommodate drainage requirements for both the construction and operational phases. This could include such things as culverts, longitudinal catch drains, sediment basins and detention basins.

A conveyor is proposed to transport product coal from Open Cut 1, under the Bruce Highway at the existing bridge crossing, to the product coal stockpiles on the north-eastern side of the Bruce Highway. This conveyor will be constructed in a way that does not pose a safety hazard or affect the flood conveyance of the bridge. The conveyor located under the Deep Creek road bridge is shown in Figure 16-4.

Roads associated with the Project's ML's include ROM coal and waste rock haul roads, site access roads and light and heavy vehicle internal roads. Construction of ROM coal and waste rock haul, light and heavy vehicle internal roads will be phased over the life of the construction and operations of the mine.

A new power distribution network will be installed to provide electricity across the site. To date, no electricity infrastructure has been identified in the proposed ML areas and as such, no relocation, replacement or removal of existing electricity infrastructure is required.

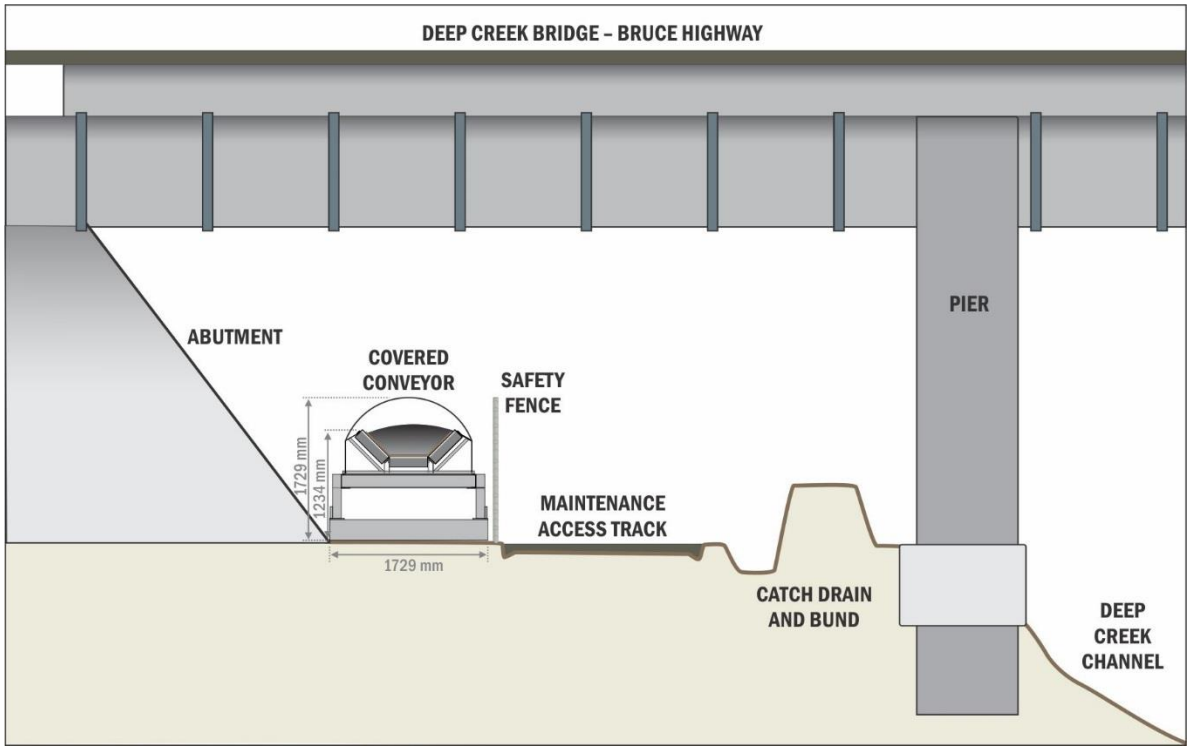


Figure 16-4 Conveyor crossing under Deep Creek road bridge

16.7.1.3 Building and Structures

Installation of plant and related building components will follow superstructure erection, including the installation of pipe works, cables and instrumentation. Where possible, main plant components will be pre-fabricated and delivered complete to site. The construction management office area will be located near the MIA supporting Open Cut 2 and Open Cut 4. The facilities will be of a temporary nature and will be replaced by the permanent administration facilities towards the end of construction. The temporary facilities will include:

- Demountable buildings including offices, workshops, meeting rooms, crib rooms / kitchen, toilets, first aid, communications and storage;
- Car park;
- A light vehicle washdown slab;
- Power supply from diesel generators;
- Temporary construction water storage;
- A temporary potable water storage, until permanent facilities are installed; and
- Temporary wastewater storage, until permanent facilities are installed.

16.7.1.4 Coal Handling and Preparation Plant

Construction of the two CHPP, ROM coal and product conveyors and stockpiles is anticipated to last approximately 12 months. Given the height and size of the CHPP modules, product stockpiles, surge bin and crushing facilities, the use of cranes, lifts and multistorey scaffolding is anticipated. All work will be in accordance with recognised building standards and regulations.

16.7.1.5 Construction Water Requirements

Both potable and construction water will be required for the construction phase of the Project. For construction water, existing farm dams and a newly constructed Raw Water Dam will be sourced. Water permits will also be sought to take water from Tooloombah Creek during construction. These permits may include direct truck fill from Tooloombah Creek or involve harvesting from Tooloombah Creek to the Raw Water Dam for subsequent truck fill. Potable water will either be transported to site by water tankers during construction, or involve treatment of groundwater bore or raw water supplies to drinking water standard via a batch WTP. All potable water will be procured, transported, treated monitored and stored in compliance with the Australian Drinking Water Guideline 2011 (NHMRC and NRMMC 2011).

16.7.2 Construction Materials, Plant and Equipment

Quarry materials for the construction of the access road and haul road base material will be sourced from existing offsite quarries. Once access to site is established, materials will be sourced from a combination of on-lease deposits where possible and licensed offsite quarries. It is not anticipated that forestry materials will be required by the Project.

The exact location and quality / suitability of the competent material deposits existing within the Project's ML areas is yet to be determined, although it is expected that appropriate materials for foundations can be sourced on-lease. This will also include the overburden extracted as part of the mining operations.

Hazardous materials will be used and stored onsite during the construction of the mine. Hazardous materials that will be used during construction include diesel fuels, lubrication oils, paints and thinners, and protective coatings. Further details regarding the usage and storage are discussed in Chapter 21 – Hazard and Risk.

All materials, plant and equipment will be delivered to the Project via road. Large and oversize loads are anticipated, particularly during the CHPP, dump station, stacker / reclaimer and heavy mining equipment construction and installation phase. Loads will mostly be hauled from either the Port of Brisbane, Port of Mackay or the Port of Gladstone.

Construction traffic will involve rigid and articulated vehicles, and light goods vehicles. Traffic flows and vehicles types are expected to vary over the construction period, reflecting the types of materials and equipment required at a specific time. The Project will use standard construction equipment, general trade equipment and specialised equipment as required (refer Table 3-9, Chapter 3 – Description of the Project for an indicative list of required construction equipment).

16.7.3 Operations

16.7.3.1 Mine Sequencing

The mining schedule is based on the development of three open cut operations producing a total of up to 10 Mtpa of ROM. Open Cut 2 will be developed initially and is anticipated to operate until year 12 (2028). Open Cut 1 is anticipated to commence operations in year 10 (2026) and operate until Year 16 (2032). Open Cut 4 will commence operations in year 11 (2027) and cease operations in 2028. The proposed open cut mine layouts and sequencing of open pit are shown in Figure 16-5.

Mining will commence at the south-eastern ends of Open Cut 1 and 2 and progress generally in a northwest direction. Mining will commence at the western end of Open Cut 4 and continue generally in an easterly direction. Being terraced mines both open cut operations will advance across strike.

The mining schedule for all three pits was established to commence operations in the lower strip ratio areas for that pit, focused on all seams suitable for mining. It is anticipated that operations in the open cuts will continue for approximately 20 years which comprises 16 years of mining and four years to finalise the rehabilitation program which commences in year 2 and continues through to the end of mine life.

The proposed mining method involves large truck and excavator mining with truck haulage direct to the crusher dump hopper or the ROM pad adjacent to each of the CHPPs. Central Queensland Coal will continue to review alternative mining methods to optimise product coal outputs. Other mining methods to improve resource recovery may be considered as the Project progresses. Refer to Table 3-11 of Chapter 3 – Description of the Project for an indicative list and schedule of required mining equipment.

Subject to statutory approvals, soil removal from both pits is scheduled to commence in Q1 2018. First shipment of product coal is scheduled in the second half of 2018. Construction of mine facilities will commence immediately after grant of the Mining Leases. Mining is to commence on the Mining Leases as soon as construction of the mine facilities has been completed. The years of mining for each of the open cut operations are shown at Table 16-3.

Table 16-3 Mining schedule

Mine operation	Years of operation
Open Cut 2 (northeast)	Year 1 – Year 12
Open Cut 1 (southwest)	Year 10 – Year 16
Open Cut 4 (northeast)	Year 11 – Year 12

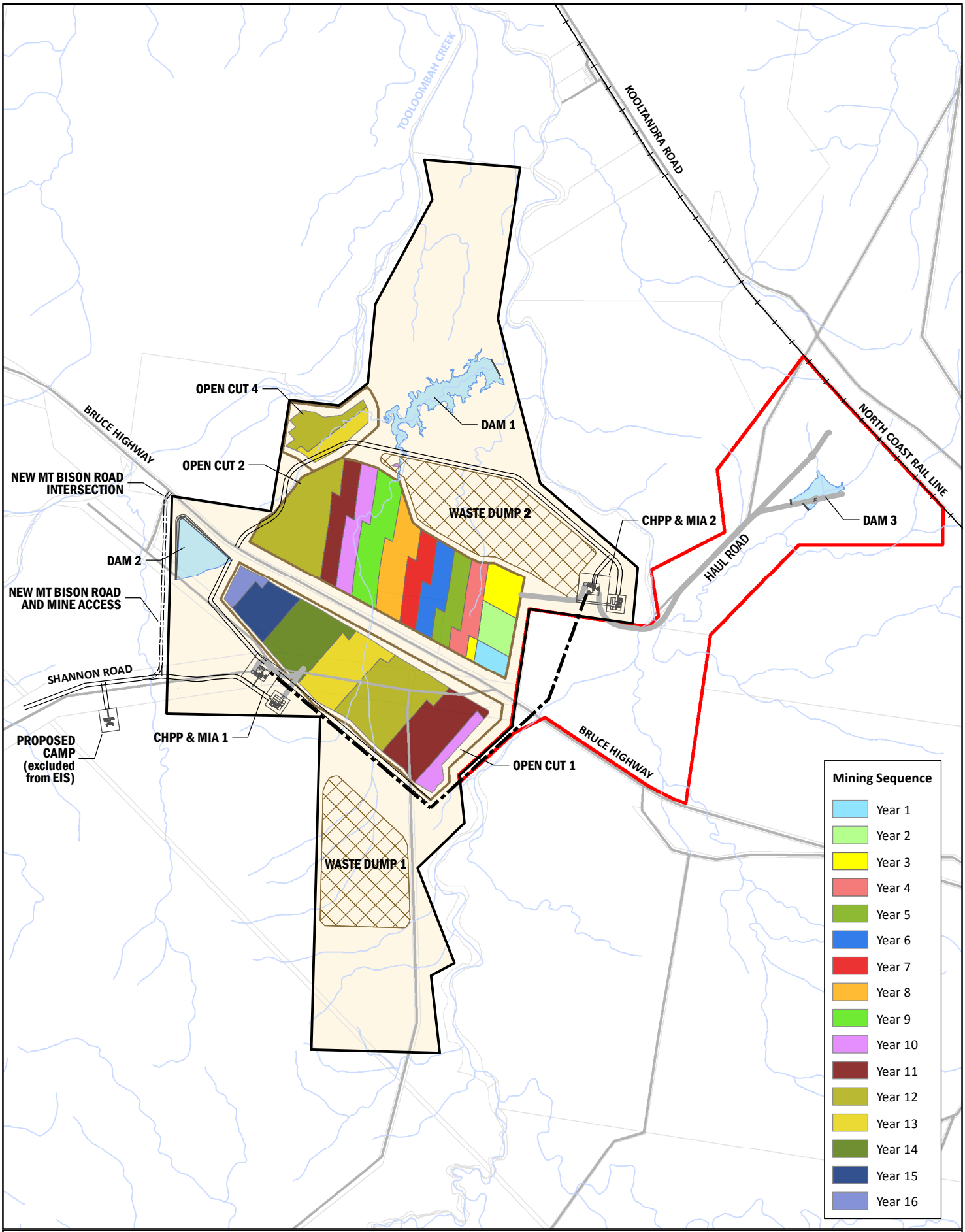
16.7.3.2 Mining Method

Open cut mining methods will target the multiple seams during mining of the three pits. Mine development will commence with the removal of vegetation and topsoil by scrapers in accordance with relevant management plans to avoid and minimise impacts. Cleared material will be placed on dedicated topsoil stockpiles or placed directly onto reshaped final landforms if available. The initial box cut will be developed utilising a ramp formed in the low wall of each of the three pits. It is proposed that most of the waste rock will be dumped to the ex-pit waste dumps (Figure 16-2) for the initial strips and then in-pit for the remaining strips.

The upper portion of weathered overburden, where possible, will be free dug and removed. Where the overburden materials become competent and the free digging operations cease, a drill and blast operation will be utilised to fracture strata. Some of the weathered sandstones and fresh sandstones will be used for concurrent civil works and construction of haul roads.

Coal mining will be undertaken using a fleet consisting of excavators, front end loaders and trucks to mine the coal seams, with the coal hauled to the CHPP for benefaction. Inter-burden waste between the main coal seams is then blasted and this waste is mined by the excavators and hauled by trucks to waste rock dumps in the previous strips. The next coal seam is mined in the block, with the coal mining and parting operation planned to be performed in a series of sections along the pit.

Initial out-of-pit dumping is required as the box cuts are developed. The ex-pit dumping for Open Cut 1 commences in 2027 and lasts until 2028 and will be to a maximum height of 40 m (RL 80 m). The ex-pit dumping for Open Cut 2 will commence in 2018 and continue until 2021 and will be to a maximum height of 45 m (RL 75 m). Open Cut 4 waste will be dumped in-pit at Open Cut 2. Rehabilitation of the out-of-pit dumps will continue through the life of the mine (refer to Chapter 11 – Rehabilitation and Decommissioning).



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Legend

- ML 80187
- ML 700022
- Open-cut Mine Pit
- Dam Catchment
- Waste Dump Area
- Overland Conveyor
- North Coast Rail Line
- Haul roads
- Proposed mine infrastructure
- Watercourse
- Main road
- Cadastral boundary

Figure 16-5
Mine development sequences

DATA SOURCE
QLD Open Source Data, 2017

CDM Smith

16.7.3.3 Coal Handling System

The coal handling system consists of a ROM coal system, a product coal system and a rejects waste system. This incorporates simultaneous coal feed from the two open cut mines supplying the CHPPs. Materials handling capacity has been set at a maximum of 2.5 Mtpa of ROM coal for each CHPP.

Raw coal from the open cut operations will be transferred by truck to one of two 100,000 t capacity ROM pads. There will be one ROM pad, ROM bin and primary crusher arrangement servicing each of the open cut operations. Secondary and tertiary crushing stations will be located immediately after the primary crushing station. This stockpile will be no more than 30 m high.

Coal will be dumped directly into a ROM bin when the CHPPs are running at capacity or deposited into the ROM stockpiles to allow surge capacity. Reclaim feed to the ROM bin from the stockpile will be by front end loader. An elevated ROM pad will be constructed using a reinforced concrete design around the crusher pocket.

Primary crushing takes place immediately under the ROM feed bin. The primary sizer is a low speed sizer, a combination of high torque and low roll speeds with a unique tooth profile.

ROM coal conveyors sized at 300 t/hour will deliver sized ROM coal to the overland conveyor streams. A single ROM coal conveyor will service each CHPP. Overland conveyors will then transfer the ROM coal from the crushers to the plant feed bin which will then feed into the CHPP.

Two CHPPs will be required to process ROM coal delivered from each of the pits and increase the recovery of the coal resource. Each CHPP will remove (wash) the unwanted sediment and rock from the coal to improve the quality of coal exported to market. The first CHPP will be established to support operations at Open Cut 2 and Open Cut 4. The second CHPP will be established to support operations at Open Cut 1.

A single conveyor sized at 300 t/hour will feed each of the CHPPs from the ROM stockpiles. At this point the feed will become a slurry through addition of water to transport and optimise feed conditions to de-sliming screens. Both CHPPs will be based on conventional wet beneficiation processes using proven technology that is used extensively throughout the Australian coal industry, for example Daunia, Caval Ridge, Maules Creek and Bengalla. The coarse coal rejects fraction (>1 mm to 50 mm) will be beneficiated in dense medium cyclones.

The fine ROM coal slurry from the de-sliming screens is pumped to a classifying cyclone module to remove the fine material and the bulk of the water from this stream. The fine coal fraction (<1 mm) will be beneficiated using spirals in a water based separation. This produces dewatered fine coal that report to the product stockpile.

The proposed tailings system will be a simple filter press system. The filter press system requires the fine particles to be conditioned with flocculants, a process carried out within thickening tanks. The thickening process forms an aqueous tailings slurry allowing tailings to be transported via a pipe network to the filter press system. The filter press method utilizes filter presses to dewater tailings forming a dry paste. The water is recycled to each of the CHPPs while the tailings paste is conveyed to the rejects surge bin for disposal amongst the significantly more prolific overburden waste material. Excess water from the rejects containment structures is also recycled.

Both CHPPs will have a single product coal conveyor sized at 250 t/hour discharging washed coal to a product coal stockpile sized at 6,000 t capacity. Product coal stacking will be via a conventional elevated gantry conveyor.

Product coal reclamation will be via front end loader and haul truck. Initially, coal will be offloaded from the haul trucks directly onto the product coal stockpile pad. At peak production, it is anticipated that there will be approximately 62 trucks and 94 truck movements along the haul road per day in Years 11 and 12 respectively. Coal will be loaded into trains for transport to market.

The product coal stockpile at the TLF will have an operational capacity of 50,000 t and be managed using dozers. Coal will be reclaimed by front end loaders and transferred to the empty train wagons. There will be approximately 1,110 train movements per year on average, subject to train and shipping schedules. A rail haulage provider will contract the rolling stock to transport coal. Product coal stockpiles will be less than 20 m high.

16.7.3.4 Rejects and Tailings Disposal

Rejects and tailings disposal will be conducted in accordance with the Project's Mineral Waste Management Plan. Over the life of the mine, the total volume of excavated waste rock from open cut activities (i.e. overburden and interburden) is expected to be approximately 558.4 million bank cubic metres (Mbcm). The estimation of tonnage and volumes of waste rock and subsoils to be excavated during each year both annually and cumulative is illustrated in Table 3-12 in Chapter 3 – Description of the Project.

The preferred method to dispose of mine waste is to truck rejects initially to ex-pit dump areas and as the open cuts develop, coarse rejects and filter press tailings will be blended with overburden and disposed of in-pit. These materials will be hauled as back loads to disposal areas using coal haulage trucks after they deliver ROM coal to the ROM stockpile.

The rejects are expected to have a low capacity to be potentially acid forming. No visible pyrite (FeS_2) was reported in the 2012 data set, although possible pyrite was reported in the described lithology. Total sulphur content in potential coal reject samples in 2012 ranged from 0.005% to 0.69% and averaging 0.10%, indicating low sulfur content for rejects. The proportion of sulfur of the total sulfur content, determined by the chromium reducible method in the coal reject samples ranged from 19.3% (coal) to 100% (carbonaceous mudstone, roof).

Predicted salinity of the rejects produced during operation is considered to be moderate (average electrical conductivity (EC) of ~0.54 dS/cm of potential reject sample analysed), and is consistent with the EC measurements of other overburden and interburden samples (RGS Environmental, 2012). Reject materials (coarse) will report to the out-of-pit waste rock storage facility during the early stages of mining, with rejects from latter stages to report to the in-pit facility, co-disposed with tailings from the two CHPPs.

Further discussion on the waste rock dump schedule, dump volumes and geochemical characteristics of the waste rock material is in Chapter 3 – Description of the Project.

16.7.3.5 Water Management

A schematic of the proposed water management network for the Project is shown in Figure 16-6. Approximately 693 megalitres (ML) per annum of water will be required during peak operations with dust suppression and coal washing forming the major water demands. This water requirement will be supplied from harvesting on-lease stormwater runoff, mine affected water from pit dewatering activities, water reuse within the CHPP, and from flood harvesting from Tooloombah Creek. These combined sources provide a 99% reliable supply. In times of extreme drought, dust suppression, product moisture correction and coal washing water use will be decreased and / or alternative water supply options explored to sustain operations. Water supply alternatives are also

discussed in Chapter 2 – Project Needs and Alternatives and mine water balance discussed in Chapter 9 – Surface Water.

The water within the mine site can be divided into four main classes as follows:

- Raw water – clean water runoff from catchments that are undisturbed or relatively undisturbed by mining activities;
- Sediment laden water – surface water runoff from disturbed catchments such as the active MIA and overburden stockpiles, all of which could contain elevated levels of sediment;
- Mine affected water – water collected in open mine pits from groundwater ingress or surface water runoff, likely to contain elevated levels of salts and metals; and
- Contaminated water - surface water runoff and process water which could potentially contain hydrocarbons, salts or other chemical contaminants, possibly because of unintended spills.

The primary objective of site water management is to separate clean water and dirty water runoff for appropriate management, to maximise water harvesting for supply operations, to contain contaminated water for reuse and to prevent uncontrolled discharges.

The proposed water management system for the Project principally comprises the following components:

- The collection mine affected water in turkey's nest storages for reuse;
- The collection of sediment laden runoff from the MIA, TLF and overburden stockpiles; for treatment and reuse and / or discharge;
- The transfer of water from the raw water dam, pit dewater dam, and environment dams to the process water dam where it is used for coal washing;
- The decant of effluent from coal washing activities and reuse of decant water within the CHPP;
- The use of water by the workforce, industrial processes, dust suppression and for firefighting (if required); and
- The managed release of mine affected water to receiving waters, governed by flow conditions, water quality objectives and instream dilution achieved within the receiving waters.

Project water usage including potable water, emergency use water (fire), raw water and mine water is outlined in Table 3-14 in Chapter 3 – Description of the Project. A more detailed discussion and assessment of water usage including water balance is described in Chapter 9 – Surface Water. The water demand for the rehabilitation activities in Years 17 – 20 is unknown at this stage; however, it is anticipated that demand will be <20 ML per year.

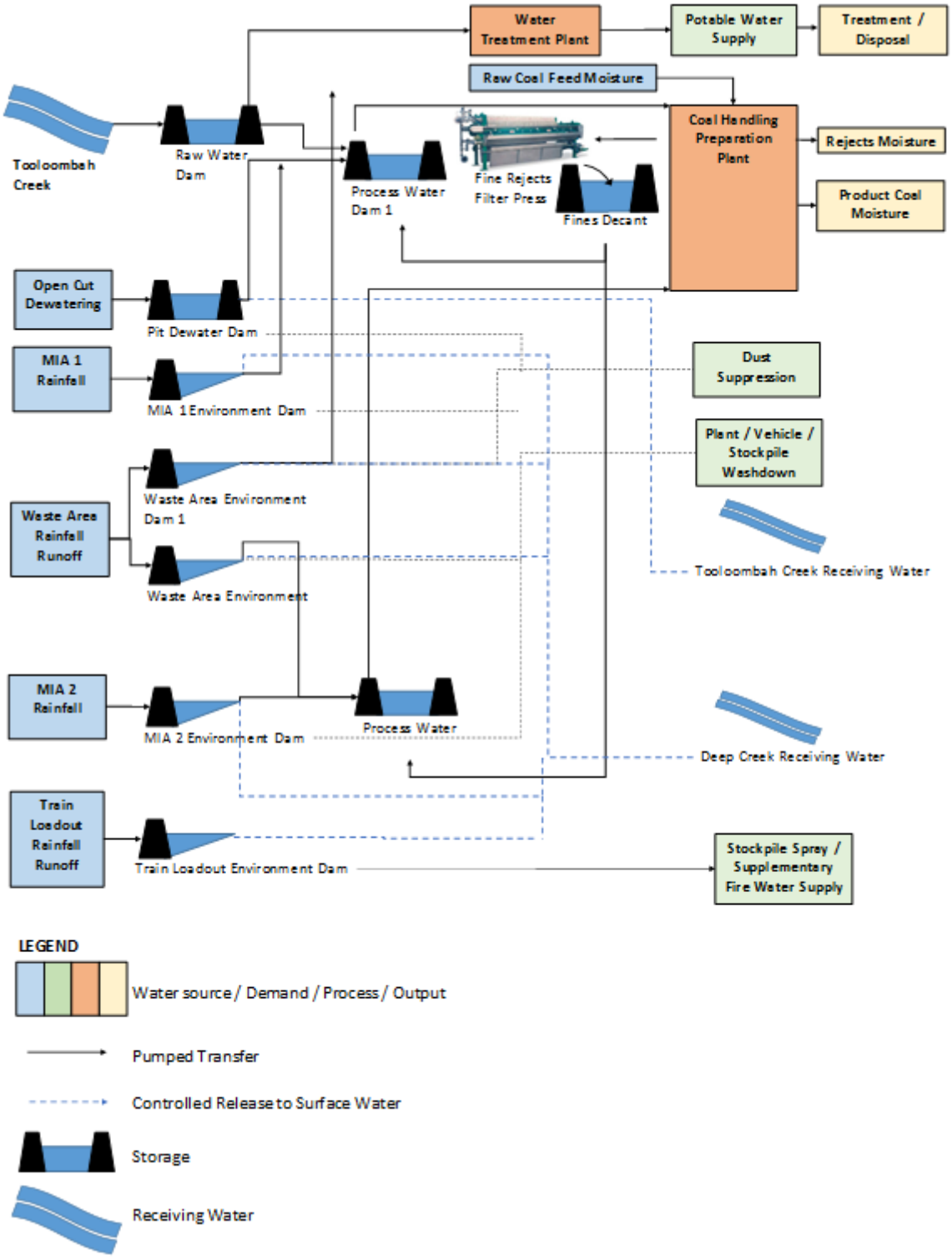


Figure 16-6 Water balance schematic

A potable water demand of approximately 6.3 ML/annum is estimated for the MIA and CHPP operations at full capacity. The potable supply will comply with standards outlined in the Australian Drinking Water Standard Guidelines (NHMRC and NRMMC 2011). A potable WTP will treat water from the raw water supply and maintain a secure supply in a potable water holding tank. A sewage treatment plant is proposed to be located near the MIA. Effluent and sludge waste streams will be appropriately treated and discharged to pits or used as mulching media, respectively.

Clean water is defined as runoff from catchments undisturbed by mining and non-mining activities. The mine has been designed to avoid any diversions of defined watercourses of high environmental value, namely Deep Creek and Tooloombah Creek. However, low order tributary gullies that discharge into Deep Creek and Tooloombah Creek and that transect the ML are diverted around mine affected areas. These clean water diversions are aimed at maintaining the health of defined watercourses of higher environmental value and to reduce contamination of otherwise clean water runoff.

Several types of dams will be required to hold mine affected runoff, including:

- Environmental dams that capture rainfall runoff from the two MIA, TLF and overburden dump areas. The primary function of the environment dams is to capture sediment laden runoff for sediment removal. A perforated riser pipe outlet is proposed to allow gravity draining of the sediment dam within 48 hours of filling. A gated outlet is proposed for potentially storing water for use (overburden and CHPP environment dams) or for stockpile spray and supplementary fire supply (TLF environment dam – dam 3). Oil / water separators are proposed for vehicle wash and workshop areas to treat hydrocarbon contaminated runoff prior to release or containment in environment dams;
- A pit dewater dam that accepts water pumped from the open cut sumps to ensure dewatering of pits and continued access to the coal resource. The pit dewater stored volumes take preference for dust suppression supply, washdown and transfer to the Process Water Dam (PWD) for coal washing use;
- A process water dam located at the MIA that supplies water to the CHPP. The PWD holds a 14-day CHPP demand volume to buffer against water supply maintenance and breakdown. The PWD is kept full from transfers from the pit dewater dam (priority 1) and the Raw Water Dam (RWD) (priority 2). The PWD does not discharge to the environment and has a design storage allowance (DSA) to ensure overtopping does not occur;
- CHPP dewatering ponds that accept high moisture coal fines from coal washing and facilitate decant return to the PWD for reuse within the CHPP. The dewatered fines are then stored in exhausted mine pits; and
- Open cuts that contain a sump (nominally 5 ML) from which groundwater inflow and rainfall runoff is stored. Water is transferred from the pit sump to an ex-pit mine dewater dam at a rate of 200 l/s.

All proposed storages and levees have undergone preliminarily assessment under the DEHP Manual for Assessing Consequence Categories and Hydraulic Performance of Structures to determine the minimum hydraulic performance requirements. A summary of the consequence assessment is shown in Table 3-15 in Chapter 3 – Description of the Project.

16.7.3.6 Water Storage Assessment

Based on the consequence assessment (summarised in Chapter 3 – Description of the Project) the following DSA, Extreme Storm Storage (ESS) and spillway capacities have been selected in accordance with the EHP consequence manual:

- Spillway capacity of 1:1,000 Annual Exceedance Probability (AEP) with freeboard allowance for wave run-up from a 1:10 AEP wind;
- DSA for a 1:20 AEP wet season:

  - Water balance modelling informed the 1:20 AEP wet season storage through Monte Carlo simulation of 127 years of historic climate data and by adding a 50% contingency to the increase in storage volume from 1 November; and

- ESS for a 1:10 AEP, 72 hr duration rainfall event:

  - The corresponding 1:10 AEP, 72 hr design rainfall depth is 300 mm as per the Bureau of Meteorology's Intensity Frequency Duration curves for the Project location.

The pit dewater dam, RWD, dewatering ponds and the PWD are designed as turkey's nest storages with no external contributing catchment. Contributing catchments to environment dams are restricted to the area of disturbance generating dirty water runoff i.e. clean water runoff is diverted around areas of disturbance. The required storage size for the dams was informed by simulating the mine water balance as discussed in Chapter 9 - Surface Water and / or by applying the following performance criteria:

- Raw Water Dam –Provide 99% reliable water supply for the life of the Project;
- Environment Dams – Sized to capture the 1:10 year ARI, 24 hr duration storm event in accordance with EHP's Stormwater Guideline: Environmentally Relevant Activities (EHP 2014c);
- Pit Dewater Dam – Sized to have no non-compliant discharges for the maximum rainfall and assuming licenced discharges, dust suppression and washdown demands, and transfer to the PWD for use within the CHPP; and
- CHPP Dewatering Ponds – Sized to have no non-compliant discharges for the maximum rainfall and assuming return of decant to the PWD.

16.7.4 Mine Infrastructure

16.7.4.1 Mine Industrial Area

MIAs will be located adjacent to each of the CHPPs. The likely MIA arrangement for both CHPPs is shown in Figure 16-2. The key components of the MIA are:

- Administration offices and staff parking;
- Petroleum, oil and lubricant storage and handling facilities;
- Vehicle and equipment wash down facilities;
- Vehicle fuelling facilities;
- Workshops and stores facilities;
- Laydown and hardstand areas;
- Electrical power substations and associated facilities;
- Raw water supply for potable water production, firefighting, coal dust suppression and coal washing; and
- Internal road network including light-vehicle access roads, heavy-vehicle haul roads and a site access road.

Diversion structures will be formed at each of the MIAs to direct clean water around the area and direct potentially contaminated water to an environmental control pond. Areas storing fuels or oils and washdown areas will be appropriately designed and bunded with runoff from these areas directed to a sump to separate oils and water prior to releasing water to the environment control pond.

16.7.4.2 Fuel Facility

During peak production, it is estimated that approximately 163.58 ML of diesel fuel will be consumed. This consumption rate will decrease to approximately 0.73 ML as the open cut operations cease.

The fuel storage facility will be located at the MIA and will comprise several interconnected self-bunded bulk diesel storage tanks. It is anticipated that approximately 660,000 L of diesel will be stored onsite at the two fuel storage areas. Diesel will be reticulated to heavy vehicle service bays, and heavy and light vehicle bowsers. Access to the fuel facility will be via the internal MIA access roads. The fuel facility will be designed and 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.

There will be no in-field fuel storage. Fuel trucks will transfer fuel from the fuel storage tanks to mine vehicles.

16.7.4.3 Petrol Oil Lubricant Storage and Handling Facilities

The petroleum, oil and lubricant will be located at the MIA. The petroleum, oil and lubricant facility is anticipated to store various quantities of transmission oil, hydraulic oil, diesel engine oil, final drive oil and waste oil. In addition, the facility will have a storage capacity for lubricants and coolants. The petroleum, oil and lubricant facility will also comprise:

- Self-bunded lube and oil storage tanks for several different types of oil and lubricants;
- Hardened on ground oil and lube tanker unloading area, allowing for oil transfer from the delivery vehicle to the storage tanks; and
- Some reticulation of oils and lubricants depending on the final configuration of the MIA facilities.

16.7.4.4 Washdown Facilities

Heavy vehicle and light vehicle washdown facilities will be located at the MIA. The washdown facilities will comprise:

- Prewash bays to remove excessive amounts of large material;
- Washpad for washing with handheld high pressure water cannons;
- Grit traps and oil / water separators; and
- Reticulation of washdown water to an environmental water storage pond.

16.7.4.5 Power Supply

The power supply for the mine site will most likely be provided by 415 V, three-phase diesel generators, installed at the MIA and the CHPPs. The MIA will incorporate two 300 KVA 415 V diesel generator sets mounted in a fully bunded area adjacent to the MIA 415 V Switchrooms. The normal mode of operation for the generators is synchronised and connected to the load through a bus tie. The generators will be sized to provide redundancy with each generator capable of carrying the total load.

The generators will include their own diesel day tanks capable of holding sufficient diesel for a minimum of seven days' operation on full load. The generators will be hired to minimise initial capital costs and the hire company will be responsible for all repairs and maintenance.

The CHPP area will be serviced by two substations, one at the raw coal area and the other at the CHPP. The raw coal substation will likely consist of one 500 KVA 415 V diesel generator set mounted in a fully bunded area adjacent to the raw coal 415 V Switchroom. Conceptually the CHPP substation will have three 500 KVA 415 V diesel generator sets mounted in a fully bunded area adjacent to the CHPP 415 V Switchroom. The normal mode of operation for the four generators is synchronised and connected to the load through bus ties with an interconnecting cable installed between the two substations. The generators will be sized to provide redundancy with three generators capable of carrying the total load. Like the generators used at the MIA, each have their own diesel tanks capable of holding sufficient diesel for a minimum of seven days' operation on full load.

A separate option to connect into the existing 11 kV transmission line maintained by Ergon Energy which provides power to the nearby township of Ogmore is under consideration. From discussion with Ergon this 11 kV line has limited capacity to support the Project; however, depending on the final power demand needed to support the CHPP operations an opportunity to connect to the Ogmore substation may still be possible.

16.7.4.6 Onsite Road Infrastructure

Access to the Operational Area of the Project will be via the Bruce Highway which will have new turn out lanes constructed connecting to the entry points to the north-eastern and south-western operational areas. The turnout lanes will be designed to DTMR standards (see Chapter 6 – Traffic and Transport for further details).

Current designs indicate a requirement of approximately 15 km of roads for access around the MIA and CHPP. Roads will rely on existing farm access tracks wherever possible and, during their construction, clearance of any sensitive environmental features such as remnant vegetation will be avoided to the extent practicable.

16.7.4.7 Sewerage

At the commencement of construction and prior to the commissioning of sewage and waste water treatment infrastructure, temporary shower and toilet facilities will be used at the mine site.

Sewage treatment will occur at a central intermittent aeration type package treatment plant planned to be located at the accommodation camp (note the accommodation is not included as part of the EIS process). Toilet facilities at the MIA will be pumped out at an appropriate schedule and trucked back to the sewage treatment plant.

16.7.4.8 Lighting

Artificial lighting will be designed, installed, operated and maintained in accordance with AS 4282:1997 Control of the Obtrusive Effects of Outdoor Lighting, to minimise the amount of light spill. Controls stipulated in this standard include consideration of the location and orientation of lighting as well as the selection and maintenance of luminaries. Any further mitigation (for example shielding, further restricting the use of lighting) will be implemented on an as needed basis.

16.7.5 Mine Decommissioning and Rehabilitation

The Project is not expected to be decommissioned for approximately 20 years or following depletion of the target coal resource. Progressive rehabilitation is proposed to be carried out as operations progress (opposed to a large operation once mining is complete). Thus, staged treatments will be applied as soon as areas become available for such. Rehabilitation of the MIAs; however, will take place once mining is completed and plant and structures decommissioned.

The review and audit of rehabilitation work undertaken during operations will be required as part of the Project's EA. More specifically, the Plan of Operations will set out the proposed program of actions to comply with the EA conditions including a program to rehabilitate any disturbed land. This Plan will also provide for compliance measures obliged by applicable legislation. The rehabilitation and decommissioning approaches, including figures showing the modelled final landforms, are described in detail in Chapter 11 – Rehabilitation and Decommissioning.

The Plan of Operations will be submitted to EHP prior to any disturbance occurring onsite and will be reviewed by an independent suitably qualified auditor. Approval by EHP to renew the Plan of Operation will take place on a five-year basis at most but more likely annually. EHP may suspend or cancel the EA in the event of inadequacy or non-compliance of operations in meeting the Plan of Operations. In addition to this, the EA will require Central Queensland Coal to provide financial assurance to EHP prior to any activities taking place onsite to cover any costs or expenses incurred in the highly unlikely event that the conditions of the EA are not met. This includes, for example, conditions relating to rehabilitation. This section specifically identifies the following key aspects relating to the rehabilitation of the Project:

- The control and management of mine waste;
- Proposed rehabilitation methods;
- The management of topsoil resources for use in rehabilitation of the site;
- Description of the planned progressive rehabilitation and revegetation of areas across the mine site;
- The integration with on-going and future rehabilitation activities across the wider mining area; and
- Rehabilitation monitoring and maintenance requirements which may apply.

Decommissioning and rehabilitation are discussed in detail in Chapter 11 - Rehabilitation and Decommissioning and summarised in the following sections. The level of detail provided is commensurate to the level of risk associated with each key closure issue and the time to closure. It sets out acceptable and realistic criteria for rehabilitation and closure that would allow the Project to meet the principles of Ecologically Sustainable Development without any unacceptable liability to the State.

16.7.5.1 Progressive Rehabilitation Program

Progressive rehabilitation will apply to the open cuts and waste rock dumps. The main features of the progressive rehabilitation process are:

- Constructing a stable land form for all disturbed areas;
- Topsoil spreading across available reshaped areas;
- Contour ripping immediately after topsoil placement to control erosion;
- Revegetation with an appropriate seed mix prior to the wet season; and
- Management of rainfall and runoff from the rehabilitated landform in sediment dams.

The proposed mine life is 20 years including the final four-year rehabilitation period. The indicative program for progressive rehabilitation is described below. Progressive rehabilitation will occur in accordance with the Plan of Operations. The Plan of Operations will identify areas to be rehabilitated and refer to the Rehabilitation Plan for specific rehabilitation details for each domain. The proposed rehabilitation program is summarised below.

Construction

Infrastructure construction to commence six months before the commencement of mining. All works areas to be cleared and grubbed with disposal of vegetation. Topsoil and subsoil to be stripped and separately stockpiled for future use. Primary sediment controls such as dams to be constructed in this phase.

Operational Years 1 to 16

Ex-Pit Dumps (EPDs) will be utilised for coal rejects (filter press tailings – refer Chapter 8 – Waste Rock and Rejects for further disposal details). During the operational life of the mine (including during decommissioning) EPDs will be stabilised and contoured to minimise potential erosion. As part of the progressive rehabilitation activities, EPDs will be reshaped, stabilised, topsoiled and seeded.

Post-mining Completion Works Years 16 – 20

All spoil piles and any remaining voids will be rehabilitated. Mine infrastructure will be decommissioned and dismantled for removal from site with the individual locations rehabilitated accordingly. Dams and access roads will remain for future beneficial use or decommissioned. Rehabilitated areas will be monitored and if necessary reworked to achieve the required completion criteria.

The aim of progressive rehabilitation is to minimise the amount of land disturbed at any one time. The indicative program for progressive rehabilitation is shown in Figure 11-5 to Figure 11-8 of Chapter 11 – Rehabilitation and Decommissioning. The final landform and final landform cross-sections are shown in Figure 11-9 of Chapter 11 - Rehabilitation and Decommissioning. These show rehabilitation at various stages, including ex-pit waste rock dumps and in-pit dumping where rehabilitation has been completed in year 4, 8, 12 and 16 and the final landform. The final landform of the rehabilitated pits and waste dumps lie outside the post mining 1,000 year Annual Recurrence Interval (ARI) flooding (Figure 11-10 of Chapter 11 - Rehabilitation and Decommissioning). Progressive rehabilitation will also include the rehabilitation of any areas disturbed during construction that are not required for ongoing operations.

16.7.5.2 Landforming

The cumulative total volume of excavated waste from open cut activities is expected to include 458 Mbcm of waste rock and subsoils disposed in-pit and 85 Mbcm disposed ex-pit in waste rock dumps. As operations commence, waste rock from the open cuts will initially be stored in the ex-pit dumps. As mining in the open cuts progress, the stored waste rock will be backfilled in-pit as part of the progressive rehabilitation. As such it is not anticipated that extensive rehabilitation will be required of the waste rock dump areas over and above re-seeding. This will; however, be assessed as mining progresses.

Expired pit areas will have the reject waste and overburden returned and will be profiled to the final desired landform specifications. Subsoil and topsoil will be replaced on the profiled landform in the reverse order to which it was stripped from the open cut domains. Where required, contour banks will be progressively installed to minimise rill erosion and direct water off the profiled landform to either a stabile surface or dedicated stabilised drainage paths or flumes constructed on the final landform.

Finalised landforms will initially be sown with either a cover crop or perennial native vegetation. The areas which have been identified for post-mining agricultural use will be sown with a mixture of pasture species including short and long lived perennial grasses and or legumes. Areas intended for ongoing nature conservation will be over sown with non-invasive perennial grasses as an interim measure until the area becomes available for inclusion in the ongoing revegetation program.

16.7.5.3 Revegetation

Revegetation activities will typically commence at the completion of land forming, such as, reshaping, re-topsoiling and drainage works. The timing of these works will ideally be scheduled to enable a preferred seasonal sowing of pasture or tree seed. Where surfaces have been prepared, the nominated revegetation specification for tree, shrub and pasture species, will be sown using seed stock or planted depending on the species, slope gradients and final land use. Rehabilitation will utilise locally relevant tree and shrub species at a density and richness consistent with the desired post-mine landform and previous land use. Plant selection for areas to be returned to a bushland landform will be based on the following criteria:

- The species will successfully establish on the available growth medium;
- The species will bind the soil; and
- The species diversity will result in a variety of structure and food and habitat resources.

Native flora used for rehabilitation will be endemic to the area, in keeping with the existing vegetation communities present prior to clearing, and ensuring habitat for extant fauna on the site is reinstated. Vegetation will be established through a combination of direct seeding or planting of tube stock from local propagules. Seed will be collected from site where possible and treated if necessary to ensure it is adapted to environmental conditions in the area. Tree and shrub establishment onsite will be dominated by the direct seeding method, currently being used at most coal mines in the Bowen Basin. An initial tree and shrub mix that could be used for rehabilitation is provided in Chapter 11 - Rehabilitation and Decommissioning and is based on the current suite of flora species found in the Project area. The final species mix will depend on the final agreed Rehabilitation Plan and will be reviewed periodically depending on changes in best practice, technology and rehabilitation monitoring results.

16.8 Legislative Background

Under the EPBC Act, the following MNES are protected:

- World Heritage Properties;
- National Heritage Places;
- Ramsar wetlands of international importance;
- The Great Barrier Reef Marine Park (GBRMP);
- Listed threatened species and communities;
- Migratory species protected under international agreements;
- The Commonwealth marine environment;
- Nuclear actions (that may have significant impacts on the environment); and
- Water resources as related to coal seam gas and large coal mining developments.

Under Part 3 of the EPBC Act, the three relevant controlling provisions for this Project are:

- World Heritage properties (sections 12 and 15A);
- National Heritage places (sections 15B and 15C);
- Listed threatened species and communities (sections 18 and 18A);
- Listed migratory species (sections 20 and 20A);
- Great Barrier Reef Marine Park (sections 24B and 24C); and
- Water resources in relation to large coal mining development (sections 24D and 24E).

Actions that are likely to have a significant impact on MNES are subject to the assessment and approval process. The EPBC Act Policy Statement 1.1: Significant Impact Guidelines (DotE 2013) define the criteria used in this EIS against which an action (that is the proposed works) may be judged as having (or not having) a significant impact.

The EPBC Act also sets out the principles of ecologically sustainable development in Section 3A. The proponent has ensured the MNES assessment for the Project has complied with these principles wherever considered appropriate.

16.8.1 Other Approvals and Conditions

A detailed description of the legislation, policy, and planning framework pertaining to the Project is provided in Chapter 1 – Introduction of this EIS.

A list of those related to biodiversity and water management are below:

- EPBC Approval for a Controlled action under the EPBC Act;
- *National Greenhouse and Energy Reporting Act 2007* (NGER Act);
- EA under the *Environmental Protection Act 1994* (EP Act);

- Water licence under the *Water Act 2000* (Water Act);
- Riverine Protection Permit under the Water Act;
- Notification of Land – for Notifiable Activities under the EP Act; and
- Permit to Take Protected Plant or Interfere with a Breeding Place under the *Nature Conservation Act 1992*.

16.9 Environmental Context

Many of the potential impacts on the relevant MNES are indirect impacts that arise due to direct impacts on intermediary receptors of the environment. To assess the potential impacts on MNES it is therefore necessary to assess the impacts on these intermediaries first. This section provides an overview of key aspects of the environmental context that will be relevant to the Project.

16.9.1 Land

16.9.1.1 Methodology

The following provides a summary of the findings related to the assessment of local geology and soil types in the Project area and surrounds as detailed in Chapter 5 – Land.

To adequately assess the potential impacts the Project may have on soils and the current land use within the Project area, the following detailed assessments have been undertaken:

- Desktop assessment, including review of publicly available literature, maps and resources relevant to the geology, soils and landforms in the Project area; and
- Field surveys and laboratory analyses undertaken focusing on characterisation of soils for land use suitability, agricultural value and potential rehabilitation (as required) as part of the EIS process to improve understanding of soils within the Project area. A detailed field soil survey of the Central Queensland Coal mine area was conducted over a four-day period in April 2017.

16.9.1.2 Existing Environment

Geology

The economic Cretaceous coal measures targeted for mining are the Central Queensland Coal Measures, contained within the Styx Basin, a small, Early Cretaceous, intracratonic sag basin that covers an area of approximately 300 km^2 onshore and 500 km^2 offshore in the Broad Sound area. The known coal bearing strata of the basin are referred to as the Styx Coal Measures and consist of quartzose, calcareous, lithic and pebbly sandstones, pebbly conglomerate, siltstone, carbonaceous shale and coal.

The Styx Basin is relatively undeveloped, except for two small scale, government owned mines that were in operation from 1919 to 1963. The Ogmore and Bowman collieries, located close to the north and northeast of ML80187 respectively, produced small qualities of low quality coal, for use in steam trains and other boiler requirements.

The majority of the Styx Coal Measures are concealed beneath Tertiary sediment. Queensland Geological Survey mapping shows the eastern margin of the Styx Basin extends to the eastern edge of the terrestrial Cainozoic sediments that conceal it. The Styx Coal Measures outcrop in the western

margin of the Styx Basin as low forested hills. These outcrops form a series of detached hills, orientated north-south, that continue for about 60 kilometres northward to the coastline near the Port of St Lawrence. The outcrops generally form small hills and hillocks, but at their greatest height, are 100 metres above the low-lying sediment flats to the east. The hills are probably the coal-barren basal section of the Styx Coal Measures sequence, which consists of thick beds of quartz-dominant sandstones.

The coal seams that comprise the Styx Coal Measures are generally thin, commonly less than two metres in thickness. Seam splitting is common and seam thicknesses vary considerably. The coal seams are relatively shallow, and the average cumulative thickness of the full sequence of coal is approximately 6 m, contained within a sequence of approximately 120 m of coal bearing strata. The coal seams dip generally to the east in the area west of the Bruce Highway, with the Violet seam, the lowest coal seam in the sequence subcropping in the western part of ML 80187.

Soils

Soil profile description and classification identified the following soils within the Project area:

- Dermosols: non-cracking clays with structured subsoil and lacking strong texture contrast between the topsoil and subsoil;
- Sodosols: Soils which have a clear and strong texture contrast from the A horizon and a slightly acidic and sodic B horizon;
- Rudosols: soils with minimal A horizon development, little or no texture or colour change with depth unless stratified or buried soils are present; and
- Kandosols: soils which lack strong texture contrast, have massive or only weakly structured B horizons and are not calcareous throughout.

Soil Fertility

pH

Soil pH has a strong influence on the solubility and form of chemical compounds, the availability of ions in the soil solution as well as microbial activity. Surface soil pH measured from samples collected across the mine ML varied from strongly acid (pH of 5.3) to mildly alkaline (that is pH exceeding pH 7.5). Several soil core samples displayed increasing alkalinity with depth changing by as much as 6.3 pH (at the surface) to 9.1 pH (at 1.2 m below the surface) in one case.

Cation Exchange Capacity

Cation Exchange Capacity (CEC) is a useful indicator of soil fertility as it indicates the soils ability to supply the important plant nutrients Ca, Mg, K, and Na. A low CEC indicates a low potential for a soil to store and release nutrients. Most soil samples across the Project area contain CEC levels that are considered to be Very Low (<6) to Low (<12).

Exchangeable Calcium and Exchangeable Potassium results were generally very low to low. Exchangeable Magnesium results were generally rated moderate to high. Exchangeable Sodium results were generally rated as very low.

Total Organic Carbon

Organic carbon is a vital component of soils, as it not only represents the carbon content of soils, but can indicate the nutrient holding capacity and fertility of a soil. Samples generally recorded low to medium levels of total organic carbon.

Emerson Aggregate Test

The Emerson Aggregate Test measures the soil dispersion potential of soils. All but one of the soil samples were rated as between Class 1 and Class 4 based on the Emerson aggregate test undertaken at the laboratory. A single result was rated as Class 8 (SS01 at 0.5 – 0.6 tested depth) and is considered an anomaly as the laboratory advised that this sample was pure sand, with no reaction, no dispersion and no ribboning.

Of the samples analysed nine were rated as Class 1 or Class 2. These sample locations indicate soils that have greater dispersive potential and, when disturbed, are prone to erosion and soil structural decline. Of the remaining 12 samples, nine were rated as Class 3 and three were rated as Class 4. These samples are considered to only have moderate dispersive tendencies, can be remoulded and will not readily disperse in water.

Sodicity

Exchangeable Sodium Percentage (ESP) measures the sodicity of a soil which, along with the Emerson aggregate test, is directly related to a soils structural stability and erosion potential. A combination of non-sodic, sodic and strongly sodic soils was identified from the soil samples. These results indicate that there are some areas of increased erosion potential associated with sodic soils in the area.

Electrical Conductivity

Electrical conductivity relates to the degree of salinity in the soil. The higher the EC value, the more soluble salt is in the soil. High soil salinity can be a limitation for vegetation growth, particularly for salt-sensitive species. Samples were generally rated Very Low to Medium across the Project area, indicating soil salinity is generally not a limitation for vegetation growth. The exceptions were samples taken from four sites at depths below 0.5 metres below ground level (mbgl), which rated between High to Very High soil salinity. indicating a build-up of salts in some subsoils.

16.9.1.3 Potential Impacts

Land Disturbance

The Project has the potential to directly disturb land areas because of the construction of onsite access roads, coal stockpiles, water management facilities, storage of overburden and backfilling, CHPP / MIA areas and other mine infrastructure used during the operational phase, rehabilitation activities, and through the direct disturbance or depletion of surface waterways and groundwater aquifers.

The clearing of vegetation and other earthmoving activities associated with construction of the Central Queensland Coal mine and mine facilities can initiate soil erosion if not done in a controlled manner, releasing sediments into nearby water systems and decreasing the overall value of the land.

Soil and Land Contamination

As the proposed mine will be an open cut mine, a change to existing and potential land use within the Project and adjacent areas will be moderate, with most land disturbance limited to areas associated with the MIA, open cut pit mines and waste rock areas. Within the CHPP / MIA areas, land degradation may occur as the result of compaction and / or topsoil removal, resulting in a reduction in land suitability, post mining. However, such areas would be relatively small and measures would be employed to recover most, if not all, of such affected areas, for example by ripping and deep ploughing of compacted surfaces post-mining.

Contamination can affect future soil use and land suitability. If not managed correctly, contamination of soils may occur because of activities related to things such as the CHPP, ROM dump station, mine affected water dams and the sewage and waste management facilities on the Project site. Storage of hazardous and other chemicals also presents a risk to soils as spills can result in significant contamination.

Erosion and Stability

Mining activities have the potential to increase the risk of erosion, particularly when soils are subject to flooding, wind, sodic in nature, or are on steep slopes. Sodosols within the central section of the haul road have physical and chemical properties that make them relatively more susceptible to erosion (highly sodic). Soils within the mine area and TLF are not considered to be high risk of erosion (non-sodic). Across the Project site there are some areas with subsoils (B horizons) displaying strongly sodic or dispersive properties. These soil properties will further increase the likelihood of erosion occurring if not properly managed.

The risk of erosion on land within the transport corridor is most likely to occur following site clearance and prior to construction of the road.

16.9.1.4 Mitigation Measures

Land Disturbance

The following mitigation measures are proposed to avoid and offset potential impacts that may occur because of construction and operation activities which could result in land disturbance:

- Erosion and Sediment Control Plans (ESCPs) will be developed and implemented prior to the commencement of construction works;
- Vegetation will be preserved with only the minimum amount of land required to operate the Project cleared at any one time. No Go Zones shall be established prior to clearing / grubbing activities and maintained throughout the life of the Project;
- Erosion and Sediment Control Plans will be developed and implemented prior to the commencement of construction works;
- No surfaces will be left open if they are not being worked on and all areas will have topsoil pulled back over and be suitably compacted once construction work in the area has finished. Grassed areas cleared for construction of any mine-related infrastructure will be re-contoured and landscaped once construction is complete to minimise erosion impacts;
- All vehicle movements will be restricted to stabilised access locations;

- Where significant excavation is required, excavated material will be deposited upslope of the work and diversion measures to control soil and water flows will be installed. Excavations will be kept open for the shortest period possible; and
- Disturbed land will be returned to pre-existing vegetative habitat condition, including cattle grazing, native vegetation or where appropriate farm dams and wetlands.

Land Degradation and Contamination

Topsoils and subsoils will be stripped, handled and stored following industry practice to prevent excessive soil deterioration. An inventory of available soils will be maintained to ensure adequate materials are available for planned rehabilitation activities.

Contamination impacts shall be remediated with current common contaminated land practices. These impacts are of a low risk following the adoption of mitigation measures listed below. The following mitigation measures are proposed:

- Ensure all refuelling facilities and the storage and handling of oil and chemicals comply with relevant Australian Standards;
- Contaminated material will be removed and placed in an appropriate area for remediation;
- Provision of appropriate spill control materials including booms and absorbent materials at refuelling facilities to contain spills;
- In the event of a large spill, sites will be investigated, managed and remediated in accordance with the requirements of the contaminated land provisions of the EP Act and the EHP Draft Guidelines;
- Onsite records will be maintained regarding any activities or incidents that have the potential to result in land contamination;
- Appropriate waste rock and rejects management and disposal; and
- As much as possible, avoiding impact to any areas of soil with sodic properties.

Erosion and Stability

Erosion in active construction or development areas cannot be eliminated. However, impacts can be controlled and minimised. Therefore, a Certified Professional in Erosion and Sediment Control (CPESC) and a Certified ESCP will be required to ensure construction activities are being undertaken in accordance with best management practices and the International Erosion and Control Association (IECA) guidelines (2008).

It is expected that greater ESC management will be required in areas of the transport corridor which have been identified as of higher erosion risk. The ESCP will include:

- Size and location of all ESCs;
- Design of ESCs to be able to cope with the required rainstorm event for the area;
- Areas requiring soil stabiliser;
- The period of maximum disturbance for each area (with critical works being scheduled for the dry season as much as practical);

- Boundaries of areas to be cleared and clear delineation on Project drawings;
- Any sediment collection structures will be inspected at intervals prescribed in the ESCP and after each significant rainfall event; and
- Temporary and permanent stormwater and drainage controls will be designed to be able to withstand the required stormwater capacity for a given average recurrence interval storm event.

16.9.2 Surface Water

16.9.2.1 Methodology

Department of Natural Resources and Mines is required to obtain and publicly provide information and data on the quantity and quality of water in Queensland for the purposes of water planning under the Water Act. A review of DNRM data indicates there are no flow gauges within the Styx Basin by which to define the hydrologic regime and determine appropriate flow triggers for release of mine affected water.

Project specific surface water field assessments were conducted in June 2011, February, May and June 2017. A total of 11 sites were surveyed over the four assessments although not all sites were sampled on each occasion. Site characteristics such as flow conditions, bank stability, and estimated water depth were recorded at each site. Survey site selection was based on Project proximity and the presence of water. Site selection was also guided by the EHP Water Monitoring and Sampling Manual (EHP 2010) and *Environmental Protection (Water) Policy 2009.*

16.9.2.2 Existing Environment

Existing Waterways and Local Catchments

The Styx River Catchment covers approximately 302,000 ha, and the main tributaries include: Deep, Granite, Montrose, Stoodleigh, Tooloombah, Waverly and Wellington Creeks. The mine area and TLF is situated within the lower catchments of Tooloombah Creek and Deep Creek. Both creeks feed directly into the Styx River (2 km north of the Project area) which discharges into the Broad Sound area approximately 33 km northeast of the Project. The haul road to the TLF crosses Deep Creek and Barrack Creek. Tooloombah Creek and Deep Creek are non-perennial or ephemeral, and largely flow only following heavy rainfall events (Figure 16-7).

Current EHP wetland mapping indicates two palustrine wetlands (non-riverine vegetated wetlands) and five lacustrine wetlands (wetlands in topographic depressions / dammed areas with little vegetation) are located within the Project boundary. Onsite observations indicate the lacustrine wetlands are a mixture of natural wetlands and farm dams. There are several existing farm dams within the mine area which are not included in wetland mapping.

Both Tooloombah Creek and Deep Creek are located outside the Project area; however, several of their tributary drainage features reside within the Project area. These drainage features are minor in nature, are ranked as either first or second order drainage features, and are classified as non-perennial.

Surface water features within the Project area include (refer to Figure 16-7):

- Minor un-named drainage lines feeding into Tooloombah Creek:
  - Two 1st order drainage lines
  - One 2nd order drainage line
- Minor un-named drainage lines feeding into Deep Creek:
  - Nine 1st order drainage lines
  - One 2nd order drainage line.

The haul road associated with the TLF crosses:

- Deep Creek as a 5th order drainage line in this area;
- Barrack Creek as a 4th order drainage line; and
- Two un-named tributaries of Barrack Creek as a 3rd order drainage line and a single 1st order drainage line.

The TLF and associated infrastructure intersect two further 1st order drainage line and a single 2nd order drainage line.

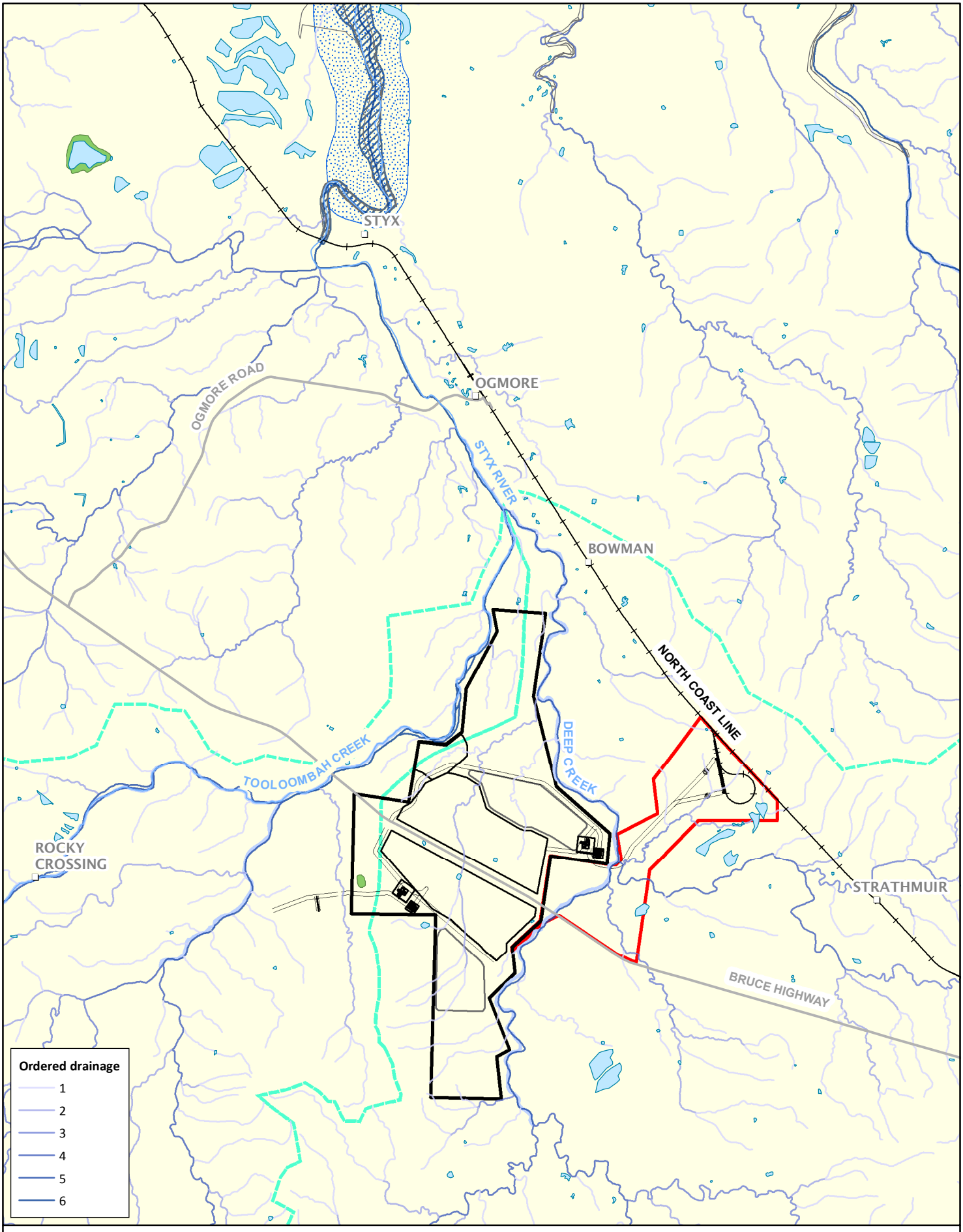
No direct works involving stream diversions are proposed for any of the main waterways traversing the Project area. The mine pit areas will require water diversions of two minor 1st order drainage lines and one 2nd order drainage line feeding Deep Creek (three diversion points). Another 2nd order drainage line to the north of the pit areas is proposed to be dammed for use as a raw water dam to supply mine operations.

The haul road crosses Deep Creek and two minor tributaries of Barrack Creek (which lies within the Deep Creek catchment. are crossed by the proposed transport corridor. These water bodies do not drain the proposed mine area site, and are not expected to be significantly impacted by the Project. A 2nd order drainage line in the Barrack Creek catchment is proposed to be dammed for use as a raw water dam supplying the TLF.

Deep Creek traverses the eastern boundary of the ML80187 and flows in a northerly direction from its beginning, approximately 16 km upstream of the southern boundary of the ML. The Deep Creek catchment is approximately 29,800 ha. Tooloombah Creek traverses the western boundary of the ML80187 and flows in a northwest direction from its beginning in the Broadsound Ranges, approximately 25 km upstream of the eastern boundary of the ML. The Tooloombah Creek catchment is approximately 37,000 ha. Both creeks are ephemeral varying between 3 m to 8 m wide near the Project. Several large and relatively deep and likely permanent pools occur on both creeks (Plate 16-1 and Plate 16-2).

Plate 16-1: Deep Creek pool adjacent to northern boundary of MLs (February 2017)

Plate 16-2: Tooloombah Creek pool adjacent to Bruce Highway (February 2017)



N

0 1 2 km

Scale @ A4 1:100,000
Date: 27/06/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Directory of important wetland
- Great Barrier Reef Coast Marine Park Zoning
- Drainage Catchment
- Reservoir
- Wetland Protection Area
- Watercourse (defined by Water Act, 2000)
- Major Rail Line
- Major Roads

Figure 16-7
Local watercourses, drainage features, wetlands, dams and catchments

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

Wetlands and Farm Dams

Wetlands may be defined as: 'Areas of permanent or periodic / intermittent inundation, whether natural or artificial, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 m' (EPA 1999). In accordance with this definition, three types of wetland systems (EPA 1999) occur within the Project area and surrounding catchments:

- Riverine: wetlands within a riverine system;
- Lacustrine: wetlands within a topographic depression or dammed river channel that cover an area greater than 8 hectares (ha) without persistent emergent vegetation and include dams; and
- Palustrine: wetlands dominated by persistent emergent vegetation and include swamps, bogs, and billabongs.

Riverine wetlands associated with Deep Creek and Tooloombah Creek lie adjacent to the boundary of the MLs. A single minor tributary of Deep Creek is located within the north of the MLs (Figure 16-7). Several lacustrine wetlands occur within ML80187; however, these are artificial and associated with grazing activities. There are two palustrine (natural) wetlands located within the western portion of the ML. The haul road crosses riverine wetland associated with Deep Creek.

A single wetland protection area (WPA), as shown on the map of referrable wetlands, is located within the Project area (Figure 16-7). There is a cluster of three WPAs mapped as occurring 14 km north of the Project associated with the floodplain between the Styx River and Stoodleigh Creek.

Macroinvertebrate sampling for water quality assessment was conducted in nine sites within the wider catchment in 2011: three sites on Deep Creek and Styx River, two sites on Tooloombah Creek and a single site on Granite Creek to the north. Results indicate that macroinvertebrate diversity within the survey area was consistent with relatively undisturbed waterways. Results of the assessment are summarised in Chapter 15 – Aquatic Ecology and detailed in Appendix A9e – Aquatic Ecology Results.

Existing Water Users

A search was carried out for allocated water entitlements from the downstream catchments associated with the Styx River. The Project is situated within the Mamelon cattle grazing property, which both runs cattle and produces dryland cropping. Supporting this land use is a series of farm dams and surface contour bunds that capture and store runoff generated by the local contributing catchments. Groundwater bores also lift water to dams and / or storage tanks in the surrounding region for domestic and stock water use.

There are several surface water entitlements in Tooloombah and Deep Creek for irrigation, stock and domestic supply. The entitlements that may be impacted by the Project by being located adjacent to or downstream of operations include the following:

- 119/CP900367 - Irrigation entitlement located on parcel of land adjacent to the Mamelon property, separated by Deep Creek, and approximately 3 km downstream of mine infrastructure and environment dam release point locations on Deep Creek;
- 1/RP616700 - Domestic / stock supply entitlement located on parcel of land adjacent to the Mamelon property and straddling Tooloombah Creek. The extraction point appears to supply

a small off-stream storage on the western overbank of Tooloombah Creek, approximately 1 km downstream of the pit dewater dam discharge location; and

- 45/MPH26062 - Irrigation entitlement on parcel of land directly bordering the Project to the north and extracting approximately 6 km downstream of the pit dewater dam proposed discharge location on Tooloombah Creek.

Following Project construction there will be no significant impact to water flows and there is unlikely to be significant water quality impacts in the Tooloombah Creek and Deep Creek catchments. Upon completion, unsurfaced roads may be a potential source of sediment entering waterways, however, this will be mitigated during the detailed Project design and by the implementation of the Project ESCP.

Surface Water Quality

The results of baseline water quality sampling of the Styx River, Barrack Creek, Tooloombah Creek and Deep Creek are collated in detail in Chapter 9 – Surface Water. The mean, median, 80th and 20th percentiles are presented in Table 16-4. The data are compared against the *Styx River, Shoalwater Creek and Water Park Creek Basins Environmental Values and Water Quality Objectives* (EHP 2014a) and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000). These water quality objectives have been selected as most relevant to the primary receiving environment. Consideration of impacts to Broad Sound which receives discharges from Styx River discharges to 33 km to the southwest, is provided in Section 16.12.

Turbidity exceeded the 50 NTU guideline for three of the 23 samples. Suspended solids exceeded the 40 mg/L guideline for two of the 14 water samples. During the February sampling event, turbidity and suspended solids exceedances were observed at both De2 and De3. This is likely attributed to the low standing water height at the time of sampling due to the dry conditions and limited rainfall during the months of January and February. There were no exceedances for turbidity and suspended solids recorded during the May or June sampling events.

Testing showed that all surface water samples exceeded the ANZECC guideline value for conductivity. High conductivity values can result from excess sodium, magnesium, calcium, chloride, sulphate and bicarbonate in streams. These salts may originate from irrigation water, soils or fertilisers. High salinity values in streams may also result from rising water tables. The higher values at the Styx River site is likely the result of estuarine influence in this section of the river. It is noted that conductivity values along Tooloombah Creek were considerably higher than Deep Creek during all surveys and regardless of flow conditions. Tooloombah Creek is a rocky creek and noticeably different in form from Deep Creek. The conductivity results likely indicate a differing geological background or parent source between the two creeks.

