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Kanmantoo Copper Mine

Ecosystem and Landscape Function Summary Report 2019

Kanmantoo Copper Mine Ecosystem and Landscape Function Summary Report 2019

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Prepared by EBS Ecology for Hillgrove Resources

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GLOSSARY AND ABBREVIATION OF TERMS

BOM	Bureau of Meteorology
EBS Ecology	Environment and Biodiversity Services Pty Ltd – trading as EBS Ecology
EBS Restoration	Environment and Biodiversity Services Pty Ltd – trading as EBS Restoration
EPBC act	*Environment Protection and Biodiversity Conservation Act 1999*
ha	hectare(s)
Hillgrove	Hillgrove Copper Pty Ltd / Hillgrove Resources
IWL	Integrated Waste Landform
Kanmantoo Mine	Kanmantoo Copper Mines, located on Mining Lease (ML) ML6345 and ML6436.
kg	kilogram(s)
km	kilometre(s)
m	metre(s)
LFA	Landscape Function Analysis
LOI	Landscape Organisation Indices
LOM	Life of Mine
ML	Mining Lease
NV Act	*Native Vegetation Act 1991*
PEPR	Program for Environment Protection and Rehabilitation
SA	South Australia(n)
SEB	Significant Environmental Benefit
SMA	Seed Multiplication Area
SPA	Seed Production Area
ssp.	sub-species
TSF	Tailings Storage Facility

EXECUTIVE SUMMARY

Hillgrove Copper Pty Ltd (Hillgrove) operates the Kanmantoo Copper Mines (Kanmantoo Mine) on Mining Lease (ML) ML6345 and ML6436, in accordance with an approved Program for Environment Protection and Rehabilitation (PEPR), which requires compliance with specific lease conditions and outcomes.

Hillgrove has engaged EBS Restoration to undertake on ground environmental management actions and rehabilitation activities at Kanmantoo Mine and surrounding properties since 2011 to contribute to meeting the requirements of the PEPR, particularly lease condition 27.3 and closure outcome 1 which require that *ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved* (Hillgrove Copper Pty Ltd 2016).

On ground environmental management actions and rehabilitation activities are also being undertaken to contribute to meeting the requirements of the *Kanmantoo Copper Mine Native Vegetation Management Plan* (Coffey 2010) and the *Kanmantoo Mine Native Vegetation Management Plan for Life of Mine Extension February 2014* (Hillgrove Resources 2014). These plans include a series of measures associated with achieving a Significant Environmental Benefit (SEB) under the *Native Vegetation Act 1991* (NV Act) to offset vegetation clearance for Kanmantoo Mine, including protection of quality remnant native vegetation and improving the condition of more degraded remnant native vegetation within the ML, as well as revegetation of pasture and disturbed areas to reduce biomass of exotic species and restore native vegetation communities.

Hillgrove has also engaged EBS Ecology to conduct annual ecological monitoring at Kanmantoo Mine and surrounding properties, to enable assessment of the status of compliance with Schedule 2 ML 6345 lease conditions 13, 14, 15 and 27.3, and associated outcomes 21, 18, 20 and 22, as well as closure outcome 1, associated with the PEPR (outlined in Table 1 on the following page).

This report summarises the activities undertaken by EBS Restoration and EBS Ecology and reports on the status of compliance with the aforementioned lease conditions and outcomes. In addition, it also presents the current SEB condition ratings of native vegetation patches managed by EBS Restoration.

The status of compliance with each of the aforementioned lease conditions and outcomes is summarised in the Table 1, on the following page. Compliance has been and is currently being met for lease condition 13 and outcome 21, and lease condition 15 and outcome 22, while lease condition 27.3 and closure outcome 1 are considered to be on track for achieving compliance in the future. However, it is unknown if lease condition 14 and outcome 18, and lease condition 15 and outcome 20 are currently being met as more investigation is required.

Table 1. Summary of status of compliance with Schedule 2 ML6345 lease conditions and outcomes.

Schedule 2 Lease Condition	Outcome	Comments on status of compliance
Fauna 13. The Lessee must in constructing and operating the Lease, ensure that there are no net adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas.	Outcome 21 No net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	**Lease condition 13 and outcome 21 have been and are being met.**
Flora 14. The Lessee must, in constructing and operating the Lease, ensure that all clearance of native vegetation is authorised under appropriate legislation and ensure no permanent loss of abundance or diversity on or off the Lease.	Outcome 18 All clearance of native vegetation is authorised under appropriate legislation and no permanent loss of abundance or diversity on or off the lease due to operations.	**It is unknown if lease condition 14 and outcome 18 are currently being met as more investigation is required.**
Weeds and Pests 15. The Lessee must in constructing and operating the Lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area and adjacent areas caused by mining operations.	Outcome 20 No introduction of new weeds and plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations. Outcome 22 No introduction of new pests (including feral animals), nor increase in abundance of existing pest species in the lease area and adjacent areas caused by mining operations.	**It is unknown if lease condition 15 and outcome 20 are currently being met as more investigation is required.** **Lease condition 15 and outcome 22 have been and are being met.**
Rehabilitation 27.3 Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.	Closure Outcome 1 Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.	**Lease condition 27.3 and closure outcome 1 are considered to be on track for achieving compliance in the future.**

Source: Hillgrove Copper Pty Ltd 2016

The following recommendations are provided to further assess compliance:

