CONTENTS

FIGURES

PLATES

TABLES

8. NATURE CONSERVATION

8.1. INTRODUCTION

This Section describes the terrestrial, aquatic and subterranean ecology of the SGCP area and surrounding environs. The potential impacts of the project are identified and assessed and, where required, appropriate mitigation, management and monitoring initiatives are proposed.

8.1.1. Legislation

8.1.1.1. Commonwealth Legislation

8.1.1.1.1. Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) is the key piece of Commonwealth legislation to protect and manage important flora, fauna and ecological communities. The *EPBC Act* provides for the identification and management of matters of national environmental significance, including threatened flora and fauna species, ecological communities, migratory animals protected under the China-Australia Migratory Bird Agreement (CAMBA), migratory birds protected under the Japan-Australia Migratory Bird Agreement (JAMBA) and the Bonn Convention, wetlands of international importance (Ramsar) and critical habitat areas. Under the *EPBC Act*, an action will require approval from the Federal Environment Minister if the action has, will have, or is likely to have a significant impact on a matter of national environmental significance.

8.1.1.2. Queensland Legislation

8.1.1.2.1. Biodiversity Offset Policy 2011

The Biodiversity Offset Policy 2011 provides a framework to increase the long-term protection and viability of the state's biodiversity values where residual impacts from a development, on an area containing State significant biodiversity values, cannot be avoided.

8.1.1.2.2. Environmental Protection Act 1994

The *Environmental Protection Act 1994* (*EP Act*) regulates environmental management and aims to achieve ecologically sustainable development. The *EP Act* outlines legal obligations and the duty of care all persons have to the environment and directions for preparing environmental protection policies.

8.1.1.2.3. Fisheries Act 1994

The *Fisheries Act 1994* (*FM Act*) provides a framework for the management, use and protection of fishery resources in Queensland. This includes fish resources and fish habitats.

8.1.1.2.4. *Land Protection (Pest and Stock Route Management) Act 2002*

The *Land Protection (Pest and Stock Route Management) Act 2002* (*LP Act*) imposes a legal responsibility for, and provides directives to, control of weeds and pest animals by all landholders on land under their management.

8.1.1.2.5. *Nature Conservation Act 1992*

The *Nature Conservation Act 1992* (*NC Act*) regulates native flora, fauna and habitat conservation within Queensland.

8.1.1.2.6. *Vegetation Management Act 1999*

The *Vegetation Management Act 1999* (*VM Act*) provides a planning framework for the management of native vegetation across Queensland. It regulates clearing of vegetation and aims to conserve Queensland's biodiversity through vegetation management.

8.1.1.2.7. *Water Act 2000*

The *Water Act 2000* (*Water Act*) regulates the management of water resources and water authorities to achieve sustainable use of water in Queensland.

A comprehensive summary of the legislative and planning framework applicable to the SGCP is provided in **Section 3—Project Approvals**.

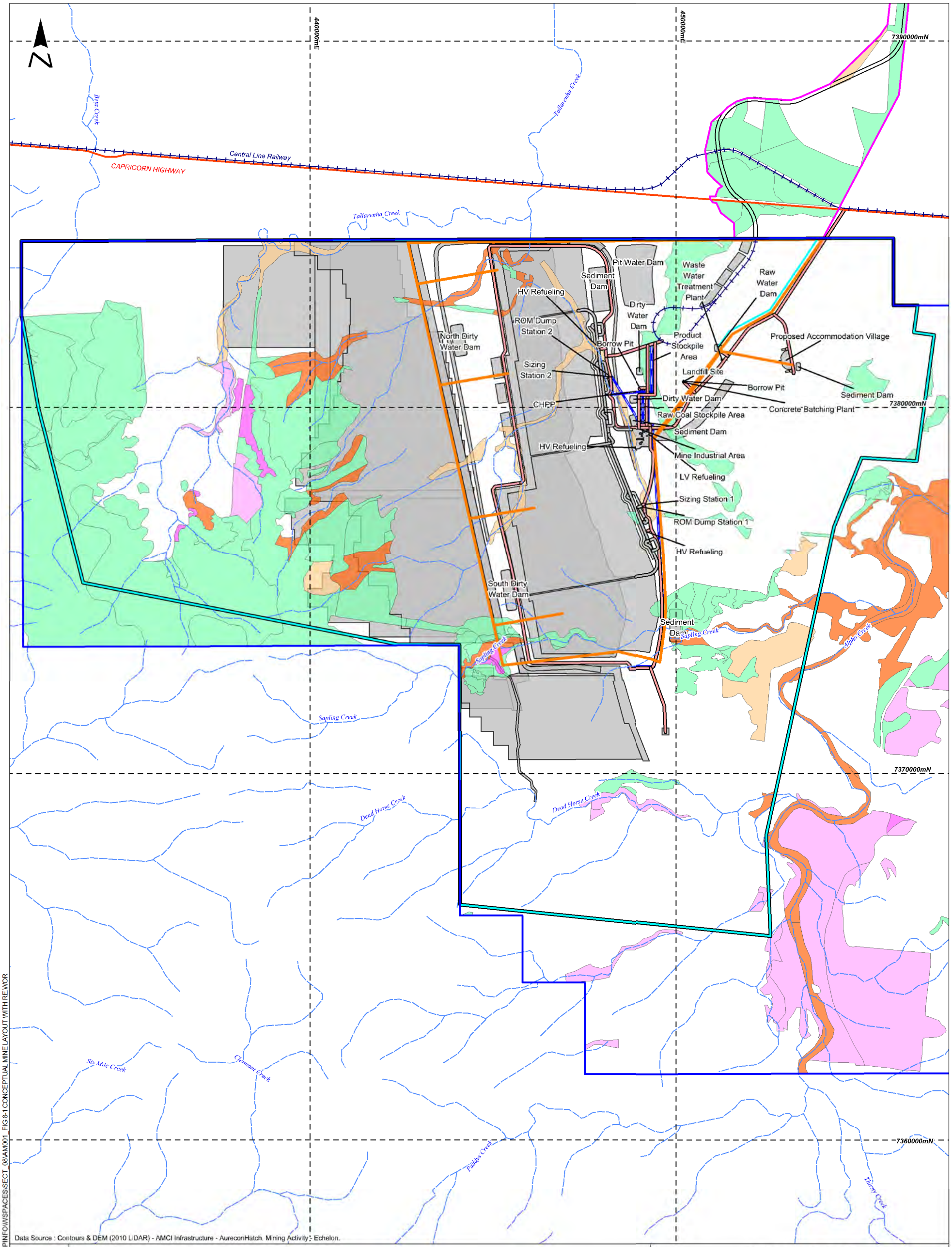
8.2. TERRESTRIAL FLORA

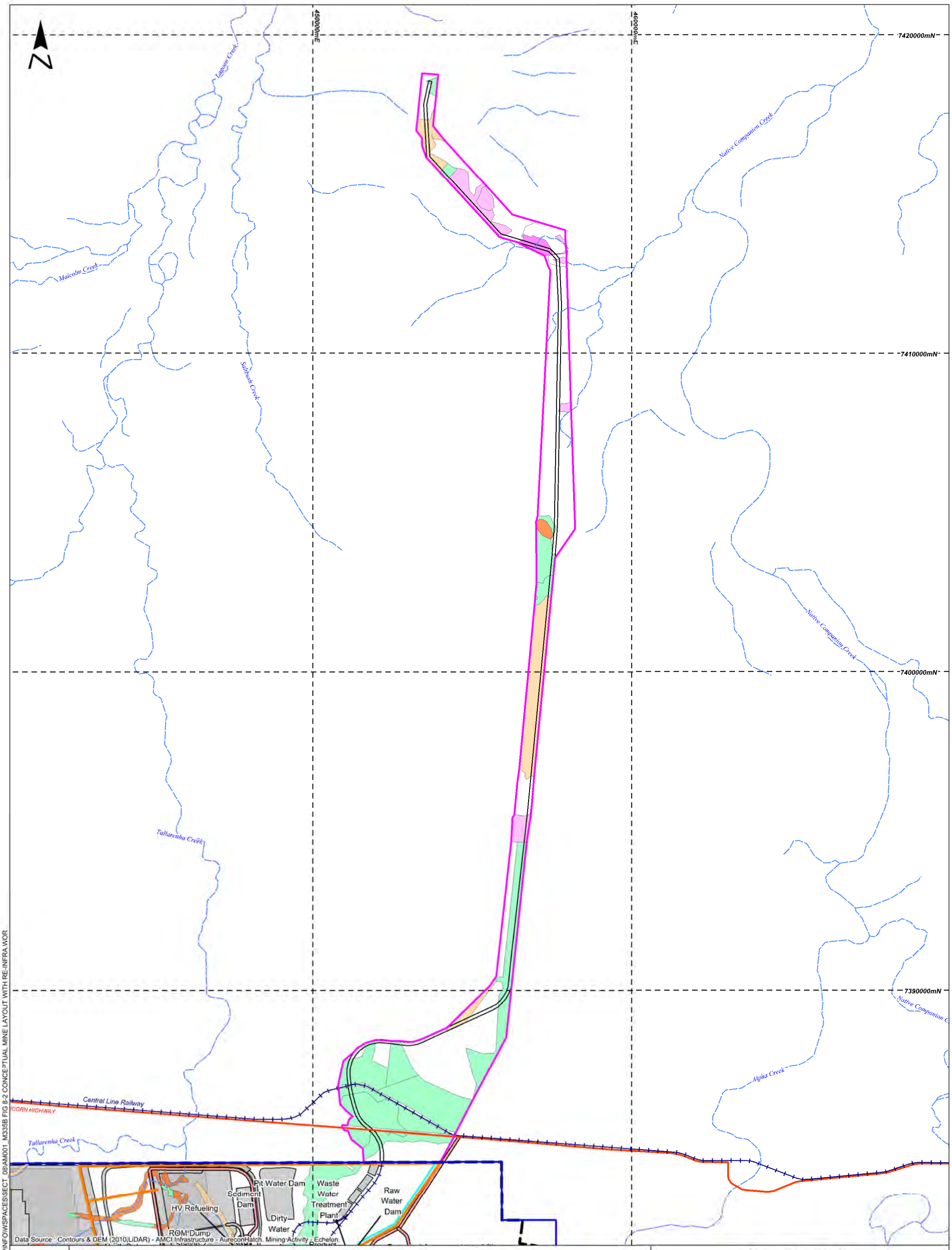
8.2.1. Study Area

The SGCP area is 46,584 ha of predominantly low-lying, undulating land with shallow relief, ranging from 378 m above sea level to 450 m above sea level. The western portion of the SGCP area contains the northern edge of the Carnarvon Range. Remnant vegetation along this range is contiguous with vegetation in the Carnarvon Ranges and Carnarvon National Park, approximately 135 km to the south. The SGCP area has historically been used for cattle grazing and occurs within both remnant and non-remnant vegetation. Remnant vegetation occurs over approximately 31 % of the SGCP area (refer to **Section 6.1.1** of **Appendix N—Terrestrial Ecology Technical Report**).

For the purposes of flora assessment, the SGCP area was divided into two arbitrary areas: the mine survey area and the infrastructure corridor area. The mine survey area is approximately 20 kilometres south-west of the town of Alpha. The mine survey area totals 42,791.62 ha and is bounded by the latitudes of -23.38° in the north and -23.51° in the south, and longitudes 146.44° in the west and 146.20° in the east. **Figure 8-1**and **Figure 8-2** detail the mine layout plan over the vegetation mapping for the site.

The infrastructure corridor area is a 100 m-wide band running north from the mine survey area for approximately 40.1 km. The infrastructure corridor is proposed to contain a railway for transporting coal from the mine area, and a maintenance road to service the rail infrastructure. Land tenure within the project area is detailed in **Section 2.1** of **Appendix N—Terrestrial Ecology Technical Report**.


N
440000mE
450000mE
7390000mN
7380000mN
7370000mN
7360000mN
Bora Creek
Tallarenha Creek
Central Line Railway
CAPRICORN HIGHWAY
Pit Water Dam
Sediment Dam
HV Refueling
Waste Water Treatment Plant
Raw Water Dam
Dirty Water Dam
ROM Dump Station 2
North Dirty Water Dam
Borrow Pit
Product Stockpile Area
Proposed Accommodation Village
Sizing Station 2
Landfill Site
Borrow Pit
Sediment Dam
CHPP
Dirty Water Dam
Concrete Batching Plant
Raw Coal Stockpile Area
Sediment Dam
HV Refueling
Mine Industrial Area
LV Refueling
Sizing Station 1
ROM Dump Station 1
HV Refueling
South Dirty Water Dam
Sediment Dam
Sapling Creek
Alpha Creek
Dead Horse Creek
Six Mile Creek
Clermont Creek
Paddys Creek
Thirsty Creek
Data Source : Contours & DEM (2010 LiDAR) - AMCI Infrastructure - AureconHatch. Mining Activity - Echelon.
LEGEND
MLA70453
Principal road
Mine survey area
Iinfrastructure corridor Survey Area
Mining Activity
Mining Activity
Infrastructure
Topsoil stockpile
Facility Area
Stream diversion
Drainage channel
Water Storage Dam
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor
Utilities
66kV overhead power line
11kV overhead power line
Raw water pipeline
Regional Ecosystem
Biodiversity status
Endangered (dominant)
Endangered (sub-dominant)
Of Concern (dominant)
Of Concern (sub-dominant)
Not of Concern
Non-remnant
METSERVE
Mining & Energy Technical Services Pty Ltd
SouthGalilee
Alpha Coal Pty Ltd
South Galilee Coal Project
Conceptual Mine Layout Plan
with RE Overlay - Year 33
2 0 2
Kilometres
Scale: 1:100,000 (A3)
12/09/2012
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 8-1
S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_08\AM001_FIG 8-1 CONCEPTUAL MINE LAYOUT WITH RE.WOR


N
450000mE
460000mE
7420000mN
7410000mN
7400000mN
7390000mN
Lagoon Creek
Malcolm Creek
Saltbush Creek
Native Companion Creek
Native Companion Creek
Native Companion C
Tallarenha Creek
Tallarenha Creek
Alpha Creek
Central Line Railway
DORN HIGHWAY
Pit Water Dam
Sediment Dam
Waste Water Treatment Plant
Raw Water Dam
HV Refueling
Dirty Water
ROM Dump
Data Source : Contours & DEM (2010 LIDAR) - AMCI Infrastructure - AureconHatch, Mining Activity - Echelon,
S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAP\INFO\WSPACE\SECT_09\AM001_M335B FIG 8-2 CONCEPTUAL MINE LAYOUT WITH RE-INFRA.WOR
METSERVE
Mining & Energy Technical
SouthGalilee
LEGEND
MLA70453
Principal road
Mine survey area
Iinfrastructure corridor Survey Area
Mining Activity
Mining Activity
Infrastructure
Topsoil stockpile
Facility Area
Stream diversion
Drainage channel
Water Storage Dam
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor
Utilities
66kV overhead power line
11kV overhead power line
Raw water pipeline
Regional Ecosystem
Biodiversity status
Endangered (dominant)
Endangered (sub-dominant)
Of Concern (dominant)
Of Concern (sub-dominant)
Not of Concern
Non-remnant
Alpha Coal Pty Ltd
South Galilee Coal Project
Conceptual Mine Layout Plan with RE Overlay (Infrastructure Corridor) - Year 33
2 0 2
Kilometres
Scale: 100,000 (A3)
12/09/2012
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 8-2

8.2.2. Methodology

A review of existing information on the flora within the SGCP area was undertaken by searching government databases and current literature. Gap analysis was undertaken subsequent to literature reviews to determine voids in the existing knowledge of flora values for the SGCP area; these knowledge gaps were targeted specifically during field surveys. Sources of information are referenced within **Section 4** of **Appendix N—Terrestrial Ecology Technical Report**, and included:

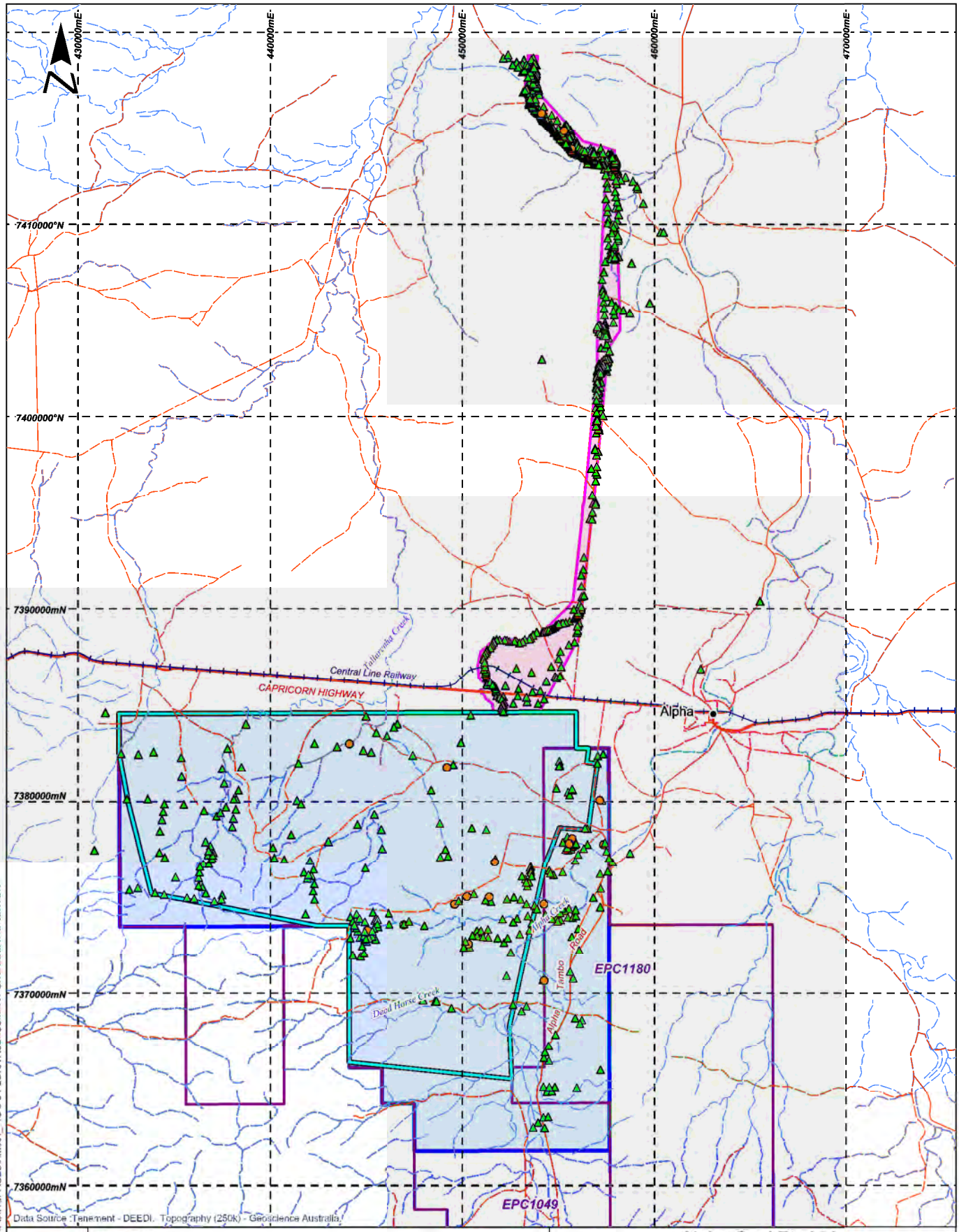
- *EPBC Act* protected matters search tool
- Queensland Herbarium flora records (HERBRECS)
- DEHP regional ecosystem (RE) and regrowth vegetation mapping, and current satellite imagery
- DEHP essential habitat and environmentally sensitive area mapping
- DEHP biodiversity planning assessment
- previous flora surveys of the SGCP area and surrounds.

Field assessments were conducted using best practice botanical sampling and methodologies (DEC NSW 2004; Neldner *et al.*, 2005). Field flora surveys were undertaken within the mine survey area in April and October 2009 and within the infrastructure corridor area in May/June and September 2011 (refer to **Figure 8-3**). Survey techniques encompassed community-level vegetation assessments as well as threatened and near threatened species searches within specific habitats. Detailed methodologies are contained within **Section 5.1** of **Appendix N—Terrestrial Ecology Technical Report**.

Field flora surveys included ground-truthing of RE mapping and extents of each ecosystem. A total of 839 survey sites were used to verify vegetation communities within the SGCP area. The mine survey area contains 272 of these sites and 567 sites are within the infrastructure corridor area.

Targeted searches for species of conservation significance were undertaken on foot either along randomly selected 50 m transects or through the examination of potential habitat of threatened flora species.

Quadrat-based systematic assessments of species and vegetation structure were conducted. A total of 22 comprehensive quadrat-based assessments were undertaken; 16 surveys were conducted within the mine survey area and six within the infrastructure corridor. Each quadrat was 50 x 10 m. These surveys were conducted in plant communities likely to be of high conservation significance and/or be subject to disturbance from the SGCP (refer to **Section 5.1.3** of **Appendix N—Terrestrial Ecology Technical Report**).



LEGEND

- MLA70453
- Exploration tenement
- Mine survey area
- Infrastructure corridor survey area
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Stream
- Population centre

Flora assessment site

- Quaternary
- Secondary

METSERVE

SouthGalilee

Alpha Coal Pty Ltd

South Galilee Coal Project

Flora Assessment Site Locations

2.5 0 2.5

Kilometres

Scale: 1:150,000 (A4)

25/07/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-3

S:\PROJECTS\AM\001_STH_GALILEE\IS\GIS_MAP\INFO\WSPACES\AM001_-IG 8-3 FLORA ASSESSMENT SITE LOCATIONS.WOR

8.2.3. Vegetation Communities

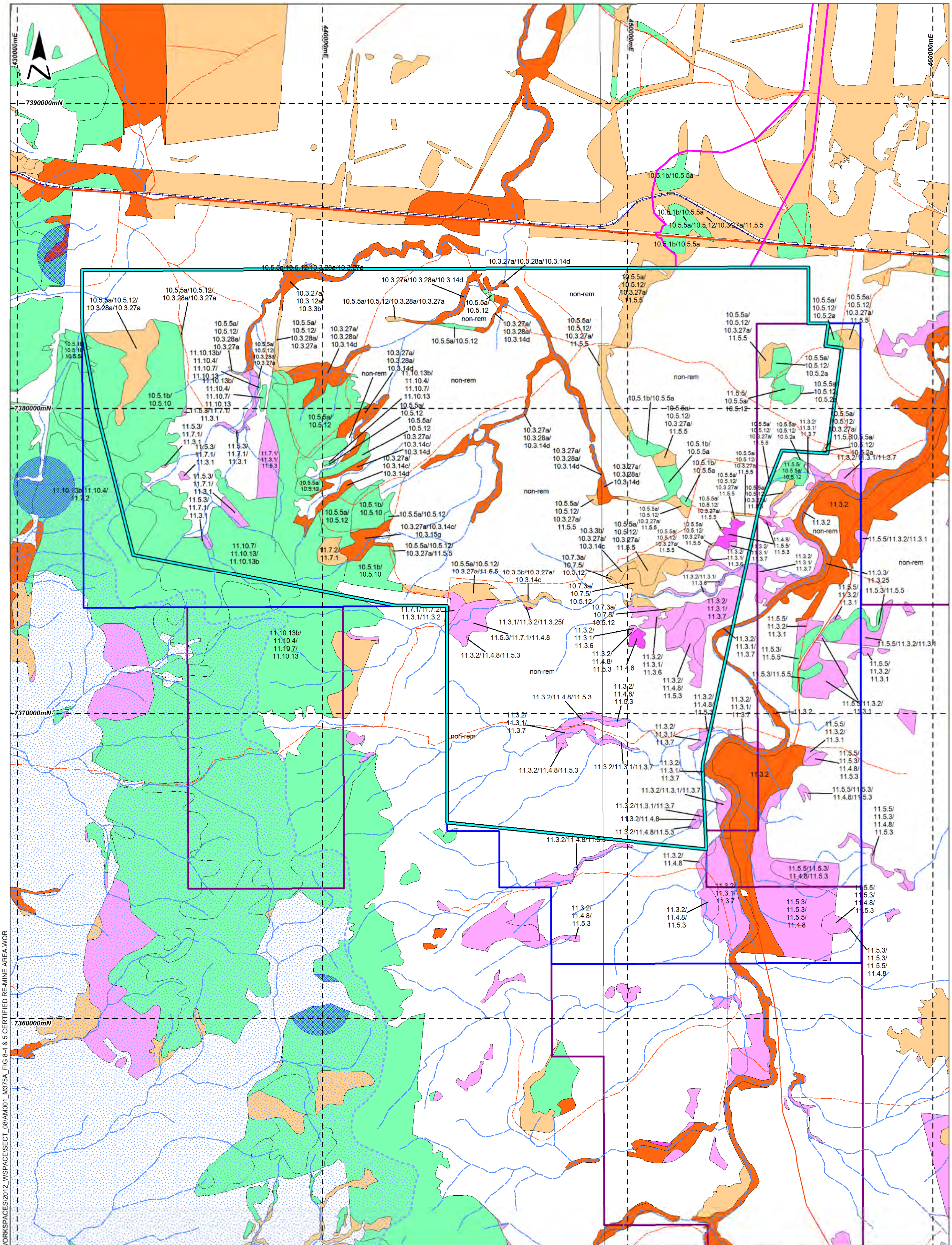
8.2.3.1. Certified Regional Ecosystems

According to certified RE mapping, 33 regional ecosystems are mapped within the SGCP area (refer to **Figure 8-4, Figure 8-5** and **Section 4.1** of **Appendix N—Terrestrial Ecology Technical Report**).

The five Land Zones contained within the SGCP are:

- Land zone 3: alluvial plains
- Land zone 4: gently undulating clay
- Land zone 5: uniform sand plains
- Land zone 7: duricrusts and footslopes
- Land zone 10: course-grained sediments.

This page intentionally left blank



LEGEND

- MLA70453
- Mine survey area
- Exploration tenement
- Infrastructure corridor survey area
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Stream

Biodiversity Status

- Endangered (dominant)
- Endangered (sub-dominant)
- Of Concern (dominant)
- Of Concern (sub-dominant)
- Not of Concern
- Non-remnant

Vegetation Management
(Vegetation Management Act 1999)

- Essential habitat

Wild River Management Areas
(Wild Rivers Act 2005)

- Proposed preservation area

METSERVE Mining & Energy Technical Services

SouthGalilee

Data Source : Tenement - DEEDI. Topography (250k) - Geoscience Australia. BPA (2003) - DERM.

Alpha Coal Pty Ltd

South Galilee Coal Project

Certified RE Mapping, Essential Habitat and Wild Rivers Management Areas

0 5
Kilometres

Scale: 1:100,000 (A3)

12/09/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-4

S:\PROJECTS\AM001 STH GALILEE EIS_MAPINFO\WORKSPACES\2012_WSPACE\SECT_08\AM001_M375A_FIG 8-4 & 5 CERTIFIED RE-MINE AREA.WOR

7,420,000 mN
7,410,000 mN
7,400,000 mN
7,390,000 mN
440,000 mE
450,000 mE
460,000 mE
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
10.7.3b/ 10.7.5/ 10.5.5a
10.7.3b
10.5.1b/ 10.5.1d/ 10.5.5a
10.5.10/ 10.5.1d/ 10.5.5a
10.7.3b/ 10.7.5
11.4.8/11.5.3/11.5.3
10.5.5a/10.5.12/ 10.3.27a/11.5.5
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
11.3.2/ 11.5.3/ 11.5.3/ 11.3.1
11.3.2/ 11.5.3/ 11.5.3/ 11.3.1
11.4.8/ 11.5.3/ 11.5.3
non-rem
10.3.15g
11.5.3/11.4.8
11.3.7
11.3.7
non-rem
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
10.5.1b/ 10.5.5a
non-rem
10.3.27a/10.3.28a/10.3.14d
10.3.27a/10.3.28a/10.3.14d
10.5.5a/10.5.12/10.3.28a/10.3.27a
10.5.5a/ 10.5.12
non-rem
10.3.27a/ 10.3.28a/ 10.3.14d
10.5.5a/ 10.5.12
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
10.5.1b/ 10.5.5a
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
10.5.5a/ 10.5.12/ 10.5.2a
10.5.5a/ 10.5.12/ 10.3.27a/ 11.5.5
10.3.27a/ 10.3.28a/
10.5.5a/10.5.12

LEGEND

- MLA70453
- Mine survey area
- Exploration tenement
- Infrastructure corridor survey area
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Stream

Biodiversity Status
- Endangered (dominant)
- Endangered (sub-dominant)
- Of Concern (dominant)
- Of Concern (sub-dominant)
- Not of Concern
- Non-remnant

Vegetation Management
(Vegetation Management Act 1999)
- Essential habitat

Wild River Management Areas
(Wild Rivers Act 2005)
- Proposed preservation area

Data Source : Tenement - DEEDI. Topography (250k) - Geoscience Australia. BPA (2003) - DERM.

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

Alpha Coal Pty Ltd

South Galilee Coal Project

Infrastructure Corridor-Certified RE Mapping, Essential Habitat and Wild Rivers Management Areas

0 5
Kilometres

Scale: 1:100,000 (A3)

12/09/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-5

S:\PROJECTS\AM001 STH GALILEE EIS_MAPINFO\WORKSPACES\2012_WSPACE\SECT_08\AM001_M375A_FIG 8-4 & 5 CERTIFIED RE-MINE AREA.WOR

8.2.3.2. Field-verified Regional Ecosystems

Refinements were made to the certified RE mapping following field survey verification (refer to **Section 5.1** of **Appendix N—Terrestrial Ecology Technical Report**). Non-remnant vegetation accounted for approximately 70 % of the SGCP area, comprising an area of approximately 32,000 ha. Non-remnant and non-regrowth vegetation communities on the SGCP area consisted of grasslands. Extensive areas were dominated by the invasive exotic perennial Buffel Grass. However, many areas were dominated by native species (refer to **section 6.1** of **Appendix N—Terrestrial Ecology Technical Report, Figure 8-6** and **Figure 8-7**). The condition of these grasslands varied with grazing pressure.