Three of the sites recorded values outside the WQO guideline range of pH 6.5 - 8, this included St1 (pH 8.15), To1 (pH 8.04) and To2 (pH 8.1), these exceedances occurred during the February sampling event.

Three of the sites recorded values outside the WQO guideline range of pH 6.5 - 8, this included St1(pH 8.15), To1 (pH 8.04) and To2 (pH 8.1). These exceedances all occurred during the February sampling event when very dry conditions had preceded the survey.

Table 16-4 2017 baseline mean, median and 80th and 20th percentiles stream water quality data for Styx River, Barrack Creek, Tooloombah Creek and Deep Creek

Parameter	WQOs	Combined water quality Results				
		Sample number	Mean	Median	80th%	20th%
In-situ results						
Water Temperature (°C)	16 – 34[5]	14	24.30	23.90	28.70	20.00
Dissolved Oxygen (%S) Lower	6.77 – 8.76[2]	14	7.59	7.54	8.04	7.20
pH	6.5 – 8.0[2]	14	1,648.44	558.75	1,293.00	348.90
Conductivity- base flow (µS/cm)	-	14	5.46	5.56	6.22	3.01
Turbidity (NTU)	50[2]	14	146.16	14.25	116.00	4.00
Laboratory results						
Total Dissolved Solids (mg/L)	600[4]	14	1,356.00	523.50	1,660.00	290.00
Suspended Solids (mg/L)	40[2]	14	98.43	7.00	32.00	5.00
Total Alkalinity as $CaC0_3$ (mg/L)	≥20[1]	14	104.64	86.50	141.00	74.00
Sulphate (mg/L)	250[4]	14	54.93	16.50	40.00	12.00
Chloride (mg/L)	-	14	505.07	105.00	434.00	68.00
Ammonia N (mg/L)	0.02	14	0.05	0.03	0.06	0.01
Nitrite (mg/L)	-	14	0.01	0.01	0.01	0.01
Nitrate (mg/L)	0.7[1]	14	0.02	0.02	0.05	0.01
Total Nitrogen (mg/L)	0.5[2]	14	1.12	0.45	1.50	0.20
Total Phosphorus as P (mg/L)	0.05[2]	14	0.28	0.15	0.22	0.03
Reactive Phosphorus (mg/L)	0.02[2]	14	0.01	0.01	0.01	0.01
Fluoride (mg/L)	1.0[2]	14	0.193	0.200	0.300	0.100
Aluminium (mg/L)	0.055[1]	14	0.014	0.010	0.010	0.010
Arsenic (mg/L)	0.024[1]	14	0.002	0.001	0.002	0.001
Barium (mg/L)	1.0[1]	14	0.089	0.065	0.150	0.030
Cadmium (mg/L)	0.0002[1]	14	0.0001	0.0001	0.0001	0.0001
Chromium (mg/L)	0.001[1]	14	0.001	0.001	0.001	0.001
Cobalt (mg/L)	1.0[3]	14	0.001	0.001	0.001	0.001
Copper (mg/L)	0.0014[1]	14	0.003	0.001	0.002	0.001
Lead (mg/L)	0.0034[1]	14	0.001	0.001	0.001	0.001
Manganese (mg/L)	1.9[1]	14	0.159	0.128	0.366	0.035
Molybdenum (mg/L)	0.010[6]	14	0.001	0.001	0.001	0.001
Nickel (mg/L)	0.011[1]	14	0.001	0.001	0.002	0.001
Selenium (mg/L)	0.005[1]	14	0.010	0.010	0.010	0.010
Silver (mg/L)	0.00005[1]	14	0.001	0.001	0.001	0.001
Uranium (mg/L)	0.01[6]	14	0.001	0.001	0.001	0.001
Vanadium (mg/L)	0.1[6]	14	0.010	0.010	0.010	0.010
Zinc (mg/L)	0.008[1]	14	0.007	0.005	0.005	0.005
Iron (mg/L)	0.2[6]	14	0.056	0.050	0.070	0.050
Mercury (mg/L)	0.0006[1]	14	0.0001	0.0001	0.0001	0.0001

Source: 1 – ANZECC; 2 – EPP (Water) 'Aquatic Ecosystem'; 3 – EPP (Water) 'Stock Water'; 4 – EPP (Water) 'Human Consumer'; 5 – EPP (Water) 'Primary Recreation'; 6 – EPP (Water) 'Irrigation'. 7 – the WQO for dissolved oxygen is based on a conversion from the % saturation to mg/L assuming temperature at 25oC and altitude of 300 mAHD. The dissolved oxygen WQO was a percentage of saturation is 85% to 110%.

Total nitrogen exceeded the guideline value for seven of the 23 samples. The February sampling event identified total nitrogen exceedances occurring for six of the seven water samples. Only one sample in May (St1) exceeded the guideline value (none in June) potentially indicating that dry conditions in February (including stock access, particularly to Deep Creek) contributed to the high values recorded.

Total phosphorous exceedances were recorded for 10 of the 23 samples. The February and May sampling events both recorded five exceedances each of seven and eight samples respectively. No exceedances were recorded in June.

The dissolved aluminium guideline value of 0.055 mg/L was exceeded at De3 (0.06 mg/L) during the February sampling event. The dissolved copper guideline value of 0.0014 mg/L was exceeded at St1 (0.002 mg/L) during the February sampling event as was the dissolved zinc guideline value of 0.008 mg/L at St1 (0.025 mg/L).

During the May sampling event, the dissolved copper guideline value was exceeded at four of the locations, including St1 (0.002 mg/L), To1 (0.002 mg/L), De1 (0.003 mg/L), De2 (0.002 mg/L) and De3 (0.018 mg/L). No other dissolved heavy metal exceedances were recorded during the May sampling event.

During the June sampling event, the dissolved aluminium guideline value of 0.055 mg/L was exceeded at De3 (0.55 mg/L). Dissolved copper exceeded the guideline value (0.001 mg/L) at St1. (0.003 mg/L). St1 also exceeded the dissolved zinc guideline value of 0.005 mg/L. The dissolved zinc recording at St1 was 0.006 mg/L.

While Project specific sampling recorded limited exceedances, the results showed copper concentrations at the Styx River site (which sits at the confluence of Tooloombah Creek and Deep Creek) were consistently above guideline values across the three surveys.

Catchment Flooding Assessment

A hydrologic and hydraulic assessment was carried out to examine the impact of mine construction and infrastructure (including flood diversions) on flood behaviour and inflows into Deep Creek and Tooloombah Creek. The results are summarised below and detailed in Chapter 9 – Surface Water.

A rainfall-runoff model was constructed to estimate peak flows, flood hydrographs and other channel inputs using actual storm events or design rainfall data. The program calculates flood discharges over time (hydrographs) by simulating rainfall over a catchment also with time, removing losses to calculate the rainfall excess runoff, and routing this runoff through the catchment model. The model examined the fully developed case and did not investigate the staged mining case. This fully developed case assumed that both the north and south pits were fully mined and no longer contributing catchments within the hydrologic model.

Both the existing case and the developed case were found to have the same critical storm duration of 24 hours. The developed case peak flows were predicted to be lower than existing case peak flows by approximately 1-4% due to the reduction in contributing catchment caused by creating open pit voids – a negligible reduction in the context of the broader catchment.

The two major mine pit components (Open Cut 1 and 2) will require diversion of two minor drainage lines of Deep Creek (one 1st and one 2nd Order drainage features). Water will be diverted to both Deep Creek and Tooloombah Creek. Diversions will be carried out in a progressive manner as the pits expand. The haul road and other infrastructure will also impact Deep Creek and Barrack Creek including the potential for direct deformation of the stream bed and altering hydraulic flows.

The effects of the construction of the project were simulated in a hydraulic model. The aim of the hydraulic assessment was to characterise the Project's impact on localised flood characteristics such as flood depth, extent and velocity, as well as to quantify the immunity of critical infrastructure and the mine pits. The river system was first modelled in its existing (ie. no project infrastructure) state, and then modified to account for the likely topographical changes occasioned by the introduction of the various levees/bunds, dams, haul roads, and other project infrastructure.

The developed case model assumed a fully developed mining scenario - flow within the tributaries located within Open Cut 1 and Open Cut 2 are completely cut-off in the model. This leads to lower depths and velocities within tributaries located downstream of the pits. The downstream end of the 2nd order minor tributary that runs through Open Pit 1 and Open Cut 2 now reports to the Raw Water Dam bunding water below 36.4 m AHD into the local contours of the area. As the upstream catchments of the tributary have been removed in the developed case, water is stored in the dam from pumping water out of Tooloombah Creek during high flow scenarios.

This resulted in a decrease in predicted peak water levels within Deep Creek and Tooloombah Creek of 0.07 m and 0.03 m, respectively. The decrease is considered minor and is unlikely to affect the aquatic ecology EVs.

The analyses have shown that the project is unlikely to alter the hydrologic and hydraulic regimes in any material fashion (ie. Runoff volumes and water levels are not greatly different from the existing scenario). Absent any such alteration, it is reasonable to conclude that there will not be any material impacts upon the water quality of Broad Sound as a result of flooding events.

16.9.2.3 Potential Impacts

Mining activities and proposed works for the Project that have the potential to impact on surface water conditions and EVs are outlined below for the different Project phases. Potential impacts are discussed and management measures aimed at mitigating those impacts are outlined.

Project Water Management Infrastructure

The mine dewatering dam that will be used throughout the life of the Project will be located in the Tooloombah Creek catchment (approximately 800 m east of the creek). The northern waste area is located approximately 200 m east of Tooloombah Creek and thereby has potential to release contaminated run-off in the creek. Another waste area located to the north of the access road that loops around the open pits is located 100 m east of Deep Creek which has the potential of releasing contaminated run-off into the creek network.

A raw water dam will be located onstream on a tributary of Deep Creek, approximately 150 m east of Deep Creek, which during the construction of the dam wall has the potential to release fuels and chemicals into the creek. During the construction stage, the refuelling of vehicles and maintenance of equipment has the potential to release fuels and chemicals into the two watercourses on either side of the Project area. This source of potential contamination is continued during the operations of the mine.

The main construction activities that could impact on surface water EVs include:

- Erosion and sedimentation during the operation phases is most likely to occur from stormwater runoff from the coal stockpile, MIA and ongoing minor earthworks associated with the maintenance of roads and dams. If stormwater runoff is not adequately contained, there is a potential for increased sedimentation and contamination to adversely impact surface water quality and receiving environments, in particular, Deep Creek. Impacts to Tooloombah Creek are unlikely, as the majority (85%) of the Project area drains towards Deep Creek; and
- The use of fuels and chemicals for vehicles and construction equipment, potentially resulting in water contamination because of spills, leaks, or other uncontrolled releases.

Operational impacts are in relation to:

- Altered catchment conditions on the hydrology of waterways and drainage lines due to excavations, buildings and infrastructure, and water harvesting (dams); and
- Stormwater runoff, erosion and contaminants from the CHPP / MIA areas.

These impacts are discussed further in Chapter 9 – Surface Water.

16.9.2.4 Mitigation Measures

To manage the potential impacts, the following mitigation and management measures are listed and expanded upon in Chapter 9 – Surface Water:

- An ESCP will be developed prior to the commencement of construction activities;
- Dust suppression measures outlined in Chapter 12 – Air Quality, including watering of roads and stockpiles, will be implemented where required to avoid wind dispersion of sediments into surface water bodies;
- Sedimentation in creek channels will be monitored as a part of the Project Receiving Environment Monitoring Program (REMP);
- All contaminated mine water onsite (mine area and TLF) will be collected using site environmental dams, preventing the water from entering local waterways. Water releases from the dams will only occur during heavy rainfall (and therefore flow) events, and in accordance with permitted release limits for discharge rates and water quality. Release levels will be dependent on the amount of flow in creeks at the time Release levels will be set for low, medium and high flow conditions (refer Chapter 9 - Surface Water);
- The raw water dam and dewatering dam will be appropriately managed and designed to capture the 0.1% AEP runoff volume. A Water Management Plan (WMP) will be developed to mitigate adverse impacts on both the water quality of nearby water resources and mine productivity;
- The redirection of all mine affected runoff and mine affected waters are made to appropriately managed environmental dams / sediment ponds which have been designed to contain the 1% AEP runoff volume;
- A REMP will be developed and implemented through the Environmental Management Plan (EMP); and
- Water monitoring will be undertaken at the environmental dams, mine-affected water dams, discharge locations and locations both upstream and downstream of the Project area.

Train Load-out Facility

The Project includes the construction and operation of a TLF on the site. The TLF may require the construction of embankments with the potential to impact on surface water flows through the site. Impacts will be managed through the provision of suitable site drainage, whereby the design philosophy will be to allow water to follow its natural paths to the extent possible. Installation of temporary drainage through the construction phase will be followed by permanent infrastructure to accommodate drainage requirements for the operational phase. This could include such things as culverts, longitudinal catch drains, sediment basins and detention basins.

Permanent drainage infrastructure will last for the life of the Project and may require ongoing maintenance to ensure it continues to fulfil design requirements.

To ensure the appropriateness of the drainage design for the TLF, a Registered Professional Engineer Queensland (RPEQ) will sign-off the final design drawings.

16.9.3 Groundwater

16.9.3.1 Methodology

Mine Groundwater Impacts Assessment Approach

The groundwater impacts assessment for the mine component of the Project adopts the methodology outlined in the mining risk framework developed by the National Water Commission, as part of the National Water Initiative (Howe 2011). This is a risk-based framework developed to promote a rigorous, transparent and nationally consistent approach to assessing and managing potential impacts of mining activities on water resources. The framework consists of several stages, to guide the groundwater impacts assessment in a logical and structured manner.

This assessment has been prepared to address the requirements of the ToR by establishing the existing groundwater EVs under the relevant legislation, plans and guidelines and assessing the potential impacts on the EVs by the Project. For a more detailed analysis refer to Chapter 10 – Groundwater for more information.

16.9.3.2 Existing Environment

The Bureau of Meteorology's (BoM's) National Groundwater Information System reports that Styx River Basin lies outside of declared groundwater management areas, including alluvial aquifer boundaries declared by the Department of Natural Resources and Mines (DNRM). The BoM database lists the purposes of all bores located within Styx catchment as "unknown". The bore census conducted for the Project in 2011 found that most bores in the are used for stock watering, with some domestic use (Styx Coal and Fairway Coal 2012).

The Hydrogeology Map of Australia defines the regional hydrogeological divisions in Australia at a scale of 1 to 5,000,000 (Geoscience Australia 2017). The aquifer types of the Styx Basin are classified as porous extensive aquifers of low to moderate productivity, and the areas surrounding Styx Basin that are located within Styx River Basin are classified as fractured or fissured extensive aquifers of low to moderate productivity. The groundwater system is understood to provide baseflow to perennial streams in the lower elevated areas of the river basin, and it is likely that some ecosystems in the lowlands of the river basin are reliant on groundwater resources, particularly during periods of prolonged drought (Styx Coal and Fairway Coal 2012).

None of the stratigraphic units within the Styx River Basin in this sequence are recognised as aquifer HSUs (refer Chapter 10 – Groundwater); however, useable supplies of groundwater are present in the Cenozoic alluvial deposits and fractured zones of Cretaceous and Permian rocks that are present.

A coal seam will not generally be classified as an aquifer because of its low hydraulic conductivity; however, within a sequence of coal seams and typical interburden rocks (such as claystone and shale) coal seams are sometimes referred to as 'aquifers' because they are more permeable than the much less-permeable interburden layers (IESC 2014).

The Styx Baseline Study (Yeats 2011) reported that for the resource drilling program, "there has been very little mention of water coming from the coals, though there have been some reports of

salty water flows from the alluvium in the upper 50 m. However, conversations and data obtained from Waratah staff (pers. comm. Leopoldo de Silva, June 2011) indicates groundwater was encountered during drilling in most boreholes, between 0 (i.e. ground level) and 30 m below ground between July 2010 and July 2011, at an average of 16 m across the preliminary investigation area".

Groundwater Bores

The Groundwater Database - Queensland (GWDBQ) contains records for 69 registered groundwater bores surrounding the Project area and within the Styx River Basin (refer Figure 10-5 in Chapter 10 – Groundwater) (Queensland Government 2017). Of these, 15 bores (22%) are identified as DNRM bores and the remaining 54 bores (78%) have unspecified ownership but are likely to be privately owned. Most bores are located within, or at the fringes of mapped Cenozoic deposits, which signifies that the alluvium, and possibly fracture zones in adjacent and underlying rocks, are targeted for local groundwater supplies.

A census of 30 regional groundwater bores was conducted by CDM Smith in February 2017 (Figure 16-8) based on the information provided in the GWDBQ. Depth to water level measurements were possible in 15 bores and water quality samples were collected from only four bores. Bores were generally found to be in poor condition, blocked by pumping equipment, or could not be found. Follow up sampling was carried out in May 2017 and included water quality sampling from seven landholder bores. Most landholder bores able to be accessed are located within, or at the fringes of the mapped Cenozoic deposits and drilled to depths of generally less than 30 m and a depth to water less than 10 m. This signifies that the alluvium, and possibly geological structure that controls the occurrence and alignment of water courses, are targeted for local groundwater supplies.

Water Table Elevation

Observations of groundwater level within Styx River Basin are mainly restricted to one (or several) measurements of depth to water table in individual groundwater bores. Historical time-series observations of water table elevation and hydraulic head are not identified within the river basin.

Measurements of water table elevation in bores across the wider area vary from approximately 1 m Australian Height Datum (AHD) near to the estuarine reach of Styx River (north of the Project) up to approximately 100 mAHD near to the river basin boundary (south of the Project). In general, the elevation of the water table follows the regional topography, being higher in upland areas and lower in lowland areas. Multi-depth measurements of hydraulic head (e.g. nested monitoring bores) that would show the direction of vertical head gradients are not identified.

Groundwater Flow

The regional groundwater flow system is driven by diffuse groundwater recharge from rainfall across Styx River Basin, slow subsurface drainage of groundwater toward the ocean, and discharge of groundwater by seepage and evapotranspiration along topographic depressions associated with watercourses, and at the coast and estuarine reaches of tidal rivers and creeks.

From the available observations of water-table elevation, the regional direction of groundwater flow generally follows topography, with movement from the direction of the river-basin boundary down slope toward the ocean. Saltwater interfaces are expected within shallow groundwater at the coast; however, there are no known measurements of deeper groundwater pressure at the coast that would indicate if there is flow of terrestrial groundwater offshore within Styx Basin (e.g. artesian groundwater pressure at the coast). Within the Project area the regional direction of groundwater flow is north-northeast toward the estuarine reach of Styx River.

Groundwater Chemistry

A review of groundwater chemistry was carried out based on limited bore data available from the GWDBQ. This is restricted to data from 16 bores with only one or two water quality samples collected from each bore.

Groundwater salinity is variable across a relatively broad range, varying from good quality for drinking [Total Dissolved Solids (TDS) < 600 mg/L] to unacceptable for drinking (TDS > 1,200 mg/L) and unacceptable for livestock (TDS > 5,000 mg/L). More generally, TDS concentration are mostly within the salinity tolerance of < 5,000 mg/L that is suitable for most livestock. The dominant ion chemistry tends to be either sodium-chloride (Na-Cl) type or no dominant type. Sodium-chloride type is consistent with ocean derived salts in groundwater recharge from rainwater, or mixing of terrestrial groundwater and marine groundwater in areas of seawater intrusion at the coast. Groundwater that is not Na-Cl type signifies geochemical interactions between groundwater recharge and subsurface minerals.

From visual inspection of these data, definitive spatial patterns in the relationship between water type and salinity are not obvious. Locations near the estuarine reach of Styx River where there is higher-salinity groundwater of Na-Cl type may be associated with seawater intrusion.

There is little data on concentrations of dissolved metals in groundwater within the area of Styx Basin. The GWDBQ contains one value for aluminium, two for copper and four for zinc. These concentrations all exceed the ANZECC Guidelines for protection of ecosystems with 95% protection level. One bore is recorded as having a dissolves zinc concentration of 18 mg/L (single measurement) which exceeds the ADWG and is close to the ANZECC Guideline value for stock water.

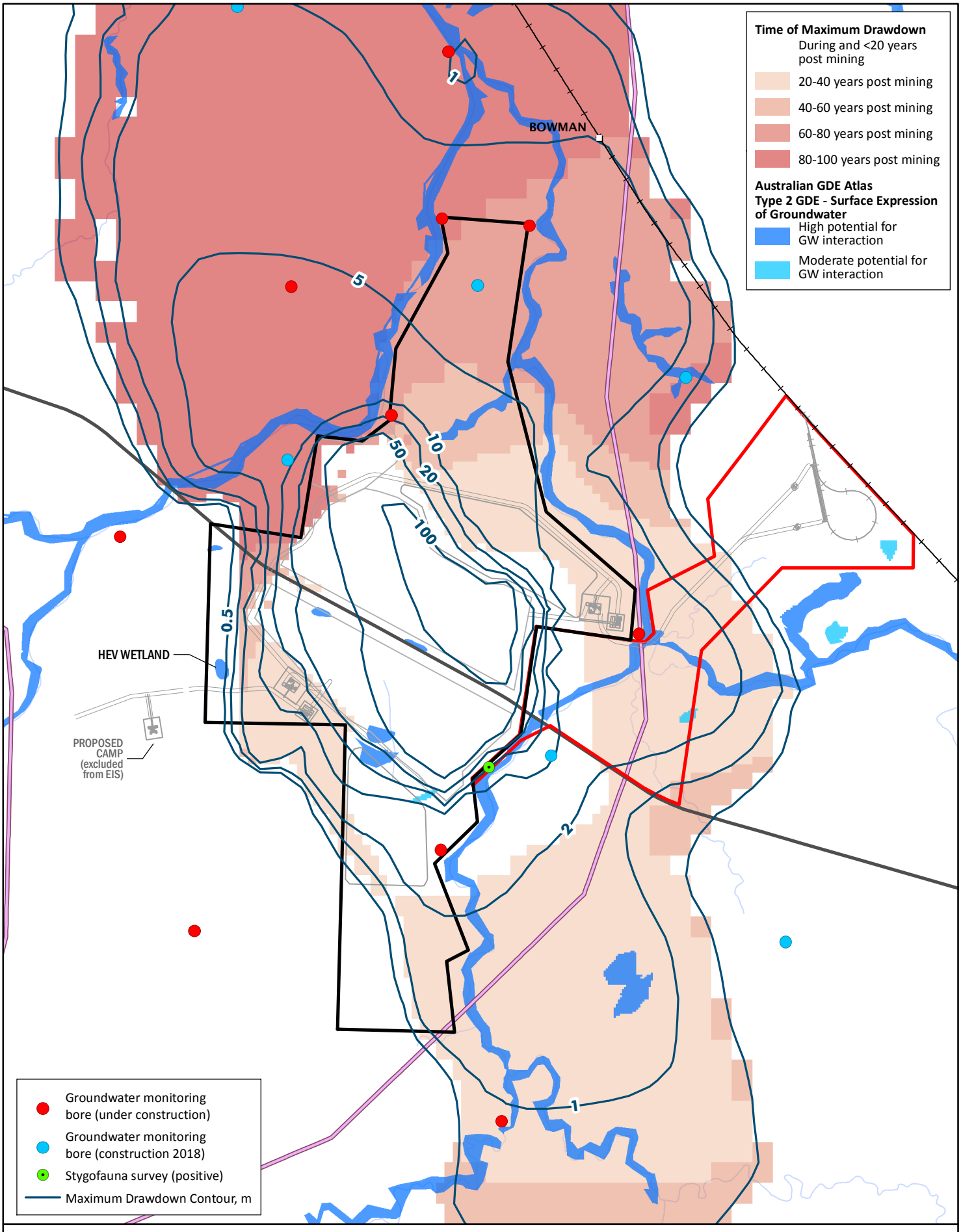


Figure 16-8
Maximum predicted groundwater drawdown impacts on GDEs

N

0 0.5 1 km

Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- Styx Basin
- North Coast Rail Line
- Main road
- Watercourse

Scale @ A4 1:60,000
Date: 15/09/17
Drawn: Gayle B.

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

Groundwater Dependent Ecosystems

GDEs Reliant on the Surface Expression of Groundwater (Type 2)

The GDE Atlas identifies potential GDEs that are reliant on the surface expression of groundwater (Type 2 GDEs) along extensive reaches of water courses both within and marginal to the Project area (i.e., Styx River, Tooloombah Creek and Deep Creek). Most of these potential Type 2 GDEs are classified as having high potential for interaction with groundwater.

Site observations during dry season sampling suggest tributaries of the Styx River are ephemeral upstream of the confluence of Deep Creek and Tooloombah Creek. However, a field survey in February 2017 identified several pools of water in localised depressions along small reaches of the two creeks that appear to be perennial, indicating that they are potentially groundwater fed. Downstream of the confluence, Styx River is identified as being tidally dominated based on short term water level variations and elevated EC measurements (refer to Chapter 9 - Surface Water). These observations suggest that any Type 2 GDEs near the Project area are likely to limited to the localised pools.

The Queensland Government Wetland Info also shows small areas of riverine, fresh water bodies along Styx River and Tooloombah Creek but the extents of these areas are much smaller than the extent of potential Type 2 GDEs identified by the GDE Atlas. Of note, is the HEV wetland that has been identified on the western side of the Project area, which is classified by the GDE Atlas as a potential Type 2 GDE with a high potential for groundwater interaction. However, site observations and local groundwater level suggest that surface water in the wetland (when present) is rainfall dominated.

It appears that the presence of Type 2 GDEs will be confined to the riverine environments of waterways (Styx River, Tooloombah Creek and Deep Creek) associated with the Project surrounds. Wetlands away from riverine environments are likely not to be connected to the groundwater system. The shallow alluvial aquifers will likely be the dominant source of groundwater for Type 2 GDEs in the area.

GDEs Reliant on the Sub Surface Expression of Groundwater (Type 3)

The GDE Atlas identifies potential GDEs that are reliant on the subsurface expression of groundwater (Type 3 GDEs) along the drainage lines (i.e. riparian zones) associated with Styx River, Deep Creek and Tooloombah Creek. At least four of the vegetation communities mapped in these areas during field surveys (Figure 16-15) have the potential for incorporating some component of groundwater in their water requirements. These include:

- Forest Red Gum woodland fringing drainage lines (RE 11.3.25) – occurs along riparian areas of drainage lines, largely outside of the Project boundary;
- Forest Red Gum woodland on alluvial plains (RE 11.3.4) – occurs in patches across the eastern side of the Project area where it is associated with the alluvial plains adjacent to Deep Creek;
- A palustrine wetland characterised by a central patch of Broad-leaved Paperbark (*Melaleuca quiquinervia*) (RE 11.5.3b) – this community occurs as an isolated community on a natural depression on the western side of the Project area (i.e. the HEV wetland); and
- Areas of semi-evergreen vine thicket (SEVT) occurring adjacent to riparian areas of Tooloombah Creek and Deep Creek.

Of the four vegetation communities, the two Forest Red Gum communities and Broad-leaved Paperbark dominated wetland are most likely to be utilising groundwater because of the relatively shallower groundwater levels (approximately 2-5 mbgl) (refer Chapter 10 – Groundwater) observed in the alluvial sediments on the margins of the drainage lines. However, these groundwater level measurements were recorded at bores located 1-2 km north of the Project area, where groundwater levels are generally shallower, and no data exist for groundwater levels of alluvial sediments closer to the Project area. In the absence of actual groundwater data, the presence of water tables within the shallow alluvial sediments interacting with the rooting system is considered very likely, and suggests the classification of high potential of groundwater interaction of riparian vegetation to the east of the mine area as appropriate.

16.9.3.3 Potential Impacts

Mine Impacts

Mining activities have the potential to impact groundwater resources. Effects refer to physical and chemical changes to the hydrogeological systems caused directly and indirectly by mining activities. For these changes to pose threats to sensitive receptors, linkages need to be identified between the effects and the sensitive receptors.

Groundwater modelling is the only practical way to predict potential regional scale effects of the mine on groundwater systems in response to the Project. In the Project assessment, the primary objectives of groundwater modelling are to predict potential rates of mine dewatering, to facilitate planning for operational mine water management, and to predict associated effects on groundwater resources at the proposed Central Queensland Coal Mine and surrounding areas during and after mining. Potential impacts and their predicted effects are described below.

Physical Disruption to Aquifers

Open cut mining involves removal and translocation of coal, overburden and interburden strata thereby creating mine-pit voids that can be progressively backfilled and rehabilitated, or left open. Backfilling of mine voids can cause permanent change of hydraulic properties of backfilled materials compared to in-situ properties (typically resulting in enhancement of hydraulic conductivity and storage capacity), but this change would not be considered particularly significant as the effect is restricted to the mine voids.

Any remaining voids that extend deeper than the pre-mine water table will become evaporative sinks that interrupt groundwater flow at the near-mine scale. Depending on the level of pit lake recovery and the surface area of the final pit lake, the voids may act as temporary or permanent groundwater sinks.

The rehabilitation of much of the mine area by backfilling of mine pits will possibly enhance the hydraulic properties of the aquifers intersected by mining. However, the pit voids remaining after mining will disconnect the alluvial aquifers associated with Tooloombah and Deep Creek. This is unlikely to be significant as in these locations the aquifers are likely to predominantly be groundwater discharge zones rather than aquifers transferring substantial quantities of groundwater downstream.

Potential impacts on groundwater resources relate to the EVs identified with the use of shallow groundwater for irrigation and stock watering, specifically existing landholder bores. The potential for irrigation supplies to be impacted by the mine (during and following closure) will be restricted to any alluvial aquifer supplies located within around 6 km upstream and downstream of the Project

due to water table decline. From the information available, there may be two irrigation supplies located at the very north of the predicted zone of influence.

Due to typically low bore yields, apart from some alluvial aquifer bores, it is probable that the farming community in the Styx Basin relies on dam water supplies. The potential for groundwater supplies to be impacted by the mine (during and following closure) will be restricted to any alluvial aquifer supplies located within around 6 km upstream and downstream of the Project due to water table decline.

Impacts to Groundwater Quantity

Open cut mining often extends below the water table. As overburden rocks and coal seams below the water table are removed, groundwater will seep into the mine void from the intersected saturated strata. Collection of this water, either via dewatering bores or in-floor sumps to facilitate dry mining conditions will depress the water table immediately surrounding the pit to the approximate elevation of the pit floor. Surrounding hydrostratigraphic units will also depressurise in response to this lowering of the water table, and a zone groundwater depressurisation that decreases in magnitude with increasing distance from the mine pit will develop. Groundwater storage will be temporary depleted within the zone of depressurisation.

Figure 16-9 presents predicted groundwater elevation contours for the Project area prior to commencement of mining and at the end of mining (year 16). The figure shows there is very little change to water table elevations upstream (south, west and east) of the proposed mine over the 16 year life of the mine, but there will likely be a significant reduction in water table elevation in the vicinity of the mine (more than 75 m) and to the north (by up to 5 m).

Figure 16-10 presents predicted groundwater drawdown contours (compared to the pre-mine condition) at the end of mining, which shows the potential extent of changes to water table elevation (assuming the 0.5 m drawdown contour) over the life of the mine (extending 14.5 km in a roughly north-south alignment and 6 km in a roughly west-east alignment).

Predicted groundwater elevation contours for the Project area 20 and 100 years after mining and rehabilitation cease show there is relatively little change to water table elevations upstream (south, west and east) of the proposed mine over the closure period, and partial recovery of the water table will occur in the near vicinity of the mine (more than 50 m). However, the groundwater recovery around the mine is likely to be offset by continued water table decline to the north for some time until a new dynamic equilibrium is reached.

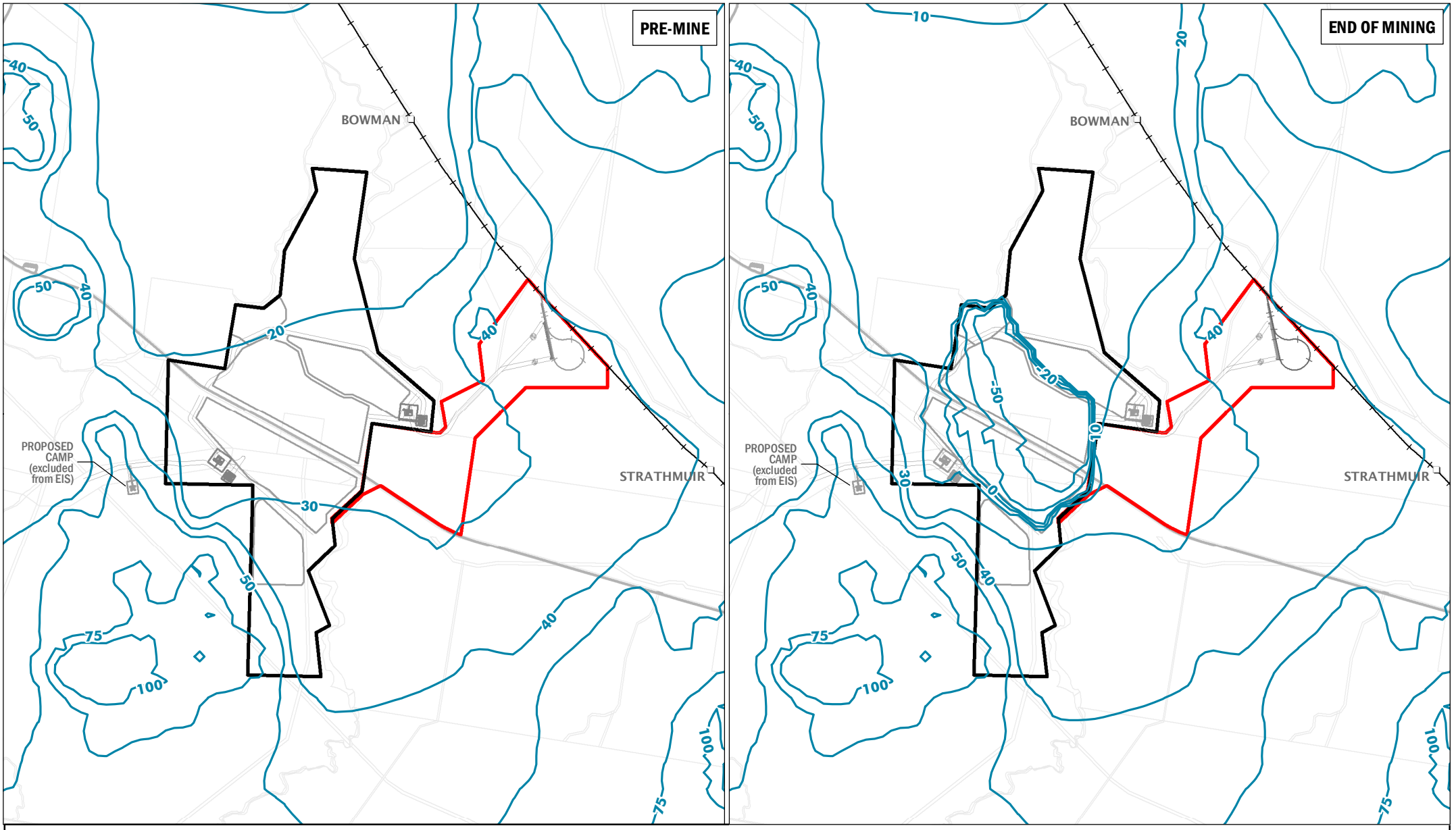
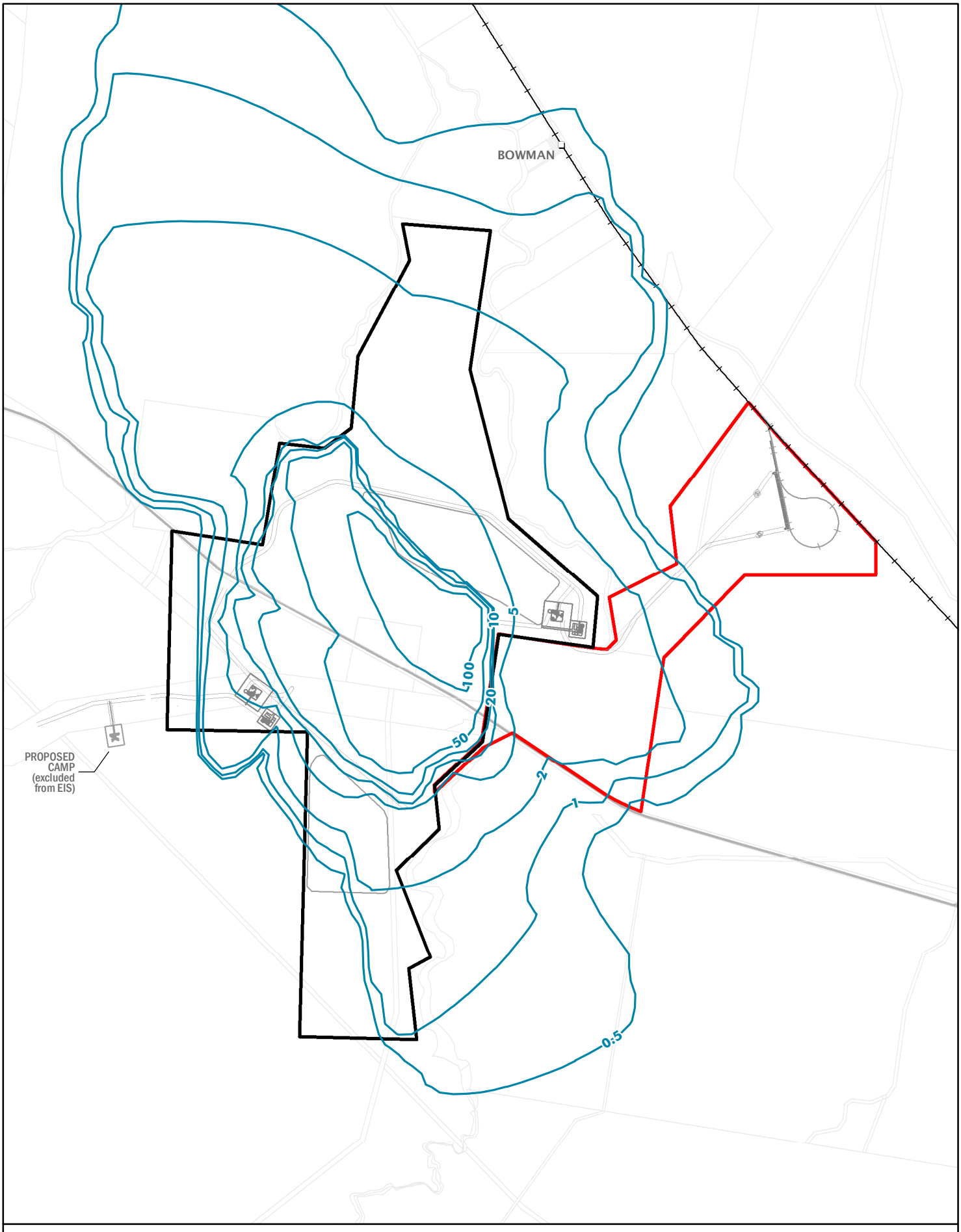


Figure 16-9
Predicted water table elevation contours pre-mining (year 0) and at end of mining (year 16)

BRUGGEMANNGD B:\BES150160 Styx Coal\GIS\DATA\MXD\FINAL\03 EIS Preparation\BES150160.03-082 R1 WT pre-mine & EOM.mxd 7/21/2017



N

0 0.5 1 km

Scale @ A4 1:60,000
Date: 21/07/17
Drawn: Gayle B.

Legend

- Drawdown contour
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Cadastral boundary

Figure 16-10
Predicted drawdown contours at end of mining (year 16)

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

BRUGGEMANNGD B:\BES150160 Styx Coal\GIS\DATA\MXD\FINAL\03 EIS Preparation\BES150160.03-083 R1 DD EOM.mxd 7/21/2017

Impacts to Groundwater Quality

The potential exists for the groundwater quality to be altered in several ways:

- Evaporative concentration of salts in open mine pits and voids remaining at the end of mining, and subsequent movement of this water away from the Project due to regional groundwater flow;
- Inducing flow of groundwater of different quality towards depressurised parts of the groundwater system associated with dewatering / depressurisation;
- Infiltration of water sourced from waste storages and mine water storages; and
- Accidental release of chemicals (such as unintended fuel spill, leakage of sewage effluent, infiltration of stormwater from mine 'contact' areas).

Groundwater modelling indicates he two pit voids remaining after mine closure will capture some or all the groundwater moving downstream from higher in the eastern part of the Tooloombah Creek catchment and much of the Deep Creek catchment. Any groundwater quality changes within this catchment zone will not impact on other parts of the Styx Basin due to the existence of the pit voids acting as permanent evaporative sinks. South and upstream of the mine even within the expected capture zone, there is unlikely to be any change in water quality due to the mine during operation or after closure.

Impact to Surface Water and GDEs

Initial modelling of the potential drawdown effect of the open cut mine operations has been carried out (refer Chapter 10 – Groundwater). At this stage, there is a 'low confidence' in the groundwater modelling results due to a lack of any long-term (time series) groundwater data that would provide insight into the temporal nature of groundwater and surface water connections. Further works are ongoing, including sampling of groundwater bores. For the purposes of the EIS we have assessed the impact based on the results of the initial modelling.

The magnitude of dewater ranges up to 100 mbgl and may persist for 100 years. The greatest dewatering (5 to 100 metres) occurs within the first 20 years of mine operation, and is centred around the immediate mine area between Tooloombah and Deep Creek (refer Figure 16-18). The cone of depression is initially steep, reflecting the change in geology from Quaternary sediments to the outcropping Bowen basin units. Further decline in the groundwater levels propagates to the north and south for the following 80 years creating an oval shaped region of impact that is affectively confined to the Quaternary sediments.

Impacts to Type 2 GDEs

Within the first 20 years (approximately) there is a predicted draw down of 20 m at sections of Tooloombah and Deep creek closest to the mine area (Figure 16-18). Further up and downstream the change in groundwater levels is less and occurs over longer time frames, up to 80 years. Due to the uncertainty within the drawdown model outputs a simplified approach to considering the impacts of drawdown is undertaken. Any change in groundwater levels of greater than 5 m will inevitably disconnect the Creeks from the groundwater, irrespective of any seasonal recharge that may cause episodic rise in water tables. Changes less than 5 m will cause a shift in the natural cycle of gaining and losing phases, but may or may not cause permanent disconnection.

The disconnection of the streams from the groundwater is not likely to impact surface flow events downstream. The impact is related to the persistence of permanent pools within the riverine

environment during low or no flow periods. A surface flow event will fill pools, that when connected to groundwater will persist longer due to the lack of drainage through the stream bed and groundwater inflow volumes. An important note is that groundwater may not provide a measurable volume of water within the pools, but may act to prevent downward leakage.

The change in the persistence and volume (depth) of the pools will adversely impact any present aquatic species. Of most ecological concern if the pools were to become dry, is the Southern Snapping Turtle, which the pools may provide important habitat for.

Sections of Deep Creek upstream of the immediate mine area are less likely to be connected to the groundwater system (Figure 16-18), with the predicted changes to groundwater levels of only several metres occurring over many decades likely to have little impact to aquatic habitat.

Downstream of the confluence of the two creeks, changes in groundwater levels may be buffered by the tidal influence that may maintain riverine water and support aquatic ecosystem, irrespective of the changing nature of groundwater connection, However, in terms of salt water ingress this may require additional investigation.

Impacts to Type 3 GDEs

Type 3 GDEs are likely to be confined to the riparian zones of Tooloombah and Deep Creek (RE 11.3.25), where the depth to groundwater will be generally less than 5 m. While several areas of terrestrial GDEs are mapped as having a high potential for groundwater connection, existing bore data suggests the groundwater is around 10 m deep. While it is possible these areas may have deep rooting systems, the dominant source of water for will be direct recharge and soil water stores.

In general, there is a substantial data gap regarding the water use patterns of terrestrial ecosystems. The presence of shallow water tables, does not necessarily equate to a viable source of water. The complication is that Type 3 GDEs, terrestrial vegetation, can have multiple sources of water, direct rainfall recharge, soil water stores, seasonal soil water from surface water flow and groundwater. The ratio of the water requirements from these four sources to a degree dictates how sensitive these vegetation types are to changes in groundwater levels. Small gradual declines in groundwater levels may not adversely impact the species water requirements, large sudden shifts in groundwater levels will cause water stress depending on the availability of other water sources. For example, if stream flow and rainfall maintain sufficient soil water stores, a change in the groundwater level may be inconsequential, however, if during a dry period, soil water stores were to become depleted and groundwater level were to decline, water stress may occur.

As with Type 2 GDEs, the area of most concern is related to areas of greater than 5 m drawdown. This may result in long-term impacts to the riparian Forest Red Gum communities, and SEVT along sections of Tooloombah Creek and Deep Creek located close to open cut mining operations. It is likely these vegetation communities will to some degree suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within these communities. It is uncertain what impact this may have on this community as most species are expected to obtain water requirements from multiple sources.

This may result in long-term impacts to the following aquatic EVs:

- Water levels in permanent waterholes on Tooloombah Creek (and potentially Deep Creek) that are connected to groundwater may decline in those areas closest to open cut mining occurs and drawdowns of 5 m to 50 m are predicted to occur. These waterholes provide potential habitat for the Southern Snapping Turtle; and

- Riparian Forest Red Gum and SEVT habitat in these same areas may also suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within this community.

16.9.3.4 Mitigation Measures

To manage the potential impacts, the following mitigation and management measures are listed and expanded upon in Chapter 10 – Groundwater:

- Where access to groundwater for stock watering or irrigation is compromised due to drawdown and this is identified to be due to mining, the following mitigation measures may be implemented:
  - Lowering of the existing pump or fitting with a new pump if sufficient saturated thickness (available drawdown) remains in the bore
  - Deepening or relocation of the bore to an area outside of the area of impact
  - Provision of alternative water supply of comparable quantity and quality to the current stock water use;
- Regular monitoring of groundwater quality will take place during the life of mine, comprising the following:
  - Quarterly field measurements of EC and pH of groundwater from the monitoring bores and monthly field measurements of the same parameters for water pumped from the mine and
  - Twelve monthly sampling of groundwater from monitoring bores and selected landholder bores for laboratory analyses of major ions, total dissolved solids and metals, as per the baseline monitoring;
- Regular monitoring and evaluation of groundwater levels / pressures at on-lease and off-lease monitoring and selected landholder bores will take place during the life of mine to assist in understanding the extent of influence of aquifer disruption on regional (Basin) scale;
- Strict management and control measures of potential pollutants and contaminant sources will be maintained to prevent uncontrolled discharge to groundwater including:
  - Provision of appropriate spill control materials including booms and absorbent materials at refuelling facilities to contain spills
  - Ensure all refuelling facilities and the storage and handling of oil and chemicals to comply with relevant Australian Standards. Management and mitigation measures for wastewater are discussed in Chapter 7 - Waste Management
  - Ensure all staff to be made aware of the potential for groundwater quality to be impacted and the requirement to report any spills
  - Establish procedures to ensure safe and effective fuel, oil and chemical storage and handling. Ensure the use of appropriately designed laydown areas for vehicles and machinery and storage areas for chemicals, oils and fuels
- All uncontrolled discharges will be reported to the EHP according to legislative requirements under the EP Act;

- Management of the potential impacts of groundwater drawdown on GDEs (such as the use of supplementary flows from treated mine water) will require ongoing monitoring of wetland and stream health, hydrological function and vegetation monitoring as part of the Project Land Use Management Plan (LUMP) and REMP. This will include at a minimum the following measures:
  - Ongoing assessment and monitoring to address the knowledge gaps identified above and allow a greater understanding of GDEs function in the area including a baseline water source study of the riparian vegetation to determine the nature of groundwater uptake. This would require a combination of soil, water and tree analyses to assess water use patterns, and the seasonal source of water
  - Monitoring of the health of the HEV wetland in the mine area
  - Monitoring of water levels in permanent waterholes on Deep Creek and Tooloombah Creek, particularly those identified as potentially impacted by severe groundwater drawdown near mining operations
  - Monitoring of riparian vegetation and SEVT health along Deep Creek and Tooloombah Creek in those areas identified as potentially impacted by severe groundwater drawdown.

16.10 MNES Assessment Methods

MNES were assessed using a combination of desktop assessment methodologies and field surveys. The desktop assessment reviewed existing ecological information pertaining to the Project area, including the Central Queensland Coal mine area and TLF. Seasonal surveys for flora and fauna were subsequently carried out to obtain current ecological information relevant to the Project area and to ground-truth the desktop assessment results.

16.10.1 Desktop Assessment

Desktop studies were undertaken prior to field assessments. The desktop reviews were used to obtain background information relating to the potential presence and distribution of species and ecological communities, including those listed under the EPBC Act and others listed under State legislation. The desktop review sourced information from:

- The Commonwealth EPBC Act Protected Matters Search Tool (25 km radius around a central point of the mine area – accessed 14 December 2016 (refer Appendix A9c – Ecological Desktop Search Results);
- EHP Wildlife Online flora and fauna species database (50 km radius around the centre of the mine area) and Species Profile Search results – accessed 14 December 2016 (refer Appendix A9c - Ecological Desktop Search Results);
- Atlas of Living Australia species database;
- Current Queensland Regional Ecosystem (RE) mapping, essential habitat mapping for threatened flora and fauna species and sensitive area mapping from the Department of Natural Resources and Mines (DNRM);
- Wetland and watercourse GIS data (EHP and Geoscience Australia);
- Great Barrier Reef Catchment Aquatic Conservation Assessments for Non Riverine Wetlands (v1.2) and Riverine (v1.1) (EHP);

- Styx Coal: Flora and Vegetation Assessment (Oberonia Botanical Services 2011) (refer Appendix A9b – Terrestrial Flora Reports);
    - Reporting of three seasonal fauna assessments for Central Queensland Coal:
        - A preliminary assessment of faunal values within and adjacent to EPC 1029, Styx Basin, central-east Queensland (Meyer 2011a)
        - September 2011 fauna survey results for EPC 1029, Styx Basin, central-east Queensland (Meyer 2011b) and
        - February 2012 fauna survey results for EPC 1029, Styx Basin, central-east Queensland (Meyer 2012) (refer Appendix A9a – Terrestrial Fauna Reports)
- Styx River Catchment Aquatic Baseline Monitoring Program, Waratah Coal Mine Project (ALS Water Resources Group 2011) (refer Appendix A9e – Aquatic Ecology Results); and
- Draft Stygofauna Survey. Report for Central Queensland Coal South Project EM Plan (GHD Water Sciences July 2012) (refer Appendix A9f – Stygofauna Results).

16.10.2 Field Surveys

Ecological field surveys were undertaken for the Project to ground-truth desktop information and identify any additional flora and fauna values not identified through the desktop study. Field surveys comprised:

- Detailed summer (wet season) fauna survey of EPC 1029 (five days) 21 to 25 March 2011 by Ed Meyer (ecological consultant);
- Summer (wet season) flora survey of EPC 1029 (five days) 21 to 25 March 2011 by Oberonia Botanical Services;
- Detailed winter (dry season) aquatic ecology survey of EPC 1029 (six days) 1 to 6 June 2011 by ALS Water Sciences;
- Spring (dry season) flora survey of EPC 1029 (five days) 25 to 29 September 2011 by Oberonia Botanical Services;
- Detailed spring (dry season) fauna survey of EPC 1029 (five days) 25 to 29 September 2011 by Ed Meyer (ecological consultant);
- Targeted threatened fauna survey of EPC 1029 (four days) 7 to 10 February 2012 by Ed Meyer (ecological consultant);
- Seasonal stygofauna survey (four days) 21 to 24 November 2011 and 15 to 18 March 2012, by ALS Water Sciences;
- Summer (wet season) flora survey of ML 80187 and immediate surrounds (three days) 8 to 10 February 2017 by Terrestria;
- Detailed summer terrestrial and aquatic fauna survey of ML 80187 and immediate surrounds (six days) 8 to 14 February 2017 by CDM Smith; and

- Opportunistic bird and spotlighting surveys carried out within the ML and surrounds during groundwater and surface water sampling by CDM Smith 1 to 4 May, and 7 to 10 August 2017 (three further surveys are to be carried out from September to December 2017).

The 2011 / 2012 ecological surveys focused on areas within a much larger footprint than the current Project area, although the majority of comprehensive fauna trapping sites were located within or near the current MLs. The February 2017 surveys focused on the MLs and the immediate surrounds including the TLF area. Surveys were conducted to consider seasonal variation and target threatened species. Additional sites were assessed in the Project area surrounds (within a 5 km buffer of the Project area boundary) to provide context. Surveys were designed to encapsulate seasonal variation in species' detectability, and survey sites were selected in representative locations of the key vegetation communities and habitat types present.

Updated information provided by the February 2017 surveys has been incorporated into this chapter. Flora and fauna survey species lists from the February 2017 surveys are also provided in Appendix A9d – Ecological Field Survey Results.

16.10.2.1 Weather Conditions

Surveys were designed to encapsulate seasonal variation in species' detectability, and survey sites were selected in locations representing the key threatened vegetation communities and dominant habitat types present on the Project area and surrounds. All surveyed areas within the Project area were visited at least once during the site studies. Table 16-5 describes weather conditions for each survey period as recorded at Saint Lawrence (located 37 km north of the Project).

Table 16-5 Weather conditions during site surveys

Survey	Temperatures during study	Rainfall and comments
March 2011	Minimum: 21.9°C Maximum: 34.6°C (source: Meyer 2011a)	23 mm rain recorded during survey. Heavy falls recorded in area in week prior to survey (145 mm). Survey undertaken following an exceptionally wet summer with well-above-average rainfall over most of coastal eastern Queensland. December 2010 rainfall totals were especially high with Marlborough recording over 560 mm of rain.
September 2011	Minimum: 10.8°C Maximum: 26.8°C (source: Meyer 2011b)	Except for August 2011, monthly rainfall totals for Marlborough (to the near south of EPC 1029) were close to average in the 6 months prior to surveys. Little rain was recorded at Marlborough in the month preceding surveys and no rain was recorded during the survey period.
February 2012	Minimum: 21.8°C Maximum: 33.2°C (source: Meyer 2012)	Rainfall in the months preceding surveys was generally at or below average. With significant rainfall in late January and storms on the 7th and 8th of February surface water was plentiful in low-lying parts of the Study area.
February 2017	Minimum: 21.8°C Maximum: 33.2°C (source: BoM 2017)	Conditions during the February 2017 survey were very hot and dry. Excepting a single day in January on which 212 mm was recorded at St Lawrence (located 74 km north of the Project area), mean rainfall in the area was below average in the months preceding the survey and across the entirety of February. How the January rain event affected the Project site is uncertain as no rain was recorded in Rockhampton on the same day.

16.10.3 MNES Suitably Qualified Study Personnel – CDM Smith

Brett Taylor

Brett is a senior ecological consultant with over ten years field experience in the industry focussing on fauna. His personal and professional interests in ecology and fauna have led Brett to travel to diverse habitats across Australia, as well as Papua New Guinea, Southeast Asia and working as a

wildlife guide in South America. He completed his Honours degree project (BSc in Ecology and Conservation Biology) in 2006 and has extensive experience in rainforest research in northern and southeast Queensland. Brett has carried out ecological surveys in a wide variety of habitats surveying both terrestrial and aquatic fauna having worked on projects throughout Queensland.

Dr Andrew Daniel

Andrew has over 20 years' experience in ecological research and management with environmental consultancies and State and government agencies. Trained as a botanist by the Queensland Herbarium, Andrew undertook numerous botanical assessments, mapping and monitoring projects for the Wildlife Ecology Section. He has 12 years of consulting experience specialising in vegetation mapping, EIA, flora and fauna management, offsets appraisal and management, and rehabilitation. Andrew has managed a broad range of projects including assessment within the mining, extractive, industrial and residential sectors. He has extensive experience in remote regions of Australia including baseline ecological assessments for mines in the Northwest Highlands, Gulf Plains, Einasleigh Uplands, Mulga Lands, and Northern and Southern Brigalow Belts of Queensland. Andrew has also authored or co-authored several scientific papers.

16.10.4 Flora Survey Methodology

This chapter refers to vegetation communities using the Queensland Herbarium's Regional Ecosystem classification system. Although sometimes different to DotEE's description of TECs and habitat for MNES species, this system allows for specific identification of areas in the chapter that would otherwise be referred to as under broad classifications such as 'eucalypt woodland.'

Three vegetation field assessments were undertaken including March and September 2011 (by Andrew Franks of Oberonia Botanical Services) and February 2017 (Terrestria). A summer survey was conducted in February 2017 to confirm the accuracy of the 2011 vegetation communities presented for remnant and regrowth vegetation within the current Project area. The revised RE mapping is somewhat different from the current DNRM vegetation mapping. The February 2017 field survey confirmed the presence and extent of TECs within the Project area and included targeted searches for threatened flora species. The 2011 surveys included six secondary sites, 34 tertiary sites and 51 quaternary sites across a wide area including the mine ML. The February 2017 survey included 24 RE code sites and 35 quaternary sites within the ML, haul road and TLF. Ground-truthed data along with contemporary aerial imagery was used to determine:

- Potential presence / absence of TECs;
- Known or potential habitat for EPBC listed flora species;
- Accuracy of RE mapping; and
- Presence of threatening processes, particularly pest flora species.

The field assessments were conducted in accordance with the Queensland Herbariums' Methodology for Survey and Mapping of REs and Vegetation Communities in Queensland, Version 3.2 (Neldner et al. 2017). Where discrepancies were identified in the field, areas were traversed by foot to confirm the extent of the change. Additional information was collected where discrepancies with RE attribution were encountered on the ground. The locations of the flora survey sites and potential TECs as per current DNRM vegetation mapping are shown in Figure 16-11.

16.10.4.1 Regional Ecosystem Code Sites

Regional Ecosystem Code Sites are used to aid in classification and detailed descriptions of REs and vegetation communities during the 2017 survey. Data collected include location, and environmental information such land zone. Structural information such as height and covers are estimated for all structural layers. Generally, only the dominant or conspicuous species that characterise each layer are recorded. Plots are not laid out using a tape, site dimensions are restricted to a commonly occurring vegetation type and condition.

Secondary Assessments

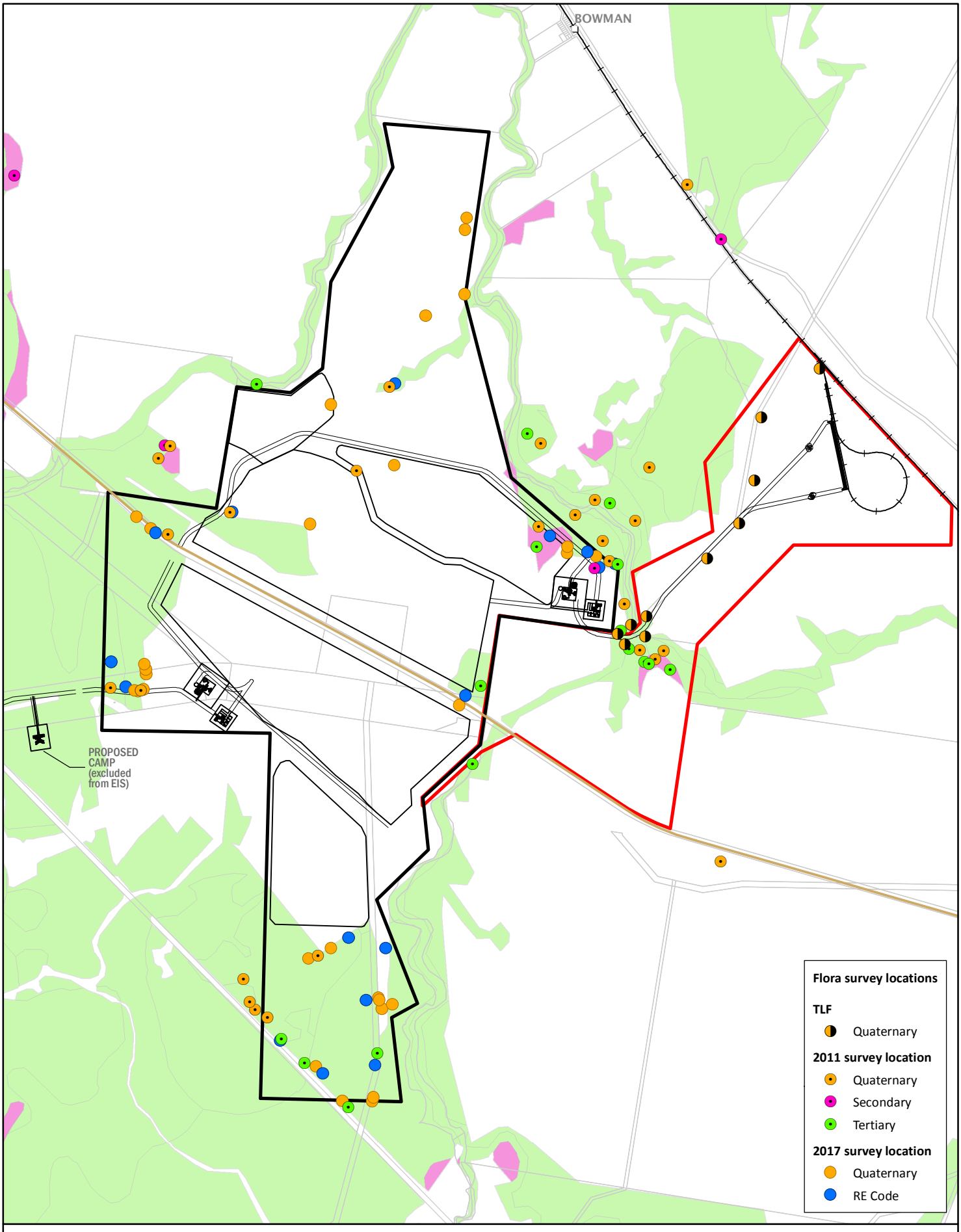
Secondary assessments involve sampling plots of at least 50 m by 10 m in size, within each defined vegetation community. This methodology was; however, subject to the size of the vegetation community, with additional sites surveyed in vegetation communities covering large areas, and a reduction in the number of sites surveyed in small communities.

Tertiary Assessments

Tertiary site assessments were used for classification and detailed descriptions of REs and vegetation communities. Data collected included location, environmental and overall structural information as well as a full species list, estimates of stem density, estimates of basal area (of woody stems using the Bitterlich stick method) and a measure of percentage cover.

16.10.4.2 Quaternary Observations

Quaternary data were used mainly as a record of field traverses and to verify RE / vegetation mapping. Quaternary sites are used to confirm / change RE polygon attribution to note changes in condition, presence of weed infestations, special habitat features and community boundaries. Site information includes dominance of flora species within structural layers, confirmation of remnant / non-remnant status, soil type, land zone, presence of threatened species and of weed species.



N

0 0.5 1 km

Scale @ A4 1:50,000
Date: 13/09/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Cadastral boundary

Remnant Vegetation

- TEC
- Remnant vegetation
- Non-remnant

Figure 16-11
Flora survey points and potential TEC vegetation – mine and TLF areas

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

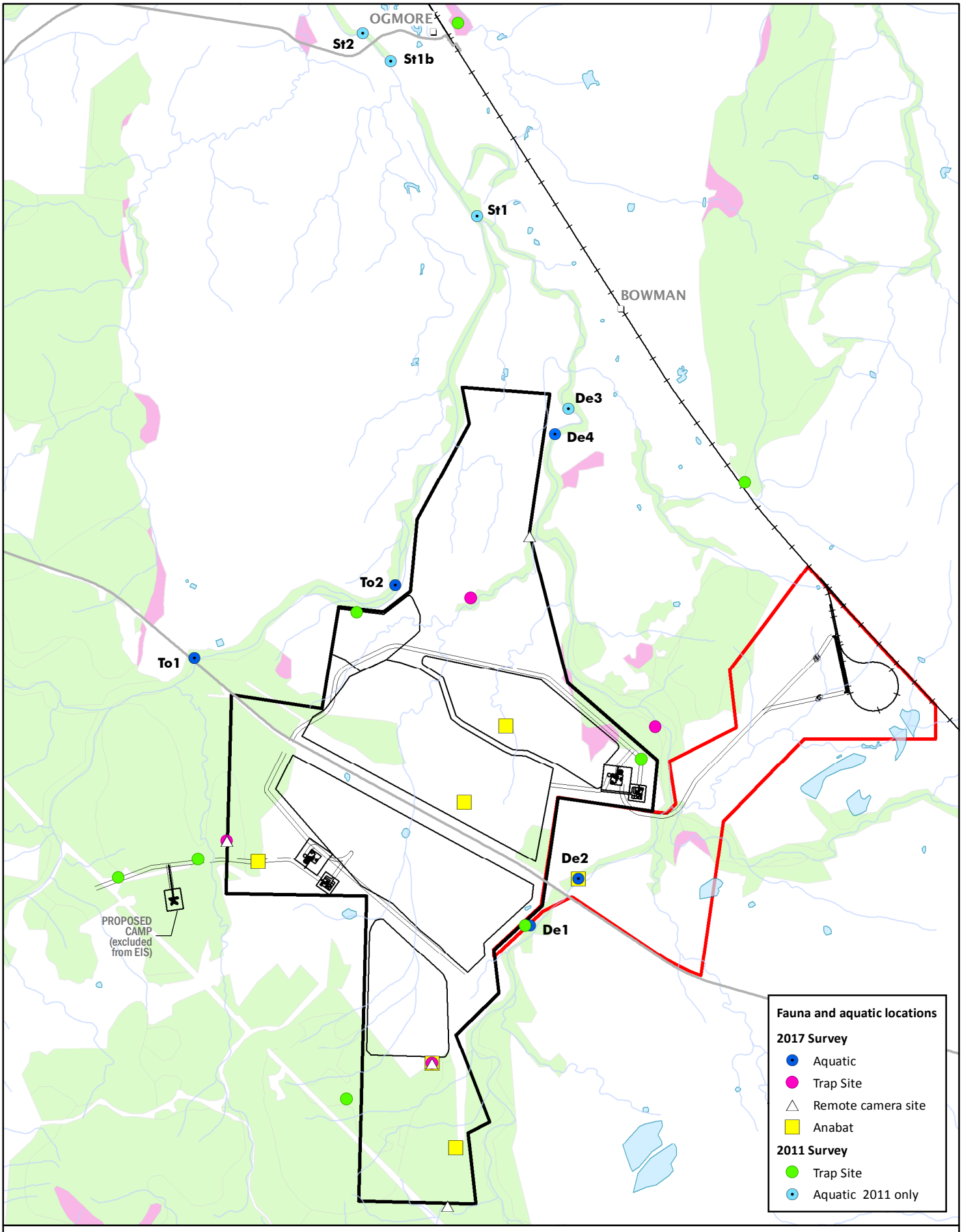
16.10.5 Fauna Survey Methodology

Four field surveys were undertaken to assess fauna within the Project area, including March and September 2011 and February 2012 (by Ed Meyer) and February 2017 (CDM Smith). A total of eight baseline survey sites were selected within the extended survey area for the 2011 surveys, and a further four sites within ML80187 were added for the February 2017 survey. Site selection was based on RE mapping, land access and the integrity of the habitat. Descriptions of the fauna trapping sites are provided below in Table 16-6 and locations of survey sites are shown in Figure 16-12. Baseline fauna trapping was carried out at each site over a period of five days and four nights at each site.

The general survey approach was to visit and assess representative faunal habitats over the Project area, recording fauna species by sightings, recognition of characteristic vocalisations, and / or identification of animal signs. The surveys focussed on conservation significant fauna species and important habitat. The techniques used during the fauna surveys are provided in Table 16-7.

Table 16-6 Description of fauna trapping sites – 2011 and 2017 surveys

Trap site	Location and coordinates	Habitat description
March 2011		
Site 1	-22.66886 149.69475	Remnant *Eucalyptus crebra* woodland with sparse shrub layer and dense cover of native grasses. Located approximately 2.5 km east of northern extent of Project area
Site 2	-22.61894 149.65978	Remnant gilgaied Brigalow (*Acacia harpophylla*) woodland, near Ogmore. Located approximately 4.5 km north of Project area.
Site 3	-22.718 149.66964	Remnant riparian open forest / woodland along Deep Creek, south of the Bruce Highway. Located on eastern boundary of Project area.
Site 4	-22.71356 149.62136	Remnant *E. crebra* / *E. exserta* woodland / open forest with a mid-dense shrubby understory of *A. rhodoxylon*, adjacent to Mt Bison Road, south of the Bruce Highway. Located approximately 1.3 km west of Project area.
September 2011		
Site 5	-22.66886 149.69475	*E. crebra* woodland with dense grassy understory, upslope from watercourse. Located approximately 300 m west of Project area.
Site 6	-22.61894 149.65978	Mixed eucalypt woodland / open forest on hill slope with sparse shrub layer and sparse grass cover, on sandy soil with small areas of exposed rock. Located approximately 200 m west of southern extent of Project area.
Site 7	-22.718 149.66964	SEVT with emergent *E. tereticornis* and *Corymbia tesselaris* fringing Tooloombah Creek. Located within northwest extent of Project area.
Site 8	-22.71356 149.62136	Remnant gilgaied Brigalow woodland with dense to mid-dense shrub layer dominated by *Carissa ovata*, to the near east of Deep Creek. Located within eastern extent of Project area.
February 2017		
Site 1	-22.7093 149.63409	Remnant *E. platyphylla* woodland with very sparse shrub layer (RE11.5.8a). Native grasses sparse at time of survey due to very dry conditions and ongoing cattle presence. Located uphill from large ephemeral wetland area on western edge of Project area.
Site 2	-22.73334 149.65887	On edge of remnant *E. crebra / E. populnea* dominated woodland (RE11.10.7). Dense understorey dominated by the introduced Lantana (*Lantana camara*) and Red Ash (*Alphitonia exselsa*). Located within southern portion of Project area.
Site 3	-22.68213 149.6625	Thin riparian *E. tereticornis* open forest strip adjacent to dense regrowth Brigalow (RE11.3.25). Dense but patchy lower shrub layer. Small pools of water present in creek. Located within northern portion of Project area.
Site 4	-22.69589 149.68464	Remnant mixed gum woodland (RE11.3.4) with patchy shrub layer dominated by the introduced Lantana Ground layer also patchy with some dense areas of sedges in low drainage channel bisecting site. On eastern edge of Project area.



