



Threatened Terrestrial Fauna Species

Assessment Report

for

Mulgrave Pit Expansion Project

South Walker Creek Mine

June 2013

Document Prepared for:
BHP Billiton Mitsui Coal Pty Ltd

Document Prepared By:
Footprints Environmental Consultants P/L
PO Box 246
Bribie Island QLD 4507
E: andrew@footprintsenviro.com.au
T: +61 7 3410 8812

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1. INTRODUCTION

BHP Billiton Mitsui Coal P/L (BMC) South Walker Creek Coal Mine (SWC) is located approximately 100 km south west of the township of Mackay within the Bowen Basin in central Queensland (see Figure 1-1).

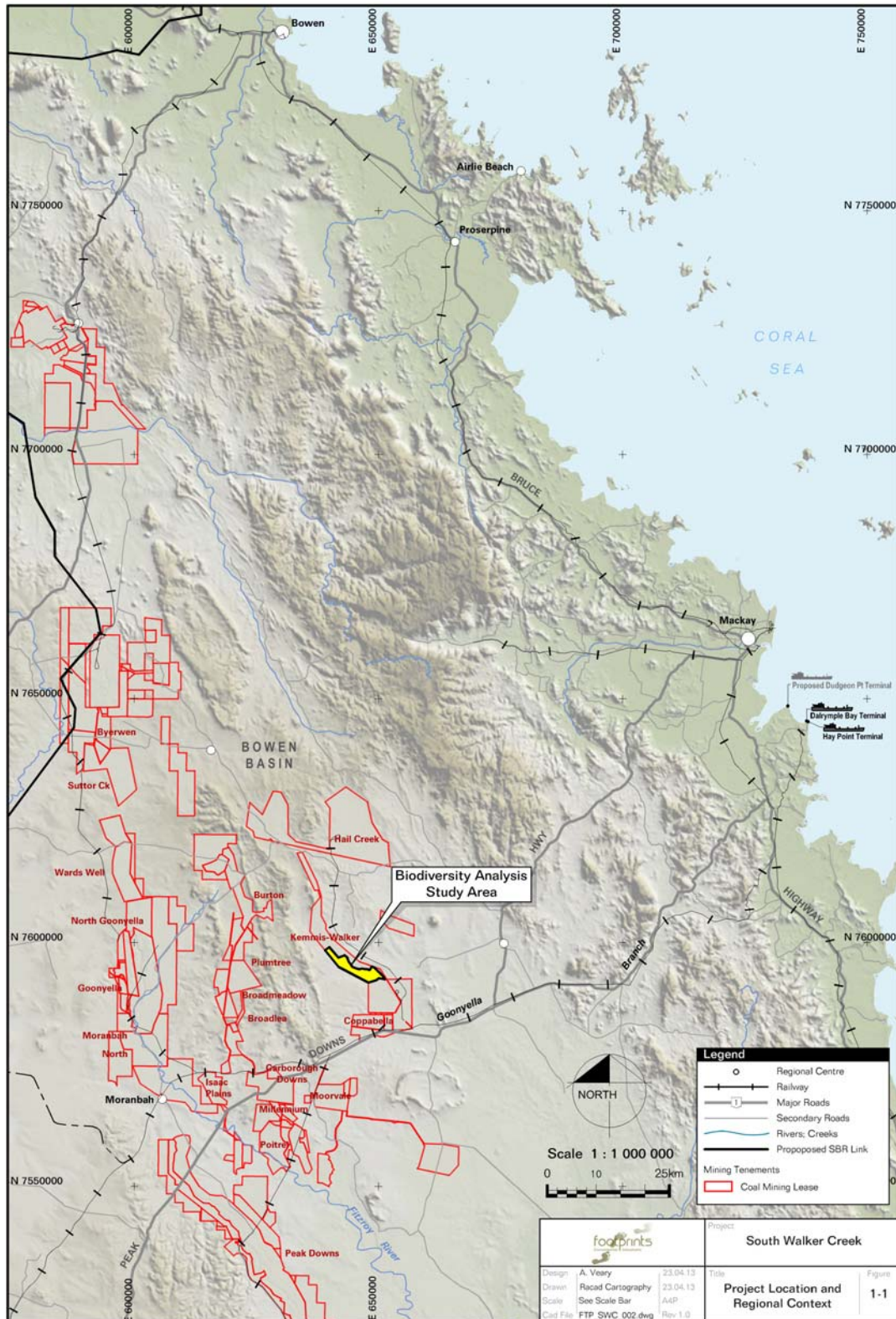


Figure 1-1 Project Location and Regional Context

Proposed expansions to the Mulgrave Pit area have progressed to a stage of requiring diversions of Carborough and Walker Creeks to accommodate the proposed expansion of Mulgrave Pit. BMC have conducted a study to identify potential creek diversion options (BMC - SWC 2013) which have progressed to selection of a preferred alignment of the watercourse diversion being Option 2A detailed below. (see Figure 1-2)

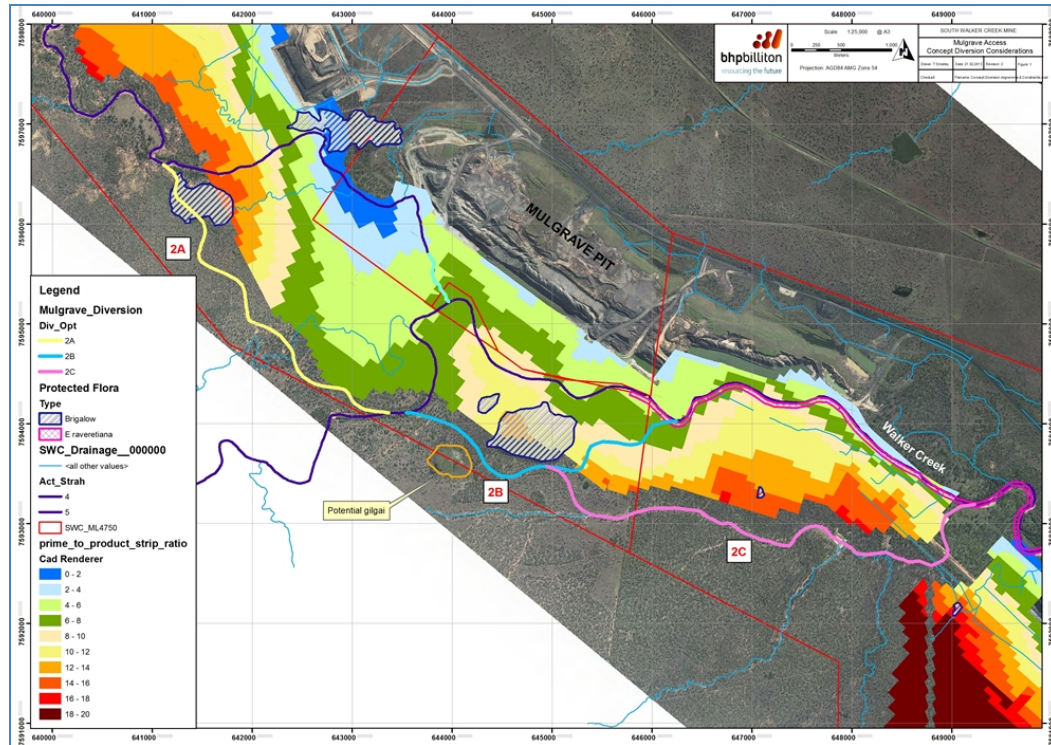


Figure 1-2 Chosen diversion option 2a and subsequent stages 2B or 2C

Ecological surveys and desktop assessments have previously been undertaken on South Walker Creek mine lease, the most recent of which being 2005, 2006 and 2007 (EcoServe and LAMR), 2010 (Austecology) and 2012 (Cardno). These previous assessments have, to varying degrees, investigated the presence of endangered fauna across the study area.

Cardno (2012) study performed a desktop habitat suitability assessment for the significant fauna species that have previously been recorded within the mining lease locality (EcoServe and LAMR 2006; Austecology 2010 and references therein), or are predicted to occur within the study area based upon EPBC Matters of National Environmental Significance search (SEWPac) and the Wildlife Online search tool (DERM).

A key recommendation from the Cardno (2012) report was that a targeted fauna survey for threatened fauna species, listed under either/both the *Nature Conservation Act 1992* and the *Environment Protection and Biodiversity Conservation Act 1999* should be undertaken with the purpose of confidently determining the presence or absence of the 'likely' and 'possibly' present species identified in that report (or other fauna species of conservation significance) within the study area.

Footprints Environmental Consultants P/L was commissioned in March 2013 by BMC to undertake the targeted threatened fauna species surveys for vertebrate fauna within and adjacent to the proposed creek diversion options within the study area as depicted in Figure 1-3.

The study area is located in central Queensland, approximately 40 km to the west of the township of Nebo. The study area is located within the bioregional area known as the northern Brigalow Belt.

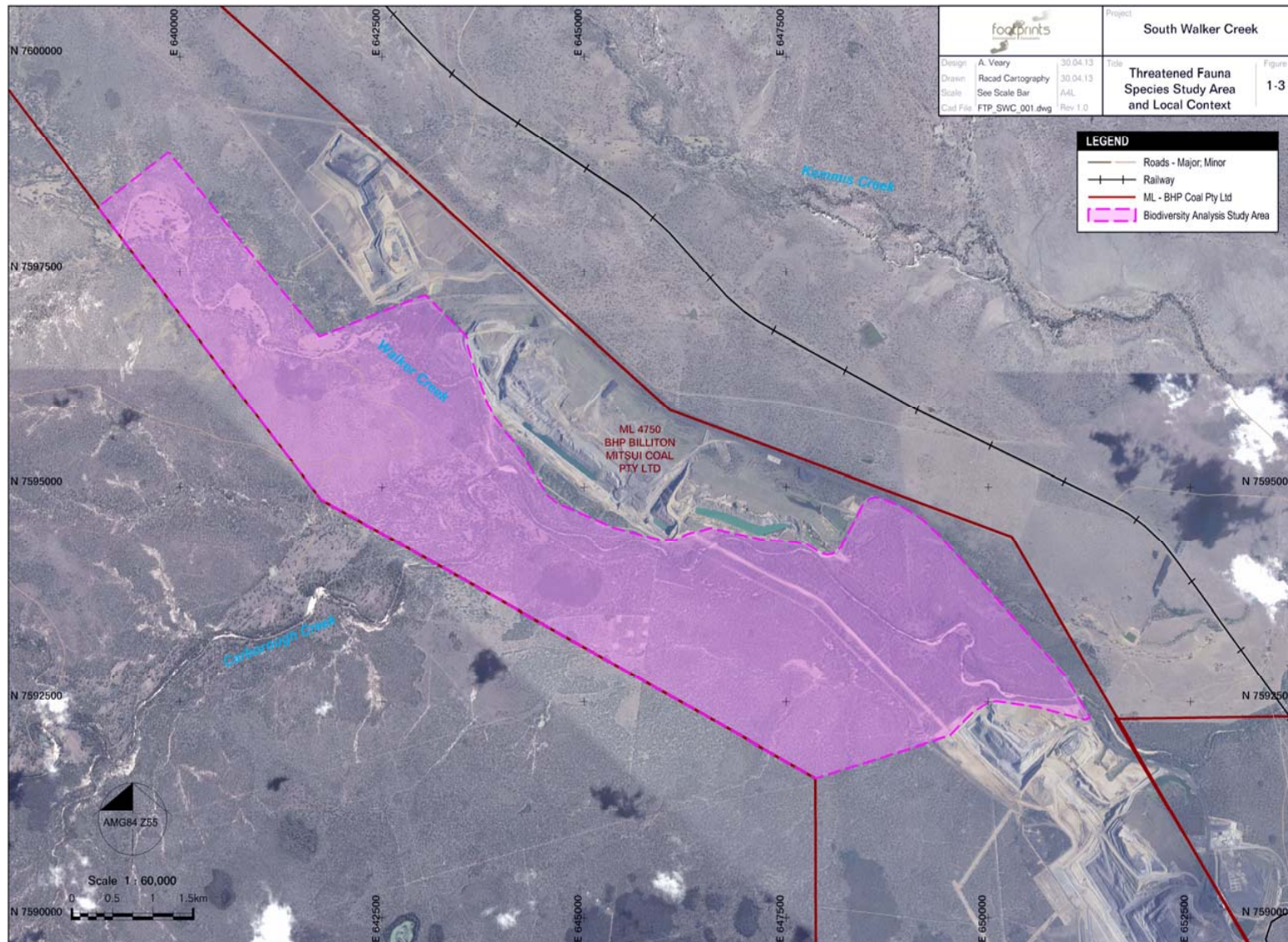


Figure 1-3 Threatened Fauna Species Study Area and Local Context

The objectives of this assessment were to:

1. Design and implement a targeted survey methodology for threatened terrestrial vertebrate fauna species located within and adjacent to the proposed creek diversion and within habitats supported within the study area.
2. Determine the nature, extent, condition and values of the suitable fauna habitats located within and adjacent to the diversion and within the study area.
3. Determine the diversity and abundance of threatened fauna species supported within these areas.

In accordance with the Scope of Works, the field component of the study was scheduled to be undertaken from the 5th to the 14th April 2013.

The following report provides the methodology and findings of the survey program and describes the characteristics of the habitats surveyed in terms of values to threatened fauna species.

1.1. Study Background

The Scope of Works provided by BMC highlighted the requirement to conduct pre-clearing surveys for nine threatened fauna species within the study area. These species and their conservation status are listed in Table 1-1 below.

Table 1-1 Conservation Significant Species Listed in SoW

Zoological Name	Common Name	Legislative Status	
		NC Act	EPBC Act
REPTILES			
<i>Paradelma orientalis</i>	brigalow scaly-foot	V	V
<i>Egernia rugosa</i>	yakka skink	V	V
<i>Denisonia maculata</i>	ornamental snake	V	V
BIRDS			
<i>Erythrotriorchis radiatus</i>	red goshawk	E	V
<i>Geophaps scripta scripta</i>	squatter pigeon	V	V
<i>Nettapus coromandelianus</i>	cotton pygmy goose	Nt	
BATS			
<i>Chalinolobus picatus</i>	little pied bat	Nt	
<i>Nyctophilus corbeni</i>	greater long-eared bat	V	V
MAMMALS			
<i>Phascolarctos cinereus</i>	koala	V	V

Source: BMC Scope of Works Mulgrave Pit Expansion and Cardno 2012.

E = Endangered; V = Vulnerable; nt = Near Threatened; slc = Special Least Concern

2. TERMINOLOGY AND NOMENCLATURE

2.1. General

For this report, the term *project area* refers generally to the lands and associated habitats surrounding the study area and the *study area* refers to the area as depicted in Figure 1-3.

A *search area* is an area established within the study area where a set of standardised survey methodologies are applied and/or continuously implemented throughout the whole field survey period. Nominally, a search area encompasses an area of approximately four hectares. Search areas were selected within representative habitats that were supported across the study area.

The study area is located within the northern Brigalow Belt Bioregion. The Brigalow Belt Bioregion is defined as one of 13 biogeographical areas of Queensland, and extends from the Queensland-New South Wales border to Townsville and encompasses approximately 36 million hectares of sub-humid and semi-arid environments (see Sattler and Williams 1999).

2.2. Flora and Vegetation

In reference to vegetation, the definition of a Regional Ecosystem (RE) follows that provided by Sattler and Williams (1999). For the purpose of this report, the status of RE's follows that of the Regional Ecosystem Description Database (REDD, Version 6.0b and Version 7.0) published by Department of Environment and Heritage Protection (DEHP) (2013). Regrowth vegetation means woody vegetation that is not remnant as defined under the *Vegetation Management Act 1999* (VMA). A declared plant refers to a species declared under the *Land Protection (Pest and Stock Route Management) Regulation 2003*.

In this report, descriptions of vegetation types are based on the structural types described by Specht (1970). Standard references relevant to the study area or region that have been employed for the taxa listed in this report are as follows: Queensland Herbarium (2002); Royal Botanic Gardens (1993); Sharpe (1986); Simon (1993); and Stanley & Ross (1983, 1986, 1989). Additional nomenclatural changes have been incorporated via regular, personal communication with staff at the Queensland Herbarium.

2.3. Fauna

Fauna refers to all vertebrate fauna and the nomenclature used in this report follows Strahan (2000) for non-flying mammals, Churchill (1998) for bats, Christidis and Boles (1994, 2008) for birds, and Cogger (2000) for reptiles and amphibians (though common names for frogs follow Ingram *et al.* 1993).

2.4. Conservation Status

Within this report, the conservation status of a species or community may be described as *Endangered*, *Vulnerable*, *Near Threatened*, *Of Concern* or *Least Concern*.

