Chapter 18

Terrestrial Ecology

TABLE OF CONTENTS

Tables

Figures

18. TERRESTRIAL ECOLOGY

18.1 Introduction

This chapter describes the terrestrial ecology present within the project area. An overview is provided of the existing environment, condition (quality) of the habitats, species diversity and presence or potential presence of conservation significant species. This chapter presents potential impacts of the project on terrestrial ecology and mitigation measures to ameliorate these impacts are also presented. Mitigation measures have also been included and will be implemented as part of the Environmental Management Plan, provided as **Appendix 9**.

For further detail on the terrestrial ecological assessment, please refer to the Terrestrial Ecology Impact Assessment Report for the Byerwen Coal Project EIS, 2013 provided in **Appendix 19**.

18.2 Methodology

A combination of desktop assessments and field surveys were conducted to identify existing terrestrial ecology values for the project area. A summary of the methodology used to undertake these tasks is provided below.

18.2.1 Desktop Assessment

The most recent desktop assessment was undertaken in March 2012 and included a review of the Commonwealth and State databases listed below:

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Protected Matters Search Tool to identify Matters of National Environmental Significance (MNES) within approximately 20 km of the project area (DSEWPaC, 2012a)
- DSEWPaC Species Profiles and Threats Database (SPRAT)
- Department of Environment and Heritage Protection (EHP) Wildlife Online database to identify flora and fauna species potentially occurring within approximately 20 km of the project area
- Queensland Herbarium HERBRECS search
- Queensland Museum Records within the project area
- EHP Regional Ecosystem Mapping (Version 6.1), High Value Regrowth Mapping (Version 2), Essential Habitat Mapping (Version 2)
- EHP Regional Ecosystem Description Database (REDD)
- EHP Environmentally Sensitive Area (ESA) mapping
- EHP Biodiversity Planning Assessment (BPA) for the Brigalow Belt Version 1.3 (DERM, 2008)
- Birds Australia Bird Atlas search
- EHP Wetland Mapping to determine the classification, extent and significance of wetlands within the project area
- Directory of Nationally Important Wetlands (Environment Australia, 2001a)
- Protected Area Estate Mapping

- EHP watercourse mapping
- published ecological information on threatened flora and fauna species and vegetation communities.

Previous studies and reports prepared for the project and for other nearby mines were also reviewed including:

- Flora and Fauna Assessment of the Exploration Permit Coal (EPC) 614 project area near Glenden, Central Queensland, a report to QCoal Pty Ltd by the Centre for Environmental Management, Central Queensland University (CQU) (Wormington *et al*, 2009)
- Byerwen Coal Baseline Flora and Fauna Study, a report to QCoal Pty Ltd by Unidel (Unidel, 2011)
- Byerwen Coal 2011 Wet Season Baseline Limnology Survey (NRA 2011)
- environmental impact statements for the Ellensfield, Caval Ridge and Daunia coal mine projects.

18.2.2 Field Survey

18.2.2.1 Flora

Separate flora field surveys have been undertaken in the project area comprising:

- general surveys to verify 1:100,000 scale Regional Ecosystem (RE) mapping and to identify and prioritise terrestrial flora values in the project area
- a targeted survey to assess whether native grasslands in the eastern part of the project area met the criteria for the 'Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin' threatened ecological community (Natural grasslands Threatened Ecological Community (TEC))
- targeted surveys to assess populations of the previously undescribed *Kelita uncinella* recorded in the initial surveys by CQU (Wormington *et al* 2009).

Terrestrial flora field surveys and the timing for each are summarised in **Table 18-1**.

Table 18-1 Summary of Terrestrial Flora Field Surveys

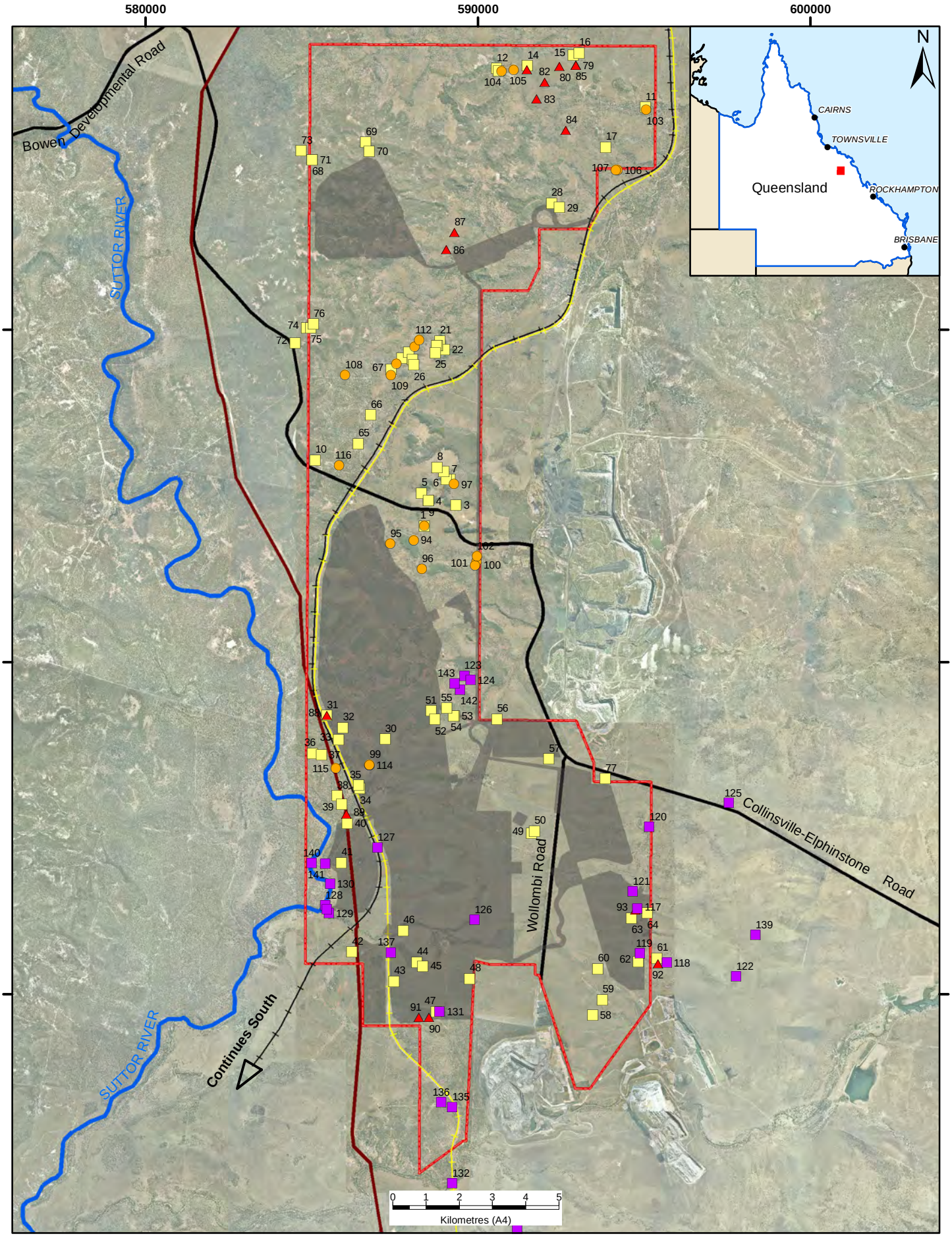
Purpose	Project area	Wet season survey	Dry season survey
General flora survey (CQU)	EPC 614	30 March - 10 April 2009	3 August 2009
General flora survey	EPC 739	-	14 - 22 October 2010
Targeted grassland survey	EPC 739	-	2 - 3 June 2011
Targeted surveys for *Kelita uncinella*	EPC 739	-	5 - 30 June 2011 24 - 29 July 2011
General flora survey	EPC 739 and EPC 614	5 - 9 March 2012	-

The primary objective of these surveys was to identify and describe vegetation communities and terrestrial flora values and to ground-truth existing RE mapping for the project area. Surveys were carried out in accordance with the Queensland Herbarium's 'Methodology for the Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland' (Neldner *et al,* 2005). For flora species unable to be identified by field surveys, specimens were submitted to the Queensland Herbarium for identification. Site data was recorded in a form compatible with the Queensland Herbarium CORVEG database. Vegetation mapping and data will be submitted to the Queensland Herbarium to assist with updating the CORVEG database, as part of the approvals process.

A total of 143 sites across the project area were assessed over three surveys. The location of these sites is shown in **Figure 18-1** and a summary of survey effort is provided in **Table 18-2**.

Table 18-2 Number of Sites and Information Collected by Site Type

Site type	No. of sites	Information collected
Secondary	16	Complete species list for 10 x 50 m plot, species structure, assemblage, diversity and abundance, record of general vegetation condition and presence of weed species.
Tertiary	23	Species structure, assemblage, diversity and abundance, record of general vegetation condition and presence of weed species.
Quaternary	77	Species present.
Not Recorded	27	CQU (2009) notes that survey data was collected from 27 survey sites, but does not describe the level of assessment completed or provide the requisite data sheets. However, subsequent floristic survey by Unidel (now AMEC) overcomes this limitation by establishing supplementary sampling sites in the areas assessed by CQU.



Legend

- Project Area
- Project Ecological Footprint
- Burdekin Moranbah Pipeline
- Formed Roads
- GAP Rail Line
- Alpha Coal Project Rail Line

Flora Survey Type

- Secondary
- Tertiary
- Quaternary
- CQU (2009) 2500m^2 Plot

Flora Survey Sites

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Figure 18-1

Byerwen Coal Project

environmental and licensing professionals pty ltd

Date: *5/02/2013*

Author: Shahram.Nasiri

Map Scale: 1:150,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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18.2.2.2 Fauna

Three separate fauna surveys were conducted in the project area between 2009 and 2012 (**Table 18-3**). Baseline fauna surveys involved fauna trapping at 13 sites and secondary habitat assessments at 22 sites within representative habitat types (**Table 18-4**). Trapping and habitat assessment sites in the project area are shown on **Figure 18-2**.

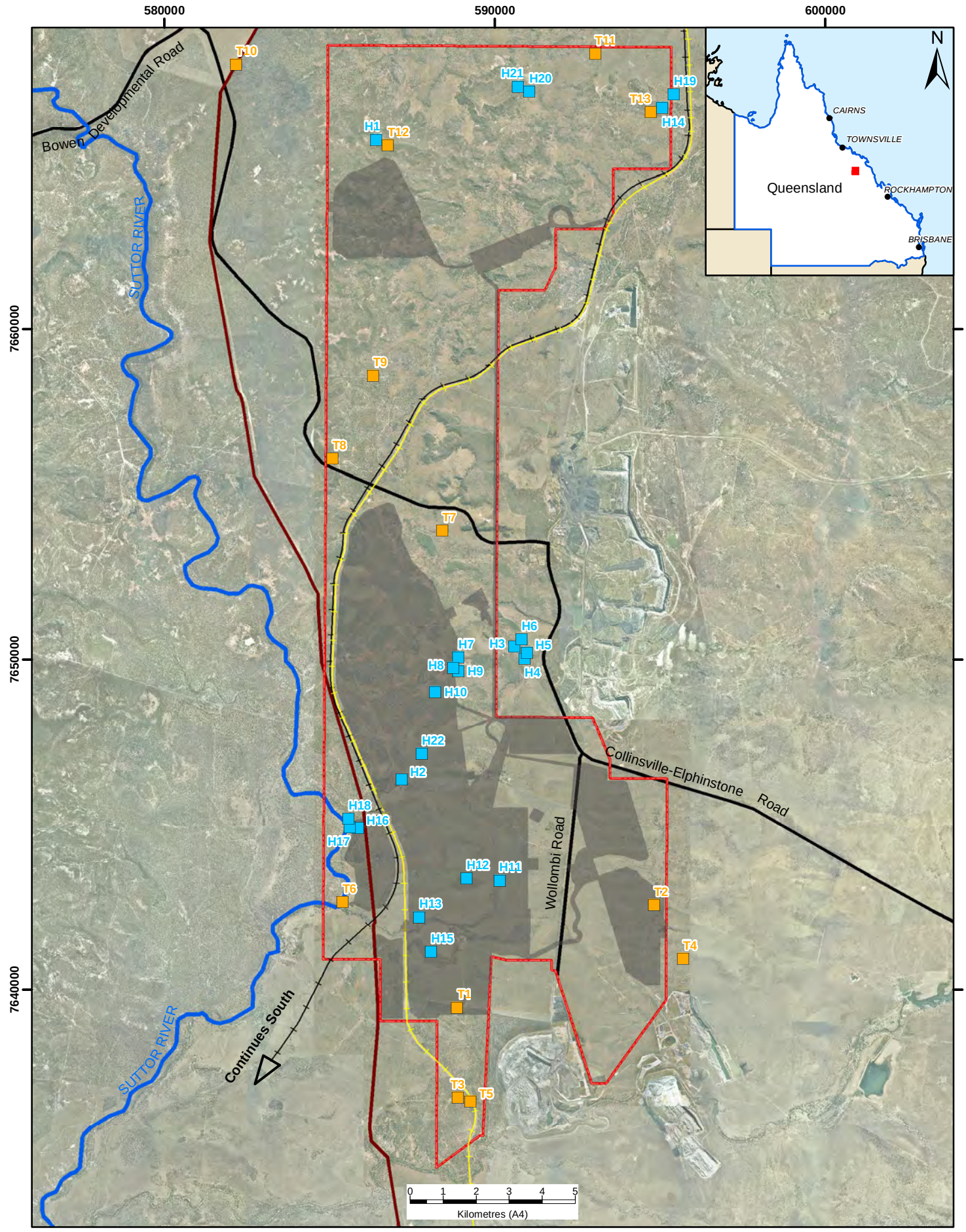
Table 18-3 Summary of Terrestrial Fauna Field Surveys

Purpose	Project area	Wet season survey	Dry season survey
General fauna survey (CQU)	EPC 614	30 March - 10 April 2009	3 - 12 August 2009
General fauna survey	EPC 739	-	14 - 22 October 2010
General fauna survey	EPC 739	5 - 9 March 2012	-

Table 18-4 Habitat Types Sampled by Survey Event

Survey	Lateritic uplifts	Undulating black cracking clays	Undulating sandy plains	Clay floodplains with gilgai	Alluvial floodplains	Wetlands	Cleared
CQU (2009)	-	-	√	√	√	-	√
AMEC (2010)	√	√	√	-	√	-	-
AMEC (2012)	√	√	√	√	√	√	√

Detailed fauna survey methodologies including a summary of trapping hours and techniques are provided in **Appendix 19.**



Legend

- Project Boundary
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Formed Roads
- Burdekin to Moranbah Pipeline
- Trapping Location
- Habitat Assessment

Fauna Survey Sites

Figure 18-2

Byerwen Coal Project

Date: *11/03/2013*

Author: samuel.ferguson

Map Scale: 1:150,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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18.2.3 Habitat Assessments

Habitat assessments captured specific microhabitat data from numerous locations within different vegetation groups across the project. This assessment of habitat features identified the presence, abundance and quality of microhabitat features considered critical for the survival of threatened, near threatened and regionally significant fauna species. Consideration of habitat quality as a predictor of the likelihood of occurrence is considered to be a precautionary approach and is particularly relevant for cryptic species.

Targeted fauna habitat assessments were carried out at 22 sites of approximately 100 m x 100 m within the project area with the aim of identifying microhabitat features for target fauna species identified through the desktop analysis. The location of these sites is shown on **Figure 18-2**.

18.2.4 Species Assessments

The likelihood of occurrence for individual species has been determined based on a review of previous records, a review of known habitat preferences and an assessment of habitat availability and the presence of microhabitat features within the project area. This included known RE associations for each species, known records and distribution ranges. Species were assigned to one of the following categories:

- **Known to occur**: this category includes species or communities which have been recorded from the project area
- **Likely to occur**: this category includes species previously recorded in proximity to the project area, and which have suitable habitat features available on site which may support the species
- **May occur**: this category includes those species where suitable habitats or RE associations are present in the project area but where there are no known records in the area
- **Unlikely to occur**: this category includes those species for which the project area offers limited or no potential habitat, is outside their known range and/or is without broader habitat requirements.

Impacts on potential habitat for flora and fauna species have been calculated based on RE associations for individual species derived from known habitat associations and published literature. RE associations provide an indication of the presence of suitable habitat but do not take account of the actual distribution of suitable microhabitat (e.g. logs, leaf litter) or niche habitat (e.g. suitable nesting sites) within each RE. The areas are therefore likely to represent an overestimate of actual habitat availability for most species.

18.3 Existing Environment

18.3.1 Project Area Description

The project area is located within the Brigalow Belt North Bioregion and on the boundary of two subregions: Wyarra Hills to the east, and the Northern Bowen Basin to the west. Land use within the Brigalow Belt North Bioregion includes grazing, cropping, tourism and mining, particularly coal, with coal deposits occurring in the Bowen and Galilee Basins. There has been historic clearing of the project site, largely to support low intensity cattle grazing.

Areas that may be representative of "wilderness" as defined under the *Nature Conservation Act 1992* (NC Act) relate to areas exempt from this history of grazing, including remnant vegetation described in **Section 18.3.5**.

The project area is comprised of numerous geological features which combine to provide a diverse and complex array of fauna habitats. Significant tracts of land within the northern and central portions of the project area are found on sandstone plateaus which fall to form steep wash out slopes. The project area also contains broad undulating plains consisting of heavier clays and sandy plains. These plains are regularly bisected by incised alluvial systems often with deep outer banks displaying a variety of exposed soil profiles and bed rock. Basaltic and lateritic outcrops occur sporadically within the project area providing varying soil structures and subsequently complex vegetation compositions and habitat features such as rocky outcrops and scalds.

18.3.2 Drainage, Waterways and Wetlands

Drainage, waterways and wetlands are described in detail in **Chapter 15** and **Chapter 19**.

The project area is located in the Burdekin River catchment. The northern and most of the central sections of the project area are within the Bowen sub-catchment and are drained by Plum Creek, Kangaroo Creek and their tributaries, which form part of the Broken River sub-catchment. The southern section of the project area is within the Suttor sub-catchment and is drained by the Suttor River and its tributaries (refer **Figure 18-3**). Watercourses in the project area are ephemeral and flow only after sustained or intense rainfall in the catchment. Stream flows are highly variable, with flows typically occurring during the wetter months (January through March) with low to no flow for the rest of the year.

No Ramsar or Nationally Important Wetlands occur within, or immediately downstream of the project area. Freshwater wetlands (palustrine, lacustrine (farm dams) and riverine) are mapped for and were observed within the project area. These include:

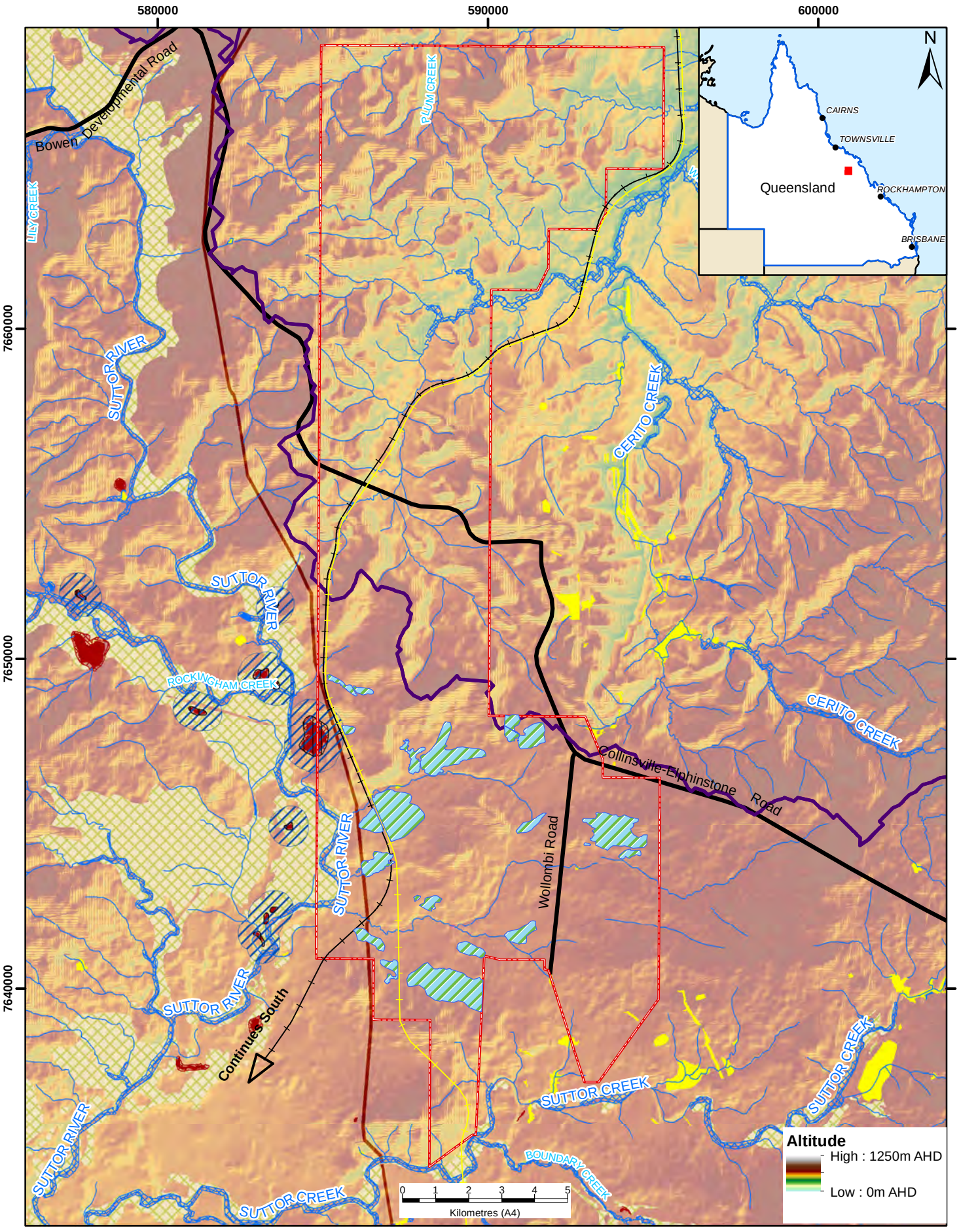
- a palustrine wetland situated on a closed depression of the Suttor River floodplain in the western portion of the project area and continuing outside the project area
- a large farm dam at site H2 (approximately 5 ha)
- gilgai wetland habitats on clay plains
- a smaller dam at site H13, occurring within a wide alluvial system along a tributary of the Suttor River in the south-east of the project area
- a smaller dam at site H19, in the northern part of the project area.

18.3.3 Connectivity and Wildlife Corridors

Habitat connectivity within the project area is linked to riparian corridors associated with the Suttor River, Kangaroo Creek and contiguous areas of remnant vegetation in the central and northern parts of the project area. The riparian corridors associated with stretches of Kangaroo Creek within the project area are intersected by the existing GAP Rail Line and Collinsville-Elphinstone Road. Areas to the south and north of the project form part of large bioregional corridors listed as having state significance in accordance with BPA mapping (refer **Figure 18-4**). A section of the corridor to the north is mapped within the project boundary but does not occur within the project footprint.

Other bioregional corridors listed as having State and regional significance in accordance with BPA mapping are mapped along the Suttor River and intersect the western project boundary. Only the regionally significant corridor occurs within the project footprint.

A large area of contiguous vegetation is located outside of the project boundary to the west of the project area. Wildlife dispersal within these patches of remnant vegetation is likely to be relatively unrestricted and may facilitate fauna movement.