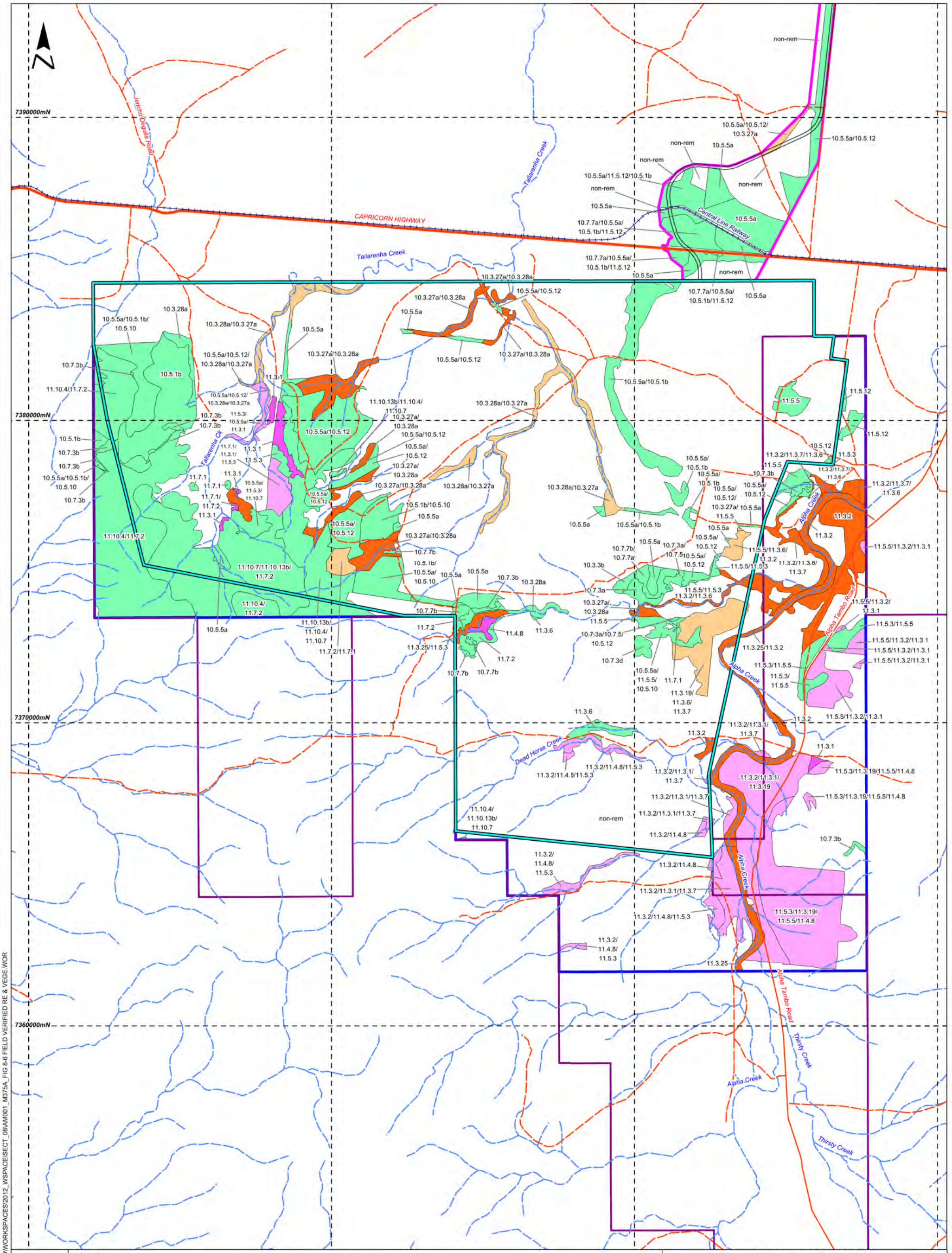
8.2.3.3. Regional Ecosystems of Conservation Significance

Nine REs with a DEHP Biodiversity Status of Concern were recorded within the SGCP area (10.3.15i, 10.3.27a, 11.3.2, 11.3.6, 11.3.25, 10.3.27b, 11.3.2b, 11.3.7, 11.7.1) (refer to **Table 8-1**, **Figure 8-4** and **Figure 8-5**).

The Endangered ecological community Brigalow, comprised of two REs (RE 11.3.1 and 11.4.8) was confirmed in the SGCP area. Brigalow occurred over 578.51 ha of the mine and infrastructure corridor survey areas (1.2 % of the total area and 4 % of remnant vegetation). Brigalow was found within the western, central and southern portions of the mine survey area, as well in the central and northern portions of the infrastructure corridor survey area (refer to **Figure 8-4** and **Figure 8-5**). The infrastructure corridor survey area had one large area of RE 11.4.8 comprising 21.35 ha. Regional ecosystem 11.3.1 occurred in small areas comprising a total of < 12 ha.

Within the mine survey area, larger stands of Brigalow (RE 11.4.8) were found over 27.96 ha in the central portion. Two stands of 66.63 ha and 17.1 ha of Brigalow (RE 11.3.1) were found in the central western portion of the mine survey area. Smaller stands of approximately 5 ha of Brigalow (RE 11.3.1) were present to the south of the aforementioned larger areas. Other areas of Brigalow within the SGCP area occur as a mosaic with other communities dominated variously by *Eucalyptus, Corymbia, Acacia* and *Callitris* species. Most of this Endangered ecological community will be avoided by the proposed SGCP. A total of 13.98ha (2.4 % of the Brigalow on-site) is proposed to be cleared (refer to **Table 8-1**).

This page intentionally left blank



S:\PROJECTS\AM001 STH GALILEE EIS_MAPINFO\WORKSPACES\2012_WSPACE\SECT_08\AM001_M375A_FIG 8-6 FIELD VERIFIED RE & VEGE.WOR

LEGEND

- MLA70453
- Mine survey area
- Exploration tenement
- Infrastructure corridor survey area
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Stream

Biodiversity Status

- Endangered (dominant)
- Endangered (sub-dominant)
- Of Concern (dominant)
- Of Concern (sub-dominant)
- Not of Concern
- Non-remnant

Data Source : Tenement - DEEDI. Topography (250k) - Geoscience Australia. BPA (2003) - DERM.

METSERVE Mining & Energy Technical

SouthGalilee

Alpha Coal Pty Ltd

South Galilee Coal Project

Mine Area-Field Verified Remnant Vegetation, RE and Biodiversity Status

2 0 2

Kilometres

Scale: 1:100,000 (A3)

12/09/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-6

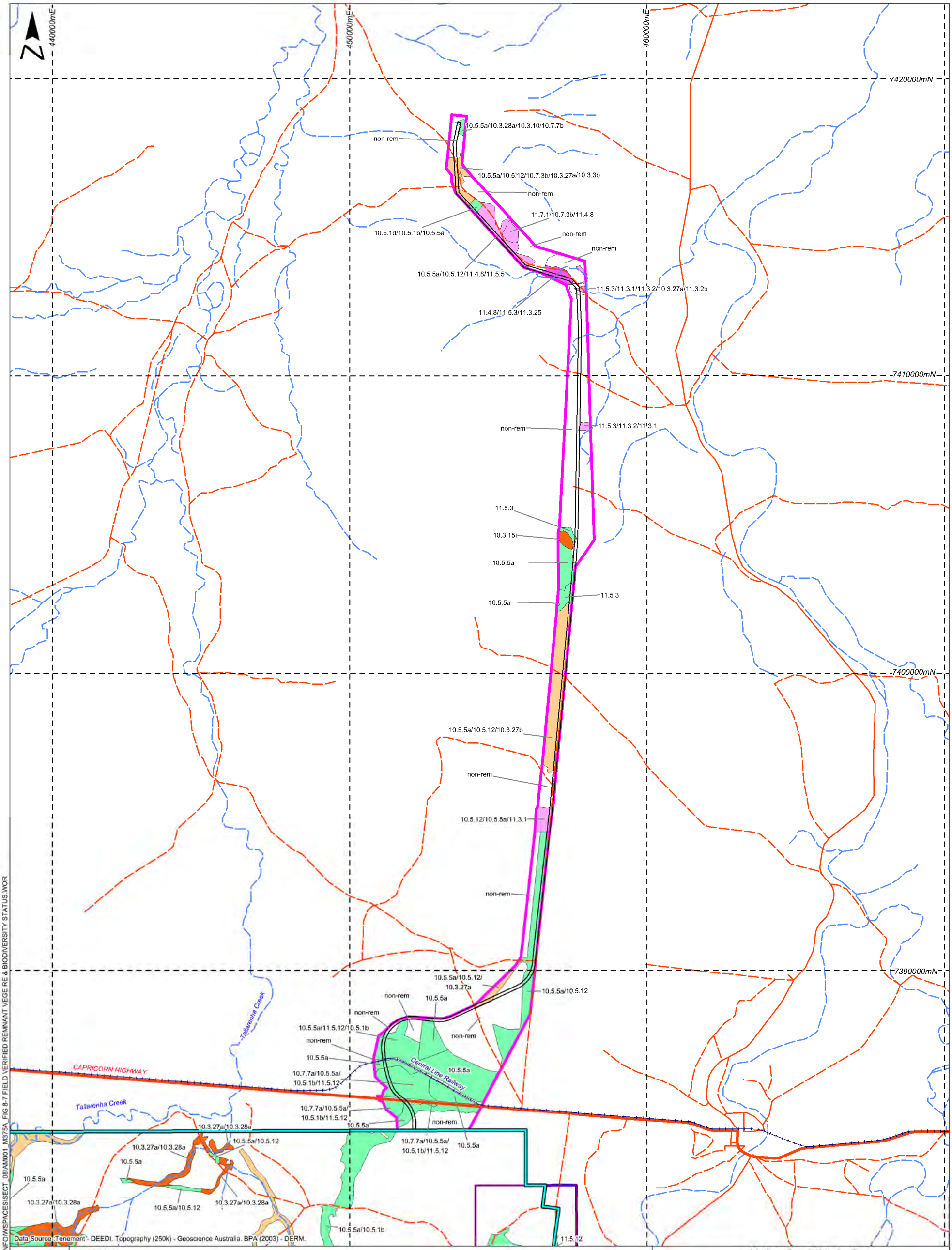

N
440000mE
450000mE
460000mE
7420000mN
7410000mN
7400000mN
7390000mN
10.5.5a/10.3.28a/10.3.10/10.7.7b
non-rem
10.5.5a/10.5.12/10.7.3b/10.3.27a/10.3.3b
non-rem
11.7.1/10.7.3b/11.4.8
10.5.1d/10.5.1b/10.5.5a
non-rem
non-rem
10.5.5a/10.5.12/11.4.8/11.5.5
11.5.3/11.3.1/11.3.2/10.3.27a/11.3.2b
11.4.8/11.5.3/11.3.25
non-rem
11.5.3/11.3.2/11.3.1
11.5.3
10.3.15i
10.5.5a
10.5.5a
11.5.3
10.5.5a/10.5.12/10.3.27b
non-rem
10.5.12/10.5.5a/11.3.1
non-rem
10.5.5a/10.5.12/
10.3.27a
10.5.5a/10.5.12
non-rem
10.5.5a
non-rem
10.5.5a/11.5.12/10.5.1b
non-rem
non-rem
10.5.5a
10.7.7a/10.5.5a/
10.5.1b/11.5.12
Central Line Railway
10.5.5a
CAPRICORN HIGHWAY
Tallarenha Creek
Tallarenha Creek
10.7.7a/10.5.5a/
10.5.1b/11.5.12
10.5.5a
non-rem
10.3.27a/10.3.28a
10.3.27a/10.3.28a
10.5.5a/10.5.12
10.7.7a/10.5.5a/
10.5.1b/11.5.12
10.5.5a
10.5.5a
10.5.5a
10.3.27a/10.3.28a
10.5.5a/10.5.12
10.3.27a/10.3.28a
10.5.5a/10.5.1b
11.5.12
Data Source: Tenement - DEEDI. Topography (250k) - Geoscience Australia. BPA (2003) - DERM.
LEGEND
MLA70453
Exploration tenement
Mine survey area
Infrastructure corridor survey area
SGCP infrastructure corridor
Principal road
Road (sealed)
Road (unsealed)
Railway
Stream
Biodiversity Status
Endangered (dominant)
Endangered (sub-dominant)
Of Concern (dominant)
Of Concern (sub-dominant)
Not of Concern
Non-reminant
METSERVE
Mining & Energy Technical
SouthGalilee
S:\PROJECTS\AM001_STH\GALILEE_EIS\GIS_MAP\INFO\WSPACE\SECT_08\AM001_M375A_FIG 8-7 FIELD VERIFIED REMNANT VEGE RE & BIODIVERSITY STATUS.WOR
Alpha Coal Pty Ltd
South Galilee Coal Project
Infrastructure Corridor-Field Verified Remnant Vegetation, Regional Ecosystems, and Biodiversity Status
12/09/2012
2 0 2
Kilometres
Scale: 1:115,000 (A3)
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 8-7

Table 8-1 Regional Ecosystems (REs) within the SGCP Area, their Extent, Status and Areas Impacted

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area Overlying Underground Mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 3: Alluvial plains									
Dominant or subdominant									
10.3.3b	*Acacia harpophylla* (Brigalow) low woodland to woodland on alluvium	Low	LC	NOC	–	12.65	11.78	0	0.87
10.3.15i	*Eucalyptus coolabah* (Coolibah) dominated Palustrine wetland (i.e. vegetated swamp). Occurs on grey clay soils in closed depressions on Tertiary sandplain or ferricrete	Low	LC	OC	–	0	0	0	0
10.3.27a	*Eucalyptus populnea* (Poplar Box) open-woodland to woodland on alluvial plains	Low	LC	OC	–	261.32	77.39	181.77	2.16
10.3.28a	*Eucalyptus melanophloia* (Silver-leaved Ironbark) ± *Corymbia dallachiana* (Dallachy's Gum) open woodland on sandy alluvial fans	Low	LC	NOC	–	293.78	174.91	118.68	0.19
11.3.1	*Acacia harpophylla* (Brigalow) and/or *Casuarina cristata* (Belah) open forest on alluvial plains	Low	E	E	E	0.62	0	0	0.62
11.3.2	*Eucalyptus populnea* (Poplar Box) woodland on alluvial plains	Low	OC	OC	–	0.27	0.0014	0	0.27

LC – Least Concern, NOC – Not of Concern, OC – Of Concern, E - Endangered

Table 8-1 Regional Ecosystems (REs) Within the SGCP Area, Their Extent, Status and Areas Impacted (cont)

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area overlying underground mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 3: Alluvial plains									
Dominant or subdominant									
11.3.6	*Eucalyptus melanophloia* (Silver-leaved Ironbark) woodland on alluvial plains	Low	LC	OC	–	2.97	2.97	0	0
11.3.19	*Callitris glaucophylla* (White Cypress Pine), *Corymbia* spp. and/or *Eucalyptus melanophloia* (Silver-leaved Ironbark) woodland on Cainozoic alluvial plains	Low	LC	NOC	–	0	0	0	0
11.3.25	*Eucalyptus tereticornis* (Forest Red Gum) or *E. camaldulensis* (River Red Gum) woodland fringing drainage lines	Low	LC	OC	–	4.63	1.39	2.13	1.11
Subdominant only									
10.3.10	*Corymbia dallachiana* and *C.oinalis* open woodland on old alluvial plains (western)	Low	LC	NOC	–	0.10	0	0	0.10

Table 8-1 Regional Ecosystems (REs) Within the SGCP Area, their Extent, Status and Areas Impacted (cont)

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area overlying underground mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 3: Alluvial plains									
Subdominant only									
10.3.27b	*Archidendropsis basaltica* (Dead Finish) open-woodland to woodland on alluvial plains	Low	LC	OC	–	2.84	0	0	2.84
11.3.2b	Palustrine wetland. *Eucalyptus camaldulensis* (sometimes *E. populnea* and or *E. tereticornis*) woodland in drainage depressions. Ground layer of grasses or sedges. Occurs on seasonally inundated drainage depressions	Low	OC	OC	–	0.07	0	0	0.07
11.3.7	*Corymbia* spp. woodland on alluvial plains.	Low	LC	OC	–	0	0	0	0
Landzone 4: Gently undulating clay									
Dominant or subdominant									
11.4.8	*Eucalyptus cambageana* (Dawson Gum) woodland to open forest with *Acacia harpophylla* (Brigalow) or *A. argyrodendron* (Blackwood) on Cainozoic clay plains	Low	E	E	E*	13.36	4.87	0	8.49

Table 8-1 Regional Ecosystems (REs) Within The SGCP area, Their Extent, Status and Areas Impacted (cont)

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area overlying underground mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 5: Uniform sand plains									
Dominant or subdominant									
10.5.1b	*Corymbia brachycarpa* (Desert Bloodwood) ± *Corymbia dallachiana* (Dallachy's Gum) low open woodland to open woodland on sand plains	Low	LC	NOC	–	151.15	9.43	137.88	3.84
10.5.1d	*Corymbia setosa* dominates the very sparse canopy (6–11 m tall). *Grevillea glauca* and *Petalostigma pubescens* are frequently present in the very sparse midstorey layer (3–6 m tall). *Acacia spp.* and *Carissa lanceolata* dominate the very sparse shrub layer (0.5-2 m tall). The ground layer is usually dominated by *Triodia pungens.* Occurs on sandplains.	Low	LC	NOC	–	2.16	0	0	2.16
10.5.5a	*Eucalyptus melanophloia* (Silver-leaved Ironbark) ± *Corymbia plena* (Large-fruited Bloodwood) ± *C. dallachiana* (Dallachy's Gum) open-woodland on sand plains	Low	LC	NOC	–	621.92	54.11	419.65	148.16
10.5.12	*Eucalyptus populnea* (Poplar Box) open woodland	Low	LC	NOC	–	37.49	0.31	0	37.18
11.5.3	*Eucalyptus populnea* (Poplar Box) and/or *E. melanophloia* (Silver-leaved Ironbark) and/or *Corymbia clarksoniana* (Clarkson's Bloodwood) on Cainozoic sand plains/remnant surfaces	Low	LC	NOC	–	13.08	0.35	0.53	12.20

Table 8-1 Regional Ecosystems (REs) Within the SGCP Area, Their Extent, Status and Areas Impacted (cont)

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area overlying underground mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 5: Uniform sand plains									
Dominant or subdominant									
11.5.5	*Eucalyptus melanophloia* (Silver-leaved Ironbark), *Callitris glaucophylla* (White Cypress Pine) woodland on Cainozoic sand plains/remnant surfaces. Deep red sands	Low	LC	NOC	–	1.18	0	0	1.18
11.5.12	*Corymbia clarksoniana* (Clarkson's bloodwood) woodland and other *Corymbia* spp. and *Eucalyptus* spp. on Cainozoic sand plains/remnant surfaces	Low	LC	NOC	–	20.22	0	20.22	0
Subdominant only									
10.5.10	*Corymbia leichhardtii* (Rusty Jacket) open woodland on sand plains	Low	LC	NOC	–	81.44	0	81.44	0
Landzone 7: Duricrusts and footslopes									
Dominant or subdominant									
10.7.3a	*Acacia catenulata* (Bendee) ± *A. shirleyi* (Lancewood), ± *Eucalyptus persistens* (Mallee Box) ± *Corymbia dallachiana* (Dallachy's Gum) low woodland on scarps	Medium	LC	NOC	–	14.43	14.43	0	0

Table 8-1 Regional Ecosystems (REs) Within the SGCP Area, Their Extent, Status and Areas Impacted (cont)

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area overlying underground mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 7: Duricrusts and footslopes									
Dominant or subdominant									
10.7.3b	*Acacia shirleyi* (Lancewood) ± *Eucalyptus exilipes* (Fine-leaved Ironbark) low woodland on scarps	Medium	LC	NOC	–	8.76	0.62	5.53	2.61
10.7.3d	*Acacia catenulata* (Bendee) low woodland on shallow red earths†	Medium	LC	NOC	–	0	0	0	0
10.7.7a	*Melaleuca uncinata* (Broom Honey myrtle) and *M. tamariscina* (Bushhouse Paperbark) with or without *Acacia leptostachya* (Slender Wattle) tall open-shrublands on ferricrete	Medium	LC	NOC	–	5.5	0	0	5.50
10.7.7b	*Melaleuca tamariscina* (Bushhouse Paperbark) very sparse open-woodland on ferricrete	Medium	LC	NOC	–	33.01	0	32.91	0.10
11.7.1	*Acacia harpophylla* (Brigalow) and/or *Casuarina cristata* (Belah) and *Eucalyptus thozetiana* (Mountain Yapunyah) or *E. microcarpa* (Grey Box) woodland or *E. cambageana* on lower scarp slopes on lateritic duricrust	Low	LC	OC	–	5.64	0	5.64	0
11.7.2	*Acacia* spp. woodland on lateritic duricrust. Scarp retreat zone	Low	LC	NOC	–	45.41	2.49	42.92	0

Table 8-1 Regional Ecosystems (REs) Within the SGCP Area, Their Extent, Status and Areas Impacted (cont)

RE Vegetation Community	Short Description (REDD)	Extent in Reserves	Status			Total Impacted Area (ha)	Area to be Cleared in the MSA (ha)	Area overlying underground mine (ha)	Area to be Cleared in the ICSA (ha)
			VM Act	Biodiversity Status	*EPBC Act*				
Landzone 7: Duricrusts and footslopes									
Subdominant only									
10.7.5	*Eucalyptus thozetiana* (Mountain Yapunyah) open woodland on scarps and on pediments below scarps	Low	LC	NOC	–	0	0	0	0
Landzone 10: Coarse-grained sediments									
Dominant or subdominant									
11.10.4	*Eucalyptus decorticans* (Gum Top Ironbark), *Lysicarpus angustifolius* (Budgeroo) ± *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks. Crests and scarps	High	LC	NOC	–	25.83	0	25.83	0
11.10.7	*Eucalyptus crebra* (Narrow-leaved Ironbark) woodland on coarse-grained sedimentary rocks	Low	LC	NOC	–	25.83	0	25.83	0
11.10.13b	*Corymbia leichhardtii* (Rusty Jacket) woodland on scarps and sandstone tablelands	High	LC	NOC	–	34.44	0	34.44	0
Total Area (ha)						**1720.12**	**355.07**	**1135.4**	**229.64**

8.2.4. Flora Species

The SGCP area contains high floristic diversity with 312 plant species from 60 plant families recorded during field surveys within the SGCP area (refer to **Appendix C** of **Appendix N—Terrestrial Ecology Technical Report**).

8.2.4.1. Species of Conservation Significance

Ten plant species of conservation significance potentially occur in the SGCP area based on desktop surveys (refer to **Section 6.1.4.1** of **Appendix N—Terrestrial Ecology Technical Report**). Three species were confirmed during flora surveys (refer to **Figure 8-8**):

- Round-leaved Heath Myrtle (*Micromyrtus rotundifolia*) is listed as Vulnerable under the *NC Act* (refer to **Plate 8-1**). It was found growing in the mine survey area within RE 10.7.7. The species is likely to occur elsewhere within the SGCP area due to the availability of suitable habitat (refer to **Section 6.1.5.1** of **Appendix N—Terrestrial Ecology Technical Report**).
- Large-podded Trefoil (*Desmodium macrocarpum*) is listed as Near Threatened under the *NC Act* (refer to **Plate 8-2**). It was located within the infrastructure corridor survey area, on the properties Saltbush and Tresillian. The population within the SGCP area occurred in RE 11.5.3 and non-remnant vegetation. The species is likely to occur elsewhere within the SGCP area due to its ability to grow in both remnant and non-remnant vegetation across the site (refer to **Section 6.1.5.2** of **Appendix N—Terrestrial Ecology Technical Report**).
- *Eleocharis blakeana* is listed as Near Threatened under the *NC Act* (refer to **Plate 8-3**). It was located in the infrastructure corridor survey area in a coolibah-dominated wetland (RE 10.3.15i). The species is unlikely to be widespread within the SGCP area due a lack of suitable habitat (refer to **Section 6.1.5.3** of **Appendix N—Terrestrial Ecology Technical Report**).

One species of conservation significance, Western Rosewood, was found adjacent to the SGCP area and is considered likely to occur within the SGCP area although it was not detected during field flora surveys:

- Western Rosewood (*Acacia spania*) is listed as Near Threatened under the *NC Act* (refer to **Plate 8-4**). An individual plant was located 700 m to the west of the northwest corner of the mine survey area in habitat contiguous with the SGCP area. It is considered likely to occur within the SGCP area due to the continuity of suitable habitat between the Western Rosewood record and the mine area. There is a historical record of the species 5.25 km south of the SGCP area. The REs 10.5.5, 10.7.3, 11.10.4, and 11.10.13 are known habitats for these species, and all of them occur within the SGCP area.

Six other species of conservation significance that were identified as potentially occurring within the SGCP area by desktop surveys are not likely to occur based on their habitat requirements or absence of local records (refer to **Section 6.1.4.1** of **Appendix N—Terrestrial Ecology Technical Report**).

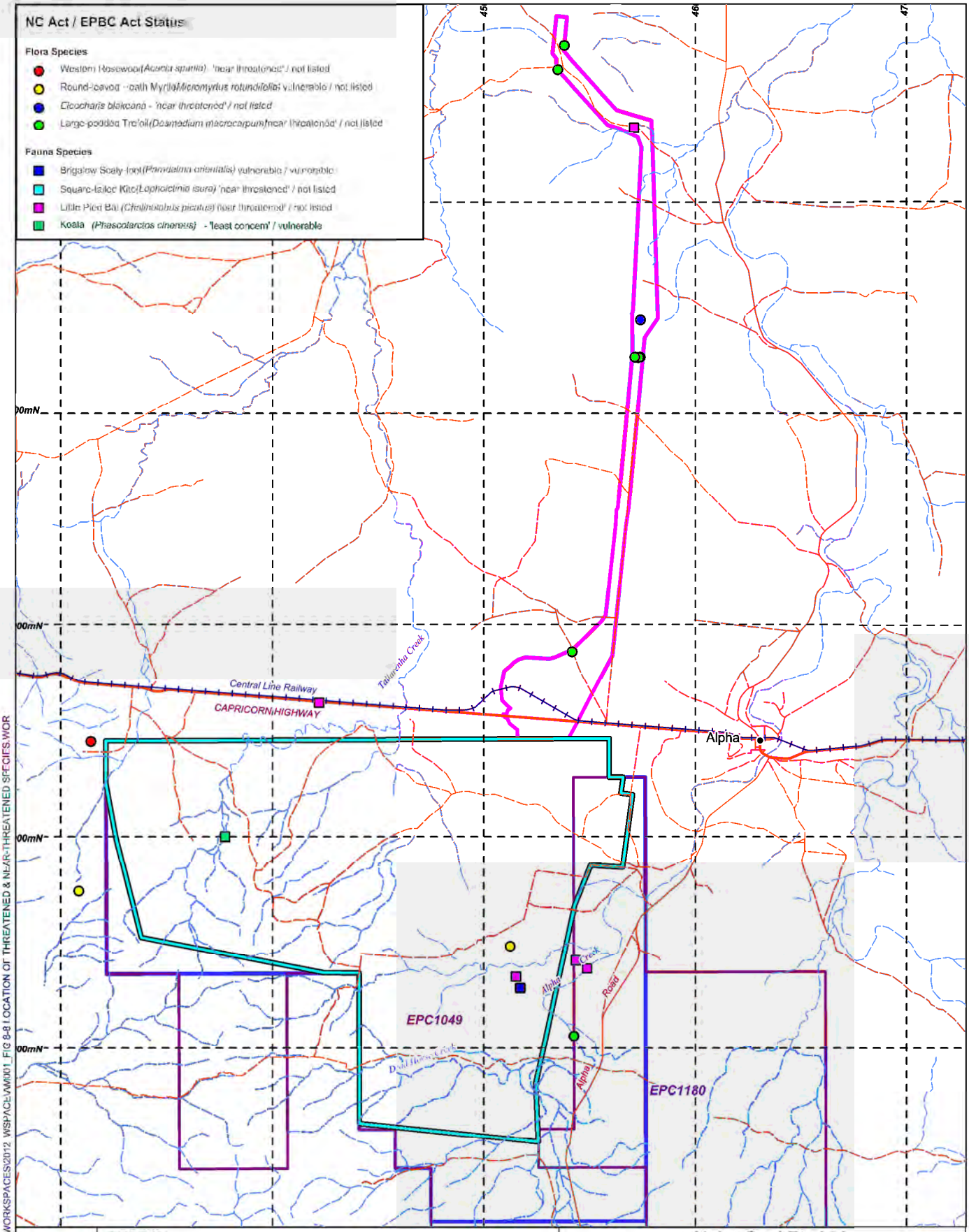

NC Act / EPBC Act Status
Flora Species
Western Rosewood (Acacia spania) 'near threatened' / not listed
Round-leaved Teatth Myrtle (Micromyrtus rotundifolia) vulnerable / not listed
Eleocharis blakeana - 'near threatened' / not listed
Large-podded Trefoil (Desmodium macrocarpum) 'near threatened' / not listed
Fauna Species
Brigalow Scaly-foot (Paradelma orientalis) vulnerable / vulnerable
Square-tailed Kite (Lophoictinia isura) 'near threatened' / not listed
Little Pied Bat (Chalinolobus picatus) 'near threatened' / not listed
Koala (Phascolarctos cinereus) - 'least concern' / vulnerable
Central Line Railway
CAPRICORN HIGHWAY
Alpha
EPC1049
EPC1180
Alpha Road
LEGEND
MLA70453
SGCP infrastructure corridor
SGCP power line
Principal road
Road (sealed)
Road (unsealed)
Railway
River
Population centre
Data Source: Tenement - DEEDI. Topography (250k) - Geoscience Australia
Alpha Coal Pty Ltd
South Galilee Coal Project
Location of Threatened and Near-Threatened Fauna and Flora Species
5 0 5
Kilometres
Scale: 1:250,000 (A4)
25/07/2012
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 8-8
METSERVE
SouthGalilee
S:\PROJECTS\AM001 STH GALILEE E SL_MAPINFO\WORKSPACES\2012 WSP\ACLAM001_FIG 8-8 LOCATION OF THREATENED & NEAR-THREATENED SPECIES.WOR

Plate 8-1 **The Vulnerable (*NT Act*) round-leaved heath myrtle (*Micromyrtus rotundifolia*) in RE 10.7.7**

Plate 8-2 **The Near Threatened large-podded trefoil (*Desmodium macrocarpum*) in RE 11.5.3.**

Plate 8-3 ***Eleocharis blakeana*** **collected from RE 10.3.15i within the Infrastructure Corridor Area**

Plate 8-4 **Western rosewood (*Acacia spania*), west of the SGCP area**

8.2.4.2. Weed Species

Twenty-eight weed species were recorded within the SGCP area. Three of these, Harrisia Cactus (*Harrisia* sp.), Prickly Pear (*Opuntia stricta*) and Velvety Tree Pear (*Opuntia tormentosa*) are listed as Class 2 weeds under the *LP Act*. All three species were localised within small areas of the SGCP and occurred in low densities.

Noogoora Burr (*Xanthium occidentale*) is listed as a 'low 3' weed under the local Government Barcaldine Pest Management Plan. This species is noted for control where practicable where it poses a risk of high infestations or spread. Noogoora Burr was widespread and common, mostly in riparian areas, within the SGCP area.

Buffel Grass (*Cenchrus ciliaris*), while not a declared weed species, has negative environmental impacts and is a problematic environmental weed (Fairfax and Fensham 2000; Kutt and Fisher, 2011). Buffel grass was dominant over large areas of non-remnant vegetation within the SGCP area.

No weeds of national significance were found in the SGCP area (refer to **Table 8-2**).

Table 8-2 Weed Species Within the SGCP Area and their Status

Species	Common Name	Status*	Barcaldine Pest Management Plan Priority	Growth Form
Acacia farnesiana	Prickly Acacia	–	_	Shrub
Alternanthera pungens	Khaki Weed	_	_	Herb
Cenchrus ciliaris	Buffel Grass	_	_	Grass
Chloris inflata	Purple-top Rhodes Grass	_	_	Grass
Chloris virgata	Feather-top Rhodes Grass	_	_	Grass
Cirsium vulgare	Bull Thistle	_	_	Herb
Citrullus lanatus	Paddymelon	_	_	Scrambling Vine
Conyza sumatrensis	Sumatran Fleabane	_	_	Herb
Cucumis anguria var anguria	West Indian Gherkin	_	_	Scrambling Vine
Gomphrena celosioides	Gomphrena Weed	–	_	Herb
Harrisia martinii	Harrisia Cactus	Pest - Class 2	_	Succulent

Table 8-2 Weed Species Within the SGCP Area and Their Status (cont)

Species	Common Name	Status (under the *LP Act*)	Barcaldine Pest Management Plan Priority	Growth Form
Heliotropium indicum	Indian Heliotrope	–	–	Herb
Indigofera tinctoria	True Indigo	–	–	Shrub
Melinis repens	Natal Grass	–	–	Grass
Opuntia stricta	Prickly Pear	Pest - Class 2	–	Succulent
Opuntia tomentosa	Velvety Tree Pear	Pest - Class 2	–	Succulent
Portulaca pilosa	Hairy Pigweed	–	–	Herb
Salsola australis	Soft Roly-poly	–	–	Herb
Senna occidentalis	Coffee Senna	–	–	Grass
Sida cordifolia	Flannel Weed	–	–	Shrub
Solanum torvum	Devil's Fig	–	–	Shrub
Sonchus oleraceus	Milk Thistle	–	–	Herb
Stapelia gigantea	Carrion Flower	–	–	Succulent
Stylosanthes hamata	Carribean Stylo	–	–	Shrub
Stylosanthes scabra	Shrubby Stylo	–	–	Shrub
Tridax procumbens	Tridax Daisy		–	Herb
Verbesina encelioides	Wild Sunflower	–	–	Herb
Xanthium occidentale	Noogoora Burr	–	Low 3	Herb

8.3. TERRESTRIAL FAUNA

8.3.1. Methodology

8.3.1.1. Survey timing

An initial pilot survey was conducted from 11 to 14 March 2009 to select sites for trapping surveys. Trapping surveys were conducted within the mine area from 14 to 19 October 2009 and 26 April to 3 May 2010. Trapping was conducted within the infrastructure corridor from 18 May to 1 June 2011. Incidental fauna sightings were also recorded during flora surveys.