These terms are used in accordance with the provisions of the following:

- Queensland *Nature Conservation Act 1992* (NCA) and its regulations and amendments (endangered, vulnerable, near threatened, special least concern and least concern);

- Queensland *Vegetation Management Act 1999* (VMA) and its regulations and amendments (endangered, of concern and least concern); and/or
- the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA) (endangered and vulnerable).

Fauna species listed as endangered, vulnerable or near threatened under the NCA and/or EPBCA are collectively referred to as “threatened species”.

With regard to migratory birds, the terms BONN, CAMBA, JAMBA and RoKAMBA refer to the following:

- BONN: Convention on the Conservation of Migratory Species of Wild Animals (1985);
- CAMBA (C): the Agreement between the Government of Australia and the Government of China for the protection of migratory birds in danger of extinction and their environment 1986;
- JAMBA (J): the Agreement between the Government of Australia and the Government of Japan for the protection of migratory birds in danger of extinction and their environment 1974; and
- RoKAMBA (RoK): Agreement between the government of Australia and the government of the Republic of Korea on the protection of migratory birds and exchange of notes 2006.

3. METHODOLOGY

3.1. Desktop Assessments

Desk-based assessments were undertaken to ascertain the existing level of available information pertaining to the study area and surrounds in order to provide a level of background field data sufficient to draw informed, valid assumptions and conclusions about the:

- location, extent and values of the habitats supported within the study area that are known/considered likely to support conservation significant fauna;
- general patterns of usage of the study area and the habitats supported therein by conservation significant fauna; and
- known or likely occurrence and distribution of conservation significant fauna and the ecological communities that are known to support these species.

3.1.1. Literature and Data

Important information sources included, but were not limited to the following:

- National, State and regional fauna databases, e.g. WildNet;
- Regional assessments which have relevance to the ecological values of the study area, i.e. Covacevich *et al.* 1997; Deer 1996; McDonald *et al.* 1991; Young *et al.* 1999; McFarland *et al.* 1999; and Woinarski & Catterall 2004;
- Commonwealth survey methodology guidelines for threatened species groups as follows;
 - microbats;
 - birds;
 - mammals;
 - reptiles; and
 - frogs
- EcoServe and LAMR (2007). Targeted Flora and Fauna Surveys - BMA South Walker Mine. Unpublished report prepared for BMA SWC Mine.
- Austecology (2010). Biodiversity Management Plan - BMC South Walker Mine. Unpublished report prepared for BMC SWC Mine.
- Cardno (2012). Walker Creek Diversion Biodiversity Assessment Report – Stage 3. Unpublished report prepared for BMC.

The current certified RE mapping data was reviewed (Version 6.0b and Version 7.0) to undertake an analysis of the RE distribution in the study area and surrounds. In addition, aerial photography supplied by BMC SWC (flown 2012) and Google Earth imagery (July 2011) was reviewed.

3.2. Search Area Location and Selection

Search areas were selected on the basis that they contained suitable habitat values and structural composition likely to support the threatened fauna species targeted for the

assessment. Each search area was chosen to provide good geographical spread and representation of vegetation communities and landscapes across the study area.

3.3. Fauna Survey Methodology

As a minimum requirement of the SoW, survey methodologies used to undertake this assessment were based on the individual significant species survey guidelines recommended by the Federal Government. These survey guidelines stipulate a variety of methods for targeted surveying of threatened species which can be summarised by the following:

- diurnal bird census – birds, e.g. squatter pigeon (*Geophaps scripta scripta*);
- active diurnal and nocturnal ground searching – reptiles, e.g. brigalow scaly-foot (*Paradelma orientalis*), yakka skink (*Egernia rugosa*), ornamental snake (*Denisonia maculata*);
- Anabat detection – microchiropteran bats, e.g. little pied bat (*Chalinolobus picatus*);
- harp trapping - microchiropteran bats, e.g. greater long-eared bat (*Nyctophilus corbeni*); and
- area searches – large mammals and birds, e.g. koala (*Phascolarctos cinereus*) and red goshawk (*Erythrotriorchis radiatus*).

Pitfall Trapping

Pitfall trapping is an excellent method of surveying for reptiles, frogs and small ground mammals. Typically, this method is implemented as part of detailed fauna survey programs to develop species inventories etc. and can form the basis of larger assessments such as EIS's.

Pitfall trapping is usually undertaken in conjunction with Elliot trapping for ground mammals and active diurnal and nocturnal searching for frogs, reptiles, birds and mammals.

However, pitfall trapping is not a very successful methodology for targeting threatened species that usually have highly specialised habitat requirements, and who, representative of their conservation status, are typically very sparsely located with low abundances. As such, pitfall trapping, whilst it is very useful to survey a particular small area/habitat niche, may not be as beneficial as conducting targeted, active, ground surveys in numerous areas supporting suitable habitat for particular threatened species.

3.3.1. Survey Program Methodologies

The survey program comprised a range of survey techniques, utilised where applicable, at each search area. The methods applied are discussed below.

All study methodologies employed for these assessments conform to, if not exceed, current recommended methodologies (e.g. McFarland *et al.* 1999, Commonwealth survey guidelines for threatened species).

3.3.1.1. Diurnal Bird Surveys

Diurnal birds were surveyed using timed, area search methods which were comprised of early morning censuses. The total minimum census time varied for each of the targeted species depending on the recommended survey methodology. Area searches were conducted at search areas and at other selected locations where suitable habitat for target species was supported. Census surveys were undertaken within four hours of sunrise and sunset. Birds were identified from either direct observations and/or their call vocalisations.

3.3.1.2. Diurnal Herpetofauna Ground Searches

Dedicated active daytime ground searches were conducted for a minimum period of one-person hour at each of the search areas and at other selected locations where suitable habitat for target species was supported. Surveys were conducted on each of the survey days to locate active/inactive reptiles and inactive frogs. Total search effort for each of the targeted species was dictated by the recommended survey methodology applicable. This method involved:

- rolling logs and rocks;
- raking soil at the base of trees and shrubs and examination under debris; and
- searching under decorticating/exfoliating bark on logs and standing dead or live trees.

Additionally, as part of the active searches, upper sections of trees were scanned with binoculars searching for basking or active arboreal/scansorial reptiles.

3.3.1.3. Nocturnal Searches

Spotlighting searches were undertaken on foot using hand-held spotlights and headlamps. These were conducted for a total of two person hours (one hour per search area for two people) at selected search areas and at other selected locations where suitable habitat for target species was supported. Searches were conducted for 60 minutes per area and replicated as dictated by survey requirements for the threatened species of interest.

During each nocturnal spotlighting session, as the herpetofauna target species are all terrestrial species, the majority of survey effort was expended on ground searching. In habitats considered suitable for arboreal species, e.g. riparian zone for koala, approximately half of the survey effort was dedicated to arboreal searches.

3.3.1.4. Insectivorous Bat Surveys

The survey program for insectivorous bat fauna was undertaken using electronic bat detectors and harp traps, as dictated by the relevant threatened species survey guidelines. Anabat detection involved both remote and active detection techniques with Anabat II detectors, used to record the ultrasonic signals of active bats. Remote detection (*i.e.* equipment programmed for unattended, fixed point, overnight detection of microbat calls) was conducted over six survey nights at nine locations across the study site. Active Anabat detection was employed during nocturnal spotlighting surveys.

Ultrasonic bat calls and locality details were recorded during the survey and subsequently analysed by Greg Ford for species identification.

3.3.1.5. Targeted Area Searches

A series of rapid biodiversity assessments and target species surveys were undertaken in a range of representative and/or distinctive habitat types throughout the study site.

For diurnal activities, each search area, nominally comprised of up to four hectares, was surveyed for up to one person hour. At each selected search area, a combination of active diurnal ground searches, primarily for reptiles, and bird surveys were undertaken. For nocturnal assessments, an area of approximately two hectares was surveyed for a minimum of one survey person hour where spotlighting searches on foot were undertaken using 30-watt spotlights and headlamps.

Targeted area searches were also undertaken for specific species, such as ornamental snake, in specific habitat types, such as brigalow gilgai associations.

3.3.1.6. Driving Spotlight Transects

Driving spotlight searches (driver plus one observer with a 100-watt spotlight) were undertaken from a 4WD along the road/track network within the study site primarily to survey for larger arboreal and/or ground mammals (e.g. koalas).

3.3.1.7. Inferential Evidence

Inferential evidence of fauna occurrence was sought and found throughout the study site. This included:

- visual inspections of trees for trunk scratches/rubbings (e. g. characteristic koala scratches);
- searches for both predator and non-predator scats (e.g. yakka skink latrine sites, koala scats); and
- fauna tracks and other signs of fauna occurrence (e.g. shed skins, nests, etc.).

Only definitive evidence was used to record a species occurrence on the study site. Scats or pellets found were identified in the field using Triggs (1999).

3.4. Threatened Species, Survey Methodology and Effort

The following table details the threatened species considered for this assessment, the applicable survey methods as dictated by the Commonwealth threatened species survey guidelines and the level of survey effort required.

Table 3-1 Conservation Significant Species, Survey Methods & Efforts Matrix

Zoological Name	Survey Timing	Methods	Effort*
REPTILES			
<i>Paradelma orientalis</i> brigalow scaly-foot	Diurnal Nocturnal	Pits & Area Searches	5 pits/3 nights
<i>Egernia rugosa</i> yakka skink	Diurnal Nocturnal	Area Searches, Elliott's	3 days/nights
<i>Denisonia maculata</i> ornamental snake	Nocturnal	Area Searches	
BIRDS			
<i>Erythrotriorchis radiatus</i> red goshawk	Diurnal	Census/Area Searches	80 hours over 10 days
<i>Geophaps scripta scripta</i> squatter pigeon	Diurnal	Census/Area Searches	15 hours/area, 10 hours flushing
<i>Nettapus coromandelianus</i> cotton pygmy goose	Diurnal	Waterbody Surveys	
BATS			
<i>Chalinolobus picatus</i> little pied bat	Nocturnal	Anabat/Harp	Active and Passive Anabat Min 5 nights, 20 trap nights
<i>Nyctophilus corbeni</i> south eastern long-eared bat	Nocturnal	Harp/Anabat	Min 5 nights, 20 trap nights areas <50Ha
MAMMALS			
<i>Phascolarctos cinereus</i> koala	Diurnal Nocturnal	Area Search/ Spotlighting	

* Effort as indicated in relevant Commonwealth Survey Guidelines.

3.5. Threatened Species Profiles

The following section provides threatened species profiles for each of the conservation significant species surveyed.

3.5.1. Brigalow Scaly-Foot

The brigalow scaly-foot (Figure 3-1) is listed as vulnerable under both the EPBCA and the NCA.

The current distribution of *P. orientalis* has not differed from its former range (Cogger 2000), although it is largely restricted to the Brigalow Belt Bioregion (QDNR & QDoE 1997).

The brigalow scaly-foot is a limb-reduced, essentially nocturnal, slow moving terrestrial lizard, usually found under logs and ground debris within brigalow forest and eucalypt woodland with an understorey of sparse tussock grass ground cover (Ehmann 1992, Cogger *et al.* 1993). It occurs in remnant brigalow and eucalypt woodlands with an understorey of brigalow and sparse tussock grass ground cover, on grey cracking clay soils (Cogger 2000). *P. orientalis* may also be found on sandstone ridges (Wilson and Knowles 1988) and has been recorded in an *Acacia falciformis* woodland with a deep leaf litter layer on Boyne Island (Cogger 2000). Brigalow scaly-foot are relatively common within sandstone timber production country in the Brigalow Belt Bioregion (*pers. comm.* M. Venz, DERM 2010, *pers. obs.* A. Veary).

Threatening processes affecting the brigalow scaly-foot include the clearance of habitat for agriculture and cattle grazing, pasture improvement, crop production and native forest logging (Cogger 2000, McDonald *et al.* 1991).



Figure 3-1 Photographs of Brigalow Scaly-foot

3.5.2. Yakka Skink

Yakka skink is listed as vulnerable under both the NCA and EPBCA.

The yakka skink is a large robust bodied, secretive, terrestrial skink to a total length of 42 cm (Cogger 1996, Ehmann 1992). It has been recorded from woodland with an open shrub understorey on coarse gritty soils in the vicinity of low rocky outcrops in low ranges (Wilson and Knowles 1988, Ehmann 1992). Within these habitats, it is known to shelter in deep burrow systems under and between partly buried rocks/logs and cavities in soil-bound root systems of fallen trees (Ehmann 1992). A frequently used defecation site near the burrow entrance often indicates its presence (Ehmann 1992, Cogger 1996). The yakka skink is known to feed on invertebrates and smaller vertebrates that venture in or near their burrow (Ehmann 1992).

Yakka skink has been recorded from a wide variety of vegetation types including poplar box (*Eucalyptus populnea*), ironbark (e.g. *E. Crebra*), brigalow (*Acacia harpophylla*), cypress pine (*Callitris glaucophylla*), mulga (*A. aneura*), bende (e.g. *A. catenulata*) lancewood (*A. shirleyi*) woodlands and open forests. Substrates can include rock, sand, clay and loamy red earth (QMDC 2008, Ehmann 1992; Schmida 1985; Hoser 1989; Wilson & Knowles 1987; Cogger 2000; Swanson 1976). They can persist in cleared land where shelter sites exist, such as log piles, however as they are long-lived and colonial their continued persistence in cleared areas is uncertain.

Colonies of presumably related individuals share a system of burrows dug under or between partly buried rocks or logs (especially very large logs, if available), into old root tracts or at the base of large trees or stumps (QMDC 2008). They may also utilise old rabbit warrens, deep gullies and tunnel erosion and sinkholes. Burrows around artificial structures such as under sheds, loading ramps and stick-raked piles are also common.

Ehmann (1992) and Wilson and Knowles (1987) report that the yakka skink, like several related species, has communal defecation sites near permanent burrows.

A variety of habitats has been reported for this species, but most fall under the general theme of rocky or lateritic substrates on slopes, with dry sclerophyll forest, open forest, woodland or shrubland (Ehmann 1983; Schmida 1985; Hoser 1989; Wilson & Knowles 1987; Cogger 2000; Swanson 1976).

Key threatening processes for this species include habitat loss through vegetation clearing/thinning, removal of timber debris and rocks/piles, removal/destruction of rabbit warrens and predation by feral animals (e.g. fox and cat).



Figure 3-2 Photograph of Yakka Skink

3.5.3. Ornamental Snake

The ornamental snake (see photographs in Figure 3-3) is listed as vulnerable under the provisions of both the NCA and EPBCA and is one of several key threatened terrestrial fauna species that have been recorded on mining leases throughout the geographic extent of the Bowen Basin (*pers. obs.* A. Veary 1998 - 2012). It has a small, well-defined distribution range, located only in mid-eastern Queensland, and confined to the Brigalow Belt, primarily within the Fitzroy River drainage system (McDonald *et al.* 1991; Cogger *et al.* 1993; Cogger 2000). In the main, the biology and ecology of the ornamental snake is considered to be poorly known (Cogger *et al.* 1993; *pers. comm.* R. Shine, Sydney University 2005) however, the recently completed ACARP research project by the author has provided insight into the biology and movement patterns of this cryptic species (Footprints Environmental Consultants 2011).

Within the drainage system of the Fitzroy and Dawson Rivers, the ornamental snake is known to primarily inhabit brigalow (*Acacia harpophylla*) forest growing on grey cracking clays supporting gilgai formations (Footprints Environmental Consultants 2011). This habitat preference is believed to reflect the relative abundance of its food source, which is principally a diet of frogs (Cogger 2000, Wilson and Swan 2003). This cryptic snake is regarded as a specialist predator of native frogs (Shine 1983; Cogger 2000). At a brigalow woodland site near Nebo, snakes were only found in the vicinity of a complex of flooded gilgai, where there was an abundance of frog prey, however snakes were not found in nearby riparian and floodplain woodland vegetation (Melzer 2001 in DEWR 2007). Surveys conducted over the last 11 years have only recorded ornamental snakes within grey cracking clay soils supporting gilgai formations (*pers. obs.* A. Veary) and ecological modelling has identified that grey cracking clays in REs 11.4.8 and 11.4.9 appear to be the primary habitat type for the ornamental snake (Footprints Environmental Consultants 2011).

Activity levels, and hence highest potential for ornamental snake detection, are typically restricted to periods following suitable summer rainfall events which create optimum conditions for its favoured prey to be most active and concentrated around its breeding sites (Footprints Environmental Consultants 2011, *pers. obs.* A. Veary 1998 - 2012; *pers. comm.* R. Shine, Sydney University 2005). Thus, the opportunity to detect the ornamental snake is highly constrained.

