



# Taroborah Coal Project

## Environmental Impact Statement

### Section 4.8 – Environmental Values and Management of Impacts – Ecology

Prepared for:  
**Shenhua International Group Pty Ltd**





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## 4.8 ECOLOGY

Assessments relating to nature conservation values attributed to the Project area and the impacts of the development of the Project can be found in the *Terrestrial Flora and Fauna Assessment Report* (Appendix 18), *Waterway Morphology and Aquatic Ecology Assessment Report* (Appendix 19) and *Stygofauna Survey Report* (Appendix 20). These assessments are further complemented by the *Environmental Offset Strategy* (Appendix 21) and the *Assessment of Matters of National Environmental Significance* (Section 5). A summary of the findings of these assessments is provided throughout the following sections.

### 4.8.1 Description of Environmental Values

This section describes the methods that were employed to assess the ecological value of the Project site, the types of flora, fauna and habitat values that were identified and any other features of particular environmental value pertaining to the Project.

The majority of the Project site is situated on undulating plains and hills, with a sandstone ridge on the eastern boundary. The Project site lies within the Fitzroy Basin catchment. The Project site is traversed by numerous ephemeral drainage lines and two primary ephemeral creeks. The main watercourse in the north of the Project site is Retreat Creek and in the south, Taraborah Creek. Both of these waterways flow in an easterly direction and ultimately flow into the Nogoia River, downstream of Fairbairn Dam, also known as Lake Maraboon. There are several pastoral dams within the Project site, including one large dam in the west central portion of the site.

Predominant land use activities on and surrounding the Project site include rainfed broadacre cereal cropping and cattle grazing. Fairbairn State Forest occurs to the immediate south and east of the Project site and encompasses approximately 10,000 ha of remnant vegetation. Other land uses include local and regional road transport on sealed roads, use of unsealed roads for local transport, the railway system, medium intensity goat grazing, residential properties and coal exploration.

ESA mapping presents Category A, B, and C areas of conservation significance and areas listed under the Directory of Important Wetlands. A review of EHP's ESAs mapping revealed that the Project site does not contain conservation parks, declared fish habitat areas, wilderness areas, aquatic reserves, heritage or historic areas, national estates, world heritage listings, sites listed by international treaties or agreements or areas of cultural significance relating to biodiversity and scientific reserves. The Project site does contain areas listed as Endangered Regional Ecosystems (EHP Biodiversity Status).

The EPBC Act Protected Matters Search Tool and the Wildlife Online Database were used to search for historical records of fauna species within an area, defined by a 100 km x 100 km square centred on a central point within the Survey Area (23° 32' 7.0794" S, 147° 56' 8.016" E).

Review of the database searches indicated the potential presence of 24 threatened species in the region of the Project site. These species are listed in Table 4.107 below.



**Table 4.107 Threatened Fauna Species, their Habitats and Likelihood of Occurrence on the Project Site**

Scientific Name Common Name	Conservation Status		Habitat	Notes
	EPBC Act 1999	NCA 1992		
Birds				
<i>Accipiter novaehollandiae</i> Grey Goshawk	Not listed	Near Threatened	The grey goshawk inhabits rainforests, forested gullies and valleys, taller woodlands, timber on watercourses and open country during dispersal (Pizzey & Knight 2007).	Suitable habitat for this species occurs on the Project site and surrounding lands. Due to the abundance of similar habitat type surrounding the Project Site, if the species was present in the region, the Project is unlikely to impact on the species.
<i>Anseranas semipalmata</i> Magpie Goose	Marine	Not Listed	The magpie goose occupies large seasonal wetlands and well vegetated dams with rushes and sedges; wet grasslands and floodplains (Pizzey & Knight 2006).	Suitable habitat for this species occurs on the Project site. However, this species is not at its distributional range and the area is not known to be a significant foraging or breeding ground.
<i>Apus pacificus</i> Fork-tailed Swift	Migratory/Marine	Least Concern	Fork-tailed Swift breeds from central Siberia eastwards through Asia, spending boreal winter in northern Australia. Known to appear and forage for aerial insects over any habitat. They are strictly aerial when visiting Australia during the austral summer (Morcombe 2002).	May potentially occur over site but was not observed during the survey period. Development on site is unlikely to affect this species as it is strictly aerial remaining high above ground. Rarely if ever comes into contact with vegetation or land.
<i>Ardea alba</i> Great Egret, White Egret	Migratory/Marine	Least Concern	Common throughout Australia, with the exception of the most arid areas. Known to prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands (Morcombe 2012).	Suitable habitat for this species occurs on Site. Given the abundance of similar habitat type surrounding the Project Site, if the species was present in the region, the Project is unlikely to impact on the species.
<i>Ardea ibis</i> Cattle Egret	Migratory/Marine	Least Concern	Widespread and common in north, north-eastern and south-eastern Australia. The species is found in grasslands, woodlands and wetlands, and is not common in arid areas. Utilises pastures and croplands, especially where drainage is poor. Will also forage in garbage dumps, and often associates with livestock (Morcombe 2012).	Suitable habitat occurs on Site, and surrounding lands. Given the presence of major watercourses and wetlands in the region, it is likely the species would prefer these sites. May benefit from human waste and livestock in the region. Overall, it is unlikely that the project would impact on this species.





Scientific Name Common Name	Conservation Status		Habitat	Notes
	EPBC Act 1999	NCA 1992		
<i>Ephippiorhynchus asiaticus</i> Black-necked Stork	Not Listed	Near Threatened	Prefers open freshwater environments, including the margins of swamps, shallow floodwaters over grasslands, wet shorelines, margins of mangroves, mudflats and estuaries (Morcombe 2002).	Limited habitat occurs on Project Site. Given the habitat associated with major watercourses and wetlands in the region, it is likely the species would prefer these sites.
<i>Erythrotriorchis radiatus</i> Red Goshawk	Vulnerable	Endangered	Inhabits undisturbed forest/woodland especially those adjacent to water bodies with large populations of birds. Hunts from a perch in dense foliage. Breeds in large eucalypts or melaleucas (Morcombe 2002).	Limited habitat occurs on Project Site. Due to the presence of large forest/woodland habitats occurring in association with Lake Maraboon to the south-east of the Project Site, it is considered unlikely that the project would impact on the species if it does occur in the region.
<i>Gallinago hardwickii</i> Latham's Snipe, Japanese Snipe	Migratory/Marine	Least Concern	Prefers low vegetation in swamps, salt marsh, heath, creek lines and irrigated cropland (Morcombe 2002).	The Project site provides limited areas of suitable habitat for this species. Given the abundance of suitable habitat in the region, the Project is not likely to impact on the species.
<i>Geophaps scripta scripta</i> Squatter Pigeon (southern)	Vulnerable	Vulnerable	This species occurs in dry grassy eucalypt woodlands and open forests, mostly in sandy sites near permanent water (Curtis et al. 2012)	The Project site lacks any permanent watercourses required to support a population in the long-term. The Project site may provide suitable habitat for this species during the wet season.
<i>Haliaeetus leucogaster</i> White-bellied Sea-eagle	Migratory/Marine	Least Concern	This species inhabits coastal and near coastal areas of northern and eastern Australia. Sometimes occur around inland drainages and large dams or lakes where sufficient prey (medium sized birds and fish) is available (Morcombe 2002).	Limited habitat on the Project Site. It is more likely that the species would occur in association with larger water bodies occurring in the region such as Nogoa river or Lake Maraboon where water and prey are readily available.
<i>Hirundapus caudacutus</i> White-throated Needletail	Migratory/Marine	Least Concern	This species occupies airspace over forests, woodlands, farmlands, plains, lakes, coasts, hilltops and timbered ranges (Pizzey & Knight 2006).	The subject site provides limited habitat for this species. It is more likely that this species occurs over the vast woodland habitats and the major wetland (i.e. Lake Maraboon) located to the south-east of the Project site.

Scientific Name Common Name	Conservation Status		Habitat	Notes
	EPBC Act 1999	NCA 1992		
<i>Melithreptus gularis</i> Black-chinned Honeyeater	Not Listed	Near Threatened	The black-chinned honeyeater occupies dry eucalypt woodland, particularly containing ironbark and box eucalypts as well as river red gum (Garnett <i>et al.</i> 2011).	Some suitable habitat may occur on the Project site however given the species range and the availability of similar habitat in the region it is unlikely the Project will adversely affect this species at a regional scale.
<i>Merops ornatus</i> Rainbow Bee-eater	Migratory/Marine	Least Concern	Common across mainland Australia. Seasonal movements from north to south during austral summer. Open woodland, forest clearings, semi-arid shrub land and grassland. Nests in long tunnel built into sandy soil or river bank (Morcombe 2002).	The Project site provides limited habitat for this species. It is highly likely that this species would occupy more suitable habitats in the region such as the banks of the Nogoa River.
<i>Myiagra cyanoleuca</i> Satin Flycatcher	Migratory/Marine	Least Concern	This species tends to inhabit heavily vegetated gullies in forests, taller woodlands. During migration, the satin flycatcher can be found in coastal forests, woodlands, mangroves, gardens and trees in open country (Pizzey & Knight 2006).	No suitable habitat occurs on the Project Site. Although individuals may occur sporadically along densely vegetated watercourses in region, the Project is not likely to impact on the species.
<i>Neochmia ruficauda</i> <i>ruficauda</i> Star Finch (eastern), Star Finch (southern)	Endangered	Endangered	The star finch is a very rare and nomadic granivore. Sightings have reduced significantly since white settlement. Found in rank vegetation along watercourses and swamps (Morcombe 2002).	Suitable habitat occurs in the region. While potential habitat for this species is present, the Project site lacks permanent watercourses. The project is unlikely to impact the species if it does occur in the region.
<i>Nettapus coromandelianus</i> Cotton Pygmy-goose	Not Listed	Near Threatened	Uncommon to rare vagrant across north-east Australia. Inhabits deep, permanent water bodies but may occupy floodplain pools during the wet season (Morcombe 2002).	Suitable habitat for this species occurs on the Project site and surrounding lands. Due to the abundance of similar habitat type surrounding the Project Site, if the species was present in the region, the Project is unlikely to impact on the species.
<i>Phaethon rubricauda</i> Red-tailed Tropicbird	Marine	Vulnerable	The red-tailed tropicbird is restricted to marine environments and breeds on offshore islands.	Individuals may be blown inland after periodical cyclone events but there is no suitable habitat available on the Project Site.
<i>Rostratula australis</i> Australian Painted Snipe	Vulnerable/ Migratory/Marine	Vulnerable	This species inhabits shallow inland wetlands, either permanent or temporary (Marchant and Higgins 1993).	Suitable habitat for this species occurs on the Project site. Due to the abundance of similar habitat type surrounding the Project Site, if the species was present in the region, the Project is unlikely to impact on the species.



Scientific Name Common Name	Conservation Status		Habitat	Notes
	EPBC Act 1999	NCA 1992		
<i>Tadorna radjah</i> Radjah Shelduck	Not Listed	Near Threatened	During the wet season the Radjah shelduck will occupy most shall waters including freshwater, saltwater and brackish swamps, mangrove lined coastal creeks and shallow river margins. During the dry season, the species tends to populate around larger permanent lagoons, paperbark swamps, man-made wetlands, mangroves, tidal flats and estuaries (Pizzey & Knight 2006).	Although suitable habitat for this species occurs on the Project site, the site occurs beyond the limit of the species distribution and it is therefore considered unlikely that this species occurs on the Project site.
<b>Mammals</b>				
<i>Dasyurus hallucatus</i> Northern Quoll	Endangered	Least Concern	Declined over range, now restricted to isolated populations across the north. Locally common in the Carnarvon range-Bowen area in rocky <i>Eucalyptus</i> woodland. May occur in other woodland and forest types (Menkhorst and Knight 2011).	Due to the current high disturbance and fragmentation of the Project Site, little suitable habitat is present. Targeted searches were carried out for this species but no evidence was found.
<i>Nyctophilus timoriensis</i> Greater Long-eared Bat, South-eastern Long-eared Bat (south-eastern form)	Vulnerable	Vulnerable	South-eastern form found through inland NSW and inland southern QLD. Roosts in tree hollows or decorticated bark. Forages in vegetation below canopy.	The Project site provides limited habitat as a result of previous disturbances that have led to a lack of roosting habitat.
<b>Reptiles</b>				
<i>Acanthophis antarcticus</i> Common Death Adder	Not Listed	Near Threatened	Death adders occur where intact shrub and leaf litter layers are present (Wilson 2009).	The Project site lacks areas of deep leaf litter, a habitat value that this species depends on. Lands to the south-east of the Project site may provide suitable habitat in association with existing woodland habitats. However, it is unlikely that the project will impact on this species.
<i>Delma torquata</i> Collared Delma	Vulnerable	Vulnerable	Restricted to south-east Queensland, north-west to Blackdown tableland and inland to Roma. Shelters in leaf litter and beneath logs and rocks. Occurs in rocky areas within dry open forest and brigalow (Wilson & Swan 2008).	As a result of previous clearing and agricultural disturbances, the Project site now contains small fragmented areas of potential habitat for this species.

Scientific Name Common Name	Conservation Status		Habitat	Notes
	EPBC Act 1999	NCA 1992		
<i>Denisonia maculata</i> Ornamental Snake	Vulnerable	Vulnerable	This species occurs in Brigalow woodlands growing on clay and sandy soils, riverside woodland, and open forest growing on natural levees (Shine 1983), showing a preference for moist areas (Wilson and Knowles 1988).	The Project site provides suitable habitat for this species. However, given the presence of Lake Maraboon and associated woodlands to the south-east of the Project site, it is highly likely that this species would prefer these habitats. In the event that the species does occur in the region, it is unlikely that the project would impact on the species.
<i>Egernia rugosa</i> Yakka Skink	Vulnerable	Vulnerable	Occurs in south-eastern, central and north-east Queensland. Lives communally in logs, rock crevices, beneath rocks and in burrows. Inhabits dry open forests, woodlands and rocky areas.	Previous activities on the Project site have resulted in extensive disturbance, fragmentation, and a subsequent lack suitable habitat for this species. It is possible this species may inhabit the Project site. The Project site is not expected to have any impacts on this species or its habitat.
<i>Furina dunmalli</i> Dunmall's Snake	Vulnerable	Vulnerable	Restricted to central south-eastern QLD. Inhabits Brigalow but has suffered decline across its range, possibly because of decline in brigalow. Prey on <i>Egernia striata</i> (Wilson and Swan 2008).	Restricted areas of suitable habitat occur in association with watercourses on the Project site. Due to the abundance of similar habitat type surrounding the Project site, if the species was present in the region, the Project is unlikely to impact on the species.
<i>Hemiaspis damelii</i> Grey Snake	Not Listed	Endangered	This species shows preference for cracking flood-prone soils in the Brigalow Belt, extending to Lockyer Valley in Southeast Queensland and the north-east interior of NSW. It shelters in soil cavities and beneath well-insulated debris (Wilson 2005).	Suitable habitat for this species occurs on the Project site. Due to the abundance of similar habitat type surrounding the Project Site, if the species was present in the region, the Project is unlikely to impact on the species.
<i>Lerista allanae</i> Allan's Lerista	Endangered	Endangered	This species' distribution is restricted to the area between Clermont and Capella (Couper & Ingram 1992). It occurs in grass tussocks on heavy-clay soil. There are no recent records despite thorough searches throughout range (Wilson & Swan 2008)	It is unlikely that this species occurs on the Project site.

Scientific Name Common Name	Conservation Status		Habitat	Notes
	EPBC Act 1999	NCA 1992		
<i>Paradelma orientalis</i> Brigalow Scaly-foot	Vulnerable	Vulnerable	Restricted to SE Queensland. Shelters in grass tussocks and leaf litter and beneath logs and sandstone. Occurs on sandstone ridges and in woodlands, brigalow and vine thickets (Wilson & Swan 2008).	Due to high disturbance, fragmentation, and a lack of rocky habitat or fallen debris there is limited suitable habitat for this species on the Project Site.
<i>Rheodytes leukops</i> Fitzroy River Turtle	Vulnerable	Vulnerable	This species is found in rivers within the Fitzroy Catchment with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles. Preferred areas have high water clarity, and are often associated with Ribbonweed ( <i>Vallisneria</i> sp.) beds (Cogger et al. 2000).	Suitable habitat for this species does not occur on the Project site. This species is not considered likely to occur on site.
<i>Strophurus taenicauda</i> Golden-tailed Gecko	Not Listed	Near Threatened	The golden-tailed gecko is endemic to the brigalow belt region and occupies dry sclerophyll forests comprising ironbark eucalypts, cypress pine and brigalow. This arboreal species shelters behind loose bark and in tree hollows (Wilson 2009).	Due to the extent of disturbance and fragmentation across the Project site, there is limited habitat available for this species. Given the abundance of similar habitat type surrounding the Project Site, if the species was present in the region, the Project is unlikely to impact on the species.
<b>Amphibians</b>				
<i>Cyclorana verrucosa</i> Rough Collared Frog	Not Listed	Near Threatened	The rough-collared frog occurs near seasonal ponds, creeks, and claypans in open country (Tyler & Knight 2011)	Suitable habitat for this species occurs on the Project site and surrounding lands. Given the abundance of ponds and creeks on lands surrounding the Project Site, the Project is unlikely to have a significant impact on the species.

Seasonal surveys were undertaken to successfully capture the full array of species diversity, abundance and ecological assemblages that may vary throughout the year based on transient and migratory factors or on meteorological and climatic conditions that fluctuate seasonally.

The following field surveys were conducted as part of the ecological assessment for the Project:

- Dry season terrestrial flora and fauna assessment (September 2011);
- Wet season terrestrial flora and fauna assessment (February – March 2012);
- Aquatic flora and fauna assessment (October 2011 and February 2012);
- Stygofauna assessment (September 2011); and
- Targeted bat survey (August 2012).

#### **4.8.1.1 Terrestrial Flora Methods**

The flora sampling methodologies were replicated in both the dry season and wet season surveys and were designed to best account for both annual and perennial species assemblages.

#### **Regional Ecosystem Mapping**

Methods used were in accordance with the Queensland Herbariums *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al* 2005).

This methodology describes the following types of sampling:

- *Secondary transects* – Consists of 20 x 50m plots. Data recorded in these sites includes a list of all species observed from all the major layers of vegetation. Species which were outside the plot but typical of the community are also listed. In addition, relative abundance for individual species in each strata is recorded, including density and foliage projection cover and height for the tree and shrub layers; and
- *Quaternary transects* or observation sites – These plots include Global Positioning System (GPS) location, the dominant species in the characteristic layer with some landform and structural data. An intuitive classification of the vegetation is also recorded. These plots are commonly used in the ground-truthing of mapping, previously completed for the local area, and to identify community boundaries.

A survey of all Regional Ecosystems (RE) on the Project site was required to supplement the Queensland Herbarium RE mapping. Consequently, the following methods were employed:

- Representative *Secondary* transects (50 x 20m plot) in each vegetation type were selected and a detailed floristic inventory of the dominant and associated woody plants (i.e. trees and shrubs) was undertaken. *Secondary* plots were positioned in vegetation representative of the community as a whole;
- In addition to the *Secondary* transects, *Quaternary* transects were also surveyed in order to assist with the mapping of RE boundaries; and



- An assessment of the condition of the vegetation type with regard to quality and conservation value was recorded.

The mapping of vegetation was undertaken through the use of aerial photographs, geological maps, and the use of a GPS in association with the findings of the field survey. Vegetation transects were conducted until additional transects yielded no significant additional species or structural variation.

### **Floristic Inventory and Community Description**

Secondary transects (50 x 20m plots) were positioned within each vegetation type and a detailed floristic inventory undertaken in accordance with the prescribed methodology. The species list for the Project was further developed through incidental recordings taken during the surveys.

In addition to identification of flora species, a range of descriptive parameters were measured at each secondary transect including, but not limited to, species density, projected foliage cover, ground cover, canopy height, and stem cover. Locations are shown in Figure 4.116.

### **Mixed Polygons**

On vegetation and RE maps, a polygon usually denotes a discrete area of one type of vegetation community. The scale at which an RE map is produced dictates the minimum area of continuous vegetation type that can be represented by one polygon. This is known as the “minimum mappable area”. If distinct vegetation communities are smaller than this minimum area, then vegetation communities are put together in “mixed polygons”. This has the consequence that when land zone maps are combined with vegetation maps to produce REs, mixed polygons containing more than one RE can be produced. Where mixed polygons are represented on an RE map, all REs represented within the polygon are denoted.

