Appendix 4

2018 Sub-tropical Rainforest Monitoring

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2018 Subtropical Rainforest Monitoring

Yancoal Australia Pty Ltd

Abel Underground Coalmine
1132 John Renshaw Drive
Black Hill NSW 2322

February 2019

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2018 Subtropical Rainforest Monitoring

Abel Underground Coalmine
1132 John Renshaw Drive
Black Hill NSW 2322

Kleinfelder Report Number: NCA19R91078

Project Number: 20192318

Prepared for:

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EXECUTIVE SUMMARY

Background

Donaldson Coal Pty Ltd (now owned by Yancoal Australia Pty Ltd) commenced operations at Abel Underground Coalmine at Black Hill in the lower Hunter Valley, New South Wales in 2008. To comply in part with conditions of consent a Flora and Fauna Management Plan (F&FMP) was prepared in 2007 by ecobiological (now Kleinfelder).

The F&FMP identified the need to establish a plan to monitor the subtropical rainforest areas of Long Gully Creek. While there are several areas of rainforest above the underground coal mine area, the most extensive and best developed lies along the Long Gully Creek system.

Annual monitoring has been conducted at Long Gully Creek for the past 11 years (2008 to 2018). This area has been identified as susceptible to impacts from mine subsidence. The Subtropical Rainforest Monitoring Plan (SRMP) is designed to examine the stability of the rainforest/dry forest interface and floristic and faunal diversity. The current study has gathered information on the presence and status of threatened species at the site and will allow best practice measures to be incorporated into the mine's Subsidence Management Plan (SMP). Monitoring of the Subtropical Rainforest will continue while the mine is in a state of Care and Maintenance, which it is at present (2018).

This document reports results of the 11th annual monitoring event since a baseline survey conducted by ecobiological in 2008. Changes in the assemblages of flora, fauna and threatened species over time are analysed to detect significant trends.

Flora

The area of transition between dry and moist forest at Transect 1 has expanded since the 2008 baseline survey, with the width of the moist forest increasing. Both transects have seen an increase in the total number of species during 2018 when compared with 2008. At Transect 1, 54 and 59 species were recorded in 2008 and 2018, respectively. At Transect 2, 51 and 52 species were recorded in 2008 and 2018, respectively. Along both Transect 1 and 2, particularly at the end of the transects, there has been an increase in the number of moist species recorded and a decline in the number of dry species within each 5 m segment. Along both Transect 1 and Transect 2 there has been a decline in Foliage Projective Cover (FPC) since the original 2008 survey event. However, this is not an isolated occurrence in the current survey. When data from the 2018 survey are compared to that of the 2009 and 2017 surveys, the total FPC along both transects is relatively similar. While severe storms occurred around

Newcastle in 2015, which has likely reduced canopy cover; reduced levels of ground, shrub and midstorey stratum since the baseline survey may reflect natural loss in vegetation between periods of disturbance, particularly an absence of fire.

Fauna

In total in 2018, (i.e. at both forest types) 44 fauna species were recorded. This comprised three arboreal mammal, four terrestrial mammal, 29 bird and eight bat species. Three of these species are threatened species listed under the NSW Biodiversity Conservation Act 2016 *and/or the Commonwealth* Environment Protection & Biodiversity Conservation Act 1999*; Little Bentwing-bat (*Miniopterus australis*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Greater Glider (*Petauroides volans*). No reptile or amphibian species were recorded during the 2018 surveys.*

A total of 27 and 28 fauna species were detected in the dry forest and rainforest habitats, respectively. Eight bat species (equal with the highest number of bat species recorded at the site) were detected in 2018. The number of bird species recorded in 2018 (29) was just below the yearly average of 32 species. Similar numbers of arboreal and terrestrial mammal species were recorded in 2018 compared to previous years.

The annual monitoring continues to provide robust baseline information on the natural variation in the diversity of species in the Long Gully Creek system. The growing dataset will provide a valuable benchmark against which future underground mining impacts can be assessed.

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ABBREVIATIONS

BC Act	NSW *Biodiversity Conservation Act 2016*
CHPP	Coal Handling Preparation Plant
EA	Environmental Assessment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (C'th)
F&FMP	Flora and Fauna Management Plan
GIS	Geographic Information System
ha	hectares
LGA	Local Government Area
SEMP	Surface Ecological Monitoring Plan

1. INTRODUCTION

1.1 BACKGROUND

Donaldson Coal Pty Ltd (now owned by Yancoal Australia Pty Ltd) commenced mining at an underground coal mine (known as Abel Underground Coal Mine) in 2008, located approximately 23 kilometres north-west of Newcastle. The mine is currently in a state of care and maintenance, with no coal extraction at this time. Should the mine re-open in the future, the seams that would be mined are located under the rural residential and forested areas at Black Hill. Mine access and associated surface infrastructure is located within the existing open cut void at Beresfield, with transfer of coal to the existing Bloomfield Coal Handling and Preparation Plant (CHPP) immediately to the north for coal washing and rail transport to the Port of Newcastle.

Underground coal mining is often associated with adverse environmental impacts due to subsidence (Bell *et al*. 2000, Sidle *et al*. 2000). Subsidence can cause loss of productive land, damage to underground pipelines and above-ground structures, decreased stability of slopes and escarpments, contamination of groundwater by acid drainage and dewatering of streams and groundwater supplies (Sidle *et al.* 2000). The key environmental concern arising from the Abel mine is the effect of subsidence on local and regional hydrology. Surface and sub-surface cracking associated with mining subsidence can alter surface flow and create preferential flow paths, thus causing dewatering and rerouting of surface water and groundwater (Sidle *et al.* 2000). Alterations in channel and drainage morphology may also affect channel erosion, sediment delivery, and routing in streams and riparian habitat.

Development approval for the Abel coal mine imposed a number of conditions of consent. These conditions included a requirement for a Flora and Fauna Management Plan (F&FMP) which was prepared by ecobiological (now Kleinfelder) in 2007. The F&FMP, which forms part of a comprehensive Environmental Management System for the Abel mine, sets out a strategy to monitor the effectiveness of conservation measures proposed within the Environmental Assessment (EA) Statement of Commitments for the overall operation of the mine. Part of this strategy was to establish a Surface Ecological Monitoring Plan (SEMP) to monitor the effectiveness of the conservation measures proposed in the EA to mitigate against subsidence

impacts on three distinct habitat areas: farm dams across the mine site; subtropical rainforest areas within Long Gully Creek; and the wet swamp within Pambalong Nature Reserve.

The SEMP outlines a monitoring plan for each of these areas by which baseline and subsequent monitoring data are to be gathered to inform future management. This document reports results from the 11th annual monitoring event for the Subtropical Rainforest Monitoring and Management Plan (SRMP) since completion of the baseline study in 2008 and is part of the overall SEMP.

1.2 SUBTROPICAL RAINFOREST

Subtropical rainforests are characterised by a dense, multi-layered tree canopy approximately 20 - 40 m tall, and are generally comprised of large emergent trees and a sub-canopy of smaller trees (Keith 2004). Subtropical rainforests, along with tropical rainforests in Queensland, have the most diverse tree flora of any vegetation type in Australia (Floyd 2008). The understorey is typically open and consists of scattered saplings, shrubs and ferns. Vines and epiphytic orchids are also common. As subtropical rainforests have high plant species diversity as well as structural complexity and biomass, they subsequently also support diverse assemblages of native fauna.

In NSW, subtropical rainforests are scattered across coastal lowlands and escarpment foothills north from the Illawarra region to the Queensland border. They typically occur on south and east aspects in valleys and foothill gullies on fertile soils such as basalt derived soils or alluvial soils, which are high in nutrients (e.g. phosphorus and calcium). Rainforests can also occur in low nutrient sandstone, such as that at Long Gully Creek, Newcastle (Floyd 1990). Subtropical rainforests tend to occur in areas with warm temperatures and with an annual rainfall of 1300 mm or greater (Keith 2004; Floyd 2008).

The primary threats to subtropical rainforest include fire and weed invasion. Rainforests are not adapted to fire due to the relatively low frequency of fire events within these communities. As a result, only a low proportion of species present in rainforest possess mechanisms for tolerating or recovering from fire. Therefore, fire can strongly influence rainforest boundaries as it promotes the establishment of fire-adapted species and encourages the replacement of rainforest with sclerophyll forest. Invasion of exotic species is also a significant threat to subtropical rainforests. There is potential for vigorous woody exotic weeds such as Camphor Laurel (*Cinnamomum camphora*), Privet (*Ligustrum* sp.) and Lantana (*Lantana camara*) to

become established in rainforest systems particularly where there is high disturbance and natural succession processes are affected (Floyd 2008; Peel 2010). Where disturbance is lower, these exotic species are generally restricted to the edges of subtropical rainforests as demonstrated at Long Gully Creek.

1.3 LOCATION

Abel Underground Mine is located within Newcastle, Cessnock and Maitland local government areas (LGAs). The majority of the underground mine and surface infrastructure is within Cessnock LGA.

The location of the underground mine area and surface facilities is shown in **Figure 1**. The underground mine area is bounded to the east by the M1 Pacific Motorway; to the west and south by a tract of forest that extends south to the Central Coast and beyond to Hornsby, and to the north by existing open cut coal mining activities within the Donaldson and Bloomfield mine leases.

The land situated above the Abel underground mine area is approximately 2,750 ha and consists of low undulating forested hills with patches of cleared land occurring on 110 rural/residential properties. Large areas of land are owned by Donaldson, Coal and Allied and the Catholic Diocese of Maitland and Newcastle. Black Hill School, various local roads and other infrastructure are located in the area.

A ridgeline associated with Black Hill runs east-west through the underground mine area. Tributaries of Buttai Creek, Viney Creek/ Weakley's Flat Creek and Four Mile Creek drain northwards from this ridgeline. A wide catchment containing Long Gully and Blue Gum Creek drains from the ridgeline providing water to the wet swamp at Pambalong Nature Reserve. Some cliff-lines and steeper gullies are located along sections of the Black Hill ridge.

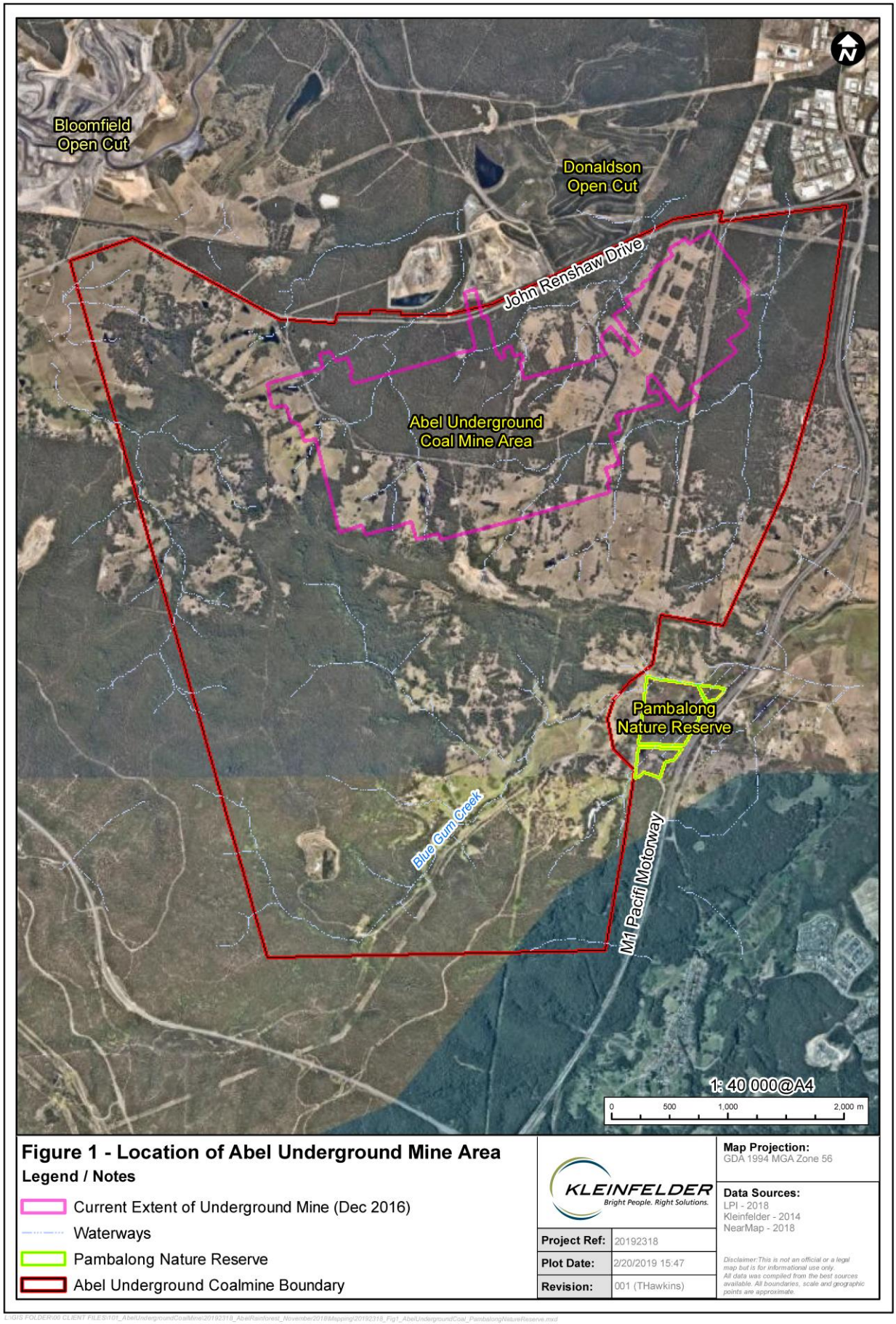

Figure 1 - Location of Abel Underground Mine Area

Legend / Notes

- Current Extent of Underground Mine (Dec 2016)
- Waterways
- Pambalong Nature Reserve
- Abel Underground Coalmine Boundary

