



Kanmantoo

Fauna Survey 2019

Kanmantoo Fauna Survey 2019

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EXECUTIVE SUMMARY

EBS Ecology (EBS) has been engaged by Hillgrove Resources since 2011 to conduct an annual fauna monitoring program over the Kanmantoo Copper (Kanmantoo Mine) Mining Lease (ML). The fauna monitoring program was undertaken in accordance with the conditions and outcomes required in the Program for Environment Protection and Rehabilitation (PEPR) for Kanmantoo Mine. As such, there must be no net adverse impacts on native fauna abundance or diversity in the ML and in adjacent areas.

The fauna monitoring program aimed to determine whether Kanmantoo Mine had met its conditions and outcomes detailed in the PEPR by:

- Conducting roaming transect surveys to record the abundance and diversity of birds;
- Performing targeted spotlighting surveys to record the abundance of the Common Brushtail Possum (*Trichosurus vulpecula*) as well as other nocturnal fauna; and
- Opportunistically recording all other fauna species encountered within the Project area.

The 2019 bird surveys recorded a total of 686 birds from 55 species over the Project area. This included three State threatened species. In 2019, species richness was the third highest on record at Kanmantoo Mine. The total abundance of birds was slightly lower than that recorded in 2018. However, over the lifetime of the fauna monitoring program, the abundance and species richness of birds has shown annual fluctuations, which may be driven by factors such as rainfall, availability of food resources and the presence (or absence) of nomadic and flocking species.

Twenty-two (22) Common Brushtail Possums were observed within the ML during the 2019 spotlight survey, while no individuals were observed in the Significant Environmental Benefit (SEB) area. To date there have been no observations of Common Brushtail Possums within the SEB area due to an absence of suitable habitat. Over the lifetime of the fauna monitoring program the number of Common Brushtail Possums has remained relatively stable, despite annual fluctuations.

The results from the 2019 fauna monitoring program confirm that there is no significant change in native fauna abundance or diversity within the ML and in adjacent areas. Hence, Hillgrove Resources has satisfied the condition (13) and outcome (21) required within the PEPR relating to the conservation of fauna.

EBS recommends the following measures to improve the ongoing management and monitoring of fauna within the Kanmantoo Mine Project area:

- Continue the fauna monitoring program at the same time each year (early spring);
- Reduce spotlighting effort to biennial surveys within the SEB areas due to the low likelihood of Common Brushtail Possums using these areas within the life of mine;
- Conduct a control program to reduce the numbers of Western Grey Kangaroos (*Macropus fuliginosus*), European Rabbits (*Oryctolagus cuniculus*) and European Brown Hares (*Lepus europaeus*) within the Project area to reduce impacts on remnant and planted native vegetation.

GLOSSARY AND ABBREVIATION OF TERMS

BOM	Bureau of Meteorology
EBS	EBS Ecology
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ha	hectares
Kanmantoo (Mine)	Kanmantoo Copper
km	Kilometre(s)
LOM	Life of Mine
ML	Mining Lease
mm	Millimetre(s)
PEPR	Program for Environment Protection and Rehabilitation
Project area	Combined area of the ML and SEB areas
SA	South Australia/South Australian
SEB	Significant Environmental Benefit

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1 INTRODUCTION

EBS Ecology (EBS) has been engaged by Hillgrove Resources since 2011 to conduct an annual fauna monitoring program over the Kanmantoo Copper (Kanmantoo Mine) Mining Lease (ML). The 2019 monitoring program marks the sixth year that EBS has also monitored the Significant Environmental Benefit (SEB) areas, located adjacent to the Kanmantoo ML. The Kanmantoo ML and the Kanmantoo SEB area in combination are named herein as the Project area. The fauna monitoring program was undertaken in accordance with the conditions and outcomes required in the Program for Environment Protection and Rehabilitation (PEPR) for Kanmantoo.

1.1 Objectives

The objective of the fauna monitoring program is to meet the conditions and outcomes as outlined in the PEPR. With regards to fauna (Condition 13), *“the lessee must in constructing and operating the Lease, ensure that there is no adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas”*. As such, the Outcome (21) required is *“no net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas”*. More specifically, the fauna monitoring program aimed to determine the abundance and diversity of fauna within the Project area by:

- Conducting roaming transect surveys to record the abundance and diversity of birds;
- Performing a targeted spotlighting survey to record the abundance of Common Brushtail Possums (*Trichosurus vulpecula*) as well as other nocturnal fauna species; and
- Opportunistically recording all other fauna species encountered within the Project area.

1.2 Project area

The Project area is located approximately 45 km south-east of Adelaide in the eastern Mount Lofty Ranges of South Australia (SA) and 1.5 km south-west of the Kanmantoo township (Figure 1). The area is representative of a transitional zone on the eastern face of the Mount Lofty Ranges, between the Adelaide Hills woodland regions and the Murray River Plains mallee. It has a long-term average rainfall of 469 mm (Figure 3 – BOM 2019b) and encompasses a variety of soil types and geological structures, conducive to an assortment of vegetation types and habitat niches.

The Project area has a history of mining activity, which started in the mid-nineteenth century and then continued between 1971 and 1976 (Hillgrove Resources 2007). Over the past 150 years, much of the ML has been extensively cleared for cropping, whilst most of the vegetated areas have been grazed by domestic stock. As a result, only small remnant patches of native vegetation in the ML have persisted, including native grasslands and woodland communities.

The SEB offset areas are located adjacent to the Kanmantoo Mine (Figure 2). SEB offset areas associated with the Life of Mine (LOM) extension have been located as near as possible to the ML on suitable Hillgrove Resources owned land parcels. The SEB areas are approximately 109.5 hectares (ha) and comprised of five properties (Figure 2), which have been managed under a mixed cropping / sheep grazing regime for over 100 years. Cropping has been confined to the flats and grazing has been on crop stubble and the higher/rockier areas. Consequently, only small remnant patches of native vegetation remain in the SEB areas, including native grasslands and a mallee community.