#### **4.8.1.2 Terrestrial Fauna Methods**

The fauna sampling methodology for the Project Site was based on survey techniques prepared by Freeman (2009), entitled *Recommended Fauna Survey Methodology for Environmental Impact Assessments*. Sampling of vertebrate fauna was conducted primarily along transects established in each of the major fauna habitat types and at changes in vegetation community groups. Secondary sites were established to provide important information on fauna species associated with preferred habitat, as well as increasing the chances of finding species of conservation significance. Their inclusion in the assessment provides a more robust survey methodology and greater survey coverage. Sampling locations are shown in Figure 4.117.

### **Detection Methods**

At each of the standard trapping sites the following survey methods were used:

- Habitat assessment;
- Pitfall trapping;
- Elliott trapping;
- Ultrasonic bat detection (Anabat);
- Funnel trapping;



- Spotlighting; and
- Active searching.

A full description of each method, as well as locations and frequencies, is provided in Appendix 18.



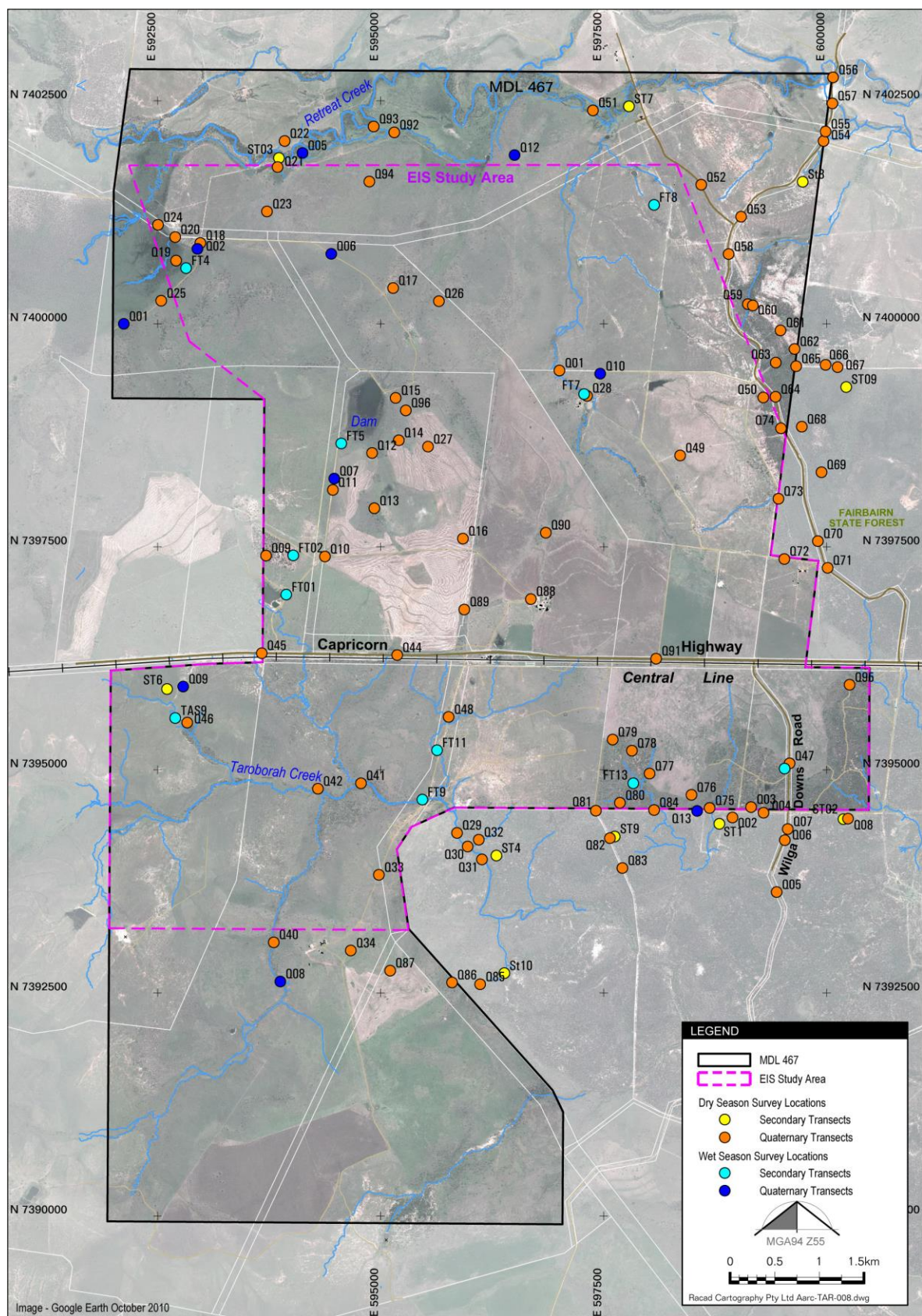


Figure 4.116 Secondary and Quaternary Flora Study Sites



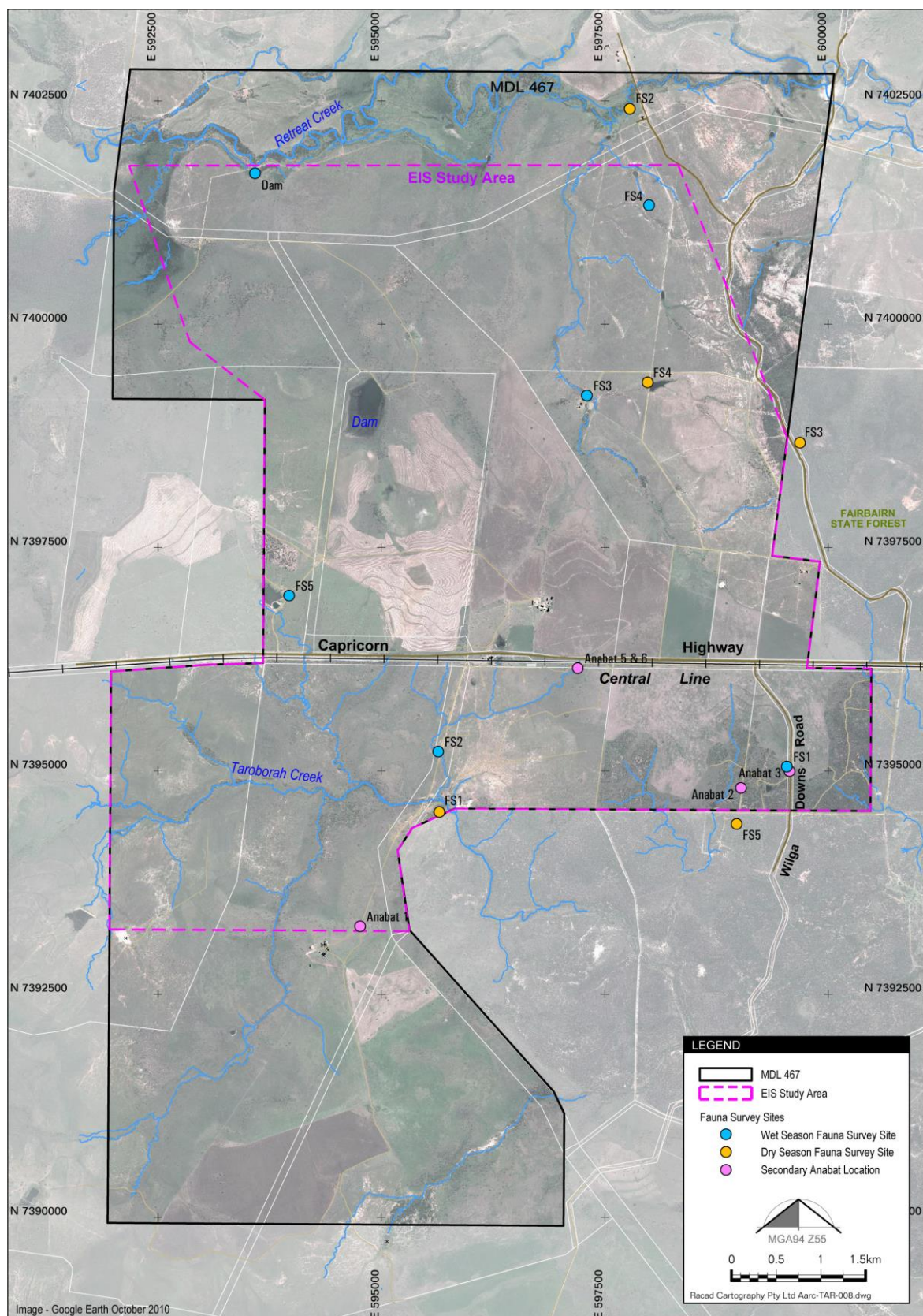


Figure 4.117 Fauna Study Locations

#### 4.8.1.3 Aquatic Assessment Methods

Two separate field surveys were undertaken over the period 26<sup>th</sup> – 30<sup>th</sup> September 2011 and the 28<sup>th</sup> February – 5<sup>th</sup> March 2012. Survey timing was chosen to coincide with seasonal variations and to examine the different ecological assemblages associated with the dry and wet seasons.

Techniques utilised to assess aquatic ecological values at each sampling site included sampling of both macro-invertebrates and aquatic vertebrate fauna (where possible) and an overall assessment of stream health.

Figure 4.118 shows the locations of each aquatic sampling site.

##### Macro-invertebrate Sampling

The shallows of the water bodies at five sites were kick-sampled (disturbing the stream bed and passing a D-frame net with a 100 micrometre (µm) mesh-size through the resulting plume, along 5-10m sections of the water body). Various microhabitats within the stream were targeted. All macro-invertebrates sampled over a 20 minute period were placed in a preservative solution and identified to family or sub-family level.

The list of macro-invertebrate species identified from the Project site was analysed for the presence / absence of “EPT” taxa. The EPT group of macro-invertebrates – Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddies flies) – are three orders of insects that are especially sensitive to disturbance. Generally there are more EPT species in areas of higher water quality and available habitat than in degraded water bodies. When this information is examined in conjunction with other data such as Stream Invertebrate Grade Number – Average Level (SIGNAL) Scores, water quality measurements, etc. a basic estimate of river health can be determined. The SIGNAL Index was developed by the National River Health Program as a tool for the bioassessment of water pollution and looks at the taxonomic composition of the invertebrate assemblage to determine river ‘health’. Each macro-invertebrate is given a grade number between 1 and 10 based on their sensitivity to various pollutants (Chessman, 2003), with a lower number indicating a higher tolerance to a range of conditions. The SIGNAL Index value is calculated by averaging the pollution sensitivity grade numbers of the families present at each site, and plotting them. Crustaceans captured in the baited traps do not contribute to the SIGNAL scoring process. This is due to the catch-release nature of the trapping methodology, which allows for individuals to be recaptured, thereby preventing the accurate calculation of catch numbers over a given timeframe.

Once the SIGNAL 2 scores have been calculated for each sampling site, the scores are plotted against the number of families found at that site. The position of a particular site on the bi-plot can provide an indication of the level of pollution and other physical and chemical factors that affect macro-invertebrate communities (Chessman, 2003).



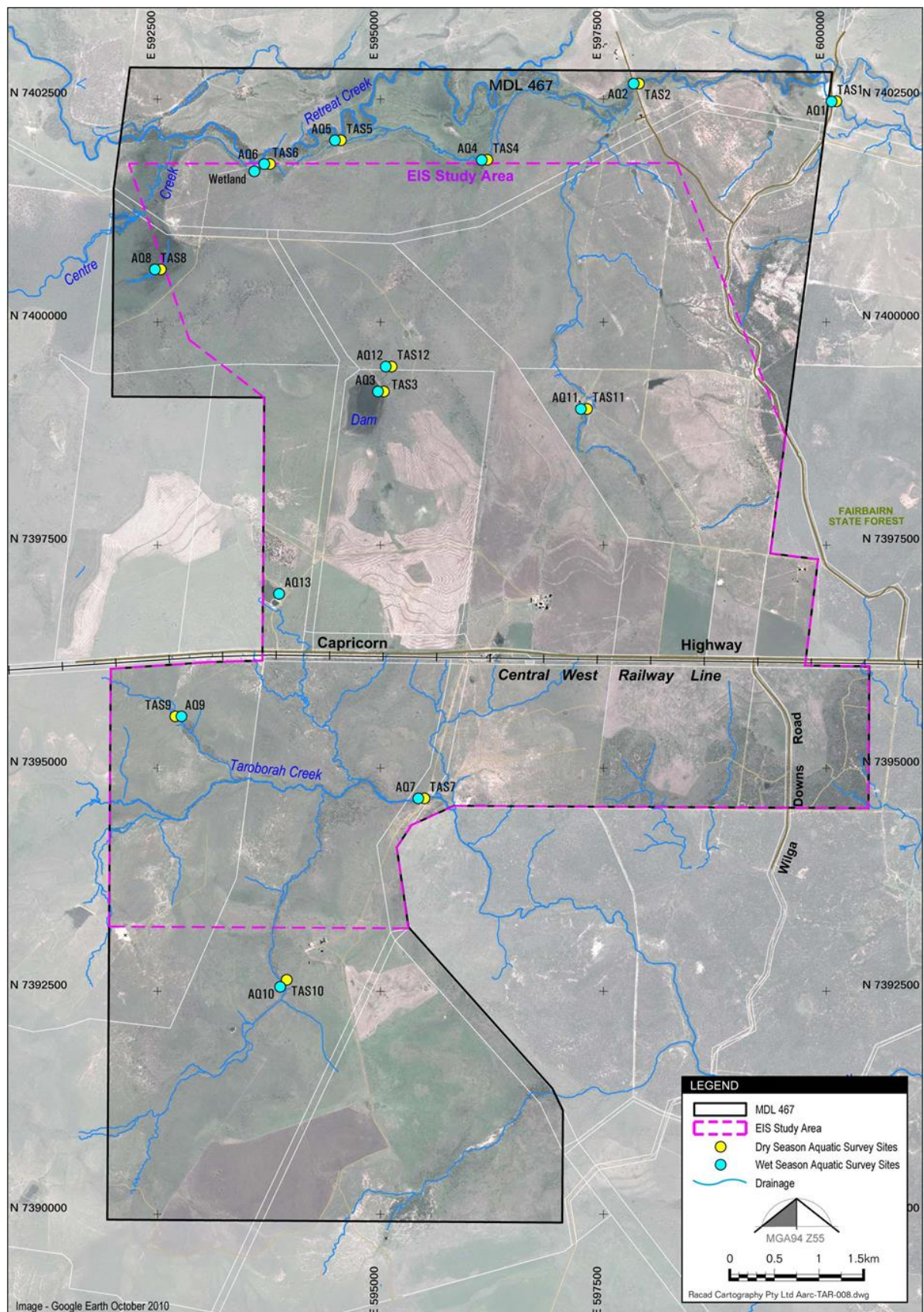


Figure 4.118 Aquatic Sampling Site Locations

## Habitat Assessment

Table 4.108 below provides a framework for interpreting habitat assessment scores.

**Table 4.108 Examples of interpretations of AUSRIVAS Habitat Assessment scores**

Habitat Assessment Score	Interpretation
0 – 35	Habitat is poor. There is limited habitat availability for in-stream fauna. There is little variation in velocity and depth of water, and the creek bed consists of a single sediment type. The water body typically consists of a small, shallow pool. Streamside vegetation, if present, consists of grasses and sedges. There is moderate to significant erosion on the banks.
36 – 70	Habitat variety is moderate. This could be due to leaf litter and other vegetation or detritus in the water, or the presence of boulders and rocks. The streamside vegetation consists mainly of grasses and sedges. There is moderate evidence of bank erosion, and the percentage of vegetative cover on the banks is less than 50%.
71 – 100	Habitat is relatively good. The bank is stable, there is variety in depth and velocity within the water body and substrate type is variable and tending towards boulders and rocks. Streamside vegetation is of trees and shrubs, adding to the bank stability. The percentage of streamside cover by vegetation is relatively high.
101 – 135	Indicates a pristine and favourable habitat. There is no bank erosion and the dominant vegetation is trees. There is great variety in depth and velocity, and the habitat is quite complex, offering many types of protection for fauna. This is usually afforded by logs and branches, leaf litter, variety in substrate type, variety in water depth, and presence of vegetation living within the water body.

## Aquatic Vertebrate Sampling

### *Drag Netting*

The water body at each survey site in which vertebrate fauna sampling was undertaken was swept using a 25 mm mesh-size drag net strung between two people as they walked slowly up sections of the water body. This method allows large sections of the watercourse to be sampled; however snags and benthic debris can allow fish to avoid the net. Watercourses too narrow / shallow to allow the net to extend were excluded from drag netting.

### *Baited Traps*

Opera-house and box traps were used at each site where trapping was undertaken to target carnivorous species. Traps were baited with either dry dog biscuits or bones to lure fish and other vertebrates into the traps. All traps were checked and emptied at first light. All animals captured were identified, their abundances recorded, and then released back into the water.

### *Spotlighting*

Spotlighting was carried out at night along various sections of the waterbodies in an attempt to observe nocturnal wildlife that are less likely to be detected by other survey methods, such as frogs and reptiles.

#### **4.8.1.4 Stygofauna Methods**

The stygofauna sampling and survey methods used to sample groundwater followed the best practice guideline of the Western Australian Environmental Protection Authority Guidance for the Assessment of Environmental Factors No. 54a (EPA, 2007).

The WA guidelines allow for the conduct of Pilot Studies where it is considered that the likelihood of finding stygofauna is low (e.g. poor groundwater quality, historic sampling of the local area has not recovered stygofauna, lack of groundwater etc.). In the event that a Pilot Study does find stygofauna, additional survey effort is required to satisfy the full WA Guideline requirements.

Stygofauna samples were collected from groundwater monitoring bores across the Project area using a weighted net of 50 µm mesh. Stygofauna sampling methods are detailed in Appendix 20 and are briefly described below. The net was lowered to the bottom of each bore, raised and lowered four times to dislodge any resting animals, then retrieved slowly to the surface. At the top of each haul, the entire contents of the net were emptied into a sieve. After six hauls the sample was transferred to a labelled jar, filled with 100 per cent (%) AR grade ethanol.

Rose Bengal dye, which stains animal tissue pink, was added to each sample before processing to allow stygofauna to be distinguished from sediments and to reduce sorting time. Samples were elutriated to separate the heavier mineral component from the lighter organic component of the sample, and poured through a sieve. The sieve contents, consisting of fine sediments, fauna, and other organic material, were spread thinly over the base of a channelled sorting tray. All fauna were identified to the lowest taxonomic level possible under dissecting microscopes and placed in vials containing 100% ethanol.

Bores sampled during the Pilot study are detailed in Table 4.109 below and depicted in Figure 4.119.

