home ranges may overlap, there tends to be a smaller non-overlapping 'core' area defined by den locations. Core areas are approximately 4 km^2 and 0.9 km^2 for males and females, respectively (Serena & Soderquist, 1989). Females tend to be territorial, although some areas may be shared by a mother and her adult daughter (Serena & Soderquist, 1989). Male core areas are much larger and overlap broadly with other males as well as females. Both sexes occur at similar densities in the Jarrah forest. Home range size may be smaller in areas where foxes are effectively controlled, and where Chuditch population densities are higher (DEC, 2012b; Mathew, 1996).

Chuditch are opportunistic feeders, foraging primarily on the ground at night. In the forest, insects and other large invertebrates comprise the bulk of their diet, though some mammals, birds and lizards are also included (DEC, 2012b; Serena *et al.*, 1991).

The Chuditch is primarily a nocturnal species, they may be diurnally active during the breeding season (April to July) or when cold, wet weather restricts nocturnal foraging (DEC, 2012b). The average life span of an established adult is two years, and wild Chuditch generally don't live past four years (Soderquist, 1988). Factors contributing to Chuditch mortality include:

- Motor vehicle strike (Chuditch commonly forage along dirt roads and tracks making them more susceptible to this);
- Illegal shooting near roads;
- Predation by foxes, raptors and feral cats;
- Injury in rabbit traps; and
- Natural accidents and disease.

The Chuditch has been recorded on camera within the Project Area during the two fauna surveys conducted by APM in 2016 and 2017.

5.2.7.3 Malleefowl – Leipoa ocellata

Malleefowl have been sighted frequently around the Project Area over recent years. Despite the recording of a number of Malleefowl (two individuals sighted during the 2016 APM survey and a further individual sighted dashing across the main road towards the town of Ravensthorpe, outside the Project Area, on the 2017 survey) and the intensive ground search (Figure 5-3), no active or recently inactive Malleefowl mounds have been located. The high level of individual activity on site provides strong evidence that the nests are local. Some of the vegetation is so thick, however, that detectability of mounds may have been reduced. Management of individuals and mounds will be incorporated into the Fauna Management Plan, and this will include more intensive searches for mounds and activity prior to ground clearing and during construction and operation.

Much of the preferred habitat of the Malleefowl has been cleared or modified across its original range, largely by grazing, to which this species is highly sensitive. The degree of fragmentation of remaining Malleefowl habitat is of particular concern and is a major limiting factor in the prevention and reversal of decline of this species (Benshemesh, 2007). Malleefowl appear to preferentially use densely vegetated for movement through the landscape and building their sheltered mounds, highlighting the importance of corridors within thick vegetation in otherwise cleared areas, such as agricultural land.

Malleefowl are also threatened by a range of introduced vertebrate fauna, through predation (e.g. by foxes) or competition for resources (e.g. rabbits and goats) (Benshemesh, 2007). Predation by foxes is thought to be limiting Malleefowl abundance and in many areas may be a major cause of its decline. The impact of fire on

Malleefowl is severe, and breeding in burnt areas is usually reduced or limited for at least 30 years. Deleterious impacts of fire may be mitigated, however, if fires burn patchily (Benshemesh, 2007).

Malleefowl have are generally monogamous and most likely pair for life (Benshemesh, 2007; Frith, 1959). During breeding season, male home-ranges are considerably contracted as they spend the majority of their time in the vicinity of their nests. Malleefowl generally build their nests over several months from autumn to spring. Egg laying usually begins in September and an egg is laid every 5 – 7 days until mid to late summer. Malleefowl chicks typically begin hatching and emerging from mounds in November, and although hatching may continue until March in some seasons, most chicks usually emerge from mounds before January (Benshemesh, 2007; Frith, 1959). Chicks receive no parental care and disperse upon eviction from the nest. As a result, mortality during the first month is high (Benshemesh, 1992).

While breeding birds tend to be sedentary, nesting in the same general area year after year (Benshemesh, 2007, 1992; Frith, 1959), a pair sometimes moves several kilometres between nesting seasons for no discernible reason (Benshemesh, 2007; Frith, 1959). Malleefowl have large home ranges up to several square kilometres which do not appear to be defended. The nest itself, however is vigorously defended by the (Benshemesh, 2007; Frith, 1959).

The proposed Project Area at the Kundip Mine Site has been extensively searched for Malleefowl and Malleefowl mounds. One historic inactive mound occurs in the 'Low Woodland Mallee and Heath' habitat southeast of the Kundip Mine Site on the hill slope adjacent the proposed TSF; however, no active or recently inactive Malleefowl mounds have been recorded within the Project Area. Despite this, Malleefowl individuals were recorded within the Project Area, suggesting that the Project Area may form part of a home range territory for a pair, or multiple pairs, of Malleefowl.

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\\MAINSERVER\Documents\APM GIS and Mapping\03_Client\APM2017GIS\ACH\02_GIS Maps\20180816_ACH026_ERD_APMSurveyTracks_Figure 4-3.mxd

Figure 5-3: APM (2018) Survey Tracks within the Ravensthorpe Gold Project Area

LEGEND

- APM Survey Tracks (2016 - 2018)
- Ravensthorpe Gold Project Area
- Mining Tenements

N

0 100 200 300 400 500

Meters

Date: 25/09/2018

Scale: 1:13,000

GDA 1994 MGA Zone 51

Author: sarah@animalplantmineral.com.au

ACHMINERALS

5.2.7.4 Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon inhabits a vast array of environments in Australia, and throughout the world (Pizzey & Knight, 2012). It is likely that individuals of this species would forage within the Kundip Mine Site as part of a broader foraging territory. Peregrine Falcons generally nest on cliffs, and sometimes in tree hollows therefore, there is no suitable natural habitat within the Project Area for nesting. However, abandoned pit walls can provide excellent artificial nesting habitat for this species. It is therefore speculated that the existing Two Boys pit could potentially provide nesting habitat.

This species has only been recorded once within the Project Area by APM in 2016. The individual was sighted opportunistically in 'Low Woodland Mallee and Heath' habitat within the Kundip Mine Site. Despite 12 sessions of bird monitoring at 6 locations within Kundip Mine Site in 2017, and intensive search efforts across the Project Area in 2016 and 2017 surveys, no further records have been made.

5.2.7.5 Ravensthorpe Range Slider Skink – *Lerista veduata*

The Ravensthorpe Range Slider Skink is a small (45 mm snout-vent) skink, endemic to the RRA (Cogger, 2014). Members of the genus *Lerista* share a high degree of commonality in their habits and ecology. Most *Lerista* sp. are burrowing species, in loose soil or sand, where they feed on ants and termites, and other small insects (Cogger, 2014). Other than generic information on the entire genus, there appears to be very little information known regarding this species, apart from the fact that it is only known from the RRA on the south coast of WA. The species has been previously recorded in Eucalypt woodlands on the south facing slopes of the Ravensthorpe Range (G. Harold pers. comm. 2004). Closer to the RGP the species has been recorded just to the west of the old Kundip townsite (G. Harold pers. comm.).

5.2.7.6 Quenda – Isoodon fusciventer

Quenda are widely distributed throughout the southwest of WA. The species is known to inhabit scrubby and swampy vegetation, with dense cover of up to 1 m high. Quenda often feed in adjacent forest and woodland that is frequently burnt, and in areas of pasture and cropland adjacent to dense vegetation. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses (DEC, 2012c). Quenda will thrive in more open habitat subject to introduced predator control.

Evidence of the presence of Quenda (diggings) was ubiquitous in all areas where understorey vegetation included sedges or dense low thickets. APM (2016) recorded Quenda diggings in all 3 fauna habitats identified in the Project Area.

5.2.7.7 Western Brush Wallaby – *Notamacropus irma*

The Western Brush Wallaby is endemic to the southwest of WA. This species prefers habitat of open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open, scrubby thickets (Van Dyck & Strahan, 2008). It is found in some larger areas of Mallee and heathland in the wheatbelt, but is uncommon in wet sclerophyll forest and absent from Karri (*Eucalyptus diversicolor*) forest where there is a dense understorey. They are primarily grazers, but little is known of food preferences. Unlike the Western Grey Kangaroo and Tammar Wallaby, it does not readily venture into open pasture adjacent to its bushland refuges (Van Dyck & Strahan, 2008).

Clearing for agriculture has fragmented the population and reduced the availability of habitat, while predation by foxes has reduced the species abundance. However, there are no specified current threats (Woinarski & Burbidge, 2016). Over the past 10 years, the Western Brush Wallaby population has increased in areas where foxes have been controlled (Woinarski & Burbidge, 2016).

One Western Brush Wallaby individual was recorded by APM south of the Project Area, nearby the Hopetoun-Ravensthope Road. Biota (2004a) also recorded this species as roadkill at the entrance to the Kundip site. The species was sighted by APM exiting the 'Low Woodland Mallee and Heath' habitat. It is considered likely that Western Brush Wallabies are present in this community, as well as the 'Damplands and Drainage' habitat within the Project Area.

5.2.7.8 Western Whipbird (Mallee) – *Psophodes nigrogularis oberon*

The Western Whipbird inhabits Mallee heath shrubbery with a dense understorey of up to 1.5 m (McNee, 1986). The presence of this species is dependent on the dense structure of the vegetation more than floristic composition (Smith, 1991). In the FRNP, the Western Whipbird is almost always recorded in long unburnt Mallee (>15 years). The species is predominantly sedentary (McNee, 1986), and builds nests close to the ground (<1 m high) in 'prickly' vegetation, predominantly in *Banksia caleyi*.

The Western Whipbird was opportunistically recorded within the Kundip Mine Site by Biota (2004). Following recommendations by the EPA to undertaken further survey work on this species, monitoring for Western Whipbird was undertaken by APM in 2017 and 3 sightings were opportunistically recorded. Both the Biota (2004) and APM (2017) surveys recorded this species in 'Low Woodland Mallee and Heath' habitat. APM also recorded this species in 'Low Dense Forest/ Forest' habitat which adjoins the aforementioned Mallee community.

APM and Biota records indicate the Western Whipbird prefers elevated open Mallee habitat on the upper hilltops and hill slopes across the eastern half of the Kundip Mine Site. Based on this species' suspected small home range, and behaviour of reusing previous nests (Smith, 1991), it is likely that Kundip Mine Site contains suitable breeding and foraging habitat for the Whipbird. However, the habitats in which this species have been recorded are broadly distributed across the Ravensthorpe Range.

5.2.8 Conservation Significant Fauna Highly or Moderately Likely to Occur but Not Recorded

5.2.8.1 Rainbow Bee-eater – *Merops ornatus*

The Rainbow Bee-eater is a widespread, highly mobile species found throughout mainland Australia, except in desert areas. The species breeds throughout most of its range, nesting in loosened soil in spoil heaps and topsoil dumps. The Kundip Mine Site would therefore contain significant areas of habitat for the Rainbow Bee-eater, most of which would be provided through artificial sources associated with previous mining.

5.2.8.2 Tammar Wallaby – Notamacropus eugenii derbianus

Tammar Wallaby have been recorded from road kill on the Ravensthorpe – Hopetoun Road (2 DBCA records) adjacent to the Project. No individuals have been sighted by APM during field surveys despite intensive on-ground searches across the Project Area. Remote sensing cameras recorded a number of macropods, and some photos may potentially be of Tammar Wallabies. However, the poor quality of nocturnal images precluded the positive identification of these captures. As a result, it is not possible to confirm presence of this species within the Project Area.

Tammar Wallabies if present would likely utilise the 'Low Woodland Mallee and Heath' and 'Low Dense Forest/ Forest' habitat types, as they require dense low undergrowth for daytime shelter, and open grassy areas for grazing (Van Dyck & Strahan, 2008). The Tammar Wallaby has suffered a recent decline in abundance and distribution, probably as a result of predation by the introduced red fox (Kinnear *et al.*, 2002).

5.2.8.3 Water Rat/ Rakali – *Hydromys chysogaster*

The Water Rat is a distinctive rodent specialised for an aquatic existence. The species generally occurs in permanent fresh or brackish water, from inland waterways to lakes, swamps and farm dams, and it can also be found in marine environments (Menkhorst and Knight, 2004). The Water Rat prefers habitats of dense, low-lying vegetation, with low density canopy cover, and shallow, narrow water bodies (Speldewinde *et al.*, 2013).

The species is largely carnivorous, consuming predominantly crustaceans, aquatic insects and fish. Among insects, water beetles (Family Dysticidae) and water bugs (Order Hemiptera) are of primary importance, and nymphs of damselflies and dragonflies (Order Odonata) can be seasonally important items. Birds, mammals, frogs, reptiles, mussels, spiders and plants are also occasionally eaten (Woollard *et al*., 1978; Harris, 1978).

Water Rats are a generalist species and have good dispersal capabilities. This species often forages on land and may move considerable distances when doing so. Water rats undertake regular movements along shorelines and follow regular routes when crossing bodies of water (Harris, 1978). While it is predominantly nocturnal, the Water Rat is often active for part of the day, in contrast with most Australian rodents. It is most active in the hours following sunset but may also be found swimming or foraging during daylight hours in the early morning or early evening (Bettink, 2016).

5.2.8.4 Western Mouse – Pseudomys occidentalis

The Western Mouse has been previously collected from 11 semi-isolated Conservation Reserves within the southern wheatbelt and south coast. Most capture sites have long unburnt vegetation, ranging from 15 to 50 years unburnt (Van Dyck & Strahan, 2008; Morris *et al*., 2008), which contain layers of extremely dense vegetation at 0.5 – 2.5 m high. Dominant overstorey taxa include *Eucalyptus* sp., *Isopogon* sp., *Acacia* sp., *Casuarina* sp. and *Melaleuca* sp. Various sedge species are also essential habitat features.

The Western Mouse is nocturnal, sheltering during the day in a burrow (20 – 30 cm deep). The species is communal with 10 animals having been collected from one burrow system. Individuals have been recorded travelling 600 m overnight from a trap-site to a burrow (Van Dyck & Strahan, 2008).

5.2.9 Conservation Significant Fauna Identified as a Factor by DBCA

5.2.9.1 Dibbler – Parantechnius apicalis

Dibblers have been recorded over an extensive area and it is likely that they can occupy a diverse range of habitats. Dibblers may prefer vegetation with a dense canopy of greater than 1 m high which has been unburnt for at least 10 years (Baczocha and Start, 1996). In some locations, the presence of Proteaceous and Myrtaceous flowering shrubs may also be important (Maxwell *et al*., 1996).

It was recognised that the Dibbler has the potential to occur within the Project Area based on a known population of Dibblers on the eastern side of the FRNP. In addition, the Project Area contains suitable habitat, appearing to be long unburnt, resulting in a thick understorey. A more intensive trapping program specifically targeting the Dibbler was undertaken by APM in 2017. This included trapping in a mosaic of post-fire heath sites within the Project Area and immediate surrounds, as the abundance of Dibblers is strongly correlated with time since fire. However, no Dibblers have been recorded within the Project Area during any of the fauna surveys.

5.2.9.2 Heath Mouse – Pseudomys shortridgei

The Heath Mouse was initially reported as a capture during the 2016 survey. The record was attributed following field identification based on diagrams of the posthallucal pad which differs slightly from the more common Bush Rat. The identification was made after direct comparison of the foot structure in the field where both the Bush Rat and the presumed Heath Mouse were available for comparison. The two specimen captures were not vouchered to the Western Australian Museum (**WAM**) for confirmation.

In 2017, an intensive trapping program was implemented for the Heath Mouse on two occasions (winter and spring) with aluminium box traps set at a high density in several different habitats across the Project Area. The trapping effort totalled almost 1000 trap nights. No records of the Heath Mouse were made despite abundant captures of the Bush Rat.

The lack of captures, the revisiting of data and photos from the 2016 survey work, and further liaison with an expert on this species (Damian Cancilla, PhD Candidate) has led to the conclusion that the Heath Mouse records from 2016 were mis-identified and were both Bush Rats with a less obvious elongated posthallucal pad.

While possible, it is unlikely the Heath Mouse occurs within the Kundip Mine Site. However, if it does, it will likely occur within the long-unburnt patches of 'Low Woodland Mallee and Heath' habitat, particularly in portions that contain *Banksia cirsioides*, which the species is known to utilise the dense and protective cover of this *Banksia* sp. to form their shallow nesting burrows (Damian Cancilla, PhD Candidate).

5.2.9.3 Western Bristlebird – Dasyornis longirostris

The Western Bristlebird is known from three locations including the Fitzgerald River National Park, Hassell (Cheynes) Beach/Waychinicup National Park/Two Peoples Nature Reserve and a translocated population near Walpole (though unknown if the population remains here). A record of two Bristlebirds at Kundip Nature Reserve (December 2003) was identified. It is unknown if the record represents permanent subpopulations or vagrant visitors across the reserve.

The Project is not in the preferred range for this species, which occurs mostly in the deep south west occupying the dense thickets and heath provided there. Although a record of two birds exist on the Jerdacuttup Road immediately south of the Project Area, APM has not identified the Bristlebird within Kundip despite transect survey work over three years (2016-2018) and targeted Bristlebird call play back monitoring over 16 acoustic survey sessions in October 2017 (8 predawn and 8 post-dusk 1 hour sessions). Furthermore, these records are isolated occurrences when they are compared to the 1000+ records made within, and adjacent to, the Fitzgerald National Park.

Based on the primary records in reserves containing bays and river systems, it is likely that the Bristlebird prefers open heaths near refuge clumps of dense watercourse thickets or taller dense shrubbery, though it is known to inhabit dense, low, closed heaths as well. The species builds low-lying nests in Sword Grass sedges. The Project Area may provide some suitable habitat, though it is not likely that birds would establish permanent populations, given the lack of permanent and large flowing water courses within the Project Area.

As exhibited by the records in the Kundip Nature Reserve, it is far more likely the species would inhabit surrounding undisturbed and unfragmented areas of native vegetation in the upper catchment of the Jerdacuttup river within the Kundip Nature Reserve. The river flows southeast along the Ravensthorpe Range where it reaches the Jerdacattup Lakes only a few kms from the ocean into the Jerdacuttup Lakes Nature Reserve. The portion of the river that extends 8 km from the Jerdacuttup Lakes retains water all year round, even when the Jerdacuttup Lakes dry out (DoE, 2004). This would be likely be a far more desirable area of suitable habitat for the Bristlebird and other birds, where a permanent source of water is provided all year round, especially for nesting.

5.2.9.4 Western Ground Parrot – *Pezoporus flaviventris*

The Western Ground Parrot is known to occur in heathland dominated by *Banksia* and *Hakea* and in low open Mallee in swampy areas. The species prefers vegetation that has been unburnt for at least six years (Cale and Burbidge, 1993). The species typically calls before dawn and after dusk and being difficult to see the species is easily missed during standard diurnal bird surveys.

The primary Western Ground Parrot population occurs within FRNP, with smaller populations to the west in the Cheyne Brach/ Waychinicup area and to the east in Cape Arid National Park and Nuytsland Nature Reserve. While these populations occur nearby the Project, and the Kundip Mine Site supports suitable vegetation, the Western Ground Parrot has not been recorded at the site during the Biota 2004 surveys or the APM 2016 and 2017 surveys.

6 DISCUSSION AND CONCLUSION

6.1 IMPACTS TO FLORA OF CONSERVATION SIGNIFICANCE

Calothamnus roseus is a species that has only been previously identified from the Ravensthorpe region. DBCA records of this species within the Project area occur in Communities 7 and 8 on the western side of Hopetoun - Ravensthorpe Road and Community 11. APM also identified populations of this species in Communities 1, 2, 5 and 9. Individuals were found to be particularly concentrated along a ridge within Community 1 and Community 7, indicating preferred habitat for this species. The number of individuals was not counted as the population did not occur within the proposed Project area at the time. Following small variations in the Project layout, a minor internal road now intersects the far eastern extent of the population polygon for this species. The majority of the population will not be impacted by the Project directly or indirectly. Overall impacts to this species are therefore expected to be low.

Dampiera sp. Ravensthorpe has been identified within the Ravensthorpe Range, though very little records have been made available in databases. The species is known to occur on weathered lateritic (gossen) rock of red to brown clayey-loam soils within hillcrests (in the rock cracks) and on hillslopes containing quartz. It is associated with regeneration after fire, and regeneration after disturbance (a DBCA record indicates 2 records found within an old drill pad). The species is associated with communities that contain re-seeder Eucalypt species found within the Ravensthorpe range, such as *Eucalyptus clivicola* mallee woodland, and occurs within shrublands of *Melaleuca hamata* and *Acacia durabilis* and *A. subcaerulea*. Craig *et al.* (2008) recorded this species 9 times across 204 sites across the entire Ravensthorpe Range (not a population estimate or number of individuals) and 3 records exist in the Range according to DBCA. The Project will impact 1 individual adjacent the firebreak, however given its response to fire, and the recent burning of the firebreak, (and continued monitoring and management of it by DBCA and ACH), it is possible the species will re-establish itself.

Hydrocotyle sp. Decipiens is a species that has been identified from the Ravensthorpe and Esperance regions. The species is known to occur in habitats such as riverbeds, banks and low-lying/ephemeral creek edges in black clay-loam soils, associated with fire disturbance (appearing after recent (<1 year) burns)). Although the Project would only result in the loss of up to four individuals from the Project area, APM (2018) extended the local population by 35 individuals with a survey in 2012 within an exploration tenement (Ard Patrick) outside and to the north of the Project area (E74/311). In light of this recent population extension, the loss of up to four individuals within the Project area will not constitute a significant impact.

Large populations of *Marianthus mollis* have been recorded multiple times in the north and east of the Project Area. This species is known to thrive in habitats consisting of hill tops with loose stones and lateritic soils and is associated with fire disturbance. This is particularly evident for the east population (the population to be impacted) where individuals were found to be highly concentrated in a strip of vegetation subject to a controlled burn by DBCA in 2008. The regenerative evidence of this species following disturbance in 2008 indicates that this species should recruit following disturbance associated with mining, and significant source populations of these species will still occur locally following the proposed amendment; the proposed impact to this species therefore will not constitute a significant impact.

Melaleuca sophisma is a species that has only been previously identified from the Ravensthorpe Region. DBCA records of this species have previously identified one population in Community 7, a second population in Community 9 and a third population in Community 2. The population in Community 7 was validated during APM surveys, a second population was identified nearby and a third population was recorded in Community 9. It is considered likely that these three communities represent preferred habitat for the species. It was identified that there may have been potential habitat for this species in the south eastern extent of the site;

however, a visual inspection of this area did not identify *Melaleuca sophisma*. None of the recorded populations will be directly impacted.

Pultenaea craigiana is a species that has only been previously identified from the Ravensthorpe Region. APM surveys recorded five individuals within Community 12 in the south-east of the Kundip Mine Site and a single individual in Community 6 towards the middle of the site. Three of the six individuals recorded by APM will be directly impacted by the Project. DBCA records have previously identified this species in seven other areas, and in multiple locations outside of the Project area, therefore there are undisturbed populations in areas surrounding the Project that will not be impacted.

Stachystemon vinosus has been recorded outside, to the south of the Project area according to the DBCA database. One population of the species was recorded during the 2017 APM field survey in the north-east of the Kundip Mine Site within Community 10. Despite extensive on-ground searches across the Project area, no other populations have been recorded. Based on DBCA records of this species, it appears to be fairly widespread within the Ravensthorpe and Esperance region. Disturbance of one population within the Project area is unlikely to impact representation of this species in the region.

Thysanotus parviflorus has been recorded outside, to the east of the Project area according to the DBCA database. APM surveys recorded three populations of this species within the Project area. Three populations occur within Communities 7 and 10 in the north of the Kundip Mine Site. These populations will not be directly impacted based on the current project layout.

6.2 IMPACTS TO VEGETATION OF CONSERVATION SIGNIFICANCE

6.2.1 PEC – Very Open Mallee over Melaleuca sp. Kundip Dense Heath

The total amount of this PEC as mapped by APM (2017) within the Project Area (34.2 ha) is more than the DBCA total mapped area in the Ravensthorpe Range (14 ha), indicating that this PEC is more widespread than indicated by the DBCA mapping based on more systematic mapping by APM (2017). A total of 1.2 ha (3.5%) out of the mapped 34.2 ha of this PEC will be impacted (Table 4-9). This amount of clearing is unlikely to impact the conservation status of the PEC, and surface water management along the road will further reduce any impacts to the community.

6.2.2 TEC/PEC – Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of WA.

A total of 38.4 ha out of the mapped 76.6 ha of this TEC/ PEC present within the Project Area is proposed to be impacted by the Project footprint (Table 4-9). Given that DBCA has mapped up to approximately 67,032 ha of this TEC/ PEC, impacts to the TEC/ PEC on a regional scale are expected to be very low and equate to around 0.1% of the overall TEC.