During dry periods when gilgai formations do not support water and the soil has shrunk to form large ground cracks, the snakes seek refuge in these ground cracks. Once the soils are wet and cracks have closed up, the snakes seek refuge in dense tussock grass clumps and in log piles where available (Footprints Environmental Consultants 2011). The snake also shelters under litter and fallen timber (Cogger 2000), becoming active only at night (Shine 1983, Footprints Environmental Consultants 2011). This suggests that vegetation groundcover characteristics may also be an important component of good quality ornamental snake habitat.

Current ecological knowledge (*pers. comm.* A. Veary 2011) suggests ornamental snake habitat requires soil landscapes that have the capacity:

- to pond shallow surface water for extended periods; and
- to provide a nutrient rich, seasonal wetland environment capable of supporting amphibious prey habitat; and also
- to dry and crack extensively on a regular basis to provide dry season snake refugia via surface cracks and sub-surface voids.



Figure 3-3 Photographs of Ornamental Snakes

3.5.4. Red Goshawk

The red goshawk (Figure 3-4) is listed as endangered under the NCA and vulnerable under the EPBCA and Garnett (1993). This raptor is considered scarce in Queensland (Storr 1973), rare (Roberts 1979) and a species of concern (QDNR & QDoE 1997) in SEQ.

Red goshawks are sparsely distributed from the Kimberley's in western Australia to north Queensland, south to north eastern New South Wales (Garnett 1993).

These birds do exhibit some seasonal movements in winter, in eastern Australia, migrating from their nest areas in the ranges down to the coastal plains, where they are associated with permanent wetlands (Czechura & Hobson 2000). Juveniles disperse widely, even reaching suitable habitat far inland.

Habitat for this species is primarily coastal and sub-coastal tall, open forest and woodlands, tropical savannas traversed by rivers lined with timber, and along the edges of rainforest (Marchant & Higgins 1993). These habitats also include forest & woodland with a mosaic of vegetational types and an abundance of birds & permanent water (Aumann & Baker-Gabb 1991). This species apparently favours riverine vegetation & rainforest ecotones (Marchant & Higgins 1993).

Breeding records have been collected from tall live trees within 1 km of permanent water (Aumann & Baker-Gabb 1991). In coastal and sub-coastal woodland regions, nests have been located above 20 m in tall trees (>30 m) that are usually within groups of the tallest trees (>25 m). Inland, trees tall enough for nesting are restricted to alongside major rivers' banks (Debus & Czechura 1988; Aumann & Baker-Gabb 1991). Red goshawks occupy large home ranges of 50-220 km², is an aerial predator capable of taking large birds (up to 1kg) which may constitute an important part of diet (Debus 1998).

In northern Australia, they start nest-building in May, lay eggs from July to September, and fledge young from October to December (Aumann & Baker-Gabb 1991; Baker-Gabb *pers. comm.*). The fledged young then remain around the nest area for another month or so (Baker-Gabb *pers. comm.*).

Deforestation & habitat fragmentation are considered to be key threatening processes (especially lowland rainforest and riverine gallery forest) (Debus 1998). This species is thought to be possibly in decline prior to European arrival (Debus 1998).

This species is very secretive and generally silent but has a distinctive voice (Marchant & Higgins 1993). Identification of this species is most likely through detection of nests (see above).



Figure 3-4 Photographs of Red Goshawk

3.5.5. Squatter Pigeon

The southern subspecies of the squatter pigeon (Figure 3-5 and Figure 3-6) is listed as vulnerable under both the NCA and the EPBCA. Squatter pigeons are small yet robust, ground dwelling, seed-eating birds with a preference for eucalypt woodland with a sparse native grass cover within close proximity to permanent water in tropical and subtropical eucalypt woodland (Frith 1982, Higgins 1996, Garnett & Crowley 2000).

The ecology of *Geophaps scripta* is poorly known and no populations estimates are given for the species (Higgins 1996). It is known that they nest on the ground; roost in low trees at night; forage on the ground, amongst sparse low grass and in improved pasture; are always near permanent water; and formally hunted and considered excellent eating (Higgins 1996). Very little is known about their breeding biology with only eight records available (Higgins 1996).

Key threatening processes detailed in Higgins (1996) note that much of their original habitat has been replaced with improved pasture for cattle grazing. However, this may be not as destructive as grazing by sheep. Improved pastures may supply an important food source.



Figure 3-5 Photograph of Squatter Pigeon



Figure 3-6 Squatter Pigeons Resting on Cattle Pad

3.5.6. Cotton Pygmy Goose

The cotton pygmy-goose is listed as rare under the Queensland NCA and as a migratory species under the EPBCA.

The cotton pygmy-goose is a small sized waterbird which favours freshwater lakes and swamps (Garnett 1993). This species was formerly known to occur within coastal and sub-coastal regions from north-eastern New South Wales (NSW) through to tropical north Queensland (Marchant and Higgins 1990). It is now regarded as a vagrant in New South Wales and its principal current distribution is from about Brisbane north to about Prince Charlotte Bay (Garnett 1993, Marchant and Higgins 1990). It is suggested that the construction of dams within central Queensland may provide an explanation for the apparent increase in numbers of cotton pygmy-goose within the region (Garnett 1993).

Almost entirely aquatic, the cotton pygmy-goose favours deep, permanent freshwater lakes and swamps which support patches of abundant growth of floating and submerged macrophytes (eg. pondweeds and waterlilies) in combination with areas of open water (Frith 1982). Within these habitats, the cotton pygmy-goose feeds primarily on aquatic vegetation (submerged parts, seeds and flowers) (Serventy 1985, Marchant and Higgins 1990). Fallen logs and open water appear to be favoured as roost sites, though birds are known to use muddy banks during the non-breeding season (Marchant and Higgins 1990). All breeding records show that the cotton pygmy-goose breeds solitarily in hollows or spouts of dead trees in, or next to, deepwater wetlands (Frith 1982, Marchant and Higgins 1990).

Drainage of wetlands, introduced aquatic plants, shooting and disturbance of breeding habitat have been previously implicated in the decline of the cotton pygmy-goose (Marchant and Higgins 1990). More recently, the introduction of exotic grasses (eg. *Echinochloa polystachya* and *Hymenachne amplexicaulis*) has been regarded as presenting a threat to the cotton pygmy-goose (Garnett 1993). These invasive grasses, which have the potential to choke waterbodies used by the cotton pygmy-goose, have been advocated in the development of ponded pastures.



Figure 3-7 Cotton Pygmy Geese

3.5.7. Little Pied Bat

The little pied bat (Figure 3-8) is listed as near threatened under the NCA. It is also regarded as near threatened by Duncan *et al.* (1999). The little pied bat is regarded as uncommon due to limited habitat availability throughout its range (Richards 2000). This species occurs within drier environments from central Queensland to central New South Wales (Hall and Richards 1979, Churchill 1998). The little pied bat has been recorded in drier open forest and woodland, chenopod shrublands, native pine forest and mallee (Churchill 1998).

The little pied bat is known to roost in small colonies, commonly up to fifteen individuals, and within a range of sites including caves, mines, rocky outcrops and occasionally in abandoned buildings (Hall and Richards 1979, Richards 2000). Hollow-bearing trees may occasionally be used as roost sites (Reardon and Flavel 1991, Churchill 1998) and in some areas, these may form the preferred roost sites (Tidemann *pers. comm.* cited in Parnaby 1992). The latter is the most likely roost habitat for this species on the study site and within surrounding area.

Large scale clearing of native vegetation cover for grazing and agriculture, and removal of mature hollow-bearing trees in timber production forests and riverine environments, are thought to be the primary factors that threaten this species (Duncan *et al.* 1999).



Figure 3-8 Photograph of Little Pied Bat

3.5.8. South Eastern Long-Eared Bat

The south eastern long-eared bat (Figure 3-9) is listed as vulnerable under both the NCA and EPBCA and vulnerable by Duncan, Baker & Montgomery (1999).

This microbat inhabits southern central Qld, central western New South Wales, north-western Victoria and South Australia (Parnaby 1995a) and is considered scattered through the remainder of Queensland (Turbill and Ellis 2006) though surveys for this species through much of western Queensland have not been undertaken (C. Clague, unpubl. in SEWPac Survey Guidelines).

The species also occurs in a range of habitats from Buloke/belah woodlands to brigalow woodlands to a variety of eucalypt and bloodwood forests/woodlands, riparian zones to dry sclerophyll forest.

Mixed eucalypt and bloodwood woodlands/forests are dominant within this species habitat throughout inland Queensland, with it being most abundant in vegetation with a distinct canopy and a dense cluttered shrub layer (Dominelli 2000; Ellis et al. 1999; Koehler 2006; Lumsden 1994; McFarland et al. 1999; Parnaby 1995; Turbill & Ellis 2006).

This species is generally found in river red gum forest, savannahs and semi-arid woodlands. It also occur in ironbark/box/*Callitris* open forests and Buloke woodland (Duncan, Baker & Montgomery 1999). It roosts in tree hollows and under loose bark (Parnaby 1995a).

Extensive loss of habitat, clearing for agriculture, timber harvesting, grazing and inappropriate fire regimes (Parnaby 1995a, Duncan, Baker & Montgomery 1999) are considered threatening process for this species.



Figure 3-9 South Eastern Long-eared Bat

3.5.9. Koala

The koala (Figure 3-10) is listed as special least concern under the NCA and it is listed as regionally vulnerable in the South-East Queensland Bioregion under the NCA. The koala is also listed as vulnerable under the EPBCA.

The koala has a widespread distribution in localised populations that are restricted to eastern Australia from Cairns to near Adelaide (Maxwell *et al.* 1996). Koalas are known to use remnant riparian vegetation as movement corridors (Martin & Handesydde 1995).

The koala is an arboreal folivore restricted to eucalypt open forest & woodland (Martin & Handesydde 1995). Favoured food trees include *Eucalyptus microcorys*, *E. tereticornis*, *E. propinqua* & *E. grandis* (Martin & Handesydde 1995). In central Queensland, the diet of the

koala also includes *E. crebra*, *E. melanophloia*, *E. populnea*, *E. cambageana* (*pers. obs.* A. Veary). Occurrence is strongly influenced by the distribution of habitat trees (Martin & Handesydde 1995).

Habitat loss/fragmentation (Maxwell *et al.* 1996, QDNR & QDoE 1997), predation by dogs, fire and disease (Maxwell *et al.* 1996) are listed threatening processes for this species.



Figure 3-10 Photograph of Koala

4. RESULTS

4.1. Survey Timing

Preliminary investigations and study area reconnaissance was conducted on 4th April, 2013. The fieldwork program for the survey was undertaken from 5th to 14th April inclusive and the 22nd to 26th April inclusive.

The principal investigator was Andrew Veary (BSc (Hons)) with assistance in the field from Elle Veary (BAppSc). Greg Ford (BAppSc, Grad Dip Resource Management) of Balance Environmental, was commissioned by Footprints Environmental Consultants to undertake the Anabat microchiropteran bat call recording analysis.

4.2. Field Survey Conditions

Excellent rainfall in the preceding summer seasons and the good rainfall in the local district over several years had recharged the waterbodies and creeks in the local area and promoted good vegetative growth, particularly in relation to the diversity and biomass of grasses.

Very little rain was recorded early in the 2012/13 summer, however good rainfall was recorded from mid January 2013. Good rainfall was recorded immediately prior to and during the survey period.

Climatic condition leading up to the survey were characterised by warm to hot (high 20's to low 30's °C), partly cloudy/overcast to fine days with warm (mid to low 20's °C), humid nocturnal conditions. Temperature and rainfall graphs are presented in Figure 4-1. Of note, whilst the ambient temperatures recorded at the gauging stations for nocturnal surveys appeared to be quite cool, ground temperatures were between 5 – 8 degrees warmer. It is interesting to note the sharp drop in nocturnal temperatures and continuing cool conditions after the rainfall recorded on the 2nd April. Early evening temperatures were warm with humid conditions prevailing. Several nocturnal reptile species (geckos and snakes) were active during the nocturnal surveys.

Survey conditions were characterised by the following:

5th to 14th April

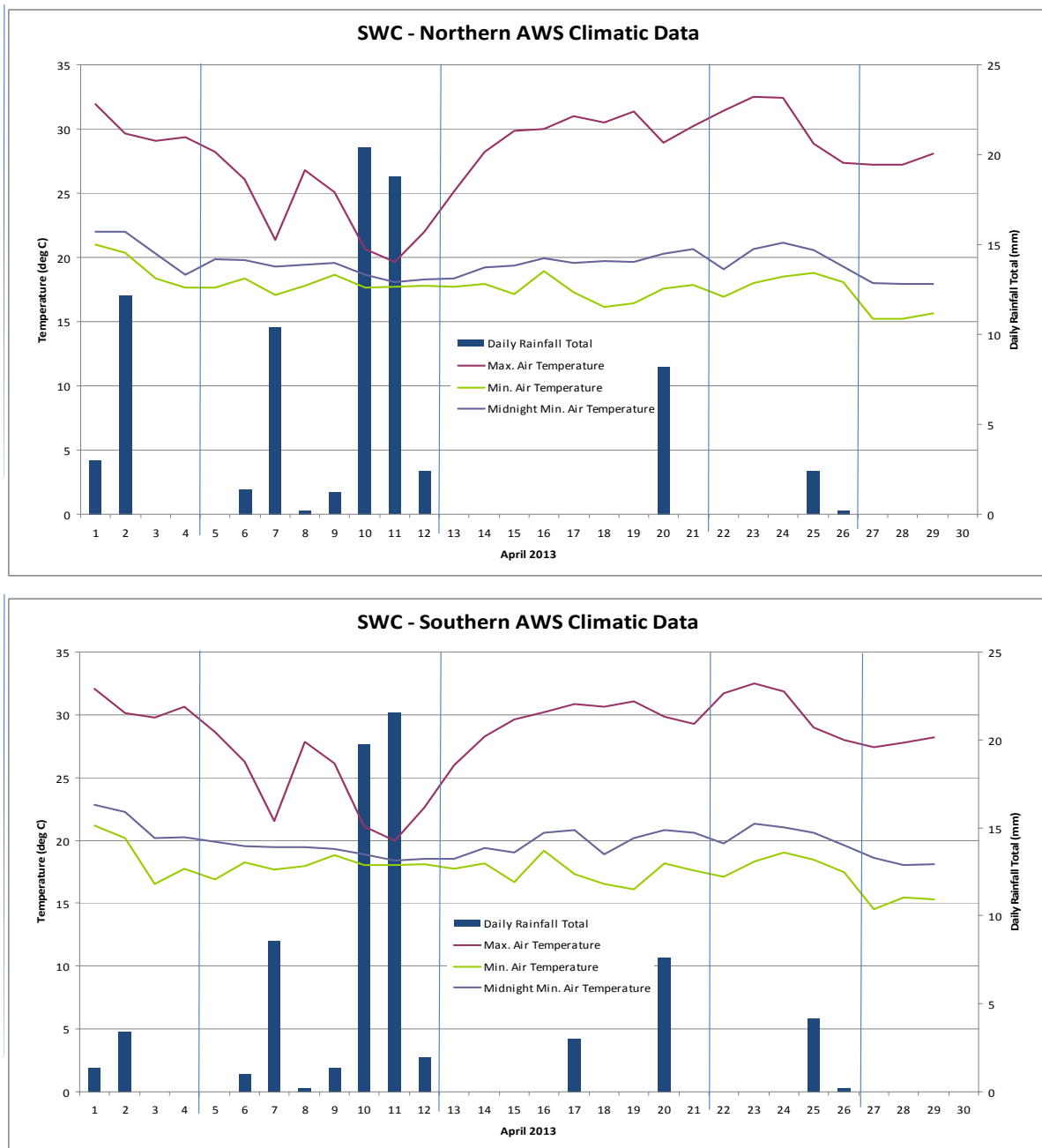
- overcast/fine days at the beginning of survey, during trap establishment and for the start of ground searching activities.
- light rain was recorded at the beginning of the weekend (6-7th) with heavy rainfall over Saturday night and Sunday.
- light rain was recorded on most days for rest of survey with heavy falls recorded on the 10th and 11th April. Diurnal surveys were completed for southern section.
- as a result of the persistent rainfall, the decision to abandon harp trapping was made, including postponing nocturnal surveys until weather conditions improved and access to most of the study area was refused by the site OCE due to safety concerns.

22nd to 26th April:

- diurnal surveys were undertaken under warm to hot (low to mid 30's °C) conditions, with fine days prevailing.

- nocturnal surveys were completed under warm (mid to low 20's °C), humid and fine to partly cloudy conditions. Localised electrical storms and heavy rainfall were observed to the south of the study area on 24th April, with late afternoon, localised storms and rainfall recorded within the study area on 25th April.