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Project Ref:	20192318
Plot Date:	2/20/2019 15:47
Revision:	001 (THawkins)

Map Projection:
GDA 1994 MGA Zone 56

Data Sources:
LPI - 2018
Kleinfelder - 2014
NearMap - 2018

Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

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2. METHODS

2.1 FLORA

Flora field sampling measures the spatial extent of the rainforest community in Long Gully Creek with the aim to determine if it is stable, expanding or contracting. Two transects spanning the width of the rainforest start and end in the adjoining dry forest (**Figure 2**). The lengths of Transects 1 and 2 are 70 m and 50 m respectively. Transects were divided into 5 m by 1 m consecutive quadrats. Flora surveys were conducted on 12 November 2018.

Information recorded in each quadrat includes:

- Total floristic content, with species recorded being classified as typically occurring in dry or moist forest habitats, and whether they formed part of the ground, shrub, midstorey or overstorey / emergent stratum; and
- An estimate of the foliage projective cover (FPC) (Walker & Hopkins 1988) of vegetation in the ground, shrub, midstorey, overstorey and vine stratums. The estimated FPC was recorded for each quadrat and for each structural layer.

A second order polynomial trend line was used to determine the transitional zones between moist and dry forest types. R^2 values were also calculated to determine how well the fitted lines explain the data. The closer the R^2 value is to 1, the higher confidence that the trend line fits the data.

For any plants that could not be identified in the field, a specimen was collected for later identification. Floristic identification and nomenclature is based on Harden (1992, 1993, 2000, 2002) with subsequent revisions as published on PlantNet (Royal Botanic Gardens and Domain Trust 2013). Plants of local conservation significance and/or listed by the ROTAP scheme (Briggs & Leigh 1996) were noted.

2.2 FAUNA

Field surveys for fauna are centred on two transects (separate from the flora transects) approximately 200 m long, one located in the rainforest and the other in the adjacent dry forest. Fauna surveys were conducted from 23 October to 31 October 2018.

Equal numbers of each trap type were used in each transect, except for the number of Elliott B traps in trees (**Table 1**). Seven traps were placed in trees in the dry forest compared to three in the rainforest (due to low number of trees large enough to support traps in the rainforest). The location of fauna survey activities is shown on **Figure 2**.

Table 1: Number of traps and nights for the subject site

Trap type	Rainforest Transect	Dry Forest Transect	Nights	Trap nights
Elliott A (small)	20	20	4	160
Elliott B (large) Tree	3	7	4	40
Elliott B (large) Ground	5	5	4	40
Harp Trap	1	1	4	8
Hair tubes (in trees)	8	8	4	64
Cage	2	2	4	16

2.2.1 Arboreal Mammals

Elliott B traps and hair tubes were placed in trees at heights of 3 m or more along transects and baited with a mixture of rolled oats, honey, peanut butter and treacle. The trunks of trees containing the traps were sprayed with a mixture of honey and water. Traps were checked daily. Wafers from the hair tubes were collected after 4-nights and checked for hair samples. Hair identification methods followed those of Brunner *et al.* (2002) and wafers are analysed in-house.

Spotlighting was conducted after dusk for one person hour at each transect and repeated on a second night (four person hours total). Trees hollows were watched at dusk to detect emerging nocturnal birds or mammals.

2.2.2 Terrestrial Mammals

Elliott A and B were baited with a mix of rolled oats, honey, peanut butter and treacle and placed on the ground at regular intervals along each transect. Traps were left in position for four consecutive nights and checked each morning.

Observations of indirect signs of terrestrial mammals such as diggings, droppings or scratch marks were noted and recorded.

2.2.3 Bats

Harp traps were erected across likely bat 'flyways' such as natural forest openings on each transect. The harp traps were left in position for four consecutive nights and checked each morning. Captured bats were identified in the field and then released into an artificial bat box

tethered to a nearby tree. This provides shelter from predators during the day and allows the bats to exit the box on nightfall.

Anabat™ ultrasonic call detectors (Titley Scientific) were used to record the calls of Microchiropteran bats feeding in the area. The units were set up at dusk to record for one hour at each transect and this was repeated on a second evening (four hours total recording). Spotlight searches of blossoming trees were also undertaken to detect Megachiropteran bat species.

2.2.4 Birds

Each transect was walked for 20 minutes and birds detected within the immediate vicinity were recorded. Birds were identified either visually, with the aid of binoculars, or by call. Surveys were conducted in the morning when bird activity is highest (Bibby *et al.* 2000). Opportunistic sightings were also recorded and listed separately to results from systematic surveys.

After dark, the calls of threatened owl species (Powerful Owl, Masked Owl, Sooty Owl and Barking Owl) were broadcast over a loudspeaker in an attempt to encourage a call response. The size, shape and content of any owl regurgitation pellets found were analysed to determine the species of owl from which the pellet originated as well as the prey species the owl had been feeding on. Analysis methods followed those of Brunner *et al.* (2002) and Triggs (1996).

2.2.5 Amphibians

Searches for amphibians were conducted along a portion of the length of the Long Gully Creek rainforest. This involved diurnal habitat searches and nocturnal spotlight surveys. Call playback was also conducted for two species of threatened barred river frogs (*Mixophyes balbus* and *M. iteratus*) in potential habitat.

As there was no standing water at the time of fauna surveys in 2018, dip netting was not conducted for tadpoles. The nocturnal surveys involved walking lengths of suitable habitat and using head torches to search for frog eye shine or movement.

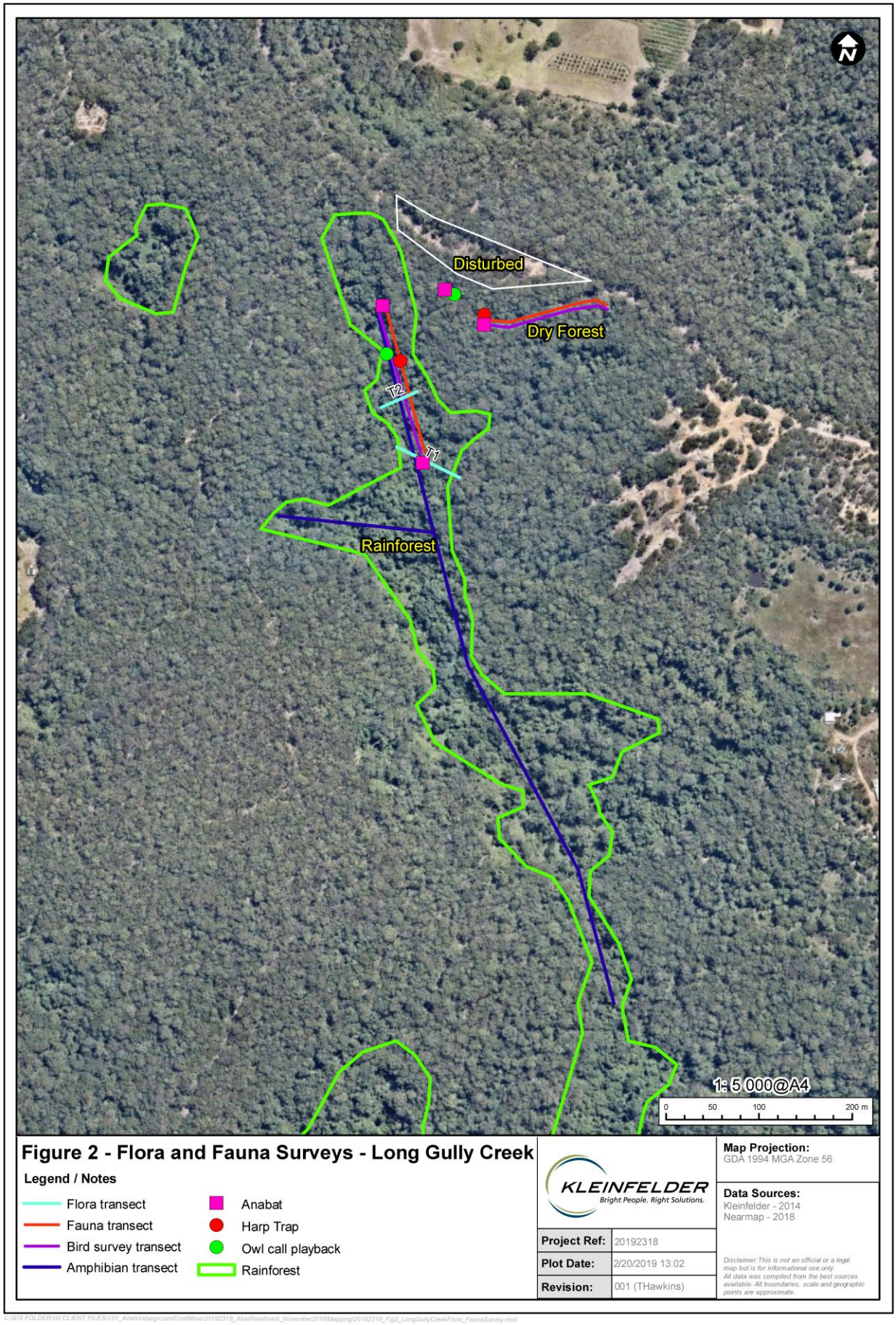
Disturbed
Dry Forest
T2
T1
Rainforest
1: 5 000@A4
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Figure 2 - Flora and Fauna Surveys - Long Gully Creek
Legend / Notes
Flora transect
Fauna transect
Bird survey transect
Amphibian transect
Anabat
Harp Trap
Owl call playback
Rainforest
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Project Ref: 20192318
Plot Date: 2/20/2019 13:02
Revision: 001 (THawkins)
Map Projection:
GDA 1994 MGA Zone 56
Data Sources:
Kleinfelder - 2014
Nearmap - 2018
Disclaimer: This is not an official or a legal map but is for informational use only. All data was compiled from the best sources available. All boundaries, scale and geographic points are approximate.

3. RESULTS

3.1 WEATHER CONDITIONS AND SURVEY ACTIVITY

The prevailing weather conditions during the trapping survey period were mild to warm days with humid mornings. A small amount of rain occurred on site during the survey period. Temperatures ranged from cool to warm in the early mornings, with warm to hot days and warm evenings. The temperature range was between 10.0 and 32.0º C. Data on weather conditions during the survey period are provided in **Table 2**.

Table 2: Weather conditions during the fauna survey period (Maitland Airport weather station)

Weather	Date					
	23/10/18	24/10/18	25/10/18	26/10/18	30/10/18	31/10/18
Temp. Min. (°C)	12.7	15.6	15.5	12.1	10.0	13.9
Temp Max. (°C)	32.0	22.6	23.8	25.1	29.3	31.2
Relative Humidity (%) 9 am	100	84	82	85	77	76
Relative Humidity (%) 3 pm	34	73	65	61	42	56
Rain	0.2	0	0	0	0	0
Max wind gust (km/hr)	28	41	28	35	31	35
Wind direction	WNW	SSE	E	SE	N	E

3.2 FLORA DIVERSITY

Field surveys in 2018 recorded 59 flora species along Transect 1 and 52 flora species along Transect 2 (**Appendix 1**). This is an increase in the number of species found during the baseline study in 2008, in which 54 and 51 flora species were detected respectively as well as in the previous year, 2017, when 49 species were recorded along each transects.