- Continue to undertake annual fauna monitoring to enable assessment of compliance with lease condition 13 and associated outcome 21;
- Undertake a review of native vegetation clearance approval documentation together with an on-ground audit of native vegetation clearance to enable assessment of compliance with lease condition 14 and associated outcome 18;
- Undertake an annual flora survey within the ML and adjacent areas to measure native flora abundance and diversity on and off the lease to enable assessment of compliance with lease condition 14 and associated outcome 18;
- Undertake an annual weed survey within the ML and adjacent areas to identify any introduction of new weeds and/or plant pathogens and measure abundance of existing weeds to enable assessment of compliance with lease condition 15 and associated outcome 20;
- Continue to monitor pests as part of the annual fauna monitoring program to continue to enable assessment of compliance with lease condition 15 and associated outcome 22; and

- Continue to undertake annual LFA monitoring to enable assessment of compliance with lease condition 27.3 and closure outcome 1. However, flora species composition and germination success should be considered as part of ongoing monitoring to provide information on how species respond to specific restoration methods, thus informing future rehabilitation activities. Such information would also be useful for assessing:
    1. Overall trends in plant species abundance and diversity, and
    2. Impacts on vegetation from threats such as total grazing pressure.

The SEB assessment only identified two patches of remnant native vegetation (patch 3 and patch 7), which are considered to have improved in SEB ratio (from 4:1 to 6:1). While a more thorough native vegetation condition assessment may potentially identify more remnant native vegetation patches with an increase in SEB ratio, SEB rehabilitation efforts and natural regeneration within other remnant native vegetation patches, particularly *Eucalyptus odorata* Low woodland patches 2, 4, 5 and 6, are considered to be significantly impacted by the high number of Western Grey Kangaroos grazing on understory forbs and shrubs. As such, it is recommended that Hillgrove consider undertaking a control program to reduce the impact of grazing by Western Grey Kangaroos.

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1 INTRODUCTION

Hillgrove Copper Pty Ltd (Hillgrove Resources) operates the Kanmantoo Copper Mines (hereafter referred to as 'Kanmantoo Mine'), located approximately 44 km southeast of Adelaide, in the southern Mount Lofty Ranges of South Australia. The mining operation is located on Mining Lease (ML), ML6345 and ML6436 and undertaken in accordance with an approved Program for Environment Protection and Rehabilitation (PEPR), which requires compliance with specific lease conditions and outcomes.

Hillgrove has engaged EBS Restoration to undertake on ground environmental management actions and rehabilitation activities at Kanmantoo Mine and surrounding properties since 2011 to contribute to meeting the requirements of the PEPR, particularly lease condition 27.3 and closure outcome 1 which require that *ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved* (Hillgrove Copper Pty Ltd 2016).

On ground environmental management actions and rehabilitation activities are also being undertaken to contribute to meeting the requirements of the *Kanmantoo Copper Mine Native Vegetation Management Plan* (Coffey 2010) and the *Kanmantoo Mine Native Vegetation Management Plan for Life of Mine Extension February 2014* (Hillgrove Resources 2014). These plans include a series of measures associated with achieving a Significant Environmental Benefit (SEB) under the *Native Vegetation Act 1991* (NV Act) to offset vegetation clearance for the Kanmantoo Mine, including protection of quality remnant native vegetation and improving the condition of more degraded remnant native vegetation within the ML, as well as revegetation of pasture and disturbed areas to reduce biomass of exotic species and restore native vegetation communities. Under the existing restoration program, four primary methods are being utilised:

- Direct seeding with native seed (following ripping / soil removal);
- Planting native flora seedlings (tube stock);
- Hydroseeding and hand broadcasting of seed on Tailings Storage Facility (TSF) walls;
- Weed control and bush care; and
- Translocation of significant flora such as *Diuris behrii* (Cowslip Orchid).

Hillgrove has also engaged EBS Ecology to conduct annual ecological monitoring at Kanmantoo Mine and surrounding properties, to enable assessment of the status of compliance with Schedule 2 ML 6345 lease conditions 13, 14, 15 and 27.3, and associated outcomes 21, 18, 20 and 22, as well as closure outcome 1, associated with the PEPR (outlined in Table 2 on the following page).

Table 2. Schedule 2 ML6345 lease conditions and outcomes.

Schedule 2 Lease Condition	Outcome
Fauna 13. The Lessee must in constructing and operating the Lease, ensure that there are no net adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas.	Outcome 21 No net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.
Flora 14. The Lessee must, in constructing and operating the Lease, ensure that all clearance of native vegetation is authorised under appropriate legislation and ensure no permanent loss of abundance or diversity on or off the Lease	Outcome 18 All clearance of native vegetation is authorised under appropriate legislation and no permanent loss of abundance or diversity on or off the lease due to operations.
Weeds and Pests 15. The Lessee must in constructing and operating the Lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area and adjacent areas caused by mining operations.	Outcome 20 No introduction of new weeds and plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations. Outcome 22 No introduction of new pests (including feral animals), nor increase in abundance of existing pest species in the lease area and adjacent areas caused by mining operations.
Rehabilitation 27.3 Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.	Closure Outcome 1 Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.

Source: Hillgrove Copper Pty Ltd 2016

1.1 Objectives

The objectives of this report are to:

- Summarise activities undertaken by EBS Restoration and EBS Ecology at Kanmantoo Mine and surrounding properties (Section 2);
- Review all ecological monitoring data collected to date by EBS Ecology (Section 2);
- Report on the status of compliance with lease conditions 13, 14, 15 and 27.3, and associated outcomes 21, 18 20 and 22, as well as closure outcome 1 (Section 3);
- Report on SEB condition ratings of native vegetation patches managed by EBS Restoration (Section 4); and
- Present a summary of the current status of compliance and provide further recommendations (Section 5).

2 SUMMARY OF ON-GOING ACTIVITIES

2.1 On-ground environmental management and rehabilitation activities

EBS Restoration has been undertaking on-ground environmental management and rehabilitation activities for Hillgrove at Kanmantoo Mine and surrounding properties since 2011.