N

0 0.5 1 km

Scale @ A4 1:60,000
Date: 13/09/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Watercourse

Remnant Vegetation

- TEC
- Remnant vegetation
- Non-remnant

Figure 16-12
Fauna and aquatic ecology survey locations

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

Table 16-7 Baseline fauna survey methods

Survey method	Description	Target listed species (as identified in desktop surveys)
Trap sites (all)		
Elliott trapping	20 baited Elliott A and B traps located 10 m apart along a single transect at each site.	▪ Northern Quoll; and ▪ Yakka Skink (around potential colonies).
Pitfall / funnel trapping	A pitfall line at each site comprising 4 x 20 L pitfall buckets, 30 m fence and 4 x funnel traps paired at each end of fence line. Positioned where suitable habitat structure occurs (woody debris, shrubby vegetation).	▪ Ornamental Snake; ▪ Dunmall's Snake; and ▪ Collared Delma.
Infrared camera traps	Infrared camera set at each trap site (5 per site in March 2011 and 2 per site in September 2011). Cameras set at four sites in 2017 in front of bait station.	▪ Northern Quoll.
General methods (across Project area including trap sites)		
Diurnal bird census	Two 20 minute bird surveys across a 20 ha area at each trap site and opportunistically throughout Study area. Birds identified by direct observation and / or by call.	▪ All bird species.
Diurnal searches for herpetofauna	Searches for frogs and reptiles under leaf litter, debris, logs and rocks. Carried out at each trap site and throughout Study area where appropriate habitat factors occurred.	▪ Ornamental Snake; ▪ Dunmall's Snake; ▪ Collared Delma; and ▪ Yakka Skink.
Anabat microbat call recording	Passive recording of microbat calls overnight (6 pm to 6 am) using Anabat recording system. Carried out at each trap site and throughout Study area where appropriate habitat factors occurred.	▪ Large-eared Pied Bat; and ▪ South-eastern Long-eared Bat.
Spotlighting surveys	Minimum ½ hour (hr) spotlighting in early evening (two people) at each trap site for nocturnal mammals and herpetofauna. Also surveying tracks at night and throughout Study area where appropriate habitat factors occurred. Call playback surveys for nocturnal bird species also carried out where considered suitable.	▪ Koala; ▪ Ornamental Snake; ▪ Grey-headed Flying-fox; and ▪ Greater Glider
Terrestrial habitat assessment	Habitat assessed for suitability to provide resources for terrestrial fauna. Habitat characters assessed include: tree hollow abundance, evidence of nesting, leaf litter, large woody debris and weed invasion.	Assessments included searches for Koala and signs of habitat use (tree scratches and scats).
Incidental records	Fauna observations were ongoing throughout the site and survey period.	N/A

16.10.7 Aquatic Ecology Methods

Two aquatic ecology field assessments were undertaken as follows (refer Figure 16-12):

- Detailed assessments at nine sites were undertaken on sites adjacent to and surrounding the current Project area from 1 to 6 June 2011:
  - Three sites on Deep Creek (De1, De2 and De3)
  - Three sites on Styx River (St1, St1b and St2)
  - Two sites on Tooloombah Creek (To1 and To2)
  - One site on Granite Creek located to the north of the Project area (Gr1)
- A subsequent less intensive survey was carried out in February 2017 (8 – 9 February) sampled four of the previous creek sites (To1, To2, De1 and De2). A fifth site (De4) was established upstream of De3 which was not able to be accessed at the time.

The local area had experienced wet conditions in the months preceding the survey in 2011 including over 500 mm in December 2010 (long-term December average 124 mm) and nearly 300 mm in March 2011 (long-term December average 133 mm). As a result, sampling conditions were considered suitable with abundant water available in creeks in the area.

Conditions during the February 2017 survey were hot and dry. Excepting a single day in January on which 212 mm was recorded at St Lawrence (located 74 km north of the Project area), mean rainfall in the area was below average in the months preceding the survey and across the entirety of February. How the January rain event affected the Project site is uncertain as no rain was recorded in Rockhampton on the same day. Nevertheless, although no flow was recorded at the time sizeable waterholes remained which were suitable for sampling at the time.

The sampling design followed that set out by EHP's *Environmental Protection (Water) Policy 2008* (EPP (Water)). Water quality parameters were assessed against the values identified in the Styx River, Shoalwater Creek and Water Park Creek Basins Environmental Values and Water Quality Objectives (EHP 2014).

A range of stream attributes were assessed, including water quality parameters, aquatic and riparian habitat descriptions, macroinvertebrate and vertebrate (fish) sampling. Aquatic habitat sites were described according to the standard proformas from the AusRivAS protocols. Information collected included in-stream and riparian plant cover, woody debris, substrate and site disturbance. Macroinvertebrates were assessed using triangular sweep nets. Water quality parameters were assessed using an onsite water quality meter and off-site laboratory testing.

Fish were sampled at each site using a combination of baited traps and electrofishing. Freshwater turtles were surveyed visually and limited trapping by hand in 2011 and turtle sampling using crab pots baited with bait fish where conducted at all sites surveyed in February 2017.

Table 16-8 Aquatic ecology survey site descriptions

De1 – Upper Deep Creek	
Site coordinates	-22.71803, 149.67018
Description	Adjacent to eastern boundary of MLs. Low flow at time of 2011 survey. Evidence of recent flooding – debris noted approx. 7 m above channel. Steep incised banks 7 m above water level. Substrate comprised small cobbles, gravel and sand. Well vegetated riparian zone at all levels with Lantana dominant in shrub layer. Channel well shaded. Some cattle access evident but likely minor due to steep banks.
Macroinvertebrate Signal score	Riffle – 4.76
Approx. channel size	3 m (riffle) to 6 m (pool)
Mean depth	0.2 m (riffle) to >0.5 m (pool)
De1 pool section – June 2011	**De1 pool section – February 2017**
	
De2 – Deep Creek (below highway)	
Site coordinates	-22.71272, 149.67582
Description	Located north of highway. Substantial pool present. Low flow at time of survey in 2011. Substrate comprised small cobbles, gravel and sand. Bank height approx. 2.5 m above channel. Thin riparian zone with moderate shade cover. Vehicle / cattle crossing point evident. Cattle access evident.
Macroinvertebrate Signal score	Riffle – 5.25
Approx. channel size	7 m (riffle) to 14 m (pool)
Mean depth	0.2 m (riffle), uncertain depth of pool – likely to retain water for extended periods
De1 pool – February 2017	
	

De3 – Lower Deep Creek	
Site coordinates	-22.66108, 149.67363
Description	Adjacent to northeast corner of MLs. Low flow at time of survey. Evidence of recent flooding – debris noted approx. 6-8 m above channel. Steep incised banks 8 m above water level. Substrate comprised largely gravel and sand. Well vegetated riparian zone at all levels. Rubber Vine (*Cryptostegia grandiflora*) dominant in some areas. Channel well shaded. Abundant woody debris observed in channel. Cattle access evident despite presence of exclusion fencing.
Macroinvertebrate Signal score	Riffle – 5.71
Approx. channel size	1.8 m (riffle) to 10 m (pool)
Mean depth	0.3 m (riffle), uncertain depth of pool – likely to retain water for extended periods
De3 riffle site – June 2011	
	
De4 – Lower Deep Creek	
Site coordinates	-22.664023, 149.672344
Description	Located approximately 700 m upstream of De3. No flow observed. Steep incised banks, 8 m above water level on west side. Substrate comprised largely gravel and sand. Well vegetated riparian zone at all levels (Rubber Vine dominant on lower east bank). Channel well shaded. Woody debris observed in channel. No obvious cattle access evident but evidence of pig presence observed.
Macroinvertebrate Signal score	
Approx. channel size	8 m (pool)
Mean depth	uncertain depth of pool – likely to retain water for extended periods
De4 pool – February 2017	
	

St1 – Upper Styx River	
Site coordinates	-22.64, 149.6624
Description	Just downstream of merge of Deep Creek and Tooloombah Creek. Low flow at time of survey. Evidence of recent flooding – debris noted approx. 6 m above channel. Shallow banks 5-7 m above water level. Substrate comprised largely gravel and sand. Very disturbed riparian zone with few tall trees and weed species common (Rubber Vine dominant in some areas). Poor channel shading. Aquatic vegetation present.
Macroinvertebrate Signal score	Riffle – 3.65
Approx. channel size	5 m (run) to 40 m (pool)
Mean depth	0.3 m (riffle area in Tooloombah Creek), main channel uncertain – 0.6 m at edge
St1 pool site – June 2011	
	
St1b – Styx River	
Site coordinates	-22.6232, 149.65187
Description	Located upstream of bridge on Ogmore Connection Road. Substrate dominated by silt / clay. Riparian zone shows evident of infrequent tidal inundation (marine couch present close to channel). Clearing evident with few tall trees present and weed species common. No channel shading. Aquatic vegetation present. Cattle access evident.
Macroinvertebrate Signal score	Riffle – 3.5
Approx. channel size	6 m to 12 m (pool)
Mean depth	Up to 2.5 m in main channel

St2 – Lower Styx River	
Site coordinates	-22.62018, 149.64848
Description	Located downstream of bridge on Ogmore Connection Road. Right bank heavily incised (6 m above channel), left bank floodplain less than 3 m above channel. Substrate dominated by silt / clay. Regular tidal inundation of site and few tall trees present as a result. Weed species common [heavy cover of Noogoora Burr (*Xanthium occidentale*)]. No channel shading. Aquatic vegetation present.
Macroinvertebrate Signal score	Riffle – 3.52
Approx. channel size	4 m to 10 m (pool)
Mean depth	Up to 1.2 m in main channel
St2 pool site – June 2011	
	
To1 – Tooloombah Creek	
Site coordinates	-22.68923, 149.62985
Description	Located adjacent to bridge over highway (downstream). Moderate flow at time of survey. Evidence of recent flooding – debris noted approx. 6 m above channel. North bank steep (>15 m above channel), gentle slope on south bank. Rocky creek with areas of substrate dominated by bedrock, as well as cobbles / gravel / sand. Well vegetated riparian zone. Channel moderately shaded. Evidence of cattle activity recorded at site.
Macroinvertebrate Signal score	Riffle – 5.77
Approx. channel size	5 m (riffle) to 17 m (pool)
Mean depth	0.3 m (riffle) to >1.5 m (pool)
To1 pool site (upstream of bridge) – June 2011	**To1 pool site (at bridge) – February 2017**
	

To2 – Tooloombah Creek downstream	
Site coordinates	-22.68083, 149.6535
Description	Located adjacent to western boundary of MLs. Moderate flow at time of 2011 survey. North bank relatively steep (7 m above channel), gentle slope on south bank. Substrate dominated cobbles / gravel / sand with large rocks sometimes present. Well vegetated riparian zone in good condition although occurrences of Rubber Vine present. Evidence of cattle activity recorded at site. Channel moderately shaded.
Macroinvertebrate Signal score	Riffle – 5.37
Approx. pool size	2.5 m (riffle) to 35 m (pool)
Mean pool depth	0.3 m (riffle), uncertain depth of pool – likely to retain water for extended periods, creek may be permanent some years

To2 riffle site – June 2011	**To2 pool site – February 2017**
	

Gr1 - Granite Creek	
Site coordinates	-22.60893, 149.54475
Description	Located downstream of highway and 13 km northwest of MLs. Moderate flow at time of survey. Series of large pools joined by riffle areas. Evidence of recent flooding – debris noted approx. 3 m above channel. Banks gently sloped, north bank approx. 5 m above channel. Substrate dominated by cobbles / gravel / sand. Riparian zone disturbed and substantially narrowed in sections. Weeds common. Channel poorly shaded. Aquatic vegetation present.
Macroinvertebrate Signal score	Riffle – 6.06
Approx. pool size	3 m (riffle) to 25 - 45 m (pool)
Mean pool depth	0.3 m (riffle), 3.8 m in deep section of pool – likely to retain water for extended periods

Gr1 riffle site – 5 June 2011	**Gr1 pool site – 5 June 2011**
	

16.10.8 Survey Effort for EPBC Listed Fauna Species

State and Commonwealth survey guidelines have been designed for a number of EPBC listed fauna species that are predicted to occur in the Project area. There are no specific guidelines available for surveying EPBC listed flora species or TECs. EPBC survey guidelines are not mandatory, but provide a guide to the best methods to assess the presence or absence of a particular species or taxa, based on the best available knowledge up to that time (DSEWPaC 2011a). These guidelines were considered during the design and conduct of the fauna surveys undertaken for this Project.

Surveys undertaken as part of the Project were also tailored to site specific conditions, including those relating to habitat quality, distribution and abundance, as well as access, weather, and time constraints to maximise the detection of species that have the potential to occur within survey sites. As such, the fauna surveys undertaken as part of the Project provide a robust and tailored survey of fauna species present within the Project area. Table 16-9 summarises the survey effort for those species considered to have potential habitat in the area compared to the generic EPBC non-mandatory guidelines. The table does not include survey methods for recently listed fauna species for which there are no survey guidelines such as Greater Glider (*Petauroides volans*) and Ghost Bat (*Macroderma gigas*).

The survey effort described below has been further enhanced by subsequent site visits required for water quality sampling (surface and groundwater) in May and August 2017. Both visits included the presence of a qualified ecologist and included searches for raptors and their nests, limited timed bird surveys, spotlighting searches, turtle trap setting in Deep and Tooloombah Creeks, and incidental recording of fauna throughout. Further surveys are planned from September to December 2017.

Table 16-9 Survey effort relative to guidelines

Central Queensland Coal field survey effort	Survey Guidelines
Brigalow reptiles – predicted species in Project area: Yakka Skink; Ornamental Snake, Dunmall's Snake and Collared Delma.	Draft referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPaC 2011a)
Diurnal active habitat searches – including searches for burrows, under leaf litter and logs, rocks, cave and crevices. Approximately 42 hours (hr) of searches over approximately 42 ha were conducted over Project area over a total of 20 days. Spotlighting - approximately 33 person hours conducted over survey periods. Also surveying driving tracks at night and throughout Study area where appropriate habitat factors occurred. Further surveys are planned for September to December 2017. Pitfall / funnel trapping - no pitfall trapping was possible in March 2011 due to wet conditions. Trapping carried out at eight sites comprising 32 trap nights. Trapping carried out at eight sites comprising 640 trap nights (March and September 2011), and four sites comprising 300 trap nights (refer Appendix A9d for separate species results for each survey).	Diurnal active habitat searches- suitable for all predicted species. 1.5 hr per hectare of habitat of average complexity over a minimum of three days. Searches for burrow systems and defecation sites for Yakka Skink. Spotlighting - suitable for predicted species. Targeting wetter areas and surrounds on warm nights. Opportunistic searches - 1.5 hr per hectare of habitat of average complexity over a minimum of three nights. Suitable for Ornamental Snake. Particularly following heavy rainfall events. Pitfall / funnel and Elliott trapping - Suitable for Ornamental Snake. Six 20 litre (l) buckets with funnel trap at each end along a 30 m drift fence Elliott trapping around potential burrow systems for Yakka Skink. Two replicates per habitat type over four days / nights.
Reptiles – predicted species in Project area: Fitzroy River Turtle and Southern Snapping Turtle	Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b).

Central Queensland Coal field survey effort	Survey Guidelines
Turtle trapping (2017 only), visual surveys, limited hand trapping carried out in 2011 aquatic ecology survey. Stream habitat assessed for suitability of species presence.	Snorkelling surveys in riffle zones of appropriate waterways. Seine netting. Turtle trapping with meat baits.
Birds – predicted species in Project area: Red Goshawk, Squatter Pigeon, Star Finch (eastern), Black-throated Finch (southern), Australian Painted Snipe and Black-breasted Button-quail	Survey guidelines for Australia's threatened birds (DEWHA 2010a)
Timed bird surveys (20 min) comprising random meander transect within 2 ha site – 56 surveys (approximately 19 hours) carried out over Project area and surrounding areas including dams and wetland areas. Raptor / nest searches in riparian and adjacent habitat during, timed bird surveys, habitat suitability, assessments and opportunistically throughout survey periods including May and August 2017 (further surveys are planned from September to December 2017). Opportunistic surveys carried out wherever appropriate habitat occurred. Approximately 4.5 hrs of call playback during spotlighting.	Area searches of suitable habitat. Suitable for: Australian Painted Snipe (10 hr over three days), Star Finch (15 hr over five days), Black-breasted Button-quail and Squatter Pigeon (15 hr over three days), Black-throated Finch (10 hr over two days) and Red Goshawk (10 days for a total of 80 hr). Targeted watches of waterholes during dry season. Suitable for Star Finch (10 hr over four days) and Black-throated Finch (6 hr over two days). Flushing surveys for Squatter Pigeon. 10 hr over three days Targeted stationary observation in potential foraging habitat (farm dams). Suitable for Australian Painted Snipe (10 hr over three days).
Mammals – predicted species in Project area: Northern Quoll	Survey guidelines for Australia's threatened mammals (DSEWPaC 2011c)
No potential Northern Quoll denning or preferred habitat lies within the Project's disturbance footprint. Trapping carried out at eight sites comprising 640 trap nights (March and September 2011), and four sites comprising 300 trap nights (refer Appendix A9d for separate species results for each survey). Camera traps set at eight sites (March and September 2011) comprising a total of 110 camera trap nights, and four sites (February 2017) comprising 20 trap nights (refer Appendix A9d for separate species results for each survey). Further targeted camera traps are planned for September – October 2017. Diurnal active habitat searches – including searches for burrows, under leaf litter and logs, rocks, cave and crevices. Approximately 42 hours of searches over approximately 42 ha were conducted over Project area over a total of 20 days.	Northern Quoll: Cage / Elliott trapping in rocky denning habitat from May-August. Other methods: daytime searches for potentially suitable habitat (extensive rocky areas with permanent water) and latrine sites; baited sand traps; hair tubes; remote cameras and spotlighting.
Mammals – predicted species in Project area: South-eastern Long-eared Bat, Large-eared Pied Bat and Grey-headed Flying-fox.	Survey guidelines for Australia's threatened bats (DEWHA 2010b)
Anabat surveys carried out over 17 nights throughout Project area. Grey-headed Flying-fox - opportunistic searches for camps and flying fox individuals while spotlighting.	South-eastern Long-eared Bat: preliminary Anabat detection. Harp trapping or mist netting in suitable habitat (less than 50 ha in size) - 20 trap nights over a minimum of five days. Large-eared Pied Bat: Anabat detectors set for 16 nights over a minimum of four days. Harp trapping or mist netting (less than 50 ha in size) – 16 trap nights over a minimum of four days. Grey-headed Flying-fox: Desktop research on existing / historic flying-fox camps, searches for camps and flying fox individuals while spotlighting.

Central Queensland Coal field survey effort	Survey Guidelines
Mammals – predicted species in Project area: Koala	EPBC Act referral guidelines for the vulnerable Koala (DotE 2014)
Opportunistic searches for individuals and signs of activity (tree scratches and scats) in eucalypt woodland habitat with a focus on riparian areas where they occurred. Spotlighting surveys.	Several methods recommended (but not prescribed due to habitat flexibility) including: transect searches, spotlighting, remote cameras, trained 'koala' dogs and searches for koala signs (such as tree scratches, scats).

16.10.9 Threatened Species Occurrence Assessment

Following the site surveys all flora and fauna species predicted as being potentially present from the desktop research were categorised as to their likelihood of occurrence in the Project area and surrounds. Four categories were used to classify the likelihood of a threatened fauna or flora species being present. Categories were defined as:

- Known (confirmed during field assessments);
- Likely (known distribution, records within or around the Project area, and suitable habitat observed during field assessments);
- Potential (known distribution, limited records of the species occurring in the wider area and possibility of suitable habitat occurring); and
- Unlikely (no suitable habitat or not known to occur within the local region).

The presence or potential presence of species, and species habitat was used to inform assessment of the potential risk of impacts from the Project on identified ecological values. Only species considered as 'known' or 'likely to occur' are considered for analysis of the potential for significant residual impacts from Project activities.

16.11 MNES Results

16.11.1 Desktop Results

16.11.1.1 World Heritage Properties

The Project lies approximately 8 km from the boundary of the Great Barrier Reef World Heritage Area (GBRWHA). The boundary is located at the rail crossing bridge on the Styx River and encompasses waters up to the coastal low water mark (Figure 16-13).

The Great Barrier Reef (GBR) covers an area of 348,000 km^2 extending along much of the Queensland coast from 10°40'S (Cape York Peninsula) south to 24°30'S (north of Bundaberg). It extends up 250 km offshore encompassing the continental shelf and oceanic waters. The GBR encompasses over 900 islands and approximately 2,500 individual reefs. The latitudinal length of the reef, the depth range across the shelf and diversity of marine habitats combine with a very diverse marine fauna making the GBR 'one of the richest and most complex natural ecosystems on earth' (UNESCO 2017).

The GBR was inscribed on the World Heritage list in 1981 being recognised for all four of the available 'natural' selection criteria:

- (vii) contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- (viii) be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
- (ix) be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; and
- (x) contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.

In addition to meeting the selection criteria, for a 'natural' property to be considered as of 'Outstanding Universal Value' (OUV) and World Heritage listing it must meet the conditions of integrity. An assessment of 'integrity' examines the extent to which the property:

- Includes all elements necessary to express its OUV;
- Is of adequate size to ensure the complete representation of the features and processes that convey the property's significance; and
- Suffers from adverse effects of development and / or neglect.

The GBRWHA is subject to a wide range of commercial and recreational uses as well as conservation zones. The *Great Barrier Reef Marine Park Act 1975* is the primary Commonwealth legislation that provides for the long-term protection of the GBR.

Broad Sound

The Styx River empties into Broad Sound which is listed in the DIWA. The wetland lies north of the Project and encompasses the GBRWHA waters pertinent to the Project. The southern boundary of the designated wetland lies close to the boundary of the WHA area but also encompasses coastal marine plains beyond the low water mark (refer Figure 16-7). The lower Styx River forms part of the catchment of the wetland. It is noted as "A good example of a marine and estuarine wetland complex within a large sheltered embayment adjacent to a broad coastal plain" (DotEE 2017a). The Broad Sound wetland encompasses an area of approximately 2,100 km^2 comprising a complex aggregation of tidal marine and estuarine wetlands. These have been formed in a sheltered embayment and have a very large tidal range of approximately 9 m.

The Broad Sound wetland area includes the Torilla Plain, a large treeless marine plain to the east of the Project area formed on the southern side of the Torilla Peninsula. In this area wetlands occur as numerous interconnected pools and channels which may merge into much larger waterbodies in the wet season.

The extreme tidal range and generally shallow depth in the Broad Sound area has a natural impact on water quality in the area. Constant high turbidity is caused by tidal resuspension of sediments largely due to the currents caused by the ingoing and outgoing tides. Nutrient and chlorophyll concentrations are generally low in this area (De'ath and Fabricius 2008). The turbidity plume

extends outwards from Broad Sound to local islands in the Capricorn area of the GBR (such as the Percy Islands group) (Kleypas 1996).

Broad Sound is in a remote location and there is limited ecological survey and monitoring data available from the area. Data which is relevant to OUVs of the GBR including MNES marine species is presented in the following sections.

Mangroves and saltmarsh communities

Saltpans and saltmarsh communities occupy 372 km^2 of the Broad Sound wetland area. Current vegetation mapping indicates large areas of saltpans and mudflats with saltbush species along the Styx River beginning approximately 15 km downstream of the Project boundary (Figure 16-13). These become extensive further downstream extending 5 km to 6 km inland on the northern bank of the river as the channel splits around Rosewood Island. Mangrove communities also occur along the banks of the river beginning 21 km downstream of the Project boundary. Mangroves occupy 216 km^2 within the wetland boundary (Figure 16-13) communities, also becoming more extensive near Rosewood Island. The extent of mangroves and saltmarsh within the wetland area did not decline between 2001 and 2013 (EHP 2017).

Broad Sound (with Shoalwater Bay) is considered one of the five main centres within the GBR for mangrove and saltmarsh communities. These are critical habitats for important juvenile marine species such as Barramundi (*Lates calcarifer*), mullet and peneid prawns. In the past, there has been extensive construction of ponded pastures in the Broad Sound area. Bund walls have been constructed to convert saltmarsh into pasture, restricting movements of juvenile fish into these areas (Goudkamp and Chin 2006), but creating additional temporary and brackish wetlands.

Coral reefs

Mapping for the GBRMPA area indicates small fringing reefs occur on Turtle Island and Charon Point approximately 35 km north-northeast of the Project boundary. Several small reefs also occur in the Clairview area (approximately 55 km north). A larger reef area occurs on the southwest edge Long Island (52 km northeast), a continental island adjacent to the west of the Torilla Peninsula (see Figure 16-13).

The structure of coral reefs in the Broad Sound area (including offshore islands such as Peak Island) has been surveyed in the past in order to examine the impact of the naturally turbid conditions and tidal range on reef development. Coral richness in the Broad Sound area is lower than in adjacent regions (De'ath and Fabricius 2008). High turbidity inhibits photosynthesis in symbiotic algae (Thompson 2006) and low tides that allow for extended exposure at low tides are not suitable for most coral species (Kleypas 1996). Kleypas (1996) examined reef systems surrounding the Broad Sound area, including the Percy Islands and Duke Island (90 km and 120 km north-east of the Project respectively). The study found that reefs within or close to Broad Sound were thinner, in shallower waters and comprised species associated with deeper waters. The effects of elevated turbidity in Broad Sound included:

- Decreasing hard coral colony size associated with distance to Broad Sound;
- Decreasing diversity of both soft and hard corals;
- Shifting coral morphology; and
- Lack of reef building (or framework) species (Kleypas 1996).

Seagrass

Seagrass mapping data from the past 30 years has been collated across the GBR area (Carter et al. 2016). There are no mapped seagrass beds known in the broad Sound area. Extensive seagrass beds occur to the northwest in the Clairview area and in Shoalwater Bay, including small patches near the islands off Stanage Bay (refer Figure 16-13). Seagrasses require suitable light conditions and appropriate nutrient levels. It is likely the extreme tidal range in Broad Sound influences the lack of seagrass likely due to high turbidity levels and prolonged exposure of tidal flats during low tides.

Large marine fauna

The seagrass beds in the northwest of the Broad Sound area support populations of Dugong (*Dugong dugon*). There is a Dugong Protection Area (DPA) (administered under the *Great Barrier Reef Marine Park Regulations 1983*) extending from Carmilla Creek south to Clairview Bluff approximately 55 km north of the Project). A second DPA occurs in the Shoalwater Bay area to the north-west of the Project. Shoalwater Bay DPA is considered the most important Dugong site in the southern area of the GBRMP. Sightings of Dugong are rare in the majority of Broad Sound. In a review of Dugong sighting data by Marsh and Penrose (2001) there are no reported sightings in the Broad Sound area. More recently extensive aerial transect surveys for Dugong and marine turtles which included Broad Sound recorded no individuals in the sound itself. The nearest reported sightings were individuals in the Clairview and Stanage Bay areas (Sobtzick et al. 2016). Given the lack of seagrass in the majority of Broad Sound it is unlikely the area downstream of the Project provides suitable habitat value for the species.

Humpback Whale (*Megaptera novaehollandiae*) is listed as Vulnerable and Migratory under the EPBC Act. The species is well known to occur in the waters off Shoalwater Bay (although not in the bay itself). There is no indication the species uses the waters of Broad Sound for resting or feeding and it is likely the tidal regime and associated turbid waters are unsuitable for the species.

Other protected marine species recorded from the region include inshore dolphin species including Australian Hump-back Dolphin (*Sousa sahulensis*) and Australian Snubfin Dolphin (*Orcaella brevirostris*), both of which are listed as Migratory marine species under the EPBC Act. Past surveys indicate that both species occur in the Shoalwater Bay area although Australian Snubfin Dolphin occurs in low numbers compared to further south in the Fitzroy River estuary (Cagnazzi 2010, Cagnazzi et al. 2013). During boat-based surveys of Broad Sound carried out over two weeks in 2013 low numbers of both species were detected (seven separate pods detected including two pods of Australian Snubfin Dolphins). All records were located north of the Styx River. Both species were detected in the channel on the western side of Rosewood Island (CQC 2013).

Marine turtles occur in the Broad Sound area and surrounds. There are large nesting aggregations of Flatback Turtles (*Natator depressus*) at Wild Duck Island (74 km north north-east of the Project) and Avoid Island (75 km north of the Project). The species nests at lower levels on many of the islands in the local region and selected mainland beaches (Limpus et al. 2002). Targeted nesting surveys in the region indicate the nearest nest sites for this species were the Carmila area (55 km north including mainland beach site and nearby Flock Pigeon Island), north-east side of Long Island (67 km north north-east), and in the Stanage Bay area (70 km north-east including mainland sites and Quail Island) (Limpus et al. 2002).

Green Turtle (*Chelonia mydas*) has been recorded nesting on several offshore islands in the region including the Percy Islands group, Curlew Island and islands and mainland beaches in Shoalwater Bay. The Shoalwater Bay sites are the nearest known nesting sites to the Project (66 km north-east) (Limpus et al. 2002). Hawksbill Turtle (*Eretmochelys imbricata*) is also known to nest in low

numbers in the Percy Islands group (Limpus et al. 2002). Loggerhead Turtle (*Caretta caretta*) has been reported as foraging in Shoalwater Bay.

Extensive aerial transect surveys for marine turtles which included Broad Sound recorded few individuals in the sound itself. Marine turtles were recorded as individuals adjacent to the west side of Long Island and in the Clairview area. Much higher densities were recorded in Shoalwater Bay (Sobtzick et al. 2016). Green Turtle is known to forage on seagrasses which does not occur in the majority of Broad Sound. The lack of marine turtle observations in the area may be an indicator that the tidal regime in Broad Sound provides low habitat value for marine turtles in general.

Shorebirds and seabirds

Broad Sound comprises wetland habitats including seagrass beds, lower intertidal and supratidal mudflats, and mangroves. Brackish and freshwater swamps and lagoons occur in adjacent upland areas. The wetland is noted as providing significant habitat for waterbirds including substantial aggregations of a range of migratory shorebirds listed under the EPBC Act (DotEE 2017a). Shoalwater Bay and Broad Sound are noted as sites of international importance (based on survey data from 1995) for the following migratory shorebirds; Bar-tailed Godwit (*Limosa lapponica*), Whimbrel (*Numenius phaeopus*), Eastern Curlew (*Numenius madagascariensis*), Terek Sandpiper (*Xenus cinereus*), Grey-tailed Tattler (*Tringa brevipes*) and Great Knot (*Calidris tenuirostris*). The intertidal flats of Broad Sound were found to support fewer shorebirds than Shoalwater Bay excepting large numbers of Great Knot (Driscoll 1996).

Surveys of waterbirds in Broad Sound have recorded 66 species, 21 of them breeding, in the eastern wetlands (Torilla Plains) in 2003 and 88 species, 25 of them breeding, mainly in the western wetlands (Styx River and adjacent plains) in 2006/2007 (Birdlife International 2017). Surveys in Broad Sound carried out by Roger Jaensch in 2008 and 2009 recorded internationally important numbers of Great Knot, Red-necked Stints (*Calidris ruficollis*), Sharp-tailed Sandpipers (*Calidris acuminata*) and Marsh Sandpipers (*Tringa stagnatilis*) at several wader sites including Charon Point (32 km north-east of the Project) and Hoogly Point (35 km north) (Jaensch 2009). Six high-tide roosts were documented on the west side of Broad Sound comprising 50 to 2,200 migratory shorebirds and larger numbers (up to 7,500 estimated in total) of other migratory shorebird species use the areas shallowly-inundated saltpans and small lakes (Birdlife International 2017).

Seabirds are considered those birds that forage in open waters such as some tern species, shearwaters, and noddys. These species generally nest on island habitats in the GBR with the majority of seabird nesting occurring on remote coral cays (Hulsman 1997). The southern GBR supports significant seabird colonies on an estimated 22 islands. Coral cays in the Capricorn-Bunker group maintain large numbers of Wedge-tailed Shearwater (*Ardenna pacifica*) and Black Noddy (*Anous minutus*) which comprise approximately 30% and 50% of the global populations of these species (Turner et al. 2006). These islands are located well offshore from Gladstone and are located 250 km east of the Project.

Seabird species in the vicinity of Broad Sound are restricted to inshore and coastal foraging species. There is a known breeding colony of Australian Pelican (*Pelecanus conspicullatus*) in Shoalwater Bay on Akens Island and Pelican Rocks (68 km north-east). This is the only breeding site within the GBR south of Cape York Peninsula (Walker et al. 1993). Little Tern (*Sternula albifrons*) nests on sandy beach areas and is known to have 'primary' nesting sites in Shoalwater Bay with minor nesting also occurring in Broad Sound (FBA 2015).

Reef 2050 Long-term Sustainability Plan

The *Reef 2050 Long-term Sustainability Plan* (CoA 2015) was released in March 2015 and is the overarching document for protecting and managing the GBR until 2050. The central objective of the Plan is 'to ensure the Great Barrier Reef continues to improve on its Outstanding Universal Value every decade between now and 2050.' The Plan seeks to coordinate management of activities in the WHA and adjacent catchment and addresses all values including species, their habitats, indigenous values and historic heritage.

The Plan identifies four key risks to the reef:

- Climate change – long-term risk addressed at both State and Commonwealth government levels to mitigate rising GHG emissions, adopt adaptation strategies and funding climate research;
- Land-based run-off – immediate system-wide risk associated with run-off from agricultural lands into the GBR lagoon;
- Coastal land use change – immediate local / regional risk associated with land use planning and development in coastal catchments including port development, coastal planning law, water extraction, and strengthening vegetation management; and
- Direct use – immediate local / regional risk associated with regulating activities within the reef itself including fishing and tourism.

The Projects contribution to GHG emissions are assessed in Section 16.14. Regarding the potential impacts specific to the Project (i.e. water quality releases in the GBR lagoon) the plan highlights the following water quality issues impacting the reef due to land-based run-off from agriculture:

- The success of recent efforts to reduce poor water quality run-off that have reduced pesticide, sediment and total nitrogen loads against 2009 baselines;
- Setting targets for 2018 for reduction in the following pollutants in 'priority areas' under the 2009 baseline:
  - dissolved nitrogen by at least 50% (80% reduction by 2025)
  - sediment loads by at least 20% (50% reduction by 2025)
  - particulate nutrient loads by at least 20%
  - pesticide loads by at least 60%
- Additional actions that may be applicable to the Project such as:
  - working with industries to measure management efforts to achieve best practice water quality management
  - reviewing and developing water quality objectives, targets and standards across the region
  - strengthening protection of natural wetlands and riparian vegetation.

16.11.1.2 Great Barrier Reef Outlook Report 2014

The *Great Barrier Reef Outlook Report 2014* (GBRMPA 2015) is the latest report produced by GBRMPA as an assessment of the performance of management measures implemented to protect the OUVs of the GBR. Outlook reports are produced every five years and provide key information into any changes required in management approaches and consideration of broader issues by governments.

The report covers the current condition of a broad range of factors associated with the GBR including:

- Habitats (such as mangroves, saltmarsh, reefs, seagrass etc);
- Species and populations including terrestrial and marine flora and fauna;
- Ecosystem health including physical, chemical and ecological processes; and
- Heritage and commercial use values.

Given the size and diversity of the GBR it is not possible or necessary to summarise the findings of the report in this document. There is very little information in the report specific to the area downstream of the proposed Project i.e. Broad Sound. As noted above the main GBR habitats closest to the Project are saltmarsh and mangrove communities. Minor coastal / island reef habitats also occur. The following points summarise the status of these attributes as outlined in the report and specific to the area of concern (including information from the Fitzroy and Whitsunday coastal zones):

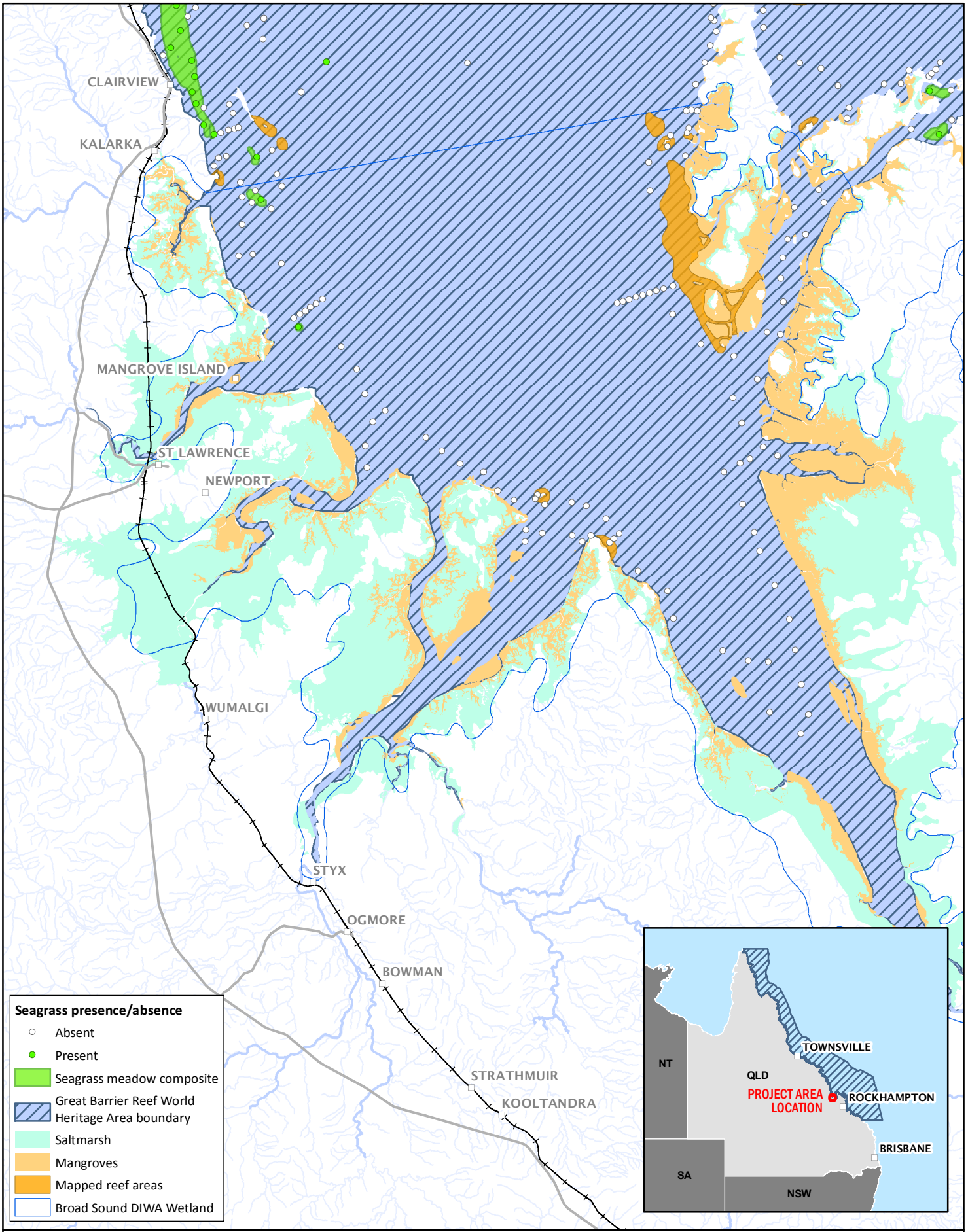
- Broad Sound is specifically mentioned within the report as providing important habitat for shorebirds;
- Mangrove forests in the GBR region are relatively stable and extent is being maintained;
- There has been a decline in coral cover and evidence of changes in species composition, particularly in inshore reefs. This is a result of declining water quality (including higher nutrients and increased turbidity) and its impacts on sensitive coral species, thereby reducing coral diversity in these habitats. Flooding from the Fitzroy River in 2011 (resulting from Cyclone Yasi) caused large declines in shallow-water soft corals with impacts extending (to a lesser extent) into deeper waters inshore of Great Keppel Island;
- Sediment loads entering the GBR lagoon are estimated as twice as high as pre-European settlement. It is; however, estimated there has been an 11% reduction in sediment loads from 2009 to 2013 due to changes in management practices. The GBR waters associated with the Project area are mapped as experiencing moderate exposure suspended solids from 2007 to 2011; and
- Similarly, nutrient inflows to the GBR are considered close to twice as high as pre-European settlement. Management practices are estimated to have reduced nutrient inflows by 16% 2009 to 2013. The GBR waters associated with the Project area are mapped as experiencing high exposure to dissolved inorganic nitrogen from 2007 to 2011.

16.11.1.3 2017 Scientific Consensus Statement

The recently released *2017 Scientific Consensus Statement* (SoQ 2017) (the 'statement') provides a comprehensive review on water quality impacts to the GBR associated with catchment land use which is an update of a 2013 review. The statement makes the following points:

- The current poor state of marine and coastal ecosystems, particularly marine habitats on the inner shelf, is largely the result of declining water quality associated with land-based run-off;
- Agricultural activity in the GBR catchment is the main source of primary pollutants (fine sediments, pesticides and nutrients) entering the GBR;
- Regionally the Wet Tropics, the Burdekin and Fitzroy areas contribute the majority of pollutant loads to the GBR;
- Catchments dominated by sugarcane growing contribute the largest inorganic nitrogen and pesticide loads, whereas grazing areas contribute the largest sediment and particulate loads. Management of land cover has been found to be effective at reducing erosion (and thereby mobilised sediments) in grazing areas, although gully and bank erosion remain a major problem; and
- Run-off impacts during major flood events affects key ecosystems such as seagrass and coral communities. In the southern GBR this has been especially apparent in the Fitzroy and Burdekin catchments in recent years (2010 -2011). Nevertheless, subsequent periods of low rainfall (and thereby low run-off) have allowed inshore seagrass and coral communities to recover although they remain in poor to moderate condition.

The Styx Basin (3,013 km^2) comprises 2% of the overall Fitzroy catchment area which is naturally dominated by the Fitzroy Basin (142,552 km^2). Modelling of sediment and pollutant loads from the Fitzroy catchment show that although loads of some pollutants contributed by the Styx catchment have effectively doubled since settlement of the area, these are much less (by more than a factor of ten) than contributions from the Fitzroy catchment (Dougall et al. 2014). The statement identifies priority catchments for water quality improvements based on pollutant exposure and the risk to coastal and marine ecosystems. The Styx catchment has been identified as low priority for sediment and particulate nutrients and minimal priority for dissolved inorganic nitrogen.



N

0 2.5 5 km

Scale @ A4 1:325,000
Date: 14/09/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- North Coast Rail Line
- Main road
- Watercourse

Figure 16-13
Great Barrier Reef World Heritage Area boundary and features

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

16.11.1.4 National Heritage Places

The National Heritage list includes natural, historic and Indigenous places considered to be of outstanding national heritage value to the Australian nation. The GBR was placed on the National Heritage List in May 2007 in accordance with the provisions of item 1A of Schedule 3 of the Commonwealth's *Environment and Heritage Legislation Amendment Act (No.1) 2003*.

It was determined by the Minister of the then Department of Environment and Water Resources the GBR should be included on the National Heritage List as the National Heritage values were demonstrated to be achieved through corresponding Wold Heritage values identified in Section 16.11.1.1.

The National Heritage criteria for the GBR are listed with corresponding World Heritage listing criteria as follows:

a) The place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history – corresponds to World Heritage criteria (vii), (viii), (ix) and (x);

b) The place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history– corresponds to World Heritage criteria (x);

c) The place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history
   - corresponds to World Heritage criteria (viii), (ix) and (x);

d) The place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of
   - A class of Australia's natural or cultural places or
   - A class of Australia's natural or cultural environments
   - Corresponds to World Heritage criteria (viii), (ix) and (x);

e) The place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group – corresponds to World Heritage criteria (vii).

The GBR is also of indigenous cultural importance for Aboriginal and Torres Strait Islanders with over 70 clan groups maintaining links to land and sea. Non-Indigenous heritage values are also represented including lighthouses and historic shipwrecks occurring throughout GBR area. Along with its biological diversity, these represent features of outstanding national heritage value leading to the GBR being registered as a place of National Heritage.

16.11.1.5 Threatened Ecological Communities

The Protected Matters Search Tool identified five listed TECs as having potential to occur in the Project area:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) – Endangered;
- Broad leaf tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland – Endangered;

- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions – Endangered;
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin – Endangered; and
- Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions – Endangered.

Current RE mapping indicates there is 12.7 ha of one RE present within the overall Project area that may be considered a Brigalow TEC (RE11.4.9) (refer Figure 16-11). Table 16-8 describes the extent of REs (as mapped by DNRM) within the Project area, within a 10 km radius of the Project area, and within the Marlborough Plains and Nebo-Connors Ranges subregions. It is important to note the potential extent of TECs outside of the Project area is based on DNRM RE mapping (which has not been ground-truthed) in which the TEC equivalent RE is dominant. Composite REs in which the TEC equivalent RE is not dominant are not included.

Table 16-10 Currently mapped REs within the Project area

RE code	VM Act status	TEC	Total within Project area (ha)	Total within a 10 km radius of Project (ha)	Total within Marlborough Plains subregion (ha)	Total within Nebo-Connors Ranges subregion (ha)
ML80187						
Non-remnant	-		1,801.6	37,232.3	543,487.3	176,257.7
11.3.4	Of Concern		9.78	925.5	10,042.1	4,287.6
11.3.25	Least Concern		16.03	1,332.4	2,955.8	8,981
11.4.2	Of Concern		174.92	2,058.6	6,121.3	1,822.1
11.4.9	Endangered	Brigalow	12.7	182.7	517.2	129.1
11.5.8a / 11.7.2	Least Concern		25.38	362.6	1,840	362.6
11.10.7	Least Concern		29.11	513.5	88.4	513.5
11.10.7 / 11.10.1	Least Concern		80.58	1,484.2	772.7	711.5
11.11.15a	Least Concern		125.52	1,090.6	20,698.4	1,949.1
ML700022						
Non-remnant	-		675.66	37,232.3	543,487.3	176,257.7
11.3.4	Of Concern		9.64	925.5	100,42.1	4,287.6
11.3.25	Least Concern		26.04	1,332.4	2,955.8	8,981
11.4.2	Of Concern		19.74	2,058.6	6121.3	1,822.1
11.4.9	Endangered	Brigalow	7.14	182.7	517.2	129.1
11.11.1	Least Concern		4.18	2619.5	3,270.6	576.7
11.11.15	Least Concern		9.72	1,090.6	20,698.4	1,949.1

16.11.1.6 Threatened and Migratory Species

Database searches identified 15 flora and 29 terrestrial fauna species listed as threatened (Endangered, Vulnerable or Critically Endangered) and 24 fauna species listed as migratory under the EPBC Act (see Table 16-11). The searches were used to inform the field investigations of species which could potentially occur in the Project area.

Table 16-11 Predicted EPBC Act listed species

Scientific name	Common name	EPBC Status	Data source	
			WN	PM
Plants				
Capparis thozetiana		V	X	X
Corymbia xanthope	Glen Geddes Bloodwood	V	X	X
Cycas megacarpa		E	X	X
Cycas ophiolitica	Marlborough Blue	E	X	X
Dichanthium setosum	Bluegrass	V		X
Hakea trineura	Three-veined Hakea	V	X	X
Eucalyptus raveretiana	Black Ironbox	V	X	
Marsdenia brevifolia		V	X	X
Neoroepera buxifolia		V	X	X
Olearia macdonnellensis		V	X	
Omphalea celata		V		X
Phaius australis	Lesser Swamp-orchid	E	X	X
Pimelea leptospermoides		V	X	X
Pultenaea setulose		V	X	X
Samadera bidwillii	Quassia	E	X	X
Reptiles				
Elseya albagula	Southern Snapping Turtle	CE	X	X
Rheodytes leukops	Fitzroy Turtle	V	X	X
Delma torquata	Collared Delma	V		X
Egernia rugosa	Yakka Skink	V		X
Denisonia maculata	Ornamental Snake	V		X
Furina dunmalli	Dunmall's Snake	V		X
Birds				
Erythrotriorchis radiatus	Red Goshawk	V	X	X
Turnix melanogaster	Black-breasted Button-quail	V	X	X
Charadrius leschenaultii	Greater Sand Plover	V,M	X	
Charadrius mongolus	Lesser Sand Plover	E,M	X	
Rostratula australis	Australian Painted Snipe	E,M	X	X
Calidris ferruginea	Curlew Sandpiper	CE,M	X	X
Calidris canutus	Red Knot	E,M	X	
Calidris tenuirostris	Great Knot	CE,M	X	X
Limosa lapponica baueri	Bar-tailed Godwit (baueri)	V,M	X	X
Limosa lapponica menzbieri	Bar-tailed Godwit (menzbieri)	CE,M		X
Numenius madagascariensis	Eastern Curlew	CE,M	X	X
Geophaps scripta scripta	Squatter Pigeon - southern subspecies	V	X	X
Epthianura crocea macgregori	Yellow Chat (Dawson)	CE,M	X	X
Poephila cincta cincta	Black-throated Finch (southern)	E		X
Neochmia ruficaunda ruficauda	Star Finch	E		X
Mammals				
Dasyurus hallucatus	Northern Quoll	E		X

Scientific name	Common name	EPBC Status	Data source	
			WN	PM
Phascolarctos cinereus	Koala	V	X	X
Petauroides volans	Greater Glider	V	X	X
Pteropus poliocephalus	Grey-headed Flying-fox	V		X
Macroderma gigas	Ghost Bat	V		X
Chalinolobus dwyeri	Large-eared Pied Bat	V		X
Nyctophilus corbeni	South-eastern Long-eared Bat	V		X
Xeromys myoides	Water Mouse	V		X
Migratory bird species				
Hirundapus caudacutus	White-throated Needletail	M		X
Apus pacificus	Fork-tailed Swift	M	M	X
Pandion cristatus	Eastern Osprey	M		X
Plegadis falcinellus	Glossy Ibis	M	X	
Pluvialis squatorola	Grey Plover	M		
Gallinago hardwickii	Latham's Snipe	M	X	X
Calidris acuminate	Sharp-tailed Sandpiper	M		
Calidris ruficollis	Red-necked Stint	M	X	
Numenius phaeopus	Whimbrel	M		X
Tringa brevipes	Grey-tailed Tattler	M		
Tringa nebularia	Common Greenshank	M	X	
Tringa stagnatilis	Marsh Sandpiper	M	X	
Xenus cinereus	Terek Sandpiper	M	X	
Gelochelidon nilotica	Gull-billed Tern	M	X	
Hydroprogne caspia	Caspian Tern	M	X	
Sterna albifrons	Little Tern	M		X
Thalasseus bergii	Crested Tern	M	X	
Cuculus optatus	Oriental Cuckoo	M		X
Monarcha melanopsis	Black-faced Monarch	M	X	X
Symposiachrus trivirgatus	Spectacled Monarch	M	X	X
Myiagra cyanoleuca	Satin Flycatcher	M		X
Rhipidura rufifrons	Rufous Fantail	M	X	X
Motacilla flava	Yellow Wagtail	M		X
Other Migratory species				
Crocodylus porosus	Estuarine Crocodile	M	X	X

1: Status: Ex = Extinct; E = Endangered; CE = Critically Endangered; V = Vulnerable; M = Migratory; 2: Database source: WN = Wildlife online (accessed from EHP 2016); PM = EPBC Protected Matters online search tool.

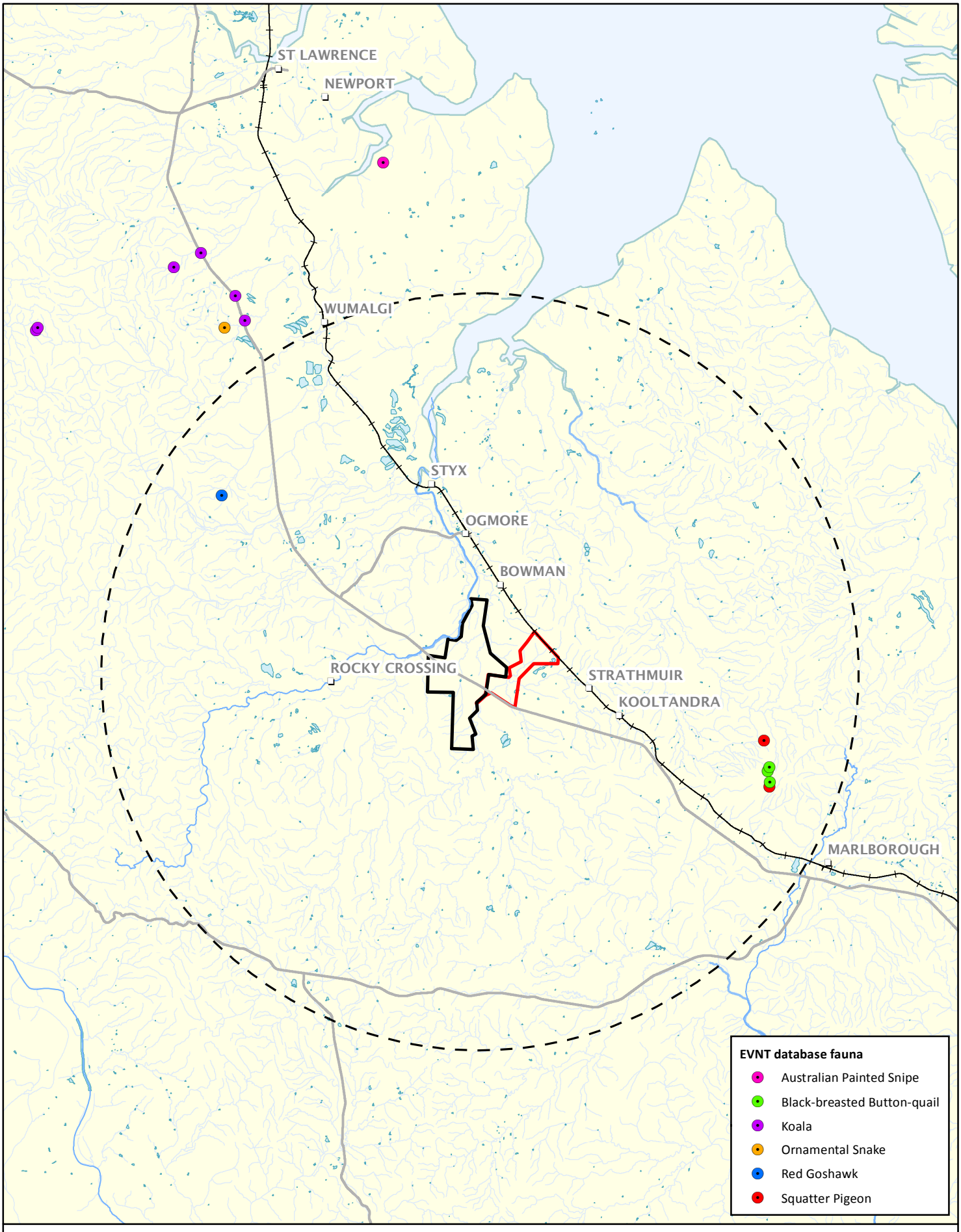
A historical account of the presence of conservation significant fauna species within the wider area surrounding the Project was conducted with the use of the Atlas of Living Australia and EHP Species Profile Search databases. Records for this region were mapped to assess the historical occurrence of conservation significant species listed under the EPBC Act within the Project area and surrounding region (see Figure 16-14).

There are several records of threatened fauna species in the wider area surrounding the Project area. Five fauna species listed as EVNT were recorded on the EHP or ALA database within a 25 km buffered radius of the Project area including:

- One old record (1905) of Red Goshawk located 17 km northwest of the MLs;
- Two records of Squatter Pigeon (southern) located approximately 18 km east of the Project area;
- Three 1996 records of Black-breasted Button-quail located 18 km east of the Project area located on the edge of hilly country;
- A single record of Ornamental Snake 24 km northwest of the ML; and
- A single record of Koala 24 km northwest of the ML. There are five additional records of Koala between 25 and 33 km to the northwest in the same general area (Figure 16-14).

There is also a single record of Australian Painted Snipe 30 km to the north of the ML. Two aquatic species have records occurring 31 km to the southwest and southeast: Southern Snapping Turtle and Fitzroy Turtle (Figure 16-14).

It is noted the databases searches also identified a number of other threatened (13 species) or migratory fauna species (nine species) as potentially occurring in the Project area (refer Appendix A9c – Ecological Desktop Search Results). These species have not been considered further in this assessment as their habitat requirements are entirely marine or they are pelagic (offshore) bird species. The Project area does not encompass any marine habitat and no impacts to marine habitat are expected because of Project activities.



N

0 3 6 km

Scale @ A4 1:325,000
Date: 29/06/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Project Area 25 km buffer
- North Coast Rail Line
- Main road
- Major watercourse
- Minor watercourse
- Reservoir

Figure 16-14
Historical records of MNES fauna species within 25 km of Project

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

16.11.2 Field Results: Overview

The biological character of the Project area is representative of that of the surrounding region which remains largely cleared for cattle grazing in lower-lying lands with small areas of cropping. Remnant vegetation in the south and west of the MLs remain connected to a substantial tract of vegetation that also comprises Tooloombah Creek Conservation Park (1 km west of the western boundary). The topography is relatively flat across much of the MLs. Vegetation in the south is connected to higher altitude rocky tabletop that intersects the far south of the MLs.

The haul road crosses Deep and Barrack Creeks and then traverses a gradual rise to the TLF area. The soils in the Project area comprise a mix of dark clay soils mainly north of the Bruce Highway, and rocky or coarse volcanic soils in the south of the MLs. Much of the area immediately surrounding the Project area to the east and north has been impacted to some degree by cattle grazing activity (such as tree clearing or thinning).

Land cleared for cattle grazing dominates the MLs, haul road and TLF areas. The MLs has been substantially cleared with 78% of the Project area mapped as non-remnant vegetation. The land on which the haul road and TLF are proposed also comprise land currently used for cattle grazing with the only remnant vegetation associated with the haul road crossing point on Deep Creek and Barrack Creek.

The major remnant habitat type remaining within the mine ML is grassy woodlands dominated by Poplar Box (*Eucalyptus populnea*), Poplar Gum and / or Narrow-leaf Ironbark. These communities occur in the south and west of the MLs. Riparian corridors along the creek lines and adjacent forests feature a relatively closed canopy with Forest Red Gum as the dominant canopy species.

Vegetation mapping of the Central Queensland Coal mine area was carried out by Oberonia Botanical Services in 2011 and resulted in changes to the extent of several vegetation communities from the original certified DNRM mapping. The only vegetation community representing a TEC is a small portion of SEVT vegetation on the eastern boundary of the ML. Ground-truthing identified areas mapped as Brigalow (RE 11.4.9) were occupied by eucalypt woodland / open forest communities.

Ground-truthing surveys in February 2017 identified a single small patch (0.6 ha) of Brigalow is located within the eastern portion of the MLs. There are also narrow patches of SEVT associated with the riparian vegetation along Tooloombah Creek although these largely lie outside of the MLs. Table 16-13 provides a description of the (non-TEC) vegetation communities ground-truthed as present to provide context for the Project areas ecological values.

In general, weed species were abundant within the ML including several Weeds of National Significance (WONS) and weeds listed under the Queensland *Biosecurity Act 2014* (see Table 16-12) and particularly along Deep Creek and Tooloombah Creek. The ground layer of cleared areas within the northern section of the mine ML is dominated by the introduced Buffel Grass (*Cenchrus ciliaris*) where cracking clays occur. Bellyache Bush occurs patchily occurs along the margins of both creeks. Rubber Vine and Lantana is common along both creeks (sometimes forming dense infestations) and occurs along the minor drainage located within the ML to the north of the Bruce Highway. Lantana occurs in varying density throughout much of the remnant vegetation in the area, and in non-remnant areas located near creek lines. Olive Hymenachne is a semi-aquatic species and was recorded in the northern extent of the ML at a farm dam (February 2017) and in a water-filled gilgai (May 2017).

Table 16-12 Declared weed species identified within Project area

Species name	Common name	Biosecurity Act category	Weeds of National Significance	2011 surveys	2017 surveys
Aristolochia elegans	Dutchman's Pipe	Category 3	No	X	
Bryophyllum delagoense	Mother-of millions	Category 3	No	X	X
Cryptostegia grandiflora	Rubber-vine	Category 3	Yes	X	X
Harrisia martinii	Harrisia Cactus	Category 3	No	X	
Hymenachne amplexicaulis	Olive Hymenachne	Category 3	Yes	X	X
Jatropha gossypifolia	Bellyache Bush	Category 3	Yes	X	X
Lantana camara	Lantana	Category 3	Yes	X	X
Opuntia stricta *Opuntia tomentosa*	Prickly Pear species	Category 3	Yes	X	X X
Parthenium hysterophorus	Parthenium	Category 3	Yes	X	X
Sporobolus fertilis	Giant Paramatta Grass	Category 3	No	X	

Table 16-13 Representative vegetation sampling descriptions (non-TEC)

RE 11.3.4	
Forest Red Gum (*Eucalyptus tereticornis*) woodland on alluvial plains	
VM Act status: Of Concern	**EP Act Biodiversity status: Of Concern**
Description of community onsite	**Site cover: 33.2 ha**
This community occurs in patches across the eastern portion of the ML where it is associated with the alluvial plains adjacent to Deep Creek. This community occurs on shallow black self-mulching clays. This vegetation community is characterised by a canopy of Forest Red Gum, Poplar Gum with Carbeen (*Corymbia tessellaris*). An understorey is often present and comprised of species such as Swamp Mahogany (*Lophostemon suaveolens*) and Red Ash (*Alphitonia excelsa*). The lower shrub layer tends to be dominated by Lantana although native species present include Coffee Bush (*Breynia oblongifolia*) and Boonaree (*Alectryon diversifolius*). The ground layer tends to be dense and dominated by grasses such as *Bothriochloa* spp., Kangaroo Grass (*Themeda triandra*) and Black Spear Grass (*Heteropogon contortus*). An understorey of Lantana is common throughout. No EVNT flora species were observed or expected.	

RE 11.3.25	
Forest Red Gum woodland fringing drainage lines	
VM Act status: Least Concern	**EP Act Biodiversity status: Of Concern**
Description of community onsite	**Site cover: 29.7 ha**
Occurs along riparian areas of drainage lines. including a tributary of Deep Creek which crosses the ML north of the Bruce Highway. Restricted to the immediate bed and banks of watercourses this woodland community is dominated by Forest Red Gum and Weeping Tea Tree (*Melaleuca leucadendra*). Along Deep and Tooloombah Creeks a mid-dense lower tree and upper shrub layer is characterised by River She-oak (*Casuarina cunninghamiana*) Weeping Bottlebrush (*Melaleuca viminalis*) as well as White Cedar (*Melia azedarach*) and Red Ash. Tooloombah Creek and sections of Deep Creek feature a range of dry rainforest species along the banks. Lantana is a common and often dense understorey species. Within the ML the sub-canopy of this community includes Carbeen, Brigalow and Northern Swamp Mahogany (*L. grandiflorus*). The lower shrub layer includes *Hibiscus heterophyllus, Capparis loranthifolia,* Wilga (*Geijera parviflora*), Sandpaper Fig (*Ficus opposita*), Currant Bush (*Carissa ovata*) and Lantana. Within the ML this habitat is restricted to a narrow strip in poor condition heavily impacted by past clearing of adjacent communities. Cattle are largely excluded from Deep and Tooloombah Creeks and this community is in good condition (although suffering extensive weed invasion). No EVNT flora species observed or expected.	 **Community along Barrack Creek**  **Community along drainage line in north of ML**

RE 11.4.2	
***Eucalyptus* spp. and / or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains**	
VM Act status: Of Concern	**EP Act Biodiversity status: Of Concern**
Description of community onsite	**Site cover: 170.6**
Dominant remnant community remaining on the clay plains within the ML, mainly north of the Bruce Highway. Dominated by Polar Box and Narrow-leaved Ironbark as well as Poplar Gum and Pink Bloodwood (*Corymbia intermedia*). The relatively open canopy of this community is evident over the sparse shrub layer and grassy understorey. Shrub species include Currant Bush, Wilga, Boonaree and Turkey Bush (*Grewia retusifolia*). Where it borders regrowing Brigalow communities, species such as Brigalow and Belah (*Casuarina cristata*) occur. Ground layer tends to be characterised by grasses such Kangaroo grass, Black Spear Grass, *Eragrostis* spp. and *Bothriochloa* spp. No EVNT species were observed and none are expected.	

RE 11.5.3b	
***Eucalyptus populnea* on closed depressions - palustrine wetland (e.g. vegetated swamp)**	
VM Act status: Least Concern	**EP Act Biodiversity status: No Concern at Present**
Description of community onsite	**Site cover: 4.1 ha**
Occurs as an isolated area in a natural depression in the western portion of the site north of Mt Bison Road. Water present during 2011 and May 2017 surveys. No water present in February 2017. This community is characterised by a central patch of Broad-leaved Paperbark with a variety of sedges and a sparse cover of hydrophytes (including *Ottelia ovalifolia*) present in 2011. Dry margins of wetland with sparse to dense cover of low sedges and forbs. Surrounded by mixed eucalypt woodland (RE11.5.8a). Impacted by cattle grazing. Cattle observed to be present in community throughout February 2017 survey. No EVNT species were observed or are expected.	
RE 11.5.8a	
***Eucalyptus platyphylla*, *Corymbia intermedia* woodland on Cainozoic sand plains / remnant surfaces**	
VM Act status: Least Concern	**EP Act Biodiversity status: No Concern at Present**
Description of community onsite	**Site cover: 56.3 ha**
This community occurs as extensive remnants along the western boundary of the ML (south of the Bruce Highway) on colluvial and residual deposits. Characterised by emergent eucalypts such as Pink Bloodwood and Queensland Peppermint (*Eucalyptus exserta*), as well as Poplar Gum and Ghost Gum. The sparse to mid-dense lower tree layer is a mix of co-dominant species including: Red Ash, Quinine Bush (*Petalostigma pubescens*) and a variety of *Acacia* spp. Shrubs include *Canthium buxifolium*, Orange Box Thorn (*Denhamia celastroides*) and scattered Lantana. Species common in the ground layer include Black Spear Grass, *Aristida* spp., *Bothriochloa* spp. and Kangaroo grass. Cattle present in this habitat during February 2017 survey. Some limited impacts from tree thinning evident. No EVNT species were observed or expected.	