Legend

- Project Area
- Main Catchment Divide
- Formed Roads
- Burdekin Moranbah Pipeline
- Drainage Lines

- Indicative extent of gilgai wetland habitat

Great Barrier Reef Wetland Protection Area

- Wetland
- Trigger Area

Areas that may include wetlands

- Remnant regional ecosystem 1-50% wetland (mosaic units)

Water Bodies

- Riverine
- Lacustrine
- Palustrine

Wetland Regional Ecosystem

- Riverine
- Palustrine

Wetlands and Drainage Features

Figure 18-3	Byerwen Coal Project
Date: 23/04/2013	**Author:** samuel.ferguson
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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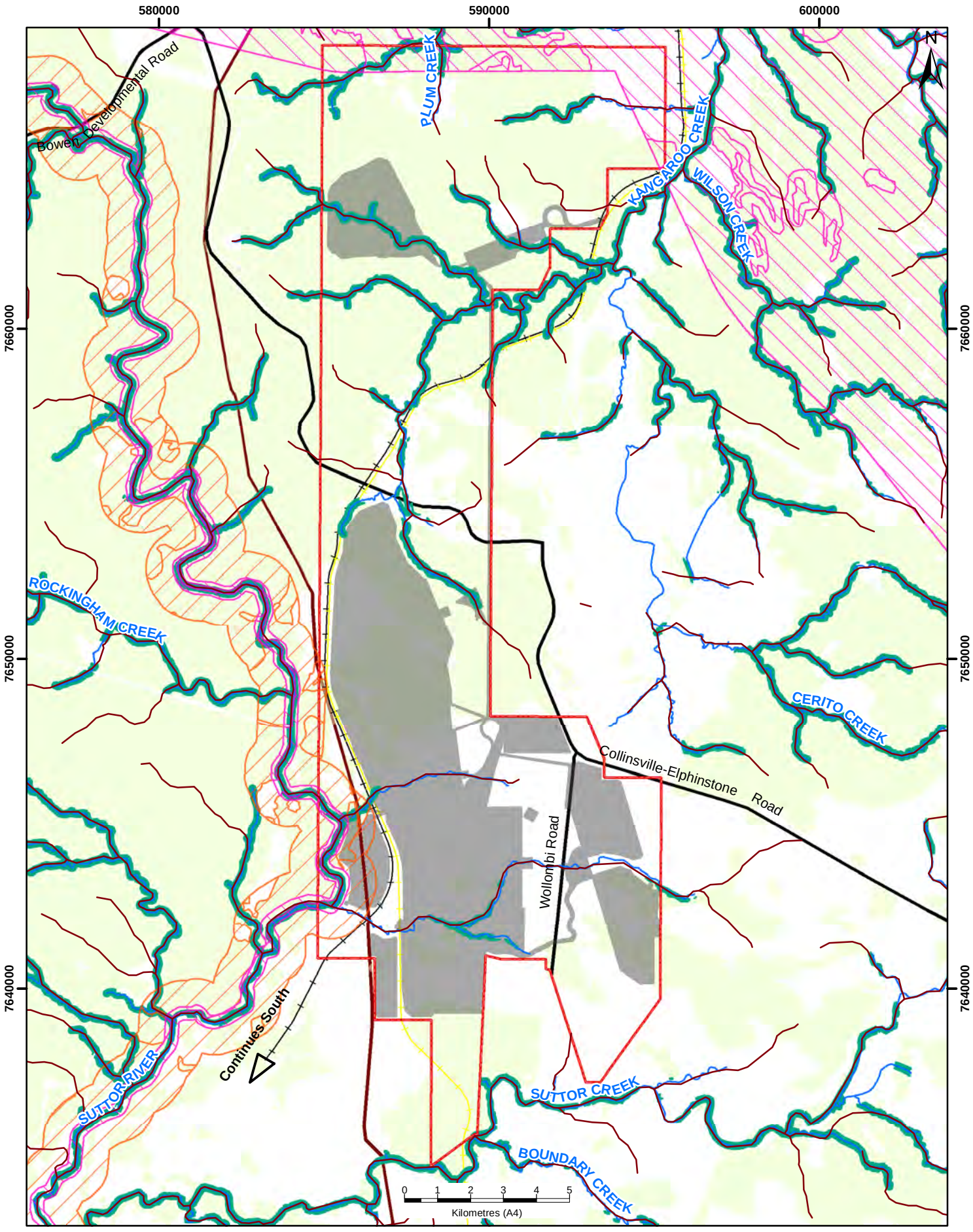

Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin Moranbah Pipeline
- Formed Roads
- Stream Order (2 and above)
- Riparian Corridor
- Remnant Vegetation

BPA Corridor

- State
- Regional

Connectivity

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Figure 18-4	Byerwen Coal Project
Date: 14/03/2013	**Author:** samuel.ferguson
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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18.3.4 Protected Areas

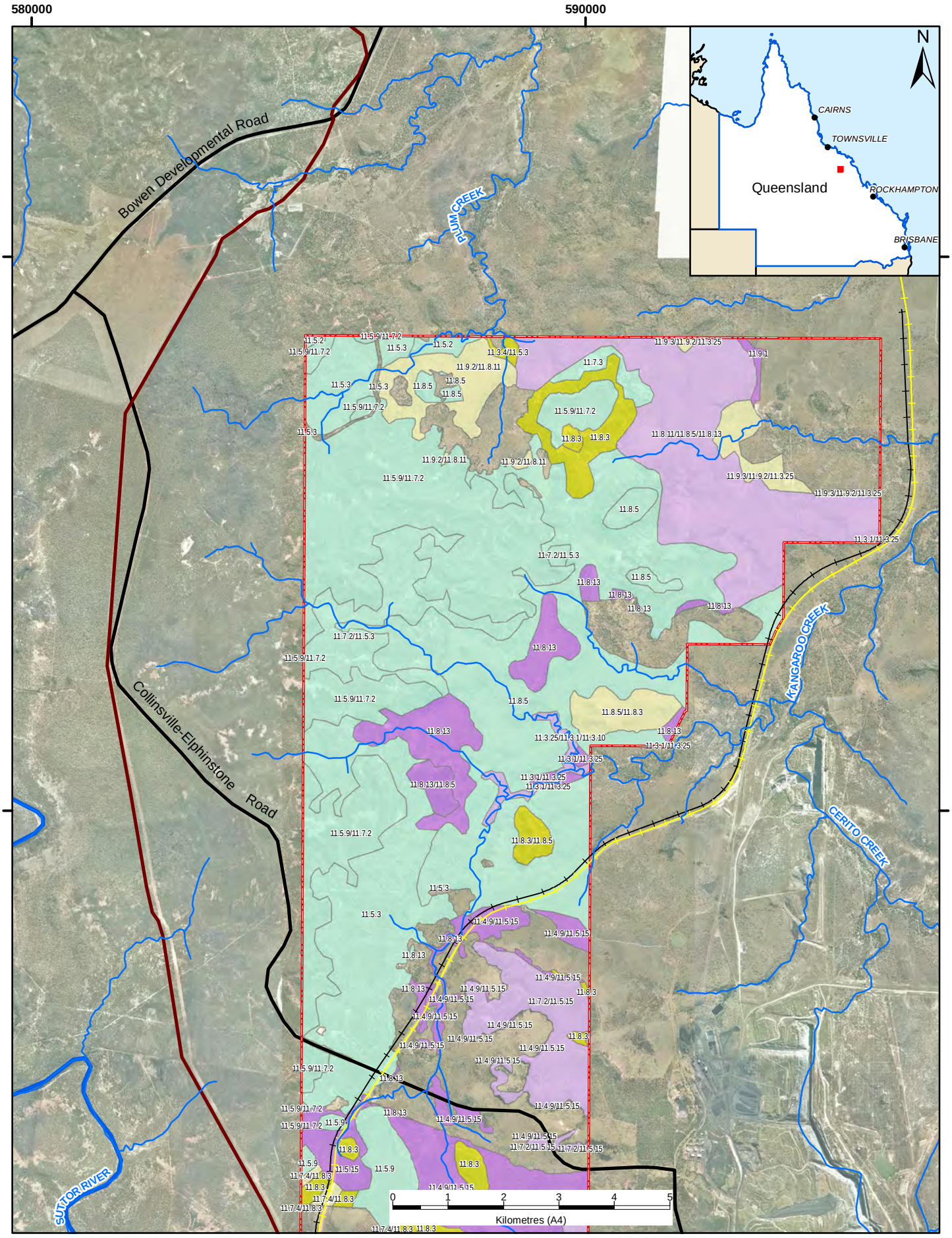
No protected area estates are located within the project area. The proposed Redcliffevale National Park is located to the east of Newlands coal mine but is remote from the project area and is not relevant to the project. The Newlands Nature Refuge abuts the eastern boundary of the project area and Blackjack Mountain Nature Reserve is located approximately 7 km from the project area.

18.3.5 Regional Ecosystems

Current certified RE mapping (Version 6.1) for the project area is shown in **Figure 18-5** and **Figure 18-6**. Certified RE mapping was verified in the field to confirm the extent and description of vegetation communities in the project area. The revised RE mapping has been used as the basis for the assessment of terrestrial flora values in the project area and is presented in **Figure 18-7** and **Figure 18-8**.

Revised RE mapping shows that 50% of the project area (approximately 11,411 ha) supports remnant vegetation. The balance of the project area (approximately 11,211 ha) is non-remnant or regrowth vegetation, comprising mostly cleared grazing land. Approximately 1,505 ha of vegetation mapped as remnant by EHP has been ground-truthed as non-remnant.

Of the 24 REs mapped by EHP for the project area, 15 were recorded during the field survey. Eight RE types not previously mapped for the project area (RE 11.4.2, 11.4.8, 11.5.1, 11.5.16, 11.7.1, 11.7.1x1, 11.7.6 and 11.8.4) are included in the revised RE mapping. In total, the revised RE mapping has recorded 23 REs from the project area. A comparison of the extent of certified RE mapping and revised RE mapping is provided in **Table 18-5**.



Legend

- Project Area
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems V6.1 (DEHP)

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - sub-dominant
- No concern at present

Certified RE Map (North)

QCOAL GROUP

Figure 18-5	Byerwen Coal Project
Date: 11/03/2013	**Author:** samuel.ferguson
	Map Scale: 1:90,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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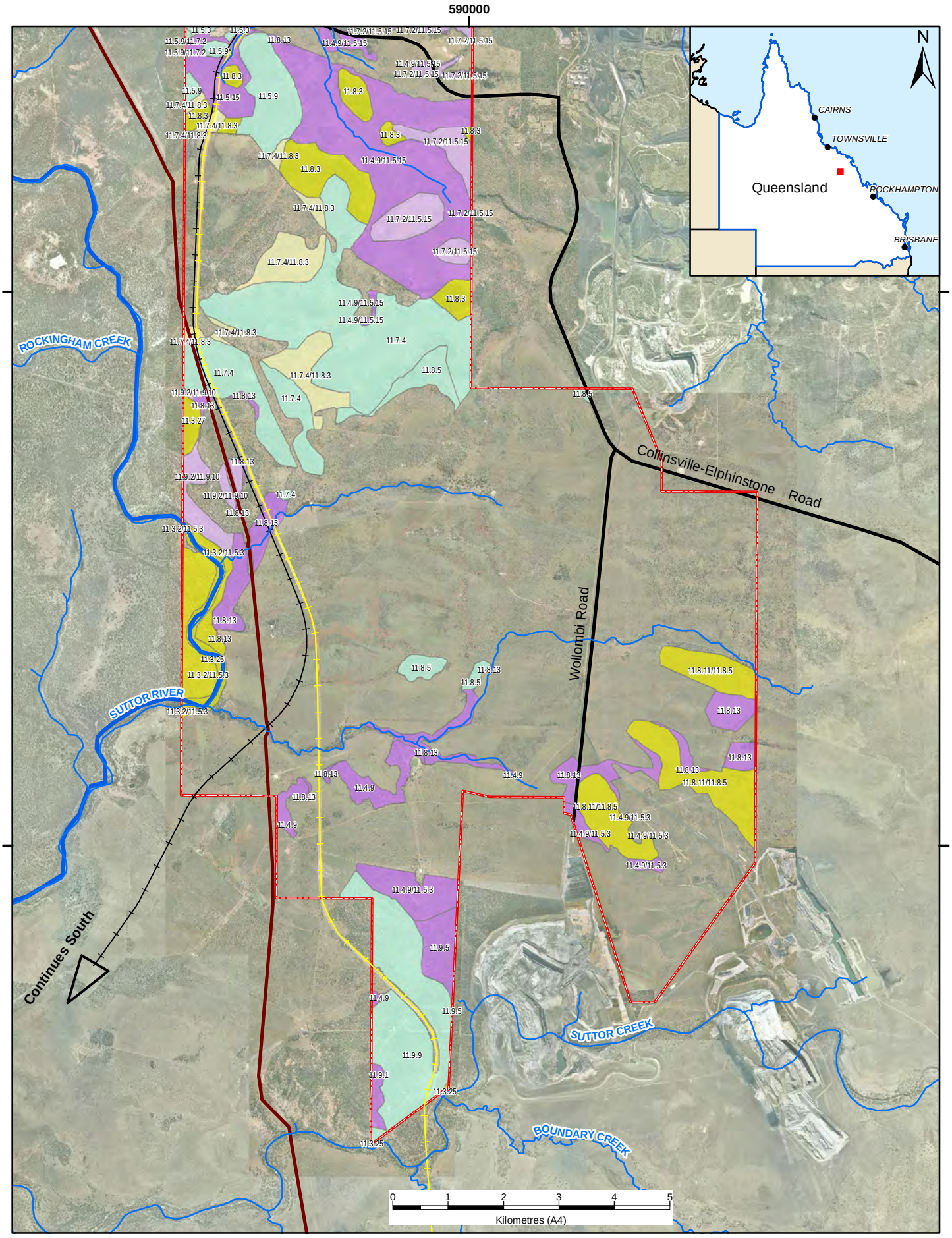

Legend

- Project Area
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems V6.1 (DEHP)

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - sub-dominant
- No concern at present

Certified RE Map (South)

QCOAL GROUP

Figure 18-6 — **Byerwen Coal Project**

Date: 11/03/2013

Author: samuel.ferguson

Map Scale: 1:90,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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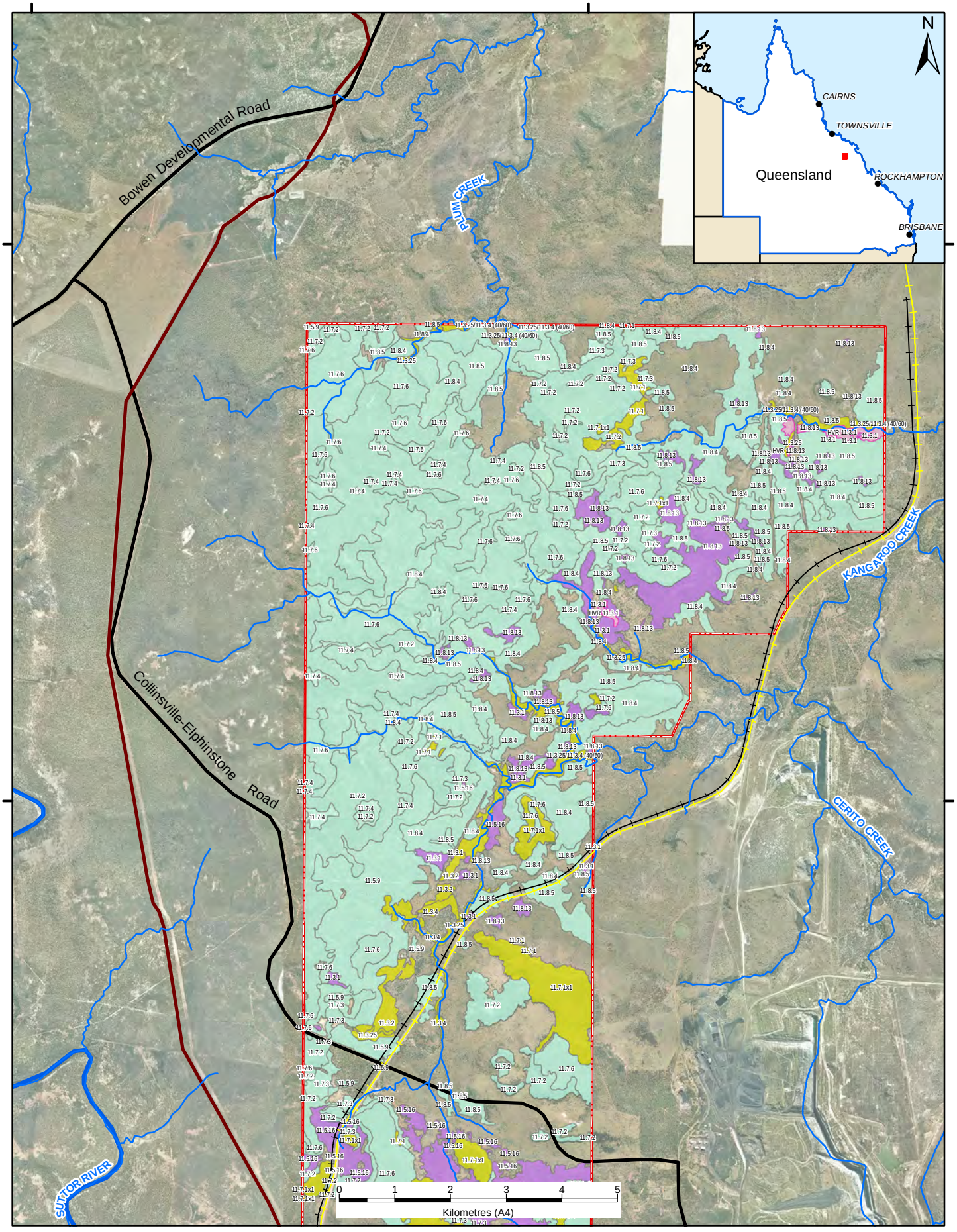

Legend

- Project Area
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems

- Endangered
- Of Concern
- No Concern
- HVR containing E; HVR containing LC

Revised RE Map (North)		QCOAL GROUP
Figure 18-7	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *11/03/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:90,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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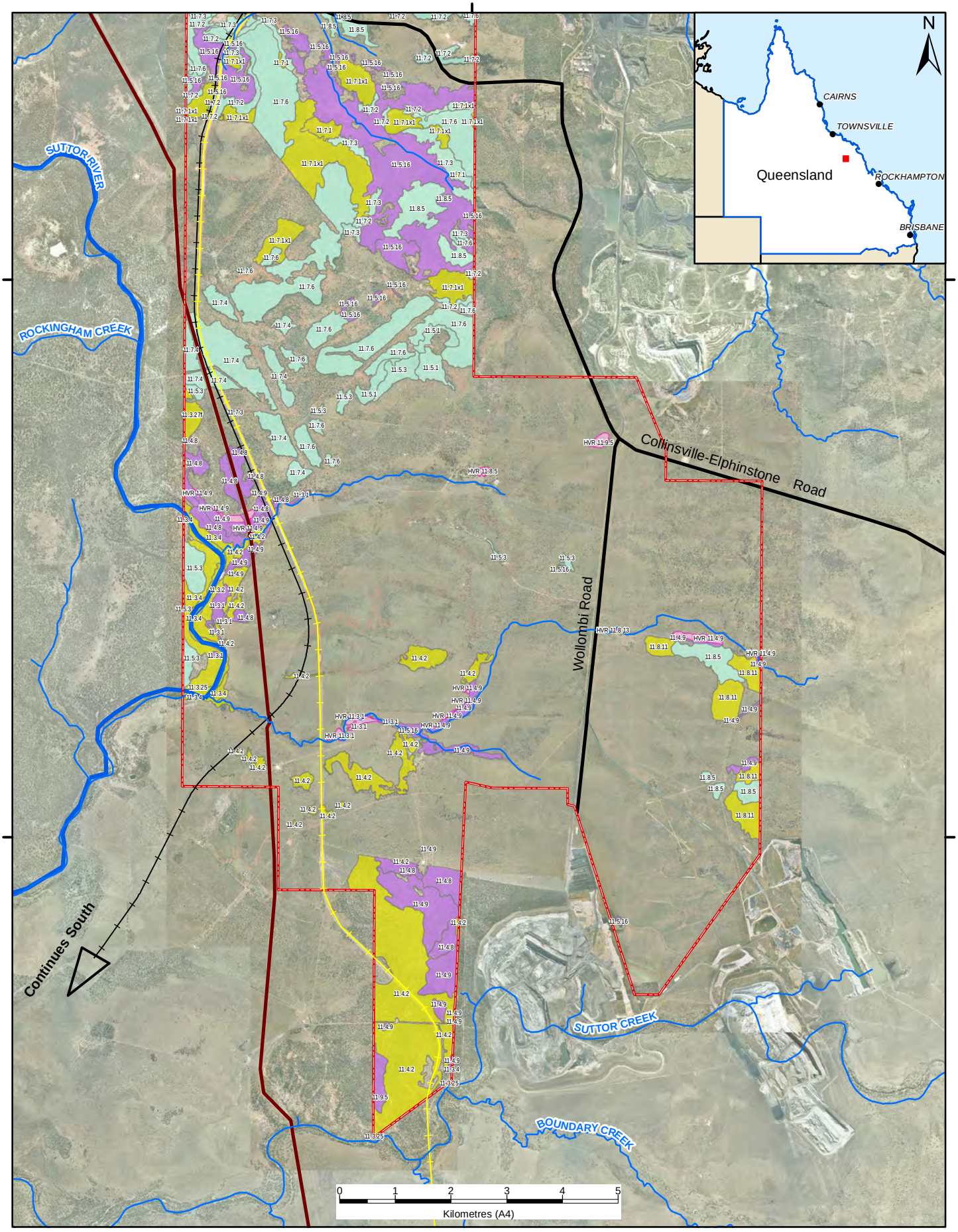

Legend

- Project Area
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems

- Endangered
- Of Concern
- No Concern
- HVR containing E; HVR containing LC

Revised RE Map (South)

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Figure 18-8 | **Byerwen Coal Project**

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Date: 5/02/2013

Author: Shahram.Nasiri

Map Scale: 1:90,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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Table 18-5 Area of Regional Ecosystems in the Project Area from Certified RE Mapping (Version 6.1) and Revised RE Mapping Prepared for the Project

RE	Description	Management status			Area (ha) (certified RE mapping)[e]	Area (ha) (revised RE mapping)	Ground-truthed site	Extent in reserves
		Biodiversity status[a]	VM Act[b] status[c]	EPBC Act[d] status				
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.	E	E	Brigalow TEC	18	118	T35, T40, Q80, Q106	Low
HVR 11.3.1	Advanced regrowth *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.	E	E	Brigalow TEC	–	36	T21	–
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	OC	OC	–	97	78	T34, Q104, Q105	Low
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.	OC	OC	–	15	223	T39, Q36	Low
11.3.10	*Eucalyptus brownii* woodland on alluvial plains.	NC	LC	–	3	–	Not observed	Low
11.3.25	*Eucalyptus tereticornis* or *Eucalyptus camaldulensis* woodland fringing drainage lines.	OC	LC	–	140	157	Q20, T21, Q38	Low
11.3.27 (11.3.27f)	Freshwater wetlands/ Lacustrine wetland (e.g. lake)/Palustrine wetland (e.g. vegetated swamp)/ *Eucalyptus coolabah* and/or *E. tereticornis* open woodland to woodland fringing swamps.	OC	LC	–	29	20	Q68	Low
11.4.2	*Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains.	OC	OC	–	–	566	Q73, Q76, Q77, Q78, Q79, Q86, T83	Low
11.4.8	*Eucalyptus cambageana* woodland to open-forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains.	E	E	Brigalow TEC	–	155	Q65, Q66, Q75, Q81, Q85, T70, T75	Low

RE	Description	Management status			Area (ha) (certified RE mapping)[e]	Area (ha) (revised RE mapping)	Ground-truthed site	Extent in reserves
		Biodiversity status[a]	VM Act[b] status[c]	EPBC Act[d] status				
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with Terminalia oblongata on Cainozoic clay plains.	E	E	Brigalow TEC	887	237	Q3, T15, T16, Q72, Q74, Q81, S82, T83	Low
HVR 11.4.9	Advanced regrowth *Acacia harpophylla* shrubby open forest to woodland with Terminalia oblongata on Cainozoic clay plains.	E	E	Brigalow TEC	–	18	Not observed	–
11.5.1	*Eucalyptus crebra*, *Callitris glaucophylla*, *Angophora leiocarpa*, *Allocasuarina luehmannii* woodland on Cainozoic sandplains/remnant surfaces.	NC	LC	–	–	58	Q14, Q90, Q91, Q93, T33	Low
11.5.2	*Eucalyptus crebra*, *Corymbia* spp., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces.	NC	LC	–	39	–	Not observed	Low
11.5.3	*Eucalyptus populnea +/-E. melanophloia +/-Corymbia clarksoniana* on Cainozoic sand plains/ remnant surfaces.	NC	LC	–	1,357	93	Q14, T33, Q61, S63, Q81, S82, T83, Q88, Q103	Low
11.5.9 (b, c)	*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces.	NC	LC	–	1,142	450	Q103, Q107, Q108, Q109, Q110, Q111, Q112, Q113, Q114, Q115	Low
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains/remnant surfaces.	E	LC	SEVT TEC	335	–	T2, Q3, T5, Q6, Q7, Q8, T9, Q10, Q13, T15, T16, T18, T19, T31	Low
11.5.16	*Acacia harpophylla* and/or *Casuarina cristata* open forest in depressions on Cainozoic sand plains/ remnant surfaces.	E	E	Brigalow TEC	–	581	T2, T5, T19	Low
11.7.1	*Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E. microcarpa* woodland on lower scarp slopes on Cainozoic lateritic duricrust.	OC	LC	–	–	71	Q4, T17, T25, Q41	Low
(11.7.1 x 1)	Semi-evergreen vine thicket.	OC	LC	–	–	534	T1, Q43	Low

RE	Description	Management status			Area (ha) (certified RE mapping)[e]	Area (ha) (revised RE mapping)	Ground-truthed site	Extent in reserves
		Biodiversity status[a]	VM Act[b] status[c]	EPBC Act[d] status				
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	NC	LC	–	1,612	2,302	Q6, Q7, Q8, T9, Q10, Q13, T18, Q23, T33, Q43, Q47, Q103, Q107, Q108, Q109, Q110, Q112, Q113, Q114, Q115	Low
11.7.3	*Eucalyptus persistens*, *Triodia mitchellii* open woodland on stripped margins of Cainozoic lateritic duricrust.	NC	LC	–	61	296	Not observed	Low
11.7.4	*Eucalyptus decorticans* and/or *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp., *Lysicarpus angustifolius* on Cainozoic lateritic duricrust.	NC	LC	–	1,064	291	Q24, T60, Q61, Q62, Q65, Q87, Q88, Q90, Q91	Low
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust.	NC	LC	–	–	1,942	T9, T18, Q42, T60, Q62, Q87, Q112	Low
11.8.3*	Semi-evergreen vine thicket on Cainozoic igneous rocks.	OC	OC	–	626	–	T1, Q4, T17, Q23, Q24, T25, Q41	Low
11.8.4	*Eucalyptus melanophloia* woodland on Cainozoic igneous rocks. Hillsides.	NC	LC	–	–	1,422	Q28, Q30, Q37, Q44, Q50	High
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.	NC	LC	–	2,776	1,334	Q3, T15, T16, S22, T26, Q27, Q28, Q29, Q30, T32, T35, Q36, Q37, Q38, T39, T40, Q44, Q45, Q46, S51, S52, S53, S54, S55, S56, S57, S58, S59, Q61, S97, S98, Q99, Q100, S102, Q104, Q105, Q106	Low
HVR 11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks.	NC	LC	–	–	3	Not observed	–
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks.	OC	OC	Natural grasslands TEC	773	117	S22, T26, Q27, Q28, Q29, Q30, S51, S52, S53, S54, S55, S56, S57, S58, S59, S97, Q98, Q99, Q100, Q101, S102	Low

RE	Description	Management status			Area (ha) (certified RE mapping)[e]	Area (ha) (revised RE mapping)	Ground-truthed site	Extent in reserves
		Biodiversity status[a]	VM Act[b] status[c]	EPBC Act[d] status				
11.8.13	Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks.	E	E	SEVT TEC	1,008	345	Q29, Q46, Q49, T31, T48	Low
HVR 11.8.13	Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks.	E	E	–	–	8	Not observed	–
11.9.1	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks.	E	E	Brigalow TEC	39	–	Not observed	Low
11.9.2	*Eucalyptus melanophloia* +/- *E. orgadophila* woodland on fine-grained sedimentary rocks.	NC	LC	–	286	–	Q20, T21	Medium
11.9.3	*Dichanthium* spp., *Astrebla* spp. grassland on fine-grained sedimentary rocks.	NC	LC	Natural grasslands TEC	57	–	Q20, T21	Low
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	E	E	Brigalow TEC	79	21	Not observed	Low
HVR 11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	E	E	Brigalow TEC	–	6	Not observed	–
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks.	NC	LC	–	445	–	Not observed	Low
11.9.10	*Eucalyptus populnea*, *Acacia harpophylla* open forest on fine-grained sedimentary rocks.	E	OC	–	28	–	Not observed	Low

RE	Description	Management status			Area (ha) (certified RE mapping)[e]	Area (ha) (revised RE mapping)	Ground-truthed site	Extent in reserves
		Biodiversity status[a]	VM Act[b] status[c]	EPBC Act[d] status				
Non-remnant	N/A	N/A	N/A	–	9,740	11,211	Q11, Q12, Q27, Q45, S51, S52, S53, S54, S55, S56, S57, S58, S59, Q64, Q67, Q68, Q69, Q71, Q75, Q76, Q77, Q78, Q79, Q84, Q85, Q86, Q89, Q92, Q94, Q95, Q96, Q101, Q116,	–

a Biodiversity Status: Detailed in the Regional Ecosystem Description Database or as assessed during field surveys: NC – No concern at present, OC – Of concern, E – Endangered

b VM Act – *Vegetation Management Act 1999*

c VM Act Status: LC – Least concern, OC – Of concern, E - Endangered

d EPBC Act – *Environment Protection and Biodiversity Conservation Act 1999*

e Current certified RE mapping (Version 6.1)

18.3.5.1 Endangered and Of Concern Regional Ecosystems

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

The revised RE mapping shows that seven of concern REs (Biodiversity Status) occur within the project area and comprise 1,766 ha of the project area.