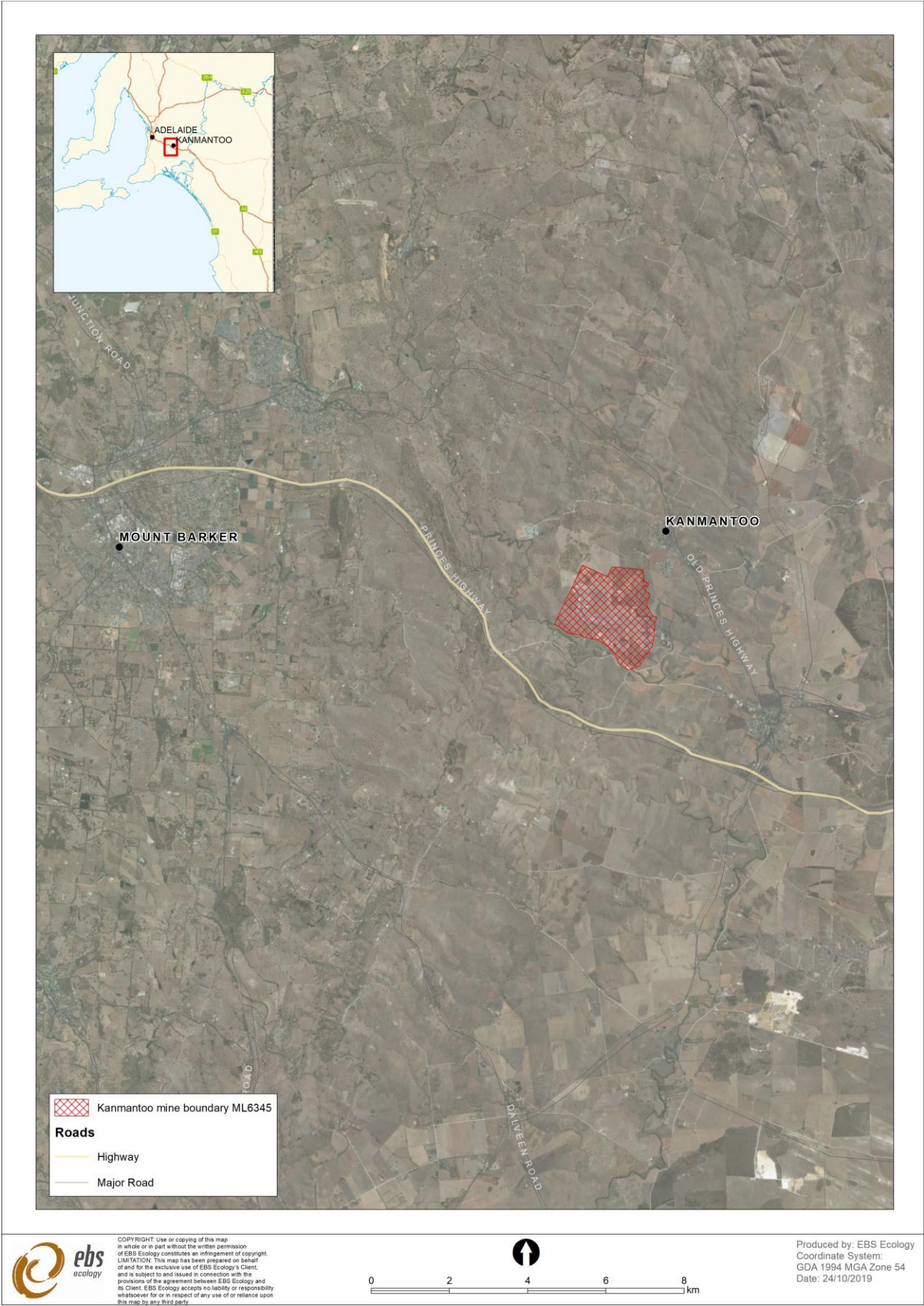


Figure 1. Location of Kanmantoo Mine with respect to local townships and Adelaide, South Australia.



Figure 2. Location of the Kanmantoo ML and SEB areas over the Project area.

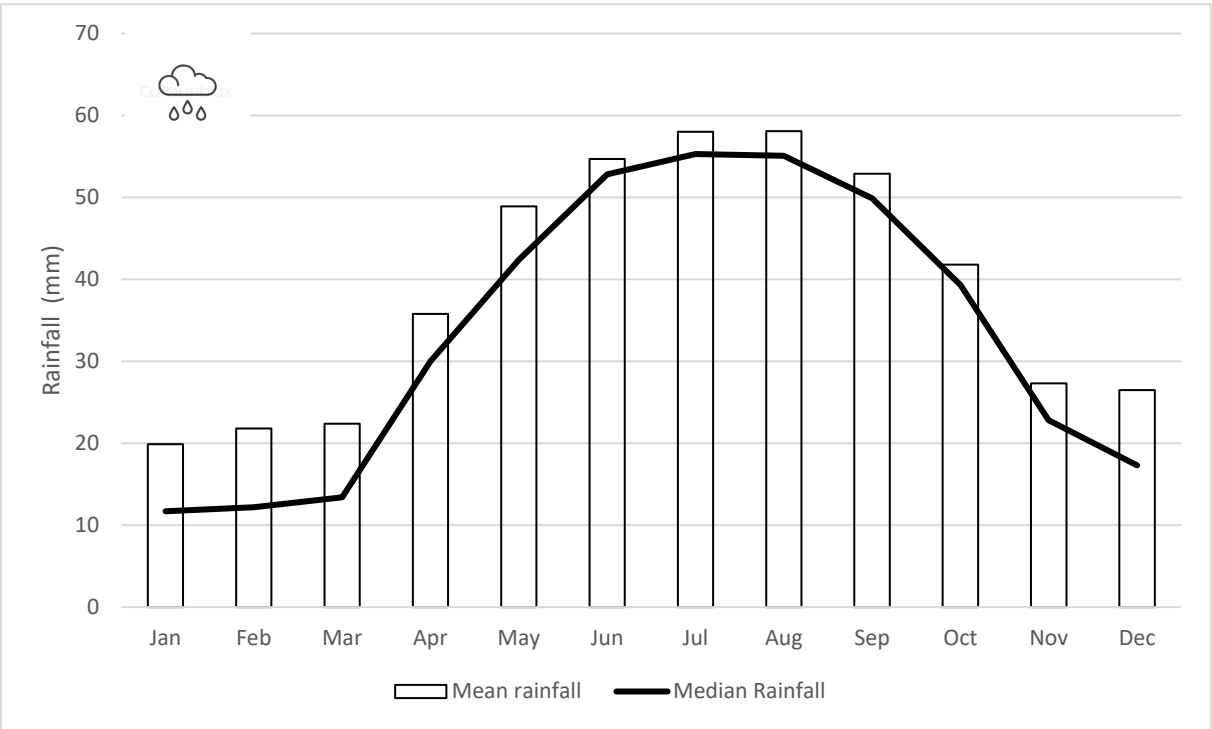


Figure 3. Mean and Median monthly rainfall at Kanmantoo Weather Station (23724) from 1874-2019 (BOM 2019b).

2 METHODS

2.1 Field Survey

The field survey was conducted by Stuart Collard (Senior Ecologist) and supported by Emma Tremain (Senior Environmental Officer) in late September 2019 to ensure consistency with previous fauna surveys of the Project area.

2.1.1 Weather conditions and rainfall

Weather conditions over the 2019 fauna survey period were characterised by mild mornings and mild afternoon temperatures (BOM 2019a) with light-moderate winds. Long term rainfall data (1874-2019) was sourced from Kanmantoo weather station (BOM 2019b). Rainfall at Kanmantoo shows annual variability, particularly over the 2011 to 2019 timeframe, as annual rainfall ranged from the lowest in 2018 (366.2 mm) to the highest in 2016 (696.8 mm) (BOM 2019b). Overall, 2011-13 and 2016-17 had above average rainfall (> 469 mm), while 2014-15 and 2018 were below average rainfall (Figure 4) (BOM 2019b). It must be noted that there is missing rainfall data for the years 2012/13 and 2017/18 and therefore their rainfall totals may be greater than the values presented in Figure 4. Furthermore, rainfall data for 2019 is limited to the months Jan-Aug, as at the time of the current report rainfall records for Sept-Dec were not yet available. Therefore, rainfall totals of 2019 are likely to be greater than the values presented in Figure 4.