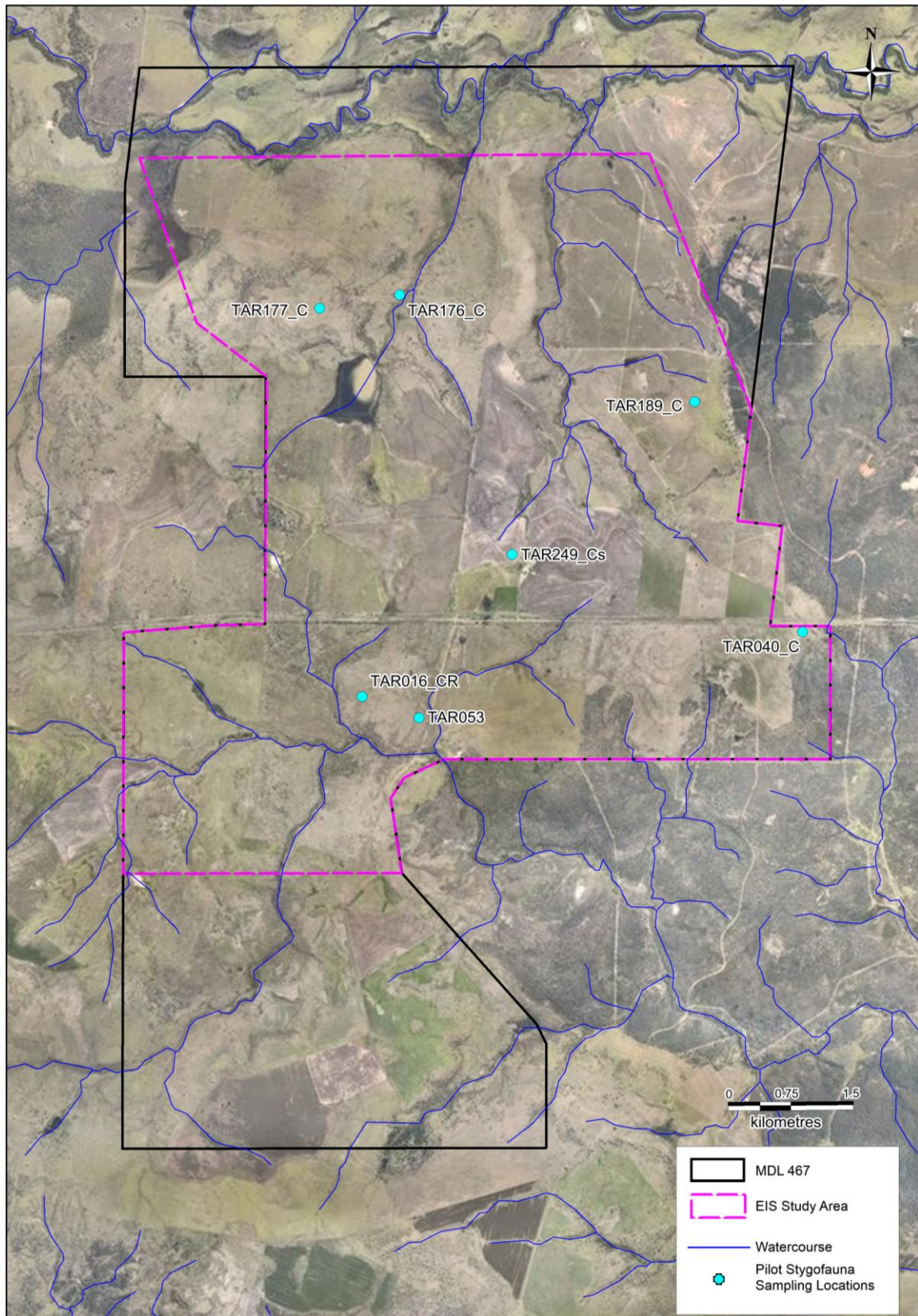


**Table 4.109 Stygofauna Bores Sampled**

<b>Bore Number</b>	<b>Date sampled</b>	<b>Easting</b>	<b>Northing</b>
TAR053	5.9.11	595641	7395113
TAR249_C	6.9.11	596634	7396972
TAR177_C	7.9.11	594586	7400197
TAR176_C	7.9.11	595549	7400349
TAR040_Cr	8.9.11	600263	7396107
TAR16_Cr	9.9.11	594958	7395360
TAR189_C	13.9.11	598843	7398818

Coordinates are in Geocentric Datum of Australia 1994 (GDA94)





**Figure 4.119 Stygofauna Sampling Sites**



## 4.8.2 Results

### 4.8.2.1 Terrestrial Flora

A total of 205 flora species were identified within and immediately adjacent to the Project site. Appendix 18 contains a detailed list of the identified flora species found during the survey. No species of conservation significance as listed by the *Nature Conservation Act 1992* (NC Act) or the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded.

Thirteen vegetation communities were identified on the Project site during the field surveys. Seven of these communities were classed as remnant vegetation as defined in the *Vegetation Management Act 1999* (VM Act). In addition, one community (Community 9) was considered to be consistent with RE 11.4.9 in terms of species composition, but did not satisfy all requirements that define remnant vegetation (i.e. > 70% of the height and / or > 50% of the cover relative to the undisturbed height and cover of a given RE). Associations within the communities reflect different vegetation structures and compositions, which occur on different geophysical locations. The vegetation communities observed together with the corresponding Queensland Herbarium RE classifications are summarised in Table 4.110.

Figure 4.120 illustrates the location of each identified vegetation community within the Project area.

**Table 4.110 Vegetation Communities and Corresponding Conservation Status**

Vegetation Community		Regional Ecosystem Equivalents	VM Act (1999) Status	EHP Biodiversity Status	EPBC Act Status
1	River Red Gum Riparian Woodland	RE 11.3.25	Least Concern	Of Concern	Not Listed
2	River Teatree Riparian Woodland	RE 11.3.3a	Of Concern	Of Concern	Not Listed
3	Lancewood Woodland	RE 11.10.3	Least Concern	No Concern	Not Listed
4	Brigalow Woodland	RE 11.9.1	Endangered	Endangered	Endangered
5	Dawson Gum Open Woodland	RE 11.4.8	Endangered	Endangered	Endangered
6	Silver-leaved Ironbark Open Woodland	RE11.5.3	Least Concern	No Concern	Not Listed
7	Silver-leaved Ironbark Open Woodland	RE 11.3.6	Least Concern	Of Concern	Not Listed
8	Poplar Box Open Woodland	RE 11.9.10	Of Concern	Endangered	Not Listed
9	Belah Low Open Woodland	RE 11.4.9*	-	-	-
10	Brigalow / Belah Low Open Woodland	RE 11.4.9	Endangered	Endangered	Endangered
11	Non-remnant Grassland	-	Not Listed	Not Listed	Not Listed
12	Palustrine Wetland	RE 11.3.27	Least Concern	Of Concern	Not Listed
13	Lacustrine Wetland	-	Not Listed	Not Listed	Not Listed
n/a	Potential Natural Grassland	RE 11.8.11	Of Concern	Of Concern	Endangered

\* This community was considered to be equivalent with RE 11.4.9 in terms of species composition but did not satisfy all requirements that define remnant vegetation (i.e. >70% of the height and/or >50% of the cover relative to the undisturbed height and cover of a given RE).

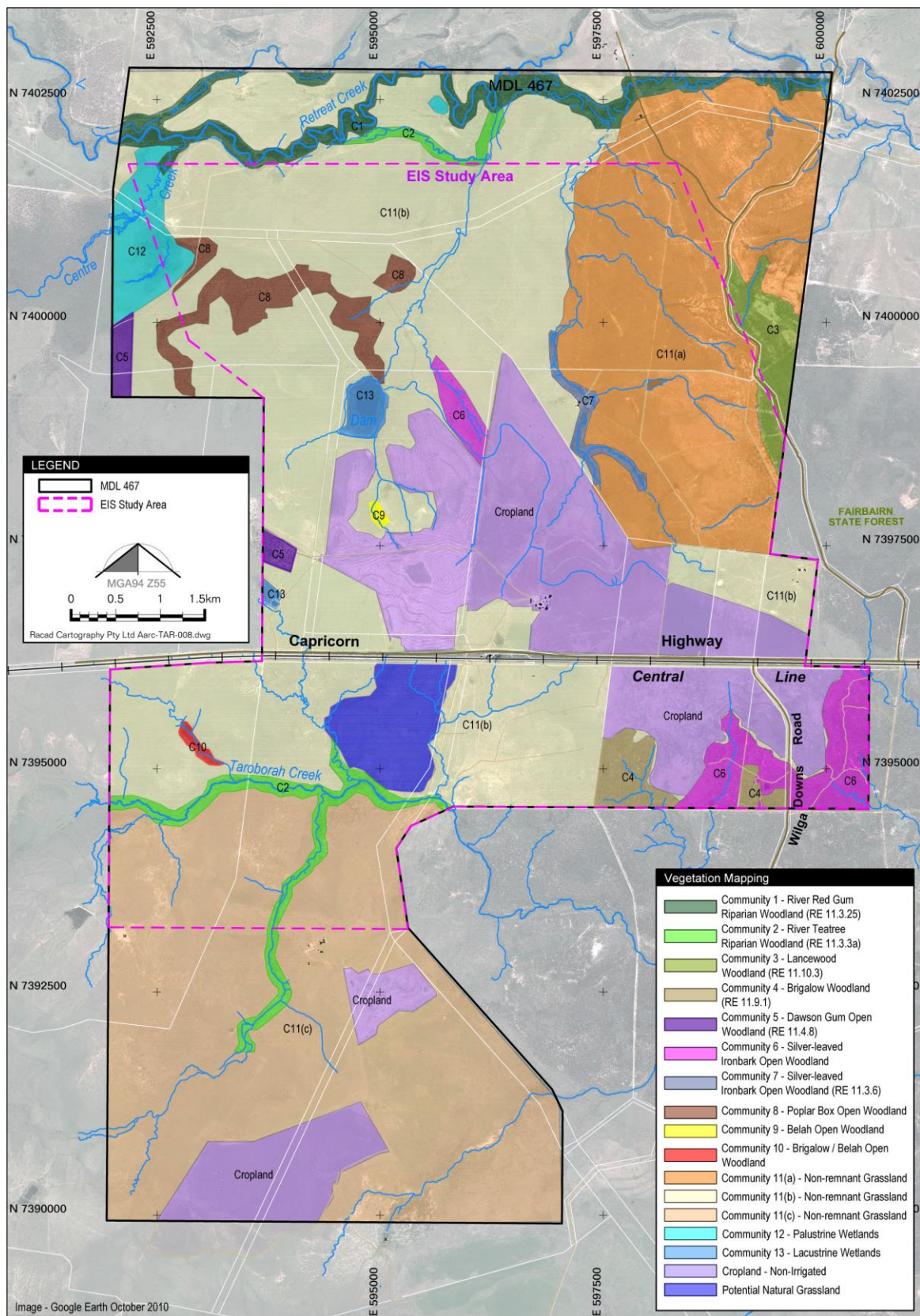


Figure 4.120 Vegetation Communities within the Project Area



### Community 1 – River Red Gum Riparian Woodland (RE 11.3.25)

The River Red Gum (*Eucalyptus camaldulensis* subsp. *acuta*) Riparian Woodland occurs along Retreat Creek in the north of the Project site (Photo Plate 4.17).



**Photo Plate 4.17 River Red Gum Riparian Woodland**

The canopy of this community is dominated by River Red Gum. Associated species forming a canopy layer to approximately 15m tall include Dawson Gum (*E. cambageana*), Forest Red Gum (*E. tereticornis*), Belah (*Casuarina cristata*) and River She-oak (*C. cunninghamiana*). The shrub layer is dominated by Doolan (*Acacia salicina*) and Sandpaper Fig (*Ficus opposita*), with many associated species, including Red Bauhinia (*Lysiphyllum cunninghamii*), Erythroxylum (*Erythroxylum australe*), Weeping Bottlebrush (*Melaleuca viminalis*), River Teatree (*M. bracteata*) and *Eremophila* species. Currant Bush (*Carissa ovata*) is also commonly encountered in this community. The weed *Parkinsonia* (*Parkinsonia aculeata*), which is a declared Class 2 weed under the LP Act, is common within this community. Stem counts within a secondary transect gave 13 shrub stems and 21 tree stems.

Introduced species Buffel Grass (*Cenchrus ciliaris*) and Umbrella Canegrass (*Leptochloa digitata*) and native species Hairy Panic (*Panicum effusum*) and Musk Basil (*Basilicum polystachyon*) are co-dominant groundcover species. Buffel Grass is less dominant within this RE than other areas of the Project site. Other commonly encountered groundcover species include *Senecio bragalowensis*, Long-leaved Matrush (*Lomandra longifolia*), River Bitter-cress (*Rorippa eustylis*) and the introduced Variegated Thistle (*Silybum marianum*). The declared Class 2 weed, *Parthenium* (*Parthenium hysterophorus*) is also present in this RE. A secondary transect consisted of 36% grass and sedge cover, 42% herb cover, 8% leaf litter and 14% bare ground.



This community is consistent with RE 11.3.25, which is described by the Regional Ecosystem Description Database (REDD) (Queensland Herbarium 2011) as “*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines”. RE 11.3.25 is listed as “Least Concern” under the VM Act, although it has an EHP Biodiversity Status of “Of Concern”. This community is not listed under the federal EPBC Act. No flora species of conservation significance were recorded within the River Red Gum Riparian Woodland.

### **Community 2 –River Teatree Riparian Woodland (RE11.3.3a)**

The River Teatree (*Melaleuca bracteata*) Riparian Woodland occurs in the south of the Project site in association with Taraborah Creek (Photo Plate 4.18).



**Photo Plate 4.18 River Teatree Riparian Woodland**

This community is characterised by a canopy, dominated by River Teatree, fringing the ephemeral watercourse. Coolabah (*Eucalyptus coolabah*) is the dominant emergent species, while Dallachy's Gum (*Corymbia dallachiana*) occurs sporadically. The open shrub layer is co-dominated by River She-oak and Red Bauhinia. Infrequent midstorey species include Wilga (*Geijera parviflora*), Holly Bush (*Alectryon diversifolius*), and Whitewood (*Atalaya hemiglauca*). Introduced Mimosa Bush occurs commonly throughout the shrub layer. Stem counts within a *Secondary* Transect recorded 2 shrub stems and 7 tree stems.

The ground layer consists of a dense cover of grasses that is dominated by Buffel Grass. Other groundcover species present include Kangaroo Grass (*Themeda triandra*), Spicytop (*Capillipedium spicigerum*), Spiked Sida (*Sida hackettiana*), Flannel Weed (*Sida cordifolia*) and Fireweed (*Senecio madagascariensis*). Fireweed is a declared Class 2 pest plant as listed under the LP Act and a



WONS. A *Secondary* Transect within this community consisted of 74% grass and sedge cover, 16 % herb cover, 2% leaf litter and 8% bare ground.

This community is considered to be consistent with RE 11.3.3a. RE 11.3.3 is described by the REDD (Queensland Herbarium 2011) as “*Eucalyptus coolabah* woodland on alluvial plains” and the subcategory RE 11.3.3a is described as “Riverine wetland or fringing riverine wetland – *Melaleuca bracteata* woodland on alluvial plains”.

RE 11.3.3 is listed by the EHP Biodiversity Status and Vegetation Management Act as “Of Concern”. This community is not listed under the EPBC Act. No flora species of conservation significance were recorded within the River Teatree Riparian Woodland.

### **Community 3 – Lancewood Woodland (RE 11.10.3)**

The Lancewood (*Acacia shirleyi*) Woodland (Photo Plate 4.19) community occurs in association with Fairbairn State Forest to the east of the Project site, and occupies an area of land on the eastern site boundary.



**Photo Plate 4.19 Lancewood Woodland**

Lancewood is extremely dominant within this community. In some areas this species forms a dense canopy at approximately 12m, with very few other species in the canopy layer but occasional emergent gum trees to approximately 20m, especially Lemon-scented Gum (*Corymbia citriodora* subsp. *citriodora*) and, particularly in the southern patch, Dawson Gum (*Eucalyptus cambageana*).

In one area, within the northern patch, it is apparent that a canopy of approximately 12m is dominated by Lancewood, with very few other canopy species. However, all of these canopy trees were dead as a result of a previous fire. The dead and scorched Lancewood trees are still standing and a dense





shrub layer has regenerated but there is no real canopy. The shrub layer is dominated by juvenile Lancewood and the occasional Red Ash (*Alphitonia excelsa*) to a height of approximately 2m. A count of woody stems within a Secondary Transect recorded 164 shrubs.

Buffel Grass occurs as the dominant species, where the canopy of Lancewood is open enough to allow groundcover growth. Various herbs also occur, including *Hibiscus sturtii* var. *grandiflorus*, *Sida atherophora* and introduced Flannel Weed.

This community is consistent with RE 11.10.3, which is described by the REDD (Queensland Herbarium 2011) as “*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks. Crests and scarps.”

RE 11.10.3 is listed by the Vegetation Management Act and EHP Biodiversity Status as “Least Concern” and “No Concern”, respectively. This community is not listed under the EPBC Act. No flora species of conservation significance were recorded within the Lancewood Woodland.

#### **Community 4 – Brigalow Woodland (RE 11.9.1)**

Brigalow (*Acacia harpophylla*) Woodland (Photo Plate 4.20) occurs in the south-east of the Project site, adjacent to Fairbairn State Forest. The patch of remnant vegetation occurring in the southeast corner of the Project site, adjacent to Fairbairn State Forest, is comprised of two contiguous but distinct vegetation communities: Community 4 – Brigalow Woodland (RE 11.9.1) and Community 6 – Silver-leaved Ironbark Open Woodland. These two communities occur in distinct stands but are interspersed within the patch and as such definite boundaries between the two communities are extremely difficult to determine from aerial images. As a result, quaternary survey sites were concentrated in this area in order to accurately determine the boundaries between the two communities. In general Lancewood Woodland occupies more surface area than Brigalow Woodland and is particularly dominant to the east of Wilga Downs Road.



**Photo Plate 4.20      Brigalow Woodland**

This community is described as Brigalow open forest to 15m with associated emergents to a height of 20m. Brigalow forms a low canopy layer, while the emergent canopy is typically dominated by Dawson Gum and associated with Silver-leaved Ironbark (*Eucalyptus melanophloia*). However, Silver-leaved Ironbark replaces Dawson Gum as the dominant emergent species in some areas.

False Sandalwood (*Eremophila mitchellii*) and Wilga exhibit a co-dominant distribution throughout the mid-storey of this community. Other commonly occurring mid-storey species include Erythroxylum, Currant Bush and Yellow Wood (*Terminalia oblongata* subsp. *oblongata*). Red Ash, Whitewood, Holly Bush and Sticky Hop-bush (*Dodonaea viscosa* subsp. *spathulata*) occur occasionally throughout the community.

The ground layer is dominated by exotic Buffel Grass. Associated grasses include Red Natal Grass (*Melinis repens*), Queensland Bluegrass (*Dichanthium sericeum* subsp. *sericeum*), and Black Speargrass (*Heteropogon contortus*). Occasional grasses and herbs present include Slender Chloris (*Chloris divaricata* var. *divaricata*), Feathertop Wiregrass (*Aristida latifolia*), Purple Lovegrass (*Eragrostis lacunaria*), Woodland Lovegrass (*Eragrostis sororia*), Prickly Chaff Flower (*Achyranthes aspera*), and Flannel Weed.

This community is consistent with RE 11.9.1 in terms of species composition and height. RE 11.9.1 is described by the REDD (Queensland Herbarium 2011) as “*Acacia harpophylla*-*Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks”. RE 11.9.1 is listed as “Endangered” under the VM Act and the EHP Biodiversity Status.

This community is listed under the EPBC Act, described as “Brigalow (*Acacia harpophylla* dominant and co-dominant)”. No flora species of conservation significance were recorded within the Brigalow Woodland.



## Community 5 – Dawson Gum Open Woodland (RE 11.4.8)

Dawson gum (*Eucalyptus cambageana*) Open Woodland (Photo Plate 4.21) occurs in two small, separate patches in the west of the Project site.



**Photo Plate 4.21 Dawson Gum Open Woodland**

This community consists of open woodland dominated by Dawson Gum (*Eucalyptus cambageana*) with an associated to occasional presence of Brigalow. The low shrub layer is dominated by Currant Bush.

The ground layer is dominated by Buffel Grass, while Spiked Sida (*Sida hackettiana*) occurs commonly. Although this community is dominated by exotic Buffel Grass, it also contains a high diversity of native grasses and sedges. Occasional native groundcover species include *Bothriochloa decipiens* var. *decipiens*, Kangaroo Grass, Barbed Wire Grass (*Cymbopogon refractus*), Sticky Sedge (*Cyperus fulvus*) and Common Fringe-sedge (*Fimbristylis dichotoma*). Introduced and occasional groundcover species present include Sabi Grass (*Urochloa mosambicensis*), Purpletop Chloris (*Chloris inflata*) and Red Natal Grass.

In terms of species composition, this community is consistent with RE 11.4.8, which is described by the REDD (Queensland Herbarium 2011) as “*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains”. RE 11.4.8 is listed as “Endangered” under the VM Act and the EHP Biodiversity Status.

This community is listed under the EPBC Act, described as “Brigalow (*Acacia harpophylla* dominant and co-dominant)”. No flora species of conservation significance were recorded within this community.



### Community 6 – Silver-leaved Ironbark Open Woodland (RE 11.5.3)

Silver-leaved Ironbark (*Eucalyptus melanophloia*) Open Woodland (Photo Plate 4.22) occurs in several fragmented patches in the central and south-eastern portions of the Project site.



**Photo Plate 4.22 Silver-leaved Ironbark Open Woodland**

This community is dominated by Silver-leaved Ironbark with an associated presence of Dawson Gum, and occasional specimens of Lemon-scented Gum and Poplar Box. The midstorey is dominated by Wilga and False Sandalwood with associated species such as Queensland Ebony (*Lysiphyllum hookeri*), Dogwood (*Eremophila longifolia*), Currant Bush and Yellow Wood. Woody stem counts completed within this community recorded 14 shrub stems and 4 tree stems within a representative Secondary Transect.

The ground layer of Community 6 is dominated by Desert Bluegrass (*Bothriochloa ewartiana*) and Spicytop. Associated grasses include Kangaroo Grass, Black Speargrass, Awnless Barnyard Grass (*Echinochloa colona*) and Buffel Grass. A Secondary Transect within this community consisted of 56% grass cover, 3% herb cover, 10% bare ground and 10% cover of regenerating shrub species.