No flora species listed as threatened under the NSW BC Act were recorded during surveys. One plant species *Eucalyptus fergusonii* subsp. *fergusonii* listed under ROTAP (Briggs and Leigh 1995) was recorded on Transect 2.

Flora species were grouped according to whether they are typically found in dry or moist forest habitat (see **Appendix 1**). **Figure 3** and **Figure 5** show the relationship between dry forest species (sclerophyllous species) and moist forest species (mesic or rainforest species) over

the length of each transect in 2008. **Figure 4** and **Figure 6** show this relationship in 2018. The trend lines for Transect 1 have changed since the baseline survey indicating that the transition between dry and moist forest has expanded slightly over the past nine years. At the start of the transect the transition from dry to moist forest commenced at approximately 5 m in 2008. In the current survey this transition occurs at approximately 4 m. At the end of the transect the transition occurred at 50 – 55 m in 2008 and now it occurs at approximately 65 m. This is a change of at least 10 m since 2008.

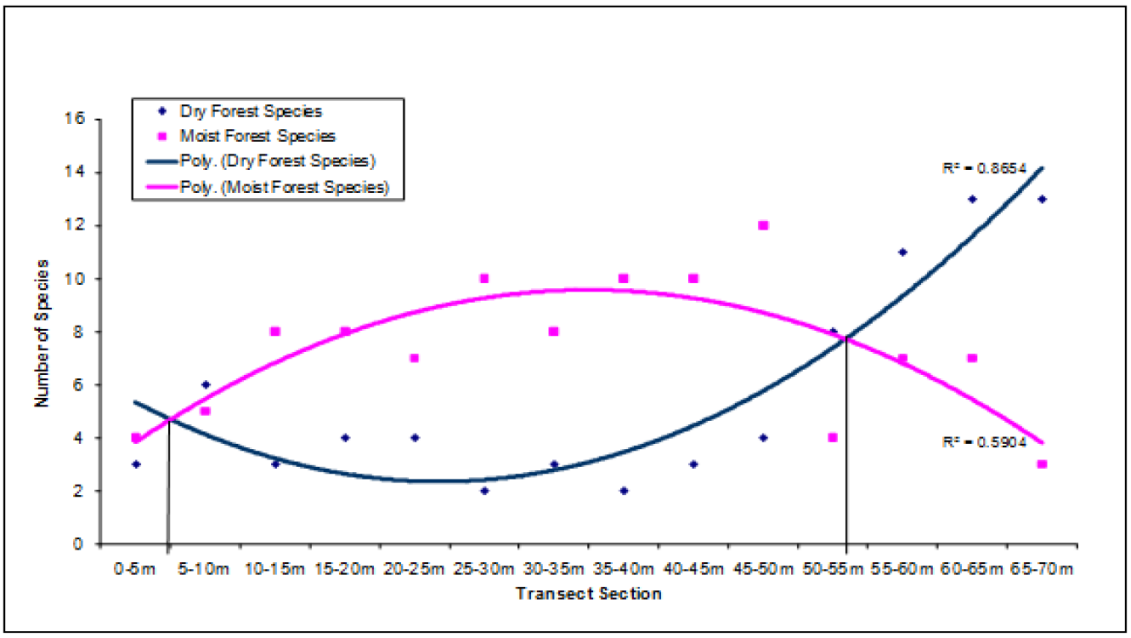

Figure 3: **Transect 1 forest species curves, showing the relationship between dry and moist forest species across the length of the transect in 2008. Black lines indicate the forest transition zones determined in 2008.**

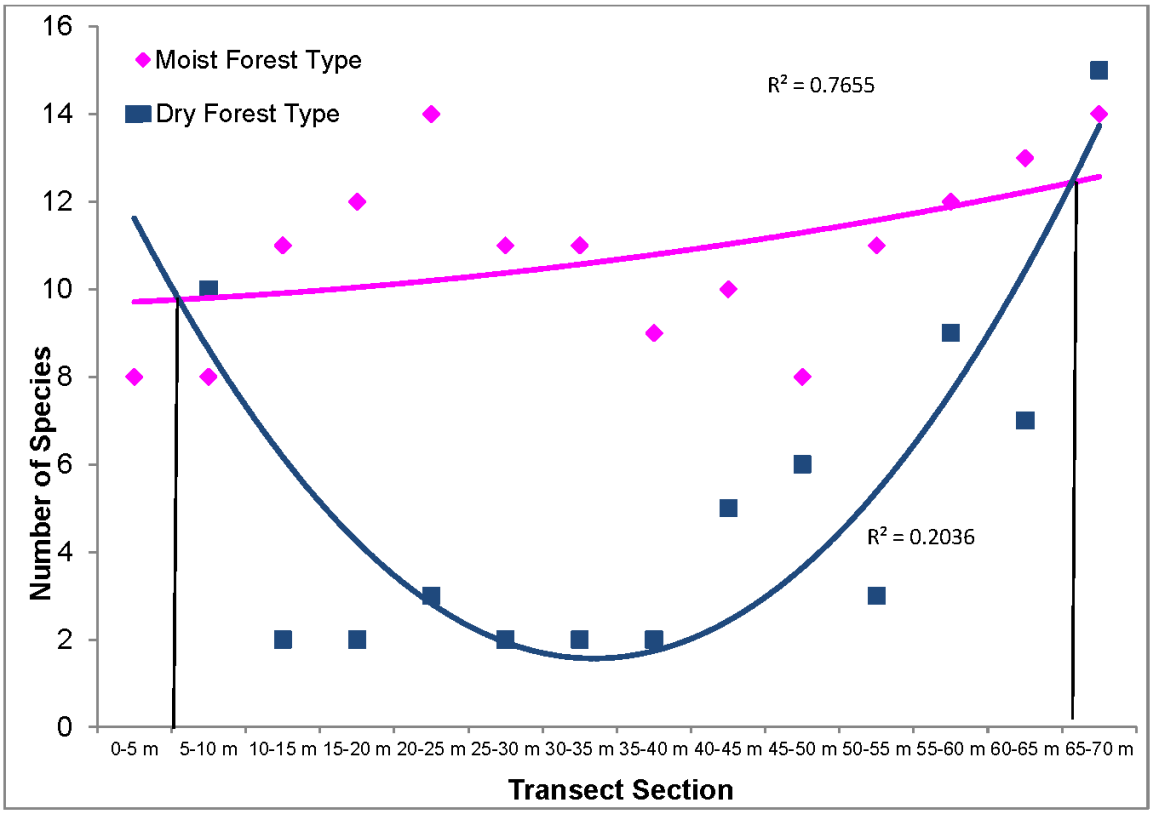

Figure 4: **Transect 1 forest species curves, showing the relationship between dry and moist forest species across the length of the transect in 2018. Black lines indicate the forest transition zone determined in 2018.**

The trend lines for Transect 2 in 2018 have shown a similar trend since 2008, with a widening of the rainforest. The transition from dry forest to moist forest commences at approximately 3.5 m in 2018 as opposed to approximately 7 m in 2008. The transition from moist forest to dry forest occurred at approximately 43 m in 2008 while it is now toward the end of the transect at 50 m.

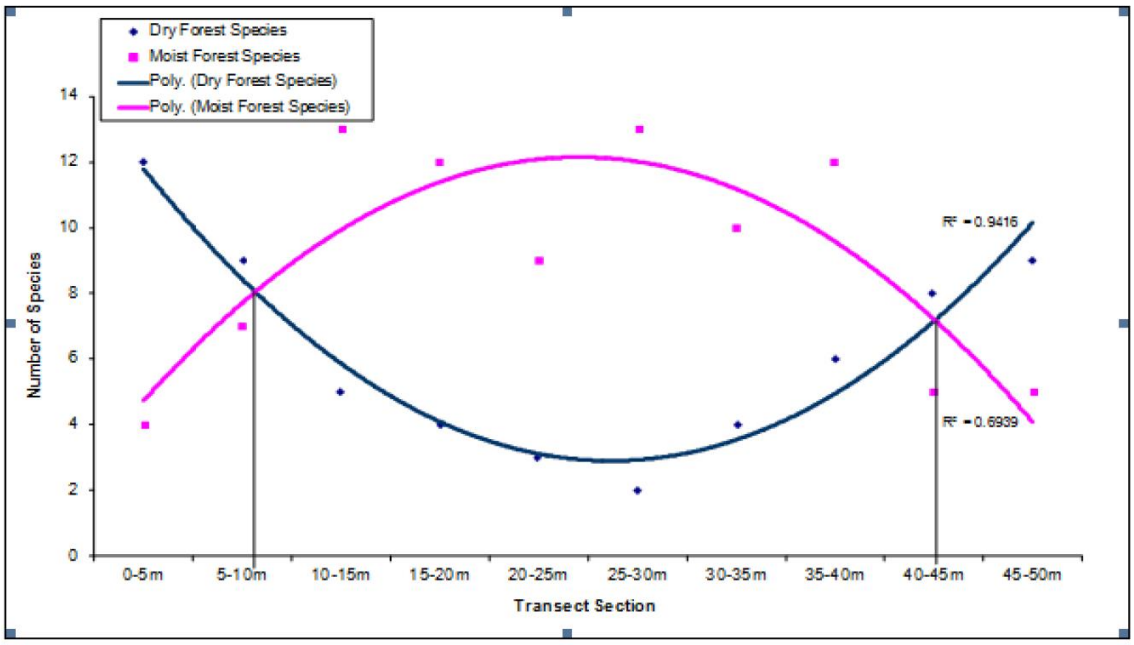

Figure 5: **Transect 2 forest species curves, showing the relationship between dry and moist forest species across the length of the transect in 2008. Black lines indicate the forest transition zones determined in 2008.**

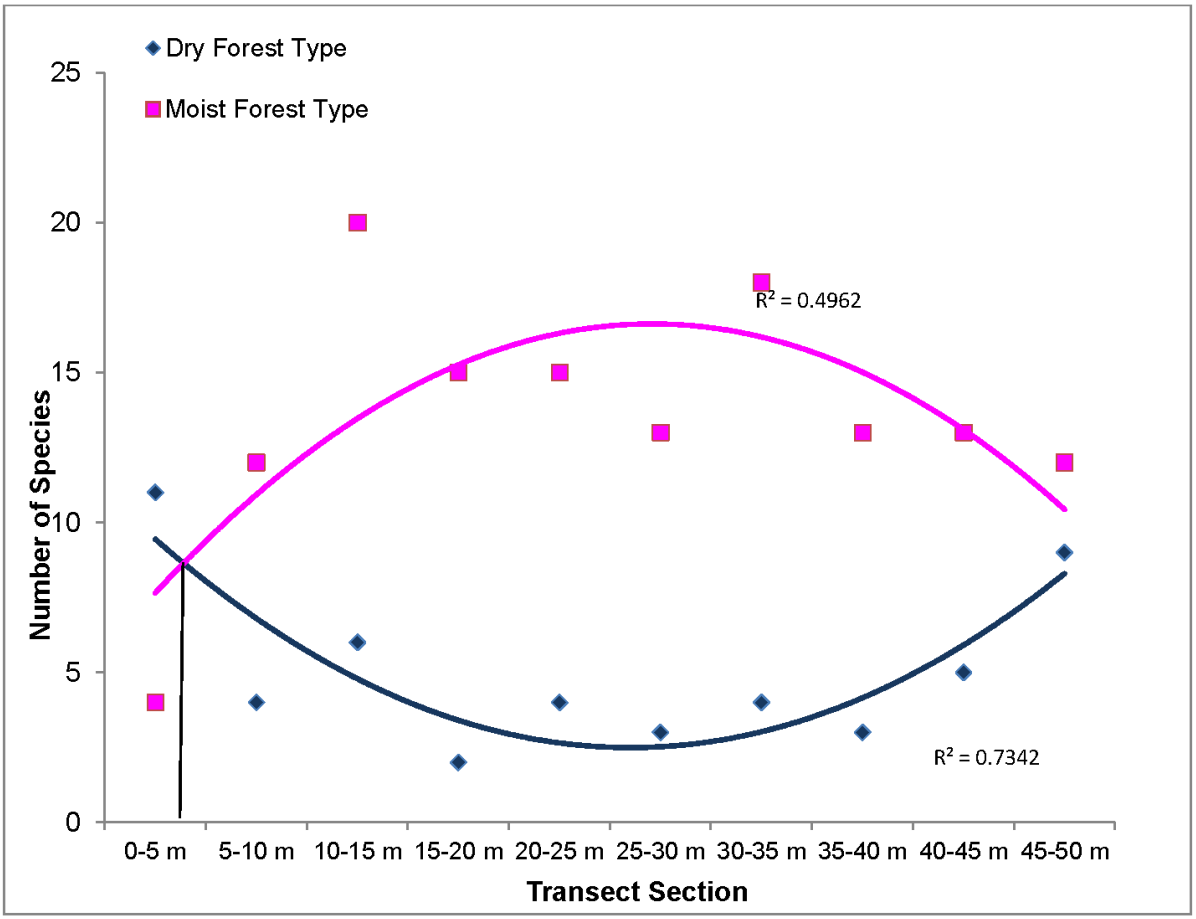

Figure 6: **Transect 2 forest species curves, showing the relationship between dry and moist forest species across the length of the transect in 2018. Black lines indicate the forest transition zones determined in 2018.**

3.3 STRUCTURAL LAYER FPC ESTIMATES

The estimated foliage projective coverage (FPC) has been separated into structural layers, including ground, shrub, midstorey, overstorey and vine layers (**Figure 7** and **Figure 8**). It should be noted that there is an inherent variability in the estimation of FPC. The estimation of FPC is not sensitive enough to detect slight changes over a single year. Rather, it is an indication of major changes over several years.