18.3.5.2 Threshold Regional Ecosystems

Certified RE map polygons containing threshold REs were targeted through flora survey sample sites (Q3, T9, T15, T16 and T18) however, these REs were not observed in the project area.

18.3.5.3 High Value Regrowth Vegetation

HVR mapping for the project area was revised based on a combination of aerial photo analysis and field surveys. Within the project area, HVR occurs predominantly as advanced brigalow regrowth with small areas of HVR 11.8.5 and HVR 11.8.13 mapped for the project area. A total of 71 ha of high value regrowth vegetation (comprising 68 ha of endangered RE and 3 ha of least concern RE) is included in the revised RE map.

Many areas mapped by EHP as HVR containing endangered REs were found to be poorly developed stands of brigalow, often with a development age of less than five years or comprising of stunted, widely spaced shrubs as a result of ongoing grazing land use. These areas have been excluded from the revised RE map. Other areas of advanced regrowth have been assessed as meeting remnant criteria and are shown on the revised RE map as remnant vegetation.

18.3.6 Threatened Ecological Communities

Three threatened ecological communities (TECs) identified as potentially occurring by the desktop assessment were confirmed as present within the project area. The area of each TEC and its constituent REs is summarised in **Table 18-6**. The distribution and extent of TECs in the project area is shown in **Figure 18-9** and **Figure 18-10**.

Table 18-6 TECs and Analogous REs Mapped as Occurring within the Project Area

EPBC community description	EPBC Act status	Equivalent RE	Area of RE within project area (revised mapping) (ha)	Representative sites (ground-truthed RE)
Brigalow (*Acacia harpophylla*) dominant and co-dominant[b]	E	11.3.1	118	T21, T35, T40, Q80, Q106
		HVR 11.3.1	36	
		11.4.8	155	Q65, Q66, Q75, Q81, Q85, T70
		11.4.9	237	Q72, Q74, S82
		HVR 11.4.9	18	
		11.5.16	581	T2, T5, T19
		11.9.5	21	-

EPBC community description	EPBC Act status	Equivalent RE	Area of RE within project area (revised mapping) (ha)	Representative sites (ground-truthed RE)
		HVR 11.9.5	6	
		Total Brigalow TEC	**1,172**	
Semi-evergreen vine thickets of the Brigalow Belt (north and south) and Nandewar Bioregions	E	11.8.13	345	Q29, Q46, Q49, T31, T48, Q29
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	E	11.8.11	117	S22, T26, Q27, Q28, Q29, S51, S52, S53, S54, S55, S56, S57, S58, S59, S97, Q98, Q101, S102

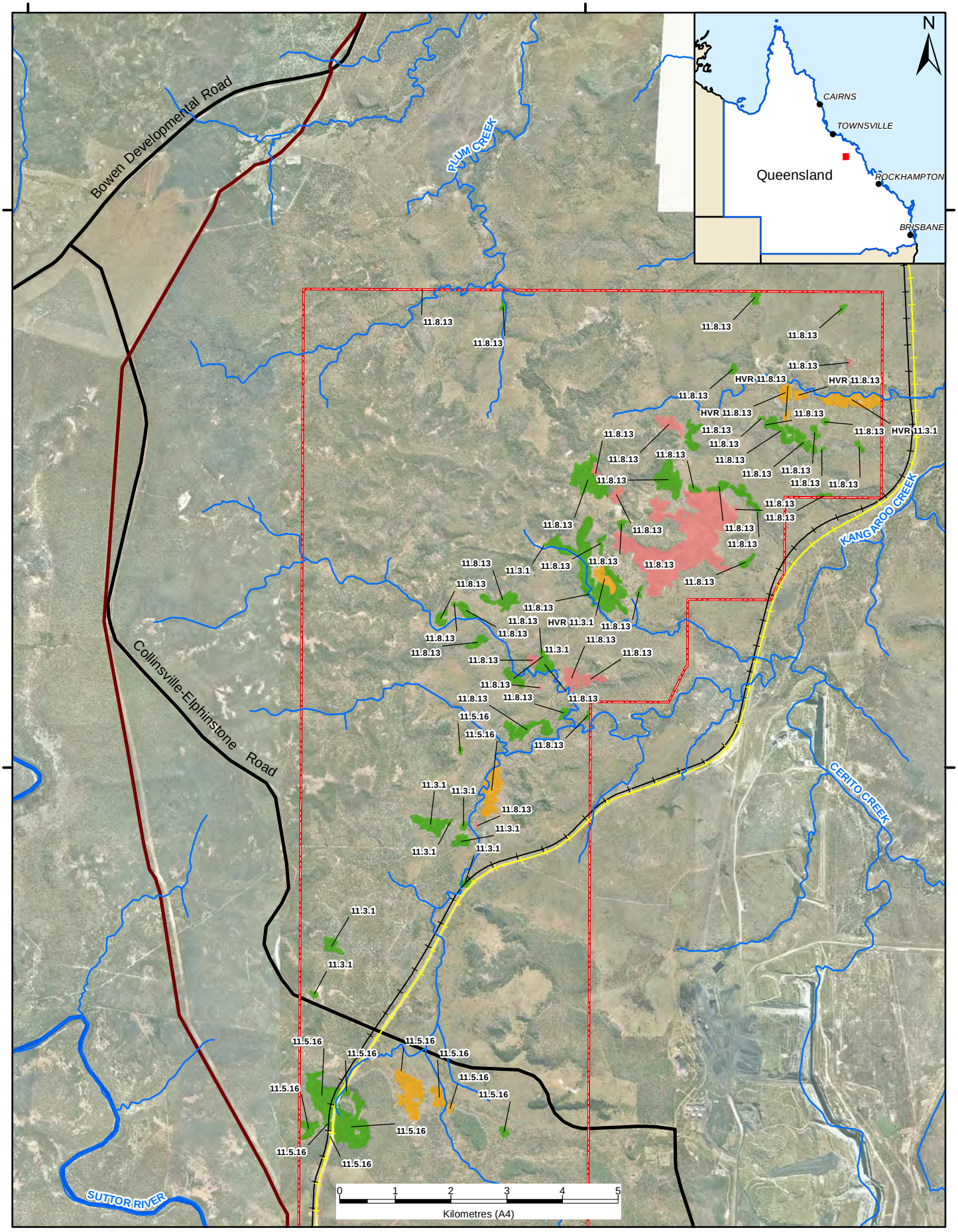
a EPBC Status: E - Endangered

b Estimated areas for brigalow TEC take into account the regrowth vegetation more than 15 years old which meets the listing requirements for the TEC.

Some areas of those REs equivalent to brigalow TEC were ground-truthed as consisting of regrowth brigalow trees. While these areas of regrowth failed to satisfy the remnant status (refer Neldner *et al*, 2005), some areas of established regrowth did achieve the criteria for identification as Brigalow TEC (refer Environment Australia, 2001b).

Similarly areas mapped as brigalow HVR were viewed in aerial imagery and ground-truthed to establish whether the regrowth qualified as a brigalow TEC. Generally, regrowth that has been cleared within the past 15 years would not have regained the structure and species composition typical of remnant brigalow and therefore does not qualify as the TEC.

Based on the revised mapping it is estimated that approximately 60 ha also mapped as HVR in the revised RE map meets the listing criteria for brigalow TEC. This regrowth has been included in the revised brigalow TEC areas provided in **Table 18-6**. The revised RE mapping indicates that approximately 1,172 ha of brigalow TEC occurs in the project area.



Legend

- Project Area
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

TEC

- Brigalow TEC (Regrowth)
- Brigalow TEC (RE)
- SEVT TEC (RE)
- Natural Grassland

Threatened Ecological Communities (North)

Figure 18-9 | **Byerwen Coal Project**

Date: *11/03/2013*

Author: samuel.ferguson

Map Scale: 1:90,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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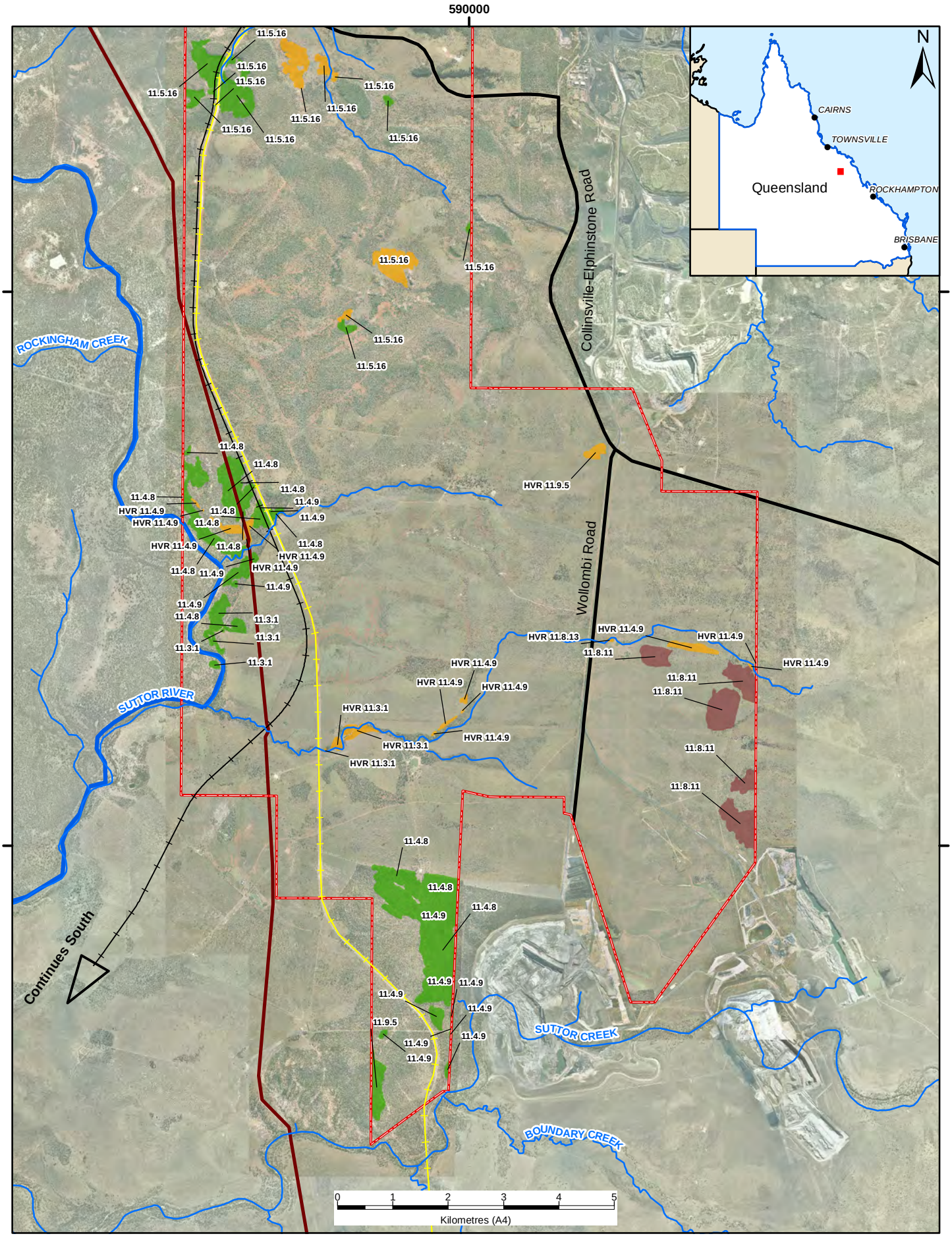

Legend

- Project Area
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

TEC

- Brigalow TEC (Regrowth)
- Brigalow TEC (RE)
- SEVT TEC (RE)
- Natural Grassland

Threatened Ecological Communities (South)

Figure 18-10

Byerwen Coal Project

Date: *5/02/2013*

Author: Shahram.Nasiri

Map Scale: 1:90,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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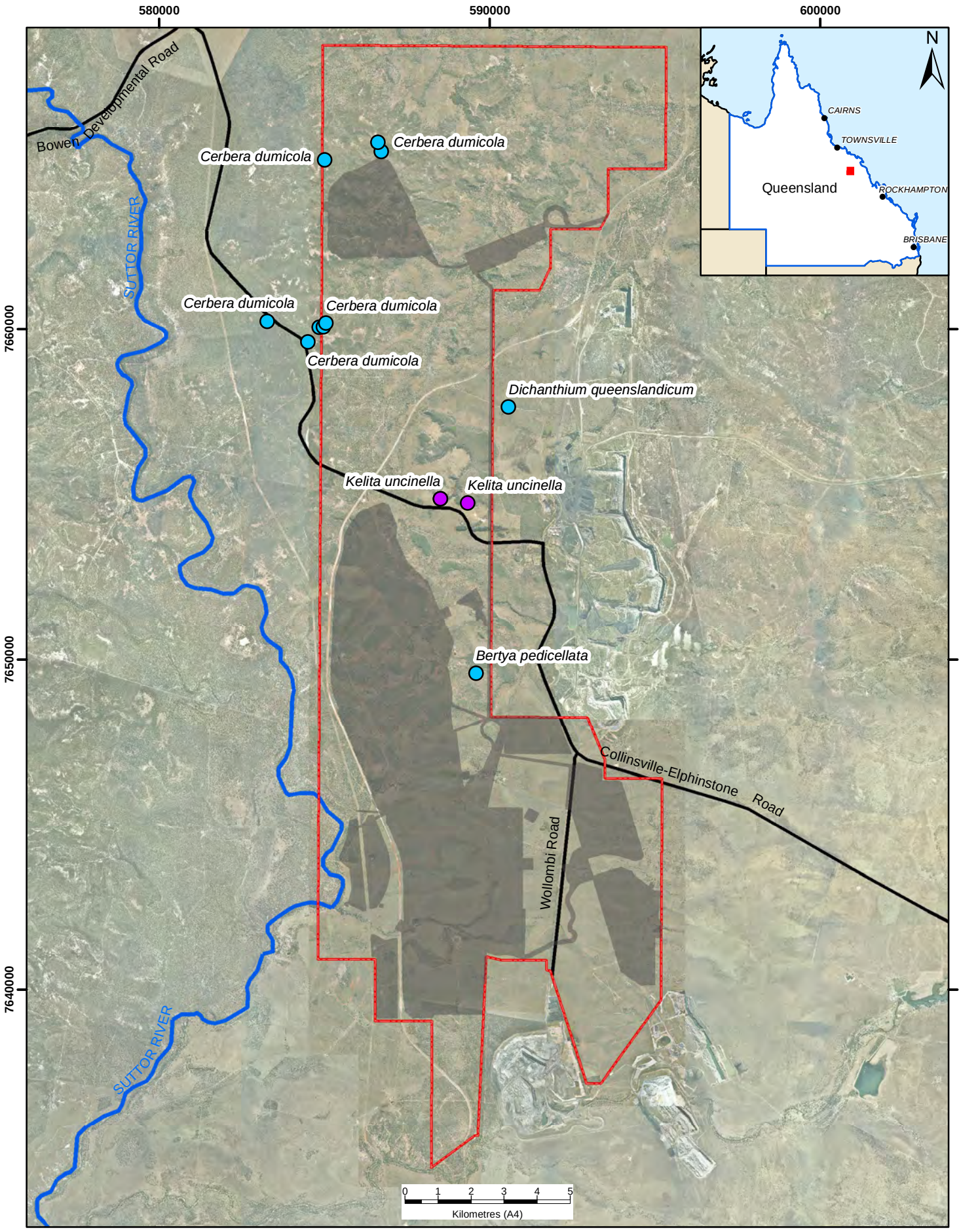
18.3.7 Flora Species

A total of 436 terrestrial flora species were recorded from the project area, including two threatened flora species listed under the NC Act and one threatened flora species listed under the EPBC Act[1]. One previously undescribed flora species, *Kelita uncinella* was also recorded from the project area. *Kelita uncinella* has not been assessed by any scientific committee and has no legislative status at present. However, the species description by Bean (2010) recommends a conservation status of endangered. The location of significant flora including threatened species and species of scientific significance (i.e. *Kelita uncinella)* in relation to the project area is shown in **Figure 18-11**. A complete flora species list for the project area is provided in **Appendix 19**.

Desktop assessments identified 11 threatened flora species either known, or with the potential to occur in the project area. Three of these species have been recorded in or immediately adjacent to the project area during field surveys (or are known from previous records). These species and others identified through desktop assessments as potentially occurring in the project area are summarised in **Table 18-7**.

[1] Note: one of these species was located slightly outside of the project area.



Legend

- Project Area
- Project Ecological Footprint
- Formed Roads

Flora Species Significance

- Threatened Species
- Scientific

Significant Flora		QCOAL GROUP
Figure 18-11	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *5/02/2013*	**Author:** Shahram.Nasiri	
	Map Scale: 1:150,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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Table 18-7 Likelihood of Threatened Flora Species Occurrence in the Project Area

Species	Common name	Status		Back On Track priority species[c]	Source[d]	Preferred habitat	Recorded location
		EPBC Act[a]	NC Act[b]				
Known to Occur							
Bertya pedicellata	–	–	NT	-	FS	This species is commonly found in open and closed forest on rocky hills with shallow skeletal or sandy soils. Often associated with brown bloodwood (*Corymbia trachyphloia*), *Dodonaea filifolia* (shrub), *Acacia catenulata*, *A. curvinervia* and lancewood (*A. shirleyi*). Clearing and inappropriate fire regimes threaten this species (Wang, 1995).	Recorded in the central part of the project area within RE 11.7.2.
Cerbera dumicola	–	–	NT	-	WO, H	*Cerbera dumicola* is a small tree or shrub growing to 4 m high, with labours foliage, bleeding latex from leaves and branches. The taxon is endemic to Central Queensland occurring primarily in Lancewood thickets away from the coast, as well as sub-coastal vine thickets (Forster, 1992). This species is often associated with lateritic jump ups (Land zone 7) common to the north-west of the project area.	Recorded from a number of locations in the north-west of the project area within RE 11.7.2, 11.7.4 and 11.7.6). Observed associated with the upper slopes of laterite breakaways.
May Occur							
Dichanthium queenslandicum	king blue grass	V	V	-	EPBC, HERBRECS, WO	An erect perennial grass to 80 cm which is known from Brigalow Belt north and south bioregions. The species inhabits both remnant and non-remnant grasslands. The primary habitat for this species is RE 11.8.11.	A single HERBRECS record occurs just outside the eastern boundary of the project area in non-remnant grassland immediately west of the Newlands Coal Mine. Detailed survey of the species' primary habitat (RE 11.8.1) was undertaken without additional specimens being located[2]. This degree of survey

[2] The areas mapped as RE 11.8.11 (and a 2 km radius surrounding these polygons) in the southeast of the project area have been subject to the following survey effort: (i) three 2,500 m^2 survey plots were established by CQU within (or in the ecotone) of the RE 11.8.11 - mapped polygons (Wormington *et al,* 2009) (polygons 117, 119 & 121; (ii) three 500 m^2 polygons were established within (or in the ecotone) of the RE 11.8.11 - mapped polygons (Unidel, 2011) (Polygons 62, 63 & 93); (iv) two 2,500 m^2 survey plots were established within 2 km of the RE 11.8.11 - mapped polygons (Wormington *et al*, 2009) (Polygons 118 & 120); (v) six 500 m^2 polygons were established within 2 km of the RE 11.8.11-mapped polygons (Unidel, 2011) (Polygons 58-61; 64 & 92) and (vi) significant traverse within the area bound by the noted survey plots was undertaken to define the extent of the RE 11.8.11 polygons.

Species	Common name	Status		Back On Track priority species[c]	Source[d]	Preferred habitat	Recorded location
		EPBC Act[a]	NC Act[b]				
							effort is considered sufficient to exclude D. queenslandicum as a known occurrence.
Dichanthium setosum	Blue grass	V	-	-	WO[3]	*Dichanthium setosum* is associated with heavy basaltic black soils and stony red-brown hardsetting loam with clay subsoil (Ayers *et al* 1996; DEC 2005a) and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture. The primary habitat for this species is RE 11.8.11.	This species was not recorded within the project area, nor within a 20 km radius of the project area. However, there are nine Queensland Herbarium specimen records from the broader Isaac Regional Council local government area, and *D. setosum* is often co-located with *D. queenslandicum*. Detailed survey of the species' primary habitat (RE 11.8.11) (refer discussion above for *D. queenslandicum*) is considered sufficient to exclude *D. setosum* as a known occurrence.
Croton magneticus	–	V	NT	-	H	A deciduous small tree or shrub growing to 5 m. Its distribution ranges from Greenvale to near Collinsville, extending to coastal islands of Magnetic and Gloucester. It inhabits deciduous vine thickets on sandstone, acid volcanic or granitic substrates.	A single HERBRECS record was located approximately 10 km north of the project area.
Eucalyptus raveretiana	black ironbox	V	V	Yes	EPBC	*Eucalyptus raveretiana* is a tree reaching 30 m–40 m that is endemic to central coastal and sub coastal Queensland. It typically occurs along rivers and streams where it may grow in association with Queensland blue gum (*Eucalyptus tereticornis*), Moreton Bay ash (*Corymbia tessellaris*), river oak (*Casuarina cunninghamiana*) and paperbark (*Melaleuca* spp.), or in coastal habitats as an emergent to rainforest on alluvium. Its distribution is scattered and disjunct, being known from the tributaries	The species has been recorded on the Bowen River and its major tributaries near Collinsville approximately 60 km north of the project area.

[3] This species was not recorded in the PMST or Wildlife online database searches. However, there are nine Queensland Herbarium specimen records from the broader Isaac Regional Council local government area, and it is recognised that *Dichanthium setosum* can co-occur with *Dichanthium queenslandicum*. On this basis, *D. setosum* has been identified as a species requiring further consideration.

Species	Common name	Status		Back On Track priority species[c]	Source[d]	Preferred habitat	Recorded location
		EPBC Act[a]	NC Act[b]				
						of the Fitzroy River, the Suttor and its upper tributaries; the Bowen, Burdekin, Don, Bogie, Broughton, O'Connell, and Andromache rivers. This species may occur along the Suttor River and tributaries in association with RE 11.3.25.	
Digitaria porrecta	finger panic grass	E	NT	-	EPBC	*Digitaria porrecta* is a loosely tufted perennial grass growing to 60 cm, known from four disjunct populations with a range extending over 1000 km. Major populations are found in the Dalby area although the species is known from the Central Highlands district near Nebo (TSSC, 2008a) but no records exist for the South Kennedy pastoral district in which the project area is located. The species is associated with heavier cracking clay soils formed on basalts in both disturbed and undisturbed habitats. Potential for the species to occur in the project area in REs 11.8.11 and 11.8.5 as well as disturbed areas on heavier clay soils.	Potential habitat exists but the closest record is located 100 km south-east of the project area. This specimen was recorded in undulating downs country, cracking self-mulching clay soil, open grassland.
Unlikely to Occur							
Cajanus mareebensis		E	E	-	EPBC	Occurs in *Melaleuca-Acacia*, *Eucalyptus-Callitris* and/or *Eucalyptus-Corymbia* grassy woodlands on sandy soils derived from granite with a lower horizon of impeded drainage	Closest HERBRECS record located west of Tully, approximately 450 km north-west of the project area.
Leucopogon cuspidatus		V	-	-		*Leucopogon cuspidatus* occurs in eastern Queensland from Blackdown Tableland in the south to the Mount Stewart area near Homestead Township in the north occurs in open forests, woodlands and heath on rocky slopes with granitic or serpentinite substrates (DSEWPaC, 2008).	Closest HERBRECS records recorded on exposed outcrops on cliff edges on decomposed granite soils on Mount Britton, in Homevale National Park located 75 km south-west of the project area.
Acacia ramiflora		V	-	-	EPBC	A slender shrub, similar in appearance to *Acacia simsii*. It is geographically restricted to the Great Dividing Range. It has been observed on sandstone hills in the Torrens Creek/Pentland area and Robertson River area. Its distribution is not known to overlap with any TECs	Known population located within White Mountains National Park located 400 km to the north-west of the project area. No known records in the vicinity of the project area.