The dominant species composition of this community is considered most consistent with RE 11.5.3 which is described by the REDD (Queensland Herbarium 2011) as “*Eucalyptus populnea* and/or *E. melanophloia* and/or *Corymbia clarksoniana* on Cainozoic sand plains/remnant surfaces”. RE 11.5.3 is listed as Least Concern under the VM Act and “No concern at present” under the EHP Biodiversity Status. This community is not listed under the federal EPBC Act.

No flora species of conservation significance were recorded within the Silver-leaved Ironbark Open Woodland.

### Community 7 – Silver-leaved Ironbark Open Woodland (RE 11.3.6)

This Silver-leaved Ironbark Open Woodland community (Photo Plate 4.23) occurs in the north-east portion of the Project site in association with one of the more prominent tributaries to Retreat Creek.



**Photo Plate 4.23 Silver-leaved Ironbark Open Woodland**

This community is best described as open woodland dominated by Silver-leaved Ironbark with associated species including Dallachy's Gum and Forest Red Gum (*E. tereticornis*) to a height of 17m. This community contains a T2 layer to 10m that is dominated by River Teatree. The T2 layer consists of a sub-dominant abundance of White Cypress Pine (*Callitris glaucophylla*) and occasional specimens of Queensland Ebony. The shrub layer is co-dominated by Soap Bush (*Acacia holosericea*) and Currant Bush and complimented by occasional specimens of Red Ash, *Erythroxylum* and *Senna sophora* var. (*40 Mile Scrub J.R.Clarkson + 6908*). Woody stem counts completed within this community recorded 14 shrub stems and 4 tree stems within a representative secondary transect.

The ground layer is co-dominated by Red Natal Grass and *Panicum decompositum* var. *tenuous*. Associated grasses include Black Speargrass and two exotic species, Awnless Barnyard Grass and Buffel Grass. Other occasional groundcover species include Many-flowered Mat-rush (*Lomandra multiflora*), Wild Jute (*Corchorus trilocularis*) and *Aristida lazardis*. A secondary transect within this community consisted of 82% grass cover, 4% leaf litter and 16% cover of regenerating shrub species.

In terms of species composition, this community is considered to be consistent with RE 11.3.6 – “*Eucalyptus melanophloia* woodland on alluvial plains”, as described by the REDD (Queensland Herbarium 2011). RE 11.3.6 is listed as “Least Concern” under the VM Act and “Of Concern” by the EHP Biodiversity Status.



This community is not listed under the federal EPBC Act. No species of conservation significance were recorded from this community.

#### **Community 8 – Poplar Box Open Woodland (11.9.10)**

The Poplar Box (*Eucalyptus populnea*) Open Woodland community (Photo Plate 4.24) occurs in the north-west of the Project site and is largely surrounded by open grasslands.



**Photo Plate 4.24      Poplar Box Open Woodland**

This community is dominated by Poplar Box, with associated canopy species such as Lancewood and Brigalow. The shrub layer is sparse and contains Mimosa Bush and *Denhamia oleaster*.

Groundcover species present include Buffel Grass, *Chloris* sp., Cobbler's Pegs (*Bidens pilosa*) and Common Joyweed (*Alternanthera nodiflora*).

This community is considered to be generally consistent with RE 11.9.10, which is described by the REDD (Queensland Herbarium 2011) as "*Acacia harpophylla*, *Eucalyptus populnea* open forest on fine-grained sedimentary rocks". RE 11.9.10 is listed under the VM Act as "Of Concern" and the EHP Biodiversity Status as "Endangered". This community is not listed under the federal EPBC Act.

No flora species of conservation significance were recorded within the Poplar Box Open Woodland.

## Community 9 – Belah Low Open Woodland (RE 11.4.9)

The Belah Low Open Woodland community (Photo Plate 4.25) occurs as a small patch of regrowth located in the central-western portion of the Project site. This community is surrounded by low open grasslands that are dominated by introduced pasture grasses (e.g. Buffel Grass).



**Photo Plate 4.25      Belah Low Open Woodland**

This community consists of a low canopy layer dominated by Belah with the sub-dominant species being Red Bauhinia. The shrub layer consists of Erythroxylum and two introduced species, Mimosa Bush and Parkinsonia. Parkinsonia is a Class 2 declared pest plant under the LP Act and a Weed of National Significance (WONS).

The ground layer is dominated by exotic grass species including Buffel Grass and Red Natal Grass.

With regard to dominant species composition, this community is considered to be consistent with RE 11.4.9 – “*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains”, as described by the REDD (Queensland Herbarium 2011), in terms of species composition. As outlined in the RE description, *Casuarina cristata* sometimes replaces *Acacia harpophylla* in the overstorey and *Lysiphyllum cunninghamii* sometimes co-dominates. However, Community 9 did not satisfy all the requirements for remnant vegetation (i.e. >70% of the height and/or >50% of the cover relative to the undisturbed height and cover of a given RE). Consequently, although RE 11.4.9 is listed as “Endangered” under the VM Act and EHP Biodiversity Status, the highly disturbed and regrowth state of this community suggests that this vegetation is non-remnant, and is therefore not of conservation significance under Queensland legislation.

RE11.4.9 is listed under the EPBC Act, described as “Brigalow (*Acacia harpophylla* dominant and co-dominant)” and includes regrowth vegetation. However, this vegetation community does not satisfy





the requirement of being Brigalow dominant or co-dominant. No flora species of conservation significance were recorded from this community.

#### **Community 10 – Brigalow/Belah Low Open Woodland (RE 11.4.9)**

This Brigalow/Belah Low Open Woodland community (Photo Plate 4.26) is located in the southwest portion of the Project site and occurs in association with a drainage line to Taraborah Creek. This community also occurs in a highly disturbed state along drainage lines associated with Retreat Creek and Taraborah Creek.



**Photo Plate 4.26 Brigalow/Belah Low Open Woodland**

The canopy of this community ranges from 6 to 8m in height and is co-dominated by Brigalow and Belah with the occasional occurrence of Coolabah. The sub-canopy exhibits a co-dominant composition of Red Bauhinia and Yellow Wood to a height of 6 m.

The shrub layer occurs to a height of 4m and is dominated by Currant Bush. Associated species include False Sandalwood and Holly Bush, while occasional species include Erythroxylum and Wilga.

The ground layer occurs to a height of 1.5m and is dominated by exotic Buffel Grass, while Awnless Barnyard Grass exhibits a sub-dominant presence. Occasional native species present within this community include Black Speargrass and *Senna sophora*.

Community 10 is consistent with RE 11.4.9 – “*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains”, as described by the REDD (Queensland Herbarium 2011). RE 11.4.9 is listed as “Endangered” under the VM Act and EHP Biodiversity Status.

This community is listed as an Endangered Ecological Community under the EPBC Act, described as “Brigalow (*Acacia harpophylla* dominant and co-dominant)”. Despite targeted searches, no flora species of conservation significance were recorded from this community.

### Community 11 – Non-Remnant Grassland

This Non-remnant Grassland community (Photo Plate 4.27) is dominated by exotic Buffel Grass and occupies large areas of land throughout the Project site.



**Photo Plate 4.27 Non-Remnant Grassland**

This community consists of low open grasslands dominated by Buffel with various native and exotic groundcover species. Woody species exhibit a scattered presence throughout this community.

Community 11a occurs in the north-east of the Project site and contains sparse emergent species such as Pink Bloodwood (*Corymbia intermedia*), Dawson Gum and Lancewood. Small scattered stands of regrowth vegetation co-dominated by Soap Bush and Red Ash also occur in this area of the Project site. A secondary transect in this area recorded a woody stem count of 6 shrub stems and no tree stems.

Within the southern portion of the site, north of Taroborah Creek, Community 11b consists of a very sparse and scattered distribution of Moreton Bay Ash (*Corymbia tessellaris*), Silver-leaved Ironbark, Brigalow and Queensland Ebony. Occasional midstorey species include Wait-a-while (*Capparis lasiantha*), Currant Bush, False Sandalwood and Erythroxylum. A *Secondary* Transect in this area recorded a sparse canopy with only 10% cover over 4m of a 50m transect.

The area south of Taroborah Creek (Community 11c) contains scattered canopy species such as Silver-leaved Ironbark, Dawson Gum and Pink Bloodwood.



This non-remnant grassland community is dominated by exotic Buffel Grass and contains a high abundance of other exotic groundcover species such as Rhodes Grass (*Chloris gayana*), Purpletop Chloris, Red Natal Grass, Parthenium, Parkinsonia and Noogoora Burr (*Xanthium pungens*). Native groundcover species occurring in some areas include Curly Bluegrass (*Dichanthium fecundum*), Annual Bluegrass (*Dichanthium sericeum* subsp. *humilius*), Queensland Bluegrass, Spring Grass (*Eriochloa procera*) and Tropical Cupgrass (*Eriochloa fatmensis*). Although lands located to the south of Taraborah Creek (Community 11c) are also dominated by Buffel, native grasses such as *Dichanthium* spp. are more abundant throughout this area. A *Secondary* Transect within this community consisted of 98% grass cover and 2% herb species.

This community is highly disturbed and is not considered to be consistent with any RE as described by the REDD (Queensland Herbarium 2011). This community is not listed under the federal EPBC Act. No flora species of conservation significance were recorded within the Low Open Grassland community.

Several areas of Community 11 are mapped by the DEHP as Natural Grassland RE (e.g. RE 11.8.11 – ‘*Dichanthium sericeum* grassland on Cainozoic igneous rocks’). These areas are now dominated by buffel grass and, generally, no longer considered to be representative of the mapped RE. However, one area of DEHP-mapped Natural Grassland, which coincides with the proposed opencut pit and infrastructure area, will be treated as consistent with RE 11.8.11 for the purpose of this Flora and Fauna Assessment, despite being considered to constitute Non-remnant Grassland following field surveys. This approach has been adopted to account for potential impacts to this mapped Natural Grassland area prior to further ground-truthing to determine its actual presence on the Project site. This area will be referred to as ‘Potential Natural Grassland’, and consequently, is classified as Of Concern under the VM Act and DEHP Biodiversity Status, and Endangered under the EPBC Act. Offsets to this area of Potential Natural Grassland are detailed in Section 4.8.3.8.

### **Community 12 – Palustrine Wetland (RE 11.3.27)**

This community occurs in association with the palustrine wetlands located in the north of the Project site (Photo Plate 4.28). The locations of this community are generally consistent with the palustrine wetlands mapped by EHP. However, ground-truthing revealed that the extent of this community in the north-west corner of the site is larger than the EHP mapped wetlands, incorporating two palustrine wetlands occurring in close proximity to each other.





**Photo Plate 4.28 Palustrine Wetland**

Woody species diversity within this community is limited to Mimosa Bush and Lignum (*Muehlenbeckia florulenta*) with occasional juvenile Eucalypts (*Eucalyptus* sp.). A secondary transect woody stem count recorded 8 shrub stems.

The ground layer consists of a co-dominant composition of native Umbrella Canegrass and introduced Nutgrass (*Cyperus rotundus*). Buffel Grass occurs throughout this community as a sub-dominant species. Native occasional ground layer species include *Panicum decompositum* var. *decompositum*, Sesbania Pea (*Sesbania cannabina*) and Common Nardoo (*Marsilea drummondii*). Exotic groundcover species include Fireweed and Variegated Thistle. A secondary transect within this community consisted of 38% grass cover, 60% sedge cover and 2% cover of herbs.

This community is considered to be consistent with RE 11.3.27, which is described by the REDD (Queensland Herbarium 2011) as “Freshwater wetland”. RE 11.3.27 is listed as “Least Concern” under the VM Act and “Of Concern” under the EHP Biodiversity Status. This community is not listed under the federal EPBC Act.

Despite targeted searches, no flora species of conservation significance were recorded from this community.

### **Community 13 – Lacustrine Wetland**

Community 13 occurs in association with two Lacustrine wetlands located in the central-west of the Project site (Photo Plate 4.29).



**Photo Plate 4.29 Lacustrine Wetland**

This community contains a very sparse canopy layer consisting of regrowth Brigalow to a height of 8m. The shrub layer occurs to a height of 2m and is dominated by exotic species including Mimosa Bush, Parthenium and Parkinsonia. Two of these species, Parthenium and Parkinsonia are listed as Weeds of National Significance and Class 2 declared pest plants under the LP Act. The woody stem count completed within a secondary transect recorded one Brigalow stem.

The ground layer exhibits a co-dominant composition of White Smartweed (*Persicaria attenuata* subsp. *attenuata*) and Couch (*Cynodon dactylon* var. *dactylon*). In some areas, Couch is replaced by Buffel Grass as the co-dominant species. Awnless Barnyard Grass occurs in association with this community. Johnson Grass (*Sorghum halepense*) occurs on occasion as a result of the surrounding sorghum cropping land use. Occasional sedges present include *Cyperus dactyloides* and Pale Spikerush (*Eleocharis pallens*). A secondary transect within this community consisted of 18% aquatic emergents, 47% grass cover, 6% herbs and 32% cover of regenerating shrub species.

Community 13 is not consistent with any RE as described by the REDD (Queensland Herbarium 2011). This community is not listed under the federal EPBC Act. No flora species of conservation significance were recorded from this community.

### **Introduced Flora**

Thirty-three introduced plant species were recorded from the Project site during the wet season and dry season flora surveys (a complete list is provided in Appendix 18). The Department of Agriculture Fisheries and Forestry (DAFF) website was searched for the status of each introduced species against the declared species list and WONS list.

Under the LP Act, pest species can be listed as Class 1, 2, or 3 declared plants. Class 1 pest species are those that are not commonly present in Queensland and, if introduced, would cause an adverse economic, environmental, or social impact. Land owners must take reasonable steps to keep land free of Class 1 pests. Class 2 pest species are established in Queensland and have, or could have, an adverse economic, environmental, or social impact. Land owners must take reasonable steps to keep land free of Class 2 pests, and often a coordinated approach by land owners, local government, and the community is required. Class 3 pest species are those that are established in Queensland and have, or could have, an adverse economic, environmental, or social impact. The primary objective of the Class 3 listing is to prevent the sale of the species, and therefore prevent their spread into new areas. Landholders are not required to keep land free of Class 3 pests, unless their land is adjacent to an environmentally significant area.

Three Class 2 declared weed species – Parthenium, Fireweed and Parkinsonia – were recorded on the Project site during the terrestrial flora surveys. A Class 3 declared weed species known as Lantana was also recorded from the Project site. All four declared weed species are also listed as WONS and are outlined in Table 4.111 together with their respective LP Act status.

**Table 4.111 Declared Plants Recorded on the Project Site**

Species Name	Common Name	Status under the LP Act
<i>Parthenium hysterophorus</i>	Parthenium Weed	Class 2
<i>Senecio madagascariensis</i>	Fireweed	Class 2
<i>Parkinsonia aculeata</i>	Parkinsonia	Class 2
<i>Lantana camara</i>	Lantana	Class 3

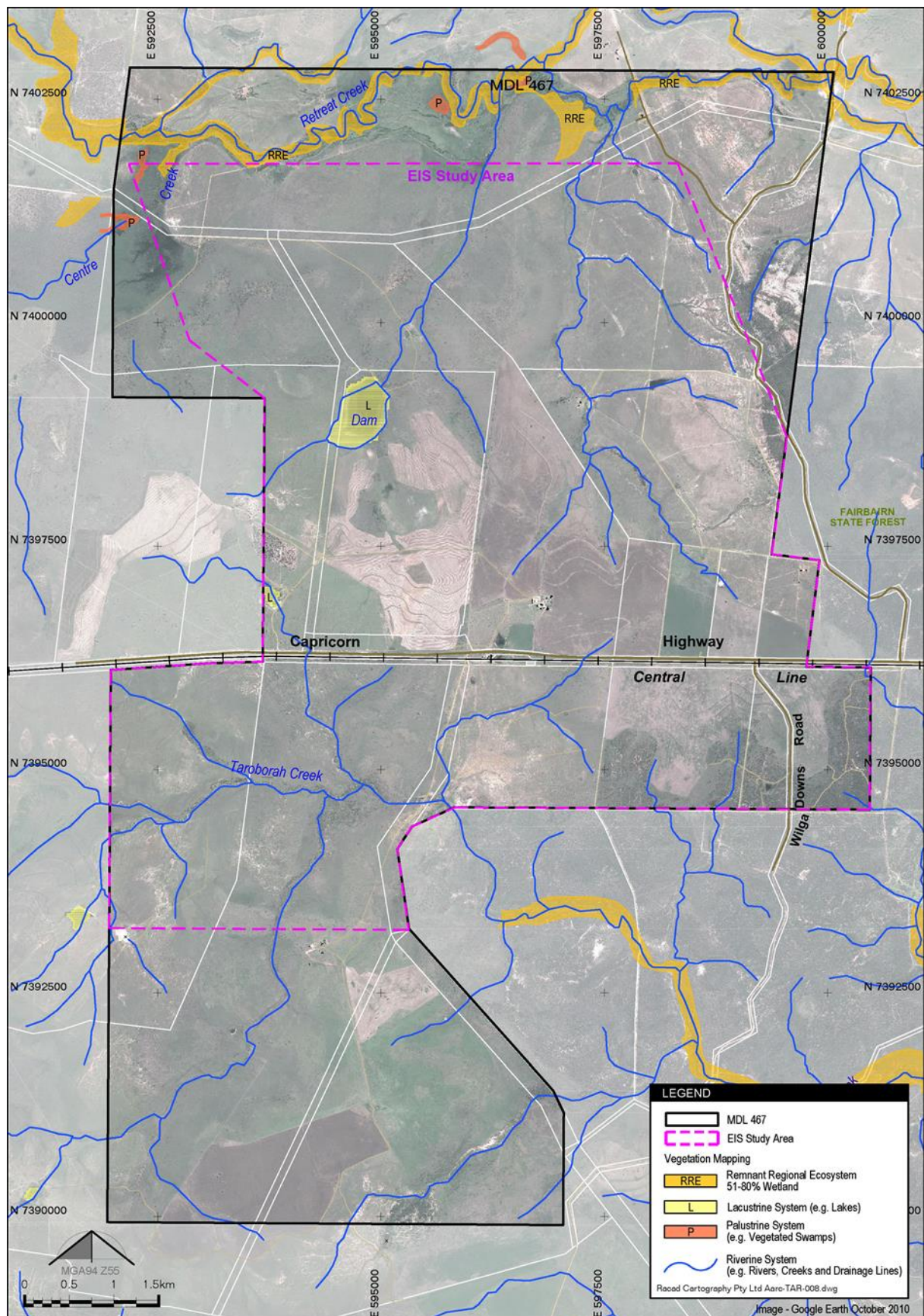
### Wetlands of the Project Area

A review of the EHP interactive WetlandMaps (2009) database revealed the presence of several lacustrine and palustrine water bodies within the Project site (Figure 4.121). None of these water bodies are outlined within the Environmentally Sensitive Areas (ESAs) mapping for the Project area, despite the close association between Endangered Regional Ecosystems (EREs) and the palustrine wetlands in the north. The EREs located on site are described and assessed within the *Taraborah Terrestrial Flora and Fauna Report* provided in Appendix 18.

Lacustrine wetlands are wetlands and deep water habitats situated in topographic depressions, dammed river channels, or artificial waterbodies i.e. lakes. Palustrine wetlands are wetlands dominated by persistent emergent vegetation i.e. vegetated swamps.

Wetland habitat mapping conducted during the field survey involved ground-truthing of wetland environments as mapped by EHP, with a focus on the Lacustrine wetlands and larger palustrine wetlands.





**Figure 4.121 EHP Mapped Wetlands Associated with the Project Area**

#### 4.8.2.2 Terrestrial Fauna

A total of 124 vertebrate fauna species were positively identified within the survey area. This comprised seven amphibians (one introduced), eight reptiles, 81 birds and 23 mammals, of which six are introduced. The complete list of all species recorded during the assessment is provided in Appendix 18.

##### Amphibians

Due to the ephemeral nature of the creeks at the Project Site, only stock watering points (dams) and two permanent water holes within creeks were observed to be holding water during the dry season surveys. Most creeks on the Project Site contained a sandy substrate and were soft enough for burrowing frogs.

Seven amphibian species including one introduced species, the Cane Toad (*Rhinella marina*), were observed within the Project site. Native amphibian species recorded from the Project site include the Greenstripe Frog (*Cyclorana alboguttata*), Spotted Grassfrog (*Limnodynastes tasmaniensis*), Green Tree Frog (*Litoria caerulea*), Broad-palmed Rocket Frog (*Litoria latopalmata*); Ornate Burrowing Frog (*Platyplectrum ornatum*) and Chubby Gungan (*Uperoleia rugosa*).