8.3.1.2. Site selection

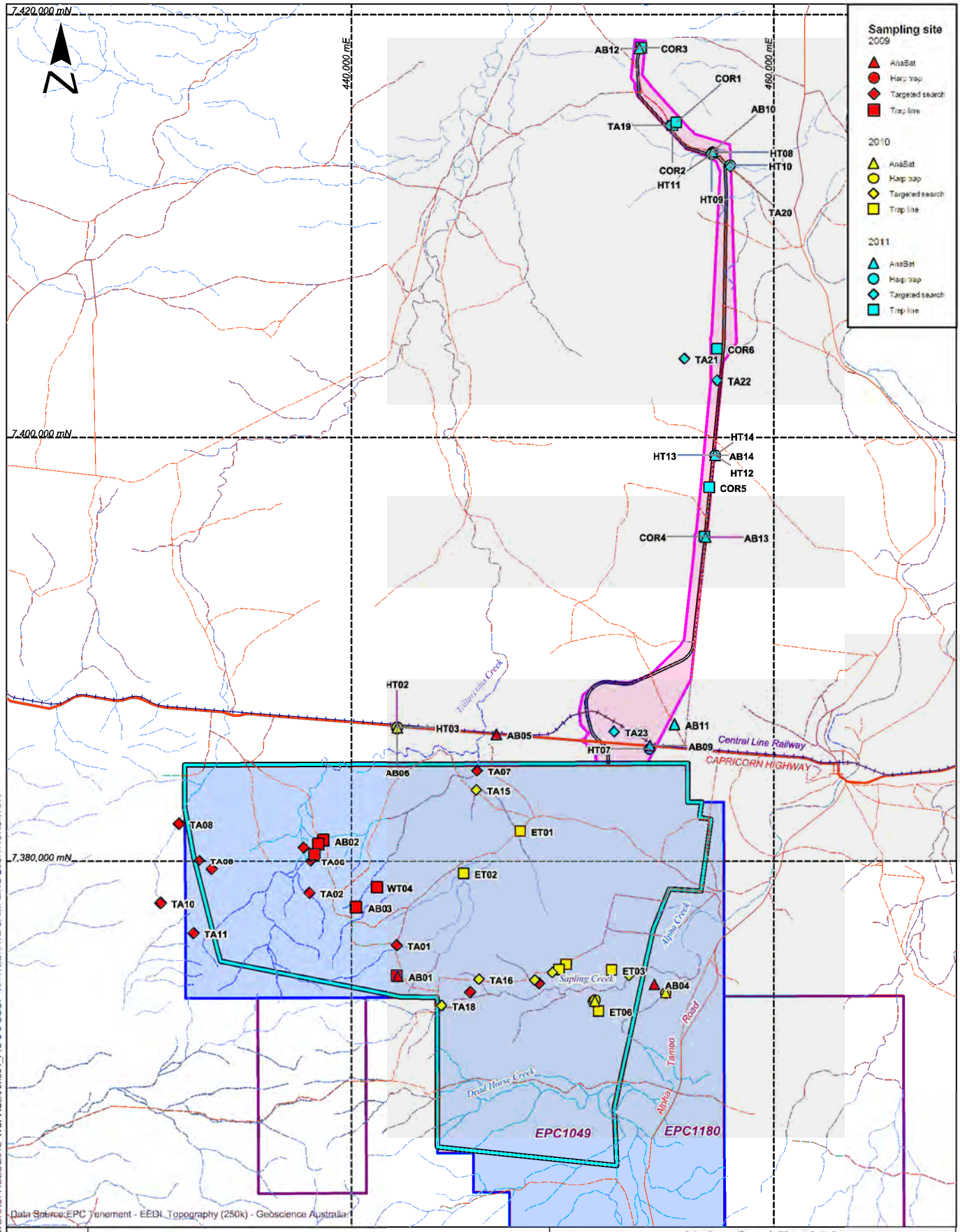
Terrestrial vertebrate survey methods aimed to maximize the number of species identified and locate threatened species. Surveys were conducted over a broad spectrum of habitats present within the SGCP area. Initial field inspection of the SGCP area in March 2009 (Matrixplus, 2009) resulted in the categorisation of landscapes and habitats into the following six types:

- Brigalow woodland on cracking clays
- eucalypt woodland with grassy ground cover
- eucalypt woodland with a low mixed shrub layer (including *Callitris*)
- eucalypt woodland with spinifex (*Triodia* spp.) ground cover
- Lancewood woodland on stony soil
- paperbark woodland.

Twelve sampling sites within the mine survey area and six sampling sites within the infrastructure corridor survey area were selected (refer to **Figure 8-9**). Sites chosen represented the highest quality fauna habitat present. The data from these high-quality sites could be used to conservatively infer the faunal communities present within lower quality examples of the same habitat types within the SGCP area. The October 2009 (dry season) survey focused on six sampling sites within the western portion of the mine survey area, called Western 1–6. The April 2010 (wet season) survey focused on six sites in the eastern section of the mine survey area (Eastern 1–6). The May 2011 (dry season) survey within the infrastructure corridor survey area assessed the sites Corridor 1–6.

Based on the species accumulation curves (**Figure 8-10**), the number of sites surveyed was considered sufficient to detect the vast majority of fauna species occurring on-site. Additional survey effort is, therefore, unlikely to reveal many additional species.

Trapping sites were supplemented by extensive targeted searches, focused on species of conservation significance. Targeted surveys involved diurnal and nocturnal visual searches of sheltering sites, waterholes or likely feeding locations of fauna of conservation significance, as specified by DSEWPaC (2011) in *Survey Guidelines for Australia's Threatened Mammals, Survey Guidelines for Australia's Threatened Birds* and *Survey Guidelines for Australia's Threatened Reptiles*. Targeted searches served to increase spatial data and allowed data collection from habitats not sampled in trapping sites (e.g., waterbodies). Detailed survey site descriptions are provided in **Section 5.2.2** and **Appendix B** of **Appendix N—Terrestrial Ecology Technical Report**.



S:\PROJECTS\AM001 STH GALILEE E SL_MAPINFO\WORKSPACES\2012 WSP\ACLAM001_FIG 8-9 SGCP VERTEBRATE SAMPLING LOCATIONS WOR

METSERVE
Mining & Energy Consulting

SouthGalilee

LEGEND

- MLA70453
- Exploration tenement
- Mine survey area
- SGCP infrastructure corridor
- Infrastructure corridor survey area
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Stream

Alpha Coal Pty Ltd

South Galilee Coal Project

Location of Vertebrate Sampling Sites in Mine Survey Area and Infrastructure Corridor

5 0 5
Kilometres

Scale: 1:250,000 (A4)

25/07/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-9

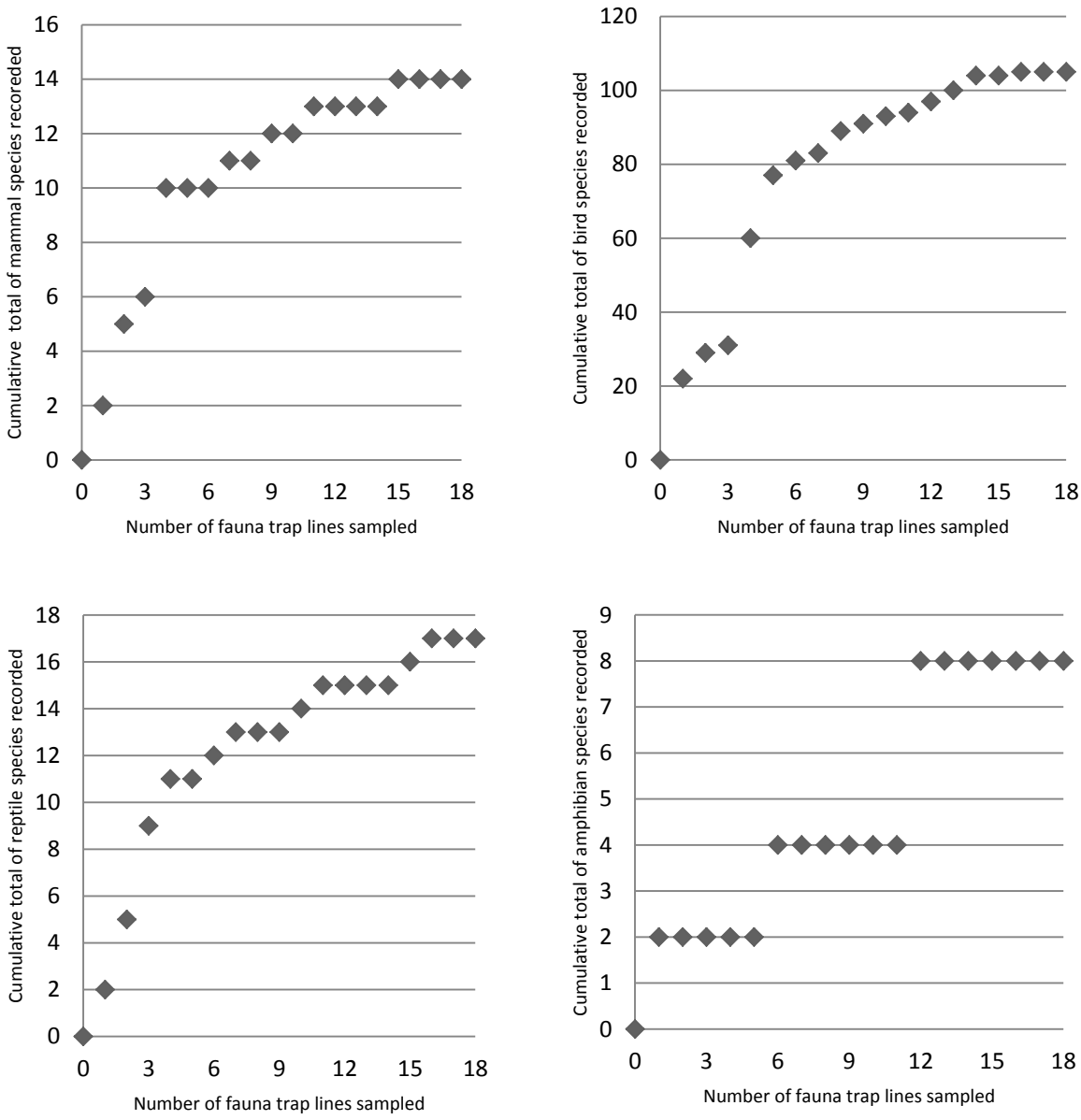


Figure 8-10 Species Accumulation Curves for the SGCP

The curves shown in **Figure 8-10** above display the rate at which new species were detected per unit sampling effort (18 trap sites in total). Very few new species of any taxonomic fauna group were being recorded. This indicates that additional sampling within the SGCP area is unlikely to detect new species. Note that these totals reflect fauna trap sites only, as other survey methods (e.g., bat call detection, targeted searches, spotlighting) do not produce comparable datasets that may be added quantitatively to the figure. Consequently, the complete diversity recorded using all survey methods is greater than that listed above, especially for certain groups such as bats and waterbirds. To avoid biases caused by sampling season, the order in which sites were added to the curves above was determined by a random number generator.

8.3.1.3. Sampling techniques

Sampling for vertebrate fauna was conducted using an array of sampling and trapping techniques (refer to **Table 8-3**) including Elliott, pitfall, funnel and harp traps. Bat calls were detected using an AnaBat detector, and birds were sampled by call detection and timed searches. Targeted searches for all fauna groups were undertaken on foot within areas of quality habitat. Nocturnal surveys were conducted both on foot and in vehicles. Detailed sampling methodologies are presented in **Section 5.2.3** of **Appendix N—Terrestrial Ecology Technical Report**.

Table 8-3 Fauna Survey Methods and Effort

Survey effort						
Survey method	Mar '09	Oct '09	Apr '10	May '11	Sep '11	Targeted species
Pit-fall buckets	–	150 trap-nights	150 trap-nights	180 trap-nights	-	Small snakes, skinks, geckos, legless lizards, dragons; frogs; small rodents, dasyurid mammals (e.g. dunnarts, planigales)
Funnel traps	–	120 trap-nights	120 trap-nights	240 trap-nights	-	As per pit-fall buckets, plus larger snakes, goannas and dragons
Elliott traps	–	625 trap-nights	500 trap-nights	584 trap-nights	-	Small terrestrial mammals (e.g. rodents, dasyurid mammals)
Harp traps	–	4 nights	4 nights	8 nights	-	Microbats
AnaBat detector	–	5 nights	3 nights	6 nights	-	Microbats
Spotlighting	–	45 min x 5 nights	90 min x 5 nights	45 min x 4 nights	45 min x 1 night	Nocturnal reptiles (e.g. snakes, geckos, legless lizards); frogs; arboreal mammals (e.g., gliders, possums); nocturnal birds (e.g., owls, frogmouths, nightjars)
Target searches	–	opportunistic	opportunistic	opportunistic	-	All taxa
Opportunistic	2 days	5 days	5 days	4 days	4 days	Birds, larger mammals (e.g. kangaroos, wallabies); diurnal lizards (e.g. dragons, goannas); large snakes; calling frogs

8.3.2. Habitat Features within the SGCP Area

The remnant vegetation and waterbodies on the SGCP area were categorised into seven faunal habitat types (refer to **Table 8-4**). Most remnant habitats were high quality and in excellent ecosystem health, with a native grass understorey, abundant debris and numerous termite mounds.

Table 8-4 Faunal habitats Within the SGCP Area

Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
Eucalypt woodland with shrubs These habitats are dominated by Silver-leaved Ironbark (*Eucalyptus melanophloia*) and Poplar Box (*E. populnea*), although in some locations a mix of eucalypt species (*Eucalyptus* and *Corymbia* spp.) occur. The canopy species include abundant hollows of a variety of sizes, providing good habitat opportunities for arboreal species. Midstorey composition consisted of two different types. Some areas were dominated by White Cypress Pine (*Callitris glaucophylla*), which formed a tall shrub layer or low canopy layer. Regrowth White Cypress Pine was also common. Where this type of understorey was abundant, ground cover grasses were uncommon, or clumped to interspaces where light penetrated to the ground. The understorey at other locations was dominated by a high diversity of low, round shrubs. Generally this layer was lower than those locations dominated by white cypress pine, resulting in a slightly different vertical structure. Native grass species were common between shrubs, although Buffel Grass (*Cenchrus ciliarus*) was common in some areas. Ground debris, particularly fallen timber, was common throughout these habitats. Rock protrusions were present at some locations within the SGCP area but were not common and were only minor in extent. Bare ground was also common, with a mosaic formed of open ground and grass cover, while thick leaf litter occurred beneath bushes or under trees. The soil was typically red sandy loam. Eucalypt woodland with shrubs is the most common vertebrate habitat type within the SGCP area.	 	Brigalow Scaly-foot (*Paradelma orientalis*) – **confirmed** from this habitat Square-tailed Kite (*Lophoictinia isura*) -- **confirmed** from this habitat Little Pied Bat (*Chalinolobus picatus*) -- **confirmed** from this habitat Ornamental Snake (*Denisonia maculata*) Dunmall's Snake (*Furina dunmalli*) Yakka Skink (*Egernia rugosa*)

Table 8-4 Faunal habitats Within the SGCP Area (cont)

Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
Eucalypt woodland with grassy understorey Habitats with a grassy understorey were common. In many locations, the understorey consisted of native grasses, such as *Themeda triandra* and *Heteropogon contortus*, while some areas were dominated by Buffel Grass that had formed thick monocultures. Those areas dominated by Buffel Grass hold less habitat value for terrestrial ground species as ground movement is inhibited. The midstorey was open, shrubs were present, but restricted to clumps or isolated individuals. As a result, the vertical density and complexity within this habitat type is considerably less than in Eucalypt woodlands with shrubs. While the canopy density varied, it was typically open and consisted of Poplar Box and Silver-leaved Ironbark. Hollow-bearing trees were common.		Brigalow Scaly-foot (*Paradelma orientalis*) Square-tailed Kite (*Lophoictinia isura*) Dunmall's Snake (*Furina dunmalli*) Ornamental Snake (*Denisonia maculata*) Yakka Skink (*Egernia rugosa*) Squatter Pigeon (*Geophaps scripta scripta*) Little Pied Bat (*Chalinolobus picatus*)
Eucalypt woodland with spinifex groundcover Structurally, eucalypt woodlands with spinifex (*Triodia* spp) are similar to eucalypt woodlands with grass. Some of the most diverse terrestrial vertebrate communities within Australia have been linked with the presence of spinifex (Pianka 1969; Morton and James 1988). Several species of terrestrial vertebrates recorded from the SGCP area are likely to be restricted to areas of spinifex (e.g. *Ctenotus pantherinus*), while others are likely to be significantly more abundant in areas of spinifex (e.g. *Ctenotus hebetior*). As a result, the vertebrate community in spinifex woodlands may be different from that found in grassy woodlands. These habitats therefore deserve separate consideration. Bird communities, which may be influenced by vertical complexity (i.e. shrubs), are likely to be similar between the two open vegetation types.		Brigalow Scaly-foot (*Paradelma orientalis*) Square-tailed Kite (*Lophoictinia isura*) Dunmall's Snake (*Furina dunmalli*) Ornamental Snake (*Denisonia maculata*) Yakka Skink (*Egernia rugosa*) Squatter Pigeon (*Geophaps scripta scripta*) Little Pied Bat (*Chalinolobus picatus*)

Table 8-4 Faunal habitats Within the SGCP Area (cont)

Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
Low open paperbark woodland Low open paperbark woodlands were not common within the SGCP area. The canopy, which consisted almost entirely of Bushhouse Paperbark (*Melaleuca tamariscina*), was very open and low. Little midstorey existed, restricted largely to regrowth canopy species. Few hollow-bearing trees were present within the habitat and arboreal species are not likely to be well represented. The ground layer consisted predominantly of grasses, separated by open areas of ground. Debris, such as fallen timber and leaf litter was present, but was not as abundant or dense as in other habitat types. These areas appeared to retain water, and are likely to provide important frog habitat.		Brigalow Scaly-foot (*Paradelma orientalis*) Dunmall's Snake (*Furina dunmalli*) Ornamental Snake (*Denisonia maculata*) Yakka Skink (*Egernia rugosa*) Squatter Pigeon (*Geophaps scripta scripta*) Little Pied Bat (*Chalinolobus picatus*)
Brigalow woodland This habitat was distinguished by a tall Brigalow (*Acacia harpophylla*) canopy. Within the canopy, hollows were rare; however, exfoliating bark was common and provided a different sheltering opportunity. Small arboreal vertebrates such as geckos are likely to use these shelter sites. The shrub layer, while present, was less dense than in the eucalypt with shrub habitat, but more dense than grassy eucalypt woodland habitats. In most cases, the predominant shrub species was Wilga (*Geijera parviflora*). The ground layer was relatively open. Recent rains sparked low, open grass growth, but typically these habitats had little green ground cover. However, fallen debris such as sticks, logs and leaf litter was often present in high densities. Furthermore, different from other habitats these areas contained cracking soils, which provide excellent sheltering opportunities for ground dwelling species. Brigalow communities observed within the SGCP area showed little evidence of senescence or weed invasion.		Brigalow Scaly-foot (*Paradelma orientalis*) Dunmall's Snake (*Furina dunmalli*) Ornamental Snake (*Denisonia maculata*) Yakka Skink (*Egernia rugosa*) Little Pied Bat (*Chalinolobus picatus*)

Table 8-4 Faunal habitats Within the SGCP Area (cont)

Habitat Type and Description	Representative Photograph	Potential Threatened or 'Near Threatened' Taxa
Bendee woodland Bendee woodland consisted of a moderately dense, tall canopy dominated by Bendee (*Acacia catenulata*). Only a few emergent eucalypts were present, resulting in few hollows. Shrubs were not common, but where present were typically regrowth of canopy species. The ground stratum was dominated by short native grasses, separated by occasional bare ground. Fallen debris, particularly moderately sized logs, was common. Where Bendee occurred on shallow red earths, termite mounds were abundant. Bendee habitats were restricted to a single location in the mine survey area where they occurred on shallow red earths overlaying ferricrete.		Brigalow Scaly-foot (*Paradelma orientalis*) c**onfirmed** from this habitat Dunmall's Snake (*Furina dunmalli*) Yakka Skink (*Egernia rugosa*) Little Pied Bat (*Chalinolobus picatus*)
Artificial and natural waterbodies Almost all waterbodies were artificial, and consisted of small to moderate-sized dams used as stock watering points. No observed dams within the SGCP area contained floating or emergent aquatic vegetation. Most dams were surrounded by grasses (native or exotic), rather than emergent macrophytes such as sedges or rushes. The edges of many dams were subject to intense trampling by cattle, and were thus devoid of vegetation. One natural, shallow wetland was located in the infrastructure corridor survey area, and consisted of a dense covering of native sedges with emergent Coolibah (*Eucalyptus coolabah*).		Cotton Pygmy-goose (*Nettapus coromandelianus*)

8.3.3. Fauna Species

Field surveys identified 230 fauna species from the SGCP area (refer to **Appendix D** of **Appendix N—Terrestrial Ecology Technical Report**), including 61 species (26.4 %) that were not recorded in other sources (i.e. DEHP Wildlife online (Wildnet), Birds Australia Atlas or Queensland Museum records). Fauna recorded included 10 species of amphibians, 35 species of reptiles, 145 species of birds and 40 species of mammals. The high diversity detected, relative to fauna surveys of nearby areas, is testament to the comprehensiveness of the surveys undertaken.

8.3.3.1. Conservation significant fauna

Four species of threatened (Endangered or Vulnerable) and Near Threatened fauna were confirmed from the SGCP area. The Brigalow Scaly-foot (*Paradelma orientalis*), Koala (*Phascolarctos* cinereus), Little Pied Bat (*Chalinolobus picatus*) and Square-tailed Kite (*Lophoictinia isura*), are listed as Vulnerable or Near Threatened under the *NC Act* and/or *EPBC Act* (refer to **Figure 8-8**). Threatened species not recorded during ecological surveys were assigned a likelihood of occurrence within the SGCP survey area based on historical records, known geographic range and habitat availability (refer to **Table 8-5**).

8.3.3.1.1. Square-tailed Kite (Lophoictinia isura)

During the October 2009 survey, two Square-tailed Kites were recorded (refer to **Figure 8-8**). It is possible that these records represent two sightings of the same individual.

Status

NC Act: near threatened; *EPBC Act*: not listed.

Distribution and habitat

Square-tailed Kites are widely distributed throughout Australia in coastal and sub-coastal regions. A variety of habitats may be used including heathlands, woodlands, forests, tropical and subtropical rainforests, timbered watercourses, hills and gorges (Pizzey and Knight 2007). However, most records are from woodlands and forests, particularly those on fertile soils with abundant small birds (Marchant and Higgins 1993).

Threats

Extensive areas of suitable woodland and forest habitats have been cleared throughout the species' range, particularly in the south. While this is still probably the major threat to the species, egg collecting, shooting and the species' slow recruitment rate hinder recovery. Other threats may include the loss of woodland bird prey species through processes such as grazing and frequent fires (Debus, 1998; Garnett and Crowley, 2000).

Table 8-5 Occurrence of Threatened and Near-threatened Vertebrate Species in the SGCP Area

Scientific Name	Common Name	*EPBC Act* Status	*NC Act* Status	Likelihood of presence	Background information and results of MET Serve field assessments
Mammals					
Dasyurus hallucatus	Northern Quoll	E	–	Possible	The EPBC protected matters search (50 km buffer) identified this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. Suitable habitat is present within the SGCP area and it is therefore possible that this species occurs within the site, despite a lack of local records. The nearest records of this species are from the Carnarvon Range, approximately 120 km south of the SGCP area.
Chalinolobus picatus	Little Pied Bat	–	NT	**Confirmed**	Calls matching this species were detected among AnaBat recordings taken by MET Serve in the infrastructure corridor in May 2011. In addition, calls that were possibly from this species, but which could not be confirmed, were detected in the October 2009 and April 2010 surveys. Suitable habitat is widespread within the SGCP area.
Phascolarctos cinereus	Koala	V	LC	**Confirmed**	Scats from Koalas were recorded in riparian woodland dominated by River Red Gum (*Eucalyptus camaldulensis*) along Tallarenha Creek (**Figure 8-9**). Koalas are likely to be thinly distributed across similar habitat elsewhere in the SGCP area.
Nyctophilus corbeni	South-eastern Long-eared Bat	V	V	Possible	The EPBC protected matters search (50 km buffer) identified that this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. Suitable habitat is present within the SGCP area and it is therefore possible that this species occurs within the site despite a lack of local records. The nearest publically available record of this species is west of Taroom, approximately 320 km away.
Reptiles					
Delma torquata	Collared Delma	V	V	Possible	The EPBC protected matters search (50 km buffer) identified that this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. Suitable habitat is present within the SGCP area and it is therefore a possibility that it occurs despite a lack of local records. The nearest record of this species is at Blackdown Tableland National Park, more than 250 km east of the SGCP area.

Table 8-5 Occurrence of Threatened and Near-threatened Vertebrate Species in the SGCP Area (cont)

Scientific Name	Common Name	*EPBC Act* Status	*NC Act* Status	Likelihood of presence*	Background information and results of MET Serve field assessments
Reptiles					
Strophurus taenicauda	Golden-tailed Gecko	–	NT	Possible	The SGCP area lies 50 km further west than the westernmost record of the Golden-tailed Gecko, and may therefore lie outside its range. There is potential habitat for the Golden-tailed Gecko within the SGCP area.
Egernia rugosa	Yakka Skink	V	V	Likely	The SGCP area contains likely or known habitat for the Yakka Skink (SEWPaC 2011). The nearest record of this species is from Bogantungun, approximately 60 km from the SGCP area.
Denisonia maculata	Ornamental Snake	V	V	Likely	The SGCP area is within the known distribution of the Ornamental Snake (SEWPaC 2011) and there is high quality habitat within the project area.
Furina dunmalli	Dunmall's Snake	V	V	Likely	The EPBC protected matters search (50 km buffer) identified that this species or its habitat may occur within the area. Ideal habitat for this species is present within the SGCP area. It is therefore considered likely that the species may occur, despite the lack of local records.
Paradelma orientalis	Brigalow Scaly-foot	V	V	**Confirmed**	The April 2010 survey conducted by MET Serve caught one specimen of this species in a patch of callitris forest towards the east of the mine survey area. This is the first record of this species within the local area and is outside of the recognised distribution of the species (SEWPaC 2011)
Rheodytes leukops	Fitzroy River Turtle	V	V	Unlikely	The EPBC protected matters search (50 km buffer) identified that this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. Permanent water is absent from Alpha Creek in the SGCP area or nearby and therefore it is considered unlikely this species will occur.

Table 8-5 Occurrence of Threatened and Near-threatened Vertebrate Species in the SGCP Area (cont)

Scientific Name	Common Name	*EPBC Act* Status	*NC Act* Status	Likelihood of presence	Background information and results of MET Serve field assessments
Birds					
Geophaps scripta scripta	Squatter Pigeon	V	V	Likely	The EPBC protected matters search (50 km buffer) identified that this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. Suitable habitat for the species is widespread throughout both remnant and non-remnant habitats. However, the SGCP area is near the western limit of the species' distribution, and may thus consist of marginal habitat. Given that the species is relatively obvious when present, local populations (if present) are probably small and/or only utilise the SGCP area sporadically. While Squatter Pigeons may not be frequent or resident, this species is likely to occur in the SGCP area in a transient capacity.
Neochmia ruficauda rifucauda	Star Finch (sth)	E	E	Unlikely	The EPBC protected matters search (50 km buffer) identified that this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present and hence the species may not occur within the local area. An inhabitant of open native grasslands and woodlands, particularly those associated with watercourses, the species is extremely uncommon in the local area and rarely detected. Buffel Grass infestations and grazing of wetland edges renders habitat unsuitable. The lack of records from the local area or region, and its general scarcity, strongly suggest the species is unlikely to occur in the SGCP area.

Headings—*EPBC Act = Environment Protection and Biodiversity Act 1999*; *NC Act = Nature Conservation Act*

Unlikely = habitat not present and no local records. Possible = Suitable habitat or local records were present; or where potential habitat was widespread but specific habitat features were absent and extensive targeted surveys did not reveal the presence of the species; or where suitable habitat was present but very limited in extent and targeted surveys did not reveal the presence of the species. Likely = Species known from area and suitable habitat is present.

Status—E = endangered; V = vulnerable; NT = near threatened; – = least concern/not listed

Table 8-5 Occurrence of Threatened and Near-threatened Vertebrate Species in the SGCP Area (cont)

Scientific Name	Common Name	*EPBC Act* Status	*NC Act* Status	Likelihood of presence*	Background information and results of MET Serve field assessments
Birds					
Poephila cincta cincta	Black-throated Finch (sth)	E	E	Likely	The EPBC protected matters search (50 km buffer) identified this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. The Black-throated Finch may have historically occurred in the project area, but has suffered a significant range contraction over the last 50 years, and has largely disappeared from south of Belyando Crossing (180 km NNW of the SGCP area). An isolated population at Bimblebox Nature Refuge, 25 km W of the infrastructure corridor survey area has been recently identified (Agnew 2011), indicating that the species may still persist locally. Surveys failed to detect Black-throated Finches within the SGCP area. These surveys were effective at detecting large numbers of other finch species (Zebra Finch, Double-barred Finch, Plum-headed Finch), indicating that surveys methods were likely adequate for detecting the Black-throated Finch, if it was present in similar densities. Nevertheless, potential habitat for the Black-throated Finch does occur in the SGCP area. The species inhabits a variety of remnant vegetation types with native grassy understories. Black-throated Finches also require nearby permanent water sources, as well as hollow trees for breeding sites. While potential habitat exists and is widespread in the SGCP area, grazing and the invasion of Buffel Grass have meant that most habitat is suboptimal. Nevertheless, given the SGCP's proximity to a known population, it is considered likely that low densities of Black-throated Finch may utilise the site, even if only in a transitory capacity.