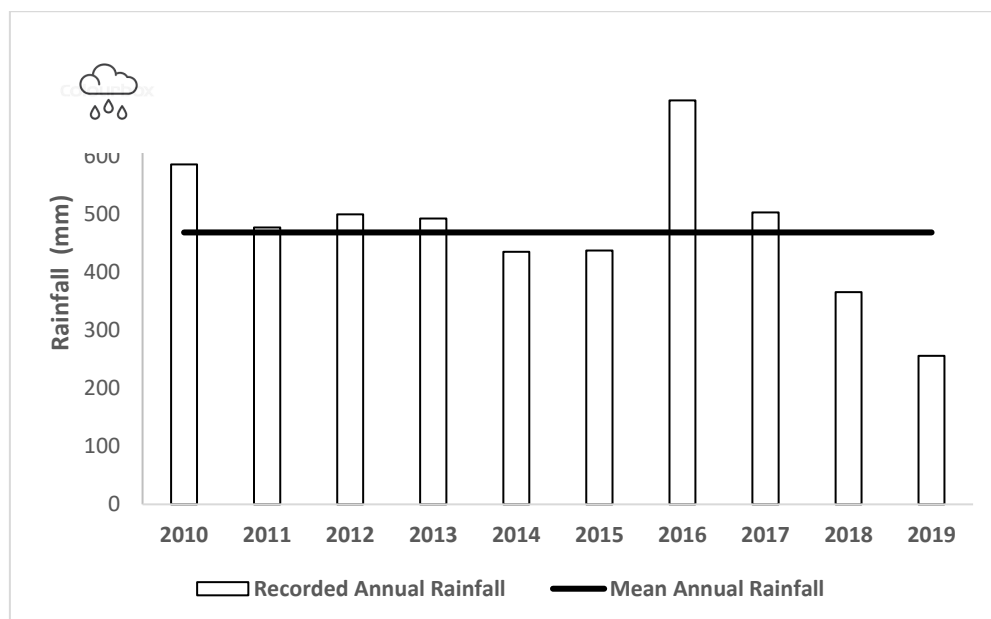


Figure 4. Mean annual rainfall at Kanmantoo weather station (23724) from 2010 to 2019.

Note: There is missing data for Oct 2012 and Oct 2017 and therefore, the total rainfall for these years may be lower than the true value (BOM 2019a). Annual Rainfall data for 2019 is limited to the months Jan-Aug, as at the time of the reporting rainfall records for Sept-Dec were not available. Therefore, the total rainfall for 2019 may be higher than the true value (BOM 2019a).

2.1.2 Survey effort per year

Mining Lease

Fauna within the ML has been monitored annually since 2011 (Table 1). Bird monitoring transects within the ML varied in number (11 to 15) before the sites were formalised in 2015, however, the areas within which birds were surveyed were comparable between years. Since 2015, the same bird monitoring transects have been monitored annually.

The spotlighting transect locations have remained consistent since the inaugural year of monitoring in 2011. However, the number of spotlighting nights has reduced from three nights (2011) to one night (2014 to present).

Significant Environmental Benefit Areas

The SEB areas were monitored for the first time in 2014 (Table 1). However, monitoring in 2014 solely focused on spotlighting possums, though, opportune observations of birds were also made. The number of spotlight nights (1) and the transects surveyed have remained consistent since inception in 2014. In 2015, nine bird monitoring transects were established. Each bird monitoring transect is monitored annually.

Table 1. Fauna survey effort per year within the ML and SEB areas of Kanmantoo Mine.

Year	ML		SEB	
	Bird transects	Spotlight nights	Bird sites	Spotlight nights
2011	15*	3	N.M.	N.M.
2012	11*	2	N.M.	N.M.
2013	11*	2	N.M.	N.M.
2014	12*	1	N.M.	1
2015	14	1	9	1
2016	14	1	9	1
2017	14	1	9	1
2018	14	1	9	1
2019	14	1	9	1

*sites not formalised
N.M. = not monitored

2.1.3 Birds

Twenty-three (23) bird transects are located over the Project area; 14 in ML and nine in the SEB area (Figure 5). These transects have been strategically positioned to represent the main habitat types and rehabilitation areas across the Project area. Each transect was surveyed by a single surveyor, who walked the entire length of the transect. Surveys were conducted only during suitable weather conditions (i.e. fine, cool-mild weather with light or no wind). Surveys are not conducted during periods of strong wind or precipitation. The following information was recorded for each bird observed:

- Species;
- Number of individuals per species;
- Behaviour of individuals (foraging, resting, or flying); and

- The substrates individual birds were using (ground, shrub, or tree).

Furthermore, all birds heard were recorded to species and the number of individuals estimated.

2.1.4 Common Brushtail Possum targeted survey

Spotlighting was conducted over repeated routes within the ML and SEB areas to systemically determine the numbers of Common Brushtail Possums in the Project area (Figure 5). The ML was surveyed from a vehicle, while the SEB area was surveyed from a vehicle as well as by foot as well as. The spotlighting routes within the ML and SEB were surveyed over one night for two hours each. All surveys commenced at least one hour after sunset.

The following information was recorded for each possum observed:

- Number of individuals;
- GPS location; and
- Habitat.

Any other fauna species observed opportunistically during spotlighting were also recorded.

2.1.5 Opportunistic observations

Any fauna species recorded within the ML or SEB area outside of systematic surveys were noted as opportune. For each opportune record, the following information was recorded:

- Species;
- Number of individuals;
- GPS location;
- Method, i.e. sight or sound; and
- Habitat.