No amphibians of conservation significance were observed on the Project site during the survey period, despite targeted searches for the species listed under the NC Act or EPBC Act that may occur in the area, i.e. the Rough Collared Frog (*Cyclorana verrucosa*).

##### Reptiles

The structural diversity of habitat types on the Project site ranged from woodlands with a dense stratum of fallen timber, to open woodlands with sandy loam soils which reptiles can easily burrow into, to non-remnant grassland with dense tussocky groundcover and little canopy. This structural diversity provides a diversity of habitat types for a variety of reptile species.

A total of eight reptile species were observed within the Project site. These species were the Open Litter Rainbow Skink (*Carlia pectoralis*), Robust Striped Skink (*Ctenotus robustus*), Carpentaria Whip Snake (*Cryptophis boschmai*), Black-headed Python (*Aspidites melanocephalus*), Keelback (*Tropidonophis mairii*), *Lerista fragilis*, Iridescent Litter-skink (*Lygisaurus foliorum*) and a gecko species (*Gekkonidae* sp.).

No reptiles of conservation significance were recorded on the Project site at the time of the surveys, despite targeted searches for species listed under the NC Act or EPBC Act that may occur in the area.

##### Birds

Avian assemblages are generally determined by factors such as food (e.g. fruit, nectar, seeds and insects) and water sources, as well as the mosaic of habitat structures such as grasses, thick understorey and canopy vegetation. Generally, the more food sources available and the more complex the structure of the vegetation, the more diverse the avifauna assemblage will be.

Food sources within the Project site included a variety of grass seeds, nectar, insects and vertebrate prey items. Soft fruiting species suitable for birds do not occur in high densities within the Project site. The Project site exhibits relatively low habitat complexity. Although the Project site comprises riparian



and wetland habitats, the majority of the project site is highly disturbed, consisting mainly of exotic grasslands and croplands.

A total of 81 bird species were recorded within the survey area during the terrestrial fauna surveys. One of these species, the Cattle Egret (*Ardea ibis*) is listed as Migratory under the EPBC Act.

Many bird species were observed using lacustrine systems located within the Project site. Species using these dams and other bodies of standing water include, but are not limited to, the Brolga (*Grus rubicunda*), Australasian Darter (*Anhinga novae hollandiae*), Straw-necked Ibis (*Threskiornis spinicollis*), Cattle Egret (*Ardea ibis*), Intermediate Egret (*Ardea intermedia*), Black Swan (*Cygnus atratus*), Plumed Whistling Duck (*Dendrocygna cytoni*), Hardhead (*Aythya australis*), Australian Pelican (*Pelecanus conspicillatus*) and the White-necked Heron (*Ardea pacifica*).

Seven raptor species were identified during the course of the survey. These were the Wedge-tailed Eagle (*Aquila audax*), Brown Falcon (*Falco berigora*), Whistling Kite (*Haliastur sphenurus*), Black-shouldered Kite (*Elanus axillaris*), Little Eagle (*Hieraaetus morphnoides*), Nankeen Kestrel (*Falco cenchroides*) and Brown Goshawk (*Accipiter fasciatus*).

Many of the most commonly encountered birds are insectivorous, including such species as the Australian Magpie (*Gymnorhina tibicen*), Willy Wagtail (*Rhipidura leucophrys*), Apostlebird (*Struthidea cinerea*), Superb Fairy-wren (*Malurus cyaneus*), Variegated Fairy-wren (*Malurus lamberti*) and Red-backed Fairy-wren (*Malurus melanocephalus*). The wide array and abundance observed in these birds is due to the readily available prey, and their ability to colonise all available habitats. Parrots were also very commonly encountered and often seen feeding on grain crops, although also frequently seen within remnant vegetation. Common species include the Sulphur-crested Cockatoo (*Cacatua galerita*), Galah (*Eolophus roseicapillus*), Red-winged Parrot (*Aprosmictus erythropterus*) and Pale-headed Lorikeet (*Platycercus adscitus*). A complete list of species observed on the Project site during the surveys is provided in Appendix 18.

Despite targeted searches for species listed under the NC Act or EPBC Act that may occur in the area, no bird species of conservation of significance were recorded during the survey.

Of the suite of bird species identified during terrestrial and aquatic surveys, three species – the Cattle Egret (*Ardea ibis*), Latham's Snipe (*Gallinago hardwickii*) and Glossy Ibis (*Plegadis falcinellus*) – are listed as Migratory and Marine under the EPBC Act. None are listed as Rare or Threatened under the NC Act.

## **Mammals**

The morphology of mammal species varies widely from small rodents to larger macropods, and even bats. The ecology of each of group is equally variable and as such they are assessed separately in the following sections.

### *Small Mammals*

Habitats suitable for small mammals include areas that provide a plentiful food source and suitable shelter. The highest density of small mammal species is usually associated with:

- Reliable rainfall which is reflected in a reliable source of food; and
- Dense ground vegetation, particularly shrubs and grasses.



The diversity of small mammals is often limited by the lack of a predictable food supply and open ground vegetation. Consequently, small mammal populations can fluctuate dramatically in response to rain which increases seed production and insect abundance. During less favourable periods, small mammal populations can be very low.

Habitats within the Project site include from riparian woodlands, open woodlands with adequate groundcover in the form of grasses, and non-remnant grassland with dense groundcover and sparse shrub and canopy cover.

#### *Medium and Large Mammals*

Factors affecting the occurrence of medium-sized mammals are varied. Important factors can include land-clearing, feral animal predation and grazing pressures. Consequently, medium-sized mammals are no longer abundant in most of eastern Australia.

Habitats on the Project site do not include areas of dense native vegetation. Rather, open woodland and non-remnant grasslands are typical of the region, which is likely to be reflected in the medium-sized mammal community.

In contrast, larger mammals such as kangaroos have been much less affected by predation and land clearing activities. In fact, many species have flourished in response to increasing grasslands and their populations are now likely to be above historical levels. Habitat for this group on the Project site commonly occurs throughout the region.

#### *Arboreal Mammals*

The majority of arboreal mammals that occur in Australia utilise tree hollows for nesting and shelter. Smith and Lindenmayer (1988) consider that a shortage of nest hollows is likely to limit arboreal mammal populations where the density of hollow bearing trees is less than two to eight trees per hectare. Large hollow-bearing trees in the broader area generally occur along creek lines or in small pockets of remnant vegetation and are usually scattered, separated by open areas that would be difficult for arboreal mammals to cross without venturing onto the ground. It is likely that such habitat is too open for many arboreal mammals and very few are known to occur within the broader region.

#### *Bats*

The density and diversity of Australian bat species is determined primarily by the availability of suitable nesting and roosting sites. Roosting sites can include locations such as thick foliage, loose exfoliating bark, rock caves or cavities, tree hollows or even fabricated structures such as old buildings and culverts (Churchill 1998).

Consequently, areas with a large number of hollow-bearing trees that occur within remnant vegetation are of high value to many bat species. As bats have a small body size, these hollows can be much smaller in size than required by arboreal mammals. Suitable hollows were present in some areas of the Project site, including larger senescing trees in the woodlands, particularly in the riparian areas. Habitats such as these appear common within the region, particularly within the adjoining Fairbairn State Forest.

#### *Observed Mammals*

A total of 28 mammal species were identified within the Project site, including six introduced species and thirteen microbat species.



The most common mammal species to occur on the Project site were the Eastern Grey Kangaroo (*Macropus giganteus*), Red-necked Wallaby (*Macropus rufogriseus*), Common Wallaroo (*Macropus robustus*), Swamp Wallaby (*Wallabia bicolor*) and the introduced House Mouse (*Mus musculus*). Less commonly observed native species were the Northern Brown Bandicoot (*Isodon macrourus*), Common Planigale (*Planigale maculata*), and Echidna (*Tachyglossus aculeatus*). Introduced species observed included the House Mouse, Feral Pig (*Sus scrofa*), Dingo/Wild Dog (*Canis lupus dingo*), Feral Cat (*Felis catus*) and the European Rabbit (*Oryctolagus cuniculus*). Four of the five introduced mammal species recorded on the Project site (i.e. Feral Pig, Dingo/Wild Dog, Feral Cat and European Rabbit) are classified as 'Class 2' pest animals under the LP Act. Domestic Cattle (*Bos taurus*) were also frequently encountered as most of the Project site is dedicated to agricultural land uses.

Thirteen microbat species have been positively identified from echolocation calls recorded from the Project site. These are White-striped Freetail Bat (*Austronomus australis*), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Little Pied Bat (*Chalinolobus picatus*), Little Broad-nosed Bat (*Scotorepens greyii*), Inland Broad-nosed Bat (*Scotorepens balstoni*), Inland Forest Bat (*Vespadelus baverstocki*), *Miniopterus orianaeoceanensis*, Northern Freetail Bat (*Chaerephon jobensis*), Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*), Beccari's Freetail Bat (*Mormopterus beccarii*), Little North-eastern Freetail Bat (*Mormopterus loriaeidei*) and long-eared bats (*Nyctophilus* species).

Some bat species have very similar calls and there can be confusion between species. Additional microbat species that could not be positively identified but may occur within the study area include Eastern Cave Bat (*Vespadelus troughtoni*), Little Broad-nosed Bat (*Scotorepens greyii*) or Northern Broad-nosed Bat (*Scotorepens sanborni*), Broad-nosed Bats (*Scotorepens* spp.) or Hoary Wattled Bat (*Chalinolobus nigrogriseus*), Inland Forest Bat (*Vespadelus baverstocki*) or Little Forest Bat (*Vespadelus vulturnus*) and Troughton's Sheath-tail Bat (*Taphozous troughtoni*). Calls of *Scotorepens* species and *Chalinolobus nigrogriseus* overlap in frequency and can be difficult to differentiate. Many calls were attributed to *Scotorepens* spp. based on pulses with relatively short duration characteristic section and no tail or up-curved tail. A few calls, however, had more angular pulse shape with longer duration characteristic section. These could have been either *Scotorepens* spp or *C. nigrogriseus*. Calls of *Taphozous troughtoni* fall within the same frequency as *Mormopterus beccarii* and identification is difficult. Due to high chance of confusion with other species and the limited distribution of this species to north-western QLD (Churchill 1998), it is highly unlikely that this species inhabits the Project site. None of these species are listed as a species of conservation significance under the NC Act, or the EPBC Act.

One mammal species of conservation significance, the Little Pied Bat (*Chalinolobus picatus*) was positively recorded within the Project site during the dry season survey as well as the supplementary Anabat survey during August 2012. *Chalinolobus picatus* is listed as Near Threatened under the NC Act. Despite targeted searches for species listed under the NC Act or EPBC Act that may occur in the area, no other species of conservation significance were recorded.

### Introduced Fauna

Six introduced pest fauna species were recorded within the Project site during field surveys. Pest species recorded within the Project site include:

- House Mouse (*Mus musculus*);
- Cane toad (*Rhinella marina*);
- Feral Cat (*Felis catus*);





- Dingo (*Canis lupus dingo*);
- European Rabbit (*Oryctolagus cuniculus*); and
- Feral Pig (*Sus scrofa*).

Four of these species – the Feral cat, Dingo, European Rabbit and Feral Pig – are declared Class 2 pest species as listed within the schedules of the LP Act.

The Cane Toad and House Mouse are non-declared species under the LP Act.

### **Fauna of Conservation Significance from the Region Not Observed on the Project Site**

A total of 24 threatened species known to occur in the region were identified from wildlife database searches and other scientific literature searches. Despite targeted searches for these species being completed during field surveys, none were found. Appendix 13 outlines the habitat requirements of those species possibly present on the Project site, but not recorded in the surveys, and notes the likelihood of their occurrence given the on-site habitat values. The assessment is based on the knowledge and opinion of experienced field ecologists, information obtained from site visits, scientific literature and communications with relevant experts or interest groups.

#### **4.8.2.3 Aquatic Biology Results**

The Project site lies within the Fitzroy Basin catchment and is traversed by two primary ephemeral creeks and several associated drainage lines. The main watercourse in the north of the Project site is Retreat Creek and in the south is Taroborah Creek. Both of these waterways flow in an easterly direction and ultimately flow into the Nogoa River, downstream of Fairbairn Dam or Lake Maraboon. Surface water within the Project site is used for stock drinking water.

#### **Aquatic Flora**

Riparian vegetation associated with Retreat Creek is characteristic of the River Red Gum (*Eucalyptus camaldulensis*) riparian woodland community known as Regional Ecosystem 11.3.25. Vegetation fringing Retreat Creek is generally co-dominated by River Red Gum and Coolabah (*Eucalyptus coolabah*), although Forest Red Gum (*Eucalyptus tereticornis*) replaces River Red Gum in some areas. Belah (*Casuarina cristata*) occurs commonly throughout the community. Mid-storey species include River Tea Tree (*Melaleuca bracteata*), Dogwood (*Eremophila longifolia*), Red Ash (*Alphitonia excelsa*) and Creek Sandpaper Fig (*Ficus coronata*).

The riparian community associated with Taroborah Creek is characteristic of the River Tea Tree (*Melaleuca bracteata*) riparian woodland community known as Regional Ecosystem 11.3.3a. This community is generally dominated by River Tea Tree, while Belah occurs commonly. Occasional canopy species include Ghost Gum (*Corymbia dallachiana*) and Poplar Box (*Eucalyptus populnea*). Mid-storey species associated with this community include Queensland Ebony (*Lysiphyllum hookeri*) and Mimosa (*Acacia farnesiana*).

#### **Groundwater Dependent Ecosystems**

The Bureau of Meteorology's (BoM) Atlas of Groundwater Dependent Ecosystems (GDEs) identifies the potential for groundwater interaction, through surface expression, sub-surface interaction, or the presence of aquifer/cave ecosystems. Mapping of likely aquifer/cave ecosystems in Queensland is currently not available. GDEs are ecosystems that depend to some degree on the surface expression



of groundwater or the sub-surface presence of groundwater. The BoM Atlas of GDEs revealed a number of areas on and around the Project site that have moderate or high potential for sub-surface groundwater interaction or surface expression of groundwater.

No ecosystems were encountered on the Project site which exhibited a high potential for interaction with the surface expression of groundwater (GDEs), except for a drainage line, which flows northward towards Retreat Creek, that is fed by a local spring (sampling location AQ/TAS11 – refer to Figure 4.118). During the dry season, Retreat Creek and Taraborah Creek were not found to be flowing, implying that these watercourses do not receive flows from surface expressed groundwater. Field surveys conducted for the Aquatic Ecology Assessment noted the potential for some vegetation communities on the Project site (e.g. Silver Leaved Ironbark Open Woodland) to be dependent on groundwater to some degree. Deep-rooted vegetation of the Silver Leaved Ironbark Open Woodland community (RE 11.3.6) occurring along the riparian zone of the above mentioned drainage line of Retreat Creek may be dependent on subsurface groundwater. Their dependence on groundwater may be permanent or intermittent to meet their water requirements. Due to the ephemeral nature of many of the watercourses in the region, it is possible that groundwater resources may be utilised to supplement water requirements.

Since groundwater levels in the vicinity of Retreat Creek have been recorded approximately 6-10 metres below ground level, only deep-rooted vegetation (such as the Eucalypt trees which form the dominant canopy) may use subsurface groundwater as a water supply.

### *Springs*

The Project site is located in the vicinity of the Great Artesian Basin (GAB) and consequently, there are a number of springs associated with the GAB in the catchments surrounding the site. No springs have been mapped within the immediate vicinity of the Project site, on both the Queensland Springs Database and the BoM GDE Atlas. The GDE Atlas does not indicate the presence of any spring-fed wetlands in the vicinity.

Despite the lack of mapped springs within the Project, aquatic ecology field assessments noted that the drainage line of Retreat Creek on which the Silver-leaved Ironbark Woodland (RE 11.3.6) is located is likely to be fed by a local spring (aquatic sampling site AQ/TAS11). Some sections of the Nogoa River are also known to be partially spring-fed from the Precipice Sandstone (Queensland Water Commission 2012). While there are a number of mapped springs within the Nogoa River and Comet River catchments, no springs are located on watercourses associated with the Project, either upstream or downstream. A number of semi-permanent pools of conservation value to the region were identified on a drainage line of Taraborah Creek during the 2011 and 2012 field surveys, although their potential for groundwater interaction could not be determined. It is noted that these waterholes were dry when recently visited in May and September of this year.

### *Inflow Dependent Ecosystems*

Inflow dependent ecosystems (IDEs) are ecosystems that rely on water in addition to rainfall. These additional water sources may be surface runoff, soil moisture, or groundwater. IDE mapping by DEHP indicates that the lacustrine wetland in the central west of the Project site coincides with an area of high likelihood for dependence on additional water sources. A substantial portion of RE 11.3.3a (River Teatree Riparian Woodland) fringing Taraborah Creek also coincides with an area mapped as being likely to be dependent on water other than rainfall. Other areas with particularly high likelihood of utilising additional water sources as mapped by DEHP include:

- Retreat Creek;



- The palustrine wetland in the northwest of the site;
- The pools identified during field surveys along the drainage line to the south of Taraborah Creek (aquatic site AQ/TAS10).

### Habitat Assessment

Habitat assessment scores have been assigned to each aquatic assessment site in accordance with AUSRIVAS methodology provided in Table 4.108. From the surveys it can be seen that overall the aquatic environments of the study area are of relatively good condition with most sites scoring between 80 and 99, which can be considered relatively good habitat, generally providing several within-channel habitat types and relatively stable and well-vegetated banks.

Habitat descriptions and assessment scores for each aquatic survey site analysed during the aquatic assessments is provided in Table 4.112.

**Table 4.112 Aquatic Habitat Assessment Scores and Descriptions**

Site	Score	Description
<b>Dry Season Survey Sites</b>		
TAS1 Retreat Creek (east)	99	TAS1 is located in a River Red Gum riparian woodland community. The dominant vegetation was primarily native and weeds were not a particular problem at this site. There was significant variation in channel habitat, with submerged logs, undercut banks and a range of channel depths. No water was recorded at this site during the dry season survey. Although bank vegetation was dominated by trees, the stability of the watercourse banks was poor.
TAS2 Retreat Creek (central)	80	TAS2 occurs in a river red gum riparian woodland community. <i>Parkinsonia</i> ( <i>Parkinsonia aculeata</i> ) and Mimosa Bush ( <i>Acacia farnesiana</i> ) were noted at this site. The variation in channel habitat was fair, with several habitat types and adequate depth in pools and riffles present. No water was recorded at this site during the dry season survey. Bank vegetation consisted predominantly of trees, although bank stability was poor.
TAS3 Large dam or Lacustrine Wetland	107	TAS3 is located on a large dam or lacustrine wetland. Water, including deep water habitats, is present year round. The variation in habitat was excellent, with several velocity/depth categories. Bank vegetation and bank stability was also excellent, as the banks were gently sloping and dominated by tree and shrub cover.
TAS4 Pastoral Dam	86	TAS4 is a small pastoral dam on black clay. Vegetation was primarily consistent with the surrounding non-remnant grasslands but included several aquatic and hydrophilic species fringing the dam. Water is present at this site year round but there is no running water under normal conditions. Bank stability was good, as the bank was gently sloping around most of the perimeter. Bank vegetation was dominated by grasses and sedges.
TAS5	85	TAS5 is located within a river red gum riparian woodland





Site	Score	Description
Retreat Creek (west)		community. Weeds were particularly invasive at this site, with the presence of Noogoora Burr ( <i>Xanthium pungens</i> ) and a high abundance of Variegated Thistle ( <i>Silybum marianum</i> ). Habitat variation was good, with rubble, logs and undercut banks present. Although bank vegetation was dominated by trees, bank stability was poor. Erosion was evident in some places where the steep banks have failed and root exposure has occurred.
TAS6 Pooled drainage line / pastoral dam associated with Retreat Creek	62	TAS6 occurs along a drainage line to Retreat Creek within non-remnant grassland. Although water is present at this site year round, there is no running water under normal conditions. Bank vegetation was dominated by grasses and sedges. Trees, including river red gum grow around part of the perimeter, while Mimosa Bush was well established. Habitat variability was very poor. Bank stability was fair with moderately sloping banks and evidence of erosion occurring close to the water. This site was heavily utilised by stock.
TAS7 Taraborah Creek	97	TAS7 is located within River Teatree riparian woodland where Buffel Grass ( <i>Cenchrus ciliaris</i> ) occurs as the dominant ground cover species. Habitat variation was good at this site, with several in-stream habitat types present. Water was not present during the dry season survey. Bank stability was good, and evidence of erosion was minor.
TAS8 Ephemeral Palustrine Wetland	82	TAS8 is located within a large, ephemeral palustrine wetland. Habitat variation was low. Erosion and scouring was very low, as this wetland is very flat and shallow, with no defined banks. Vegetation associated with the wetland is dominated by Lignum ( <i>Muehlenbeckia florulenta</i> ) while grasses and sedges form a dense, short ground layer. Only a small amount of water was present during the dry season survey.
TAS9 Drainage line to Taraborah Creek	62	TAS9 is located within a sandy, 1 <sup>st</sup> order drainage line to Taraborah Creek. There was little habitat variation. It was apparent that water is not persistent but present only during and immediately after rain events. Bank stability was fair, although erosion of the banks was evident and the bank vegetation consisted primarily of grass.
TAS10 Drainage line to Taraborah Creek	111	TAS10 is located within an unnamed 1 <sup>st</sup> order drainage line to Taraborah Creek. The vegetation community consisted of River Teatree riparian woodland. Water was present in pools during the dry season survey. Habitat variation within this creek was excellent, with a variety of in-stream habitat types present and little erosion/scouring of the channel. Bank stability was good, which is most likely a result of the bank vegetation that is dominated by trees.
TAS11 Drainage line to Retreat Creek	101	TAS11 is located within a drainage line flowing northward towards Retreat Creek. Flowing water was recorded during the dry season survey. This drainage line is fed by a spring. Habitat variation was excellent, due to the presence of several in-stream habitat types, including pools, runs and riffles. Channel scouring was minimal, however a small amount of bank erosion was observed. Bank stability was good and bank vegetation was dominated by grass