6.3 IMPACTS TO FAUNA OF CONSERVATION SIGNIFICANCE

The RGP is located at the southern end of the Ravensthorpe-Kundip copper-gold belt. This belt stretches 20 km in a north-south orientation, from just north of Ravensthorpe to south of the historic town of Kundip. Within the Kundip Mine Site there is significant historical disturbance legacy from small operations that commenced in the early 1900s. The number of mine shafts around the Kundip Mine Site is beyond count and of concern, having been left open without safety exclusion fencing by the previous tenement holders.

In the early 1900s much of the original vegetation at the Kundip Mine Site was cleared, with larger trees being felled and used for bracing mine shafts and the construction of gantries. Tall hollow bearing Eucalypt and Corymbia species, which would have provided essential nesting and roosting habitat for a number of arboreal and semi arboreal non-volant (non-flying) species and a number of predatory volant species, are all but absent. The current over-story vegetation does not accurately reflect the vegetation that would have been present had these small-scale mining operations not proliferated. There is little doubt that this major shift in vegetation attributes would have had a major impact on the faunal assemblages of the area. In addition to the changes in vegetation structure, the small-scale mines of the early and mid-1900s and the subsequent larger scale activities in more recent times have resulted in the clearing of approximately 30 ha within the Kundip Mine Site.

Nevertheless, the area still has intrinsic value in both vegetation and its associated fauna assemblages and contains a significant area of remnant vegetation. It was reflected in the surveys, that the small patch (<1 ha) of remnant vegetation between Kaolin Pit, Western Gem Pit and the Tailings Storage Facility continues to support a diverse array of mammals and reptiles. The innumerable mine shafts distributed across the site provide refuge for species such as the Chuditch and small Microchiropteran bats which would, under normal circumstances, take refuge in standing and fallen hollow limbs (or refugia offered by granite inselbergs).

Refugia are priority habitats for biodiversity conservation, due to their unique ecological and biological attributes (Keppel *et al.* 2012). They have led to the development of unique evolutionary units, they function to preserve habitats and potentially provide protection to biota under periods of stress, to survive, and to radiate under more benign conditions (Keppel *et al.* 2012). It is recommended that, whilst these sites do not occur in disturbance areas, refugial vegetation types surrounding the Project area are identified and surveyed over the life of the mine for both flora and fauna. These provide good research and preservation units under long term mining activities.

6.3.1 Current local and regional environmental values

The RGP occurs on the periphery of the Fitzgerald Biosphere, which is one of 15 biodiversity hotspots. The most valuable ecological attributes within this biosphere are protected within the Fitzgerald River National Park (FRNP). Radiating out from the FRNP, the peripheral areas of the biosphere are now regarded as buffer zones as of June 2017. They were previously known as ‘zones of co-operation’, where development can take place in an ecologically sustainable manner. The intent of the buffer zone is that development does not constrain or inhibit the radiation or movement of local fauna species, many of which have become threatened by fragmentation, land clearing, increased feral predation and competition from non-native species.

The Kundip Mine Site is situated in the foothills of the Ravensthorpe Range approximately 0.4 - 1 km north of the Kundip Nature Reserve (Reserve No. 31128). There is little capacity for the Kundip Mine Site to impact on local and regional flora and fauna values beyond the direct impacts of clearing for construction and operation. The activities forecast for Kundip are unlikely to constrain or inhibit the movement or radiation of species around the Project area, where they are free to radiate in large tracts of undisturbed vegetation.

The RGP Project will not degrade the local and regional fauna conservation values.

6.3.2 Future local environmental values

The RGP is not likely to have significant impact on site specific flora, vegetation and fauna values. Rather, the proposal to recommence mining presents a unique opportunity to improve conservation and land management through the implementation of mining and mine site related environmental management practices, such as introduced fauna, fire and weed management.

To date, very limited resources have been invested locally in fauna conservation by government and non-government entities, as evidenced by the number of key threatened species known to occur but not recently recorded and reported. For instance, records of the Chuditch are sporadic across the region and most are more than two decades old, however, the species is known to occur at Kundip and was recorded during the 2017 fauna survey of the Project area.

Local environmental values will be further improved through collaboration between ACH Minerals and Edith Cowan University. ACH Minerals has already instigated a process to increase the amount of zoological research at the site by providing some financial and a large amount of in-kind support to two Masters students with studies focussed on the habitat requirements of the Chuditch and the Malleefowl, which would be ideal, given the evidence found by APM of these species occurring, and occurrence of suitable habitat in and around the Kundip Mine Site.

The level of site specific localised impact from clearing and construction has the potential to be rapidly offset by the longer-term net positive impacts of proactive mine site environmental management.

6.3.3 Conservation Significant Fauna Impact Assessment

6.3.3.1 Carnaby's Cockatoo – Calyptorhynchus latirostris

Kundip Mine Site was assessed for the presence of suitable nesting habitat. Trees suitable for nesting typically must have a Diameter at Breast Height **(DBH)** of at least 500 mm. Across the Project Area only three trees were found that had the potential to host nesting hollows (and one other close to the minimum DBH) as outlined in Table 6-1. None of these trees were found to contain hollows. The potential nesting habitat present in the Project area is therefore not well represented for this species. Any disturbances associated with the construction and operation of the RGP will not have an impact on available breeding habitat for the Carnaby's Cockatoo given that no hollow-bearing trees have been identified.

Table 6-1: Black Cockatoo Nesting Tree Assessment

Tree ID	Diameter Breast Height (mm)	Height (m)	Hollows	Fire (Years since)
1	570	18	None	>10
2	510	16	None	>10
3	490	16	None	>10
4	720	15	None	>10

Carnaby's Cockatoo are likely to forage over several TECs including the 'Proteaceae Dominated Kwongkan Shrublands of the southwest coastal floristic province of WA' TEC (DoEE, 2018b). Vegetation communities have been identified within the Project area that are representative of this TEC and, therefore, it is evident that foraging habitat is present for this species within the Project area.

Carnaby's Cockatoo feed on a range of *Banksia* sp. *Hakea* sp., *Eucalyptus* sp. and *Corymbia* sp. and are therefore most likely to feed in the 'Low Woodland Mallee and Heath' habitat type. This habitat type is spread across 408.8 ha in the Project area, and 36.8 % (150.3 ha) will be cleared.

Development of the Project will therefore temporarily reduce the overall foraging habitat for the Carnaby's, but the impact of this in the Fitzgerald region is likely to be low given the amount of 'Excellent' condition vegetation in the surrounding area outside of the Disturbance Footprint (Craig, 2004; Craig *et al*., 2008) and included in the protected Kundip Nature Reserve (31128) to the south of the Kundip Mine Site.

Moreover, the Carnaby's Cockatoo has been observed feeding on revegetated foraging habitat at rehabilitated mine pits in the Jarrah Forest within eight years of establishment. Newly revegetated foraging habitat may be more productive for Carnaby's Cockatoo because of a lack of canopy (Valentine *et al*., 2014). Therefore, the impact associated with the clearing of vegetation will not be permanent as rehabilitated habitat will increase in value following mine closure and during the course of regeneration.

Based on regional vegetation mapping (DBCA, 2018; Craig, 2004;Craig *et al*., 2008) it is estimated that there is approximately 67,032 ha of Proteaceae dominated Kwongkan shrublands of the Southeast Coastal Floristic Province of WA in the Project region. The proposed Project clearing will therefore impact 0.1 % of this total area of potential foraging habitat. DoEE Species Profile and Threats Database mapping indicates that this vegetation type extends along the south coast from Albany, west of the Project Area, to Cape Arid National Park in the east (approximately 500 km).

Altered fire regimes that reduce the flowering and fruiting potential of species within vegetation types that are used for foraging have the potential to reduce local available food supply, which could compound the effect of the loss of foraging habitat from clearing. Fire management and mitigation actions in place on site, will reduce the potential impacts of intense fire on this species.

Carnaby's Cockatoos regularly use open artificial water (e.g. water troughs and ponds), late in the afternoon, prior to roosting for the night. While very unlikely to become entrapped, birds drinking from the TSF will be exposed to Cyanide. Maintaining a Cyanide concentration in tailings water below 50 mg/L, the level considered safe for wildlife, this risk will be mitigated.

Noise, vibration, lighting, entrapment and fragmentation are not likely to significantly impact this species.

6.3.3.2 Chuditch – Dasyurus geoffroii

The Chuditch has been recorded by APM in both 2016 and 2017 foraging on the periphery of the 'Low Woodland Mallee and Heath' habitat, likely utilising the patches of 'Low Dense Forest/ Forest' surrounding this habitat. As this species is an opportunistic feeder, its overlapping occurrence within both habitats is not unusual (Morris & Orell, 1993). Within the Project Area, 32.7% (17.2 ha) of this habitat type will be cleared. In the area within which this species was recorded was a number of mine shafts and a significant amount of building debris from the old Kundip Battery.

Records of conservation significant fauna were as expected in this region as the formal database records often do not reflect what is known locally and recorded anecdotally. For example, the last formal record of Chuditch was in the mid-1990s. However, mine site personnel have observed individuals in the area over recent years. Therefore, the capture of Chuditch on remote sensing cameras was anticipated.

Based on the solitary nature of this species and its large home ranges (DEC, 2012b; Serena and Soderquist, 1989), it is probable that numbers of Chuditch in this area would be very low. Given that this species was found within the same approximate area within the past two surveys, it is likely that 'Low Dense Forest/Forest' represents significant fauna habitat for the Chuditch present in that area. It is also possible that other areas

within the Kundip Mine Site that contain similar vegetation, might also provide significant foraging habitat for the Chuditch, given that the individual/s recorded have continued to use the site.

Clearing for construction of the mine site will impact foraging opportunities and home range of Chuditch found during the surveys (APM, 2018). However, significant tracts of similar habitat are likely to occur within the 10,369 ha of undisturbed vegetation mapped in the Ravensthorpe Range mapped by Craig *et al.* (2008) and nearby in the Kundip Nature Reserve.

The contraction of home ranges due to habitat fragmentation associated with mine infrastructure within Kundip may increase territoriality between Chuditch individuals (males). This has the potential to result in an increase of intraspecific competition for a mate (Belcher & Darrant, 2004) and a rise in the associated impacts of this (injury or potential death of male Chuditch). Female territoriality of den sites may also increase if female Chuditch home-ranges begin to overlap (Glen & Dickman, 2005), however this impact is minimised given the lack of suitable natural breeding habitat and lack of active/inactive nest recordings within the Project Area. The cost of territorial defence for females and mate competition in males (energy expenditure, risk of injury, competition for food resources) is likely to push individuals to occupy an exclusive territory instead, *i.e.* to move into undisturbed habitat outside of the Development Envelope (Belcher & Darrant, 2004; Glen & Dickman, 2005). This will likely mitigate the effects of home-range contraction due to habitat fragmentation within the Kundip Mine Site. The sufficient amount of suitable breeding and foraging habitat present outside of the Project Area is likely to normalise the home-range sizes and territories of Chuditch individuals occupying the Kundip-Ravensthorpe area and allow for a number of non-overlapping female ranges, which is integral to maintaining high population densities (Glen & Dickman, 2005).

Vehicle strike have a limited potential to influence local numbers of Chuditch. Vehicle speeds around the mine site would be too slow to present a threat to this elusive and agile species. Nevertheless, personnel will need to be vigilant driving around the site at night when it is possible that Chuditch may be immobilised by vehicle headlights/ spotlights, increasing the likelihood of vehicle strike. The overall risk from this can be mitigated through the application of speed limits and awareness, removal of road-kill at least 10 m from roads (as Chuditch will feed on road kill), inductions for discussions, and recording of sightings (including road-kills, if it were to occur).

The construction of Kundip Mine Site will likely attract a number of invertebrate species and small rodents through the creation of food wastes, potential shelter/ habitat for nests in buildings/ waste materials, and lighting (which would attract a number of invertebrate species including moths). It is therefore probable that the higher concentration such prey items would also attract the Chuditch. There is commonly an inverse relationship between the size of an animal's home range and density of its food resources, as increased resource availability can reduce competition and energy expenditure (Smith, 1968; Litvaitis *et al*., 1986). As a result, increased resource availability may inflate the carrying capacity of fauna habitat, and Chuditch that persist in the area post-construction may derive some benefit from the constructed mine site that provides abundant food resources and a more complex array of refuge. Physical structures created by humans can also increase and improve habitat heterogeneity. Shine and Fitzgerald (1996) were able to show that large pythons were prepared to use artificial shelters if they offered the same characteristics (e.g. thermal stability) as natural shelters. Research on Koolan Island of the Northern Quoll (PhD student; Jai Thomas, Murdoch University) has provided validation for the concept that post-mining landforms can provide suitably heterogeneous habitats for burrow, crevice or den dependent species, such as the Chuditch. These artificial habitats could result in an increased abundance and overall fitness of the local population after initial land clearing. Additionally, the potential increase in prey resources from the Mine Site may increase the amount of female Chuditch using the area in the future to derive their nutritional requirements for rearing young (Belcher & Darrant, 2004) and may consequently increase the likelihood of mothers using the mine shafts as nesting habitat.

ACH are committed to supporting a Masters Research project for this species in conjunction with Edith Cowan University. The outcomes of this research will be specifically aimed at better managing the local population. The focus of the research will be on the value of artificial habitats for sustaining populations during mining and continued management and monitoring of the population following closure.

Feral cats and introduced predators such as foxes, also predate heavily on Chuditch and an increase in these predator populations is perhaps the greatest potential threat for local Chuditch. This will be managed with proactive introduced animal control to mitigate this threat.

Increased frequency or severity of fire associated with mining is not likely to influence denning opportunities for Chuditch as there are no hollow-bearing fallen logs in the Project Area. However, altered fire regimes have the potential to greatly reduce ground and mid-storey cover in fragmented vegetation and increase exposure of foraging Chuditch to foxes and cats.

6.3.3.3 Dibbler – Parantechnius apicalis

'Low Woodland Mallee and Heath' is the habitat type most likely to be occupied by the Dibbler and is present across the majority of Project Area (408.8 ha). Based on the current Disturbance Footprint, 36.8% (150.3 ha) of this habitat type will be cleared.

The 'Proteaceae dominated Kwongkan shrublands', which extends over 76.6 ha in the Project Area, is recognised as valuable habitat for the Dibbler. It is estimated that there is approximately 67,032 ha of Proteaceae dominated Kwongkan shrublands in the Project region. DoEE Species Profile and Threats Database mapping indicates that this vegetation type extends along the south coast from Albany, west of the Project Area and to Cape Arid National Park in the east (approximately 500 km). Therefore, the proposed clearing of 38.4 ha for the RGP will impact < 0.1% of this vegetation type.

The mainland habitat of the Dibbler is characterised by the presence of long unburnt heathland, typified by sandy substrates and occasionally lateritic soils (Baczocha & Start, 1996). The Dibbler's requirement for long-unburnt vegetation may be related to high invertebrate density in thick leaf litter accumulations or to the cover afforded by dense vegetation which protects against predators, including birds of prey, foxes, and cats (Friend, 2003). In the absence of foxes, the Dibbler may occupy vegetation at an earlier stage of recovery after fire (Friend, 2003). Dibblers occupy distinct but overlapping home ranges and are thought to have relatively high site fidelity (Friend, 2003).

While this species is unlikely prone to vehicle strike, its persistence in the area would be intrinsically linked to the extent of habitat fragmentation arising from the construction of roads and infrastructure around the Project Area. Fragmentation is known to constrain an individual's ability to derive sufficient resources within its home range and can often lead to a decline in the local population to vulnerable levels in remnant vegetation. As a result, a loss of individuals and populations in all remnants across a site can occur. The constraint on resources can also cause individuals to cross barriers (roads) between habitats, which increases their exposure and subsequently elevates their risk of predation. Increased frequency of fire can also significantly increase the vulnerability of foraging individuals to predation in open areas.

If the Dibbler were present in the Project Area, all secondary impacts of light, noise, vibration and entrapment would have a deleterious impact on this species. It is possible that construction of the mine infrastructure and artificial lighting may increase the availability of invertebrate prey for this species. However, other impacts are likely to assert a greater deterrent for this species.

6.3.3.4 Heath Mouse – Pseudomys shortridgei

In 1987 this species was rediscovered in southwest WA in the FRNP, after being known only from scattered records in WA since 1906. The Heath Mouse has since been found at three other sites in the southern wheatbelt (Van Dyck & Strahan, 2008). Western Australian populations of the species are mainly associated with species-rich heath, with records from mixed scrub and Mallee. Within WA, Heath Mice have not been found in heath vegetation left unburnt for any less than 10 years, and as the vegetation matures they can eventually attain high densities in 30-year-old unburnt heath (Van Dyck & Strahan, 2008).

Though possible, it is unlikely the Heath Mouse occurs within the Project Area. If this species does occur, the habitat it would most likely occur within would be the long unburnt patches of 'Low Woodland Mallee and Heath', the most widely distributed habitat type within the Project Area. 36.8 % (150.3 ha) of the 'Low Woodland Mallee and Heath' habitat present in Project Area will be cleared.

The Heath Mouse, though functionally different to the Dibbler, will suffer the same impacts from the Project.

6.3.3.5 Malleefowl – Leipoa ocellata

The Kundip Mine Site has been extensively searched for Malleefowl and Malleefowl mounds. Given that the proposed Disturbance Footprint does not contain any active or recently inactive Malleefowl mounds, it is unlikely to represent significant breeding habitat for the species. Only one historic inactive mound is known to exist within the Project Area. The lack of suitability for nesting may be a function of the fire history. In areas where Malleefowl have been sighted during the field survey work, the vegetation and detritus layer is so thick and lacks any corridors or partially open areas, that the construction of mounds does not seem viable when compared to vegetation in other Project areas where mounds are common (M. Ladyman pers obs).

Despite there not being any mounds identified, Malleefowl individuals were recorded within and outside of the Project Area, suggesting that the Project Area may form part of a home range territory for a pair, or multiple pairs, of Malleefowl. The value of the foraging habitat depends specifically on the proximity of active mounds to the Project Area, but these mounds have simply not been located.

Within the Project Area, Malleefowl are most likely to occur within the 'Low Woodland Mallee and Heath' habitat, which is the most common habitat type, encompassing 408.8 ha. Of this, 36.8% (150.3 ha) of this habitat type will be cleared.

The clearing of vegetation within the Project Area is unlikely to significantly reduce the regional availability of suitable habitat, as the surrounding areas, outside the Development Envelope are of 'Excellent' condition (Craig, 2004; Craig *et al*., 2008). These adjacent areas likely provide a plentiful food resource and include significant tracts of relatively undisturbed vegetation for Malleefowl to move through without increasing their exposure to predators. Further, Malleefowl have large home ranges averaging 4 km^2 (Booth, 1987), and do not display territoriality (beyond defence of the nest site during breeding), meaning small changes to range areas, as a result of development of the Project are unlikely to significantly impact individuals.

ACH are committed to supporting a Masters Research project of this species in conjunction with Edith Cowan University. The focus of the research will be determining how clearing and topsoil stockpile creations can be modified to benefit nesting Malleefowl. The outcomes of this research will be specifically aimed at better managing the local population.

The greatest potential for impact to Malleefowl will come from vehicle strike and increased predation. Malleefowl are commonly observed on roadsides at dawn. They forage along the edges of roads where they can move easily between groves of vegetation where food is abundant. It is during this period where they are most susceptible to vehicle strike. When the sun is low, Malleefowl are very difficult to detect even at 40 kilometres per hour (**km/h**) and individuals are commonly observed dashing across roads out from under thick cover giving drivers limited time to avoid collisions.

Internal roads will have low vehicle speeds of 40 kph or less. It is therefore unlikely that individuals will be observed on the major connective roads. They are more likely to be observed on the peripheral roads.

One of the risks in clearing for the construction of the mine site is the increased potential for introduced fauna to predate Malleefowl individuals. Adult Malleefowl are extremely vulnerable to predation by foxes, while chicks are vulnerable to both foxes and cats. Increasing the road network around the mine site is very likely to increase the mobility of both these predators, and thereby increase predation opportunities. Therefore, ACH has committed to proactively manage introduced predators to reduce the potential for this secondary impact.

Altered fire regimes are not likely to significantly impact Malleefowl as much of the habitat that would typically be used for mound construction appears to be unsuitable due to the dense accumulation of vegetation and detritus in excessively long unburnt areas, which is potentially inhibiting nest construction. Though increased fire is not a preference for the Project, it would not be detrimental to this species locally within the Kundip site.

Incandescent lighting, noise, vibration and entrapment are not potential impacts for this species. As Malleefowl are not nocturnal and do or can forage on invertebrates, it would therefore be reasonable to expect Malleefowl to forage around the mine site area if construction of infrastructure is presenting resource opportunities. Moreover, individuals frequently nest and forage in roadside vegetation in the wheatbelt where larger tracts of remnant vegetation are not available. In these cases, vehicles create incessant noise in the day and night which has not been observed to inhibit nesting individuals or nest selection sites (i.e. the Malleefowl are not avoiding these high noise areas).

6.3.3.6 Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon inhabits a broad array of environments in Australia and throughout the world (Pizzey & Knight, 2012). This species nests in recesses of cliff faces, tree hollows or large abandoned nests. The record of the Peregrine Falcon at the Kundip site was expected for this species as it was observed in close association with a disused mine pit nearby the 'Low Woodland Mallee and Heath'. This species uses steep cliffs of exposed rock as nesting sites and old mine pits can provide excellent artificial nesting habitat. It is possible that the sighting of the Falcon near the disused mine pit, could reflect the presence of a nest, however no survey effort has been employed to confirm the presence/ absence of a nest in the area.

During the commencement of the Project, blasting within the existing Two Boys pit should be considered to take place outside of the nesting season for this species, as once a nest has been disturbed, local individuals will find another nest site and not return. The lack of access to the potential nest through blasting for the Falcon, will prevent an accurate assessment of the species presence/ absence in the area.

With regard to foraging, Peregrine Falcons would forage broadly over the sites and would not be specifically dependent on any one vegetation type. Whilst an opportunistic sighting within the 'Low Woodland Mallee and Heath habitat' was recorded, this species is not limited to this foraging habitat. Based on the current Disturbance Footprint, 36.8% (150.3 ha) of 'Low Woodland Mallee and Heath' in the Project Area will be cleared.

No other impacts associated with mining are likely to disturb the Peregrine Falcon.

6.3.3.7 Quenda – Isoodon fusciventer

Suitable habitat for the Quenda exists within the Disturbance Footprint and Quenda diggings have been recorded within the Project Area by APM in 2016. The Project is likely to impact individuals of this species through the reduction of habitat availability. Further, individuals may be killed if animals are trapped in burrows (Quenda can use old rabbit burrows to nest) or nests during clearing operations, though unlikely given

the noise disturbance generated for this process. The Quenda is one of the most urban adapted species of mammal in the southwest and populations will very likely rebound once clearing and construction is complete. The construction of mine infrastructure will provide an abundance of refuge for this species and invertebrates attracted by lighting and the creation of unique microhabitats for invertebrates and small reptiles will likely provide an additional food source for this species.

Evidence of the Quenda was ubiquitous in all areas where ground storey vegetation comprised sedges or dense low thickets. Quenda diggings were present mainly in the 'Damplands and Drainage Line' habitats, however the recent abundant rainfall may have caused individuals to radiate out of this habitat, resulting in the evidence of foraging being found within a number of sites. In total, 33.2 % (28.0 ha) of the 'Damplands and Drainage Line' habitat in the Project Area will be cleared based on the current Disturbance Footprint.

Quenda are vulnerable to vehicle strike where they occur in suitable habitat adjacent to roads that carry high traffic loads, but the reduction of vehicle speeds around the mine site would result in few deaths as Quenda are quite agile. Altered fire regimes could have mixed effects on this species. As Quenda are omnivorous, fires can promote new growth in the form of underground tubers, bulbs and corms, which have increased nutritional value. However, fire can also remove the valuable detrital layer that supports many of the invertebrate species Quenda consume. Fire can also increases the risk of predation. Where fire is occurring patchily, and refuge remains available, Quenda could prosper providing introduced fauna numbers are low.

Incandescent lighting, noise and vibration may initially impact the activity of local Quenda that persist beyond the clearing stage. However, there are innumerable examples where artificial light and noise fail to deter Quenda from foraging in a peri-urban environment (M. Ladyman, pers. obs).

6.3.3.8 Rainbow Bee-eater – *Merops ornatus*

The Rainbow Bee-eater is a widespread, highly mobile species found throughout mainland Australia, except in desert areas. The species breeds throughout most of its range, nesting in loosened soil in spoil heaps and topsoil dumps. The Kundip Mine Site would therefore contain significant areas of habitat for the Rainbow Bee-eater, most of which would be provided through artificial sources associated with previous mining.

Given this species is widespread, highly mobile and has a large breeding range throughout Australia the development of the Project is not expected to significantly impact the species. Future disturbance is also likely to provide greater nesting opportunities at the site.