Table 8-5 Occurrence of Threatened and Near-threatened Vertebrate Species in the SGCP Area (cont)

Scientific Name	Common Name	*EPBC Act* Status	*NC Act* Status	Likelihood of presence*	Background information and results of MET Serve field assessments
Birds					
Falco hypoleucos	Grey Falcon	–	NT	Possible	The Grey Falcon is widely but sparsely distributed through the arid and semi-arid zone of Australia. Its breeding range is thought to have contracted since the 1950s, now being confined to the arid parts of its range. Grey Falcons are highly mobile animals, and are known to travel over hundreds of kilometres. The SGCP area is within this species' range, but little suitable breeding habitat occurs in the SGCP area.
Grantiella picta	Painted Honeyeater	–	V	Possible	The SGCP area is within this species' range. Painted Honeyeaters are nomadic, with their movements strongly influenced by the fruiting of mistletoe. The SGCP area in general lacked a high density or diversity of mistletoe, and is unlikely to constitute important habitat. Nevertheless, Painted Honeyeaters are highly mobile and sporadic in occurrence and may utilise any mistletoe in a transient capacity. It is therefore considered possible that Painted Honeyeaters occur in the SGCP area.
Lophoictinia isura	Square-tailed Kite	–	NT	**Confirmed**	The October 2009 survey conducted by MET Serve produced two records of this species, most likely representing two observations of the same individual. Given that the species was not recorded in any of the other four surveys, it is unlikely that the SGCP area supports a sizeable population.
Nettapus coromandelianus	Cotton Pygmy-goose	–	NT	Likely	The SGCP area lies near the western edge of the species' range. Cotton Pygmy-geese breed in wetlands with abundant floating vegetation, and this habitat was lacking within the SGCP area. However, in March 2009 this species was observed approximately 60 km east of the SGCP area, and is likely to utilise artificial waterholes within the SGCP area occasionally and transiently.
Rostratula australis	Australian Painted Snipe	V	V	Possible	The EPBC protected matters search (50 km buffer) identified this species or its habitat may occur within the area. No local records from specimen- or observation-backed databases were present. Australian Painted Snipe preferentially inhabit ephemeral and semi-ephemeral wetlands with emergent aquatic and semi-aquatic vegetation. Within the SGCP area, there is little or no suitable habitat for this species in most years. Suitable habitat may occur intermittently in flooded areas during years of extreme rainfall, and at these times Australian Painted Snipe may utilise the SGCP area. However, under such conditions habitat is rarely limiting for the species, and it is unlikely that the SGCP area is significant for the Australian Painted Snipe.

8.3.3.1.2. Brigalow Scaly-foot (Paradelma orientalis)

During the April 2010 survey one Brigalow Scaly-foot was captured in a pitfall trap at site Eastern 6 (refer to **Figure 8-8**). The discovery of this individual is significant as it extends the known distribution for the Brigalow Scaly-foot by over 100 km (refer to **Section 6.2.4.2** of **Appendix N—Terrestrial Ecology Technical Report**).

Status

NC Act: Vulnerable; *EPBC Act*: Vulnerable.

Distribution and habitat

The Brigalow Scaly-foot is found mainly in the Brigalow Belt bioregion, from Inglewood in the south, north to Emerald, east to Gladstone and west to Blackall (DERM, 2010a). The record from the SGCP is the first verified record of the species from the wider Alpha region and is outside of the recognised distribution of the species. Brigalow Scaly-foots occur in a range of forest types throughout the Brigalow belt bioregion, particularly those with dense ground cover.

Threats

While it may be common in suitable areas, habitat loss has been identified as a threat to the Brigalow Scaly-foot.

8.3.3.1.3. Little Pied Bat (Chalinolobus picatus)

Calls of this species were detected at three locations within the mine survey area in 2009 and 2010 and positive identification was confirmed for calls recorded within the infrastructure corridor survey area in 2011 (refer to **Figure 8-8**).

Status

NC Act: near threatened; *EPBC Act*: not listed.

Distribution and habitat

Little Pied Bats occur north from the Mallee region of South Australia/Victoria to the Tropic of Capricorn and are most common west of the Great Dividing Range in semi-arid regions. However, individuals have also been located in scattered areas closer to the coast (Churchill, 2008).

Little Pied Bats are typically found in dry habitats including open forests, woodland, mulga woodlands, chenopod scrublands, callitris forest, and mallee (Churchill, 2008), and they have even been detected using notophyll vine forest gullies (Eyre *et al.*, 1997). In drier parts of its range, populations probably heavily depend on riparian areas (EPA 2003).

Threats

Threats to the Little Pied Bat include habitat clearing, fragmentation and loss of potentially important roosting locations such as old trees, tunnels, caves and mine shafts.

8.3.3.1.4. Koala (Phascolarctos cinereus)

Scats from Koalas were recorded in riparian woodland dominated by Poplar Box (*Eucalyptus populnea*) along Tallarenha Creek (**Figure 8-8**). Koalas are likely to be thinly distributed across similar habitat elsewhere in the SGCP area.

Status

NC Act: Least Concern; *EPBC Act*: Vulnerable.

Distribution and habitat

Koalas are distributed across most of eastern Australia. Koalas utilise a broad range of eucalypt forests and woodlands, but tend to show preferences for certain tree species in certain regions (Krockenberger *et al*. 2012). Riparian forests dominated by River Red Gum are important habitats for Koalas in semi-arid Queensland (Gordon *et al.* 1988). Studies of Koalas near Clermont (one of few Brigalow Belt sites studied to date) suggest that *Eucalyptus populnea* also forms a dominant component of their diet (Ellis *et al.* 2002).

Threats

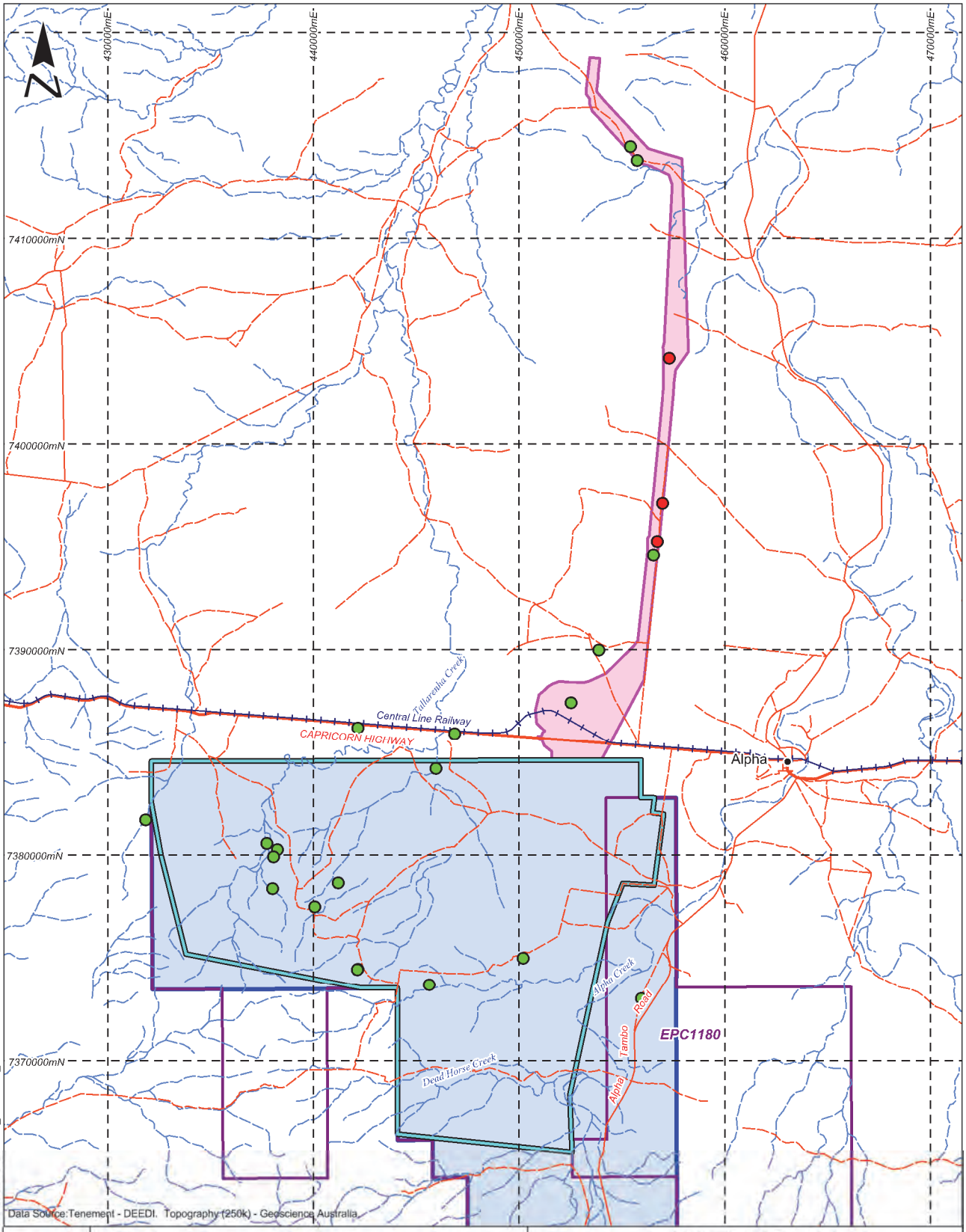
Habitat loss is the major threat to the Koala in Queensland (Natural Resources Management Ministerial Council 2009). Koalas reach their greatest densities in south-east Queensland, where populations are under increasing pressure from urbanisation (Dique *et al.* 2004). In drier parts of the state, populations have suffered marked declines in recent decades due to drought (TSSC 2012). This may constitute a temporary and natural fluctuation in wild populations (Gordon and Hrdina 2005), but one that may be exacerbated by climate change. Other threats to Koalas include collisions with vehicles, disease, predation by dogs and habitat degradation from weeds.

8.3.4. Migratory Species

Two migratory species, listed under the *EPBC Act*, have been identified within the SGCP area: the Rainbow Bee-eater (*Merops ornatus*) and the Eastern Great Egret (*Ardea alba modesta*) (refer to **Figure 8-11**). Seven other migratory species potentially occur in the SGCP area but were not recorded during field surveys (refer to **Table 8-6**).

The Rainbow Bee-eater was commonly observed within remnant vegetation, along tracks and within open grazing pasture. There were none reported in the April or May surveys, suggesting that they are summer breeding visitors. Nesting birds were observed in central parts of the mine survey area (e.g. -23.718349˚, 146.585464˚; -23.715689˚, 146.584152˚). These two nesting sites are outside the current proposed mine disturbance area. Rainbow Bee-eaters are likely to be common within most areas of the SGCP area and are abundant in the local area.

The Eastern Great Egret was observed on multiple occasions, usually at farm dams. They are likely to occur wherever similar water bodies are found within the SGCP and local areas. The species is highly dispersive, and often moves towards the coast during the dry season (Marchant and Higgins, 1990). The Eastern Great Egret has been recorded from numerous sites across the SGCP area, and is likely to be relatively common.



S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_08\AM001_FIG 8-11 MIGRATORYSPECIES.WOR

METSERVE
Mining & Energy Technical Services Pty Ltd
SouthGalilee

LEGEND

- MLA70453
- Exploration tenement
- Mine survey area
- Infrastructure corridor survey area
- Principal road
- Road (sealed)
- Road (unsealed)
- Railway
- Stream
- Population centre

Location of Migratory Species

- Eastern Great Egret
- Rainbow Bee-eater

Alpha Coal Pty Ltd

South Galilee Coal Project

Migratory Species within the Survey Area

5 0 5

Kilometres

Scale: 1:250,000 (A4)

30/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-11

Table 8-6 Migratory Species Present or Potentially Present in the SGCP Area

Species name	Likelihood and comments
White-bellied Sea Eagle *Haliaeetus leucogaster*	Possible. Being primarily restricted to coastlines and large inland waterways, it is unlikely that the SGCP area contains important habitat. May occasionally occur along water-bodies in the SGCP area.
White-throated Needletail *Hirundapus caudacutus*	Possible. The SGCP area is unlikely to represent important habitat for the species, as it lies at the western edge of its range. The SGCP is unlikely to render local habitat unsuitable for this species.
Rainbow Bee-eater *Merops ornatus*	**Confirmed.** Common in local area. Mining will avoid known breeding locations.
Eastern Great Egret *Ardea alba modesta*	**Confirmed.** Common in local area.
Cattle Egret *Ardea ibis*	Possible. The SGCP area lies further west than its regular central Queensland distribution, and it is unlikely to represent important habitat for the species.
Cotton Pygmy-goose *Nettapus coromandelianus albipennis*	Likely. Little suitable habitat occurs in the SGCP area, but the species may occasionally use artificial dams within the project area.
Latham's Snipe *Gallinago hardwickii*	Possible. Recorded from local area, but favourable habitat (shallow, vegetated edges of wetlands) was scarce within the SGCP area.
Australian Painted Snipe *Rostratula australis*	Possible. Little suitable habitat occurs in SGCP area, but the species may utilise flooded pasture during years of exceptional rainfall.
Fork-tailed Swift *Apus pacificus*	Possible. The SGCP area is unlikely to represent important habitat for the species. The SGCP is unlikely to render local habitat unsuitable for this species.

8.3.4.1. Bioregionally Significant Fauna

Nineteen species of bioregionally significant fauna were recorded during fauna surveys in the SGCP area (refer to **Section 6.2.5** of **Appendix N—Terrestrial Ecology Technical Report**). Individual species and the potential for the SGCP to impact these species are discussed in **Section 8.6.2.7**.

8.3.4.2. Pest Animals

Seven pest animal species have been recorded from the SGCP area (refer to **Table 8-7**). These include four species listed as Class 2 declared animals under the *LP Act*. Under the *LP Act*, a Class 2 pest 'is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact'. Management of these pests requires coordination and they are subject to programs led by local government, community or landowners. Landowners must take reasonable steps to keep land free of Class 2 pests (DEEDI, 2009).

Cattle and horses were also found on the SGCP area but these are domestic livestock animals and are not considered to be feral.

Table 8-7 Pest Animal Species Recorded in the South Galilee Coal Project Area

Common Name *Scientific Name*	*LP Act*	Potential Biological Impacts
Cane Toad *Rhinella marina (Bufo marinus)*	Not listed	Highly toxic, and may fatally poison native predators. Preys upon a wide variety of small native animals. Competes for resources with native species. The biological effects, including lethal toxic ingestion caused by cane toads, are a key threatening process listed under the *EPBC Act*.
Wild Dog *Canis lupus familiaris*	Class 2	Can carry diseases, such as distemper and parvovirus. Competes with native fauna for resources and preys upon a wide variety of native animals. When wild dogs are culled, feral cats may increase in numbers. As such, control measures should target both species concurrently.
Feral Cat *Felis catus*	Class 2	Preys upon a wide variety of native animals and has been implicated in the extinction of a number of native species (Burbidge and Manley, 2002). Competes for resources with native species. Predation by feral cats is a key threatening process listed under the *EPBC Act*.
House Mouse *Mus musculus*	Not listed	May compete for resources with native species especially during drought. May cause economic impacts, especially during plagues.
Rabbit *Oryctolagus cuniculus*	Class 2	Competes for resources with native species and degrades land through burrowing and grazing. Competition and land degradation by rabbits is a key threatening process listed under the *EPBC Act*.
Feral Pig *Sus scrofa*	Class 2	Degrades water-bodies through wallowing and foraging, may spread diseases and weeds, preys on nesting ground birds and competes for resources with native species. Predation, habitat degradation, competition and disease transmission by feral pigs is a key threatening process listed under the *EPBC Act*.
House Sparrow *Passer domesticus*	Not listed	Found mainly in association with human settlements. May spread disease, but generally poses no significant environmental threat.

8.4. SURFACE AQUATIC ECOLOGY

This Section describes the surface aquatic ecology at the SGCP, and the methodology used to assess the surface aquatic ecology and water quality of the Project site.

For the purpose of the SGCP EIS, surface aquatic ecosystems consist of:

- rivers and streams of various stream orders (excluding drains and gullies) that lie within non-tidal, freshwater reaches
- backwaters
- wetlands, billabongs and gilgais
- any dams in the project areas that might support aquatic communities.

8.4.1. Study Area

The study area for the assessment of surface aquatic ecology comprises MLA 70453 and the SGC infrastructure corridor.

8.4.2. Methodology

8.4.2.1. Approach

The surface aquatic ecology values of the site were determined through a combination of a desktop and field surveys. The literature review process was carried out to identify data gaps and provide a broad-level assessment of the aquatic ecosystems and associated ecological values present or likely to be present in the study area. The field assessment provided detailed, site-specific data that could be used to assess what ecological values might be affected by the SGCP through particular activities and to assess whether or not viable examples of those ecological values occur in areas that will not be affected by the SGCP.

Sampling was carried out twice during post-wet season conditions, once by Aquateco in April 2010 and once by ALS in July 2011. The findings of both field studies are summarised in this section with further detail provided in **Section 3** of **Appendix O—Aquatic Ecology Technical Report**. On both occasions, sampling covered macroinvertebrate, macrocrustacean, fish and aquatic macrophyte communities, aquatic habitat assessment and *in situ* water quality monitoring.

Based on the desktop surveys of ephemeral streams in Central Queensland, no targeted surveys for rare and threatened aquatic taxa were deemed to be required.

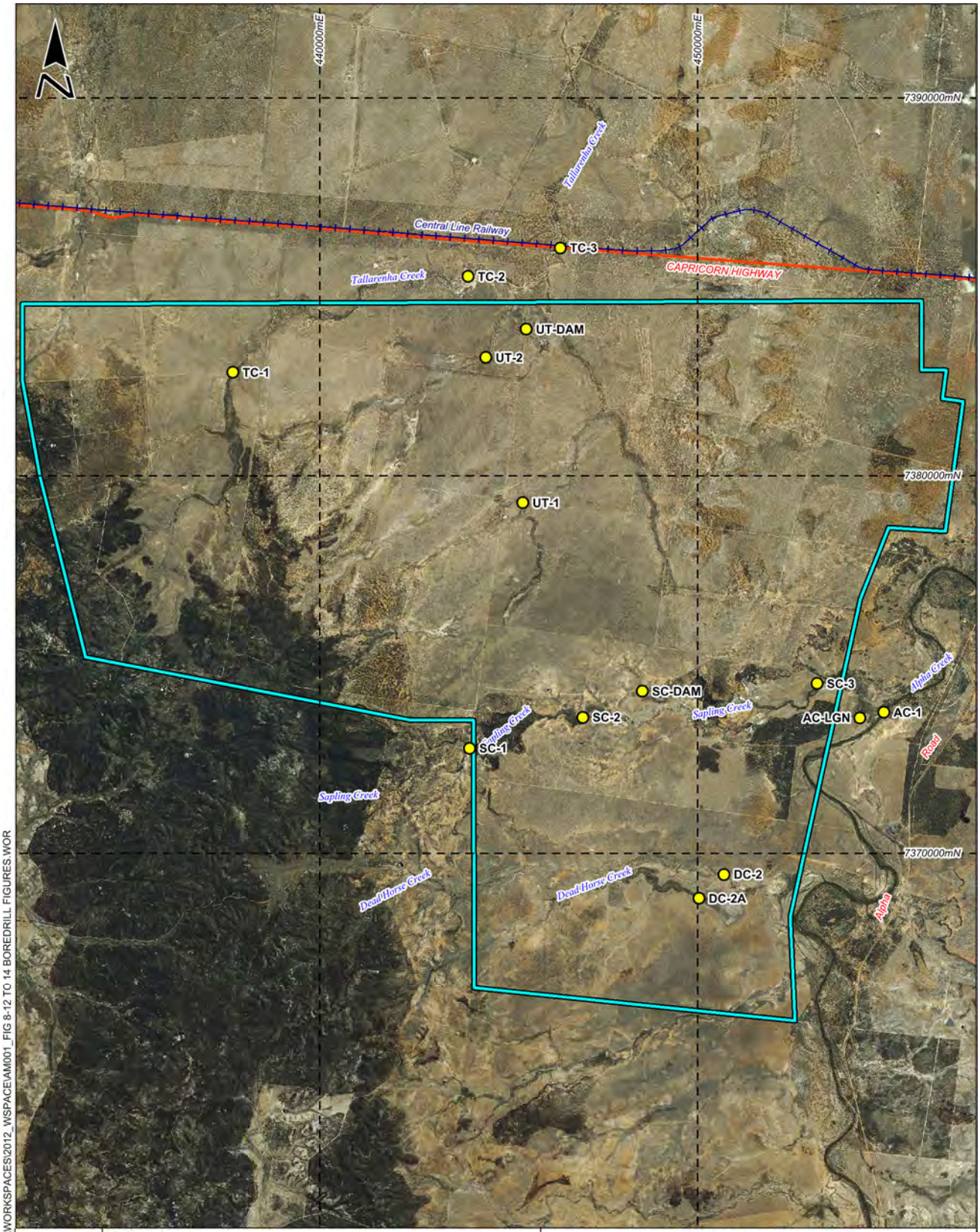
8.4.2.2. Site Selection

Based on the results obtained from the desktop study, 11 sampling sites were identified for the aquatic ecology study (refer to **Table 8-8** and **Figure 8-12**). These included 10 sites within or adjacent to MLA 70453 and one site adjacent to the Infrastructure Corridor. Site selection was influenced by:

- the need to sample both upstream and downstream of the proposed mining area
- sample site access
- the availability of wetted aquatic habitat as many of the creeks on the Project area flow only during and immediately after a rainfall event.

Table 8-8 Aquatic Survey Sites

Monitoring Site	Site Description	Justification
Tallarenha Creek		
TC-1	Upstream (Control)	Upstream reference site –no impact proposed due to mining or mine runoff. Acts as a control for monitoring future impacts.
TC-2 (Could not be sampled due to accessibility issues)	On-site (Impacts)	Area of stream potentially impacted by subsidence impacts from underground mining.
TC-3	Downstream (Impact)	Characterises receiving environment downstream of underground mining area.
Unnamed Tributary		
UT-1	On-site (Impact)	Impact site located within open pit mining area.
UT-2	On-site (Impact)	Site chosen for habitat assessment.
Sapling Creek		
SC-1	Upstream (Control)	Upstream reference site – no direct impacts proposed due to mining or mine runoff. Acts as a control for monitoring future impacts.
SC-2	On-site (Impact)	Area of stream impacted by open pit mining and located downstream of underground mining area. This site was sampled on both surveys to examine temporal variation.
SC-3	Downstream (Impact)	Characterises the receiving environment downstream of the mining area.
SC-Dam	Upstream (Control)	Sampled for *in situ* water quality and assessed for habitat characteristics.
Dead Horse Creek		
DC-2	Reference (Control)	A reference site nearby the SGCP area.
Alpha Creek		
AC-1	Upstream (Control)	Site upstream of any mine impacts.
AC-2	Downstream (Impact)	Site potentially impacted by uncontrolled releases from the southern sediment dam. This site was sampled on both surveys to examine temporal variation.
Saltbush Creek Tributary		
Site 04	Representative Infrastructure Corridor Waterway	Site adjacent the northern section of the Infrastructure Corridor that had retained sufficient water for sampling in July 2011 and could be considered as representative of stream habitat intersected by the Infrastructure Corridor.



S:\PROJECTS\AM001 STH GALILEE EIS_MAPINFO\WORKSPACES\2012_WSPACE\AM001_FIG 8-12 TO 14 BOREDRILL FIGURES.WOR

METSERVE
Mining & Energy Technical Services Pty Ltd

SouthGalilee

LEGEND

- MLA70453
- Railway
- Principal road
- Groundwater Bores

Alpha Coal Pty Ltd

South Galilee Coal Project

Aquatic Ecology Sample Site Locations

0 5

Kilometres

Scale: 1:150,000 (A4)

30/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-12

8.4.2.3. Macroinvertebrates

Sampling of macroinvertebrates was undertaken in accordance with the *Monitoring and Sampling Manual, Environmental Water Protection (DERM, 2009a)*. Pool bed and edge habitats were sampled as part of the April 2010 survey. Because the April 2010 survey determined that edge habitat tended to host the greater diversity and few, if any, taxa were unique to pool bed samples, Australian River Assessment System (AUSRIVAS) style macroinvertebrate sampling for the July 2011 sampling round was restricted to edge habitat. However, the ALS July 2011 study also involved the collection of composite habitat samples where there was atypical habitat, such as shallow flowing water over sand bars. Such habitats often support different macroinvertebrate assemblages, so it was essential to survey these areas to provide a truly representative sample of diversity and taxonomic composition within the study area.

Further information is provided in **Section 2.5.2** of **Appendix O—Aquatic Ecology Technical Report**.

8.4.2.4. Fish

Fish surveys were carried out using a variety of tools, including:

- backpack electrofishing
- fyke nets
- seine nets
- collapsible bait traps.

Of these, only electrofishing and bait trapping were used during the 2010 and 2011 surveys. Backpack electrofishing was carried out using different equipment on each of the sampling occasions (Smith-Root electrofisher in 2010 and a NIWA EF300 electrofisher in 2011). The sampling procedures also differed, with the April 2010 survey applying continuous effort until the available habitat was sampled, while in July 2011, ALS carried out five replicate 2.5 minute 'shots' where there was sufficient habitat, in order to provide both a measure of within-site catch per unit effort variation and a representative indication of what species occurred at each site. For each shot, the amount of on time was recorded and catches were kept separate. There were some sites for which the amount of available habitat in July 2011 was restricted. For those sites, a similar approach to that used in April 2010 was adopted.

Further information is provided in **Section 2.5.3** of **Appendix O—Aquatic Ecology Technical Report**.

8.4.2.5. Aquatic habitats

As per the QLD AUSRIVAS *Monitoring and Sampling Manual, Environmental Water Protection (DERM, 2009a)*, site habitat conditions were recorded in a systematic and comparable way between sites, by completing QLD AUSRIVAS habitat assessment field sheets.

The habitat inventory at each site included the whole reach (100 m section of the river), the habitats sampled, and the surrounding riparian and terrestrial environment. The information recorded was largely used to describe the nature of aquatic habitats present within the study area and any existing impacts potentially affecting them, but was also used to interpret trends in the biological data.

8.4.2.6. Water Quality

Physical and chemical parameters were measured at each site using a TPS 90FL series multiprobe in April 2010 (AQUATECO, 2010) and a YSI650 MDS multi-parameter water quality meter in 2011. Both instruments were used to measure pH, Electrical Conductivity (EC) (µS/cm), Salinity (g/L), Water Temperature (degrees Celsius (°C)), and Dissolved Oxygen (DO) level (% saturation and milligrams per litre (mg/L)) *in situ*. Turbidity (nephelometric turbidity units (NTU)) was measured using the TPS multiprobe in April 2010, while a Hach 2100P turbidity meter was used to measure turbidity in July 2011. Alkalinity, a key factor influencing the makeup of macroinvertebrate communities, was measured in July 2011 using alkalinity field titration kits.

Water quality data were assessed against relevant guidelines:

- *ANZECC & ARMCANZ (2000) Water Quality Guidelines* (freshwater ecosystems with a species protection level of 95 %)
- *Queensland Water Quality Guidelines 2009* (central coast Queensland region, lowland streams).

8.4.3. Existing Environment

8.4.3.1. Stream Condition and Land Use

Streams within the SGCP area flow into the Belyando River, which is part of the Burdekin River catchment. The Belyando River catchment is the largest sub-catchment within the Burdekin River Basin, covering 73,335 square kilometres (Australian Natural Resources Atlas, 2007). Streams in the upper Belyando sub-catchment are ephemeral, flowing most during the wet season. Water quality and quantity in these streams is therefore highly variable and largely dependent on the time of year in relation to seasonal rainfall.

Grazing accounts for approximately 94 % of land use in the Belyando Catchment, with small areas under conservation management, or used for forestry and dryland agriculture. The majority of land within the Belyando sub-catchment is considered to be in fair condition, though parts of it are either highly vulnerable or in marginal condition (Dight, 2009). Floodplain clearing has caused major losses of riparian vegetation, thus waterways in the Belyando sub-catchment often have elevated suspended sediment concentrations (Dight, 2009). There are several national parks and scientific areas within this sub-catchment of high conservation value.

8.4.3.2. Aquatic habitats

A range of aquatic habitats including creeks of various stream order and palustrine and lacustrine waterbodies were assessed during the course of the study. Lacustrine systems are large, open, waterbodies such as reservoirs and dams. Palustrine systems include gilgais, billabongs, swamps and wetlands (DERM, 2009b). Gilgais are wetlands that form on cracking clays in Brigalow forests and fill with rain during the wet season.

Detailed descriptions of the aquatic habitats present are provided in **Section 3.3** of **Appendix O—Aquatic Ecology Technical Report**.

8.4.3.3. Macroinvertebrates

The most common taxa recorded in April 2010 and July 2011 included microcrustacea (cladocerans, copepods and ostracods), members of order Diptera (true flies), the midge family Chironomidae (Tanypodinae and Chironominae), baetid Ephemeroptera (mayflies) and dytiscid and hydraenid water beetles (Coleoptera).

In April 2010, 19 out of the 25 (AURIVAS-level resolution) taxa recorded were insects (76 %). In July 2011, 64 out of the 78 taxa (82 %) recorded were insects. This is based on AUSRIVAS-level taxonomic resolution groupings. Further information on the distribution and abundance of macroinvertebrates is provided in **Section 3.5.1** of **Appendix O—Aquatic Ecology Technical Report**.

The 'health' status of macroinvertebrate communities was assessed based on comparisons with guideline ranges for Central Queensland and based on QLD AUSRIVAS model bandings for each site. Further information on the macroinvertebrates present, including pollution sensitive taxa, is provided in Sections 3.5.2 and 3.5.3 of **Appendix O—Aquatic Ecology Technical Report**.

8.4.3.4. Fish

A total of 76 species occur in the Burdekin Basin. Many of these species are not highly abundant within this system or have not been recorded for some time (Pusey *et al.*, 2004). Of these, 58 are Australian species, including two species introduced from other river basins (Yellowbelly, *Macquaria ambigua* and Eel-tailed Catfish, *Tandanus tandanus*). Two species are endemic to the Burdekin River, the Small-headed Grunter (*Scortum parviceps*) and the Soft-spined Catfish (*Neosilurus mollepsiculum*). Seventeen exotic species are recorded for the catchment.

Of 76 species known from the Burdekin Basin, 20 have been recorded in the Belyando River system (**Table 8-9**). Because of the low stream order of sites within the SGCP area, many species do not utilise the area. For example, Snub-nosed Garfish (*Arrhamphus sclerolepis*) are a catadromous species (move downstream to spawn), so are generally found in areas with more direct connectivity to the lower catchment. Long-finned Eels (*Anguilla reinhardtii*) are restricted to below Burdekin Falls Dam and its presence in the Belyando catchment is based on historical records prior to dam construction (Alluvium, 2007).

Table 8-9 Fish species within the Upper Reaches of the Burdekin River System

Common Name	Scientific Name
Agassiz's Glassfish	*Ambassis agassizii*
Snub-nosed Garfish +	*Arrhamphus sclerolepis*
Fly-speckled hardyhead	*Craterocephalus stercusmuscarum*
Mosquitofish *	*Gambusia holbrooki*
Western Carp Gudgeon	*Hypseleotris klunzingeri*
Midgley's Carp Gudgeon	*Hypseleotris* sp.1
Spangled Perch	*Leiopotherapon unicolor*
Golden Perch #	*Macquaria ambigua*
Eastern Rainbowfish	*Melanotaenia splendida*
Purple-spotted Gudgeon	*Mogurnda adspersa*
Bony Bream	*Nematalosa erebi*
Black Catfish	*Neosilurus ater*
Hyrtl's Tandan	*Neosilurus hyrtlii*
Soft-spined Catfish	*Neosilurus mollepsiculum*
Sleepy Cod	*Oxyeleotris lineolatus*
Flathead Gudgeon	*Philypnodon grandiceps*
Rendahl's Catfish	*Porochilus rendahli*
Small-headed Grunter	*Scortum parviceps*
Tilapia*	*Oreochromis mossambicus*
Long-finned Eel +	*Anguilla reinhardtii*

Based on Department of Primary Industries and Fisheries (DPIF) surveys and databases.

* denotes exotic species

# denotes translocated species

+ denotes species with migratory requirements.

Surveys in the SGCP study area recorded 11 of the 20 species historically recorded from the Belyando catchment (refer to **Table 8-10**). This included two exotic pest fish species (Mosquitofish (*Gambusia holbrooki*) and Tilapia) and one translocated species (Yellowbelly).