Site	Score	Description
TAS12 Palustrine Wetland	66	TAS12 is located within a palustrine wetland, apparently fed by overflow from the adjacent large lacustrine wetland (i.e. TAS3). Water was recorded during the dry season survey; however, there was little evidence of flowing water. Habitat variation was poor. Scouring and bank erosion was minimal, with little bank erosion noted. Vegetation was dominated by rushes within the wetlands and grass on the banks.
<b>Wet Season Survey Sites</b>		
AQ1 Retreat Creek (east)	99	AQ01 is located along Retreat Creek, in the north-east corner of the site. This aquatic sampling site provided good aquatic habitat with rubble and gravel and boulders surrounded by little sediment. There was habitat variety with deep riffles and pools and all four habitat types (slow shallow, slow deep, fast deep and fast shallow). Little or no enlargement of islands or point bars and/or channelisation was observed. The banks were moderately unstable with moderate frequency and size of eroded areas. Stream bank surfaces were well vegetated with grasses forming the dominant vegetation type.
AQ2 Retreat Creek (central)	88	AQ2 is located along Retreat Creek, adjacent to the northern boundary of the site. This site was found to provide a good composition of gravel, rubble or other stable habitat with deep pools and riffles present. Some new increase in bar formation, mostly from coarse gravel, was evident. The banks were moderately stable with infrequent, small areas of erosion. Vegetation type along the banks was dominated by grasses.
AQ3 Large dam or Lacustrine Wetland	61	AQ3 occurs as a large dam or lacustrine wetland located in the central region of the site. There was a lack of aquatic habitat with very little rubble or gravel present and only the one velocity type present (pools). Heavy deposits of fine materials were present at the site. The banks were moderately unstable with side slopes up to 60% on some banks and eroded areas of moderate size and frequency. The stream banks were largely covered by vegetation with grasses and sedges forming the dominant vegetation type.
AQ4 Pastoral dam	80	AQ4 occurs in a pastoral dam on a sub-channel of Retreat Creek. The availability of aquatic habitat was less than desirable at this site where there is little rubble or gravel. Some scouring and deposition in pools was evident where grades steepen. The banks were moderately unstable with side slopes up to 60% on some banks with moderate size and frequency of eroded areas. The stream banks were largely covered by vegetation with grasses forming the dominant vegetation type.
AQ5 Retreat Creek (west)	67	AQ5 is located along Retreat Creek in the west of the Project site. There was an obvious lack of aquatic habitat and only three of the four depth/velocity habitat types were present. Occasional riffles or bends and bottom contours provided some habitat. Some scouring and deposition in pools was evident where grades steepen. Less than 50% of the stream bank was covered by vegetation. Grasses form the dominant vegetation type.

Site	Score	Description
AQ6 Pooled drainage line / pastoral dam associated with Retreat Creek	80	AQ6 occurs in the pooled drainage line/pastoral dam near Retreat Creek in the northwest of the Project site. There was an apparent lack of habitat at this site with little rubble or gravel and only the occasional riffle or bend present. Some scouring and deposition in pools was evident where grades steepen. The banks were moderately unstable with moderate frequency and size of eroded areas and side slopes up to 60% in some areas. The banks consist of over 80% vegetation cover with grasses forming the dominant vegetation type.
AQ7 Taroborah Creek	83	AQ7 is located on Taroborah Creek in the southwest portion of the Project site. Although adequate depths in pools, riffles and bends provided some habitat, there was a lack of substrate and cover variety at this site. All four habitat types (slow shallow, slow deep, fast deep and fast shallow) were present. The site was found to have moderate levels of deposition on bars and pools partly filled with silt. Bends, deeper pools and riffles provide some habitat at this site. The banks were moderately stable with infrequent and small areas of erosion that were mostly healed over. Greater than 80% of the stream bank surfaces were covered by vegetation with grasses forming the dominant vegetation type.
AQ8 Palustrine wetland	94	AQ8 occurs within a palustrine wetland located in the northwest corner of the site. This site provided good aquatic habitat with a variety of substrate types and elements of cover (e.g. gravel, rubble, submerged logs, undercut banks, etc.). There was little or no sedimentation, deposition or scouring. Stream bank surfaces were well vegetated with grasses forming the dominant vegetation type.
AQ9 Drainage line to Taroborah Creek.	71	AQ9 is located along a drainage line to Taroborah Creek. Habitat availability at this site was less than desirable with little rubble, gravel or other stable habitat and only the occasional bend present. The banks were moderately stable with infrequent small areas of erosion and greater than 80% cover by vegetation. Grasses form the dominant vegetation type.
AQ10 Drainage line to Taroborah Creek	99	AQ10 occurs in the southwest of the project site along a drainage line to Taroborah Creek. This site provided good aquatic habitat with a variety of substrate types and elements of cover (e.g. gravel, rubble, submerged logs, undercut banks, etc.) as well as the occasional riffle or bend. Only three of the four habitat types (slow shallow, slow deep, fast deep and fast shallow) were present. There was little or no sedimentation, deposition or scouring. The banks were stable with no evidence of erosion or bank failure and greater than 80% vegetation cover. Trees form the dominant vegetation type.
AQ11 Drainage line to Retreat Creek	90	AQ11 is located along a drainage line to Retreat Creek in the east of the Project site. This site provided good aquatic habitat with a variety of substrate types and elements of cover (e.g. gravel, rubble, submerged logs, undercut banks, etc.) as well as the occasional riffle or bend. All four habitat types (slow shallow, slow deep, fast deep and fast shallow) were present. Moderate levels of sedimentation and deposition were observed. The banks were stable with no evidence of erosion or bank failure. Greater than



Site	Score	Description
		80% of the banks were covered by vegetation, of which trees form the dominant vegetation type.
AQ13 Lacustrine Wetland/ Pastoral dam	61	AQ13 represents the pastoral dam located adjacent to the western boundary of the Project site. This water body is mapped on the EHP Wetlands mapping as a lacustrine wetland. This site was found to have a distinct lack of aquatic habitat with very little rubble or gravel present and only the one velocity type present (pool). Heavy deposits of fine materials were present at the site. The banks were moderately stable with small and infrequent areas of erosion mostly healed over. The stream banks were largely covered by vegetation with grasses and sedges forming the dominant vegetation type.

A detailed summary of the stream morphology, surface water and stream sediment results from the aquatic ecology assessment are provided in Appendix 19. In addition, the summary includes detailed descriptions of the riparian vegetation communities occurring on the Project site, together with a summary of WONS and other introduced species observed during the aquatic surveys.

### Aquatic Fauna

A total of six fish, five amphibian and six reptile species were identified in association with the riparian communities on the Project site. Each group is summarised below and a complete listing including the habitat description and the species recorded at each sampling site is provided in Appendix 19.

#### Amphibians

Five amphibian species were recorded from the Project site during the aquatic surveys. These included the Spotted Grassfrog (*Limnodynastes tasmaniensis*), Green Tree Frog (*Litoria caerulea*), Person's Tree Frog (*Litoria peronii*), Greenstripe Frog (*Cyclorana alboguttata*) and Cane Toad (*Rhinella marina*).

#### Fish

Six fish species were detected within the Project site during the field surveys. The most commonly recorded fish species was Spangled Perch (*Leiopotherapon unicolor*), closely followed by Southern Purple-spotted Gudgeon (*Mogurnda adspersa*) and Agassiz's Glassfish (*Ambassis gassizii*). Less commonly recorded species include Bony Bream (*Nematalosa erebi*), Eastern Rainbowfish (*Melanotaenia splendida*) and Fly-specked Hardyhead (*Craterocephalus stercusmuscarum*). All of these species are native and occur commonly in rivers and creeks throughout central-eastern Queensland.

#### Reptiles

Two aquatic reptile species, the Keelback (*Tropidonophis mairii*) and Eastern Snake-necked Turtle (*Chelodina gicollis*) were recorded during aquatic surveys of the Project site. An additional four reptile species were observed in association with riparian communities on the Project site. These species were the Brown Tree Snake (*Boiga irregularis*), Dubious Dtella (*Gehyra dubia*), Open Litter Rainbow Skink (*Carlia pectoralis*), and a gecko species (*Gekkonidae* sp.).



## Macro-invertebrates

A total of 47 macro-invertebrate taxa were identified during the wet season and dry season surveys. Some of the more commonly encountered macro-invertebrates included true fly (Diptera: Tanyptodinae), backswimmers (Hemiptera: notonectidae), water boatmen (Hemiptera: Corixidae), and diving beetles (Coleoptera: Dytiscidae). These four families together accounted for approximately 43% of all specimens identified. Hemiptera: Corixidae were the most commonly encountered taxa where macro-invertebrate sampling was conducted.

Of the taxa identified during the aquatic surveys, 40 were used to compute a SIGNAL 2 Score for each sampling site. Figure 4.122 shows SIGNAL 2 biplot classifications for each quadrant. Figure 4.123 shows the result of the SIGNAL 2 assessment of macro-invertebrate assemblages within and surrounding the Project site during the surveys.

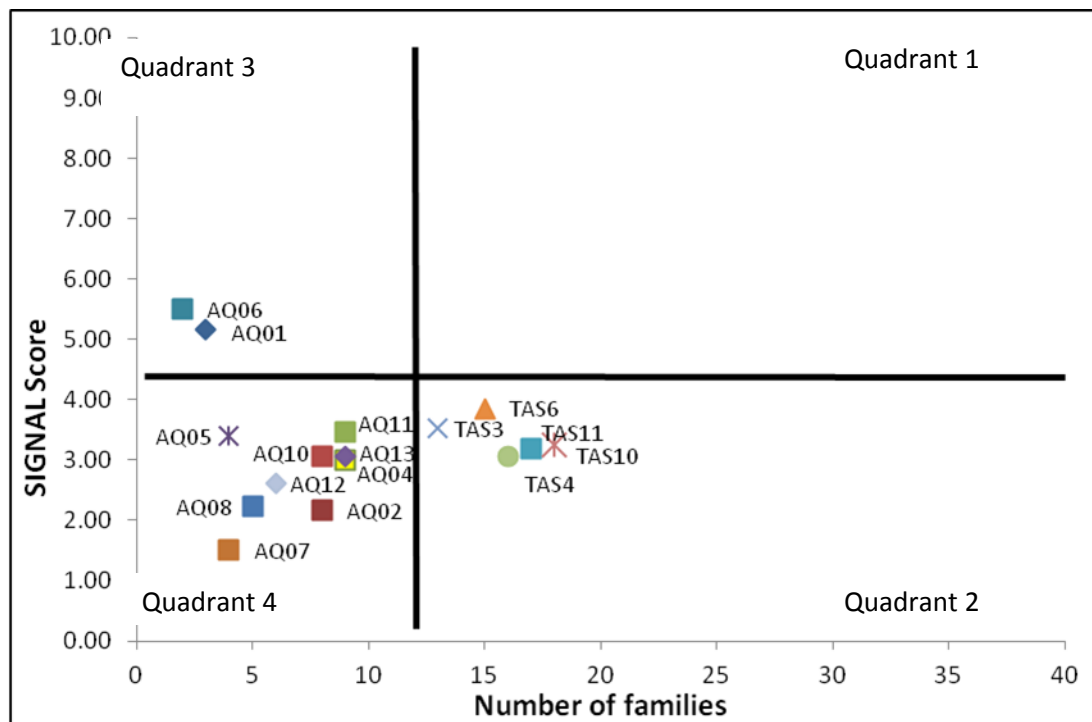
The Signal Bi-plot indicates a distinct difference in SIGNAL scores when comparing the results from the dry season and wet season sampling sites (identified via prefix TAS and AQ respectively). As shown in Figure 4.123 all dry season sampling sites fell within Quadrant 2, while the majority of sites sampled during the wet season fell within Quadrant 4.

There are numerous factors that affect the distribution and density of macro-invertebrates. The variation in SIGNAL scores may be due to climatic conditions prior to surveys. The wet season survey was conducted immediately following a month of substantial rainfall (93.8 mm) when the watercourses were relatively fast flowing. A study conducted by Fritz and Dodds (2005) showed that a greater than 50 year flood can reduce site richness by up to 97% immediately following the flood event, effectively demonstrating that flooding in intermittent streams is an important factor in macro-invertebrate density and richness. As recruitment by aquatic invertebrates can be slow, it is possible that few species had a chance to build up sufficient numbers for detection following wet season rainfall events. The dry season survey was conducted during a period of little rainfall (i.e. 1 mm in the two months prior). This may have been sufficient time for less common species to become detectable.

<b>Quadrant 3</b>  Often indicating toxic pollution or harsh physical environments	<b>Quadrant 1</b>  Indicates favourable habitat or chemically dilute water
<b>Quadrant 4</b>  Usually indicating urban, industrial, or agricultural pollution	<b>Quadrant 2</b>  Often indicating high salinity or nutrient levels (may be natural)

**Figure 4.122 SIGNAL 2 Bi-Plot Interpretation**





**Figure 4.123 SIGNAL Bi-Plot**

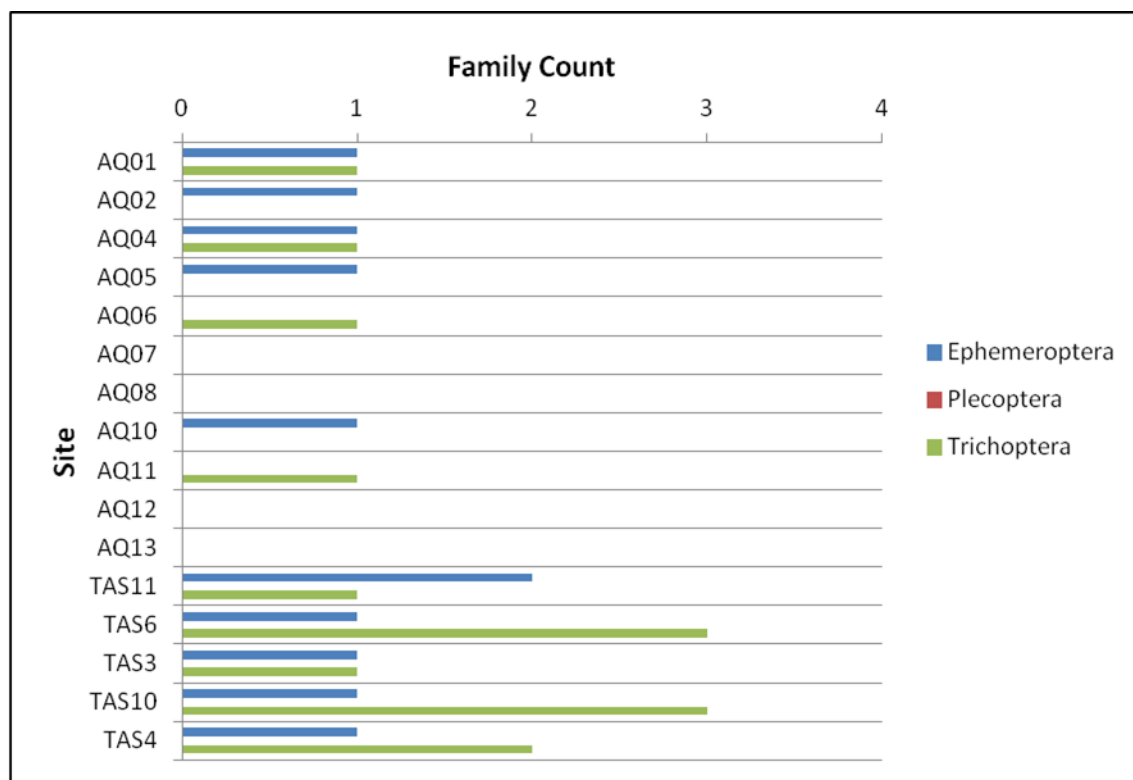
It is likely that several years' worth of background data will be required before the natural fluctuations are adequately understood. Understanding natural fluctuations is a priority as any changes in the SIGNAL score must be considered in light of these natural changes.

It is generally accepted that three orders of macro-invertebrates, the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) are most sensitive to disturbance (Marshall et al, 2001). The total number of families of these groups occurring at sites can be used to assess degradation of habitat and water quality. The use of EPT analysis is limited to regional comparisons, as the comparison of fauna varies between regions and larger river systems.

Figure 4.124 shows that Ephemeroptera and Trichoptera taxa were identified at the majority of the survey sites where macro-invertebrate dip-netting was conducted. No taxa belonging to the Plecoptera order were identified at any of the sites. Trichoptera individuals were more commonly encountered during the dry season survey.

Crustacean species encountered during the field surveys include shrimp (*Paratya* sp.), yabbi (*Cherax destructor*) and freshwater crab (*Austrothelphusa transversa*). The freshwater crab (*Holthuisana* sp.) was encountered in high abundance whilst trapping within the Project site during the wet season. Freshwater crabs were recorded from three of the four sampling sites (i.e. AQ01, AQ02 and AQ07) where trapping was conducted. This species is not included in the SIGNAL scoring. The freshwater crabs were recorded from the larger, swift flowing sandy and/or rocky aquatic sites.





**Figure 4.124 EPT Richness**

#### 4.8.2.4 Stygofauna Results

The stygofauna Pilot study, undertaken in accordance with the *Western Australian Environmental Protection Authority – Guidance for the Assessment of Environmental Factors No. 54a (August 2007)*, failed to detect any stygofauna during the study and subsequent analysis. However, failing to detect stygofauna from within the study area does not preclude the possibility of stygofauna from being identified elsewhere on or outside of the lease if a more intensive investigation were to be undertaken.

The groundwater quality measurements recorded during the Pilot study (pH of 7.46 to 10.07 and EC of 0.301 to 1.388  $\mu\text{S}/\text{cm}$ ) are consistent with known tolerance levels of Australian stygofauna Queensland (Hancock and Boulton, 2008). Stygofauna are known to persist in water ranging from fresh to brackish, tolerating salinity up to 35ppt (Humphreys, 1999) and have been found in dysoxic waters with a DO of below 1%/L (Humphreys, 2006).

However, it is understood that the aquifer underneath the Taraborah EPC is not in hydraulic continuity with local alluvial aquifers and is a confined aquifer. The risk of impaction by the proposed mining activities (such as groundwater abstraction and excavation of the aquifer) upon significant stygofauna populations is considered to be low due to the isolated nature of the aquifer and the presence of much more suitable habitat being present in relatively close proximity to the site.