Key activities include:

- Weed control;
- Seed collection;
- Maintenance and management of the Seed Production Area (SPA);
- Maintenance and management of the Seed Multiplication Area (SMA);
- Management of the seed bank;
- Vegetation enhancement and rehabilitation program; and
- Fire risk reduction program (i.e. slashing of vegetation etc.).

To date, approximately 97 hectares of hydroseeding, hand seeding and pre-stripped seeding has been undertaken and actively managed on previously degraded landforms including Integrated Waste landform's (IWL) and grazed / cropped areas within and outside the mine lease (Figure 1). Refer to the *Kanmantoo Copper Mine Environmental Management, Revegetation and SEB Offset Program 2018-2019 Progress Report* (EBS Restoration 2019) for more detailed information on rehabilitation activities.

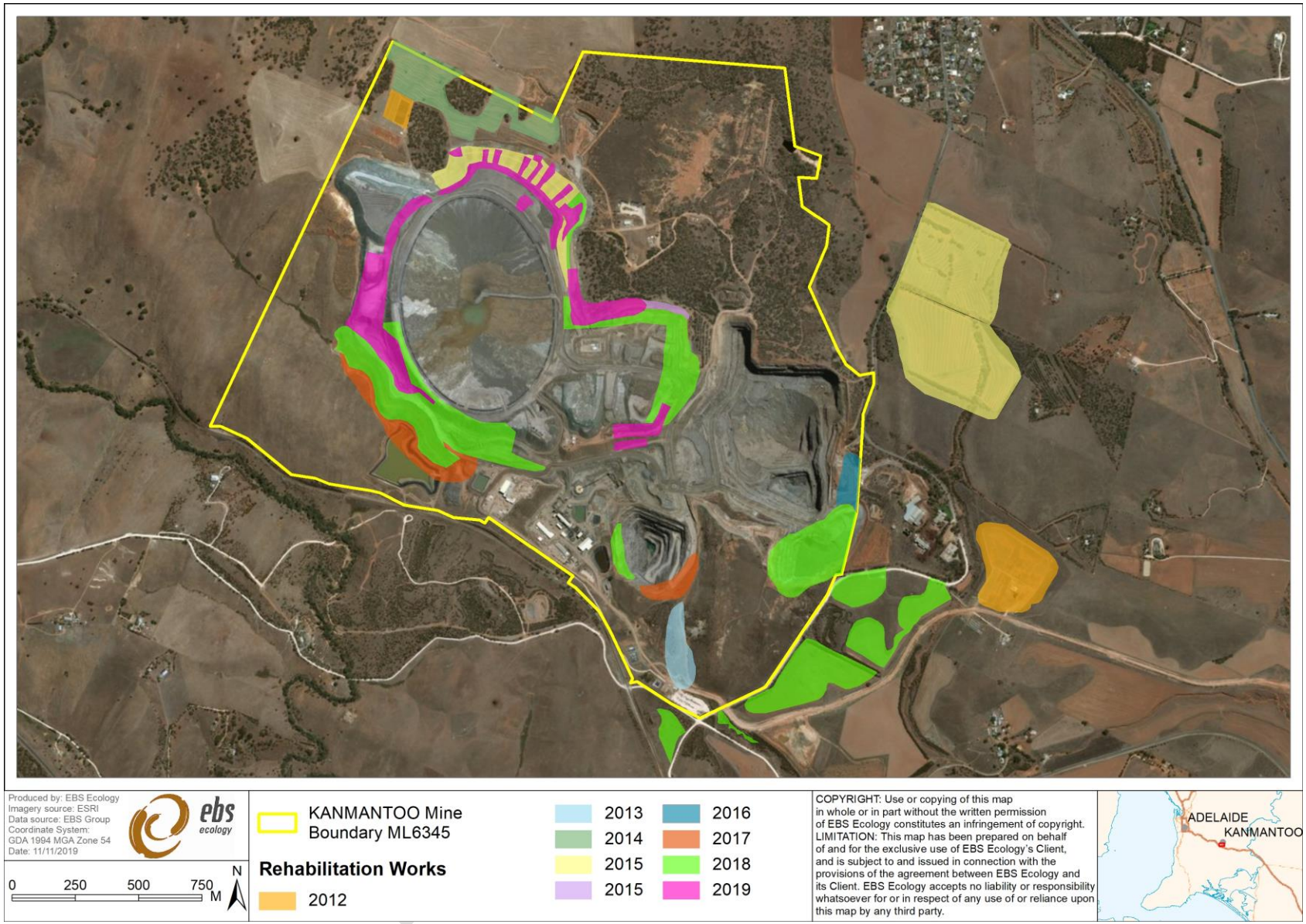

Figure 1. Location of hydroseeding, hand seeding and pre-stripped seeding activities at Kanmantoo Mine (ML and SEB areas) undertaken annually to date.

2.2 Monitoring activities

EBS Ecology has been undertaking an annual fauna monitoring program, as well as a Landscape Function and Analysis (LFA) monitoring program, for Hillgrove at the Kanmantoo Mine and surrounding properties since 2011.

2.2.1 Fauna monitoring program

The annual fauna monitoring program aims to determine whether Kanmantoo Mine is meeting lease conditions 13 and 15, and outcomes 21 and 22 respectively, by:

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

Refer to the *Kanmantoo Fauna Survey 2019* report (EBS Ecology 2019a) for more information on the fauna monitoring program.