Table 8-10 Distribution of Fish and Macrocrustacean Species Among Study Sites

Site	Site 04	TC-1	TC-3	SC-1	SC-2	SC-3	AC-1	AC-2	DC-2A	AC-Dam	UT-Dam
Eastern Rainbowfish		●	●		●		●	●		●	
Purple-spotted Gudgeon	●		●		●	●	●	●	●	●	●
Western Carp Gudgeon	●	●	●			●	●		●	●	●
Midgely's Carp Gudgeon										●	
Spangled Perch			●	●	●	●	●	●		●	
Olive Perchlet		●					●			●	●
Hyrtl's Tandan			●				●	●		●	
Tilapia										●	
Bony Bream			●								
Yellowbelly			●								
Mosquitofish							●				
Freshwater Prawn	●		●		●		●	●		●	
Atyid Shrimp	●		●								
Yabby	●	●			●	●			●		

(Refer to **Figure 8-11** for site locations)

None of the endemic fish species recorded during April 2010 and July 2011 or historically known from the Belyando catchment are listed as threatened species under either State or Commonwealth legislation.

Purple-spotted Gudgeon, Western Carp Gudgeon, Spangled Perch and Eastern Rainbowfish were the most commonly recorded species in the study area. These species prefer shallow, slow-moving, sand-dominated pool habitats.

Two exotic and one translocated species were recorded in small numbers. Mosquitofish and Tilapia are listed noxious pest species and have the ability to proliferate under disturbed conditions, which is of potential relevance to the SGCP.

Wetland habitat, such as the site where Tilapia were recorded in July 2011, often support large juvenile populations of Tilapia. Detection of Tilapia in July 2011 in a wetland adjacent to Alpha Creek, albeit in very low numbers, is significant due to the species propensity to rapidly increase in number and proliferate into adjoining waters.

Most fish captured were in good physical condition. However, fungal growth was observed on an Eastern Rainbowfish specimen at site AC-1, while a recently dead Spangled Perch was observed on the bank at site TC-3.

Three macrocrustacean taxa were recorded in the July 2011 study: *Macrobrachium* spp. (Freshwater Prawn), Atyid Shrimp and the yabby, *Cherax destructor*. Freshwater prawns were fairly ubiquitous. Atyid Shrimp were recorded from fish sample catches at two sites, but were among the macroinvertebrate sample by-catch at AC-1 and AC-Lagoon. Yabbies were present in all catchments except Alpha Creek and was not recorded from wetland habitat. In April 2010, relatively large numbers of yabbies were caught at both the SC-2 (Sapling Creek) and AC-1 (Alpha Creek sites). Another macrocrustacean, *Austrothelphusa* sp. (freshwater crab) was recorded at both sites in April 2010, but were not recorded in July 2011.

8.4.3.5. 'Migratory' Fish

The two fish species that occur in the Belyando River catchment that undertake movement for spawning, Long-finned Eel and Snub-nosed Garfish, are unlikely to occur in the SGCP area. Therefore, the creation of barriers as part of the SGCP will not affect those species. There may exist potadromous (move wholly within freshwater reaches) species within the upper Burdekin Basin for which inter-basin movement is critical for their recruitment success and longer term genetic viability (Alluvium, 2007). Spangled Perch, Eastern Rainbowfish, Olive Perchlet and Carp Gudgeon have all been recorded undergoing within-stream movements, often in response to discharge (Baumgartner 2003; Pusey *et al*. 2004). The small, localised scale of barriers as part of the SGCP will not affect inter-basin movement for these potadromous species, but it might have some effect on their local population status.

Spangled Perch are one of the better species in terms of negotiating through fish passage barriers (DPI, 2009a), so it is potentially less vulnerable to fish barrier impacts than some of the other species present.

Fish habitat Areas (FHAs) play an essential role in sustaining local and regional fisheries and are protected under the *Fisheries Act*. FHAs in the Burdekin River catchment are confined to coastal rivers and adjacent coastline such as the Bohle River, Burdekin River, Bowling Green Bay and Cleveland Bay. There are no FHAs within or adjacent to the SGCP area.

8.4.3.6. Aquatic Reptiles and Mammals

Two crocodile and five turtle species occur in the Burdekin River catchment. Estuarine Crocodiles (*Crocodylus porosus*) only extend as far up the catchment as the Burdekin River Dam wall, and freshwater crocodile (*Crocodylus johnstoni*) were introduced to the Townsville region. As such, neither is expected to occur in the Project area.

Although no turtle species were found during site surveys (Aquateco, 2010), species potentially occurring in the study area include:

- *Chelodina canni* (Cann's Long-necked Turtle)
- *Emydura macquarii krefftii* (Krefft's Turtle)
- *Elseya irwini* (Yellow-headed Snapping Turtle)
- *Elseya latisternum* (Saw-shelled Turtle)
- *Chelodina longicollis* (Snake-necked Turtle).

Yellow-headed Snapping Turtles are endemic to the Burdekin Catchment and listed as a high priority for conservation under DEHP's "Back on Track" prioritisation framework for the conservation of Queensland wildlife.

Platypuses (*Ornithorhynchus anatinus*) are known to occur in the Burdekin River catchment. They are listed as being 'Special Least Concern' wildlife under the *NC Act*, and regarded as being of inherent value and importance for maintaining aquatic ecosystems. While platypuses were not found during aquatic surveys, Alpha Creek offers potential habitat for Platypus.

8.4.3.7. Aquatic Flora

Sites surveyed for aquatic flora generally lacked abundant macrophyte cover. Emergent species were the dominant form represented and no floating forms were recorded. This is typical of ephemeral stream habitat.

Aquatic surveys detected seven species of aquatic plants not recorded in terrestrial ecology surveys (**Section 3.6.1** of **Appendix O—Aquatic Ecology Technical Report**). None of these are of conservation significance.

Paragrass (*Urochloa mutica*), a weed of ponded pasture, was present at both UT-Dam and SC-Dam. It is not declared under the *LP Act*.

8.4.3.8. Water Quality

The study area was characterised, in part or whole, by EC, DO, pH and turbidity levels outside guideline ranges, though this is common for ephemeral stream systems impacted by cattle, and at different stages of drying out.

There were some key differences between stream and wetland/reservoir/dam habitat water quality, with the latter characterised by relatively low EC, alkalinity and turbidity levels.

Water quality in stream and dam/wetland habitat was a function of flow conditions, sediment type, degree of bed and bank disturbance and presence/absence of aquatic plants and algae. DO levels were generally low, which for stream habitat other than Alpha Creek, probably relates to lack of flow. The contribution of plant and algal photosynthesis probably accounted for sites that featured supersaturated DO levels. The presence of organic rich sediment and detritus and lack of flows probably accounted for the very low (hypoxic) DO levels observed at certain sites. Many sites recorded high turbidity levels, but organic rich sediment, combined with low water levels and heavy bed and bank erosion through cattle access explained the very high turbidity levels.

Based on alkalinity levels recorded in July 2011, conditions within the study area range from very soft water to very hard water. In terms of receiving waters, the lower reaches of Sapling Creek and the lagoon adjacent Alpha Creek (AC-lagoon) featured soft water, whereas Tallarenha Creek and Alpha Creek featured hard water. Hence, the receiving waters most vulnerable to enhanced metal bioavailability are the lower reaches of Sapling Creek and the lagoon adjacent Alpha Creek. Water quality data collected for the SGCP area indicated that background dissolved aluminium and iron concentrations above guideline levels have been recorded in Sapling Creek.

8.5. SUBTERRANEAN FAUNA

Stygofauna communities are often dominated by crustacean invertebrates, but also contain oligochaetes, insects, other invertebrate groups, and occasionally fish. Species occur in limestone, calcrete, and fractured rock aquifers, but seem most abundant in alluvial aquifers (Hancock and Boulton, 2008) where they are likely to contribute to water quality through processes such as biochemical filtration (Hancock, *et al.*,2005).

The hyporheic zone is a region beneath and alongside a stream bed where there is mixing of shallow groundwater and surface water. The flow dynamics and behaviour in this zone (termed hyporheic flow or underflow) is recognised to be important for surface water/groundwater interactions, as well as fish spawning, among other processes.

The term 'troglofauna' in this study refers to subterranean 'terrestrial animals' that live in underground air-filled cavities, such as caves, rock fractures, calcrete cavities, or solute cavities. Most troglofauna taxa are invertebrates, and include millipedes, spiders, pseudoscorpions, isopods, and insects.

8.5.1. Methodology

8.5.1.1. Approach

Sampling for stygofauna was undertaken from 16 to 21 June 2011 where a total of 22 groundwater bores were sampled. In addition, specialised troglofauna traps were placed in 28 groundwater bores and three sites were sampled for hyporheic fauna (**Table 8-11**). The troglofauna traps were left in place for a period of six weeks. The traps were removed from 3 to 5 August 2011.

The Queensland government requires stygofauna and troglofauna sampling in areas where stygofauna and troglofauna are 'likely' to occur, and for the SGCP, there is a requirement that sampling should meet the requirements for surveys undertaken for Environmental Impact Assessments in Western Australia, as detailed in the following documents:

- WA EPA Guidance Statement No. 54, Guidance for the Assessment of Environmental Factors : Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA, 2003)
- WA EPA Guidance Statement No. 54a, Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (EPA, 2007).

8.5.1.2. Site Selection

Stygofauna sampling for this project was conducted in bores that fulfilled the following criteria:

1. aperture of 50 mm diameter or greater
2. intersect the water table
3. preferably lined and slotted through the water column
4. vertical (not angled)
5. geographically spread across the proposed mine lease and include reference bores outside the potential zone of impact (i.e. water drawdown zone)
6. cover all hydrogeological units present, including a focus on shallower alluvial aquifers if present
7. of varying age, in excess of six months, and preferably undisturbed (i.e. not regularly pumped or purged)
8. have EC less than 5,000 µS/cm (and preferably less than 1,500 µS/cm) and a DO in the range of 2 to 4 mg/L.

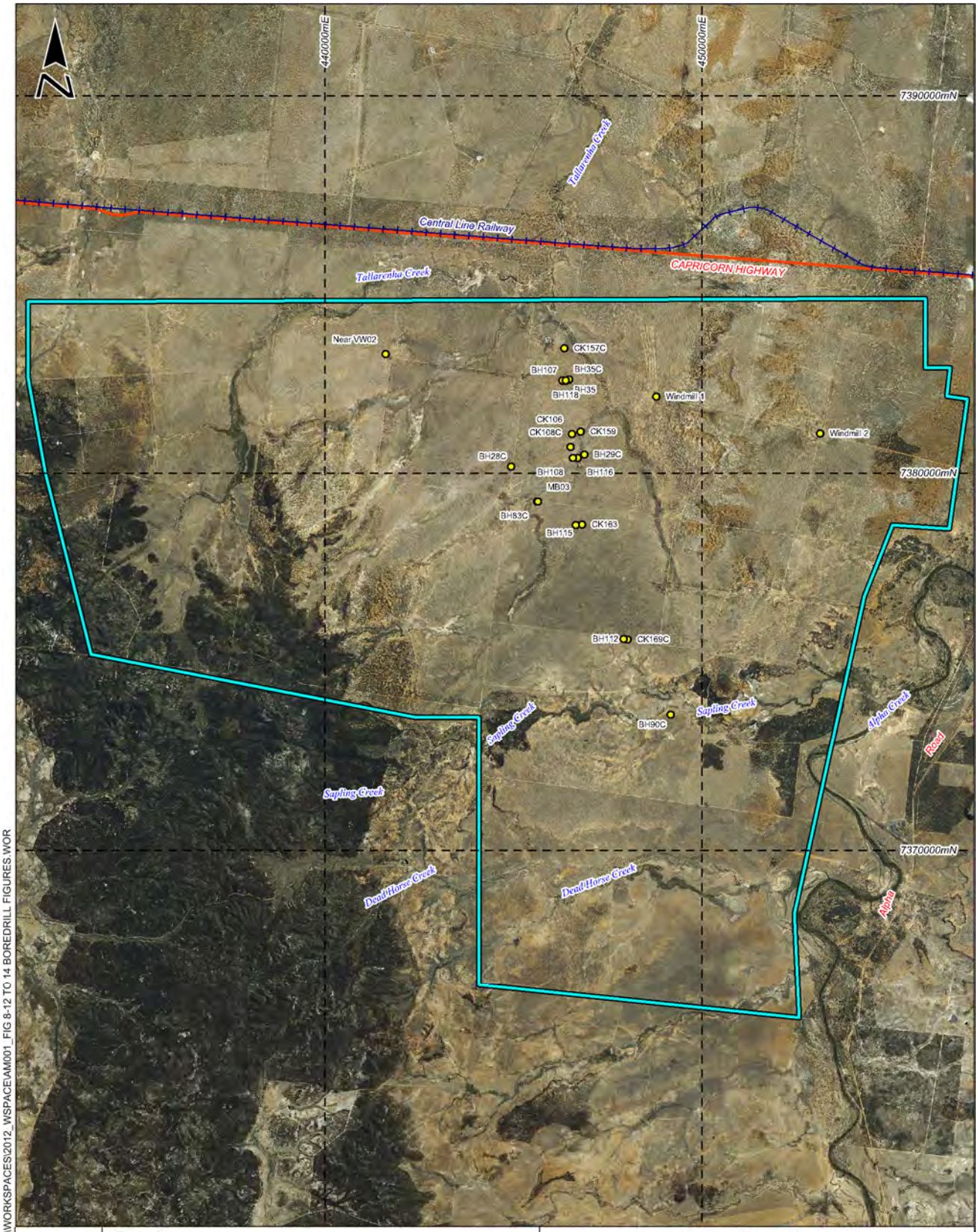
A total of 22 groundwater bores were identified for stygofauna sampling (refer to **Table 8-12** and **Figure 8-13**). Six of these bores were also used for troglofauna sampling. Stygofauna sampling preceded troglofauna sampling.

Table 8-11 Location and Characteristics of Groundwater Bores used for Stygofauna Sampling

Bore ID	Easting	Northing	Depth to Water (m)	Depth to End of Hole (m)	Bore Diameter (mm)	Bore Covered	Tree Roots Present
BH90C	449168	7373639	46.71	72	150	Yes	No
BH83C	445625	7379288	58.98	121	50	Yes	No
CK169C	448028	7375639	61.57	75	50	No	No
BH35	446482	7382516	42.80	90e	50	Yes	No
BH116	446704	7380453	49.88	53	150	Yes	No
BH108	446584	7380455	50.33	85	50	Yes	No
BH35C	446483	7382519	42.87	62e	50	Yes	No
BH107	446294	7382499	43.50	56	150	Yes	No
BH118	446388	7382497	42.92	79e	50	Yes	No
CK157C	446349	7383348	39.13	70e	50	Yes	No
Near VW02	441609	7383187	65.07	85e	150	Yes	No
BH29C	446886	7380537	49.39	69	50	Yes	No
CK108C	446516	7380738	49.85	80e	125	Yes	No
Windmill 1	448783	7382079	28.86	60e	150	No	No
CK106	446558	7381079	49.21	87	150	No	No
CK159	446780	7381142	48.09	71e	150	No	No
BH28C	444944	7380215	59.43	139	50	Yes	No
MB03	445648	7379294	59.22	80	50	Yes	No
BH115	446652	7378676	60.32	85	50	Yes	No
CK163	446826	7378680	59.72	76	50	No	No
Windmill 2	453138	7381101	25.31	40e	150	No	No
BH112	447923	7375649	63.18	78	50	No	No

Table 8-12 Details of Bores Sampled for Troglofauna

Bore ID	Easting (m)	Northing (m)	Depth of casing (m)	Depth to end of hole or to water (m)	Length of rock exposed (m)	Depth of trap placement (m)
BH15C	447100	7375762	54	67.26	13.26	60
BH28C	444944	7380215	54	59.43	5.4	56
BH83C	445625	7379288	55	58.98	4	56
BH109	446600	7378494	55	60	5	56
BH112	447923	7375649	50	63.18	13.2	53
CK163	446826	7378680	54	59.72	5.3	56
CK169C	448028	7375639	47	61.57	14.57	50
BH07C	446223	7374293	60	69.1	9.1	65
BH88	447122	7374266	56	62	6	60
BH90C	449168	7373639	40	46.71	6.7	43
BH100	447188	7376736	57	63.7	6.7	61
BH100C	447194	7376719	57	64	7	60
BH111	447190	7376532	54	63.4	9.4	60
BH114	448233	7372403	39	52.5	13.5	47
BH120	447403	7376513	53.5	63.5	10	57
BH121	447848	7374868	40	54.6	14.6	50
BH123	448441	7372589	42	53.6	11.6	47
CK167	447547	7376415	57	63.1	6.1	60
CK172	447597	7376629	52	62.94	10.94	56
SP137	448005	7375052	40	54.4	14.4	50
SP141	446517	7374271	43	69.3	26.3	65
SP137C	447886	7374873	39	54.51	15.51	43



LEGEND

- MLA70453
- Railway
- Principal road
- Groundwater Bores

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

Alpha Coal Pty Ltd

South Galilee Coal Project

Location and Characteristics of Stygofauna Sampling Boreholes

0 5

Kilometres

Scale: 1:150,000 (A4)

30/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-13

S:\PROJECTS\AM001 STH GALILEE EIS_MAPINFO\WORKSPACES\2012_WSPACE\AM001_FIG 8-12 TO 14 BOREDRILL FIGURES.WOR

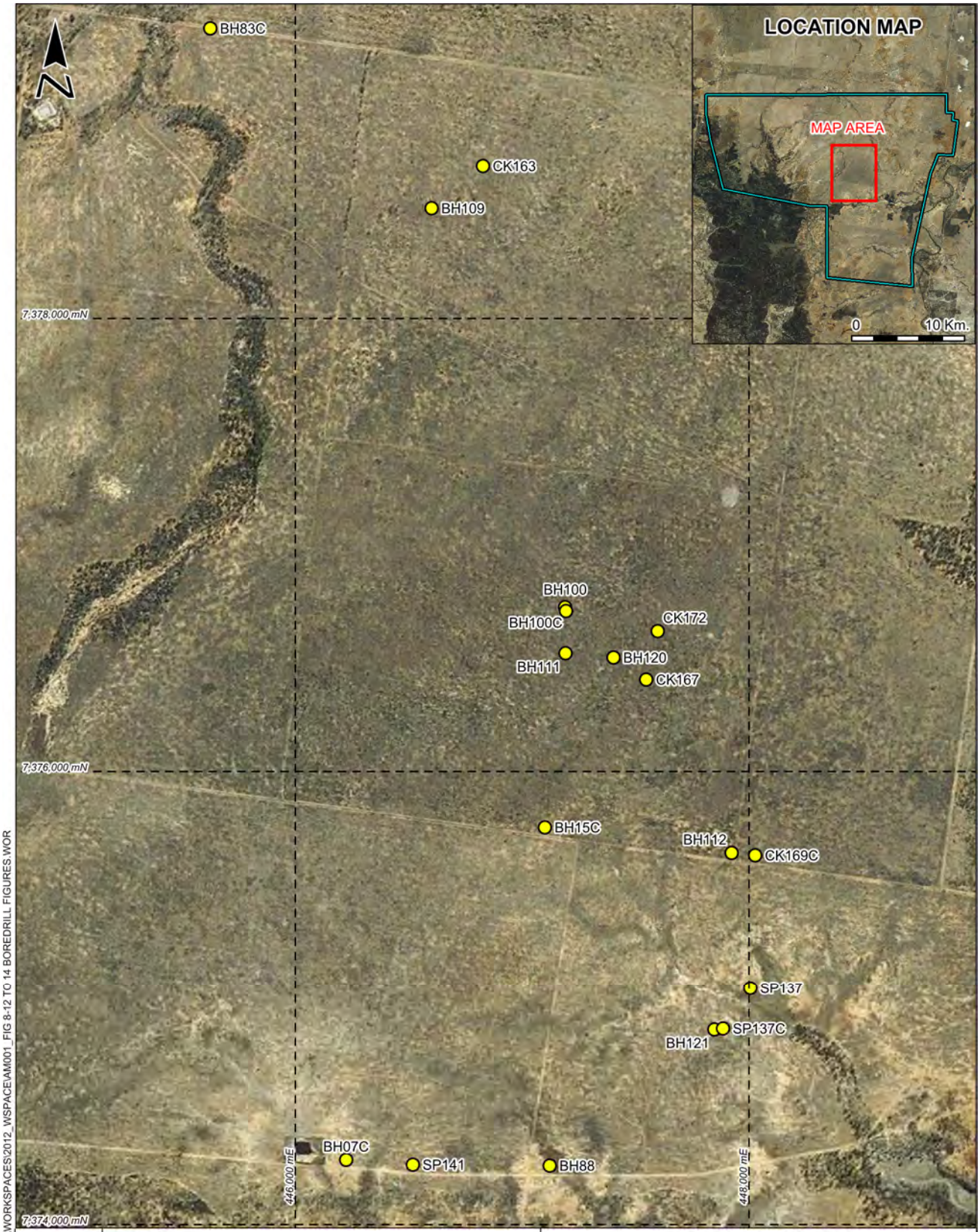
Attempts were made to collect stygofauna from the hyporheic zone of Sapling Creek using Karaman-Chappuis pits. The hyporheic site was located approximately 100 m north of BH90C (55K 449168 mE, 7373639 mN) (refer to **Figure 8-14**). Three pits were excavated into the dry sand bed of the creek using a spade at points considered likely to be near water (i.e. outside of bends, areas of damp sand, depressions in sand bed). A confining layer of clay was encountered at depths of between 10 and 20 cm. In two of the pits there was no standing water, indicating that the local water table had receded beneath the clay layer and the hyporheic zone was absent. In the third pit, a thin film of approximately 1 cm was present over the clay layer, however this pit was in an area heavily visited by cattle and the origin of the water was unlikely to have been through connections to the aquifer. As a result, no hyporheic faunal samples were collected and it is concluded that no true hyporheic zone exists within Sapling Creek at this locality. Further hyporheic sampling is not recommended.

Previous troglofauna assessments of Queensland have focussed on cave habitats. Troglofauna communities are known from the Chillagoe, Undarra, and Rope Ladder Caves in north Queensland. The fauna of these caves includes plant hoppers, cockroaches, centipedes, spiders and isopods (Howarth and Stone 1990, Weinstein and Slaney 1995, Eberhard and Humphreys, 2003). The troglofauna sampling at South Galilee is the first non-cavernous survey in central Queensland.

The selection of groundwater bores for troglofauna sampling for this project was undertaken to fulfil the following criteria:

- 50 mm or greater in diameter (in order to allow access for troglofauna traps)
- preferably intersect the water table in order to provide a humid atmosphere within the bore, although this is not a specific requirement
- unlined, or if lined, not block access to prospective geological formations that may contain troglofauna
- vertical (not angled)
- capped at the surface to limit the ingress of terrestrial fauna
- geographically spread across the proposed mine lease and include reference bores outside the potential zone of impact
- represent all prospective geological units
- varied in age, in excess of six months, and preferably undisturbed.

Traps were placed in 28 bores at SGCP from 16 to 21 June 2011 (refer to **Figure 8-14**). Troglofauna traps were recovered from 22 bores (refer to **Table 8-13**) between 3 and 5 August 2011. Six of the 22 groundwater bores used for troglofauna sampling were also used for stygofauna sampling. The six stygofauna net hauls collected from the six dual purpose bores also provided an important scrape of the exposed rock surface between the end of the PVC lining and the beginning of the water table. This scraping process is a useful method for collecting troglofauna. Each stygofauna sample was assessed for the presence of troglofauna.



S:\PROJECTS\AM001 STH GALILEE EIS_MAPINFO\WORKSPACES\2012_WSPACE\AM001_FIG 8-12 TO 14 BOREDRILL FIGURES.WOR

METSERVE Mining & Energy Technical Services Pty Ltd

SouthGalilee

LEGEND

- MLA70453
- Railway
- Principal road
- Groundwater Bores

Alpha Coal Pty Ltd

South Galilee Coal Project

Location and Characteristics of Stygofauna Sampling Boreholes

500 0 500

Metres

Scale: 1:25,000 (A4)

30/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-14

Table 8-13 Stygofauna Fauna Collected from South Galilee Coal Project Survey Bores

BORE ID	Stygofauna Recovered	Other Fauna Recovered	Family	Genus	Species
BH90C	NIL	NIL	-	-	-
CK169C	NIL	13 Coleoptera	Hydraenidae	*c.f. Hydraena*	*Larvae*
BH35	NIL	NIL	-	-	-
BH116	NIL	NIL	-	-	-
BH108	NIL	NIL	-	-	-
BH35C	NIL	NIL	-	-	-
BH107	NIL	NIL	-	-	-
BH118	NIL	NIL	-	-	-
CK157C	NIL	NIL	-	-	-
Near VW02	NIL	NIL	-	-	-
BH29C	NIL	NIL	-	-	-
CK108C	NIL	NIL	-	-	-
Windmill 1	NIL	4 Oligochaeta	Naididae	*Nais*	*sp.*
CK106	NIL	NIL	-	-	-
CK159	NIL	NIL	-	-	-
BH28C	NIL	NIL	-	-	-
MB03	NIL	NIL	-	-	-
BH115	NIL	NIL	-	-	-
CK163	NIL	NIL	-	-	-
Windmill 2	NIL	7 Oligochaeta	Naididae	*Nais*	*sp.*
BH112	NIL	4 Collembola 4 Coleoptera	Oncopoduridae Hydraenidae	*Oncopodura* *c.f. Hydraena*	*sp.* *Larvae*

Detailed descriptions of the sampling methodologies for stygofauna, hyporheic fauna and troglofauna are provided in **Sections 2.6, 2.7** and **2.8** of **Appendix O—Aquatic Ecology Technical Report**.

8.5.2. Existing Environment

8.5.2.1. Regional Geology and Groundwater

The SGCP is located within the Late Carboniferous-Middle Triassic Galilee Basin. The Galilee Basin has an area of approximately 247,000 km^2 and is a large scale intracratonic basin with predominantly fluvial sediment infill. It can be divided into northern and southern regions with a boundary in the vicinity of the Barcaldine Ridge extension of the Maneroo Platform.

The southern Galilee Basin is divided into two depositional centres by the Pleasant Creek Arch; the Powell Depression to the west and the Sprinsgure Shelf to the east. The SGCP is located in the southern region of the Galilee Basin.

The rocks of the Galilee Basin are of similar age to those of the Bowen Basin (Late Permian) which are exposed to the east of the Drummond Basin. The Bowen and Galilee Basins are separated along a north-trending structural ridge between Anakie and Springsure, referred to as the Springsure Shelf. Much of the western portion of the Galilee Basin is interpreted as occurring beneath Mesozoic sediments of the Eromanga Basin. The Anakie Inlier comprises older Palaeozoic rocks.

Late Permian, coal-bearing strata of the Galilee Basin sub-crop are found in a linear, north-trending Belt in the central portion of the exposed section of the Basin and are essentially flat lying (dip generally < 1° to the west). No major, regional scale fold and fault structures have been identified in regional mapping of the SGCP area.

Quaternary deposits in the SGCP are mostly alluvial and consist of gravel, sand and poorly consolidated clayey sandstone. Thickness of the Quaternary sediments varies over the Project area, but generally thickens to the east. Thicker alluvium is associated with current surface water drainage systems and may contain localised occurrences of groundwater, especially following wet season rainfall, but the alluvium is not extensive or continuous, with limited effective storage. It is therefore not regarded as a significant groundwater resource.

Tertiary deposits overlie the Galilee Basin and comprise consolidated siltstone and sandstone typically 5 to 15 m thick and are thickest in the northern and central region of the SGCP. These sediments are not regarded as comprising a significant groundwater resource as only limited and minor flows have been encountered.

The Cainozoic unconformably overlies the Rewan Formation and Permian Sequence and the Rewan Formation only occurs in the west of the project area. The Late Permian to Early Triassic Rewan Formation unconformably overlies the Bandanna Formation. The formation is composed of terrestrial alluvial sediments including meandering channel deposits and flood-basin siltstone and sandstone units.

8.5.2.2. Stygofauna

Compared to surface environments, groundwater fluctuates less in level and in physico-chemical variables such as EC, temperature and pH (Hancock *et al.*, 2005). Groundwater ecosystems also generally have lower DO and less readily available organic matter than surface water environments (Humphreys, 2002). As there is no direct photosynthesis in aquifers, stygofauna rely on connections to the land surface to provide them with food. These connections may be hydrological, with infiltrating water bringing dissolved or particulate organic matter to form the basis of subterranean food webs, or it may be more direct, with tree roots that extend below the water table providing leachates or organic carbon or fine rootlets for food (Hancock *et al.*, 2005).

Generally, stygofauna biodiversity is highest near the water table and declines with depth (Datry *et al.*, 2005). Stygofauna biodiversity is also higher in areas of recharge where the water table is close (< 10 m) to the land surface (Humphreys, 2000; Hancock and Boulton 2008). This is because the water table is likely to have the highest concentration of oxygen and organic matter. Stygofauna still occur at considerable depth below the water table, but are fewer in number, have lower diversity, and may be different species (Datry *et al.*, 2005).

In Australia, stygofauna are known from alluvial, limestone, fractured rock, and calcrete aquifers (Hancock *et al.*, 2005; Humphreys, 2008). As yet, no species are known from coal aquifers apart from a copepod from central Queensland that occurred in a shallow seam adjacent to an alluvial aquifer (ALS *unpublished*). As stygofauna require a space to live, the porosity of the sediments, degree of fracturing, or extent of cavity development must be sufficient, as must the connectivity between the living spaces.

The National Water Commission (NWC) has reported (NWC Waterlines, 2011) that extensive gaps exist in knowledge of the distribution, composition and biodiversity value of Australian stygofauna. Despite this incomplete inventory it is apparent that stygofauna are present across a variety of Australian subsurface environments and are generally characterised by high diversity and local-scale endemicity. They are also often of high scientific interest.

Several small surveys have confirmed the presence of at least four stygofaunal taxa (one Copepoda, two Bathynellacea, and one Amphipoda) in the Bowen Basin. To date, two species are known from near Clermont, one near Collinsville, and one near Nebo. These were collected from alluvial/sedimentary aquifers rather than coal seam aquifers. The likely reason for this is that the water in the alluvial aquifers has lower EC than coal seam aquifers.

A number of stygofauna studies have been completed in the Galilee Basin. AustralAsian Resource Consultants (AARC) surveyed 28 bores within the Alpha Coal Project and Kevin's Corner Project between March and June 2010. A single cyclopoid copepod was collected from one of those bores in March 2010. This animal was identified as *Macrocyclops albidus*, a cosmopolitan surface-dwelling copepod that is occasionally collected from groundwater. This species is a widespread surface species known from Australia, America, and Europe. The bore it was collected from was located on a large floodplain between two rivers and is approximately 900 m from the nearest river, so it is likely that the species migrates between aquifer and surface water when the rivers flow. Based on those results, AARC concluded that 'no significant stygofauna populations were found in the impact area of the Alpha Coal Project, so mining here is unlikely to significantly threaten stygofauna.' However, they did note that their study design targeted coal seam aquifers rather than alluvial aquifers due to the nature of the bores available and that stygofauna might occur in alluvial aquifers not identified or sampled by their pilot study.

The fauna collected from SGCP as part of the stygofauna survey are presented in **Table 8-14**. These were limited to one beetle (Coleoptera: Hydraenidae), one worm (Oligochaeata: Naididae) and one springtail (Collembola). All of these taxa are common surface water aquatic macroinvertebrate taxa. No stygofauna were recorded. This corroborates the findings of the pilot stygofauna survey for the Alpha Coal Project and Kevin's Corner Project EIS by AARC (2010). It is noteworthy that the four groundwater bores identified below that recorded surface water aquatic macroinvertebrate taxa were all uncovered. Ingress of surface water fauna into the groundwater bore could have occurred during recent flooding events. The presence of surface water aquatic fauna in the groundwater bores is of no significance to the stygofauna assessment for the EIS.