Survey conditions immediately prior to undertaking the surveys were considered to be optimal for a detailed fauna survey of this nature, however, due to unexpected, persistent rainfall experienced during the first survey period, conditions experienced were considered wetter and cooler than should have been experienced and were considered less than optimal. Good conditions for the second period prevailed, however, the effects of the preceding cooler two week period may have had negative effects on the activity levels of, in particular, reptiles.



**Figure 4-1 Temperature and Rainfall Records for April 2013
(Northern and Southern Weather Stations)**

4.3. Survey Limitations

Rainfall was recorded across the project area from the 6th to 12th which resulted in poor survey conditions for those survey day/nights. The rainfall recorded on most nights also resulted in poor Anabat recordings, with water impeding the microphones and excessive insect noise recorded. Access to the southern sector of the study area was good during the survey period with the exception of mine site access being closed on the 7th and 12th of April due to potentially hazardous road conditions resulting from the heavy rainfall. Due to the rainfall recorded during the first survey period, harp traps were deconstructed on 11th April and Anabat recorders were removed from site, three nights prematurely.

Considerable rainfall was recorded in the upper catchments of Walker and Carborough Creeks prior to the 5th April, but not within study area, which resulted in the creek levels rising, precluding access to the northern sector of the study area, i.e. northwards from Carborough Creek and westwards from Walker Creek. As a result, this portion of the study area was assessed from the 22nd to 26th April, through rapid biodiversity habitat assessments of habitat type, structure, content and suitability to support the targeted threatened species. Limited diurnal and nocturnal ground searching plus active and overnight Anabat microbat recording were undertaken during this period. No harp trapping was performed due to the limited time available to survey the northern area.

4.4. Search Areas

The fauna survey program included a late summer seasonal field investigation at 127 search areas, including harp trap locations and Anabat recording sites. For reasons discussed above, the full survey program for harp trapping for microbats and Anabat recording was not able to be implemented and more focus was placed upon habitat assessment to determine the likely presence of microbat species.

The location of each search area is depicted in Figure 4-2 below.

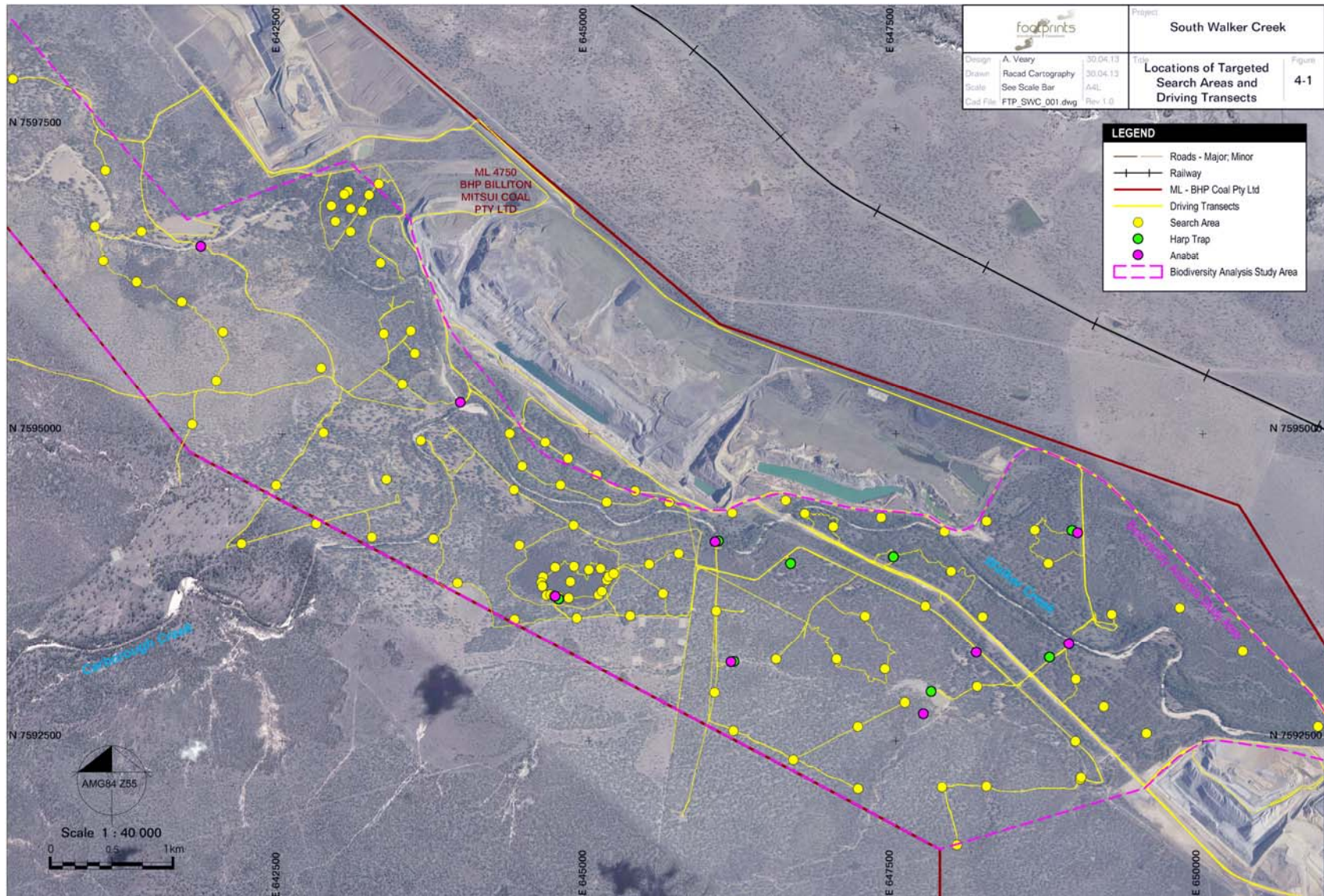


Figure 4-2 Location of Targeted Search Areas and Methods

4.5. Broad Habitat Descriptions

Descriptions of the key fauna habitat attributes of each of the main vegetation communities surveyed are presented in Table 4-1 to Table 4-8. Photographs of the habitats supported at each of the survey sites are presented in Figure 4-3 to Figure 4-10.

Table 4-1 Riparian Zone Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p>1</p> <p>Riparian Zones of Walker and Carborough Creeks</p>	<p>Mixed eucalypt tall open woodland, dominated by <i>E. tereticornis</i> with <i>C. tessellaris</i>, <i>C. clarksoniana</i>, <i>C. cristata</i>, <i>E. platyphilla</i> and <i>E. populnea</i>. <i>E. raveretiana</i> was common in groves along downstream sections of Walker Creek. Shrub layer was non-existent and ground cover was almost completely dominated by very tall and very dense cover of Panic grasses. Ground timber, in any form, was all but absent. Similarly, leaf litter was very scarce and decorticating bark off standing trees was absent. Tree hollows, from large (>20 cm) to small (<5 cm) were common. There was extensive evidence of both historic and recent, hot fires. Buffel grass was considered rare in the landscape area. There was extensive evidence of cattle grazing impacts in those areas outside of the operation zone of the mine.</p>





Figure 4-3 Riparian Zones of Walker and Carborough Creeks
Table 4-2 Poplar Box Woodland on Alluvial Plains Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p>2 <i>Eucalyptus populnea</i> (poplar box) Woodland on Alluvium</p>	<p>Minor creeks and drainage tributaries of Walker Creek dominated (almost homogeneously) by <i>E. populnea</i> tall, open woodlands. There was no structured shrub layer for most of this habitat, with the ground cover characterised by open cover of tussock grasses, dominated by numerous native grasses including spear grass, kangaroo grass, barbed-wire grass, awned (<i>Aristida</i> sp.) grasses. There were areas of red natal/Rhodes grass in more disturbed areas, e.g. along track margins. Buffel grass was, for the most, absent. Tree hollows, from large (>20 cm) to small (<5 cm) were common however decorticating bark off standing trees was absent. Fallen timber resources were common, predominantly comprised of large, fallen limbs or dead stag trees. Much of the fallen timber resource was riddled with various ant and/or termite species. Leaf litter was sparse to absent. There was extensive evidence of cattle grazing impacts in those areas outside of the operation zone of the mine.</p>





Figure 4-4 Poplar Box Open Woodland on Alluvium

Table 4-3 Poplar Gum Woodland on Sand Plains Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p>3</p> <p><i>E. platyphilla</i> (poplar gum) Woodland on Deeply Weathered Sand Plains</p>	<p>Large expanses of homogenous open woodland with no shrub layer and sparse ground cover of tussock grasses, comprised of native grasses on very coarse sand plains. Tree hollows were all but absent within this habitat, with only small hollows recorded, as was decortivating bark. Both leaf litter and ground timber were absent. There was extensive evidence of cattle grazing impacts in these areas.</p>



Figure 4-5 Poplar Gum of Deeply Weathered Sand Plains

Table 4-4 Narrow-leaved Ironbark Woodland on Alluvium Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p>4 <i>E. crebra</i> (narrow-leaved ironbark) on alluvial plains</p>	<p>Small pockets of <i>E. crebra</i> within the riparian zone/alluvial plains of Walker and Carborough Creeks, characterised by tall, open woodland, with a scrappy shrub layer of dead finish and other assorted <i>Acacia</i> spp. Ground cover was dominated by a good cover of native grasses and buffel grass was all but absent from this landscape. Tree hollows were not apparent in this habitat, nor were trees with decorticated sheets of bark. Ground timber resources were uncommon to absent, as was leaf litter layers. There was extensive evidence of cattle grazing impacts in those areas outside of the operation zone of the mine.</p>

**Figure 4-6 Narrow-leaved Ironbark Open Woodland on Alluvium**

Table 4-5 Brigalow Woodland with Gilgai Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p>5 <i>Acacia harpophylla</i> (brigalow) closed woodland/low forest</p>	<p>Dominated by low, closed woodland of brigalow on deep cracking grey clays with well developed gilgai formations. In areas where gilgai were less well developed to absent, yellow wood formed a dense understory to the brigalow. Ground cover was dominated by native grass species, with patches of blackcurrant bush scattered throughout. Fallen timber and leaf litter was common to abundant, though trees with decorticated bark were not. Bog marsh and other floating aquatic emergents were common in those gilgai that supported surface water, indicating that these gilgai had supported surface water for extended periods of time.</p>



Figure 4-7 Brigalow Closed Woodland with Gilgai Formations

Table 4-6 Mixed Eucalypt and Acacia Regrowth Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p>6</p> <p>Mixed Eucalypt and Acacia Regrowth Areas</p>	<p>These habitats were characterised by areas of regrowth of mixed eucalypt and acacia species, dominated by <i>E. crebra</i>, <i>E. populnea</i>, <i>E. tereticornis</i> and <i>A. salicina</i>. These areas had been cleared historically for pastoral land improvement. Understorey/shrub layer consisted of regrowth eucalypts and acacias. Ground cover was dominated by buffel grass with some native species persisting, e.g. kangaroo grass, black spear grass, giant spear grass, etc..</p>



Figure 4-8 Mixed Eucalypt and Acacia Regrowth

Table 4-7 Poplar Box Woodland on Sand Plains Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p style="text-align: center;">7</p> <p><i>Eucalyptus populnea</i> (poplar box) open woodland on deeply weathered sand plains</p>	<p>Within these habitats, there was no structured shrub layer for most of this habitat, however, extensive areas of <i>Carissa ovata</i> (black-current bush) and dead finish (<i>Acacia</i> sp, <i>Archidendropsis</i> spp.) dominated. These species are indicative of highly disturbed areas (D. Johnson, <i>pers. comm.</i>) as was observed through extensive and high levels of cattle grazing in this area. The ground cover was characterised by an open, sparse cover of tussock grasses, dominated by numerous native grasses including spear grass, kangaroo grass, barbed-wire grass, awned grasses. There were areas of red natal/Rhodes grass in more disturbed areas, e.g. along track margins. Buffel grass was, for the most, absent. Tree hollows were common and decorticated bark off standing trees was absent. Fallen timber resources were uncommon to absent. Leaf litter was sparse to absent. There was extensive evidence of heavy cattle grazing (stocking densities and duration) impacts in this area.</p>



Figure 4-9 Poplar Box on Deeply Weathered Sand Plains

Table 4-8 Artificial Waterbody Habitat Description

Habitat Area	Key Fauna Habitat Characteristics
<p style="text-align: center;">8</p> <p>Constructed Farm Dam</p>	<p>An excavated farm dam on an ephemeral drainage line proposed for part of the diversion. Highly disturbed margins as a result of cattle gaining access to drink. No floating or emergent aquatic vegetation supported within the dam. It was evident at the time of the survey that the dam wall had been breached during recent flood events. There was evidence around the dam that water levels within the waterbody fluctuate regularly.</p>

**Figure 4-10 Photographs of Constructed Farm Dam**

4.6. Survey Methods and Application Locations

Table 4-9 provides a summary of the target threatened species and the specific habitat areas at which methods to survey for these species were applied.

Harp trapping was undertaken at eight sites within the study area that supported suitable habitat for the target species, with the level of effort dictated by the relevant survey guidelines. Due to inclement weather, survey conditions on most nights that traps were deployed were considered sub-optimal. Harp traps were closed permanently after six nights due to the weather which resulted in the traps being open for three nights less than planned. The surveys produced a total of up to six harp trap nights per harp trap site, totalling 40 trap nights (as opposed to the planned 54 nights) which was less than the minimum number of trap nights recommended by the Federal survey guidelines.

Table 4-9 Conservation Significant Species, Survey Method and Survey Site Application Matrix

Zoological Name	Common Name	Survey Method Summary	Broad Habitat Areas							
			1	2	3	4	5	6	7	8
REPTILES										
<i>Paradelma orientalis</i>	brigalow scaly-foot	Searches	✓	✓	?	✓	✓	✓	✓	
<i>Egernia rugosa</i>	yakka skink	Searches, Elliot's	✓	✓	?	✓	✓	✓	✓	
<i>Denisonia maculata</i>	ornamental snake	Searches					✓			
BIRDS										
<i>Erythrotriorchis radiatus</i>	red goshawk	Census/Area Searches	✓	✓	?	✓				
<i>Geophaps scripta scripta</i>	squatter pigeon	Census/Searches	✓	✓	✓	✓	✓	✓	✓	✓
<i>Nettapus</i>	Cotton pygmy goose	Waterbody Searches								✓
BATS										
<i>Chalinolobus picatus</i>	little pied bat	Anabat and Harp	✓	✓	?	✓	✓			✓
<i>Nyctophilus corbeni</i>	greater long-eared bat	Harp and Anabat	✓	✓	?	✓	✓	✓	✓	✓
MAMMALS										
<i>Phascolarctos cinereus</i>	koala	Area Search/Spotlighting	✓	✓	✓	✓	✓	✓	✓	

✓ = Potentially suitable habitat, survey methods applied in this area.

? = Vegetation community unlikely to support suitable habitat characteristics for the target species. Survey methodologies amended accordingly.

4.7. Recorded Fauna Assemblage

The records collated from the desktop review and the current surveys are provided in detail in APPENDIX A to APPENDIX D. An overview of the primary findings of the field investigations for the surveys and characteristics of the recorded fauna assemblage are provided below.

4.7.1. Species Richness and Assemblage Characteristics

The fauna values of SWC mine leases have been investigated through a series of studies (i.e. Melzer *et. al.* 1996, Houston & Melzer 1996, Tucker *et. al.* 1999, EcoServe & LAMR 2005a). The integration of the results of those studies provides a useful inventory of local biodiversity values (232 taxa recorded Table 4-10), a useful insight to seasonal variation in fauna assemblages and a highly relevant dataset with which to compare the survey results for the study site.

Table 4-10 Summary of Previous Fauna Survey Results for SWC

Faunal Group	SWC Records	EcoServe 2006	Total Records for SWC 2006
Frogs	11	4	11
Reptiles	33	24	39
Birds	142	76	148
Mammals	20	26	34
Total	206	130	232

The field investigation program provided records for 134 terrestrial vertebrate fauna species (Table 4-11), comprising nine frog, 17 reptile, 80 bird and 28 mammal species. These records have been collated from area searches, census methods and incidental observations.

Table 4-11 Summary of Species Richness

Faunal Group	Database Records (w)	Mulgrave Pit Expansion
Frogs	0	9
Reptiles	3	17
Birds	132	80
Mammals	4	28
Total	139	134

w = Qld Wildlife Online Database

The low species diversity recorded for the project reflects the highly disturbed nature of the study site. The results are within the range of expected results for the type and extent of fauna habitats on the study site. A high proportion of the species recorded from the survey program are highly adaptable taxa that do not have habitat, niche and/or dietary specialist requirements. A large proportion of this recorded fauna assemblage was comprised of species regarded as common and widespread throughout the wider region.