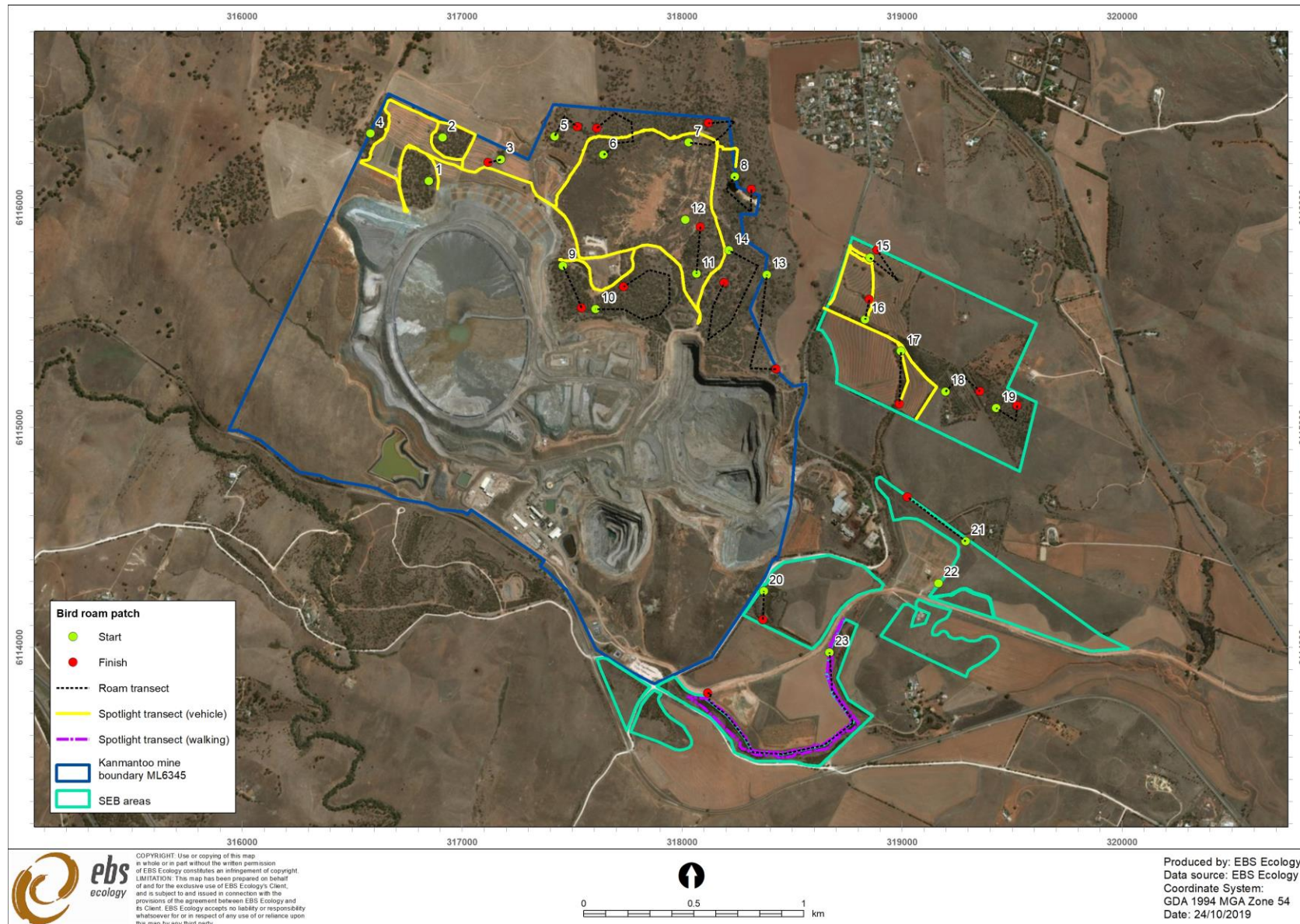


Figure 5. Locations of bird survey transects and spotlight (Common Brushtail Possum targeted survey) transects (vehicle and on foot) over the Project area.

3 RESULTS

3.1 Bird Survey 2019

3.1.1 *Species richness*

Fifty-five (55) bird species were recorded over the Project area at survey sites and opportunistically in 2019 (Appendix 1). The families of birds with the greatest representation were:

- Meliphagidae (Honeyeaters) six species;
- Psittaculidae (Parrots) five species;
- Acanthizidae (Australian Warblers) four species;
- Columbidae (Pigeons & Doves);
- Cacatuidae (Cockatoos); and
- Pachycephala (Whistlers) three species.

Five species were observed at Kanmantoo Mine for the first time in 2019, which were:

1. Long-billed Corella (*Cacatua tenuirostris*);
2. Mistletoebird (*Dicaeum hirundinaceum*);
3. Rufous Songlark (*Megalurus mathewsi*);
4. Southern Boobook (*Ninox boobook*); and
5. Golden Whistler (*Pachycephala pectoralis*).

3.1.2 *Bird abundance*

A total of 686 birds from 55 species were recorded over the Project area at survey sites and opportunistically in 2019 (Appendix 1). The most abundant species over the Project area in 2019 were:

- White-winged Chough (*Corcorax melanorhamphos*) (58 individuals);
- Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*) (57 individuals); and
- Crimson Rosella (*Platycerus elegans*) (44 individuals).

3.1.3 *Threatened species*

Three bird species that have a threatened status in South Australia were observed in 2019. The State 'Rare' White-winged Chough (*Corcorax melanorhamphos*), was abundant, primarily within the ML, but this species was also recorded in the SEB area (Figure 6). The State 'Rare' Elegant Parrot (*Neophema elegans*) was widespread over the ML area. The State 'Vulnerable' Diamond Firetail (*Stagonopleura guttata*) was found at two locations in the ML and two locations within the SEB area (Figure 6).

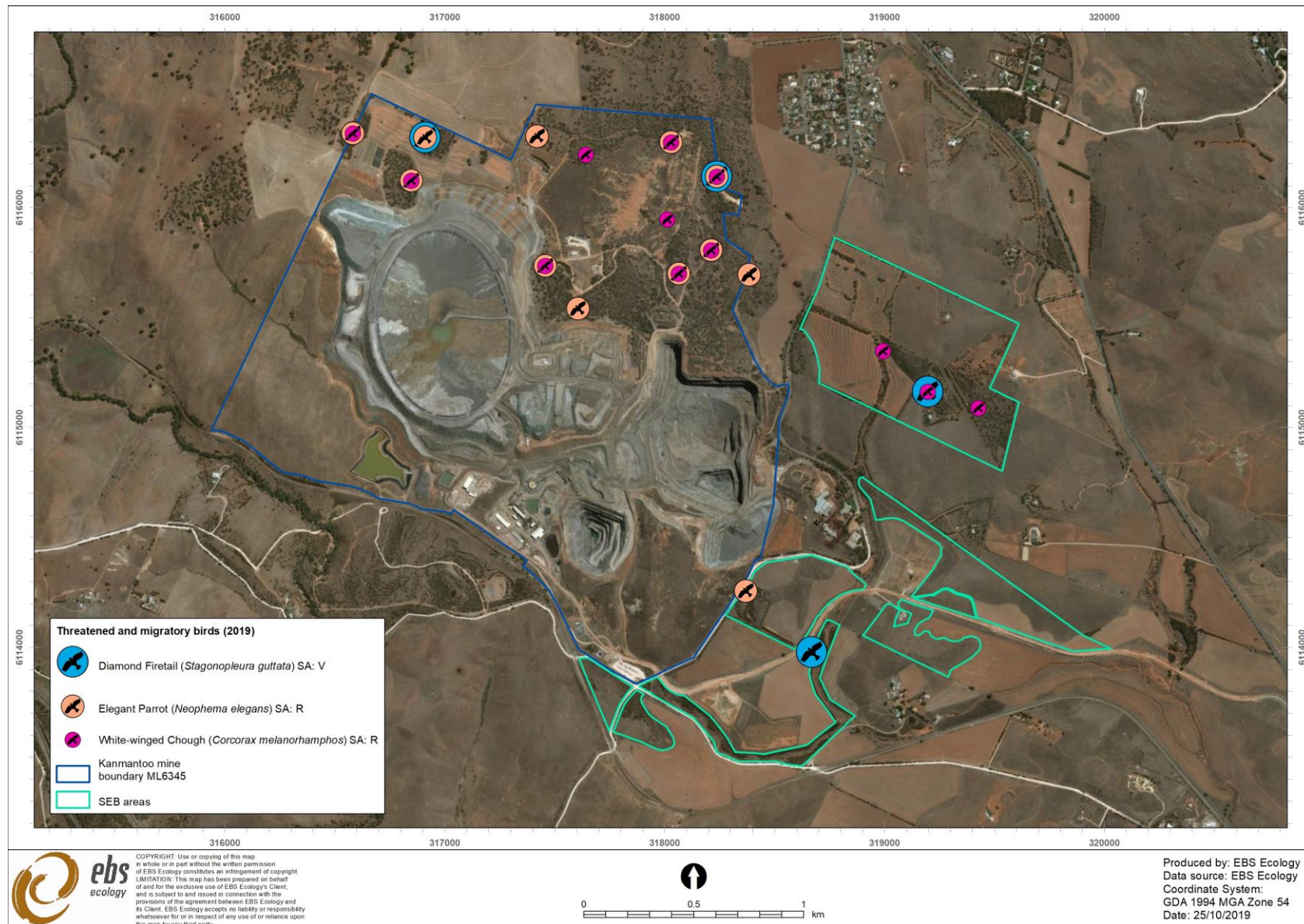


Figure 6. Locations of State threatened bird species observed during the 2019 fauna monitoring program.

3.2 Bird Survey 2011-2019

3.2.1 Species richness

The species richness of birds at Kanmantoo Mine has fluctuated over the lifetime of the fauna monitoring program (Figure 7). The mean bird species richness recorded per year over the monitoring program is $48.1 \mu \pm 3.0$ S.E. (2011-2019). Fewer bird species were recorded from 2011 to 2014 due to lower search effort, with survey sites confined to the ML only (see Section 2.1.2 above).