2.2.2 LFA monitoring program

The annual LFA monitoring program aims to determine whether Kanmantoo Mine is meeting lease condition 27.3 and closure outcome 1 by conducting annual LFA surveys within the ML and surrounding properties to achieve a time series trajectory of land condition across the site, enabling critical indicators to be identified, their values analysed and utilised for revision of future management activities (i.e. adaptive management) if required. Refer to the *Kanmantoo Copper Mine: Landscape Function Analysis Report 2019* (EBS Ecology 2019b) for more information on the LFA monitoring program.

3 INFORMATION SUPPORTING COMPLIANCE

3.1 Lease condition 13 and outcome 21 (native fauna abundance and diversity)

Lease condition 13	Outcome 21
The Lessee must in constructing and operating the Lease, ensure that there are no net adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas.	**No net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.**

Data collected during the annual fauna monitoring program has been reviewed to assess compliance with lease condition 13 and outcome 21. An overview of the key results from the annual fauna monitoring program is presented below. Refer to the *Kanmantoo Fauna Survey 2019* report (EBS Ecology 2019a) for more detailed information.

3.1.1 Birds

The species richness of birds has fluctuated over the lifetime of the fauna monitoring program (Figure 2). The mean bird species richness per year over the monitoring program is 48.1 µ ± 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, before expanding to include the SEB areas from 2015 onwards. Due to a 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 2).

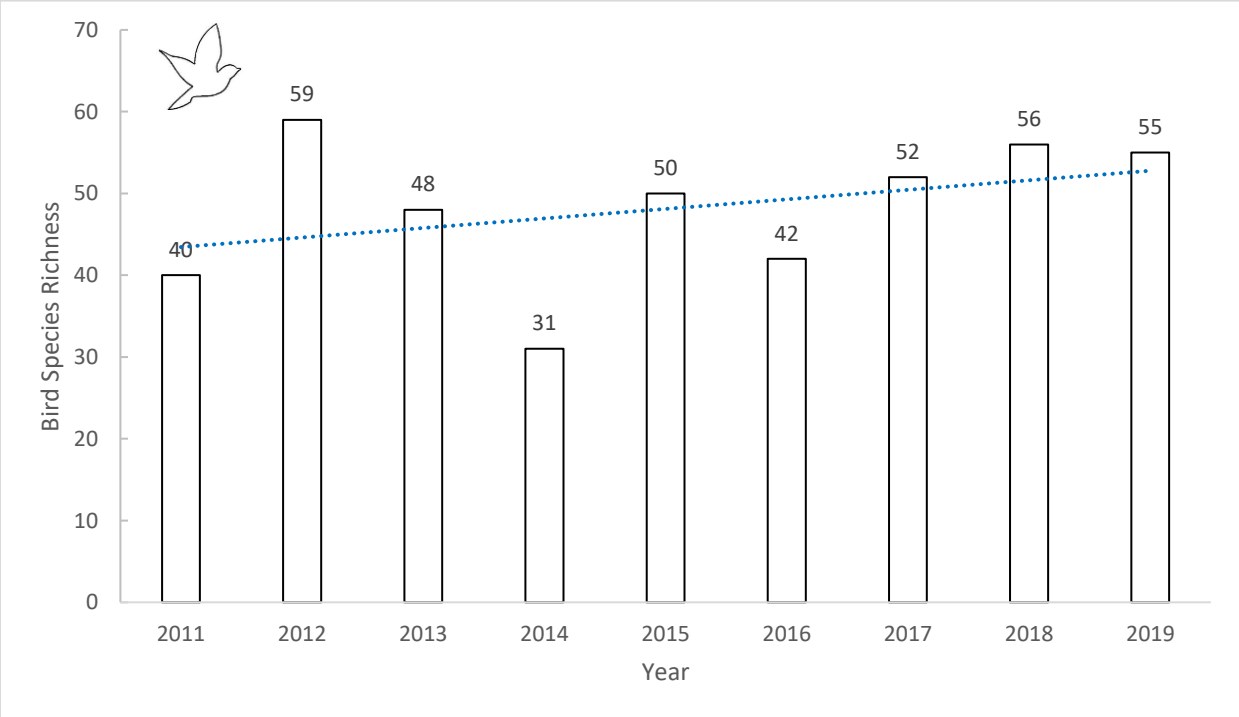

Figure 2. Bird species richness recorded over the fauna monitoring program 2011-2019. *Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015*.

The abundance of birds has also fluctuated over the lifetime of the fauna monitoring program (Figure 3). The average number of birds recorded per year over the monitoring program is 648.3 μ ± 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. Despite greater consistency in search effort since 2015, bird abundance has remained variable between years (Figure 3).