The total FPC for the ground, shrub, midstorey and overstorey strata recorded in 2018 along Transect 1 is generally lower than that found in the 2008 survey, with a few unremarkable exceptions along the transect. For example, the FPC for shrub cover at 55 – 60 m along

Transect 1 was 59 % higher in 2008 compared with 2018. A similar trend is present for all structural layers between 2008 and 2018, with the exception of vines. This is because the total FPC for vines in 2008 was low compared with 2009 and 2016, and it is therefore the only stratum in 2018 that shows a similar level to that recorded in 2008.

Generally, the total FPC of the ground cover and midstorey stratum along Transect 2 was noticeably higher in the 2008 survey compared with the 2009, 2017 and 2018 surveys. Total FPC levels found in 2018 were generally lower than that found in the 2009 and similar to the 2017 surveys, with the exception of the ground layer, which was markedly lower than 2017 at all points. For the shrub layer, levels of FPC found in 2018 were higher than 2017 with the exception of the 10 – 15 m point along the transect. For all other strata, data in 2018 roughly mirrored the trends of 2008, 2009 and 2017.

Shrub FPC was 0% at the 0-5 m interval along Transect 2 in 2017 and 2018, while it was significantly higher (approx. 70%) in the same region of the transect in 2008. The ground cover layer also shows a similarly noticeable difference with 62% and 51% recorded in 2017 and 2018 respectively, and 130% in 2008. A noticeable difference also occurs with the FPC of vines at the 45 – 50 m mark between 2008, where it was at 90%, and around 30% in 2009, 2017 and 2018. Aside from this difference at the 45 – 50 m mark, the total FPC of the vine substratum was generally very similar between all five survey years shown in the figures.

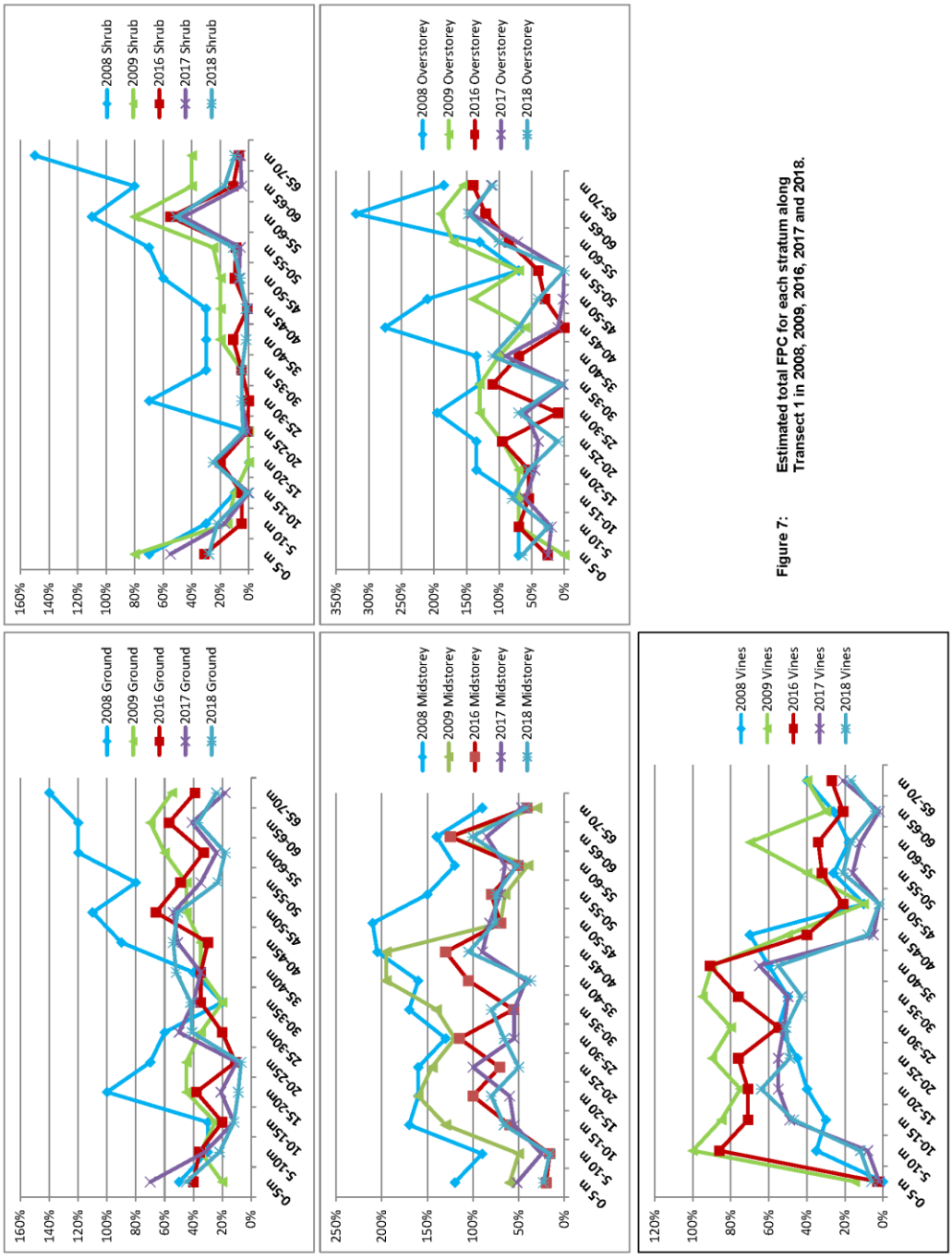

Figure 7: **Estimated total FPC for each stratum along Transect 1 in 2008, 2009, 2016, 2017 and 2018.**

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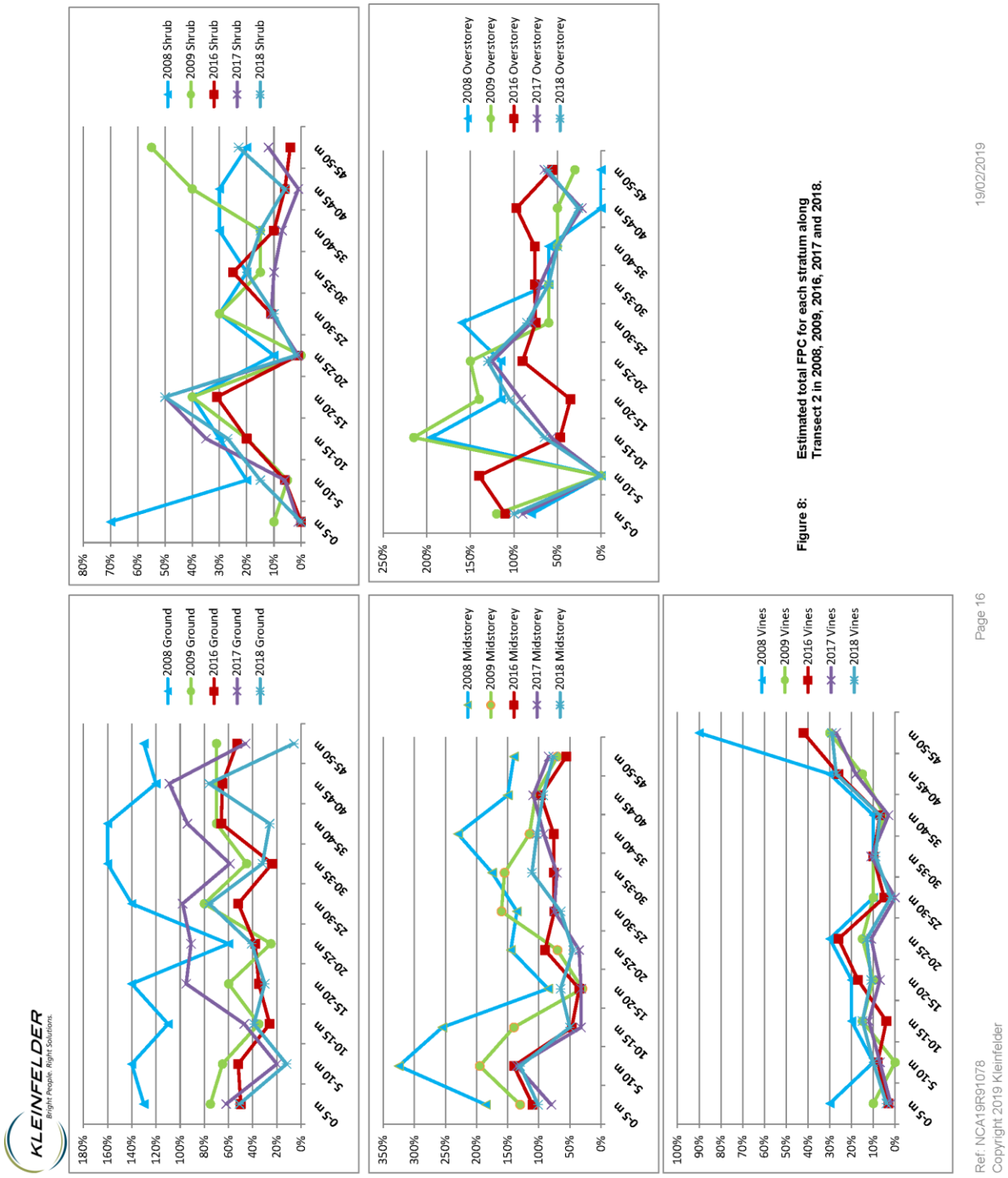

Figure 8: **Estimated total FPC for each stratum along Transect 2 in 2008, 2009, 2016, 2017 and 2018.**

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3.4 FAUNA SPECIES RICHNESS

In total, (i.e. at both forest types across all years of monitoring) 103 fauna species have been recorded, comprised of seven arboreal mammal, nine terrestrial mammal, 18 bat, four herpetofauna and 65 bird species (see **Figure 9**). Of these, 10 are listed as vulnerable under the BC Act and/or the EPBC Act. These are:

- Little Bentwing-bat (*Miniopterus australis*; BC Act);
- Eastern Bentwing-Bat (*Miniopterus schreibersii oceanensis;* BC Act);
- Eastern Freetail-bat (*Mormopterus norfolkensis;* BC Act);
- Southern Myotis (*Myotis macropus*; BC Act);
- Powerful Owl (*Ninox strenua*; BC Act);
- Greater Glider (*Petauroides volans;* EPBC Act);
- Grey-headed Flying-fox (*Pteropus poliocephalus*; BC Act & EPBC Act);
- Koala (*Phascolarctos cinereus*; BC Act & EPBC Act);
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris;* BC Act);
- Sooty Owl (*Tyto tenebricosa*; BC Act).

In 2018 a total of 27 and 28 fauna species were recorded in the Dry Forest and Rainforest habitats, respectively. These results are below the average number of species recorded across all years (35 in the Dry Forest, 30 in the Rainforest) (**Figure 9**).

No feral species were detected during the 2018 survey.