6.3.3.9 Ravensthorpe Range Slider Skink – *Lerista veduata*

One Ravensthorpe Range Slider Skink was captured in a pit trap during the Biota (2004a) survey. The pit trap was located within the PEC 'Very open Mallee over *Melaleuca* sp. Kundip dense heath' which contains proteaceous thickets. The soils of this vegetation community were described as skeletal pale grey to orange loamy sands with lateritic gravel.

Whilst impacts to individuals of this species are possible, the number of individuals likely to be impacted is expected to be small as the species is likely not abundant in the area. Survey efforts by APM in 2016 and 2017, and intense raking through soil by Biota (2004b) specifically where an individual was collected, have failed to yield additional individuals.

The location of the individual collected was in the 'Low Woodland Mallee and Heath' habitat type in the higher topography of the Project Area (the north east corner) by Biota (2004). This area will be disturbed for the inclusion of WRL north, which will include the clearing of 37.1 ha of native vegetation. However, in total, only 150.3 ha (36.8 %) of the Low Woodland Mallee and Heath habitat of the 408.8 ha present in the Project area, will be cleared.

Altered fire regimes, specifically an increase in burn frequency or intensity, may threaten this species at a local scale. Being fossorial this species is likely vulnerable to intense wildfires that burn hotter in the dense heath, rather than more open areas with lower fuel loads. In addition, there is some possibility for entrapment in drill holes that are excavated below the surface and left uncapped. However, these are not likely to be present following rehabilitation of drill collars in the Project Area.

6.3.3.10 Tammar Wallaby – Notamacropus eugenii derbianus

The Tammar Wallaby inhabits coastal scrub, heath, dry sclerophyll forest and thickets in Mallee and woodland (Van Dyck & Strahan, 2008). This species is nocturnal, sheltering in dense, low vegetation during the day, and grazing in open grassy areas at night. Tammar Wallabies do not require any specialised habitat for breeding. Individuals have defined home ranges that overlap with those of other individuals. While several wallabies are often observed feeding in the same area, this species is solitary, and no social grouping has been observed except between females and their young at foot (Van Dyck & Strahan, 2008).

While Tammar Wallabies have not previously been recorded within the Project Area, it is considered to potentially occur due to the presence of suitable habitat and two sightings of road kill along the Hopetoun – Ravensthorpe Road. In total, 32.7% (17.2 ha) of the 'Low Dense Forest/ Forest' habitat, and 36.8% (150.3 ha) of the 'Low Woodland Mallee and Heath' habitat present in Project Area will be cleared. The availability of 'Excellent' condition (Craig, 2004; Craig *et al.*, 2008) low and dense vegetation throughout the areas surrounding the Project Area is expected to be utilised for daytime shelter and suggests that impacts to this species will be minimal.

The Project is unlikely to impact the survival of the population within the vicinity of the Project Area, particularly if introduced animal control is undertaken, as it is introduced fauna predation that is the greatest threat to this species following the impact of land clearing.

Vehicle strikes are a potential impact associated with the Project. Reduction of vehicle speeds to 40 kph or less would greatly reduce the likelihood of vehicle strikes when driving through site. Increased traffic on the Hopetoun Ravensthorpe Road, as a function of the mining operation, will increase the likelihood of fauna deaths between Kundip and Ravensthorpe. The likelihood can be decreased if traffic in periods of low or no daylight is reduced.

6.3.3.11 Water Rat – Hydromys chrysogaster

The Water Rat has not previously been recorded within the Project Area. It has the potential to occur, as there are permanent water sources within historical excavation areas and surrounding areas. It may also occur within the nearby Steere River and associated tributaries when they flow following rainfall, particularly within any pools that may temporarily form during winter and spring (Jun – Oct). The species prefers shallow, narrow waterways with dense, low surrounding vegetation (Speldewinde *et al.*, 2013).

Based on the habitat preference of the Water Rat, there is unlikely to be suitable sites for this species within the Project Area. Following construction of the mine, this species could occasionally appear in permanent mine ponds or dams; however, these are unlikely to provide food or shelter, and if this species were to enter the Project Area and use partial suitable habitat, it would likely only be temporary. If present, this species would be expected to be confined to the 'Damplands and Drainage' habitat within the Project Area, 33.2% (28.0 ha) of which will be cleared.

There are unlikely to be significant impacts to this species as a result of the mine development.

6.3.3.12 Western Brush Wallaby – *Notamacropus irma*

The Western Brush Wallaby was recorded both during the Biota (2004a) survey as roadkill, and the APM 2017 survey as an opportunistic sighting. Both records of the Western Brush Wallaby have been made on the Hopetoun - Ravensthorpe road near 'Low Woodland Mallee and Heath'. In total, 36.8% (150.3 ha) of the 'Low Woodland Mallee and Heath' habitat present in the Project area will be cleared. This species prefers open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open, scrubby thickets (Van Dyck & Strahan, 2008). Vegetation within the Project area, however, consists primarily of dense undergrowth (perhaps a result of the suspected long unburnt vegetation), which is not favoured by the species.

It is possible that the species utilises the area due to the mosiac of dense undergrowth with disturbed areas and the development of the Project may push the species into surrounding areas. Given the availability of 'Excellent' condition (Craig, 2004; Craig *et al.*, 2008) vegetation in these areas, however, this is unlikely to impact the survival of the population within the vicinity of the Project Area, particularly if introduced fauna control is undertaken. It is likely that a mosaic of burnt and unburnt vegetation exists in the surrounding areas which could be beneficial for this species.

Vehicle strikes are a potential impact associated with the Project. Reduction of vehicle speeds below 50 km per hour would greatly reduce the likelihood of vehicle strikes. Increased traffic on Hopetoun - Ravensthorpe Road, as a function of the mining operation, will increase the likelihood of fauna strike. The likelihood can be decreased if traffic in periods of low or no daylight is reduced.

6.3.3.13 Western Bristlebird – Dasyornis longirostris

The Western Bristlebird has not been recorded by APM during any of the transect survey work over three years (2016-2018) or the 16 targeted call play back monitoring sessions undertaken in October 2017 (APM, 2018). The species has previously been recorded in 2003 along the Jerdacuttup Road south of the Project Area in the Kundip Nature Reserve.

If this species is present in the Project Area, it is likely to only be transitory. The Western Bristlebird is likely to inhabit the areas of the Damplands and Drainage Lines habitat, adjacent to Low Woodland Mallee and Heath , in the west of the Project Area where the Damplands habitat is most represented. A total of 33.2% (28.0 ha) of the 'Damplands and Drainage' habitat and 36.8% (150.3 ha) of the 'Low Woodland Mallee and Heath' habitat present in the Project Area will be cleared. This will not constitute a significant impact to this species as these habitat types are represented extensively over the entire Ravensthorpe Range and south west.

If this species is a transitory visitor along the Hopetoun-Ravensthorpe Road, the potential impacts to this species could include vehicle strike. However, this species is known to be shy and difficult to sight, often remaining hidden in the dense heath (Morcombe, 2011), and this behaviour may mitigate some of the risk of vehicle strike . Indirect impacts include loss of Project Area and surrounding undisturbed vegetation due to high intensity burns caused by mine-related actions. However, this is expected to be a very low likelihood based on the management in place for accidental fires on site, and the protection of the firebreak within the site, preventing the rapid spread of fire into adjacent vegetation.

6.3.3.14 Western Ground Parrot – *Pezoporus flaviventris*

The largest population of Western Ground Parrot occurs within the FRNP, with smaller populations to the west in the Cheyne Brach/ Waychinicup area and to the east in Cape Arid National Park and Nuytsland Nature Reserve. While the Project Area occurs nearby these populations and supports suitable vegetation, the Western Ground Parrot has not been recorded within the site during the Biota 2004 surveys or the APM 2016 and 2017 surveys.

The Biota 2004 search effort comprised 17 hours of census observation within discrete habitat types and a further 23 hours attributed to walking transects. The APM 2017 search effort comprised 16 hours of call playback pre-dawn and post-dawn and no individuals of the Western Ground Parrot were identified. Though this species may forage within the vegetation assemblages of the Project Area, it would not be specifically dependent upon them and the extent of proposed disturbance is not likely to influence local or regional populations.

Altered fire regimes have the potential to adversely impact this species that is dependent on a particular suite of vegetation for feeding. Loss of significant tracts of vegetation to wildfire would result in individuals foraging elsewhere. Patchy mosaic burns can benefit the species, however, by increasing food diversity. Fire Management has the potential to reduce impacts to this species, should individuals use the Kundip site.

The Western Ground Parrot is very susceptible to predation as it spends the majority of its activity feeding, resting and nesting on the ground in low, dense heathlands. In the context of an active mine site and increased vehicle presence there is some potential for vehicle strikes as this species flies with rapid speed, but very low over the low heath vegetation. Movements are typically limited to one hour prior to sunrise and one hour after sunset which can be a period of high vehicle activity with personnel shift changes. The unusual movement times also mean that this species may be deterred from using habitats around the site if area is constantly illuminated.

This species is also likely to be deterred from occupying habitats around the mine site due to noise and vibration.

6.3.3.15 Western Mouse – Pseudomys occidentalis

The Western Mouse occurs in dry shrubland, Mallee, and woodland that is long unburnt (15-50 years) and contains patches of dense understorey (Lee, 1995). This species has likely been in decline since before European settlement in Australia, which may have been accelerated by the loss of habitat due to land clearing, altered fire regimes, and predation by foxes and cats (Morris *et al*., 2008). Remaining populations are now restricted to small fragments (i.e. nature reserves of less than 1,000 ha), increasing their vulnerability (Morris *et al*., 2008).

The Western Mouse has not been recorded within the Project Area during surveys. Potential habitat may exist in the future, dependent on fire regimes. Within the Project Area, Western Mouse is likely to be located within long-unburnt patches of 'Low Dense Forest/Forest', 32.7% (17.2 ha) of which will be cleared. Much of the Project Area has not been burnt for >10 years. Despite this, the development of the Project Area would be unlikely to significantly impact this species due to the large amount of 'Excellent' or higher condition vegetation surrounding the Project Area, including the nearby Kundip Nature Reserve. Persistence of local populations of this species is more likely as ACH will actively manage introduced fauna on site.

6.3.3.16 Western Whipbird (Mallee) – *Psophodes nigrogularis oberon*

The Western Whipbird (Mallee) is confined to coastal or near coastal regions of southwest WA. The species inhabits Mallee heath shrubbery with dense understorey of up to 1.5 m (Cale and Burbidge, 1993; McNee, 1986). The Western Whipbird relies on dense stands of vegetation that is long unburnt (>15 years) (McNee, 1986).

Western Whipbird (Mallee) (*P. nigrogularis oberon*) was delisted from the EPBC Act in 2009 as land clearing was no longer considered a key threat to the species, given the remaining populations occur predominantly within reserves. Populations of the species that occur in the Stirling Range National Park and the FRNP have been identified as the two largest populations across the subspecies geographic distributions (TSSC, 2009).

Clearing of habitat outside reserves may be a threat to the subspecies, but the Committee judged that clearing will not cause a substantial reduction in numbers of the species in the immediate future.

The Western Whipbird has been recorded within the Kundip Mine Site by Biota in 2004 and APM in 2017. These recent records, coupled with the high site fidelity, suggest the Kundip Mine Site contains suitable breeding and foraging habitat for this species.

Records indicate that this species prefers elevated open Mallee habitat on the upper hilltops and hill slopes, which occurs in the eastern half of the Kundip Mine Site. Similar habitat is broadly distributed across the Ravensthorpe Range, meaning that the proposed extent of disturbance is unlikely to have a significant impact on local or regional populations. Of the two habitats within which the Whipbird has been recorded, 36.8% (150.3 ha) of 'Low Woodland Mallee and Heath' habitat and 32.7% (17.2 ha) of the 'Low Dense Forest/Forest' habitat, will be cleared.

Given the species has an affinity for reusing nests/ nest sites, an increased frequency of fire is likely to have a significant impact on nesting success of local individuals. Any increase in the presence of feral cats may also impact this species because nest construction occurs in relatively low strata vegetation. The management of fire and introduced fauna by ACH will contribute significantly to the security of individuals of this species that persist following clearing and construction.

It is unlikely that the Western Whipbird (Mallee) will respond favourably to increases in noise and vibration. It is more likely that nesting pairs will move away from the Development Envelope, though they may continue to forage in the vicinity.

While the RGP will have a localised impact on habitat within the Project area that may potentially support fauna of Conservation Significance, the extent of 'Excellent' or higher quality vegetation in adjacent areas and throughout the region will provide a suitable refuge and source of foraging for fauna relocating from the Project area.

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APPENDICES

APPENDIX 1: CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA

Department of Parks and Wildlife

CONSERVATION CODES

For Western Australian Flora and Fauna

Specially protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.

Categories of specially protected fauna and flora are:

T **Threatened species**

Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.

Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN **Endangered species**

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU **Vulnerable species**

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX **Presumed extinct species**

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA **Migratory birds protected under an international agreement**

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

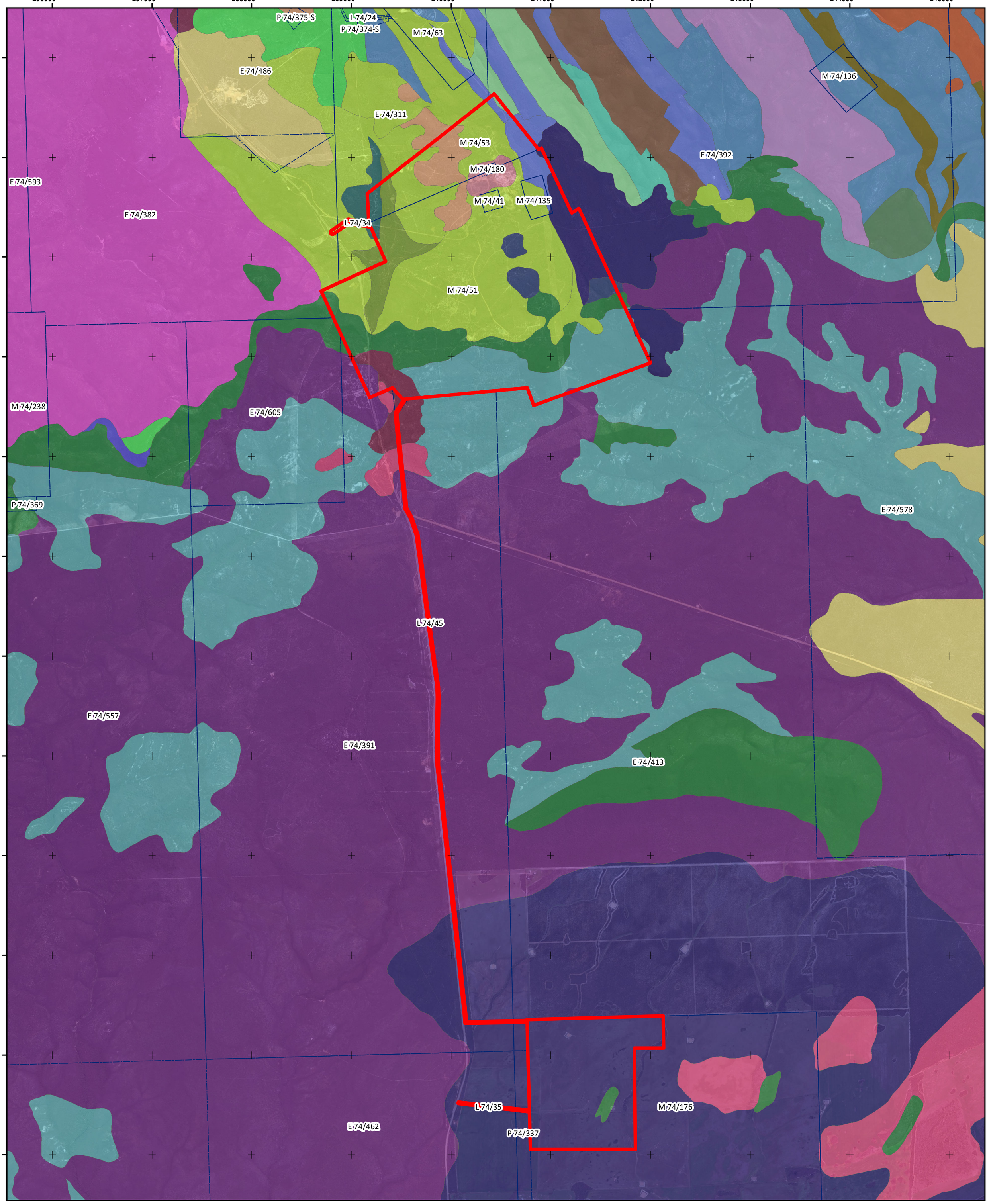
4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens
[2]Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

APPENDIX 2: RAVENSTHORPE AND COCANARUP GEOLOGY MAP

Ravensthorpe and Cocanarup Geology 1:100,000



LEGEND

Geological Units					
AAv	ACs	Czl	PLBy		
ABk	AMb	Czs	Qa		
ABt	AMd	Czsr	Qcb		
ACc	AYt	Opencut	Qcg		
ACg	Afv	PLBk	TPp		
ACp	Czf	PLBsc	RGP Development Envelope		
	Czi	PLBsd	Mining Tenements		

Document Name: 20180117_ACH014_BiolRpt_Geology

Author: sarah@animalplantmineral.com.au

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Kilometers

Scale: 1:24,500
Date: 17/01/2018
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APPENDIX 3: 2004 BIOTA BIOLOGICAL SURVEY REPORT

BIOta | Biota Environmental Sciences

Fauna and Fauna Assemblages of the Kundip and Trilogy Study Sites

Fauna and Fauna Assemblages Report

Prepared for:

Tectonic Resources NL

Prepared by:

Biota Environmental Sciences Pty Ltd

May 2004

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Front cover photographs - Honey Possum, Pygmy Possum, typical habitat and the trapdoor spider *Aname mainae* overlaid on aerial photography of the study site.

Fauna and Fauna Assemblage Survey Report of the Kundip and Trilogy Study Sites

Contents

Tables

Figures

Plates

Summary

Introduction
Tectonic Resources NL as owners of the Phillips River Gold Project aim to develop the gold/copper resource at the Kundip site and the polymetallic resource at the Trilogy site, located 16 and 26 kilometres southeast of Ravensthorpe respectively. An open cut pit is planned for the Trilogy deposit, whilst underground mining and an open cut are planned for the deposits at Kundip.

Aims and Methods
A field survey was conducted over a 10-day period between the 5/1/2004 and 14/1/2004, following a 12-month period of slightly above average rainfall, though this was preceded by an extended dry period.

The primary aims of the survey were to:
- Collect information on the presence of vertebrate fauna and selected invertebrate taxa (short range endemics);
- Document the relative abundance of species;
- Document the components of the physical environment (ie. the fauna habitat); and
- Document existing levels of disturbance.

Systematic censusing focused on the Kundip study site, as the Trilogy site comprised cleared farmland. The central component of the systematic censusing consisted of seven trapping grids, each located within a defined habitat. Each trapping grid consisted of two rows of six pitfall traps. The rows were set approximately 50m apart, and the pits (alternating 20 litre buckets and pvc tubes) within rows were spaced at approximately 8m intervals and connected with a single length of 30 cm high flywire fence. At each site, a medium size Elliott trap was placed adjacent to each pit and a row of eight Elliott traps was positioned such that it bisected the two pit lines. In addition to these sites, a single transect of 25 cage traps was established through the *Eucalyptus clivicola* woodland.

Twenty-three 40 minute and two 60 minute avifauna censuses were conducted across nine sites during the survey. Censuses were typically made from 6 a.m. through to midday.

Targeted invertebrate groups were sampled through systematic and opportunistic collections during the survey and included:
- Araneae (Spiders, in particular Trapdoor and Wolf Spiders);
- Pseudoscorpionida (Pseudoscorpions);
- Scorpionida (Scorpions);
- Diplopoda (Millipedes); and
- Pulmonata (Land snails).

A range of non-systematic fauna survey activities was undertaken by the survey team to supplement the trapping and investigate additional habitats identified during the course of the survey.

Results
The field survey recorded a combined total of 99 vertebrate species including 62 species of bird, 11 native mammals, two introduced mammals, 21 reptiles and three frogs.

The total of 62 species of birds comprised 30 families and included 24 non-passerine and 38 passerine species. The tally from the Kundip site comprised 18 non-passerines and 35 passerines from a total of 27 families. The tally from the Trilogy site comprised six non-passerines from three families and four passerines from four families.

The survey recorded 13 species of mammals, comprising one tachyglossid (Echidna), one dasyurid (carnivorous marsupial), two macropods (kangaroos and wallabies), one

burramyid (Pygmy Possum), one tarsipedid (Honey Possum), three vespertilionids (vespertilionid bats), one molossid (sheathtail bat), one native and one introduced murid (murid rodents) and one canid (Fox).

The reptiles comprised four geckos, three pygopodids, one agamid, one varanid, 10 skinks and two elapid snakes. All were recorded from the Kundip site.

Over 30 invertebrate taxa were recorded from the Kundip study site, many of which were not identified beyond family level. The only taxa identified to genus or species level were those belonging to groups known to include short-range endemics (Mygalomorphs, Pulmonate land snails), that were otherwise of conservation significance (Buprestidae), or for which expertise was readily available at the WA Museum (eg. wolf spiders and other spider groups).

Two species of mygalomorph spiders from the family Nemesiidae were recorded from the Kundip project area; *Aname mainae* and *Chenistonia tepperi*. Both species (as they are currently recognised) have broad distributions through the South-west of WA. A single *Bothriembryon* that was not known to Ms Shirley Slack-Smith (WA Museum) was collected during the survey from leaf litter at KU8. The conservation status of this taxon is unknown.

A search of the CALM Schedule and Priority Fauna database for species potentially occurring in the area yielded five Schedule 1 species, one Schedule 4 species and five Priority species. An additional Schedule 1, Schedule 4 and Priority taxon may occur in the area based on other information. The 14 conservation significant species potentially occurring in the area are discussed briefly below.

Schedule 1 Fauna

- Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under *EPBC Act 1999*)

Recorded on three occasions as flocks of between two and seven individuals flying over the project area.

- Western Ground Parrot *Pezoporus wallicus flaviventris* (Endangered under *EPBC Act 1999*)

It is possible, but not probable that the species occurs in the study area. Factors in favour of its occurrence are that the study area lies between known populations and the habitat appears suitable. Factors against its occurrence are that the distribution of the subspecies is well known, and that although the area is relatively frequently visited by birders, this taxon has not been recorded.

- Malleefowl *Leipoa ocellata* (Vulnerable under *EPBC Act 1999*)

A single record from the project area. This species appears to be relatively common in the Ravensthorpe district compared to elsewhere in its range, and has been recorded throughout mallee-heath habitat in the Fitzgerald Biosphere Reserve (Teale et al. in prep.).

- Chuditch *Dasyurus geoffroyii* (Vulnerable under *EPBC Act 1999*)

Single record of this species from the Kundip townsite during 1992.

- Dibbler *Parantechinus apicalis* (Endangered under *EPBC Act 1999*)

Record from Kundip in 1986.

- Heath Rat *Pseudomys shortridgei* (Vulnerable under *EPBC Act 1999*)

This species was not recorded during the current survey, however suitable habitat occurs across much of the lease. Within the Fitzgerald Biosphere Reserve, this species appears to be largely confined to habitats with a mallee overstorey on variable soils, including loamy-sands and sandy-loams with a laterite component, stony clays and sandy light clay on greenstone (Cooper et al. 2003; Teale et al. in prep.).

Schedule 4 Fauna

- Peregrine Falcon *Falco peregrinus*

This widespread species, although common in parts of WA, would be rare or scarce in the project area according to Johnstone and Storr (1998). It primarily inhabits wooded watercourses and lakes, coastal cliffs, rivers and ranges, none of which are prevalent in the project area.

- Carpet Python *Morethia spilota imbricata*

This sub-species is broadly distributed across much of the South-west, but has been given its protected status due to the fact that it is not common anywhere in its range. Teale et al. (in prep.) collated just three records from two sites for the Fitzgerald Biosphere Reserve.

Priority Taxa

- *Lerista viduata* (Priority 1)

Single individual recorded from a pit trap at KU2.

- Quenda *Isoodon obesulus fusciventer* (Conservation Dependent, Priority 4)

No convincing evidence of this species was recorded from the project area, although old diggings that may indicate the presence of this species were recorded along the Steere River. This species has been recorded from the Fitzgerald Biosphere Reserve as far east as Bandalup Hill (Teale et al. in prep.).

- Tammar *Macropus eugenii derbianus* (Conservation Dependent, Priority 4)

Not recorded during the survey but there are two recent records of road kills from just south of the old Kundip townsite on the Ravensthorpe to Hopetoun Road.

- Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* (Priority 4) (Vulnerable under *EPBC Act* 1999)

Identified on six occasions from calls given in mallee associations (sites KU1, KU2 and KU3). Johnstone (pers. comm. 2004) considered this species to be common throughout the Ravensthorpe district in suitable habitat.