Species	Common name	Status		Back On Track priority species[c]	Source[d]	Preferred habitat	Recorded location
		EPBC Act[a]	NC Act[b]				
						(TSSC, 2008b).	
Cycas ophiolitica		E	E	-	EPBC	A trunked cycad that rarely grows to 4 m. *Cycas ophiolitica* grows on hills and slopes in sparse, grassy open forest at altitude ranges 80 m–400 m above sea level. Preferred habitat includes shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana*, *C. erythrophloia*, *C. xanthope* and *Eucalyptus fibrosa*. *Cycas ophiolitica* has also been found on mudstone in association with *Corymbia dallachiana*, *C. erythrophloia* and *Eucalyptus crebra*, and on alluvial loams with *Corymbia intermedia*, *Eucalyptus drepanophylla* and *E. tereticornis* (Hill, 1998; Queensland Herbarium, 2007).	The species occurs in two disjunct populations with a northern population near Marlborough and a southern population near Rockhampton (Queensland Herbarium 2007). Closest population is restricted to the Rockhampton and therefore considered unlikely to occur in the project area.

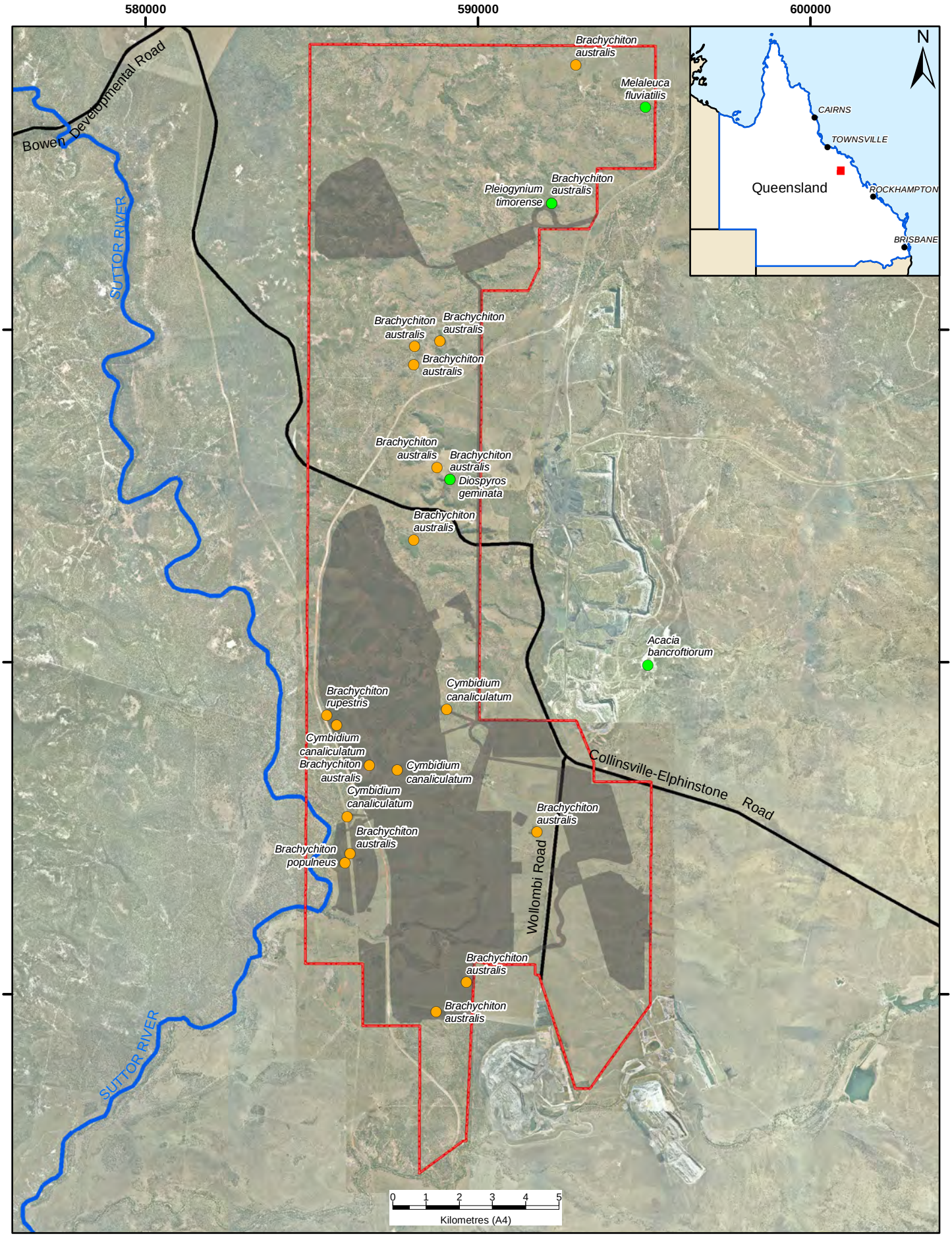
a EPBC Act Status: V – Vulnerable, E – Endangered
b NC Act Status: NT – Near Threatened, V – Vulnerable, E – Endangered
c Back on Track priority species for the Burdekin region (DERM, 2010a).
d EPBC – EPBC Protected Matters Search, HERBRECS – Queensland Herbarium , WO – Wildlife Online, FS – Field Surveys.

18.3.7.1 Flora of Bioregional Significance

The application of a range of generic criteria may be applied to define or classify non-threatened bio-regionally significant flora species. These include regional endemicity, isolated distribution, disjunction, reaching limits of geographical range, or special scientific, cultural and commercial interest. Analysis of HERBRECS data and field assessment indicates that three regionally significant species occur in the project area and an additional two species are located in close proximity to the project area (**Table 18-8**). Recorded locations of bio-regionally significant flora species within the project area are shown in **Figure 18-12**.

Table 18-8 Regionally Significant Flora Species

Regionally significant species	Preferred habitat	Recorded location
Diospyros geminata	A Queensland endemic species which is restricted to vine thickets in the project area. The species is observed to be locally rare within its preferred habitat.	Q4
Melaleuca fluviatilis	A tree up to 30 m, endemic to Queensland, which was restricted to riparian vegetation (RE 11.3.25). The species was observed to be locally rare within its preferred habitat, occurring as scattered individuals along larger stream channels.	Q20
Pleiogynium timorense (Burdekin plum)	A species endemic to Queensland which is restricted in the project area to vine thickets occurring on basalt (RE 11.8.13). The species has particular significance as a cultural resource.	Q47, T48, Q49
Acacia bancroftiorum	A species endemic to Queensland which is locally restricted to *Acacia shirleyi* woodlands (RE 11.7.2) and mixed eucalypt woodlands (RE 11.5.9). Dense thickets of the species were observed in disturbed areas north of the project area.	Closest HERBRECS record in proximity to Newlands Mine approximately 5 km from the project area.
Phyllanthus maderaspatensis	A Queensland endemic species known to be common in woodlands within the Brigalow Belt North Bioregion where it is recognised as a non-threatened priority species. The species is recorded from the HERBRECS database only.	Closest HERBRECS record along Collinsville-Elphinstone Rd approximately 20 km east of project area.



Legend

- Project Area
- Project Ecological Footprint
- Formed Roads

Flora Species Significance

- Bioregional
- Type A

Flora of Bioregional Signficance and Type A Species		QCOAL GROUP
Figure 18-12	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *5/02/2013*	**Author:** Shahram.Nasiri	
	Map Scale: 1:150,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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18.3.7.2 Flora Species of Cultural, Commercial or Recreational Significance

A number of plant species recorded from the project area are identified as species of cultural, commercial or recreational significance. These species are discussed below.

Culturally Significant Flora Species

Culturally significant flora species are those that were, and continue to be, used by indigenous people for food, medicine and materials for timber and tools.

Species recorded within the project area that may have provided food resources (e.g. seeds, leaves and berries) for indigenous people includes: wattles (*Acacia* sp.), split jack (*Capparis lasiantha*), wild orange (*Capparis canescens*), current bush (*Carissa ovata*), ruby saltbush (*Enchylaena tomentosa*), and narrow-leaved bottle tree (*Brachychiton rupestris*), Kurrajong (*Brachychiton populneus*) and Burdekin plum (*Pleiogynium timorense*).

Flora species that have medicinal properties that may have been utilised by indigenous people for ailments such as wounds, bites and headaches include: wattles, soap tree (*Alphitonia excelsa*), native quinine (*Petalostigma pubescens*), flax lilies (*Dianella* spp.), cockatoo apple (*Planchonia careya*), Kurrajong (*Brachychiton populneus*) and hop bush (*Dodonaea viscosa*).

Plant species that may have provided materials for utensils, spear throwers, canoe paddles, boomerangs, fibre, digging sticks and dye for indigenous people include: eucalypts (*Eucalyptus* and *Corymbia* spp.), paperbarks (*Melaleuca* spp.), native quinine, flax lilies, cockatoo apple and Casuarina species.

Commercial Significant Flora Species

Several tree species of commercial significance were observed in the project area, with the following uses:

- Lemon-scented spotted gum (*Corymbia citriodora*): engineering (e.g. wharf/bridge construction, poles, railway sleepers and mining timbers), construction (e.g. house framing, flooring, fencing and landscaping), decorative (e.g. furniture and joinery) and other uses such as tool handles, agricultural machinery, sporting goods, boat construction and carriage building
- Narrow-leaved red ironbark (*Eucalyptus crebra*): engineering (e.g. wharf/bridge construction, poles and railway sleepers), construction (e.g. house framing, flooring, fencing and landscaping), and decorative uses such as furniture and joinery
- Queensland blue gum (*Eucalyptus tereticornis*): engineering (e.g. wharf/bridge construction, poles, railway sleepers and mining timbers), construction (e.g. house framing, flooring, fencing, and landscaping), decorative (e.g. furniture and joinery), other uses such as structural plywood, boat construction and carriage building
- Burdekin plum (*Pleiogynium timorense*): decorative (e.g. cabinet making, turnery).

Other species of commercial significance which were recorded within the project area correspond with the Type A plants, further described in **Section 18.3.7.3**.

Recreational Significant Flora Species

National parks, reserves or conservation areas with public access are not located within the project area. As a result, there are minimal attractions for the area to be used for recreational activities and therefore no vegetation communities or flora species of recreational value are considered to be present.

18.3.7.3 Horticultural Species

Horticultural species recorded as growing in the project area included four species classified as Type A flora species. Type A restricted plants are horticultural species that are not considered sufficiently rare to be classified as threatened species, however are harvested and traded to an extent that if unregulated a threat to the species may arise (DERM, 2010b). To ensure that populations of these species are not depleted to a point of becoming threatened the taking of these species is regulated under the NC Act. Type A Flora Species recorded during the field study and general locations within the project area are detailed in **Table 18-9**. The location of these species as recorded in the project area is shown in **Figure 18-12**.

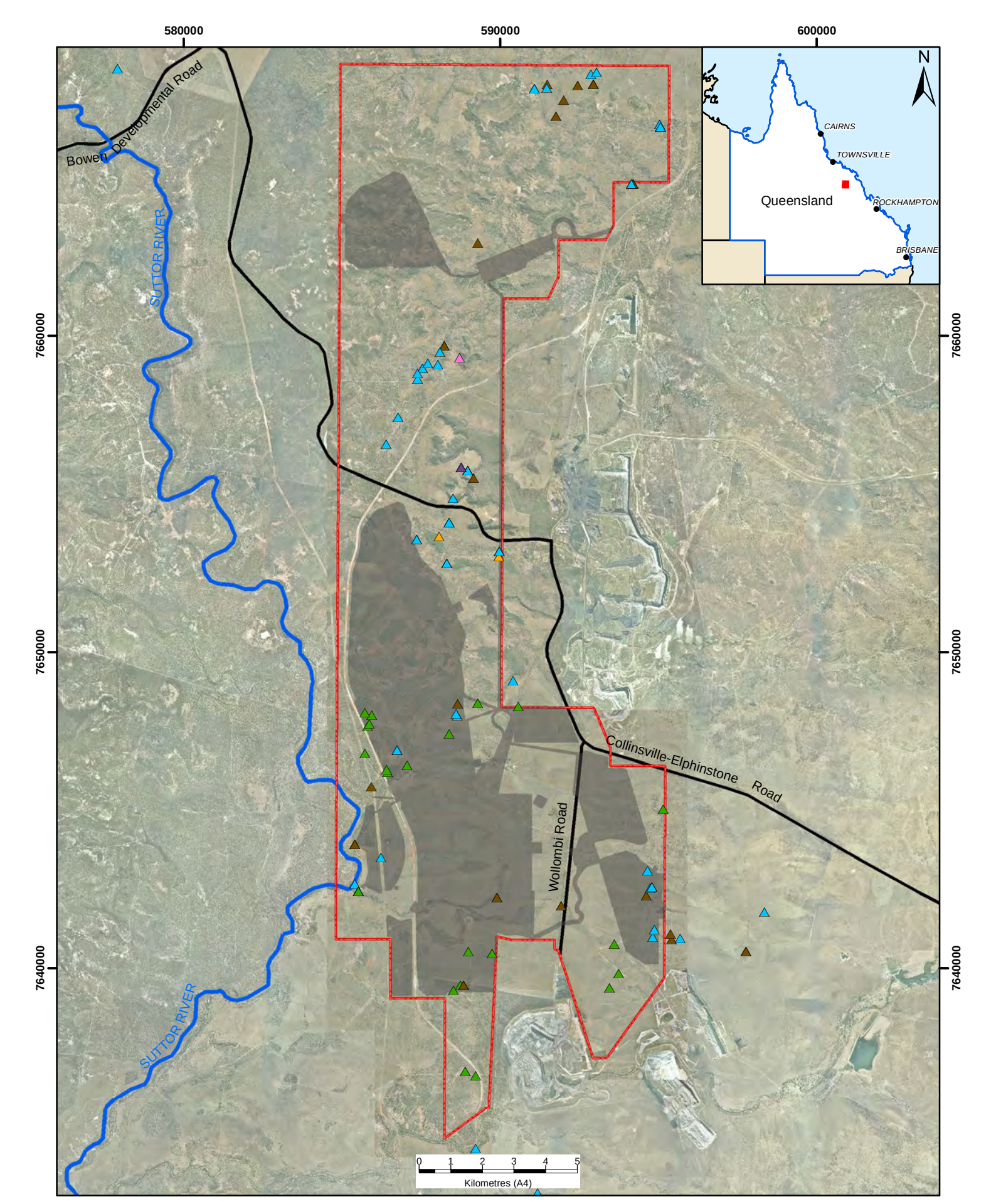
Table 18-9 Type A Flora Species Recorded within the Project area

Species	Common name	Recorded location
Brachychiton australis	broad-leaved bottle tree	Ten individuals recorded throughout the project area.
Brachychiton populneus	kurrajong	One individual of this species was located near the south-west boundary of the project area.
Brachychiton rupestris	narrow-leaved bottle tree	Two specimens recorded in the centre of the project area.
Cymbidium canaliculatum	black orchid	Two specimens recorded in the south of the project area.

18.3.7.4 Weed Species

Site surveys identified 56 introduced flora occurring within the project area. Of these species four were Weeds of National Significance (WONS) species, *Cryptostegia grandiflora, Opuntia stricta, Opuntia tomentosa* and *Parthenium hysterophorus*. Six introduced flora species occurring within the project area are declared as Class 2 Pests under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act). Noogoora burr (*Xanthium pungens*), declared as a regionally significant weed under the Whitsundays Regional Council Pest Management Plan (WRC, 2009), was also observed in the project area. The general location of these declared weeds is described in **Table 18-10** and shown in **Figure 18-13**.

The most widespread environmental weed encountered was buffel grass (*Cenchrus ciliaris*) which was a pervasive pest in nearly all communities encountered, however was most prevalent in woodland REs 11.5.16 and 11.8.5. The species is also the dominant ground cover in non-remnant areas where it has been established as cattle fodder. Other common environmental weed species include a large number of grasses (*Sporobolus coromandelianus*, *Eriochloa meyeriana*, *Eragrostis cilianensis*, *Dichanthium aristatum*, *Cynodon dactylon*, *Bothriochloa pertusa*), Sida spp. (*Sida spinosa*, *Sida rhombifolia*), *Xanthium pungens*, *Xanthium spinosum* and scattered occurrences of sensitive weed (*Mimosa pudica*). Weed cover generally reflects site history and disturbance with areas intensively utilised for grazing typically devoid of native ground covers.



Legend

- Project Area
- Project Ecological Footprint
- Formed Roads

Weeds Species

- Fireweed
- Harrisia cactus
- Noogoora Burr
- Parthenium
- Prickly Pear
- Rubber Vine
- Velvety tree pear

Location of Weeds Across the Project Area	
Figure 18-13	**Byerwen Coal Project**
Date: *5/02/2013*	**Author:** Shahram.Nasiri
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
G:\CLIENT\SA-TO-D\BYEGEN - Byerwen EIS\GIS\Maps\EIS Chapters\EIS_Chpt_18_TerrestrialEco\BYEGEN_weeds.mxd	

Table 18-10 WONS, State and Locally Declared Weeds Recorded in the Project area

Scientific name	Common name	Declaration*	Field sites	RE	Comments
Cryptostegia grandiflora	rubber vine	Class 2 WONS	Q20, Q45	11.3.25, non-remnant	Scattered occurrences are restricted to riparian areas and heavily disturbed non-remnant vegetation.
Harrisia martinii	harrisa cactus	Class 2	Q11, T19, T21, T31, T40, Q64, Q65, Q66, Q67, T70, Q81, S82, Q84, Q89, Q92, Q94, Q95, Q96	11.3.1, 11.4.8, 11.4.9, 11.5.16, non-remnant	All occurrences were <5% cover. Found only on heavier soils including cracking clays and alluvium.
Opuntia tomentosa	velvet pear	Class 2 WONS	T1, T17	11.7.1 x 1	Typically scattered large individuals within vine thicket communities. The majority of occurrences are <5% cover.
Opuntia stricta	prickly pear	Class 2 WONS	T2, Q3, Q4, T5, Q11, Q12, T15, T16, T19, T21, S22, T26, Q27, T31, T32, T35, T40, T48, S51, S52, S54, S55, S57, S59, S97, Q98, Q100	11.5.16, 11.8.5, 11.3.1, 11.3.2, 11.3.4, 11.8.11, 11.8.13, non-remnant	Typically scattered occurrences at <5% cover. A pervasive species occurring in the majority of ecosystems surveyed.
Parthenium hysterophorus	parthenium	Class 2 WONS	T2, Q3, T5, Q11, Q12, T15, Q13, T16, T19, Q20, T21, T26, Q28, Q29, T32, T34, T35, Q36, Q38, T39, S53, Q99, S102, Q104, Q105, Q106	11.3.1, 11.3.2, 11.3.25, 11.3.4, 11.5.16, 11.7.2, 11.8.4, 11.8.5, 11.8.11, 11.8.13, non-remnant	A pervasive species forming ground cover in heavier soil substrates. Typical cover is <5% in ecosystems of low disturbance although cover of up to 20% was observed in heavily degraded and grazed areas.
Senecio madagascariensis	fireweed	Class 2	Q12	11.3.25	In low abundances at sites associated with Suttor River.
Xanthium pungens	noogoora burr	WRC	Recorded in the south west of the project area along Suttor River.	11.3.1, 11.3.25	In low to high densities at sites associated with Suttor River.

Note *: WONS = Weed of National Significance; Class 2 under the LP Act; or WRC= declared locally under the Whitsundays Regional Council Pest Management Plan

18.3.8 Fauna Species

The four comprehensive fauna surveys conducted between 2009 and 2012 resulted in the detection of 222 vertebrate species. The species richness is composed of 15 amphibian species, 34 reptile species, 148 bird species and 25 species of mammal including 17 bat species. A full species list is provided in **Appendix 19**.

18.3.8.1 Threatened Fauna Species

Six threatened fauna species listed under the EPBC Act and/or NC Act were recorded from the project area during fauna surveys. A further four threatened fauna species are considered likely to occur in the project area. These species and others identified through desktop assessments as potentially occurring in the project area are summarised in **Table 18-11**. Discussion of the range, breeding, recruitment, feeding and movement requirements for species known or considered likely to occur in the project area is also provided below.

Table 18-11 Likelihood of Threatened Fauna Species Occurrence in the Project Area

Species		Status		Habitat requirements	Assessment summary
Common name	**Scientific name**	**EPBC Act[a]**	**NC Act[b]**		
Known to Occur					
ornamental snake	*Denisonia maculata*	V	V	Woodlands and open forests containing brigalow (*Acacia harpophylla*), gidgee (*Acacia cambagei*), blackwood (*Acacia argyrodendron*) or coolabah (*Eucalyptus coolabah*) communities or pure grassland associated with gilgais or other wetlands. Microhabitat features include coarse woody debris such as fallen timber as well as rocky areas and deep soil cracks.	The ornamental snake was recorded during the 2009 and 2012 surveys from riparian forests associated with the Suttor River floodplain and brigalow communities in the southern part of the Project area. The habitat condition on the site is considered generally poor relative to pre-clearing or remnant condition (due to thinning and grazing impacts); however the habitat quality for this species is moderate to high and provides important habitat. This species occurs in many disturbed areas, including cleared land with gilgai microrelief.
cotton pygmy-goose	*Nettapus coromandelianus*	–	NT	Deep, freshwater lagoons, swamps and dams with floating or emergent vegetation adjacent to hollow bearing trees or stags.	The cotton pygmy-goose was recorded utilising a dam in the southern part of the project area during the 2009 dry season. Large farm dams, such as that located at site H2 habitat for this species, which is expected to be an occasional vagrant in the project area. There is limited habitat available for this species in the project area, and overall habitat value is low.
black-necked stork	*Ephippiorhynchus asiaticus*	–	NT	Ephemeral and permanent wetlands, including floodplains or flooded pastures and swamps as well as shallow banks of rivers.	A black-necked stork was detected during the 2010 survey within a large wetland located in the south-west of the project area (H2). Aside from the wetland from which this species was recorded, habitat quality across the project area is low.
square-tailed kite	*Lophoictinia isura*	–	NT	Open forest and woodlands generally near a watercourse.	One observation of this species foraging over immature eucalypt regrowth south-west of the project area was recorded during the 2012 survey. Open woodland and forest in proximity to water afford foraging habitat for this species. All remnant vegetation types provide suitable foraging habitat for this species. More mature woodlands and open forests are likely to support nesting habitat. Overall habitat quality is moderate to high.

Species		Status		Habitat requirements	Assessment summary
Common name	Scientific name	EPBC Act[a]	NC Act[b]		
squatter pigeon	*Geophaps scripta scripta*	V	V	Open dry eucalypt woodland on sandy soil near permanent water.	Squatter pigeons were detected during the 2009, 2010 and 2012 surveys from grassy woodlands in the southern parts of the project area and sites (T5, T8 and H19). Despite its conservation status, this species is widespread in central Queensland (Wormington *et al,* 2009) and is expected to occur in grassy woodland habitats in proximity to watering points across the site. Overall habitat quality for this species is moderate to high within remnant vegetation and low in previously cleared lands and regrowth vegetation.
little pied bat	*Chalinolobus picatus*	–	NT	Open, eucalypt forests and woodlands with hollow bearing trees or stags.	Positive records from echolocation recordings at sites in the southern part of the project area (T1, T2, T3, T4, T5). Subsequent habitat assessments recorded suitable habitat trees with potential roosting hollows along alluvial corridors. Overall habitat quality for this species is moderate to high within remnant vegetation and low in previously cleared lands and regrowth vegetation.
Likely to Occur					
black-throated finch (southern)	*Poephila cincta cincta*	E	E	Riparian areas within open eucalypt, acacia or melaleuca forest and woodlands.	Two individuals suspected to be *Poephila cincta cincta* were recorded during baseline surveys, although a positive identification was not made. Although they could not confidently be attributed to *P. cincta cincta* in the field, a precautionary approach is adopted and the species has been considered as a likely occurrence.
common death adder	*Acanthophis antarcticus*	–	NT	Remnant or mature regrowth vegetation with a shrubby understorey and dense leaf litter. Diverse vegetation communities afford habitat (eg wet sclerophyll forests, woodlands, shrub lands, grasslands, rainforest and coastal heath lands).	This species has the potential to occur in all areas of remnant vegetation with shrubby understorey and a thick layer of leaf litter within the project area.
Australian painted snipe	*Rostratula australis*	V, M	V	Ephemeral and permanent shallow, freshwater wetlands and inundated grasslands, sewage ponds and dams.	The large dam (H2) within the south-west of the project area and the ephemeral gilgai wetlands afford habitat for this species.

Species		Status		Habitat requirements	Assessment summary
Common name	Scientific name	EPBC Act[a]	NC Act[b]		
May Occur					
red goshawk	*Erythrotriorchis radiatus*	V	E	Coastal and sub coastal tall, open forest, tropical savannah, woodland, rainforest edges and gallery forest along, or adjacent to, watercourses and wetlands	Eucalypt forest and woodlands adjacent to the Suttor River and the south-west of the project area afford foraging and potentially breeding habitat. This species was not detected during the survey.
Mount Cooper striped lerista	*Lerista vittata*	E	E	Woodlands dominated by ironbark (*Eucalyptus crebra* and *E. melanophloia*) and bloodwood (*Corymbia clarksoniana* and *C. intermedia*) with shrub and/or grassy ground layers on deep red earths, undulating plains and steep hills on granitic rocks as well as SEVT which extends onto areas of ironstone (duricrust) and spinifex communities.	This species was not detected during fauna surveys, however lower quality habitat in RE 11.5.9 and SEVT vegetation areas exists in the north-west section of the project area.
yakka skink	*Egernia rugosa*	V	V	Dense ground cover and abundant course woody debris (eg hollow logs) or rock in a variety of vegetation types including: poplar box (*Eucalyptus populnea*), ironbark, brigalow (*Acacia harpophylla*), cypress pine (*Callitris glaucophylla*), mulga (*A. aneura*), bendee (*A. catenulata*) lancewood (*A. shirleyi*) woodlands and open forests.	This species was not detected during fauna surveys but habitat may be suitable within remnant vegetation on the uplifts and escarpments in the north-western parts of the site within areas that have dense ground cover and fallen hollow logs.
star finch	*Neochmia ruficauda ruficauda*	E	E	Damp grasslands, sedgelands or grassy woodlands (composed of *Eucalyptus coolabah*, *E. tereticornis*, *E. tessellaris*, *Melaleuca leucadendra*, *E. camaldulensis* and *Casuarina cunninghamii*) near permanent water or regularly inundated areas.	Not recorded during field surveys, nor are there records in proximity to the project area. Poplar box/blue gum woodlands associated with the Suttor River may represent potential habitat for this species.
northern quoll	*Dasyurus hallucatus*	E	–	Forest or woodland with rocky areas and complex vegetation structure in a variety of vegetation types including: eucalypt forest and woodlands, rainforests, sandy lowlands, shrublands and grasslands.	Not recorded in the project area despite active searching for scats and overhangs which may provide shelter for denning purposes. It is still possible that this species may utilise the area although undetected.