Table 8-14 Terrestrial Fauna Collected from SGCP Troglofauna Traps

Bore ID	Nematoda	Coleoptera (Adult)	Coleoptera (Larvae)	Oribatida	Oligochaeta (Enchytreidae)
BH15C	-	-	-	-	-
BH28C	40	-	-	-	-
BH83C	1 040	-	-	-	-
BH109	2 880	-	-	-	-
BH112	48	1	-	-	-
CK163	48	-	-	-	-
CK169C	-	31	23	-	-
BH07C	2	-	-	-	-
BH88	960	-	-	-	-
BH90C	-	-	-	-	-
BH100	-	-	-	-	-
BH100C	-	-	-	-	-
BH111	-	-	-	66	-
BH114	-	-	-	-	-
BH120	-	-	-	-	-
BH121	-	-	-	-	-
BH123	116	-	-	-	-
CK167	-	-	-	-	-
CHK172	-	-	-	-	207
SP137	-	-	-	-	-
SP141	-	-	-	-	-
SP137C	-	-	-	-	-

The absence of stygofauna from the 22 groundwater bores sampled in the SGCP area is significant and suggests the presence of stygofauna in the SGCP area is unlikely. The 22 groundwater bores selected for sampling were widespread across the MLA, and bore selection targeted the main aquifer types within the study area. A second round of stygofauna sampling in the 2012 post-wet season to fully accord with the WA guidelines (2003 & 2007) will verify this.

The groundwater quality survey results demonstrate that salinity in the SGCP is within the range where stygofauna are likely to be found (i.e. < 5 000 µS/cm) and this was the case for all 22 bores sampled where average salinity was 1,839.3 µS/cm. Water temperature was normal for groundwater bores and pH tended to be higher than optimal for the presence of stygofauna (i.e. average pH was 7.68). However, this is not considered a limiting factor for the presence of stygofauna.

8.5.2.3. Hyporheic Fauna

No hyporheic fauna was collected as part of the SGCP as no true hyporheic zone exists within Sapling Creek at the locality chosen for sampling.

8.5.2.4. Troglofauna

The occurrence of troglofauna is strongly influenced by geology. Troglofauna require small subterranean fissures and voids for habitat. Lateral connectivity of these voids is important because it enables animals to move about underground, while vertical connectivity through to the surface is important for supplying carbon and nutrients.

The fauna collected from SGCP troglofauna survey are listed in **Table 8-14.** All taxa collected in the SGCP troglofauna traps are commonly encountered in soil habitats (Coleman *et al.*, 2004) and this is likely to be the origin of these animals, either by falling into the bore, or being already present in the leaf-litter despite pre-treatment. Recent flooding prior to sampling may have also washed some taxa into boreholes.

In the SGCP area, the traps that contained fauna were set between 47 and 60 m below ground surface, and no troglofaunal oligochaetes or nematodes are known from this depth. Very little organic matter is likely to be present in the solid geologies at such depths, particularly if there is minimal fracturing. It is difficult to state definitively that these animals are troglofauna given the scant taxonomic knowledge of the worm fauna in Queensland. The difficulties in identifying oligochaetes and nematodes are recognised in Guidance Statement 54 and 54a, where exceptions are made for requirement to identify these groups to species (EPA, 2003, 2007).

Sufficient living space is critical for troglofauna, and this is influenced by geology and the extent of weathering or fracturing. Significant open caverns are not expected to extend far below the land surface. Information on the amount of available pore space in the SGCP area is scant. Generally, the void space available in strata associated with coal seam geologies is limited at depths of 47 m compared to other rock types known to suit troglofauna such as karst, calcrete, pesoliths, or lava tubes. This makes the presence of fauna at the depths sampled highly unlikely. Reviews of geological bore logs from the site confirm that the general lack of void spaces available in the strata would preclude the presence of troglofauna.

Weathered sandstone beside Sapling Creek (approximate location 55K 449200 E, 7373600 N) shows superficial hollows and cavities up to 15 cm across and 12 cm deep. These cavities did not appear to extend far into the rock, nor were there substantial connections between cavities. Where the sandstone outcrop met the confining clay layer marking the bed of the creek, no cavities were found, so it is unlikely that troglofauna were present at this point.

The impact of subterranean humidity on the quality of troglofauna habitat is poorly studied, however, it may represent a risk to troglofauna species in some cases. For this reason the air temperature and relative humidity both externally at the entrance to the bore as well as within the bore at a depth of 30 m was measured. In all cases relative humidity was significantly higher within the bore suggesting a suitable habitat for the presence of troglofauna, if indeed they exist within the MLA.

8.6. POTENTIAL IMPACTS

This Section describes the potential impacts of the construction and operation of the SGCP on terrestrial flora and fauna, aquatic ecology and subterranean fauna.

8.6.1. Potential Impacts on Terrestrial Flora

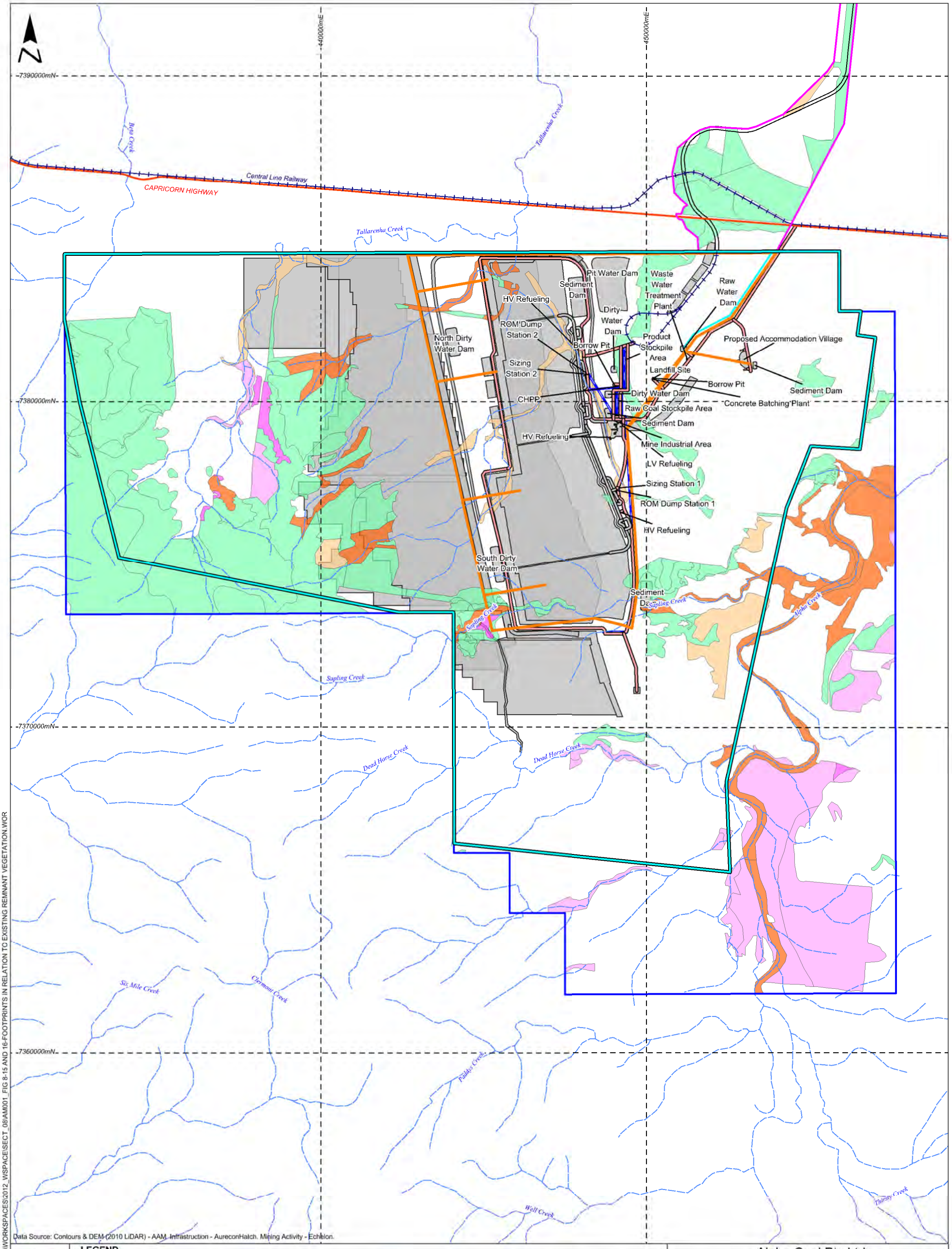
Potential impacts of the construction and operation of the SGCP on terrestrial flora include:

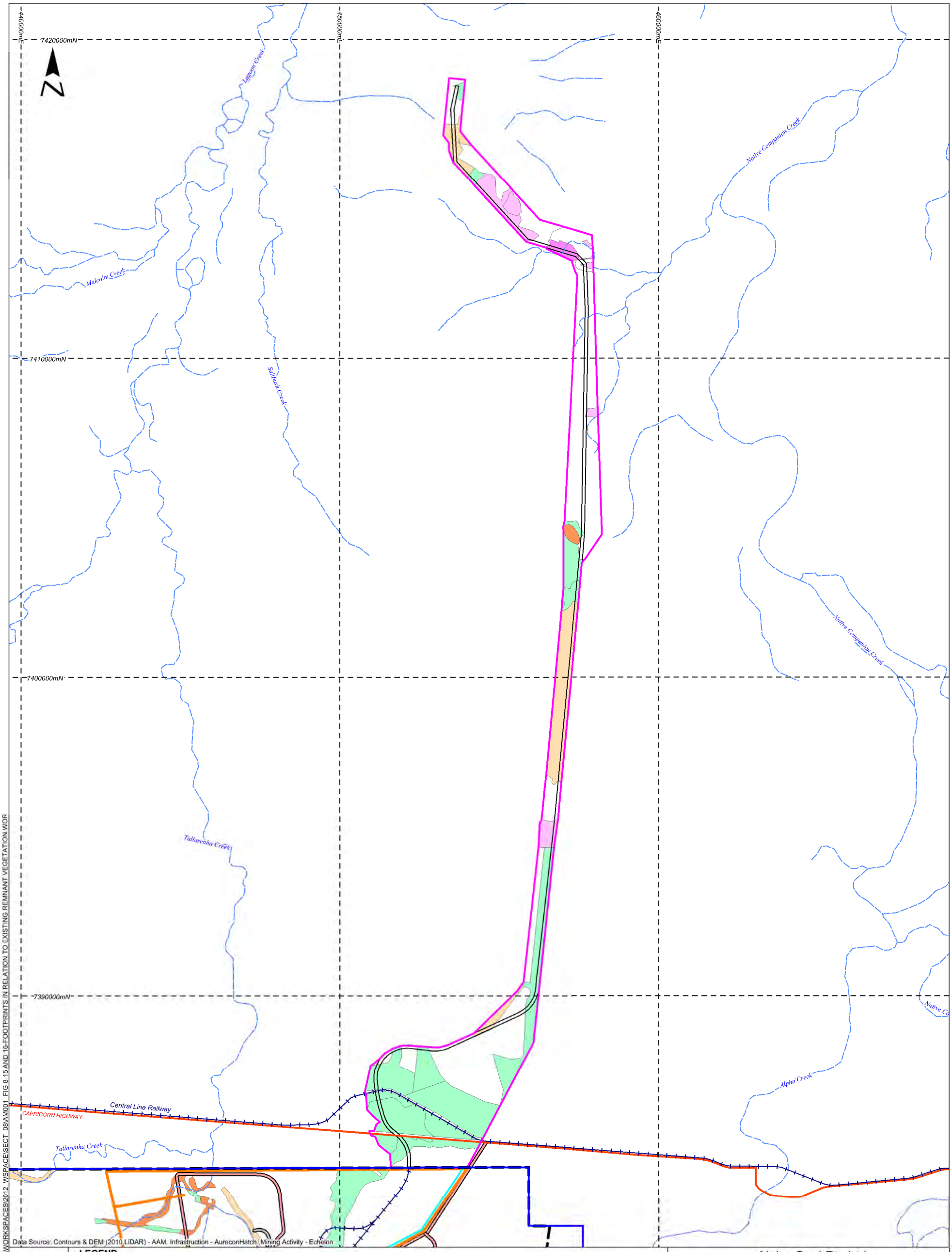
- vegetation clearing
- edge effects and fragmentation
- dust
- subsidence and hydrological impacts
- weeds
- altered fire regime
- release of contaminants
- cumulative impacts.

8.6.1.1. Vegetation Clearing

Of the 46,584 ha within the SGCP area, approximately 31 % (14,532 ha) is remnant vegetation. The avoidance of impacts to remnant vegetation (especially threatened REs and TECs) has been a key consideration during mine planning. The mine footprint has been positioned in areas of primarily non-remnant vegetation. As a result, while the mine footprint occupies 24.8 % of the SGCP area, it contains only 12 % (1,720 ha) of the remnant vegetation within it (refer to **Table 8-1, Figure 8-15** and **Figure 8-16**). Most of this remnant vegetation occurs within areas designated for longwall mining, and will not be cleared. Approximately 585 ha of remnant vegetation will be cleared for the open pit mining area and associated infrastructure (approximately 355 ha will be cleared within the mine survey area and 230 ha will be cleared within the infrastructure corridor survey area).

This page intentionally left blank


N
440000mE
450000mE
7390000mN
7380000mN
7370000mN
7360000mN
Big Creek
Tallarenha Creek
Central Line Railway
CAPRICORN HIGHWAY
Tallarenha Creek
Pit Water Dam
Waste Water Treatment Plant
Raw Water Dam
Sediment Dam
HV Refueling
Dirty Water Dam
ROM Dump Station 2
North Dirty Water Dam
Borrow Pit
Product Stockpile Area
Proposed Accommodation Village
Sizing Station 2
Landfill Site
Borrow Pit
Sediment Dam
CHPP
Dirty Water Dam
Concrete Batching Plant
Raw Coal Stockpile Area
Sediment Dam
HV Refueling
Mine Industrial Area
LV Refueling
Sizing Station 1
ROM Dump Station 1
HV Refueling
South Dirty Water Dam
Sediment Dam
Sapling Creek
Sapling Creek
Alpha Creek
Sapling Creek
Dead Horse Creek
Dead Horse Creek
Six Mile Creek
Clermont Creek
Paddys Creek
Well Creek
Thirsty Creek
Data Source: Contours & DEM (2010 LiDAR) - AAM. Infrastruction - AureconHatch. Mining Activity - Echelon.
LEGEND
MLA70453
Principal road
Mine survey area
Iinfrastructure corridor Survey Area
Mining Activity
Mining Activity
Infrastructure
Topsoil stockpile
Facility Area
Stream diversion
Drainage channel
Water Storage Dam
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor
Utilities
66kV overhead power line
11kV overhead power line
Raw water pipeline
Regional Ecosystem
Biodiversity status
Endangered (dominant)
Endangered (sub-dominant)
Of Concern (dominant)
Of Concern (sub-dominant)
Not of Concern
Non-remnant
METSERVE
Mining & Energy Technical
SouthGalilee
Alpha Coal Pty Ltd
South Galilee Coal Project
Mine Footprint in Relation to Existing Remnant Vegetation in the Mine Area
2 0 2
Kilometres
Scale: 1:115,000 (A3)
12/09/2012
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 8-15
S:\PROJECTS\AM001 STH GALILEE EIS_MAP\INFO\WORKSPACES\2012_WSPACE\SECT_08\AM001_FIG 8-15 AND 16-FOOTPRINTS IN


440000mE
450000mE
460000mE
7420000mN
7410000mN
7400000mN
7390000mN
N
Lagoon Creek
Malcolm Creek
Saltbush Creek
Native Companion Creek
Tallarenha Creek
Central Line Railway
CAPRICORN HIGHWAY
Alpha Creek
Data Source: Contours & DEM (2010 LiDAR) - AAM. Infrastruction - AureconHatch. Mining Activity - Echelon.
LEGEND
MLA70453
Principal road
Mine survey area
Iinfrastructure corridor Survey Area
Mining Activity
Mining Activity
Infrastructure
Topsoil stockpile
Facility Area
Stream diversion
Drainage channel
Water Storage Dam
Heavy vehicle road
Light vehicle road
On-site rail component
Coal & rejects conveyor
Utilities
66kV overhead power line
11kV overhead power line
Raw water pipeline
Regional Ecosystem
Biodiversity status
Endangered (dominant)
Endangered (sub-dominant)
Of Concern (dominant)
Of Concern (sub-dominant)
Not of Concern
Non-remnant
METSERVE
Mining & Energy Technical
SouthGalilee
Alpha Coal Pty Ltd
South Galilee Coal Project
Mine Footprint in Relation to Existing Remnant Vegetation in the Infrastructure Corridor
2 0 2
Kilometres
Scale: 1:115,000 (A3)
12/09/2012
Proj. : MGA Z55
Datum: GDA 1994
FIGURE 8-16
S:\PROJECTS\AM001 STH GALILEE EIS_MAP\NFO\WORKSPACES\2012_WSPACE\SECT_08\AM001_FIG 8-15 AND 16-FOOTPRINTS IN RELATION TO EXIS

Within the mine survey area, clearing will be primarily associated with the open cut mining area and waste rock emplacements. Smaller areas will be cleared for water management infrastructure, roads, stockpiles and other ancillary infrastructure. All clearing within the infrastructure corridor survey area is associated with the 100 m wide infrastructure corridor.

The REs most impacted by clearing within the mine survey area are 10.3.28a (174.9 ha), 10.3.27a (77.4 ha) and 10.5.5a (54.1 ha) (refer to **Table 8-1**). The REs most impacted by the infrastructure corridor are 10.5.5a (148.2 ha) and 10.5.12 (37.2 ha) (refer to **Table 8-1**). All are listed as of Least Concern under the *VM Act* and have the biodiversity status 'Not Of Concern', except for 10.3.27a, which has the biodiversity status 'Of Concern'.

8.6.1.2. Clearing of vegetation with conservation significance

In total, 275 ha of REs with an Of Concern biodiversity status will be impacted by the proposed activities. The most highly impacted Of Concern RE is 10.3.27a (approximately 261 ha); the remaining Of Concern REs impacted on are REs 11.3.2, 11.3.25, 11.3.6 and 11.7.1 (approximately 14 ha). Mitigation measures to address potential impacts are described in **Section 8.7**.

Small areas of Threatened Ecological Communities (TECs) protected under *the EPBC Act* will be impacted by the proposed activities. Approximately 13 ha of RE 11.4.8 is proposed to be cleared (approximately 8 ha in the infrastructure corridor and 5 ha in the mine survey area). In addition, 0.62 ha of RE 11.3.1 will be cleared in the infrastructure corridor. REs 11.4.8 and 11.3.1 are classified as environmentally sensitive areas (ESAs) under the EP Regulation. As a result, they are protected under the *EP Act*. These REs correspond to the Brigalow TEC under the *EPBC Act*. This clearing is likely to have a minor impact on these communities in a bioregional context.

Clearing will result in increased habitat fragmentation. Fragmentation of 'Of Concern' or Endangered REs will result in a reduction of core habitat values of these areas. The removal of any existing vegetation within the SGCP area may impact locally significant and/or State or Commonwealth protected species. Vegetation clearing will be undertaken in accordance with the mitigation measures described in **Section 8.7** to minimise the potential impacts.

8.6.1.3. Fragmentation

Fragmentation is a major threat to Australian vegetation communities and native plants (Burgman *et al.*, 2007). Fragmentation occurs when larger areas of habitat are dissected into smaller remnants dissected by a matrix of dissimilar habitats (Hannah *et al.*, 2007). Fragmentation is a key threat to the persistence of biodiversity (Cox, Dickman and Hunter, 2003; Fletcher, 2005). Even small, linear cleared strips that bisect native vegetation impede the passage of native species and cause fragmentation (Goosem and Marsh 1997; Carthew, Horner and Jones, 2009). The SGCP will increase fragmentation of remnant vegetation. Remnant vegetation within the SGCP region is already highly fragmented and several mining projects are proposed in the Galilee Basin. In fragmented landscapes, further clearing of vegetation has the potential to exacerbate impacts on ecosystems and species that are already under pressure from existing fragmentation (Souli *et al.*, 2004; McIntyre, McIvor and Heard, 2002).

Portions of the SGCP area, particularly in the east, have been subjected to fragmentation as a result of agricultural activities. However, some areas (most notably in the west of the mine survey area) still maintain significant corridor values. The SGCP is not expected to significantly impact on major corridors.

8.6.1.4. Edge Effects

Edge effects increase the fragmentation of landscapes (Fletcher, 2005) and occur as a result of environmental and ecological changes along the perimeter of a disturbed area of vegetation. Weed infestations are a common edge effect due to the increase in light availability in cleared areas coupled with the lack of competition by native plants. Weeds often establish along edges of cleared areas and then spread into the existing uncleared vegetation. Changes to the microclimate (temperature, soil moisture, humidity) along edges can impede native plant species growth and seed viability (Rowley *et al.*, 1993).

Edge effects are expected to occur as a result of the SGCP where there is clearing of remnant vegetation. However, edge effects will be avoided to a large extent by the positioning of the mine outside of remnant vegetation as much as practicable. The SGCP is to be situated predominantly in non-remnant vegetation and will avoid most REs of conservation significance in the area. The implementation of the measures described in **Section 8.7** will mitigate the intrusion of weed species into remnant vegetation due to edge effects.

Vegetation along Alpha Creek in the east of the SGCP area provides important connectivity with larger expanses of remnant vegetation to the west, south and north-east. This vegetation will remain largely intact.

8.6.1.5. Dust

Excessive dust reduces photosynthesis and inhibits plant growth (Thompson *et al.*, 1984; Sharifi, Gibson and Rundel, 1997). Pollutants in dust can also impede plant growth (Farmer, 1993; Doley, 2006). Excessive dust associated with clearing, earthworks, vehicle movements, windblown emissions and blasting within the SGCP area will potentially impact on vegetation. Areas that have the greatest potential to be affected by dust are within a limited area adjacent to the open pit mining area and haulage routes.

8.6.1.6. Subsidence and Hydrological Impacts

The removal of underground material through longwall mining results in the fissuring and subsidence of overlying strata (Singh 2003). These impacts have been modelled for the SGCP, and are described in detail in **Section 20.3.2.5**. Specific impacts on ecological values of the SGCP area are discussed here.

The primary impact of longwall mining on overlying surface ecosystems stems from alterations to hydrology caused by cracks and fissures in rock underlying streams and wetlands (Booth *et al.* 1998; Dawkins, 2003; NSW Scientific Committee, 2008). This causes an increased exchange between surface and ground water, and may cause the subsequent drying of waterways overlying longwall panels (NSW Scientific Committee 2008). Cracking may also release gases and leachates that can contaminate aquifers and spring-fed streams downstream (NSW Scientific Committee 2008).

In contrast to the well documented impacts of longwall mining on aquatic environments (Waddington and Kay 2003; NSW Scientific Committee 2008), little is known regarding the impact of subsidence and cracking on terrestrial ecosystems. Impacts tend to be most pronounced on steeper, gorge-type environments (Elsworth and Liu 1995; Holla and Barclay 2000; Sidle *et al.*, 2000; Waddington and Kay 2003), which are generally absent from the SGCP area. For terrestrial ecosystems on shallow gradients, these impacts are generally minor (Frazier *et al.* 2012). Impacts are expected to be greatest on ecosystems dependent on the seasonal or permanent retention of water within the root profile due to underlying rock inhibiting drainage. Species vulnerable to impacts include phreatophytes (species with deep roots extending to the water table), those in riparian ecosystems, and ecosystems depending on springs (e.g. RE 11.10.14) or a high water table (e.g. upland swamps) (NSW Scientific Committee 2008). Most of these ecosystem types were absent from the SGCP area, and/or will not be impacted by proposed longwall mining.

Approximately 1,135 ha of remnant vegetation overlie the proposed longwalls. No threatened ecological communities are contained within this vegetation. The primary REs involved are 10.5.5a (419.65 ha), 10.5.1b (137.88 ha), 10.3.28 (118.68 ha) and 10.3.27a (181.77 ha). None of these are likely to be dependent on water sources threatened by subsidence or cracking. Two less abundant REs may be impacted by longwall mining (REs 10.7.7b and 11.3.25). Both are listed as of Least Concern under the *NC Act*.

RE 10.7.7b is a shrubland dominated by *Melaleuca tamariscina* that grows on skeletal soils that are waterlogged for short periods following rain, and this may be impacted by cracking associated with subsidence. Approximately 48.6 ha of this RE overlie proposed longwall panels. No data currently exist concerning the effects of subsidence on this specific RE. However, it is predicted that local die-off may occur in the proximity of any cracks arising through subsidence.

RE 11.3.25 is a riparian forest dominated by River Red Gum (*Eucalyptus camaldulensis*). Approximately 35.8 ha of this RE overlie proposed longwall panels. Additional areas of riparian vegetation along Tallarenha Creek, downstream from the longwall panels may be impacted by reduced stream flow, due to subsidence of the creek bed and/or cracking of rock overlying longwall panels (**Section 4.3.3** of **Appendix F—Surface Water Technical Report**). The predicted impacts to riparian vegetation downstream of the proposed longwall panels depend on the degree to which flow is reduced by subsidence and cracking. In a worse-case scenario, flow may temporarily or permanently cease. Due to the low order of streams potentially impacted by longwall mining and the low volume of water carried by these, it is expected that any downstream impacts to riparian vegetation are likely to be confined to the immediate vicinity of the SGCP area. Higher order streams within the catchment are unlikely to suffer significant water reductions resulting from the SGCP, and riparian vegetation along these streams is unlikely to be impacted.

Altered stream flows could affect dispersal and replenishment of aquatic species (Dawkins 2003). Such effects are expected to be minimal in the SGCP, as only high-order streams are being impacted (i.e. not important as movement corridors), and these waterways are ephemeral.

An occasional and local impact of longwall mining is plant death resulting from the release of gas emissions (Everett *et al.* 1998). The frequency and intensity of such events is poorly documented. The SGCP Pre-Feasibility Study (AMCI and Bandanna Energy, 2011) indicates that work undertaken on tenements immediately to the north of the SGCP found no economically recoverable reserves of gas. Therefore, methane was not considered to be a likely significant management issue from an operational perspective. No significant indications of gas have been reported during SGCP exploration drilling activities to date (AMCI and Bandanna Energy, 2011).

The final potential impact of subsidence in the SGCP relates to an increased potential for weed invasion. Subsidence may produce trough-like depressions above the mined-out panel (Booth *et al.*, 1998). This may cause an increase in surface water pooling, or increased soil moisture content in some locations. This could potentially increase weed abundance (particularly Buffel Grass) which alters habitat structure and renders infested areas less suitable for some native flora and fauna. Parthenium Weed (*Parthenium hysterophorus*) can also increase in abundance with increased soil moisture. This species is currently scarce and patchy within the region (Agriculture & Resource Management Council of Australia & New Zealand, Australian & New Zealand Environment & Conservation Council and Forestry Ministers, 2000) and is absent from the SGCP area (refer to **Section 6.1.7** of **Appendix N—Terrestrial Ecology Technical Report**). An increase in pooled water due to subsidence may provide breeding habitat for Cane Toads, which have a deleterious impact on native fauna.

Overall, while the impacts of subsidence and cracking resulting from longwall mining are not insignificant, they are markedly less than those of open cut mining (i.e. the removal of all vegetation and habitat). For most remnant vegetation overlying longwall panels in the SGCP, ecosystem function is not expected to be compromised. This was a major consideration in the planning of longwall mining in areas with extensive remnant vegetation, and open cut mining in areas of mostly non-remnant vegetation.

8.6.1.7. Weeds

Twenty-eight weed species were recorded in the SGCP area, including three species listed under the *LP Act* as class 2 weeds (i.e. Velvety Tree Pear, Prickly Pear and harrisia Cactus). These three cactus species occurred in low numbers throughout the SGCP area and do not currently pose a significant threat to environmental values.

Although not declared under the *LP Act*, the Barcaldine Regional Council (2010) recommends that Noogoora Burr (*Xanthium occidentale*) be subject to surveillance and any isolated infestations controlled. Weed species have the potential to impact on threatened species through broad scale habitat alteration and competition with native pants that provide food and shelter to fauna species.

Soil disturbance, coupled with the introduction of weed seeds from outside the SGCP area via vehicular traffic, has the potential to result in the establishment and spread of new weeds on-site. Mitigation and management measures for weeds are provided in **Section 8.7.1**.

8.6.1.8. Fire

Fire plays a role in vegetation succession patterns and habitat mosaics in the Desert Uplands bioregion. Periodic, low intensity mosaic burning promotes diversity of habitats (Fensham and Fairfax, 2007; Price, Kutt and McAlpine, 2010). It is not expected that the SGCP project will significantly increase the frequency or intensity of fires within the region. Due to the difficulty of controlling fires during the dry season, it is recommended that fire bans be in place across the SGCP area. Fire is not expected to impact on species or REs of conservation significance unless hot, intense burns are allowed to proliferate.

8.6.1.9. Release of Contaminants

Release of mine-affected water or other contaminants has the potential to pollute waterways and to impact on vegetation health adjacent to the SGCP area. The design and operation of water management infrastructure, waste rock emplacements and chemical/fuel storage facilities will be undertaken in accordance with relevant legislation and standards, and as such, no additional mitigation measures are proposed.

8.6.1.10. Cumulative Impacts

Cumulative impacts are the result of multiple developments in an area. An individual development may have negligible impact; however, when coupled with the impacts of other projects, the cumulative changes to the environment over time can lead to more substantial impacts than those associated with any single development.

For example, a single project within an area surrounded by areas of biodiversity value will have negligible impacts whilst regional biodiversity is still mostly intact, but when multiple developments occur in the region, despite each having negligible impact in isolation, the sum of individual changes imparts environmental harm.

Cumulative impacts increase exponentially with successive developments and negative impacts on regional biodiversity are likely to occur within a rapid timeframe once development exceeds a threshold level within a given region (Theobald, Miller and Hobbs, 1997; McIntyre, McIvor and Heard, 2002; Fletcher, 2005). The threshold level for these impacts is difficult to quantify and varies depending on the nature of development, the biota impacted on and the landscape in which development occurs (Stakhiv, 1988).

8.6.1.11. Potential Impacts on Threatened or Near Threatened Flora

Three threatened or Near Threatened flora species were confirmed in the SGCP area (refer to **Figure 8-8,** and one Near Threatened flora species (i.e. Western Rosewood) was considered likely to be present despite having not been detected.

8.6.1.12. Round-leaved Heath Myrtle

Round-leaved Heath Myrtle was recorded within RE 10.7.7 in the eastern portion of the mine survey area (on the Sapling property). The populations within and in close proximity to the SGCP area appear to be limited in extent.

The core of the identified Round-leaved Heath Myrtle population is not expected to be directly impacted by the SGCP. However, the open pit mining area and waste rock emplacement may result in changes to the surface and groundwater hydrology and chemistry. Acid mine drainage has been known to largely destroy affected areas of vegetation (Bell *et al.*, 2001). Mitigation measures to address acid mine drainage is proposed in **Section 7—Land**, and include selective placement of potentially acid-forming (PAF) material within the waste rock emplacements, covering PAF material with non-acid forming material and on-site water management infrastructure.

The Round-leaved Heath Myrtle population to the west of the mine survey area is not expected to be affected by the SGCP, and therefore no specific management or mitigation recommendations are recommended.

Loss of connectivity between populations restricts the ability of new dispersal of seed into an area affected by localised threatening processes. In addition to the known population, other populations may exist within the mine survey area and not have been detected. The total area covered by known potential habitat for this species (REs 10.7.3, 11.7.2 and 11.10.3) that will be impacted within the mine survey area is approximately 66 ha (consisting of approximately 18 ha to be cleared and 49 ha to be potentially impacted by subsidence). It is unlikely that the Round-leaved Heath Myrtle occurs in the infrastructure corridor survey area given the intensity of survey effort over a narrow area.