- Western Mouse *Pseudomys occidentalis* (Priority 4)

Habitat for this species is described as shrublands on clay loams, usually with a laterite component, that have not been burnt for 15-30 years (Lee 1995). Though not recorded during the current survey, this species may occur in the Kundip area.

- Western Brush Wallaby *Macropus irma* (Priority 4)

During the current survey this species was recorded from a single carcass on the Ravensthorpe to Hopetoun Road, just to the north of the mine entrance.

Recommendations

The following recommendations arise from the fauna survey of the Kundip study area:

1. The opportunity exists, should the project proceed, to utilise existing cleared and disturbed areas for proposed new disturbances. The use of these disturbed areas should be maximised as part of project design.

2. Within the Kundip lease area, mature woodland habitat is restricted in distribution and supports both an abundant and species rich fauna assemblage. This is evident in the very high number of captures of species such as the Western Pygmy Possum *Cercartetus concinnus* and *Diplodactylus granariensis granariensis*. Clearing of mature woodland should be minimised wherever possible.

3. The proponent should undertake an additional seasonal survey of the project area to more fully document the faunal assemblage and identify any additional constraints. This study could usefully target threatened fauna taxa not well represented during the current survey including Schedule listed rodent and bird species.

1.0 Introduction

1.1 Project Background

Tectonic Resources NL as owners of the Phillips River Gold Project aim to develop the gold/copper resource at the Kundip site and the polymetallic resource at the Trilogy site, located 16 and 26 kilometres southeast of Ravensthorpe respectively (Figure 1.1). An open cut pit is planned for the Trilogy deposit, whilst underground mining and an open cut are planned for the deposits at Kundip. A final proposed footprint of the project area was not finalised at the time of preparing this report.

The Trilogy deposit is situated on freehold land that is currently an operating wheat/sheep farm (mining lease M74/176), whilst the Kundip deposits are encompassed by granted mining leases M74/41, 51, 53 and 135, and P74/153. M74/51 encompasses much of the historic mining area of Kundip with existing pits, numerous shafts, abandoned buildings and infrastructure, including tracks.

Given that the Trilogy site comprises farmland, the trapping effort focussed on the remnant vegetation within the Kundip study site. An assessment of the Trilogy site was made during a brief two-hour site visit.

1.2 Regional Setting

The project areas are situated entirely within the Esperance Plains Bioregion (Thackway and Cresswell 1995, Environment Australia 2000) of the South-west of Western Australia, a region recognised as one of the world's biodiversity hotspots (Myers et al. 2000). Furthermore, Kundip and Trilogy are situated within the zone of cooperation of the Fitzgerald Biosphere Reserve, an area established to help manage conservation efforts within the Fitzgerald River National Park.

The Ravensthorpe Range is the most significant inland topographic feature in the Fitzgerald Biosphere Reserve, and part of an important vegetation corridor. It also comprises the upper catchment of the Steere River, and some of the catchment of the Jerdacuttup River.

1.2.1 Fauna Habitats

Fauna habitats align closely with the major vegetation communities, which reflect changes in slope, aspect and soil type. A vegetation survey of the Kundip study site recognised 18 vegetation types (Craig 2004). These fall within three broad habitat types based on those recognised by Teale et al. (in prep.) in their review of the fauna of the Fitzgerald Biosphere Reserve:

- Mallee-heath –various species of mallee eucalypts over an understorey ranging from scrub to heath from 0.5-2.0 m tall on variable soil types;
- Woodland – Moort *Eucalyptus platypus* and mallet of various species with a shrubland or heath understorey over very sparse herbs on loamy to clayey soils; and
- Shrubland –shrub lifeforms over 2 m, with or without a lower shrub storey.

In addition the Trilogy site comprised a fourth broad habitat type:

- Farmland – habitat includes open paddocks, farm dams, buildings and shelter belts.

1.2.2 Previous Surveys

Teale et al. (in prep.) summarise a variety of biological surveys that have been carried out in the Fitzgerald Biosphere Reserve, and include data from the collection at the Western

Australian Museum. Whilst none of these surveys have trapped for vertebrate fauna within either the Kundip or Trilogy Project areas, Sanders (1996) established a number of survey sites in the area surrounding Kundip and data from these sites are included in this document. Information has also been obtained from data collected by Craig and Chapman (1998), Chapman (2000) and Biota (2000) for the Bandalup Hill proposal. All data presented in Teale et al. (in prep.) and used for regional context herein were collected by the authors (including R. Teale and G. Harold), are supported by specimen based collections, or were sourced from the collection at the Western Australian Museum.

Teale et al. (in prep.) summarise data collected from over 20,000 Elliott trap nights, 2,000 cage trap nights and 9,000 pit trap nights, in addition to opportunistic sightings from over 200 sites throughout the Fitzgerald Biosphere Reserve. These data provide a valuable tool for placing the fauna assemblages recorded from Kundip in regional context. This is particularly the case for rare and uncommon fauna.

1.3 Aims

This report documents the results of a 10 day fauna and fauna assemblage survey of the Kundip study site, and a brief reconnaissance survey (over 2 hours) of the Trilogy site. In general, the discussion on aims and methodology that follows is largely focussed on the work undertaken in the Kundip study area.

The primary aims of the surveys were to:

- Collect information on the presence of vertebrate fauna and selected invertebrate taxa (short range endemics after Harvey (2002));
- Document the relative abundance of species;
- Document the components of the physical environment (ie. the fauna habitat); and
- Document existing levels of disturbance.

These data have been collected to permit the Environmental Protection Authority (EPA) to apply the overarching principles for Environmental Impact Assessment of Biodiversity outlined in Position Statement No. 3 *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and draft Guidance for the Assessment of Environmental Factors for Fauna Surveys (EPA 2003).

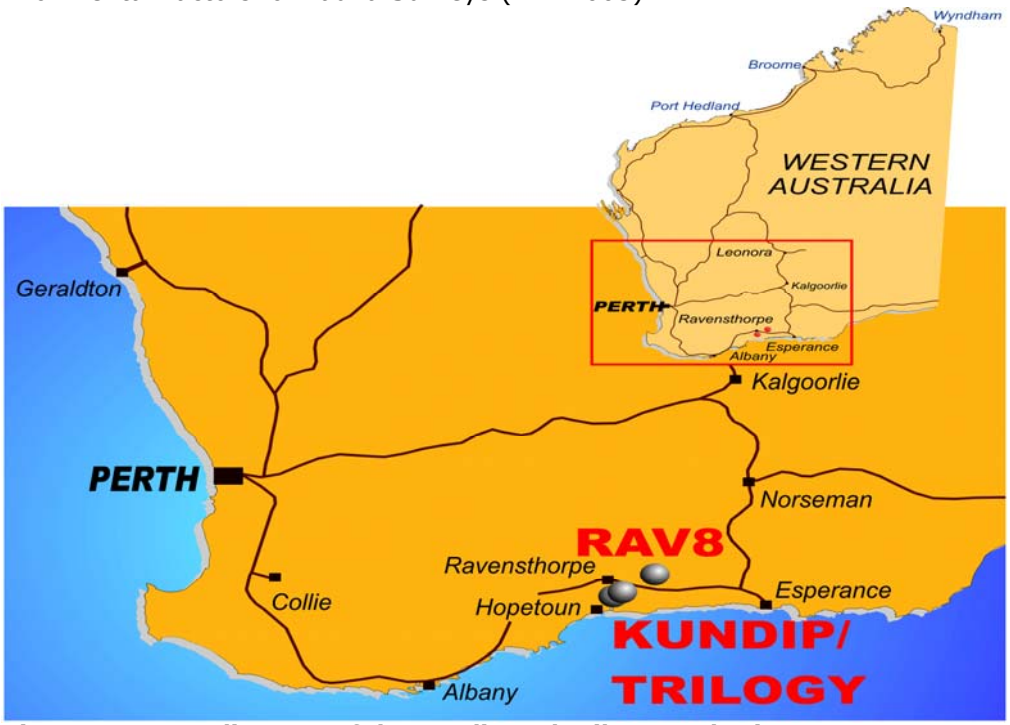

Figure 1.1: Locality map of the Kundip and Trilogy study sites.

2.0 Survey Methodology

2.1 Survey Timing and Weather

The survey was conducted over a 10-day period between the 5/1/2004 and 14/1/2004, following a 12-month period of slightly above average rainfall (Tables 2.1 and 2.2). Maximum temperatures taken at Ravensthorpe for the duration of the survey ranged between 17.8°C and 39.5°C (Table 2.3). Minimum temperatures recorded from the same station during the same period ranged between 12.2°C and 18.6°C. Ravensthorpe received 40.7 mm of rainfall during the survey, all falling in the first four days, with most rainfall (20.3 mm) falling on the 6/1/04.

2.2 Survey Team

The vertebrate fauna sampling for this survey was conducted under "Licence To Take Fauna For Scientific Purposes" No. SF004121 issued to RJ Teale and also covering Mr Greg Harold. Ethics approval was granted under the Western Australian Museum (WAM) application to the Department of Conservation and Land Management (DCLM) Animal Ethics Committee, which covers Mr. Roy Teale as a Research Associate with the WAM. The Fauna survey team comprised Mr. Roy Teale (Biota Environmental Sciences) and Mr. Greg Harold (consultant). Ms. Kim Bennett (Tectonic Resources NL) assisted with site orientation and Mr. Ian Field, Mr. Tim Nolan and Mr. Cliff Clarke (Tectonic Resources NL) assisted with set-up and coordination of logistics. Dr. Gillian Craig (consultant) kindly provided descriptions and mapping of vegetation types, description of soils, and an invaluable introduction to the project area.

Analysis of bat recordings was completed by Dr. Kyle Armstrong (Biota Environmental Scientists).

Invertebrate identification was undertaken by Ms. Karen Edward (Biota Environmental Sciences) using the resources of the WA Museum. Dr. Volker Fromenau, Dr. Mark Harvey, Ms. Julianne Waldock and Ms. Shirley Slack-Smith (all of the WA Museum) provided assistance with invertebrate identification and information.

Also acknowledged are Ms. Norah Cooper, Mr. Brad Maryan and Ms. Rachael O'Shea (WAM) who assisted with confirmation of herpetofauna and mammal identifications.

2.3 Systematic Censusing

Sampling was targeted within the lease area (as indicated by Tectonic Resources NL at the time of survey), with additional unusual habitat types outside of this area being sampled wherever possible.

The central component of the systematic censusing consisted of seven trapping grids (Table 2.4; Figures 2.1 and 2.2), each located within a defined habitat. In selecting survey sites equal weight was also given to accessibility of sites such that pitfall traps, Elliotts and cage traps could be regularly checked.

Systematic fauna sampling, the primary component of the study, was completed on the basis of grid installation in habitats considered to be representative of the range of units apparent within the project area. Not all areas within the project area were ground-truthed or sampled for fauna.

Trapping design replicates that used by the authors (and originally A. Chapman) at the Bandalup Hill locality (Craig and Chapman 1998). This was undertaken with the intention of using the two datasets (Bandalup Hill and Kundip) to provide some regional context.

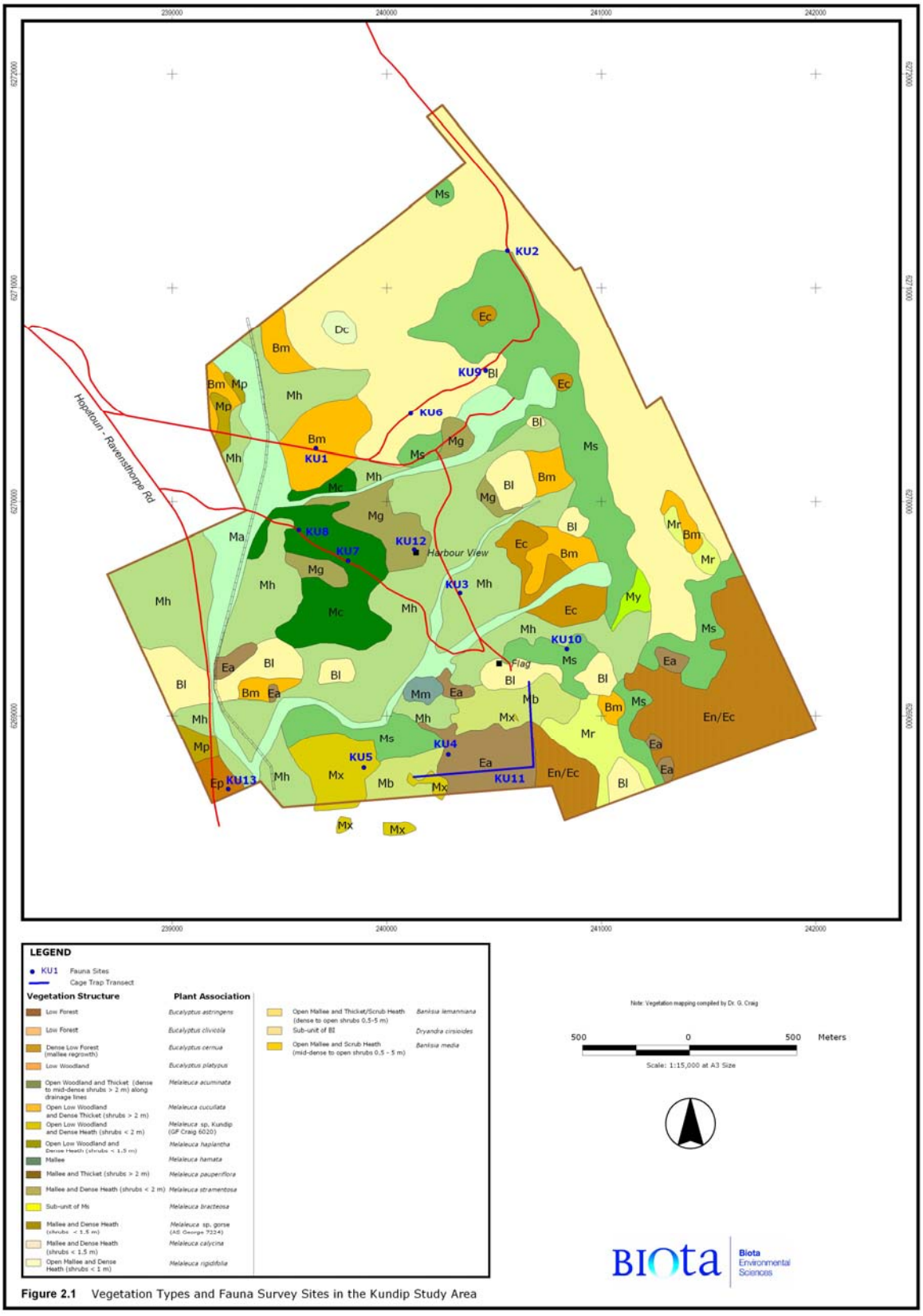

Figure 2.1 Vegetation Types and Fauna Survey Sites in the Kundip Study Area

Table 2.1: Climatological summary for Hopetoun North using data from 1996 to 2003 (data provided by the Western Australian Bureau of Meteorology).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Daily Maximum Temperature	25.6	25.4	24.7	23.5	21.7	19.4	18.2	18.8	20.5	21.1	23.1	23.9	
Mean Daily Minimum Temperature	15.0	15.6	14.3	12.8	10.5	8.6	7.6	7.8	8.9	9.8	12.1	14.1	
Mean Monthly Rainfall (mm)	42.9	24.5	29.7	29.0	30.2	35.3	65.2	55.5	53.9	38.4	36.6	24.7	465.7
Monthly Rainfall 2003	4.8	25.4	31.6	31.6	50.2	33.2	72.6	66.6	54.0	65.8	74.4	5.0	515.2

Table 2.2: Climatological summary for Ravensthorpe using data from 1901 to 2003 (data provided by the Western Australian Bureau of Meteorology).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Daily Maximum Temperature	29.2	28.4	26.6	23.7	20.0	17.2	16.2	17.1	19.5	22.3	24.8	27.3	
Mean Daily Minimum Temperature	14.0	14.5	13.5	11.8	9.6	7.9	6.8	6.6	7.5	8.9	10.9	12.7	
Mean Monthly Rainfall (mm)	22.8	25.3	31.2	32.8	45.0	44.0	47.1	44.9	41.5	38.1	29.6	22.3	427.7
Monthly Rainfall 2003	5.8	34.8	70.9	37.5	33.0	18.2	55.1	56.0	33.7	29.2	45.9	20.8	440.9

Table 2.3: Daily Meteorological Observations for Ravensthorpe for 4/1/04 – 15/1/04 (data provided by the Western Australian Bureau of Meteorology).

Day	Maximum	Minimum	Temperature at 9am	Temperature at 3pm	Rainfall 24 hours to 9am
5/1/04	17.8	15.2	16.0	16.2	15.2
6/1/04	21.9	13.7	16.4	20.4	20.3
7/1/04	19.2	13.2	16.0	18.2	3.4
8/1/04	21.0	12.2	15.9	19.5	1.8
9/1/04	25.2	14.0	16.4	22.4	0
10/1/04	27.2	13.4	21.0	25.7	0
11/1/04	33.4	12.4	24.5	31.2	0
12/1/04	39.5	18.6	32.5	30.5	0
13/1/04	22.6	15.2	16.0	-	0
14/1/04	26.9	15.4	18.5	-	0
15/1/04	26.0	14.4	21.9	20.0	0

Table 2.4: Trapping grid location and trap effort (WGS84 datum, Zone 51).

Site #	Location (AMG)	Trap Type	Date Opened	Date Closed	Nights Open	# of traps	Total effort (trap nights)
KU1	239670mE 6270247mN	Elliott Pit	7/1/2004 6/1/2004	12/1/2004 12/1/2004	5 6	20 12	100 72
KU2	240563mE 6271172mN	Elliott Pit	7/1/2004 6/1/2004	12/1/2004 12/1/2004	5 6	20 12	100 72
KU3	240342mE 6269570mN	Elliott Pit	7/1/2004 6/1/2004	12/1/2004 12/1/2004	5 6	20 12	100 72
KU4	240288mE 6268814mN	Elliott Pit	7/1/2004 7/1/2004	14/1/2004 14/1/2004	7 7	20 12	140 84
KU5	239894mE 6268754mN	Elliott Pit	7/1/2004 7/1/2004	13/1/2004 13/1/2004	6 6	20 12	120 72
KU6	240113mE 6270410mN	Elliott Pit	7/1/2004 7/1/2004	13/1/2004 13/1/2004	6 6	20 12	120 72
KU7	239820mE 6269724mN	Elliott Pit	8/1/2004 8/1/2004	14/1/2004 14/1/2004	6 5	20 12	120 72
KU8	239591mE 6269866mN	Opp.			-	-	-
KU9	240462mE 6270613mN	Opp.			-	-	-
KU10	240840mE 6269310mN	Opp.			-	-	-
KU11	Transect	Cage	9/1/2004	14/1/2004	5	25	125
KU12	240121mE 6269778mN	Opp.			-	-	-
KU13	239262mE 6268655mN	Opp.			-	-	-
					Total	**Elliott Pit Cage**	**800 516 125**

Opp – designates opportunistic hand foraging, head-torching and raking only.

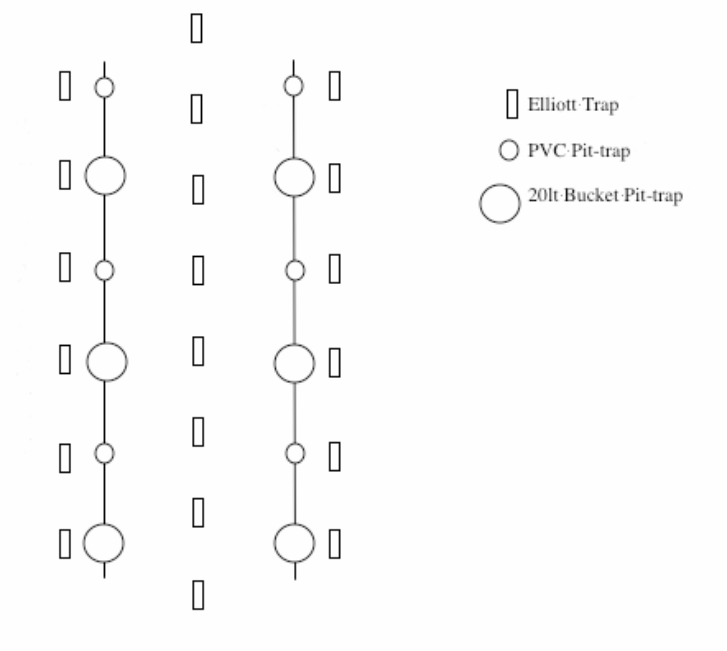

Figure 2.2: Trapping grid layout used at the Kundip site (nb. distance between the two lines of pits varied between 30m and 50m).

Each trapping grid consisted of two rows of six pitfall traps. The rows were set approximately 50m apart, and the pits (alternating 20 litre buckets and pvc tubes) within rows were spaced at approximately 8m intervals and connected with a single length of 30 cm high flywire fence (Figure 2.2). At each site, a medium size Elliott trap was placed adjacent to each pit and a row of eight Elliott traps was positioned such that it bisected the two pit lines (Figure 2.2). In addition to these sites, a single transect of 25 cage traps was established through the *Eucalyptus clivicola* woodland (KU11 in Table 2.4).

2.3.1 Avifauna Sampling

Twenty-three 40 minute and two 60 minute avifauna censuses were conducted across nine sites during the survey (Table 2.5). Censuses were typically made from 6am through to midday (except KU13) (Table 2.5). Individual censuses were confined to discrete habitat types typically corresponding to vegetation types. In addition, opportunistic records were made of species that were either not recorded during censuses or that were uncommon.

Table 2.5: Systematic avifauna censuses undertaken at each of the fauna sites.

Date	Site KU1	Site KU2	Site KU3	Site KU4	Site KU5	Site KU6	Site KU7	KU8	KU13
9/1/04		11:05 – 11:45	9:35 – 10:15	8:40 – 9:20	7:30 – 8:10	10:20 – 11:00	6:35 – 7:15		
10/1/04	6:05 – 6:45	7:05 – 7:45		11:00 – 11:40	10:15 – 10:55	8:06 – 8:46	9:20 – 10:00		
11/1/04	-	-	-	-	-	-	-	-	
12/1/04	9:07 – 9:47	7:42 – 8:22	6:13 – 6:53			10:30 – 11:10			
13/1/04	10:45 – 11:25		11:45 – 12:25	7:45 – 8:25	6:15 – 6:55	9:23 – 10:03	8:37 – 9:17		13:15 – 14:15
14/1/04				6:05 – 6:45				7:30 – 8:30	

2.3.2 Bats

Bats were sampled by recording echolocation calls only. A comprehensive survey of bats, which would include trapping to determine the presence of bats not readily recorded by microphones, was not undertaken during the survey. Echolocation calls were recorded with an Anabat II bat detector, which detects and transforms the ultrasonic echolocation that bats emit whilst foraging. Sampling was undertaken on two nights (12/1/2004 and 13/1/2004) at two sites (KU4 and KU12). On both occasions a delay switch was connected to the detector to maximise the time that calls could be collected. Calls were recorded onto TDK C90 audio cassette tapes using an Optimus CTR116 cassette recorder. Calls were then transformed with a ZCAIM V and analysed using Anabat 6 software. Variables measured from call sequences were compared with those in Fullard et al. (1991) to aid identification.

2.3.3 Invertebrate Sampling

Targeted invertebrate groups were sampled through opportunistic and systematic collections during the survey. Prior to field work, WAM staff were consulted to confirm invertebrate groups of interest and to identify any specific curation methods (eg. the preservation of Wolf Spiders for DNA analyses).

Invertebrate groups targeted during the survey included:

- Araneae (Spiders, in particular Trapdoor and Wolf Spiders);
- Pseudoscorpionida (Pseudoscorpions);

- Scorpionida (Scorpions);
- Diplopoda (Millipedes); and
- Pulmonata (Land snails).

Wolf Spiders were collected whilst head-torching at night at three locations; KU2, KU4, and KU12. These specimens were supplemented by those collected from pit traps at all systematic trapping sites (KU1 – KU7). Trapdoor spiders were targeted using pit-traps supplemented with burrow excavation at KU13. Trapdoor and wolf spiders were preserved in 70% ethanol, with one or two legs removed and placed in 100% ethanol for future molecular studies.

Hand foraging was undertaken for pseudoscorpions, involving peeling bark and lifting rocks. The latter technique was also used to search for scorpions, with additional specimens collected from pit traps. The remaining two groups (millipedes and land snails) were searched for whilst raking leaf litter and other debris. Representative samples of other invertebrates from pit traps were collected, placed in 70% ethanol and lodged with the WA Museum.