Harp trapping surveys were undertaken at eight locations within the southern section of the study area. Trapping was undertaken within areas that supported suitable habitat for the

target species; *Nyctophilus corbeni* and *Chalinolobus picatus*. These surveys produced a total of 40 harp nights. No microbats were captured.

Anabat surveys provided variable call recordings with high levels of background noise (e.g. rainfall and insect noise). Fourteen microbat species were positively recorded from the surveys with as many as three other species present but unable to be reliably identified due to inter-specific call similarities. The full Anabat analysis database is presented in APPENDIX E.

4.8. Conservation Significant Species and Their Habitats

Of the nine species targeted for this survey, only two species were identified through the surveys, namely the squatter pigeon and little pied bat. Two squatter pigeons were observed on a track in mixed eucalypt woodland on alluvial plains near a farm dam in the southern section of the study area and definitive recordings of little pied bat were collected from habitats supported along both Walker and Carborough Creeks.

The habitat requirements for red goshawk and cotton pygmy-goose are well defined and the study area does not support these habitat values to support a resident population of either species. The cotton pygmy-goose may pass through the study area transiently, utilising the habitats of the farm dam, but it is considered highly unlikely that it would be a resident species. The known distribution and habitat requirements of the red goshawk preclude this species from occurring within or adjacent to the study site.

Harp trapping surveys were considered sub-optimal for surveying for *N. corbeni* due to the unseasonal weather conditions. That said, Anabat surveys did record *Nyctophilus* spp. from a range of habitats within the study area and it may be possible that *N. corbeni* was one of the recorded calls. This species requires a range of habitats including mixed eucalypt woodland with dense shrub understorey. The study area supported a range of eucalypt and acacia woodlands, however, the understorey tall shrub layer in most habitats was poorly developed, if at all. The distribution of this species is unclear in central Queensland due to lack of survey data for this species.

Surveys for koala did not produce any records, nor, more importantly, any signs of koalas. Koalas typically leave very characteristic scratch marks on smooth barked eucalypts, such as forest red gum *E. tereticornis*. This species was very common and widely distributed within the riparian zones of Walker and Carborough Creeks. Searches for scratch marks and koala scats did not produce any records for this species. Of note, koala scratches persist on smooth barked eucalypts for some time, even surviving bark shedding events, if deep enough. The complete lack of these scratches indicates that the area does not support koalas either transiently, nor as residents.

Extensive ground searching and nocturnal surveys for brigalow scaly-foot and yakka skink failed to produce records, nor, in the case of yakka skink, any signs of the species. Brigalow scaly-foot have few specific habitat requirements and have been recorded from a range of habitats, provided that there is suitable fallen ground timber and/or windrowed timber piles for the species to seek refuge in/under. In addition to eucalypt woodlands, brigalow scaly foot occur in sandstone hill habitats seeking refuge between/under sandstone rocks and boulders. Yakka skink, similarly have few habitat requirements other than suitable structure to develop communal burrows in, typically fallen timber, windrowed timber piles, rabbit warrens, goanna burrows, etc.. Within the study area, only two broad habitat areas potentially supported such habitat qualities to support these two species, namely the poplar box woodlands on alluvial plains and potentially the brigalow woodlands. These broad habitat areas are depicted in Figure 4-11 below.

Surveys within the brigalow gilgai communities recorded several reptile species, but none of the targeted species, specifically ornamental snake and brigalow scaly-foot. Of particular note was the lack of frog species, the primary food source for ornamental snakes, from all developmental stages, i.e. tadpoles, metamorphs, juveniles, sub-adults or adults, within the gilgai areas. A few adult frogs were observed, but the numbers were very low *c.f.* other gilgai habitats surveyed (*pers. obs.* A. Veary). The reasons for this are unclear, but may be related to the late summer rainfall which was light and steady as opposed to typical summer storms which produce high volumes of water in short time periods. These differences in rainfall patterns may have resulted in the gilgai not filling up with water as light, steady rain tends to soak into the soil profile, whereas short, heavy rain periods tend to cause the clay soils to expand quickly and retain water in the gilgai depressions that form the ponded areas. These areas then support ideal habitat for frogs to breed, on which the ornamental snake then preys upon. Whilst nine species of frog were recorded for the surveys, it must be noted that the numbers of each species recorded was considered very low. The affects of the lack of flooded gilgai and paucity of frogs in this habitat on ornamental snake populations is unknown.

4.9. Higher Value Broad Habitat Areas

As a result of the surveys, three areas within the study area have been identified as supporting higher ecological and biodiversity values, particularly in relation to the targeted threatened species of this study. These areas and the species for which they are considered to provide high value habitat are detailed in Table 4-12 and Figure 4-11 below. These areas have been delineated based upon the structural elements supported within each area (e.g. fallen timber resources, tree hollows, windrowed timber, leaf litter, diversity of vegetative structure, etc.), their role in supporting threatened species and the ecological links they provide to threatened species, i.e. riparian zones provide important movement corridors for most vertebrate fauna. The relative values of these areas has also been determined on the level of disturbance by pastoral and mining activities.

Table 4-12 Targeted Species, High Value Habitats and Assessment of Occurrence Matrix

Zoological Name	Potential Suitable Habitat Areas (as detailed in Figure 4-11)	Study Area Occurrence within Listed Habitat Areas	Justification of Occurrence
REPTILES			
<i>Paradelma orientalis</i> brigalow scaly-foot	Poplar box woodland on alluvial plains Brigalow gilgai woodlands	Likely	Within these habitat areas due to presence of structural habitat features, but unlikely to occur elsewhere within the study area.
<i>Egernia rugosa</i> yakka skink	Poplar box woodland on alluvial plains	Possible	Within this habitat area. Vegetation clearing, impacts of cattle grazing and inappropriate frequency and intensity of fires are a major impact to species survival in other habitats elsewhere on site, destruction of suitable communal burrows etc..
<i>Denisonia maculata</i> ornamental snake	Brigalow gilgai woodlands	Likely	Within this defined, highly specific habitat type. Unlikely to be resident within other habitats within the study area.
BIRDS			
<i>Erythrotriorchis radiatus</i> red goshawk	No suitable habitat supported within the study area	Highly Unlikely	Study area outside of known distribution, marginal habitat. Unsuitable habitat for species within or adjacent to study area.
<i>Geophaps scripta scripta</i> squatter pigeon	All habitat areas including those not detailed in Figure 4-11	Recorded	Within study area and elsewhere within SWC leases. Will occur within all habitats supported within SWC leases. These habitats support roosting, breeding and foraging resources for this species.
<i>Nettapus coromandelianus</i> cotton pygmy-goose	No suitable habitat supported within the study area to support resident population recorded within the study area	Possible	Nomadic occurrence only, potentially utilising the farm dam in the southern section as a staging facility.
BATS			
<i>Chalinolobus picatus</i> little pied bat	Riparian zone Poplar box woodland on alluvial plains Brigalow gilgai woodlands	Recorded	Recorded in previous surveys, and within study area for the current study. These habitats support roosting, breeding and foraging resources for this species.
<i>Nyctophilus corbeni</i> South eastern long-eared bat	Riparian zone Poplar box woodland on alluvial plains	Likely	These habitats support roosting, breeding and foraging resources for this species. The lack of

Zoological Name	Potential Suitable Habitat Areas (as detailed in Figure 4-11)	Study Area Occurrence within Listed Habitat Areas	Justification of Occurrence
	Brigalow gilgai woodlands		structured understorey shrub layer through most of these habitats and within habitats in the wider study area limits the value of these habitats for this species.
MAMMALS			
<i>Phascolarctos cinereus</i> koala	Riparian zone Poplar box woodland on alluvial plains Other eucalypt woodlands in study area and wider SWC leases	Unlikely as resident population. May use woodland and riparian habitats as movement corridors.	No characteristic scratches/scats were recorded from the study area. Whilst suitable habitat was present for this species, due to the complete lack of evidence of occurrence, it is considered unlikely to occur on a longer term basis. It must be noted that creek lines and riparian zones form important movement corridors for this species.

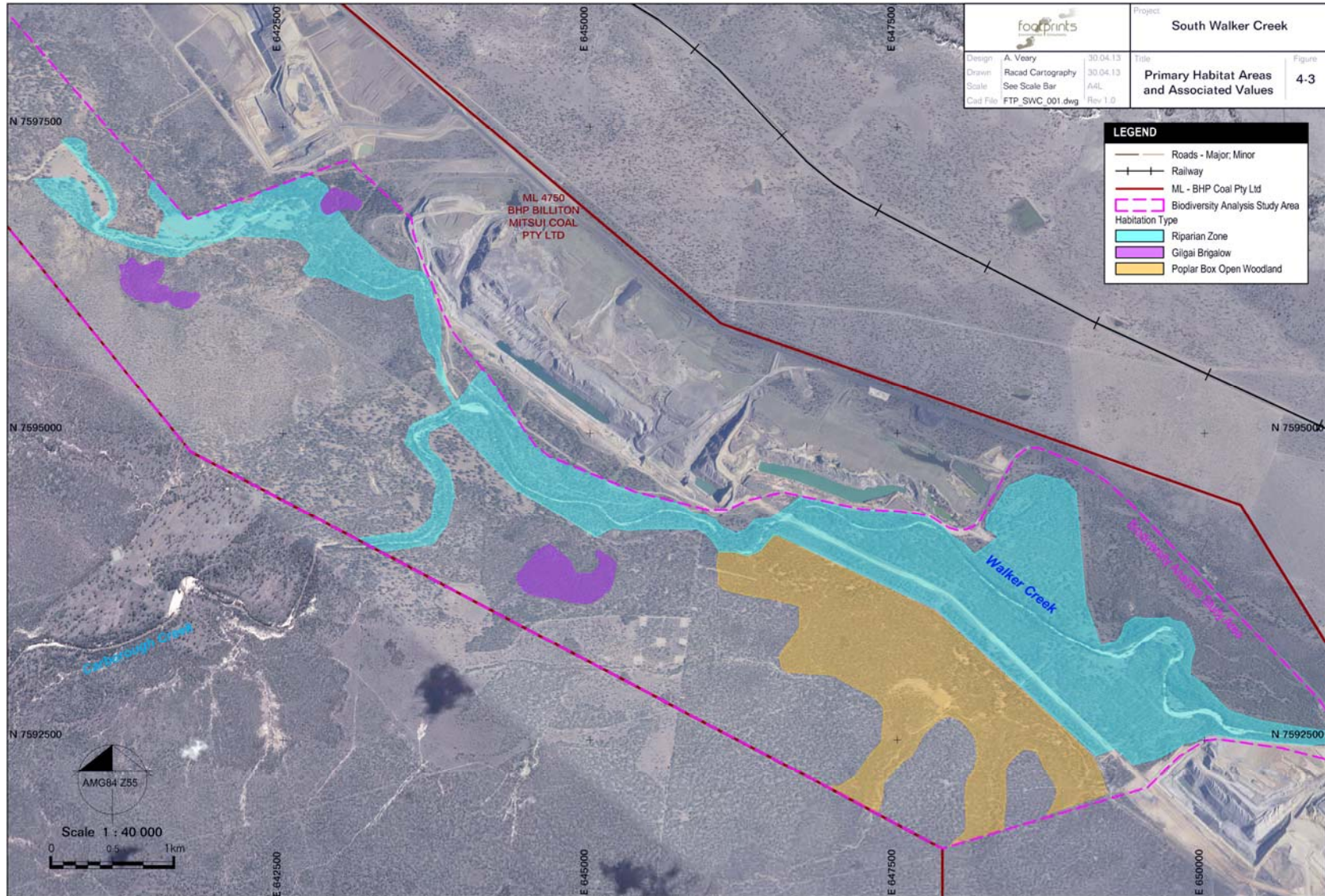


Figure 4-11 High Value Habitat for Threatened Species

5. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1. Survey Overview

General observations whilst undertaking the threatened species surveys indicate that the fauna assemblage recorded may be considered depauperate, with a low diversity of species recorded and low total counts of individuals from each species.

The reason for this lack of fauna diversity and abundance may be linked to the productivity of the habitats surveyed. Habitat assessments indicate that the survey area is characterised by large areas of essentially monotypic vegetation on deeply weathered sand plains (e.g. poplar gum and poplar box woodlands). In addition, of particular note, was the almost complete absence of buffel grass from most areas of the study area, with grass cover dominated by native grasses. A few introduced species (e.g. red natal) were noted in disturbed areas (i.e. along tracks).

These results are thought to be caused by the following:

1. Most of the northern section of the study area has been significantly impacted upon by pastoral land management practises (i.e. overgrazing, overstocking, vegetation thinning and clearing).
2. Whilst most of the canopy vegetation cover within the southern section of the study site is relatively intact, the pressures of pastoral activities (historical and current) are evident.
3. Inappropriate, historically and more recent, fire regimes are evident, with most areas being subjected to too frequent and too hot fire regimes. These impacts are evident in the lack of ground timber in large areas of the study site.

These land management practices have not only affected the diversity and abundance of common wildlife, but have had an impact on threatened species which typically have very specific habitat niche requirements. Continual clearing and burning results in gross simplification of habitats, in terms of distribution, diversity and structure. These broad scale activities, leading to habitat simplification have been identified as key threatening processes to the persistence and survival of many threatened species.

5.2. Threatened Species

The survey positively identified the presence of squatter pigeon within habitats supported within the study area. This species is listed vulnerable under the Commonwealth EPBCA and/or the Queensland NCA.

Of the nine species targeted for this study, red goshawk and cotton pygmy goose are considered highly unlikely to occur as residents within habitats supported on the study area. Furthermore, no records for koala were recorded and it is considered that the study area does not support a resident population of koala.

Brigalow scaly-foot and yakka skink are considered likely to occur with the poplar box woodlands on alluvial plains and potentially within the brigalow woodlands.

Little pied bat, was recorded from the riparian habitats of Carborough and Walker Creeks and has also been identified in the area from previous surveys. South eastern long-eared bat was not recorded, however calls were identified to genus level (impossible to differentiate call recordings to species level for *Nyctophilus* spp.). It is possible that these calls were from south eastern long-eared bats, but confirmation of species is only possible

through harp trapping, which was incomplete due to weather constraints. It must be noted that the high value riparian zone and poplar box woodlands on alluvial plains do support roosting, therefore breeding, resources (i.e. tree hollows) and foraging resources for both microbat species.

The brigalow woodlands containing gilgai formations support suitable habitat to support the presence of the ornamental snake. This vegetation association is listed at State and Federal levels as an endangered community. Ornamental snakes are considered highly likely to occur within these areas.

Habitat assessment of the study area has identified three areas that support high ecological and biodiversity values for threatened species. These areas were; riparian zones, poplar box woodland on alluvial plains and brigalow woodlands with gilgai formations.

5.3. Conclusions

Targeted threatened species surveys and habitat assessment of the study area and surrounds have identified the known presence of two threatened species, squatter pigeon and little pied bat. In addition, three broad habitat areas have been identified as providing suitable refuge, foraging and breeding habitat considered likely to support four other target species. These species and their habitat associations are:

- Brigalow scaly-foot – poplar box woodland on alluvial plains and brigalow gilgai woodland;
- Yakka skink – poplar box woodland on alluvial plains and brigalow gilgai woodland;
- Ornamental snake – brigalow woodlands with gilgai formations; and
- South eastern long-eared bat – poplar box woodlands on alluvial plains, brigalow woodlands and riparian zones.

With respect to red goshawk and cotton pigmy goose, the study area is outside the known distribution of red goshawk and does not support suitable habitat for this species, whilst for cotton pigmy goose, the site does not support suitable breeding habitat for this species. The farm dam located in the southern section of the study area may be utilised by this species as a staging platform during migrations in the local and wider regions.

No records of, nor evidence of, koala were observed during the study. The occurrence of this species as residents in the local area is considered unlikely. However, riparian zones form important movement corridors for this and many other native species and the value of these corridors should not be overlooked.

5.4. Recommendations

In Queensland, all native plants and animals are protected under the provisions of the NCA.

As a result of negotiations by the Queensland Resources Council (QRC), on behalf of its signatory members, DERM has produced an approved species management program for tampering with animal breeding places under Section 88 of the NCA and Section 332 of the *Nature Conservation (Wildlife Management) Regulation (2006)* (DERM 2010g) for **least concern wildlife** for the mining sector. The species management program (SMP) provides a working arrangement for activities that may require the tampering with animal breeding places in a way that meets the legislative requirements of the NCA.

The SMP does not obviate the operation of any other legislation and may only be applied by an entity that has obtained written approval from DEHP to operate under this SMP (the approved entity).