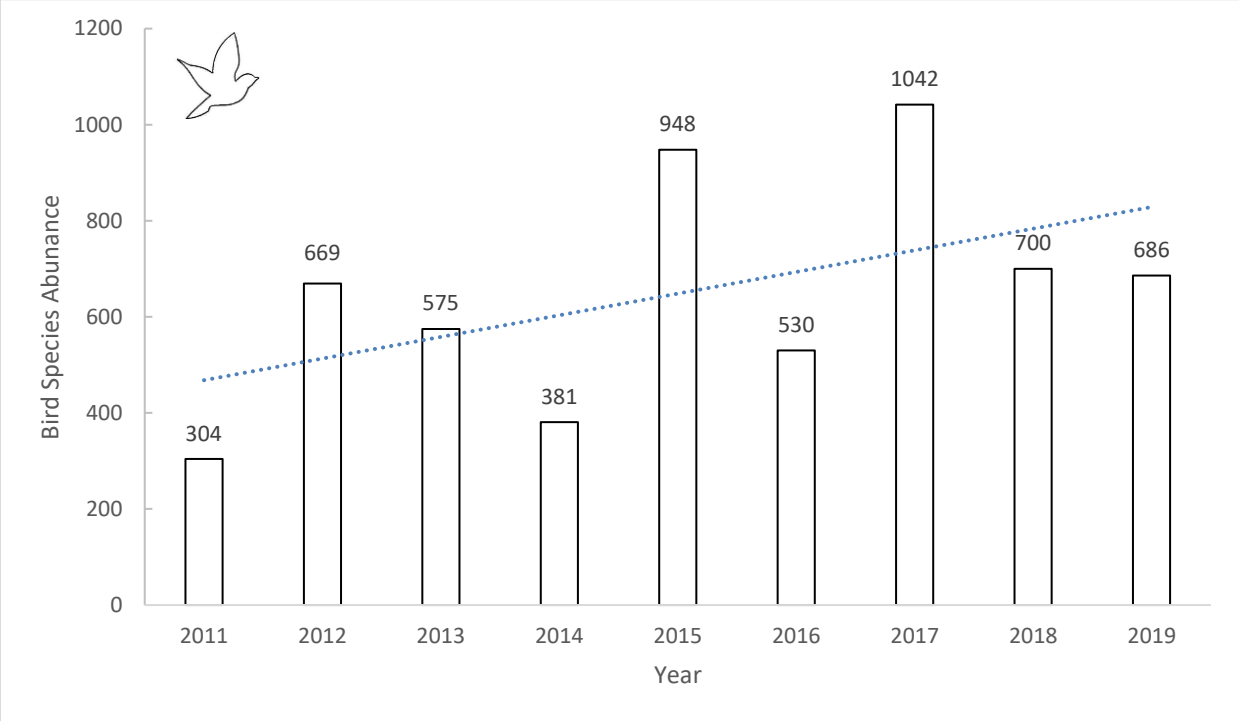

Figure 3. Bird abundance recorded over the fauna monitoring program 2011-2019. Please note that monitoring was confined to the ML from 2011 to 2014 and expanded to include SEB areas from 2015.

Small variations in the numbers of bird species is expected due to changing seasonal conditions, movements and resource availability. Fluctuations in the number of birds observed are influenced by the presence of nomadic and flocking species and variations in the numbers of ground foraging species as well as nectivorous species. None of the six indicator bird species, identified to determine whether the mine has impacted on birds, have been observed to be in decline since the fauna monitoring program commenced (EBS Ecology 2019a).

New bird species have been added to the cumulative species list each year, which 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 within the ML and surrounding properties. In particular, it is expected that as the areas of remnant and restored habitat within and outside the ML area mature and improve, they will provide habitat for an increased number and potentially greater diversity of birds.

3.1.2 Mammals

Over the lifetime of the fauna monitoring program, the numbers of Common Brushtail Possums have fluctuated annually (Table 3 and Figure 4). Note that field survey occurred over multiple nights for the first three years, but has been undertaken in one night since 2014.

Since 2015, numbers have been relatively stable ranging from 14 to 30 individuals. The average number of possums observed per night is 22.3 μ ± 3.5 S.E. There have been no observations of Common Brushtail Possums within the SEB area to date.

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

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Number of Common Brushtail Possums 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

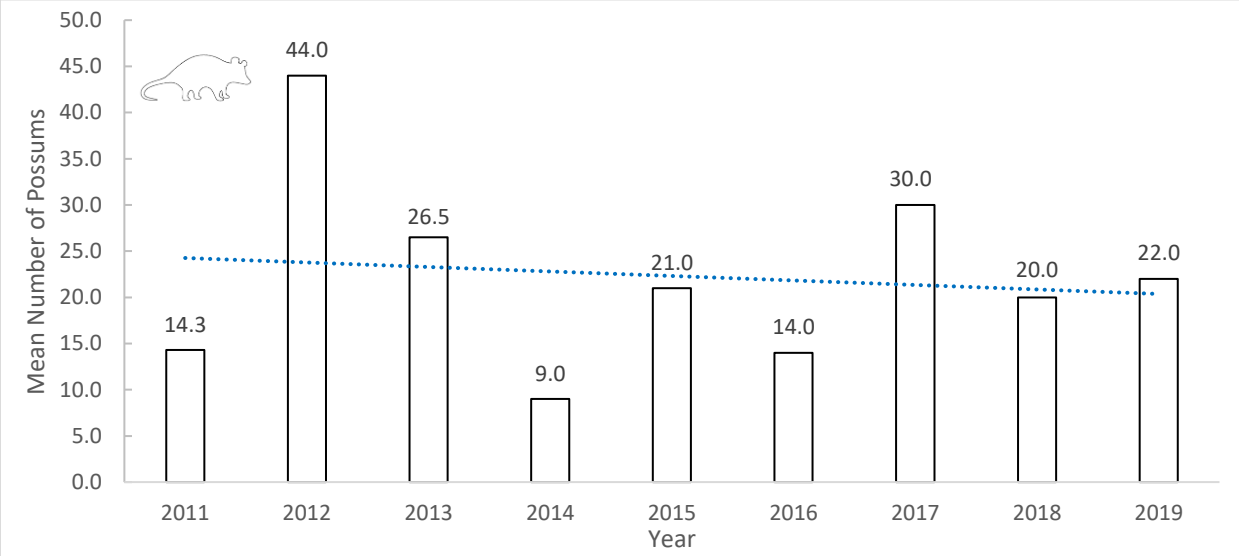

Figure 4. Mean Common Brushtail Possum abundance recorded over the fauna monitoring program 2011-2019. Note that monitoring was confined to the ML from 2011-2014 and expanded to include SEB areas from 2015.