2.3.4 Non-systematic Sampling

A range of non-systematic fauna survey activities was undertaken by the survey team to supplement the trapping and investigate additional habitats identified during the course of the survey. These included:

- Habitat specific searches for Schedule and Priority listed fauna species;
- Searching (including head-torching) of microhabitats for reptile, frog and small mammal species;
- Opportunistic sightings and records;
- Identification of road kills and other animal remains; and
- Recording and identification of secondary signs (where possible) including tracks, scats and diggings.

2.4 Vegetation Types and Fauna Habitat Classification at each Survey Site

The descriptions of vegetation and soils presented below are based on those collated by Craig (2004). These have been amalgamated into the broad fauna habitats outlined in Teale et al. (in prep.).

The majority of the project area comprised mallee-heath habitat, with the heath component being dominated by proteaceous and/or myrtaceous species. *Banksia* species were a dominant component of the vegetation in the northern portion of the study area whilst *Melaleuca* species formed a common component of the understorey in the middle and southern sections. The Steere River runs in a north-south direction along the western edge of the project area, and was fed by a number of small tributaries extending to the east and exits into the Culham Inlet. Neither the Steere River nor its tributaries held water during the survey, although a number of small dams did. Areas of woodland habitat occurred along the southern boundary.

2.5 Survey Limitations

The survey was appropriately resourced by the proponent given the scale and nature of the proposed operation. Survey timing was appropriate for recording reptiles, whilst unseasonal rainfall increased the probability of detecting some frog species. Timing may not have been ideal for mammal species given the dry conditions over the 12 – 18 months

prior to last winter. In respect of key invertebrate groups (including short-range endemics), the rainfall encouraged activity in many groups including mygalomorph spiders and land snails. Timing was appropriate for wolf spiders as populations tend to support mostly adults during late summer. However the time of the year was not suitable for recording millipedes.

Table 2.6: Habitat, vegetation and soil descriptions for each of the sites at Kundip (vegetation and soils descriptions provided by Craig 2004) and Trilogy.

Site	Habitat	Vegetation Description	Soils Description
KU1	Mallee – heath.	Very open mallee and low proteaceous and myrtaceous heath (< 1 m) with *Banksia media* a characteristic species	Grey to yellow sand of varying depth over mottled clay loams.
KU2	Mallee – heath.	Open mallee and very dense proteaceous thicket where *Banksia lemanniana* is typical.	Skeletal pale grey to orange loamy sands with lateritic gravel.
KU3	Mallee – heath.	Dense to mid-dense shrub mallee (1-4 m tall) and myrtaceous heath.	Grey-brown to red-brown loamy clay sand with lateritic gravel.
KU4	Woodland	Mid-dense low forest of Brown Mallet *Eucalyptus astringens over Melaleuca rigidifolia*	Grey, calcareous clay loam.
KU5	Mallee – heath.	Very open mallee and dense shrub heath (1-1.5 m) dominated by *Melaleuca* sp. Kundip	Pale grey sandy loams with quartzite rubble.
KU6	Mallee – heath.	Open mallee and very dense proteaceous thicket where *Banksia lemanniana* is typical.	Skeletal pale grey to orange loamy sands with lateritic gravel.
KU7	Shrubland	Dense thicket of *Melaleuca cucullata.*	Poorly drained, orange-brown clay loams.
KU8	Debris	Disturbed area with abandoned buildings, sheets of tin and other debris.	Poorly drained, orange-brown clay loams.
KU9	Debris	Disturbed area with abandoned buildings, sheets of tin and other debris.	Skeletal pale grey to orange loamy sands with lateritic gravel.
KU10	Mallee – heath.	Mid-dense to open mallee and dense heath communities dominated by *Melaleuca stramentosa*	Orange-brown mottled clay loams with ironstone rubble.
KU11	Mixed	*Eucalyptus astringens* low forest and mid-dense mallee with dense heath.	Grey, calcareous clay loam and orange-brown mottled clay loams with ironstone rubble.
KU12	Mallee – heath.	Mid-dense to open mallee and dense heath communities dominated by *Melaleuca stramentosa*	Orange-brown mottled clay loams with ironstone rubble.
KU13	Woodland	*Eucalyptus platypus* Moort low woodland.	White clay or loamy clays with quartz rubble, 'moort clays'.
TR1	Farmland	Paddock grasses and weeds.	Not recorded

Plate 2.1: Cleared farmland at the Trilogy site.

Plates 2.2 – 2.7: Habitats at each of the trapping sites.

Plate 2.2: Habitat at KU1.

Plate 2.3: Habitat at KU2.

Plate 2.4: Habitat at KU3.

Plate 2.5: Habitat at KU4.

Plate 2.6: Habitat at KU5.

Plate 2.7: Habitat at KU7.

3.0 Vertebrate Fauna Inventory Survey

3.1 Background

The survey of the Kundip and Trilogy sites recorded a combined total of 99 vertebrate species. Table 3.1 provides a summary of the number of species recorded from each major vertebrate group during the survey.

Table 3.1: Number of species recorded during the survey of the Kundip and Trilogy study sites.

Fauna Group	Total
Avifauna	62
Native Mammals	11
Introduced Mammals	2
Reptiles	21
Amphibians	3
Total	**99**

3.2 Birds

Introduction

The regional (south-west) avifauna has been summarised by Storr (1991), who provides an annotated list of 379 species of birds. The majority of these would not be expected to occur in the project area due to habitat considerations, in particular the lack of tall woodlands, heaths, wetlands etc. Of more relevance would be small surveys carried out locally, including those by Chapman and Newbey (1995), Sanders (1996), Craig and Chapman (1998), Chapman (2000), Biota (2000) and Buchanan (2004). Several of these are summarised in Teale et al. (in prep.) and discussed further below.

The Assemblage

A total of 62 species of birds was recorded during the current survey. This total comprised 30 families and included 24 non-passerine and 38 passerine species (Table 3.2). The tally from Kundip comprised 18 non-passerines and 35 passerines from a total of 27 families. The tally from the Trilogy site comprised six non-passerines from three families and four passerines from four families.

Of the 62 species, nine were recorded only from the Trilogy site (Table 3.3). These included all the waterfowl, and several species typical of farms and open habitat in the South-west such as the Australian Kestrel, Black-shouldered Kite, Yellow-throated Miner, Magpie-lark and Australian Pipit. Habitat at the Trilogy site comprised open paddocks, farm dams, farm buildings and shelter-belts of *Eucalyptus* spp with little or no understorey.

Breeding

Breeding records were obtained for two species:

- A male Emu was recorded with four chicks; and
- A Dusky Woodswallow was seen feeding two chicks.

Annotated List

Table 3.2 presents data for all bird species recorded from each fauna habitat unit. Each species is discussed individually in the following annotated list (†Recorded from the Kundip site; ø Recorded from the Trilogy site).

CASUARIIDAE

Emu - *Dromaius novaehollandiae*[†]
Typically recorded from scats in open habitats including the *Eucalyptus astringens* low forest (KU4) and from access track in the *Melaleuca* sp Kundip (KU5). A male was recorded with four young at the Flag mine.

MEGAPODIIDAE

Malleefowl – *Leipoa ocellata* [†]
Dr. Gillian Graig and Ms. Kim Bennett recorded a single individual on the 5/1/2004 from the main access track where it crosses the *Melaleuca acuminata* drainage near the Railway Heritage Trail.

PHASIANIDAE

Brown Quail – *Coturnix ypsilophora* [†]
Recorded on eight occasions from its call given typically late in the evening or early in the morning. Recorded from mallee (KU3 and KU12) and open mallee scrub heath (KU6).

ANATIDAE

Australian Shelduck - *Tardorna tadornoides* [ø]
Two birds recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Australian Wood Duck - *Chenonetta jubata* [ø]
Ten individuals recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Grey Teal - *Anas gracilis* [ø]
Ten individuals recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Pacific Black Duck - *Anas superciliosa* [ø]
Only recorded (n=16) from from a farm dam in the vicinity of the proposed Trilogy Mine.

ACCIPITRIDAE

Black-shouldered Kite – *Elanus caeruleus axillaris* [ø]
Single individual seen foraging over farmland in the vicinity of the proposed Trilogy Mine.

Square-tailed Kite – *Hamirostra isura* [†]
Single bird recorded over *Eucalyptus astringens* (KU4) on the 10/1/04 and again on the 13/1/04. Another single individual, possibly the same bird, recorded over mallee (KU3) on the 13/1/04.

Brown Goshawk – *Accipiter c. cirrocephalus* [†]
Recorded on one occasion. Single bird recorded over mallee (KU3).

FALCONIDAE

Nankeen Kestrel - *Falco cenchroides* [ø]
Single bird seen over farmland in the vicinity of the proposed Trilogy Mine.

TURNICIDAE

Painted Button-quail - *Turnix varia* [†]
Single bird recorded from a pit trap at KU3.

COLUMBIDAE

Common Bronzewing – *Phaps chalcoptera* [†]
Single bird recorded from edge of access track at KU1. Noted to be moderately common on highway between Ravensthorpe and the Kundip project area.

Brush Bronzewing – *Phaps elegans* [†]
Single individual recorded at access to project area. Also observed on the road verge between Ravensthorpe and Kundip, although less often than the Common Bronzewing.

PSITTACIDAE

Carnaby's Cockatoo – *Calyptorhynchus latirostris* †
Recorded on three occasions as flocks of between two and seven individuals flying over the project area. These birds were not positively identified as *C. latirostris,* rather the identification is based on the current distribution of the two White-tailed Black Cockatoos in WA as given by Johnstone and Storr (1998).

Purple-crowned Lorikeet – *Glossopsitta porphyrocephala* †
Small flocks regularly flying over the project area. Recorded feeding in the *Eucalyptus astringens*.

Australian Ringneck - *Platycercus zonarius* †
Uncommon within the project area but common on the road verge between Ravensthorpe and Kundip. Recorded from most sites with trees including KU1, KU2, KU4, KU6, KU7 and KU13. Commonly seen foraging on the road verge between Ravensthorpe and Kundip particularly adjacent to taller Mallee Woodland. Often in mixed company with Red-capped Parrots *Platycercus spurius*.

Red-capped Parrot – *Platycercus spurius* †
Rare within the project area although apparently more common near tall woodlands closer to Ravensthorpe. Single bird recorded from open low woodland at (KU5) and two birds from mallee over dense heath at KU2.

Numerous birds were seen on the road between Ravensthorpe and Kundip particularly in the Salmon Gums woodland. Often in mixed company with Australian Ringnecks *Platycercus zonarius*.

CUCULIDAE

Fan-tailed Cuckoo – *Cacomantis flabelliformis* †
Single individual recorded from the dense shrub mallee near KU3.

Shining Bronze-cuckoo - *Chrysococcyx lucidus* †
Recorded from calls at KU1, KU6 and KU8.

STRIGIDAE

Boobook Owl – *Ninox novaeseelandiae* †
Single bird recorded as a road kill near the entrance to the Kundip project area.

TYTONIDAE

Barn Owl – *Tyto alba* †
Rare. Two records of this species, each of single birds detected whilst head-torching. A single animal recorded from near a shaft adjacent to KU2 and another single bird recorded from the Flag Mine area.

PODARGIDAE

Tawny Frogmouth - *Podargus strigoides* †
Single bird recorded as a road kill near the entrance to the Kundip project area.

CAPRIMULGIDAE

Spotted Nightjar – *Eurostopodus argus* †
Single bird observed on main access track adjacent to KU1.

MALURIDAE

Blue-breasted Fairy-wren – *Malurus pulcherrimus* †
Recorded on four occasions as either singles or small family groups of between two and four individuals. Habitats include dense to mid-dense shrub mallee (KU3), open mallee over dense shrub heath (KU5) and dense *Melaleuca cucullata* thicket (KU7).

PARDALOTIDAE

Spotted Pardalote (Yellow-rumped Pardalote) – *Pardalotus punctatus xanthopyge* †
Moderately common in the open mallee at KU5 and from scattered mallee at KU7. Recorded predominantly from its call.

Striated Pardalote - *Pardalotus striatus* †
Recorded from all systematic census sites, though apparently less common than the Spotted Pardalote. Like its cogener, recorded predominantly from call.

ACANTHIZIDAE

White-browed Scrubwren – *Sericornis frontalis maculatus* †
Moderately common, recorded on 13 occasions; mainly ones and twos, but also as a group of three. Mostly in low dense shrubs. Recorded from all main census sites with the exception of KU1, though most records from the dense shrub heath of *Melaleuca* sp Kundip at KU5.

Shy Groundwren – *Hylacola cauta* †
Sightings probably underestimate the relative abundance of this species as it was often seen crossing or flying in front of the vehicle but was not always recorded. Mainly recorded from the heaths and mallee on lateritic and gritty surfaces. Recorded from Sites KU2, KU5 and KU6.

Weebill – *Smicrornis brevirostris* †
Very common; third most commonly recorded species. Recorded on 56 occasions, mostly from calls but also as singles, twos and a group of three. Most commonly recorded from the canopy of eucalypts particularly in the *Eucalyptus astringens* low forest at KU4 (seven records), but also from mallees at all other sites.

Broad-tailed Thornbill (Inland Thornbill) – *Acanthiza apicalis* †
Recorded on five occasions, typically as pairs. Often seen in dense mid-height shrubs and *Banksia* spp. Not recorded from KU2, KU3 and KU5.

MELIPHAGIDAE

Brown Honeyeater – *Lichmera indistincta* †
The sixth most commonly recorded species (n=36). Typically recorded from calls, but also as singles and occasionally in twos. Recorded from all sites though most records (n=23) from the *Melaleuca cucullata* thicket at KU7.

Purple-gaped Honeyeater – *Lichenostomus cratitius* †
Recorded on nine occasions, most records from the *Melaleuca cucullata* thicket at KU7 (n=8) and a single record from KU5.

White-eared Honeyeater – *Lichenostomus leucotis novaenorciae* †
Recorded on just three occasions. Single birds recorded from KU1, KU5 and KU7.

Brown-headed Honeyeater – *Melithreptus brevirostris leucogenys* †
Two birds recorded from the open mallee over dense proteaceous thickets including *Banksia lemanniana* at KU2.

Western White-naped Honeyeater – *Melithreptus chloropsis* †
Most records (n=12) from the *Eucalyptus astringens* low forest at KU4, but also from the *Melaleuca cucullata* thickets at KU7 (n=3) and *E. platypus* at KU13 (n=1).

New Holland Honeyeater – *Phylidonyris novaehollandiae* †
The most abundant (301 individuals) and frequently recorded (145 records) species from the project area. Common across the seven main census sites with the exception of the mallee at KU3 from which just a single individual was noted.

Tawny-crowned Honeyeater – *Phylidonyris melanops* †
Recorded on 30 occasions, mostly as single birds or from calls but also as twos and small loose groups. Most commonly recorded from the low dense heath of *Melaleuca* sp. Kundip at KU5 (n=37) but also noted from KU1 (n=1), the proteaceous thickets at KU2 (n=9) and the *Melaleuca cucullata* thickets at KU7 (n=2).

Yellow-throated Miner - *Manorina flavigula* ø
Only recorded from the mallee shelter-belts within the open farmland of the Trilogy project area.

Western Little Wattlebird – *Anthochaera lunulata* †
Moderately common (17 records), particularly in vegetation associations supporting *Banksia* spp., eg. KU1, KU2 and KU6. Usually recorded as singles or from calls and occasionally in twos.

Red Wattlebird – *Anthochaera carunculata* †
Recorded from all sites with the exception of KU2. Most records from taller trees in the area including within the *Eucalyptus astringens* low forest at KU4 and emergent eucalypts at KU7 where it was typically recorded from calls.

PETROICIDAE

Western Yellow Robin - *Eopsaltria australis griseogularis* †
Just two records of this species from the project area. One from dense mallee at KU1 and another from *Melaleuca* thickets in the drainage line at KU8.

Southern Scrub-robin – *Drymodes brunneopygia* †
Calls from this species were heard at all sites within the project area.

POMATOSTOMIDAE

White-browed Babbler - *Pomatostomus superciliosus* †
Detected from calls at KU2 and KU6.

CINCLOSOMATIDAE

Western Whipbird – *Psophodes nigrogularis oberon* †
Uncommon. Recorded on six occasions from its call. All calls were from mallee associations including KU1, KU2 and KU3. A complete account of recordings of this species is given in Section 5.1.

PACHYCEPHALIDAE

Crested Bellbird - *Oreoica gutturalis* †
Recorded from calls on nine occasions including from Sites KU1, KU3, KU6, KU7 and KU8.

Golden Whistler - *Pachycephala pectoralis fuliginosa* †
Recorded from its call, as single birds or in pairs. Recorded from open mallee at KU1, KU2 and KU5 and from the dense *Melaleuca cucullata* thicket at KU5.

Grey Shrike-thrush – *Colluricincla harmonica rufiventris* †
Recorded on four occasions including a single bird from the *Eucalyptus astringens* low forest at KU4 and three from the open mallee at KU5.

DICRURIDAE

Restless Flycatcher - *Myiagra inquieta inquieta* †
This species was only recorded from the Steere River within the lease boundary.

Magpie-lark - *Grallina cyanoleuca* ø
Single bird recorded from a farm dam in the vicinity of the proposed Trilogy Mine.

Willie Wagtail - *Rhipidura l. leucophrys* †
Recorded on just four occasions; twice from a small dam near KU3, once from a clearing along Steere River near KU8 and once from a small dam in the vicinity of KU7.

CAMPEPHAGIDAE

Black-faced Cuckoo-shrike - *Coracina n. novaehollandiae* †
Three records. Two records from the *Eucalyptus astringens* low woodland at KU4 and a single bird seen flying over mid-dense shrub mallee at KU3.

ARTAMIDAE

Dusky Woodswallow - *Artamus cyanopterus* †
Adults were regularly seen feeding two chicks at KU5, also seen over KU4 and KU7.

CRACTICIDAE

Grey Butcherbird - *Cracticus t. torquatus* †
Recorded from just two calls; one bird heard at KU5, another heard calling at KU6.

Australian Magpie - *Cracticus tibicen dorsalis* † ø
Single bird seen on track adjacent to KU7.

CORVIDAE

Australian Raven - *Corvus coronoides* † ø
Often recorded as birds flying overhead or from its call, this species was observed on 10 occasions including singles, twos and a group of three.

Grey Currawong - *Strepera versicolor* †
Recorded on 28 occasions across most sites but particularly in the disturbed areas.

HIRUNDINIDAE

Welcome Swallow - *Hirundo neoxena* †
Common, particularly around the abandoned sheds and buildings associated with previous mining operations. Often observed foraging along the access tracks.

Tree Martin - *Hirundo nigricans* †
Flocks of up to 12 birds seeing hawking for insects over several sites.

ZOSTEROPIDAE

Grey-breasted White-eye - *Zosterops lateralis gouldi* †
Recorded on 61 occasions with between one and three individuals seen at most sites within the study area. However, 46 records from the *Melaleuca cucullata* thickets at KU7.

MOTACILLIDAE

Australian Pipit - *Anthus a. australis* ø
Moderately common though restricted to the cleared paddocks at the proposed Trilogy mine.

Discussion

The 53 species at Kundip were represented by 1153 records, 26% of which were contributed by a single species, the New Holland Honeyeater (Table 3.2). Thirty-four species were recorded from ten or fewer individuals, with 13 being recorded from just one individual (Table 3.2).

The honeyeaters (Meliphagidae) were both the most abundant and specious family of birds within the Kundip project area. The nine species of honeyeaters comprised 17% of the total number of species and represented 42% of all records. The numerical dominance of the New Holland Honeyeater at Kundip compares favourably with the findings at Bandalup Hill during the 2000 October survey where this species comprised 26% of all records (Biota 2000).

The data collected from Trilogy was of an opportunistic nature and largely focussed on a small dam adjacent to the proposed mine.

In October 2000, a survey at the Bandalup Hill project area recorded a total of 70 species of birds from 30 families, including 28 non-passerines and 42 passerines (Biota 2001). Thirty-six of these species were recorded from Bandalup Hill itself whilst 31 were recorded from the adjacent Shoemaker-Levy site. Early studies by Craig and Chapman (1998) and Chapman (2000) increased the Bandalup total to 82 species. This compares to 379 species known from the South-west region (Storr 1991), 220 bird taxa recorded from the Fitzgerald Biosphere Reserve from over 201 sites investigated by Teale et al. (in prep.) and 89 species reported by Chapman and Newbey (1995) for the Ravensthorpe Range. Clearly, additional species would be detected from the Kundip site with further survey work, though given the relatively small array of different bird habitats available, the additional number of species is likely to be small. All species recorded from Kundip have been recorded from the Bandalup Hill study site. A survey of the Kundip Nature Reserve between 22 and 26 December 2003 recorded 48 species (Buchanan 2004).

There are six avian species of high conservation significance recorded from the Fitzgerald Biosphere Reserve that were not recorded in the Kundip Project area. These include:

- The Peregrine Falcon *Falco peregrinus* has been recorded from Bandalup Hill (Biota 2001);
- The Bush Stone-curlew *Burhinus grallarius* has been recorded from the Pallinup Nature Reserve and a single bird was heard calling 3 km southeast of Ravensthorpe during late 1997 (A. Sanders pers. comm., Teale et al. (in prep.)).
- Baudin's Cockatoo *Calyptorhynchus baudinii* has been reported from the Cocanarup Timber Reserve and in the northern sections of the Fitzgerald Biosphere Reserve (Teale et al. in prep.);
- A Ground Parrot *Pezoporus wallicus flaviventris* was collected from the Hopetoun to Ravensthorpe Rd in June 1995; other localities include Hamersley Drive and Moir track intersection, south of Old Ongerup Rd, West River Rd and Drummond Track;
- Rainbow Bee-eaters *Merops ornatus* have been recorded relatively frequently within the Biosphere Reserve, mostly from the northern section (Teale et al. in prep.); and
- Western Bristlebird *Dasyornis longirostris* was reported calling from East Mt Barren in July 1997 (A. Sanders pers. comm.), with one individual recorded on Bell track in 1981 and several birds recorded near Middle Mount Barren in 1997 (Teale et al. in prep.). This species was also recently sighted (December 2003) within the Kundip Nature Reserve (Buchanan 2004).

Table 3.2: Avifauna records from the Kundip (KU1 - 13) and Trilogy (TR1) survey sites during the January 2004 survey.

Common and Species Name	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU12	KU13	TR1	Opp	Total
Emu *Dromaius novaehollandiae*			2	4									6
Malleefowl *Leipoa ocellata*												1	1
Brown Quail *Coturnix ypsilophora*			3			1			4				8
Australian Shelduck *Tadorna tadornoides*											2		2
Australian Wood Duck *Chenonetta jubata*											10		10
Grey Teal *Anas gracilis*											10		10
Pacific Black Duck *Anas superciliosa*											16		16
Black-shouldered Kite *Elanus caeruleus axillaris*											1		1
Square-tailed Kite *Hamirostra isura*			1	2									3
Brown Goshawk *Accipiter fasciatus didimus*			1										1
Australian Kestrel *Falco cenchroides cenchroides*											1		1
Painted Button-quail *Turnix varia*			1										1
Common Bronzewing *Phaps chalcoptera*	1												1
Brush Bronzewing *Phaps elegans*												1	1
Carnaby's Cockatoo *Calyptorhynchus latirostris*	2					4	7						13
Purple-crowned Lorikeet *Glossopsitta porphyrocephala*	3	1	11	94	44	3	34	2					192
Australian Ringneck *Platycercus zonarius zonarius*	6	2		3		1	7			3			22
Red-capped Parrot *Platycercus spurius*		2			1								3
Fan-tailed Cuckoo *Cacomantis flabelliformis flabelliformis*			1										1
Shining Bronze Cuckoo *Chrysococcyx lucidus plagosus*	2					2		1					5
Boobook Owl *Ninox novaeseelandiae*												1	1
Barn Owl *Tyto alba delicatula*									1				1
Tawny Frogmouth *Podargus strigoides*												1	1
Spotted Nightjar *Eurostopodus argus*	1												1
Blue-breasted Fairy-wren *Malurus pulcherrimus*			3		5		2						10
Spotted Pardalote *Pardalotus punctatus*	2		1	3	6	3	9	1		1			26
Striated Pardalote *Pardalotus striatus uropygialis*	1	3	4	2	3	2	3	1					19
White-browed Scrubwren *Sericornis frontalis*		1	5	2	7	1	3	4					23
Shy Groundwren *Hylacola cauta*		4			2	5							11
Weebill *Smicrornis brevirostris*	1	3	6	17	15	11	15	1		2			71
Western Gerygone *Gerygone fusca fusca*				1									1

Table 3.2: Avifauna records from the Kundip (KU1 - 13) and Trilogy (TR1) survey sites during the January 2004 survey.