Of the 18 conditions detailed in the Section 4 of the SMP, the salient points for the proposed works include the following conditions:

- 4.2 Maintain a register of tampering with animal breeding places.
- 4.4 Minimise impacts to fauna during activities.
- 4.5 Consult with DEHP for interfering with breeding places for animals that are:
 - i. Special least concern; or
 - ii. Least concern but colonial breeders.
- 4.8 For construction projects:
 - a. Undertake a prior environmental assessment regarding animal breeding places. This assessment must be conducted by a suitably qualified and experienced person.
 - b. Where practicably safe, assess the value of permanent and temporary water sources as possible breeding habitat for aquatic wildlife including platypus, turtles, frogs and fish.
- 4.11 Where tampering would also take protected wildlife, the approved entity must attempt to enlist the assistance of a licensed spotter-catcher and/or carer.
- 4.13 Where required, as determined by a suitably qualified and experienced person, the approved entity must provide the necessary support to allow for nest relocation, such as a substitute platform (there are existing successful examples for osprey and white bellied sea-eagle).
- 4.18 Animal species prescribed as 'extinct in the wild', 'endangered', 'vulnerable', 'rare' or 'near threatened' under the Wildlife Regulation are not subject to this Species Management Program.

Under the SMP, authorised actions with respect to animal breeding places are detailed in Table 5-1 below.

Table 5-1 Authorised Management Actions for Animal Breeding Places

Species group	Breeding Status	Action
Least concern – special least concern or colonial breeding	All	Consult with DEHP. Specific authority to take [#] is required (damage mitigation permit or approved species management program).
Other least concern species	Contains young or eggs	Avoid unnecessary disturbance. Breeding place may be removed and eggs/young handed over to a licensed wildlife carer. Preferable to allow eggs to hatch and/or young to mature and move away from a breeding place. As a last resort, eggs may be destroyed*.
Other least concern species	No eggs or young	Proceed with caution. Remove breeding place if applicable.

Where the removal or translocation of wildlife is required, the 'take' must be facilitated by a suitably licensed and experienced person.

* There are two acceptable methods for destroying or terminating eggs: quickly breaking an egg and crushing its contents; or reducing the temperature of the egg to less than 4 degrees C for at least 4 hours.

The NCA and its Regulations provide direction on the management intent for **endangered, vulnerable and near threatened** wildlife under s14 and s19 of the Regulations respectively. The relevant aspects of the management intents as they relate to this project are as follows:

- To take action to ensure viable populations of the wildlife in the wild are preserved or re-established.
- To cooperate with the Commonwealth and other State agencies:
 - For the ongoing protection and management of the wildlife and its habitat; and
 - To work towards a national conservation status for the wildlife and its habitat.
- To protect the critical habitat, or the areas of major interest, for the wildlife.
- To monitor and review environmental impact procedures to ensure they:
 - Accurately assess the extent of the impact, on the wildlife, of the activities to which the procedures relate; and
 - Provide for effective measures to mitigate any adverse impact of the activities on the wildlife; and
 - If there is an adverse impact of the activities on an area in which the wildlife normally lives, provide for the enhancement of other areas where the wildlife normally lives.

As a result of the assessments undertaken as part of this study, it is recommended that once the final design and location of the proposed diversion(s) of Carborough and Walker Creeks is/are finalised and the progression of Mulgrave Pit is mapped and documented, BMC/SWC commit to preparing a threatened species management plan for those species either known, or considered likely, to occur within the habitats supported within the study area. These species include the following:

- Brigalow scaly-foot;
- Yakka skink;
- Ornamental snake;
- Squatter pigeon;
- Little pied bat; and
- South eastern long-eared bat.

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APPENDIX A: FROG DATABASE

- Status: 1-** *Queensland Nature Conservation Legislation Amendment Regulation (No. 2) 1997*
 E = Endangered; V = Vulnerable; nt = Near Threatened
 Species without entries in '**Status**' column are listed as "least concern" under the Regulation.
 # = introduced species
- 2-** *Environmental Protection and Biodiversity Conservation Act 1999*
 E = Endangered; V = Vulnerable
- 3-** Australian Action Plan Endangered Vulnerable Insufficiently known
 Tyler 1997. Frog Action Plan e v r

Zoological Name	Common Name	Status			WildLife Online	Mulgrave Pit Expansion
		1	2	3		
HYLIDAE	Tree Frogs					
<i>Cyclorana alboguttata</i>	greenstripe frog					✓
<i>Litoria caerulea</i>	green treefrog					✓
<i>Litoria inermis</i>	bumpy rocketfrog					✓
<i>Litoria latopalmata</i>	broad-palmed rocketfrog					✓
<i>Litoria rothii</i>	red-eyed treefrog					✓
<i>Litoria rubella</i>	naked treefrog					✓
MYOBATRACHIDAE	Southern Frogs					
<i>Platyplectorum ornatus</i>	ornate burrowing-frog					✓
<i>Limnodynastes tasmaniensis</i>	spotted marsh frog					✓
BUFONIDAE	True Toads					
<i>Rhinella marina</i>	cane toad	#				✓
Total Number of Species Recorded						9

APPENDIX B: REPTILE DATABASE

Status: 1- Queensland Nature Conservation Legislation Amendment Regulation (No. 2) 1997

E = Endangered; V = Vulnerable; nt = Near Threatened

Species without entries in '**Status**' column are listed as "least concern" under the Regulation.

= introduced species

2- Environmental Protection and Biodiversity Conservation Act 1999

E = Endangered; V = Vulnerable

3- Australian Action Plan

Endangered

Vulnerable

Insufficiently known

Cogger *et al.* 1993. Reptile Action Plan

e

v

i

Zoological Name	Common Name	Status			WildLife Online	Mulgrave Pit Expansion
		1	2	3		
GEKKONIDAE	Geckos					
<i>Gehyra catenata</i>						✓
<i>Gehyra dubia</i>						✓
<i>Heteronotia binoei</i>	Bynoe's gecko					✓
<i>Oedura monillis</i>	ocellated velvet gecko					✓
AGAMIDAE	Dragons					
<i>Pogona barbata</i>	bearded dragon				✓	
SCINCIDAE	Skinks					
<i>Carlia foliorum</i>						✓
<i>Carlia munda</i>						✓
<i>Carlia pectoralis</i>						✓
<i>Carlia schmeltzii</i>						✓
<i>Cryptoblepharus virgatus</i>	wall skink					✓
<i>Ctenotus robustus</i>						✓
<i>Ctenotus trauchii</i>						✓
<i>Eulamprus quoyii</i>	eastern water skink				✓	
<i>Morethia boulengeri</i>						✓
<i>Morethia taeniopleura</i>	fire-tailed skink					✓
COLUBRIDAE	Colubrid Snakes					
<i>Boiga irregularis</i>	brown tree snake					✓
<i>Dendrelaphis punctulata</i>	common tree snake					✓
ELAPIDAE	Elapid Snakes					
<i>Demansia psammophis</i>	yellow-faced whip snake				✓	
<i>Furina diadema</i>	red-naped snake					✓
<i>Pseudonaja textilis</i>	eastern brown snake					✓
Total Number of Species Recorded					3	17

APPENDIX C: BIRD DATABASE

Status: 1 - Queensland Nature Conservation Legislation Amendment Regulation (No. 2) 1997

E = Endangered; V = Vulnerable; nt = Near Threatened

Species without entries in 'Status' column are listed as "least concern" under the Regulation.

= introduced species

2 - Environmental Protection and Biodiversity Conservation Act 1999

E = Endangered; V = Vulnerable; m = Migratory

3 - China-Australia, Japan-Australia & Republic of Korea Migratory Bird Agreements for conservation of migratory birds and habitats (C.J.R)

4 - Australian Action Plan Critically Endang'd Endang'd Vulnerable Near Threatened Least Concern

Garnett and Crowley, 2000.

Australain Birds Action Plan

ce e v t l

Zoological Name	Common Name	Status				WildLife Online	Mulgrave Pit Expansion
		1	2	3	4		
DROMAIDAE	Emus						
<i>Dromaius novaehollandiae</i>	emu					✓	✓
PHASIANIDAE	Pheasants and allies						
<i>Coturnix ypsilophora</i>	brown quail						✓
ANATIDAE	Swans, Geese and Ducks						
<i>Anas gracilis</i>	grey teal					✓	✓
<i>Anas rhynchotis</i>	Australasian shoveler					✓	
<i>Anas superciliosa</i>	Pacific black duck					✓	✓
<i>Aythya australis</i>	hardhead					✓	✓
<i>Chenonetta jubata</i>	Australian wood duck					✓	✓
<i>Cygnus atratus</i>	black swan					✓	
<i>Dendrocygna arcuata</i>	wandering whistling-duck						✓
<i>Malacorhynchus membranaceus</i>	pink-eared duck					✓	
<i>Stictonetta naevosa</i>	freckled duck	nt				✓	
PODICIPEDIDAE	Grebes						
<i>Tachybaptus novaehollandiae</i>	Australasian grebe					✓	
ANHINGIDAE	Darters						
<i>Anhinga melanogaster</i>	Australasian darter					✓	✓
PHALACROCORACIDAE	Cormorants						
<i>Phalacrocorax carbo</i>	great cormorant					✓	
<i>Phalacrocorax melanoleucos</i>	little pied cormorant					✓	✓
<i>Phalacrocorax sulcirostris</i>	little black cormorant					✓	✓
<i>Phalacrocorax varius</i>	pied cormorant					✓	
PELECANIDE	Pelicans						
<i>Pelecanus conspicillatus</i>	Australian pelican					✓	
ARDEIDAE	Herons, Bitterns & Egrets						
<i>Ardea alba</i>	great egret		m	CJ		✓	
<i>Ardea intermedia</i>	intermediate egret					✓	✓
<i>Ardea pacifica</i>	white-necked heron					✓	✓
<i>Egretta garzetta</i>	little egret					✓	
<i>Egretta novaehollandiae</i>	white-faced heron					✓	✓
THRESKIORNITHIDAE	Ibises and Spoonbills						
<i>Platalea flavipes</i>	yellow-billed spoonbill					✓	
<i>Platalea regia</i>	royal spoonbill					✓	✓
<i>Threskiornis molucca</i>	Australian white ibis					✓	
<i>Threskiornis spinicollis</i>	straw-necked ibis					✓	✓
CICONIIDAE	Storks						
<i>Ephippiorhynchus asiaticus</i>	black-necked stork	nt			l	✓	
ACCIPITRIDAE	Osprey, Hawks and Eagles						
<i>Aquila audax</i>	wedge-tailed eagle					✓	✓
<i>Aviceda subcristata</i>	Pacific baza					✓	✓
<i>Elanus axillaris</i>	black-shouldered kite					✓	✓
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		m	C		✓	✓
<i>Haliastur sphenurus</i>	whistling kite					✓	✓
<i>Milvus migrans</i>	black kite					✓	✓
FALCONIDAE	Falcons						
<i>Falco berigora</i>	brown falcon					✓	✓
<i>Falco cenchroides</i>	nankeen kestrel					✓	✓
<i>Falco longipennis</i>	Australian hobby					✓	
GRUIDAE	Cranes						
<i>Grus rubicunda</i>	brilga					✓	
RALLIDAE	Rails, Gallinules and Coots						
<i>Fulica atra</i>	Eurasian coot					✓	
<i>Gallinula tenebrosa</i>	dusky moorhen					✓	
<i>Tribonyx ventralis</i>	black-tailed native-hen					✓	
OTIDIDAE	Bustards						

Zoological Name	Common Name	Status				WildLife Online	Mulgrave Pit Expansion
		1	2	3	4		
<i>Ardeotis australis</i>	Australian bustard				t		✓
SCOLOPACIDAE	Sandpipers and allies						
<i>Actitis hypoleucos</i>	common sandpiper					✓	
JACANIDAE	Jacanas						
BURHINIDAE	Stone-curlews						
<i>Burhinus grallarius</i>	bush stone-curlew				t		✓
CHARADRIIDAE	Lapwings, Plovers & Dottrels						
<i>Euseyornis melanops</i>	black-fronted dotterel					✓	✓
<i>Vanellus miles</i>	masked lapwing					✓	✓
COLUMBIDAE	Pigeons and Doves						
<i>Geopelia humeralis</i>	bar-shouldered dove					✓	✓
<i>Geopelia striata</i>	peaceful dove					✓	✓
<i>Geophaps scripta scripta</i>	squatter pigeon (sth. subsp.)	v	v		t	✓	✓
<i>Ocyphaps lophotes</i>	crested pigeon					✓	✓
<i>Phaps chalcoptera</i>	common bronzewing					✓	✓
CACATUIDAE	Cockatoos						
<i>Cacatua galerita</i>	sulphur-crested cockatoo					✓	✓
<i>Cacatua roseicapilla</i>	galah					✓	✓
<i>Cacatua sanguinea</i>	little corella					✓	
<i>Lophochroa leadbeateri</i>	Major Mitchell's cockatoo		v			✓	
<i>Nymphicus hollandicus</i>	cockatiel					✓	✓
PSITTACIDAE	Parrots						
<i>Aprosmictus erythropterus</i>	red-winged parrot					✓	✓
<i>Barnardius zonarius</i>	Australian ringneck					✓	
<i>Barnardius zonarius barnardi</i>	mallee ringneck					✓	
<i>Platycercus adscitus</i>	pale-headed rosella					✓	✓
<i>Psephotus haematonotus</i>	red-rumped parrot					✓	
<i>Trichoglossus haematodus</i>	rainbow lorikeet						✓
CUCULIDAE	Old World Cuckoos						
<i>Cacomantis variolosus</i>	brush cuckoo						✓
CENTROPODIDAE	Coucals						
<i>Centropus phasianinus</i>	pheasant coucal					✓	✓
<i>Chrysocolaptes basaloides</i>	Horsfield's bronze-cuckoo					✓	
<i>Cuculus pallidus</i>	pallid cuckoo		m			✓	
STRIGIDAE	Hawk Owls						
<i>Ninox novaeseelandiae</i>	southern boobook						✓
TYTONIDAE	Barn Owls						
<i>Tyto alba</i>	barn owl						✓
PODARGIDAE	Australian Frogmouths						
<i>Podargus strigoides</i>	tawny frogmouth						✓
AEGOTHELIDAE	Owlet-nightjars						
<i>Aegotheles cristatus</i>	Australian owlet-nightjar						✓
APODIDA	Typical Swifts						
<i>Hirundapus caudacutus</i>	white-throated needletail		m	CJ		✓	
HALCYONIDAE	Kingfishers and Kookaburras						
<i>Dacelo leachii</i>	blue-winged kookaburra						✓
<i>Dacelo novaeguineae</i>	laughing kookaburra					✓	✓
<i>Todiramphus macleayii</i>	forest kingfisher					✓	✓
<i>Todiramphus sanctus</i>	sacred kingfisher					✓	✓
MEROPIIDAE	Bee-eaters						
<i>Merops ornatus</i>	rainbow bee-eater		m	J		✓	
CORACIIDAE	Dollarbird						
<i>Eurystomus orientalis</i>	dollarbird		m			✓	✓
CLIMACTERIDAE	Australo-Papuan Treecreepers						
<i>Climacteris picumnus</i>	brown treecreeper				t	✓	
MALURIDAE	Fairy-, Emu- & Grass-wrens						
<i>Malurus cyaneus</i>	superb fairy-wren					✓	
<i>Malurus lamberti</i>	variegated fairy-wren					✓	
<i>Malurus melanocephalus</i>	red-backed fairy-wren						✓
<i>Malurus splendens</i>	splendid fairy-wren					✓	
PARDALOTIDAE	Pardalotes, Bristlebirds, Scrubwrens and Thornbills						
<i>Acanthiza apicalis</i>	inland thornbill					✓	
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill					✓	
<i>Acanthiza nana</i>	yellow thornbill					✓	
<i>Acanthiza reguloides</i>	buff-rumped thornbill					✓	
<i>Acanthiza uropygialis</i>	chestnut-rumped thornbill					✓	
<i>Chthonicola sagittata</i>	speckled warbler				t	✓	
<i>Gerygone fusca</i>	western gerygone					✓	
<i>Gerygone olivacea</i>	white-throated gerygone						✓
<i>Pardalotus striatus</i>	striated pardalote					✓	✓