In 2019, species richness was the third highest on record at Kanmantoo Mine with a total of 55 bird species observed.

Due to greater consistency in search effort since 2015, species richness is relatively stable between 50 to 56 species after a low species count in 2014 (Figure 7). Variability in species richness does not appear to be correlated with rainfall (Figure 7).

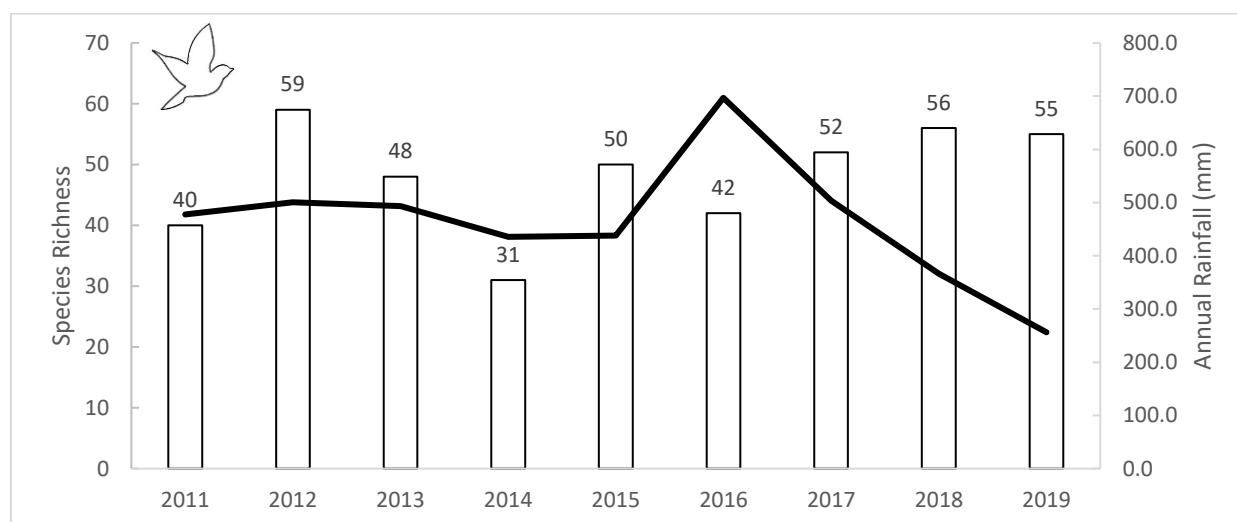


Figure 7. Bird species richness recorded over the fauna monitoring program 2011-2019 in relation to annual rainfall. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.

Note: Annual Rainfall data for 2019 is limited to the months Jan-Aug, as at the time of the reporting rainfall records for Sept-Dec were not available. Therefore, the total rainfall for 2019 may be higher than the true value (BOM 2019a).

3.2.2 Bird abundance

The abundance of birds at Kanmantoo Mine has fluctuated over the lifetime of the fauna monitoring program (Figure 8). The average number of birds recorded per year over the monitoring program is $648.3 \mu \pm 79.8$ S.E. (2011-2019). Fewer birds were recorded from 2011 to 2014 due to lower search effort, with survey sites confined to the ML only.

In 2019, species richness was the third highest on record at Kanmantoo Mine with a total of 686 individuals observed. Bird abundance in 2019 was substantially less compared to the abundances in 2015 (948 individuals) and 2017 (1042 individuals). However, the total number of birds observed at Kanmantoo in 2019 was similar that recorded in 2018 (Figure 8).

Despite greater consistency in search effort since 2015, bird abundance has remained variable between years. Variability in bird abundance does not appear to be strongly correlated with rainfall (Figure 8). However, the higher total abundance in 2017 may be linked to the high rainfall in the previous year.

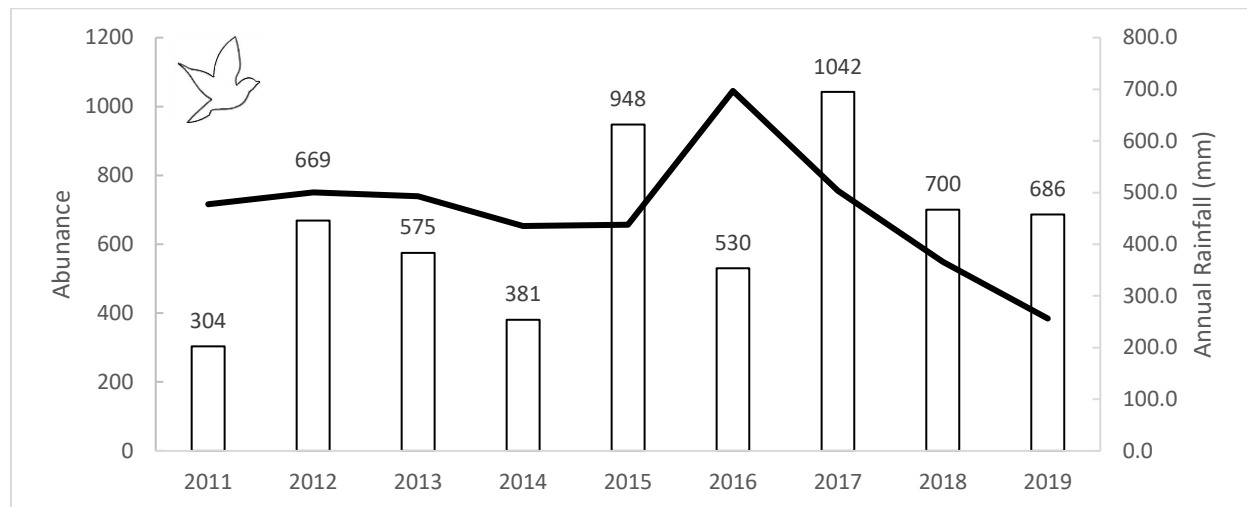


Figure 8. Bird abundance recorded over the fauna monitoring program 2011-2019 in relation to annual rainfall. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.

Note: Annual Rainfall data for 2019 is limited to the months Jan-Aug, as at the time of the reporting rainfall records for Sept-Dec were not available. Therefore, the total rainfall for 2019 may be higher than the true value (BOM 2019a).

3.2.3 Threatened species

A total of eight State threatened species have been observed at Kanmantoo Mine over the lifetime of the fauna monitoring program and in 2019 three of these species were observed (Table 2).

Table 2. Bird species of conservation significance recorded at Kanmantoo Mine between 2011 and 2019.

Species name	Common name	EPBC	SA	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Calyptrorhynchus funereus</i>	Yellow-tailed Black Cockatoo		V		7			8		65		
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	22	24	16	34	97	36	45	76	58
<i>Falco peregrinus</i>	Peregrine Falcon		R	2	2			4	1			
<i>Myiagra inquieta</i>	Restless Flycatcher		R								1	
<i>Melanodryas cucullata cucullata</i>	Hooded Robin		R	2								
<i>Microeca fascians fascians</i>	Jacky Winter		R			1						
<i>Neophema elegans</i>	Elegant Parrot		R	7	16	12	9	19	55	28	27	30
<i>Stagonopleura guttata</i>	Diamond Firetail		V	6	16	4		5		4	13	6
Number of threatened species per year				5	5	4	2	5	3	4	4	3

SA: South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes:** V: Vulnerable. R: Rare. **EPBC:** *Environment Protection and Biodiversity Conservation Act 1999*.