Common Name Species Name	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU12	KU13	TR1	Opp	Total
Broad-tailed Thornbill *Acanthiza apicalis*	2			2		1	2	2					9
Brown Honeyeater *Lichmera indistincta indistincta*	5	5	2	3	8	1	23						47
Purple-gaped Honeyeater *Lichenostomus cratitius*					1		8						9
White-eared Honeyeater *Lichenostomus leucotis novaenorciae*	1				1		1						3
Brown-headed Honeyeater *Melithreptus brevirostris leucogenys*		2											2
Western White-naped Honeyeater *Melithreptus chloropsis*				12			3			1			16
New Holland Honeyeater *Phylidonyris novaehollandiae*	29	57	1	30	42	50	74	10		8			301
Tawny-crowned Honeyeater *Phylidonyris melanops*	1	9			37		2						49
Yellow-throated Miner *Manorina flavigula*											2		2
Western Little Wattlebird *Anthochaera lunulata*	6	7				4	1	4		3			25
Red Wattlebird *Anthochaera carunculata*	4		4	7	2	4	13	2					36
Western Yellow Robin *Eopsaltria australis griseogularis*	1							1					2
Southern Scrub-robin *Drymodes brunneopygia*	2	3	1	5	7	3	3	3					27
White-browed Babbler *Pomatostomus superciliosus*		1				1							2
Western Whipbird *Psophodes nigrogularis oberon*	3	2	1										6
Crested Bellbird *Oreoica gutturalis*	1		2			3	1	2					9
Golden Whistler *Pachycephala pectoralis fuliginosa*	2	1			3		1	2					9
Grey Shrike-thrush *Colluricincla harmonica rufiventris*				1	3								4
Restless Flycatcher *Myiagra inquieta inquieta*								1					1
Willie Wagtail *Rhipidura leucophrys leucophrys*			2				1	1					4
Magpie-lark *Grallina cyanoleuca*											1		1
Black-faced Cuckoo-shrike *Coracina novaehollandiae*			1	2									3
Dusky Woodswallow *Artamus cyanopterus*				1	6		2						9
Grey Butcherbird *Cracticus torquatus torquatus*					1	1							2
Australian Magpie *Cracticus tibicen*							1						1
Grey Currawong *Strepera versicolor plumbea*	2	3	3		2	8	7	1		2			28
Australian Raven *Corvus coronoides perplexus*			1	1		4	1				3		10
Welcome Swallow *Hirundo neoxena*	1	6	10		2	12	4						35
Tree Martin *Hirundo nigricans nigricans*		12			8	3							23
Grey-breasted White-eye *Zosterops lateralis gouldi*	1	3	1		3	3	46	3		1			61
Australian Pipit *Anthus australis australis*											7		7

3.3 Mammals

Assemblage

The survey recorded 13 species of mammals, comprising one tachyglossid (Echidna), one dasyurid (carnivorous marsupial), two macropods (kangaroos and wallabies), one burramyid (Pygmy Possum), one tarsipedid (Honey Possum), three vespertilionids (vespertilionid bats), one molossid (sheathtail bat), one native and one introduced murid (murid rodents) and one canid (Fox).

Annotated List

Table 3.3 contains the mammal records from each fauna habitat type. The species are discussed individually in the following annotated list.

TACHYGLOSSIDAE

Echidna - *Tachyglossus aculeatus*

Evidence of this species in the form of diggings was recorded from the *Eucalyptus astringens* low woodland at KU4 and the open mallee and dense proteaceous thicket at KU6.

DASYURIDAE

Grey-bellied Dunnart – *Sminthopsis griseoventer*

Trapped on nine occasions from five sites, including KU1 (M55051), KU2 (M55059), KU4, KU5 (M55050) and KU7 (M55052 - 3). Captures comprised four males and five females including one carrying pouch young.

MACROPODIDAE

Western Grey Kangaroo - *Macropus fuliginosus*

Although scats and tracks (of varying ages) were recorded from most sites across the project area, actual sightings of animals were uncommon with just three records. Single animals were observed at KU3, KU4 and KU5. More individuals would likely be encountered in the open pasture at Trilogy particularly where such pastures lie adjacent to remnant vegetation.

Western Brush Wallaby – *Macropus irma*

Single dead animal recorded as a road kill adjacent to the entrance to the Kundip project area.

BURRAMYIDAE

Western Pygmy Possum – *Cercartetus concinnus*

This species was recorded on 56 occasions (M55054 – 8) from all sites pit-trapped during the survey. The majority of records (n=37, 66%) came from the *Eucalyptus astringens* woodland site KU4, with the low woodland of *Melaleuca cucullata* yielding the next highest number (n=9, 16%). The remaining sites yielded between one and three captures. The tally comprised 35 males and 21 females including five that were carrying pouch young.

TARSIPEDIDAE

Honey Possum – *Tarsipes rostratus*

Easily the most commonly recorded mammal from the project area, this species was recorded on 84 occasions from all sites with pit traps. The most number of captures (n=25, 30%) was recorded from KU2 which supported a large number of flowering *Banksia lemanniana*. The sex ratio of captures was skewed towards males with 47 captures compared to just 29 female captures (the sex of eight animals was unrecorded). Three of the females were carrying pouch young.

VESPERTILIONIDAE

Gould's Wattled Bat – *Chalinolobus gouldii*

Calls of this species were recorded adjacent to the mine shafts at KU12.

Chocolate Wattled Bat - *Chalinolobus morio*
Calls of this species were recorded from the *Eucalyptus astringens* woodland at KU4.

Southern Forest Bat - *Vespadelus regulus*
Calls of this species were recorded from the *Eucalyptus astringens* woodland at KU4.

MOLOSSIDAE

White-striped Freetail Bat – *Tadarida australis*
Calls of this species were recorded from about the mine shafts at KU12

MURIDAE

Bush Rat – *Rattus fuscipes*
This common species was recorded on 16 occasions, including 10 records from the *Melaleuca* sp. Kundip dense heath at KU5. Also recorded from dense low mallee at KU3 and similar habitat along the cage transect (KU11).

INTRODUCED MAMMALS

MURIDAE

House Mouse - *Mus musculus*
Six records of this species including single records from KU1, KU2 (M55049), KU6 (M55048) and KU 7 and two records from KU3.

CANIDAE

Red Fox - *Vulpes vulpes*
Scats recorded from the vehicle track adjacent to KU3.

Discussion

The survey recorded 13 species of mammals (Table 3.3), which compares to 17 recorded by Biota (2000) from Bandalup Hill, 17 by Chapman (2000) and Chapman and Craig (1998) also from Bandalup Hill, and 13 recorded by Sanders (1996) from the Bandalup Corridor in the vicinity of Bandalup Hill.

A search of the Museum's fauna record database for specimens vouchered from an area bounded by -33.6596°S (Northern Latitude), -33.6966°S (Southern Latitude), 120.2164°E (Western Latitude) and 120.1745°E (Eastern Latitude) yielded two taxa; *Macropus eugenii derbianus* and *Rattus fuscipes*.

Although the mammal assemblage recorded by this survey was comparable to that documented at Bandalup Hill, there is a notable decrease in the abundance of rodents compared to that documented by Chapman (2000). This may be due in part to a difference in survey effort:

1. This study - 516 pit-trap nights, 800 Elliott trap nights and 125 cage trap nights over one season; versus
2. Chapman (2000) - 480 pit-trap nights, 1000 Elliott trap nights and 200 cage trap nights across spring 1999 and autumn 2000.

However, there is also likely to be a climatic element, possibly reflected in the relative abundance of the House Mouse *Mus musculus* (a species known to respond quickly to favourable conditions). Chapman (2000) documented 211 records of this species, compared to just six recorded during this survey. Similarly, he reported 147 records of the Southern Bush Rat *Rattus fuscipes* compared to 16 from this survey. With respect to the rarer species, Chapman (2000) documented 17 records of the Western Mouse *Pseudomys occidentalis* and five records of the Heath Rat *Pseudomys shortridgei*. No records of either were recorded during the current survey. If rodent numbers are generally low as is suggested by these data then the chances of detecting rarer species such as the Heath Rat are greatly diminished.

Notably, a targeted survey for the Heath Rat carried out at the Bandalup Hill study site between the 2/2/04 and 6/2/04 also failed to record this species from sites where it was previously recorded. Further discussions on the occurrence of rare species are given in Section 5.1.

Table 3.3: Mammals recorded at each of the primary survey locations.

Species Code	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU11	KU12	Opp	Total
TACHYGLOSSIDAE											
Tachyglossus aculeatus				S		S					
DASYURIDAE											
Sminthopsis griseoventer	1	3		1	2		2				9
MACROPODIDAE											
Macropus fuliginosus	S	S	1	1	S	1	S	S			3
Macropus irma										1	1
BURRAMYIDAE											
Cercartetus concinnus	2	2	2	37	1	3	9				56
TARSIPEDIDAE											
Tarsipes rostratus	7	25	16	6	9	13	8				84
VESPERTILIONIDAE											
Chalinolobus gouldii									C		C
Chalinolobus morio				C							C
Vespadelus regulus				C							C
MOLOSSIDAE											
Tadarida australis									C		C
MURIDAE											
Rattus fuscipes			2		10			4			16
*Mus musculus**	1	1	2			1	1				6
CANIDAE											
*Vulpes vulpes**			S								

* Denotes introduced species.
c Denotes calls.
s Denotes signs, eg. tracks, scats etc.

3.3.1 Bats

At least four bat species are likely to be present, based on examination of call sequences: *Chalinolobus gouldii* (Figure 3.1, Table 3.4), *C. morio* (Figure 3.2, Table 3.4), *Vespadelus regulus* (Vespertilionidae; Figure 3.3, Table 3.4) and *Tadarida australis* (Molossidae; Figure 3.4, Table 3.4). Many sequences were of poor quality, limiting the confidence with which some sequences could be classified.

Seven bats may occur within the project area on the basis of previously defined distribution and habitat preferences (Table 3.5). Of these species, none are listed for the area on the mammal database of the Western Australian Museum.

Table 3.4: Mean values for three call variables used to identify bat species (Mean ± Standard Deviation, with range; n: number of sequences analysed, with total number of pulses in brackets).

Species	n	Minimum Frequency	Maximum Frequency	Duration
Chalinolobus gouldii	1(7)	27.2±0.45 Range 27-28	33.2±1.89 Range 30.5-35	6.6±0.8 Range 5.75-7.75
Chalinolobus morio	1(5)	49.7±0.61 Range 48.5-50	60.75±2.84 Range 58-65	2.54±0.25 Range 2.25-2.75
Tadarida australis	1(6)	11.64±0.63 Range 11-13	15.57±0.45 Range 15-16	12.76±1.82 Range 9.75-14.5
Vespadelus regulus	4(17)	42.94±1.2 Range 40.5-44.5	67.71±6.19 Range 52-75	3.94±1.36 Range 2.25-6.5

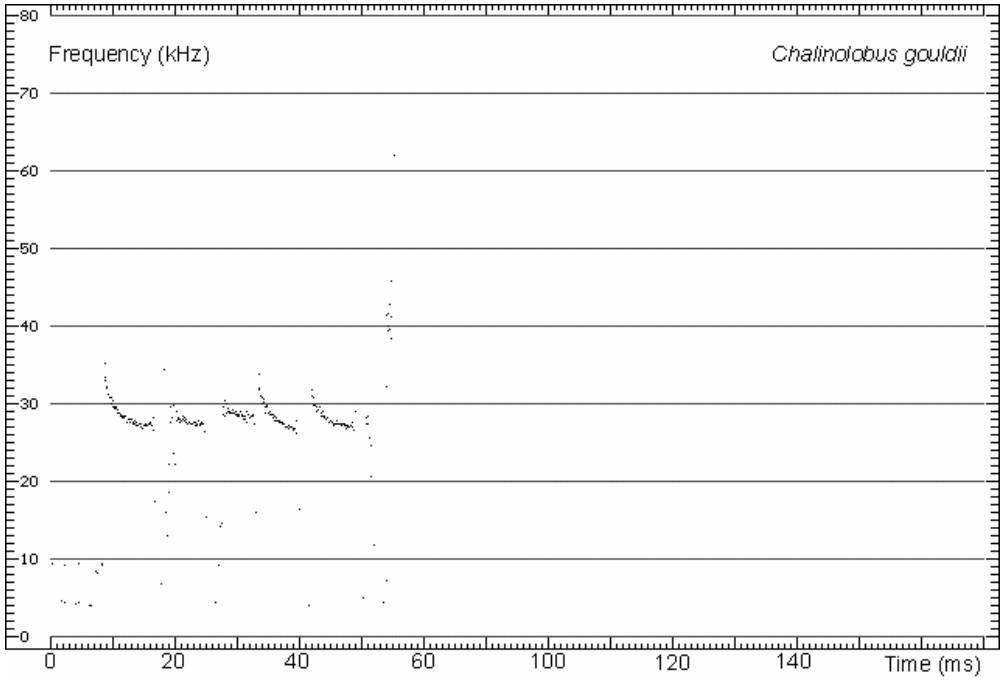

Figure 3.1: Call sequence identified as that of Gould's wattled Bat *Chalinolobus gouldii.* The minimum frequency of calls in this sequence is relatively low for this species, and relatively close to that of *Mormopterus planiceps*. Time is compressed between each pulse in this and each sequence to follow.

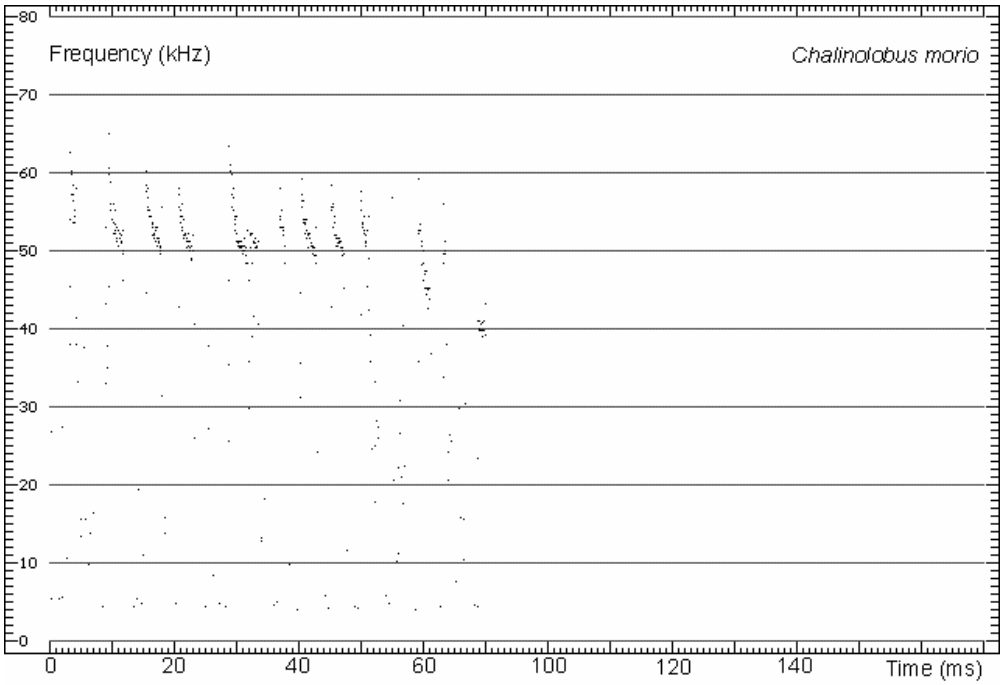

Figure 3.2: Call sequence identified as that of the Chocolate Wattled Bat *Chalinolobus morio*. This was the only sequence recorded of this species.

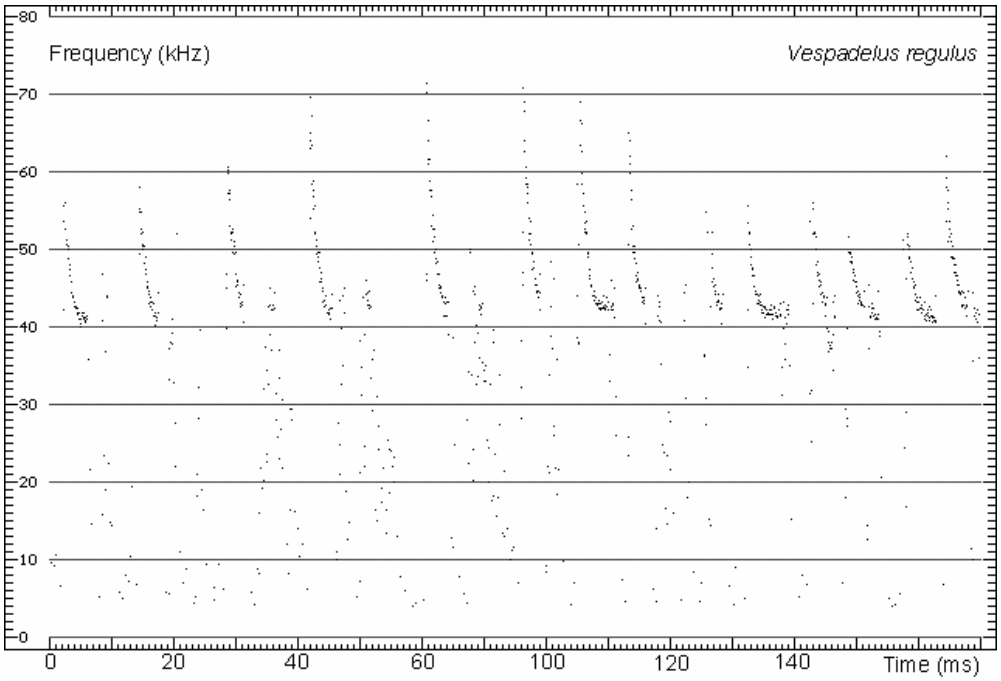

Figure 3.3: Call sequence of the Little Forest Bat *Vespadelus regulus*. Most sequences attributed to this species were difficult to identify unambiguously since they were of a type usually produced in clutter.

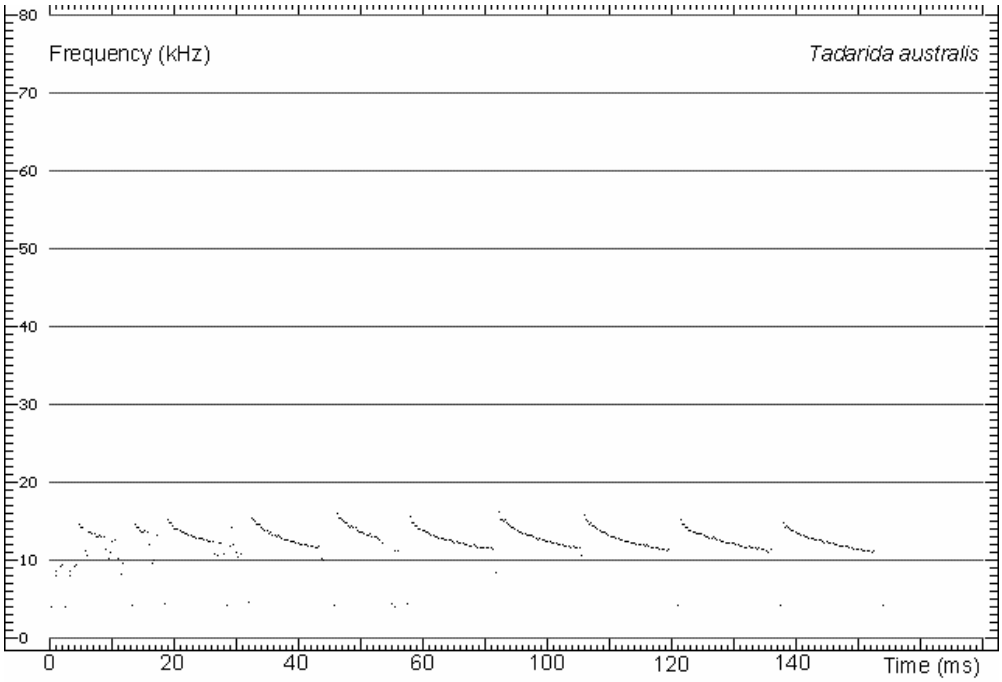

Figure 3.4: Call sequence of the White-striped Freetail Bat *Tadarida australis*.

Table 3.5: Summary of bat species potentially occurring in the vicinity of Kundip (sources: Western Australian Museum; Churchill 1998).

Common Name	Scientific Name	Roost Habitats	Foraging Habitat[1]	Food Preference	Aerial Foraging Niche
Gould's Wattled Bat	*Chalinolobus gouldii*	Tree hollows, foliage, buildings, under bark	Most habitats	Predominantly moths but a generalist	Within the lower level of canopy and along edges
Chocolate Wattled Bat	*Chalinolobus morio*	Tree hollows, buildings, under bark, bridges, martin nests	Forest, woodland, scrub	Predominantly moths but a generalist	Between canopy and understory, forest trails
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Tree hollows, foliage, buildings, under bark	Various: forest, woodland, scrub	Predominantly moths but a generalist	Gleaner, in and around vegetation
Greater Long-eared Bat	*Nyctophilus timoriensis*	Tree hollows, under bark	Tall eucalypt forests, mallee and woodlands.	Largely feeds on ground where beetles make up a significant component of their diet	Gleaner of underside of leaves and ground feeder.
Southern Forest Bat	*Vespadelus regulus*	Tree hollows	Various: forest, woodland, mallee, shrublands	Predominantly moths but also beetles and other aerial insects	In and around vegetation. Foraging at less than half the canopy height
Western Freetail Bat	*Mormopterus* sp	Tree hollows	Various: forest, woodland, mallee, coastal heaths	Unknown.	Unknown
White-striped Freetail Bat	*Tadarida australis*	Trees	Forest, woodland, scrub, urban	Moths and beetles.	Open areas, above canopy, ground

[1] Foraging habitats summarised from Churchill (1998) and are not necessarily present in the project area.

3.4 Herpetofauna

The Assemblage

Three frog and 21 reptile species were recorded from the project area during the current study (Table 3.6). The reptiles comprised four geckos, three pygopods, one agamid, one varanid, 10 skinks and two elapid snakes (common names after Cogger, 1996). Specimens lodged with the WA Museum have been assigned numbers R154175 - 243 and R154431 - 59. These are given below where relevant.

Evidence of breeding was noted for a number of species including *Diplodactylus granariensis granariensis, Cryptoblepharus virgatus clarus, Hemiergis initialis initialis*, *Hemiergis peronii peronii* and *Morethia obscura*.

Table 3.6 summarises the records of herpetofauna from each site and opportunistic collections. Each species is discussed individually in the following.

Annotated List

MYOBATRACHIDAE

Bleating Froglet - *Crinia pseudinsignifera*
Recorded on two occasions. Captured from beneath tin and leaf litter at KU9 (R154188) and pit-trapped at KU1 (R154451).

?White-footed Trilling Frog - *Neobatrachus kunapalari*
Single specimen (R154452), pit-trapped from gravelly sand at KU1. Note that this individual was not heard calling so the identification remains tentative.

HYLIDAE

Spotted-thighed Tree Frog - *Litoria cyclorhyncha*
Recorded from two specimens and a number of calls. A single animal was collected whilst head-torching at KU2 (R154431) and another from KU12. Numerous calls were heard at KU12 and from pools of water in the open cut pit adjacent to KU2.

GEKKONIDAE

Clawless Gecko - *Crenadactylus ocellatus ocellatus*
Recorded on 13 occasions, either from under debris or pit-traps, typically from clayey soils. Four animals recorded from the *Eucalyptus astringens* low woodland at KU4 (R154187, R154199 and R154232), single animal recorded from beneath debris at KU6 (mallee on clay) and eight were recorded from beneath tin and wood piles at KU8 (R154192 - 93), KU9 and KU10 (R154189 - 91).

Wheatbelt Stone Gecko - *Diplodactylus granariensis granariensis*
Recorded on 30 occasions. Most records (n=18) from the *Eucalyptus astringens* woodland at KU4 where there was plenty of fallen timber for shelter (R154175 – 77, R154179, R154237-38, R154433, R154454 – 56 and R154458 – 59) and included 11 animals collected head-torching one evening. Also recorded from KU1 (n=1), KU3 (n=2; R154180, R154443), KU5 (n=3; R154181, R154450), KU6 (n=3; R154445), KU7 (n=2; R154178, R154239) and KU12 (n=1). Records included one gravid female.

Marbled Gecko - *Christinus marmoratus*
Recorded on 14 occasions, either head-torching (n=1), raking beneath debris (n=3), from pit-traps (n=3) or from under tin and wood-piles (n=7). Most records (n=7) from those sites with tin and wood-piles (KU8, KU9 and KU10; R154183 - 86), although also recorded from the *Eucalyptus astringens* low woodland at KU4 (n=3) and the mallee at KU3 (n=3). A single animal was pit trapped from amongst *Banksia media* at KU1.

Barking Gecko - *Underwoodisaurus milii*
Ten records of this species, mostly hand captured from beneath tin and wood-piles (KU8 and KU9) or located whilst head-torching (KU12). Only two records from pit-traps (KU2 and KU7). Four specimens vouchered including R154236, R154432 and R154436 – 7.