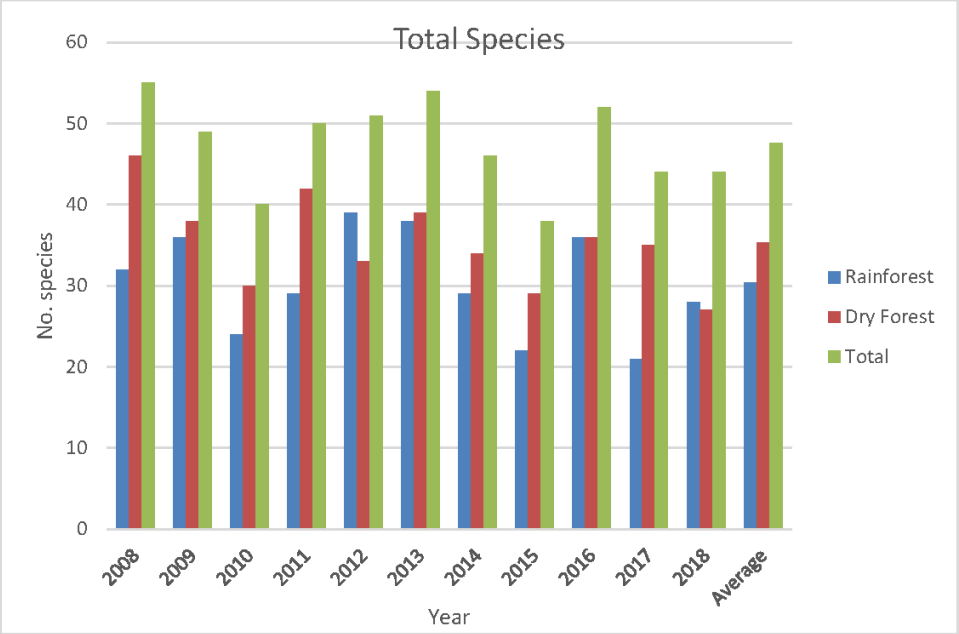

Figure 9: **Fauna Species Richness in Dry Forest and Rainforest transects from 2008 to 2018.**

Each fauna group is discussed in more detail below, with comparisons made between the current results and the data collated annually since the 2008 baseline study. Selected photographs of fauna species recorded during surveys of Long Gully Creek from all years are also provided in **Appendix 3**.

3.4.1 Arboreal Mammals

Three arboreal mammal species were recorded during the survey period; the lowest number of arboreal mammals recorded along with 2009 and 2017. The three arboreal mammal species detected in 2018 were the Greater Glider (*Petauroides volans*), Common Brushtail Possum (*Trichosurus vulpecula*) and Brown Antechinus (*Antechinus stuartii*). The number of arboreal mammal species recorded in the dry forest and rainforest transects in 2018 was lower than numbers recorded in the previous seven years. The total number of species recorded in 2018 was 1.3 species below the average (4.3; **Figure 10**).

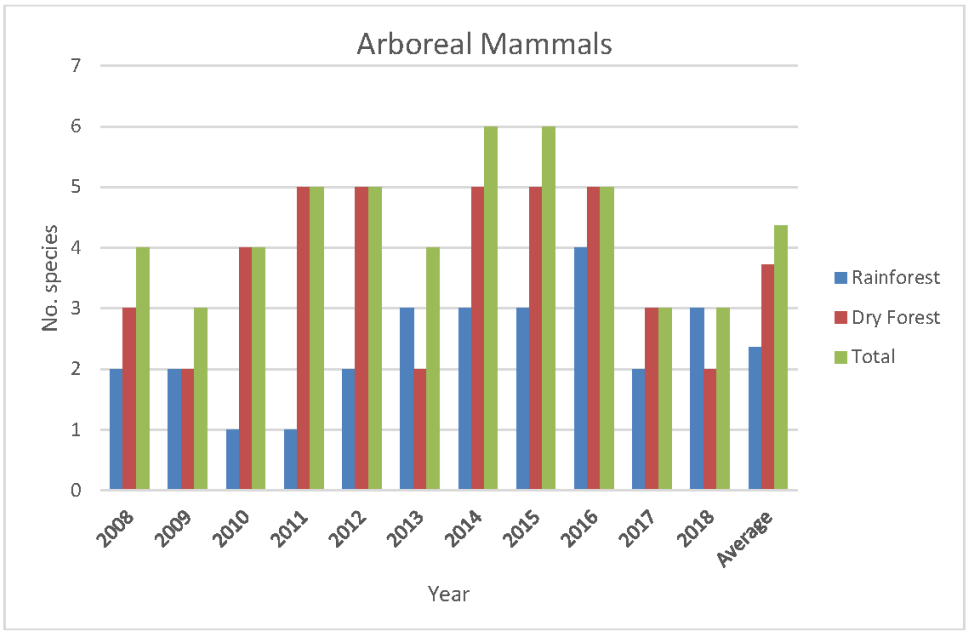

Figure 10: Arboreal Mammal Species Richness within the Dry Forest and Rainforest transects from 2008 to 2018.

Noticeable absences in the 2018 survey included the Feathertail Glider (*Acrobates pygmaeus*), Common Ringtail Possum (*Pseudocheirus peregrinus*) and Sugar Glider (*Petaurus breviceps*). Whilst the Feathertail Glider has been detected sporadically (not detected in 2009, 2012, 2013, 2016 and 2017), suggesting that they are relatively cryptic, the Common Ringtail Possum has been detected in the previous four years. Interestingly however, the Common Ringtail Possum was not recorded in the first four years of monitoring, suggesting that movements in and out of these areas might be cyclical and depend on local resources, climatic variables and the presence of large forest owl predators.

3.4.2 Terrestrial Mammals

Four terrestrial mammal species were detected during the 2018 survey. These were; Brown Antechinus (*Antechinus stuartii*), Bush Rat (*Rattus fuscipes*), Long-nosed Bandicoot (*Perameles nasuta*) and Swamp Wallaby (*Wallabia bicolor*). Terrestrial mammal species richness was higher than the number recorded in 2017 and was slightly higher than the average (3.4 species) for all years across both transects (**Figure 11**). The Long-nosed Bandicoot (*Perameles nasuta*) was detected in 2017 and now 2018; this species has been detected sporadically since surveys began in 2008, suggesting that these animals may be

moving in and out of local areas following favourable local conditions (e.g. presence of resources, absence of predators and favourable climatic conditions).

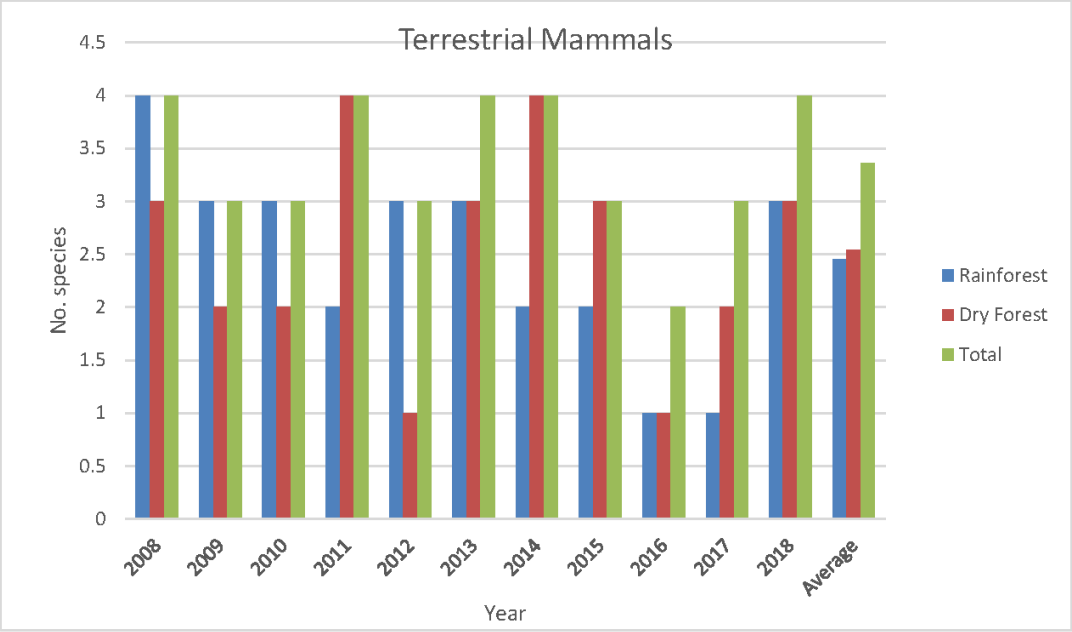

Figure 11: **Terrestrial Mammal Species Richness within the Dry Forest and Rainforest transects from 2008 to 2018.**

3.4.3 Bats

Eight species of bat were confirmed as occurring on the subject site during the 2018 survey. Two of these species were captured in a harp trap and seven of the eight species were detected from Anabat™ ultrasonic call recordings. Two of these species are listed as threatened under the NSW BC Act: Little Bentwing-bat (*Miniopterus australis*) and the Grey-headed Flying Fox (*Pteropus poliocephalus*). The trend in the number of species recorded since 2010 has been positive, with both 2015, 2016 and 2017 recording the equal highest species richness to date; although in 2018 there was a small decrease with eight bat species recorded but still above average over all years (n=7.3) (**Figure 12**).

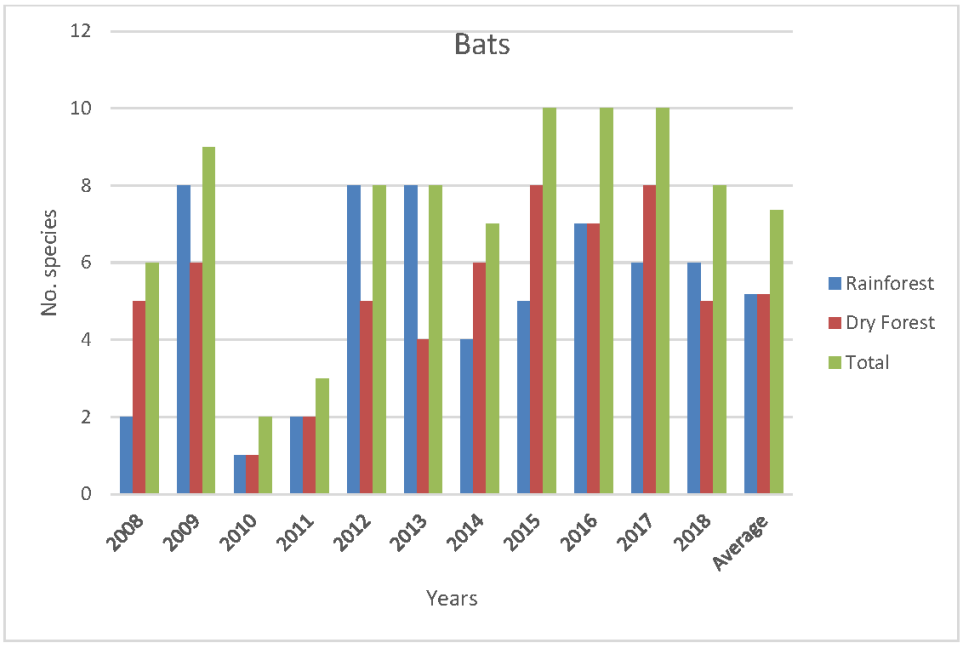

Figure 12: **Bat Species Richness within the Dry Forest and Rainforest transects from 2008 to 2018.**

3.4.4 Birds

Twenty-nine bird species were detected in 2018, slightly below the yearly average of 31.6 species. Bird species richness has remained relatively stable across all years with the exception of 2015 when only 19 species were detected (**Figure 13**).

The threatened Powerful Owl (*Ninox strenua*) and Sooty Owl (*Tyto tenebricosa*) were both recorded in 2016, however no owl species were detected in 2018. These species can be cryptic and it may take several nights of survey before they are detected. One species not previously detected at the subject site (Masked Lapwing *Vanellus miles*) was recorded flying over the Dry Forest in 2018. This species is generally recorded in open areas such as grasslands, mudflats and urban areas. Its presence is considered opportunistic, due to the site's proximity to rural residential developments.