Three of the eight species of conservation concern have been recorded consistently within the Kanmantoo Mine: The White-winged Chough and Elegant Parrot are the only two threatened species that have been recorded on each annual survey since 2011, while the Diamond Firetail has been observed for seven of

the nine survey years. The abundance of White-winged Choughs and Elegant Parrots appears to be stable, if not, steadily increasing, while the numbers of Diamond Firetails also appear stable (Figure 9).

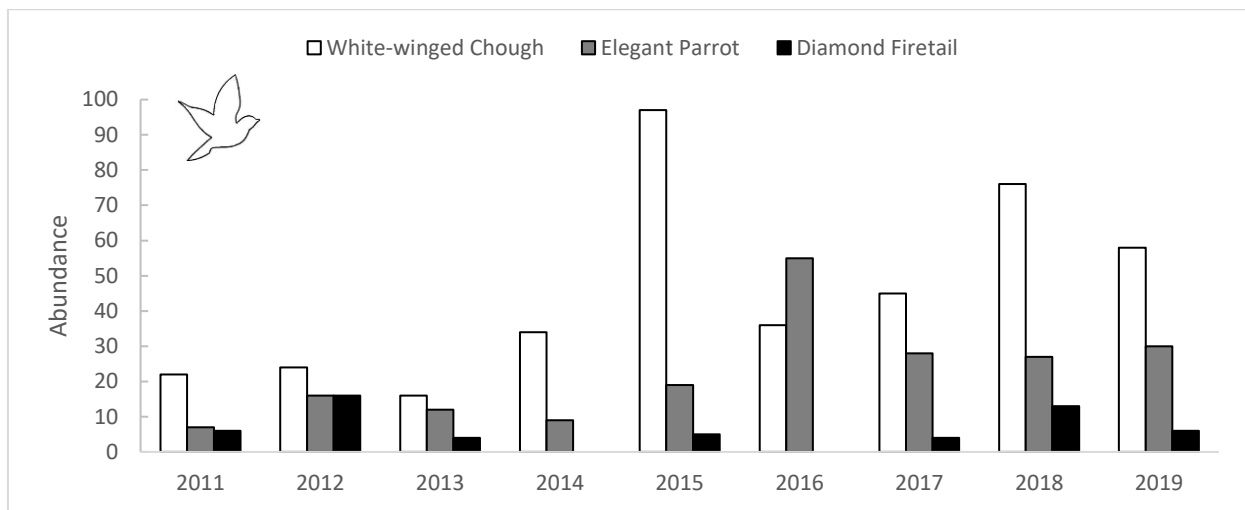


Figure 9. Number of individual White-winged Choughs, Elegant Parrots and Diamond Firetails recorded over the Kanmantoo Mine fauna monitoring program 2011-2019.

The remaining 5 of the eight species of conservation concern have been recorded inconsistently within the Kanmantoo Mine: The Peregrine Falcon (*Falco peregrinus*) has been observed in four survey years, the Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*) on three surveys, while the Jacky Winter (*Microeca fascinans fascinans*), Hooded Robin (*Melanodryas cucullata cucullata*) and Restless Flycatcher were observed only on one survey (Table 2). Due to the low number of records of these species, trends in the number of individuals that are utilizing the Kanmantoo Mine cannot be assessed.

3.3 Possum survey 2019

In 2019 a total of 22 Common Brushtail Possums was observed within the ML, while no observations of the species occurred in the SEB area (Figure 11; Table 3).

3.4 Possum survey 2011-2019

To date there have been no observations of Common Brushtail Possums within the SEB area. In the ML, the number of individuals observed per night has ranged from the lowest of 9 individuals in 2014 to the highest of 44 individuals in 2012.

The average number of possums observed per night is $22.3 \mu \pm 3.5$ S.E. (2011-2019). Over the lifetime of the fauna monitoring program the numbers of Common Brushtail Possums have fluctuated annually (Table 3). Since 2015 numbers of Common Brushtail Possums have been relatively stable ranging from 14 to 30 individuals.

Table 3. Observations of Common Brushtail Possums 2011-2019.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number observed	43	88	53	9	21	14	30	20	22
Number of nights surveyed within ML	3	2	2	1	1	1	1	1	1
Average number of possums observed per night	14.3	44.0	26.5	9.0	21.0	14.0	30.0	20.0	22.0

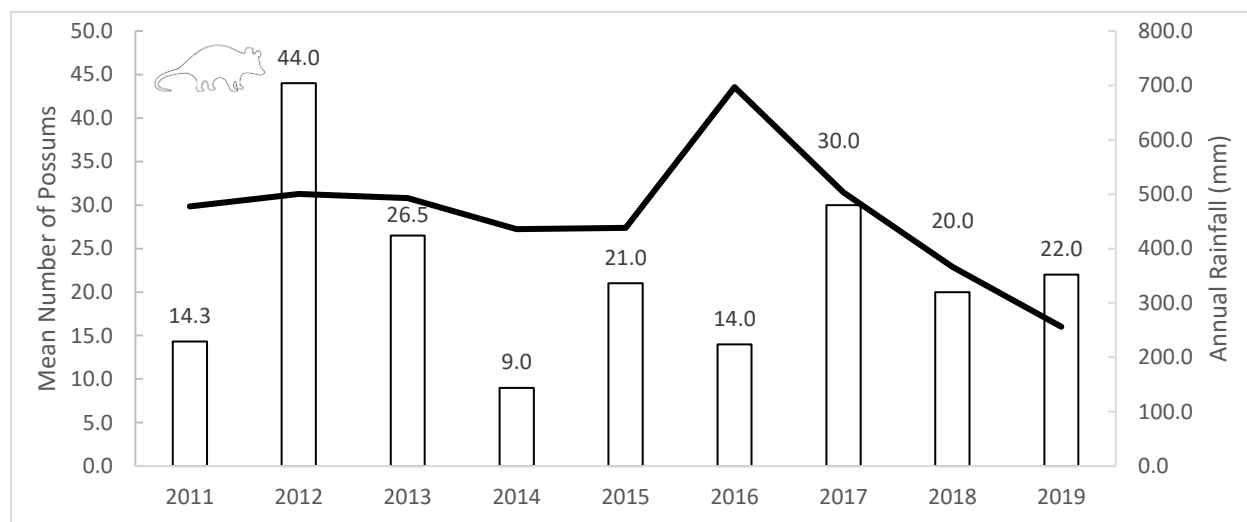


Figure 10. Mean possum abundance recorded over the fauna monitoring program 2011-2019 in relation to annual rainfall. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.

Note: Annual Rainfall data for 2019 is limited to the months Jan-Aug, as at the time of the reporting rainfall records for Sept-Dec were not available. Therefore, the total rainfall for 2019 may be higher than the true value (BOM 2019a).

3.5 Opportunistic observations 2019

3.5.1 *Frogs*

No frogs were observed or heard during the 2019 survey, possibly due to the dry seasonal conditions.

3.5.2 *Pest and over-abundant species*

The Western Grey Kangaroo (*Macropus fuliginosus*) was the most abundant mammal species recorded in the Project area. This species was most abundant within the ML (28 individuals) compared with the SEB area (six individuals). A single Common Ringtail Possum (*Pseudocheirus peregrinus*) was observed during the spotlight surveys in *E. odorata* woodland within the ML area. Two introduced mammal species were recorded in small numbers in 2019; the Rabbit (*Oryctolagus cuniculus*) and the European Brown Hare (*Lepus europaeus*).



Figure 11. Locations and number of Common Brushtail Possums (*Trichosurus vulpecula*) observed during the 2019 fauna survey at Kanmantoo Mine.