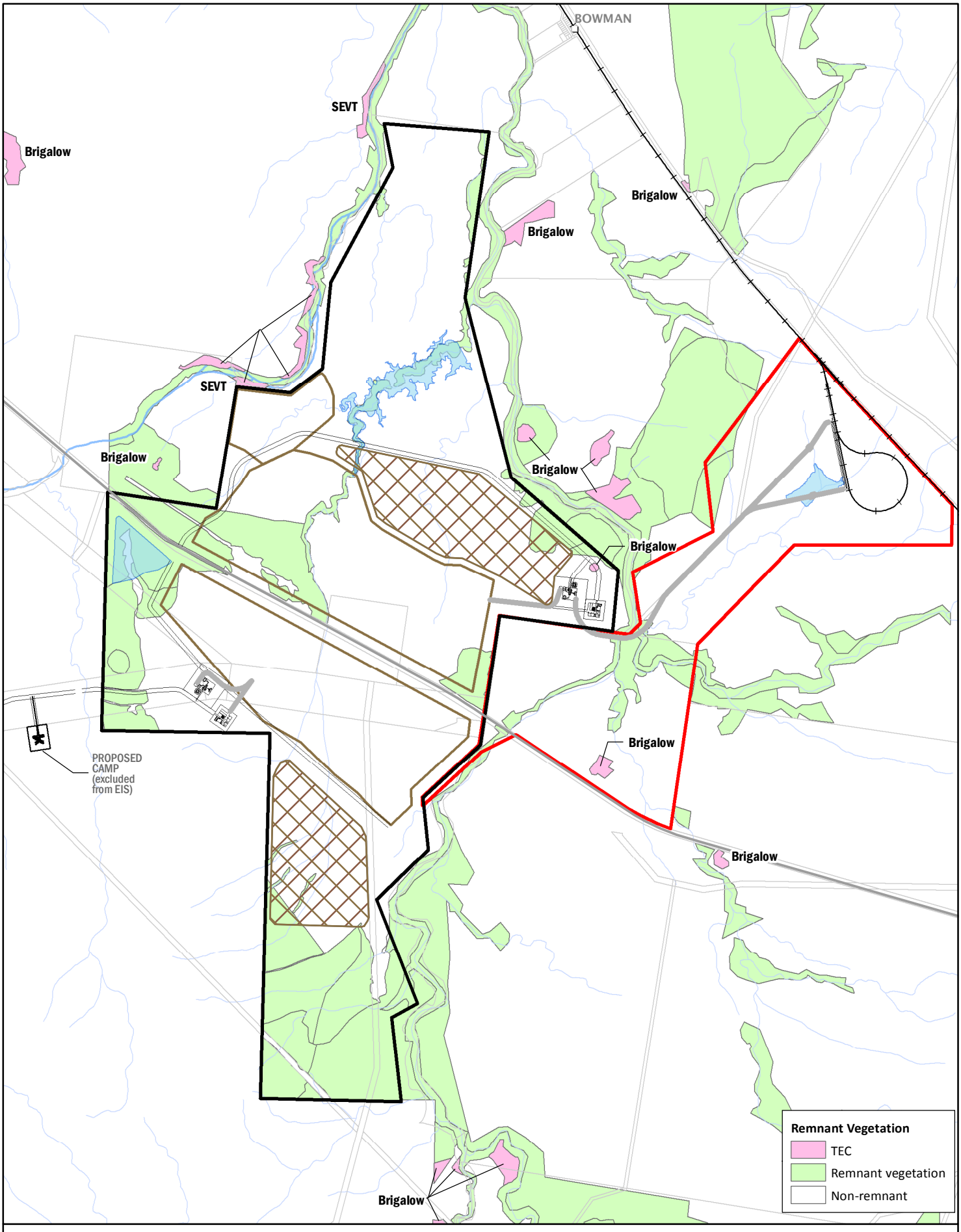
RE 11.10.3	
***Acacia shirleyi* open forest on coarse-grained sedimentary rocks - crests and scarps**	
VM Act status: Least Concern	**EP Act Biodiversity status: No Concern at Present**
Description of community onsite	**Site cover: 36.6 ha**
Restricted to rocky elevated habitat in the southeast corner of the ML. The mid-dense canopy layer is dominated by Lancewood (*Acacia shirleyi*) with emergent Pink Bloodwood. There is a lower tree layer including Quinine Bush, *Canthium buxifolium* and *Melaleuca nervosa.* Lower shrub and ground layers are often sparse on the rocky substrate. Shrubs include Medicine Bush (*Pogonolobus reticulatus*) and Bitterbark (*Alstonia constricta*). Grasses present include perennial species such as Wiry Panic (*Entolasia stricta*), *Eragrostis elongatus* and *Bothriochloa pertusa*. This community is in good condition and is likely less attractive to cattle for browsing, impacts due to grazing are limited. No EVNT species were observed and none are expected.	
RE 11.10.7	
***Eucalyptus crebra* woodland on coarse-grained sedimentary rocks**	
VM Act status: Least Concern	**EP Act Biodiversity status: No Concern at Present**
Description of community onsite	**Site cover: 77.3 ha**
Restricted to lower slopes of elevated habitat in the southeast of the ML. The canopy is dominated by Poplar Gum and Clarkson's Bloodwood (*Corymbia clarksonia*). A shrub layer varies from mid-dense to sparse and is characterised by the presence of Red Ash, Quinine Bush, *Acacia longispicata* and Red Kamala (*Mallotus philippensis*). Lantana is dominant in the lower shrub layer and often in high density. This community has been variably impacted by cattle grazing with some evidence of previous tree clearing (few mature trees present). No EVNT species were observed and none are expected.	
RE 11.11.15a	
***Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics**	
VM Act status: Least Concern	**EP Act Biodiversity status: No Concern at Present**
Description of community onsite	**Site cover: 109.66 ha**
This community occurs in the southern extent of the ML. This woodland community is dominated by a mixture of Poplar Gum and Narrow-leaved Ironbark with a range of less dominant eucalypts including Carbeen and Ghost Gum. The lower tree and shrub layers tends to be sparse including Red Ash, Broad-leaved Paperbark, Beefwood (*Grevillea striata*) and Quinine Bush. Lantana is also present in scattered and sparse patches. Ground cover comprises a mix native grass species including Black Spear Grass, *Bothriochloa* spp., Kangaroo Grass and *Panicum* spp. This community appears in fair condition although is subject to cattle grazing. Canopy tree cover remains high. No EVNT species were observed and none are expected.	

16.11.3 Field Results: Threatened Ecological Communities

Field surveys confirmed that two EPBC-listed TECs are associated with two REs occurring within the Project area. Current DNRM vegetation mapping is not always accurate in predicting the appropriate RE on the ground, including TECs. Field inspections indicated the current mapping of the extent of the Brigalow TEC (RE 11.4.9) is inaccurate with only a small patch extant outside of the currently mapped area. Proposed revised mapping of REs (including TECs) within the transport corridor is shown on Figure 16-15. A summary of the TECs located in the Project area is provided in Table 16-14. A detailed discussion of the presence / likelihood of TECs within the Project area is then provided.

Table 16-14 TEC vegetation communities located within Project area

RE 11.3.11	
Semi-evergreen vine thicket on alluvial plains	
VM Act status: Endangered	**EP Act Biodiversity status: Endangered**
Description of community onsite	**Site cover: 0.4**
This community occurs on the edge of the eastern boundary of the ML (north of the highway) and is associated with alluvial terraces along Tooloombah Creek where five patches occur in the localised area (within 200 m of the ML boundary). Single patch (2.9 ha) occurs partially within the ML (refer Figure 16-15). This vegetation community is characterised by a relatively low canopy (7 – 10 m) comprising a variety of species including Python Tree (*Gossia bidwillii*), Red Kamala, Peanut Tree (*Sterculia quadrifida*), White Cedar, Tuckeroo (*Cupaniopsis anacardioides*) among other taxa. Forest Red Gum and Carbeen occur as occasional emergents. A varied understorey with abundant vines is present and comprised of species such as Chain Fruit (*Alyxia ruscifolia*), Queensland Ebony (*Diospyros geminata*), Sandpaper Fig, Broad-leaved Cherry (*Exocarpos latifolius*), and Velvet Mock-orange (*Notelaea microcarpa*) and Currant Bush. This community is in a reasonable condition given evidence of past tree clearing for cattle grazing purposes. Rubber Vine is commonly present on the edge of this community. No EVNT flora species were observed or expected.	
RE 11.4.9	
Brigalow (*Acacia harpophylla*) shrubby woodland on Cainozoic clay plains	
VM Act status: Endangered	**EP Act Biodiversity status: Endangered**
Description of community onsite	**Site cover: 0.61 ha**
This community occurs as an isolated remnant patch within the eastern portion of the ML. Much of the ML north of the Bruce Highway comprises dark cracking clays with extensive low regrowth of this community. Several patches occur in the surrounding area particularly to the northeast of the mine ML where patches occur east of Deep Creek (refer Figure 16-15). This community is characterised by an open forest canopy of Brigalow with occasional Poplar Box. Upper and lower shrub layers are mid-dense comprising False Sandalwood (*Eremophila mitchellii*), Currant Bush, Boonaree and Queensland Ebony (*Disospyros humilis*). The ground layer tends to be dominated by introduced pasture grasses. This community is heavily impacted by cattle grazing. No EVNT flora species observed.	



N

0 0.5 1 km

Scale @ A4 1:50,000
Date: 13/09/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- Dam Catchment
- Waste Dump Area
- Open-cut Mine Pit
- North Coast Rail Line
- Haul roads
- Main road
- Major watercourse
- Minor watercourse
- Cadastral boundary

Figure 16-15
Revised Project RE mapping and corresponding TECs from field verifications

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

16.11.3.1 Brigalow (*Acacia harpophylla* dominant and codominant)

Brigalow communities are listed as endangered under the EPBC Act. In the past, this community has been subject to extensive vegetation clearing for agriculture and grazing activities. This has reduced much of the former extent of this community to isolated, small fragments. Current threats include continued vegetation clearing, inappropriate fire regimes and introduced weeds and feral animals. Vegetation communities potentially containing Brigalow TECs within and around the Project area are mapped as: RE 11.4.9 – Brigalow shrubby woodland on Cainozoic plains.

Site surveys indicate 0.61 ha of this community occurs in a single patch within the mine area. An assessment of the community was also carried out using the criteria outlined in Butler (2007). The criteria specify that a Brigalow ecological community can be excluded from the list of Brigalow communities if it meets any one of the following three criteria:

- Vegetation has been comprehensively cleared (not thinned) within the past 15 years;
- Exotic perennial plants have more than 50% cover; assessed in a minimum area of 0.5 ha (100 m by 50 m); and
- Individual patches of Brigalow are smaller than 0.5 ha.

Observational data obtained from the 2017 field assessment indicates that the area containing Brigalow RE within the Project area shows obvious signs of cattle disturbance but is generally in good condition and is confirmed as meeting the threshold conditions for a Brigalow TEC. The extent of this RE across the Project area remains at 0.61 ha. Isolated patches also occur outside ML80187, particularly to the northeast (Figure 16-15).

16.11.3.2 Broad Leaf Tea-tree (*Melaleuca viridiflora*) Woodlands in High Rainfall Coastal North Queensland

Broad Leaf Tea-tree woodlands in high rainfall coastal north Queensland are listed as endangered under the EPBC Act. This community is characterised by a dominant canopy of Broad Leaf Tea-tree restricted to the Wet Tropics and Central Mackay Coast bioregions in Queensland. There are no corresponding vegetation communities recorded in the Project area which is also located outside the range of this community.

16.11.3.3 Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregion

The Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions are listed as endangered under the EPBC Act. This ecological community is characterised by grassy woodlands with a dominant canopy of Coolibah (*E. coolabah*) and / or Black Box (*E. largiflorens*). This is a floodplain ecological community located within the upper reaches of the Murray-Darling Basin and the southern Fitzroy basin. The Project area is located outside of this range. Nevertheless, no vegetation communities corresponding to this TEC were recorded onsite during ground-truthing surveys.

16.11.3.4 Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin

Natural Grasslands of the Queensland central highlands and the northern Fitzroy Basin (referred to as 'Natural Grassland' below) are listed as endangered under the EPBC Act. Recognised threats for this community include degradation from agricultural activities, clearing for mining and infrastructure and introduced pests and weeds. The potential for this TEC to occur within the Project area was considered in consultation with the Commonwealth listing advice for this TEC (TSSC 2008a).

In tropical areas 'Natural Grasslands' feature 'indicator' grasses including *Dichanthium* and *Aristida* species. The grasslands in the Project area are the result of previous clearing activities and are dominated by introduced species. There are no areas of this TEC within the Project area.

16.11.3.5 SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions

Semi-evergreen vine thicket of the Brigalow Belt (north and south) and Nandewar Bioregions are listed as endangered under the EPBC Act. Current threats include a high level of fragmentation of remaining SEVT, inappropriate fire regimes, introduced weeds and cattle grazing. Vegetation communities potentially containing SEVT TECs within and around the Project area are mapped as RE 113.11 – SEVT and semi-deciduous notophyll rainforest on Cainozoic alluvial plains.

There are no criteria for excluding patches of this community from being considered a TEC as long as the requirements defined within the VM Act are met for a vegetation patch to be classed as remnant vegetation in Queensland. Current mapping does not indicate the presence of SEVT in the Project area or local surrounds. Site surveys indicates the edge of a 2.9 ha patch of SEVT adjacent to Tooloombah Creek is intersected by the Project boundary, with 0.4 ha lying within the mine ML. Four more patches of this TEC covering approximately 19 ha in total, occur along the creek, although outside of the ML (see Figure 16-15).

16.11.3.6 Summary of TEC Surveys

Detailed investigations undertaken as part of the flora and fauna surveys within the Project area identified 0.61 ha of potential Brigalow TEC associated with RE 11.4.9 in a single patch within the MLs, and potential for 0.4 ha of SEVT TEC associated with 11.3.11 both within ML80187. No other TECs were recorded within the Project area during field assessments.

16.11.4 Field Results: Threatened Species

16.11.4.1 Overview

Fifteen flora species and 29 fauna species listed under the EPBC Act have the potential to occur within the Project area and surrounds based on the results of the desktop EPBC Protected Matters Search Tool and database searches. Onsite surveys and habitat suitability assessments confirmed the presence of Southern Snapping Turtle, Squatter Pigeon, Greater Glider and Koala within the MLs (see Figure 16-16). One further species is considered as likely to occur: Ornamental Snake. Threatened species that are known or likely to occur are referred to in more detail in the following sections. A further eight species are considered as having some potential to occur in the Project area based on available habitat (see Table 16-15).

A number of marine fauna listed as MNES were included in the EPBC Online Protected Matters database search results. These species have not been assessed in detail within this EIS due to the distance the Project is away from potential marine habitat. The habitat values for marine species in Broad Sound are outlined in Section 16.11.1.

Table 16-15 Likelihood of occurrence of EPBC Act listed species

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Plants			
Capparis thozetiana	V	Spiny shrub endemic to central Queensland in the Marlborough–Rockhampton region where it is confined to serpentinite hills and adjacent undulating colluvial aprons. The species grows on mostly shallow skeletal serpentinitic soils in woodland communities dominated by *Eucalyptus fibrosa* and *Corymbia xanthope*.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 20 Wildlife online database records from wider area.
Glen Geddes Bloodwood *Corymbia xanthope*	V	Occurs in woodlands with *E. fibrosa* on ridges or hill slopes on serpentinite geology with sandy soils. This community is recognised as a distinct regional ecosystem (RE 11.11.7 *E. fibrosa* subsp. *fibrosa*, *C. xanthope* woodland on serpentinite).	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 16 Wildlife online database records from wider area.
Cycas megacarpa	E	Trunked cycad grows to 5m tall. Is endemic to southeast Queensland from Bouldercombe in the north, to near Woolooga in the south, in woodland or open woodland dominated by eucalypts, usually on rocky substrate.	**Unlikely.** Two Wildlife online database records from wider area to the south. Species is not known to occur this far north.
Marlborough Blue *Cycas ophiolitica*	E	Occurs from Marlborough in the north, to the Fitzroy River near Rockhampton in the south, in woodland or open woodland dominated by eucalypts, often on serpentinite substrates. Plants occur along hilly outcrops and in lower regions near creek systems.	**Unlikely.** No suitable habitat occurs and no cycads recorded. 23 Wildlife online database records from wider area.
Bluegrass *Dichanthium setosum*	V	Associated with heavy basaltic black soils and stony red-brown hard setting loams with clay subsoil. Found in moderately disturbed areas such as cleared woodlands, grassy roadside remnants, grazed land and highly disturbed pastures.	**Unlikely.** No suitable habitat in Project area. No database records. EPBC Online search only.
Black Ironbox *Eucalyptus raveretiana*	V	Grows along watercourses on alluvial flats or open woodland. Associated with RE 11.3.25a and occasionally 11.3.11 (DotEE 2017b).	**Unlikely**. Single Wildlife online database record from wider area (25 km to south of ML). Suitable habitat within ML (RE11.3.25) is heavily degraded. Better habitat occurs along Deep Creek, however no individuals have been recorded for this species within the region and not recorded during site surveys.
Hakea trineura	V	Occurs on serpentinite-derived so mostly on gravelly ridges and slopes, often with *E. fibrosa* and *C. xanthope* woodland over hummock grassland on hills.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 13 Wildlife online database records from wider area.
Marsdenia brevifolia	V	Erect or loosely scrambling sub-shrub up to 1 m tall. Plants occurring north of Rockhampton grow on serpentine rock outcrops or on black crumbly soils derived from serpentine in woodland dominated by *C. xanthope* and *E. fibrosa*. Despite this close association with serpentine, the species is not a serpentine endemic. Also grows in woodland on granite soils dominated by *E. granitica*, *C. leichhardtii* and *E. acmenoides*.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 17 Wildlife online database records from wider area.

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Neoroepera buxifolia	V	Shrub or small tree growing to 6 m high. Known from two small areas between Marlborough and Yaamba, and between Rockhampton and Yeppoon, in Queensland. This species occurs along creek banks or in creek beds on serpentinite soils (Batianoff et al., 2000) in riparian vine thicket, vine forest, *Melaleuca* or eucalypt woodland or open forest with rainforest species in the understorey.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 26 Wildlife online database records from wider area.
Olearia macdonnellensis	V	Viscid aromatic shrub to 1.2 m high. Occurs in eucalypt open forest in the Marlborough region of central Queensland, all records are from rocky serpentinite hills and ridges. Associated vegetation / species includes open forests of *C. xanthope* and *E. fibrosa*.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. Six Wildlife online database records from wider area.
Omphalea celata	V	Known from three rocky sites in central east Queensland occurring in SEVT. Locations are Hazlewood Gorge, near Eungella; Gloucester Island, near Bowen; and Cooper Creek in the Homevale Station area, northwest of Nebo (TSSC 2008b).	**Unlikely.** Well outside of known range of species. No database records. EPBC Online search only.
Lesser Swamp Orchid *Phaius australis*	E	Commonly associated with coastal wet heath / sedgeland wetlands swampy grassland or swampy forest and often where Broad-leaved Paperbark (*M. quinquinervia*) or Swamp Mahogany (*E. robusta*) is found (Sparshott and Bostock, 1993). It is restricted to the swamp-forest margins, where it occurs in swamp sclerophyll forest, swampy rainforest, or fringing open forest. Mostly found in southeast Queensland and further south. Isolated population in Byfield National Park.	**Unlikely.** No suitable habitat in Project area. No database records. EPBC Online search only.
Pimelea leptospermoides	V	A shrub growing to 1 m high. Occurs from near Marlborough to Rockhampton in Queensland. Found in most serpentine soil vegetation communities, but not in riverine forest. Notably on black clays on stony hillsides and sandy clay in *E. fibrosa* and *C. xanthope* open woodland. Also, tall open forest, open forest and low open forest, all with a grassy and / or heathy understorey, and in woodland with a *M. bracteata* subcanopy layer where prolonged flooding occurs.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 44 Wildlife online database records from wider area.
Pultenaea setulosa	V	An erect shrub growing on serpentine substrates in *E. fibrosa* and / or *C. xanthope* woodlands or open forests on ridges, hills and slopes.	**Unlikely.** No suitable habitat (serpentine landscapes) observed within the Project area. 11 Wildlife online database records from wider area.
Quassia *Samadera bidwillii*	V	Occurs in lowland rainforests or rainforest margins. Also found in other forest types, such as open forest and woodland. Usually found in areas adjacent to both temporary and permanent watercourses up to 510 m altitude. Commonly associated trees in open forest and woodlands include *C. citriodora, E. propinqua, E. acmenoides, E. tereticornis, C. intermedia, E. siderophloia, E. moluccana, E. cloeziana* and *E. fibrosa*.	**Unlikely.** No suitable species associations observed within the Project area. Two Wildlife online database records from wider area.

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Reptiles			
Southern Snapping Turtle *Elseya albagula*	CE	Occurs in Fitzroy, Mary and Burnett Rivers and associated drainages in southern coastal Queensland. Prefers flowing, clear well-oxygenated waters. Occurs in lower densities in rivers with intermittent flows (TSSC 2014).	**Known.** Styx River catchment is separated from the Fitzroy Basin, however identified in Deep Creek during 2011 aquatic ecology surveys. Two Wildlife Online records from wider area. Nearest records are located over 60 km south on Marlborough Creek and the Mackenzie River both of which are part of the Fitzroy Basin.
Fitzroy Turtle *Rheodytes leukops*	V	Fitzroy Turtle is restricted to the rivers of the Fitzroy Basin. It prefers large pools and connecting flowing riffle habitats with clear water. It generally does not move far within its home range. It is known to feed on aquatic insect larvae, freshwater sponges and Ribbonweed (*Valisneria* spp.) (Tucker et al. 2001).	**Unlikely.** Uncertain whether species occurs in Styx catchment which is separated from the Fitzroy Basin. Five Wildlife Online records from wider area, all located in the Fitzroy Basin. Nearest records are located over 70 km south of the Project and associated with Marlborough Creek (part of the Fitzroy Basin).
Collared Delma *torquata*	V	Occurs in soil cracks on heavy stoney soils west of Brisbane. Also recorded from Blackdown Tablelands west of Rockhampton. Known from REs on land zones 3, 9 and 10 including 11.3.2, 11.9.10, 11.10.1 and 11.10.4 (DotEE 2017b).	**Unlikely.** No database records from wider area. Nearest record from south of Rockhampton. No suitable habitat within Project area. EPBC Online search only.
Yakka Skink *Egernia rugosa*	V	Occurs in dry forests, woodlands and rocky areas (usually on well drained, coarse gritty soils) including Poplar Box on alluvial soils, low ridges, Callitris on sands, Belah (Ehmann 1992; Cogger 2000; Drury 2001; Wilson 2015). Also occur in highly degraded sites and where there are log piles and rabbit warrens (EPA 2003).	**Potential.** Sparse large woody debris is present in wooded habitat in the south of the ML and in habitat adjacent to Deep Creek near Site 4 (2017). No database records in near vicinity. Nearest record in Blackwater region approximately 100 km southwest of Project. EPBC online search only.
Ornamental Snake *Denisonia maculata*	V	Occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and adjacent areas of clay and sandy loams. The species is a frog predator found in woodlands and shrublands, such as Brigalow, and in riverine habitats, and lives in soil cracks and under fallen timber (Ehmann 1992; Wilson 2015). Potential habitat is associated with REs 11.3.3, 11.4.3, 11.4.6, 11.4.8, 11.4.9 and 11.5.16 or where they occurred before clearing. (DSEWPaC 2011b).	**Likely.** Recorded on three occasions during the 2011/2012 fauna surveys. All recorded in areas associated with remnant RE 11.4.9 outside of the current Project area: two records 3.5 km west and one record 5.8 km northwest of the ML. No Wildlife Online records from the wider area. A single ALA record located approximately 24 km north of the Project area. Soils in the Project area are generally suitable and gilgai habitat is widespread in the ML north of the Bruce Highway.
Dunmall's Snake *Furina dunmalli*	V	Rarely encountered. Occurs in a variety of habitats including forests to woodlands on sandy soils, cracking soils with Brigalow scrub, and dry vine scrub. Occurs in the Brigalow Belt in southeast inland Queensland.	**Potential.** No database records from wider area. EPBC Online search only. Species is on the northern edge of its range in this area. Nearest record to Project is from Mt Archer, Rockhampton and species previously recorded from Yeppoon (DotEE 2017b). Most northerly record is from Clermont area over 400 km west of the Project. Suitable cracking clay substrate occurs in Project area although vegetation mostly cleared in this habitat.

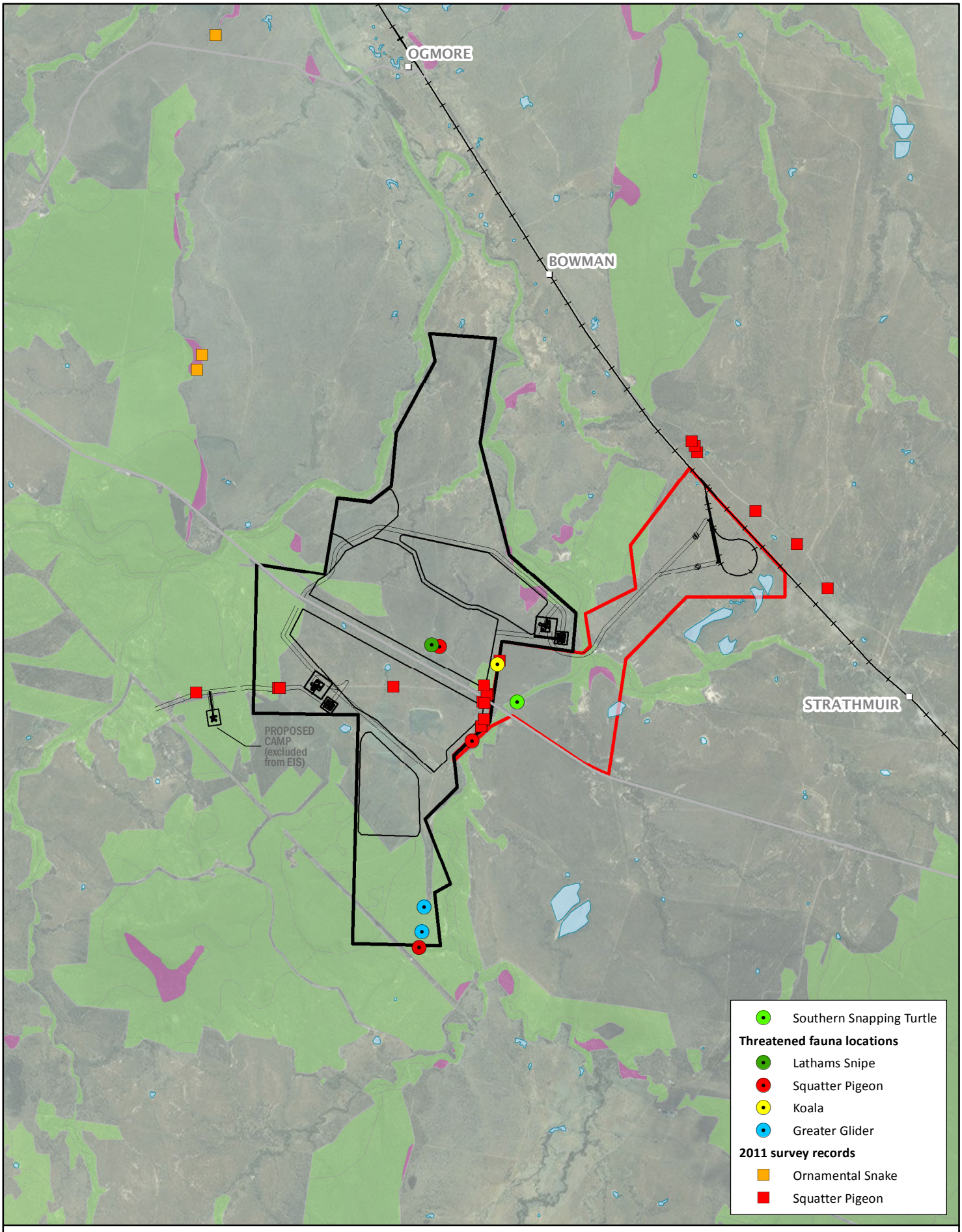
Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Birds			
Squatter Pigeon (southern) *Geophaps scripta scripta*	V	Dry grassy eucalypt woodlands and open forests, also *Callitris* and *Acacia* woodlands. Most birds live in sandy sites near permanent water (Frith 1982; Blakers et al. 1984; and Crome and Shields 1992). Often around cattle yards and other disturbed areas.	**Known.** Species observed on all surveys including within the ML. Species is relatively common in the wider area and there are 23 Wildlife Online database records.
Red Goshawk *Erythrotriorchis radiatus*	V	Endemic to northern and eastern Australia in coastal and subcoastal areas with large home ranges of up to 200km^2. Occurs in woodlands and forests and prefers mosaic habitats that hold a large population of birds and permanent water. Riparian areas are heavily favoured (Marchant and Higgins 1993).	**Potential.** One Wildlife Online database record (1999) from wider search area. Preferred riverine nesting habitat adjacent to Project area although local landscape is heavily cleared. Southern extent of ML remains well vegetated. Species may utilise Project area for foraging should it occur in the area.
Australian Painted Snipe *Rostratula australis*	E	Terrestrial shallow wetlands, ephemeral and permanent, usually freshwater but occasionally brackish. They also use inundated grasslands, saltmarsh, dams, rice crops, sewage farms and bore drains (Marchant and Higgins 1993).	**Potential.** May be occasional visitor to dams in the Project area. Prefers shallow wetlands with adjacent vegetative cover for shelter. Very uncommon species that occurs erratically over eastern and northern Australia. Three database records from wider region recorded on wetlands to the north of Project area associated with the Broad Sound region (including St Lawrence wetlands) where the species is known to occur.
Greater Sand Plover (*Charadrius leschenaultia*) Lesser Sand Plover (*Charadrius mongolus*) Red Knot (*Calidris canutus*) Great Knot (*Calidris ferruginea*)	V, M E, M E, M CE, M	These are shorebird species that occur on intertidal habitats in sheltered coastal areas. Species such as Great Knot may occasionally occur on inland wetlands. The extensive Broad Sound wetland area is known to support nationally important populations of several migratory shorebird species including Great Knot and Terek Sandpiper (Bamford et al. 2008).	**Unlikely.** There are database records for these species in the wider area. The boundary of Broad Sound occurs approximately 8 km upstream of the northern boundary of the Project area. Preferred habitat does not occur on or near the Project area.
Eastern Curlew *Numenius madagascariensis*	CE, M	Mainly forage on intertidal mudflats and sandflats and occasionally ocean beaches, and roost on sandy spits and islets, in mangroves and saltmarsh, and along high water mark on beaches (Higgins and Davies 1996).	**Unlikely.** Both species recorded in Broad Sound area well to north of the current Project during the 2011/2012 fauna surveys. Several Wildlife Online records from the wider area for all three species. There is no suitable estuarine / marine habitat for these species located within or near the current Project area.
Bar-tailed Godwit (baueri) *Limosa lapponica baueri*	V, M	Mainly occurs in coastal habitats such as tidal flats, estuaries, lagoons, bays and harbours. Sometimes occurs on brackish wetlands, saline flats or sewage farms located near coast (Higgins and Davies 1996). May occur on larger waterbodies in inland areas.	
Western Alaskan Bar-tailed Godwit *Limosa lapponica menzbieri*	CE, M	Subspecies migrates from breeding grounds in North America. Same habitat as Bar-tailed Godwit (baueri) (which migrates from Siberian region). In Australia, this subspecies occurs in north western Australia.	**Unlikely.** No database records. EPBC Online search only. Species does not occur in this region of Australia.

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Curlew Sandpiper *Calidris ferruginea*	CE, M	Generally found on wetland habitat along the coast including tidal flats, salt pans and sewage ponds. They also occur on nearby coastal freshwater / brackish wetlands and less commonly on inland wetlands (Pizzey and Knight 2012).	**Potential.** There are limited database records from the wider area for this species. Preferred estuarine habitat does not occur on or near the Project area, however the species occasionally occurs on inland freshwater wetlands close to the coast, particularly during migration periods.
Black-breasted Button-quail *Turnix melanogaster*	V	Cryptic species that occurs in dry rainforest and vine-thickets with abundant leaf-litter. They have also been recorded in Brigalow, Belah and Bottle-tree scrubs, and in eucalypt forests with a dense understorey including Lantana (Marchant and Higgins 1993).	**Unlikely.** Three database records located 18 km east of Project area. No potential habitat within ML. Very marginal habitat along Tooloombah Creek where understorey of vine thicket occurs in a narrow band along steep creek bank. No evidence of presence (i.e. platelets) was observed during surveys.
Yellow Chat (Dawson) *Epthianura crocea macgregori*	CE	Occurs on marine plain wetlands in the Fitzroy River Delta, Torilla Plains and Curtis Island in central Queensland (Houston et al. 2004; Jaensch et al. 2004). Requires grassland, dense beds of rush or sedge, bare mud and / or shallow water, and patches of Samphire (Houston et al. 2004).	**Unlikely.** 50 Wildlife Online database records from wider area. These records are likely to be associated with the extensive Torilla Plains located approximately 40 km east of the Project area. There is no suitable marine habitat in or near the Project area. Targeted surveys in 2011/2012 located in potential habitat to the north of the Project did not record the species.
Black-throated Finch (southern) *Poephila cincta cincta*	E	Occurs in grassy open woodlands near water. Prefers areas of intact woodlands with a variety of native grasses for year round feeding. Nests in large trees, sometimes in tree hollows and arboreal termite nests.	**Unlikely.** Suitable grassy woodland habitat exists however, Project area is south of the species current known range. No database records. EPBC online search only.
Star Finch *Neochmia ruficaunda ruficauda*	E	Occurs mainly in dense, damp grasslands bordering wetlands and watercourses, as well as open grassy woodlands near permanent water. Forages for seeds in tall native grasses (Higgins et al. 2006).	**Unlikely.** Although once widespread this species is now very rare. Project area is south of the species current known range. No database records. EPBC online search only.

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Mammals			
Northern Quoll *Dasyurus hallucatus*	E	Formerly occurred in a variety of habitats across northern Australia and Queensland. Now most common in rocky eucalypt woodland and open forest within 200 km of the coast (Menkhorst and Knight 2004).	**Potential.** Habitat within the mine area is cleared and / or unsuitable. No Wildlife Online or ALA database records from the search area (EPBC Online Search only). Nearest records are 65 km west in the Middlemount area (1969 record) and in Stanage Bay 110 km and 130 km to the northeast (1929 record and 1990 record). The nearest recent records are in Homevale National Park (2011 records) 170 km to the northwest and the Mt Morgan area (2000 record) 120 km to the southeast. The south-west corner of the ML may provide suitable habitat where a rocky jump-up occurs providing potential den habitat in the form of rock crevices on crest of jump-up (refer Figure 16-21). Species requires access to permanent freshwater and none is nearby (nearest waterhole approximately 1.5 km). This area occupies approximately 25 ha within the ML boundary and adjoins a large area of contiguous woodlands that remain tenuously connected to more suitable habitat to the west (rocky ranges).
Koala *Phascolarctos cinereus*	V	Feed almost entirely on eucalypts (Martin et al. 2008); most likely in riverine and riparian habitats.	**Known.** Scats recorded in both 2011 surveys. Species recorded in Poplar Box woodland remnant (RE11.4.2) within ML in February 2017 survey. Forest Red Gum along creeks likely the most favoured habitat for this species. Eleven Wildlife Online record from wider area.
Greater Glider *Petauroides volans*	V	May occur in a range of eucalypt dominated habitats from coastal areas to ranges. Needs large hollow-bearing trees for daytime roosting. Favours habitats with a diversity of eucalypt species (Kavanagh 1984).	**Known.** Two individuals recorded in woodland habitat (RE11.11.15a) in south of ML in February 2017. Also noted in Feb 2012 survey but no location provided. No database records from wider area. EPBC Online search only. Nearest records from mainland adjacent to Shoalwater Bay. Suitable habitat in southern and eastern extent of ML where continuous forest with large hollows remain.

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
Grey-headed Flying-fox *Pteropus poliocephalus*	V	Nomadic species that generally roosts at sites near water and within 50 km of the coast, generally with rainforest, paperbark or casuarina species (Eby and Roberts, 2012). Generally, occurs further south but regular roost site found near Finch Hatton (Eungella area) in recent years (Roberts et al. 2008).	**Potential.** No database records from the wider area. Little Red and Black Flying-fox have been recorded during the 2011/2012 surveys. Black Flying-fox was observed roosting at a large colony site in the township of Marlborough 50 km southeast of the Project. A survey of the colony found no other species resident at the time. There are no roost sites where the species is known to occur in the region surrounding the Project. Current DotEE (2017) data on monitored flying-fox roosts indicates that Finch Hatton (200 km north of the Project) is the nearest roost regularly utilised by the species. They have been recorded using a roost at Middlemount (96 km west of the Project) in 2014 but not during subsequent surveys. To the south the species has been recorded at roost sites in the Bundaberg area (approximately 350 km south of the Project). There is a low potential for the species to forage in the Project area during eucalypt flowering periods given the Project area lies in the northern extent of its accepted range. There is potential roost habitat adjacent to the Project area along Tooloombah Creek and Deep Creek although no camp sites were observed or are known from the wider area.
Ghost Bat *Macroderma gigas*	V	One of the largest microbat species in the world. Roosts in shallow caves, abandoned mines and rock piles. Australia's only carnivorous bat (Churchill 2008).	**Potential.** No database records from wider area. EPBC Online search only. Well known maternity colony known to occur at Mt Etna caves approximately 90 km southeast of Project area. No suitable habitat observed within mine disturbance area but jump-up at southern extent of ML may provide suitable rocky crevices for roosting.
Large-eared Pied Bat *Chalinolobus dwyeri*	V	Species has been recorded roosting in disused mine tunnels, rock overhangs, caves and Fairy Martin (*Petrochelidon ariel*) nests (Eyre et al. 1997; Thompson 2002). Appears to be closely associated with the presence of sandstone escarpment country for roost sites.	**Potential.** No database records from search area. EPBC Online search only. ALA records from the 1990s to the east of the Project area associated with the mainland adjacent to Shoalwater Bay. No suitable habitat observed within mine disturbance area but jump-up at southern extent of ML may provide suitable rocky crevices for roosting.

Species name	EPBC Act status	Habitat preference	Likelihood of occurrence in the Project area
South-eastern Long-eared Bat *Nyctophilus corbeni*	V	Occurs in a variety of dry forest habitats including River Red Gum, open woodland, mallee, brigalow and other arid and semi-arid habitats. It roosts in tree hollows or under bark (NSW NPWS 2003). Surveys suggest the species requires large tracts of forest to occur (Turbill et al. 2008).	**Unlikely.** While there is suitable habitat for this species, the Project area is located substantially north of its current known distribution. There are no database records from the area for this species. There are 596 records of this species in the Atlas of Living Australia database and the nearest record is approximately 400 km south of the Project area in the Expedition Range. The nearest records from the EHP species database comes from the same area and is likely to be the same record. EPBC Online search only.
Water Mouse *Xeromys myoides*	V	Occurs in mangroves, saltmarsh, sedged lakes near foredunes and coastal freshwater swamps. Requires relatively large areas of intertidal flats over which to forage (Gynther and Janetzki 2008).	**Unlikely.** No database records from wider area. No suitable habitat within or near Project area. EPBC Online search only.



N

0 1 2 km

Scale @ A4 1:80,000
Date: 14/09/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Reservoir

Remnant Vegetation

- TEC
- Remnant vegetation
- Non-remnant

Figure 16-16
Threatened fauna records – 2011, 2012 and 2017 survey results

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

16.11.4.2 Known to Occur

Southern Snapping Turtle – Critically Endangered

Ecology and habitat: One of Australia's larger turtle species. It is a slow-growing species that reaches maturity between 15 to 20 years old (Limpus 2008). This species prefers clear, flowing and well-oxygenated waters. Like the Fitzroy Turtle it takes in oxygen through cloacal respiration (Clark et al. 2008). The species still occurs in non-flowing waters but at much reduced densities.

The young are largely carnivorous feeding on benthic invertebrates. Older individuals become largely herbivorous feeding on fallen fruits from riparian vegetation and aquatic macrophytes (Limpus 2008; Limpus et al. 2011).

Distribution and breeding: Most available females will breed in each successive year. When breeding the species is known to travel long distances to known nest site aggregations. Nest sites appear similar to the Fitzroy Turtle (*Rheodytes leukops*) and are usually located in sand and loam deposits left by flooding events (Hamann et al., 2007; Limpus et al., 2011). Both species have been recorded using the same nesting banks on the Fitzroy River (GHD 2016). Southern Snapping Turtle has an extended nesting season which varies between catchments. In the Fitzroy River breeding aggregations have been observed from May to December (Limpus et al., 2011).

In recent years the species has been found to be heavily impacted by nesting failure. Successful incubation of nest clutches has been heavily impacted by stock trampling and predation with close to 100% of eggs lost (Limpus 2008; Limpus et al. 2011). Turtles sampled at multiple study sites across the three catchments indicate a 'severe depletion' of immature turtles (Limpus 2008; Limpus et al. 2011), and therefore little recruitment into the breeding population.

Endemic to flowing waters in the Fitzroy, Burnett and Mary River Basins and associated coastal drainage basins in southeast Queensland.

Threats: The main threat to the species is the low survival rate (almost total loss) of eggs and hatchlings from known nest aggregation sites in the Fitzroy, Burnett and Mary River Basins. Predation occurs via native and feral species including dogs, foxes, pigs and monitor lizards. Cattle trampling of nest sites may also be an issue. The construction of dams and weirs leads to adverse impacts to habitat including direct submersion of nest sites, fragmentation of habitat and separation from nest sites, changed flow regimes and degrading riparian habitat.

Field survey results: There are no records of the species occurring in the Styx catchment previously. A single individual was recorded in Deep Creek (site De3) as an incidental capture during the June 2011 aquatic ecology survey (see Figure 16-16) although no photo evidence is available to verify the record. No Snapping Turtles were captured during the 2017 survey. Based on site observations taken in February 2017 (when there was no flow in either creek) there are several large pools along Deep Creek north of the highway crossing that appear relatively permanent, although turbid, which may provide long-term habitat for the species, albeit at low densities. Tooloombah Creek appears to provide better habitat for the species due to the lack of turbidity observed in this system. A substantial (long and deep) and permanent pool exists adjacent to the southern side of the highway.

Squatter Pigeon (southern) - Vulnerable

Plate 16-3: Squatter Pigeon recorded during Project surveys (March 2011)

Ecology and habitat: The Squatter Pigeon is largely terrestrial, foraging and breeding on the ground. The southern subspecies occurs mainly in dry grassy eucalypt woodlands and open forests (Frith, 1982; Crome and Shields, 1992). It also inhabits Callitris and Acacia woodlands and was reported from open plains in its historical southern range (Frith, 1982). Most birds live in sandy sites near permanent water (Blakers et al. 1984; Reis 2012). Squatter Pigeons dust-bathe and are often encountered on dirt tracks and in areas of bare soil denuded of ground cover by livestock (Frith, 1982; Higgins and Davies, 1996). They are usually encountered as pairs, family groups or small flocks (Reis 2012). Although they remain common in heavily grazed country in tropical Queensland they are typically more common in un-grazed land (Woinarski and Ash, 2002, Reis 2012). These birds mainly feed on seeds, although insects are a seasonally important part of the diet (Reis 2012).

The total population size is estimated at 40,000 breeding birds and is thought to occur as a single interbreeding population. This estimate; however, is considered to be of low reliability. No populations have been identified as being especially important to the long-term survival or recovery of the Squatter Pigeon (southern).

Distribution and breeding: This species was historically found from Cape York Peninsula in Queensland south to the Dubbo region in New South Wales (NSW). There have been no official records in NSW since the 1970s and the species has declined greatly in southern Queensland (Higgins and Davies 1996; NSW NPWS 2003). Over its current range the species persists at numerous sites and no recent declines have been observed (Garnett et al. 2011).

Breeding in southern Queensland is known throughout the year but does appear to be greatly influenced by rainfall (Reis 2012). The nest is a shallow depression on the ground lined with grass and often sheltered by a log or tussock grass (Frith 1982; Higgins and Davies 1996).

Threats: Much of the original habitat in Queensland has been replaced with pasture for livestock (Higgins and Davies 1996). Threats to existing populations include clearing and fragmentation of

habitat, overgrazing by livestock and feral herbivores, trampling of nests by livestock and feral animals, predation by cats and foxes, and illegal shooting (NSW NPWS 2003).

Field survey results: Recorded during every site survey and throughout ML and surrounds, although mostly south of Bruce Highway (Figure 16-16, Plate 14-4). The species was mainly observed in pairs or as individuals but groups of up to six individuals recorded. The species is not associated with particular REs and was often recorded in cleared habitat.

Greater Glider - Vulnerable

Ecology and habitat: Greater Gliders are typically found in mature eucalypt forests and woodlands with a variety of eucalypt species and a high density of large tree hollows (van der Ree et al. 2004). The diet is largely composed of eucalypt leaves and sometimes flowers. Large hollows in old trees are favoured as shelter sites during the daytime (Goldingay 2012). Sites with a high abundance of suitable hollows appear to support higher populations. The species uses relatively small home ranges of 1 ha – 4 ha in more productive forests (Gibbons and Lindenmayer 2002), but up to 16 ha in more open and dry habitats (Smith et al. 2007).

Distribution and breeding: The species occurs across eastern Australia in a broad swathe of territory associated with the Great Dividing Range. It is known to occur from north Queensland (Atherton Tablelands) to central Victoria.

Females breed in their second year giving birth to a single young each year (March to June). Their low birth rate may cause isolated populations in small forest fragments to be vulnerable to extinction (van der Ree et al. 2004).

Threats: Greater Glider is thought to be particularly sensitive to forest clearing / logging and forest fragmentation. They appear to have a poor dispersal ability being relatively restricted to intact forests / woodlands. They are thought to be susceptible to major disturbances such as frequent or intense fires (TSSC 2016). Climate modelling suggests the species may be threatened by potentially increased temperatures associated with climate change, particularly populations in north Queensland (Kearney et al. 2010).

Field survey results: Two individuals were recorded during spotlighting surveys of the site in February 2011 (see Figure 16-16). The individuals were recorded in the continuous tracts of eucalypt woodland that characterise the southern portion of the ML and adjacent vegetation. Also recorded in February 2012 surveys although the location of the sighting is not known. There are no database records of the species occurrence from the wider area surrounding the Project. Suitable habitat within or near the ML is likely to be restricted to this area due to the extensive clearing carried out elsewhere.

Koala (combined populations of Qld, NSW and ACT) - Vulnerable

Ecology and habitat: Koalas have a distinct association with eucalypt woodland and forest habitat types containing suitable food trees (Hume and Esson, 1993; Moore and Foley, 2000; and Martin et al. 2008). They are not necessarily restricted to bushland or remnant areas and are known to exist and breed within farmland and the urban environment (Dique et al. 2004). Similarly, movement is not confined to vegetated corridors, as they also move across cleared rural land and through suburbs (Martin et al. 2008). They use a variety of trees, including many non-eucalypts, for feeding, shelter and breeding purposes (Dique et al. 2004; and Martin et al. 2008).

They are known to have localised preferences throughout their range, selecting some tree species over others (Pahl and Hume 1990). They are also known to favour individual trees and this has been

suggested to be a response to a variety of factors including; high leaf moisture content, high leaf nitrogen content (which is often related to low fibre content making leaves more palatable) and low levels of chemicals compounds which are expressed by eucalypts to resist herbivory (Pahl and Hume 1990; Hume and Esson 1993; and Moore and Foley 2000).

Distribution and breeding: Koalas occur throughout northeast, central and southeast Queensland, extending south through Victoria into South Australia and Kangaroo Island. Breeding occurs in spring / summer when males become territorial, attacking and fighting rivals and using loud bellows to advertise their presence (Martin et al. 2008). Young permanently leave the females pouch after seven months, but continue to ride on the mothers back until 12 months and the beginning of a new breeding season. After this time, adolescent females may remain in the natal habitat, but males generally disperse to new territories between one to three years of age (Dique et al. 2003; and Martin et al. 2008).

Threats: Current threats to Koalas include habitat destruction and fragmentation, bushfire and disease. Populations around urban / populated areas are also at increased risk of mortality due to dog attack and road strike (Maxwell et al. 1996).

Field survey results: The species was observed in Poplar Box remnant woodland within the ML during spotlighting for the February 2017 site survey (Figure 16-16). Scats attributed to this species identified near south eastern boundary of ML in September 2011 and tree scratches / scats elsewhere in the wider area in March 2011.

16.11.4.3 Likely to Occur

Ornamental Snake – Vulnerable

Plate 16-4: Ornamental Snake recorded during Project surveys (March 2011)

Ecology and habitat: Ornamental Snake occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands in Brigalow, Gidgee (*Acacia cambagei*), Blackwood (*A. argyrodendron*) or Coolabah-dominated vegetation communities associated with moist areas, particularly gilgaied landscapes. It also occurs in modified grassland associated with gilgais, and lake margins and

wetlands (Melzer 2012). The species has been recorded in the following REs none of which occur in the Project area: 11.4.6, 11.4.8, 11.4.9 and 11.3.3 (DotEE 2017b).

Ornamental Snake shelters in soil cracks and under fallen timber. It is a nocturnal species and feeds almost entirely on frogs, though lizards may very occasionally be eaten (Ehmann 1992; Wilson 2015). They are known to congregate around waterholes and temporary pools where frogs are abundant. They are most likely to be encountered following heavy summer rains (Melzer 2012). Gilgais are a known important habitat for the species and the presence of remnant vegetation is not required for the species to occur (DSEWPaC 2011a).

Distribution and breeding: The species occurs in the eastern half of the central and northern Brigalow Belt, mainly in the Fitzroy and Burdekin Basins. High population densities are known from the Isaac River (Dysart, Moranbah and Nebo) and Dawson River catchments (Melzer 2012).

Threats: Threats to Ornamental Snake include: habitat clearing and fragmentation; altered water quality and hydrology affecting gilgai and wetland habitat; habitat degradation by cattle and exotic weed species, predation by feral species; and consuming Cane Toads (*Rhinella marina*). The species is generally not found in areas with high numbers of Cane Toads (Melzer 2012).

Field survey results: Two individuals were recorded in remnant Brigalow habitat 3 km west of the northern boundary of the ML in September 2011. One individual was recorded in Brigalow habitat along a minor drainage line approximately 5.8 km northwest of the northern boundary of the ML in March 2011 (Figure 16-16).

There are suitable cracking clay soils within the ML north of the Bruce Highway where regrowth Brigalow occurs including extensive gilgai formations. No individuals were observed within the ML during the Project surveys despite targeted surveys (trapping, habitat searches and spotlighting) within this area in both February 2012 and February 2017.

16.11.5 Field Results: Migratory Species

16.11.5.1 Overview

A total of 24 species listed as Migratory under the EPBC Act were predicted to occur in the Project area through the EPBC Protected Matters search and database searches (see Table 16-16). During field assessments five species were recorded within the Project area:

- Latham's Snipe;
- Oriental Cuckoo;
- Fork-tailed Swift; and
- Rufous Fantail.

Glossy Ibis is listed as Migratory and was recorded in estuarine / wetland habitat north of the current Project area during the 2011/2012 surveys. This species is considered as 'likely to occur' within the ML given the habitat occurring in the Project area and local surrounds.

One additional species listed as Migratory is predicted as 'likely to occur' in the area:

- White-throated Needletail (Special Least Concern NC Act, Migratory EPBC Act).

A further three species listed only as Migratory under the EPBC Act were recorded during the 2011/2012 site surveys in estuarine wetland habitat associated with the Styx River / Broad Sound area 14 km to the north of the ML:

- Whimbrel;
- Gull-billed Tern; and
- Caspian Tern.

There is no suitable estuarine habitat (mangroves, mudflats or salt pans) for Whimbrel within or near the ML. The tern species may also occur over larger inland wetlands / dams but suitable sites do not occur within the ML as observed in February or May 2017. As such these species are not treated as 'known' or 'likely to occur' in the Project area and therefore there will be no impacts on these species and they are not considered further in this document.

Estuarine Crocodile is also listed as Migratory under the EPBC Act and is considered likely to occur in the waterways surrounding the Project based on anecdotal evidence and observations of 'slides' on Deep Creek in 2011. However, the most suitable habitat for this species is the Styx River downstream of the Project.

A further four listed migratory species are considered to have some potential to occur sporadically within the Project area (Table 16-16).

Table 16-16 Likelihood of occurrence of EPBC Act listed Migratory species

Species name	EPBC Act Status	Habitat preference	Likelihood of occurrence in the Project area
Migratory shorebirds			
Latham's Snipe *Gallinago hardwickii*	M	Occurs on swamp and marsh margins and in wet pasture (Pringle 1987).	**Known.** Up to 15 individuals observed at farm dam within the proposed mine area in February 2017. Single Wildlife Online record.
Whimbrel *Numenius phaeopus*	M	Occurs on coastal mudflats, coral cays, estuaries, sewage ponds and sometimes flooded grasslands or paddocks. Roosts in mangroves (Pizzey and Knight 2012).	**Unlikely.** Recorded in Broad Sound area well to north of the current Project during the 2011/2012 fauna surveys. Several Wildlife Online records from the wider area. There is no suitable estuarine / marine habitat for these species located within or near the current Project area.
Grey Plover *Pluvialis squatorola* Terek Sandpiper *Xenus cinereus* Grey-tailed Tattler *Tringa brevipes*	M M M	Shorebird species that occur on intertidal habitats in sheltered coastal areas. The extensive Broad Sound wetland area is known to support nationally important populations of several migratory shorebird species including Terek Sandpiper (Bamford et al. 2008).	**Unlikely.** There are no database records for these species from the wider area. EPBC online search only. Preferred habitat does not occur on or near the Project area.
Sharp-tailed Sandpiper *Calidris acuminata* Common Greenshank *Tringa nebularia* Marsh Sandpiper *Tringa stagnatilis* Red-necked Stint *Calidris ruficollis*	M	These species are generally found on wetland habitat along the coast including tidal flats, salt pans and sewage ponds. They also occur on nearby coastal freshwater / brackish wetlands and less commonly on inland wetlands (Pizzey and Knight 2012).	**Potential.** There are limited database records from the wider area for these species. Preferred estuarine habitat does not occur on or near the Project area; however, these species occasionally occur on inland freshwater wetlands close to the coast, particularly during migration periods.

Species name	EPBC Act Status	Habitat preference	Likelihood of occurrence in the Project area
Other migratory bird species			
Eastern Osprey *Pandion cristatus*	M	Mainly coastal habitats but can occur on inland rivers and lakes (Debus 2012).	**Potential.** Suitable habitat adjacent to Project area along Tooloombah Creek and Deep Creek. No database records. EPBC Online search only.
Glossy Ibis *Plegadis falcinellus*	M	Terrestrial wetlands, preferring inland freshwater wetlands with abundant aquatic flora (Pringle 1985; and Marchant and Higgins 1990).	**Likely.** Recorded in 2011 northwest of the ML on estuarine sedge swamp. Seasonal wetlands and shallow dams in the Project area provide ephemeral habitat for this species. Single Wildlife online database record.
Gull-billed Tern *Gelochelidon nilotica*	M	Similar to the above species. Generally coastal habitats but may occur well inland. As well as wetlands can be found on grasslands, crops and ploughed fields where it forages for insects.	**Potential.** Recorded on September 2011 survey although sighting location north of Project. Dams / wetlands within the Project area are generally small. More likely to occur downstream of the Project foraging along the Styx River and associated extensive wetland areas.
Caspian Tern *Hydroprogne caspia*	M	Mostly coastal habitats but also inland terrestrial wetlands including lakes, reservoirs and large rivers (Higgins and Davies 1996).	**Potential.** Recorded on 2012 survey to the north of the Project area associated with estuarine habitat. Dams / wetlands within the Project area are generally small. More likely to occur downstream of the Project foraging along the Styx River and associated extensive wetland areas.
Crested Tern *Thalasseus bergii*	M	Largely coastal species that may also occur on tidal rivers and larger inland rivers (Pizzey and Knight 2012).	**Unlikely.** No database records. EPBC online search only. No suitable habitat present for this species.
Little Tern *Sternula albifrons*	M	Coastal species that also occurs on coastal waterbodies such as brackish lakes, salt fields and sewage ponds (Pizzey and Knight 2012).	**Unlikely.** No database records. EPBC online search only. No suitable habitat present for this species.
Oriental Cuckoo *Cuculus optatus*	M	Rainforest, vine thickets, wet sclerophyll forest and open forest and woodland (Higgins 1999).	**Known.** Recorded on March 2011 survey although sighting location unknown. May be occasional visitor to denser woodlands (such as riverine and adjacent woodland) in the Project area.
White-throated Needletail *Hirundapus caudacutus*	M	Aerial non-breeding summer visitors that may occur over any habitat type, including cleared land and infrastructure.	**Likely**. Wide ranging aerial species which migrates from the northern hemisphere to eastern Australia. May occur over the Study area in the summer months. No database records from wider area. EPBC Online search only.
Fork-tailed Swift *Apus pacificus*			**Known.** Recorded during the September 2011 survey although well to the northwest of the ML. Wide ranging aerial species which migrates from the northern hemisphere to Australia. May be occasional aerial visitor to the Project area in the summer months. Single Wildlife Online record from wider area.

Species name	EPBC Act Status	Habitat preference	Likelihood of occurrence in the Project area
Spectacled Monarch *Symposiachrus trivirgatus* Black-faced Monarch *Monarcha melanopsis*	M	Both species generally occur in dense vegetation such as rainforests, wet sclerophyll forests and other dense vegetation such as mangroves. Sporadically occurs in drier sclerophyll forests, woodlands, parks and gardens (Higgins et al. 2006).	**Potential.** There are limited WildNet database records for these species from the wider area. In general, the habitat in the Project area is open, dry and unsuitable. More suitable (dense) habitat occurs along the adjacent creek lines. Species may utilise the Project area during autumn / spring migrations.
Satin Flycatcher *Myiagra cyanoleuca*	M	Satin Flycatchers are mostly found in eucalypt forest, favouring wet forests, moist gullies and watercourses (Higgins et al. 2006).	**Potential.** This species may occasionally utilise the Study area during autumn / spring migrations. No database records. EPBC online search only.
Rufous Fantail *Rhipidura rufifrons*	M	Generally occur in dense vegetation, mainly in rainforests, but also in wet sclerophyll forests and other dense vegetation such as mangroves, drier sclerophyll forests, woodlands, parks and gardens (Higgins et al. 2006).	**Known.** Recorded on March 2011 survey although sighting location unknown. May occur throughout the Project area including regrowth Brigalow. Six database records from wider area. More likely in denser woodlands such as riverine and adjacent woodland.
Yellow Wagtail *Motacilla flava*	M	Sporadic visitor to coastal areas. Prefers short grass or bare ground close to swamps, sewage ponds and saltmarsh. May occur on airfields, playing fields or town lawns (Pizzey and Knight 2012).	**Unlikely.** No database records. EPBC online search only. Very occasional visitor to Queensland.
Migratory reptile			
Estuarine Crocodile *Crocodylus porosus*	M	Habitat includes marine habitats such as mangroves, but they also commonly occur in freshwater habitats such as rivers, lakes and swamps.	**Likely.** No database records. EPBC online search only. Anecdotal accounts of species in Styx River and reports of slides in Deep Creek from June 2011 aquatic ecology survey.

16.11.5.2 Migratory Species Known or Predicted as Likely to Occur

The following sections provide descriptions of the habitat preferences of the migratory species that were observed during field assessments or are considered likely to occur within the Project area. All were found in low numbers (see below) and, given the relatively small areas of preferred habitat present, it is considered unlikely the Project area supports significant populations of any of the species referred to below. It is unlikely that the Project area provides locally or regionally important habitat for these species.

Most of these species are dispersive or seasonal migrants that move location as conditions for foraging and / or breeding become suitable. There are no distinct migratory routes for these species at or near the Project area. As such, no maps of migration routes are presented. Migratory routes for those species that move seasonally are described in the text.

Glossy Ibis

Recorded in the wider area to the north of the Project on a brackish swamp associated with the Styx River marine plains during the September 2011 survey. The Project area is likely to provide suitable habitat, particularly following heavy rainfall.

The Glossy Ibis is a widespread species, occurring throughout the northern hemisphere and over much of Australia. This species breeds in dense colonies, often with other species of ibis and waterbirds (Marchant and Higgins 1990). Outside of the breeding season, the species is nomadic, seeking suitable foraging areas. It feeds on aquatic invertebrates and occurs in terrestrial wetlands, preferring inland freshwater wetlands with abundant aquatic flora (Pringle 1985; and Marchant and Higgins 1990). Core breeding habitat for the species is within the Murray-Darling Basin (NSW and Victoria), the Macquarie Marshes in NSW and in southern Queensland.

Latham's Snipe

This migratory shorebird species was recorded at a single farm dam on Mamelon Station in February 2017. Several visits to the site were made to ascertain the number of individuals present. Up to 15 individuals were recorded.

Latham's Snipe is a secretive species that occurs in swamp and marsh margins and in wet pasture, feeding mainly on earthworms and insect larvae (Pringle 1987). Latham's Snipe breeds mainly in Japan, arriving in northeast Queensland during the northern winter and then moving south through the coastal / sub-coastal areas of south east Queensland into much of eastern Australia during spring / summer (Pringle 1987; and Pizzey and Knight 2012). The species does not breed in Australia. It has been recorded in Australia from the Cape York Peninsula through South Australia. The species may occur around shallow wetlands and farm dams in the Project area.

Fifteen individuals are an unusually high number for this species on a relatively small site (approximately 0.6 ha in extent). The species was not recorded elsewhere within the Project area during the February 2017 survey (or other Project related surveys) and no other migratory shorebird / wader species was recorded within or near the ML. The Commonwealth's *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DotE 2015a) treats Latham's Snipe differently to the other migratory shorebirds listed under the EPBC Act due to the different habitats and behaviour of the species. The Guideline states that important habitat for the species may be identified where:

- Areas have previously been identified as internationally important for the species; and
- Areas that support at least 18 individuals of the species (DotE 2015).

Six important sites have been identified in Australia located in Victoria (five sites) and Tasmania (one site) (DotEE 2017b). Therefore, the Project is not considered as 'important habitat' for Latham's Snipe.

Oriental Cuckoo

A single record of this species 1.3 km east of the ML during the March 2011 survey.

Oriental Cuckoo breeds in China, Japan and Mongolia in the northern summer. It migrates south to the Australasian region. It is widespread but sparsely recorded across eastern Queensland in the summer months (September to May). The species may occur in a wide range of habitats including relatively cleared areas such as leafy trees in paddocks (Pizzey and Knight 2012).

White-throated Needletail and Fork-tailed Swift

Fork-tailed Swift was recorded during 2011 and 2012 surveys of the wider area.

The White-throated Needletails and Fork-tailed Swift are widespread over eastern and south eastern Australia during the warmer months. Both species breed in eastern Asia and spend the non-breeding season mainly in Australia, and occasionally in New Guinea and New Zealand (Blakers et al. 1984; and Higgins 1999). White-throated Needletail arrives in eastern Australia in late October moving south along both sides of the Great Dividing Range as far south as Tasmania. Fork-tailed Swift also arrives in October but may occur throughout Australia (Higgins 1999). Both are aerial foraging species and can occur over most habitats including heavily disturbed areas. They are commonly associated with storm fronts. Although White-throated Needletail is likely to be more commonly observed in the Project area only Fork-tailed Swift has been recorded.

Rufous Fantail

A single record of this species during March 2011 survey. Most suitable habitat for this occurs along Deep Creek and Tooloombah Creek.

Rufous Fantails occur in moist habitats, including closed forest s, coastal scrubs, mangroves and along watercourses and gullies, and urban / rural areas during mid-year migration (Pizzey and Knight 2012; Higgins et al. 2006). They predominantly feed on small insects within the understorey (Higgins et al. 2006). The species occurs across Northern Australia from the Kimberley to Cape York and down the entire eastern coast (Pizzey and Knight 2012). The eastern races migrate to the north in early autumn and return in early spring to breed (Pizzey and Knight 2012; Higgins et al. 2006).

16.11.5.3 Migratory Bird Habitat

Several man-made farm dams / wetlands of varying size occur within the Project area or immediate surrounds. The only site within the Project area, on which migratory waterbirds were recorded, is a pair of dams located within the north of the Central Queensland Coal mine area which was the location of several Latham's Snipe in February 2017. Observations in February 2017 showed water remaining in these sites despite the very dry conditions at the time. These dams may provide relatively permanent habitat for these species, although similar wetland habitat is abundant across the wider area.

As defined under the Significant Impact Guidelines 1.1 (DotE 2013), an area may be classified as an 'important habitat' for a migratory species if the area contains:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- Habitat that is of critical importance to the species at particular life-cycle stages;
- Habitat utilised by a migratory species that is at the limit of the species range; and / or
- Habitat where the species is declining.

It is considered unlikely the area can be considered as 'important habitat' because:

- The species were observed in low numbers and there is no evidence suggesting the region supports an ecologically significant proportion of the populations of any of these species;

- Given the widespread distribution of all of the species observed and the lack of observed breeding / nesting within the Project area, there is no evidence to suggest the habitat is of critical importance at particular life-stages for these species; and
- The Project area is not at the limit of any of the species range or is it known to be habitat where any of the species is declining.

In addition, the Project area is unlikely to serve as a significant 'staging' site (resting place and feeding ground) for migratory shorebirds travelling via the East Asian Australasian Flyway.

Estuarine Crocodile

Not observed during any surveys but there is ample anecdotal evidence of the species presence in the Styx River (including just downstream of the junction of Tooloombah and Deep Creeks) and 'evidence of the presence of estuarine crocodiles' was observed at site De2 during aquatic ecology surveys in June 2011.

Their habitat includes marine habitats such as mangroves, but they also commonly occur in freshwater habitats such as rivers, lakes and swamps. Crocodiles have wide and varied diets which differ between habitats. Prey size increases with the size of the crocodile, with the diet of juveniles consisting of smaller prey such as insects, crustaceans and occasionally small mammals such as rats. Larger crocodiles feed on fish, crabs, turtles, birds and mammals including large prey items such as wallabies, pigs, water buffalo, cattle and horses.

16.11.6 Summary of MNES Baseline

Based on a review of existing records, habitat preferences, and field survey of habitats, ecological communities, and species, the following MNES are known or are considered likely to occur within or near the Project area:

- Threatened Ecological Community:
  - Brigalow (Endangered) (known)
  - SEVT (Endangered) (known)
- Threatened Species:
  - Southern Snapping Turtle (Critically Endangered) (known)
  - Squatter Pigeon (southern) (Vulnerable) (known)
  - Ornamental Snake (Vulnerable) (likely)
  - Greater Glider (Vulnerable) (likely)
  - Koala (Qld, NSW and ACT populations) (Vulnerable) (known)
- Migratory Species:
  - Glossy Ibis (likely)
  - Latham's Snipe (known)
  - Oriental Cuckoo (known)

  - White-throated Needletail (likely)
  - Fork-tailed Swift (known)
  - Rufous Fantail (known)
  - Estuarine Crocodile (likely).

An assessment of the potential impacts associated with the Project on these communities and species is provided in Section 16.12.

16.12 Potential Impacts to MNES

The Project has the potential to impact MNES, including threatened fauna, vegetation communities and other ecological values within the Project area and surrounds. These include:

- TECs;
- Populations of threatened and migratory fauna;
- Habitat for threatened and migratory fauna; and
- Downstream ecological values impacting:
  - Great Barrier Reef World Heritage Area
  - National Heritage Places – Great Barrier Reef
  - Great Barrier Reef Marine Park.

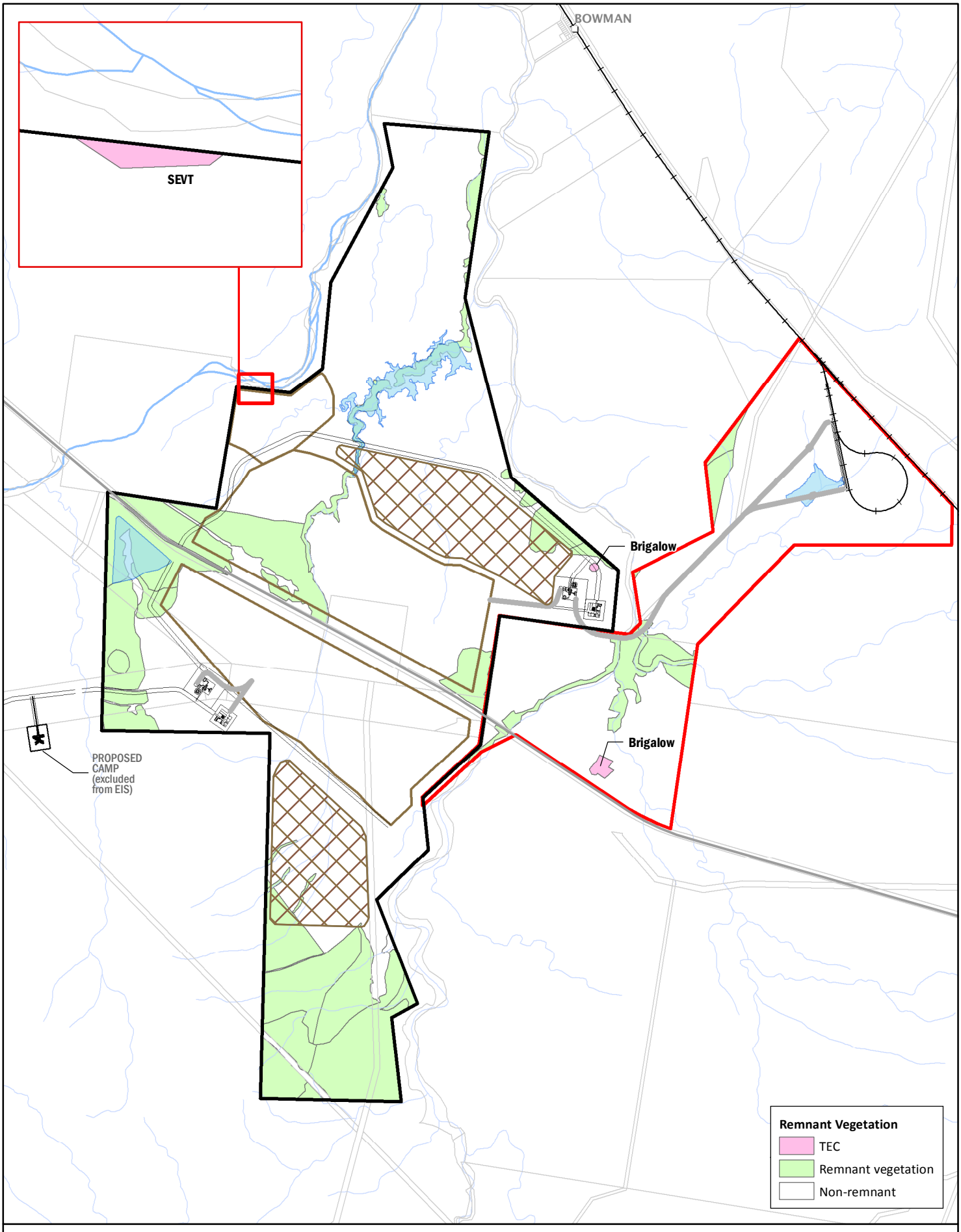
Throughout the construction, operation and decommissioning phases, the Project has the potential to impact on MNES values through the following activities:

- Removal of remnant vegetation for mine infrastructure (CHPP / MIA areas), waste rock dump areas, dams, open cut pits, TLF and site access and haul roads;
- Topsoil stripping;
- Construction of above ground buildings and facilities;
- Day and night time operation of coal mining activities;
- Stockpiling and transportation of the coal resource; and
- General transportation movements.

Considering key threats faced by the relevant MNES and the location of potential habitat within the Project area in relation to Project activities, potential impacts relating to the TECs found within and around the Project area include: habitat clearance and degradation, subsidence impacts, changes in surface water quality and hydrology, groundwater changes, dust, weeds, and fire. These are described in further detail below.

16.12.1 Vegetation Clearance and Degradation

Clearance of remnant habitat will necessarily occur during the construction phase of the Project. Under the current Project footprint an approximate total of 138.4 ha of remnant habitat is predicted to be cleared within the mine and associated infrastructure areas, haul road and TLF over the lifespan of the Project. Direct clearing of vegetation (including TECs) is expected to be minimised or eliminated in some areas during continuing refinement of the design of the mine and infrastructure footprint. The majority of remnant habitat to be impacted will be open woodland dominated by Poplar Box and Narrow-leaf Ironbark (RE 11.4.2) or Forest Red Gum (RE 11.3.25 and 11.3.4). The vegetation communities and associated MNES values predicted to be impacted by clearing are described in Table 16-17 and depicted in Figure 16-17.



Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- Dam Catchment
- Waste Dump Area
- Open-cut Mine Pit
- North Coast Rail Line
- Haul roads
- Main road
- Major watercourse
- Minor watercourse
- Cadastral boundary

N

0 0.5 1 km

Scale @ A4 1:50,000
Date: 13/09/17
Drawn: Gayle B.

Figure 16-17
Revised Project RE mapping and corresponding TECs from field verifications

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

BRUGGEMANNGD \\brbsvr1\PRO\Project\BES150160.03-Styx Coal Project 5 mtpa EIS Preparation\CADD GIS\GIS\DATA\MXD\Chapter 16\BES150160.03-016 R1 Revised Project RE mapping and corresponding TECs from field verifications.mxd 9/13/2017

Table 16-17 Predicted impact on extant vegetation communities and potential MNES habitat

RE	Brief description	MNES habitat	Extent of impact (ha)	Total within a 10 km radius of Project (ha)	Total within Marlborough Plains subregion (ha)
11.3.4	Forest Red Gum woodland on alluvial soils	Koala – Forest Red Gum is a known preferred forage tree species – core foraging habitat Greater Glider – may provide hollow-bearing habitat where it occurs next to continuous woodlands in the south of the mine ML	7.92	925.5	10,042.1
11.3.11	SEVT on alluvial soils	SEVT TEC	0.4	5.22	112.9
11.3.25	Forest Red Gum riparian woodland	Koala – Forest Red Gum is a known preferred forage tree species – core foraging habitat Greater Glider – may provide hollow-bearing habitat where it occurs next to continuous woodlands in the south of the mine ML Ornamental Snake – may provide habitat where it occurs within the ML adjacent to cleared / regrowth Brigalow habitat	28.5	1,332.4	2,955.8
11.4.2	Poplar Box / Narrow-leaf Ironbark woodland on Cainozoic clay plains	Koala – Foraging habitat as Poplar Box considered feed species Squatter Pigeon observed in this habitat	94.84	2058.6	6,121.3
11.4.9	Brigalow shrubby woodland on Cainozoic clay plains	Brigalow TEC Ornamental Snake – species recorded in this community outside of the Project area	0.2	182.7	517.2
11.10.7	Narrow-leaf Ironbark woodland on metamorphosed sediments	Koala – Not considered foraging habitat as Narrow-leaf Ironbark considered supplementary feed species during drought Greater Glider - likely to utilise habitat where recorded in adjacent RE11.11.15a	6.84	513.5	88.4
11.11.15a	Narrow-leaf Ironbark on metamorphosed sediments	Koala – Not considered foraging habitat as Narrow-leaf Ironbark considered supplementary feed species during drought Greater Glider observed in this habitat Squatter Pigeon observed in this habitat	0.11	1,090.6	20,698.4
	Non-remnant (cleared)		1,065.8	37,232.3	543,487.3
Total remnant vegetation area			**13.1 ha**		

The site access road that traverses the mine ML will impact 0.2 ha of a small patch of Brigalow TEC. The Open Cut 4 area is predicted to clear the edge (0.4 ha) of a SEVT TEC adjacent to Tooloombah Creek.

TEC degradation may occur following vegetation clearing because of changes within the newly created edges of the community which have the potential to expose the understorey to factors such as solar radiation, wind, and intrusive species (such as edge effects). The species composition may change to some extent, with species adapted to the forest edge becoming more prevalent, while interior species may disappear over time. However, this effect is not predicted to be significant on the minor areas of TEC associated with the Project which are minor in extent and already impacted by cattle grazing activities.

16.12.1.1 Habitat for MNES Fauna

Much of the mine area footprint has been cleared for cattle grazing. The remainder is dominated by grassy woodlands. Most of the haul road and TLF is also cleared of remnant vegetation.

Squatter Pigeon was recorded within or near the Central Queensland Coal mine area during all surveys for the Project. This is a widely distributed species that occurs in grassy woodlands with a preference for sandy areas near permanent water. Due to this open habitat preference, there are no recommended REs in which this species may be found. Within the mine ML the species was recorded in Poplar Box woodland (RE 11.4.2) and Narrow-leaf Ironbark woodland (RE 11.11.15a) but was more commonly observed in non-remnant habitat. Squatter Pigeon was not detected within the transport corridor but was recorded to the north of the TLF area during 2011 surveys. Clearing for the mine component will largely be focussed on RE 11.4.2 (see Table 16-17 and Figure 16-17).

Southern Snapping Turtle was recorded during aquatic ecology surveys in June 2011 in Deep Creek. The individual was captured at a large permanent pool on the northern side of the Bruce Highway. Although the species prefers flowing waters it may occur in low densities in either creek line adjacent to the Project as large pool areas are present on both. Tooloombah Creek appears to provide better habitat for the species due to the better water clarity and presence of SEVT vegetation species that may provide instream fruits as forage value. The only proposed clearing along either creek will be the haul road crossing area at which no sizeable pool occurs.

Survey records from 2011 indicate the Ornamental Snake occurs in the wider area surrounding the Project area where it was recorded in Brigalow woodland (RE 11.4.9). However, no individuals of Ornamental Snake were recorded within the mine ML during surveys conducted for the Project. Suitable habitat for this species may occur where alluvial cracking clays and gilgai depressions occur to the north of the Bruce Highway. This habitat has been heavily impacted by clearing and there are substantial areas of patchy Brigalow regrowth. A degraded strip of riparian vegetation along a creek line that passes through this area may also provide shelter and foraging habitat. Nevertheless, the species does not require overhead vegetation to occur. No habitat for Ornamental Snake was identified within the area of the haul road and TLF.

Greater Glider was recorded in tall Narrow-leaf Ironbark woodland (RE 11.11.15a) in the south of the ML in February 2017. It was also recorded in the area in February 2012 although the location was not provided. The species prefers extensive tracts of woodlands with large tree hollows. The most likely habitat for the species within or near the Project is the woodlands in the southern portion of the mine ML which remains connected extensive vegetation to the south and west and to riparian vegetation along Deep Creek which likely retains abundant large hollows in Forest Red Gums. This area will be impacted to a minor degree by clearing for the haul road (see Table 16-17 and Figure 16-17).

Koala was observed on one occasion in February 2017 on the east edge of the Project boundary. A road-killed individual was observed approximately 10 km east of the Project area on the same survey. Signs of Koala presence (scratches and scats) were noted during the 2011 surveys to the west of the southern portion of the ML. The mine ML comprises tracts of remnant woodlands largely comprising forage tree species (Poplar Box in RE 11.4.2) and supplementary (drought) forage species (Narrow-leaf Ironbark in RE 11.4.2, 11.10.7 and 11.11.15a). The mine ML contains a degraded and narrow linear remnant of riparian forest containing Forest Red Gum, considered a preferred forage tree species in RE 11.3.25. This habitat also occurs in better condition along both Deep Creek and Tooloombah Creek which lie adjacent to the ML boundary. A section of this habitat is impacted by the haul road crossing on Deep Creek. The mine ML also contains small patches of RE 11.3.4 adjacent to the riparian community along Deep Creek on the eastern boundary. This community also contains Forest Red Gum as well as a variety of other eucalypt species. The projected clearing of these communities required for the Project are presented in Table 16-17.

Southern Snapping Turtle has been recorded in Deep Creek in 2011. Suitable habitat for the species may also occur in Tooloombah Creek. The only direct impacts of vegetation clearance / habitat disturbance from Project construction on potential habitat for the species would be the haul road crossing at Deep Creek and Barrack Creek. There is no pool habitat at these crossing points and therefore there will be no impacts on Southern Snapping Turtle.

16.12.2 Fauna Mortality and Injury

Direct mortality to MNES fauna may occur during tree clearing and during the construction phase of the Project and collision with increased vehicular activity during all Project phases. Mortality from tree clearing has potential to impact Koala and Greater Glider. Clearing and earthworks in cracking clay / gilgai habitat north of the highway has potential to impact Ornamental Snake should it occur in the area. Squatter Pigeon is not expected to be directly impacted during clearing activity. Southern Snapping Turtle is not expected to be impacted as no suitable creek habitat (large waterholes) will be impacted.

Increased traffic within the Central Queensland Coal mine area may impact Squatter Pigeon, Ornamental Snake (should it occur in this area) and Koala. A focus point for potential collisions may be the haul road crossing of the Deep Creek riparian corridor and adjacent alluvial habitat which provides the most suitable habitat for Koala. Increased traffic in the wider region resulting from workers accessing the Project may pose an increased risk to the regional population of Koalas, although the additional traffic generated by the Project would be negligible relative to existing traffic movements already occurring on the Bruce Highway which bisects the mine ML.

Fauna may potentially also become exposed to mortality risk if using the operational site as shelter, although the CHPP / MIA areas are located well away from vegetated habitat. The TLF is also located in cleared area and well away from potential habitat for koala.

No impacts are expected once the decommissioning phase has been completed and no further Project related traffic occurs within the Project area.

16.12.3 Change in Surface Water Quality and Hydrology

The Project will involve the construction of structures and diversion systems which will modify surface water flows, and potentially surface water quality. The potential impacts of these may manifest mainly during the construction and operation phase of the Project.

The main construction activities that could impact on surface water quality values include:

- Excavations and earthmoving including topsoil and mine spoil removal and stockpiling, for the construction of open cut mine pits and mine infrastructure including site access roads, cut and cover and drifts, environmental dams, the haul road and TLF. This may potentially lead to erosion and sedimentation, deterioration of water quality, and changes to water flows; and
- The use of fuels and chemicals for vehicles and construction equipment, potentially resulting in water contamination because of spills, leaks, or other uncontrolled releases.

Operational impacts are in relation to:

- Altered catchment conditions on the hydrology of waterways and drainage lines due to open cut mine pit excavations and associated redirection of minor waterways, buildings and infrastructure and water harvesting (dams); and
- Stormwater runoff, erosion and contaminants from the TLF, mine spoil areas and MIA / CHPP areas.

The Project activities that may impact surface water quality and hydrology are described in detail in Chapter 9 – Surface Water. Changes in water flows and quality in water bodies have the potential to affect downstream terrestrial flora and fauna through changes in the size and nature of the habitat. Given there is very little TEC vegetation in the Project area or surrounds, it is considered unlikely that changes to water quality and hydrology in this component of the Project area would be to the extent that they would affect vegetation, including any vegetation in TECs.

Most of the Project lies within the catchment of Deep Creek. This could potentially affect aquatic MNES (such as Southern Snapping Turtle) adjacent to and downstream of the Project area. Squatter Pigeon occurs in the area and is reliant on permanent water sources, and therefore may also be impacted by changes to surface water quality.

Downstream MNES values potentially impacted also includes the waters and coastal habitats of Broad Sound and the habitats (terrestrial and marine) of the GBRWHA. This includes coastal saltmarsh and mangrove communities which provide extensive potential habitat for Migratory shorebirds.

An assessment of impacts from existing (or baseline) water quality observed in the tributaries discharging to Broad Sound was not undertaken. It is difficult to make this assessment without a suitable baseline data set for Broad Sound which experiences a complex and broad range of water quality characteristics reflecting influences from freshwater and marine waters (refer Section 16.11.1.1). Water quality impacts to Broad Sound are likely to be limited to mobilisation of sediments and associated nutrients as discussed in Section 16.12.3.2.

Any potential impacts are expected to be mitigated once the decommissioning phase has been completed.

16.12.3.1 Hydrology

Most of the catchment for Deep Creek and Tooloombah Creek lies upstream of the Project. Modelling of local flood levels in Deep Creek and Tooloombah Creek because of a reduction in catchment size due to Project activities shows only a very minor reduction in peak flows. Under a 1,000 Average Recurrence Interval (ARI) rainfall event there is predicted to be a 2 cm reduction in peak flood level at the confluence of Deep Creek and Tooloombah Creek (i.e. the Styx River) downstream of the Project. Flood / rainfall diversions within the Project infrastructure will lead to a predicted localised rise in peak flood levels in Deep Creek of 7 cm, and Tooloombah Creek of 3 cm, with a consequent minor rise in flow rates at these times. This is not expected to impact instream habitat in the creeks adjacent to, or downstream of the mine ML, including the Styx River.

A 25 megalitre (ML) RWD is proposed to be built across a second order watercourse to the north of mining activities to supply potable water for the life of the Project. As the upstream catchments will be removed due to Project construction, water is to be stored in the dam by pumping water out of Tooloombah Creek during flow events following high rainfall.

Watercourse and creek crossing structures may cause an increase in runoff velocity due to construction of culverts and conveyance features that eliminate natural features such as meanders and increase in slope. However, with appropriately designed stormwater and crossing structures this is unlikely to cause more than localised and very minor changes to surface hydrology.

Given the minor changes described above no significant impacts to MNES or the GBRWHA are considered likely because of Project-associated changes to hydrological regimes in the area.

16.12.3.2 Sedimentation of Waterways

During construction and operation sediment can be mobilised and transported by surface water during rainfall events ultimately discharging into Deep Creek drainage lines which can result in negative impacts on water quality and aquatic habitats. Specifically, increased suspended sediments can reduce light penetration, decreasing photosynthesis of aquatic flora and decrease dissolved oxygen.

This may impact downstream refugial pools in Deep Creek and Tooloombah Creek, as well as the Styx River. Suspended sediments from runoff will likely contain elevated nitrogen and phosphorus levels due to the agricultural activities within the surrounding landscape. Increased nutrients can promote algal growth and in extreme cases result in blooms and surface water deoxygenation within low flow situations. Most of the catchment associated with the Project lies in Deep Creek is consequently more at risk from sedimentation impacts.

The waters of Broad Sound are subject to a large tidal regime with resulting high turbidity levels. The currents associated with the tides already leads to constant resuspension of sediment in the water column. As a result, there are few habitats supporting GBR OUVs directly downstream of the Project (such as coral reefs, seagrass meadows and large marine fauna). Downstream mangrove communities entrain suspended sediments contributing to the extension of existing mud banks (Furukawa 1996) in the area, potentially extending mangrove habitat and creating more foraging habitat for local shorebirds, although this effect may be subdued by the large tidal regime in the area. Given the background occurrence of high turbidity in Broad Sound waters it is considered very unlikely that the accidental and temporary release of suspended sediments from Project activities will possibly be of a magnitude that may impact GBR OUVs.

Several Project components including the site access road and haul road, will traverse a number of drainage features. At these crossings impacts may include riparian vegetation clearing, direct

deformation of the bed and banks, and alteration of hydrological flows. Consequential impacts may include riparian vegetation decreased instream and riparian habitat, and vegetation removal and earthworks leading to increased erosion and sediment entering downstream waterways. The haul road crosses Deep Creek and Barrack Creek. There are no large waterholes at these crossing points which will require direct disturbance during construction. As a result, no direct impact to MNES habitat is considered likely.

16.12.3.3 Accidental Release of Pollutants

Changes to surface water quality may also occur due to contaminated runoff from the haul road, spoil dump areas, coal stockpiles, coal conveyor and other infrastructure elements such as environmental dams. Coal mine water collected in dewatering and sediment dams may contain a range of pollutants (depending on the source material) such as hydrocarbons and heavy metals. The release of pollutants into the surrounding environment and waterways has the potential to cause mortality to aquatic fauna, degrade stream habitat quality near the Project and degrade downstream stream water quality. Without mitigation, potential exists for several potential contaminants to enter waterways including: contaminated mine dewatering runoff; contaminated runoff from waste rock stockpiles; aqueous waste streams including oily waste water (from heavy equipment cleaning); contaminated runoff from chemical storage areas; potentially contaminated drainage from fuel oil storage areas; and general washdown water.

A large mine dewatering dam (833 ML) that will be used throughout the life of the Project will be in the Tooloombah Creek catchment (approximately 800 m east of Tooloombah Creek). The dewatering dam will store ground and surface waters pumped from the mine pits. It will be built to a 1:1,000 AEP standard flood spillway capacity. The dam water will be subject to controlled releases into Tooloombah Creek under the strict conditions of the Project EA. Dam water is also proposed to be used for coal processing and for general services at the CHPP / MIA areas and for dust suppression onsite.

During operations, the creeks are not anticipated to be directly impacted by surface water runoff from Project facilities (such as the CHPP / MIA areas) as runoff will be captured in a number of environmental dams for re-use or treatment.

Deep Creek which is located approximately 250 m from the eastern edge of the Open Cut 1 pit area and 500 m from the south-eastern corner of Open Cut 2. Other potential sources of pollutants include the MIA / CHPP 2 areas which are located approximately 250 m and 500 m from Deep Creek respectively. The southern waste rock dump and the waste rock dump adjacent to Open Cut 2 are located relatively close to Deep Creek and thereby have potential to release contaminated run-off in the creek. Surface water run-off from the TLF facility will be diverted into environmental dams for remediation before discharge into Barrack Creek. The waste rock dams and the TLF environmental dam will be built to a 1:100 AEP standard flood level capacity.

Contaminated runoff has the potential to impact potential habitat for Southern Snapping Turtle should waterholes on Deep Creek and Tooloombah Creek be impacted. Contaminated runoff also has the potential to enter the Styx River and Broad Sound, temporarily impacting localised GBR OUVs such as coastal mangroves and saltmarsh communities and migratory shorebirds. However, given the transient nature of such an event (should it occur) and the large tidal regime in Broad Sound, it is considered any contaminated runoff will be diluted by tidal waters and unlikely to cause any significant or lasting impact to these values.

The proposed detailed design of the water storages and other water infrastructure components associated with the Project is described in detail in Chapter 9 – Surface Water.

16.12.4 Change in Groundwater

Initial modelling of the potential drawdown effect of the open cut mine operations has been carried out (refer Chapter 10 – Groundwater). At this stage, there is a 'low confidence' in the groundwater modelling results due to a lack of any long-term (time series) groundwater data that would provide insight into the temporal nature of groundwater and surface water connections. Further works are ongoing, including sampling of existing groundwater bores (refer Figure 16-18) and installation of ten more Project-associated bores to expand the knowledge of local groundwater conditions and assess the potential for future impacts (see Chapter 10 for detailed discussion on groundwater). For the purposes of the EIS we have assessed the impact based on the results of the initial modelling.

The Project area is dominated by shallow alluvial aquifers. A review of groundwater bore information and GDEs in the Project area indicates the water table reaches the rooting depth of riparian vegetation along Tooloombah Creek and Deep Creek (RE 11.3.25) and the alluvial community adjacent to Deep Creek (RE 11.3.4) although there is a lack of understanding around the groundwater environmental requirements of these communities. Elsewhere it is unlikely that groundwater interacts with terrestrial vegetation.

Potential impacts on GDEs will depend on the magnitude of the alteration to groundwater connection as well as the positive or negative influences additional drivers have on their condition. The magnitude of dewater ranges up to 100 mbgl and may persist for 100 years. The greatest dewatering (5 m to 100 m) occurs within the first 20 years of mine operation, and is centred around the immediate mine area between Tooloombah and Deep Creek (see Figure 16-18). The cone of depression is initially steep, reflecting the change in geology from Quaternary sediments to the outcropping Bowen basin units. Further decline in the groundwater levels propagates to the north and south for the following 80 years creating an oval shaped region of impact that is affectively confined to the Quaternary sediments.

16.12.4.1 Impacts on Waterholes – Type 2 GDEs

The groundwater system associated with the creeks is held within the shallow Quaternary sediments. Recharge to this system will be from direct rainfall, leakage from the creek during surface flow events and from the underlying Bowen basin units. It is likely the dissection of the landscape by stream flow has intercepted the shallow water tables, such that groundwater is exposed as pools, rather than groundwater discharge occurring as flowing springs.

While no long-term groundwater data exists, it is likely upstream of the tidal influence at the confluence of the two creeks, the nature of groundwater connection will vary spatially and temporally depending on the magnitude of the rise and fall of groundwater levels in response to recharge events. The depth to the groundwater associated with both creeks will increase further upstream, away from the coast. The lower reach of Tooloombah Creek is tidal and likely to be permanently connected. It is likely water ways will be permanently gaining / losing streams. During high surface flow periods, the deep-water column within the streams (>5 metres) will recharge the adjacent Quaternary sediment aquifer (losing phase). As the surface flow recedes, there will be a corresponding rise in groundwater levels and during low flow, or no flow periods, the groundwater levels will intercept the base of the stream causing groundwater inflow (gaining phase). During prolonged periods of dry weather with little to now surface flow events groundwater levels will fall, potentially becoming disconnected with the base of the stream.

Within the first 20 years (approximately) there is a predicted draw down of 20 m at sections of Tooloombah and Deep creek closest to the mine area (see Figure 16-18). Further up and downstream the change in groundwater levels is less and occurs over longer time frames, up to 80

years. Due to the uncertainty within the drawdown model outputs a simplified approach to considering the impacts of drawdown is undertaken. Any change in groundwater levels of greater than 5 m will inevitably disconnect the Creeks from the groundwater, irrespective of any seasonal recharge that may cause episodic rise in water tables. Changes less than 5 m will cause a shift in the natural cycle of gaining and losing phases, but may or may not cause permanent disconnection.

The disconnection of the streams from the groundwater is not likely to impact surface flow events downstream. The impact is related to the persistence of permanent pools within the riverine environment during low or no flow periods. A surface flow event will fill pools, that when connected to groundwater will persist longer due to the lack of drainage through the stream bed and groundwater inflow volumes. An important note is that groundwater may not provide a measurable volume of water within the pools, but may act to prevent downward leakage.

The change in the persistence and volume (depth) of the pools will adversely impact any present aquatic species. Of most ecological concern if the pools were to become dry, is the Southern Snapping Turtle, which the pools may provide critical habitat for.

Sections of Deep Creek upstream of the immediate mine area are less likely to be connected to the groundwater system (Figure 16-18), with the predicted changes to groundwater levels of only several metres occurring over many decades likely to have little impact to aquatic habitat.

16.12.4.2 Impacts to Riparian Habitat – Type 3 GDEs

Type 3 GDEs are likely to be confined to the riparian zones of Tooloombah and Deep Creek (RE 11.3.25), where the depth to groundwater will be generally less than 5 m. The dominant source of water for other vegetation communities will be direct recharge and soil water stores.

In general, there is a substantial data gap regarding the water use patterns of terrestrial ecosystems. The presence of shallow water tables, does not necessarily equate to a viable source of water. The complication is that terrestrial vegetation can have multiple sources of water: direct rainfall recharge, soil water stores, seasonal soil water from surface water flow and groundwater. The ratio of the water requirements from these four sources to a degree dictates how sensitive these vegetation types are to changes in groundwater levels. Small gradual declines in groundwater levels may not adversely impact the species water requirements, large sudden shifts in groundwater levels will cause water stress depending on the availability of other water sources. For example, if stream flow and rainfall maintain sufficient soil water stores, a change in the groundwater level may be inconsequential; however, if during a dry period, soil water stores were to become depleted and groundwater level were to decline, water stress may occur.

The area of most concern is related to areas of greater than 5 m drawdown. This may result in long-term impacts to the riparian Forest Red Gum communities, and SEVT along sections of Tooloombah Creek and Deep Creek located close to open cut mining operations. It is likely these vegetation communities will to some degree suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within these communities. It is uncertain what impact this may have as most species are expected to obtain water requirements from multiple sources including rainfall and surface flow events in adjacent creeks. This has potential to reduce the extent of habitat for fauna species in the area including that suitable for Koala, and at its worst may impact riparian connectivity along these sections of the creeks.

Semi-evergreen vine thicket occurs in several discrete patches along Tooloombah Creek adjacent to Open Cut 4 (refer Figure 16-15). It is uncertain what impact groundwater drawdown may have on this community as most species are expected to obtain their water needs from rainfall and soil water

and are unlikely to be reliant on the water table. Emergent gums, including Forest Red Gum are more likely to suffer impacts.

Brigalow is a drought tolerant species known to withstand extremely low soil water. The species is relatively shallow-rooting (often less than 2 mbgl). Water use is related to rainfall rather than potential evapotranspiration (Tunstall and Connor 1981). The shallow aquifers within the Central Queensland Coal mine area and surrounds are alluvial, and for the most part groundwater is located at least 4 m below the surface. At this level, the groundwater is not considered likely to impact Brigalow communities. No significant impacts to the wider catchments are expected.

16.12.4.3 Aquifer Salinisation

As the mine is located within parts of the Styx Basin where water table elevation is close to or at ground surface, it is expected that there will be impact on the existing interactions between groundwater and surface water, particularly in the lower parts of the valleys. Figure 16-18 shows the maximum extent of predicted drawdown (as indicated by the 0.5 m contour) associated with long term capture and discharge of groundwater by evaporative losses from the pit voids remaining after mine closure. The extent of predicted long-term drawdown provides the basis for identifying areas where reduced baseflow is expected during dry periods.

The zone of influence is predicted to extend beyond the township of Ogmore to within 5 km of Styx township. There is the potential for drawdown associated with the Project to capture some of the Styx River stream flow, in addition to flow in the tributary creeks around the Project itself. This could impact on the extent of the normal tidal influence in Styx River (i.e. extending further upstream) and brackish river water recharging the riparian zone within the predicted zone of drawdown influence. Further work will be required to assess the groundwater impacts that could arise if this were to occur.

During and following wet periods, when stream flows occur, it is probable that additional stream losses will occur within the predicted drawdown zone. In the immediate vicinity of the mine where stream reaches occur within areas having predicted long-term drawdowns of more than a few metres, it can be expected that existing baseflow may cease permanently.

Predicted changes to existing interactions between groundwater and surface water is described in Section 16.9.3 and variously throughout this chapter. The predicted impact will be on Type 1 GDEs, where they exist. Further work is required to fully assess how these types of GDEs will respond to the potential changes in groundwater quantity.

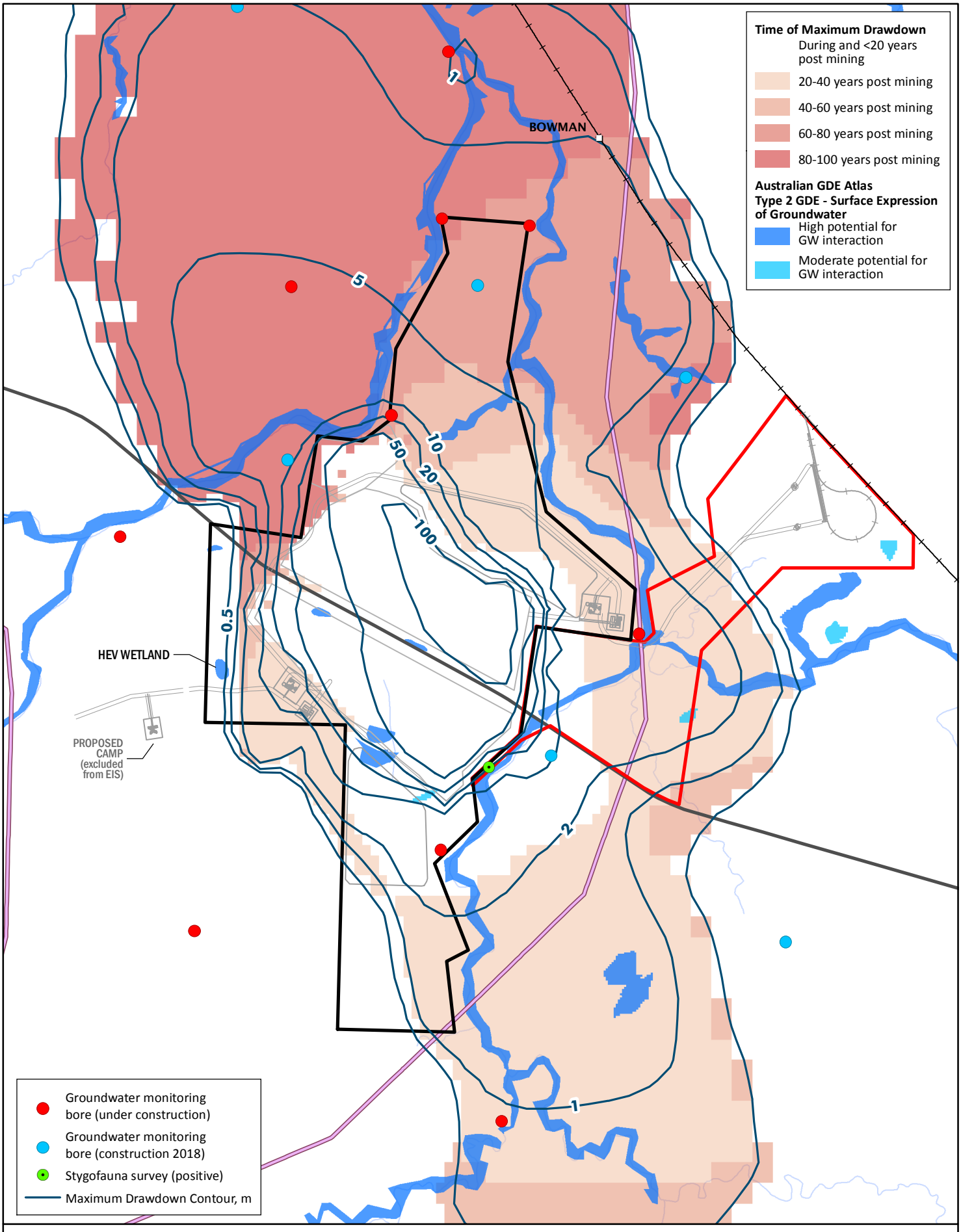
16.12.4.4 Summary

Based on the limited knowledge of local groundwater conditions and characterisation of GDEs in the area it is considered likely that permanent waterholes in Tooloombah Creek are connected to the water table. This is less certain for the waterholes in Deep Creek which may only be connected to the water table in very wet conditions and are therefore potentially more resilient to a reduction in the level of groundwater. As a result, groundwater drawdown may also have a localised impact on water levels in permanent waterholes on Tooloombah Creek and Deep Creek, potentially impacting habitat for Southern Snapping Turtle and reducing fauna access to watering points. Figure 16-18 indicates the large waterhole observed on Tooloombah Creek to the south of the highway is unlikely to be impacted by groundwater drawdown.

There are no impacts expected to GBR OUVs from groundwater drawdown associated with the Project. Coastal vegetation communities such as mangroves and saltmarsh are located outside of the area of predicted maximum groundwater drawdown.

Groundwater drawdown may result in long-term impacts to the following MNES:

- Water levels in permanent waterholes on Tooloombah Creek (and potentially Deep Creek) that are connected to groundwater may decline in those areas closest to open cut mining occurs and drawdowns of 5 m to 50 m are predicted to occur. These waterholes provide habitat for the Southern Snapping Turtle (Critically Endangered – EPBC Act);
- Riparian Forest Red Gum communities in these same areas may also suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within this community. These habitats provide foraging habitat for Koala (Vulnerable - EPBC Act); and
- Patches of SEVT (an Endangered TEC) habitat in these same areas may also suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within this community.



N

0 0.5 1 km

Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- Styx Basin
- North Coast Rail Line
- Main road
- Watercourse

Scale @ A4 1:60,000
Date: 15/09/17
Drawn: Gayle B.

Figure 16-18
Maximum predicted groundwater drawdown impacts on GDEs

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

16.12.5 Dust

Airborne dust may be generated by construction activities, operational stockpiles and transport activities. Vegetation within and surrounding the Project area, including TECs, has the potential to be adversely impacted by the application of high dust loads. Increased dust can result in respiratory issues in fauna, adverse impacts on plant photosynthesis and productivity (Chaston and Doley 2006), changes in soil properties ultimately impacting plant species assemblages' (Farmer 1993), and mortality and / or decrease in aquatic health on aquatic communities from the toxicity of poor water quality. Evidence of potential impacts on entire vegetation communities is scarce. Many studies focus on specific impacts to single species. Recent research on threatened flora in a semi-arid environment in Western Australia found no significant impact on plant health because of a range of dust accumulation loads caused by vehicle movements (Matsuki et al. 2016). Studies conducted by Connell Hatch (2008) into the impacts of coal dust deposition on cotton crops recorded a dust deposition rate of 500 mg/m^2/day as the threshold level for adverse impacts.

The predominant wind directions from the region are as follows: from the north and northeast during spring; north, northeast and southeast during summer; in autumn, the winds are primarily from the southeast; and southerly and southeast winds are more frequent during the winter season (refer Chapter 4 – Climate for more information). Vegetation in the vicinity of Project activities has potential to be impacted during construction works for infrastructure such as access roads and the raw water dam. This includes Tooloombah Creek (and associated patches of SEVT vegetation) and Deep Creek and the adjacent Tooloombah Creek Conservation Park. Dust deposition may also impact waterholes along creeks impacting potential habitat for Southern Snapping Turtle.

There may be some potential for dust impacts on Deep Creek due to its proximity to mine infrastructure. Deep Creek is located approximately 250 m from the eastern edge of open cut 1 mine area and the southern spoil dump. The south eastern corner of the open cut 2 is located 500 m away from Deep Creek and the adjacent spoil dump is located between 300 m and 400 m from the creek. The northern MIA (MIA 2) is located approximately 250 m from Deep Creek. The coal conveyor runs adjacent to Deep Creek including utilising the existing highway bridge. Coal dust spillover from the conveyor may impact the adjacent waterway impacting potential habitat for Southern Snapping Turtle. Vegetation along Deep Creek may also provide preferred foraging habitat for Koala due to the presence of Forest Red Gum.

Modelling of the potential impacts of dust deposition has been carried out (refer Chapter 12 – Air Quality). Dust deposition during both construction and operation are well below air quality threshold criteria (as administered under the Queensland EP Act) with no 24 hr dust deposition rates of more than 2 mg/m^2/day predicted during Project operation at any of the local receptor sites used for the modelling. Predicted annual average dust deposition rates due to the Project, with and without ambient background concentrations, are well within the amenity guideline at all sensitive receptors. With recommended mitigation measures, these concentrations can be reduced further below threshold standards and it is considered unlikely there will be any significant effect on vegetation surrounding the Project.

The Styx River and the wetland areas within the GBRWHA boundary are located to the north of the township of Styx which is approximately 10 km north of the Project (refer Figure 16-13). The closest modelled sensitive receptor to this location is Ogmore township, which is approximately 5 km closer to the Project. The maximum predicted daily dust deposition generated by the Project activities at this sensitive receptor is 0.02 mg/m^2/day which is much lower than the threshold criteria of 120 mg/m^2/day. Therefore, dust deposition impacts from the Project on the wetlands and waters of the GBRWHA are considered negligible at worst.

Upon decommissioning, all potential dust generating areas will be rehabilitated and revegetated, and dust is unlikely to cause further impacts.

16.12.6 Pests and Weeds

Pests and weeds may pose a significant threat to MNES values within and surrounding the Project area, including TECs and habitat for threatened fauna and direct predation. Introduced grasses dominate the ground layer in many areas because of the long grazing history within the Project area. Much of the remaining remnant vegetation habitat already contains a high proportion of introduced grass species and woody weeds (Lantana and Rubber Vine), particularly in the vicinity of creek lines. Olive Hymenachne, which has the potential to infest wetland areas and was observed at two wetland sites. Other problem weed species such as Parthenium, also toxic to cattle, is presently limited in extent having only been recorded on Tooloombah Creek. Any potential introductions of weeds and pests as a result of Project activities (including construction and operational phases), particularly transportation and operation of construction vehicles and equipment, will therefore need to be managed.

No impacts are likely once the decommissioning phase has been completed.

16.12.7 Fire

Fire is a natural part of the Australian landscape, and most vegetation communities are adapted to periodic fires. However, changes in the natural fire regime may result in changes in the species composition and / or structure of the vegetation.

Project activities are not inherently likely to cause fires, although there is potential for coal stockpiles to combust. In regard to the rehabilitation and decommissioning phase of the Project, spontaneous combustion is considered a low risk of occurring. It has been considered as it is a potential issue associated with final voids, particularly where coal seams (and other carbonaceous materials) are left exposed (that is not capped or covered). There is also the possibility that a bushfire occurring post-closure could ignite the remaining or redundant coal seams if they are near the fire.

Within the vicinity of mining activities, the majority of remaining remnant vegetation is woodland with a grassy understorey and is subject to cattle grazing, which under normal grazed circumstances would also be relatively resistant to carrying fires. All vegetation along the haul road and the TLF area consists of cleared lands and is grazed apart from habitat on and adjacent to the haul road crossing of Deep Creek and Barrack Creek. A potential hazard exists if grassy woodlands remain ungrazed for some time and develop high fuel loads that could carry fires under dry conditions. Woody weeds such as Lantana, which is common along and close to drainage lines in the area, provide additional risks by increasing potential fire fuel loads in these areas impacting potential Koala habitat. Such fires may also be damaging to Brigalow or SEVT if occurring frequently or at high intensity.

16.12.8 Noise

Noise and vibration levels will remain elevated after construction when mining commences, although these will be more constant and less intermittent. Sources include primarily movements of haulage trucks, operation of coal handling equipment (including conveyors), open cut mine blasting and train loading. Blasting will remain as part of the open cut operations but will be on a very intermittent basis

Understanding of the impacts of noise on fauna is limited. There are no current government policies or guidelines that recommend thresholds or limits in relation to fauna. Noise may adversely affect wildlife by interfering with communication, masking the sound of predators and prey, causing stress or avoidance reactions, and in some cases, may lead to changes in reproductive or nesting behaviour. Excessive noise may lead some species to avoid noisy areas, potentially resulting in the fragmentation of species habitat. Radle (2007) states the consensus that terrestrial fauna will avoid any industrial plant or construction area where noise or vibration presents an annoyance to them. Additionally, many animals react to new noise initially as a potential threat, but quickly 'learn' that the noise is not associated with a threat (Radle 2007). Currently, the Project area would experience noise and vibration levels typical of rural areas, with natural sounds, such as bird calls generating most noise. Farm machinery and rural traffic would cause occasional elevated levels in localised areas.

Construction, operation, and closure of the Project will result in increased noise from traffic, machinery, blasting, piling, and the presence of personnel, primarily in the MIA, open cut mine pits haul road and TLF. If noise or vibration is intermittent, fauna may pause their activities or flee the area. Conventional blast methods and piling employed during construction will create a higher level of intermittent noise and vibration pulses which could potentially disturb fauna. However, blasting and piling would only occur during daylight hours during the construction and operation phase of the Project.

Many fauna species, particularly birds, are likely to become habituated to constant background noise due to routine mining and processing operations. In addition, most noise will attenuate relatively quickly with increasing distance, while the local hilly topography will act as a barrier to noise generated by the mine and associated facilities. Noise modelling (refer Chapter 13 – Noise and Vibration) indicates that operational noise levels below 60 dB are not expected to cause adverse responses in fauna. The relatively low level of impulsive or low frequency noise at a distance from operations is also not likely to impact fauna. The noise and vibration from haul truck movements could potentially produce the most likely occurrence of impact on fauna located near the transport corridor.

The generation of construction and operational noise, within the Central Queensland Coal mine area, will largely be in cleared areas in which Squatter Pigeon and Ornamental Snake may occur. It is likely that individuals that occur on the site will leave the immediate area of impact. During operation, the species may become habituated to adjacent habitat following completion of construction disturbance. Other significant fauna habitat nearest to construction and operation noise sources is likely to be adjacent to the southern waste rock dump and along the haul road where intact vegetation communities provide habitat for Greater Glider and Koala. Given Koala occurs in urban habitats it is considered unlikely noise will be a significant impact on this species. With measures to mitigate noise impacts implemented as part of the Project design and management noise is not expected to cause a significant impact to MNES fauna in the area.

16.12.9 Lighting

Artificial lighting from infrastructure and machinery may impact fauna within the Study area during construction and operation. Artificial lighting may have a range of impacts across different groups of taxa and between species within these groups. Rodents may avoid brightly lit areas at night. Frogs and nocturnal reptiles may congregate at artificial lights to feed on insects attracted to light (Perry et al. 2008). Similarly, many microbat species may congregate at artificial lighting (Rich and Longcore 2006), although other species may avoid well-lit areas (Threlfall et al. 2013). Species such as Sugar Glider (*Petaurus breviceps*) have been experimentally shown to reduce foraging time under artificial lighting (Barber-Meyer 2007), although whether this effect occurs in natural situations is

unknown. Known impacts on birds include disruption of migratory patterns and choice of nest sites (Longcore and Rich 2004).

There are few if any studies to suggest the fauna inhabiting the woodland around the Project area will be impacted to more than a minor extent. As suggested by the evidence above there will be differing responses between species or taxa group with some responses considered quite benign (e.g. microbats and other taxa attracted to night lighting). Habitat around the Project area is largely cleared or woodland with a limited suite of species present. Significant fauna habitat nearest to the CHPP / MIA 2 area is likely to be Forest Red Gum habitat which may support Koala. This species was also observed onsite in Poplar Box woodland which will remain adjacent to the open cut areas. Non-remnant areas containing regrowth Brigalow and gilgaied habitat surrounding the CHPP / MIA 2, Open Cut 2 and the adjacent waste spoil area may provide habitat for Ornamental Snake. Squatter Pigeon occurs in woodland as well as cleared grassy habitat in the area but it is uncertain what impact lighting will have on this species. Koala may occur, although given the species occurs in suburban habitats Project lighting is not expected to impact this species. With informed lighting design, this habitat will be at a distance where light levels would have attenuated to levels where they are unlikely to be causing a significant impact to fauna.

16.13 Mitigation and Management Measures

Mitigation measures have been developed to minimise impacts associated with construction and operation of the Project. Mitigation strategies have been developed based on the following criteria:

- Avoid potential impacts where possible;
- Minimise the severity and / or duration of the impact; and
- Offset unavoidable impacts.

The recommended mitigation measures to ameliorate potential impacts to MNES associated with the Project are outlined in the following sections.

16.13.1 Vegetation Clearance and Degradation

To minimise the need for clearing, and to mitigate the impacts, the following measures have been incorporated into the environmental management strategy:

- Continuing refinement of the design of the mine and infrastructure design is expected to avoid any direct impact to TECs within the mine footprint;
- To avoid unnecessary vegetation clearing or risk of damaging vegetation, any occurrence of Brigalow or SEVT community within the vicinity of construction works will be fenced off and appropriately marked as a No-Go Zone to site workers;
- The Project is located on the Mamelon property. Mamelon encompasses a total area of 6,478 ha of which the Project footprint covers 1,070 ha. CQC have proposed destocking the majority of the property and restricting cattle access to already cleared habitat in the south-west and south of the property. This area encompasses approximately 1,000 ha. The remaining area, including the creek lines which lie adjacent to the mine area, will be managed and allowed to regenerate;
- Where vegetation clearance is required, then clearance will only take place once a Permit to Clear has been issued by the site environmental officer;

- All clearance will be carried out under ecological supervision;
- Revegetation of any exposed surfaces will be undertaken as soon as practicable, using native species where appropriate;
- All workers will be briefed on the importance of TECs, their location and procedures for working around them, as appropriate; and
- The site will be subject to a progressive rehabilitation program throughout the life of the Project that will seek to reinstate previously occurring vegetation communities present, thereby reinstating TECs and habitat for MNES fauna where present on the site.

16.13.2 Mortality and Injury

Workers at the site will be instructed to stop where feasible, when fauna are observed crossing roads and tracks. All clearing works will be supervised by a qualified fauna spotter catcher in all remnant habitat. Speed limits will be in place on all roads throughout the Project area and set at levels which minimise the risk to fauna. All staff / contractors will be educated on the occurrence of MNES species (such as Koala) and local fauna in the area and encouraged to observe strict speed limits outside of the Project area when travelling to and from the Project, particularly during the night. Signage would be provided in areas of concern. Should a Koala be found in a working area then works will stop and an appropriate handler called in to relocate the animal to a place of safety.

During operations, speed limits will be in place on all roads throughout the Project area.

Appropriate fauna infrastructure such as an underpass / culvert and Koala-proof fencing would be provided along the haul road crossing of the riparian corridor along Deep Creek and Barrack Creek to avoid fauna from venturing onto the road within Koala habitat. This fencing will also function to 'funnel' fauna under the crossing culvert / bridge.

The Project LUMP will include other general measures to mitigate impacts to fauna such as:

- Prior to any vegetation disturbance a trained ecologist or other qualified environmental specialist will be onsite to remove fauna (if required). Hollow-bearing trees will be marked and hollows inspected for the presence of arboreal fauna prior to tree-felling. Construction areas that pose a risk to fauna will be fenced off where practical;
- The Project LUMP will include measures for monitoring and record wildlife road collision incidents throughout construction and operation to help remediate 'high risk' collision areas, potentially involving installation of additional fencing and passages, and set conditions for attending to injured native wildlife;
- Appropriate speed limits will also be in place throughout the site and all contractors will be educated on the risks to local fauna to minimise impacts when driving;
- Fauna infrastructure (such as barriers and underpasses) will be installed along the haul road where it intersects with a potential fauna corridor (Deep Creek / Barrow Creek area) to reduce the likelihood of collision with vehicles. Fauna infrastructure design will be informed by the latest design considerations such as DTMR's Fauna sensitive road design manual Vol 2 (QG 2010); and
- To reduce the risk of mortality to native wildlife, no domestic animals will be allowed onsite.

Significant Species Management Plans will be developed and implemented for MNES fauna species known or likely to occur on the site. The plan will identify potential impacts on these species (including identified habitat) because of Project activities from throughout the life of the Project (construction, operation and decommissioning). The Plan will detail specific management measures to mitigate the potential impacts and will incorporate adaptive management principles to allow for the adoption of new measures where necessary as the Project progresses.

16.13.3 Change in Surface Water Quality and Hydrology

Mitigation measures related to surface water are detailed in Chapter 9 – Surface Water. A detailed REMP will be developed and implemented and will include monitoring of surface water quality in key targeted locations throughout the life of the Project including before construction. The REMP will be developed in accordance with EHP Guidelines and will be periodically updated as required throughout the life of the Project. The REMP will also be designed to include monitoring measures associated with the GDE monitoring program outlined in the Section 16.13.4.

Areas of disturbed or exposed soil will be managed so that the loss of sediment is minimised, such as minimising the areas of exposed soil, not exposing soil or undertaking clearing or earthworks during rainfall events. In addition, a minimum number of heavy equipment would be used and a minimum number of passes by heavy equipment will be employed to help minimise land disturbance, erosion and dispersion of soils.

The design of the creek crossings along the haul road will be undertaken such that impacts on surface water, both upstream and downstream, are minimised. Flow in the creeks crossed by the corridor are expected to be intermittent, at best, given their position high in the catchment. As such, it is not anticipated that the haul road will have an impact on vegetation communities or downstream MNES because of surface water impacts.

The Project is located on the Mamelon property. Mamelon encompasses a total area of 6,478 ha of which the Project footprint covers approximately 1,070 ha. CQC have proposed destocking the majority of the property and restricting cattle access to already cleared habitat in the south-west and south of the property. This area encompasses approximately 1,000 ha. The remaining area, including the creek lines which lie adjacent to the mine area, will be managed and allowed to regenerate. This measure will contribute to localised water quality improvements, and contribute to improving the water quality entering Broad Sound and the GBRWHA through the following:

- The long-term restoration of this habitat, and in particular allowing vegetation to regrow along the riparian zones along Deep Creek and Tooloombah Creek (which are presently mostly cleared), will capture / entrain sediment and nutrient run-off from the property;
- The restoration of cleared areas will also reduce soil erosion on cleared areas of the property, thereby reducing the entrainment of sediments entering creek lines during bouts of heavy rainfall; and
- The removal of cattle from much of the property will also remove a source of long-term nutrient input into creek lines following rainfall.

The Project will be subject to a WMP including the following mitigation measures:

- Bunding of chemical storage facilities and appropriate storage of chemicals according to AS 1940 - 'The storage and handling of flammable and combustible liquids';
- Spill containment kits located onsite and near likely impacted waterways;

- Locate and design roads and other built infrastructure so that minimal run-off to waterways occurs;
- Disturbed or exposed soil will be managed so that the loss of sediment is minimised, such as minimising the areas of exposed soil, not exposing soil or undertaking clearing or earthworks during rainfall events;
- The mine dewatering dam is located outside of any drainage area and will be designed to a 1 in 1,000 AEP standard flood event (spillway capacity);
- The redirection of all mine affected runoff and mine affected waters are made to appropriately managed environmental dams / sediment ponds which have been designed to capture the 1 in 100 year AEP standard flood event (spillway capacity);
- Retention Basins to allow a pre-treatment of water and wastewater prior to discharge into the aquatic environment. The discharge of wastewater and stormwater will be similar to water quality of receiving waters and in accordance with the water quality objectives for the Styx River Basin for lowland waters; and
- Discharge (if any) of treated wastewaters to receiving water will occur during wet periods where possible.

The design of the creek crossings along the haul road has been undertaken such that impacts on surface water, both upstream and downstream, have been minimised. The bridge and culvert crossing designs will limit afflux change and will result in no change to downstream flows or direction. As such, it is not anticipated that the transport corridor will have an impact on vegetation communities or downstream MNES habitat (such as for Southern Snapping Turtle, Estuarine Crocodile and GBRWHA waters) because of surface water impacts.

The Project will also be subject to an ESCP. The ESCP is to be certified by a suitably qualified person and will be approved by the appropriate authority prior to the commencement of works. The plan will include as a minimum the following control measures:

- Sediment fences will be installed along the down slope sides for any disturbed areas experiencing runoff;
- Site drainage will divert all clean water runoff around disturbed areas;
- Erosion control devices will be installed in diversion drains; and
- Construction works will only disturb the minimal amount of land required for operation.

In addition, the following management measures will be implemented to minimise the risk of pollutants and contaminants entering local water ways:

- The proponent will ensure that that all construction machinery is maintained to minimise the risk of spill or leakage;
- All refuelling facilities and the storage and handling of oil and chemicals will be in appropriately designed sites and will comply with relevant Australian Standards. Procedures will be established so fuel, oil and chemical are storage and handled to Australian Standards. These materials will be stored within bunded areas with a storage capacity of 100% of the largest vessel and 10% of the second largest vessel. The bunding will have floors and walls that are lined with an impermeable material;

- Appropriate spill control materials including booms and absorbent materials will be onsite at all times. These will be used for mitigating and managing events where a substance is spilled into the surrounding waters; and
- Wash-down areas for plant and equipment will be clearly marked to prevent contaminated water from leaching into soils or flowing into nearby watercourses.

16.13.3.1 Reef 2050 Long-term Sustainability Plan

The ToR requests it be demonstrated how the proposed action will provide a net benefit to water quality in the GBRWHA and is consistent with the objectives of the *Reef 2050 Long-term Sustainability Plan* (GoA 2015) including the following reductions (based on a 2009 baseline) in sediment, nitrogen and pesticide loads in 'priority areas':

- Reducing dissolved nitrogen loads by at least 50 per cent in priority areas, on the way to achieving up to an 80 per cent reduction by 2025;
- Reducing sediment loads by at least 20 per cent in priority areas, on the way to achieving up to 50 per cent reduction by 2025;
- Reducing end-of-catchment particulate nutrient loads by at least 20 per cent in priority areas; and
- Reducing end-of-catchment pesticide loads by at least 60 per cent in priority areas.

The Plan also sets out a number of other actions that are applicable to the Project including the following:

- Working with industries to measure management efforts to achieve best practice water quality management; and
- Reviewing and developing water quality objectives, targets and standards across the region.

Surface water quality sampling for the Project (2011 and 2017) recorded the following background data from the surface waters adjacent to the Project:

- Turbidity and suspended solids loads were generally low and below water quality objectives set for the Styx River catchment. High levels of turbidity and suspended solids were recorded in two large waterholes in Deep Creek (in February 2017) following an extended dry period and no flow conditions; and
- High levels of total nitrogen, ammonia and phosphorus were recorded (above local water quality objectives) across most sites in Tooloombah Creek, Deep Creek and the Styx River in June 2011 and February 2017.

It is also known that the waters of Broad Sound are naturally turbid and low in nutrients due to the large tidal range in the area (De'ath and Fabricius 2008).

The Project is in the lower catchments of both Tooloombah Creek and Deep Creek. It is uncertain to what extent the Project area currently contributes to sediment or nutrient loads entering the creeks. It is noted that the entire Project area is subject to cattle grazing (thereby contributing to nutrient run-off) and comprises areas of dispersive and sodic soils that are prone to erosion (as evident during site inspections). Cattle will be excluded from the majority of the Property and vegetation will be allowed to regenerate in cleared areas, thereby reducing potential nutrient loads and sediment from bank erosion entering local waterholes.

The mitigation measures detailed above in the previous sections are designed to at least maintain background water quality in the adjacent creek lines. The implementation of a REMP will also provide continuous data on local water quality in the Styx River catchment which was not previously available. The Project site layout and design will necessarily reduce the local catchment impacts through a reduction in catchment area. The removal of cattle and restoration of cleared habitat surrounding the mine will also reduce these impacts. With the reduction in catchment run-off area and proposed mitigation and monitoring measures the Project has the potential to provide a net benefit to water quality in the GBRWHA.

16.13.4 Change in Groundwater

16.13.4.1 Groundwater General

A detailed WMP will be established for the Project. This will include establishing shallow groundwater monitoring bores and monitoring existing landholder bores located within the likely zone of mine influence. CQC is currently installing ten Project-associated bores to expand the knowledge of local groundwater conditions and monitor the potential for future impacts (refer Figure 16-18). Further additional Project bores are planned for installation in 2018. The location / configuration of monitoring bores together with the landholder bores, has been designed to provide sufficient coverage for the Project and surrounding area to detect and monitor groundwater effects from the Project. Based on the information collected during the first few years of mining, a need for expansion or rationalisation of the monitoring network may be identified.

Groundwater monitoring will include the following:

- Mine water inflow monitoring will consist of daily measurements of all water pumped from the mine pit;
- Quarterly field measurements of EC and pH and total petroleum hydrocarbons (TPH) of groundwater from the monitoring bores located on the mine lease and monthly field measurements of the same parameters for water pumped from the mine;
- Quarterly field measurements of EC and pH of groundwater from the monitoring bores located off the mine lease;
- Six monthly sampling of groundwater from monitoring bores and selected landholder bores for laboratory analyses of major ions, TDS and metals using methodologies that are suitable for comparison with the baseline monitoring; and
- Where groundwater quality impacts are identified, monitoring may be intensified to include the analysis of potentially harmful substances associated with oil, fuel and chemical handled onsite (e.g. benzene, toluene, ethylbenzene and xylenes).

The current model of groundwater drawdown is based on limited groundwater data and its results are therefore of 'low confidence.' Of note is the lack of time series groundwater level monitoring data and aquifer testing data for the different hydrostratigraphic units that are critical in the development of aquifer properties during the calibration of the groundwater model and to the understanding of groundwater and surface water interactions. While groundwater monitoring of landholder bores has been ongoing, these bores are not located in optimum positions, therefore a further ten Project-related bores are being installed to further inform the modelling that will be done to inform the SEIS and to form part of the ongoing groundwater monitoring regime to be described in the Projects WMP. These bores are strategically located to improve the spatial distribution of groundwater monitoring, with eight of these adjacent water ways.

In the long term monitoring of these bores will allow for a better understanding of local groundwater conditions and observations regarding actual drawdown caused by mining activity. Data collected from the WMP in the first years of mining will be used to verify the groundwater drawdown model predictions and, if necessary, provide a basis for recalibration of the groundwater model. As mining progresses, a need for further model updates will be assessed every twelve months based on quarterly reviews of groundwater monitoring data and findings of impact verification. It is expected the confidence level of model predictions will increase over time as the model is updated to reflect the observed effects on groundwater from the monitoring program.

In the first instance however, data from the bores will provide a critical dataset to assess key assumptions regarding groundwater connection with surface water systems. The assessment of the presence of GDEs is largely based upon existing desktop evaluations of the landscape setting, ecosystem type and hydrology (near permanent pools) and currently suggests there is a groundwater contribution. At this stage, this assumption has not been validated with field based groundwater data.

Groundwater level data from the bores will be used to evaluate the:

1) Hydraulic gradient between the shallow groundwater adjacent to the creeks and the surface water level within the creeks. The impact that dewatering may have on the groundwater supply to the GDEs, depends largely on the understanding the nature of groundwater and surface water connection. This process will involve installing gauges within the pools of Tooloombah and Deep Creeks.

   For the permanent pools to be connected to the groundwater a positive gradient from the groundwater to the creek is required. If a negative gradient exists (the elevation of the groundwater is lower than the elevation of the water within the creek) then groundwater inflow is less likely (and this needs to be evaluated both intra- and inter-annually. If a positive gradient exists then groundwater inflow is likely. There are several possible groundwater and surface water connection relationship, they are:

   - The creeks are disconnected from groundwaters in the area of investigation – where groundwater levels remain lower than the creeks, such that there is no connection between the groundwater and the creek bed and an unsaturated zone exists
   - The creeks are connected to the groundwater but receive no groundwater inflow - where groundwater levels are equal to or lower than the creek, such that the movement of water is from the creek into the groundwater and
   - The creeks are connected to the groundwater and groundwater inflow occurs – in this case the creeks may be a) permanently connected such that there always exists a positive hydraulic gradient to the water level in the creek and permanent inflow of groundwater, or b) the gradient may alternate (+ to -) such that the nature of groundwater connection has a temporal element, switching from gaining to losing depending on climate conditions.

2) The rate of groundwater inflow into the creeks. It is important to note, that determining the nature of groundwater connection (point 1) does not provide actual groundwater inflow volumes, additional information pertaining to aquifer hydraulic properties is required. The rate and volume of groundwater inflow into the creeks is the combination of the existing hydraulic gradient, effective porosity and the hydraulic conductivity of the surrounding aquifer. Testing of aquifer properties of the newly installed bores will enable groundwater inflow calculations to be made.

3) Additional water chemistry sampling and analyses from the groundwater and surface water can assist in identifying the timing of groundwater inflows and the volume of groundwater inflow. It is likely the chemistry of the groundwater and surface water is different. End member analyses, and isotopic signatures (stable and non-stable) can be used to identify groundwater inflow as it mixes with surface waters.

16.13.4.2 GDEs

Although there is uncertainty in the modelling of groundwater drawdown outputs, and regarding the nature of groundwater connection it remains likely these landscapes comprise GDEs and that access to groundwater will be compromised due to drawdown. This is of most concern within the riverine environments of Tooloombah and Deep Creeks.

The practice of supplementary surface water flows to maintain riparian vegetation health is widely used as a management tool in providing environmental flow requirements to waterways and wetlands across Australia. In most cases, environmental flow programs are established where the 'natural flow' of a system has been altered by water diversion, reservoir or dam constructions. The implementation of a supplementary water program for the Project will need to consider the nature of connection between groundwater and the creeks and terrestrial GDEs. This relationship will become more apparent after information has been gathered from the newly installed groundwater bores. Supplementary surface water flows should aim to simulate the natural pattern of environmental flows or offset drawdown of the water table by providing additional recharge to the root zone of riparian vegetation to replenish the shallow groundwater stores at times when groundwater is intermittently accessed by the vegetation. This process would require an evaluation of the frequency and size of flows that would generate sufficient inflow to maintain the depth of the pools within the creek that persisted during low flow periods and infiltration and recharge to the water table, as to maintain appropriate groundwater levels necessary to maintain the riparian condition.

Further understanding of the hydrological function of the identified GDEs in the area is required to develop mitigation measures including the following:

- Environmental water requirements of the GDEs such as minimum water depth and pool size to maintain a healthy aquatic environment, and the likely water demand to riparian vegetation provided by surface flows compared with deeper groundwater;
- Knowledge of the conductance properties of stream bed material will help determine the rate at which pools receive groundwater (during the wet phase) and the rate at which the pools lose water due to leakage to the groundwater (during dry phases) as this depends on the hydraulic properties of the stream beds; and
- The water budget of the pools. Understanding the relationships between the frequency of surface flow events and persistence of in-stream pools is important, as it may indicate that pools can be maintained (irrespective of groundwater inflows) through managed environmental flows. It will also be important to understand if the presence of shallow groundwater provides a volume of water required and / or provides a buffer to stream leakage.

The success of providing supplementary flows can be measured by monitoring the condition of the target 'end point' of the system, in this case the riparian vegetation communities. The hypothesis proposed is that a portion of the water requirements of the riparian vegetation is provided by shallow groundwater, predominantly during dry periods when stream flows are absent. Wetland and stream health and vegetation monitoring will be implemented as part of the LUMP and REMP.

This will include at a minimum the following measures:

- Ongoing assessment and monitoring to address the knowledge gaps identified above and allow a greater understanding of GDE function in the area including a baseline water source study of the riparian vegetation to determine the nature of groundwater uptake. This would require a combination of soil, water and tree analyses to assess water use patterns, and the seasonal source of water;
- Monitoring of water levels and water chemistry in permanent waterholes on Deep Creek and Tooloombah Creek, particularly those identified as potentially impacted by severe groundwater drawdown near mining operations;
- Monitoring of local groundwater levels and chemistry in areas associated with Deep Creek and Tooloombah Creek; and
- Monitoring of riparian vegetation health along Deep Creek and Tooloombah Creek in those areas identified as potentially impacted by severe groundwater drawdown.

As drawdown depends on a range of factors, its impacts will need to be managed adaptively. Adaptive management will involve monitoring groundwater impacts and, based on the severity of impacts, implementing appropriate mitigation measures to minimise impacts on existing groundwater EVs as mining takes place.

With an understanding of the hydrological function of the waterholes in the area and environmental water requirements of the instream ecosystems, as well as ongoing surface and groundwater monitoring, trigger levels will be established for the depth of waterholes that are required to maintain a healthy istream environment. These levels will incorporate the combination of stream flow inundation and groundwater inputs. It is likely that theses triggers will represent the low flow period of the creeks, when groundwater inputs represent a larger % of the waterholes water budget. Where water levels decline below the trigger it is assumed that this is occurring because of groundwater extraction and dewatering. At this point a Project supplementary water program will be initiated to maintain waterhole depth at a level that will sustain ecological function. Supplementary water is likely to be derived from treated mine water and will be within the water quality objectives set for the lowland waters of the Styx River.

As a last resort, where vegetation communities are found to be unavoidably impacted by groundwater drawdown these areas will be subject to the Project Biodiversity Offset Delivery Plan (ODP).

16.13.5 Dust

Dust is not anticipated to significantly impact aquatic and terrestrial habitat in the area surrounding the Project. Nevertheless, vegetation communities and waterholes may be at risk from dust deposition issues such as riparian vegetation along Deep Creek and Tooloombah Creek, particularly those close to Project infrastructure such as the conveyors on Deep Creek. This has potential to impact MNES such as SEVT communities along Tooloombah Creek, riparian Forest Red Gum habitat most suitable for Koala and stream habitat for Southern Snapping Turtle.

A vegetation monitoring program will be implemented as part of the Project LUMP and will include measures to monitor the health of vegetation communities considered to be at risk from dust deposition issues. The Project REMP will also include water quality monitoring of at risk waterholes on the creeks. Results of the vegetation / water quality monitoring will be used to inform adaptive management of mitigation measures where impacts are found to be occurring.

The following measures have been developed to ensure dust levels resulting from the Project are kept to a minimum:

- The coal conveyor will be covered (although not fully enclosed) and will incorporate 'spill protectors' along the sides for the entire length of operation to minimise fugitive coal dust emission;
- Areas which have the potential to give rise to airborne dust such as unsealed roads, tracks, spoil areas and coal stockpiles will be wetted down regularly using water from environmental dams;
- Speed limits will be implemented throughout the site to minimise dust generated;
- Areas stripped of topsoil for Project construction will be rehabilitated as soon as practicable where not required during operations;
- Regular cleaning of machinery and vehicles tyres to prevent wheel entrained dust emissions;
- Design haul roads to have a less erodible surface, particularly where adjacent threatened fauna habitat occurs, such as using materials with a lower silt content and / or applying chemical dust suppressants or paving used for haul roads; and
- Further dust suppression mitigation measures are discussed in Chapter 12 - Air Quality.

16.13.6 Pests and Weeds

Threatened species habitats, as well as threatened plant species potentially occurring within the Project area, may be susceptible to impacts from weeds. The potential impacts and mitigation measures would be like those described for TECs.

One of the key threats to Ornamental Snake is contact with Cane Toads. Cane Toads are already prevalent in the Project area, and will have been present in the area for a long time. The Project may provide additional habitat for Cane Toads in the water storage (environmental) dams to be constructed for the Project. However, it is considered that given their presence within the Project area, which already contains several farm dams suitable for Cane Toad breeding, it is unlikely that the Project would significantly promote the presence of Cane Toads relative to numbers already present.

Key identified pest threats to Squatter Pigeon (as well as many native fauna species) include predation by Red Fox (*Vulpes vulpes*) and feral Cats (*Felis catus*), land degradation caused by European Rabbits (*Oryctolagus cuniculus*), and tramp ant invasion (refer Table 16-25). Rabbit were encountered within the mine site area during surveys and cats were identified in the wider area during spotlighting surveys. Dingo (*Canis lupus dingo*) has been encountered in the area during previous surveys – a known predation risk for Koala.

Mitigation measures to limit attraction of the Project area to predators (e.g. appropriate waste management and limiting shelter sites) will be part of the LUMP. The presence of the mine is not considered likely to be conducive to increases in the abundance of Rabbits in the landscape and the surrounding area will remain open for cattle grazing. The LUMP will also ensure there is no likelihood of the importation of tramp ants into the area, which is most likely through the importation of construction machinery. It is considered unlikely that Project activities would introduce a new pest species or promote a population increase in pest species that are known to be present.

Weed and pest management will be an important and integral part of proposed site management activities, and will be detailed in the Project LUMP. This Plan will include measures and monitoring to be developed and managed in accordance with the requirements of the Biosecurity Act, and will include the following measures:

- Implementation of sediment control mechanisms to minimise the risk of weed seed washing into waterways;
- Implement control strategies outlined in the Department of Agriculture and Fisheries (Qld) (DAF) weed and pest animal fact sheets and other relevant Commonwealth State and local Government biosecurity management strategies;
- Pre-construction weed mapping be undertaken to accurately determine the extent of weeds and pests;
- Vehicle wash down procedures;
- Minimise the use of off-road vehicle movements;
- Onsite waste disposal strategies (particularly for food wastes) to be employed that will not encourage the presence of pest fauna;
- Cattle will be excluded from Tooloombah Creek and Deep Creek within lands controlled by Central Queensland Coal thereby reducing potential weed introduction / spread. The buffer will include riparian vegetation a minimum of 100 m from the centre line of the creek bed;
- Strategies for the storage of construction and operation materials / equipment to be employed that will not encourage the presence of resident pest fauna;
- Regular onsite inspections of site infrastructure / equipment for resident pest fauna and establishment of register for pest sightings; and
- Monitoring and weed and pest inspections particularly in responses to reported outbreaks or from complaints or adjacent property owners.

Waste storages are not likely to have significant impacts on native flora and fauna within the Study area, as all waste produced because of the Project will be stored and disposed of appropriately, as per the relevant legislation.

16.13.7 Fire

Fire management is an essential component to all coal mining operations and as such, the following measures have been developed to reduce the potential impacts of a site fire:

- Fire management measures for the Project will be developed and implemented within the LUMP prior to construction;
- Specific onsite smoking areas will be designated;
- Onsite burning of any material will be managed via a Risk Assessment;
- Reduced fuel and fuel free zones will be maintained surrounding facilities;

- Fire-fighting equipment will be regularly maintained and adequate staff training will be implemented. Training and equipment will address fighting fires on facilities, as well as for fighting wildfires; and
- Weed management to prevent habitat degradation and potential increased fire risk.

Should instances of spontaneous combustion occur during mining operations, the details of the materials involved, presence of pyrite, location, date, time and climatic conditions will be recorded on the mine survey plans. These areas will be assessed at closure to ensure appropriate mitigation measures are in place to minimise the likelihood of spontaneous combustion occurring post-mine closure.

16.13.8 Noise

Noise is not expected to have a significant effect on MNES fauna. Accepted noise management practices will be implemented to minimise noise disturbance. As defined in the EMP to be prepared for the Project, all operation vehicles (mine fleet and off-site transport) will be fitted with standard silencers (mufflers) and kept in good repair. Stationary equipment will be housed in buildings with noise attenuating walls, where practicable.

The following measures will be implemented to reduce any impacts which may result from construction and operational noise:

- Noise will be mitigated by properly maintaining all equipment used onsite in accordance with manufacturers specifications;
- Enforcing speed limits to ensure that all mining operations are operating at the lowest possible noise level to minimise the impacts of noise and vibration upon wildlife; and
- Further details of mitigation measures for noise control within the Project area are provided in Chapter 13 – Noise and Vibration.

16.13.9 Lighting

Project lighting is not considered to be a significant issue for fauna. Lighting required during the construction period is expected to be minor as construction is expected to be carried out largely in daylight hours.

Night lighting will mainly be limited to lights required for safety and security. During operations Project lighting will be minimised (i.e. low luminance) as far as possible, and directed towards the CHPP / MIA areas and open cut pit areas and thereby away from fauna habitat to reduce any minor localised impacts even further. Further investigations will be carried out during the detailed design phase of the Project into low-light spill lighting options.

A Construction and Operation Environmental Management Plan (CEMP and OEMP) will be produced prior to construction commencing. This will detail and illustrate the potential impacts from lighting during both the construction and operation phases of the Project and inform the Project lighting design to minimise these impacts. Further investigations will be carried out during the development of the CEMP / OEMP into low-light intensity spill lighting options. Draft CEMP and OEMP frameworks are at Appendix 12a and 12b.

16.14 Greenhouse Gas Assessment

Greenhouse gases (GHGs) are a natural part of the atmosphere. They absorb and re-radiate the sun's warmth, and maintain the Earth's surface temperature at a level necessary to support life. Human actions, particularly burning fossil fuels (coal, oil and natural gas), agriculture and land clearing are increasing the concentrations of greenhouse gases in the atmosphere. This is the enhanced greenhouse effect, which is contributing to warming of the Earth.