### 4.8.3 Potential impacts and mitigation measures

#### 4.8.3.1 Potential Impacts of the Project

The following potential impacts on nature conservation values may occur as a result of the Project:

- The construction of the eastern opencut mine haul road through the Brigalow Woodland (RE 11.9.1) will result in the loss of a limited area of Brigalow vegetation;
- The injury or death of terrestrial fauna species may occur during the lifetime of the Project, with the greatest potential to occur during the construction phase;
- Edge effects resulting from the proposed works can include the introduction and establishment of weeds, alteration to microclimatic conditions (such as greater light intensity, more wind penetration, lower humidity) and a reduction in plant health through loss of tablsynthetic potential (as a result of plants being covered by dust generated from vehicle movement on unsealed tracks). In the absence of appropriate control measures, the Project has the potential to cause impacts in relation to edge effects, predominantly in relation to the introduction and / or spread of weed species throughout the Project site;
- Additional noise from mine site operations may disturb fauna on the Project site. Noise effects can be highly species dependant and may vary widely. Impacts from noise will be concentrated around the opencut pit / process plant / haul roads / decline area, whilst the rest of the majority of the Project site and associated habitat types will be unaffected;
- Increased lighting may affect both nocturnal and diurnal fauna. The effects of artificial lighting will vary with different species. Additional lighting commonly attracts insects, which will result in a higher abundance of amphibians, microbats and reptiles who will be able to take advantage of concentrated, light-attracted prey;
- Loss of habitat may result in a loss of biological diversity (with associated removal of leaf litter, hollow bearing trees, fallen timber and resultant changes to soil biota);
- A change in population dynamics may occur, although it is not expected to be significant. Species most susceptible to a decline are low mobility species. Species such as amphibians and smaller reptiles may become genetically isolated;
- Land clearing activities associated with the Project may increase soil erosion, inadvertently causing silting or sedimentation of riverine habitats and waterholes downstream. Soil erosion may also trigger a loss of nutrients to one area, causing a disruption of natural nutrient cycling;
- Processing and mining activities on the Project site may contaminate riverine habitats and waterholes downstream;
- Nutrients such as Nitrogen and Phosphorus can enter aquatic water systems as by-products of human and industrial wastes (e.g. detergents, sewage, fertilisers etc.). Increased nutrients can increase the abundance of algae and aquatic plants causing eutrophication of waterways;
- The Project site may encounter an increase in pest fauna species (including the Cane Toad, European Rabbit, Feral Pig and Feral Cat) due to the increased availability of food sources which will occur once the Project site is operational;
- The introduction of additional weed species and spread of weeds on the Project site via transport of seeds on vehicles and machinery; and

- Groundwater reductions may impact the deep-rooted Eucalypt trees that grow along both Retreat Creek and Taraborah Creek in terms of the availability of local groundwater for these trees.

In addition, land subsidence from underground mining may impact on any of the seven vegetation communities located above the underground mining footprint.

A subsidence assessment was conducted by IMC Mining Group Pty Ltd (IMC) in 2013 and is provided in Appendix 10. This assessment provides predictions of the nature and extent of surface subsidence impacts (strain, tilt and cracking at the surface). In the worst case scenario, surface subsidence would result in a decline in land elevation of up to approximately 2m and tension cracks may occur to a depth of 5m with a maximum width of 0.2 to 0.3m.

Subsequent disturbance and potential impacts from land subsidence on existing environmental values may include:

- Increasing land elevation angles, changing surface-soil drainage patterns and potentially destabilising root systems on any of the seven vegetation communities located above the underground mining footprint;
- The drainage profile may experience subtle changes as a result of subsidence. The predicted minor changes in topography may result in additional ponded areas. While most areas of ponding would be shallow and dry quickly after rainfall events, prolonged ponding of surface water, if not mitigated, may provide additional habitat for Cane Toads;
- Significant areas of artificial long-term ponding also have the potential to cause changes in vegetation type or remnant status. While the majority of the area to be impacted by subsidence consists of non-remnant grasslands and croplands, some areas of remnant vegetation may be impacted by subsidence-induced ponding. In the event that subsidence leads to the creation of ponded areas of significant depth (i.e. 1m or greater) there could be significant impacts on remnant vegetation. Such changes in hydrological regime, if not mitigated in a timely manner, can cause dieback of terrestrial flora species resulting in the loss of remnant vegetation and/or a shift in community composition to wetland species; and
- Surface cracking occurs as a result of tensile strain on the ground surface. Tension cracking may occur over the chain pillars left between longwall panels. It is expected that any cracks will be less than 5m deep and a maximum width of 0.2 to 0.3m in the worst case scenario. While tension cracking will not necessarily impact on vegetation communities, the rehabilitation of cracks will involve remedial earthworks and may lead to impacts on vegetation.

The Project area that will experience some measure of disturbance as a result of the direct impacts associated with the mining activity is detailed in Table 4.113 and illustrated in Figure 4.125. However, only the areas associated with the opencut mine and surface infrastructure (with an impact area of approximately 473 ha) are expected to experience a complete loss of current vegetation cover, of which only approximately 3 ha is considered remnant vegetation, 149.4 ha is considered remnant grassland and the rest being non-remnant grassland.

### **Dust Impacts to Adjacent Vegetation Communities**

Community 4 (Brigalow Woodland) is located immediately east of the opencut pit in the south of the Project site. Activities conducted at the pit will generate dust (including coal dust) that has the





potential to impact vegetation. However, prevailing winds on the Project site originate from the north-northeast through to the east and southeast, influencing the prevailing direction of dust dispersal. Due to the location of Community 4 to the east of the pit, prevailing winds will minimise potential impacts of dust on vegetation.

Community 10 (Brigalow / Belah Low Open Woodland) is located immediately adjacent to a dam in the west of the Project site. The dam is expected to result in minimal dust generation, precluding any significant impact to this vegetation community.

Air mitigation measures will be implemented for all potential dust-generating activities on the site, minimising impacts to vegetation. These measures are outlined in Section 4.6.2.2 and detailed in Appendix 15 (Air Quality Impact Assessment).

### **Impacts to Groundwater Dependent Ecosystems**

Dewatering of aquifers is a typical requirement for opencut mining operations where the opencut pit is lower than the water table. This results in lowering of the water table, known as groundwater drawdown. Groundwater drawdown may cause salinisation and/or contamination of aquifers, altering the chemistry and quality of groundwater (Eberhard et al. 2004). Drawdown of the water table may cause desiccation of sediments, altering the balance of aerobic and anaerobic processes and influencing the microbial composition within populations (Tomlinson and Boulton 2008). Mortality of subterranean fauna may occur as a result of stranding due to drawdown of the water table (Stumpp and Hose 2013).

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) modelled groundwater drawdown for the Project (AGE 2014). The maximum extent of groundwater drawdown extends up to approximately 3.5 km beyond the Project site, predominantly to the east. Within this extent of drawdown, vegetation communities or flora species that depend to some degree on access to sub-surface groundwater may be impacted if the groundwater level falls lower than the root zone.

Groundwater levels in the vicinity of Retreat Creek have been recorded at approximately 6 - 10 mgbl; only deep-rooted vegetation (such as the Eucalypt trees) may use subsurface groundwater as a water supply. A groundwater reduction of approximately 5 m has been modelled around Retreat Creek, while a 30 m reduction has been modelled around Taroborah Creek. This may result in impacts to vegetation that utilise groundwater, such as deep-rooted Eucalypt species associated with RE 11.3.25, 11.3.3a or 11.3.6. Vegetation lacking deep-roots (i.e. shrubs and groundcover species) is not anticipated to be impacted by operational groundwater drawdown.

Mining activities may disturb groundwater flow regimes, spatially and/or temporally. For example, disturbance to hydrological connectivity patterns may alter the quality, flow and/or flux of groundwater, potentially affecting nutrient cycling (Tomlinson and Boulton 2008). More broadly, changes to the groundwater regime may “alter the rate and nature of subsurface ecological processes, resulting in reduced availability of carbon, nitrogen and phosphorous, with flow-on effects for biodiversity and ecosystem services” (Tomlinson and Boulton 2008, p.20), particularly those that rely directly on access to groundwater. Drawdown of the shallower water table in the Tertiary sands and gravels during the operations phase of the Project will mostly affect the area south of Retreat Creek and north of Taroborah Creek, but only where this shallower groundwater is present.

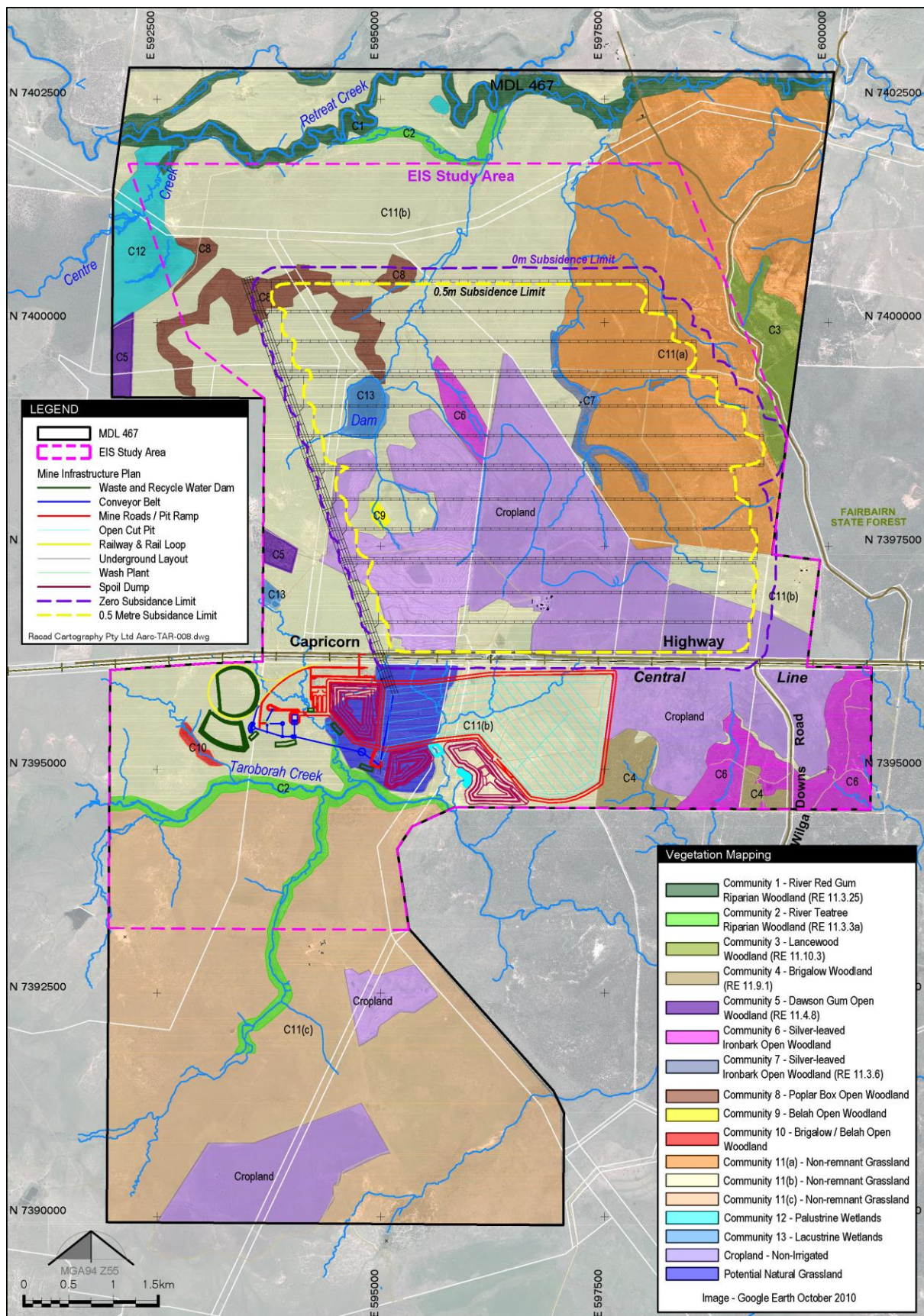


**Table 4.113 Disturbance Area of Remnant Vegetation**

	<b>Vegetation Community</b>	<b>Regional Ecosystem Equivalents</b>	<b>VM Act Status</b>	<b>EHP Biodiversity Status</b>	<b>EPBC Act Status</b>	<b>Total Area (ha)</b>	<b>Total Disturbance Area including Subsidence (ha)</b>	<b>Total Area to be Cleared (ha)</b>
1	River Red Gum Riparian Woodland	RE 11.3.25	Least Concern	Of Concern	-	190.1	0.0	0.0
2	River Teatree Riparian Woodland	RE 11.3.3a	Of Concern	Of Concern	-	143.0	0.0	0.0
3	Lancewood Woodland	RE 11.10.3	Least Concern	No Concern	-	95.2	11.2	0.0
4	Brigalow Woodland	RE 11.9.1	Endangered	Endangered	Endangered	72.6	2.76	2.76
5	Dawson Gum Open Woodland	RE 11.4.8	Endangered	Endangered	Endangered	31.2	0.0	0.0
6	Silver-leaved Ironbark Open Woodland	RE 11.5.3	Least Concern	No Concern	-	191.2	31.9	0.0
7	Silver-leaved Ironbark Open Woodland	RE 11.3.6	Least Concern	Of Concern	-	33.2	33.2	0.0
8	Poplar Box Open Woodland	RE11.9.10	Of Concern	Endangered	-	130.9	67.0	0.0
9	Belah Low Open Woodland	RE 11.4.9*				4.1	4.1	0.0
10	Brigalow / Belah Low Open Woodland	RE 11.4.9	Endangered	Endangered	Endangered	8.5	0	0.0
11	Non-remnant Grassland	-	-	-	-	5,632.5	1701.6	320.8
12	Palustrine Wetlands	RE 11.3.27	Least Concern	Of Concern	-	112.5	0.0	0.0
13	Lacustrine Wetlands	-	-	-	-	32.2	27.41	0.0
n/a	Potential Natural Grassland	RE 11.8.11	Of Concern	Of Concern	Endangered	163.5	0.0	149.4

\* This community was considered to be equivalent with RE 11.4.9 in terms of species composition but did not satisfy all requirements that define remnant vegetation (i.e. >70% of the height and/or >50% of the cover relative to the undisturbed height and cover of a given RE).





**Figure 4.125 Disturbance Footprint of Vegetation Communities on the Project Site**



#### 4.8.3.2 Management of Native Flora and Fauna

Measures to minimise the impacts on native flora and fauna, and strategies regarding rehabilitation of the Project area, are outlined below:

- Vegetation clearing on the Project site will be minimised such that only those areas required for the operation of the Project are disturbed;
- Native vegetation removal will be conducted only after:
  - The areas to be cleared have been clearly delineated and identified to equipment operators and supervisors;
  - Weed control measures such as vehicle wash downs have been implemented to prevent the spread of weed species along riparian corridors;
  - Appropriate erosion and sediment-control structures are in place; and
  - Clearance from environmental staff has been obtained.
- Suitable sediment and erosion control measures will be implemented to prevent sediment deposition in adjacent retained habitats. To ensure the availability of seed for mine rehabilitation works, retained areas of existing vegetation will be protected and maintained throughout the Project;
- The selection of flora species to be used in rehabilitation works will be appropriate to the landscape elements of the Project site. Rehabilitation species will be consistent with community descriptions;
- Where possible, any landforms created as a result of the Project will be contoured to resemble the original local topography;
- Project infrastructure planning and construction will avoid the creation of shallow, ponded areas including septic and other tank overflows that form a permanent seep;
- Habitat areas due to be impacted by the Project shall be inspected prior to any vegetation clearing to determine whether any fauna are present. Any fauna observed within an area to be disturbed will be given the opportunity to move on naturally or relocated before clearing occurs;
- The Staff Induction Program will incorporate a section on the conservation values on the Project site and surrounding areas to facilitate staff awareness. This will include photographs, brief descriptions and management requirements of any species of conservation significance known from the Project site or surrounding areas; and
- Areas disturbed by the Project will be rehabilitated progressively as soon as possible after disturbance to minimise the risk of soil erosion and the length of time the land is altered from its pre-mining condition. Rehabilitation aims to restore native vegetation and rehabilitate the land so it is capable of sustaining low intensity cattle grazing.



## Rehabilitation Monitoring

The rehabilitation strategy, embodying the concepts and recommendations outlined above including provisions for a monitoring regime, is provided throughout Section 3.7.3.

Indicators will be monitored in accordance with the rehabilitation monitoring program and assessed against completion criteria to determine the success of rehabilitation. Long term rehabilitation monitoring will be required and shall become an important component of the operational responsibilities during the life of the mine and following mine closure. The success of the rehabilitation works for each mine domain will be measured by comparing a number of rehabilitation completion criteria for rehabilitated areas with similar, existing, undisturbed ecosystems (analogue sites) over time.

Multiple analogue sites on and around the Project site will be established to provide a representation of the pre-mining vegetation type and landscape characteristics of the immediate area. These analogue sites will be established prior to construction and data collected at each, to establish appropriate key flora indicators.

The following parameters and evidence will be recorded annually at each analogue and rehabilitation site and assessed:

- Aspect and slope;
- Percentage groundcover;
- Grass and herb density per hectare;
- Shrub density per hectare;
- Tree density per hectare;
- Species composition;
- Soil chemical and physical properties;
- Erosion evidence – depths of rills, erosion lines, surface crusting and slopes; and
- Site photographs.

A Rehabilitation Report will be developed that provides evidence that monitoring data is meeting specified containment and trigger levels, in order to protect environmental values.

### 4.8.3.3 Management of Aquatic Values

The proposed mine infrastructure and opencut footprint will not result in the loss of semi-permanent and ephemeral aquatic habitat, however, the land subsidence which will occur as a result of underground mining has the potential to impact approximately 33.1 ha of ephemeral aquatic habitat associated with various tributaries.



Strategies to minimise the impacts on aquatic flora and fauna are outlined below:

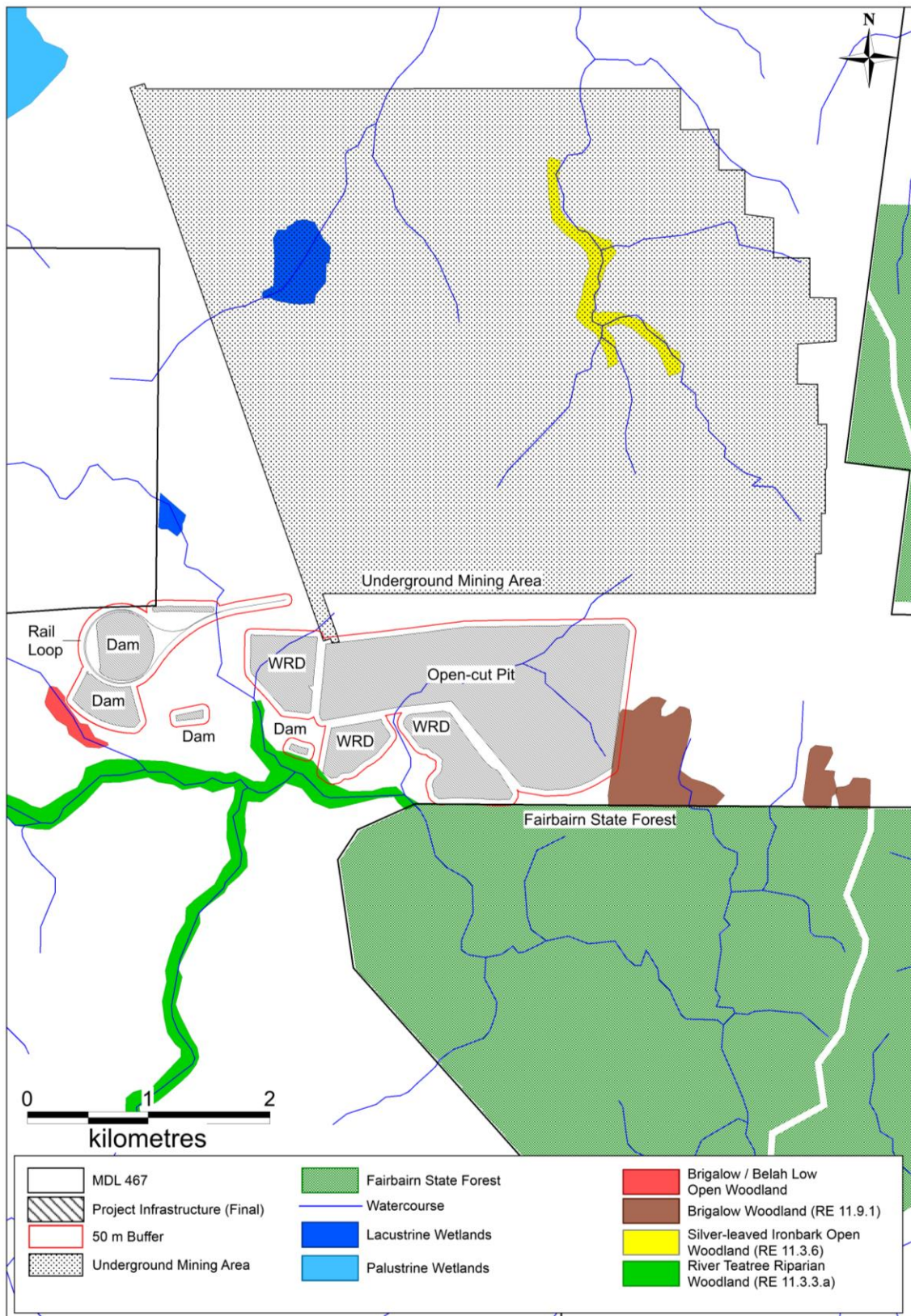
- All contaminated mine water and process water will be contained within a closed loop system and recycled. No contaminated mine water or process water will be discharged from the Project site;
- Sediments traps will be designed downstream of all land disturbances such as spoil dumps to remove sediment from storm water flowing off these areas prior to release;
- A water quality and sediment quality monitoring programme will be initiated and continued throughout the Project life. This program will ensure that the early detection of impacts is identified and documented, thereby allowing mitigation strategies to be altered or developed;
- Project disturbances will be progressively rehabilitated on completion of work. Where possible, a 50m buffer zone has been implemented around sensitive aquatic ecosystems as illustrated in Figure 4.126; and
- A Pest Management Plan will be developed, to monitor the presence of, and success of control strategies for pest plant and animal species within the Project site.