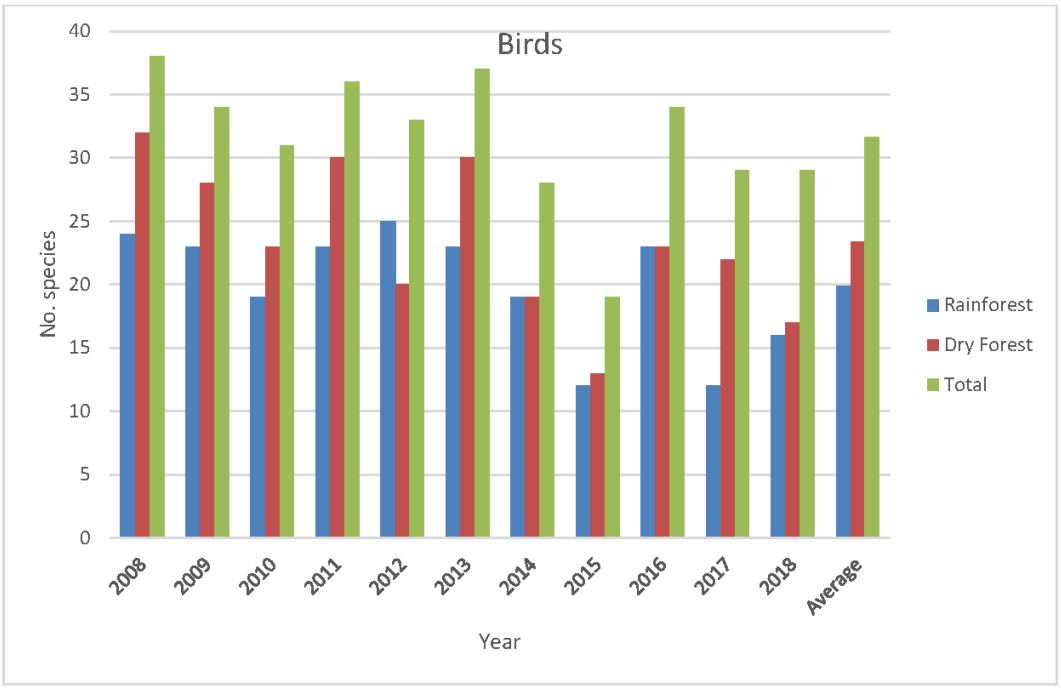

Figure 13: **Bird Species Richness within the Dry Forest and Rainforest transects from 2008 to 2018.**

3.4.5 Amphibians

No amphibian species were detected during surveys in 2018. There was no standing water present during the time of survey. Amphibian species richness has also been low in previous years of the survey (mean = <1), with one species detected in the 2016 survey, and several other previous years having no results (**Figure 14**).

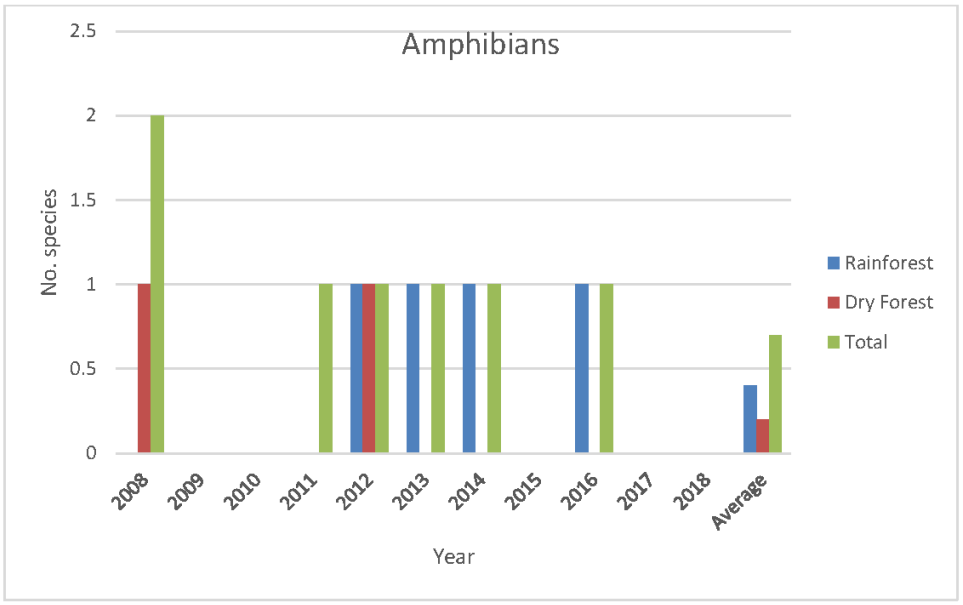

Figure 14: **Amphibian Species Richness within the Dry Forest and Rainforest transects from 2008 to 2018.**

3.4.6 Reptiles

Reptiles are not specifically targeted by the monitoring program; however, any opportunistic sightings are noted. No reptile species were recorded in the 2018 survey (**Figure 15**).

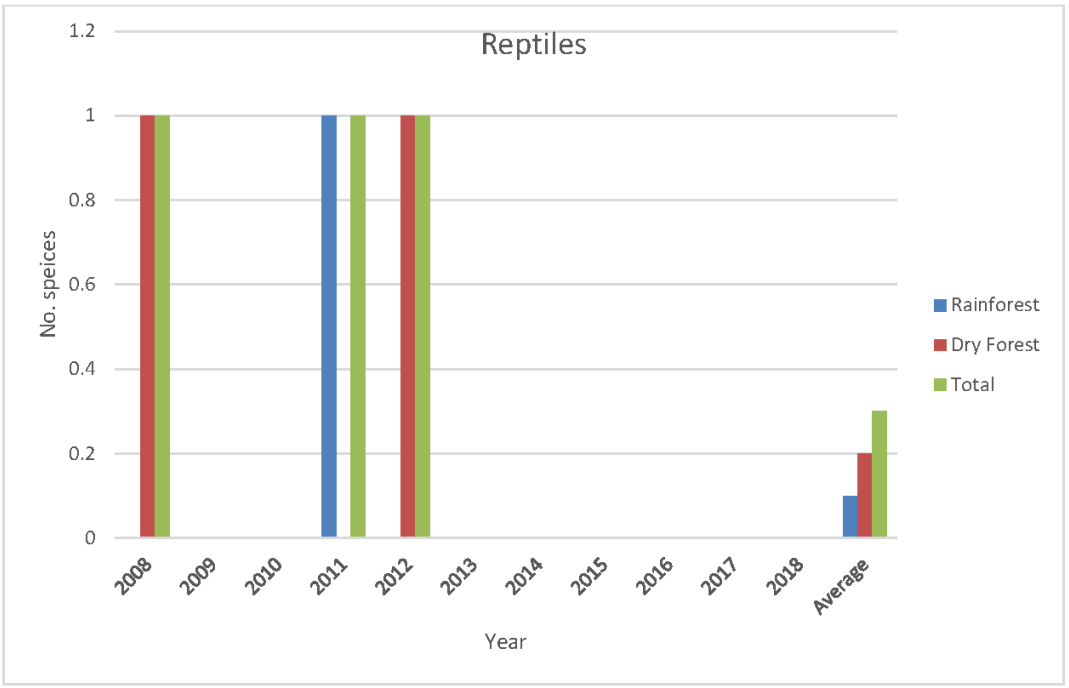

Figure 15: **Reptile Species Richness within the Dry Forest and Rainforest transects from 2008 to 2018.**

3.4.7 Powerful Owl / Prey Interactions

In eastern Australia, Greater Gliders are one of the most important prey items to Powerful Owls. Predation by Powerful Owls has been shown to be an important factor in the regulation of Greater Glider populations. In a study by Kavanagh (1988), a population of Greater Gliders was observed to remain stable for a period of 17 months, after which point a steady decline was observed that coincided with an increase in Powerful Owl activity in the area. **Figure 16** shows the fluctuating presence/absence of Powerful Owls and Greater Gliders within the study area over time. The pattern suggests that Powerful Owls could be focusing their foraging in different sections of their range based on Greater Glider presence, in accordance with optimum foraging theory. As the owls predate on gliders their numbers fall to a point where foraging efficiency is unprofitable. At this point the owls may move to another area of their large home range where they can forage more efficiently, allowing glider numbers to increase within the study area, as seen in 2013 - 2014. The owls may then return when glider numbers are sufficiently high again; which may be the case in 2015 when a Powerful Owl was recorded for the first time since 2012. In 2016, both Greater Gliders and Powerful Owls were detected for the second year in a row. Whilst it might have been expected that Greater Glider numbers

would be on the decrease given the presence of Powerful Owls in the area over two consecutive years, their detection again is likely explained by a lag time between the presence of Owls and the decrease in Glider numbers. Given that Powerful Owls have not been detected in the area since 2012, this may have provided a window of time for Gliders to increase their numbers significantly under conditions of minimal predation. Even with the return of the Powerful Owl to the area in 2015, it is not surprising that there are still enough Greater Gliders in the area to be detected given the healthy population that had likely built up over the several years prior to the Powerful Owl's return to the area. As mentioned in the 2016 report it was hypothesised that Greater Gliders may not be detected in 2017 due to the presence of the Powerful Owl. The 2017 surveys did not detect either species, suggesting that the Powerful Owl population reduced the number of Greater Gliders to the point where the area was no longer a preferred foraging area. Mentioned in last year's report was the expectation that Greater Gliders would be detected in 2018, which has transpired with the sighting of two Greater Gliders within the rainforest in 2018. This suggests that with the absence of the Powerful Owl in the last two years we are now seeing the returned presence of Greater Gliders. This interaction between Greater Gliders and Powerful Owls may also provide an insight into the fluctuating presence and absence of the Common Ringtail Possum, which is also a prey species of the Powerful Owl.

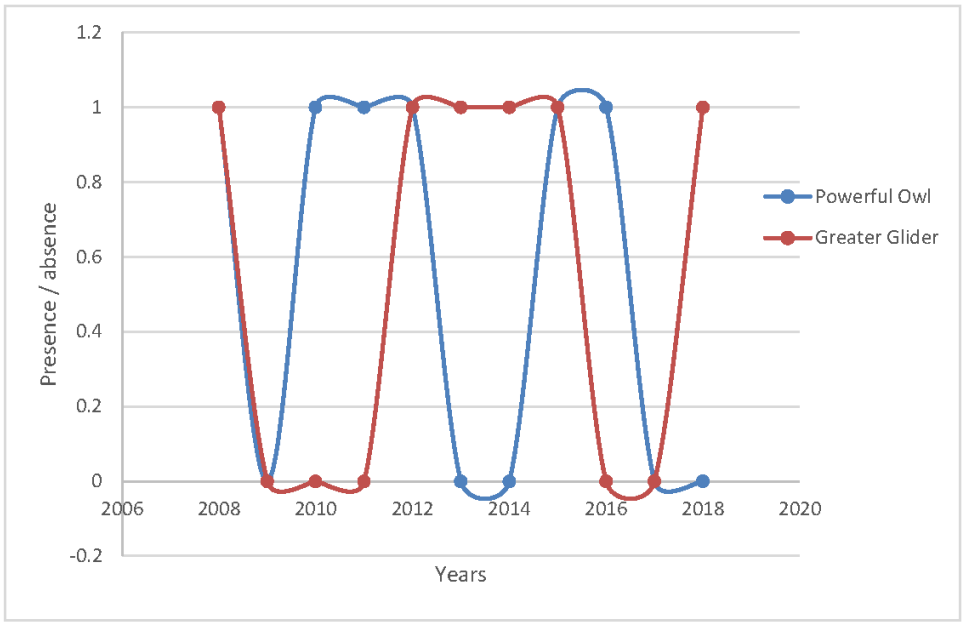

Figure 16: **Presence/absence of Powerful Owls and Greater Gliders within the study area during monitoring events over all years.**

4. DISCUSSION AND CONCLUSIONS

Monitoring of the subtropical rainforest area along Long Gully Creek has been undertaken in 2018 in accordance with the F&FMP for Abel Underground Coalmine (ecobiological 2007). This 11th annual monitoring report documents the current extent of the subtropical rainforest community and the species richness of flora and fauna inhabiting it. Future annual surveys will contribute to a growing dataset from which significant change may be identified.

A total of 59 flora species along Transect 1 and 52 flora species along Transect 2 were recorded during the current survey. This represents a slight increase in floral species richness in both Transects since the original 2008 survey. The point of transition between dry and moist forest at Transect 1 has expanded since the 2008 survey, with the width of the moist forest increasing. Along Transect 1, particularly at the end of the transect, there has been an increase in the number of moist species recorded and a decline in the number of dry species within each 5 m segment. This shift in the transition zone between the two forest types has been caused by an increase in moist species such as *Cissus antarctica* (Water Vine) and *Tetrastigma nitens,* and a decline in dry species such as *Cayratia clematidea* (Native Grape), *Clematis glycinoides* (Headache Vine) and *Eustrephus latifolius* (Wombat Berry). Interestingly, those species listed above as having declined are all dry forest vine species, with this stratum showing a noticeable decline along both transects in 2018. Additionally, there has been a reduction in the occurrence of *Lantana camara* (Lantana) along the transect which has also contributed to the reduction in dry species. The transitional zones of the dry and moist forest along Transect 2 are also similar to those changes identified along Transect 1 in 2018, with a widening of the moist forest since 2008, reaching the end of the Transect in 2018. Again, the absence of dry forest vine species is particularly apparent along this Transect.