Species		Status		Habitat requirements	Assessment summary
Common name	Scientific name	EPBC Act[a]	NC Act[b]		
koala	*Phascolarctos cinereus*	V	V, SLC	Eucalyptus dominated temperate, sub-tropical and tropical forest, woodland and semi-arid habitats.	No koala observations were recorded during the fauna survey. Eucalyptus woodland in riparian corridor (RE 11.3.25) may afford habitat however if koala are present within the project area they are expected to be unlikely.
south-eastern long-eared bat	*Nyctophilus corbeni*	V	V	Inland woodland vegetation dominated by eucalypt and bloodwood species as well as box, ironbark and cypress pine woodlands. Loose bark, fissures and hollows on trees afford roosting habitat.	This species was not recorded during the fauna surveys, however potentially suitable habitat occurs in woodland vegetation dominated by eucalypt and bloodwood species as well as box, ironbark and cypress pine woodlands. Loose bark, fissures and hollows on trees afford roosting habitat.
Unlikely to Occur					
brigalow scaly-foot	*Paradelma orientalis*	V	V	Open forests and woodland containing remnant vegetation, including: brigalow, cypress, bull oak, spotted gum, vine thickets and *Acacia falciformis*, with abundant coarse woody debris and dense leaf litter.	Open forests and woodland containing remnant vegetation with abundant coarse woody debris and dense leaf litter in the central and southern parts of the project area afford habitat however, this species reaches its northern distributional limit near Nebo. Numerous surveys conducted over the last decade between Nebo and Collinsville have failed to detect this species further north and, as such, it is considered unlikely to occur in the project area.
stripe-tailed delma	*Delma labialis*	V	V	Dense leaf litter or other ground cover in low and tall open forests, open woodland (all with grassy understory), wet sclerophyll forest, coastal microphyll /notophyll vine forests/thickets, eucalypt forest and woodland with dense grass trees (*Xanthorrhoea* sp.) and acacia mid-storey to understory, spinifex, and seasonally dry tea-tree (*Melaleuca viridiflora*) swamp.	The distribution of this species is not expected to extend past the Clarke Range approximately 100 km west of the project area. If present, it would be expected to be found in areas of remnant vegetation located on the foothills of uplifts in the north-western parts of the project area.
retro slider	*Lerista allanae*	E	E	Non-cracking black soils on undulating plains formed on basalt, shale, sandstone and unconsolidated sediments.	All known records taken from the Basalt Downs subregion near Clermont (Young *et al* 1989). Considered unlikely to occur because of its restricted distribution.

a EPBC Act Status: V – Vulnerable, E – Endangered, M – Migratory
b NC Act Status: NT – Near threatened, V – Vulnerable, E – Endangered, SCL – Special Least Concern

Ornamental snake – Known to occur

The ornamental snake is endemic to Queensland and occurs in the Dawson and Fitzroy River drainage system of central coastal Queensland (Cogger et al, 1993). During the day the species shelters under fallen timber, coarse woody debris, rocks, bark and in deep soil cracks on gilgai mounds, particularly during dry periods. At night, the species forages near water, almost exclusively on frogs. The ornamental snake gives birth to live young with an average litter size of seven offspring.

Cotton pygmy-goose – Known to occur

The cotton pygmy-goose is a rare vagrant in the southern part of its range on the north coast of New South Wales, however is relatively common in suitable aquatic habitats in north eastern Queensland (Marchant & Higgins, 1990, Blakers et al, 1984). The cotton pygmy-goose requires dead trees with hollows near water for nesting and roosting sites (NPWS, 1999). The species feeds on seeds, inflorescences and other parts of aquatic vegetation. Seasonal changes in abundance have been observed, where birds gather on water that remains in the winter season.

Black-necked stork – Known to occur

The black-necked stork is mainly restricted to coastal and near coastal areas of northern and eastern Australia. This species feeds on fish, small crustaceans and amphibians (Pringle, 1985). They breed from March to May and nest using a large platform of sticks and other vegetation built in a small tree in or near water. Male and female pairs bond for several years. Outside the breeding seasons small family groups may be partially nomadic or may stay in the one location (Pringle, 1985).

Square-tailed kite – Known to occur

Despite this species being recorded within inland Australia it is more commonly known to occur in coastal and sub-coastal Eastern Australia and south western Western Australia (Marchant and Higgins, 1993). The square-tailed kite routinely hunts in the morning and afternoons or evenings. It feeds on passerines, especially honeyeaters, and insects in the tree canopy (Marchant and Higgins, 1993). It is most commonly observed foraging on the boundary of remnant and cleared areas. The breeding season occurs July to February with nests generally located along or near watercourses in the fork or on a large, horizontal limb of *eucalypt* spp. (Cameron, 1992; Jolly, 1989).

Squatter pigeon – Known to occur

The squatter pigeon is patchily distributed through Queensland. The diet of this species consists of fallen grass seeds, herbs and shrubs. The squatter pigeon breeds from March to September (in the tropics) in a scape in the ground lined with dry grass. It is often seen in pairs or in small family groups. Movement is restricted as this species is ground dwelling and flies to nearby trees only when flushed or for courtship.

Little pied bat – Known to occur

This species has a wide distribution in south inland Queensland. Although little is known of their movement, closely related species are known to fly 5 km from their roosting sites to feed. Their diet consists of insects and they breed in October.

Black-throated finch (southern) – Likely to occur

The black-throated finch has two subspecies, *Poephila cincta cincta*, the southern subspecies, found south of Townsville, listed as endangered under the EPBC and NC Act and the northern subspecies, *Poephila cincta atropygialis*, found north of Cairns with its range extending south (Zann, 1976). This southern subspecies is largely constricted to the northern part of its former distribution, which extended from north-east NSW to Queensland's Atherton Tablelands and west to central Queensland. According to the National recovery plan for the Black-throated finch southern subspecies (*Poephila cincta cincta*) (BTF Recovery Team, 2007) REs in which this species has been recorded within the Brigalow Belt North Bioregion include REs 11.3.12, 11.3.25b, 11.3.27, 11.3.30, 11.3.35 and 11.11.19.

The black-throated finch feeds on fallen grass seed and requires daily water. It can breed all year, however breeding activity peaks in February and May. They nest in loose colonies in trees and shrubs (DEWHA, 2009). The movement patterns on this species are poorly understood, however a study of foraging ecology (Mitchell, 1996) suggested that the finch may undertake some movements in response to rainfall or drought prompted by food availability. It is also suggested that outside of breeding periods there may be some local movement away from nesting areas in search of food resources (Mitchell, 1996).

This species was targeted during the survey with repeat visits to dams and wetlands with the goal of recording this species coming in to water. Two individual birds suspected to be the black-throated finch were observed in proximity to the large wetland in the south-west of the project area. The birds were not viewed through binoculars and were sighted for a short period of time. The black-throated finch (southern) may be confused with the chestnut-breasted mannikin (*Lonchura castaneothorax*) in particular, which is common along the north east coast of Australia and from which it cannot be distinguished without close examination. As such, the presence of this species has not been confirmed. For the purpose of this assessment, a precautionary approach has been adopted and it is assumed that the species observed is the threatened southern sub-species.

Given this species preference for riparian habitats it is considered that it may travel along the Suttor River riparian corridor which is located approximately 2 km to the south west of where this species was observed. It is considered that this species would be a rare vagrant to the project area and may have dispersed into this area following a number of good seasons.

Common death adder – Likely to occur

The common death adder is distributed form the Gulf region of the Northern Territory across to central and eastern Queensland and New South Wales (Cogger, 2000). This species is generally associated with areas of dense leaf litter that allow this species to hide and ambush prey. Common death adders are generally sedentary but may be encountered as they move between shelter sites in search of mates on warm evenings. This species breeds in February or March and can give birth from 2–32 live young.

Australian painted snipe – Likely to occur

The Australian painted snipe has a scattered distribution throughout Queensland and south-eastern Australia but has also been recorded less frequently in Tasmania, South Australia, the Northern Territory and Western Australia. This species forages nocturnally on mud flats and in shallow water (DSEWPaC, 2003). The painted snipe nests on the ground among tall vegetation, in a scrape in the ground lined with grass and leaves. It breeds September to December. Some individuals are apparently resident while others appear to be nomadic, temporarily occupying areas where suitable habitat exists (DSEWPaC, 2003).

18.3.8.2 Fauna of Bioregional Significance

Fauna species of bioregional significance include species of regional endemicity, with isolated distributions, reaching limits of geographical range, or special scientific, cultural and commercial interest. Species listed as a priority in the Back on Track Actions for Biodiversity (DERM, 2010a) are also considered to be of bioregional significance.

The likelihood of bioregional significant fauna species occurrence in the project area is summarised in **Table 18-12**.

Habitat within the project area was found to support species of bio-regional significance. All of the fauna surveys recorded the grey-crowned babbler (eastern) (*Pomatostomus temporalis temporalis*) and the Australian bustard (*Ardeotis australis*) within the project area. Both species are considered to potentially utilise and were observed within a wide range of habitat types that occur within the project area. Despite neither of these species being listed under Commonwealth and State legislation, these species

are considered to be near threatened in accordance with the IUCN 1994 guidelines (Garnett and Cowley, 2000).

18.3.8.3 Fauna of Cultural Significance

Fauna of cultural significance are those species that have an indigenous, historic, aesthetic or social value. Species of high cultural significance include the short-beaked echidna (*Tachyglossus aculeatus*), platypus (*Ornithorhynchus anatinus*) and koala (*Phascolarctos cinereus*).

The likelihood of culturally significant fauna species occurrence in the project area is summarised in **Table 18-12**.

Table 18-12 Likelihood of Bioregional or Culturally Significant Fauna Species Occurrence in the Project Area

Species		Status		Habitat requirements	Assessment summary
Common name	**Scientific name**	**EPBC Act[a]**	**NC Act[b]**		
Known to Occur					
grey-crowned babbler	*Pomatostomus temporalis temporalis*	-	-	Open forests, woodlands and road verges with grassy ground cover.	All fauna surveys detected this species within a range of habitat types.
Australian bustard	*Ardeotis australis*	-	-	Australian bustards are found in tussock grassland, grassy woodland, and low shrublands.	All fauna surveys detected this species within a range of habitat types.
short-beaked echidna	*Tachyglossus aculeatus*	-	SLC	The echidna has a wide range or diverse habitats across Australia. Refuge microhabitat includes shrubs, hollow logs, rocky areas or old burrows. Except for nursery burrows, they have no fixed nest or shelter sites.	Echidnas were detected in all three fauna surveys in numerous locations around the project area.
May Occur					
koala	*Phascolarctos cinereus*	V	V, SLC	Eucalyptus dominated temperate, sub-tropical and tropical forest, woodland and semi-arid habitats.	No koala observations were recorded during the fauna survey. Eucalyptus woodland in riparian corridor (RE 11.3.25) may afford habitat however if koala are present within the project area they are expected to be rare.
Unlikely to Occur					
platypus	*Ornithorhynchus anatinus*	-	SLC	Permanent, freshwater streams, lakes or rivers, including artificial dams.	No suitable habitat. No records in the project area.

a EPBC Act Status: V – Vulnerable
b NC Act Status: V – Vulnerable, SLC – Special Least Concern

18.3.8.4 Migratory Species

Five migratory fauna species listed under the EPBC Act were recorded from the project area during fauna surveys. A further five species are likely to occur in the project area. A number of migratory species were recorded using farm dams and wetland areas in the project area, which are considered to provide the most suitable habitat. Inundated gilgai areas are also expected to provide temporary wetland habitats for migratory species, in particular species such as the Latham's snipe (*Gallinago hardwickii*) and the Australian painted snipe (*Rostratula australis*). These species and others identified through desktop assessments as potentially occurring in the project area are summarised in **Table 18-13**. Overall the habitat values for migratory species are limited and of low value.

Table 18-13 Likelihood of Migratory Fauna Species Occurrence in the Project Area

Species		Status		Habitat requirements	Assessment summary
Common name	**Scientific name**	**EPBC Act[a]**	**NC Act[b]**		
Known to Occur					
eastern great egret	*Ardea modesta*	M	-	Freshwater wetlands and intertidal mudflats.	Recorded utilising farm dams within the project area. No suitable nest sites were observed in the project area.
white-bellied sea-eagle	*Haliaeetus leucogaster*	M	-	Permanent waterbodies including: estuaries, dams and wetlands.	Recorded at a small farm dam adjacent to Kangaroo Creek to the north east of the project area. Could nest in proximity to the Suttor River
Latham's snipe	*Gallinago hardwickii*	M	-	Open, freshwater wetlands with low, dense vegetation including: swamps, flooded grasslands or heathlands and bogs.	Recorded at large dam (H2) located to the south west of the project area. Inhabits open, freshwater wetlands with low, dense vegetation. Suitable habitat present in association with Palustrine wetland (S3). Foraging habitat rather than breeding habitat as species does not breed in Australia.
rainbow bee-eater	*Merops ornatus*	M	-	Ubiquitous, potentially foraging over any habitat type. Nests in soft, loamy soil or flat ground of a bank.	This species was detected numerous times during the fauna surveys. Stream banks in the project area may provide burrow sites for this species.
rufous fantail	*Rhipidura rufifrons*	M	-	The undergrowth of woodlands, forests, coastal and sub-coastal scrub including semi evergreen vine thicket, riparian areas and mangroves.	This species was recorded at H2 and H12 in the project area and is associated with the undergrowth of woodlands, forests and riparian areas. There are no breeding records in proximity to the project area and no suitable nest sites were observed at the time of the fauna survey.
Likely to Occur					
cattle egret	*Ardea ibis*	M	-	Grassy, open pastures and shallow, open wetlands.	Riparian areas of the project area. Suitable habitat present in association with Palustrine wetland (S3).
fork-tailed swift	*Apus pacificus*	M	-	High to low airspace over varied habitat (rainforest to semi-desert).	This species forages aerially over a range of habitat types and is considered likely to occur in the project area.
white-throated needletail	*Hirundapus caudacutus*	M	-	Ubiquitous, potentially foraging over any habitat type.	This species forages aerially over a range of habitat types and is considered likely to occur in the project area.

Species		Status		Habitat requirements	Assessment summary
Common name	Scientific name	EPBC Act[a]	NC Act[b]		
Australian painted snipe	*Rostratula australis*	V, M	V	The Australian painted snipe inhabits shallows and margins of freshwater wetlands, dams, marshy areas and wet pastures.	Cryptic species with irregular occurrence. The large dam (H2) within the south-west of the project area and the ephemeral gilgai wetlands afford habitat for this species. Suitable habitat present in association with Palustrine wetland (S3).
satin flycatcher	*Myiagra cyanoleuca*	M	–	Inhabits heavily vegetated gullies in eucalypt dominated forests and taller woodlands, often near wetlands and watercourses.	This species was recorded at locations outside the project area and is considered likely to occur in riparian environs along the Suttor River.
May Occur					
glossy ibis	*Plegadis falcinellus*	M	-	Well vegetated freshwater wetlands, wet pastures, flood plains saline areas.	Grassy, open pastures and shallow, open wetlands in riparian areas of the project area. Suitable habitat present in association with Palustrine wetland (S3).
Unlikely to Occur					
barn swallow	*Hirundo rustica*	M	-	Prefers disturbed open agricultural areas and open urban areas for forage and roost.	Prefers disturbed open agricultural areas and open urban areas for forage and roost. Most recordings originate from coastal areas.

a EPBC Act Status: V – Vulnerable, M - Migratory
b NC Act Status: V – Vulnerable

18.3.8.5 Introduced Fauna

Six introduced pest fauna species were recorded during the field surveys and it is likely that an additional three pests occur with the project area. Of these, four Class 2 pests and two non-declared pests were observed. These species are detailed in **Table 18-14**.

Table 18-14 Pest Fauna Species Observed During the Field Surveys or Likely to Occur within the Project Area

Scientific name	Common name	Declaration*	Likelihood
Canis lupus dingo	dingo	Class 2	Present
Canis lupus familiaris	feral dog	Class 2	Present
Capra hircus	goat	Class 2	Likely
Felis catus	feral cat	Class 2	Present
Hemidactylus frenatus	house gecko	Class 1	Likely
Mus musculus	house mouse	Non-declared	Present
Oryctolagus cuniculus	rabbit	Class 2	Likely
Bufo marinus	cane toad	Non-declared	Present
Sus scrofa	feral pig	Class 2	Present

Note *: Declaration under the LP Act as Class 1, Class 2, or Class 3

Feral pest species such as the feral dog, cat, goat, pig and rabbit would be expected to occur throughout the project area and were observed in all habitat types throughout the project area.

A significant amount of cane toads (*Bufo marinus*) were observed within the gilgai habitats located on the black soil plains located in the south and south east of the project area. Cane toads were also observed in large numbers in the sandstone uplift and escarpments to the north west of the study. This finding is of importance given that this area is also potential habitat for the endangered northern quoll (*Dasyurus hallucatus*), a species whose likelihood of occurrence was assigned the category of "may occur", which feed on the cane toad. Ingestion of a cane toad results in the death of a northern quoll and as a result the cane toad is recognised as a key threatening process for this species.

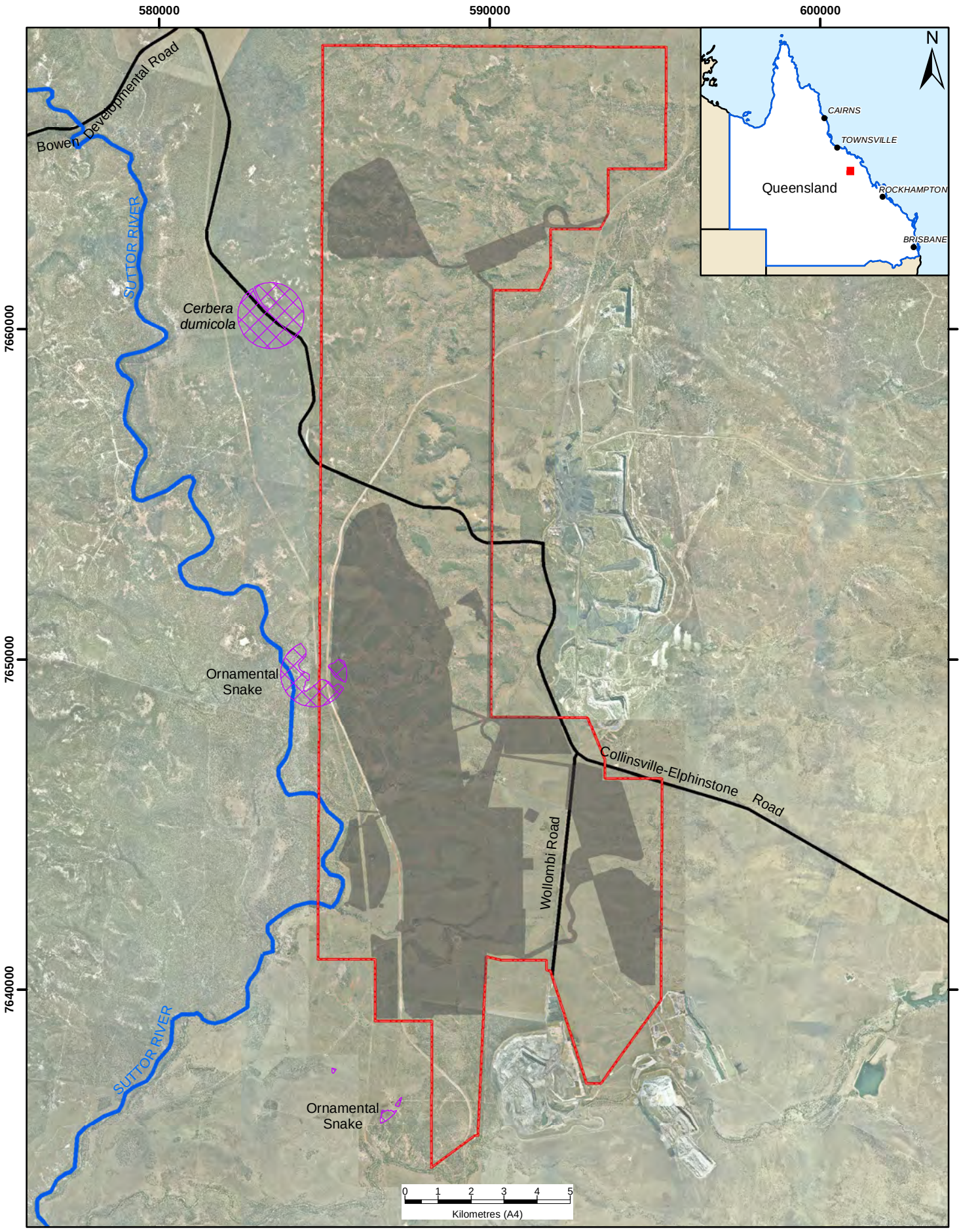
18.3.8.6 Breeding Places

Wetlands within the project area provide potential breeding habitat for wetland bird species. Tree hollows also represent important breeding habitat for a range of arboreal species including birds, possums and bat species. Hollows were generally found to be most common within eucalypt forests on undulating sandy plains and the alluvial floodplains within poplar box/blue gum. Hollows are generally restricted to large mature trees within the landscape, thus hollows can be expected to occur within the areas of mature remnant vegetation and would not be expected to occur in areas that have been previously cleared.

The lateritic topped uplifts to the north of the project area were targeted during the field survey to confirm the presence of caves that may represent breeding places for a range of fauna species. Inspection of escarpments generally found wind eroded crevices to be of an insufficient size and depth to represent suitable breeding species for the northern quoll (*Dasyurus hallucatus*) or other small mammal species.

18.3.9 Essential Habitat

The project area contains EHP mapped Essential Habitat Areas (EHAs) for the near threatened flora species *Cerbera dumicola* and vulnerable ornamental snake (*Denisonia maculata*). Mapped essential habitat areas are shown in **Figure 18-14**. Both species are known to occur in the project area.



Legend

- Project Area
- Project Ecological Footprint
- Formed Roads
- VMA Essential Habitat

Essential Habitat	QCOAL GROUP
Figure 18-14	**Byerwen Coal Project**
Date: *5/02/2013*	**Author:** Shahram.Nasiri
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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18.4 Potential Impacts and Mitigation Measures

18.4.1 Impact Footprint

The direct footprint of all mining and infrastructure areas as described in **Chapter 7** totals approximately 7,000 ha. For the purpose of the terrestrial ecology impact assessment this footprint area has been buffered so that any additional areas that will be isolated or cleared as a result of mining and/or associated infrastructure (e.g. non-viable linear corridors between haul roads and pits) are included within the impact footprint. The total impact footprint considered for the terrestrial ecology impact assessment (the 'project ecological footprint') is approximately 7,480 ha. The breakdown of the difference between the direct footprint area provided in **Chapter 7** and the buffered ecological footprint area adopted for the terrestrial ecology impact assessment in terms of REs, RE category and TECs is provided in **Table 18-15**, **Table 18-16** and **Table 18-17** respectively.

Table 18-15 Project Footprint RE Breakdown

RE	Direct footprint (a)	Footprint adopted for terrestrial ecology impact assessment (b)	Difference (b-a)
11.3.1	8	9	1
11.3.25	9	9	0
11.3.4	1	2	1
11.4.2	126	156	30
11.4.8	33	35	2
11.4.9	61	62	1
11.5.1	20	20	0
11.5.16	186	190	4
11.5.3	31	31	0
11.7.1	20	20	0
11.7.1x1	194	194	0
11.7.2	217	241	24
11.7.3	40	40	0
11.7.4	172	175	3
11.7.6	791	842	51
11.8.11	79	84	5
11.8.13	15	18	3
11.8.4	59	75	16
11.8.5	177	188	11
HVR 11.3.1	11	11	0
HVR 11.4.9	6	7	1
HVR 11.8.13	0	0	0
HVR 11.8.5	1	1	0

RE	Direct footprint (a)	Footprint adopted for terrestrial ecology impact assessment (b)	Difference (b-a)
HVR 11.9.5	2	2	0
Non-remnant	4751	5069	318
Total	**7010***	**7481**	**471**

***** This is comparable to the total footprint area described in **Chapter 7** (7,000 ha) with the discrepancy an artefact of GIS mapping
Note: Impact calculations rounded to the nearest whole number

Table 18-16 Project Footprint Breakdown by RE Category

RE	Direct footprint (a)	Footprint adopted for terrestrial ecology impact assessment (b)	Difference (b-a)
Endangered RE	303	314	11
Of concern RE	429	465	36
No concern at present RE	1507	1612	105
HVR	20	21	1
Non-remnant	4751	5069	318
Total	**7010***	**7481**	**471**

***** This is comparable to the total footprint area described in **Chapter 7** (7,000 ha) with the discrepancy an artefact of GIS mapping
Note: Impact calculations rounded to the nearest whole number

Table 18-17 Project Footprint TEC Breakdown

RE	Direct footprint (a)	Footprint adopted for terrestrial ecology impact assessment (b)	Difference (b-a)
TEC Brigalow	307	316	9
TEC SEVT	15	18	3
TEC Natural Grasslands	79	84	5
Not TEC	6609	7063	454
Total	**7010***	**7481**	**471**

***** This is comparable to the total footprint area described in **Chapter 7** (7,000 ha) with the discrepancy an artefact of GIS mapping
Note: Impact calculations rounded to the nearest whole number

18.4.2 Direct Impacts

18.4.2.1 Land Clearance

Land clearance will occur during the construction phase as a result of the establishment of supporting infrastructure, including the northern and southern mine infrastructure areas (MIAs), internal haul roads, linear infrastructure and creek diversions and during the operational phase as a result of the progressive development of open cut pits and associated waste rock placement areas. No clearing will be required outside of the project mining leases.