Greenhouse gases include water vapour, carbon dioxide (CO_2), methane, nitrous oxide and some artificial chemicals such as chlorofluorocarbons (CFCs). Water vapour is the most abundant GHG. These gases vary in effect and longevity in the atmosphere, but scientists have developed a system called Global Warming Potential to allow them to be described in equivalent terms to CO_2 (the most prevalent GHG) called equivalent carbon dioxide emissions (CO_2-e). A unit of one tonne of CO_2-e (t CO_2-e) is the basic unit used in carbon accounting. An emissions inventory, or 'carbon footprint', is calculated as the sum of the emission rate of each GHG multiplied by the global warming potential.

The following assessment determines the CO_2-e emissions from the Project according to international and Commonwealth guidelines.

16.14.1 Assessment Methodology

The DotEE monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia and publishes GHG emission factors for a range of anthropogenic activities. The methodology for calculating GHG emissions is published in the *National Greenhouse Accounts* (NGA) *Factors Workbook* (DotEE, 2016). This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources.

The scope that emissions are reported, as defined by the NGA Factors Workbook is determined by whether the activity is within the organisation's boundary (Scope 1 – Direct Emissions) or outside the organisation's boundary (Scopes 2 and 3 – Indirect Emissions). The scopes are described as follows:

- Scope 1 Emissions: direct (or point-source) emission factors give the kilograms of CO^2-e emitted per unit of activity at the point of emission release (such as fuel use, energy use, manufacturing process activity, mining activity, and onsite waste disposal);
- Scope 2 Emissions: indirect emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO_2-e per unit of electricity consumed; and
- Scope 3 Emissions: indirect emissions for organisations that:
  - Burn fossil fuels: to estimate their indirect emissions attributable to the extraction, production and transport of those fuels; or
  - Consume purchased electricity: to estimate their indirect emissions from the extraction, production and transport of fuel burned at generation and the indirect emissions attributable to the electricity lost in delivery in the transmission and distribution network.

The definition, methodologies and application of Scope 3 emission factors are currently subject to international discussions and have the potential to cause much confusion. Large uncertainty exists in the accurate quantification of these emissions. Emission factors used in this assessment have been

derived from either the DotEE, site-specific information, or from operational details obtained from similar emission sources.

Emission factors used in this report have been sourced from the NGA Factors Workbook (DotEE 2016) as indicated in Table 16-18. For this assessment Scope 1 emissions have been calculated in accordance with the NGA Factors Workbook methodology.

Table 16-18 Emission factors

Scope	Emission source	Emission factor	Source
1	Combustion emissions from ULP (stationary)	2.38 t CO2-e / kL	NGA Factors Workbook, 2016
	Combustion emissions from diesel (stationary)	2.68 t CO2-e / kL	NGA Factors Workbook, 2016
	Combustion for transport (general)	2.69 t CO2-e / kWh	NGA Factors Workbook, 2016
	Extraction of coal (fugitive) - Queensland	0.02 t CO2-e / tonnes raw coal	NGA Factors Workbook, 2016

16.14.2 Quantification of Emissions and Conclusion

At this stage, the Project will draw electricity from onsite generators which are quantified under Scope 1 emissions. As such there are no Scope 2 emissions required to be considered in this assessment. Table 16-19 outlines the estimated GHG emissions for the construction and maximum operational phase (year 12) of the Project. The estimated total life of Project emissions is also provided. The following assumptions have been made for this assessment:

- The construction stage will require four months for completion;
- 100 construction staff will travel approximately 1.8 km round-trip in 10 vehicles per day;
- 500 operational staff will travel approximately 1.8 km round-trip in 20 vehicles per day; and
- No electricity will be purchased from the grid.

Table 16-19 Estimated GHG emissions (CO2-e tonnes)

Emission source	Scope	Annual emissions (t CO2e)		Life of Project emissions (t CO2-e)
		Construction	Operation (year 12)	
Staff Movements	1 (direct)	4.1	24.9	125
Equipment	1 (direct)	17,574	216,748	1,512,483
Generator	1 (direct)	3.3	3,759	47,324
Haulage	1 (direct)	-	59,282	85,670
Fugitive Coal	1 (direct)	-	200,000	683,523
	Total	**17,581**	**479,814**	**2,329,125**

The results of the assessment of GHG emissions from the proposed Project may be summarised as follows:

- The total emissions during the construction phase are 17,581 tonnes CO_2-e during the construction phase, with most of the emissions from the diesel consumption by the construction equipment;
- During the operational phase, the annual emissions are projected to be 479,814 tonnes CO_2-e, which is above the threshold of reporting of 25,000 tonnes CO_2-e. Therefore, this Project will trigger NGER reporting requirements;

- The Life of Project emissions are estimated to be 2,329,125 tonnes CO_2-e; and
- The estimated maximum annual operational phase emissions (479,814 tonnes CO_2-e) represent approximately 0.09% of Australia's latest GHG inventory estimates of 527 Mt CO_2-E (2015).

16.15 MNES Significant Impact Assessment

The natural habitat on and surrounding the Project area has been fragmented and disturbed by historical agricultural activities such as grazing. Much of the mine area is dominated by cleared lands and the introduced Buffel Grass. The southern and western areas are dominated by remnant vegetation communities subject to varying levels of disturbance. The dominant vegetation type is eucalypt woodlands. Despite this, the Project area holds value for MNES species and communities. This section provides an assessment of impacts of the Project on MNES values. The selection of impacts discussed and their evaluation is based on:

- The current understanding and layout of the Project (Section 16.4.3 and Chapter 3 – Description of the Project);
- Currently known information about the MNES affected (Section 16.11); and
- Information on potential impacts of Project construction and operation (Section 16.12) and proposed mitigation measures (Section 16.13) as detailed further in the following chapters:
  - Chapter 10 – Surface Water
  - Chapter 11 – Groundwater
  - Chapter 12 – Air Quality
  - Chapter 13 – Noise and Vibration.

16.15.1 Impact Significance - World Heritage Properties

The GBR is the sole World Heritage property triggered by the Project. An assessment of impact significance has been completed as per the Commonwealth's Significant Impact Guidelines (DotE 2013). Under the guidelines 'an action is likely to have a significant impact on the World Heritage values of a declared World Heritage property if there is a real chance or possibility that it will cause:

- One or more of the World Heritage values to be lost;
- One or more of the World Heritage values to be degraded or damaged; or
- One or more of the World Heritage values to be notably altered, modified, obscured or diminished.'

The impact assessment has been undertaken with a focus on the Outstanding Universal Values as described for listing of the GBRWHA and outlined in Table 16-20. The ToR requests an assessment using the 'key values and attributes outlined in the *Great Barrier Reef Outlook Report 2014* (GRBMPA 2014).' It has been considered here that the key values reviewed in the report do not differ from the Outstanding Universal Values for which the GBR was nominated in 1981. The key values of the GBR as they apply to the area in relatively close proximity to the Project have been described in Section 16.11.1 and summarised in Table 16-20.

The majority of GBR OUVs do not apply to the Broad Sound area downstream of the Project. The large tidal regime (approximately 9 m) in the sound creates naturally high turbidity levels as sediments constantly undergo resuspension in the water column due to tidal currents. The combination of the local tidal regime and turbidity levels has a negative effect on many potential GBR OUVs within the local area including coral reef formations and seagrass extent. This has follow-up negative impacts on the presence and diversity of marine fauna associated with these habitats.

The only likely impact on the values of the GBRWHA from Project activities are associated with the potential release of polluted and / or sediment laden waters released into Tooloombah Creek or Deep Creek and thereby into the Styx River (Section 16.12.3). Although, any such impact will be transient and diluted by the strong tidal actions in the area. The assessment concludes that with the proposed general mitigation measures described in Section 16.13, and surface water specific measures described in Section 16.3.4 implemented, no WHA values will be lost, degraded or damaged, or notably altered, modified, obscured or diminished because of Project activities. As a result, there will be no significant impact on a World Heritage Property.

Table 16-20 World Heritage values potentially indirectly impacted by the Project

WHA criteria	Outstanding Universal Value elements of the GBRWHA	Relevance to the Project area	Project impacts on GBRWHA
Criterion vii Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance	The GBR is of superlative natural beauty above and below the water, and provides some of the most spectacular scenery on earth. It is one of a few living structures visible from space, appearing as a complex string of reefal structures along Australia's northeast coast. From the air, the vast mosaic patterns of reefs, islands and coral cays produce an unparalleled aerial panorama of seascapes comprising diverse shapes and sizes. The Whitsunday Islands provide a magnificent vista of green vegetated islands and spectacular sandy beaches spread over azure waters. This contrasts with the vast mangrove forests in Hinchinbrook Channel, and the rugged vegetated mountains and lush rainforest gullies that are periodically cloud-covered on Hinchinbrook Island. On many of the cays there are spectacular and globally important breeding colonies of seabirds and marine turtles, and Raine Island is the world's largest green turtle breeding area. On some continental islands, large aggregations of over-wintering butterflies periodically occur. Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours; for example, spectacular coral assemblages of hard and soft corals, and thousands of species of reef fish provide a myriad of brilliant colours, shapes and sizes. The internationally renowned Cod Hole near Lizard Island is one of many significant tourist attractions. Other superlative natural phenomena include the annual coral spawning, migrating whales, nesting turtles, and significant spawning aggregations of many fish species.		

WHA criteria	Outstanding Universal Value elements of the GBRWHA	Relevance to the Project area	Project impacts on GBRWHA
	Scenic vistas (above and below water) Aerial panorama of seascapes Reef structures, spectacular coral diversity, and reef fish diversity Whitsunday Islands, Hinchinbrook Island and Channel, and Cod Hole, Lizard Island Seabird and marine turtle nesting colonies Migrating Whales	The Project has potential to temporarily impact localised water clarity through the unplanned release of pollutants / sediments into the Styx River. However, Broad Sound already has naturally high turbidity levels, The Project will not impact scenic vistas or aerial seascapes within the GBRWHA. Reefs in the Broad Sound area are comparatively depauperate due to the large tidal regime and naturally high turbidity levels. This effect extends to offshore reefs such as the Percy Islands (120 km north-east of the Project area) (Kleypas 1996). The nearest mapped reef structures to the Project are small areas at Turtle Island and Charon Point where the Styx River opens into Broad Sound (35 km north). Larger reefs (likely more suitable for reef fish abundance) are located around the islands adjacent to the Torilla Peninsula (50 km north north-east) as well as offshore. The Whitsunday Islands are approximately 240 km north of the Project. Hinchinbrook and Lizard Island are not applicable to the Project area. Extensive mangrove and saltmarsh habitat occur along the Styx River channel. These areas have a low potential to be transiently impacted by poor water quality resulting from accidental releases of polluted waters from the Project. The nearest large marine turtle nest sites are large Flatback Turtle aggregations at Wild Duck Island (74 km north north-east of the Project) and Avoid Island (75 km north). Nearest seabird nesting colony (Australian Pelican) is at Akens Island in Shoalwater Bay (68 km northeast of the Project). Little Tern is known to nest in minor aggregations in Broad Sound. No other seabird nesting colonies known from the local region including the offshore islands. Nearest significant seabird colonies at the Capricorn-Bunker group of islands (over 250 km east of the Project). No Project impacts are possible. There is no information to indicate that Broad Sound is used as a resting / calving area during Humpback Whale migrations.	As described in Section 16.11.1 the OUVs most relevant to the Project area are the extensive downstream mangrove / saltmarsh communities and migratory shorebird populations. The Project is located 9.5 km upstream of the WHA boundary. The only impact the Project can conceivably have on the OUV elements closest to the Project are water quality impacts due to releases of contaminated water (mine dewater or chemical spills) and sediments (refer Section 16.12.3). The Project will have negligible impact on freshwater inflows into the Styx River. Background stream nutrient levels (derived from surface water quality monitoring for the Project) are already above water quality objectives for the Styx River. The waters of Broad Sound are already naturally turbid due to resuspension of sediments caused by the large tidal regime in the area. Significant impacts to estuarine vegetation is not considered likely due to the transient nature of the impact and the local effect (including dilution) of the large tidal range. Project mitigations for surface water quality are described in Section 16.12.3 and in detail in Chapter 9 – Surface Water. The Proponent will implement an ESCP during all stages of the Project. The Project design incorporates elements (i.e. diversions and environmental dams) to manage operational rainfall run-off. Environmental dams will retain water from open cut mine pits for the life of the Project. A Project REMP and WMP will be developed and implemented for the life of the Project. No significant impact to water quality is expected and consequently there will be no impacts to OUVs of the GBRWHA.

WHA criteria	Outstanding Universal Value elements of the GBRWHA	Relevance to the Project area	Project impacts on GBRWHA
Criterion viii An outstanding example representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features	The GBR, extending 2,000 kilometres along Queensland's coast, is a globally outstanding example of an ecosystem that has evolved over millennia. The area has been exposed and flooded by at least four glacial and interglacial cycles, and over the past 15,000 years reefs have grown on the continental shelf. During glacial periods, sea levels dropped, exposing the reefs as flat-topped hills of eroded limestone. Large rivers meandered between these hills and the coastline extended further east. During interglacial periods, rising sea levels caused the formation of continental islands, coral cays and new phases of coral growth. This environmental history can be seen in cores of old massive corals. Today the GBR forms the world's largest coral reef ecosystem, ranging from in-shore fringing reefs to mid-shelf reefs, and exposed outer reefs, including examples of all stages of reef development. The processes of geological and geomorphological evolution are well represented, linking continental islands, coral cays and reefs. The varied seascapes and landscapes that occur today have been moulded by changing climates and sea levels, and the erosive power of wind and water, over long time periods. One-third of the GBR lies beyond the seaward edge of the shallower reefs; this area comprises continental slope and deep oceanic waters and abyssal plains.		
	Geomorphological evolution including reef development Sea level change and island development In-shore fringing reefs, mid-shelf reefs and outer reefs	Project area boundary located 9.5 km upstream of WHA boundary. Boundary located in estuarine waters of the Styx River. The nearest sizeable reef to the Project is located on the southwestern edge of Long Island (and adjacent islands) west of the Torilla Peninsula (50 km north-northeast of the Project). Reefs in the Broad Sound area are comparatively depauperate due to the large tidal regime and naturally high turbidity levels. This effect extends to offshore reefs such as the Percy Islands (120 km north-east of the Project area) (Kleypas 1996). There is no information on the status of these particular reef communities. Monitoring of Keppel Island inshore reefs located 150 km to the south (associated with the Fitzroy River basin) are considered to be in very poor condition (2013/2014 study period) due to recent major flooding events carrying sediments, nutrients and low salinity water combined with the results of previous bleaching events. Inshore reefs on the Whitsunday Islands (located 240 km north) appear to be in better condition with higher coral cover, although selected for more pollutant tolerant species (Thompson et al. 2014).	Changes to water quality and quantity may have a negative impact on marine ecological processes. As stated for the previous criteria the Project will have negligible impact on freshwater inflows into the Styx River and the only likely impact on the relevant OUV elements closest to the Project are water quality impacts (refer Section 16.12.3). Background stream water nutrient levels (derived from surface water quality monitoring for the Project) are already above water quality objectives for the Styx River. The waters of Broad Sound are already naturally turbid due to resuspension of sediments caused by the large tidal regime in the area. With the mitigations for surface water quality as described in Section 16.13.3 and in detail in Chapter 9 – Surface Water, appropriately implemented throughout all stages of the Project no significant impact to marine water quality through the Styx River is expected and consequently there will be no impacts to OUVs of the GBRWHA.

WHA criteria	Outstanding Universal Value elements of the GBRWHA	Relevance to the Project area	Project impacts on GBRWHA
Criterion ix An outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals	The globally significant diversity of reef and island morphologies reflects ongoing geomorphic, oceanographic and environmental processes. The complex cross-shelf, longshore and vertical connectivity is influenced by dynamic oceanic currents and ongoing ecological processes such as upwellings, larval dispersal and migration. Ongoing erosion and accretion of coral reefs, sand banks and coral cays combine with similar processes along the coast and around continental islands. Extensive beds of *Halimeda* algae represent active calcification and accretion over thousands of years. Biologically the unique diversity of the GBR reflects the maturity of an ecosystem that has evolved over millennia; evidence exists for the evolution of hard corals and other fauna. Globally significant marine faunal groups include over 4,000 species of molluscs, over 1,500 species of fish, plus a great diversity of sponges, anemones, marine worms, crustaceans, and many others. The establishment of vegetation on the cays and continental islands exemplifies the important role of birds, such as the Pied Imperial Pigeon, in processes such as seed dispersal and plant colonisation. Human interaction with the natural environment is illustrated by strong ongoing links between Aboriginal and Torres Strait Islanders and their sea-country, and includes numerous shell deposits (middens) and fish traps, plus the application of story places and marine totems.		
	Ecological physical processes and connectivity Formation of reefs, sand banks and coral cays Hard corals and *Halimeda* algae Marine taxa diversity Island plant colonisation processes Aboriginal and Torres Strait Islander history and sea-culture	The Project has potential to temporarily impact localised water clarity through the unplanned release of pollutants / sediments into the Styx River. The Project is located inland and will not conceivably impact the connectivity of ecological processes within the GBR. The nearest sizeable reef to the Project is located on the southwestern edge of Long Island (and adjacent islands). These are continental islands adjacent to west of the Torilla Peninsula (50 km north-northeast of the Project). Reefs in the Broad Sound area are comparatively depauperate due to the large tidal regime and naturally high turbidity levels. This means hard coral colonies decrease in size and diversity and lack reef building species as turbidity increases (towards the mainland). Nearest significant *Halimeda* colonies at the Capricorn-Bunker group of islands (over 250 km east of the Project). No Project impacts are possible. The Project will not conceivably interfere with plant colonisation processes. The islands of Broad Sound have cultural significance for the Darumbal and Woppaburra people. Archaeological surveys have located sites and materials of cultural significance including middens and fish traps.	Changes to water quality and quantity may have a negative impact on marine ecological processes. As stated for the previous criteria the Project will have negligible impact on freshwater inflows into the Styx River and the only likely impact on the relevant OUV elements closest to the Project are water quality impacts (refer Section 16.12.3). Background nutrient levels (derived from surface water quality monitoring for the Project) are already above water quality objectives for the Styx River. The waters of Broad Sound are already naturally turbid due to resuspension of sediments caused by the large tidal regime in the area. With the mitigations for surface water quality as described in Section 16.13.3 and in detail in Chapter 9 – Surface Water, appropriately implemented throughout all stages of the Project no significant impact to marine water quality through the Styx River is expected and therefore no impacts to WHA values. The Project will not interfere with existing Aboriginal and Torres Strait Islander historical sites within the WHA) or interfere with current access and cultural rites.

WHA criteria	Outstanding Universal Value elements of the GBRWHA	Relevance to the Project area	Project impacts on GBRWHA
Criterion x Contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	The enormous size and diversity of the GBR means it is one of the richest and most complex natural ecosystems on earth, and one of the most significant for biodiversity conservation. The amazing diversity supports tens of thousands of marine and terrestrial species, many of which are of global conservation significance. As the world's most complex expanse of coral reefs, the reefs contain some 400 species of corals in 60 genera. There are also large ecologically important inter-reefal areas. The shallower marine areas support half the world's diversity of mangroves and many seagrass species. The waters also provide major feeding grounds for one of the world's largest populations of the threatened dugong. At least 30 species of whales and dolphins occur here, and it is a significant area for humpback whale calving. Six of the world's seven species of marine turtle occur in the GBR. As well as the world's largest green turtle breeding site at Raine Island, the GBR also includes many regionally important marine turtle rookeries. Some 242 species of birds have been recorded in the GBR. Twenty-two seabird species breed on cays and some continental islands, and some of these breeding sites are globally significant; other seabird species also utilize the area. The continental islands support thousands of plant species, while the coral cays also have their own distinct flora and fauna.		

WHA criteria	Outstanding Universal Value elements of the GBRWHA	Relevance to the Project area	Project impacts on GBRWHA
	Coral diversity Important inter-reefal areas Dugong Whales and dolphins Marine turtles (including Raine Island) Seabird breeding sites Island flora	The nearest sizeable reef to the Project is located on the southwestern edge of Long Island (and adjacent islands). These are continental islands adjacent to west of the Torilla Peninsula (50 km north-northeast of the Project). Reefs in the Broad Sound area are comparatively depauperate due to the large tidal regime and naturally high turbidity levels. It's uncertain if there is any 'ecologically important inter-reefal area' located outside of this area. There are no records of Dugong known in close proximity to the Project. There are no seagrass meadows known in the majority of Broad Sound most likely due to the large tidal range and high turbidity levels. There is a Dugong Protection Area located north of Clairview Bluff located 54 km north of the Project. Inshore dolphin species such as Australian Snubfin and Indo-Pacific Humpback Dolphin have been recorded in low numbers in Broad Sound north of the Styx River (CCP 2013). There is no evidence whale species utilise the local area. The nearest large marine turtle nest sites are large Flatback Turtle aggregations at Wild Duck Island (74 km north north-east of the Project) and Avoid Island (75 km north). Low level nesting of Flatback and Green Turtle occurs on various islands and beaches in the wider area. Raine Island is not applicable to the Project area. Nearest seabird nesting colony (Australian Pelican) is at Akens Island in Shoalwater Bay (68 km northeast of the Project). Little Tern is known to nest in minor aggregations in Broad Sound. No other seabird nesting colonies known from the local region including the offshore islands. No impacts considered likely. Knowledge of the island vegetation in the Broad Sound region is scant due to the remote nature of the area limiting access. Turtle Island (near the mouth of the Styx River) has the only known example of Brigalow vegetation located on an island. The Project will not conceivably impact island flora.	Changes to water quality and quantity may have a negative impact on marine ecological processes. As stated for the previous criteria the Project will have negligible impact on freshwater inflows into the Styx River and the only likely impact on the relevant outstanding universal value elements closest to the Project are water quality impacts (refer Section 16.12.3). Background nutrient levels (derived from surface water quality monitoring for the Project) are already above water quality objectives for the Styx River. The waters of Broad Sound are already naturally turbid due to resuspension of sediments caused by the large tidal regime in the area. The area of Broad Sound downstream of the Project (and Styx River) appears to provide poor habitat value for large marine fauna (refer Section 16.11.1). Significant impacts to marine fauna populations from accidental water / pollutant release from the Project is not considered likely due to the transient nature of the impact and the local effect (including dilution) of the large tidal range. With the mitigations for surface water quality as described in Section 16.13.3 and in detail in Chapter 9 – Surface Water, appropriately implemented throughout all stages of the Project no significant impact to marine water quality through the Styx River is expected and consequently there will be no impacts to OUVs of the GBRWHA.

16.15.2 Impact Significance - National Heritage Place

The GBR is the sole National Heritage Place triggered by the Project. An assessment of impact significance has been completed as per the Commonwealth's Significant Impact Guidelines (DotE 2013). Under the guidelines 'an action is likely to have a significant impact on the National Heritage values of a National Heritage place if there is a real chance or possibility that it will cause:

- One or more of the National Heritage values to be lost;
- One or more of the National Heritage values to be degraded or damaged; or
- One or more of the National Heritage values to be notably altered, modified, obscured or diminished.'

The National Heritage values of the GBR are the same as the World Heritage Property values as described in Section 16.11.1. As such, the significant impact assessment of the Project activities on GBRWHA values as provided in Table 16-20 also describes the assessment of National Heritage values for the GBR. The assessment concludes that with the proposed mitigation measures implemented, no National Heritage values will be lost, degraded or damaged, or notably altered, modified, obscured or diminished because of Project activities. Consequently, there will be no significant impact on a National Heritage Place.

16.15.3 Impact Significance – TECs

As noted in Section 16.11.3, two TECs have been encountered within the Project area: Brigalow and SEVT. Known information about Brigalow and SEVT is summarised in the community profiles shown in Table 16-21 and Table 16-23.

The significance of impacts for each of the two endangered ecological communities occurring within the Project area are evaluated in Table 16-22 (Brigalow) and Table 16-24 (SEVT) using the significant impact criteria provided in DotE (2013). Clearing of remnant vegetation may not occur within either community with further Project design refinement resulting in no direct reduction in the extent of this ecological community.

16.15.3.1 Brigalow

Table 16-21 Key data on Brigalow

Brigalow (*Acacia harpophylla dominant and co-dominant*)
Baseline Data Results
Current DNRM RE mapping identifies a single patch (12.4 ha) of vegetation community (RE 11.4.9) present within the Project area which is associated with the Brigalow TEC. *Ground-truthed data* Ground-truthing identified current DNRM mapping is incorrect and the mapped area is composed of eucalypt communities (RE 11.3.4). A single isolated patch (0.61 ha) identified as having potential to constitute a Brigalow TEC. Located in the east of the MLs and mapped as RE 11.4.9. The community present satisfies threshold conditions for a Brigalow TEC (refer Butler 2007). There are scattered small patches in the surrounding area, particularly adjacent to Deep Creek and the northeast boundary of the mine ML.
Conservation Status
Endangered
Key Threats
The Brigalow ecological community has been historically extensively cleared for cropping and / or pasture. Current key threats to this threatened community are from activities which further reduce the extent, cause a decline in the condition of the vegetation, or impede the recovery of the community. Threatening activities include: continued tree clearing, high total grazing pressure, fire, lack of knowledge and proliferation of exotic species. Note that these threats do not operate in isolation but interact, sometimes in synergistic action (DotEE 2017).
Recovery Plans

Brigalow (*Acacia harpophylla dominant and co-dominant*)
There is no State or Commonwealth recovery plan for this community. The Commonwealth Approved Conservation Advice (TSSC 2013) for Brigalow TEC lists the following 'priority recovery and threat abatement actions' for this community applicable to the Project: ▪ Threat reduction / control including mitigating impacts where clearing of Brigalow communities is unavoidable such as minimising hydrological disruption, weed spread, dissection of patches and offsetting; ▪ Manage areas of Brigalow including fire, weed and pest management; and ▪ Encourage landholders to balance primary production and the conservation of native flora and fauna within and close to the ecological community.
Threat Abatement Plans
For the Brigalow TEC the following Commonwealth Threat Abatement Plan is considered relevant: ▪ Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (CoA 2011). ▪ The plan outlines objectives relating to the impacts caused by cane toads, largely on predatory fauna, rather than on the vegetation community itself. Cane toads were observed on the site during fauna surveys (including within Brigalow TEC) and are likely to have been present for a long time. The Project will not possibly interfere with any of the Plan's objectives and they are not considered further.

The current site layout (refer Figure 16-17) will remove 0.2 ha of the patch of Brigalow TEC that remains within the mine ML. Continuing refinement of the design of the mine and infrastructure design is expected to avoid any direct impact to TECs within the mine footprint. The threat of weed invasion may also impact this community although the area is already degraded by introduced species at present. The Project LUMP will include measures to control weed invasion / proliferation across the Project area. No other potential impacts predicted from Project activities.

Table 16-22 Assessment against significant impact criteria: Brigalow TEC

Criterion	Assessment against Significance Criteria
Brigalow (*Acacia harpophylla* dominant and co-dominant)	
Reduce the extent of an ecological community	Direct vegetation clearing of a portion (0.2 ha) of the sole small patch of this TEC may occur because of clearing for the main site access road within the mine ML. However, continuing refinement of the design of the mine and infrastructure design is expected to avoid any direct impact to TECs within the mine footprint. A vegetation monitoring program will be undertaken throughout the life of the Project. Should impacts be detected to the TEC, such as a decrease in habitat quality that can be attributed to the Project activities, appropriate mitigation measures will be implemented to address the root cause of the impacts. Should the TEC be detrimentally impacted because of mining activities, affected areas will be revegetated and an appropriate offsets program implemented.
Fragment or increase fragmentation of an ecological community	The Project area has a long history of grazing land use. This has resulted in clearing of native vegetation such that this TEC is now heavily fragmented across the local landscape. The Project will not further fragment this TEC, as above ground activities are for the most part in cleared lands.
Adversely affect habitat critical to the survival of the community	A total of 0.2 ha of Brigalow TEC may be cleared for construction of the Project under the current Project design. There is no definition of habitat critical to the survival of this community. This is a widespread community extending from Charters Towers south to northern NSW and west to Cunnamulla. Given the wide extent of occurrence and the very minor and isolated extent of the TEC within the Project area it is considered unlikely the Project will adversely affect habitat critical to the survival of the community.

Criterion	Assessment against Significance Criteria
Modify or destroy abiotic factors necessary for an ecological community's survival	Brigalow communities are known to develop horizontal root systems and the majority of hydrological interactions occur in the top 1 m of soil (Tunstall and Connor 1981). Monitoring of bores in the Project area has indicated the current depth of groundwater to be more than 6 m below ground level in the Central Queensland Coal mine area. Groundwater drawdown associated with Project dewatering activities may result in some reduction of groundwater levels, but is not expected to impact this community. Potential changes to surface water quality (such as sedimentation and contaminated runoff) will be mitigated against using measures detailed in the Project ESCP and WMP. This is not expected to impact the minor occurrence of Brigalow associated with the area.
Cause a substantial change in the species composition of an occurrence of the ecological community	The Project is unlikely to impact the species composition within this TEC. The Project's overarching LUMP will incorporate effective weed management during all phases of the Project to minimise the likelihood of an increase in weed species populations or the introduction of new weed species to the Project area. Should a decrease in understorey species associated with Brigalow be observed during monitoring, understorey revegetation will be implemented. The Project is considered unlikely to cause substantial change in the species composition of an occurrence of the TEC.
Cause a substantial reduction in the quality or integrity of an occurrence of the ecological community	The Project is unlikely to cause a substantial reduction in the quality or integrity of this TEC. Quality or integrity may be defined as the extent and distribution of a vegetation community and its condition for designated purposes including habitat for fauna and flora species (DEC 2008). Weed and land management practices incorporated into the Project LUMP will aim to minimise the impact on communities. The Project will also develop an ESCP and WMP to minimise impacts associated with surface water runoff. Clearing of this community for the Project is predicted at 0.2 ha. With the mitigation measures in place, the Project is considered unlikely to cause a substantial reduction in the quality of an occurrence of the TEC.
Interfere with the recovery of the ecological community	Brigalow TEC communities subject to clearing are minimal in extent and will be the subject of an offset strategy and rehabilitation as mentioned above. There is no State or Commonwealth recovery plan for this community. The Commonwealth Approved Conservation Advice (TSSC 2013) for the Brigalow TEC lists several priority management actions designed to conserve the community. The Project at worst may have minimal direct (clearing) impacts on the Brigalow community (0.2 ha predicted). All impacts to TECs will be subject to the Project ODP. The Project LUMP will incorporate pest and weed management, fire management and monitoring / management of groundwater and surface water values. The Project will not interfere with any of recommendations included within the Commonwealth Conservation Advice for this community and is considered unlikely to interfere with the recovery of the TEC.

16.15.3.2 Semi-evergreen Vine Thicket

Table 16-23 Key data on SEVT

SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions
Baseline Data Results
Current EHP RE mapping does not identify this community as occurring in the Project area or surrounds. *Ground-truthed data* There are five linear polygons of an SEVT TEC (RE 11.3.11) located along the edge of Tooloombah Creek and adjacent to the northwest boundary of the mine ML (total cover of 19.63 ha). The edge of one of these patches is located within the ML (0.4 ha).
Conservation Status
Endangered
Key Threats
The SEVT ecological community has been historically extensively cleared for cropping and / or pasture. This community now remains highly fragmented. Current key threats to this threatened community are from activities which further reduce the extent, grazing pressure from both introduced and native herbivores, and weed invasion, particularly those that promote the incursion of fires. Threatening activities include: continued tree clearing, high total grazing pressure, fire and proliferation of exotic species. Note that these threats do not operate in isolation but interact, sometimes in synergistic action (DotEE 2017).
Recovery Plans
National recovery plan for the listed SEVT ecological community (McDonald 2010) provides the main framework for the community's recovery. Objectives of the recovery plan include: ▪ To increase the area of the SEVT ecological community and its representation in conservation reserves or under conservation agreements (MOUs); ▪ Ensure 'best-practice' management is applied to sites containing the SEVT ecological community; and ▪ Encourage involvement of landholders and the community in the conservation and management of the SEVT ecological community.
Threat Abatement Plans
For the SEVT TEC the following Commonwealth Threat Abatement Plans are considered relevant: ▪ Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads (CoA 2011). The plan outlines objectives relating to the impacts caused by cane toads, largely on predatory fauna, rather than on the vegetation community itself. Cane toads were observed on the site during fauna surveys (including within Brigalow TEC) and are likely to have been present for a long time. The Project will not possibly interfere with any of the Plan's objectives and they are not considered further. *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs* (CoA 2017a). The plan outlines objectives and actions to reduce the impacts of feral pigs on MNES communities and species. The most applicable impact to the SEVT TEC is habitat degradation. Feral pigs already occur on the site. Pest management will be incorporated into the Project LUMP which will be in line with one of the objectives set out in the Plan. The Project will not possibly interfere with any of the Plan's objectives.

The current site layout (refer Figure 16-17) will remove 0.4 ha of the patch of SEVT TEC that remains along the western edge of the mine ML. Continuing refinement of the design of the mine and infrastructure design is expected to avoid any direct impact to TECs within the mine footprint. The threat of weed invasion may also impact this community although the area is already degraded by introduced species at present. The Project LUMP will include measures to control weed invasion / proliferation across the Project area. Groundwater drawdown has some potential to impact SEVT patches associated with Tooloombah Creek near Open Cut 4 although there is uncertainty of the likelihood or extent of impact (refer Section 16.12.4). In general, the flora species present in this community are unlikely to require access to groundwater apart from emergent eucalypts such as Forest Red Gum. Vegetation health of these patches will be monitored under the Project LUMP. Should impacts be detected and unable to be ameliorated these areas will be included in the Project ODP. No other potential impacts are predicted from Project activities.

Table 16-24 Assessment against significant impact criteria: SEVT TEC

Criterion	Assessment against Significance Criteria
SEVT of the Brigalow Belt and Nandewar bioregions	
Reduce the extent of an ecological community	Direct vegetation clearing of a portion (0.4 ha) of this TEC may occur because of clearing for Open Cut 4 within the MLs. Potential impacts may occur in the long-term outside of the ML due to groundwater drawdown although the extent of these impacts are uncertain. Continuing refinement of the design of the mine and infrastructure design is expected to avoid any direct impact to TECs within the mine footprint. A vegetation monitoring program will be undertaken throughout the life of the Project (refer Section 16.13.4). Should impacts be detected to the occurrences of this TEC outside the mine ML boundary, such as a decrease in habitat quality that can be attributed to the Project activities (groundwater drawdown), appropriate mitigation measures will be implemented to address the root cause of the impacts such as the provision of supplementary water flows. Where mitigation measures are not found to ameliorate impacts to the TEC be detrimentally these areas will be incorporated into the Project ODP.
Fragment or increase fragmentation of an ecological community	The Project area has a long history of grazing land use. This has resulted in clearing of native vegetation such that this TEC is now heavily fragmented across the local landscape. The Project will not further fragment this TEC, as above ground activities are for the most part in cleared lands.
Adversely affect habitat critical to the survival of the community	A total of 0.4 ha of SEVT TEC may be cleared for construction of the Project. There is no definition of habitat critical to the survival of this community. This is a widespread community extending from coastal Townsville south to the Liverpool Plains region of NSW. Given the wide extent of occurrence and minor extent of those fragments within the Project area it is considered unlikely the Project will adversely affect habitat critical to the survival of the community.
Modify or destroy abiotic factors necessary for an ecological community's survival	Potential changes to surface water quality (such as sedimentation and contaminated runoff) will be mitigated against using measures detailed in the Project ESCP and WMP (refer Section 16.13.3). This is not expected to impact the occurrence of SEVT associated with the area which is located away from the main channel of Tooloombah Creek. Groundwater drawdown associated with Project dewatering activities may result in some reduction of groundwater levels, but it is uncertain whether this will impact occurrences of this community, particularly along Tooloombah Creek near Open Cut 4. These areas will be monitored for changes in health as part of the LUMP. Should the TEC be found to detrimentally impacted, appropriate mitigation measures will be implemented to address the root cause of the impacts such as the provision of supplementary water flows. Where mitigation measures are not found to ameliorate impacts to the TEC be detrimentally these areas will be incorporated into the Project ODP. There is potential for Project activities to modify abiotic factors necessary for the SEVT TECs survival (i.e. groundwater drawdown) in the local area although the extent or likelihood of this impact is uncertain.
Cause a substantial change in the species composition of an occurrence of the ecological community	The Project is unlikely to impact the species composition within this TEC. The Project's overarching LUMP will incorporate effective weed management during all phases of the Project to minimise the likelihood of an increase in weed species populations or the introduction of new weed species to the Project area. Should a decrease in understorey species associated with SEVT be observed during monitoring, understorey revegetation will be implemented. The Project is considered unlikely to cause substantial change in the species composition of an occurrence of the TEC.

Criterion	Assessment against Significance Criteria
Cause a substantial reduction in the quality or integrity of an occurrence of the ecological community	The Project is unlikely to cause a substantial reduction in the quality or integrity of this TEC. Quality or integrity may be defined as the extent and distribution of a vegetation community and its condition for designated purposes including habitat for fauna and flora species (DEC 2008). Weed and land management practices incorporated into the Project LUMP will aim to minimise the impact on vegetation communities. The Project will also develop an ESCP and WMP to minimise impacts associated with surface water runoff. Clearing of this community for the Project is predicted at 0.4 ha. Groundwater drawdown associated with Project dewatering activities may result in some reduction of groundwater levels, but it is uncertain whether this will impact occurrences of this community, particularly along Tooloombah Creek near Open Cut 4. These areas will be monitored for changes in health as part of the LUMP. Should the TEC be found to detrimentally impacted, appropriate mitigation measures will be implemented to address the root cause of the impacts such as the provision of supplementary water flows. Where mitigation measures are not found to ameliorate impacts to the TEC be detrimentally these areas will be incorporated into the Project ODP. There is potential for Project activities to cause a substantial reduction in the quality / integrity of localised occurrences SEVT TEC through groundwater drawdown although the extent or likelihood of this impact is uncertain.
Interfere with the recovery of the ecological community	A maximum total of 0.4 ha of this TEC may be impacted during clearing activities for the Project. Groundwater drawdown has potential to impact localised occurrences of this community further. An offset strategy will be developed to compensate for potential changes in patches of the TEC adjacent to the Project resulting from groundwater drawdown. The offsets strategy will be developed in consultation with DotEE. Hence, activities associated with the Project are not expected to interfere with the recovery of this TEC.

16.15.4 Impact Significance – Threatened Species

As noted in Section 16.11.4, five fauna species have been encountered within or near the Project area thereby being considered known or likely to occur and potentially be subject to Project impacts: Squatter Pigeon, Southern Snapping Turtle, Ornamental Snake, Greater Glider and Koala. Current information about each listed species is summarised in the 'key data' tables shown in the following sections. Assessment of impact significance has been completed as per the Commonwealth's Significant Impact Guidelines (DotE 2013). These included criteria for species listed as Vulnerable or Critically Endangered at the time the Section 75 decision for this Project was made (3 February 2017).

The vulnerable species assessments commence with an evaluation of the likely importance of the population, as defined within the significant impact criteria for vulnerable species:

'An important population is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and / or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and / or
- Populations that are near the limit of the species range.

Given the specificity of the above definition and the scarcity of information and records available for most listed species and populations in the region (and Australia), it is difficult to determine: 1) attributes such as breeding and dispersal behaviour and whether the population is a 'key source' and 2) the genetic diversity of individuals inhabiting a population or sub-population. Given the paucity of information available, significance of impacts to threatened species has been based on experience of the assessment team and the latest available information.

16.15.4.1 Squatter Pigeon

Squatter Pigeon has been observed on multiple occasions within the Project area. Table 16-25 summarises the species presence in the Project area, known threats to the species, and the relevant Commonwealth and State documents applicable to the species recovery.

Table 16-25 Key data on Squatter Pigeon

Squatter Pigeon (southern) (*Geophaps scripta scripta*)
Baseline Data Results
Twenty-three WildNet records exist for Squatter Pigeon occurring within wider 50 km radius of study area. Individuals, pairs and small groups recorded within MLs and surrounds during all surveys in March and September 2011, February 2012 and February 2017. The species occurs in grassy woodlands and it is known to prefer sandy soils in areas close to water. The species can also occur in cleared areas. The species has been recorded in RE 11.10.7 and RE 11.4.2 within the MLs, but was more regularly recorded in cleared habitat.
EPBC Status
Vulnerable
Key Threats
Squatter Pigeon has undergone a significant decline in the southern range of its previous extent. DotEE (2017) identified the following the following known threats to the Squatter Pigeon: ▪ Habitat loss through vegetation clearing; ▪ Degradation of habitat due to overgrazing by domesticated stock; ▪ Degradation of habitat by weed invasion such as Buffel Grass; and ▪ Predation by introduced species mainly cats and foxes.
Recovery Plans
There is no recovery plan in place for this species.
Threat Abatement Plans
For Squatter Pigeon, the following Commonwealth Threat Abatement Plans are considered relevant: ▪ Threat abatement plan for predation by feral cats (DotE 2015b): – Sets out four objectives for controlling feral cats including control in different landscapes, effectiveness of control options, alternative strategies to aid threatened species recovery and public support for cat management ▪ Threat abatement plan for competition and land degradation by rabbits (DotEE 2016b): – Establishes a national framework to guide and coordinate Australia's response to the impacts of European rabbits on biodiversity. Identifies the research and management actions required to ensure the long-term survival of those native species and communities impacted by the presence of rabbits. Replaces the previous threat abatement plan published in 2008 (DEWHA) ▪ Threat Abatement Plan for Predation by the European Red Fox (DEWHA 2008): – Sets out prioritising management areas including ascertain the degree of threat to the survival of threatened species and communities, the potential for recovery of threatened species and communities, threatened species likely to benefit through fox control in specific areas, and cost efficiency and effectiveness of fox control in a particular area.

The subspecies range occurs north to Townsville and west to Charleville. Important populations of the Squatter Pigeon have been identified as those isolated and sparsely distributed sub-populations that occur south of the Carnarvon Ranges in central and southern Queensland including;

- Populations occurring in the Condamine River catchment and Darling Downs of southern Queensland;
- Populations occurring in the Warwick-Inglewood-Texas region of southern Queensland; and
- Any population that may potentially occur in NSW (Squatter Pigeon Workshop 2011).

North of the Carnarvon Ranges the species remains common and is considered to be distributed as a single, continuous (that is inter-breeding) sub-population (DotEE 2017). Therefore, individuals in the Project area are unlikely to be key sources for breeding, dispersal, or maintaining genetic diversity. Under the definition provided in the MNES guidelines (DotE 2013) the individuals occurring in the Project area cannot be considered an important population.

Table 16-26 depicts Project records of the species presence, the Project footprint and the available remnant habitat for Squatter Pigeon on the site based on the vegetation communities present (RE 11.4.2, 11.10.7 and 11.11.15a). The Project footprint will require clearing a total of 101.8 ha of suitable remnant habitat for the species.

Table 16-26 Assessment against significant impact criteria: Squatter Pigeon (southern)

Criterion	Assessment against significance criteria (vulnerable)
Squatter Pigeon (southern subspecies) (*Geophaps scripta scripta*)	
Lead to a long-term decrease in the size of an important population of the species	As stated above there is no important population existing on the site. It is uncertain how many individuals occur in the area. A maximum of 6 individuals were observed in a single area on one occasion. Other observations were largely of pairs or single birds. It is considered likely that individuals disturbed by construction activities will simply move away from the area of disturbance. The Project is unlikely to lead to a long-term decrease in an important population.
Reduce the area of occupancy of an important population	The species is known to occur within the mine area and surrounds. There is no important population existing on the site. Database records indicate the species occurs widely across the local and wider region. The species preferred habitat is grassy woodlands which occurs widely across the local region. Individuals were located in RE 11.4.2, 11.10.7 and 11.11.15a. The species was also commonly observed in cleared habitat. Clearing for the Project is predicted to remove a total of 101.8 ha of these communities. The entire Project footprint is estimated at 1,230 ha, the majority of which is already cleared lands – 1,093 ha. The Project will reduce the occupancy of the species across the local region although to no more than a minor extent.
Fragment an existing important population into two or more populations	There is no important population existing on the site. The species is sparsely distributed across a wide range. The Project is unlikely to fragment an existing important population.
Adversely affect habitat critical to the survival of the species	The species occurs in grassy woodlands which remains abundant across much of its range including the local area surrounding the Project area. Squatter Pigeon may also occur in disturbed areas partially cleared for cattle grazing. The Project will not adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	There is no important population existing on the site and relatively few individuals have been recorded. The Project will not disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The species occurs across a broad swathe of eastern Queensland from Townsville south to the NSW border. The species preferred habitat is grassy woodlands which occurs widely across this area. The species occurs in low numbers within the Project area. Given the extent of occurrence of Squatter Pigeon the Project is considered unlikely to decrease the availability of habitat to the extent the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	Weed and pest control measures will be incorporated into the Project LUMP to control the introduction and spread of weed species across the Project area. The LUMP will be in place for the life of the Project, and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to Project infrastructure. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the species to decline	The Project LUMP will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.

Criterion	Assessment against significance criteria (vulnerable)
Interfere substantially with the recovery of the species	There is no State or Commonwealth recovery plan for this species. With mitigation of potential impacts incorporated within the Project LUMP, any potential impact on Squatter Pigeon will be minor and is considered unlikely to interfere with the recovery of the species.

16.15.4.2 Ornamental Snake

Ornamental Snake has been recorded three times to the west of the Project area. Table 16-27 summarises the species presence in the Project area, known threats to the species, and the relevant Commonwealth and State documents applicable to the species recovery.

Table 16-27 Key data on Ornamental Snake

Ornamental Snake (*Denisonia maculata*)
Baseline Data Results
There is a single record (ALA database) of the species in the wider area located 24 km northeast of the mine ML. Two individuals were recorded in remnant Brigalow habitat 3 km west of the northern boundary of the ML in September 2011. One individual was recorded in Brigalow habitat along a minor drainage line approximately 5.8 km northwest of the northern boundary of the ML in March 2011. No individuals detected within the Project area despite targeted searches in February 2012 and 2017. Nevertheless, there are suitable cracking clay soils within the mine ML north of the Bruce Highway where regrowth Brigalow occurs including extensive gilgai formations. There is very little remnant vegetation in this area.
EPBC Status
Vulnerable
Key Threats
The Ornamental Snake has undergone a decline in abundance in the past few decades. DotEE (2017b) identified the following the following known threats to the Ornamental Snake: ▪ Habitat Loss: Clearing (roads, ploughing, railways, mining-related activities, pipeline constructions); ▪ Habitat fragmentation; ▪ Habitat Degradation: Overgrazing by stock, especially cattle, or grazing of gilgais during the wet season leads to soil compaction and compromising of soil structure; ▪ Alteration of landscape hydrology in and around gilgai environments; ▪ Alteration of water quality through chemical and sediment pollution of wet areas; ▪ Contact with Cane Toads: as the Ornamental Snake has a diet almost exclusively of various frog species, the species is susceptible to being lethally poisoned by ingesting Cane Toads, which are abundant within its range; ▪ Predation by feral species; and ▪ Invasive weeds.
Recovery Plans
Two key documents have been developed for the recovery of the Ornamental Snake: ▪ *Draft Recovery Plan for the Queensland Brigalow Belt Reptiles*: Drafted by WWF-Australia in 2006 (Richardson 2008): Recovery plans set out the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or TECs; and ▪ The Action Plan for Australian Reptiles (Cogger et al. 1993). The report identifies three crucial research areas: – Ground surveys to determine the full geographic range and habitat requirements of the species – Research into basic biology and ecology of the species – Research into the species decline and major factors behind the decline.

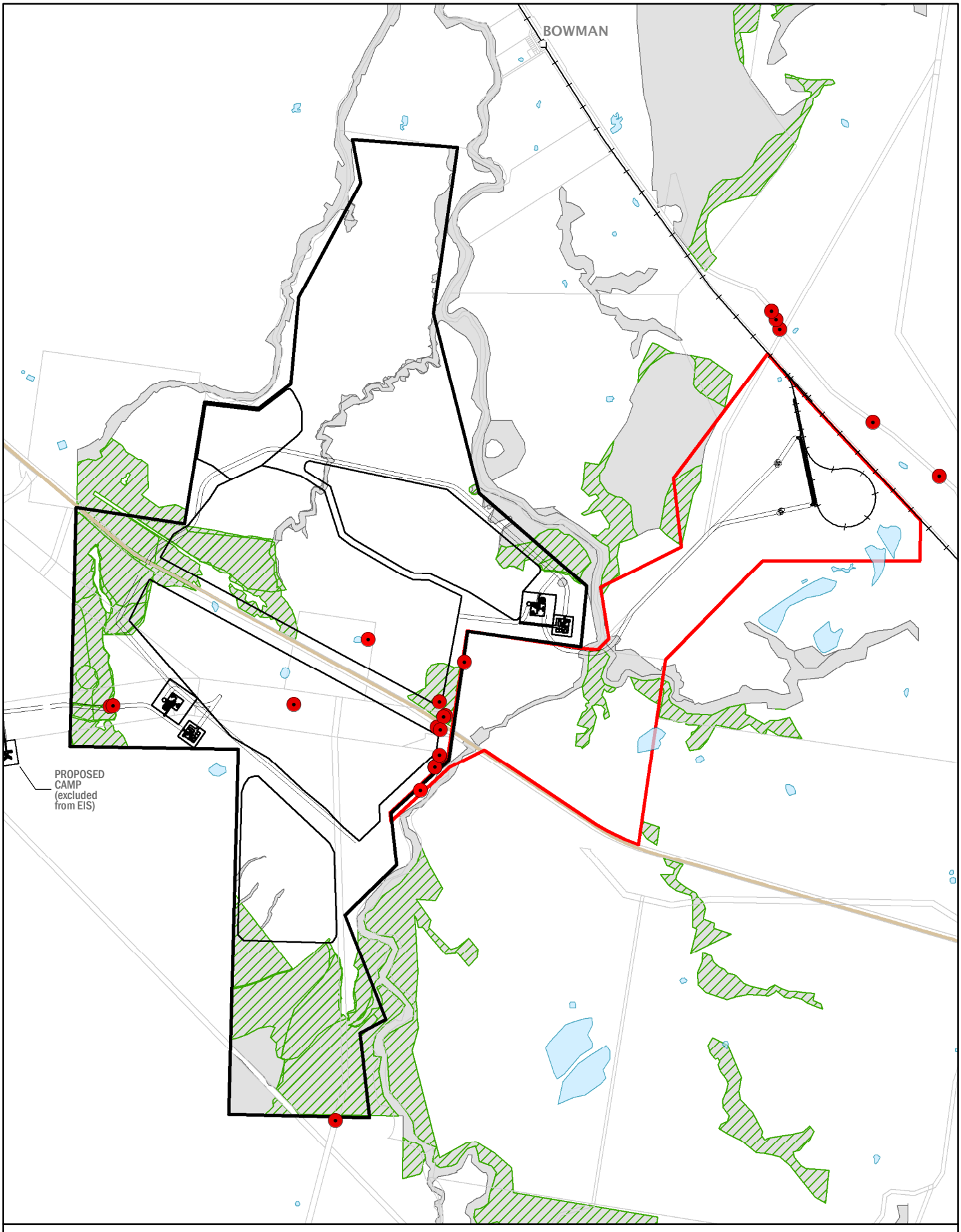


Figure 16-19
Potential habitat for Squatter Pigeon

N

0 0.5 1 km

Scale @ A4 1:50,000
Date: 24/07/17
Drawn: Gayle B.

Legend

- Field-observed Squatter Pigeon location
- Squatter Pigeon Potential Habitat
- Ground-truthed Remnant Vegetation
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Reservoir
- Cadastral boundary

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

The Commonwealth DotEE considers an occurrence of 'important habitat' for Ornamental Snake, as described in the 'Draft referral guidelines for the nationally listed Brigalow Belt reptiles' (DSEWPaC 2011a), is a surrogate definition for an 'important population' of the species. The guidelines state an occurrence of suitable habitat is considered important for Ornamental Snake when it is:

- Habitat where the species has been identified during a survey;
- Near the limit of the species' known range;
- Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations); or
- A habitat type where the species is identified during a survey, but which was previously thought not to support the species.

Ornamental Snake occurs as far north as Charters Towers (250 km northwest of the Project area) south to the Dawson River valley. The species has not been recorded within the Project area during site fauna surveys or from database records, although it is known to occur in remnant Brigalow habitat west of the Project. Suitable habitat for the species within the Project area (cracking clay soils close to wetlands / watercourses and featuring gilgais) occurs in the northern portion of the mine ML, although the majority of this is cleared lands. There is substantial similar habitat surrounding the Project footprint and it is unlikely the area may be considered as a viable landscape corridor. Under the guidelines there is no occurrence of 'important habitat' in the Project area.

The Project footprint will impact approximately 24 ha of degraded riparian vegetation located along an ephemeral drainage line within cracking clay soils which may provide suitable foraging and shelter habitat for Ornamental Snake (refer Figure 16-20).

The following significant impact assessment under the MNES guidelines (DotE 2013) has been informed by the information detailed above.

Table 16-28 Assessment against significant impact criteria: Ornamental Snake

Criterion	Assessment against significance criteria (vulnerable)
Ornamental Snake (*Denisonia maculata*)	
Lead to a long-term decrease in the size of an important population of the species	The species is known from the wider area but has not been identified in the Project area. As stated above no 'important habitat' has been identified within the Project area. Potential cracking clay habitat for the species has been identified in the northern portion of the mine area, the majority of which is cleared. This area will be impacted by clearing activities for the mine including 24 ha of suitable remnant habitat (degraded riparian habitat along a minor drainage line) within Brigalow on gilgais / cracking clays. This area will be subject to environmental offsets. With measures in place to protect surface water quality and quantity downstream of Project activities it is considered unlikely to lead to a long-term decrease in an important population.
Reduce the area of occupancy of an important population	No 'important habitat' has been identified within the Project area. Potential habitat observed within the mine area is restricted to the northern portion of the Project area. The Project is unlikely to reduce the extent of 'important habitat' for Ornamental Snake in the area.
Fragment an existing important population into two or more populations	No 'important habitat' has been identified within the Project area. There is little suitable habitat for this species within the entirety of the Project area. A dry ridge line separates the mine area from much of the transport corridor already acting as a natural dispersal barrier across the landscape for Ornamental Snake. Habitat to the west of the corridor is also hilly and dry. The Project will not fragment 'important habitat'.

Criterion	Assessment against significance criteria (vulnerable)
Adversely affect habitat critical to the survival of the species	Ornamental Snake has not been identified as occurring within the Project area and no 'important habitat' has been identified. There is little suitable habitat for this species within the entirety of the Project area and it will not be subject to direct impacts (vegetation clearing). Potential indirect impacts through surface water quality changes downstream of the mine area will be monitored and mitigated against. It is considered unlikely the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Ornamental Snake has not been identified as occurring within the Project area and no 'important habitat' has been identified. There is little suitable habitat for this species within the entirety of the Project area. It is considered unlikely the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Ornamental Snake has not been identified as occurring within the Project area and no 'important habitat' has been identified. Potential cracking clay habitat for the species has been identified in the northern portion of the mine area, the majority of which is cleared. This area will be impacted by clearing activities for the mine including 24 ha of suitable remnant habitat (degraded riparian habitat along a minor drainage line) within Brigalow on gilgais / cracking clays. It is considered unlikely the Project will impact the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The LUMP will incorporate management strategies to control the introduction and spread of weed species across the Project area. The LUMP will be in place for the life of the Project, and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to Project infrastructure. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the species to decline	The LUMP will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	The Project does not interfere with the overall objectives of the *Draft Recovery Plan for the Queensland Brigalow Belt Reptiles*. With mitigation of potential Project impacts through subsidence rehabilitation, surface water management, an offset program (if required) and measures incorporated within the LUMP, any potential impact on Ornamental Snake, should it occur in the Project area, will be minor and is considered unlikely to interfere with the recovery of the species.

16.15.4.3 Greater Glider

Greater Glider was recorded in woodlands in the south of the Project area. Table 16-29 summarises the species presence in the Project area, known threats to the species, and the relevant Commonwealth and State documents applicable to the species recovery.

Table 16-29 Key data on Greater Glider

Greater Glider (*Petauroides volans*)
Baseline Data Results
No previous records of this species within 50 km radius of Project area. Two individuals recorded in tall Narrow-leaf Ironbark dominated woodland in the south of the MLs. Also recorded in February 2012. Remnant habitat across most of the ML and corridor appears much less suitable as the species prefers continuous tracts of vegetation. Woodland in the south of the MLs, and outside of any Project development, remains connected to a large tract of continuous vegetation and retains trees with large hollows.
EPBC Status
Vulnerable

Greater Glider (*Petauroides volans*)
Key Threats
The broad area of occurrence likely remains similar to pre-European settlement, although the actual area of occupancy has declined substantially (TSSC 2016). The following are considered known threats to the Greater Glider: ▪ Habitat loss and fragmentation; ▪ High intensity or frequent fires; ▪ Climate change may reduce area of occupancy, particularly in north Queensland; and ▪ Over-predation by owl species (TSSC 2016).
Recovery Plans
There is no recovery plan in place for this species. The Commonwealth's Approved Conservation Advice for Greater Glider (TSSC 2016) lists priority conservation actions that may be applicable to the Project including: ▪ Reduce the frequency and intensity of prescribed burns; ▪ Identify appropriate levels of patch retention, habitat tree retention, and logging rotation in hardwood production; and ▪ Protect and retain hollow-bearing trees, suitable habitat and habitat connectivity.

The species occurs from Victoria, north to the Atherton Tablelands in Queensland and is conventionally accepted as a single species. The north Queensland population is considered a separate subspecies (*P. v. minor*) from the widespread south eastern population (*P. v. volans*). The Project area is located within the occurrence of the central Queensland population in this case and is not located near the edge of the species range. There is no evidence to indicate a population in the area is likely to be a key population for breeding, dispersal or maintaining genetic diversity in the species.

Figure 16-20 depicts the suitable habitat for the species on the within the Project area. The Project will require clearing a total of 6.95 ha of this habitat for the southern waste rock dump.

Table 16-30 Assessment against significant impact criteria: Greater Glider

Criterion	Assessment against significance criteria (vulnerable)
Greater Glider	
Lead to a long-term decrease in the size of an important population of the species	No 'important population' has been identified within the Project area. The most suitable habitat for the species appears restricted to where the species was recorded in the southern portion of ML80187 where woodland remains contiguous with extensive habitat. Habitat in the remainder of the Project area including the TLF is largely cleared, fragmented or restricted to narrow strips of riparian vegetation. The Project requires clearing of 6.95 ha of this habitat. Given the remaining habitat surrounding the Project area it is considered unlikely the Project will lead to a long-term decrease in the size of the local population of Greater Glider.
Reduce the area of occupancy of an important population	No 'important population' has been identified within the Project area. The species has been recorded within the mine area. The Project requires clearing of 6.95 ha of habitat in which the species is most likely to occur. However, the Project area remains contiguous with abundant similar habitat in the wider surrounds to the south and west. It is considered unlikely the Project will reduce the area of occupancy of an important population of Greater Glider in the area.
Fragment an existing important population into two or more populations	No 'important population' has been identified within the Project area. The Project requires clearing of 6.95 ha of habitat in which the species is most likely to occur in the south of the ML. This area remains contiguous with abundant similar habitat in the wider surrounds to the south and west. The species is much less likely to occur elsewhere in the Project area. It is considered unlikely the Project will fragment an existing 'important population' into two or more populations.
Adversely affect habitat critical to the survival of the species	There is no indication the Project area comprises habitat critical to the survival of the Greater Glider. The Project requires clearing of 6.95 ha of habitat in which the species is most likely to occur which remains contiguous with abundant similar habitat in the wider surrounds to the south and west. There is no indication the Project area comprises habitat critical to the survival of the Greater Glider.

Criterion	Assessment against significance criteria (vulnerable)
Disrupt the breeding cycle of an important population	No 'important population' has been identified within the Project area. Where possible, clearing activities will take place outside the known breeding season for Greater Glider (March-June). A qualified fauna spotter will carry out a thorough survey for the species prior to any clearing of potential habitat taking place. It is considered unlikely the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	There is suitable woodland habitat for the species in the southern portion of the ML. Most of the Project area is cleared of remnant vegetation. There is abundant suitable habitat for the species in the area to the south and west of the ML. It is considered unlikely the Project will impact the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The Project LUMP will incorporate measure to control the introduction and spread of weed and pest species across the Project area, although the local landscape is already subject to extensive weed infestation and pest species were also observed on several occasions including Dingo. The LUMP will be in place for the life of the Project, and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to Project infrastructure. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the species to decline	The Project LUMP will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	There is no State or Commonwealth recovery plan for this species. The Approved Conservation Advice for Greater Glider (TSSC 2016) outlines management actions intended to aid the recovery of the species. Given the minor extent of clearing involved and with mitigation of potential Project impacts including pre-clearing surveys in suitable habitat to identify suitable tree hollows any potential impact on Greater Glider, should it occur in the Project area, will be minor and is considered unlikely to interfere with the recovery of the species or any of the actions outlined in the Approved Conservation Advice.

16.15.4.4 Koala

A single Koala was recorded in Poplar Box woodland in the centre of the Project area. Table 16-31 summarises the species presence in the Project area, known threats to the species, and the relevant Commonwealth and State documents applicable to the species recovery.

Table 16-31 Key data on Koala

Koala (*Phascolarctos cinereus*) (Qld, NSW and ACT populations)
Baseline Data Results
There are 11 WildNet records of Koala occurring within the wider 50 km radius of Project area. The nearest record to the Project is approximately 25 km northwest of the MLs along the Bruce Highway. The species was recorded in a patch of Poplar Gum woodland in February 2017. Signs of the species presence (such as tree scratches) were also observed in September 2011 in the continuous woodlands to the south just west of the MLs. Remnant habitat within the proposed mine impact areas is predominantly Poplar Box and Narrow-leaf Ironbark dominated woodland. Poplar Box is considered a forage tree species for Koala. Narrow-leaf Ironbark is considered a supplementary forage tree species in drought (Australian Koala Foundation 2015). Forest Red Gum occurs along creek lines and small areas of adjacent alluvial forest. This is a preferred forage tree for the species and is likely to be the most favoured habitat in the area (Australian Koala Foundation 2015).
EPBC Status
Vulnerable

Koala (*Phascolarctos cinereus*) (Qld, NSW and ACT populations)
Key Threats
Koala populations have undergone a substantial decline in the past few decades. DotEE (2017) identified the following the following known threats to the Koala: ▪ Habitat loss and fragmentation; ▪ Deaths from vehicle collisions; ▪ Deaths from dog (feral and domestic) attacks; ▪ Diseases including *Chlamydia* strains and Koala Retrovirus; and ▪ The effects of climate change and droughts.
Recovery Plans
There is no Queensland or national recovery plan for this species. A national recovery plan is to be developed to follow the objectives set out in the *National Koala conservation and management strategy 2009-2014* (NRMMC 2009). The strategy aimed to provide a framework to incorporate state and local actions into broader national actions. The Commonwealth's Approved Conservation Advice for Koala (TSSC 2012) lists priority management actions that may be applicable to the Project including: ▪ Developing plans to mitigate vehicle strike risk where Koalas are known to occur; ▪ Investigate formal conservation arrangements, management agreements and covenants on private land; ▪ Manage other known threats such as eucalypt dieback and dog predation; and ▪ Engage with private landholders and land managers responsible for the land on which populations occur.

The 'EPBC Act referral guidelines for the vulnerable Koala' (DotE 2014) does not refer to any 'important populations' of Koala due to a lack of information at the time of writing. The guidelines provide a 'koala habitat assessment tool' to assist in the determining the sensitivity, value and quality of lands potentially impacted under development proposals. The assessment tool is to be used to determine whether lands may be considered as 'critical to the survival of the Koala' and therefore critical to the long-term survival and recovery of the species. The results of the assessment are to aid the decision-making process and determine whether a Project may need to be referred to DotEE based on potential significant impacts to Koalas and / or habitat critical to the survival of the species. Although the Project is already the subject of an EPBC referral an assessment has been made of the habitats value to Koala within the Project area (Table 16-32) to inform the significant impact assessment.

Table 16-32 Koala habitat appraisal as per species impact guidelines

Attribute	Score		
Koala occurrence	2	Desktop	▪ EPBC online report identifies Koala as 'known to occur' in the Project area. ▪ 11 wildlife online records within a 50 km radius, although closest record is 24 km northwest of the Project. ▪ No other records of this species from the wider area.
		On-ground	▪ On-ground fauna surveys carried out across Project area over 3 survey periods and a total of 20 survey days. One individual identified within mine area during spotlighting. Tree scratches / scats with potential to be that of Koala identified adjacent to southern portion of mine ML.
Vegetation structure and composition	2	Desktop	▪ Eucalypt woodlands / open forest dominate the remnant vegetation remaining within both the mine area and haul road as per current DNRM mapping.

Attribute	Score		
		On-ground	▪ The Project area is largely cleared. The dominant canopy trees in the remaining remnant vegetation includes Poplar Box (forage trees for Koala in the region) and Narrow-leaf Ironbark (considered a supplementary forage tree species, particularly in drought conditions). There are also narrow bands of riparian vegetation featuring Forest Red Gum along creek lines in the northern portion of the mine ML and in the haul road. Forest Red Gum is considered to be a preferred forage species (Australian Koala Foundation 2015).
Habitat connectivity	1	Desktop	▪ The remnant vegetation in the west of the site although fragmented remains connected to contiguous woodlands including riparian vegetation. Site and adjacent riparian corridors bisected by 100 km/hr, two lane highway.
Key existing threats	0	Desktop	▪ The Australian Koala Foundation Koala map does not identify any road kill records in the wider area surrounding the Project area.
		On-ground	▪ Dingo encountered during several surveys but predation levels unknown. Road mortality recorded during site surveys in February 2017 on highway approximately 10 km east of Project area. Bruce Highway bisects site.
Recovery value	0	Desktop	▪ The impact area largely encompasses forage tree species which are widespread in the local region. Degraded riparian line featuring forage tree species in north of mine ML will be heavily impacted by Project. The haul road will impact minor extent of watercourse vegetation featuring forage tree species. ▪ The Project area lies within an already fragmented landscape. The Project area is not expected to function as an important corridor. A contiguous landscape corridor to the west of the Project, which is already bisected by an existing highway will not be impacted by the Project.
Total	**5**	**Decision – habitat considered 'critical to the survival of the Koala' as per the 'EPBC Act referral guidelines for the vulnerable Koala' (DotE 2014) (that is overall habitat score ≥ 5)**	

Under the referral guidelines for Koala (DotE 2014) it is recommended that a project be referred where it is proposed to 'clear ≥ 20 ha of habitat containing known Koala food trees in an area with a habitat score ≥ 8.' Where this is not proposed, the guidelines recommend that a referral be based on an appraisal of the Project considering factors such as Koala density and level of habitat fragmentation.

The species was detected in the mine area during spotlighting in February 2017. A road killed specimen was also recorded to the east of the site during the same survey. Signs of presence (tree scratches / scats) were identified in the area during previous surveys. There is preferred foraging habitat (comprising Forest Red Gums) within the mine area and haul road which will be disturbed by vegetation clearing. It is uncertain whether the species occurs in more than low densities in the area. The Project is understood to require the following clearing of habitat within the mine area and haul road:

- Clearing of 36.4 ha of preferred feed tree habitat (Forest Red Gum communities - RE 11.3.4 and 11.3.25); and
- Clearing of 94.8 ha of feed tree habitat (Poplar Box RE 11.4.2) (refer Figure 16-21).

In total 131.2 ha of habitat that may be considered critical to the survival of Koala (that is with a habitat score of 5) is proposed to be cleared for the Project.

The following significant impact assessment (Table 16-33) under the MNES guidelines (DotE 2013) has been informed by the information detailed above.

Table 16-33 Assessment against significant impact criteria: Koala

Criterion	Assessment against significance criteria (vulnerable)
Koala (*Phascolarctos cinereus*) – Qld, NSW and ACT populations	
Lead to a long-term decrease in the size of an important population of the species	No 'important population' has been identified within the Project area. Habitat that may be considered as 'critical to the survival of Koala' occurs on the mine area and haul road. The species was identified as present in Poplar Box habitat in the eastern portion of the mine area north of the highway. The Project requires clearing of 131.2 ha of foraging habitat. The Project has the potential to lead to an increase in Koala road deaths in the local area. Mitigation actions including fauna crossing structures at the haul road crossing suitable for Koala will be included in the Project design. Given the Project area it is considered unlikely the Project will lead to a long-term decrease in the size of an important population of Koala.
Reduce the area of occupancy of an important population	No 'important population' has been identified within the Project area. The species has been recorded within the mine area. Habitat that may be considered as 'critical to the survival of Koala' may occur in the mine area and haul road. The Project requires clearing of 131.2 ha of foraging habitat. However, the Project area remains contiguous with abundant similar habitat in the wider surrounds. It is considered unlikely the Project will reduce the area of occupancy of an important population of Koala in the area.
Fragment an existing important population into two or more populations	Habitat that may be considered as 'critical to the survival of Koala' may occur in the mine area and haul road. However, most of the Project lies on cleared lands. The Project area including the adjacent riparian corridors along creek lines are already bisected by a highway. The Project design will incorporate fauna crossing structures on the haul road crossing of Deep Creek. It is considered unlikely the Project will fragment an existing 'important population' into two or more populations.
Adversely affect habitat critical to the survival of the species	Under the referral guidelines for Koala (DotE 2014) the Project area contains habitat that may be considered as 'critical to the survival of Koala.' The Project requires clearing approximately 131.2 ha of this habitat. Under the referral guidelines the Project will adversely affect habitat critical to the survival of the species. This habitat will be the subject of a Project ODP.
Disrupt the breeding cycle of an important population	No 'important population' has been identified within the Project area. Where possible, clearing activities will take place outside the breeding season for Koala (October-May). A qualified fauna spotter will carry out a thorough survey for the species prior to any clearing of potential Koala habitat taking place. It is considered unlikely the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	There is suitable woodland habitat for the species in the mine area and haul road. However; most of the Project area is cleared of remnant vegetation. There is abundant suitable habitat for the species in the area surrounding the Project. It is considered unlikely the Project will impact the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat	The Project LUMP will incorporate measure to control the introduction and spread of weed and pest species across the Project area, although the local landscape is already subject to extensive weed infestation and pest species were also observed on several occasions including Dingo. The LUMP will be in place for the life of the Project, and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to Project infrastructure. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the species to decline	The Project LUMP will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.