Zoological Name	Common Name	Status				WildLife Online	Mulgrave Pit Expansion
		1	2	3	4		
<i>Pardalotus punctatus</i>	spotted pardalote					✓	
<i>Pardalotus rubricatus</i>	red-browed pardalote					✓	
<i>Smicromis brevirostris</i>	weebill					✓	✓
MELIPHAGIDAE	Honeyeaters						
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater					✓	
<i>Certhionyx variegatus</i>	piebald honeyeater					✓	
<i>Entomyzon cyanotis</i>	blue-faced honeyeater					✓	✓
<i>Grantiella picta</i>	painted honeyeater		v			✓	
<i>Lichenostomus penicillatus</i>	white-plumed honeyeater					✓	
<i>Lichenostomus virescens</i>	singing honeyeater					✓	
<i>Lichmera indistincta</i>	brown honeyeater					✓	✓
<i>Manorina flavigula</i>	yellow-throated miner					✓	✓
<i>Manorina melanocephala</i>	noisy miner					✓	✓
<i>Melithreptus alboocularis</i>	white-throated honeyeater					✓	✓
<i>Melithreptus brevirostris</i>	brown-headed honeyeater					✓	
<i>Philemon citreogularis</i>	little friarbird					✓	✓
<i>Philemon corniculatus</i>	noisy friarbird					✓	✓
<i>Plectorhyncha lanceolata</i>	striped honeyeater					✓	
EOPSALTRIIDAE	Robins and Scrub-robins						
<i>Eopsaltria australis</i>	eastern yellow robin					✓	
<i>Melanodryas cucullata</i>	hooded robin					✓	
<i>Microeca fascinans</i>	jacky winter			t		✓	✓
<i>Petroica goodenovii</i>	red-capped robin					✓	
POMATOSTOMIDAE	Australo-Papuan Babblers						
<i>Pomatostomus temporalis</i>	grey-crowned babbler				t	✓	✓
CINCLOSTOMIDAE	Quail-thrushes and allies						
<i>Cinclosoma punctatum</i>	spotted quail-thrush						
NEOSITTIDA	Sittellas						
<i>Daphoenositta chrysoptera</i>	varied sittella					✓	
PACHYCEPHALIDAE	Whistlers, Shrike-thrushes and allies						
<i>Colluricincla harmonica</i>	grey shrike-thrush					✓	
<i>Falcunculus frontatus</i>	crested shrike-tit					✓	
<i>Oreoica gutturalis</i>	crested bellbird				t	✓	
<i>Pachycephala rufiventris</i>	rufous whistler					✓	✓
DICRURIDAE	Monarchs, Fantails and Drongo						
<i>Grallina cyanoleuca</i>	magpie-lark					✓	✓
<i>Myiagra inquieta</i>	restless flycatcher					✓	
<i>Myiagra rubecula</i>	leaden flycatcher					✓	
<i>Rhipidura fuliginosa</i>	grey fantail					✓	
<i>Rhipidura leucophrys</i>	willie wagtail					✓	✓
CAMPEPHAGIDAE	Cuckoo-shrikes and Trillers						
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike					✓	✓
<i>Coracina papuensis</i>	white-bellied cuckoo-shrike					✓	✓
<i>Lalage sueurii</i>	white-winged triller					✓	
ORIOOLIDAE	Orioles and Figbirds						
<i>Oriolus sagittatus</i>	olive-backed oriole					✓	
ARTAMIDAE	Woodswallows, Butcherbirds and Currawongs						
<i>Artamus leucorhynchus</i>	white-breasted woodswallow					✓	✓
<i>Artamus personatus</i>	masked woodswallow					✓	
<i>Artamus superciliosus</i>	white-browed woodswallow					✓	
<i>Cracticus nigrogularis</i>	piebald butcherbird					✓	✓
<i>Cracticus torquatus</i>	grey butcherbird					✓	✓
<i>Gymnorhina tibicen</i>	Australian magpie					✓	✓
<i>Strepera graculina</i>	piebald currawong					✓	
PARADISAEIDAE	Birds of Paradise						
<i>Dicrurus bracteatus</i>	spangled drongo		m				✓
CORVIDAE	Crows and allies						
<i>Corvus coronoides</i>	Australian raven					✓	
<i>Corvus orru</i>	torresian crow					✓	✓
CORORACIDAE	Mud-nesters						
<i>Corcorax melanorhamphos</i>	white-winged cough					✓	
<i>Struthidea cinerea</i>	apostlebird					✓	✓
PTILINORHYNCHIDAE	Bowerbirds						
<i>Chlamydera maculata</i>	spotted bowerbird					✓	
MOTACILLIDAE	Old World Wagtails and Pipits						
<i>Anthus novaeseelandiae</i>	Richard's pipit					✓	✓
PASSERIDAE	Sparrows, Weaverbirds, Waxbills and allies						
<i>Neochmia modesta</i>	plum-headed finch					✓	

Zoological Name	Common Name	Status				WildLife Online	Mulgrave Pit Expansion
		1	2	3	4		
<i>Stagonopleura guttata</i>	diamond firetail					✓	
<i>Taeniopygia bichenovii</i>	double-barred finch					✓	✓
<i>Taeniopygia guttata</i>	zebra finch					✓	
DICAEIDAE	Flowerpeckers						
<i>Dicaeum hirundinaceum</i>	mistletoebird					✓	
HIRUNDINIDAE	Swallows and Martins						
<i>Hirundo ariel</i>	fairy martin					✓	✓
<i>Hirundo neoxena</i>	welcome swallow					✓	✓
<i>Hirundo nigricans</i>	tree martin						✓
SYLVIIDAE	Old World Warblers						
<i>Acrocephalus stentoreus</i>	clamorous reed-warbler					✓	
<i>Cisticola exilis</i>	golden-headed cisticola						✓
ZOSTEROPIIDAE	White-eyes						
<i>Sturnus vulgaris</i>	common starling	#				✓	
Total Number of Species Recorded						133	80

APPENDIX D: MAMMAL DATABASE

- Status: 1- Queensland Nature Conservation Legislation Amendment Regulation (No. 2) 1997**
 E = Endangered; V = Vulnerable; nt = Near Threatened; slc = Special Least Concern
 Species without entries in 'Status' column are listed as "least concern" under the Regulation.
 # = introduced species
- 2- Environmental Protection and Biodiversity Conservation Act 1999**
 E = Endangered; V = Vulnerable
- 3- Australian Action Plan**
- | | Critically Endang'd | Endang'd | Vulnerable | Insufficiently known | Lower risk | Data deficient |
|--|---------------------|----------|------------|----------------------|------------|----------------|
| Maxwell <i>et. al.</i> 1996. Marsupials & Monotremes | ce | e | v | | l | dd |
| Lee 1995. Rodents | ce | e | v | | | |
| Duncan <i>et. al.</i> 1999. Bats | ce | e | v | | l | dc |

Zoological Name	Common Name	Status			WildLife Online	Mulgrave Pit Expansion
		1	2	3		
TACHYGLOSSIDAE	Echidnas					
<i>Tachyglossus aculeatus</i>	short-beaked echidna	slc				✓
PERAMELIDAE	Bandicoots and Bilbies					
<i>Isoodon macrourus</i>	northern brown bandicoot					✓
PHASCOLARCTIDAE	Koala					
<i>Phascolarctos cinereus</i>	koala	slc	V	l	✓	
PETAURIDAE	Wrist-winged Gliders					
<i>Petaurus breviceps</i>	sugar glider					✓
PSEUDOCHEIRIDAE	Ringtail Possums and Greater Glider					
<i>Petauroides volans</i>	greater glider					✓
PHALANGERIDAE	Brushtail Possums					
<i>Trichosurus vulpecula</i>	common brushtail possum					
MACROPODIDAE	Wallabies, Kangaroos					
<i>Macropus giganteus</i>	eastern grey kangaroo				✓	✓
<i>Macropus rufus</i>	red kangaroo				✓	
PTEROPODIDAE	Flying-foxes, Fruit-bats, Blossum-bats					
<i>Pteropus scapulatus</i>	little red flying-fox			l		✓
EMBALLONURIDAE	Sheath-tailed bats					
<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tailed bat			l		✓
MOLOSSIDAE	Free-tailed bats					
<i>Chaerephon jobensis</i>	northern free-tailed bat			l		✓
<i>Mormopterus beccarii</i>	Beccari's Free-tailed bat			l		✓
<i>Mormopterus ridei</i>	eastern little free-tailed bat			l		✓
VESPERTILIONIDAE	Vespertilionid Bats					
<i>Chalinolobus gouldii</i>	Gould's wattled bat			l		✓
<i>Chalinolobus morio</i>	chocolate wattled bat			l		✓
<i>Chalinolobus nigrogriseus</i>	hoary wattled bat			l		✓
<i>Chalinolobus picatus</i>	little pied bat	nt		l		✓
<i>Miniopterus australis</i>	little bent-winged bat			l		✓
<i>Miniopterus orianea oceanensis</i>	bent-winged bat			l		✓
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat			l		+
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat			l		+
<i>Scotorepens balstoni</i>	inland broad-nosed bat			l		✓
<i>Scotorepens greyii</i>	little broad-nosed bat			l		✓
<i>Vespadelus baverstocki</i>	inland forest bat			l		✓
<i>Vespadelus troughtoni</i>	eastern cave bat			l		✓
CANIDAE	Dingo and Fox					
<i>Canis familiaris</i>	dog	#				✓
<i>Canis lupus dingo</i>	dingo	#				✓
<i>Vulpes vulpes</i>	fox	#			✓	
FELIDAE	Cat					
<i>Felis catus</i>	feral cat	#				✓
LEPORIDAE	Rabbit and Hare					
<i>Oryctolagus cuniculus</i>	rabbit	#				✓
SUIDAE	Pig					
<i>Sus scrofa</i>	pig	#				✓
BOVIDAE	Horned Ruminants					
<i>Bos taurus</i>	cattle	#				✓
Total Number of Species Recorded					4	28

+ = Positive identification to genus level, species identification impossible for these genus

APPENDIX E ANABAT ANALYSES DATABASE

Table 1. Microbat species recorded at South Walker Creek, 6-11 April 2013.

◆ = species positively identified from call data; □ = species possibly present, but not reliably identified

Detector:	SN 05917					SN 80224					SN 81202
Date:	6-Apr	7-Apr	8-Apr	9-Apr	10-Apr	6-Apr	7-Apr	8-Apr *	9-Apr	10-Apr	6-Apr *
No. sequence files:	782	1029	292	181	21	669	1552	1161	346	741	67
No. of calls identified:	9	76	56	55	7	31	46	38	49	9	28
SPECIES											
<i>Chalinolobus gouldii</i>	◆	◆	◆	◆	□	◆	◆	◆	◆	◆	◆
<i>Chalinolobus morio</i>						◆			◆	◆	
<i>Chalinolobus nigrogriseus</i>											□
<i>Chalinolobus picatus</i>	□			□	□	□	□	□	□		□
<i>Nyctophilus sp.</i>			◆	◆			◆		◆	◆	
<i>Scotorepens balstoni</i>	◆	◆	◆	□	□	□	◆	◆	□	□	
<i>Scotorepens greyii/S. sanborni</i>	□		◆	◆	◆	◆	◆	◆	◆	◆	◆
<i>Vespadelus baverstocki</i>			◆			□	□	◆	◆	□	
<i>Vespadelus troughtoni</i>						◆			◆		
<i>Miniopterus australis</i>				◆		◆	◆		◆	◆	
<i>Miniopterus orianae oceanensis</i>				◆		□			□		
<i>Chaerephon jobensis</i>						◆			◆		
<i>Mormopterus beccarii</i>						□	□		◆		◆
<i>Mormopterus ridei</i>	□	□	□	□	□		□				
<i>Saccolaimus flaviventris</i>	◆	◆	◆	◆		◆	◆	◆	◆		◆

Table 1. Microbat species recorded at South Walker Creek, 6-11 April 2013.

◆ = species positively identified from call data; □ = species possibly present, but not reliably identified

Detector:	SN 81208					SN 81287				
Date:	6-Apr	7-Apr	8-Apr *	9-Apr	10-Apr	6-Apr	7-Apr	8-Apr *	9-Apr	10-Apr
No. sequence files:	773	863	1147	2202	1913	620	2906	952	1462	757
No. of calls identified:	57	81	72	47	15	82	34	15	34	20
SPECIES										
<i>Chalinolobus gouldii</i>	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
<i>Chalinolobus morio</i>	◆	◆				◆	◆			◆
<i>Chalinolobus nigrogriseus</i>				□						
<i>Chalinolobus picatus</i>		□								
<i>Nyctophilus sp.</i>	◆	◆			◆	◆	◆			
<i>Scotorepens balstoni</i>	◆	◆	◆	□	◆	◆	◆	◆	◆	□
<i>Scotorepens greyii/S. sanborni</i>	◆	◆	◆	◆	◆	◆	◆	◆	◆	
<i>Vespadelus baverstocki</i>	◆	◆	◆	◆		□	□		□	
<i>Vespadelus troughtoni</i>					◆					
<i>Miniopterus australis</i>				◆	◆	◆	◆		◆	◆
<i>Miniopterus orianae oceanensis</i>		□	□			□	□		□	
<i>Chaerephon jobensis</i>	◆			◆		◆	◆			
<i>Mormopterus beccarii</i>	◆	◆	◆							
<i>Mormopterus ridei</i>	□	◆		□		◆	□		◆	□
<i>Saccolaimus flaviventris</i>	◆	◆	◆	◆		◆	◆	◆	◆	

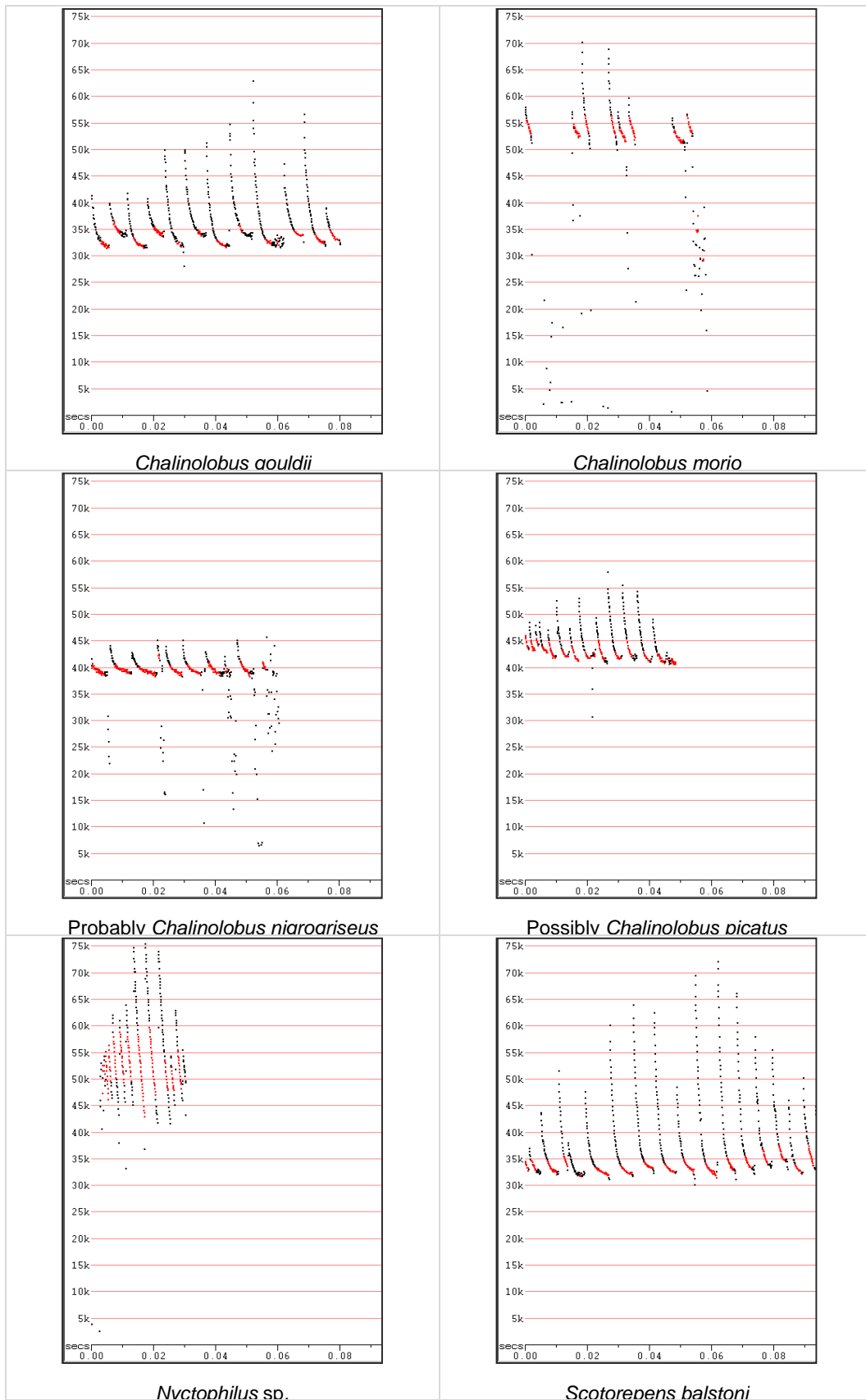


Figure 1 Representative call sequences recorded at South Walker Creek, April 2013. (10msec per tick; time between pulses removed)