PYGOPODIDAE

Aprasia repens
Just a single specimen recorded from the grey sands at KU1 (R154457).

Delma australis
Recorded on just three occasions, all from pit-traps. Single recorded from amongst the *Banksia lemanniana* on skeletal loams at KU6 (R154234) and two from similar habitat at KU2 (R154242 – 3).

Fraser's Legless Lizard - *Delma fraseri fraseri*
Just two records, both from pit traps. A single animal trapped in the *Banksia lemanniana* on skeletal pale grey loams at KU6 (R154435) and another from mallee on red brown loamy clays at KU3 (R154194).

AGAMIDAE

Ctenophorus maculatus griseus
This species was recorded on four occasions all from the pale gravelly sands at KU1. A single female was pit trapped, whilst the remainder were seen active in sunny patches.

VARANIDAE

Southern Monitor - *Varanus rosenbergi*
Recorded on nine occasions, typically as opportunistic records of animals crossing access tracks, but also from cage traps, Elliott traps and pit traps.

SCINCIDAE

Cryptoblepharus virgatus clarus
Second most commonly recorded species (n=28) after *Diplodactylus g. granariensis*. Most records were of individuals seen on timber, including crates and pallets etc lying around the old mines and on fallen logs particularly in debris piles on the side of tracks, but also on mine shaft walls. Six specimens vouchered including (R154195 – 98, R154235 and R154449). Records included one gravid female.

Ctenotus impar
Recorded on three occasions, including two records from the *Banksia lemanniana* on skeletal pale grey loamy sands at KU6 (R154226 – 7) and a single from similar habitat at KU2 (R154442).

Ctenotus labillardieri
A single animal was recorded from beneath tin at KU9 (R154453).

Hemiergis initialis initialis
One of the most commonly recorded species with 24 records, mostly raked from beneath soil and litter in the *Eucalyptus astringens* woodland at KU4 (n=8) or the *E. platypus* woodland at KU13 (n=3), but also from beneath tin and wood-piles at KU8 and KU9 (n=3). Pit-trapped at all trapping sites. Twelve individuals vouchered including R154211 – 20, R154439 – 40 and R154447. Records included two gravid females.

Hemiergis peronii peronii
This species was pit-trapped on seven occasions, including one each from KU3 and KU7, two from KU2 (including R154434) and three from KU5. In contrast, it was recorded on 15 occasions from beneath layers of tin and wood-piles, mostly from KU9 (n=12; R154202 – 08), but also from KU8 (n=2, R154209 – 10) and KU10 (n=1, R154201). Specimens were also raked from beneath wood and leaf litter particularly along windrows. Specimens included two gravid females.

Lerista distinguenda
Recorded on just five occasions, all as pit-trapped animals. Most records from amongst *Banksia lemanniana* at KU6 (n=4, including R154229, R154231 and R154240 – 1), with a single animal recorded from the *Banksia media* at KU1 (R154230).

Lerista viduata
Single specimen collected from a pit trap at KU2 (determined by Greg Harold).

Menetia greyii
This species was relatively uncommon with just four records. Single animals were pit-trapped from KU3, KU4 (R154228), KU5 (R154441) and KU6 (R154233).

Morethia obscura
Recorded on twelve occasions including seven from pit traps, four collected from beneath debris and one observed active. Records from KU3 (n=2 including R154224), KU4 (n=3, including R154222 and R154225), KU6 (n=4 including R154221 and R154223), KU8 (n=2) and KU9 (n=1). Records included one gravid female.

Bobtail - *Tiliqua rugosa rugosa*
Recorded on just two occasions, a single animal trapped at KU2 and a skull collected from KU4.

ELAPIDAE

Dugite - *Pseudonaja affinis affinis*
Recorded on two occasions, one specimen caught in an Elliott trap (where it regurgitated a partially digested *Cercartetus concinnus*) and a second disturbed from a wood pile in the *Eucalyptus astringens* woodland.

Tiger Snake - *Notechis scutatus occidentalis*
Single specimen seen on highway adjacent to the main access track.

Discussion
The thoroughness of surveys is often gauged in terms of the completeness of the recorded species assemblage in comparison to the known and predicted assemblage, as collated from the State's collection (housed at the WA Museum) and published and unpublished studies. The current study recorded three frogs and 21 reptiles (Table 3.6). This compares to 70 species recorded from the Fitzgerald Biosphere Reserve (Teale et al. in prep.) comprising two hylids (tree frogs), 13 myobatrachids (ground frogs), one cheluid (freshwater tortoise), six agamids (dragon lizards), six geckos (geckos), six Pygopodidae (legless lizards), 20 Scincidae (skinks), two Varanidae (monitor lizards), five Typhlopidae (blind snakes), one Boidae (python) and eight Elapidae (front-fanged snakes) (from Teale et al. in prep.). These latter tallies have been sourced from collections and surveys spanning many decades and a greater array of habitats than present in the Kundip survey area (Teale et al. in prep.). The potential occurrence of many of these species within the Kundip study site could be discounted based on the absence of suitable habitat (eg. lack of granite outcrops for *Ctenophorus ornatus*).

A more appropriate comparison is probably gained from analysis of comparable surveys (in terms of area, duration and habitats examined) carried out locally. Biological surveys at Bandalup Hill associated with the Ravensthorpe Nickel project have been undertaken since 1998, whilst Sanders (1996) conducted trapping in the Bandalup Corridor and Chapman undertook a trapping program in the Ravensthorpe Range. Craig and Chapman (1998) and Chapman (2000) recorded five species of frog and 18 species of reptiles from the proposed Halley's pit area and the long term monitoring sites at Bandalup Hill. Further studies at Bandalup Hill added seven additional species, and investigations of sandy substrates adjacent to Bandalup Hill as part of the Shoemaker extension added another one species (Biota 2001 and Teale et al. in prep.). Four frogs and 22 reptiles were collected from study sites examined by Sanders (1996), whilst Chapman and Newbey (1995) recorded seven frog and 27 reptiles from the Ravensthorpe Range surveys. From

these comparisons it can be seen that the Kundip survey recorded a relatively standard assemblage for the region given the survey duration, and that additional sampling would in all likelihood add additional species.

Notably absent from the results were any records of blind snakes (Typhlopidae) despite the apparent suitability of conditions (approximately 30 mm of rainfall over four days). The review by Teale et al. (in prep.) indicates that up to five species may be recorded from the Biosphere Reserve, including one currently undescribed species known from the Cocanarup Timber Reserve and possibly Cape Arid National Park to the east of Esperance.

Snakes in general were poorly represented during the survey with just three records across two species (Table 3.6). An additional four species of elapid snakes including the Crowned Snake *Elapognathus coronatu*s, Bardick *Echiopsis curta*, Gould's Snake *Parasuta gouldii* and Black-backed Snake *P. nigriceps*, and one python the Carpet Python *Morelia spilota imbricata* may all occur at Kundip. The latter species is listed as a Schedule 4 species and is discussed in more detail in Section 5.1.

With the exception of the skink *Lerista viduata* and the Carpet Python *Morelia spilota imbricata,* none of the herpetofauna recorded or potentially occurring are of special conservation status according to State lists. However, little is known of the distribution and taxonomic status of the as yet undescribed blind snake *Ramphotyphlops* sp., so its conservation status is questionable.

Of additional note is the possible occurrence of the dragon *Amphibolurus norrisi*. The known distribution of this species was extended westward to Bandalup Hill by Chapman (1998), currently the only known locality for this species in the Fitzgerald Biosphere Reserve.

A search of the Museum's fauna record database for an area bounded by -33.6596°S (Northern Latitude), -33.6966°S (Southern Latitude) 120.2164°E (Western Latitude) and 120.1745°E (Eastern Latitude) yielded seven taxa (Appendix B), comprising two myobatrachid frogs, one agamid, one gecko and three skinks.

Table 3.6: Herpetofauna records from the Kundip project area.

Species Code	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU9	KU10	KU11	KU12	KU13	Opp	Total
Myobatrachidae															
Crinia pseudinsignifera	1								1						2
Neobatrachus kunapalari	1														1
Hylidae															
Litoria cyclorhyncha		1										7			8
Gekkonidae															
Crenadactylus ocellatus ocellatus				4		1		2	3	3					13
Christinus marmoratus	1		3	3				3	2	2					14
Diplodactylus granariensis granariensis			2	18	3	3	2					1			30
Underwoodisaurus milii		1					1	1	3			4			10
Pygopodidae															
Aprasia repens	1														1
Delma australis		2				1									3
Delma fraseri fraseri		1	1												2
Agamidae															
Ctenophorus maculatus griseus	4														4
Varanidae															
Varanus rosenbergi	1	2	3		1	1					1				9
Scincidae															
Cryptoblepharus virgatus clarus		5	1	2		1		5	8	3		3			28
Ctenotus impar		1				2									3
Ctenotus labillardieri									1						1
Hemiergis initialis initialis	1	2	1	10	2	1	1	2	1				3		24
Hemiergis peronii peronii		3	2	2	3		1	2	12	1					26
Menetia greyii			1	1	1	1									4
Morethia obscura			2	3		4		2	1						12
Lerista distinguenda	1					4									5
Lerista viduata		1													1
Tiliqua rugosa rugosa		1		1											2
Elapidae															
Notechis scutatus occidentalis														1	1
Pseudonaja affinis affinis							1						1		2
Total species	**9**	**11**	**9**	**9**	**5**	**10**	**5**	**7**	**9**	**4**	**1**	**4**	**1**	**1**	**24**

4.0 Invertebrate Fauna Inventory Survey

4.1 Overview

Many recent publications have highlighted taxonomic groups of invertebrates with naturally small distributions (less than 10, 000 km^2) (general reference, Harvey 2002; freshwater snails, Ponder and Colgan 2002; land snails, Clark and Richardson 2002). These taxa are variously described as narrow range endemics or short-range endemics (see Harvey 2002) and are in part characterised by poor dispersal capabilities, confinement to disjunct habitats and low fecundity (Harvey 2002, Ponder and Colgan 2002). Given the importance of short-range endemism to the conservation of biodiversity, the assessment of such invertebrate taxa is a potentially important component of impact assessment. Examples of taxonomic groups that show high levels of short-range endemism in this respect include millipedes, mygalomorph spiders, and freshwater and terrestrial molluscs.

The survey of Kundip recorded over 30 invertebrate taxa, many of which were not identified beyond family level. Only those taxa belonging to groups known to include short-range endemics (Mygalomorphs, Pulmonate land snails), that were otherwise of conservation significance (eg. Buprestidae) or for which expertise was readily available at the WA Museum (eg. wolf spiders and other spider groups) were identified to genus or species level.

4.2 Arachnida

4.2.1 Mygalomorph Spiders

Two species of mygalomorph spiders from the family Nemesiidae were recorded from the Kundip project area; *Aname mainae* and *Chenistonia tepperi*. Three juvenile females from this family were excavated from burrows in the Moort *Eucalyptus platypus* woodland (KU13) and could not be identified beyond family level.

- *Aname mainae*

A total of nine specimens were collected, all of which were adult males and all from pit-traps. This species (Plate 4.1) was widespread throughout the project area, recorded from all sites with the exception of KU2 and KU4. At KU4 it was apparently replaced by another species *Chenistonia tepperi* (see below). Its absence from KU2 probably reflects a sampling artefact, as it was recorded from the same vegetation type (and presumably soil type) at KU6. The distribution of *A. mainae* is shown in Figure 4.1.

Plate 4.1: *Aname mainae* from KU5.

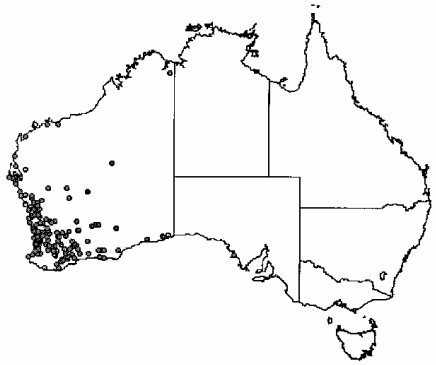

Figure 4.1: Distribution of *A. mainae* (map provided by the WA Museum).

- *Chenistonia tepperi*

Apparently much less widespread in the project area than *Aname mainae*, *C. tepperi* (Plate 4.2) was only recorded from three adult males collected from pit-traps in the *Eucalyptus astringens* woodland on grey, calcareous clay loam. The broader distribution of *C. tepperi* encompasses mostly coastal localities in the far South-west, with scattered records from the Wheatbelt.

Plate 4.2: *Chenistonia tepperi* from KU4.

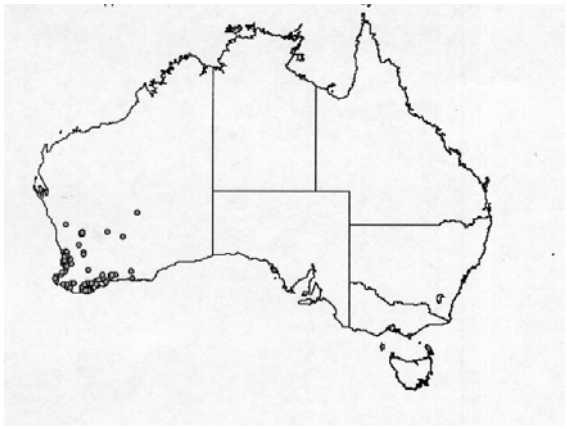

Figure 4.2: Distribution of *C. tepperi* (map provided by the WA Museum).

4.2.2 Lycosidae Wolf Spiders

The family Lycosidae is currently the subject of a detailed taxonomic review by Dr. Volker W. Framenau of the Western Australian Museum and many specimens collected cannot be allocated to a described species. There are currently 145 wolf spider species in 22 genera in Australia (http://www.alphalink.com.au/~framenau/Lycosidae/) with an estimated 300-500 species awaiting description (Dr. Volker Framenau pers. comm. 2004).

Five species of Lycosidae were collected during the survey including *Hoggicosa* sp (member of the *bicolor* group) (Plate 4.3), *Lycosa ariadnae*, *Venator* sp1 (undescribed species, Plate 4.4), *Venator* sp2 (undescribed species) and *Zoica* sp1 (new species). The *Zoica* sp is of interest as it is a rarely collected genus due to its small size (Framenau pers. comm. 2004). This particular species was only collected from the sandy loam with a quartzite rubble in the south-west sector of the lease at KU5, but may well occur elsewhere. This site also supports a potentially new species of *Melaleuca* that may have a very restricted distribution (Dr. Gillian Craig pers. comm. 2004).

Plate 4.3: *Hoggicosa* species from KU2.

Plate 4.4: *Venator* sp1 collected from KU4.

Lycosa ariadnae is one of the most commonly collected Wolf Spiders within the WA Museum's collection. This largely southwestern Western Australian species has a distribution demarcated by a line drawn from the Murchison River Bridge through Mullewa, 30km east of Wubin, between Merredin and Southern Cross to Hopetoun (McKay 1979). A single specimen is also known from South Australia (see Figure 4.3). It is absent from Karri forest and some areas of Jarrah (McKay 1979). This current classification encompasses two distinct taxa, with those collected from Kundip representing the nominate form (Dr. V. Framenau pers. comm. 2004).

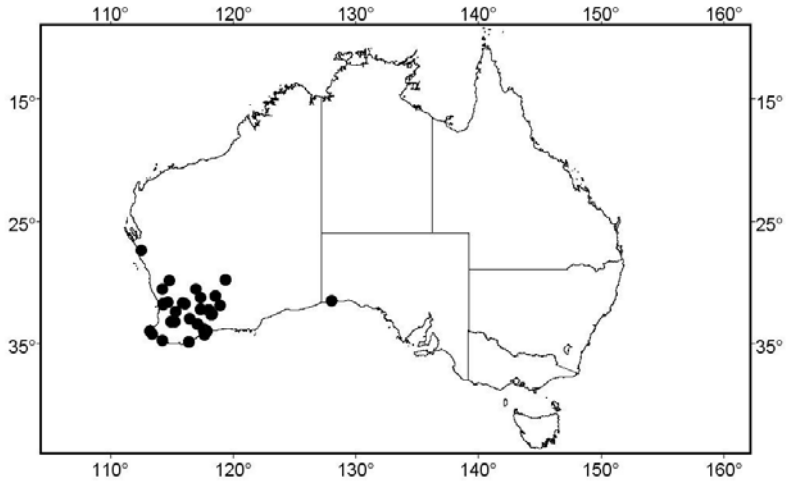

Figure 4.3: Distribution of *Lycosa ariadnae* (map provided by the Western Australian Museum).

4.2.3 Other Spiders

Several other spiders were collected during the survey, either from pit traps or whilst head-torching. These included a species of *Isopedella* from the family Sparassidae, and representatives of the Gnaphosidae, Oxyopidae, Salticidae, Zoridae and Zodariidae.

4.3 Pulmonata

4.3.1 *Bothriembryon* snails

A single Bothriembryon that was not known to Ms Shirley Slack-Smith (WA Museum) was collected during the survey from leaf litter at KU8. *Bothriembryon* snails are potentially of interest as they may have relatively small distributions (ie. short-range endemics). Additional collections could be made in winter, when these species are typically active, to better document their occurrence within and adjacent to the project area.

4.4 Scorpionida

Two species of scorpion were collected from the study area comprising several specimens of the buthid *Archisometrus austroccidentalis* and a single juvenile urodacid that could not be identified beyond the level of genus, *Urodacus* sp. *A. austroccidentalis* was represented by seven specimens from four sites including KU3, KU4, KU5 and KU8. The *Urodacus* sp was collected from beneath a large rock at KU6.

4.5 Buprestidae

Two species of buprestid beetle were collected during the survey. The following information regarding taxonomy and identification was kindly provided by Mr David Knowles.

Astraeus (*Depollus*) *multinotatus* is endemic to WA with records from the Murchison, Coolgardie, Yalgoo, and Mallee bioregions (after Thackway and Cresswell 1995). Specimens have been collected from mid September through to early February on *Allocasuarina dielsiana*, *A. humilis* and *A. helmsii*.

Cisseis duodecemaculata is a widespread species recorded from the Swan, Geraldton Sandplain, Avon-Wheatbelt, Jarrah Forrest, Mallee, Esperance, Coolgardie and Hampton bioregions, as well as inter-state (after Thackway and Cresswell 1995), between early November and early March. In Western Australia, this species has been collected from *Allocasuarina corniculata*, *A. littoralis*, *A. acutivalvis*, *A. huegeliana*, *A. humilis* and *Xanthorrhoea preissii*. According to Mr David Knowles (pers. comm. 2004), it represents one of the most widespread and common members of its genus and is probably a complex of similar species.

5.0 Conservation Significance

5.1 Threatened Fauna

Native fauna species which are rare, threatened with extinction or have high conservation value are specially protected by law under the *Western Australian Wildlife Conservation Act 1950.* In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA).

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 1998* recognises four distinct schedules of taxa:

1. Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;

2. Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;

3. Schedule 3 taxa are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, which are declared to be fauna in need of special protection; and

4. Schedule 4 taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, fauna are also classified under four different Priority codes:

Priority One Taxa with few, poorly known populations on threatened lands.

Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Two Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.

Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Three Taxa with several, poorly known populations, some on conservation lands.

Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Four Taxa in need of monitoring.

Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

Conservation Dependent Species

This list includes species previously listed as Specially Protected Fauna (Schedule 1) but that have benefited from fox baiting such that populations have increased substantially. However, it is felt that without continued baiting and monitoring, populations may again be at risk.

Two Schedule listed fauna were recorded from the project area; Carnaby's Cockatoo *Calyptorhynchus latirostris* and the Malleefowl *Leipoa ocellata*. The survey also recorded three Priority species; the skink *Lerista viduata,* Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* and Western Brush Wallaby *Macropus irma*. See under each species in the above annotated lists for more details.

A search of the CALM Schedule and Priority Fauna database for species potentially occurring in the area yielded six Schedule 1 species, two Schedule 4 species and six Priority species (see Appendix C). An additional Schedule 1, Schedule 4 and Priority taxon may occur in the area based on other information. More detailed discussion for these species of conservation significance is given below.

Schedule 1 Fauna

- Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under *EPBC Act 1999*)

This species occupies the south-western zone between Kalbarri and Esperance, and was recorded during the current survey. It feeds on the seeds and flowers of a range of species including *Banksia*, *Dryandra*, *Hakea*, *Eucalyptus* and *Grevillea*. Clearing of semiarid sandplains and removal of its principal nesting tree (salmon gum) from the Wheatbelt has been implicated in the decline of this species (Garnett 1992; Johnstone and Storr 1998).

Recorded on three occasions as flocks of between two and seven individuals flying over the project area. These birds were not positively identified as *C latirostris,* rather the identification is based on the current distribution of the two White-tailed Black Cockatoos in WA as given by Johnstone and Storr (1998).

- Western Ground Parrot *Pezoporus wallicus flaviventris* Schedule 1 (Endangered under *EPBC Act 1999*)

At the time of European settlement, the Western Ground Parrot probably extended though coastal and near-coastal areas from Point Malcolm in the east to Dongara in the north. They had disappeared from all areas west of Albany in the first few decades of the 20th century, although recent unconfirmed reports from around Jurien Bay raise hope that a small population may still exist there. Until the existence of this population is confirmed, it is generally accepted that Western Ground Parrots remain in only three areas. The main population is found within Fitzgerald River National Park, with smaller populations to the west in the Cheyne Beach/Waychinicup area and to the east in Cape Arid National Park and Nuytsland Nature Reserve. The total population is estimated to be only about 250 individuals. The population trends of the Fitzgerald River and Cape Arid populations are not clear due to large variations in the number of singing birds recorded but recent surveys indicate that the Cheyne Beach population has declined dramatically and may be close to extinction.

The subspecies typically occurs in low heathland, including low *Banksia* and *Hakea*, and often occurs in low open mallee in swampy areas. Sites are typically not occupied until they are at least six years post fire, often older, and densities typically increase until the vegetation is 20 to 30 years post-fire.

It is possible, but not probable that the species occurs in the study area. Factors in favour of its occurrence are that the study area lies between known populations and the habitat appears suitable. In addition, the subspecies typically only calls well before dawn or well after dusk and is almost impossible to see, so it may be missed by standard diurnal bird surveys. Factors against its occurrence are that the distribution of the subspecies is well

known and that the area is relatively frequently visited by birders yet this species has not been recorded.

- Malleefowl *Leipoa ocellata* Schedule 1 (Vulnerable under *EPBC Act 1999*)

Just the single record from the project area. This species appears to be relatively common in the Ravensthorpe district compared to other areas in its range, and has been recorded throughout mallee-heath habitat in the Fitzgerald Biosphere Reserve (Teale et al. in prep.).

No attempt was made to systematically search the project area for active mounds during the current survey and such a search of the impact areas may be warranted once these have been identified.

- Chuditch *Dasyurus geoffroyii* (Vulnerable under *EPBC Act 1999*)

Single record of this species from the Kundip townsite during 1992. A single male roadkill was also recorded in May 1994 10km east of Ravensthorpe on Highway 1 in mallee-heath (Teale et al. in prep.).

- Dibbler *Parantechinus apicalis* (Endangered under *EPBC Act* 1999).

Record from Kundip in 1986.

- Heath Rat *Pseudomys shortridgei*

Within the Fitzgerald Biosphere Reserve this species appears to be largely confined to habitats with a mallee overstory on variable soils including loamy-sands and sandy-loams with a laterite component, stony clays and sandy light clay on greenstone (Cooper et al. 2003; Teale et al. in prep.). A component common to all capture sites was the presence of sedges in the understorey and that the vegetation was long unburnt (greater than 20 years) (Teale et al. in prep.).

This species was not recorded during the current survey, however suitable habitat occurs across much of the lease. Teale et al. (in prep.) report 77 capture events across 11 sites within the Fitzgerald Biosphere Reserve. The discussion in Section 3.3 notes that rodent captures in general were fairly low when compared to some historical trapping events. It is considered likely that this species would occur within the lease, though its abundance may fluctuate both temporally and spatially dependent on condition and age of the vegetation.

Recent molecular analysis found that the level of genetic divergence between populations in eastern and western Australia supported the current treatment of those populations as single species (Cooper et al. 2003).

It is recommended that seasonal trapping be undertaken at the study site in spring 2004 in an attempt to capture this species.

Schedule 4 Fauna

- Peregrine Falcon *Falco peregrinus*

This widespread species, although common in parts of WA, would be rare or scarce in the project area according to Johnstone and Storr (1998). It primarily inhabits wooded watercourses and lakes, coastal cliffs, rivers and ranges, none of which are prevalent in the project area.

- Carpet Python *Morethia spilota imbricata*

This sub-species is broadly distributed across much of the South-west, but has been given its protected status due to the fact that it is not common anywhere in its range. Just three records from two sites were collated by Teale et al. (in prep.) for the Fitzgerald Biosphere Reserve.