Criterion	Assessment against significance criteria (vulnerable)
Interfere substantially with the recovery of the species	There is no State or Commonwealth recovery plan for this species. The Approved Conservation Advice for Koala (TSSC 2012) outlines management actions intended to aid the recovery of the species. With mitigation of potential Project impacts through installation of fauna infrastructure on the haul road, an environmental offsets program and measures incorporated within the Project LUMP, any potential impact on Koala, should it occur in the Project area, will be minor and is considered unlikely to interfere with the recovery of the species or any of the actions outlined in the Approved Conservation Advice.

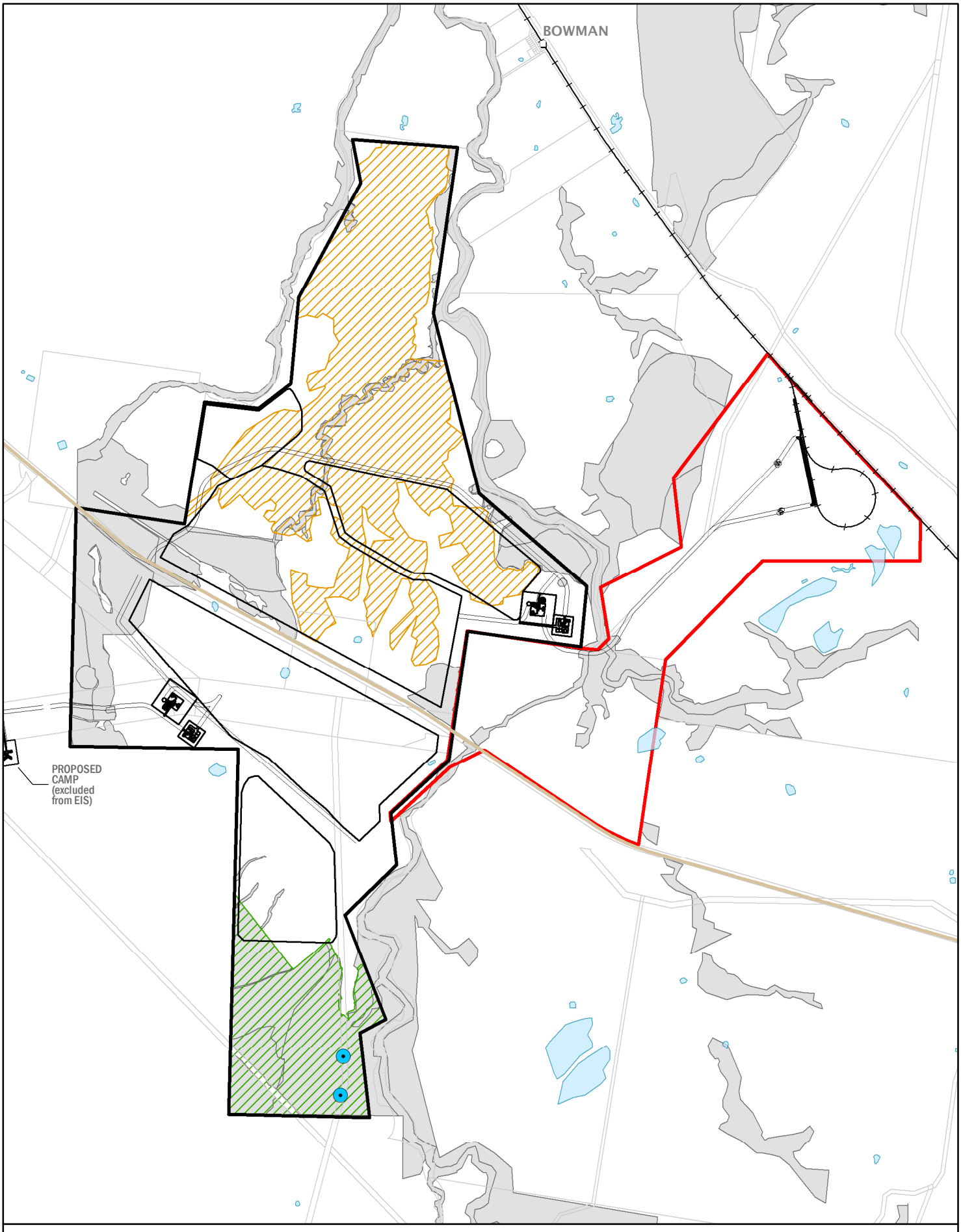


Figure 16-20
Potential habitat for Greater Glider and Ornamental Snake

N

0 0.5 1 km

Scale @ A4 1:50,000
Date: 24/07/17
Drawn: Gayle B.

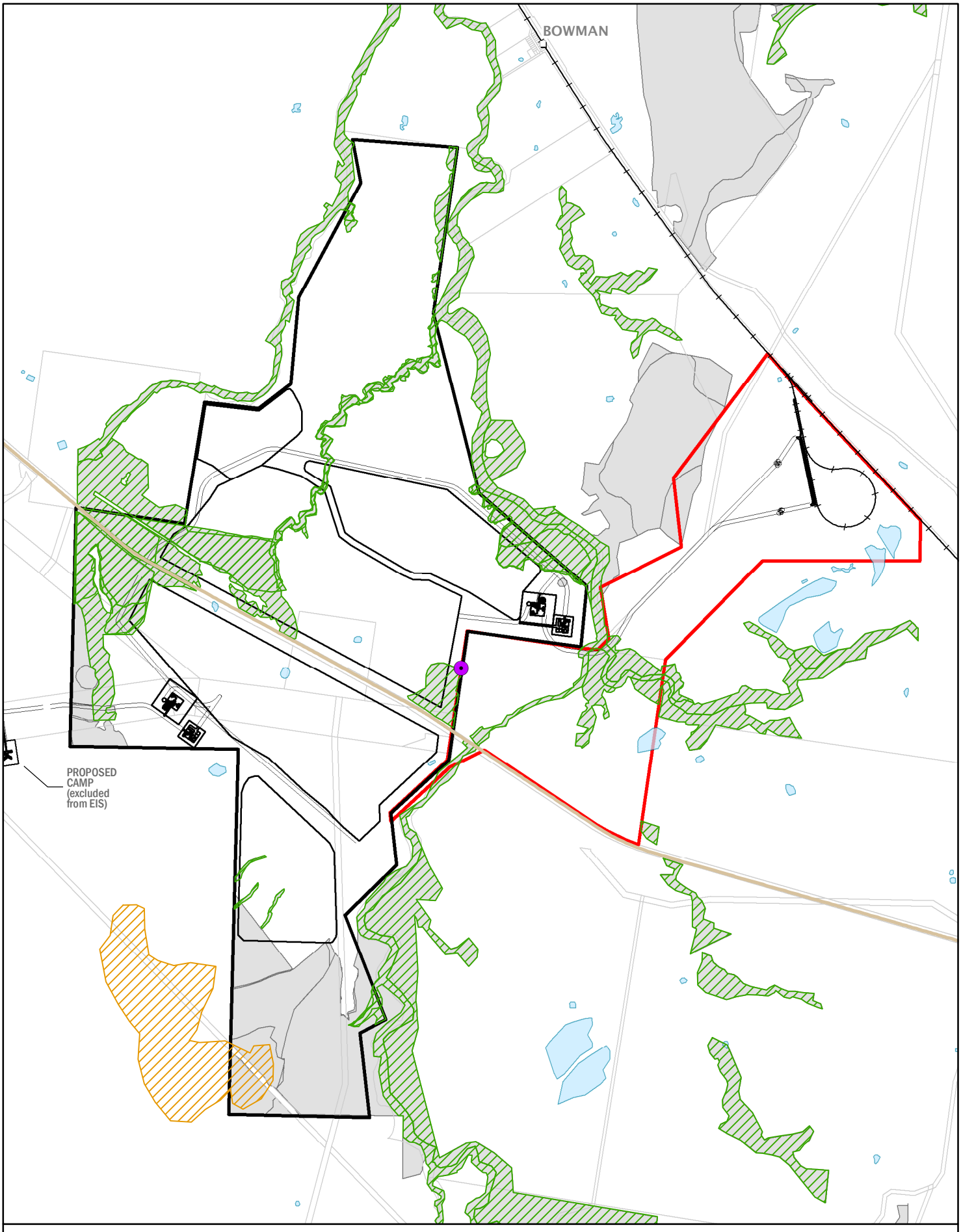
Legend

- Greater Glider
- Greater Glider Potential Habitat
- Ornamental Snake Potential Habitat
- Ground-truthed Remnant Vegetation
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Reservoir
- Cadastral boundary

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

BRUGGEMANNGD \\brbsvr1\PRO\Project\BES150160.03-Styx Coal Project 5 mtpa EIS Preparation\CADD GIS\GIS\DATA\MXD\Chapter 16\BES150160.03-015 R2 Potential habitat for greater glider & ornamental snake.mxd 7/24/2017



Legend

- Koala
- Preferred habitat
- Potential denning (rocky) habitat – Northern Quoll
- Ground-truthed Remnant Vegetation
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Reservoir
- Cadastral boundary

N

0 0.5 1 km

Scale @ A4 1:50,000
Date: 21/09/17
Drawn: Gayle B.

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

Figure 16-21
Potential habitat for Koala and Northern Quoll

CDM Smith

16.15.4.5 Southern Snapping Turtle

Southern Snapping Turtle was recorded in a large permanent waterhole in Deep Creek during 2011 aquatic ecology surveys for the Project. Table 16-29 summarises the species presence in the Project area, known threats to the species, and the relevant Commonwealth and State documents applicable to the species recovery.

Table 16-34 Key data on Southern Snapping Turtle

Southern Snapping Turtle (*Elseya albagula*)
Baseline Data Results
The nearest records are 31 km to the southwest and southeast (ALA / WildNet records) in the Fitzroy River Basin. A single individual caught and identified in Deep Creek during Project aquatic ecology surveys in June 2011. Freshwater species that prefers flowing habitats whereas the creeks adjacent to the MLs are ephemeral. Likely to occur in low densities as a result, presuming it still occurs. The Styx River is unlikely to provide habitat for the species as evidence of an estuarine influence (estuarine grass species along banks) was observed downstream of the confluence of Deep and Tooloombah Creeks.
EPBC Status
Critically Endangered
Key Threats
The main threat to the species is the ongoing mass loss of eggs and hatchlings, as well as degradation of habitat in the river basins in which it occurs, particularly through the construction of dams and weirs (TSSC 2014).
Recovery Plans
Draft Recovery Plan for the White-throated Snapping Turtle (Elseya albagula) (CoA 2017b): Recovery plans set out the objectives and strategies necessary to stop the decline of the species including: ▪ Improving the recruitment of hatchlings into the population; ▪ Minimising adult mortality / injury above background rates; ▪ Improving stream flows, habitat quality and connectivity throughout the species distribution; and ▪ Increasing public awareness and participation in the species conservation.

The species occurs in the Fitzroy, Burnett and Mary River catchments and adjacent catchments in southeast Queensland. The nearest database records are approximately 30 km south of the Project in Marlborough Creek (part of the Fitzroy River catchment). The species was recorded once in Deep Creek during aquatic ecology surveys for the Project in June 2011 (refer Figure 16-16). There is suitable habitat for the species adjacent to the Project area in the freshwater reaches of Tooloombah Creek and Deep Creek although the species is likely to occur in low densities. The species prefers to nest in sandy loam banks preferably with little ground cover and shaded.

For Critically Endangered species a 'population' is defined as:

- A geographically distinct regional population, or collection of local populations; or
- A population, or collection of local populations, that occurs within a bioregion.

Given the species has not been detected in the Styx catchment previously, has a poor dispersal ability over land and is not known to occur north of the Project area, the local population may be considered 'a geographically distinct regional population.'

The *Draft Recovery Plan for the White-throated Snapping Turtle (Elseya albagula)* (CoA 2017b) identifies habitat critical to the survival of Southern Snapping Turtle as:

- Riverine systems with permanent water, including waterholes, within the species' distribution; and
- All currently known and new nesting sites.

The following significant impact assessment under the MNES guidelines (DotE 2013) has been informed by the information detailed above.

Table 16-35 Assessment against significant impact criteria: Southern Snapping Turtle

Criterion	Assessment against significance criteria (critically endangered)
Southern Snapping Turtle (*Elseya albagula*)	
Lead to a long-term decrease in the size of a population of the species	The size of the population and distribution in the Styx catchment is unknown. There will be no direct construction impact to suitable habitat because of the Project. The Project will have negligible influence on surface water inflows to the adjacent creeks (refer Section 16.12.3). Impacts such as degraded surface water quality due to chemical spills or sediment inflows will be mitigated under the Project WMP (refer Section 16.13.3). Groundwater drawdown modelling suggests the Project may impact permanent waterholes in the long-term along sections of the creeks situated close to open cut mining activity, particularly Tooloombah Creek which appears more connected to the local water table than Deep Creek. Water level and water quality monitoring of targeted waterholes will occur as part of the REMP (refer Section 16.13.4). However, the current groundwater modelling is based on limited groundwater data and is considered as 'low confidence' at this stage. Ongoing groundwater monitoring including the installation of dedicated monitoring bores is ongoing and will lead to better refinement of the groundwater model for the area. A dedicated program will be developed and implemented to assess the water requirements of GDEs associated with the Project area, riparian vegetation health monitoring, monitoring of water levels and quality in 'at risk' sites, and measures to replenish waterholes if necessary (refer Section 16.13.4). Mitigation measures will include a Significant Species Management Plan. Should declining water levels be considered a risk to resident turtle species then a relocation program will be implemented transferring individuals to identified waterholes elsewhere in the catchment. The creeks are ephemeral and surface water inflows will be negligibly impacted meaning rainfall recharge of waterholes will not be impacted. At this stage, the potential extent of impact is uncertain. With the mitigation measures implemented the Project is considered unlikely to lead to a long-term decrease in a population.
Reduce the area of occupancy of the species	Groundwater drawdown modelling suggests the Project may impact permanent waterholes along sections of the creeks situated close to open cut mining activity, particularly Tooloombah Creek which appears more connected to the local water table than Deep Creek. The extent of potential impact remains uncertain at this stage due to limited groundwater data. The areas of higher modelled impact is limited to those portions of Tooloombah Creek and Deep Creek that are situated closest to open cut mining activity. Mitigation measures will include a Significant Species Management Plan, dedicated program to assess the water requirements of GDEs associated with the Project area, riparian vegetation health monitoring, monitoring of water levels and quality in 'at risk' sites, and measures to replenish waterholes if necessary. At this stage, the potential extent of impact is uncertain. With the mitigation measures implemented the Project is considered unlikely to lead to a minor reduction of occupancy of the species.
Fragment an existing population into two or more populations	The areas of higher modelled impact are limited to those portions of Tooloombah Creek and Deep Creek that are situated closest to open cut mining activity. Tooloombah Creek and Deep Creek are ephemeral and surface water inflows will be negligibly impacted meaning rainfall recharge of waterholes will not be impacted. The Styx River will not be impacted due to estuarine influence detected downstream of the confluence of Deep Creek and Tooloombah Creek. The Project will not 'fragment an existing population'.
Adversely affect habitat critical to the survival of the species	The creeks adjacent to the Project may contain critical habitat due to the likely presence of permanent waterholes. It is unknown where or if the species nests in the catchment. At this stage, the potential extent of impact is uncertain. Mitigation measures will include a Significant Species Management Plan, dedicated program to assess the water requirements of GDEs associated with the Project area, riparian vegetation health monitoring, monitoring of water levels and quality in 'at risk' sites, and measures to replenish waterholes if necessary. With the mitigation measures implemented the Project is considered unlikely to lead to adversely affecting habitat critical to the survival of the species.

Criterion	Assessment against significance criteria (critically endangered)
Disrupt the breeding cycle of a population	It is unknown where or if the species nests in the catchment. The species nests in sandy loam banks above the water line. This habitat may be restricted to sections of Deep Creek. The Project area is already subject to significant potential nest disruption due to the observed presence of cattle and feral pigs in the area. Cattle will be excluded from Tooloombah and Deep Creek on Project-controlled lands thereby reducing potential damage to nest sites should they occur in the area. It is considered unlikely the Project will disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The size of the population and distribution in the Styx catchment is unknown but the species is likely to occur in low densities. The water level and quality of the adjacent creeks will be monitored. A Significant Species Management Plan will be in place. Should declining water levels be detected and considered a risk to resident turtle species then a relocation program will be implemented transferring individuals to identified waterholes elsewhere in the catchment. The creeks are ephemeral and surface water inflows will be negligibly impacted meaning rainfall recharge of waterholes will not be impacted. At this stage, the potential extent of impact is uncertain. Considered at its worst extent groundwater drawdown will only have a potential zone of substantial impact in sections of the creeks closest to open cut mining. It is considered unlikely the Project will impact the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the critically endangered species habitat	The Project LUMP will incorporate measure to control the introduction and spread of weed and pest species across the Project area, although the local landscape is already subject to extensive weed infestation and pest species were also observed on several occasions including Dingo. The LUMP will be in place for the life of the Project, and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to Project infrastructure. The Project is considered unlikely to result in invasive species becoming established in this species' habitat.
Introduce disease that may cause the species to decline	The Project LUMP will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species	The Project does not interfere with the overall objectives of the *Draft Recovery Plan for the White-throated Snapping Turtle*. At this stage, it is uncertain the extent of impact, if any, there will be on habitat for the species adjacent to the Project. The Project will implement mitigation of potential Project impacts through a program to assess the water requirements of GDEs associated with the Project area, water level and quality monitoring, and a Significant Species Management Plan including freshwater turtle monitoring in the local catchment. The Project will also implement an offset program which will include measures (if required) to support programs to aid the recovery of the species such as protection of nest sites as presently carried out for the Fitzroy Turtle by Greening Australia. Any potential impact on Southern Snapping Turtle, should it occur in the Project area, will be minor and is considered unlikely to interfere with the recovery of the species.

16.15.5 Impact Significance - Migratory Species

As noted in Section 16.11.5, four fauna species listed as Migratory are considered known to occur, and a further three species are considered likely to occur and potentially be subject to Project impacts. One of these is listed as a Migratory Shorebird species.

Currently known information about the listed species is summarised in the community profiles shown in Table 16-36. Significance of the impacts to migratory species assessed using the significant impact criteria outlined in DotE (2013) (Table 16-37).

The migratory species assessments commence with an evaluation of the presence of 'important habitat' as defined within the significant impact criteria for migratory species:

'An important population is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and / or that are:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species;
- Habitat that is of critical importance to the species at particular life-cycle stages;
- Habitat utilised by a migratory species which is at the limit of the species range; and / or
- Habitat within an area where the species is declining.

Table 16-36 Key data on listed migratory species

Migratory species
Glossy Ibis (*Plegadis falcinellus*)
Baseline Data Results
Recorded on estuarine wetlands to the north of the Project area in 2011. There is potential shallow wetland habitat present for this species.
Key Threats
Threats to this species as identified by DotEE (2017) include; loss and / or degradation of foraging and especially breeding habitat through alteration of water flows, drainage and / or clearing of wetlands for development, frequent burning of wetland vegetation used as nest sites, salinization, groundwater extraction and invasion by exotic plants or fishes. Localised threats include hunting, use of pesticides, and general human disturbance.
Recovery Plans
Currently no recovery, conservation or threat abatement plans have been developed for the Glossy Ibis in Australia.
Latham's Snipe (*Gallinago hardwickii*)
Baseline Data Results
Up to 15 individuals recorded at a vegetated dam north of the highway and within the ML in February 2017. No other records of the species. This species inhabits open, freshwater wetlands with low, dense vegetation including swamps, flooded grasslands, heathlands, around bogs and other water bodies (DotEE 2017). This habitat may be abundant (as both natural or man-made wetlands) within the mine ML following heavy rains.
Key Threats
Key threats to this species include: ▪ Land clearing, habitat fragmentation and / or habitat degradation due to agricultural activity, as well as other rural and urban developments; ▪ Climate change altering atmosphere / hydrosphere temperatures, rainfall patterns and / or frequency of severe weather events; ▪ Competition and / or habitat degradation by weeds; ▪ Increased predation from feral species; ▪ Declining water quality (salinity, nutrient and / or turbidity) and changes in wetland hydrology; and ▪ Pollution due to oil spills and other chemical pollutants (DotEE 2017).
Recovery Plans
Wildlife Conservation Plan for Migratory Shorebirds (DEH 2006).
Oriental Cuckoo (*Cuculus optatus*)
Baseline Data Results
Single individual recorded in March 2011. Location unknown. Species has broad habitat requirements and may occur in wooded remnant habitats throughout.
Key Threats
There are no threats listed for this species.
Recovery Plans
The *Threat abatement plan for predation by feral cats* (DotE 2015b) has been adopted for this species.
White-throated Needletail (*Hirundapus caudacutus*)
Baseline Data Results
Not recorded, but likely to occur seasonally over the Project area. Aerial foraging visitor to eastern Australia.

Migratory species
Key Threats
Key threats to the White-throated Needletail include: ▪ Land clearing, habitat fragmentation and / or habitat degradation in northern hemisphere; ▪ Direct exploitation by humans including hunting; and ▪ Collision with human infrastructure including windows and utility and service lines.
Recovery Plans
No threat abatement or recovery actions either underway or proposed due to the limited nature of any threats to the species and its mobility (DotEE 2017).
Fork-tailed Swift (*Apus pacificus*)
Baseline Data Results
Recorded in March 2011 and February 2012. Likely to occur seasonally over the Project area. Aerial foraging visitor to the entire Australian mainland.
Key Threats
DotEE (2017) has identified collision with overhead wires, windows and lighthouses as threats to this species although it is recognised that these impacts affect only a few individuals. Hence these threats are not threats to the species overall.
Recovery Plans
Due to the limited nature of any threats to the species and its mobility, there are no threat abatement or recovery actions either underway or proposed.
Rufous Fantail (*Rhipidura rufifrons*)
Baseline Data Results
Recorded in 2011. Location unknown. Most suitable habitat in the Project area for this species is the closed canopy forest along Tooloombah Creek and Deep Creek.
Key Threats
The main threat to this species is the continued clearing and fragmentation of suitable moist forest habitat (particularly along migration routes) by expanding urbanisation and other development.
Recovery Plans
No recovery plans currently exist for this species.
Estuarine Crocodile (*Crocodylus porosus*)
Baseline Data Results
No individuals recorded. Slides observed on Deep Creek in June 2011. Anecdotal reports of species regular occurrence in Styx River where likely most suitable habitat (estuarine) occurs.
Key Threats
The main local threats to this species include entrapment in fishing nets and habitat destruction including by feral animals, particularly in the Northern Territory (DotEE 2017).
Recovery Plans
No recovery plans currently exist for this species.

Table 16-37 Assessment against significant impact criteria: Migratory Species

Criterion	Assessment
Migratory Species	
Does the migratory species habitat within the Project area represent 'important habitat'?	There is no evidence that habitat within the Project area should be considered as important habitat for a migratory species. Four species listed as Migratory were observed during site surveys. All species are widespread, observed as individuals or small numbers and therefore with very small proportions of their populations observed on the Project area. Only Latham's Snipe was observed at a farm dam in relatively large numbers (15 individuals). Under the *EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DotEE 2015) important habitat for this species may be defined as areas that support at least 18 individuals. Although this remains a large number of individuals in a small area for this species, the habitat in which it was recorded remains widespread in the surrounding area. There is no habitat for Estuarine Crocodile within the Project area and there is unlikely to be 'important habitat' for this species in the local surrounds. None of the species observed or likely to occur are known to be declining or are at the limit of their range. Therefore, migratory species habitat within the Project area is unlikely to represent 'important habitat.'
Substantially modify, destroy or isolate an area of important habitat for a migratory species	Migratory species habitat within the Project area is unlikely to represent 'important habitat', as noted above. Several waterbodies within the Project footprint will be cleared / removed although and several environmental dams will be added. There is no reason to consider the Project will have a significant impact on 'important habitat' for any of the species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Migratory species habitat within the Project area is unlikely to represent 'important habitat', as noted above. Habitat suitable for wetland migratory species within the Project boundary (creeks, waterholes, riparian vegetation, and farm dams) is already highly modified by past grazing practices. Weed species including Rubber Vine and Lantana were commonly observed in the understorey of riparian vegetation along Tooloombah and Deep Creeks. The Project LUMP will incorporate procedures for the management of invasive species to limit the potential impact of feral predators and weed species on migratory species and their habitat. The Project is considered unlikely to result in invasive species becoming established in migratory species habitat.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	What constitutes an 'ecologically significant proportion of the population' is ill-defined. For migratory shorebirds, this has been defined as a site supporting 0.1% of the flyway population (DEWHA 2009). The current flyway population estimate for Latham's Snipe is 30,000 (Hansen et al. 2016) i.e. an ecologically significant proportion of the population is 30 individuals. Under the significant impact guidelines, factors that should be considered for each species includes the species' population status, genetic distinctiveness specific behavioural patterns including site fidelity and dispersal patterns (DotE 2013). None of the migratory species recorded were observed in large enough numbers that may represent an ecologically significant proportion of the population of a migratory species. Only one species was recorded on more than a single survey event (Fork-tailed Swift). Coupled with the lack of 'important habitat' for migratory species occurring within the Project area, no significant impacts on a migratory species are expected.

16.16 Cumulative Impacts

The nature of the Styx River catchment is rural with approximately 78% of lands occupied by agriculture dominated by cattle grazing. A review of the latest publicly available information regarding proposed developments in Queensland found no large-scale industrial or mining developments proposed for the catchment other than the Central Queensland Coal Mine Project and there are no such Projects within a minimum of 100 km radius of the Project area.

The nearest mining operation to the Project is the Kunwarara magnesite mine located 60 km to the southeast. The mine began operation in 1991 and is currently owned by Sibelco. Magnesite resides close to the surface layers and is mined using open cut pits generally between 15 m to 18 m deep. The mine is mainly divided into three sections - KG1, KG2 and KG3 pit areas. The KG1 pits are located in predominantly cleared lands. The KG2 and KG3 pit areas are located adjacent to patches of Endangered vegetation. There is no information available regarding any current or proposed expansion plans for the project and the project is not considered further.

The only major development known from the surrounding area is the proposed expansion of the Shoalwater Bay Training Area by the Department of Defence. This area lies largely within the adjacent Shoalwater catchment which also drains into Broad Sound to the northeast of the Project area. The original proposal identified a 'likely expansion area' stretching west from the existing training area to the approximate east bank of the Styx River located to the north of the Project. Based on opposition from local communities it has been recently assessed that a reduced expansion area is 'achievable' (DoD 2017). As such, the extent of the proposed expansion and the potential changes to land use are unknown at this stage.

The next closest proposed development is the Capricorn Integrated Resort proposed by Iwasaki Sangyo and located 110 km due east of the Project at Corio Bay. Although a final ToR was issued for the Project in May 2014 no further documentation regarding the Project is available. The Project EIS is said to be still in preparation.

Given there are no other large projects currently known to have identified lands within the Styx River catchment, the Project impacts to terrestrial ecology will only add to those impacts that are a result of current land use in the catchment. These background land use impacts have already been characterised within this chapter. There are no other projects in the catchment or surrounds which the potential Project impacts to terrestrial ecology subject to this assessment could conceivably add to.

16.16.1 Reef 2050 Long-term Sustainability Plan

The ToR requests it be demonstrated how the proposed action will provide a net benefit to water quality in the GBRWHA and is consistent with the objectives of the *Reef 2050 Long-term Sustainability Plan* (GoA 2015) including the following reductions (based on a 2009 baseline) in sediment, nitrogen and pesticide loads in 'priority areas':

- Reducing dissolved nitrogen loads by at least 50 per cent in priority areas, on the way to achieving up to an 80 per cent reduction by 2025;
- Reducing sediment loads by at least 20 per cent in priority areas, on the way to achieving up to 50 per cent reduction by 2025;
- Reducing end-of-catchment particulate nutrient loads by at least 20 per cent in priority areas; and
- Reducing end-of-catchment pesticide loads by at least 60 per cent in priority areas.

The Plan also sets out a number of other actions that are applicable to the Project including the following:

- Working with industries to measure management efforts to achieve best practice water quality management; and
- Reviewing and developing water quality objectives, targets and standards across the region.

Surface water quality sampling for the Project (2011 and 2017) recorded the following background data from the surface waters adjacent to the Project:

- Turbidity and suspended solids loads were generally low and below water quality objectives set for the Styx River catchment. High levels of turbidity and suspended solids were recorded in two large waterholes in Deep Creek (in February 2017) following an extended dry period and no flow conditions; and
- High levels of total nitrogen, ammonia and phosphorus were recorded (above local water quality objectives) across most sites in Tooloombah Creek, Deep Creek and the Styx River in June 2011 and February 2017.

It is also known that the waters of Broad Sound are naturally turbid and low in nutrients due to the large tidal range in the area (De'ath and Fabricius 2008).

The Project is in the lower catchments of both Tooloombah Creek and Deep Creek. It is uncertain to what extent the Project area currently contributes to sediment or nutrient loads entering the creeks. It is noted that the entire Project area is subject to cattle grazing (thereby contributing to nutrient run-off) and comprises areas of dispersive and sodic soils that are prone to erosion (as evident during site inspections). Cattle will be removed from the majority of the Mamelon property prior to the commencement of construction and thereby reducing potential nutrient loads and sediment from erosion entering local watercourses (i.e. Deep and Tooloombah Creeks).

The Project activities will not conceivably add pesticide or nutrient loads to the Styx River. The Project site layout and design will necessarily reduce the local catchment impacts through a reduction in catchment area. Mine water releases from the Project will be avoided where possible but subject to the water quality objectives already in place for the lower Styx River catchment where required. The Project occupies a very small area within the Styx River catchment and is considered unlikely to provide additional water quality impacts to surface water entering the GBRWHA to those already existing in the catchment.

The mitigation measures detailed in Section 16.13.3 are designed to at worst maintain existing background water quality in the adjacent creek lines. The implementation of a REMP will also provide continuous data on local water quality in the Styx River catchment which was not previously available. With the reduction in catchment run-off area and proposed mitigation and monitoring measures the Project has the potential to provide a net benefit to water quality in the GBRWHA.

16.17 Biodiversity Offsets

16.17.1 Introduction

The *EPBC Act Environmental Offsets Policy 2012* (Offsets Policy) defines offsets as measures that compensate for the residual adverse impacts of an action on the environment. The Queensland Environmental Offsets Policy (QEOP) identifies an environmental offset as an action taken to counterbalance unavoidable, residual impacts to Matters of National, State, and / or Local Environmental Significance that result from an activity or a development. In both cases, an offset may be located within or outside the geographic site of the impact, and are applicable as an additional management tool once residual impacts from an action have been incurred despite measures to avoid or minimise impacts being applied.

Avoidance and mitigation measures are the primary strategies for managing the potential significant impacts of a project. Offsets are not intended to reduce the likely impacts of the Project,

but are implemented to compensate any residual (after mitigation) significant impact (see Section 16.15).

It is essential for the Project to address and incorporate these offsets issues and policies early in the Project planning lifecycle to examine design options that avoid impacts, reduce any likely impacts through mitigation, and accept that any residual impacts associated with the Project be offset.

16.17.2 Legislation

The Offsets Policy outlines the approach to environmental offsets under the EPBC Act. The policy applies to offsetting requirements in terrestrial and aquatic (including marine) environments and applies to projects assessed under the EPBC Act.

Under the Offsets Policy, offsets act as a compensation mechanism for impacts (direct and indirect) to all protected matters under the EPBC Act including the two relevant MNES for this Project:

- Listed threatened species and ecological communities; and
- Migratory species.

Offsets under Commonwealth legislation are only required where residual impacts are considered significant as defined under the detailed significance criteria (DEWHA 2009). Hence the Project will not require offsets where it is able to either avoid or successfully mitigate potential impacts such that the net residual impact is not significant.

The key aims of the Offsets Policy are to:

- Ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
- Provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
- Deliver improved environmental outcomes by consistently applying the policy;
- Outline the appropriate nature and scale of offsets and how they are determined; and
- Provide guidance on acceptable delivery mechanisms for offsets.

Ten overarching principles are defined in the Offsets Policy to be applied in determining the suitability of offsets.

The first eight principles require that suitable offsets must:

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action;
- Be built around direct offsets but may include other compensatory measures;
- Be in proportion to the level of statutory protection that applies to the protected matter;
- Be of a size and scale proportionate to the residual impacts on the protected matter;
- Effectively account for and manage the risks of the offset failing;

- Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action);
- Be efficient, effective, timely, transparent, scientifically robust and reasonable; and
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

The last two principles require that in assessing the suitability of an offset, government decision-making will be:

- Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty; and
- Conducted in a consistent and transparent manner.

For this Project, any residual impacts must be offset in accordance with the Commonwealth legislation.

16.17.2.1 State Legislation

The QEOP provides a single, streamlined framework for environmental offsets which replaces a number of former policies. The framework was introduced in July 2014 and includes:

- *Environmental Offsets Act 2014* – this is the primary legislation that establishes a head of power for the State to impose offset conditions and rules around how offsets will be required and delivered. It outlines offsets will be required to counterbalance a significant residual impact of a prescribed activity on a prescribed environmental matter. Key definitions are established and it also provides for the making of an Environmental Offsets Policy;
- *Environmental Offsets Regulation 2014* – the regulation defines those prescribed environmental matters that may require an offset and are referred to as 'Matters of State Environmental Significance'. It also sets out the requirements of an Offset Delivery Plan and provisions for advance offsets; and
- *Environmental Offsets Policy 2014* – this policy provides operational detail and as to how offsets will be assessed and need to be delivered. The policy includes information on relationship between Commonwealth and State offsets, criteria that offsets must meet, offset delivery options and staging of offsets.

16.17.3 Method for Developing Offsets Delivery Plan

Central Queensland Coal will develop an ODP in accordance with the relevant Commonwealth and State policies. The Plan will offset the residual impacts detailed in the previous section. The aim of Plan will be to provide an overall net environmental gain. Central Queensland Coal considers the most effective and efficient way to achieve this is to provide an ODP which includes all aspects of the Project, rather than a piecemeal approach to offsetting. The Plan will incorporate the provision for acquiring future offsets should they be required due to the impacts of subsidence, or other unforeseen impacts resulting from Project activities.

Central Queensland Coal will continue to collaborate with the relevant agencies (such as DAF, DNRM, EHP, and DotEE) regarding offset options to ensure optimal environmental net benefit. The Plan will identify solutions that:

- Will protect against or repair residual impacts to matters of Commonwealth and State environmental significance;
- Relate specifically to the matter (for example, species or their habitat) being impacted; and
- Seek to ensure that the health, diversity and productivity of the environment are maintained or enhanced.

16.17.3.1 Development of an Offsets Delivery Plan

It is proposed that the key steps for development and implementation of an ODP will be as follows:

- Step 1: Identifying and quantifying residual Project impacts;
- Step 2: Identification of applicable offset requirements to address residual Project impacts;
- Step 3: Smart consolidated approach to meeting offset requirements – finalisation of Draft Plan;
- Step 4: Relevant agency input and approval of ODP;
- Step 5: Implementation of ODP; and
- Step 6: Ongoing monitoring of ODP.

Throughout each of these steps, consultation will be undertaken with key stakeholders including State and Commonwealth government departments and interested community groups. These steps are explained below.

Step 1: Identifying and quantifying residual Project impacts

The desired outcome of the first step is a definition and quantification of residual impacts resulting from the Project. Through the EIS process many of the expected impacts identified have been avoided and / or reduced through appropriate mitigation. The remaining residual impacts have been identified and quantified for the Project in Table 16-38.

Step 2: Identification of applicable offset requirements to address residual Project impacts

The second step in developing the ODP is proposed to involve the quantification of offset requirements based on relevant offset policies, including the EPBC Act EOP and any applicable State offset policies and regulations. In collaboration with the relevant government departments, Central Queensland Coal will determine the offset requirements under the relevant policies which are triggered. Recovery plans specific to impacted species will also be used for guidance. It is anticipated that a Project Approval administered by the State Government will specify the level of offsetting required to meet requirements under the relevant Acts.

As a part of this step, the identification of available and acceptable offset measures will be assessed, including as a preference direct land-based offsets to ensure that the aim is achieved of compensating for any authorised unavoidable impacts confirmed through pre-clearance surveys.

Central Queensland Coal will consider the use of both direct and indirect offsets in the development of the ODP. Generally, direct offsets require restoration, rehabilitation or enhancement of 'like-for-like' habitat. Indirect offsets include financial contribution toward applied research, education, habitat enhancement, restoration, rehabilitation, or connectivity. Under the EPBC Act, the aim is for direct offsets to account for 90% of the total offsets; however, deviation from this requirement may be considered under certain circumstances.

Any required direct offsets will entail the identification of potentially suitable areas that may be secured for long-term conservation outcomes. It will be essential that the offsets may be secured for management (by covenant or other acceptable mechanism) to ensure environmental gain and meet regulatory requirements.

Step 3: Smart consolidated approach to meeting offset requirements – finalisation of Draft Plan

As a part of this step, it is proposed that Central Queensland Coal develop an ODP that acceptably satisfies all approval requirements, in an ecologically strategic manner. This step will involve discussions with relevant state agencies (EHP, DAF, DNRM), DotEE and any other identified key interest groups to ensure the best ODP is formed.

Central Queensland Coal will aim to provide a smart, strategic approach to meeting the specified offset requirements, as a package, rather than separate offset proposals addressing each policy. This step will also analyse other policies such as those under *Carbon Credits (Carbon Farming Initiative) Act 2011* and *National Greenhouse and Energy Reporting Act 2007* to see if there are offsets required that could be included in the ODP. This step will incorporate an assessment of how any necessary offsets may be developed and coordinated using best practice in planning and implementation, ensuring the best ecological outcomes. This planning step will be critical to ensure that the best outcome is secured from the ODP.

The development of the ODP will include further ground-truth verification and detailed assessment of the following aspects:

- Appropriate location and type of land and vegetation;
- Assessment of healthy vegetation that could be utilised in offsets (using detailed analysis of mapping, aerial imagery, and fieldwork including BioCondition assessment);
- Land use and land management techniques that may improve on methods contributing to historical degradation;
- Maximising connectivity of ecosystems, where possible;
- Maximising relationships to state and national wildlife corridors, providing regional and national context and value;
- Low risk areas – limited edge effects, fragmentation, ecosystem failure, fire;
- Potential for securing strategic land acquisitions, partnerships, and protections / covenants;
- Opportunities to add to relevant research programme; and
- Ongoing monitoring and management techniques and schedules.

An important approach during this step is to finalise assessment of the existing environment in the region in and around the proposed offset area (to the extent it falls outside of the Project area and therefore outside of assessment already undertaken) to determine the ecological processes already enhancing natural regeneration (such as natural recruitment and regrowth). Incorporating these processes into the offsets strategy will help ensure a successful, reliable and cost efficient approach to offsets.

Step 4: Relevant agency input and approval of ODP

This proposed step will entail the submission of the Draft ODP to seek approval from relevant governmental agencies, ready for implementation. The purpose of this step is to provide opportunity for the relevant authorising agencies to comment on the Draft Strategy (which will be incorporated into the draft as necessary). Because of this step it is also proposed that approval will be secured, thereby ensure confidence that the approach taken in the finalised Strategy will meet all requirements and may be implemented to secure the necessary environmental outcomes.

Step 5: Implementation of ODP

The next proposed step is necessarily the conduct on-ground implementation of the ODP in all offset areas. This step will mark the commencement of the implementation of the approved ODP.

Implementation will include important measures such as the securing of land necessary for offsets in an acceptable manner (such as through purchase or use of covenants on title), as the majority of policies require a covenant or change of land title to ensure perpetuity of the offset area.

Step 6: Ongoing Monitoring of Offset Proposal

The final but ongoing step in the proposed delivery of the ODP will be to conduct ongoing monitoring and reporting of all offset areas for the required period in accordance with the ODP and the statutory processes to gain Project approvals.

Approval conditions usually require ongoing monitoring (and associated reporting) of offset areas until a specific time has passed or targets are achieved. This step continues to assess and monitor the implementation of the ODP. It should audit and monitor offset areas against timely targets set out in the Plan (these should utilise BioCondition methodologies) that will ensure overall offset targets are met (such as for vegetation offsets remnant status is achieved within the specified timeframe).

Monitoring will require site visits, or if capabilities and technologies allow, remote sensors and analysis. Reporting must meet requirements of government departments. Monitoring will allow for ongoing identification of further appropriate measures that may be undertaken (if required) to ensure the ultimate environmental goals of the Plan.

16.17.4 Potential Residual Impacts

Sections 16.12, 16.13 and 16.15 identify the Project's potential environmental impacts and the mitigation measures. The current Project footprint and design have been planned to avoid significant environmental impacts, where possible or practicable, however, unavoidable residual environmental impacts have been identified. This section includes the identified and potential future residual impacts that may require offsets.

Ground-truthed MNES within the overall Project area include:

- Two Endangered REs (all of which are equivalent to EPBC Act listed TECs);
- Known habitat for Squatter Pigeon, Koala, Greater Glider, Southern Snapping Turtle and migratory bird species; and
- Potential habitat for Ornamental Snake.

The areas of predicted impact of vegetation clearing based on ground-truthed vegetation mapping are detailed in Table 16-38. Several of these matters overlap and the overall extent of impact encompasses an area of 131.46 ha. As such, biodiversity offsets will be required.

Direct clearing of TECs is expected to be eliminated during continuing refinement of the design of the mine and infrastructure footprint. They are considered here under the current design footprint for the sake of completeness.

There is further potential in the long-term for impacts to MNES because of possible groundwater drawdown impacts in the vicinity of open cut mining operations which may impact sections of Deep Creek and Tooloombah Creek including potential impacts:

- On riparian vegetation (RE 11.3.25) which provides foraging habitat for Koala;
- On SEVT vegetation patches identified along Tooloombah Creek; and
- To water levels in permanent waterholes which provide habitat for Southern Snapping Turtle (*Elseya albagula*) (listed as Endangered – NC Act and Critically Endangered – EPBC Act). This species was recorded in Deep Creek within the maximum predicted groundwater drawdown area in June 2011 (refer Chapter 15 – Aquatic Ecology for more information).

These areas will be subject to vegetation monitoring under the Project LUMP and wetland health monitoring and management under the REMP. Where vegetation communities or waterhole habitat are found to be unavoidably impacted by groundwater drawdown these areas will be subject to the Project Biodiversity ODP.

Table 16-38 Identified residual and potential impacts to MNES

Matter of concern	Description	Impact area total (ha)
Identified residual impacts from Project clearing activity		
TECs	RE11.4.9 listed as a Brigalow TEC and considered suitable habitat for Ornamental Snake	0.2
	RE11.3.11 listed as SEVT TEC	0.4
Habitat for threatened fauna	Ornamental Snake: RE 11.4.9 and 11.3.25. Overlaps with habitat for Koala.	25.5
Habitat for threatened fauna	Koala (based on presence of foraging habitat') – 11.3.4, 11.3.25, and 11.4.2.	130.86
	Overall impact area	**131.46 ha**

The clearing of the vegetation for both the TECs and the listed species will remain as residual impacts, thereby requiring offsetting. Where the clearing of one RE patch affects both a TEC and a listed species, only one offset is required.

16.17.5 Potential Offset Activities

Under the Offsets Policy it is recognised that direct land-based offsets should comprise a minimum of 90% of the offset requirements for any given impact. At this stage, the residual significant impacts due to vegetation clearing for the Project is 0.6 ha of TEC and 130.86 ha of habitat for threatened species. Central Queensland Coal will continue to liaise with the relevant State governing body (EHP) and DotEE to discuss the preferred approach and outcomes for offsetting these impacts.

Offsets under the EPBC Act Offsets Policy require the quality of vegetation to be at least similar to that impacted. The quality of the vegetation requiring offsetting will be assessed using EHP's 'Guide to determining terrestrial habitat quality' (EHP 2017). The assessment methods are based on the BioCondition Assessment Manual (developed by the Queensland Herbarium), and align with the

EPBC Act Offsets Policy measure of 'habitat quality.' This allows for a consistent framework for environmental offsets between the State and Commonwealth approval process.

When considering direct offsets, Central Queensland Coal considers it important, if possible, to acquire lands local to the area of impact. As such an initial investigation of leasehold lands (i.e. lands not under current protection such as National Parks, State Forests and Nature Refuges) has been undertaken within a 50 km radius of the Project area in order to determine the quantity and spatial extent of potential offset areas. The area of REs available (under current DNRM mapping) within a 50 km radius and a 100 km radius of the Project area, and analogous to the MSES potentially impacted by the Project are provided in Table 16-39.

Table 16-39 Extent of regional mapped REs (ha) associated with potential residual impacts of Project activities

RE	50 km radius of Project area	100 km radius of Project area	Marlborough Plains subregion	Nebo-Connors Range subregion
11.3.4	3,561	11,326	9,985	4,230
11.3.11	485	689	74	430
11.3.25	7,749	21,007	928	8,902
11.4.2	6,485	9,702	6,121	1812
11.4.9	694	1,541	517	129

The above assessment does not include those composite vegetation polygons that may also include the REs listed as either a dominant or subdominant mixed community. However, for the purposes of offsetting these communities may still be of value where they can be secured and are located to enhance EVs such as within or adjacent to recognised regional biodiversity corridors and / or adjacent to already existing protected areas.

16.17.5.1 Potential Offset Options

Mamelon Property

Central Queensland Coal is currently investigating options for offsetting purposes for both the initial predicted residual impacts as well as the potential long-term impacts related to subsidence. Where possible, offsets will be preferentially located within the 50 km radius investigation area. Central Queensland Coal will seek to achieve synergistic habitat and conservation benefits. This will be done by integrating potential offset opportunities with the surrounding landscape and landuse on lands / habitat of an equivalent (or better) condition, or suitable for rehabilitation, and located within Mamelon property which is owned by Central Queensland Coal.

Mamelon encompasses a total area of 6,478 ha of which the Project ML covers 2,275 ha. Significant portions of remnant vegetation remain outside of the Project boundary. The major impact to MNES as a result of the Project is to habitat for Koala. The table below summarises the remnant vegetation remaining on the property and outside the Project footprint as mapped under State vegetation mapping. The mapping indicates that up to 686 ha may be available within Mamelon that can be used for environmental offsets for Koala. There is also 45 ha of SEVT vegetation which may be suitable for offsetting impacts to SEVT along Tooloombah Creek (in the event such impacts occur). In addition, there are an additional 370 ha of remnant vegetation that will not be impacted under the Project footprint. Ground-truthing vegetation surveys indicate this includes 161 ha of vegetation suitable for Koala (RE 11.3.4, 11.3.25, 11.4.2and 11.5.8a) and therefore suitable for potential use as environmental offsets for the property.

Surveys of the property will be required to confirm the vegetation actually present on the site and its suitability for offsetting purposes relevant to the Project impacts. Surveys will be carried out using the methods described in the Queensland *Guide to determining terrestrial habitat quality* (EHP

2017) and will obtain the required information for input into DotEE's 'Offsets Assessment Guide,' as required under the EPBC Act environmental offsets policy. Site offsets assessment surveys will not take place until the extent of impacted vegetation required under the finalised Project footprint is determined through the EIS and SEIS process. The final Project Offsets Delivery Plan will detail Central Queensland Coal's approach to managing environmental offsets on the property should this approach be taken.

Table 16-40 Mamelon property - remnant vegetation outside of Project footprint

RE	Area outside of Project (ha)	Suitability for MNES
11.3.4	15.8	Variety of eucalypt species present including Forest Red Gum. Suitable for Koala.
11.3.25	58.9	Canopy dominated by Forest Red Gum. Occurs along creek lines. Suitable for Koala and potentially Ornamental Snake.
11.3.29	115	Variety of eucalypt species present over *Melaleuca* understorey. Suitable for Koala.
11.4.2	168.1	Poplar Box dominated woodland. Suitable for koala.
11.4.9	4.6	Brigalow (TEC). Unsuitable for Koala.
11.5.8a/11.7.2	297.3	Variety of eucalypt species present in 11.5.8a (90% dominance in community polygon) including Forest Red Gum. Suitable for Koala. *Acacia* species dominate 11.7.2 which is unsuitable for Koala.
11.10.7	484.4	Narrow-leaved Ironbark dominated woodland. Marginal foraging habitat for Koala.
11.10.7/11.10.1	618.7	Narrow-leaved Ironbark dominated woodland for 11.10.7 (90% dominance in community polygon). Marginal foraging habitat for Koala. 11.10.1 Dominated by Spotted Gum (*Corymbia citriodora*) with other species. Suitable for Koala.
11.11.1	135	Narrow-leaved Ironbark dominated woodland. Marginal foraging habitat for Koala.
11.11.15a	536	Narrow-leaved Ironbark dominated woodland. Marginal foraging habitat for Koala.
11.11.18	45	Semi-evergreen vine thicket (TEC). Unsuitable for Koala.

As part of the Offsets Strategy, CQC may also investigate a management and monitoring approach for vegetation patches to increase the overall coverage and connectivity of such communities in the immediate vicinity of the Project area. This may be applied on the Mamelon property itself. The northern portion of the property has potential to be allowed to regenerate tree cover over approximately 250 ha connecting Tooloombah Creek and Deep Creek, much of which is likely to have comprised Brigalow TEC communities.

Rehabilitation could also be applied to vegetation on and adjacent to sections of Tooloombah Creek and deep Creek which are relatively thin due to past clearing for cattle grazing. The Mamelon property encompasses a total area of 6,478 ha of which the Project footprint covers approximately 1,070 ha. CQC have proposed destocking the majority of the property and restricting cattle access to already cleared habitat in the south-west and south of the property. This area encompasses approximately 1,000 ha. The remaining area, including the creek lines which lie adjacent to the mine area, will be managed and allowed to regenerate. This measure will in the long-term also contribute to localised water quality improvements, and contribute to improving the water quality entering Broad Sound and the GBRWHA.

At least 5 km of riparian vegetation lies within the Mamelon property boundary and close to the mine area which may be rehabilitated and expanded. Significant portions of non-remnant habitat along drainage lines also occur within Mamelon to the south of the ML. Vegetation rehabilitation of these areas will enhance the available foraging habitat for Koala in the area in the future.

Strategic Offset Investment Corridor

Where offsetting investigations indicate that lands on the Mamelon property are not suitable or insufficient then Central Queensland Coal will utilise lands within potential regional biodiversity corridors such as identified in a Strategic Offset Investment Corridor (SOIC) close to the impacted Project area.

The Southern Brigalow Belt and New England Tableland SOIC (the SOIC) has been developed by EHP to identify some of the best places in the landscape for environmental offsets. The SOIC identifies 'conservation hubs' as potential focus areas for providing environmental offsets. Three hubs exist near the Project area: Styx Hub; Marlborough Hub; and the Torilla Plains Hub (see Figure 16-22). As part of the SOIC, EHP has developed a register of landholders who have indicated an interest in allocating lands towards offset proposals.

The SOIC footprint identifies several potential habitat areas considered to be of 'high value' or 'key linkage' within a 50 km radius to the south, east and north of the Project area (Figure 16-22). These areas lie for the most part within the same subregion as most of the Project area (Marlborough Plains) as well as adjacent subregions (Nebo-Connors Range and Boomer Range). Central Queensland Coal will liaise with EHP (including the register of interested landholders under the strategy) during offsetting investigations.

Other options include locating offsets, where possible, adjacent to existing local protected areas including National Parks, State Forests and Nature Refuges. There is an array of protected areas surrounding the Project area. The potential for locating adjacent offset properties and 'value-adding' to existing conservation reserves will also be investigated. For example, the SOIC identifies several properties to the south of the Project area as 'high value' or 'key linkage' areas that abut Eugene State Forest and Goodedulla National Park (see Figure 16-22).

Central Queensland Coal may also achieve habitat and conservation benefits through other strategies such as:

- Nest hollows. There is the potential that artificial nest hollows could be installed in appropriate vegetation and locations to offset any loss of habitat for birds, bats, gliders, and other species which utilise nest hollows. The planning of nest hollow requirements and best location for installations could be incorporated in this ODP to increase the overall ecological value of the Offset areas;

- In the unlikely event the Project is found to impact GBR values (such as through accidental releases of polluted water) Central Queensland Coal will investigate using the Australian Government Reef Trust to deliver biodiversity-related offsets; and

- Offsetting GHG emissions. To add further value to both the ODP and outcomes, and to the GHG emission requirements under legislation, Central Queensland Coal will evaluate the best way in which habitat offsets and revegetation for carbon sequestration can be integrated.

Central Queensland Coal will investigate other programmes being conducted locally, regionally and nationally to determine if they can provide information (such as ongoing monitoring data), research assistance, to get a higher net benefit for the environment through indirect offsets. For example, Greening Australia is known to carry out programmes in the Fitzroy Basin to benefit Fitzroy River Turtle populations and nesting. This programme may be expanded to support Southern Snapping Turtle populations. Other examples may be associated with the Caring for Country initiative (DotEE) and Environmental Stewardship Program (DotEE).

16.17.6 Conclusion and Offsets Delivery Plan

Offsets will be applied to compensate residual environmental impacts remaining after all practical and practicable management and mitigation actions have been applied.

Unavoidable residual ecological impacts have been quantified for the above-ground construction and operation activities associated with the Project as described above.

Central Queensland Coal will seek to achieve synergistic benefits where possible on Central Queensland Coal lands thereby providing net environmental benefits close to the area of impacts. Where required Central Queensland Coal may seek additional outcomes with nearby landholders and / or other environmental programs in the region to achieve enhanced conservation outcomes.

Central Queensland Coal proposes to submit a detailed Draft ODP for State and Commonwealth approval within 30 days prior to any impacts occurring on MNES or Matters of State Environment Significance. The ODP will provide a detailed account of the proposed offset settlement including (but not restricted to) the following:

- Identification of proposed offset lands including a description of current land use;
- Ecological condition (through the Biocondition Assessment process) of potentially impacted areas within the Project area and the proposed offset lands;
- Measures to secure the land as an approved offset area; and
- Proposed management and monitoring measures to ensure the required conservation outcome occurs.

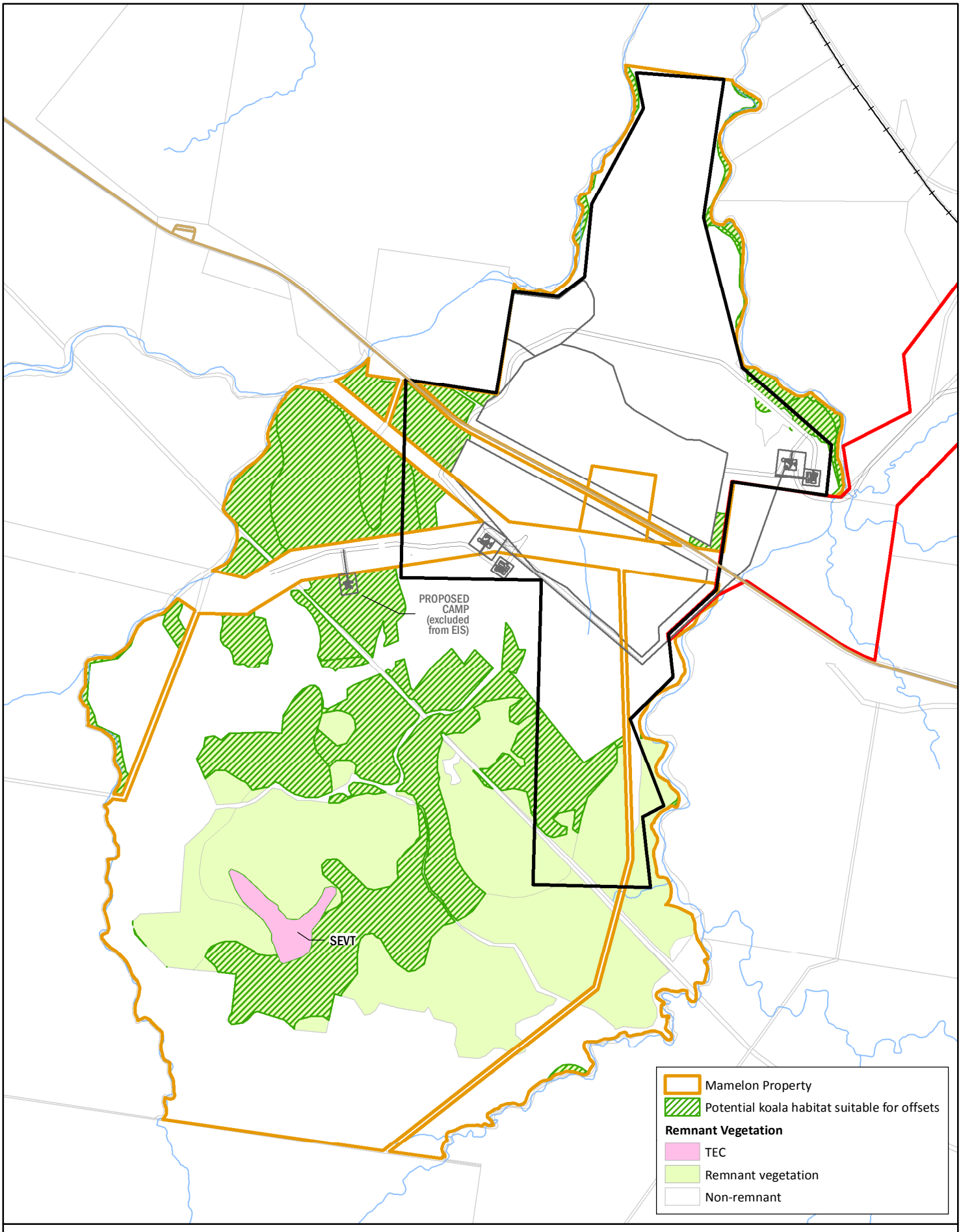


Figure 16-22
Mamelon property – remnant vegetation suitable for MNES habitat offsets

N

0 0.5 1 km

Scale @ A4 1:60,000
Date: 19/09/17
Drawn: Gayle B.

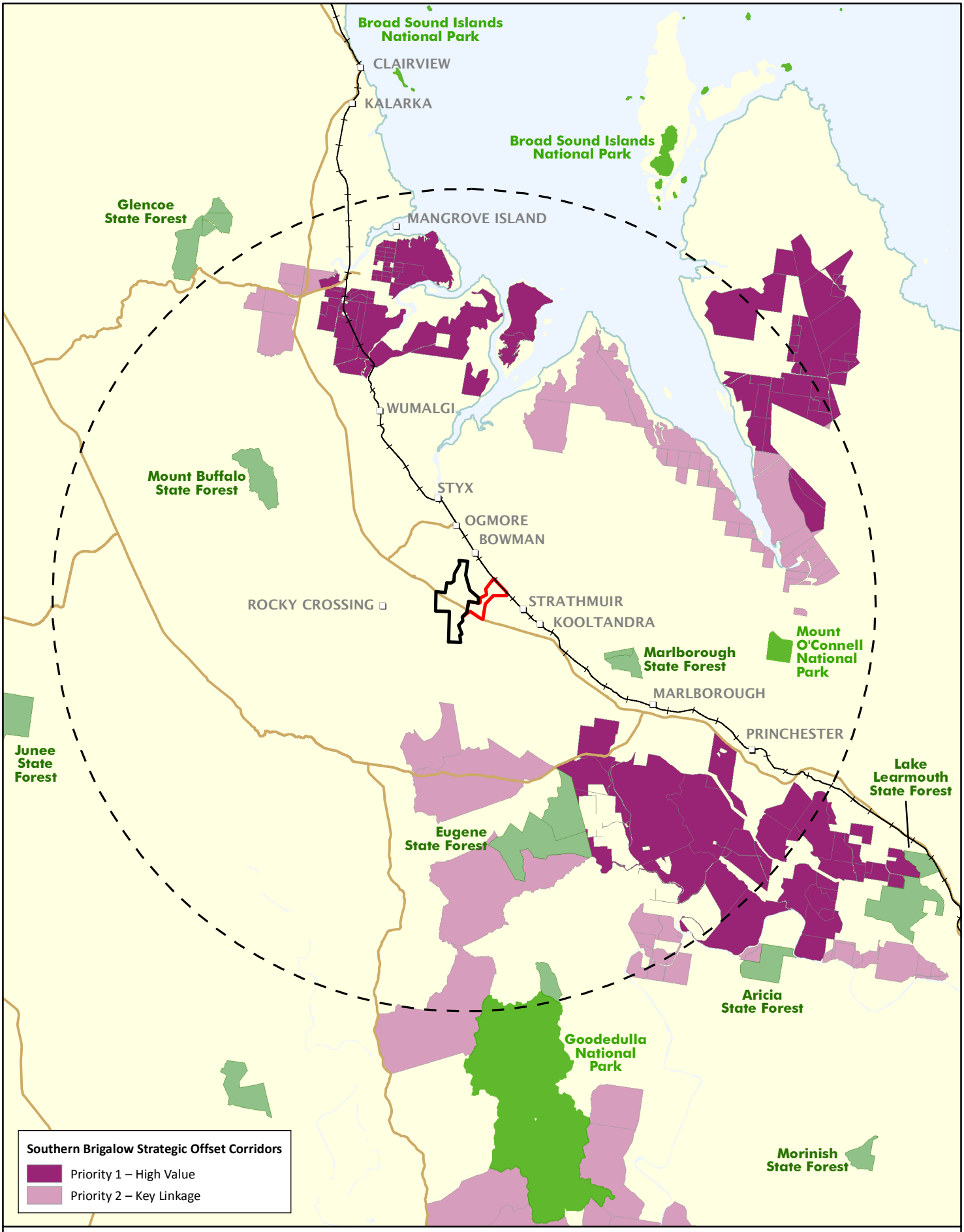
Legend

- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Cadastral boundary
- Watercourse

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

SINCLAIRA B:\BES150160 Styx Coal\GIS\DATA\MXD\FINAL\.03 EIS Preparation\BES150160.03-098 R1 Mamelon - veg mnes habitat.mxd 9/19/2017



N

0 5 10 km

Scale @ A4 1:600,000
Date: 02/08/17
Drawn: Gayle B.

Legend

- National Park
- State Forest
- Project area 50 km buffer
- ML 80187
- ML 700022
- North Coast Rail Line
- Main road

Figure 16-23
Southern Brigalow Belt and New England Tableland SOIC Project Area

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017

CDM Smith

16.18 Water Resources Assessment

The size and purpose of the development was identified by the Commonwealth Minister as being a controlled action for the purposes of the water trigger. This section describes the impacts from the mine on water resources, along with any potential impacts from the supply of water for the mining operations. Consideration of the 'Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources and Significant Impact Guidelines 1.3: Coal seam gas and large coal mining developments—impacts on water' has been considered during the assessment process and is provided in detail in Chapter 9 – Surface Water and Chapter 10 – Groundwater. A checklist allowing reference of the guidelines with information provided in this chapter and Chapter 10 - Groundwater is provided at the end of this section (Table 16-41).

16.18.1 EPBC Water Trigger

On 22 June 2013, the *Environment Protection and Biodiversity Conservation Amendment Act 2013,* came into effect which amended the EBPC Act to include water resources related to coal seam gas and large coal mining developments as a MNES (the 'water trigger'). Under the EPBC Act, an action which involves a coal seam gas development or large coal mining development requires approval from the Minister if the action has, or is likely to have a significant impact on a water resource. A large coal mining development is described under section 528 of the EPBC Act as:

'Any coal mining activity that has, or is likely to have, a significant impact on water resources (including any impacts of associated salt production and / or salinity):

(a) in its own right; or

(b) when considered with other developments, whether past, present or reasonably foreseeable developments.'

The 'Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources' (the Guideline) explains the relevant assessable impacts are those that relate to impacts on a water resource of activities that form part of the process of extracting coal. Associated infrastructure, that is not part of the extraction process, is not included in the above definition of a 'large coal mining development'.

16.18.2 Coal Extraction Activities

The water trigger is limited to the assessment of impacts from the following activities:

- Water supply for use in the extraction of coal;
- Management of water generated because of extraction of coal;
- Impacts to groundwater from mining activities; and
- Management of waste generated because of extraction of coal.

These activities are considered to form part of the extraction of coal process. Activities independent to the coal extraction process are not required to be considered for the water trigger.

Activities that are preliminary and necessary for the extraction of coal to occur are captured under this definition and hence, are assessed against the EPBC Act, such as:

- Open cut including removal of overburden;
- Process water dam construction;
- Construction of the dewatering dam;
- Construction of the two CHPPs and MIAs; and
- Operational water supply for dust suppression on haul roads, firefighting water and other extraction purposes.

16.18.3 Associated Infrastructure

The Guideline states that development of associated infrastructure that is not part of the extraction process is not included in the definitions of 'coal seam gas development' or 'large coal mining development'.

This may include:

- Transport infrastructure, such as pipelines, road or rail infrastructure;
- Office / housing and amenity construction; and
- Environment protection, monitoring and associated land management activities.

As such the water demand for the construction and the operation of the following components of the Project are not considered to be captured under the water trigger and not included within this assessment:

- Construction of the haul road;
- Construction of the railway loop and TLF;
- Construction of the water supply infrastructure; and
- Construction of onsite access roads and flood protection levees.

16.18.4 Exemptions from the Water Trigger

A review of the available exemptions demonstrated that there were no applicable exemptions to the Project.

16.18.5 Significant Impact Assessment

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Assessments of significant impact consider the sensitivity, value, and quality of the water resource which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. These values have been identified and discussed in detail in Chapter 9 – Surface Water and Chapter 10 – Groundwater, and are summarised in Sections 16.9.2 and Section 16.9.3 of this chapter as well as in this Water Resources Assessment.

16.18.5.1 Significant Impact Criteria

The general criteria under the Guideline is 'an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to the hydrology of a water resource or the water quality of a water resource, that is of sufficient scale or intensity as to reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes, or to create a material risk of such reduction in utility occurring.'

A significant impact criteria assessment considers the precautionary principal, mitigation and management measures and any beneficial impacts from the use of the water.

16.18.5.2 Styx River Catchment

The Styx River catchment is located on the coast in Central Queensland, approximately 180 km south from Mackay and 150 km north of Rockhampton. The catchment is bordered by the Connors Ranges in the northwest, the Broadsound Ranges to the southwest and empties into Broad Sound near Rosewood Island, south of Saint Lawrence. The Styx catchment represents a transitional zone between the slow-flowing streams of the adjacent and much larger Fitzroy Basin and steep, fast-flowing streams located to the north.

The Styx River Catchment covers approximately 301,300 ha, and the main tributaries include: Deep, Granite, Montrose, Stoodleigh, Tooloombah, Waverly and Wellington Creeks. Many of the creeks are poorly documented and observations from the current survey indicate that many of the smaller waterways are intermittent or ephemeral from the late dry season onward.

The main land use is agriculture which occupies 78% of the catchment, and cattle grazing is the predominant form of agriculture carried out in the region (Melzer et al 2008). Many cleared areas are badly eroded from sheet and gully erosion, particularly in the centre of the catchment and this occurs in association with particular soil types (Melzer et al 2008).

The water quality of rivers and streams within the study area is classified as high and the catchment is classified as being only slightly modified from the natural condition (ANRA 2010). Many of the creeks of the region record high turbidity during periods of high flow due to the erodible and dispersive soils present in the catchment (Melzer et al. 2008).

The mine area and TLF is situated within the lower catchments of Tooloombah Creek and Deep Creek. Both creeks feed directly into the Styx River (2 km north of the Project area) which discharges into the Broad Sound area approximately 33 km northeast of the Project. Deep Creek has a total catchment area of 29,801 ha and Tooloombah Creek has a catchment area of 36,968 ha. The haul road to the TLF crosses Deep Creek and Barrack Creek (which lies within the Deep Creek catchment). Tooloombah Creek and Deep Creek are non-perennial or ephemeral, and largely flow only following heavy rainfall events.

The Project is situated within the Mamelon cattle grazing property, which both runs cattle and produces dryland crops. The Mamelon property is owned by the Proponent and is currently being leasing for these uses. Supporting this land use is a series of farm dams and surface contour bunds that capture and store runoff generated by the local contributing catchments. Groundwater bores also lift water to dams and / or storage tanks in the surrounding region for domestic and stock water use.

16.18.5.3 Value of Local Water Resources

Surface Water

The primary surface water features near the Project area are Tooloombah Creek which lies adjacent to the northwest boundary of ML80187, and Deep Creek lying adjacent to the eastern boundary and crossed by the haul road (Figure 16-7). Several minor (first or second order) drainage lines located within the Deep Creek catchment also traverse the mine area. The most distinct of which is the 2nd order stream that runs through the Open Cut 1 in a northeast direction, passing under the Bruce Highway and finally discharging to Deep Creek to the north of Project activities.

There is a single palustrine wetland (non-riverine with emergent vegetation) considered to be of High Ecological Value located to the south west of the Central Queensland Coal mine area (see Plate 16-5; refer Figure 16-7) and several rural water storage dams on either side of the Bruce Highway alignment. The dams within the mine area are used for stock watering on Mamelon Station.