Remnant vegetation clearance within the project area has been minimised by concentrating development within cleared areas in the southern part of the project area. Only very limited clearing of remnant vegetation is required for the establishment of the South and East pits and the southern MIA.

While the need for land clearance has been minimised through the site layout, full development of the project over the 50 year period would result in the loss of approximately 2,391.1 ha of remnant native vegetation and 21.4 ha high value regrowth. The majority of this vegetation would be cleared from the West Pit, North Pit and northern MIA with smaller areas of clearing associated with the other pits as well as the central infrastructure corridor connecting the northern and southern MIAs.

Vegetation clearing over the life of the project would result in a reduction in the extent of endangered and of concern vegetation communities and a reduction in the available habitat for fauna, including threatened and migratory species within the project area. The majority of the remnant vegetation to be cleared (1,612.8 ha) is classified as no concern at present (by biodiversity status), with the remaining area comprised of endangered (313.9 ha) and of concern (465.2 ha) RE types. The effects of land clearance may include:

- loss of vegetation communities or individual threatened species
- reduced species abundance and biodiversity
- loss of habitat, loss of connectivity between habitat areas and associated diminished fauna movement
- loss of land stabilisation and riparian filtration functions.

A summary of total clearing areas by RE type is provided in **Table 18-18**. Clearing of vegetation will occur in stages as mining progresses. The location of areas to be cleared over the entire mine life in relation to the project ecological footprint is shown in **Figure 18-15** and **Figure 18-16**. A detailed breakdown of clearing areas by mine stage is provided in **Appendix 19**.

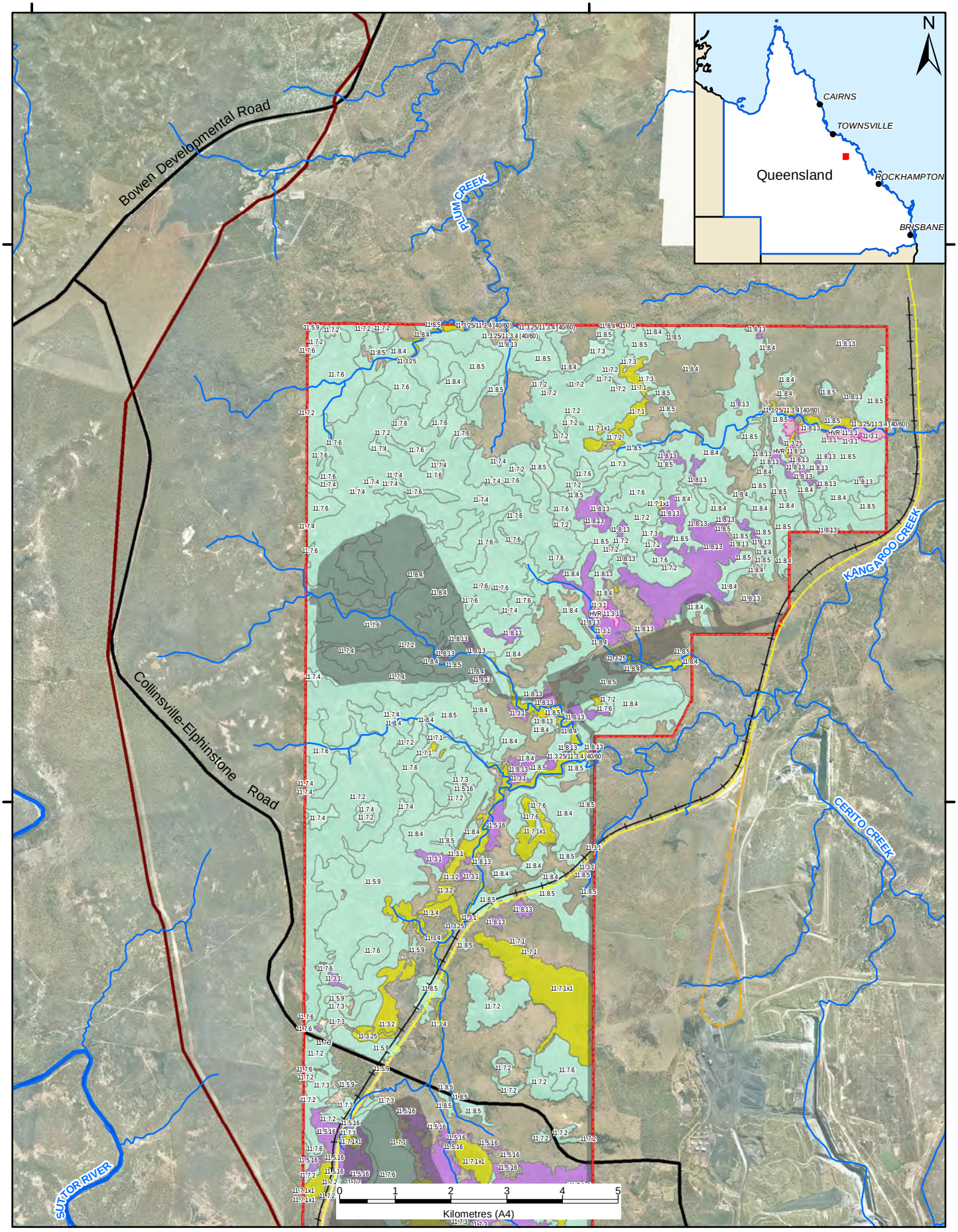
Table 18-18 Area of Impact by RE

RE	Biodiversity status	VM Act status	TEC	Impact area (ha)
11.3.1	Endangered	Endangered	Brigalow	8.7
11.3.4	Of concern	Of concern	–	1.6
11.3.25	Of concern	Least concern	–	8.7
11.4.2	Of concern	Of concern	–	156.4
11.4.8	Endangered	Endangered	Brigalow	34.6
11.4.9	Endangered	Endangered	Brigalow	62.2
11.5.1	No concern at present	Least concern	–	20.2
11.5.3	No concern at present	Least concern	–	31.0
11.5.16	Endangered	Endangered	Brigalow	190.4
11.7.1	Of concern	Least concern	–	214.1
11.7.2	No concern at present	Least concern	–	240.7
11.7.3	No concern at present	Least concern	–	40.3

RE	Biodiversity status	VM Act status	TEC	Impact area (ha)
11.7.4	No concern at present	Least concern	–	175.0
11.7.6	No concern at present	Least concern	–	841.9
11.8.4	No concern at present	Least concern	–	74.8
11.8.5	No concern at present	Least concern	–	188.1
11.8.11	Of concern	Of concern	Natural grasslands	84.4
11.8.13	Endangered	Endangered	SEVT	18.0
			Total Remnant	**2,391.1**
HVR 11.3.1	Endangered	Endangered	Brigalow	11.0
HVR 11.4.9	Endangered	Endangered	Brigalow	7.6
HVR 11.8.5	No concern at present	Least concern	-	0.6
HVR 11.8.13	Endangered	Endangered	-	0.4
HVR 11.9.5	Endangered	Endangered	Brigalow	1.8
			Total HVR	**21.4**
			Non-Remnant	**5,070.2**
			Total	**7,482.7**

General mitigation measures to be implemented to reduce the impacts of vegetation clearance and habitat loss include:

- Clear delineation of areas of native vegetation requiring removal to equipment operators and supervisors before any clearance to ensure disturbance is minimised.
- Maintenance of retained areas of existing vegetation to assist in providing a source of seed for mine rehabilitation works.
- Preparation of a Rehabilitation Management Plan and Mine Closure Plan which incorporates rehabilitation monitoring and trials.
- Use of native species for rehabilitation wherever possible. If native species are unsuccessful, introduced stoloniferous grasses may be to achieve rapid surface coverage. Buffel grass or a similar species may be used in areas identified for grazing where a suitable buffer to native vegetation is established using a non-invasive cover crop mixed with native grass seed.
- Monitoring of rehabilitation success including survival of regrowth and return of fauna species conducted at locations representative of the range of conditions impacting the rehabilitating areas. Reviews of monitoring data to assess trends and monitoring program effectiveness.



Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems

- Endangered
- Of Concern
- No Concern
- HVR containing E; HVR containing LC

Vegetation Community Impacts (North)

QCOAL GROUP

Figure 18-15	**Byerwen Coal Project**
Date: *11/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:90,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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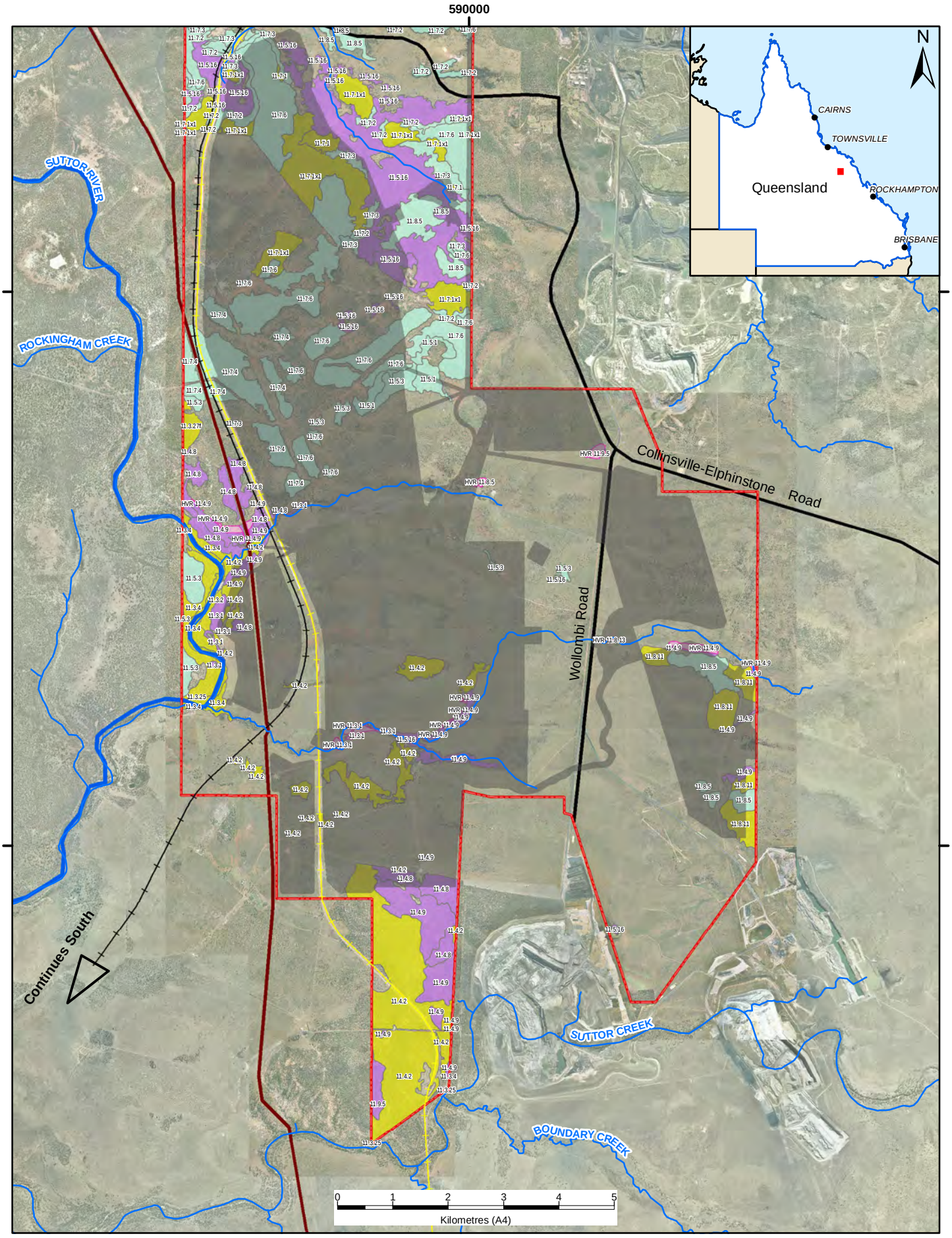

Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads

Regional Ecosystems

- Endangered
- Of Concern
- No Concern
- HVR containing E; HVR containing LC

Vegetation Community Impacts (South)

QCOAL GROUP

Figure 18-16	Byerwen Coal Project
Date: 11/03/2013	**Author:** samuel.ferguson
	Map Scale: 1:90,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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18.4.2.2 Habitat Loss

It is important to note that the overall habitat value of the project area has been significantly affected by historical clearing and the ongoing effects of grazing. The project will cause further impact on these (already highly compromised) habitats. However, habitat loss has been minimised by concentrating development in cleared areas as described above. The primary residual impacts on habitat within the project footprint would be expected to arise as a result of:

- Removal of permanent, yet artificial, water sources associated with the dams at H2 and H13. These dams are the only sources of permanent water in the southern part of the project area and are an important resource for wetland birds and other terrestrial fauna species. This includes species which were observed near site H2 such as the squatter pigeon and cotton pygmy-goose. Removal of these dams represents the loss of a habitat resource for these species and potentially the black-throated finch which was recorded from the same area. Other potentially permanent water sources identified using aerial photography are located approximately 6.5 km to the north-west (adjacent to the Suttor River) and 6 km to the south-west.
- Removal of gilgai wetland habitat from the southern part of the project area. Historic clearing has reduced the habitat value of these wetlands through the removal of vegetation and microhabitat features however, gilgai on cracking clay soils represent a loss of potential habitat for the ornamental snake.
- Encroachment on riparian vegetation associated with Suttor Creek by the waste rock dumps associated with South Pit 1.
- Removal of riparian vegetation associated with the North Pit footprint.
- Removal of habitat, such as tree hollows and coarse woody debris, from within pit and infrastructure footprints.
- Reducing the catchment area of the palustrine wetland on the south-west boundary of the project area (S3). Further discussion is provided in **Section 8.1.3** of the Aquatic Ecology Impact Assessment (AMEC 2012).

Impacts on habitat and associated fauna will be minimised by:

- minimising vegetation clearance along drainage features in order to maintain bank stability, habitat connectivity and movement corridors for terrestrial fauna species and a habitat refuge for fauna seeking shelter and water
- clearing riparian vegetation in a staged manner to allow fauna to migrate to adjacent habitats
- having a suitably qualified spotter-catcher available when clearing in habitat areas
- progressive rehabilitation of mined areas to incorporate the provision of nest hollows and microhabitat features such as trees and logs.

18.4.2.3 Habitat Fragmentation/Loss of Connectivity

Habitat fragmentation occurs when continuous areas of habitat, such as forests, woodlands or grasslands, are subdivided into a number of separate components. This term encompasses two interrelated components: habitat loss (i.e. a reduction in the amount of habitat) and fragmentation (i.e. a breaking apart of habitat) (Bennett, 2006). The impacts of habitat fragmentation are also scale-dependent and may differ depending on the species or community under consideration. For example, loss of small areas of habitat that do not present a significant barrier to movement by highly mobile

species (e.g. birds of prey) may present a much greater barrier to dispersal of less mobile or far-ranging species (e.g. amphibians or small reptiles such as skinks).

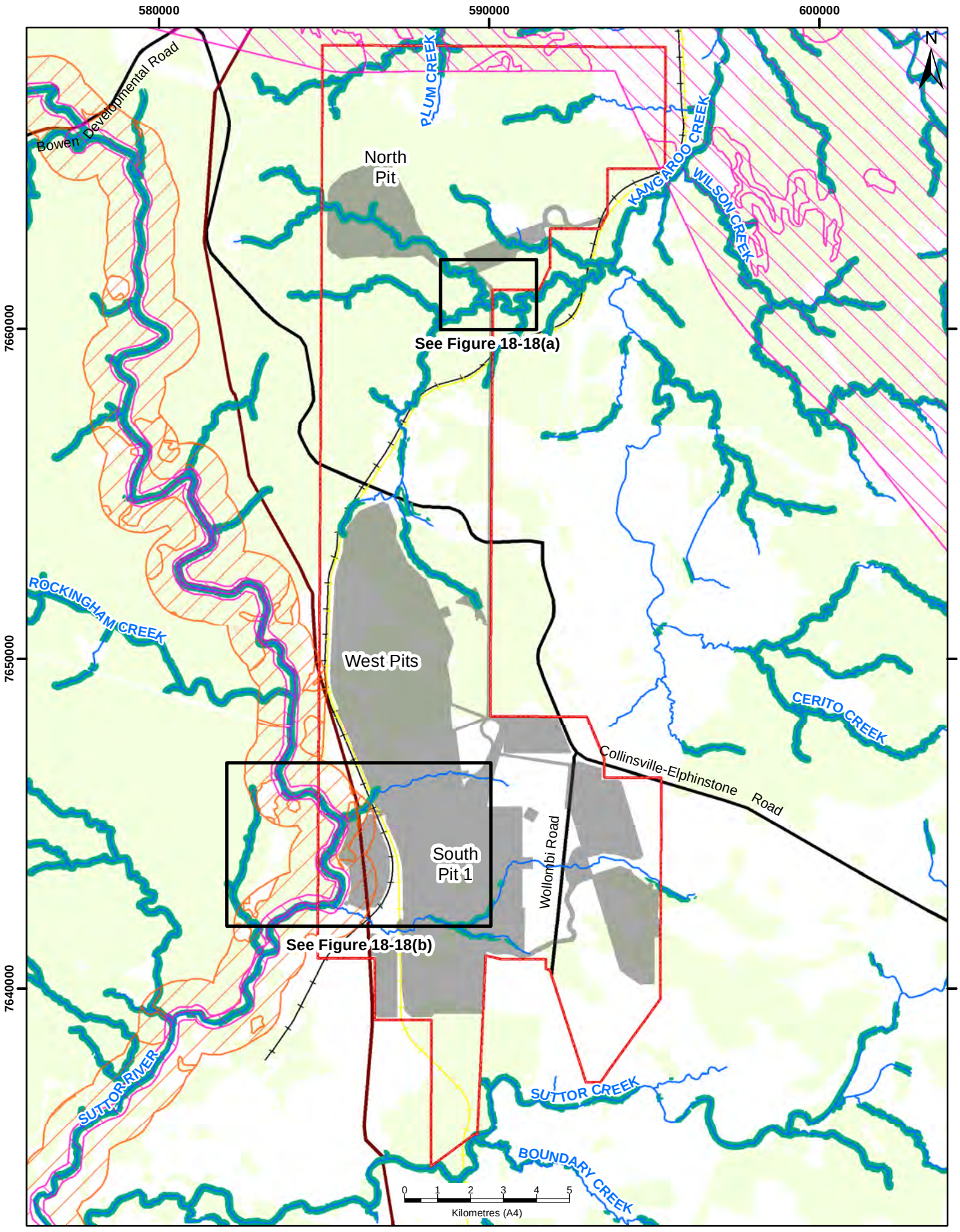
Connectivity across the broader project area has been considered in terms of habitat connections and broader corridors with regional linkages beyond the boundaries of the project area. Within the project area connectivity is linked to riparian corridors associated with the Suttor River and Kangaroo Creek and contiguous areas of terrestrial vegetation in the central and northern portions of the project area.

There are three primary areas of impact on connectivity within the project area as a result of the project, namely:

- Loss of connectivity within the band of terrestrial vegetation in the central part of the project area associated with the establishment of the West Pit (**Figure 18-17**). This would result in areas to the east of the pit footprint becoming isolated from large, contiguous tracts of vegetation to the west of the project area. While isolated, this patch of vegetation is still relatively large and will sustain habitat but has the potential to fragment populations of less mobile species.
- Removal of riparian corridors along the tributary of Kangaroo Creek and excise of remnant vegetation from the contiguous band in the northern part of the project area associated with the establishment of the North Pit (**Figure 18-17**).
- Reduced connectivity of riparian corridors along Kangaroo Creek associated with the construction of the central infrastructure corridor (**Figure 18-18**). Fauna movement along this corridor and access for less mobile species to upstream habitats to the south and west would be restricted. The alignment of the road also increases the potential for interaction between vehicles and fauna moving along the corridor, which would be mitigated by imposing slower speed limits at the crossing point.

The out of pit waste rock dumps associated with South Pit 1 will encroach on the regionally significant corridor associated with the Suttor River, reducing its width and is expected to cause a minor impact to connectivity along this north-south running corridor (**Figure 18-18**). Modelling undertaken by KBR (2012) indicates that armouring would be required to prevent scouring of the waste rock dump during a 1,000 year ARI flood event which has the potential to encroach further on both this and the State significant corridor associated with Suttor River. Placement of waste rock would need to be closely supervised to ensure no unnecessary clearing occurs and that water and sediment are managed to avoid impacts on vegetation and water quality within and adjacent to the Suttor River.

These impacts on connectivity are expected to have minor impacts on both regional-scale connectivity as a whole, and the value of State and regionally significant biodiversity corridors.



Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads
- Stream Order (2 and above)
- Riparian Corridor
- Remnant Vegetation

BPA Corridor

- State
- Regional

Site-scale Connectivity Impacts	QCOAL GROUP
Figure 18-17	**Byerwen Coal Project**
Date: *14/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:150,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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Figure 18-18(a) - Impacts on Kanagaroo Creek Riparian Corridor

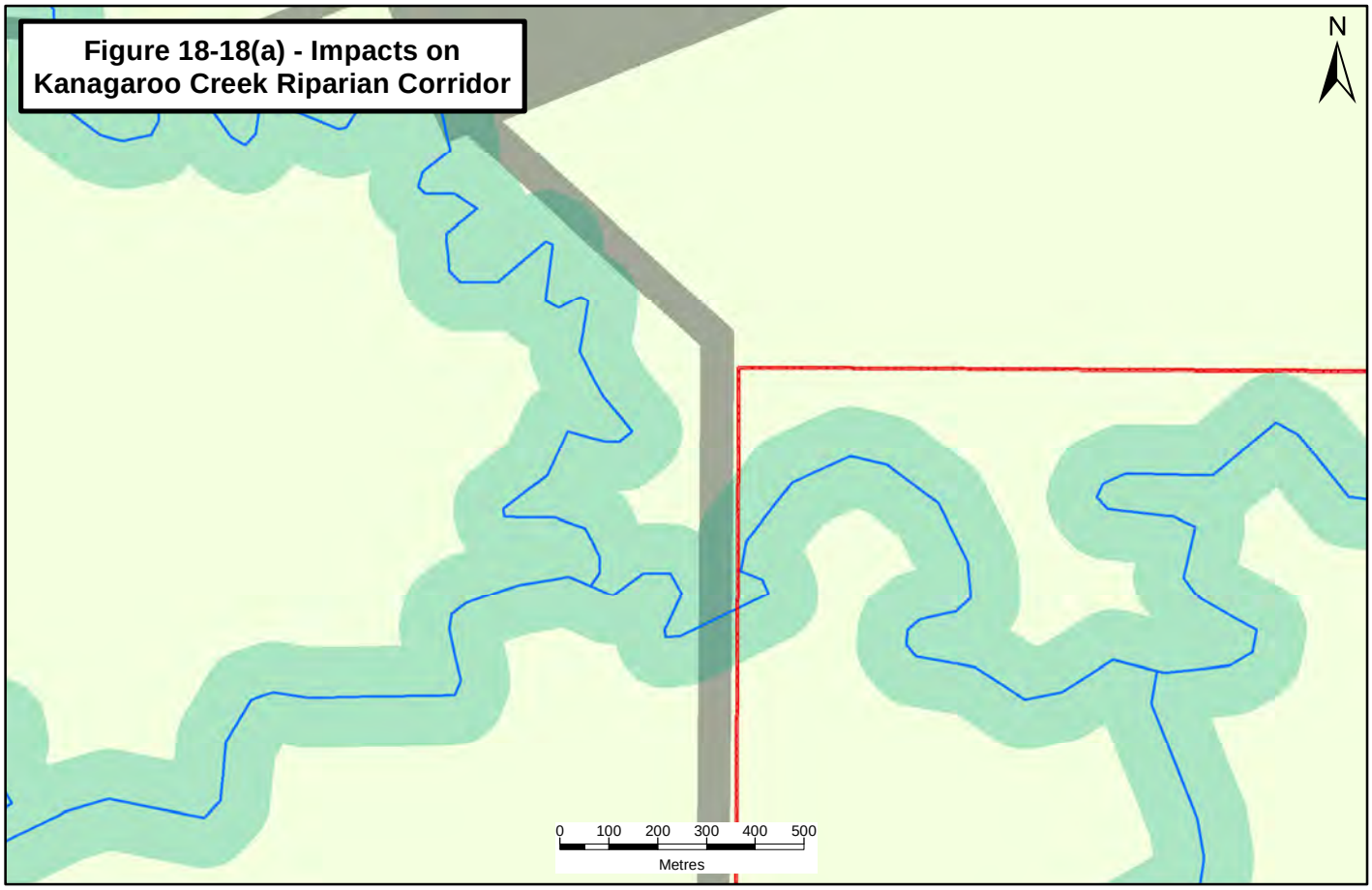
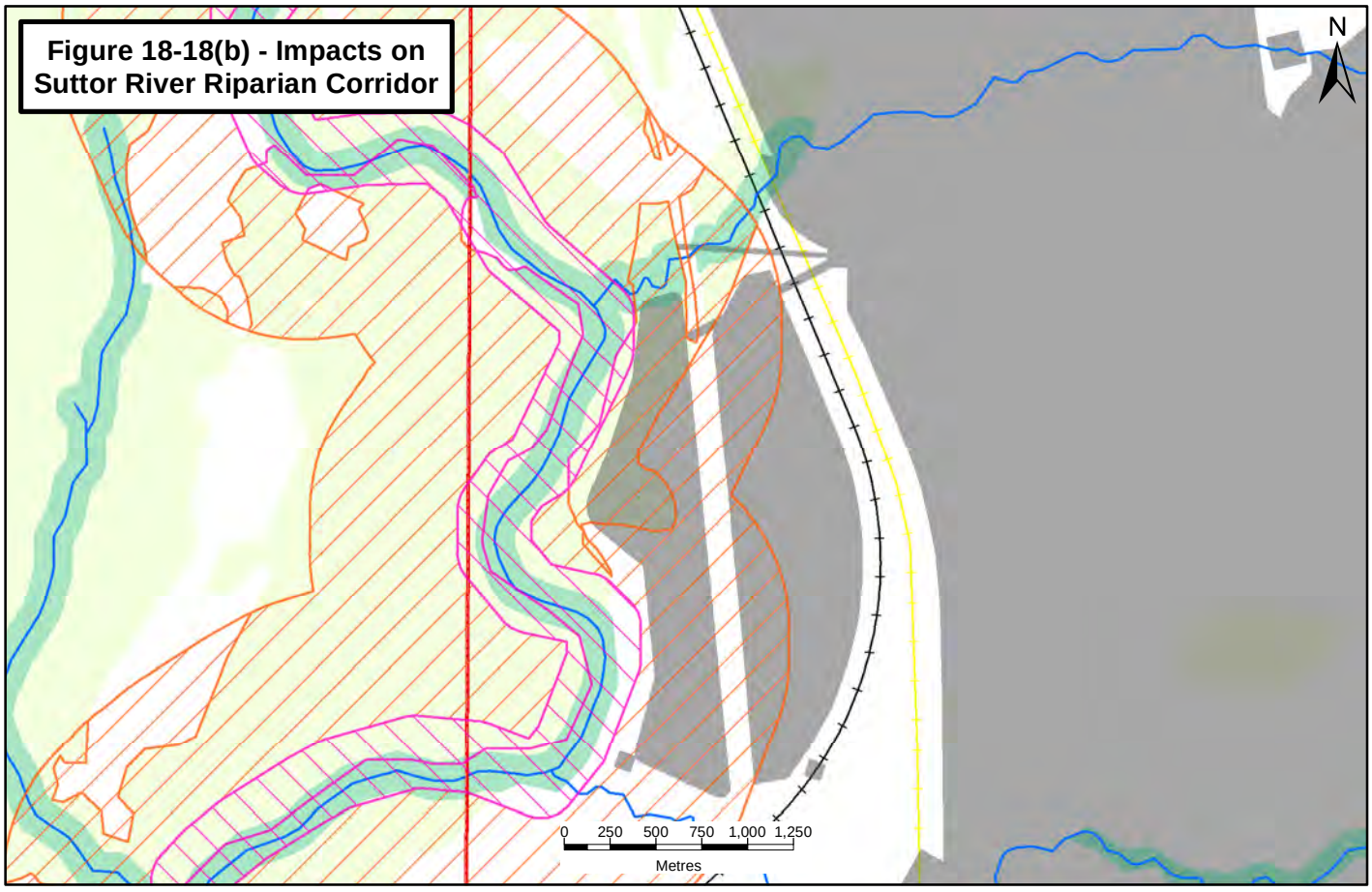


Figure 18-18(b) - Impacts on Suttor River Riparian Corridor



Legend

- Project Area
- Project Ecological Footprint
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline
- Formed Roads
- Stream Order (2 and above)
- Riparian Corridor
- Remnant Vegetation

BPA Corridor

- State
- Regional

Impacts on Riparian Corridors	
Figure 18-18	**Byerwen Coal Project**
Date: *14/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:15,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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18.4.2.4 Edge Effects

A key impact associated with the clearing of vegetation and construction of infrastructure and open cut pits is the creation of smaller patches of vegetation, with a greater edge to surface area ratio. Impacts associated with this increase in edge area are known as 'edge effects' and include increased exposure to weed invasion, light and wind penetration (which can alter microclimate features). Plant communities may become susceptible to disease and an overall decrease in health; over time community structure and composition may change as a result. The quality of associated fauna habitats may deteriorate as a result and some species are known to avoid disturbed habitats.