Priority Taxa

- *Lerista viduata* (Priority 1)

The majority of records of this species are from eucalypt woodland on the south facing slopes of the Ravensthorpe Range immediately north of Ravensthorpe (G. Harold pers. comm. 2004). Closer to the study area they have been recorded from the Moort Woodland *Eucalyptus platypus* just to the west of the old Kundip townsite (G. Harold pers. comm.). Over two hours of raking in this same habitat within the lease boundaries did not yield this species, however, one specimen was collected from a pit trap at KU2. This species is represented by just 14 specimens in the State collection.

- Quenda *Isoodon obesulus fusciventer* (Conservation Dependent, Priority 4)

This species is locally common in and adjacent to wetlands in the South-west of the state and recently its classification has changed from a Priority 4 species to Conservation Dependent. No convincing evidence of this species was recorded from the project area although old diggings that may indicate the presence of this species were recorded along Steere River.

This species has been recorded from the Fitzgerald Biosphere Reserve as far east as Bandalup Hill (Teale et al. in prep.).

- Tammar *Macropus eugenii derbianus* (Conservation Dependent, Priority 4)

Not recorded during the survey but two recent records of road kills from just south of the old Kundip townsite on the Ravensthorpe to Hopetoun Road.

- Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* (Vulnerable under *EPBC Act 1999*)

Identified on six occasions from calls given in mallee associations (sites KU1, KU2 and KU3). Teale et al. (in prep.) have compiled 165 records from 76 sites across the Fitzgerald Biosphere Reserve. The records include an adult feeding a sub-adult in October 2000 and of a nest with two eggs in September 1993. Sanders (1996) found the species to be widespread and common during the Fitzgerald Biosphere Reserve study with the majority of records being from open mallee over a dense heath understorey, but with some also from heath and shrubland. Johnstone (pers. comm. 2004) considered this species to be common in suitable habitat throughout the Ravensthorpe district, compared to elsewhere in its range.

- Western Mouse *Pseudomys occidentalis* (Priority 4)

Teale et al. (in prep.) document 279 capture events from 37 sites within the Fitzgerald Biosphere Reserve with most records from mallee. The last moderate capture rate for this species was documented by Chapman (2000) who recorded 17 capture events at Bandalup Hill. Additional trapping at Bandalup Hill yielded just one other individual (Biota 2001).

Habitat for this species is described as shrublands that have not been burnt for 15-30 years on clay loams, usually with a laterite component (Lee 1995).

This species may well occur in the project area but at population levels that are currently very difficult to detect. It is therefore suggested that a seasonal trapping program be undertaken in an attempt to capture this species.

- Western Brush Wallaby *Macropus irma* (Priority 4)

The Western Brush Wallaby is considered to be uncommon over much of its range (Christensen 1995). The preferred habitat of this species is open forests and woodlands but it also occurs in scrubby thickets, mallee and heath. Teale et al. (in prep.) document thirty-one records from 14 sites plus an additional nine specimens from nine locations documented by the WA Museum, all from the Fitzgerald Biosphere Reserve. Sites are typically in mallee-heath and animals are mostly encountered whilst travelling along roads and tracks, and as roadkills.

During the current survey this species was recorded from a single carcass on the Ravensthorpe to Hopetoun road, just to the north of the mine entrance.

5.2 Requirement for Referral Under the *EPBC Act 1999*

In determining whether Tectonic Resources NL have any obligations in respect of the Kundip project under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC), the following was considered:

- does the project constitute an 'action' that would affect any of the triggers for Federal referral identified in the Act.

Under the Act, an 'action' consists of 'a project, development, undertaking, activity or series of activities'. Actions are required to be referred under the *EPBC Act 1999* if they take place on Commonwealth land or are an action by the Commonwealth, or are likely to significantly impact a matter of National Environmental Significance (NES). The project is not on Commonwealth land or a Commonwealth action and would not require referral on this basis, leaving consideration of the NES factors only.

There are currently six NES factors identified in the Act. Five of these, Ramsar wetlands, World Heritage properties, migratory waders, nuclear actions and Commonwealth waters, are clearly not relevant to this project. The only possible trigger factor of relevance relates to threatened flora and fauna species and threatened ecological communities.

The fauna surveys of the sites recorded one species listed as Endangered (Carnaby's Cockatoo) and two species (Malleefowl and Western Whipbird) listed as Vulnerable under the *EPBC Act 1999*.

Local populations of the Western Whipbird will be impacted by the development of the Kundip site. These birds are resident within the area and may be displaced by development of the pits and associated infrastructure. The exact extent of this impact is unclear as the foot print for the development is uncertain. This species is considered locally common in the region (Ron Johnstone pers. comm. 2004)

It is also unclear to what extent the Malleefowl will be impacted. A single Malleefowl was recorded from the mallee west of the Harbour View site and may well range into the proposed development areas. As with the Western Whipbird, this species is considered locally common in the region (Ron Johnstone pers. comm. 2004)

It is unlikely that the project will directly impact populations of Carnaby's Cockatoos other than by contributing to the regional cumulative reduction of potential foraging habitat through clearing of vegetation. This species predominantly nests within smooth-barked eucalypts including wandoo *Eucalyptus wandoo* and salmon gums *E. salmonophloia*, but also in red morel *E. longicornis*, York gum *E. loxophleba*, tuart *E. gomphocephala* and marri *Corymbia calophylla* (Johnstone and Storr 1998). Within the Fitzgerald Biosphere Reserve, breeding records have been obtained from the Stirling Range and Cocanarup Timber Reserve (10km west of Ravensthorpe; A. Sanders pers. comm.).

In summary, it is our opinion that the proposal to develop the Kundip operations requires referral to the Federal Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999*. This is based principally on the very probable impacts of the project on the population of Western Whipbirds currently resident within the project area, but also that the level of impact to Malleefowl is uncertain. Both these species are considered common in the region (Ron Johnstone pers. comm. 2004) and their occurrence on site is not exceptional (see also Biota 2000, Chapman 2000). This assessment should be revisited once project definition is finalised and a more accurate review of potential impacts is possible.

5.3 Recommendations

The following recommendations arise from the fauna survey of the Kundip study area:

1. The opportunity exists, should the project proceed, to utilise existing cleared and disturbed areas for proposed new disturbances. The use of these disturbed areas should be maximised as part of project design.

2. Within the Kundip lease area, mature woodland habitat is restricted in distribution and supports both an abundant and species rich fauna assemblage. This is evident in the very high number of captures of species such as the Western Pygmy Possum *Cercartetus concinnus* and *Diplodactylus granariensis granariensis*. Clearing of mature woodland should be minimised where possible.

3. The proponent should undertake an additional seasonal survey of the project area to more fully document the faunal assemblage and identify any additional constraints. This study could usefully target threatened fauna taxa not well represented during the current survey including Schedule listed rodent and bird species.

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2 UNLESS SPECIFICALLY AUTHORISED IN THE CONDITIONS OF THIS LICENCE OR OTHERWISE IN WRITING BY THE EXECUTIVE DIRECTOR, SPECIES OF FAUNA DECLARED AS LIKELY TO BECOME EXTINCT, RARE OR OTHERWISE IN NEED OF SPECIAL PROTECTION SHALL NOT BE CAPTURED OR OTHERWISE TAKEN.

3 NO FAUNA SHALL BE TAKEN FROM ANY NATURE RESERVE, WILDLIFE SANCTUARY, NATIONAL PARK, MARINE PARK, TIMBER RESERVE OR STATE FOREST WITHOUT PRIOR WRITTEN APPROVAL OF THE EXECUTIVE DIRECTOR. NO FAUNA SHALL BE TAKEN FROM ANY OTHER PUBLIC LAND WITHOUT THE WRITTEN APPROVAL OF THE GOVERNMENT AUTHORITY MANAGING THAT LAND.

4 NO ENTRY OR COLLECTION OF FAUNA TO BE UNDERTAKEN ON ANY PRIVATE PROPERTY OR PASTORAL LEASE WITHOUT THE CONSENT IN WRITING OF THE OWNER OR OCCUPIER, OR FROM ANY ABORIGINAL RESERVE WITHOUT THE WRITTEN APPROVAL OF THE DEPARTMENT OF INDIGENOUS AFFAIRS.

5 NO FAUNA OR THEIR PROGENY SHALL BE RELEASED IN ANY AREA WHERE IT DOES NOT NATURALLY OCCUR, NOR HANDED OVER TO ANY OTHER PERSON OR AUTHORITY UNLESS APPROVED BY THE EXECUTIVE DIRECTOR, NOR SHALL THE REMAINS OF SUCH FAUNA BE DISPOSED OF IN SUCH MANNER AS TO CONFUSE THE NATURAL OR PRESENT DAY DISTRIBUTION OF THE SPECIES.

6 THIS LICENCE AND THE WRITTEN PERMISSION REFERRED TO AT CONDITIONS 3 & 4 MUST BE CARRIED BY THE LICENSEE OR AUTHORISED AGENT AT ALL TIMES FOR THE PURPOSE OF PROVING THEIR AUTHORITY TO TAKE FAUNA WHEN QUESTIONED AS TO THEIR RIGHT TO DO SO BY A WILDLIFE OFFICER, ANY OTHER STATE OR LOCAL GOVERNMENT EMPLOYEE OR ANY MEMBER OF THE PUBLIC.

7 **********ANY INTERACTION INVOLVING GAZETTED THREATENED FAUNA THAT MAY BE HARMFUL AND/OR INVASIVE MAY REQUIRE APPROVAL FROM THE COMMONWEALTH GOVERNMENT DEPARTMENT , "ENVIRONMENT AUSTRALIA", PHONE 02 6274 1111. INTERACTION WITH SUCH SPECIES IS CONTROLLED BY THE COMMONWEALTH GOVERNMENT'S "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999" & "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION REGULATIONS 2000" AS WELL AS CALM'S WILDLIFE CONSERVATION ACT & REGULATIONS.**********

8 NO BIOPROSPECTING INVOLVING THE REMOVAL OF SAMPLE AQUATIC AND TERRESTRIAL ORGANISMS (BOTH FLORA AND FAUNA) FOR CHEMICAL EXTRACTION AND BIOACTIVITY SCREENING IS PERMITTED TO BE CONDUCTED WITHOUT SPECIFIC WRITTEN APPROVAL BY THE EXECUTIVE DIRECTOR OF C.A.L.M.

9 FURTHER CONDITIONS (NUMBERED 1 TO 10) ARE ATTACHED.

PURPOSE KUNDIP FAUNA SURVEY (20KM NORTH OF HOPETOUN)

WILDLIFE CONSERVATION ACT 1950
WILDLIFE CONSERVATION REGULATIONS

Regulation 17:- Licence to Take Fauna for Scientific Purposes

FURTHER CONDITIONS (OF LICENCE NUMBER SF 4401)

1. The licensee shall ensure that all due care is taken in the capture and handling of fauna to prevent injury or mortality resulting from that capture or handling. Where traps or other mechanical means or devices are used to capture fauna these shall be inspected at regular intervals throughout each day of their use. At the conclusion of research all markers etc and signs erected by the licensee and all traps shall be removed, all pitfalls shall be refilled or capped and the study area returned to the condition it was in prior to the research/capture program. During any break in research, cage traps should be removed and pitfalls either removed, capped or filled with sand.

2. No collecting is to be undertaken in areas where it would impinge on pre-existing scientific research programs.

3. Any form of colour marking of birds or bats to be coordinated by the Australian Bird and Bat Banding Schemes.

4. Any inadvertently captured specimens of fauna which is declared as likely to become extinct, rare or otherwise in need of special protection is to be released immediately at the point of capture. Where such a specimen is injured or deceased, the licensee shall contact CALM licensing staff at Kensington (08 9334 0434) for advice on disposal. Records are to be kept of any fauna so captured and details included in the report required under further condition 6 below.

5. Prior to any renewal of this research licence the licensee shall submit a summary report outlining work conducted under this licence and work proposed for the next research period.

6. Within one month of the expiration of this licence (or at such other time or times as the Executive Director may determine) the holder shall furnish to the Executive Director [ATTENTION: WILDLIFE CLERK] a return setting out in full detail the number of each species of fauna taken during the currency of the licence, the localities where the species was/were taken and the method of handling of such fauna and disposal of specimens. A copy of any paper or report resulting from this research should be lodged in due course with the Executive Director. In the case of consultants, a list of the fauna handled, the localities involved and a copy of the interpretive data prepared should be lodged.

7. As a general rule not more than ten specimens of any one protected species shall be permanently taken from any location less than 20km apart. Where exceptional circumstances make it necessary to take large series in order to obtain adequate statistical data the collector will proceed with circumspection and justify their actions to the Executive Director in advance.

8. No fauna, whether dead or alive, may be taken out of Western Australia without the necessary export permit issued under the *Wildlife Conservation Act 1950.* It should be noted that the permit will not be issued unless the State to which the fauna is going has approved that fauna entering that State. In addition to the requirements of the Australian States, the Commonwealth controls exports overseas through Commonwealth legislation administered by the Australian Nature Conservation Agency.

9. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence shall be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected which represents a significant extension of geographic range shall be donated on request to the Western Australian Museum.

10. To prevent any unnecessary collecting in this state, all specimens and material collected under the authority of this license shall, on request, be loaned to the Western Australian Museum. Also, the unused portion or portions of any specimen collected under the authority of this license shall be offered for donation to the Western Australian Museum or made available to other scientific workers if so required.

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Records from WA Museum database search

Appendix 2

BIOta

Amphibia collected between
-33.659632, 120.174566 and -33.696645, 120.216496

Myobatrachidae
Crinia pseudinsignifera
Pseudophryne guentheri

Reptiles collected between
-33.659632, 120.174566 and -33.696645, 120.216496

Agamidae
Ctenophorus maculatus griseus

Gekkonidae
Crenadactylus ocellatus ocellatus

Scincidae
Ctenotus labillardieri
Hemiergis peronii peronii
Lerista viduata

Mammals collected between
-33.659632, 120.174566 and -33.696645, 120.216496

Macropodidae
Macropus eugenii derbianus

Muridae
Rattus fuscipes

Records from CALM rare fauna database search

Appendix 3

BIOta

#250

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

Your Ref:
Our Ref: 2001F001096V06
Enquiries: Christine Freegard
Phone: (08) 9334 0579
Fax: (08) 9334 0278
Email: christinef@calm.wa.gov.au

Mr Roy Teale
Biota Environmental Sciences Pty Ltd
First Floor Suite 2
186 Scarborough Beach Rd
MT HAWTHORN WA 6016

Dear Mr Teale

REQUEST FOR THREATENED FAUNA INFORMATION

I refer to your request of 5 December for information on threatened fauna occurring in the vicinity of Kundip (15 km north of Hopetoun).

A search was undertaken for this area of the Department's Threatened Fauna database, which includes species which are declared as '*Rare or likely to become extinct* (Schedule 1)', '*Birds protected under an international agreement* (Schedule 3)', and '*Other specially protected fauna* (Schedule 4)'. Attached are print outs from these databases where records were found.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the sixth point that refers to the requirement to undertake field investigations for the accurate determination of threatened fauna occurrence at a site. The information supplied should be regarded as an indication only of the threatened fauna that may be present.

An invoice for $110.00 (includes GST), being the set charge for the supply of this information, will be forwarded.

It would be appreciated if any populations of threatened fauna encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss threatened fauna management, please contact my Senior Zoologist, Dr Peter Mawson on 08 93340421.

Yours sincerely

Freegard

.....

for Keiran McNamara
EXECUTIVE DIRECTOR

9 December, 2003

WILDLIFE BRANCH: 17 Dick Perry Avenue, Kensington Western Australia 6151
Phone: (08) 9334 0455 Fax: (08) 9334 0278 Website: www.naturebase.net
Postal Address: Locked Bag 104 Bentley Delivery Centre Bentley Western Australia 6983

Attachment

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

THREATENED FAUNA INFORMATION

Conditions In Respect Of Supply Of Information

* All requests for data to be made in writing to the Executive Director, Department of Conservation and Land Management, Attention: Senior Zoologist, Wildlife Branch.

* The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided without the prior consent of the Executive Director, Department of Conservation and Land Management.

* Specific locality information for Threatened Fauna is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for Threatened Fauna may not be used in reports without the written permission of the Executive Director, Department of Conservation and Land Management. Reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Senior Zoologist is to be contacted for guidance on the presentation of Threatened Fauna information.

* Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Conservation and land Management accepts no responsibility for this.

* Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.

* It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened Fauna of the area in question. Its comprehensiveness is dependent of the amount of survey carried out within a specified area. The receiving organisation should employ a biologist/zoologist, if required, to undertake a survey of the area under consideration.

* Acknowledgment of the Department of Conservation and Land Management as the source of data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Conservation and Land Management, Attention: Senior Zoologist, Wildlife Branch.

Threatened and Priority Fauna Database

33.65963 °S 20.174566 °E / 33.69665 °S 20.216496 °E Kundip

*	Date	Certainty	Seen	Location Name	Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Dasyurus geoffroii **Chuditch** *1 records*

This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors.

1992	1	1	KUNDIP	Day sighting

Parantechinus apicalis **Dibbler** *0 records*

This small carnivorous marsupial inhabits dense, long unburnt coastal heath and populations appear to be very ephemeral. It was recorded in Kundip in 1986. It could possibly occur in the area in question.

Pseudomys shortridgei **Heath Mouse (Dayang)** *0 records*

This species inhabits long unburnt heath and mallee scrub on sandy soils. It has a very limited distribution in the southeastern wheatbelt through to the south coast. It could possibly occur in the area in question.

Leipoa ocellata **Malleefowl** *0 records*

This species was once widely distributed across southern Australia. It prefers woodland or shrubland with an abundant litter layer that provides essential material for the construction of its nest mound. Records in surrounding areas suggest that this species may occur in the area in question.

Calyptorhynchus latirostris **Carnaby's Black-Cockatoo** *0 records*

This species moves around seasonally in flocks to feeding areas in proteaceous scrubs and heaths and eucalypt woodlands as well as pine plantations. Breeding occurs in winter/spring, mainly in the eastern forests and wheatbelt where they can find mature hollow-bearing trees to nest in. It may occur in the area in question.

Schedule 4 - Other specially protected fauna

Falco peregrinus **Peregrine Falcon** *0 records*

This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land. It may occur in the area in question.

Priority One

Lerista viduata **Lerista viduata** *1 records*

A small skink known only from the Ravensthorpe Range.

1993	1	3	Kundip	Caught or trapped

Priority Two

Tuesday, 9 December 2003 **Department of Conservation and Land Management**

Threatened and Priority Fauna Database Page 2 of 2

33.65963 °S 20.174566 °E / 33.69665 °S 20.216496 °E Kundip

*	Date	Certainty	Seen	Location Name	Method

0 records

Priority Three

0 records

Priority Four

Macropus eugenii derbianus **Tammar Wallaby** *3 records*

This species prefers thickets of Melaleuca, Sheoak or other large shrubs associated with grassland.

1990	1	1	Kundip
1994	1	1	Kundip
1994	2	1	Kundip

Macropus irma **Western Brush Wallaby** *0 records*

This species occurs in areas of forest and woodland supporting a dense shrub layer. Records in surrounding areas suggest that this species may occur in the area in question. It is known to occur in Kundip Nature Reserve.

Pseudomys occidentalis **Western Mouse** *0 records*

This species occurs most frequently in areas of long-unburnt vegetation on sandy clay or loam with a matrix of gravel. It is known to feed on the seeds of quandong (Santalum acuminatum) and various sedge species. Records in surrounding areas suggest that this species may occur in the area in question.

Psophodes nigrogularis oberon **Western Whipbird (stlin WA subsp)** *0 records*

This subspecies occurs from the Stirling Range east to Munglinup and north to Lake Grace and inhabits areas of mallee and heath, nesting in dense vegetation. It may occur in the area in question.

* Information relating to any records provided for listed species:-
Date: date of recorded observation
Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.
Seen: Number of individuals observed.
Location Name: Name of reserve or nearest locality where observation was made
Method: Method or type of observation

Tuesday, 9 December 2003 **Department of Conservation and Land Management**

APPENDIX 4: 2005 BIOTA BIOLOGICAL SURVEY REPORT

Biota Environmental Sciences

13 January 2005

Ms. Kim Bennett
Environmental Manager
Tectonic Resources NL
Suite 4, 100 Hay Street
Subiaco WA 6008

Dear Kim

Kundip Phase II Fauna Survey - Summary of Findings

Introduction

Tectonic Resources NL, as owners of the Phillips River Gold Project, aim to develop the gold/copper resource at the Kundip site and the polymetallic resource at the Trilogy site, located 17 and 27 kilometres southeast of Ravensthorpe respectively. An open cut pit is planned for the Trilogy deposit, whilst underground mining and an open cut pits are planned for the deposits at Kundip.

This letter summarises the findings of Phase I of the fauna survey, documented in greater detail in Biota (2004), and provides an overview of Phase II highlighting the key findings, particularly in respect of small mammal captures.

Fauna Survey Phase I

A field survey was conducted over a 10-day period between the 5/1/2004 and 14/1/2004, following a 12-month period of slightly above average rainfall, though this was preceded by an extended dry period.

The methodology utilised during the survey is described in Biota (2004).

The field survey recorded a combined total of 99 vertebrate species, including 62 species of bird, 11 native mammals, two introduced mammals, 21 reptiles and three frogs.

Over 30 invertebrate taxa were recorded from the Kundip study site, many of which were not identified beyond family level. Two species of mygalomorph spiders from the family Nemesiidae were recorded from the Kundip project area; *Aname mainae* and *Chenistonia tepperi*. Both species (as they are currently recognised) have broad distributions through the South-west of WA. A single *Bothriembryon* that was not known to Ms Shirley Slack-Smith (WA Museum) was collected during the survey from leaf litter at KU8. The conservation status of this taxon is unknown.

A search of the CALM Schedule and Priority Fauna database for species potentially occurring in the area yielded five Schedule 1 species, one Schedule 4 species and five Priority species. An additional Schedule 1, Schedule 4 and Priority taxon may occur in the area based on other information.

Schedule 1 Fauna

- *Carnaby's Cockatoo *Calyptorhynchus latirostris* (Endangered under *EPBC Act 1999*)

14 View Street Nth Perth WA 6006 | t: (08) 9328 1900 | f: (08) 9328 6138 | e: biota@biota.net.au | abn: 49 092 687 119

- Western Ground Parrot *Pezoporus wallicus flaviventris* (Endangered under *EPBC Act 1999*)
- *Malleefowl *Leipoa ocellata* (Vulnerable under *EPBC Act 1999*)
- Chuditch *Dasyurus geoffroyii* (Vulnerable under *EPBC Act 1999*)
- Dibbler *Parantechinus apicalis* (Endangered under *EPBC Act 1999*)
- Heath Rat *Pseudomys shortridgei* (Vulnerable under *EPBC Act 1999*)

Schedule 4 Fauna
- Peregrine Falcon *Falco peregrinus*
- Carpet Python *Morethia spilota imbricata*

Priority Taxa
- **Lerista viduata* (Priority 1)
- Quenda *Isoodon obesulus fusciventer* (Conservation Dependent, Priority 4)
- Tammar *Macropus eugenii derbianus* (Conservation Dependent, Priority 4)
- *Western Whipbird (southern WA subspecies) *Psophodes nigrogularis oberon* (Priority 4) (Vulnerable under *EPBC Act* 1999)
- Western Mouse *Pseudomys occidentalis* (Priority 4)
- *Western Brush Wallaby *Macropus irma* (Priority 4)

Species noted with an "*" were recorded during the Phase I survey.

Given the number of fauna of Conservation Significance that may occur in the project area it was recommended that:

1. The proponent should undertake an additional seasonal survey of the project area to more fully document the faunal assemblage and identify any additional constraints. This study could usefully target threatened fauna taxa not well represented during the current survey including Schedule listed rodent and bird species.

Of particular consideration was the possible presence of the Heath Rat *Pseudomys shortridgei* and the population size of the Western Whipbird *Psophodes nigrogularis oberon.*

Overall captures of rodents (even potentially abundant species such as *Rattus fuscipes*) was low, possibly reflecting a poor season. It was felt that if rodent numbers were generally low as was suggested by the trapping data (and comparisons to other studies (Chapman and Craig 1998, Chapman 2000)) then the chance of detecting rarer species such as the Heath Rat was greatly diminished.

It was agreed that the results of the seasonal survey could be written as a brief letter style report to be appended to the original report.

Fauna Survey Phase II

Methodology
The Phase II survey was completed between 16/11/04 – 23/11/04 and involved Dr. Michael Craig (Biota), Mr. Greg Harold (Consultant) and Mr. Andy Chapman (Consultant). The aim of the Phase II survey was to target threatened fauna taxa not well represented during the Phase 1 survey, including Scheduled rodent and bird species (see Biota 2004).

Minimum temperatures during the survey ranged form 4.0°C to 19.2°C and maximum temperatures ranged from 18.0°C to 37.4°C (Table 1). No rainfall was recorded during the survey but 27.9 mm had fallen in November 2004 prior to the survey.