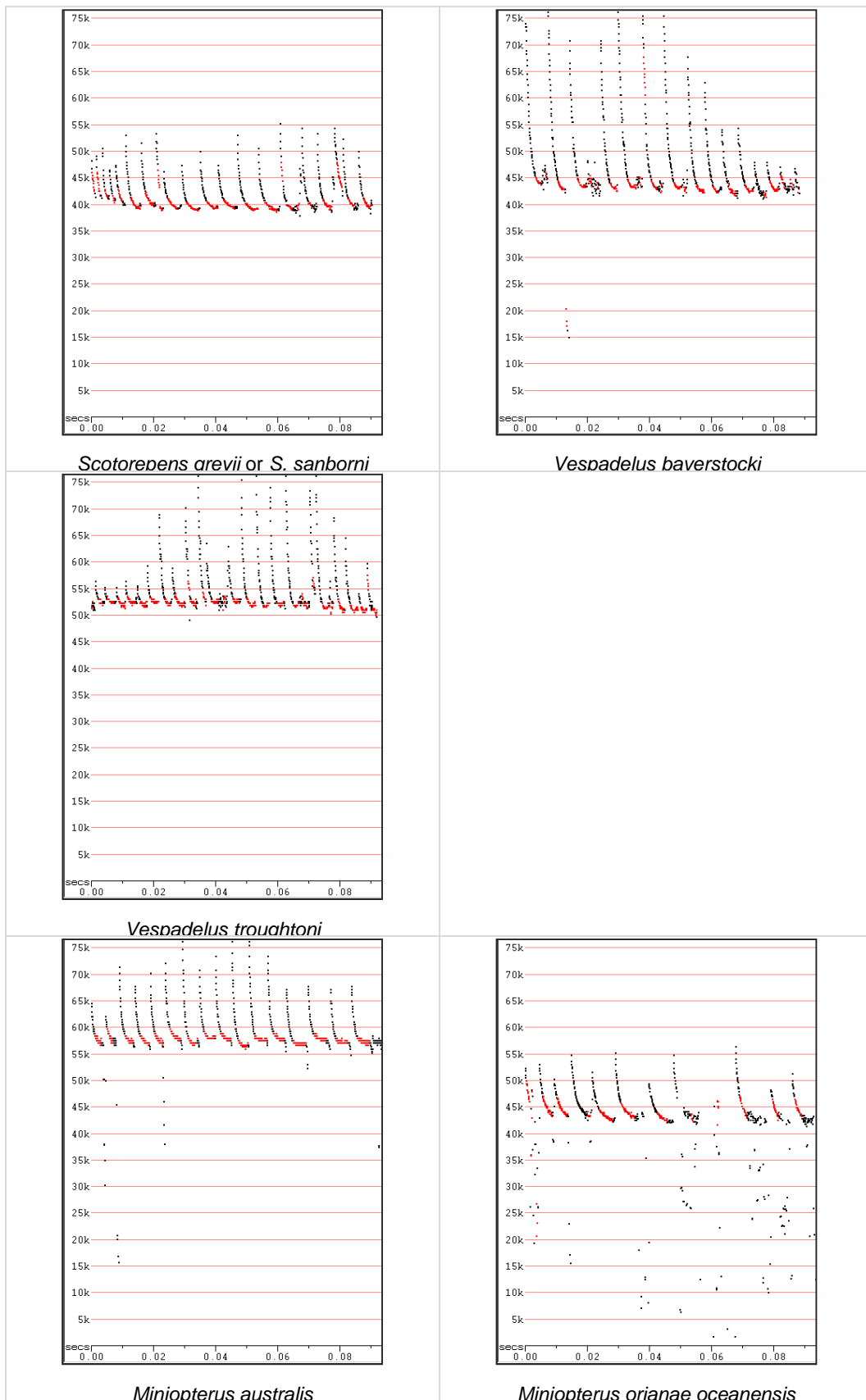


Figure 1 (cont.) Representative call sequences recorded at South Walker Creek, April 2013. (10msec per tick; time between pulses removed)

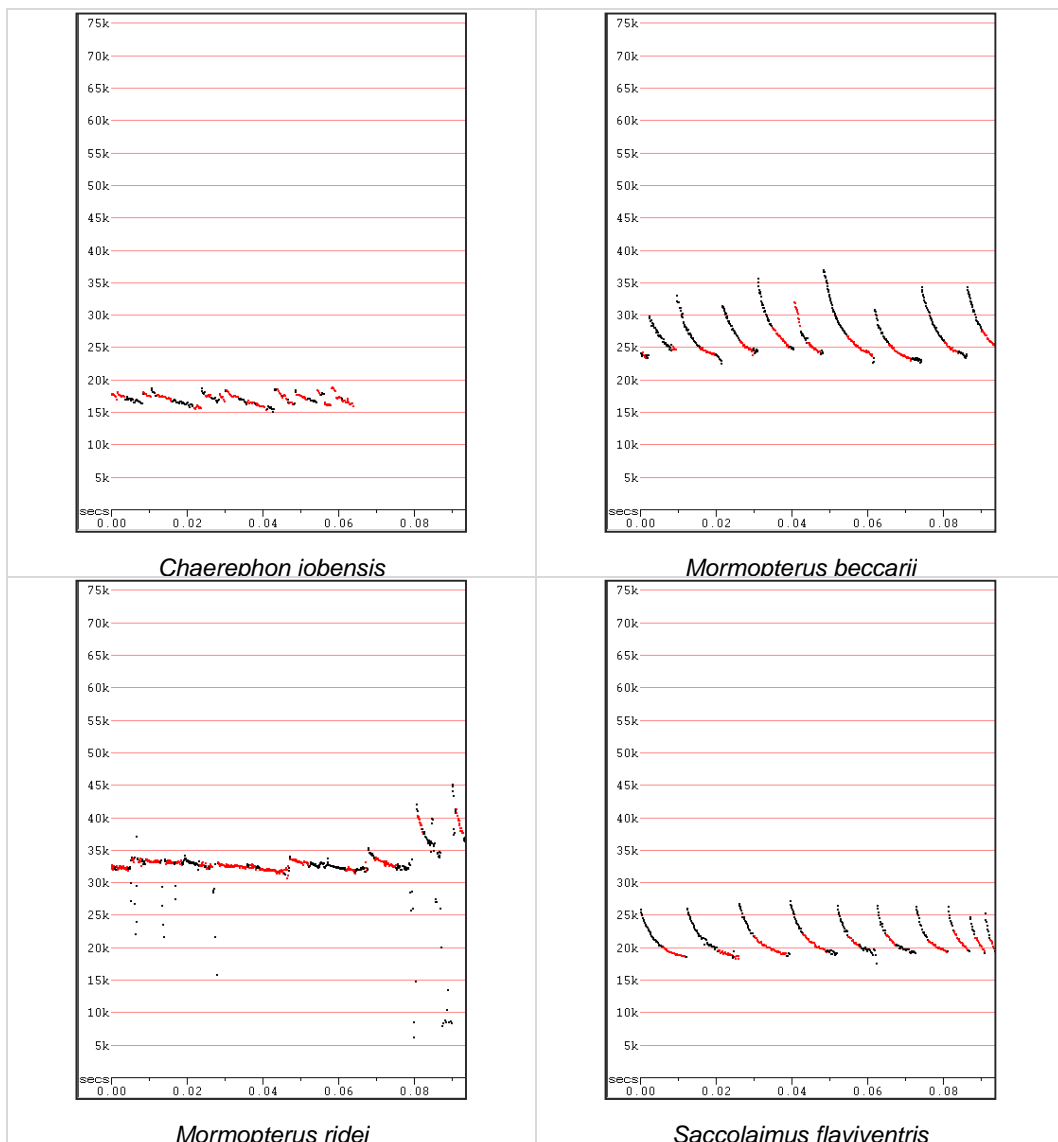


Figure 1 (cont.) Representative call sequences recorded at South Walker Creek, April 2013. (10msec per tick; time between pulses removed)

Table 1. Microbat species recorded at South Walker Creek, 22-25 April 2013.

- ◆ = species positively identified from call data
- = species possibly present, but not reliably identified

Date:	22-Apr	23-Apr	24-Apr	25-Apr	22-Apr
No. sequence files:	6	3099	1454	31	6
No. of calls identified:	1	182	75	11	1
SPECIES					
<i>Chalinolobus gouldii</i>		◆	◆	◆	
<i>Chalinolobus morio</i>		◆	◆		
<i>Chalinolobus nigrogriseus</i>		◆	◆		
<i>Chalinolobus picatus</i>		◆	◆	□	
<i>Nyctophilus</i> sp.		◆	◆		
<i>Scotorepens balstoni</i>		□	□		
<i>Scotorepens greyii</i> / <i>S. sanborni</i>		◆	◆		
<i>Vespadelus baverstocki</i>		◆	◆	□	
<i>Vespadelus troughtoni</i>			◆		
<i>Mormopterus beccarii</i>	◆	◆	◆		◆
<i>Mormopterus ridei</i>		◆	◆	□	
<i>Saccolaimus flaviventris</i>		◆	◆		
<i>Taphozous troughtoni</i>		□			

Species not reliably identified

Most calls were reliably attributed to known species, although several species that are likely to occur in the area have similar call characteristics and are difficult to differentiate using call data. These are discussed below.

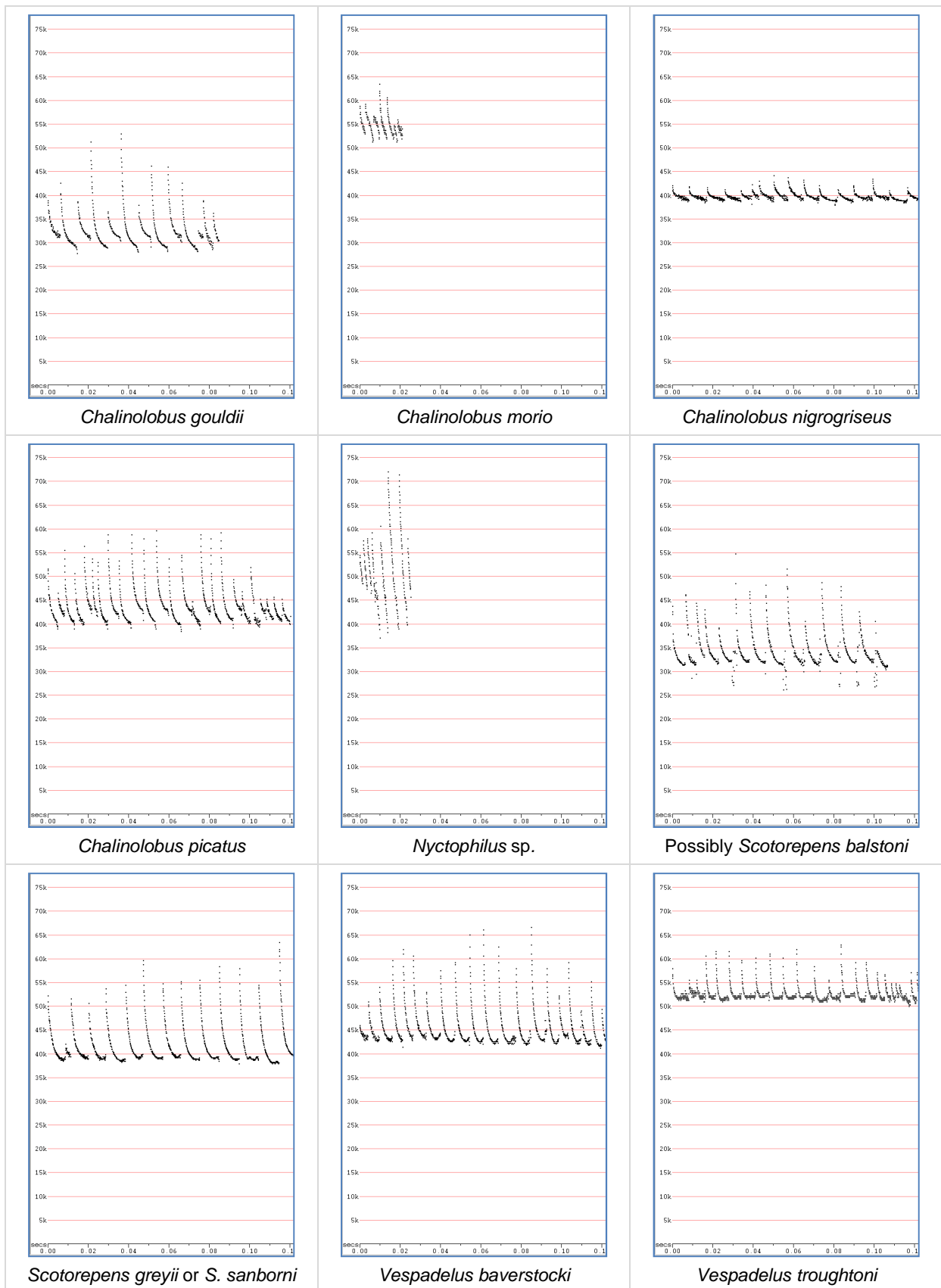
Chalinolobus picatus* / *Scotorepens greyii* / *S. sanborni* / *Vespadelus baverstocki

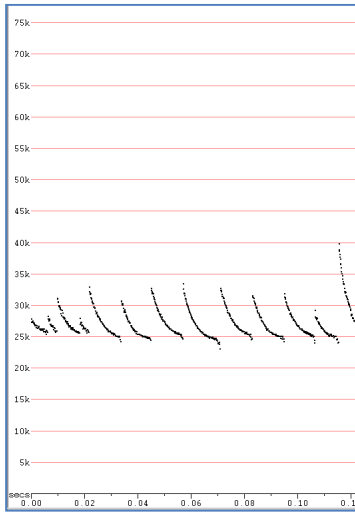
The two *Scotorepens* species cannot be reliably differentiated and both potentially occur in the study area; hence, they are listed as a single species unit in Table 1.

All four species' calls have steep, broad-band pulses with curved bodies and substantial overlap in characteristic frequency (Fc). *Scotorepens greyii*/*S. sanborni* (Fc=36-41 kHz) and *V. baverstocki* (Fc=39-46 kHz) generally produce calls with uniform pulse frequency, whereas most *C. picatus* calls (Fc=39-43 kHz) exhibit distinctive frequency alternation between successive pulses.

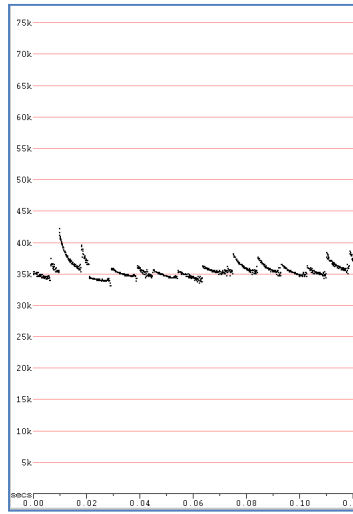
Calls with uniform pulse frequency below 39 kHz were positively identified as *S. greyii*/*S. sanborni*, while those with Fc>42 were attributed to *V. baverstocki*. A small number of alternating *C. picatus*

APPENDIX Representative bat-call sequences recorded at South Walker Creek, 22-25 April 2013.
(10msec per tick; time between pulses removed)

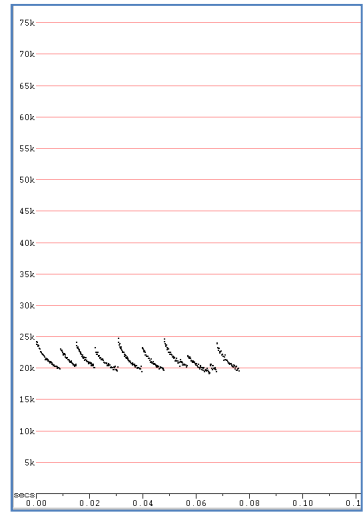




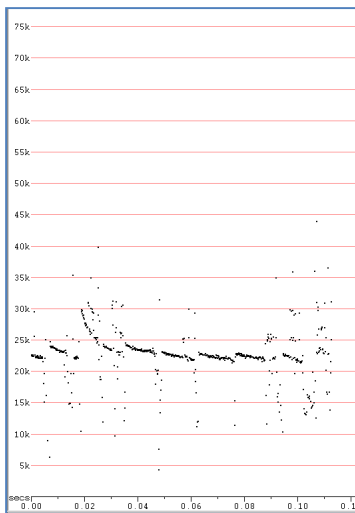
Mormopterus beccarii



Mormopterus ridei



Saccolaimus flaviventris



Possibly *Taphozous trougtoni*