Monitoring records of Common Brushtail Possums are restricted to the remnant Peppermint Box (*Eucalyptus odorata*) woodlands of the ML, with no individuals observed within the SEB area, most likely due to an absence of suitable den sites (tree hollows) (refer to EBS Ecology 2019a for more detail).

3.1.3 Status of compliance

Fauna monitoring data collected to date by EBS Ecology, confirms that there are no net adverse impacts from the site operations on native fauna abundance or diversity in the Lease area and in adjacent areas. As such, lease condition 13 and outcome 21 have been and are being met.

3.2 Lease condition 14 and outcome 18 (native vegetation, abundance and diversity)

Lease condition 14	Outcome 18
The Lessee must, in constructing and operating the Lease, ensure that all clearance of native vegetation is authorised under appropriate legislation and ensure no permanent loss of abundance or diversity on or off the Lease.	**All clearance of native vegetation is authorised under appropriate legislation and no permanent loss of abundance or diversity on or off the lease due to operations.**

A review of native vegetation clearance approval documentation together with an on-ground audit of native vegetation clearance has not been undertaken by EBS Ecology. Therefore, an assessment of compliance relating to all native vegetation clearance being authorised under appropriate legislation has not been undertaken.

However a review of previous flora surveys and EBS Restoration annual reports (2011-2019) has been undertaken to assess compliance relating to no permanent loss of (flora) abundance or diversity on or off the lease due to operations.

Approximately 212 native flora species are known to occur within the ML and surrounding areas from previous flora surveys (Ecological Associates 2007a; Ecological Associates 2007b; EBS Ecology 2013a; EBS Ecology 2015c; EBS Ecology 2019c), which are listed in Appendix 1. Approximately 71 native flora species have been used by EBS Restoration in revegetation and rehabilitation works since 2011 to current, including 62 species previously recorded within the ML and/or surrounding properties (Appendix 1). The remaining 9 species include:

- one native species, *Arthropodium sp*., which has only been identified to genus level, which may or may not be *Arthropodium fimbriatum* or *Arthropodium strictum*, both of which have been previously recorded within the ML and/or surrounding properties; and
- 8 native species which although not previously recorded within the ML or surrounding properties, are known to occur within the broader region.

Revegetation and rehabilitation works have included planting of tubestock, direct seeding, hand broadcast/sowing of seed and hydroseeding areas disturbed by mining operations as well as significant areas of land previously used for agricultural cropping and/or grazing. Majority of the seed material has either been collected from within the ML and surrounding areas or sourced from the on-site Seed Production Area (SPA) or Seed Multiplication Area (SMA) located on land directly adjacent to ML.

Whilst the primary aim of the revegetation and rehabilitation works are to compensate for the unavoidable removal of native vegetation associated with mining works by achieving a Significant Environmental Benefit (SEB) in accordance with the *Native Vegetation Act 1991*, they also contribute to achieving compliance with lease condition 14 and outcome 18 (relating to no permanent loss of (flora) abundance and diversity on or off the lease due to operations), by occurring over a significantly large area on and off the lease and incorporating as many diverse species as possible. By revegetating areas previously used for agricultural cropping and/or grazing, Hillgrove are increasing flora abundance and diversity in these particular areas to compensate for the unavoidable removal of vegetation associated with mining works.

Whilst only 73 out of the 184 native species known to occur within the ML and surrounding areas are included in the revegetation and rehabilitation works, it is not practicable to include all species known to occur within the area due to difficulties in sourcing seed and propagating as well as a limited budget.

It should also be noted that the current abundance and diversity of flora species within remaining/retained native vegetation within the ML is currently unknown and therefore cannot be compared to flora conditions recorded by previous flora surveys (Ecological Associates 2007a; Ecological Associates 2007b; EBS 2013). Neither fauna monitoring nor LFA monitoring programs, undertaken by EBS Ecology, or works and reporting undertaken by EBS Restoration, monitor flora abundance or diversity within the ML and surrounding areas. Therefore it is not possible to fully assess compliance relating to no permanent loss of (flora) abundance or diversity on or off the lease due to operations.

3.2.1 Status of compliance

EBS Ecology is unable to comment on whether all clearance of native vegetation has been authorised under appropriate legislation or not.

Although the revegetation and rehabilitation works that Hillgrove have been undertaking since 2011 to current, will contribute to achieving compliance relating to no permanent loss of (flora) abundance or diversity on or off the lease due to operations, the current status of abundance and diversity within the ML has not been assessed. Therefore it is unknown if lease condition 14 and outcome 18 are currently being met.

3.3 Lease condition 15 and outcomes 20 and 22 (weeds, plant pathogens and pests)

Lease condition 15 **The Lessee must in constructing and operating the Lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area and adjacent areas caused by mining operations.**	**Outcome 20** **No introduction of new weeds and plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations.** **Outcome 22** **No introduction of new pests (including feral animals), nor increase in abundance of existing pest species in the lease area and adjacent areas caused by mining operations.**

Data collected during the annual fauna monitoring program (EBS Ecology 2019a) and provided in the *On-ground Environmental Management Report 2018-2019* (EBS Restoration 2019) has been reviewed to assess compliance with lease condition 15 and outcomes 20 and 22. An overview of the key results is presented below. Refer to the *Kanmantoo Fauna Survey 2019* report (EBS Ecology 2019a) and the *On-ground Environmental Management Report 2018-2019* (EBS Restoration 2019) for more detailed information.