Along both Transect 1 and Transect 2 there has been a general decline in FPC since the original 2008 baseline survey. However, this is not an isolated occurrence in the current survey. When data from the current survey are compared to that of the 2009 and 2017 surveys, the total FPC along both transects is similarly low, with a few exceptions. This decrease has been observed in all levels of stratum and likely reflects a combination of factors including storm damage of overstorey trees during 2015, as well as a lack of fire disturbance over a prolonged period of time.

In total, (i.e. at both forest types) 44 fauna species were recorded, comprising three arboreal mammal, four terrestrial mammal (NB: Brown Antechinus is considered both arboreal and

terrestrial), eight bat and 29 bird species in 2018. Three of these species are listed as vulnerable under the BC Act and/or the EPBC Act; Greater Glider (*Petauroides volans*), Little Bentwing-bat (*Miniopterus australis*) and the Grey-headed Flying-fox (*Pteropus poliocephalus*).

In 2018 a total of 27 and 28 fauna species were recorded in the Dry Forest and Rainforest habitats respectively. These results are below the average number of species recorded across all years (35 in the Dry Forest, 30 in the Rainforest). Notable absences from the Rainforest monitoring in 2018 included: arboreal mammals such as the Sugar Glider, Feathertail Glider and Common Ringtail Possum; large forest owls; and, some locally common bird species such as the Rufous Whistler, Grey Shrike-thrush, Scarlet Honeyeater, Striated Thornbill and White-throated Treecreeper. Some of the noted bird species were however detected in the Dry Forest in 2018. The lower species richness (compared with the average) within the Rainforest and Dry Forest in 2018 is likely to be due to a range of factors including individual species' detectability and home range size, availability of foraging resources (lack of blossom / fruit observed during survey), local climatic conditions and predator/prey interactions as discussed below.

Comparing the presence/absence of gliders and owls shows a fluctuating pattern that might suggest that the Powerful Owls are regulating the Greater Glider population within the study area and move throughout their territory as foraging efficiency becomes unprofitable. This pattern also provides a likely explanation for the fluctuation of presence of the Common Ringtail Possum in the study area which was last recorded in the Rainforest in 2015. During 2018 surveys the Greater Glider was again detected, suggesting an alleviation of the predation pressure from the Powerful Owl population (not detected over the last two years). Further monitoring will show if this pattern continues over time. However, presence/absence data only allows further hypotheses to be generated; population studies would be required to draw any robust conclusions regarding the population dynamics of these species.

The annual monitoring continues to provide valuable baseline information on the natural variation in the abundance and diversity of species in the Long Gully Creek system. The growing dataset will provide a sound benchmark against which future potential underground mining impacts can be assessed.

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APPENDIX 1: FLORA SPECIES RECORDED: 2008 – 2018

Family	Scientific Name	Common Name	Forest Type	Stratum	Transect 1											Transect 2										
					2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Orchidaceae	*Dendrobium sp.*		Dry	-	x	x	x	x	x	x	x	x	x	x	x						x					
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower	Dry	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Blechnaceae	*Doodia aspera*	Rasp Fern	Dry	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Convolvulaceae	*Dichondra repens*	Kidney weed	Dry	Ground								x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Cyperaceae	*Gahnia aspera*		Dry	Ground						x						x	x								x	x
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick Trefoil	Dry	Ground											x											
Lamiaceae	*Plectranthus parviflorus*		Dry	Ground	x	x	x	x	x	x	x	x	x	x	x											
Oxalidaceae	*Oxalis perennans*		Dry	Ground																		x	x	x		
Poaceae	*Oplismenus aemulus*	Basket Grass	Dry	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Poaceae	*Oplismenus imbecillis*	Creeping Beard Grass	Dry	Ground											x											x
Pteridaceae	*Pellaea falcata*	Sickle Fern	Dry	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cyperaceae	*Cyperus tetraphyllus*		Dry	Ground				x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x	x
Cyperaceae	*Cyperus sp.*		Dry	Ground									x													
Phytolaccaceae	**Phytolacca octandra*	Inkweed	Dry	Ground										x												
Solanaceae	**Solanum mauritianum*	Wild Tobacco	Dry	Ground										x												
Euphorbiaceae	*Croton verreauxii*	Green Native Cascarilla	Dry	Midstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Malvaceae	*Hibiscus heterophyllus*	Native Rosella	Dry	Midstorey	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	Dry	Midstorey	x																					
Moraceae	*Ficus sp.*		Dry	Overstorey	x																					
Myrtaceae	*Eucalyptus acmenoides*	White mahogany	Dry	Overstorey												x	x	x	x	x	x	x	x	x	x	x
Myrtaceae	*Eucalyptus fergusonii subsp. fergusonii*	Grey Ironbark	Dry	Overstorey												x	x	x	x	x	x	x	x	x	x	x
Myrtaceae	*Melaleuca styphelioides*		Dry	Overstorey	x	x	x	x	x	x	x	x	x	x	x											
Myrtaceae	*Syncarpia glomulifera*	Turpentine	Dry	Overstorey	x	x	x	x	x	x	x	x	x	x	x											
Fabaceae (Mimosoideae)	*Acacia longissima*	Long-leaf Wattle	Dry	Shrub											x	x	x	x	x	x	x	x	x	x	x	x
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood	Dry	Shrub	x	x	x	x	x	x	x	x	x	x	x											
Oleaceae	*Notelaea longifolia*	Large Mock-olive	Dry	Shrub	x	x									x	x	x	x	x	x	x					
Verbenaceae	**Lantana camara*	Lantana	Dry	Shrub	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Family	Scientific Name	Common Name	Forest Type	Stratum	Transect 1											Transect 2										
					2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Aphanopetalaceae	*Aphanopetalum resinosum*	Gum Vine	Dry	Vine	x	x	x	x	x	x		x	x													
Apocynaceae	*Marsdenia rostrata*	Common Milk Vine	Dry	Vine	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x		
Apocynaceae	*Parsonsia straminea*	Monkey Rope	Dry	Vine	x			x	x		x	x	x		x							x				x
Bignoniaceae	*Pandorea pandorana subsp. pandorana*	Wonga Wonga Vine	Dry	Vine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Dioscoreaceae	*Dioscorea transversa*	Native Yam	Dry	Vine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	Dry	Vine	x	x	x	x	x	x		x	x		x											
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily	Dry	Vine	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsaparilla	Dry	Vine																					x	
Ranunculaceae	*Clematis glycinoides*	Headache Vine	Dry	Vine							x	x	x													
Vitaceae	*Cayratia clematidea*	Native Grape	Dry	Vine	x	x	x	x	x	x		x	x		x	x	x	x								
Orchidaceae	*Sarcochilus falcatus*	Orange-blossom Orchid	Moist	Ground												x	x	x								
Polypodiaceae	*Pyrrosia confluens var. confluens*	Horse-shoe Felt Fern	Moist	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Araceae	*Gymnostachys anceps*	Settlers Flax	Moist	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Blechnaceae	*Blechnum patersonii subsp. patersonii*	Strap Water Fern	Moist	Ground												x	x									x
Commelinaceae	*Aneilema acuminatum*		Moist	Ground				x	x			x	x	x	x	x	x	x	x	x					x	
Davalliaceae	*Arthropteris tenella*		Moist	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern	Moist	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pteridaceae	*Adiantum formosum*	Giant Maidenhair Fern	Moist	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pteridaceae	*Adiantum hispidulum*	Rough Maidenhair Fern	Moist	Ground	x	x	x	x	x	x	x	x	x	x	x	x	x	x						x	x	x
Pteridaceae	*Pteris tremula*	Australian brake	Moist	Ground									x	x												
Euphorbiaceae	*Alchornea ilicifolia*	Dovewood	Moist	Midstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Euphorbiaceae	*Baloghia inophylla*	Brush Bloodwood	Moist	Midstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fabaceae (Mimosoideae)	*Pararchidendron pruinosum var. pruinosum*	Snow Wood	Moist	Midstorey	x	x	x	x	x	x																
Flacourtiaceae	*Scolopia braunii*	Flintwood	Moist	Midstorey												x	x	x	x	x	x	x	x	x	x	x
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum	Moist	Midstorey	x																					
Lauraceae	*Neolitsea australiensis*	Green Bolly Gum	Moist	Midstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Monimiaceae	*Doryphora sassafras*	Sassafras	Moist	Midstorey												x	x		x	x	x					

Family	Scientific Name	Common Name	Forest Type	Stratum	Transect 1											Transect 2										
					2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Monimiaceae	*Wilkiea macrophylla*	Large-leaved Wilkiea	Moist	Midstorey												x	x	x	x	x	x					
Moraceae	*Ficus fraseri*	Sandpaper Fig	Moist	Midstorey	x																					
Moraceae	*Streblus brunonianus*	Whalebone Tree	Moist	Midstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Phyllanthaceae	*Actephila lindleyi*	Actephila	Moist	Midstorey																		x	x	x	x	
Rutaceae	*Geijera salicifolia var. latifolia*		Moist	Midstorey										x	x	x	x								x	x	x
Sapindaceae	*Alectryon subcinereus*	Native Quince	Moist	Midstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x
Sapindaceae	*Diploglottis cunninghamii*	Native Tamarind	Moist	Midstorey											x							x	x	x		
Sapindaceae	*Guioa semiglauca*		Moist	Midstorey	x	x	x	x	x	x				x	x	x	x										x
Sapindaceae	*Mischocarpus australis*		Moist	Midstorey							x	x	x	x	x							x	x	x	x	x
Ebenaceae	*Diospyros pentamera*	Myrtle Ebony	Moist	Midstorey									x		x									x		x
Solanaceae	*Solanum stelligerum*	Solanaceae	Moist	Midstorey									x	x										x	x	x
Boraginaceae	*Ehretia acuminata*	Koda	Moist	Overstorey												x	x	x	x	x	x		x	x		
Cornaceae	*Alangium villosum subsp. polyosmoides*	Muskwood	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x											
Cunoniaceae	*Schizomeria ovata*	Crab Apple	Moist	Overstorey			x	x	x	x	x	x	x	x	x											
Ebenaceae	*Diospyros australis*	Black Plum	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x				
Elaeocarpaceae	*Elaeocarpus obovatus*	Blueberry Ash	Moist	Overstorey												x	x	x	x	x	x	x	x	x	x	x
Lauraceae	*Cryptocarya microneura*	Murrogun	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x											
Meliaceae	*Toona ciliata*	Red Cedar	Moist	Overstorey												x	x	x	x	x	x	x	x	x	x	x
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x											
Oleaceae	*Olea paniculata*	Native Olive	Moist	Overstorey						x						x	x	x	x	x	x					
Podocarpaceae	*Podocarpus elatus*	Plum Pine	Moist	Overstorey														x	x	x	x	x	x	x	x	x
Rhamnaceae	*Alphitonia excelsa*	Red Ash	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x
Sapotaceae	*Planchonella australis*	Black Apple	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Urticaceae	*Dendrocnide excelsa*	Giant Stinging Tree	Moist	Overstorey	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
Urticaceae	*Dendrocnide photinophylla*	Shiny-leaved Stinging Tree	Moist	Overstorey	x	x	x	x	x		x	x	x	x	x				x	x	x			x	x	x
Cardiopteridaceae	*Citronella moorei*	Churnwood	Moist	Overstorey									x													
Monimiaceae	*Daphnandra apatela*	Socketwood	Moist	Overstorey																				x	x	x
Capparaceae	*Capparis arborea*	Native Pomegranate	Moist	Shrub	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Celastraceae	*Denhamia Sylvestris*	Narrow-leaf Orangebark	Moist	Shrub											x											
Eupomatiaceae	*Eupomatia laurina*	Bolwarra	Moist	Shrub											x											x
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea	Moist	Shrub												x	x	x	x	x	x		x	x	x	x
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	Moist	Shrub	x	x	x	x	x	x		x	x		x											