The impacts of edge effects are difficult to quantify as these effects occur gradually over time. Therefore, direct impacts such as vegetation loss and fragmentation are used to determine impacts. Rehabilitation of disturbed areas and the provision of buffers around undisturbed areas of remnant vegetation will help to minimise edge effects. Similarly, adopting other measures described throughout this chapter will help to lessen the impact of edge effects over the life of the project.

18.4.2.5 Impacts on Surface Water

Impacts on surface waters arising from the project with the potential to impact terrestrial flora and fauna values in the project area are:

- temporary impacts on surface water inflows to the palustrine wetland on the south-western boundary of the project area
- diversion of tributaries of the Suttor River in the southern part of the project area
- diversion of tributaries of Kangaroo Creek in the northern part of the project area
- impacts associated with altered flow paths, flow volumes and water quality associated with waterway crossings (e.g. for roads).

Surface Water Inflows to Palustrine Wetland

During mining, the catchment supplying water to the palustrine wetland on the south-western project area boundary would be disrupted, temporarily reducing flow to the wetland (KBR 2012). Impacts and proposed mitigation are discussed in **Chapter 19**.

Watercourse Diversions

Watercourse diversions (described in **Chapter 16**) will result in the loss of riparian vegetation and associated habitat resources for fauna species over the short-to-medium term. The loss of stabilisation and filtration functions associated with riparian vegetation can lead to erosion and a reduction in water quality which can have indirect impacts by reducing food sources for terrestrial fauna species. Subject to re-establishment of 'natural' channels which include riparian vegetation and appropriate management to prevent erosion, only minor impacts on terrestrial flora and fauna values are expected as a result of watercourse diversions. Connectivity impacts associated with watercourse diversions are discussed in **Section 18.4.2.3**.

Waterway Crossings

Waterway crossings associated with the central infrastructure corridor will result in the loss of riparian vegetation and reduced access to surface water resources in Kangaroo Creek. In addition to habitat loss, indirect effects such as decreased water quality, particularly sedimentation, may decrease foraging opportunities for waterbirds, such as ducks, storks and egrets. Diminished water quality associated with dust and sediment-laden runoff from roads can also impact aquatic fauna and indirectly impact terrestrial fauna by reducing food sources. Connectivity impacts associated with this waterway crossing are discussed in **Section 18.4.2.3**. Impacts associated with waterway crossings will be reduced by

minimising the number of crossings required, designing to prevent scour and implementing appropriate sediment and erosion controls at crossing points.

18.4.2.6 Impacts on Groundwater

The groundwater assessment (**Chapter 17**) concluded that there is little or no groundwater-surface water interaction in the project area. In the absence of groundwater baseflows to wetlands and drainage features and the absence of surface expressions of groundwater, any groundwater drawdown is likely to have a negligible impact on terrestrial flora and fauna values in the study area.

Groundwater dependent ecosystems (GDE) fall into four categories:

- Terrestrial GDE (woodlands dependent on shallow groundwater, and vegetation along dry riverbeds). There are no terrestrial GDE in the project area although they may exist along the Suttor River to the west of the project area. It is considered that there is no groundwater - surface water interaction between the aquifer sequences beneath the project area and the Suttor River alluvium so project mining activities will have no impact on terrestrial GDE.
- River Baseflow GDE (ecosystems reliant on groundwater discharging to streams, springs, seeps and swamps). No springs, seeps or swamps are known in the project area and there is no groundwater - surface water interaction between the aquifer sequences beneath the project area and the watercourses that traverse the project area. Project mining activities can therefore have no impact on river baseflow GDE.
- Aquifer GDE (ecosystems that exist in the subsurface, entirely dependent on groundwater). Stygofauna are the subject of a separate study (see **Chapter 20**).
- Wetland GDE. There are no records of wetland GDE in the Belyando Suttor river systems.

With the exception of stygofauna (refer **Chapter 20**) it is concluded that there are no GDE which can be impacted by the project's mining activities.

18.4.2.7 Dust

Dust generation has the potential to smother plants, reducing photosynthesis and resulting in decreased vegetation condition or the death of vegetation. Loss of vegetation also has indirect impacts on terrestrial fauna through the loss of food and habitat resources. Project activities likely to generate dust include open cut mining, waste rock stockpiling, vehicle movements, stockpiling (topsoil, waste rock, ROM and product coal), coal processing and coal transport (e.g. conveyors, haul trucks, etc).

Doley (2006) examined the physical effects of dust on vegetation and suggested that the most sensitive plant functions may be altered with monthly dust loads (deposition) of about 266 mg/m^2/day for dust with medium diameters of 50 µm. Dust deposition contours for the project area generated from air quality modelling provided in **Chapter 22** indicate a 266 mg/m^2/day deposition rate may be exceeded in the immediate vicinity of mining operations, as shown in Figure 22-7, 22-12 and 22-17. Areas where this deposition rate may be exceeded appear to be mainly within the project footprint. As limited vegetation will be retained within the project footprint, detrimental dust effects on plant health would be minor. Potential indirect impacts on terrestrial fauna associated with potential direct impacts on vegetation from dust deposition, are expected to be negligible.

18.4.2.8 Noise

Increased noise from blasting, operation of machinery, vehicle traffic and coal processing have the potential to disturb terrestrial fauna and impact on feeding and breeding behaviour. Noise effects on wildlife and other animals are categorised as primary, secondary, or tertiary. Primary effects are direct physical auditory changes, such as eardrum rupture, temporary and permanent hearing threshold shifts,

and auditory effects as stress, behavioural changes, interference with mating, and detrimental changes in the ability to obtain sufficient food, water, cover and predation. Tertiary effects are the direct result of both primary and secondary effects, and potentially include population declines. It is unlikely there will be any primary effects on wildlife.

The learning ability of many animal species is discussed by Busnel (1971). The animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quickly to ignore the noise source, particularly when it exists in the presence of humans.

Migratory birds have the potential to be influenced by noise from the project. Studies of birds (Larkin, 1996) have shown that they will habituate to loud noises that are not biologically meaningful for them. For example if the noise is associated with possible harm such as thunder on a cloudy day, birds will avoid it, but routine noises such as traffic will not disturb them. Examples are provided of sea-birds that voluntarily co-exist with relatively loud noise environments, such as around airports, and birds roosting on light-posts above busy motorways.

Background levels of incidental noise will increase once the mine commences operation. Noise impacts may cause interference with communication within species. The degree of noise disturbance is often species specific and influenced by a number of factors including volume, frequency and noise characteristics. Those species that rely on sound for their basic behaviour such as birds are most likely to be impacted (Coffin, 2007). Some animals are likely to become habituated to the background noise emissions created by the project. For example, wetland birds in the Caley Valley wetland near Bowen have remained in areas impacted by background noise from the existing port facility. Species in the area may have become more tolerant of mining related noise emissions given the proximity to Newlands Mine.

For these reasons, the impact on fauna is not expected to be significant outside of the immediate vicinity of mining operations. High intensity activities such as blasting however will be generally restricted to daylight hours (refer **Chapter 24**) which will to minimise impacts on the breeding and feeding behaviour of nocturnal animals.

18.4.2.9 Light

Key sources of light generation in the project area will be the open cut pits, the CHPPs and the mine infrastructure areas, associated access roads and rail facilities. Headlights and flashing lights associated with vehicle movements will also contribute. Combined, these sources would also be expected to result in ‘sky glow’ or the general lightening of the night sky. Light spill has the potential to impact on nocturnal species by disrupting feeding behaviour and reducing effective home ranges. It can also impact on the breeding behaviour of some species. Conversely, increased light will attract insects which may be beneficial for some insectivorous nocturnal feeders. This may benefit a small number of fauna species, such as some bird and bat species. Threatened species which are active at night and may be impacted by light spill in the project area include the brigalow scaly-foot, common death adder, ornamental snake, echidna, northern quoll, koala and Mount Cooper striped lerista.

18.4.2.10 Traffic Impacts (Mortality, Noise, Dust)

Traffic generation associated with the project has the potential to impact terrestrial flora and fauna in the following ways:

- mortality resulting from vehicle collision
- dust generation, which has the potential to smother roadside plants thereby affecting vegetation condition and reducing available habitat and food resources
- noise disturbance which can disrupt fauna behaviour.

Direct fauna mortality associated with vehicle movement on haul roads, access roads and rail lines has the potential to impact on a number of fauna species. Reptile species which may use road verges as habitat are susceptible to collision as they are less mobile than other species. The slow-moving squatter pigeon is also known to be at risk of vehicle strike.

The highest risk of direct fauna mortality is likely to be associated with vehicles travelling along the central infrastructure corridor. This risk is heightened in the northern section of the project area where the infrastructure corridor crosses fauna movement corridors associated with Kangaroo Creek. These crossings will be designed to minimise the potential for interaction with fauna. Reduced speed limits will also be adopted along the infrastructure corridor to minimise the risk for interaction with fauna by vehicle collision. In addition, lighting may also be provided at major intersections and points of major infrastructure along the corridor.

Other watercourse crossings associated with haul roads connecting open cut pits and the mine infrastructure areas will be designed to minimise the potential for vehicle interaction with fauna. Native fauna injured during construction and operational phases of the project would be taken to a vet or wildlife carer. In the event of injuries to domestic fauna or livestock, personnel would call for veterinary assistance and notify the appropriate landholder.

18.4.2.11 Increased Fire Risk

The project has the potential to increase fire risk associated with the operation of vehicles, activities undertaken by site personnel (e.g. from welding, cigarette butts) and spontaneous combustion of thermal coal. Uncontrolled fires have the potential to alter ecosystem characteristics and directly and indirectly impact on ecological values in the project area. Appropriate management systems will be put in place to prevent accidental ignition of fires as well as spontaneous combustion of coal. This will include active watering, orientation of stock and waste piles based on wind directions, and wind breaks. Vegetation retained on site will be managed for fuel load and appropriate fire regimes will be put in place to maintain biodiversity values while minimising the risk of bushfire. Fire regimes and management measures will be documented in a site-specific fire management plan.

18.4.2.12 Weeds

An increase in bare ground and open areas, associated with land clearance required for the project, will favour weedy species, particularly parthenium, which can suppress the regeneration of native species and reduce the available habitat for native species. Vehicles, machinery and material movement associated with the project will also have the potential to introduce new weeds and pests into the area, and/or facilitate the spread of weeds.

Under the LP Act it is the legal responsibility of all land owners to control declared weeds occurring on land under their management. As such the proponent is responsible for the management and control of declared and problem weeds on the project site. As weed species occur throughout the project area, the aim of weed management will be to prevent the introduction of new weed species to the project area and manage existing weed populations to prevent further infestation. Of particular note is the need to manage the potential for parthenium weed to establish in areas of natural grasslands TEC to be retained adjacent to the East Pit 2 footprint.

Weed management measures to be implemented in the project area include:

- Wash down facilities will be constructed at access points for vehicles arriving and departing from the project site. These facilities will be bunded and located away from drainage lines to minimise the risk of weed spread.

- Vehicles entering the project site and leaving properties known to contain declared weeds will be thoroughly washed down before entering clean areas; ensuring that wheels, wheel arches and the undercarriage are free of mud and plant material.
- Radiators, grills and vehicle interiors will be cleaned of accumulated seed and plant material.
- Drivers will be advised to keep vehicles to roads or compacted surfaces (preventative) and reduce vehicle movements in wetted soil where avoidance is not possible.
- Identified weeds of management concern, including declared and environmental weeds, will be controlled in accordance with local best practice management as described in the pest fact sheets published by Biosecurity Queensland and the Department of Agriculture, Fisheries and Forestry.
- Treated areas will be monitored to assess the success of declared weed eradication.
- Weed management will be included in the site induction program for the project to promote awareness of weed management issues.
- Implementation of the Weed and Pest Management Plan provided as part of the Environmental Management Plan (refer **Appendix 9**).

18.4.2.13 Pest Animals

Feral animals declared as pests under the LP Act represent a threat to primary industries and natural resources and responsibility for control rests with landholders. The following LP Act declared pest animals were observed or are likely to occur within the project area:

- feral dog (*Canis lupus familiaris*)
- dingo (*Canis lupus dingo*)
- feral cat (*Felis catus*)
- feral pig (*Sus scrofa*)
- rabbit (*Oryctolagus cuniculus*)
- goat (*Capra hircus*).

Other introduced species identified within the project area were the cane toad (*Bufo marinus*), house mouse (*Mus musculus*) and house gecko (*Hemidactylus frenatus*). These species are not declared pests and, as such, no formal control is required. However, cane toads are considered to pose a threat to the ornamental snake, common death adder, northern quoll and rainbow bee-eater (through usurping of nesting burrows), and control programs are recommended to mitigate impacts on these species. The impacts of these species are likely to include the following:

- predation on native species
- competition for food resources, which may decrease abundance of prey for native predator species
- habitat changes due to destruction of plants; changed floristic composition; reduced regeneration of plants; alteration of soil structure; increased invasion and spread of weeds
- increased access for non-native predator species
- toxicity to native species
- reduced water quality and availability
- spread of exotic invertebrates and creation of habitats suitable for disease, including the spread of root-rot fungus, *Phytophthora cinnamomi*.

Under the LP Act it is an offence to feed a declared pest animal or take a declared pest. The following general mitigation measures are proposed for the management of pest animal species:

- appropriate disposal and management of wastes on site
- Implementation of the Weed and Pest Management Plan provided as part of the Environmental Management Plan (refer **Appendix 9**).

18.4.3 Indirect Impacts

Indirect impacts associated with the project may include downstream impacts on surface water and impacts outside the boundaries of the project area related to noise, dust and light generation.

Discharges of mine water would be managed in accordance with the water management strategy for the project outlined in **Chapter 8**. Subject to appropriate management of mine-affected water and sediment-affected water, downstream impacts on surface water resources as a result of the project would be expected to be negligible. A hydrogeological assessment has indicated there are no notable groundwater dependent ecosystems, in addition a specific stygofauna assessment has indicated no stygofauna requiring management or mitigation associated with this project.

Impacts on terrestrial flora and fauna values outside the boundaries of the project area related to noise, dust and light generated by the project are expected to be negligible to minor.

18.4.4 Impacts on Terrestrial Flora Values

18.4.4.1 Endangered and Of Concern Vegetation Communities

Impacts on endangered and of concern REs have been avoided where possible by siting infrastructure in cleared areas or areas containing vegetation communities with lesser conservation value (i.e. least concern RE types). Despite this, the establishment of open cut pits and surface infrastructure for the project will result in the loss of 313.9 ha of remnant endangered RE and 465.2 ha of remnant of concern RE from the project area (refer **Table 18-19**).

Table 18-19 Area of Clearing for Remnant REs

Biodiversity status	REs represented	Impact area (ha)
Endangered	11.3.1, 11.4.8, 11.4.9, 11.5.16, 11.8.13	313.9
Of Concern	11.3.4, 11.3.25, 11.4.2, 11.7.1, 11.8.11	465.2

A substantial amount of the clearing in endangered and of concern RE types will occur from the northern extent of the West Pit (i.e. West Pit 3) which supports areas of endangered brigalow (RE 11.5.16). A total of 190.4 ha of RE 11.5.16 from an estimated 3,759 ha throughout the bioregion (including previously unmapped areas within the project area) would be cleared as a result of the project. The remaining area of endangered and of concern RE will primarily be cleared from the following footprint areas:

- North Pit – clearing of small areas of endangered semi-evergreen vine thicket (RE 11.8.13)
- South Pits 1 and 2 – clearing of mostly fragmented areas of endangered brigalow communities (RE 11.4.9, 11.4.8, 11.5.16), smaller areas of RE 11.3.1 (brigalow) associated with the Suttor River floodplain and of concern RE 11.4.2 (*Eucalyptus* spp. and/or *Corymbia* spp. grassy woodland)
- East Pit 2 – clearing in areas of native grassland (RE 11.8.11) and smaller areas of endangered brigalow woodland (RE 11.4.9)

- Northern Infrastructure Area and Central Infrastructure Corridor–clearing of very small areas of endangered semi-evergreen vine thicket (RE 11.8.13) and of concern riparian eucalypt woodland (RE 11.3.4) associated with tributaries of Kangaroo Creek.

Impacts on endangered and of concern REs will be minimised by marking the areas to be cleared to avoid unnecessary loss of these communities. Progressive rehabilitation of mined areas will also be undertaken in accordance with a Rehabilitation Management Plan which may include using species characteristic of the original ecosystems wherever possible (refer **Chapter 10**). Residual impacts on endangered and of concern vegetation communities are addressed in the offset strategy outlined in **Chapter 21**.

18.4.4.2 High Value Regrowth

Clearing for the establishment of open cut pits and supporting infrastructure will result in the loss of 20.8 ha of endangered HVR RE. This clearing area is mostly comprised of regrowth brigalow vegetation communities (refer **Table 18-20**).

Table 18-20 Area of Clearing for High Value Regrowth RE

Biodiversity status	REs represented as HVR	Impact area (ha)
No concern at present	HVR 11.8.5	0.6
Endangered	HVR 11.3.1, HVR 11.4.9, HVR 11.8.13, HVR 11.9.5	20.8

18.4.4.3 Threatened Ecological Communities

Clearing for the establishment of open cut pits and supporting infrastructure will result in an overall reduction in the extent of TECs in the project area. **Table 18-21** summarises the area of threatened ecological communities within the project footprint.

Table 18-21 Area of Clearing for Listed TECs

TEC	REs represented	Impact area (ha)
Brigalow (*Acacia harpophylla*) dominant and co-dominant	11.3.1, 11.4.8, 11.4.9, 11.5.16, 11.9.5	316.3
Natural grasslands	11.8.11	84.4
Semi-evergreen vine thicket	11.8.13	18.0

Open cut mining activities may also result in the altered distribution of cracking clay soils supporting brigalow and natural grassland communities and soils supporting the SEVT TEC. Separate stockpiling of soils from these areas for use in rehabilitation and/or offset areas will be considered. Brigalow and SEVT communities are also fire-sensitive and may be impacted by altered fire regimes in the project area. Management of weeds is required to prevent weed invasion and associated habitat degradation and/or increased fire risk. In particular, management will address:

- edge effects in the areas of SEVT TEC affected by the new rail loop
- measures to prevent the spread of parthenium into adjacent areas of natural grassland TEC in the vicinity of the East Pit 2.

Impacts on TECs in the project area will be minimised as described in **Section 18.4.2**. Impacts which cannot be avoided, minimised or mitigated in this manner are addressed in the offsets strategy provided in **Chapter 21**.

18.4.4.4 Watercourse Vegetation

The extent of watercourse vegetation clearance has been calculated in accordance with the Regional Vegetation Management Code for the Brigalow Belt and New England Tablelands bioregions (DERM, 2009) which specifies the following buffer distances from the high bank of watercourses:

- 50 m for stream order 1 or 2 watercourses
- 100 m for stream order 3 or 4 watercourses
- 200 m for stream order 5 or greater watercourses.

Based on these definitions a total of 247.3 ha of remnant watercourse vegetation would be removed from the project area. Impacts on remnant watercourse vegetation will be mitigated by:

- designing the central infrastructure corridor to minimise the number of waterway crossings where it intersects Kangaroo Creek and tributaries
- maintaining adequate buffers from the Suttor River riparian corridor, and providing appropriate scour and erosion protection to maintain the integrity of vegetation and ecological function
- restricting disturbance of watercourse vegetation to that necessary for the works
- maintaining adequate buffer distances from watercourses not directly impacted by mining
- emulating natural vegetation communities along realigned watercourses through planting endemic species characteristic of the original vegetation communities impacted.

Residual impacts on watercourse vegetation are addressed in the offset strategy outlined in **Chapter 21**.

18.4.4.5 Significant Flora Species

A number of threatened flora species, and the previously undescribed species *Kelita uncinella* are either known, considered likely to occur or have the potential to occur in the project area. Specific impacts and mitigation measures for those significant flora species known or likely to occur are outlined below.

Bertya pedicellata - Known to occur

Bertya pedicellata is listed as near threatened under the NC Act and was recorded from RE 11.7.2 in the central part of the project area. This species occurs in a wide range of habitat types, and has been recorded flowering from March–November with fruit from August–November. Threats to this species are unknown but are likely to include habitat loss, inappropriate fire regimes, mining and construction activities.

Recorded populations within the project area are outside the project footprint and will not be impacted by mining and associated activities. Approximately 240.7 ha of potential habitat for this species will be cleared from the North Pit footprint, West Pit footprint and northern MIA. Access to these areas was limited during the field survey and it is considered possible that there are additional populations of this species.

Fragmentation of potential habitat for this species would also occur, with remaining habitat exposed to edge effects and associated potential for weed invasion and degradation of habitat. Impacts on potential habitat for this species will be minor if appropriate weed, pest and fire management regimes are adopted.

Cerbera dumicola - Known to occur

Cerbera dumicola is listed as near threatened under the NC Act and is known to occur at a number of locations in the far northwest of the project area. Known populations of this species in the project area were associated with REs 11.7.2, 11.7.4 and 11.7.6. The ecology of this species is not well understood but threats are likely to include habitat loss, inappropriate fire regimes, mining and construction activities.

Recorded populations within the project area are outside the project footprint and will not be impacted by mining and associated activities. Approximately 1,257.7 ha of potential habitat for this species will be cleared from the North Pit footprint and the northern extent of the West Pit (i.e. West Pit 3). Access to these areas was limited during the field survey and it is considered possible that there are additional populations of *C. dumicola.* If present, mining in these areas would result in the loss of *C. dumicola* plants from the pit footprints.

Fragmentation of potential habitat for this species would also occur, with remaining habitat exposed to edge effects and associated potential for weed invasion and degradation of habitat. This species has been observed to re-sprout following fire (SGAP, 2007); while this species is therefore expected to be relatively fire-tolerant too frequent fires may have an adverse impact on this species. Appropriate fire management regimes will be implemented to minimise the potential for adverse impacts on this species.

Kelita uncinella - Known to occur

Kelita uncinella has not been assessed by any scientific committee and has no legislative status at present. However, the species description by Bean (2010) recommends a conservation status of endangered. Analysis of habitat data for this species reported by Unidel (2011) suggest that *K. uncinella* occupies habitats protected from fire and is likely to be a fire-sensitive species. Buffel grass was also observed to be absent or rare from sites supporting known populations and may out compete *K. uncinella* in suitable microhabitats.