8.6.1.13. Large-podded Trefoil

Large-podded Trefoil was recorded within RE 11.5.3 and an area of non-remnant vegetation along the infrastructure corridor survey area, within the properties Saltbush and Tresillian. The population on Saltbush lies 50 m to the west of the proposed infrastructure corridor and the population on Tresillian lies 100 m to the east of the infrastructure corridor. This herb is likely to be more widespread within the SGCP survey area than the two records suggest.

While the two known populations of Large-podded Trefoil will not be impacted by the proposed infrastructure corridor, areas of potential habitat will be removed. Large-podded trefoil could occur in any remnant or non-remnant vegetation in land zones other than 7 and 10. As such, approximately 4,964 ha of potential habitat will be cleared for the SGCP, while approximately 5,113 ha could be impacted by subsidence.

The Large-podded Trefoil populations within the SGCP area appear to be limited in extent. Small populations of plants can be at risk of extinction due to random stochastic events. However, as this species was recorded within non-remnant grasslands and other previously cleared areas, the species may tolerate substantial disturbance.

8.6.1.14. *Eleocharis blakeana*

Eleocharis blakeana was observed in a wetland within the infrastructure corridor survey area on the property Saltbush. The proposed alignment of the infrastructure corridor (refer to **Figure 8-8**) bypasses this wetland.

Threats to wetlands in general may include weeds, pollution, altered drainage patterns, draining for agricultural or residential land, or heavy grazing in drier areas. The latter factor is the primary threatening process facing the population of *E. blakeana* in the SGCP area. Grazing is not expected to increase as a result of the SGCP. Given that most other wetlands within the SGCP were artificial waterbodies with heavily grazed edges, it is unlikely that significant populations of this species occur elsewhere in the survey area. Consequently, impacts of the SGCP on *E. blakeana* are expected to be negligible.

8.6.2. Potential Impacts on Terrestrial Fauna

Potential impacts on terrestrial fauna arising from the construction and operation of the SGCP include:

- habitat loss
- edge effects and fragmentation
- direct mortality
- subsidence and hydrological impacts
- weeds
- pest animals
- altered fire regime
- noise and vibration
- artificial light
- cumulative impacts.

8.6.2.1. *Potential impacts of fragmentation and edge effects on fauna*

Some patches of remnant vegetation may become isolated during the SGCP development. These patches would be expected to still have ecological value (acting as corridors for fauna moving between Alpha Creek and other areas of remnant vegetation) and will be retained where practicable.

Edge effects impact on fauna species in terms of changes to microclimates and habitats (Garden *et al.*, 2007). Changes to the thermal environment along edges alter the suite of species that may utilise edge areas, and may increase the susceptibility to predation, further reducing the biodiversity values of a fragmented area (Andren and Anglestam, 1988; May and Norton, 1996; Webb, Shine and Pringle, 2005).

8.6.2.2. Direct Mortality

Clearing of vegetation during the development phase of the SGCP presents a risk of direct mortality to threatened fauna. The increased passage of vehicular traffic and machinery both during construction and operation of the mine has potential to injure fauna species and cause direct mortality. Human-induced mortality is also a risk, particularly to snake species and the Brigalow Scaly-foot, which mimics a snake when disturbed.

8.6.2.3. Pest Animals

Six pest animal species were recorded in the SGCP area. Several of these species, including the Feral Pig and European Rabbit, have the potential to cause serious environmental harm. Predatory pest species such as Feral Cats, Pigs and Wild Dogs present a major risk to threatened species.

Wild Dogs have the potential to impact on native fauna particularly reptiles and medium-sized mammals. Many native vertebrate species benefit from the control of Wild Dogs, but Feral Cats should be controlled concurrently to prevent the populations increasing in the absence of Wild Dogs.

Predation by Feral Cats may pose additional threats to the conservation of biodiversity within the SGCP area. Feral Cats are Class 2 pests under the *LP Act* and are Key Threatening Processes under the *EPBC Act*. In addition to their negative impacts on biodiversity, Wild Dogs and Cats may prey upon local stock and may harbour and spread diseases to domestic animals.

Feral Pigs impact on biodiversity values by predation of native species and through habitat degradation and vegetation damage.

Biological effects including lethal toxic ingestion caused by Cane Toads are also listed under the *EPBC Act*. Any new water bodies, including ponding areas, roadside ditches and flood channels, can increase breeding opportunities for cane toads.

8.6.2.4. Altered fire regimes

Altered fire regimes that include more intense burns, typically late in the dry season, and frequent burns, are a threatening process to numerous fauna species, particularly as a result of changes in vegetation. It is not anticipated that the SGCP will increase the frequency and intensity of fires within the region.

8.6.2.5. Noise and Vibration

The effects of noise and vibration on fauna are variable, changing according to the frequency and duration of noise and vibration. Ecological effects vary between species, although it seems many species are able to adapt to increased levels of noise and vibration. While animals are likely to be disturbed and potentially have panicked reactions to loud, novel sounds (Fletcher and Busnel, 1978) there is evidence that repeated exposure to loud sounds (such as mine blasting or 'bird scare guns') can be tolerated by most species (Welch and Welch, 1970). Because no species of conservation significance are known to nest adjacent to the mine area, impacts of noise and vibration are likely to be negligible from a biodiversity viewpoint. However, due to limited evidence available on impacts of noise and vibration on Australian species, the true impacts are not predictable.

8.6.2.6. Artificial Light

The mine, and associated buildings and roads will increase the amount of artificial light on-site. Little is known regarding the effects of artificial light on fauna (Longcore and Rich, 2004). The effects of light are complex, and depend on the visual biology of the species. For nocturnal species (e.g. sea turtles and migratory birds) that orientate using natural light sources such as the moon and stars, artificial lights interfere with navigation (Salmon *et al.,* 1995; Poot *et al.,* 2008). The resulting mortality observed at flood lights, oil rigs and other structures provides a clear, direct illustration of an ecological impact of artificial light (Howell *et al.,* 1954; Longcore *et al.,* 2012).

However, the impacts of artificial light can also be very subtle. For many species, light is an important cue for regulating circadian rhythms, and artificial light may interrupt natural patterns of sleep and cell repair (Ben-Shlomo and Kyriacou, 2010). Likewise, the timing of dawn singing, egg laying and other daily activities of birds can be disturbed by artificial lighting (Miller, 2006; Kempenaers *et al.,* 2010). This can have impacts on their reproductive success (Kempenaers *et al.* 2010).

Artificial light can have important impacts on nocturnal predators and their prey. Several prey species reduce their activity in the presence of artificial light (Baker and Richardson, 2006; Rotics *et al.,* 2011; Davies *et al.,* 2012). Conversely, the densities of predators are higher in artificially lit environments (Davies *et al.,* 2012). Insectivorous nocturnal animals such as bats, frogs and geckos may be especially attracted to the high densities of prey at lights (Rydell, 1992). However, these elevated prey densities may be partially offset by a reduced ability of these species to forage and/or orientate in the presence of artificial lighting (Buchanan, 1993; Stone *et al.,* 2009; Orbach and Fenton, 2010). Declines in populations of insects attracted to lights (Conrad *et al.,* 2006) can also have secondary impacts on diurnal birds and other fauna that depend on them for food.

In contrast to the many impacts of artificial light on animals, little research has been carried out on plants. Some laboratory studies have suggested that artificial lighting may interfere with photosynthesis (Roman *et al.,* 2000) and flower development (Wang *et al.,* 2003). However, there is a lack of research into the impacts of artificial lighting on natural plant communities.

While numerous potential ecological impacts of artificial light have been identified by previous studies, the severity of these impacts on the conservation of species is typically unknown. With the exception of sea turtles (e.g. Salmon *et al.,* 1995), the effects of artificial lighting on Australian fauna of conservation significance has not been investigated. Artificial lighting is not listed in the Australian Government's Species Profile and Threats Database as an important threat to any of the species of conservation significance known from or potentially occurring within the SGCP area. There may be some mortality of the Rainbow Bee-eater associated with collisions with light-bearing structures during migration, although this is predicted to have minimal to no effect on their population (DSEWPaC 2012).

8.6.2.7. Cumulative Impacts

A number of mining projects are currently proposed for the Galilee Basin. The cumulative impacts of land clearing and transport infrastructure corridors will result in increased fragmentation, increased edge effects, reduction of biodiversity corridors and removal of large tracts of faunal habitat. These impacts may reduce the likelihood of recolonisation of species into an area, disturb the seasonal movements of species and reduce dispersal between areas of remnant suitable habitat (Theobald, Miller and Hobbs, 1997).

The threatened fauna species most likely to be negatively affected by cumulative impacts is the Brigalow Scaly-foot. The stronghold of this species is in Queensland's Brigalow Belt bioregion, an area that has seen a drastic reduction in its extent of remnant vegetation (Kutt, Hannah and Thurgate, 2003). While the SGCP is unlikely to have significant impacts on the overall population of the species, the cumulative effects of development within the region are likely to be detrimental. To mitigate the potentially negative impacts of clearing vegetation for the SGCP, it is recommended that remaining vegetation be managed for biodiversity conservation purposes and biodiversity corridors are established between remnant habitats (SEWPaC, 2011).

8.6.2.8. Potential Impacts on Threatened and Near Threatened Fauna Species Confirmed from the SGCP Area

Two threatened and two Near Threatened terrestrial vertebrate species are confirmed from the SGCP area. These are the threatened Brigalow Scaly-foot (*Paradelma orientalis*) and Koala (*Phascolarctos cinereus*), and the Near Threatened Little Pied Bat (*Chalinolobus picatus*) and Square-tailed Kite (*Lophoictinia isura*). The potential impacts of the SGCP on these species are discussed below.

8.6.2.8.1. Brigalow Scaly-foot (Paradelma orientalis)

Loss of habitat is a major threat to the Brigalow Scaly-foot (Richardson, 2008). The remnant vegetation unit in which the Brigalow Scaly-foot was found is on the eastern side of the mine survey area. The current conceptual mine plans show that vegetation in the vicinity of the confirmed Brigalow Scaly-foot record will not be cleared or directly impacted by the SGCP. However, it is likely that the species occurs widely within the SGCP area, and all of the SGCP area (including non-remnant vegetation) is suitable for this species. Approximately 4,990 ha of potential Brigalow Scaly-foot habitat is proposed to be cleared for the SGCP. Approximately 5,235 ha of Brigalow Scaly-foot habitat will be potentially indirectly affected by subsidence associated with longwall mining, although the risk of habitat becoming unsuitable for Brigalow Scaly-foots as a result of subsidence is negligible. During clearing operations there is a threat of direct mortality to Brigalow Scaly-foots from machinery and vehicles. During and after the operational life of the mine, removal of habitat, weed infestation, pest animals and reduced connectivity between high-quality remnant habitat may constitute threats to the species (Tremul, 2000, Kutt, hannah and Thurgate, 2003; Richardson, 2008).

8.6.2.8.2. *Little Pied Bat (Chalinolobus picatus)*

Little Pied Bats are dependent on wooded areas containing suitable hollow trees for roosting, but forage over a wide range of landscapes. Clearing of hollow-bearing trees and too-frequent fires are a threat to the species (SEWPaC, 2011b). Multiple AnaBat recordings from different locations and times of year suggest Little Pied Bats may be widespread and relatively common permanent residents within the SGCP area. Due to the fact that the SGCP area provides mostly non-remnant habitat, the impact of the SGCP on local Little Pied Bat populations is anticipated to be minor. Little Pied Bats may experience direct injury or mortality during clearing, particularly if roost trees are damaged. Removal of roost trees will potentially impact on the local persistence of Little Pied Bats.

8.6.2.8.3. *Square-tailed Kite (Lophoictinia isura)*

Square-tailed Kites favour large tracts of open woodlands (especially along riparian zones). This conspicuous species was only recorded on one of five surveys, and therefore the local population is small and/or transitory. The Square-tailed Kite's highly mobile nature means they are unlikely to suffer direct injury from clearing activities. Proposed mining activities will mainly occur within non remnant habitats, which may be utilised for foraging by the species, but is unsuitable as breeding habitat (Debus, 1998). While approximately 585 ha of remnant vegetation is proposed to be cleared, the nature of the clearing (a long, narrow infrastructure corridor and the removal of small islands of remnant vegetation in the mining area) means that habitat for the species within the local region will not be significantly reduced (Garnett and Crowley, 2000).

8.6.2.8.4. *Koala (Phascolarctos cinereus)*

The SGCP will result in the removal of 135.2 ha of potential habitat for Koalas (woodlands dominated by River Red Gum or Poplar Box) to accommodate the mine pit. Additional loss of River Red Gum woodland along Tallarenha Creek is possible due to subsidence and cracking associated with longwall mining. The amount of habitat that may be impacted by subsidence is difficult to predict due to potential downstream impacts, but is expected to be between 2 and 100 ha. Whether this results in the death of Koala food trees is unknown, but unlikely. The clearing of habitat along tributaries of Tallarenha Creek may disrupt the movement of Koalas across the site. Additional, minor impacts on local Koala populations due to the SGCP may result from feral predators, collisions with vehicles, changed fire regimes, and direct mortality during clearing.

8.6.2.9. *Potential Impacts on Threatened and Near Threatened Fauna Species Likely to Occur in SGCP Area*

One Endangered (*EPBC Act* and *NC Act*), four Vulnerable (*EPBC Act* and *NC Act*) and one Near Threatened (*NC Act*) fauna species are likely to occur within the SGCP area but were not detected during fauna surveys. The potential impact of the SGCP on these species is discussed below.

8.6.2.9.1. Ornamental Snake (Denisonia maculata)

The SGCP area is within the known distribution of the Ornamental Snake and adjacent to areas mapped as likely habitat (SEWPaC, 2011a). Because of the cryptic nature and seasonal activity of this species, it is difficult to detect. Ornamental Snakes most commonly inhabit cracking soil types, particularly where there is gilgai microrelief (Richardson, 2008). As Ornamental Snakes will disperse widely to move between feeding habitat, connectivity between appropriate habitat types is important (SEWPaC, 2011a). While most of the SGCP area is dominated by sandy soils, small areas of heavy clay are found interspersed with sandy soils (usually associated with Brigalow RE 11.4.8). The Ornamental Snake eats frogs, and therefore impacts on surface hydrology and water quality that affect frog species will potentially indirectly affect Ornamental Snakes. Clearing of vegetation will remove approximately 13 ha of high-quality habitat for the Ornamental Snake. Because the Ornamental Snake is known to utilise remnant and non-remnant vegetation (SEWPaC, 2011a; Wilson and Swan, 2005, 2010), much of the mine survey area and infrastructure corridor area, excluding rocky ridges, is potentially suitable habitat.

8.6.2.9.2. Yakka Skink (Egernia rugosa)

The Yakka Skink is a colonial species that lives in family groups using long-term home sites (Richardson, 2008). The Yakka Skink is difficult to detect during surveys and the species was not recorded during the surveys. If sites containing burrow systems of the Yakka Skink are cleared, it is likely to impact on the local population viability. Yakka Skinks utilise a variety of habitats and can be found within landzones 3, 4, 5, 7, 9 and 10 (SEWPaC, 2011a). Clearing of habitat is a major threat to the Yakka Skink (Richardson, 2008). Due to the lack of high quality habitat across much of the SGCP area (i.e. non remnant vegetation), the impacts on Yakka Skinks are likely to be minimal, should they occur on-site.

8.6.2.9.3. Dunmall's Snake (Furina dunmalli)

Dunmall's Snake occurs in very low densities and is also cryptic in habit, making it very difficult to detect during surveys. Clearing vegetation reduces the availability and suitability of habitat, and is a major threat to Dunmall's Snake (Richardson, 2008). Dunmall's Snake potentially utilises all remnant habitats within the SGCP area, particularly open woodland containing adequate ground cover and debris.

8.6.2.9.4. Death Adder (Acanthophis antarcticus)

Death Adders are camouflaged, cryptic snakes that hide in natural ground cover. They are difficult to detect during survey efforts. Clearing of vegetation, cattle grazing and pest animals are major threats to death adders. Death Adders potentially occur in all remnant forest types in the SGCP area where there is adequate deep leaf litter and other ground cover. The proposed project is unlikely to have population-level impacts on Death Adders due to the availability of higher quality habitat in the wider region.

8.6.2.9.5. Squatter Pigeon (Geophaps scripta scripta)

Squatter Pigeons are highly mobile and move over large areas depending on resource availability (particularly seeding native grasses). Because of their mobile nature, they are expected to move away from vegetation clearance activities undertaken for the SGCP. Squatter Pigeons are typically easily detected, and as they were not detected in any surveys, a local population (if present) is likely to be small and/or transitory. The SGCP is unlikely to cause population-level impacts within the region due to the existence of suitable habitat adjacent to the site and the highly mobile nature of the species.

8.6.2.9.6. Cotton Pygmy-goose (Nettapus coromandelianus)

The Cotton Pygmy-goose has been recorded approximately 60 km east of the SGCP area. While the species was not recorded at the SGCP area, the SGCP is located within the species' range. Little suitable habitat occurs within the SGCP area, although this species may use artificial waterbodies in a transient capacity. Due to the lack of habitat, the proposed SGCP is unlikely to impact on this species.

8.6.2.9.7. Black-throated Finch (Poephila cincta cincta)

A population of Black-throated Finches has been recorded within the Bimblebox Nature Refuge, 25 km west of the infrastructure corridor survey area. This species was not detected within the SGCP area during any of the five surveys. However, given the existence of suitable habitat and the close proximity to a known population, it is possible that small numbers of Black-throated Finches may utilise the site at least in a transitory capacity. If present, the Black-throated Finch is most likely to occur in remnant, eucalypt-dominated woodlands within the infrastructure corridor survey area, or in the western and southern portions of the mine survey area. Clearing of remnant eucalypt woodlands, the removal of permanent water sources, and damage to understorey grasses from cattle or weeds may potentially reduce the availability of this habitat for the Black throated Finch, should it occur on the SGCP site.

8.6.2.10. Potential Impacts on Migratory Species

Two migratory species listed under the *EPBC Act* are known to occur within the SGCP area, the Rainbow Bee-eater (*Merops ornatus*) and Eastern Great Egret (*Ardea alba modesta*). Eight other migratory species have the potential to occur within the SGCP area (refer to **Section 6.2.4.4** of **Appendix N—Terrestrial Ecology Technical Report**).

The SGCP is not anticipated to significantly impact on recorded or likely migratory species as:

- the species are common in the local and regional area (i.e. Rainbow Bee-eater and Eastern Great Egret)
- considerable alternative habitat exists outside of the proposed impact areas (i.e. Rainbow Bee-eater, Eastern Great Egret, Cattle Egret, Fork-tailed Swift, White-throated Needletail)
- no loss of habitat (i.e. Fork-tailed Swift, White-throated Needletail).

Although impacts on migratory species are predicted to be minimal or nil, the presence of two *EPBC Act* listed species and the potential presence of others within the SGCP area were factors in the SGCP being determined a controlled action by DEWHA (now SEWPaC) under the provisions for listed migratory species (sections 20 and 20A) in the *EPBC Act*.

Nesting Rainbow Bee-eaters were observed in the central section of the SGCP area. However, the observed nesting sites were located outside of the proposed disturbance footprint. Rainbow bee-eaters often nest in disturbed areas (e.g. sandy roadside embankments), and the nesting sites observed within the SGCP area were in such a location.

8.6.2.11. Potential Impacts on Bio-regionally Significant Species

8.6.2.11.1. Yellow-spotted Monitor (Varanus panoptes)

Clearing of remnant and non-remnant vegetation for the SGCP will remove habitat for Yellow-spotted Monitors. However, given the broad diversity of grassed and wooded habitats occupied, and the abundance of these habitats in the surrounding areas, it is unlikely that the SGCP will have significant impacts on this species' regional population.

8.6.2.11.2. Black Falcon (Falco subniger)

The Black Falcon was recorded in two out of five surveys (both within the mine survey area), and it is unlikely that the SGCP area supports a large population. Nevertheless, removal of large trees and grasslands to accommodate the mine and infrastructure may reduce the suitability of the SGCP area for the species.

8.6.2.11.3. Australian Bustard (Ardeotis australis)

The Australian Bustard utilises most open to semi-open habitats within the SGCP survey area in low densities, and was recorded in four out of five surveys. The primary threats to the species across its range are altered fire regimes, predation (especially of nests) by dogs and overgrazing by cattle (Australian Wildlife Conservancy, undated). It is not anticipated that the SGCP will significantly elevate any of these threats. The primary impact will be through removal of habitat.

8.6.2.11.4. Bush Stone-curlew (Burhinus grallarius)

The Bush Stone-curlew occurred in low densities throughout wooded parts of the SGCP area, and was recorded in three out of five surveys. Primary threats to the species throughout its range include clearing and fragmentation of habitat, removal of fallen logs and other debris, and introduced predators (Department of Sustainability and Environment, 1997). Removal of remnant wooded habitats constitutes the primary anticipated impact on the species.

8.6.2.11.5. Barking Owl (Ninox connivens)

Habitat loss and degradation is the major threat to the survival of the Barking Owl across its range (Birds Australia, 2010). Loss of hollow-bearing trees impacts on the species by removing nesting sites as well as habitat for hollow-dependent prey such as gliders, possums and parrots (Birds Australia, 2010). habitat removal is the primary impact of the SGCP on the Barking Owl.

8.6.2.11.6. Brown Treecreeper (Climacteris picumnus)

Brown Treecreepers were common residents of most remnant habitats within the SGCP area. They require hollow trees (dead or alive) for nesting, and forage anywhere there are standing and/or fallen trees. The primary threats to their survival pertain primarily to their requirement for ample standing and fallen timber, and include habitat clearing and fragmentation, inappropriate fire regimes and collection of fallen timber (Cooper and Walters, 2002; Cooper *et al.*, 2002; NSW Department of Environment and Conservation, 2005a). The primary impact of the SGCP on Brown Treecreepers is the removal of remnant habitat.

8.6.2.11.7. White-eared Honeyeater (Lichenostomus leucotis)

White-eared honeyeaters are less common after clearing and bushfire (Birds Australia, 2005), and rarely fly over open spaces, preferring to use corridors with tree cover (Birds Australia, 2005). White-eared Honeyeaters were recorded only in shrubby forests on hills in the southwest of the mine survey area. These areas are unlikely to be impacted by proposed activities.

8.6.2.11.8. Hooded Robin (Melanodryas cucullata)

Hooded Robins have suffered massive declines in the southern half of Australia, caused primarily by widespread clearing of dry woodland habitats. habitat fragmentation and reduction in habitat quality lead to local extinction of hooded robins (Garnet and Crowley, 2000; Watson *et al.*, 2003). In Queensland, where woodlands remain widespread and less fragmented, Hooded Robins remain relatively common. habitat clearing is the primary impact of the proposed SGCP. While this single project may not have significant impacts on the species' population, the cumulative impacts of wide-scale clearing for the SGCP and other regional projects may affect the species' long-term regional conservation.

8.6.2.11.9. Grey-crowned Babbler (Pomatostomus temporalis)

Grey-crowned Babbler populations have declined throughout southern parts of their range as a result of clearing and fragmentation of woodland habitats (Birds Australia, 2008b). Grey-crowned Babblers often, however, utilise regrowth habitats, in addition to remnant woodlands. They were recorded in four of five surveys of the SGCP area, and were locally common. Cumulative impacts of the SGCP alongside multiple other projects involving vegetation clearing may cause local population declines of this species.

8.6.2.11.10. Narrow-nosed planigale (Planigale tenuirostris)

There appear to be no major threats to the Narrow-nosed Planigale, apart from localised threats through habitat removal (Ellis *et al.*, 2008). Mining activities will remove some habitat, but given the abundance of suitable habitat in surrounding areas, overall impacts on the regional population are expected to be minimal.

8.6.2.11.11. Common Dunnart (Sminthopsis murina)

There appear to be no major threats to the Common Dunnart, although it has experienced declines in the southern parts of its range (i.e. Victoria) (Dickman *et al.*, 2008). The primary impact of the SGCP is through the removal of woodland habitats.

8.6.2.11.12. Common Brushtail Possum (Trichosurus vulpecula)

Despite being abundant in urban centres of Australia, the Common Brushtail Possum has undergone declines across central Australia, thought to be due to predation by introduced predators, habitat fragmentation, loss of denning sites and altered fire regimes (Department for Environment and Heritage, 2009; DEWHA, 2009). Removal of remnant woodland habitat, especially those containing hollow trees, is the primary impact of the SGCP.

8.6.2.11.13. Rufous Bettong (Aepyprymnus rufescens)

Rufous Bettongs inhabit a broad range of woodlands and open areas, as long as they contain a dense grassy understorey. It was locally common within the SGCP area, being recorded on all five surveys. Rufous Bettongs have undergone declines in the south of its range due to intensification of agricultural practices and habitat destruction from introduced rabbits (Burnett and Winter, 2008). While none of these threats are anticipated to increase as a result of the SGCP, project-specific impacts include removal of habitat and increased vehicular traffic.

8.6.2.11.14. Spectacled hare-wallaby (Lagorchestes conspicillatus)

Spectacled hare-wallabies inhabit a broad range of wooded and open habitats, but are dependent on large tussock grasses for shelter. In central Queensland, overgrazing coupled with prolonged drought conditions has led to decreases in the quantity and quality of sheltering sites (Wildlife Australia, undated). Spectacled hare-wallabies will be impacted by vegetation clearance, as well potentially through collisions resulting from increased vehicular traffic.

8.6.2.11.15. Black-striped Wallaby (Macropus dorsalis)

Black-striped Wallabies are dependent on dense shrubby thickets (e.g. Brigalow, cypress pine) adjacent to grassy foraging areas. Loss of these thickets through clearing, inappropriate fire regimes, or via grazing by rabbits, goats, sheep and cattle threatens the species (NPWS, 1999). Predation by introduced predators following loss of shelter is an additional threat. The primary impact of the SGCP will be the removal of remnant woodland habitat.

8.6.2.11.16. Swamp Wallaby (Wallabia bicolor)

Swamp Wallabies are dependent on dense wooded habitats (including regrowth), with a shrubby understorey. The primary impact of the SGCP will be habitat removal.

8.6.2.11.17. Inland Forest Bat (Vespadelus baverstocki)

The ecology of the Inland Forest Bat is poorly known, but it is thought to roost primarily in hollow trees, including very small dead stumps (DEC, 2005b). Like other inland bats, it appears to be dependent on riparian corridors, both for roosting sites and for water (DEC, 2005b). As such, any impacts of the SGCP on the hydrology of local creeks may impact this species. Removal of hollow trees along drainage lines may impact this species by reducing available habitat and through direct injury to roosting bats.

8.6.2.11.18. Desert Mouse (Pseudomys desertor)

The Desert Mouse occupies a range of grassland habitats, including pastures produced following the clearing of remnant woodland. It was within these altered landscapes that they were recorded in the SGCP area. The most important habitat requirement is a dense cover of native hummock or tussock grasses, and low pressure from fire and grazing (Kutt *et al.*, 2004). The invasion of introduced Buffel Grass is a major threat (Read and Woinarski, 2008), along with inappropriate fire regimes and high stocking rates. The SGCP may impact the species by removing grassland habitat.

8.6.3. Potential Impacts on Surface Aquatic Ecology

While there is existing disturbance of aquatic environments from cattle, road and creek crossing construction, small-scale riparian vegetation clearing and potentially agricultural runoff, many of the sites surveyed were remote and close to natural condition. Water quality in the Project area was often poor with respect to EC, DO, pH and turbidity, but this is not unexpected for ephemeral stream habitat at different stages of the hydrograph. In terms of the aquatic flora and fauna supported by waterways in the Project area, there were no species of high conservation value detected, and most of the fish and macroinvertebrates present were generalists. However, the macroinvertebrate community was diverse and was close to reference condition. It also contained a number of plecopteran, ephemeropteran, trichopteran and other pollution-sensitive taxa that could potentially be vulnerable to the impacts of mine runoff.

Activities associated with the construction phase with the potential to impact on the surface water aquatic ecosystem values in the Project include:

- pit construction
- diversion of low order streams around the pit areas
- removal of riparian vegetation from streams both within the infrastructure corridor and the MLA
- instream works associated with road, rail and conveyor crossings

- movement of vehicles and the plant to, from and around the construction site.

The key activities associated with the operation phase of the SGCP include:

- pit excavation and dewatering
- underground mining
- processing, handling and transport of ore material
- managing water on-site.

8.6.3.1. Habitat Removal

Open pit mining for the SGCP will result in the permanent loss of low order stream habitat and lacustrine habitat. The potentially impacted low order stream habitat, while largely physically intact, is dry for much of the year and is, of low habitat value to local aquatic fauna. It is also likely to be replicated outside the MLA. Drainage channels and a stream diversion will divert flow around the open pit mining area. Therefore, upstream reaches will be physically connected to downstream reaches through a modified physical habitat. The potential loss of the dams on the unnamed tributary of Tallarenha Creek and Sapling Creek is of greater relevance. The former was the only site assessed that featured any submerged macrophyte species and, in that respect, was relatively unique within the study area. Both dams appear to retain water for long periods of time, and are therefore likely to support migratory birds from time to time as well as macroinvertebrate and fish fauna. However, the aquatic fauna of those dams is not particularly unique.

8.6.3.2. Removal and Modification of Riparian Vegetation

Riparian vegetation provides bank stabilisation, shading of stream habitat, organic material and large woody debris as a food and shelter source for aquatic fauna and it contributes to the retention of water in stream systems. As such, a loss of riparian vegetation associated with the SGCP could decrease stream integrity and function. Apart from sections of stream and lacustrine systems that will be permanently removed from within the open pit mining area, some riparian vegetation disturbance and clearing will be required for road and other infrastructure crossings. The number of such crossings is yet to be determined. However, at each crossing location, riparian vegetation clearing is expected to occur within confined corridors and the impacts would be highly localised.

8.6.3.3. Modification of Instream habitat

There may be a requirement for disturbance of instream habitat during construction of crossings, where either new creek crossings or temporary weirs are built, or pylons may need to be placed in creeks to support bridges. Such impacts would generally be short-term and localised. Appropriate precautions are to be adopted in terms of construction methods and timing in relation to seasonal rainfall.

8.6.3.4. Barriers to Fish Passage

Fish passage barriers will potentially be created as part of the SGCP. However, most of these will likely be temporary in nature. Temporary barriers could arise through temporary levee construction to support other infrastructure construction, including road, rail and conveyor crossings and the Sapling Creek stream diversion.

Given their likely temporary nature and the fact that none of the fish species present in the study area are obligate migratory species, such barriers are likely to have minimal impact on the resident fish community.

8.6.3.5. Runoff and chemical spills

Earthworks associated with the construction phase have the potential to result in sediment mobilisation to waterways through direct disturbance to bed and banks, runoff from stockpiled material or the clearing of vegetation near waterways. While some of the resident fish species in receiving waters tolerate very high turbidity in the short-term, there are a number of pollution-sensitive macroinvertebrate species present that could be detrimentally affected by such impacts.

In addition to the potential for increased sediment mobilisation, chemical spills could arise through traffic accidents or through chemicals not being stored appropriately. Those spills would most likely involve grease and oils and, in most cases, spills would be small and localised, such that minimal environmental harm occurs. However, there is a low chance that large spills could occur or that other potentially harmful chemicals could be involved. Further discussion is provided in **Section 9—Water Resources** and **Section 19—Hazard and Risk**.