4 DISCUSSION

4.1 Birds

The results of the 2019 survey suggest little change in the species richness and abundance of the bird community within the Project area, compared with the 2018 survey. The small variations in the numbers of threatened species is expected, due to changing seasonal conditions, movements and resource availability across the site.

Fluctuations in the number of birds observed at Kanmantoo Mine appear to be in part influenced by the presence of nomadic and flocking species and variations in the numbers of ground foraging species as well as nectivorous species. For example, a flock of 260 Black-faced Woodswallows (*Artamus cinereus*), a nomadic species, and 65 Yellow-tailed Black Cockatoos, a flocking species, were observed in the 2017 survey, greatly increasing the total number of birds recorded for the monitoring program that year. There were no large flocking events during the 2019 survey, although a higher than usual number of migratory species (e.g. White-winged Triller and Rufous Songlark) may be indicative of the drier than usual conditions prevalent across much of south-eastern Australia.

Annual rainfall data does not appear to be correlated with bird abundance or species richness (Figure 7; Figure 8). However, if rainfall data were treated with greater sensitivity, such as looking at the quantity and timing of rainfall within a given year and linking this to the flowering requirements for dominant tree and shrub species, such as Peppermint Box (*Eucalyptus odorata*), then the variability in the number and species richness of nectivorous species may be further explained. Likewise, determining how the rainfall influences soil moisture and the growth of understorey weeds may help explain the variability in the numbers of ground-foraging bird species.

Given the variable nature of the bird community at Kanmantoo Mine, it is imperative that a suite of indicator species is identified to determine whether the mine has impacted on birds. Indicator species should be resident, woodland-dependent species that are not favoured by impaired tree health nor human mediated landscapes (Read *et al.* 2015). The following species found within the Project area meet these criteria:

1. Brown Treecreeper (*Climacteris picumnus*);
2. Diamond Firetail (*Stagonoplerua guttata*);
3. Grey Shrike-thrush (*Colluricincla harmonica*);
4. Rufous Whistler (*Pachycephala rufiventris*);
5. White-winged Chough (*Corcorax melanorhamphos*); and
6. Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*).

The abundance of these species shows variability between years, however, none of the species has been identified to be in decline since the fauna monitoring program commenced in 2011 (Table 4).

It is recommended that future monitoring should focus upon these six indicator species when analysing the impact of the mine for future years in order to determine whether Kanmantoo Mine has satisfied its requirements under the PEPR. It is important to maintain the same level of monitoring effort so that trends for these indicator species can continue to be accurately monitored over time.

Table 4. Observations of the abundance of indicator species 2011-2019.

Species name	Common name	EPBC	SA	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill			33	43	31	21	90	43	38	54	57
<i>Climacteris picumnus</i>	Brown Treecreeper			5	12	17	9	8	11	5	10	11
<i>Colluricincla harmonica</i>	Grey Shrike-thrush			4	1	3	3	14	13	4	8	15
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	22	24	16	34	97	36	45	76	58
<i>Pachycephala rufiventris</i>	Rufous Whistler			6	9	6	2	3	6	9	10	2
<i>Stagonopleura guttata</i>	Diamond Firetail		V	6	16	4		5		4	13	6

Some other notable trends and observations from the dataset more generally include:

- Yellow Thornbills have only been recorded in 2018 & 2019 with no previous records;
- There were no Varied Sitella records in 2017, 2018 and 2019, compared with small numbers on the previous 6 survey years;
- White-winged Trillers were in high abundance in 2019, coinciding with a general influx of northern migrants;
- A general increasing trend for Elegant Parrot and New Holland Honeyeater during the data collection period; and
- Diamond Firetail recorded in revegetation area in 2019.

Each year that the survey runs, new species continue to be added to the cumulative species for the Project area (5 new species in 2019). This can be attributed, in part to natural cycles such as seasonal variation and bird migration. However, the changes can also reflect local-scale changes in the vegetation structure and composition of the vegetation communities at the Project area. In particular, it is expected that as the areas of remnant and restored habitat within and outside the ML area mature and improve, this will provide habitat for an increased number and potentially greater diversity of birds.

4.2 Brushtail Possum

Common Brushtail Possums were restricted to the remnant Peppermint Box (*Eucalyptus odorata*) woodlands of the ML, with no individuals observed within the SEB area. The occurrence of Common Brushtail Possums within the ML is associated with the availability of den sites in the form of hollows within Peppermint Box. Common Brushtail Possums prefer large hollows that are deeper than 1 m (Inions *et al.* 1989). Such hollows take approximately 200 to 400 years to develop in other eucalypt species (Inions *et al.* 1989), and therefore, the habitat within the SEB area may only become suitable after centuries without intervention. Even with the installation of possum boxes, Common Brushtail Possums may not colonise the SEB areas located outside the ML as dispersal is uncommon for adult and even for juvenile possums.

Furthermore, crossing a fragmented landscape would make them vulnerable to Red Fox (*Vulpes vulpes*) predation (Byrom *et al.* 2015), which may delay potential colonisation. Additionally, food resources within the SEB areas may be insufficient until the planted Peppermint Box trees reach maturity, which could take over 20 years.

4.3 Pest and over-abundant species

Grazing pressure from over-abundant native and pest herbivore species could be negatively impacting the quality of remnant vegetation in the ML and the success of revegetation. Western Grey Kangaroos, rabbits and hares were all frequently sighted throughout the ML and their control through shooting and baiting may be warranted to ensure that native fauna species are not adversely impacted by reduced habitat quality.

5 CONCLUSION

The results from the 2019 fauna monitoring program confirm that there is no discernible loss of native fauna abundance or diversity in the Mine Lease area and in adjacent SEB areas as demonstrated by the results of the bird and Common Brushtail Possum surveys. As such, Hillgrove Resources has satisfied the condition (13) and outcome (21) required for fauna conservation within the PEPR.

6 RECOMMENDATIONS

EBS recommends the following measures to improve the management and monitoring of fauna within the Kanmantoo Mine Project area:

- Continue the fauna monitoring program at the same time each year (early spring) with annual analysis of trajectories for threatened and indicator fauna species;
- Change to biennial spotlighting within the SEB areas due to the low likelihood of Common Brushtail Possums using/colonising these areas in the short-term;
- Conduct a control program to reduce the numbers of Western Grey Kangaroos, rabbits and hares within the Project area. These are likely to be adversely affecting remnant and planted native vegetation and associated faunal communities.

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8 APPENDIX

Appendix 1. Total bird species observed during the period (2011-2019) spring surveys in both the ML and SEB areas (point counts and opportunistic).