A rehabilitation strategy specific to the needs of riparian habitat found on the Project site shall be developed following annual monitoring of riparian environments likely to be impacted by land subsidence. This monitoring data will be used to define practical rehabilitation success criteria and will include provision for stream hydrology in addition to riparian vegetation.

In addition, nutrient loading will be controlled on the Project site to avoid eutrophication of aquatic water systems. Nutrient limitation strategies include:

- Diversion of wastewater effluents as part of the surface water management system on the Project site which retains dirty water and diverts clean surface water;
- Restrict the use of phosphate-containing detergents where practical;
- Where possible, bioactive glyphosate shall be used for the treatment of weeds that are located in close proximity to watercourses;
- Installation of sewage treatment facilities with sufficient capacity to handle site waste; and
- Monitoring of receiving waters.





**Figure 4.126 Infrastructure Buffer Zone (50 m)**

#### 4.8.3.4 Management of Stygofauna

A pilot stygofauna sampling program was conducted in September 2011 at seven bores located on the Project site. No stygofauna were identified in the groundwater samples collected during the pilot program and it was concluded that the lack of any significant stygofauna populations did not warrant further sampling. However, on review of the geological characteristics of the sampling locations, it was determined that the pilot program did not adequately target suitable stygofauna habitat, such as alluvium; one of the sampled bores was located within Tertiary Basalt (Tb), while the remaining six were located within Aldebaran sandstone.

#### Stygofauna Sampling Program

It is proposed that an additional round of sampling will be conducted to ensure that all likely stygofauna habitats on and around the Project site are sampled. The sampling program will therefore target areas of alluvium that were not previously sampled. Since completion of sampling in 2011, a number of additional groundwater bores have been drilled on the Project site, including two within alluvium. Proposed sampling locations are detailed in Table 4.114 and Figure 4.127.

Bores located within Quaternary alluvium (Qa) are associated with the floodplain of various creek lines, including Retreat Creek, Taraborah Creek, Kettle Creek and tributaries of Centre Creek. Bores located within Tertiary / Quaternary alluvium (TQa) are typically high-level, dissected alluvial deposits associated with stream valleys.

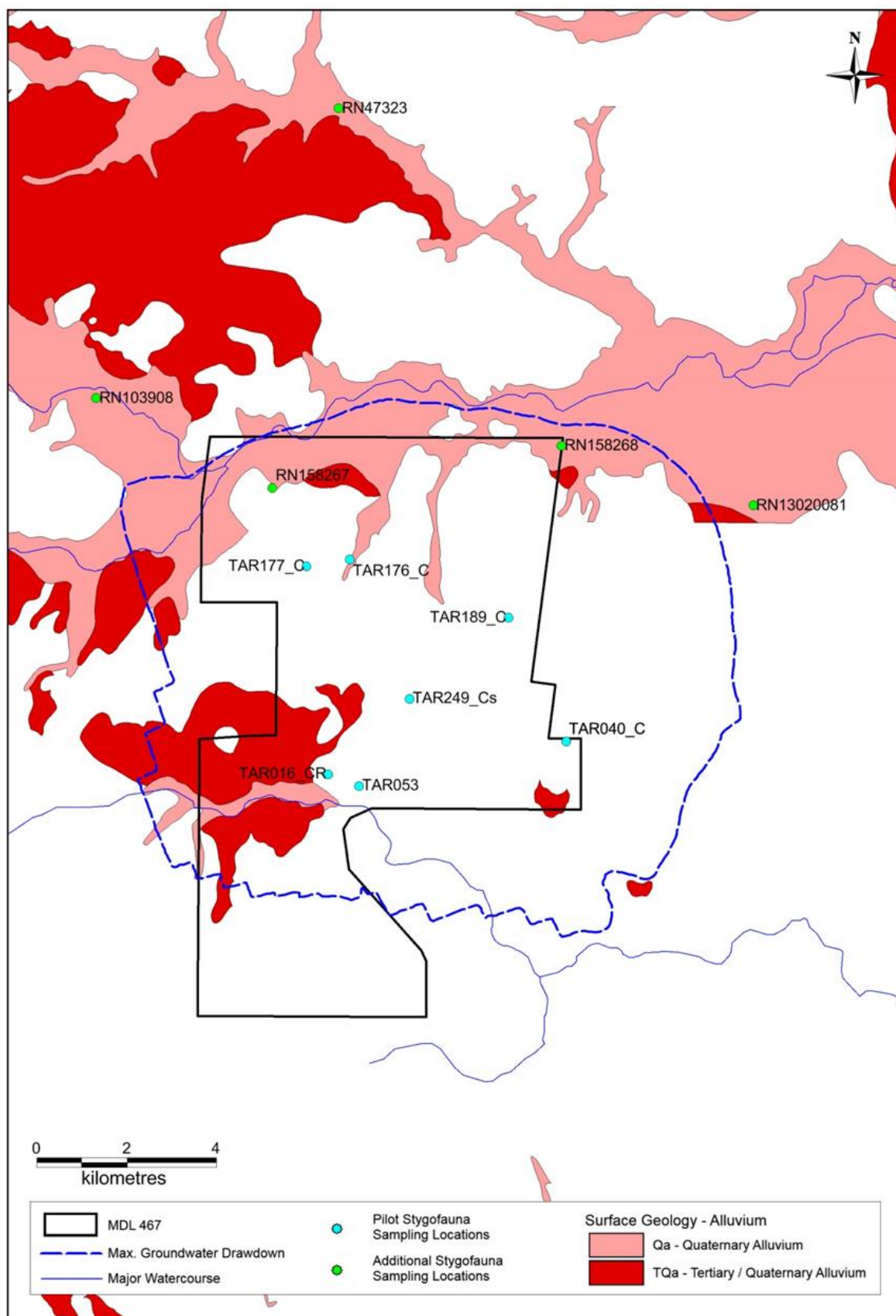
While additional sampling targeting potential stygofauna habitats increases the likelihood of positively identifying stygofauna populations, a lack of results does not necessarily preclude the possibility that stygofauna are indeed present.

**Table 4.114 Stygofauna Sampling Locations**

Bore Number	Easting*	Northing*	Geological Unit	Bore Type and Status
<b>Located on the Project Site</b>				
RN158267 (MB09)	593575	7401714	Qa	Sub-artesian facility, existing
RN158268 (MB10)	600019	7402656	Qa	Sub-artesian facility, existing
<b>Surrounding the Project Site</b>				
RN13020081	604305	7401322	Qa	Sub-artesian facility, abandoned but useable
RN103908	589641	7403715	Qa	Sub-artesian facility, existing
RN47323	595052	7410179	Qa	Sub-artesian facility, existing

\* MGA GDA 94, Zone 55





**Figure 4.127 Stygofauna Sampling Locations**



#### 4.8.3.5 Management Strategies for Species of Conservation Significance

One species of conservation significance, the Little Pied Bat (*Chalinolobus picatus*) was positively recorded within the Project site.

General management strategies that will be undertaken in consideration of the presence of the Little Pied Bat on the Project site include:

- Hollow-bearing trees, both living and dead (although relatively uncommon on the Project area), will be retained where possible as potential roost sites;
- Retention of native vegetation adjacent to water points such as dams and watercourses will be undertaken, where possible, to maintain insect abundance near drinking sites; and
- Allowing fauna spotters to conduct a thorough survey of the site prior to any vegetation clearing.

In addition, a range of bat specific mitigations measures aimed at minimising the impacts to the Little Pied Bat habitat, as well as other bats species, have been developed in accordance with the Australasian Bat Society and are provided in Appendix 18.

#### 4.8.3.6 Management of Subsidence

To mitigate the impacts of subsidence, a Subsidence Management Plan will be developed in accordance with the requirements of the EHP guideline *Watercourse Subsidence – Central Queensland Mining Industry (DRAFT Version 7)*. Recommended subsidence mitigation measures include the following:

- While surface tilt will be unavoidable, the impacts on sensitive landscape features and surface drainage will require consideration, and appropriate subsidence management strategies will be implemented. Subsidence-induced ponding will be mitigated by the completion of minor remedial drainage earthworks to re-establish free drainage. Minor remedial drainage works shall ensure that subsidence does not result in hydrological changes that would impact on the ecological functioning (including species composition or remnant status of vegetation communities) of impacted areas; and
- Because surface cracking will only occur over a small portion of the subsided area, the exact locations of tension cracks will be confirmed through monitoring. Surface cracks will then be rehabilitated using remedial earthworks and the use of sealants, where required. While tension cracking will not necessarily impact on vegetation communities, the rehabilitation of cracks may lead to impacts on vegetation. Consequently, the rehabilitation of cracks will need to be managed appropriately to avoid impacts on vegetation. A rehabilitation plan will be prepared to guide remediation works on tension cracks whilst minimising impacts on surrounding ecosystem values. The rehabilitation program will be designed to accommodate potentially disturbed vegetation communities affected by tension cracks.

Further information regarding the likely impacts and mitigation measures associated with land subsidence is provided in Appendix 10.

#### **4.8.3.7 Management of Introduced Flora and Fauna**

##### **Introduced Flora**

The risks posed by weeds in mining areas include the introduction of new species, the spread of weeds to adjacent areas, and increases in weed abundance in disturbed areas. Weeds can also diminish rehabilitation efforts by outcompeting species selected for revegetation and reduce overall land productivity.

The best form of weed control is the prevention of their establishment on site. Small infestations can often be treated efficiently; however, the large-scale eradication of established infestations can incur significant management costs.

Threat mitigation plans will be developed and included in a Weed Management Plan (WMP) developed for the Project to prevent the spread of weeds throughout the site, thereby reducing the liability costs associated with the eradication of infestations.

Control measures to be included in the WMP include:

- Risk assessment of high biosecurity risk species and their sites;
- Restricting vehicles to designated roads where practical;
- Preventing water and fertilisers (when used) from running into bushland;
- Managing buffers or windbreaks around disused revegetated areas (when applicable); and
- Cleaning of machinery and off-road vehicles (including visitors).

Biosecurity Queensland promotes a number of wash-down procedures, enabling industry to meet these requirements, which will be implemented on the Project site. Weed eradication and management strategies will be developed in consultation with Pest Fact Sheets (made available by DAFF) to ensure the most effective methods of eradication are employed on the Project site.

Weed management will also be addressed during the Site Induction Program for the Project to inform staff of the weed species likely to be encountered on the Project site, the locations of known weed infestations, and how to report the presence of new infestations.

##### **Introduced Fauna**

Six introduced pest fauna species were recorded during the field surveys, four of which are defined as Class 2 Pests under the Queensland LP Act.

Pest animal control methods employed on the Project site will use scientific information and informed judgment to implement the most humane method that is effective in a given situation to reduce the negative impacts that a method has on an animal's welfare (DAFF 2011).

In accordance with the Australian Animal Welfare Strategy (2008), taking into account changes in whole of community standards, the objectives of pest animal control on the Project site are to:

- 1) Meet the statutory requirements of the LP Act;
- 2) Promote and use only humane and effective methods of pest animal control; and



- 3) Undertake best practice standards in all situations where there is potential for human to animal interaction.

When choosing a control technique, it is the aim of the Project to balance the effectiveness of the technique, its humaneness, and public safety. The Project shall only undertake pest animal control methods that are scientifically proven to remove or destroy the animal with next to no pain, suffering or mental anguish. No biological or chemical methods of control will be used to control pest animal species on the Project site.

Measures that will be considered in the management of Class 2 pest species on the Project site include:

- Effective dingo control methods include shooting and fencing in combination with current land management practices;
- Feral Cat control measures include trapping;
- European Rabbit control measures include ripping warrens and shooting; and
- A combination of physical controls will be employed where practical to control the Feral Pig, including shooting and/or barrier construction.

In addition, food scraps will not be left out as these attract pests. Food scraps will be disposed of in appropriately sealed containers / bins and collected by a suitably qualified contractor.

#### **4.8.3.8 Environmental Offsets**

An *Environmental Offset Strategy* (AARC 2014) has been developed for the Project to mitigate impacts on prescribed environmental matters listed by EHP under the *Environmental Offsets Act 2014*, *Environmental Offsets Regulation 2014* and *Queensland Environmental Offset Policy 2014* (QEOP). Prescribed environmental matters include Matters of State Environmental Significance (MSES), as well as Matters of National Environmental Significance (MNES) identified by the Department of Environment (DoE) under the EPBC Act, and Matters of Local Environmental Significance described by a local government. The complete *Environmental Offset Strategy* (AARC 2014) including methodology is provided in Appendix 21.

The main purpose of the QEOP 2014 is to protect prescribed environmental matters where impacts will remain from development. Offsets are required when an applicant has demonstrated that despite all efforts to avoid or minimise impacts on prescribed environmental matters, there is still a significant residual impact.

The Commonwealth Environmental Offsets Policy 2012 (EOP) also applies as it establishes offset requirements for unavoidable impacts to any MNES listed under the EPBC Act.

The offset strategy aims to satisfy the requirements of both the EOP and the QEOP through consultation with DoE and EHP to agree on a suitable outcome and to ensure those offset options that are complementary will satisfy policy requirements at both levels of government.

#### **Offset Obligations**

Offset obligations for the Project have been determined by assessing any identified prescribed environmental matters in regards to the location of proposed Project infrastructure and subsidence





effects and by calculating the area of proposed land disturbance for each environmental value. This is considered to be the residual impact of the Project (which is unable to be otherwise avoided or mitigated).

Table 4.115 provides a summary of the residual impacts on prescribed environmental matters. Matters relevant to the Project which will require offsetting include VM Act 1999 listed Endangered or Of Concern REs, EPBC Act 1999 Endangered Ecological Communities, REs with a designated buffer zone of remnant watercourses and a NCWR 2006 listed fauna species.

For the purpose of calculating environmental offsets for the Project, two EPBC Act 1999 listed endangered ecological communities have been considered:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) – encompassing RE 11.9.1 on the Project site; and
- Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin – consistent with RE 11.8.11. Although mapped during field surveys as a Non-remnant Grassland community, it has been considered to be Natural Grassland to calculate environmental offsets prior to further ground-truthing of this community.

The first ecological community consists of RE 11.9.1 which is classified as BVG 25a. The second ecological community consists of RE 11.8.11, classified as BVG 30b. The total area of residual impact to BVG 25a will be 2.76 ha and the total area of residual impact to BVG 30b will be 149.43 ha. Table 4.115 below summarises disturbance areas and conservation status for each impacted RE.

The offset obligation for protection of vegetation communities in Table 4.115 is considered sufficient for habitat replacement of the Echidna.

All modelled subsidence impacts on prescribed environmental matters are not proposed to be offset up-front. A large proportion of these potential impacted areas may not occur for 5 – 10 years into the mine life, therefore an adaptive approach was taken as the actual extent of subsidence and impact may vary. Reconciliation of modelled impacts and actual impacts will be undertaken at regular intervals.

**Table 4.115 Summary of Project Impacts on Areas of Prescribed Environmental Matters**

Regional Ecosystem	Short Description	EPBC Status	VM Act Status	Broad Vegetation Group	Impact	Area of Impact(ha)
11.9.1	Brigalow Woodland	Endangered	Endangered	BVG1M: 25a	Clearing	2.76
11.8.11	<i>Dichanthium sericeum</i> Natural Grassland	Endangered	Of Concern	BVG1M: 30b	Clearing	149.43
<b>Total</b>	-	-	-	-		<b>152.19</b>

**Table 4.116 Broad Vegetation Group Descriptions**

BVG	Description
25a	Open-forests to woodlands dominated by <i>Acacia harpophylla</i> sometimes with <i>Casuarina cristata</i> on heavy clay soils. Includes areas co-dominated with <i>Acacia cambagei</i> and/or emergent <i>Eucalypt</i> spp. (land zones 3, 4, 5, 7, 9, 11)
30b	Tussock grasslands dominated by <i>Astrebla</i> spp. (Mitchell Grass) or <i>Dichanthium</i> spp. (bluegrass) often with <i>Iseilema</i> spp. on undulating downs or clay plains. (land zones 9, 3, 4, 8, [5])

### Proposed Offset Options

To demonstrate that sufficient offset land exists for the Project, a desktop assessment was undertaken to identify suitable supply options within the Brigalow Belt Bioregion, in which the Project is situated.

The desktop assessment involved a GIS based spatial analysis of Queensland Government mapping layers (sourced from the Queensland Government Information Service 2014) within the Brigalow Belt Bioregion. Appendix 21 outlines the data sources considered for identifying potential offsets.

The area of land determined to be available for offset supply (via desktop assessment), located within the Brigalow Belt Bioregion is provided in Table 4.117 below for each BVG.

**Table 4.117 Offset Supply Availability Within Brigalow Belt Bioregion**

BVG	Offset Area Requirements <sup>1</sup>		Brigalow Belt Bioregion (ha)		
	Area	Values	Cat X	Cat C	Cat B
25a	11.04	Endangered vegetation within BVG 25a within Brigalow Belt Bioregion, excluding Class A Agricultural Land	1,474,000	13,400	138,500
<b>TOTAL (ha)</b>			<b>1,625,900</b>		
30b	597.72	Vegetation within BVG 30b within Brigalow Belt Bioregion, excluding Class A Agricultural Land	101,100	187.7	118,400
<b>TOTAL (ha)</b>			<b>219,688</b>		

1. Offset Area Requirement = impact area x relevant multiplier (4)

### Offset Delivery

The QEOP 2014 and EOP 2012 is the required framework for providing offsets for unavoidable impacts of the Taraborah Coal Project. Shenhua plans to deliver offsets after Project approval, but before commencement of activities. At this stage of Project development, Shenhua is considering a number of different mechanisms for offset delivery (including a combination of mechanisms).

The preferred option to meet the regulatory requirements associated with the QEOP 2014 is to undertake a Proponent-driven Offset via an agreement with an offset broker/provider, as described



within the policy, for the provision of an offset area. This will facilitate land based offsets for significant residual impacts on ecological features as a result of the Project.

In accordance with the requirements of the QEOP 2014, an Offset Delivery Plan following Project approval (unless the mechanism of financial settlement to an offset fund is selected) will be formulated. The purpose of the Offset Delivery Plan is to:

- Describe the prescribed environmental matters to which the offsets pertain;
- Describe the relevant attributes of the offset supply land, including details of any person with an interest in the land, the existing land use of the supply land, and any impact these attributes may have on delivery of the offset; and
- Describe the mechanism to secure the land as a legally secured offset area and state why this mechanism is considered reasonable and practicable.

The Offset Delivery Plan will be developed in accordance with the requirements of the QEOP 2014, *Environmental Offsets Act 2014* and *Environmental Offsets Regulation 2014*.

It is proposed that written quarterly reports outlining the progress on locating and legally securing an offset property will be provided to EHP at the end of each quarterly month (i.e. March, June, September and December).

Within the Offset Delivery Plan, the land on which offsets are undertaken is required to be legally secured to assist in ensuring a conservation outcome may be achieved. This legally binding mechanism will protect the land until:

- EHP is satisfied that the actions and obligations outlined in the Offset Delivery Plan have been fully completed; and
- The offset has been secured for a period that, as a minimum, covers the duration of impacts to prescribed environmental matters as a result of the Project.

Land utilised for provision of land based offsets is required to be legally secured to ensure a conservation outcome is achieved. Offset land is legally secured if it is:

- An environmental offset protection area in accordance with the *Environmental Offsets Act 2014*;
- An area of high nature conservation value in accordance with the VM Act 1999, secured for the purposes of an offset;
- A nature refuge under the *Nature Conservation Act 1992* (NC Act 1992), secured for the purposes of an offset;
- A protected area under the NC Act 1992, secured for the purposes of an offset; or
- Covered by a statutory covenant for environmental purposes under the *Land Act 1994* or *Land Title Act 1994*.

The relevant legislation prescribes the mechanisms for legally securing such areas.