8.6.3.6. Alteration of Hydrology

The construction of the mine pits, on-site water management infrastructure and the stream diversion channel will alter the local hydrology. The Sapling Creek stream diversion will result in the creation of entirely new aquatic habitat. Rainfall on the mine site that would otherwise flow directly into creeks will be retained in the surface water management infrastructure and released infrequently only when design criteria are exceeded (refer **Section 9—Water Resources** for more detail). This would result in reduced flows downstream, which in turn, could reduce aquatic ecosystem functioning in affected reaches and/or create greater habitat fragmentation of stream habitat in such reaches. The lower reaches of Sapling Creek and the lagoon adjacent to Alpha Creek are the most vulnerable to such effects. While these waterbodies are ephemeral and are dry for much of the year, they represent important habitat refugia and, in the case of the lagoon, uncommon habitat within the study area. Potential impacts on hydrology are discussed in **Section 9—Water Resources**.

8.6.3.7. Direct Mortality

There is a potential for semi-aquatic fauna such as turtles to be killed accidentally during riparian vegetation clearing or during instream works. Those associated with isolated pools are most at risk due to their inability to move quickly into alternate habitat during construction. While no turtle species were recorded in the Project area, mortalities associated with construction have the potential to reduce local populations if present.

Cann's Long-necked Turtle and Snake-necked Turtle are known to undertake long, overland migrations for nesting and in response to habitat degradation (Cann, 1998) and may wander into construction areas. In addition, the increased traffic in the Project area could result in an increased frequency of turtle road kills. Amphibian species that rely on the seasonal flows within Sapling Creek are likely to be impacted by the diversion during construction through direct mortality, and is other fauna that inhabits the riparian and instream habitats removed during clearing and creek diversion.

8.6.3.8. Release of Mine affected Water

The surface water infrastructure of the project will be designed to contain as much water as practicable on site and as such discharges of water would only occur in extreme events when surface water infrastructure design criteria are exceeded. Further discussion of the potential impacts associated with releases of mine water is provided in **Section 9—Water Resources**.

8.6.3.9. Coal Dust Emissions

There is the potential for coal dust emissions to enter and contaminate waterways, particularly with respect to heavy metals (Swer and Singh, 2003 *In* GHD, 2010). This may potentially have a negative impact on aquatic fauna if deposition reaches high levels in close proximity to aquatic habitats. This is unlikely to occur to any significant degree at the SGCP.

8.6.3.10. Subsidence

Underground mining has the potential to result in the subsidence of stream bed and banks. The main streams potentially affected within the Project area are low order streams that are of limited value to aquatic flora and fauna in terms of habitat. However, slumped bed and banks in these creeks may lead to high levels of sediment mobilisation into Tallarenha and eventually into Alpha Creek. This could have potential impacts on aquatic fauna and habitat quality in those systems. Further discussion of subsidence impacts on surface water is provided in **Section 9—Water Resources**.

8.6.3.11. Proliferation of Pest Fauna

Pest fish species (e.g. Tilapia) currently occur in the study area and have a high propensity to spread. Tilapia are an aggressive species when nesting and also consume macroinvertebrates that native species may otherwise eat. Pest species such as Tilapia often out-compete native species under degraded habitat conditions. As discussed, the SGCP has the potential to degrade the aquatic ecosystems in the study area in a number of ways, if not appropriately managed.

8.6.3.12. Cumulative Impacts

Cumulative impacts refer to the potential for SGCP operations to contribute to the potential impacts from all mines, agricultural or industrial activities in the catchment. There are a number of proposed coal mines in the study region including Alpha Coal Project, Galilee Coal Project; Carmichael Coal Project; Kevin's Corner Coal Project and the Macmines Coal Project. In the context of the aquatic environment, there are two potential contributions that these mines may make to local and regional impacts:

- altered catchment hydrology, with associated ecological and fluvial geomorphological implications
- reduction in water quality in the downstream environment, with associated ecological and social implications.

The mining projects mentioned above are within the Belyando River catchment and cumulatively cover a relatively large percentage of the upper tributaries of this river. The proposed mining operations within the area operate in similar ecological areas (ephemeral creeks and drainage paths) within the Belyando River catchment. There is the potential for cumulative effects of these projects impacting upon the Belyando River at a local level. In periods of extreme flow, where runoff from these mines may not be effectively contained, cumulative impacts on surface water quality could potentially extend into the Burdekin River and beyond to coastal lagoons of the Great Barrier Marine Park. However background water quality during such flows is likely to be significantly impacted under natural conditions. Further information on potential cumulative impacts on surface waters is provided in **Section 9—Water Resources**.

8.6.4. Potential Impacts on Subterranean Fauna

8.6.4.1. Stygofauna

While no stygofauna were detected from the SGCP area to date, recent sampling within the Galilee Basin to the north of the SGCP has recovered stygofauna. A second round of sampling is to be carried out within the SGCP area as per the WA guidelines.

Mines incorporate a range of water-affecting activities in their operations, which have the potential to cause some degree of change in natural water regimes. These include some or all of the following:

- mining below the water table
- water supply development (e.g. groundwater, dewatering, surface water)
- desalination for potable supply (with subsequent brine disposal)
- dust suppression
- seepage
- tailings disposal
- rock storages

- backfilling and rehabilitation works
- water diversions and surface sealing
- hazardous and dangerous goods storage
- water storages including waste water ponds.

In recognition of the above mining activities, direct effects on groundwater dependent ecosystems (GDEs) may be as follows:

- quantity (groundwater levels, pressures and fluxes)
- quality (concentrations of salts and other toxic water quality constituents)
- groundwater interactions (interactions between groundwater systems and between groundwater and surface systems)
- physical disruption of aquifers (excavation of mining pits and underground workings).

The potential impact of the SGCP on local to regional groundwater resources and subsequently on GDEs (and stygofauna in particular) will depend largely on the scale of the SGCP mining operation, climatic conditions and the geological setting. Detailed discussion of the potential impacts of the project on groundwater systems is provided in **Section 9—Water Resources**.

8.6.4.2. Hyporheic Fauna

No hyporheic fauna were recorded as part of the SGCP survey as no true hyporheic zone exists within Sapling Creek at the locality chosen for sampling.

8.6.4.3. Troglofauna

The invertebrates collected with the troglofauna traps included oligochaete and nematode worms, oribatid mites, and several beetles. It was not possible to identify the fauna to species given the poorly known taxonomy for all of these groups in Queensland. However, all of the taxa are commonly encountered in soil communities and this is likely to be the origin of the animals collected during the survey carried out as part of this study.

Troglofauna are unlikely to occur in the SGCP area. If present, they would probably be confined to the void spaces of unconsolidated sediments overlying the Permian strata. As all boreholes are cased (and unslotted) for the top 47 m of the vertical profile, access to this part of the stratigraphy was not possible.

8.6.4.4. Potential cumulative impacts

For the SGCP area, quantification of the direct potential cumulative impacts of mining on the region's groundwater systems is difficult at a large scale, particularly the potential for mine activities to impact on:

- groundwater quantity (i.e. alteration to groundwater levels and fluxes)

- groundwater quality (i.e. alteration to regional salinity levels and concentrations of other important toxicants)
- groundwater – surface water interaction (i.e. reduction to levels of interaction between groundwater and surface systems e.g. reduced baseflow to streams, reduced recharge of aquifers and a reduced water table depth)
- physical disruption to aquifers (i.e. will the SGCP contribute to the permanent disruption of a groundwater system).

All of the above cumulative impacts could influence groundwater quantity and quality and, ultimately, obligate groundwater-dependent fauna (stygofauna).

8.7. MITIGATION MEASURES

8.7.1. Terrestrial Flora and Fauna

8.7.1.1. Clearing of vegetation

Clearing of vegetation will be undertaken using a staged approach. Staged clearing of vegetation allows animals to move away from clearing operations into adjacent, uncleared habitats. Clearing will also be conducted with fauna spotter-catchers in communication with the operators of the clearing machinery. Fauna removal will be undertaken immediately prior to clearing.

Any flora species of conservation significance within the clearing footprint will be surveyed, marked and recorded for purposes of biodiversity offsets prior to the undertaking of clearing operations. Flora species of conservation significance may be removed where practicable for translocation unless a management plan for the flora species states that the species removal will be offset by propagation by seed.

8.7.1.2. Rehabilitation and Revegetation

Rehabilitation of disturbance areas will be undertaken throughout the life of the SGCP in accordance with a rehabilitation management plan. A Mine Rehabilitation and Closure Plan will be prepared to direct land rehabilitation during and after the operational life of the mine. Re-establishing vegetation cover will be undertaken with a view to creating self-sustaining ecosystems similar to surrounding ecosystems. The final land use will be a combination of grazing and native bushland.

Only native species will be used for revegetation, apart from any sterile grass cultivars that are required to ensure soil stability. The use of exotic grass species (e.g. Buffel Grass) in the rehabilitation of native bushland areas is strongly discouraged as such activities may promote the spread of the exotic grass species into otherwise unaffected areas, and restrict the development of the native groundcover vegetation. Locally collected seed will be used where practicable to preserve local genetic integrity.

Buffer zones will be established around areas of threatened ecological communities and communities with a conservation-significant biodiversity status, where clearing is adjacent to these areas. Buffer zones are particularly important where surrounding land use exerts strongly negative influences on remnant ecosystems for example when surrounding vegetation is cleared (Fischer *et al.*, 2006).

Retained areas of native vegetation will be monitored and managed for the life of the project to reduce weed infestation and promote biodiversity values in the areas.

Trees will be felled into the construction zone to avoid impacting on vegetated margins.

Topsoil and mulch will be stockpiled where practicable for use on retained vegetation and rehabilitation areas to promote revegetation and retention of soil quality.

Vegetation clearing and construction will be limited to dry weather conditions where practicable to minimise erosion, runoff and soil disturbance.

Disturbed vegetation areas that are no longer required post-construction will be stabilised and revegetated as soon as practicable and monitored for weeds as per the Weed and Pest Animal Management Plan (WPAMP) (refer to **Section 8.7.1.3**).

8.7.1.3. Weed and Pest Animal Management Plan

A WPAMP will be prepared and implemented over the life of the SGCP. The WPAMP will include a monitoring program and auditable performance measures, including reductions in class 1 and 2 pest animals and noxious weeds.

Reasonable measures will be taken to control Velvety Tree Pear, Prickly Pear and harrisia Cactus in the SGCP area, with particular focus on areas near and within remnant vegetation. New weed infestations will be recorded and controlled where applicable under the *LP Act*.

The introduction and/or spread of weed species will be mitigated by:

- restricting light vehicle movement in areas outside of regular activity, particularly on irregularly used tracks
- restricting vehicle movement during and following rainfall, where practicable
- implementing strict wash-down procedures for all vehicles (including clearing and construction machinery) entering clearance zones, grazing areas or conservation areas
- controlling weeds according to guidelines under the relevant Weed Fact Sheet from the Department of State Development, Infrastructure and Planning (DSDIP)
- training and awareness of all staff.

Rehabilitation of disturbed land will not include seeding with exotic grasses. Surrounding landholders are legally obliged to take reasonable steps to keep land free of Class 2 *LP Act* listed weeds, thus reducing the potential of continued weed species dispersal into the SGCP area from surrounding properties. Cooperative weed management programs between properties may increase the effectiveness of these controls.

Vertebrate pest control activities will be undertaken in consultation and cooperation with local authorities and landholders, particularly for pests such as Feral Pigs, Wild Dogs and Feral Cats, in accordance with relevant best-practice management guidelines and the *LP Act*. Putrescible waste will not be allowed to accumulate outside designated areas. These designated areas will be animal-proof and the wastes regularly removed or buried.

Where practicable, the SGCP will reduce new Cane Toad breeding opportunities by minimising the creation of additional small waterbodies suitable for Cane Toad breeding (e.g. ponding areas, roadside ditches or flood channels).

SGCP employees and contractors will be made aware of environmental obligations and compliance requirements through the site induction program.

8.7.1.4. Direct Mortality

The SGCP will involve clearing remnant native vegetation and non-remnant vegetation adjacent to remnant vegetation, which will remove habitats for threatened and Near Threatened species. To minimise negative impacts on fauna in the SGCP area it is recommended that a Threatened Species Management Plan (TSMP) be prepared and implemented prior to the commencement of construction.

Fauna spotter-catchers will be used to relocate any fauna species of conservation significance prior to clearing activities during the construction phase.

Clearing will occur in one direction through the vegetation, to allow fleeing animals to disperse into adjacent habitat. Strategies for dealing with sick or injured wildlife found during clearing will be detailed within the TSMP and should involve contacting identified local wildlife carers.

Hollow-bearing trees will be inspected for fauna prior to felling. Hollow-bearing trees will be retained and placed in retained areas of vegetation to provide habitat for terrestrial fauna species.

Clearing contractors and operators will be made aware of the potential presence of threatened or Near Threatened vertebrate species and instructed to temporarily cease clearing if any vertebrates are observed, allowing a spotter-catcher to relocate the animal. To minimise potential impacts, clearing will be:

- carried out using a phased approach, initially retaining 'habitat trees' for two to three days before the continuation of clearing, thereby allowing animals to move away from the clearing footprint
- undertaken with a qualified spotter-catcher on hand to immediately relocate affected animals.

Vehicles will use designated light or heavy vehicle roads on-site wherever practicable, and speed limits will be adhered to.

SGCP employees and contractors will be made aware of environmental obligations and compliance requirements through the site induction program. Any injured fauna will be taken to the nearest veterinarian or wildlife carer as soon as practicable. Any fauna mortality will be reported to DEHP within 24 hours.

8.7.1.5. Altered Fire Regime

Inappropriate fire regimes can detrimentally alter the composition of groundcover and debris. Therefore, care will be taken to avoid too-frequent fires in the SGCP area, especially where Brigalow Scaly-foots are known to, or may potentially, occur. Any fire management activities (e.g. 'cool' burns) will be limited to small areas to retain unburned areas as refugia for fire-intolerant species. Annual burning of any area will be avoided.

A Fire Management Plan will be established for the area in cooperation with regional fire authorities. Appropriate fire fighting equipment and trained personnel will be available on-site to respond to fires.

Fire management will include maintaining fire breaks between coal stockpile, restrictions on cigarette smoking and maintenance of fire breaks within the SGCP area.

8.7.1.6. Threatened Species Management Plan

A Threatened Species Management Plan (TSMP) will be developed and implemented for the SGCP. The TSMP will contain the proposed monitoring and reporting timeframes for management of each threatened species impacted on by the SGCP to facilitate auditing of environmental performance measures. The TSMP will include key indicators for future, ongoing monitoring of biodiversity values within the project area.

The TSMP will include specific mitigation and management measures to address predicted impacts on threatened species and communities. Such measures include:

- Remnant vegetation in the SGCP area will be managed for biodiversity values, including implementation of an appropriate fire regime, pest animal and weed management and exclusion of stock
- Cleared areas not forming part of the operational mine (e.g. infrastructure corridor edges) will be revegetated.
- There will be staged rehabilitation and revegetation of overburden as the mine operational life progresses in areas that are no longer being mined
- Fire regime management will include precautions such as clearing fire breaks between coal stockpiles to avoid ignition of native vegetation from spontaneous combustion of coal, and restricting cigarette smoking and the dumping of rubbish (particularly glass) in areas of vegetation

- All staff will be made aware of the potential presence of rare and threatened species within the project area and the reporting measures for any sightings of species of conservation significance
- Where practicable, unnecessary vehicle movement during and following rainfall will be restricted
- Cattle will be excluded from waterways and remnant vegetation to prevent fouling and habitat degradation.

8.7.1.7. Environmental Offsets

Environmental offsets are measurable conservation outcomes undertaken to counterbalance an impact that causes a loss in biodiversity values, and achieve an equivalent or better environmental outcome for the biodiversity values impacted (DERM, 2011b). For mining activities in Queensland, offsets are required when there is residual environmental impact following minimisation and avoidance measures by the proponent. Biodiversity offset principles are contained within the *Queensland Biodiversity Offsets Policy 2011, Policy for Vegetation Management Offsets 2011* and the *Queensland Government Environmental Offsets Policy 2008* (DERM, 2011b).

Avoidance and mitigation of impacts on the seven threatened species and the threatened REs listed in **Section 8.6** will be demonstrated in accordance with a TSMP. However, there are likely to be residual impacts from the SGCP. Residual impacts on biodiversity include a net loss of habitat for the Brigalow Scaly-foot (*Paradelma orientalis*), listed as Vulnerable under the *EPBC Act* and the *NC Act*, net loss of habitat for the Koala (*Phascolarctos* cinereus), listed as Vulnerable under the *EPBC Act*, and removal of habitat for the Round-leaved Heath myrtle (*Micromyrtus rotundifolia*) and Large-podded Trefoil (*Desmodium macrocarpum*), which are listed as Vulnerable and Near Threatened, respectively, under the *NC Act*. There will be a small amount of clearing of Regional Ecosystems (REs) of conservation significance, which may require offsetting.

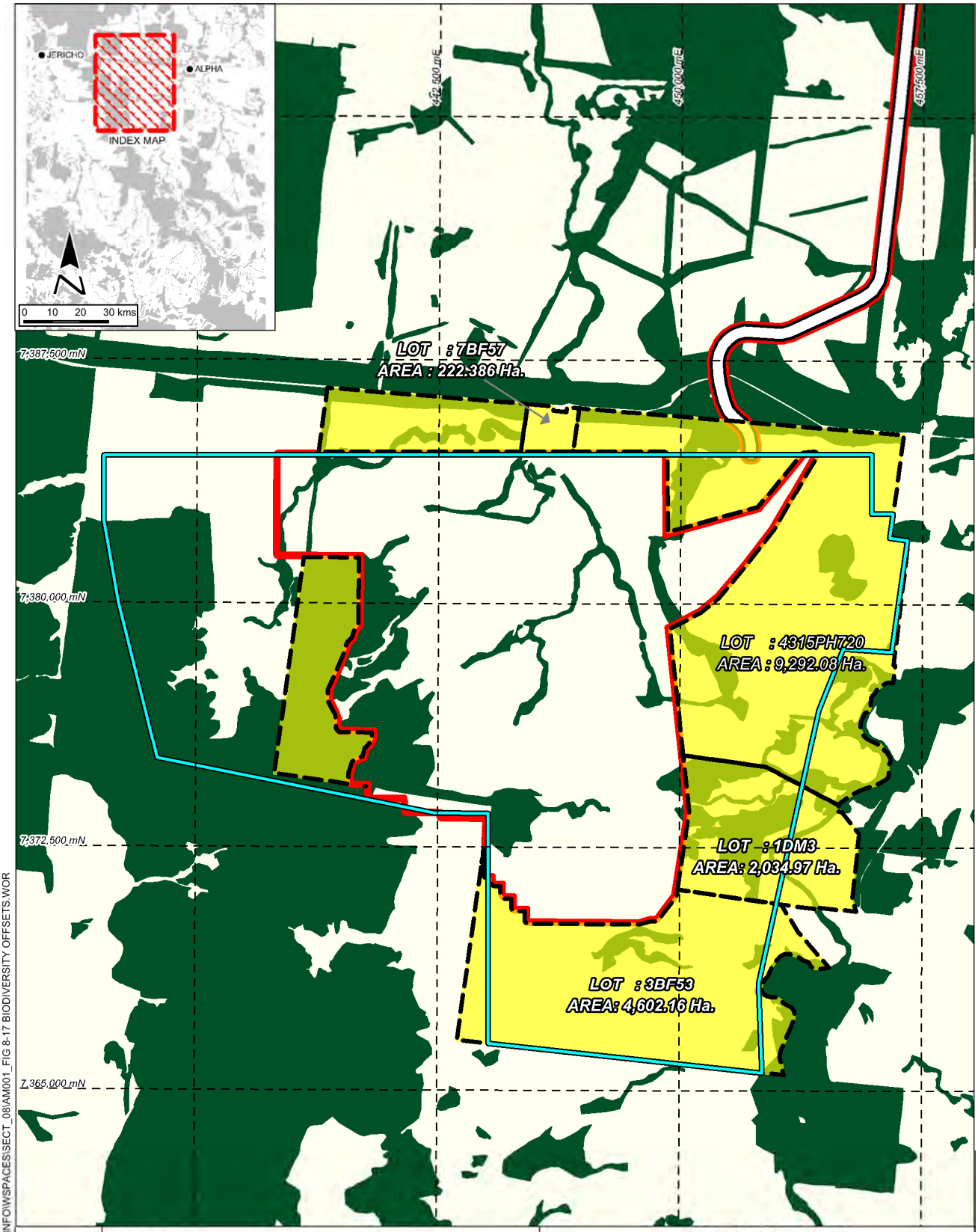
Due to residual impacts on threatened species, their habitats and threatened REs posed by the SGCP, a Biodiversity Offsets Strategy will be developed and implemented. Offset options will be presented in the Biodiversity Offsets Strategy and will outline measures to ensure that these offsets are managed to maintain and enhance biodiversity values. These proposed offsets are summarised below.

SGCP has acquired several properties on which the mining activities are planned (**Figure 8-17**). Mining activities will occupy a central portion of these properties. The mine has been carefully positioned to avoid impacting on regional ecosystems of conservation value, with the open-cut mine area lying predominantly within non-remnant vegetation. A total of 4960 ha of (mostly) non-remnant vegetation will be removed, most of which is potential habitat for the Brigalow Scaly-foot and Large-podded Trefoil.

To compensate for these losses, and to provide a net environmental benefit of the SGCP, areas outside the mine footprint are proposed to be protected and restored to high-quality remnant vegetation (**Figure 8-17**). Areas outside the mine footprint already contain a higher proportion of remnant vegetation than those being impacted by the mine. These areas thus potentially exceed requirements for ecological equivalence. This will be quantified by a suitably qualified ecologist using ecological equivalence methodologies (DERM, 2011c).

Remnant vegetation outside the mine footprint is currently fragmented and under pressure from grazing. The SGCP offers an excellent opportunity to increase the amount of remnant vegetation in the Alpha region. The SGCP proposes to restore up to 16,000 hectares of mostly non-remnant vegetation back to high quality remnant vegetation (**Figure 8-15**). This offset area would be kept free of cattle, and managed for weeds and pest animals according the *Land Protection (Stock route and Pest Management) Act* and the provisions of the *Biodiversity Offsets Policy 2011*. This will greatly increase the biodiversity values of the existing ecosystem. It will also establish a substantial biodiversity corridor, linking currently fragmented remnant vegetation with extensive tracts of remnant vegetation in the Carnarvon Ranges, to the south of the SGCP area (**Figure 8-15**).

Restored vegetation will provide important habitat for the Brigalow Scaly-foot, Koala and other threatened species, including Square-tailed Kites, Black-throated Finches, Squatter Pigeons, Death Adders, Yakka Skinks, Dunmall's Snake and Little Pied Bats. The potential offset area will be planted with threatened plant species (Round-leaved Heath Myrtle and Large-podded Trefoil) as required under the BOP. Alpha Creek, a significant waterway, meanders along the eastern boundary of the SGCP, within the proposed offset area, and will benefit from the restoration of riparian vegetation in the SGCP area.



LEGEND

- MLA70453
- SGCP infrastructure corridor
- Border of infrastructure
- Proposed Biodiversity Offset Areas

Data Source: Cadastral (Barcaldine May2010) - DERM

Alpha Coal Pty Ltd

South Galilee Coal Project

Biodiversity Offsets

2.5 0 5

Kilometres

Scale: 1:175,000 (A4)

31/08/2012

Proj. : MGA Z55
Datum: GDA 1994

FIGURE 8-17

S:\PROJECTS\AM001_STHGALILEE_EIS\GIS_MAPINFO\WSPACES\SECT_08\AM001_FIG 8-17 BIODIVERSITY OFFSETS.WOR

8.7.2. Surface Aquatic Ecology

8.7.2.1. Habitat Removal

To compensate for the potential removal habitat and provide habitat suitable for aquatic fauna to move into and through, the stream diversions will mimic the natural materials and geometry of the stream reaches lost, where practicable. The Australian Coal Association Research Program (ACARP) have conducted research into 'Design and Rehabilitation Criteria for Bowen Basin River Diversions' (Earth Tech, 2002) and the Department of Natural Resources and Mines have created the 'Central West Water Management and Use Regional Guideline: Watercourse Diversions–Central Queensland Mining Industry' (undated). These guidelines will be considered during the detailed design of the creek diversion. Key considerations for creek diversion construction include to:

- carry out clearing of riparian vegetation for the proposed creek diversion in a staged manner, to allow fauna to migrate to adjacent habitat areas
- carry out works during the dry season when minimal (if any) water is present, so as to reduce impacts on water quality and fish movements
- rehabilitate diversion with appropriate riparian species
- monitor diversion rehabilitation.

8.7.2.2. Removal and Modification of Riparian Vegetation

Cleared sections of riparian vegetation could be affected by weed invasion, which, if not monitored, could affect downstream reaches. This will be managed with precautionary weed control measures including:

- a Weed and Pest Management Plan will be developed to propose and monitor the success of control strategies for pest plant and animal species within the Project site
- a rehabilitation monitoring programme will be developed for the SGCP
- reasonable steps will be taken to keep land free from Class 2 pests such as Parthenium (*Parthenium hysterophorus*) and Lantana (*Lantana camara*), which are known to occur in the study region
- measures to control the spread of these weeds including vehicle washdowns will be adopted across the Project
- the location of known weed infestations (particularly Parthenium) should be monitored prior to construction and any new infestations encountered during construction reported to the Environmental Officer
- care will be taken when removing topsoil in known weed areas

- Construction sites are to be rehabilitated as soon as practicable, preferably with excavated topsoil from the same area so that native plant seed stock is given a chance to recolonise the area (provided the soil is not suspected of containing weed seeds).

8.7.2.3. Modification of Instream habitat

Reductions in the potential for impacts on instream habitat will be achieved through minimising the number of creek crossings or temporary levees required, where practicable and using bridge crossing designs that minimise the number of pylons required, or only require pylons on upper banks for support.

8.7.2.4. Barriers to Fish Passage

Given their likely temporary nature and the fact that none of the fish species present in the study area are obligate migratory species, barriers are likely to have minimal impact on the resident fish community. Therefore specific mitigation is not required. Minimisation of barriers to fish movement will however be considered in any crossing designs associated with the Project.

8.7.2.5. Runoff and chemical spills

The key mitigation measures to reduce the potential impacts from runoff include:

- wherever practicable, avoid construction works near streams
- where the avoidance of construction works in, near, or adjacent to streams is not practicable, these works will be performed during the dry season. If exposed soils cannot be rehabilitated prior to the wet season, appropriate barriers to reduce sediment transport (e.g. silt curtains) will be installed well before significant rainfall occurs. Such measures must be adequate to manage the heavy rainfall events experienced at the site
- where practicable, construction in stages will be carried out such that cleared areas can be rehabilitated quickly while construction progresses
- stockpiled excavated earth material will be stored away from waterways and bunded such that runoff does not enter the waterway, but is captured in a temporary storage reservoir and either treated or removed from site
- the use of vegetation such as grasses and macrophytes as sediment filters will be considered where practicable. Where this is not practicable, geotextile, rip rap and stabilisation techniques will be considered.

Further information is provided in **Section 9—Water Resources**.

The key mitigation measures to reduce the potential impacts from chemical spills include:

- current best practice for the management of fuels, oils and chemicals on site will be adhered to at all times
- all chemicals will be stored appropriately in a secure area with MSDS for each chemical stored and spills kits made readily available in that area
- construction staff will be trained to use spill kits to contain spills
- all spills will be reported, no matter how minor, and the impacts and reasons for their occurrence investigated. In the event of fuel, chemical or oil spills outside of bunded areas the material will be contained to prevent transport into waterways. Removal and secure disposal of contaminated soils and rehabilitation of exposed soil will be performed
- all chemical loads will be properly secured during transport and MSDS sheets for each are to be stored with the transport vehicle
- safe driving and general safe work practices will be applied when transporting chemicals.

Further information is provided in **Section 19—Hazard and Risk**.

8.7.2.6. Alteration of Hydrology

The construction of the mine pits, on-site water management infrastructure and the stream diversion channel will alter the local hydrology. The surface water management system proposed for the project is described in detail in **Section 9—Water Resources** and **Appendix F—Surface Water Technical Report**.

8.7.2.7. Direct Mortality

Reduced speed limits will be put in place near waterways to reduce the potential for transient fauna to be impacted by vehicle movements. Any road kills will be reported to the environmental supervisor. Further discussion of mitigation measures is provided in **Section 8.7.1.4**.

8.7.2.8. Release of Mine Affected Water

The surface water management system for the SGCP and proposed monitoring network is provided in **Section 9—Water Resources** and **Section 5** of **Appendix F—Surface Water Technical Report**.

8.7.2.9. Coal Dust Emissions

To further limit the potential for coal dust contamination of waterways:

- an Air Quality Management Plan will be developed and implemented

- ballast bridges will be constructed over waterways so that the risk of direct inputs of coal dust is reduced
- train wagons will not be overloaded
- train wagons will be washed regularly
- best practice coal loading and unloading procedures will be adopted
- train operators will operate in accordance with procedures in the Air Quality Management Plan
- an Erosion and Sediment Management Plan will be developed that incorporates a section on reducing the runoff of coal dust into waterways. This will outline how coal dust from the CHPP is to be contained and treated.

8.7.2.10. Subsidence

There are no industry standard methods for managing subsidence issues associated with underground mining in Australia, but North Moranbah Mine have adopted mitigation strategies used successfully at Goonyella Mine, which might be applicable to the SGCP. These include pre-ripping of the surface prior to underground mining, which reduces the scale of subsidence should it occur, and inserting pylons immediately downstream of where subsidence occurs to act as groynes to divert sediment runoff from downstream reaches. However, pre-ripping will increase the impacts on vegetation and terrestrial fauna associated with the project, and these impacts have not been considered within the scope of the EIS.

8.7.2.11. Proliferation of Pest Fauna

While there is no feasible way of controlling Tilapia abundance or spread directly once they are established, the Proponent should minimise the risk of aquatic environment degradation a much as possible through the mitigation measures identified above so that Tilapia are not favoured over native fish species. The location and spread of Tilapia will continue to be monitored during the life of the mine as part of the WPAMP.

8.7.2.12. Cumulative Impacts

Environmental Management Plan (EM Plan) guidelines should ensure mine operations minimise impacts to waterways by managing potential for any waterway contamination, especially during periods of river flow. This may require sediment pond design and construction catering for extreme event floods as well as undertaking best practice on-site mine wastewater management. At 35,720 km^2, the Belyando River is the second largest sub-catchment of the Burdekin River Catchment (130,000 km^2). The potential for regional cumulative impacts to negatively affect the Great Barrier Reef, if managed within defined EM Plan guidelines, are expected to be negligible.

8.7.3. Subterranean Fauna

8.7.3.1. Stygofauna

Following a second round of sampling in the 2012 post-wet season there will be two possible outcomes:

If no stygofauna are recovered from a second sampling event then it can be concluded (based on two comprehensive sampling events) that stygofauna do not occur within the SGCP MLA, and on that basis, should not be considered a relevant environment factor. No further sampling would be recommended.

If stygofauna are detected during a second sampling event then, based on the conservation significance and ecological requirements of the animals collected, the objective should be to maintain the abundance, diversity, geographic distribution and productivity of stygofauna at species and ecosystem levels through avoidance or management of threatening processes.

8.7.3.2. Hyporheic Fauna

No hyporheic faunal samples were collected as part of this project as no true hyporheic zone exists within Sapling Creek at the locality chosen for sampling.

8.7.3.3. Troglofauna

DEHP requires project proponents to follow the Western Australia Guidance Statements 54 and 54a (EPA 2003, 2007), which recommend two rounds of sampling for a total of 60 samples in areas known to have diverse troglofauna communities. However, in areas where the chance of troglofauna is low, allowance is made for fewer samples to be collected. The Permian geology in the SGCP area contains no known voids or sufficient fractures suitable for troglofauna, so it is unlikely that the site supports a diverse subterranean terrestrial fauna. The lack of troglofauna to date and the unfavourable habitat conditions present suggests that a significant troglofauna community does not exist within the SGCP and is therefore not considered to be a relevant environmental factor in the SGCP EIS. No additional sampling of troglofauna in the SGCP area is recommended or warranted.