These rural water storage dams have not been defined as wetlands by EHP and all are characterised as artificial lacustrine wetlands. Lacustrine wetlands are typically open, water-dominated systems (for example, lakes). This definition also applies to modified systems (for example, dams), which are like lacustrine systems (for example, deep, standing or slow-moving waters).

Plate 16-5: Wetland of high ecological value within ML80187 (May 2017)

There are several surface water entitlements in Tooloombah and Deep Creek for irrigation, stock and domestic supply. The entitlements that may be impacted by the Project by being located adjacent to or downstream of operations include the following:

- 119/CP900367 - Irrigation entitlement located on parcel of land adjacent to the Mamelon property, separated by Deep Creek, and approximately 3 km downstream of mine infrastructure and environment dam release point locations on Deep Creek;
- 1/RP616700 - Domestic / stock supply entitlement located on parcel of land adjacent to the Mamelon property and straddling Tooloombah Creek. The extraction point appears to supply

a small off-stream storage on the western overbank of Tooloombah Creek, approximately 1 km downstream of the pit dewater dam discharge location; and

- 45/MPH26062 - Irrigation entitlement on parcel of land directly bordering the Project to the north and extracting approximately 6 km downstream of the mine dewater dam proposed discharge location on Tooloombah Creek.

Existing Surface Water Quality

There are no DNRM stream gauges in the Styx River catchment from which to derive past water quality data. Surface water field assessments were conducted at 11 sites across four separate events in June 2011, February and May 2017 (refer Chapter 9 – Surface Water and Chapter 15 – Aquatic Ecology for more detail). The June 2011 assessment included nine sites across a wider area including Deep Creek, Tooloombah Creek, Granite Creek and the Styx River (including estuarine sites). The 2017 surveys were restricted to seven sites adjacent to the Project and included Deep Creek, Tooloombah Creek and one site in the Styx River downstream of the confluence of Deep and Tooloombah Creek. In May and June, water samples were also collected from Barrack Creek following heavy rainfall associated with cyclone Debbie in April 2017. Conditions were variable in the area over the survey periods with flowing creeks recorded in June 2011 and May 2017. Conditions in February 2017 were extremely dry, following a period of low rainfall and no flow was recorded.

Turbidity exceeded the 50 NTU (the WQO) for three of the 14 samples in February 2017 only. Suspended solids exceeded 10 mg/L (the WQO) for three of the 14 water samples. During the February sampling event, turbidity and suspended solids exceedances were observed at two Deep Creek sites and the Sty. This is likely attributed to the low standing water height at the time of sampling due to the dry conditions and limited recent rainfall. There were no exceedances for turbidity during the May sampling event. Exceedance for suspended solids was recorded at one site on Deep Creek in May. There were no exceedances for turbidity or suspended solids during the 2011 sampling event.

Testing showed that all surface water samples exceeded the ANZECC guideline value for conductivity. There are no Queensland guideline values for conductivity. High conductivity values can result from excess sodium, magnesium, calcium, chloride, sulphate and bicarbonate in streams. These salts may originate from irrigation water, soils or fertilisers. Additionally, high salinity values in streams can result from rising water tables. It is noted the Project area is located just above the estuarine influence of waters in the Styx River. Salt water in higher tides reach the confluence of Deep and Tooloombah Creek.

A single pH result from the Styx River from 2011 was above the WQO for estuarine waters associated with the Styx River with a reading of 9.19. This value was retested after re-calibration of the meter when the pH recorded was 9.8. The pH result for site St1 should therefore be treated with caution. The pH result from two sites in Tooloombah Creek collected in February 2017 were just above the WQO and may have reflected the lack of flow at the time. Neither site was above the WQO in May 2017 when both creeks were flowing. The site on Barrack Creek was sampled for the first time in May 2017 and recorded 6.48 which is just below the WQO for this parameter.

Total nitrogen and ammonia marginally exceeded the guidelines at most sites in all surveys. Total oxidised nitrogen exceeded the guidelines at four sites including all of the Styx River sites in 2011 but only one site in May 2017. Total phosphorus exceeded the guidelines at a single Styx River site in 2011 and at almost all sites in the 2017 samples. No metals recorded dissolved concentrations above the recommended values (refer to Chapter 9 – Surface Water, for further discussion).

Groundwater

A review of existing groundwater bore data from the Styx River catchment was carried out. Most bores in the surrounding area are located within, or at the fringes of the mapped Cenozoic deposits (see Figure 16-8), which signifies that the alluvium, and possibly geological structure that controls the occurrence and alignment of water courses, are targeted for local groundwater supplies.

Groundwater samples were collected from several bores in the wider area for the Project in February, May and June 2017. concentrations of chemicals in groundwater are compared against the Australian and New Zealand Guidelines (ANZECC Guidelines) (ANZECC and ARMCANZ 2000) that are relevant to protection of freshwater aquatic ecosystems and stock drinking water, and the Australian Drinking Water Quality Guidelines (ADWG) (NHMRC, NRMMC 2011).

Groundwater salinity is variable across a relatively broad range, varying from good quality for drinking (TDS < 600 mg/L) to unacceptable for drinking (TDS > 1,200 mg/L) and unacceptable for livestock (TDS > 5,000 mg/L). More generally, TDS concentration are mostly within the salinity tolerance of < 5,000 mg/L that is suitable for most livestock. The dominant ion chemistry tends to be either sodium-chloride (Na-Cl) type or no dominant type. Sodium-chloride type is consistent with ocean derived salts in groundwater recharge from rainwater, or mixing of terrestrial groundwater and marine groundwater in areas of seawater intrusion at the coast. Groundwater that is not Na-Cl type signifies geochemical interactions between groundwater recharge and subsurface minerals. The majority of groundwater samples collected at the have salinity that falls into the unacceptable palatability category for drinking water.

There are few data on concentrations of dissolved metals in groundwater within the area of Styx Basin. Existing bore data contains one value for aluminium, two for copper and four for zinc. These concentrations all exceed the ANZECC Guidelines for protection of ecosystems (95% protection level). One bore is recorded as having a dissolves zinc concentration of 18 mg/L (a single measurement) which exceeds the ADWG and is close to the ANZECC Guideline value for stock water.

Riparian and aquatic vegetation, a relatively diverse freshwater fish fauna, and freshwater turtles have been recorded in or along a number of pools along Deep Creek and Tooloombah Creek that are potentially dependent on subsurface expression of groundwater; therefore, ecological values are identified with shallow groundwater.

Chapter 10 – Groundwater provides a detailed analysis of groundwater values associated with the Project area.

Groundwater Dependent Ecosystems

While regional-scale hydrogeological systems may provide useful groundwater resources for pastoral or other uses, groundwater also supports surface and subsurface ecosystems, which can themselves be beneficial users of groundwater resources. The Australian groundwater dependent-ecosystem (GDE) toolbox (Richardson et al. 2011) provides a framework to assist with the identification of GDEs and the management of their water requirements. Three types of GDEs are defined:

- Aquifer and cave ecosystems (Type 1) where groundwater-inhabiting ecosystems (e.g. stygofauna) reside;
- Ecosystems dependent on the surface expression of groundwater (Type 2) including wetlands, lakes, seeps, springs, and river baseflow systems, providing water to support aquatic biodiversity through access to habitat; and

- Ecosystems dependent on subsurface presence of groundwater (Type 3) include terrestrial vegetation which depends on groundwater on a seasonal, episodic or permanent basis to prevent water stress and generally avoid adverse impacts to their condition.

There are two sources of information pertaining to the presence of GDEs, the National Atlas of GDEs and the Queensland Wetland GDE Layer. The GDE Atlas presents the current knowledge of ecosystems that may depend on groundwater across Australia. The Queensland Wetland GDE Layer presents the current knowledge of ecosystems reliant on groundwater across Queensland. A desktop analysis and review of the available information was carried out and was enhanced by onsite observations. The results are summarised in the following sections. Further detail is provided in Chapter 10 - Groundwater.

GDEs Reliant on the Surface Expression of Groundwater (Type 2)

The GDE Atlas identifies potential GDEs that are reliant on the surface expression of groundwater (Type 2 GDEs) along extensive reaches of water courses both within and marginal to the Project area (i.e., Styx River, Tooloombah Creek and Deep Creek). Most of these potential Type 2 GDEs are classified as having high potential for interaction with groundwater.

Site observations during dry season sampling suggest tributaries of the Styx River are ephemeral upstream of the confluence of Deep Creek and Tooloombah Creek. However, a field survey in February 2017 identified several pools of water in localised depressions on Tooloombah and Deep Creek that appear to be perennial, indicating that they are potentially groundwater fed. Downstream of the confluence, Styx River is identified as being tidally dominated based on short term water level variations and elevated EC measurements. These observations suggest that any Type 2 GDEs near the Project area are likely to limited to the localised pools.

The Queensland Government Wetland Info also shows small areas of riverine, fresh water bodies along Styx River and Tooloombah Creek but the extents of these areas are much smaller than the extent of potential Type 2 GDEs identified by the GDE Atlas. Of note, is the HEV wetland that has been identified on the western side of the Project area, which is classified by the GDE Atlas as a potential Type 2 GDE with a high potential for groundwater interaction. However, observations during two field surveys in 2017 suggest that surface water in the wetland (when present) is rainfall dominated. For example, the wetland was dry in February 2017 but was subsequently inundated after heavy rainfall associated with Cyclone Debbie in April 2017. Groundwater levels measured in bores near the HEV wetland have also been observed to be approximately 9-10 mbgl (refer Chapter 10 – Groundwater), further indicating that the wetland is unlikely to be an area of active groundwater discharge.

It appears that the presence of Type 2 GDEs will be confined to the riverine environments of waterways (Styx River, Tooloombah Creek and Deep Creek) associated with the Project surrounds. Wetlands away from riverine environments are likely not to be connected to the groundwater system. The shallow alluvial aquifers will likely be the dominant source of groundwater for Type 2 GDEs in the area.

GDEs Reliant on the Sub Surface Expression of Groundwater (Type 3)

The GDE Atlas identifies potential GDEs that are reliant on the subsurface expression of groundwater (Type 3 GDEs) along the drainage lines (i.e. riparian zones) associated with Styx River, Deep Creek and Tooloombah Creek (Figure 16-18). At least four of the REs mapped in these areas during field surveys (refer to Chapter 14 - Terrestrial Ecology) have the potential for incorporating some component of groundwater in their water requirements. These include:

- Forest Red Gum woodland fringing drainage lines (RE 11.3.25) – occurs along riparian areas of drainage lines, largely outside of the Project boundary. Vegetation is dominated by Forest Red Gum and Weeping Tea Tree;
- Forest Red Gum woodland on alluvial plains (RE 11.3.4) – occurs in patches across the eastern side of the Project area where it is associated with the alluvial plains adjacent to Deep Creek. Vegetation is dominated by Forest Red Gum, Poplar Gum with Carbeen;
- Poplar Box (*Eucalyptus populnea*) on palustrine wetland (RE 11.5.3b) – this community occurs as an isolated community on a natural depression on the western side of the Project area (i.e. the HEV wetland). The community is characterised by a patch of Broad-leaved Paperbark with a variety of low sedges and forbs on the margin, and hydrophytes in the centre when surface water is present; and
- Areas of SEVT (RE 11.3.11) occurring adjacent to riparian areas of Tooloombah Creek and Deep Creek.

Of the four vegetation communities, the two Forest Red Gum communities (RE 11.3.25 and RE 11.3.4) and Weeping Tea Tree dominated wetland are most likely to be utilising groundwater in their water use because of the relatively shallower groundwater levels (approximately 2-5 mbgl) (refer Chapter 10 – Groundwater) observed in the alluvial sediments on the margins of the drainage lines. However, these groundwater level measurements were recorded at bores located 1-2 km north of the Project area, where groundwater levels are generally shallower, and no data exist for groundwater levels of alluvial sediments closer to the Project area. In the absence of actual groundwater data, the presence of water tables within the shallow alluvial sediments interacting with the rooting system is considered very likely, and suggests the classification of high potential of groundwater interaction of riparian vegetation to the east of the mine area as appropriate.

The GDE Atlas also identifies areas of potential Type 3 GDEs with low to moderate potential of groundwater interaction on the southwestern margin of the Project area. Measured groundwater levels in these areas have been observed to be approximately 10-12 mbgl (refer Chapter 10 – Groundwater). Groundwater levels have been observed to be even deeper (i.e. approximately 25 mbgl) further away from the southwestern edge of the Project area. Although, these observations do not preclude deep-rooted plant species from potentially using the underlying groundwater, it is likely that groundwater is only a small component of water use during periods of limited soil water availability (i.e. droughts).

Stygofauna

A comprehensive seasonal study sampling for the presence of stygofauna has been carried out for the Project in November 2011 and March 2012. Sampling was carried out at seven landholder bores from the surrounding area and 23 Project-related bores, 20 of which were located within the Project boundary. Forty samples were collected over the two surveys (refer Appendix A9f – Stygofauna Results). Most of the Project-related bores are located within the potential area of predicted groundwater drawdown related to the Project. The landholder bores are all located outside of the predicted drawdown area.

Over the two surveys, five sites recorded the presence of subterranean fauna, with four sites recording subsurface species which can be classed as stygofauna. A total of six morpho-species were found within four higher taxa (refer Chapter 15 – Aquatic Ecology and Appendix A9f - Stygofauna Results). All but one location is located outside of the Project boundary and potential groundwater drawdown area. Samples from a single Project-associated bore hole, located adjacent to Deep Creek contained five individuals of a single species of *Acari* that may be considered to have a 'stygophile'

life habit. Stygophiles are facultative subterranean species, able to complete their whole life cycles both underground and on the surface. The remaining taxa were found in landholder bores.

It is considered unlikely the single morpho-species identified within the drawdown zone is restricted to the predicted zone of impact related to the Project. The Project will not cause the loss of a localised endemic stygofauna community.

16.18.5.4 Impacts to Hydrological Characteristics

Surface Water

The Project will impact on surface water flows as mine infrastructure will decrease the local rainfall catchment area. The Project is largely located within the catchment of Deep Creek. The two major mine pit components (Open Cut 1 and Open Cut 2) will require diversion of two minor drainage lines of Deep Creek (one 1st and one 2nd Order drainage features). Water will be diverted to both Deep Creek and Tooloombah Creek. Diversions will be carried out in a progressive manner as the pits expand. The haul road and other infrastructure will also impact Deep Creek and Barrack Creek including the potential for direct deformation of the stream bed and altering hydraulic flows.

Modelling of local flood levels in Deep Creek and Tooloombah Creek because of a reduction in catchment size due to Project activities shows only a very minor reduction in peak flows. Under a 1,000 Average Recurrence Interval rainfall event there is predicted to be a 2 cm reduction in peak flood level at the confluence of Deep Creek and Tooloombah Creek (the Styx River) downstream of the Project. Flood diversions within the Project infrastructure will lead to a predicted localised rise in peak flood levels in Deep Creek of 7 cm, and Tooloombah Creek of 3 cm, with a consequent minor rise in flow rates at these times. Changes of this magnitude to peak flows is considered unlikely to impact on aquatic habitat values, particularly as peak flows only occur for short duration of time.

A 25 ML raw water dam is proposed to be built across a 2nd order watercourse to the north of mining activities (within the mine ML) to supply potable water for the life of the Project. As the upstream catchments will be largely removed due to Project construction, water is to be stored in the dam by pumping water out of Tooloombah Creek during flow events following high rainfall. This is not expected to impact aquatic downstream EVs due to the ephemeral nature of the creek.

Groundwater

Initial modelling of the potential groundwater drawdown effect of the open cut mine operations has been carried out (refer Chapter 10 – Groundwater). At this stage, there is a 'low confidence' in the groundwater modelling results due to a lack of any long-term (time series) groundwater data that would provide insight into the temporal nature of groundwater and surface water connections. Further works are ongoing, including sampling of groundwater bores and further refinement of the drawdown modelling process will continue with further information.

The magnitude of groundwater drawdown ranges up to 100 mbgl and may persist for 100 years. The greatest dewatering (5 to 100 m) occurs within the first 20 years of mine operation, and is centred around the immediate mine area between Tooloombah and Deep Creek. The cone of depression is initially steep, reflecting the change in geology from Quaternary sediments to the outcropping Bowen basin units. Further decline in the groundwater levels propagates to the north and south for the following 80 years creating an oval shaped region of impact that is effectively confined to the Quaternary sediments (refer Figure 16-18).

Human Use

The potential for irrigation supplies to be impacted by the mine (during and following closure) will be restricted to any alluvial aquifer supplies located within around 6 km upstream and downstream of the Project due to water table decline. From the information available, there may be two irrigation supplies located at the very north of the predicted zone of influence. No significant impacts via disruption of local aquifers are predicted because of the Project.

Due to typically low bore yields, apart from some alluvial aquifer bores, it is probable that the farming community in the Styx Basin relies on dam water supplies. The potential for groundwater supplies to be impacted by the mine (during and following closure) will be restricted to any alluvial aquifer supplies located within around 6 km upstream and downstream of the Project due to water table decline.

Three bores are known to be located within the predicted zone of mine influence (drawdown of the water table). Of these, only one exists in an area (on Mamelon Station itself) where drawdown of more than 1 m is likely. Local bore construction data is limited and based on only one bore located in the northern extremity of mine influence (0.5 m – 1 m). This is a shallow bore and mine induced drawdown of more than 1 m could mean that the continued use of the bore will be jeopardised.

GDEs

The groundwater system associated with the creeks is held within the shallow Quaternary sediments. Recharge to this system will be from direct rainfall, leakage from the creek during surface flow events and from the underlying Bowen basin units. It is likely the dissection of the landscape by stream flow has intercepted the shallow water tables, such that groundwater is exposed as pools, rather than groundwater discharge occurring as flowing springs.

While no long-term groundwater data exists, it is likely upstream of the tidal influence at the confluence of the two creeks, the nature of groundwater connection to Type 2 GDEs will vary spatially and temporally depending on the magnitude of the rise and fall of groundwater levels in response to recharge events. The depth to the groundwater associated with both creeks will increase further upstream, away from the coast. The lower reach of Tooloombah Creek is tidal and likely to be permanently connected. It is likely waterways will be permanently gaining / losing streams. During high surface flow periods, the deep-water column within the streams (>5 m) will recharge the adjacent Quaternary sediment aquifer (losing phase). As the surface flow recedes, there will be a corresponding rise in groundwater levels and during low flow, or no flow periods, the groundwater levels will intercept the base of the stream causing groundwater inflow (gaining phase). During prolonged periods of dry weather with little to now surface flow events groundwater levels will fall, potentially becoming disconnected with the base of the stream.

Within the first 20 years (approximately) there is a predicted draw down of 20 m at sections of Tooloombah and Deep Creek closest to the mine area (Figure 16-18). Further up and downstream the change in groundwater levels is less and occurs over longer time frames, up to 80 years. Due to the uncertainty within the drawdown model outputs a simplified approach to considering the impacts of drawdown is undertaken. Any change in groundwater levels of greater than 5 metres will inevitably disconnect the Creeks from the groundwater, irrespective of any seasonal recharge that may cause episodic rise in water tables. Changes less than 5 m will cause a shift in the natural cycle of gaining and losing phases, but may or may not cause permanent disconnection.

The disconnection of the streams from the groundwater is not likely to impact surface flow events downstream. The impact is related to the persistence of permanent pools within the riverine environment during low or no flow periods. A surface flow event will fill pools, that when connected

to groundwater will persist longer due to the lack of drainage through the stream bed and groundwater inflow volumes. An important note is that groundwater may not provide a measurable volume of water within the pools, but may act to prevent downward leakage.

The change in the persistence and volume (depth) of the pools will adversely impact any present aquatic species. Of most ecological concern if the pools were to become dry. What remains unclear is what will be the rate of loss of water from the pool if groundwater levels were to drop and the creek became disconnected, and what is the time required to dry out a pool that is no longer connected to the groundwater.

Sections of Deep Creek upstream of the immediate mine area are less likely to be connected to the groundwater system, with the predicted changes to groundwater levels of only several metres occurring over many decades likely to have little impact to aquatic habitat.

Type 3 GDEs are likely to be confined to the riparian zones of Tooloombah and Deep Creek (RE 11.3.25), where the depth to groundwater will be generally less than 5 m. While several areas of terrestrial GDEs are mapped as having a high potential for groundwater connection, existing bore data suggests the groundwater is around 10 m deep. While it is possible these areas may have deep rooting systems, the dominant source of water for will be direct recharge and soil water stores.

As with Type 2 GDEs, the area of most concern is related to areas of greater than 5 m drawdown. This may result in long-term impacts to the riparian Forest Red Gum communities, and SEVT along sections of Tooloombah Creek and Deep Creek located close to open cut mining operations. It is likely these vegetation communities will to some degree suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within these communities. It is uncertain what impact this may have on this community as most species are expected to obtain water requirements from multiple sources.

To summarise, based on characterisation of GDEs in the area it is considered likely that permanent waterholes in Tooloombah Creek are connected to the water table. This is less certain for the waterholes in Deep Creek which may only be connected to the water table in very wet conditions and is therefore potentially more resilient to a reduction in the level of groundwater. As a result, groundwater drawdown may also have a localised impact on water levels in permanent waterholes on Tooloombah Creek and Deep Creek potentially reducing habitat in the area for aquatic fauna and flora. Figure 16-18 indicates the large waterhole observed on Tooloombah Creek (to the south of the highway) and the mapped HEV wetland are unlikely to be impacted by groundwater drawdown.

This may result in long-term impacts to the following aquatic values:

- Water levels in permanent waterholes on Tooloombah Creek (and potentially Deep Creek) that are connected to groundwater may decline in those areas closest to open cut mining occurs and drawdowns of 5 m to 50 m are predicted to occur. These waterholes provide habitat for the Southern Snapping Turtle; and
- Riparian Forest Red Gum and SEVT habitat in these same areas may also suffer adverse impacts in the long-term if groundwater levels decline below the necessary rooting depth required for tree species within this community.

Stygofauna

Terrestrial vegetation overlying shallow groundwater ecosystems, where the water table intersects the root zone of the vegetation, is thought to provide favourable habitat conditions for stygofauna (Eamus et al. 2006 Eamus 2009 and Hancock and Boulton 2008). Clearing of vegetation may therefore reduce the habitat quality of shallow groundwater ecosystems for stygofauna. However, existing vegetation within the potential impact area and where landholder bores were located has generally been cleared for cattle grazing, including in all areas where stygofauna were recorded, indicating that the absence of vegetation does not preclude the occurrence of stygofauna.

Mining operations have the potential to impact stygofaunal communities in the Project area by directly disturbing groundwater ecosystems through:

- The removal of top soil, overburden and open cut coal mining;
- Road transportation of coal which may lead to compression of soils and reduce habitat quality of groundwater ecosystems for stygofauna; and
- Drawdown of the water table and reduction of groundwater pressure. Groundwater drawdown will be greatest close to the mine area itself but also presents to the north and east of the mine area, and to a lesser extent to the south of the Project.

Six stygofauna morpho-species were identified across the 30 bores, five of which are located out of the predicted zone of groundwater drawdown resulting from the Project. A single morpho-species was only found within the predicted impact area but it is considered highly unlikely this species is restricted to the Project area itself. Therefore, no stygofaunal species is considered restricted to the potential impact area, with the extent of disturbance to groundwater ecosystems associated with the Project likely an order of magnitude smaller than the likely distribution of stygofaunal species of the local area.

16.18.5.5 Changes to Water Quality

Surface Water

Mining activities have the potential to impact the water quality within the vicinity and downstream of the Project. Without mitigation, potential exists for several potential contaminants to enter waterways including: contaminated mine dewatering runoff; contaminated runoff from waste rock stockpiles; aqueous waste streams including oily waste water (from heavy equipment cleaning); contaminated runoff from chemical storage areas; potentially contaminated drainage from fuel oil storage areas; and general washdown water.

The accidental release of pollutants can result in direct acute fatality of flora and fauna (that is through coating) or indirectly through chronic illness and mortality via slow long-term release of the contaminants.

The release of mine affected water has the potential to affect existing physical and biochemical conditions within the receiving waterways that control the movement and cycling of energy and materials within and between ecosystems. This can further influence water quality through changes to the production and degradation of organic matter.

During construction and operation sediment can be mobilised and transported by surface water during rainfall events, ultimately discharging into existing farm dams, drainage lines and watercourses. If stormwater runoff is not adequately contained, there is a potential for increased

sedimentation and contamination to adversely impact surface water receiving environments, i.e. Tooloombah Creek, Deep Creek and the Styx River.

The design of the mine has included several environmental dams to mitigate the potential for these impacts to occur (refer to Section 16.7.3.5).

The EVs for the receiving waters include irrigation and stock watering. Accidental release of pollutants and contaminants may adversely impact downstream agricultural operations and prevent use of the water for human consumption.

Groundwater

The two pit voids remaining after mine closure will capture some or all of the groundwater moving downstream from higher in the eastern part of the Tooloombah Creek catchment and much of the Deep Creek catchment. Any groundwater quality changes within this catchment zone will not impact on other parts of the Styx Basin due to the existence of the pit voids acting as permanent evaporative sinks. South of the mine and up-hydraulic gradient, even within the expected capture zone, there is unlikely to be any change in water quality due to the mine during operation or after closure.

The potential exists for the groundwater quality to be altered by accidental release of contaminants to shallow groundwater. This may be caused by unintended spillages of fuels, leakage of sewage effluent, mobilisation of surface contaminants by stormwater (and subsequent recharge) and seepage of mine waste water. These activities have the potential to locally degrade groundwater quality, and will be a focus of the Project WMP development and implementation.

16.18.5.6 Cumulative Impacts

The catchment the Project is located within is relatively small. The Tooloombah Creek catchment comprises approximately 36,000 ha and Deep Creek comprises a further 29,000 ha. For the purposes of this cumulative impact assessment on water resources we have chosen to restrict the assessment to the overall Styx River catchment as it is inconceivable the Project will have impacts beyond this area. The ranges to the west and south of the Project catchment areas drain into the Fitzroy Basin which remains separate from the Styx River catchment.

The nature of the Styx River catchment is rural with approximately 78% of lands occupied by agriculture and dominated by cattle grazing. A review of the latest publicly available information regarding development in the region found no large-scale industrial or mining developments proposed for the catchment other than the Central Queensland Coal Mine Project.

The nearest mining operation to the Project is the Kunwarara magnesite mine located 60 km to the southeast which is outside the Styx River catchment and is not connected to the local aquifers. The mine began operation in 1991 and is currently owned by Sibelco. Magnesite resides close to the surface layers and is mined using open cut pits generally between 15 m to 18 m deep. There is no information available regarding any of the mine's impacts regarding groundwater or surface water or any current or proposed expansion plans for the Project and the Project is not considered further.

The only major development known from the wider area is the proposed expansion of the Shoalwater Bay Training Area by the Department of Defence. This area lies largely within the adjacent Shoalwater catchment which also drains into Broad Sound to the northeast of the Project area. The original proposal identified a 'likely expansion area' stretching west from the existing training area to the approximate east bank of the Styx River located to the north of the Project. Based on opposition from local communities it has been recently assessed that a reduced expansion area

is 'achievable' (DoD 2017). As such, the extent of the proposed expansion and the potential changes to land use are unknown at this stage.

Given there are no other large projects currently known to have identified lands within the Styx River catchment or the Styx groundwater basin, the Project impacts to local water resources will only add to those impacts that are a result of current land use in the catchment. These background land use impacts are already characterised within this section through the identification of local water quality values and description of aquatic EVs such as stygofauna and GDEs. There are no other projects in the catchment or surrounds which the potential Project impacts to water resources subject to this assessment could conceivably add to.

16.18.5.7 Management and Mitigation

Surface Water

The Project is located on the Mamelon property. Mamelon encompasses a total area of 6,478 ha of which the Project footprint covers approximately 1,070 ha. CQC have proposed destocking the majority of the property and restricting cattle access to already cleared habitat in the south-west and south of the property. This area encompasses approximately 1,000 ha. The remaining area, including the creek lines which lie adjacent to the mine area, will be managed and allowed to regenerate. This measure will contribute to localised water quality improvements, and contribute to improving the water quality entering Broad Sound and the GBRWHA through the following:

- The long-term restoration of this habitat, and in particular allowing vegetation to regrow along the riparian zones along Deep Creek and Tooloombah Creek (which are presently mostly cleared), will capture / entrain sediment and nutrient run-off from the property;
- The restoration of cleared areas will also reduce soil erosion on cleared areas of the property, thereby reducing the entrainment of sediments entering creek lines during bouts of heavy rainfall; and
- The removal of cattle from much of the property will also remove a source of long-term nutrient input into creek lines following rainfall.

The Project design has incorporated the following components as part of the wider Project WMP. With these design elements, it is considered the potential impacts from the Project to downstream surface water quality are appropriately minimised to the greatest possible extent.

A single mine dewatering dam will be constructed to contain mine groundwater pumped from the open cut pit areas over the life of the Project. The dewatering dam is located outside of any drainage area and will be constructed to store a 1:1,000 AEP standard flood event (spillway capacity).

Several environment dams are proposed to capture rainfall runoff from the CHPP / MIA areas, TLF and waste rock dump areas. The primary function of the environment dams is to capture sediment laden runoff for sediment removal. The environment dams will be designed to contain 1:100 year AEP storm event. A perforated riser pipe outlet is proposed to allow gravity draining of the sediment dam within 48 hours of filling. A gated outlet is proposed for potentially storing water for use (overburden and CHPP environment dams) or for stockpile spray and supplementary fire supply (TLF environment dam – dam 3). Oil / water separators are proposed for vehicle wash and workshop areas to treat hydrocarbon contaminated runoff prior to release or containment in environment dams.

A large raw water dam will be used to collect water from Tooloombah Creek during flow periods to be used for coal processing and site potable water. The dam will be located on the un-named

tributary of Deep Creek which intersects this area. This water will be preferentially used for dust suppression supply, washdown and for coal processing (washing) use.

A water release strategy will be developed based on the *Styx River, Shoalwater Creek and Water Park Creek Basins Environmental Values and Water Quality Objectives* (EHP 2014). As part of the Project REMP water monitoring will be undertaken at the environmental dams, mine-affected water dams, discharge locations and locations both upstream and downstream of the Project area. Discharge from the dewatering dam is to be restricted to flow trigger events in the relevant creek catchments. Discharge events will also be limited by the quality of water to be released (refer Chapter 9 - Surface Water for detailed information).

To manage other potential impacts to water quality, the following mitigation and management measures are listed and expanded upon in Chapter 10 – Surface Water:

- An ESCP will be developed prior to the commencement of construction activities;
- Dust suppression measures outlined in Chapter 12 – Air Quality, including watering of roads and stockpiles, will be implemented where required to avoid wind dispersion of sediments into surface water bodies;
- A WMP will be developed to mitigate adverse impacts on the water quality of nearby water resources; and
- A REMP will be developed and implemented through as part of the overall Project EMP.

Groundwater

A WMP will be established for the Project (refer Chapter 10 – Groundwater). This will include establishing shallow groundwater monitoring bores and monitoring existing landholder bores located within the likely zone of mine influence. The location / configuration of monitoring bores together with the landholder bores, will be designed to provide sufficient coverage for the Project and surrounding area to detect and monitor groundwater effects from the Project. Based on the information collected during the first few years of mining, a need for expansion or rationalisation of the monitoring network may be identified.

Groundwater monitoring will include the following:

- Mine water inflow monitoring will consist of daily measurements of all water pumped from the mine pit;
- Quarterly field measurements of EC and pH and TPH of groundwater from the monitoring bores located on the mine lease and monthly field measurements of the same parameters for water pumped from the mine;
- Quarterly field measurements of EC and pH of groundwater from the monitoring bores located off the mine lease;
- Six monthly sampling of groundwater from monitoring bores and selected landholder bores for laboratory analyses of major ions, TDS and metals using methodologies that are suitable for comparison with the baseline monitoring; and
- Where groundwater quality impacts are identified, monitoring may be intensified to include the analysis of potentially harmful substances associated with oil, fuel and chemical handled onsite (e.g. benzene, toluene, ethylbenzene and xylenes).

The current model of groundwater drawdown is based on little data and is of 'low confidence' as a result. Data collected from the WMP in the first years of mining will be used to verify the groundwater drawdown model predictions and, if necessary, recalibrate the groundwater model. As mining progresses, a need for further model updates will be assessed every twelve months based on quarterly reviews of groundwater monitoring data and findings of impact verification. It is expected the confidence level of model predictions will increase over time as the model is updated to reflect the observed effects on groundwater from the monitoring program.

To manage the potential impacts, the following additional mitigation and management measures are listed and expanded upon in Chapter 10 – Groundwater:

- Where access to groundwater for stock watering is compromised due to drawdown and this is identified to be due to the Project, the following mitigation measures may be implemented:
  - Lowering of the existing pump or fitting with a new pump if sufficient saturated thickness (available drawdown) remains in the bore
  - Deepening or relocation of the bore to an area outside of the area of impact
  - Provision of surplus water from mine dewatering, if the quality is deemed suitable for the current groundwater use; and
  - Provision of alternative water supply of comparable quantity and quality to the current stock water use;
- Strict management and control measures of potential pollutants and contaminant sources will be maintained to prevent uncontrolled discharge to groundwater; and
- All uncontrolled discharges will be reported to the EHP according to legislative requirements under the EP Act.

Although there is uncertainty in the modelling of groundwater drawdown outputs, it remains likely that access to groundwater for localised GDEs will be compromised due to drawdown. This is most of concern within the riverine environments of Tooloombah and Deep Creeks.

The practice of supplementary surface water flows to maintain riparian vegetation health is widely used as a management tool in providing environmental flow requirements to waterways and wetlands across Australia. The implementation of a supplementary water program should aim to simulate the natural pattern of environmental flows or offset drawdown by replenishing the shallow groundwater stores at times when groundwater is intermittently accessed by riparian vegetation. This process would require an evaluation of the frequency and size of flows that would generate sufficient infiltration and recharge to the water table, as to maintain appropriate groundwater levels necessary to maintain the riparian condition.

Further understanding of the hydrological function of the identified GDEs in the area is required to develop mitigation measures including the following:

- Environmental water requirements of the GDEs such as minimum water depth and pool size to maintain a healthy aquatic environment, and the likely water demand to riparian vegetation provided by surface flows compared with deeper groundwater;
- Knowledge of the conductance properties of stream bed material will help determine the rate at which pools receive groundwater (during the wet phase) and the rate at which the pools lose water due to leakage to the groundwater (during dry phases) as this depends on the hydraulic properties of the stream beds; and

- The water budget of the pools. Understanding the relationships between the frequency of surface flow events and persistence of in-stream pools is important, as it may indicate that pools can be maintained (irrespective of groundwater inflows) through managed environmental flows.

The success of providing supplementary flows can be measured by monitoring the condition of the target 'end point' of the system, in this case the riparian vegetation communities. Wetland and stream health and vegetation monitoring will be implemented as part of the LUMP and REMP. This will include at a minimum the following measures:

- Ongoing assessment and monitoring to address the knowledge gaps identified above and allow a greater understanding of GDEs function in the area including a baseline water source study of the riparian vegetation to determine the nature of groundwater uptake. This would require a combination of soil, water and tree analyses to assess water use patterns, and the seasonal source of water;
- Monitoring of the health of the HEV wetland in the mine area;
- Monitoring of water levels in permanent waterholes on Deep Creek and Tooloombah Creek, particularly those identified as potentially impacted by severe groundwater drawdown near mining operations; and
- Monitoring of riparian vegetation and SEVT health along Deep Creek and Tooloombah Creek in those areas identified as potentially impacted by severe groundwater drawdown.

As drawdown depends on a range of factors, its impacts will need to be managed adaptively. Adaptive management will involve monitoring groundwater impacts and, based on the severity of impacts, implementing appropriate mitigation measures to minimise impacts on existing groundwater EVs as mining takes place.

16.18.6 Conclusion of Water Resources Assessment

Based on the assessment provided above, the Project is predicted to affect existing water resources because of the extraction of coal, although the extent of these impacts remains uncertain. Surface water features likely to be affected include permanent waterholes on Tooloombah Creek and Deep Creek because of groundwater drawdown. The Project will have a negligible impact on surface water flows in the area.

Three off-site stock watering bores are expected to be affected by drawdown, although only one significantly. This bore is located within the Mamelon property area and existing use (cattle grazing) is not expected to continue during Project operation. No water resources used for human consumption will be affected. With the ongoing groundwater monitoring and refinement of the groundwater modelling process, and implementation of management measures and appropriate monitoring and development of a supplementary flow program (in the event groundwater drawdown impacts are detected to environmental resources) to make good any impacts on water resources, the Project is not expected to result in a significant impact on water resources under the EPBC Act.

Table 16-41 IESC Guidelines cross reference checklist

IESC Guidelines	MNES Chapter Section	Groundwater Chapter	Surface Water Chapter
Description of the proposed project			
A regional overview of the proposed project area including a description of the geological basin, coal resource, surface water catchments, groundwater systems, water-dependent assets, and current and reasonably foreseeable coal mining, CSG developments and other water-intensive activities, including irrigation, should be provided.	Section 16.4 The Central Queensland Coal Project	Section 10.5.5 Section 10.8	Section 9.4.2 Section 9.4.6 Section 9.12
The description of the proposed project should clearly describe the proposal's location, purpose, scale, duration, disturbance area, and the means by which it is likely to have a significant impact on water resources and water-dependent assets.	Section 16.4.3 Section 16.9.2 Section 16.9.3 Section 16.12	Section 10.6 Section 10.7	Section 9.10
Description of impacts to water resources and water-dependent assets			
For all relevant water resources and water dependent assets, a description of existing conditions, conceptual and / or numerical modelling of potential impacts and a description of proposed mitigation and management measures are needed.	Section 16.9.2 Section 16.9.3 Appendix A6 – Groundwater Technical Report	Section 10.5 Section 10.6 Section 10.9	Section 9.4 Section 9.5 Section 9.6 Section 9.7 Section 9.10 Section 9.11
For each potential impact, the impact to the water resource, the resultant impact to any water-dependent assets, and the consequence or significance of the impact should be clearly articulated.	Section 16.9.2 Section 16.9.3 Section 16.18	Section 10.6	Section 9.10
2.1 Conceptual modelling			
Conceptual models must be based on the best available science and should consider relevant field data and investigations, expert advice, relevant scientific literature, and other appropriate information sources. Conceptual models should identify the geological formations, water resources, and water-dependent assets likely to be impacted by the proposal. They should be developed at appropriate scales which enable clear description of important impact pathways, how these would be influenced by the proposal, and the expected responses in identified water resources and water-dependent assets.	Appendix A6 – Groundwater Technical Report	Section 10.5.12	Not applicable

IESC Guidelines	MNES Chapter Section	Groundwater Chapter	Surface Water Chapter
In general terms, a conceptual model can be effectively summarised by pictorial hydrological, hydrogeological and ecological representations of the project site showing the stores, flows and uses of water, including use of water by ecosystems. Reliable conceptual models provide the scientific basis for developing analytical and numerical models and site water and salt balances. Conceptual models are also useful in the problem formulation stage of ecological risk assessment to show stressors, sources and cause-effect pathways.	Appendix A6 – Groundwater Technical Report – Section 2.4	Section 10.5.12 Figure 10-11	Not applicable
2.2 Analytical and numerical modelling			
Modelling should be undertaken to fulfil a specific purpose such as understanding potential impacts to a particular water resource. This purpose should inform the model design and assumptions which should be clearly described and justified in the project assessment documentation. The model should be constructed in accordance with the conceptual model, and calibrated and verified with appropriate baseline data.	Appendix A6 – Groundwater Technical Report – Section 4.3	Section 10.5.12	Section 9.6 Section 9.7
Results from modelling should be presented to show a range of possible outcomes based on uncertainty analysis.	Appendix A6 – Groundwater Technical Report – Section 4.2 and Section 4.3		Not applicable
Impact analysis should be based on modelling results (or other methods, where appropriate) and should clearly articulate the potential impact pathways. Details of the proposed monitoring and management plans should be clearly linked to the impact analysis.	Refer Appendix A6 – Groundwater Technical Report Section 16.9.2.3 Section 16.9.3.3 Section 16.18.5	Section 10.6 Section 10.7	Section 9.10
2.3 Water and Salt Balances			
Site-specific salt and water balances, complemented by an understanding of the inputs, outputs and diversions of water in a region, should be provided for both pre- and post-development scenarios under a range of potential climatic conditions.	16.12.4.3 Aquifer Salinisation Refer Appendix A6 - Groundwater Technical Report	Sensitivity analysis undertaken in Groundwater Technical Report explores the effects of higher and lower recharge and potential aquifer salinisation and and groundwater and surface water interaction	Section 9.6.2

IESC Guidelines	MNES Chapter Section	Groundwater Chapter	Surface Water Chapter
3. Data, management and monitoring			
Baseline data provides the foundation for developing environmental objectives and outcomes. Baseline measurements are also required to measure changes to water resources and water-dependent assets because of a development proposal. Baseline data is needed for all water resources, including contextual information such as dates and locations of measurements, sampling protocols, flow conditions and elevations of the reference points from which water levels were measured.	Section 16.9.2 Section 16.9.3 Refer Groundwater Chapter 10 and Surface Water Chapter 9 for detailed discussions	Section 10.5.7 Section 10.5.8 Section 10.5.11	Section 9.5.2 Section 9.5.3 Section 9.5.4
Baseline ecological data should be sufficient to identify all surface water dependent and groundwater-dependent assets, and the current condition of and stressors on these assets, to inform ecological risk assessment. Results of habitat, fauna (including stygofauna) and flora surveys should be included.	Discussed variously throughout Chapter 16 – see Chapters 16.10, 16.11 Chapter 15 – Aquatic Ecology, Section 15.7.4 and Section 15.7.5 Appendix 9b – Terrestrial Flora Reports Appendix A9e – Aquatic Ecology Results Appendix A9f – Stygofauna Results	Section 10.5.13	Addressed in Groundwater Chapter 10
Adequate ecological and hydrological (for quick response systems) baseline data would generally be for a period of around two years, at a frequency sufficient to capture likely changes in the system. Relevant information generated by a bioregional assessment should be included.	Section 16.9.2 Section 16.9.3 Section 16.11 (but ecological information discussion variously throughout Chapter 16)	Section 10.5.7	Section 9.5
Proposed management and mitigation measures should be detailed, and references provided to previous projects, case studies or scientific literature that support the adequacy of the measure in the project context. The monitoring plan should detail how performance of the proposed mitigation measures will be assessed. It should also outline contingency plans if the environmental objectives are not met. If offsets are proposed, the potential management options that were considered and investigated prior to offsetting should be described.	Section 16.9.2 Surface Water Section 16.9.3 Groundwater Section 16.17 Offsets	Section 5 Specific groundwater level and quality trigger levels to be set in the EMP based on further monitoring (refer to Chapter 23 - EA conditions).	Section 3.4 Section 3.6 Section 4.2.3 Section 5.1 Section 5.2

IESC Guidelines	MNES Chapter Section	Groundwater Chapter	Surface Water Chapter
Plans for ongoing monitoring and management are expected where significant impacts to water resources and water-dependent assets are predicted. Plans should focus on a robust monitoring programme to inform the management and mitigation of likely impacts and to reduce the uncertainty of predicted impacts.	Discussed in Section 10.8.4 (Groundwater) and Section 9.11.4 (Surface Water) See also Chapter 23 Draft Environmental Authority Conditions	Section 10.8.4	Section 9.11.4
The rationale and design for monitoring programmes should be provided, including appropriate quality assurance. These should include the hypotheses to be tested by the monitoring programmes, the temporal and spatial frequency (or resolution) of monitoring, the potential parameters and indicators to be monitored, and the analytical methods to be applied. The monitoring programmes should identify the triggers and thresholds associated with environmental objectives and outcomes and the proposed management measures if those levels are reached or exceeded. Triggers and thresholds should be based on the best available science, including expert opinion. Any departures from published guidelines or standard monitoring methods should be justified based on site-specific data.	Discussed in Section 10.8.4 (Groundwater) and Section 9.11.4 (Surface Water) See also Chapter 23 Draft Environmental Authority Conditions	Section 10.8.4	Section 9.11.4
Information is needed on findings from monitoring programmes, including raw data, analysis of data, and the performance of mitigation measures against the environmental objectives. The monitoring and management programmes should be robust and provide for an adaptive management approach to predicted impacts to water resources and water dependent assets.	Discussed in Section 10.8.4 (Groundwater) and Section 9.11.4 (Surface Water) See also Chapter 23 Draft Environmental Authority Conditions	Section 10.8.4	Section 9.11.4
4. Cumulative Impacts			
The assessment of cumulative impacts needs to consider all relevant past, present and reasonably foreseeable actions, programmes and policies that are likely to impact on water resources.	Section 16.16	Section 10.7.3	Section 9.12
The scale of a cumulative impact assessment needs to cover spatial and temporal boundaries large enough to include all potential significant impacts on water resources from the proposed project, when considered with other activities within the region.	Section 16.16	Section 10.7.3	Section 9.12 Section 9.13
A quantitative assessment of cumulative impacts is preferred. However, a qualitative or semi-quantitative approach may be used if data are lacking. Assessments may also require consideration of interactive or synergistic impacts in addition to a summation of individual proposals or impacts.	Section 16.16	Section 10.7.3	Section 9.12 Section 9.13

IESC Guidelines	MNES Chapter Section	Groundwater Chapter	Surface Water Chapter
There may be a need to further develop groundwater and surface water models to enable the prediction of cumulative impacts. Local-scale cumulative impact assessments should be undertaken by the proponent. These would ideally be informed by regional assessments such as strategic assessments, Cumulative Management Area models and / or completed Bioregional Assessments.	Discussed variously throughout Chapter 16 Appendix A6 for groundwater model discussion	Discussed variously through Chapter 10 Appendix A6 for groundwater model discussion	Appendix A6 for groundwater model discussion
5. Risk Assessment			
Where a proposal referred to the IESC could have a significant impact on water resources and water-dependent assets, the proponent will need to determine the scope of potential impacts and their likelihood and consequence. The risk assessment should address the potential impact of the proposed project as well as the potential cumulative impact of all past, present and reasonably foreseeable actions that are likely to impact on water resources and water-dependent assets. The IESC will also consider whether the proponent has demonstrated that the risk can be either avoided or suitably mitigated and may suggest further actions to mitigate or manage residual risks.	Refer Chapter 9 (Surface Water) and Chapter 10 (Groundwater)	Section 10.7 Section 10.9	Section 9.13
Available bioregional assessments will assist in the risk analyses by identifying possible risks and consequences of impacts to water resources and water dependent assets from CSG and large coal mining development proposals within specific bioregions. Where a development proposal occurs within an area subject to a bioregional assessment, the IESC will consider the bioregional assessment in its review of the proponent's risk assessment.	Not applicable to this assessment	Not applicable to this assessment	Not applicable to this assessment

16.19 Conclusion

The Project is located largely within the Marlborough subregion of the Brigalow Belt South bioregion. A small portion in the south of the Central Queensland Coal mine area lies within the adjacent Nebo-Connors Ranges subregion. The region has experienced a long history of human disturbance due to agriculture and mining activities. The Project area is representative of the wider region and landscape with over 78% of the Project area cleared and currently mapped as non-remnant. Remnant vegetation within the Project area is largely confined to the south and west of the mine area and along the adjacent creek lines of Tooloombah Creek and Deep Creek. Within the Central Queensland Coal mine area, the ground layer in cleared habitats was generally observed to be highly disturbed and often dominated by the exotic Buffel Grass, particularly on the dark clay soils north of the Bruce Highway.

The Project lies approximately 8 km from the boundary of the Great Barrier Reef World Heritage Area. The Styx River empties into Broad Sound which is listed in the Directory of Important Wetlands of Australia. The wetland lies north of the Project and encompasses the Great Barrier Reef waters pertinent to the Project. The Broad Sound wetland encompasses an area of approximately 2,100 km^2 comprising a complex aggregation of tidal marine and estuarine wetlands. These have been formed in a sheltered embayment and have a very large tidal range of approximately 9 m. Broad Sound comprises wetland habitats including seagrass beds, lower intertidal and supratidal mudflats, and mangroves. Brackish and freshwater swamps and lagoons occur in adjacent upland areas. The wetland is noted as providing significant habitat for waterbirds including substantial aggregations of a range of migratory shorebirds.

Small fringing reefs occur on Turtle Island and Charon Point approximately 35 km north-northeast of the Project boundary where the mouth of the Styx River empties into the main body of Broad Sound. Several small reefs also occur in the Clairview area (approximately 55 km north). A larger reef area occurs on the southwest edge Long Island (52 km northeast), a continental island to the west of the Torilla Peninsula.

Vegetation within the Project area was composed of 10 RE types situated on five landforms: alluvial river and creek flats; Cainozoic clay plains; Cainozoic sand plains / remnant surfaces; coarse-grained sedimentary rocks; moderately to strongly deformed and metamorphosed sediments and interbedded volcanics; reflecting the underlying geology and position in the landscape. Field verification of REs within the Project area identified inconsistencies in current RE mapping, relating to RE composition and polygon size. Field verification of REs within the Project area identified inconsistencies in current RE mapping, relating to RE composition and polygon size. Remnant vegetation communities listed as the Brigalow TEC and SEVT TEC were observed during field assessments as two very small polygons located in the east of the mine area and adjacent to the western boundary of the mine ML.

No listed flora species were observed during the field assessments and no species identified as occurring in the wider area during desktop searches was identified as having a high likelihood of occurring within the Project area.

Listed fauna species observed in the Project area include Greater Glider, Koala and Squatter Pigeon (all listed as Vulnerable under the NC and EPBC Act), Southern Snapping Turtle (listed as Endangered under the NC Act and Critically Endangered under the EPBC Act), and several bird species listed as Migratory (EPBC Act). Ornamental Snake (listed as Vulnerable under the NC and EPBC Act) was recorded to the west of the Project area.

The Project will require unavoidable significant impacts to ecological matters of Commonwealth significance including: remnant vegetation considered as a TEC under the EPBC Act; and habitat that may be considered as 'critical to the survival' of Koala. Significant impacts will be a result of clearing for open cut mining and associated infrastructure and the haul road. The total extent of these impacts to all MNES has been calculated to be 131.46 ha and will be the subject of the Project ODP.

The Project area is dominated by shallow alluvial aquifers. Groundwater modelling suggests (based on limited groundwater data) there are potential long-term impacts associated with groundwater drawdown, particularly on GDEs: riparian vegetation along the creek lines and permanent waterholes. These habitats provide habitat for Koala and Southern Snapping Turtle respectively. The magnitude of drawdown ranges up to 100 mbgl and may persist for up to 100 years in the area to the north of the Project. The greatest drawdown (5 m to 100 m) occurs within the first 20 years of mine operation, and is centred around the immediate open cut pit operations located closest to Tooloombah Creek and Deep Creek.

The mitigation measures proposed as part of the Project will minimise additional indirect impacts to terrestrial fauna and flora communities within and surrounding the Project area from construction and operational activities, including downstream impacts to the Great Barrier Reef World Heritage Area. These measures include fauna crossing infrastructure to minimise fauna traffic collisions along the haul road and a detailed REMP to monitor the health of vegetation, aquatic health and fauna communities adjacent to the Project for indirect impacts such as dust, surface water contamination. A detailed study program will be developed and implemented to better understand the local connections between the water table and GDEs and provide input into further mitigations to potential drawdown impacts. With control measures in place indirect impacts to fauna and flora are not expected to be significant.

16.20 Commitments

Central Queensland Coal's commitments, in relation to MNES are provided in Table 16-42.

Table 16-42 Commitments - MNES

Commitments
Develop and implement a Land Use Management Plan which will establish a vegetation monitoring program, identify pest and weed management controls, fire management measures and principles for managing fauna.
Develop and implement Significant Species Management Plans for managing those threatened species known or likely to occur on the site.
Fauna infrastructure (barriers and underpasses) to be installed along the haul road where it intersects with a potential fauna corridor (Deep Creek / Barrow Creek area).
A trained ecologist or other qualified environmental specialist to inspect potential roost or den habitat (such as tree hollows and large woody debris) for resident fauna prior to any clearing works.
Construction areas that pose a risk to fauna will be fenced off where practical.
Fauna crossings will be erected to warn drivers of areas throughout the site utilised by fauna populations.
Appropriate speed limits to be in place throughout the site and all contractors to be educated on the risks to local fauna. Speed limits will also minimise the impacts of noise and vibration upon wildlife and reduce the potential for dust accumulation impacts on fauna habitat.
Where clearing hollow-bearing trees is required and arboreal fauna (such as gliders or microbats) are detected, appropriate nest boxes will be installed adjacent to those areas. Nest box use will be regularly monitored to ensure effectiveness of nest box design and placement.
Measures for monitoring and recording wildlife road collision incidents throughout construction and operation to help remediate 'high risk' collision areas and set conditions for attending to injured native wildlife.
Ensure mine vehicles and traffic are strictly controlled and do not operate in areas (such as threatened species habitat) outside the needs of mine operations.
Prepare and implement a Water Management Plan that outlines the monitoring and management measures for surface water and groundwater.

Commitments
Develop and implement a Receiving Environment Monitoring Program in accordance with EHP Guidelines and periodically update as required throughout the life of the Project.
Ensure REMP and LUMP include coordinated measures to assess the ecological function and monitor GDEs adjacent to the Project that may be impacted by groundwater drawdown.
Design and implement a Project Erosion and Sediment Control Plan to be certified by a suitably qualified person, prior to construction.
Develop and implement a series of dust mitigation and monitoring measures.
Implement noise management measures to minimise noise disturbance.
Project lighting will be minimised (i.e. low luminance) as far as possible, and directed towards work areas and thereby away from fauna habitat.
Develop and submit to EHP and DotEE an Offsets Delivery Plan in accordance with the relevant State and Commonwealth policies, prior to construction.

16.21 ToR Cross-reference Table

Table 16-43 ToR cross-reference

Terms of Reference	Section of the EIS
Background and description of the action	
The MNES section must include background to the action and describe in detail all components of the action for example (but not limited to), the construction, operation and (if relevant) decommissioning components of the action.	Sections 16.4 and 16.7
This must include the precise location of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on MNES.	Sections 16.4.3 and 16.7
The description of the action must also include details on how the works are to be undertaken (including stages of development and their timing) and design parameters for those aspects of the structures or elements of the action that may have relevant impacts.	Section 16.7
The MNES section must include how the action relates to any other actions (of which the proponent should be reasonably aware that have been, or are being, taken or that have been approved in the region affected by the action. A map showing relevant regional projects must be provided.	Section 16.16
The MNES section must provide details on the current status of the action as well as any feasible alternatives to the action to the extent reasonably practicable, including: • If relevant, the alternative of taking no action	Section 16.5.1
• a comparative description of the impacts of each alternative on the MNES protected by controlling provisions of Part 3 of the EPBC Act for the action, and	Section 16.5.1
• sufficient detail to make clear why any alternative is preferred to another.	Section 16.5
Short, medium and long-term advantages and disadvantages of the options should also be discussed.	Section 16.5
Should the proponent wish to conduct development and associated offsets in stages, the EIS must include a description of stages, using maps where appropriate, and discuss any risks and or benefits of staging the action.	Section 16.7
Description of the environment including MNES	
The MNES section must provide a description of the environment of the proposal site and the surrounding areas that may be affected by the action. It is recommended that this include the following information: • A description of the location, extent and heritage values of the Great Barrier Reef World Heritage Area and National Heritage Place and the environment of the Great Barrier Reef Marine Park that may be impacted by the action.	Section 16.11.1
• A description of the surface and groundwater resources which may be impacted by the action, and Listed threatened and ecological communities, and migratory species (including suitable habitat) that are likely to be present in the vicinity of the site, including details of the scope, timing (survey season/s) and methodology for studies or surveys used to provide information on the listed species/community/habitat at the site (and in areas that may be impacted by the project).	Sections 16.9.2 and 16.9.3
• Include details of: o how best practice survey guidelines are applied, and o how the surveys are consistent with (or a justification of divergence from) published Australian Government guidelines and policy statements.	Section 16.10

Terms of Reference	Section of the EIS
The draft EIS must include a habitat assessment for each relevant listed threatened species and communities, and migratory species. The habitat assessment must include, but not limited to, the habitat area (in hectares), quality, location and use specifications of known and potential suitable habitat in relation to the project disturbance area. The Department would expect the habitat assessment be informed by, at a minimum, a desktop assessment of relevant Commonwealth and State Government databases and the outcomes of field surveys.	Section 16.11
The draft EIS must consider and discuss the value of suitable habitat present within the project site and how it may be impacted by the project (as per the requirements below). **Relevant impacts** The MNES section must include a description of all of the relevant impacts of the action. Relevant impacts are impacts that the action will have or is likely to have on MNES. Impacts during the construction, operational and (if relevant) the decommissioning phases of the project should be addressed, and the following information provided: • a description of the relevant impacts (direct, indirect and consequential) of the action on MNES taking account of any relevant approved Conservation Advices for listed threated species and communities as well as any agreements or plans that cover impacts on MNES including (but not limited to): recovery plans, threat abatement plans for processes that threaten species; wildlife conservation plans, strategic assessments, etc.)	Sections 16.12 and 16.15
• provide an analysis of potential and likely impacts of the proposed action on the integrity and Outstanding Universal Value of the Great Barrier Reef World Heritage property ○ including on impacts relating to water quality – fine sediment and nitrogen, and impacts relating to habitat – seagrass, mangroves, saltmarsh and shallow reef	Section 16.15.1
• provide an analysis of potential and likely impacts of the proposed action on the values of the Great Barrier Reef National Heritage place	Section 16.15.2
• demonstrate how the proposed action will provide a net benefit for water quality in the Great Barrier Reef World Heritage property, consistent with The Reef 2050 Long-Term Sustainability Plan (2015), and	Section 16.13.3
• reference the key values and attributes outlined in the Great Barrier Reef Outlook Report 2014 (Great Barrier Reef Marine Park Authority) that may be impacted by the proposed development	Section 16.15.1
• a detailed analysis of the nature, extent and significance of the likely direct, indirect and consequential impacts relevant to MNES and/or their known and potential habitat, including likely short-term and long-term impacts (refer to the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance for guidance on the various types of impact that need to be considered)	Section 16.15
• a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible	Section 16.12
• any technical data and other information used or needed to make a detailed assessment of the relevant impacts, including a description of the methodology used to determine whole of project impacts (in hectares) to habitat for listed threatened species and communities and listed migratory species; and	Section 16.10
• an explanation of how Indigenous stakeholders' views of the action's impacts to biodiversity and cultural heritage have been sought and considered in the assessment, including where relevant, how guidelines published by the Commonwealth in relation to consulting with Indigenous peoples for proposed actions that are under assessment have been considered and applied, and	Section 16.4.6

Terms of Reference	Section of the EIS
• where the proposal is a coal seam gas development or large coal mining development and likely to significantly impact on a water resource refer to the: ○ *Independent Expert Scientific Committee's (IESC) information guidelines for proposals relating to the development of coal seam gas and large coal mines where there is a significant impact on water resources*. ○ *Significant Impact guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources*.	Section 16.18
The project will be submitted to the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC). The draft EIS must include a completed checklist (located within the IESC Guidelines) to ensure that the information requirements for the IESC review have been addressed.	Section 16.18.6
The MNES section should also provide a detailed assessment of any likely impact that this proposed action may facilitate on the following (at the local, regional, state, national scale): • sections 12 and 15A (world heritage values of a declared World Heritage property)	Sections 16.12 and 16.15.1
• sections 15B and 15C (the heritage values of a National Heritage place)	Section 16.12 and 16.15.2
• sections 18 and 18A (Listed threatened species and communities)	Sections 16.12 and 16.15.3 and 16.15.4
• sections 20 and 20A (Listed migratory species)	Section 16.12 and 16.15.5
• sections 24B and 24C (Great Barrier Reef Marine Park)	Section 16.12
• sections 24D and 24E (a water resource, in relation to coal seam gas development and large coal mining development).	Section 16.18
The MNES section should identify and address cumulative impacts, where potential project impacts are in addition to existing impacts of other activities (including known potential future expansions or developments by the proponent and other proponents in the region and vicinity).	Section 16.16
The MNES section should also address the potential cumulative impact of the proposal on ecosystem resilience.	Section 16.16
The cumulative effects of climate change impacts on the environment must also be considered in the assessment of ecosystem resilience.	Section 16.15
Proposed avoidance and mitigation measures	
The MNES section must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action on MNES.	Section 16.13
The information provided must discuss how the proposed action is not inconsistent with: • any relevant threat abatement plan for listed threatened species and communities • any relevant recovery plan for listed threatened species and communities, and	Section 16.16
• relevant conventions and agreements of which a migratory species is listed, including the Bonn Convention, CAMBA, JAMBA and agreements relevant to the conservation of the species.	Section 16.15
The MNES section must include, and substantiate, specific and detailed descriptions of the proposed avoidance and mitigation measures, based on best available practices and must include the following elements:	Section 16.13 and Section 16.20

Terms of Reference	Section of the EIS
• A consolidated list of measures proposed to be undertaken to avoid, mitigate and manage the relevant impacts of the action on MNES, including: ○ a description of proposed avoidance and mitigation measures to deal with relevant impacts of the action, including mitigation measures proposed to be taken by State/Territory governments, local governments or the proponent	
○ assessment of the expected or predicted effectiveness of the mitigation measures, including the scale and intensity of impacts of the proposed action and the on-ground benefits to be gained through each of these measures	Section 16.13
○ discussion of how the proposed mitigation and management measures are consistent with actions included in relevant Recovery Plans and Threat Abatement Plans for listed threated species and communities	Section 16.16
○ a discussion of how the proposed mitigation and management measures are consistent with the objectives of The Reef 2050 Long-Term Sustainability Plan (2015)	Section 16.13.3
○ including how impacts to surface water flow and quality and to groundwater quality and groundwater regimes will be managed during construction, operation and decommissioning of the project	Sections 16.13.3 and 16.13.4
○ how final voids will be managed to avoid ongoing impacts to MNES following the end of the operational phase of the project	Section 16.7.5
○ details of the rehabilitation of the site, including how this will be staged and the outcomes proposed to be achieved to ensure habitat for listed threatened species and communities is reinstated, and	Section 16.7.5
○ any statutory or policy basis for the mitigation measures.	Section 16.7.5
• A strategy for the continuing management, mitigation and monitoring of relevant MNES impacts of the action, including a description of the outcomes that will be achieved and any provisions for independent environmental auditing.	Chapter 14 and Chapter 15
• A detailed outline of a Construction Environmental Management Plan (CEMP) for the continuing management, mitigation and monitoring of relevant impacts of the action on MNES.	Section 16.13 and Appendix 12a and Appendix 12b
• The CEMP outline must be consistent with the Department's Environmental Management Plan Guidelines (2014), and must include: ○ objectives ○ risk assessment ○ environmental management activities and mitigation measures ○ the timing of actions ○ a monitoring program, which must include: ▪ performance indicators (clear and concise criteria against which achievement of outcomes are to the measured), which are capable of accurate and reliable measurement ▪ outcomes (time bound outcomes as measured by performance indicators), which might include milestones (interim outcomes) ▪ monitoring requirements (timing and frequency of monitoring to detect changes in the performance indicators, to determine if outcomes are being achieved, and to inform adaptive management), and ▪ trigger values for corrective actions • potential corrective actions to be implemented if trigger values are reached, and how environmental incidents and emergencies will be managed • roles and responsibilities (clearly stating who is responsible for activities), and • auditing and review mechanisms.	Appendix 12a and Appendix 12b

Terms of Reference	Section of the EIS
Greenhouse Gases	
The MNES section is to outline the cumulative direct and indirect greenhouse gas emissions of the proposed action. An inventory of the projected greenhouse gas emissions associated with the proposed action is to be provided. This inventory should include scope 1 and 2 emissions and, for context, an outline of total global greenhouse gas emissions.	Section 16.14
Environmental Outcomes	
The MNES section may include information on the outcomes that the proponent will achieve for matters of national environmental significance. Outcomes need to be specific, measurable and achievable, and must be based on robust baseline data.	Discussed variously throughout this Chapter and Chapter 14, Chapter 15 and Chapter 17
Outcomes must be developed in consideration of DOEE's *Outcomes-based Conditions Policy 2016* and *Outcomes-based Conditions Guidance 2016,* with suitable justification for considerations identified in the policy and guidance.	
The MNES section may include the details of specific environmental outcomes to be achieved, and reasoning for these in reference to relevant Recovery Plans, Conservation Advices and Threat Abatement Plans.	
Residual significant impacts/offsets	
Environmental offsets are broadly understood to mean actions taken outside a development site that compensate for the significant residual impacts of that development. Offsets are not intended to replace avoidance and mitigation which are expected to be the primary strategies for managing the potential impacts of development proposals. Note: offsets do not make an unacceptable impact acceptable and do not reduce the likely impacts of a proposed action. Instead, offsets compensate for any residual significant impact. The MNES section must provide details of: • residual significant impacts on MNES that are likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account	Section 16.17
• where residual significant impacts are likely to occur, the reasons why the avoidance or mitigation of these significant impacts is not expected to be achieved.	
The MNES section must include details of an offset package proposed to be implemented to compensate for the residual significant impact of the project if these are determined likely, as well as an analysis about how the offset(s) meets the requirements in the Department's Environmental Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012 (EPBC Act Offset Policy).	Section 16.17.5
The offset package can comprise a combination of direct offsets and other compensatory measures, so long as it meets the requirements of the EPBC Act Offset Policy. Offsets should align with conservation priorities for the impacted protected matter and be tailored specifically to the attribute of the protected matter that is impacted in order to deliver a conservation gain. Proponents also have the option of using the Australian Government Reef Trust to deliver biodiversity-related offsets, for example for residual significant impacts relating to water quality and to habitat associated with the Great Barrier Reef.	Section 16.17.5
Offsets should compensate for an impact for the full duration of the impact (i.e. should impacts be in perpetuity the offsets should also be in perpetuity).	Noted
Offsets must directly contribute to the ongoing viability of the MNES impacted by the project and deliver an overall conservation outcome that improves or maintains the viability of the	Noted

Terms of Reference	Section of the EIS
MNES as compared to what is likely to have occurred under the status quo, that is, if neither the action not the offset had taken place.	
Offsets required by the State can be applied if the offsets meet the Department's EPBC Act Offset Policy. The outcomes of the offset strategy need to be specific, measurable and achievable, and should be based on robust baseline data.	Noted
Note: offsets do not make an unacceptable impact acceptable and do not reduce the likely impacts of a proposed action. Instead, offsets compensate for any residual significant impact.	Noted
The MNES section must include an offset strategy to compensate for significant residual impacts on MNES. The offsets strategy must include: • objectives	Section 16.7
• quantity of impacts which are being offset	Section 16.17.4
• the type of offsets proposed (direct/indirect)	Section 16.17.5
• the location (including a geo-referenced map) and suitability of proposed direct offsets	Section 16.17.5
• current land tenure of any proposed offset and the method of securing enduring protection of the offset site and managing the offset for the life of the impact	To be provided once Offset requirements are finalised
• how any proposed staging of the overall development will impact the delivery of offsets	
• specific environmental outcomes to be achieved, and reasoning for these in reference to relevant statutory recovery plans, conservation advices and threat abatement plans	
• a completed 'offsets guide'. All figures used to determine the suitability of offsets including habitat quality scores at the project site must be derived using a suitably robust and repeatable framework. Details about each framework must also be provided	
• risk assessment	
• environmental management activities and mitigation measures or customize, by referring to specific measures as follows, including the timing of actions	
• a monitoring program, which must include: ○ performance indicators (clear and concise criteria against which achievement of outcomes are to the measured), which are capable of accurate and reliable measurement	
○ outcomes (time bound outcomes as measured by performance indicators), which might include milestones (interim outcomes)	
○ monitoring requirements (timing and frequency of monitoring to detect changes in the performance indicators, to determine if outcomes are being achieved, and to inform adaptive management), and	
○ trigger values for corrective actions	
• potential corrective actions to be implemented if trigger values are reached, and how environmental incidents and emergencies will be managed	
• roles and responsibilities (clearly stating who is responsible for activities)	
• auditing and review mechanisms, and	
• an analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy.	

Terms of Reference	Section of the EIS
Environmental record of person(s) proposing to take the action	
The information provided must include details of any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: • the person proposing to take the action	Section 16.3
• details of any consultation with Indigenous stakeholders	Section 16.4.6
• projected economic costs and benefits of the project, including the basis for their estimation through cost/benefit analysis or similar studies, and	Section 16.4.2
• employment opportunities expected to be generated by the project (including construction and operational phases).	Section 16.4.2
Economic and social impacts should be considered at the local, regional and national levels. Details of the relevant cost and benefits of alternative options to the proposed action should also be included. Identification of affected parties is required, including a statement mentioning any communities that may be affected and describing their views.	Section 16.4.2
Documentation must be provided substantiating how estimated benefit/cost figures have been derived.	Chapter 19, Appendix 10a
Information sources	
For information given in the MNES section, the proponent must state: • the source of the information; • how recent the information is; • how the reliability of the information was tested; • what uncertainties (if any) are in the information; and • what guidelines, plans and/or policies were considered.	Noted
Conclusion	
An overall conclusion as to the environmental acceptability of the proposal on each MNES should be provided, including: • a discussion on compliance with the requirements of the EPBC Act, including the objects of the EPBC Act, the principles of ecologically sustainable development and the precautionary principle • reasons justifying undertaking the proposal in the manner proposed, including the acceptability of the avoidance and mitigation measures, and • if relevant, a discussion of residual impacts and any offsets and compensatory measures proposed or required for significant residual impacts on MNES, and the relative degree of compensation and acceptability.	Section 16.19