3.3.1 Weeds

Approximately 94 weed species (Appendix 2) are known to occur within the ML and surrounding areas from previous flora surveys (Ecological Associates 2007a; Ecological Associates 2007b; EBS Ecology 2015c; EBS Ecology 2019c). However, as no other specific data on weed species and abundance since 2007 is available, an assessment of compliance relating to no introduction of new weeds, nor increase in

abundance of existing weeds in the lease area and adjacent areas caused by mining operations, has not been undertaken.

Despite this, EBS acknowledges that Hillgrove implement various procedures and management measures to prevent the introduction of new weeds and/or plant pathogens and avoid increasing the abundance of existing weeds in the ML and adjacent areas, including, but not limited to, site vehicle entry standards and approval procedures. Furthermore, a significant amount of weed control, including boom spraying, tractor slashing, spot spraying, brushcutting, targeted woody weed control and hand weeding has been undertaken within the ML and SEB areas on an annual basis since 2011 by EBS Restoration, as directed by Hillgrove, to control existing weed species and prevent an increase in abundance of existing weed species (refer to various EBS Ecology and EBS Restoration annual reports for more detail). It is EBS Ecology's understanding that Hillgrove will continue to undertake weed control in the future, while the PEPR is in place.

3.3.2 Pests

The following four pest species are known to occur in the ML area and surrounding region:

- European rabbit (*Oryctolagus cuniculus*);
- European (brown) hare (*Lepus capensis*);
- House mouse (*Mus domesticus*); and
- Red fox (*Vulpes vulpes*) (Hillgrove Copper 2016).

Pest species recorded within the ML and surrounding areas during baseline fauna surveys undertaken by Ecological Associates (February – March 2007 and September 2007) and during annual fauna monitoring undertaken by EBS Ecology (2011-2019) are presented in Table 4 and shown in Figure 5. Data collected by Ecological Associates in 2007 is considered to form the baseline for existing pest species (both type and abundance) in the ML and surrounding areas.

The House mouse has not been recorded by EBS Ecology as this would require pit trapping, which is not undertaken as part of annual fauna monitoring. However, the 2012 LFA monitoring report mentioned "*high mouse numbers in 2011*" and is most likely a reference to the mouse plague in early 2011 (EBS Ecology 2012c). Furthermore, House mouse populations are known to fluctuate significantly with seasonal conditions, and generally decline in cold weather over winter, when reproductive rates are low (Singleton *et al.* 2001).

Table 4. Pest species recorded within the ML and surrounding areas during baseline fauna surveys (Feb-Mar 2007 and Sep 2007) and annual fauna monitoring surveys (2011-2019).

Species	Feb – Mar 2007	Sep 2007	2011	2012	2013	2014	2015	2016	2017	2018	2019
European rabbit (*Oryctolagus cuniculus*)	1	2	38	9	0	2	27	8	1	7	1
European (brown) hare (*Lepus capensis*)	3	6	4	0	0	0	8	2	2	4	3
Red fox (*Vulpes vulpes*)	4	0	2	0	2	0	5	1	0	0	0
Domestic cat (*Felis catus*)	0	0	0	2	0	0	0	1	1	0	0
House mouse (*Mus domesticus*)	13	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: Ecological Associates 2007c and 2007d; EBS Ecology annual fauna monitoring reports: EBS Ecology 2012b; 2013b; 2014; 2015a; 2015b; 2017; 2018a; 2018b; 2019a.

Although the Domestic cat was not recorded by Ecological Associates in neither fauna survey in 2007, it has been recorded in low numbers (one or two individuals) by EBS Ecology during annual fauna monitoring surveys in 2012, 2016 and 2017. Although this species could be considered a new pest to the ML and surrounding areas, it is more likely that it has been present in the region in the past but was simply not observed during the 2007 fauna surveys. Furthermore, it was identified by Ecological Associates (2007c Flora Assessment) as “known to, or likely to, occur at the site”.

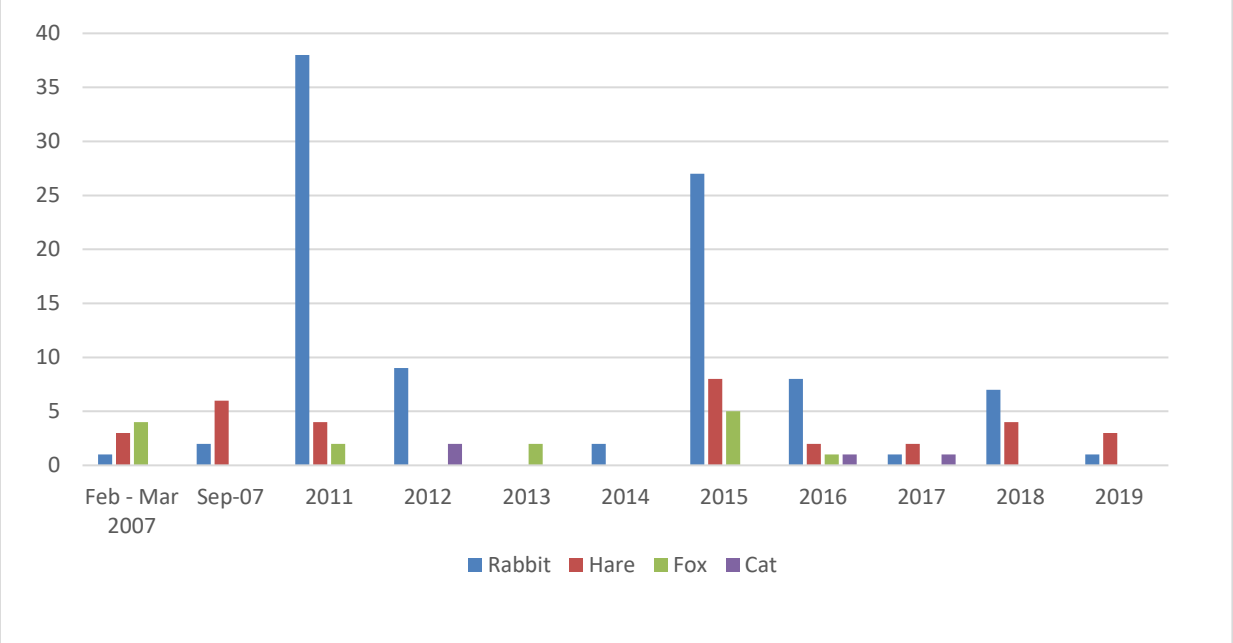

Figure 5. Pest species (excluding House Mouse) observed within the ML and surrounding areas during baseline fauna surveys (Feb-Mar 2007 and Sep 2007) and annual fauna monitoring surveys (2011-2019).