No known populations will be impacted as a result of the project. Indirect impacts could arise from alterations to fire regimes within the species' habitat or through actions that increase the incursion of buffel grass. Indirect impacts on potential habitat for this species would be negligible provided appropriate weed, pest and fire management regimes are adopted. As part of weed management, known populations occurring on the project area may be monitored during construction and operation.

18.4.5 Impacts on Terrestrial Fauna Values

Table 18-22 provides a summary of impacts on potential habitat for threatened and migratory fauna species known or likely to occur in the project area based on RE associations (i.e. remnant vegetation) within the project area. It should be noted that these calculations provide an estimate of habitat loss based on broadly suitable habitat only. As such, areas of broadly suitable habitat which have been identified may not actually be of significance, or therefore require mitigation, when determining impacts on the species in question.

Table 18-22 Impacts on Potential Habitat for Threatened and Migratory Fauna Species

Species		Status		RE associations within the project area	Area (ha) of remnant vegetation impacted within the project area[c]
Common name	Scientific name	EPBC Act[a]	NC Act[b]		
Known to Occur					
ornamental snake	*Denisonia maculata*	V	V	11.3.1, 11.3.25, 11.3.4, 11.4.2, 11.4.8, 11.4.9, 11.8.11, 11.8.13, 11.8.4, 11.8.5	E – 123.5 OC – 251.1 NC – 262.9
cotton pygmy-goose	*Nettapus coromandelianus*	–	NT	11.3.1, 11.3.2, 11.3.25,11.3.4, 11.3.27	E - 8.7 OC -10.3
black-necked stork	*Ephippiorhynchus asiaticus*	–	NT	11.3.1, 11.3.25, 11.3.4, 11.3.27	E - 8.7 OC -10.3
square-tailed kite	*Lophoictinia isura*	–	NT	11.3.25, 11.3.2, 11.3.4, 11.5.1, 11.7.1, 11.7.4 11.7.6	OC – 224.4 NC - 1037.1
squatter pigeon	*Geophaps scripta scripta*	V	V	11.3.2, 11.3.4, 11.3.25, 11.5.1, 11.7.4, 11.7.6,	OC -10.3 NC - 1037.1
little pied bat	*Chalinolobus picatus*	–	NT	11.3.1, 11.3.2, 11.3.4, 11.3.25, 11.5.1, 11.7.1, 11.7.2, 11.7.4, 11.7.6, 11.9.5	E – 8.7 OC – 224.4 NC – 1277.8
eastern great egret	*Ardea modesta*	M	-	11.3.2, 11.3.25, 11.3.27	OC – 8.7
white-bellied sea-eagle	*Haliaeetus leucogaster*	M	-	11.3.25, 11.3.27,	OC – 8.7
Latham's snipe	*Gallinago hardwickii*	M	-	11.3.25, 11.3.27	OC – 8.7
rainbow bee-eater	*Merops ornatus*	M	-	Aerial foraging over all RE types	E – 313.9 OC – 465.2 NC – 1,612.0
rufous fantail	*Rhipidura rufifrons*	M	-	11.3.25, 11.3.27, 11.9.5	OC – 8.7
Likely to Occur					
black-throated finch (southern)	*Poephila cincta cincta*	E	E	11.3.1, 11.3.2, 11.3.25, 11.3.4, 11.3.27, 11.4.2, 11.4.8, 11.4.9, 11.5.1, 11.5.16, 11.5.3, 11.5.9, 11.8.11, 11.8.13, 11.8.4, 11.8.5	E – 207.9 OC – 160.0 NC – 238.3[d]

Species		Status		RE associations within the project area	Area (ha) of remnant vegetation impacted within the project area[c]
Common name	Scientific name	EPBC Act[a]	NC Act[b]		
common death adder	*Acanthophis antarcticus*	–	NT	11.3.1, 11.7.4, 11.7.6, 11.7.1x1, 11.9.5	E – 8.7 OC – 214.1 NC – 1,016.9
Australian painted snipe	*Rostratula australis*	V, M	V	11.3.25, 11.3.2, 11.3.27, 11.9.5	OC – 8.7
cattle egret	*Ardea ibis*	M	-	11.3.2, 11.3.25, 11.3.27,	OC – 8.7
fork-tailed swift	*Apus pacificus*	M	-	Aerial foraging over all RE types	E – 313.9 OC – 465.2 NC – 1,612.0
white-throated needletail	*Hirundapus caudacutus*	M	-	Aerial foraging over all RE types	E – 313.9 OC – 465.2 NC – 1,612.0
satin flycatcher	*Myiagra cyanoleuca*	M	-	Riparian forest on adjoining the Suttor River	0

a EPBC Act Status: V – Vulnerable, E – Endangered, M - Migratory
b NC Act Status: NT – Near Threatened, V – Vulnerable, E - Endangered
c Area calculation based on RE biodiversity status: E - Endangered, OC - Of concern, NC - No concern at present
d The quantum of impact was determined by buffering potential watering sites for this species by a distance of 1 km and determining the extent of remnant grassy woodland within this area.

The following sections provide an assessment of impacts on terrestrial fauna values known or likely to occur within the project area.

18.4.5.1 Threatened Fauna

Ornamental snake – Known to occur

The loss or degradation of riparian habitat surrounding drainage features, dams, wetlands and particularly gilgai is expected to have the largest impact on the ornamental snake. The main area of high value habitat are the lower areas of the clay floodplains containing regenerating brigalow stands and gilgai located within the footprint of South Pit 2 as well as DEHP-mapped essential habitat (refer **Figure 18-14**) within the waste rock footprint associated with the West Pits.

The drainage features within the project area, particularly in the southern half, are also habitat of value for the ornamental snake. The relocation of the watercourse between West Pit 1 and South Pit 1 and the intersection of creek crossing by the central infrastructure corridor is also expected to impact ornamental snake habitat.

The Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPaC, 2011), including the ornamental snake, determined that clearing two or more hectares of "important habitat" represents a significant threat to the ornamental snake. It was also determined that the alteration of water quality or quantity affecting four or more hectares of important riparian habitat is significant to this species. Given the location of the habitat within a central activity area within the project area, there is limited potential for rehabilitation of the disturbed habitat.

Management measures will focus on minimising the impact on riparian vegetation associated with the location of the waste rock dumps within the Suttor River floodplain (refer **Chapter 16**). Adequate buffers will be maintained from retained vegetation and scour protection provided for the dump to minimise the potential for erosion, sedimentation and associated impacts on water quality, particularly during larger flood events. Vehicle movements around the dump will be minimised, particularly at night, to reduce the risk of vehicle strike and the disruption associated with lighting in this habitat.

The Queensland Brigalow Belt Reptile Recovery Plan (Richardson, 2006) covers 16 threatened reptile species, including the ornamental snake. The overall recovery objective of the plan is to secure and improve the long term survival of the species and their key habitat, and to raise awareness of reptile conservation issues within the community. Of the management practices recommended in the recovery plan for the continued survival of reptile species (including the ornamental snake), the project will be able to ensure compliance with the following:

- managing the impact of feral animals
- adaptive fire management.

Cotton pygmy-goose – Known to occur

The greatest impact on the cotton pygmy goose is expected to be the removal or degradation of permanent and/or ephemeral wetlands as well as the surrounding riparian habitat, as this species is almost entirely aquatic and utilises these water bodies and nearby stags as foraging and breeding habitat. The cotton pygmy-goose was observed within the southern dam at H2 located within the footprint of West Pit 1. The cotton pygmy-goose is likely to use both farm dams in the southern section of the disturbance footprint and the nearby section of Suttor River (in times of inundation). While the two farm farms (H2 and H13) are within the disturbance footprint, the project is not expected to impact the Suttor River with the appropriate management of the adjacent waste rock dumps.

The removal of the dams and wetland areas at H2 and H13 will incur a loss of foraging and breeding habitat for this species, however as the cotton pygmy-goose is highly mobile it is expected that this species can migrate to adjacent water bodies with suitable fringing vegetation. Disturbance to other drainage features such as the creek diversion between South Pit 1 and 2 and the central infrastructure corridor creek crossings which approach the northern MIA are not expected to affect the cotton pygmy-goose as this species is likely to use a variety of wetlands and dam areas seasonally and is capable of relocating with changes in the availability of suitable wetland habitat.

Black-necked stork – Known to occur

The black-necked stork is expected to be most affected by the loss of foraging and breeding habitat within the project area. This species forages and nests adjacent to permanent or ephemeral wetlands and was detected foraging in the wetland associated with the dam at H2. Dams in the southern half of the disturbance footprint, particularly those within the West Pit 1 and South Pit 1 footprint provide high value breeding and foraging habitat for the black-necked stork.

While other suitable foraging and nest sites occur outside of the project area, this species is secretive and nests in isolated pairs in wetlands with low levels of disturbance (Dorfman *et al*, 2001). Light and noise resulting from the construction, operation and decommissioning stages of the project may disrupt black-necked stork foraging or breeding behaviour and displace them from the local area.

Other potential impacts as a result of the phases and activities associated with the project include increased abundance of cane toads, road mortality and collision with barbed wire fences and overhead feeder lines. With a wingspan of up to 2 m, collision with powerlines constituted the main cause of anthropogenic mortality within the black-necked stork distribution in NSW (Clancy, 2010). To a lesser extent, collision with barbed wire fences occurred more with juvenile birds.

Bird flight diverters attached to feeder lines are known to reduce to avian collisions with powerlines and will be considered when developing mitigation strategies. The use of plain wire, opposed to barbed wire will be considered to reduce juvenile black-necked storks (as well as other species prone to collision (e.g. kangaroos, emus)) collision and probably mortality. A strategy to reduce vehicle collisions will also be developed.

Square-tailed kite – Known to occur

The removal or degradation of vegetation along drainage features, such as the Suttor River and permanent water sources are expected to have the largest effect on square-tailed kite breeding and foraging habitat. This species constructs nests in the fork or on a large limb of mature eucalypts within 1 km of water (Aumann and Baker-Gabb 1991). Based on RE associations, approximately 10 ha of breeding habitat occur in the project area while foraging habitat would also include areas of non-remnant vegetation. This figure does not account for the availability of microhabitat features with the REs, therefore the affected high value breeding habitat may be more constrained within the project area and disturbance footprint. With the avoidance of wetlands and drainage features by project infrastructure where ever practicable, potential impacts on these highly mobile species are expected to be minor.

Squatter pigeon – Known to occur

General threats to the squatter pigeon population are primarily associated with habitat degradation and increased predation from introduced species (QPWS, 1999). Historically, populations of the squatter pigeon declined during the late nineteenth and early twentieth centuries. However, the decline in numbers has now slowed. There is an abundance of suitable available habitat in Central Queensland and the species is relatively widespread and locally abundant throughout its range (DSEWPaC 2012b). Threats to this species include loss of habitat due to clearing for agricultural or industrial purposes, habitat degradation by grazing herbivores (e.g. sheep, cattle, rabbits) and excessive predation, particularly by cats and foxes.

Grassy woodland habitat would be removed from the project area as a result of the establishment of the West Pits and South Pit 1 footprints. However, this area is likely to represent an overestimate of impacts on habitat for this species, as squatter pigeon typically occurs in proximity to water. Clearing would result in a localised reduction of breeding and foraging habitat in the southern part of the project area however, this habitat type is widespread in the region and impacts on the species as a whole would be minor.

There is also a risk of mortality to both adult birds and young due to vehicle strike as this species is ground-dwelling. Where possible, clearing in proximity to water will be undertaken outside breeding times (September through October), with fauna spotter-catchers employed to search for nests and/or stir up birds ahead of clearing works outside these times. Reduced speed limits will be imposed on haul roads close to watering points during the construction and early operational phases of the project prior to the removal of suitable habitat from within the project footprint.

Little pied bat – Known to occur

The little pied bat was detected at five sites (T1 to T5) within the southern section of the disturbance footprint and will be directly impacted by the loss of vegetation during the development of South Pit 2 and East Pit 2. This species roosts in tree hollows of mature trees, such as eucalypts and can forage up to 17 km from a roost site (Churchill, 2008). The highest density of hollow-bearing trees in the project area would be expected to occur along the Suttor River and within poplar box woodlands (RE 11.4.2) around site H15.

Remnant vegetation associated with little pied bat habitat within the project area may be affected through the phases of the project. Subject to appropriate management of the waste rock dumps located

on the edge of the floodplain, no impact on hollow-bearing trees in the Suttor River riparian zone would be expected to result from the project. Mature hollow-bearing trees would be lost from the poplar box woodlands near site H15 and also in other areas of remnant vegetation within North Pit, the northern MIA, West Pit 1, 2 and 3, South Pit 1 and 2, and East Pit 2.

Habitat fragmentation and loss of connectivity may also affect the little pied bat. Little pied bats appear to be most scarce in highly fragmented landscapes; however the habitats where they do persist are well-connected, small patches of native vegetation (IUCN, 2012). The habitat loss within the footprint of West Pit 3 and the associated waste rock dump will fragment high value habitat resulting in an isolated stand of remnant vegetation. Other impacts include light pollution and increased dust levels which may interfere with insect behaviour and breeding resulting in loss of food sources for bats.

Consideration will also be given to the maintenance and/or re-establishment of connectivity in habitat through the central part of the project area.

Black-throated finch (southern) – Likely to occur

This species was targeted during the survey with repeat visits to dams and wetlands with the goal of recording this species coming in to water. A pair of black-throated finches was tentatively recorded in proximity to the large wetland at H2. This record is treated as tentative because it is based on a fleeting glimpse of two birds without the aid of binoculars and the fact that the species can be readily confused with other finches. The precautionary principal has been applied and the species is treated as though likely to be present. As there are no previous records of this species in or near the project area, it is thought that these individuals may have dispersed along the Suttor River following consecutive years of high summer rainfall. It is not confirmed whether these individuals were the northern subspecies or the threatened southern species and for the purpose of this assessment, a precautionary approach assumed that the species observed is the threatened southern sub-species.

The main impact on the black-throated finch is potentially the removal or degradation of riparian habitat. While the black-throated finch inhabits open woodlands and forest with a grassy understorey, almost all recent records, south of the tropics, have been in riparian habitat (BTF Recovery Team, 2004). The foraging habitat of the black-throated finches requires access to water and grass seeds while breeding habitat is variable. Nesting may occur in a fork of a tree, shrub, sapling or hollow of a native or non-native species in remnant or non-remnant vegetation (DSEWPaC, 2012c). The relatively broad breeding microhabitat suggests that distance to a suitable water source may be a limiting habitat factor. The dams located at H2 and H13 within the footprint of West Pit 1 and South Pit 1, respectively, is expected to have the largest effect on black-throated finch in terms of habitat loss as they sites afford high value wetlands fringed by eucalypt species and Brigalow adjacent to pastoral grasslands. The Suttor River riparian corridor is also considered to afford breeding and foraging habitat for the black-throated finch. Impacts on this species will be mitigated by conducting detailed searches of nesting habitat within proximity to important water sources (i.e. transects along the Suttor River riparian corridor and dam at H2) and replicating suitable habitats where possible.

The overall objective of the National recovery plan for the Black-throated finch southern subspecies (BTF Recovery Team, 2007) is to manage and protect the black-throated finch and its habitat, and to promote the recovery of the southern subspecies. Guidelines for habitat management for the black-throated finch southern subspecies, as outlined in the recovery plan includes:

- management practices aimed at minimising impacts on habitat by domestic stock and rabbits,
- fire management
- weed management strategies to minimise invasion of habitat by exotic weed species, including exotic grasses.

The project will ensure compliance with these management practices by implementing weed and pest management procedures and fire management protocols. Subject to appropriate management of weeds, introduced fauna species and fire regimes, impacts on this species, expected to result from the project will be negligible.

Common death adder – Likely to occur

The main effect on the death adder as a result of project development will be the loss of habitat within shrubby remnant or mature eucalypt or acacia woodland (particularly in Brigalow). Potential habitat occurs throughout the project area but specifically areas within the footprint of South Pit 2, West Pit 3 and the northern section of the central infrastructure corridor and the northern MIA were identified as high value areas for this species.

Additional impacts on the common death adder as a result of project development include increased road mortality, habitat alternation due to weed establishment and potential changes in fire regimes and the increased abundance of cane toads. Conversely, stored equipment/supplies may create shelter resources which could have safety implications.

Impacts on this species will be managed by employing fauna spotter-catchers to flush out individual animals prior to clearing in remnant areas and implementing appropriate weed, pest and fire management protocols and measures to reduce vehicle strike. This species is venomous and personnel interacting with this species will be trained in the management and handling of venomous snakes.

Australian painted snipe – Likely to occur

Impacts and mitigation measures specific to the Australian Painted Snipe are outlined in the section below under migratory fauna.

18.4.5.2 Migratory Fauna

There are ten EPBC-listed migratory species that occur or are likely to occur within the project area. The potential impacts to migratory species in the project area are predicted to be minor or negligible as many of the species are highly mobile and capable of relocating with changes in the availability of suitable wetland habitat.

Eastern great egret – Known to occur

The removal or degradation of permanent and/or ephemeral wetlands is likely to have the largest effect on the eastern great egret. Gilgais, inundated flood plains, dam sites and water courses, particularly those concentrated in the south-western section of the project area, afford foraging habitat for this species. The large wetland associated with the dam at H2 and the dam at H13 are located within the footprints of West Pit 1 and South Pit 1, however the dam at H19 and the riparian areas along the Suttor River are located outside the development footprint and are likely to experience little disturbance. The waste rock dump however, located west of South Pit 1 will be managed to reduce the probability of habitat degradation within the Suttor River riparian areas.

Disturbance to other drainage features such as the creek diversions between South Pit 1 and 2 and the central infrastructure corridor creek crossings are not expected to affect the eastern great egret as this species is highly mobile and capable of relocating with changes in the availability of suitable wetland habitat.

As this species breeds in colonies in the northern parts of Australia, no disturbance to breeding habitat is expected as a result of this project.

White-bellied sea-eagle – Known to occur

The white-bellied sea-eagle is generally associated with coastal environments and large, inland bodies of water or major drainages. It is a highly mobile species that is likely to use suitable habitat in the project

area as a flyover resting site or potentially to forage. Project activities are expected to have a minor or negligible effect on the white-bellied sea-eagle.

Latham's snipe and Australian painted snipe – Known and Likely to occur respectively

The removal or degradation of ephemeral water bodies is likely to have the largest effect on Latham's snipe and the Australian painted snipe. High value habitat includes the large wetland associated with the dam at H2 and the dam at H13 which are both located within the footprints of West Pit 1 and South Pit 1. The creek diversion and crossings between South Pit 1 and South Pit 2 and south of the Northern Infrastructure Area is also likely to affect the habitat for these species. The dam at H19 and the riparian areas along the Suttor River are located outside the development footprint and no impacts on these areas are expected to result from the project. Impacts on the Latham's snipe and Australian painted snipe will be mitigated by having a suitably qualified spotter-catcher available when clearing in habitat areas and the provision of suitable habitat associated with offset benefits for the species as discussed in **Chapter 35**. These species may also benefit from the generation of foraging opportunities associated with the creation of new dams and cleared areas.

Rainbow bee-eater – Known to occur

The rainbow bee-eater is a common and widespread species across Australia inhabiting a range of habitat types throughout the project area including remnant and non-remnant vegetation. Foraging habitat is varied and includes disturbed and undisturbed areas while breeding habitat involves the excavation of a burrow in soil such as along a river bank, dam wall, gravel pit or soil piles. Sandy banks associated with water courses within the footprint of West Pit 2 and 3 and the Suttor River afford high quality nesting habitat. The excavation of open pits and the stocking of waste rock may increase the availability of nesting sites, while conversely create susceptibly of nest disturbance through ongoing project activities.

This species utilises a broad range of habitats and all remnant vegetation within the project footprint would be considered suitable habitat for this species. Large areas of suitable remnant habitat remain in areas which would not be disturbed by mining and the impacts presented in **Table 18-22** somewhat overstates the extent of impact. Impacts on this species will be mitigated by timing works in and around watercourses to avoid breeding times (September to February) and to deploy fauna spotter-catchers to search for nest burrows in stream banks when works during this period cannot be avoided.

Rufous fantail – Known to occur

This species utilises the shrub layer sub canopy of woodlands adjacent to riparian areas as breeding and foraging habitat. High value habitat is located at the farm dam at site H2 and the riparian corridor of waterways in the southern section of the project area. The removal of the dam and diversion of the creek located between South Pit 1 and South Pit 2 is likely to impact foraging habitat however, this species typically breeds in moister vegetation types. Impacts on breeding habitat for this species will be mitigated by minimising impacts on the Suttor River riparian corridor as described throughout **Section 18.4** of this chapter.

Cattle egret – Likely to occur

The cattle egret inhabits predominately shallow and open wetlands, but unlike the eastern great egret, forages away from wetlands in low lying grasslands and improved pastures. Suitable habitat for this species is more prevalent within the southern half of the project area, largely within the footprint of the West and South pits, within non-remnant vegetation in proximity to water.

As the cattle egret appears tolerant of some level of ground disturbance, the largest effect as a result of project activities is expected to be displacement during the construction phase. While noise and vehicle traffic may reduce cattle egret activity during the operational phase, new dams and cleared areas may generate foraging opportunities. As this species breeds in colonies in the coastal areas of Australia, no disturbance to breeding habitat is expected as a result of this project.

Fork-tailed swift and white-throated needletail – Likely to occur

The fork-tailed swift and white-throated needletail are highly mobile, aerial species which adapt to many habitat types. Breeding and foraging habitat are considered unlikely to be affected by the project.

Satin flycatcher – Likely to occur

Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. The satin flycatcher is considered likely to occur in riparian vegetation adjoining the Suttor River (outside of the project area).

18.4.5.3 Bioregional and Culturally Significant Fauna

Three species within the project area are recognised for their bioregional or culturally significance. The culturally significant short-beaked echidna occupies a wide range of habitats across a large distribution and the effects of habitat loss as a result of land clearing are expected to be minimal. Road mortality resulting from increased traffic, particularly along the central infrastructure corridor, is likely to have the largest impact on ground dwelling short-beaked echidna. Measures to avoid vehicle strike will be applied.

The bioregional significant Australian bustard (*Ardeotis australis*) and grey-crowned babbler (eastern) (*Pomatostomus temporalis temporalis*) also have large distributions and habitat loss expected to only have a minor impact these species.

18.5 Conclusion

The project area supports a relatively diverse range of vegetation communities and terrestrial flora and fauna species. While large parts of the project area are cleared, key areas of remnant vegetation are associated with the Suttor River in the west, Kangaroo Creek and surrounding areas in the north, and the east-west band of terrestrial vegetation associated with elevated areas in the centre of the project area. The project area also supports important areas of the brigalow, semi-evergreen vine thicket and natural grasslands TECs.

Remnant vegetation in the project area has linkages to recognised State-significant biodiversity corridors but does not itself form part of these corridors. Overall, the project area sits on the eastern edge of large, contiguous tracts of vegetation to the west of the project area, with more intact landscape-scale linkages in the north.

Key habitat resources for fauna identified through the assessment include permanent water sources associated with farm dams, riparian corridors associated with the Suttor River and Kangaroo Creek, gilgai habitats in the south of the project area and large tracts of contiguous remnant vegetation in the northern and central parts of the project area. In particular, the dam located at site H2 was observed to support a high diversity of wetland and small passerine birds and is considered to provide a habitat resource for a number of threatened and migratory species.

In total six threatened fauna species were recorded from the project area; the ornamental snake, cotton pygmy-goose, black-necked stork, square-tailed kite, squatter pigeon and little pied bat. Two individuals suspected to be black-throated finch were also observed, although a positive identification was not made. A precautionary approach as to the likelihood of occurrence of this species was adopted and as such the species is considered as a likely occurrence. Further fauna surveys may confirm the presence and distribution of the black throated finch in the project area. Three threatened fauna species are considered likely to occur in the project area; the black-throated finch (southern subspecies), common death adder and Australian painted snipe.

The project area is known to support two threatened flora species (*Bertya pedicellata* and *Cerbera dumicola*) and one previously undescribed genus in the family Amaranthaceae (*Kelita uncinella*) which was discovered during field surveys (this species is not impacted by the project).

In total five migratory fauna species were recorded from the project area with a further five species considered likely to occur in the project area. In addition to use of farm dams and wetland areas in the project area, inundated gilgai areas are also expected to provide temporary wetland habitats for migratory species, in particular species such as the Latham's snipe (*Gallinago hardwickii*) and the Australian painted snipe (*Rostratula australis).*

Land clearance and habitat loss associated with the establishment of open cut pits and supporting infrastructure are the main impacts on the terrestrial flora and fauna values of the project area. The project will result in the loss of approximately 2,391.1 ha of remnant native vegetation from within the footprint. This will result in an overall reduction in the extent of endangered (313.9 ha) and of concern (465.2 ha) vegetation communities in the project area.

Land clearance will also result in impacts to connectivity with loss of connectivity in the central project area, removal of riparian corridors along the tributary of Kangaroo Creek, excise of vegetation from the contiguous band in the northern project area, reduced connectivity of riparian corridors along Kangaroo Creek and encroachment on riparian corridors along Suttor River.

Removal of permanent water sources associated with farm dams may result in the loss of a habitat resource for a suite of threatened and migratory species. Impacts on terrestrial flora and fauna values have been mitigated by concentrating development in cleared areas in the south of the project area. Other specific considerations to be addressed through future project design and development include:

- maintaining adequate buffers from the Suttor River riparian corridor, and providing appropriate scour and erosion protection to maintain the integrity of vegetation and ecological function
- provision for fauna movement along riparian corridors associated with Kangaroo Creek and the appropriate design of waterway crossings where this intersects the central infrastructure corridor
- measures to limit vegetation loss and impacts on connectivity where the central infrastructure corridor intersects laterite 'jump-ups' in the central part of the project area
- management of edge effects and habitat for less mobile species in areas of terrestrial vegetation which will be isolated by the establishment of the West Pits.

With the implementation of proposed mitigation measures, the project is expected to result in minor impacts on terrestrial flora and fauna values. Site-scale impacts on connectivity are expected to have a minor impact on regional-scale connectivity and the value of State-significant biodiversity corridors to the north.