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater									2		2	4
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				33	43	31	21	90	43	38	54	57
<i>Acanthiza nana</i>	Yellow Thornbill											19	14
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				3							1	
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar							1	1		1		
<i>Alauda arvensis</i>	Eurasian Skylark			*	1		3		3		1	2	
<i>Anas gracilis</i>	Grey Teal					16				6	10	1	
<i>Anas superciliosa</i>	Pacific Black Duck					1				10	9		
<i>Anthochaera carunculata</i>	Red Wattlebird				1	16	5	1	15	1	27	9	15
<i>Anthus australis</i>	Australian Pipit					5	4				6		2
<i>Aphelocephala leucopsis</i>	Southern Whiteface				6	9					3		2
<i>Aquila audax</i>	Wedge-tailed Eagle				3	8				1			
<i>Artamus cinereus</i>	Black-faced Woodswallow				2	3					260		
<i>Artamus cyanopterus</i>	Dusky Woodswallow						8	2	13	5	3	2	2
<i>Artamus personatus</i>	Masked Woodswallow						4						
<i>Artamus superciliosus</i>	White-browed Woodswallow						2						
<i>Aythya australis</i>	Hardhead					1					4	1	
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo									1	3	14	2
<i>Cacatua sanguinea</i>	Little Corella				2			1	54	2	9		

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Cacatua tenuirostris</i>	Long-billed Corella												7
<i>Cacomantis pallidus</i>	Pallid Cuckoo					1			1				
<i>Caligavis chrysops</i>	Yellow-faced Honeyeater											1	
<i>Calyptrorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		V			7					65		
<i>Carduelis carduelis</i>	European Goldfinch			*								8	5
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo				1						2		
<i>Chalcites osculans</i>	Black-eared Cuckoo					1							
<i>Chenonetta jubata</i>	Australian Wood Duck					3			19		2		
<i>Cincloramphus crualis</i>	Brown Songlark					2	1						
<i>Climacteris picumnus</i>	Brown Treecreeper				5	12	17	9	8	11	5	10	11
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				4	1	3	3	14	13	4	8	15
<i>Columba livia</i>	Feral Pigeon [Rock Dove]			*		20	20				2		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				1	2	4	4	3		6	3	1
<i>Corcorax melanorhamphos</i>	White-winged Chough		R		22	24	16	34	97	36	45	76	58
<i>Corvus mellori</i>	Little Raven				5	3	15	12	26	11	65	24	17
<i>Dacelo novaeguineae</i>	Laughing Kookaburra								1			1	1
<i>Daphoenositta chrysoptera</i>	Varied Sittella				7	5	21	4	3	5			
<i>Dicaeum hirundinaceum</i>	Mistletoebird												1
<i>Egretta novaehollandiae</i>	White-faced Heron					1				1	1		
<i>Elanus axillaris</i>	Black-shouldered Kite				3	2	1						
<i>Elseyornis melanops</i>	Black-fronted Dotterel					3					5		
<i>Eolophus roseicapilla</i>	Galah				12	17	17	15	60	18	43	30	28

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Epthianura albifrons</i>	White-fronted Chat					33	18		2			1	
<i>Falco berigora</i>	Brown Falcon				4	6	1	3	4	2	4	4	2
<i>Falco cenchroides</i>	Nankeen Kestrel				3	2	1	1		3	1	2	1
<i>Falco peregrinus</i>	Peregrine Falcon		R		2	2			4	1			
<i>Gallina tenebrosa</i>	Dusky Moorhen					3							
<i>Gavicalis virescens</i>	Singing Honeyeater				7	8	6	4	14	12	4	28	13
<i>Geopelia placida</i>	Peaceful Dove											1	1
<i>Glossopsitta concinna</i>	Musk lorikeet					6				2	18	3	19
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet					20							
<i>Grallina cyanoleuca</i>	Magpie-lark				2	1	1	2	3	1	2		5
<i>Gymnorhina tibicen</i>	Australian Magpie				32	16	15	34	57	48	65	22	29
<i>Hieraaetus morphnoides</i>	Little Eagle								1				
<i>Hirundo neoxena</i>	Welcome Swallow				2	6	17		1	37	32	13	6
<i>Lalage tricolor</i>	White-winged Triller					3						1	13
<i>Lichenostomus pencillatus</i>	White-plumed Honeyeater					18	30	7					
<i>Malurus cyaneus</i>	Superb Fairy-wren				4		1		4			4	4
<i>Megalurus mathewsi</i>	Rufous Songlark												6
<i>Melanodryas cucullata cullata</i>	Hooded Robin (South East ssp)		R		2								
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater					6	18	11	19	3	18	32	29
<i>Melithreptus lunatus</i>	White-naped Honeyeater											2	
<i>Merops ornatus</i>	Rainbow Bee-eater				7	7	1	2	3	1	4		
<i>Microeca fascinans</i>	Jacky Winter		R				1						

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Milvus migrans</i>	Black Kite						1						
<i>Myiagra inquieta</i>	Restless Flycatcher		R									1	
<i>Neochmia temporalis</i>	Red-browed Finch											1	4
<i>Neophema elegans</i>	Elegant Parrot		R		7	16	12	9	19	55	28	27	30
<i>Ninox boobook</i>	Southern Boobook												1
<i>Ocyphaps lophotes</i>	Crested pigeon					9	4			4	2	5	5
<i>Pachycephala pectoralis</i>	Golden Whistler												1
<i>Pachycephala rufiventris</i>	Rufous Whistler				6	9	6	2	3	6	9	10	2
<i>Pardalotus punctatus</i>	Spotted Pardalote					3							
<i>Pardalotus striatus</i>	Striated Pardalote				15	26	32	15	26	9	26	37	38
<i>Passer domesticus</i>	House Sparrow			*		10	8	1				4	11
<i>Petrochelidon nigricans</i>	Tree Martin				12	38	32	50	68	4	41	28	37
<i>Petroica goodenovii</i>	Red-capped Robin								1			1	
<i>Phaps chalcoptera</i>	Common Bronzewing						1			2	1	2	2
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater						2		21	12	13	25	25
<i>Platycercus elegans</i>	Adelaide Rosella				33	49	64	42	85	58	65	51	44
<i>Podargus strigoides</i>	Tawny Frogmouth								1		1		1
<i>Pomatostomus superciliosus</i>	White-browed Babbler								8	1	5	13	17
<i>Psephotus haematonotus</i>	Red-rumped Parrot				10	57	27	56	19	15	25	13	12
<i>Ptilotula penicillata</i>	White-plumed Honeyeater				16				13	8	20	28	18
<i>Rhipidura albiscapa</i>	Grey Fantail											9	6
<i>Rhipidura leucophrys</i>	Willie Wagtail				10	11	11	8	22	13	11	19	14

SPECIES NAME	COMMON NAME	EPBC	SA	Exotic	2011	2012	2013	2014	2015	2016	2017	2018	2019
<i>Sericornis frontalis</i>	White-browed Scrubwren						1						
<i>Smicronis brevirostris</i>	Weebill				3		61	20	56	15	8	18	14
<i>Stagonopleura guttata</i>	Diamond Firetail		V		6	16	4		5		4	13	6
<i>Sturnus vulgaris</i>	Common Starling			*	2	27	11		52	37	11	6	22
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe					8	1				4	2	
<i>Tadorna tadornoides</i>	Australian Shelduck									13			
<i>Threskiornis spinicollis</i>	Straw-necked Ibis								6				
<i>Todiramphus sanctus</i>	Sacred Kingfisher					1							
<i>Tribonyx ventralis</i>	Black-tailed Native Hen				6	3							
<i>Tribonyx ventralis</i>	Black-tailed Native Hen				6	3							
<i>Trichoglossu haematodus</i>	Rainbow Lorikeet				2	8	11	2					3
<i>Turdus merula</i>	Common Blackbird			*				5				1	1
<i>Tyto delicatula</i>	Eastern Barn Owl										1	1	
<i>Vanellus miles</i>	Masked Lapwing					3			4	2		1	1
<i>Zosterops lateralis</i>	Silvereeye						4					3	1
		Total Abundance			304	669	575	381	948	530	1042	700	686
		Total Diversity			40	59	48	31	50	42	52	56	55

SA: South Australia (*National Parks and Wildlife Act 1972*). **VU/V:** Conservation Codes: V: Vulnerable. R: Rare.

EPBC: *Environment Protection and Biodiversity Conservation Act 1999*.

*Denotes introduced species



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