Family	Scientific Name	Common Name	Forest Type	Stratum	Transect 1											Transect 2										
					2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Pittosporaceae	*Pittosporum multiflorum*	Orange Thorn	Moist	Shrub	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	Moist	Shrub														x	x	x	x	x	x	x		
Menispermaceae	*Legnephora moorei*	Round-leaf Vine	Moist	Vine												x	x									
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine	Moist	Vine		x	x	x	x	x					x											
Menispermaceae	*Stephania japonica var. discolor*	Snake vine	Moist	Vine	x																					
Moraceae	*Trophis scandens*	Burny Vine	Moist	Vine												x	x		x	x	x	x	x	x	x	x
Myrsinaceae	*Embelia australiana*		Moist	Vine																		x	x	x	x	x
Ripogonaceae	*Ripogonum album*	White Supplejack	Moist	Vine	x																x					
Rubiaceae	*Morinda jasminoides*	Sweet Morinda	Moist	Vine	x	x		x	x	x	x	x	x			x	x		x		x	x		x	x	x
Vitaceae	*Cissus antarctica*	Water Vine	Moist	Vine	x	x	x	x	x	x	x	x	x	x	x	x	x					x		x	x	x
Vitaceae	*Tetrastigma nitens*		Moist	Vine	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x
Vitaceae	*Clematicissus opaca*	Pepper Vine	Moist	Vine											x											
				Total	**54**	**48**	**47**	**51**	**51**	**50**	**44**	**51**	**56**	**49**	**59**	**51**	**51**	**45**	**47**	**45**	**49**	**44**	**43**	**53**	**49**	**52**

* Denotes an introduced species

APPENDIX 2: FAUNA SPECIES RECORDED 2008 - 2018

Scientific name	Common name	Dry Forest											Rainforest										
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Birds																							
Acanthiza lineata	Striated Thornbill	+		+	+		+	+	+	+	+	+				+			+	+			
Acanthiza pusilla	Brown Thornbill	+		+	+	+		+			+	+	+	+		+					+		
Acanthorhynchus tenuirostris	Eastern Spinebill	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+		+			
Aegotheles cristatus	Australian Owlet-nightjar	+	+				+			+			+					+					
Ailuroedus crassirostris	Green Catbird					+								+		+	+				+	+	+
Alectura lathami	Australian Brush-turkey															+							
Alisterus scapularis	Australian King-Parrot		+		+		+						+					+					
Cacatua galerita	Sulphur-crested Cockatoo																	+					
Cacomantis flabelliformis	Fan-tailed Cuckoo	+		+				+				+				+			+		+	+	+
Cacomantis variolosus	Brush Cuckoo	+			+		+	+			+	+							+				
Centropus phasianinus	Pheasant Coucal	+																					
Chalcites lucidus	Shining Bronze-Cuckoo		+								+		+										
Cinclosoma punctatum	Spotted Quail-thrush	+	+											+									
Colluricincla harmonica	Grey Shrike-thrush	+				+	+				+	+	+		+	+	+	+					
Coracina novaehollandiae	Black-faced Cuckoo-shrike		+				+																
Coracina tenuirostris	Cicadabird	+				+	+				+								+				
Cormobates leucophaeus	White-throated Treecreeper	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+			+		+
Corvus coronoides	Australian Raven	+		+	+	+	+					+						+		+			
Cracticus nigrogularis	Pied Butcherbird				+																		
Cracticus tibicen	Australian Magpie			+																			
Dacelo novaeguineae	Laughing Kookaburra		+		+		+										+						
Dicaeum hirundinaceum	Mistletoebird						+																
Eopsaltria australis	Eastern Yellow Robin	+	+	+	+		+	+	+	+	+		+	+	+	+	+	+	+	+	+		+
Eurostopodus mystacalis	White- throated Nightjar											+										+	
Eurystomus orientalis	Dollarbird									+								+					
Falcunculus frontatus	Crested Shrike-tit										+												
Gerygone mouki	Brown Gerygone	+	+	+	+			+		+			+	+	+	+	+	+	+	+	+	+	+
Leucosarcia picata	Wonga Pigeon	+	+		+		+			+	+				+	+		+	+	+	+		+
Lichenostomus chrysops	Yellow-faced Honeyeater	+	+	+	+	+	+	+	+	+	+	+				+		+					
Lopholaimus antarcticus	Topknot Pigeon														+								
Macropygia amboinensis	Brown Cuckoo-dove	+	+		+		+			+			+	+	+	+	+	+	+		+	+	+
Malurus cyaneus	Superb Fairy-wren		+											+		+	+						
Malurus lamberti	Variegated Fairy-wren					+	+	+			+			+									
Manorina melanophrys	Bell Miner	+			+		+	+	+	+													
Meliphaga lewinii	Lewin's Honeyeater	+	+	+	+	+	+		+	+	+		+	+	+	+	+	+		+	+	+	+
Melithreptus lunatus	White-naped Honeyeater	+															+						

Scientific name	Common name	Dry Forest											Rainforest										
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Menura novaehollandiae	Superb Lyrebird																+				+		+
Monarcha melanopsis	Black-faced Monarch	+	+	+	+			+					+	+	+	+	+	+	+	+	+		+
Myiagra rubecula	Leaden Flycatcher	+	+		+																		
Myzomela sanguinolenta	Scarlet Honeyeater	+	+	+	+			+		+	+	+	+	+	+	+			+		+	+	
Neochmia temporalis	Red-browed Finch		+																				
Ninox novaeseelandiae	Southern Boobook			+										+									
Ninox strenua#	Powerful Owl				+								+		+	+	+			+	+		
Oriolus sagittatus	Olive-backed Oriole									+							+						
Pachycephala pectoralis	Golden Whistler	+	+	+	+		+	+			+	+	+	+	+	+	+	+	+				+
Pachycephala rufiventris	Rufous Whistler			+		+	+						+					+	+				
Pardalotus punctatus	Spotted Pardalote	+	+	+	+	+		+	+	+	+	+	+	+		+	+		+		+		+
Philemon corniculatus	Noisy Friarbird				+													+					
Pitta versicolor	Noisy Pitta					+								+	+		+		+		+	+	
Platycercus eximius	Eastern Rosella		+		+					+				+							+		
Psophodes olivaceus	Eastern Whipbird	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+
Ptilonorhynchus violaceus	Satin Bowerbird						+								+			+	+		+		+
Rhipidura albiscapa	Grey Fantail	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					+	
Rhipidura rufifrons	Rufous Fantail			+		+	+		+	+	+		+					+	+	+	+	+	+
Scythrops novaehollandiae	Channel-billed Cuckoo				+	+	+										+						
Sericulus chrysocephalus	Regent Bowerbird																	+					
Strepera graculina	Pied Currawong	+	+				+			+		+											
Symposiachrus trivirgatus	Spectacled Monarch																+						
Todiramphus sanctus	Sacred Kingfisher	+	+	+	+	+		+	+			+	+					+			+		
Trichoglossus haematodus	Rainbow Lorikeet	+								+	+								+				
Tyto tenebricosa#	Sooty Owl			+		+	+										+				+		
Sericornis citreogularis	Yellow-throated Scrubwren						+						+	+	+	+	+		+		+	+	+
Sericornis frontalis	White-browed Scrubwren	+	+		+		+	+		+	+		+	+						+	+		
Vanellus miles	Masked Lapwing											+											
Zosterops lateralis	Silvereye	+	+	+	+	+			+	+		+	+	+	+	+	+						
	Total	**32**	**28**	**23**	**30**	**20**	**30**	**19**	**13**	**23**	**22**	**17**	**24**	**23**	**19**	**23**	**25**	**23**	**19**	**12**	**23**	**12**	**16**
Reptiles																							
Cyclodomorphus gerrardii	Pink-tongued Skink															+							
Varanus varius	Lace Monitor	+				+																	
	Total	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Amphibians																							
Litoria fallax	Green Reed Frog	+				+											+	+	+				
Litoria peronii	Peron's Tree Frog	+			+																+		
	Total	**2**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**0**
Arboreal mammals																							
Acrobates pygmaeus	Feathertail Glider	+		+	+			+	+				+	+	+	+	+	+	+				
Antechinus stuartii	Brown Antechinus	+	+	+	+	+	+	+	+	+	+	+								+	+	+	+

Scientific name	Common name	Dry Forest											Rainforest										
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Antechinus swainsonii	Dusky Antechinus				+																		
Petauroides volans #	Greater Glider					+	+	+	+	+			+										+
Petaurus breviceps	Sugar Glider	+	+	+	+	+				+	+									+		+		
Phascolarctos cinereus #	Koala								+	+												+		
Pseudocheirus peregrinus	Common Ringtail Possum					+		+										+		+				
Trichosurus vulpecula	Common Brushtail Possum			+	+	+		+	+	+	+	+		+			+	+	+	+	+	+	+	+
	Total	**3**	**2**	**4**	**5**	**5**	**2**	**5**	**5**	**5**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**4**	**2**	**3**
Terrestrial mammals																							
Antechinus stuartii	Brown Antechinus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Antechinus swainsonii	Dusky Antechinus				+																		
Isoodon macrourus	Northern Brown Bandicoot																					+	
Macropus rufogriseus	Red-necked Wallaby							+															
Perameles nasuta	Long-nosed Bandicoot	+		+					+				+	+	+								+
Rattus fuscipes	Bush Rat	+	+		+		+				+	+	+	+	+	+	+	+		+			+
*Rattus rattus**	Black Rat							+	+								+		+		+		
Tachyglossus aculeatus	Short-beaked Echidna						+																
Wallabia bicolor	Swamp Wallaby				+			+		+		+	+					+					+
	Total	**3**	**2**	**2**	**4**	**1**	**3**	**4**	**3**	**1**	**1**	**3**	**4**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**4**
Bats																							
Austronomus australis	White-striped Free-tailed Bat					+			+		+						+	+		+	+	+	
Chalinolobus morio	Chocolate Wattled Bat	+	+		+			+	+	+	+	+	+			+			+			+	
Chalinolobus gouldii	Gould's Wattled Bat	+	+					+	+	+				+			+			+	+		
Falsistrellus tasmaniensis/ Scotorepens orion	Eastern False Pipistrelle / Eastern Broad-nosed Bat		+							+	+			+						+			+
Miniopterus australis #	Little Bentwing Bat	+	+	+		+	+	+	+	+	+	+	+	+		+	+	+	+		+	+	
Mormopterus norfolkensis #	Eastern Free-tail Bat							+			+			+							+		
Mormopterus ridei	Ride's Free-tail Bat					+		+						+			+	+	+	+	+	+	+
Myotis macropus #	Southern Myotis										+							+					
Nyctophilus geoffroyi	Lesser Long-eared Bat				+						+												
Nyctophilus gouldii	Gould's Long-eared Bat		+											+								+	+
Nyctophilus sp.												+	+						+		+		+
Pteropus poliocephalus #	Grey-headed Flying Fox	+								+													+
Rhinolophus megaphyllus	Eastern Horseshoe Bat						+		+			+	+				+	+		+			+
Scotorepens rueppellii #	Greater Broad-nosed Bat																+						
Vespadelus pumilus	Eastern Forest Bat	+	+			+	+	+	+	+	+			+	+		+	+					
Vespadelus troughtoni	Eastern Cave Bat					+							+	+			+	+					
Vespadelus sp.							+		+									+					
Vespadelus vulturnus	Little Forest Bat								+	+	+	+									+	+	
Total		**5**	**6**	**1**	**2**	**5**	**4**	**6**	**8**	**7**	**9**	**5**	**2**	**8**	**1**	**2**	**8**	**8**	**4**	**5**	**7**	**6**	**6**
Total (All species)		**45**	**37**	**30**	**40**	**32**	**38**	**33**	**28**	**37**	**34**	**27**	**30**	**33**	**22**	**27**	**37**	**36**	**27**	**20**	**38**	**21**	**28**

= Vulnerable (NSW BC and/or EPBC Acts); * Introduced species

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APPENDIX 3: SELECTED PHOTOGRAPHS

Plate 1: **Left - Long-nosed Bandicoot in a cage trap. Right – Little Bentwing-bat.**

Plate 2: **Left - Brown Antechinus. Right - Greater Glider.**

Plate 3: **Top - Green Catbird. Middle - Scarlet Honeyeater. Bottom - Wonga Pigeon**

APPENDIX 4. STAFF CONTRIBUTIONS

The following Kleinfelder staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Mark Dean	BSc. MEnv. Mgt	Ecologist	Fauna surveys and report writing
Luke O'Brien	BEnvSc & Mgt	Ecologist (Zoologist)	Fauna survey
Yann Buissiere	BEnvMgt	Botanist	Flora survey and Report writing
Kristy Peters	BParkMgt/ BSc (Hons)	Senior Ecologist	Report review
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	Figure preparation

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APPENDIX 5. LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the NSW *Biodiversity Conservation Act 2016* (License Number: SL100730, Expiry: 31 March 2019) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick native plants for identification purposes.

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