The number of Rabbits, Hares and Foxes recorded within the ML and surrounding areas has fluctuated from 2007 to 2019 (Table 4 and Figure 5). In particular, there was a significant increase in the number of Rabbits in 2011 with 38 recorded, compared to baseline numbers in 2007 of only one and two, and again in 2015 with 27 recorded, compared to only two recorded the previous year (2014). The number of Hares also increased in 2015 with eight recorded, compared to baseline numbers in 2007 of only three and six, as did the number of Foxes with five recorded in 2015, compared to baseline numbers in 2007 of only four.

It is possible that the annual fluctuations in pest species recorded within the ML and surrounding areas are driven by factors such as rainfall, availability of food resources and the presence or absence of predator species (both native and introduced).

Long term rainfall data (1874-2019) sourced from Kanmantoo weather station (#23724) shows significant annual variability, particularly over the last 14 years from 2006 to 2019 as shown in Figure 6, with the lowest recorded in 2006 (271.9 mm) and 2008 (329.4 mm) and the highest recorded in 2016 (696.8 mm) and 2010 (586.4 mm) (BOM 2019). With a mean (average) rainfall of 469 mm, below average rainfall was recorded in 2006, 2007, 2008, 2014, 2015, 2018 and 2019, and above average rainfall was recorded in 2009 - 2013, 2016 and 2017. Unfortunately, some rainfall data is missing for the years 2006, 2008, 2012 and 2017 and therefore the annual rainfall totals for these years may be greater than the values shown in Figure 6. Furthermore, rainfall data for 2019 is limited to the months January to August, as at the time of this report, rainfall records for September to December were not available. Therefore, annual rainfall for 2019 is likely to be greater than that shown in Figure 6.

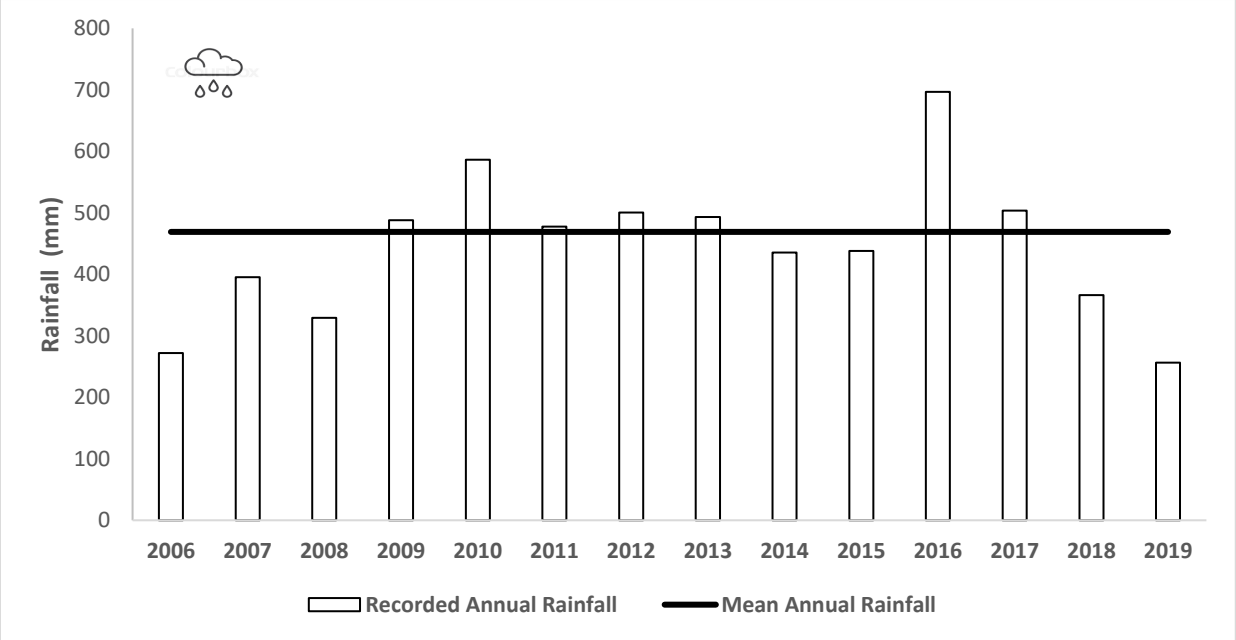

Figure 6. Annual rainfall at Kanmantoo weather station for the years 2006 - 2019 with mean annual rainfall (based on data from 1874 - 2019) (BOM 2019).

Note: Data is missing for July 2006, Feb 2008, Oct 2012 and Oct 2017 and therefore, the total rainfall shown 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 reporting, rainfall records for Sept-Dec were not available. Therefore, the total rainfall for 2019 is likely to be higher than that shown (BOM 2019).

It is possible that above average annual rainfall in 2009 and/or 2010 contributed to an increase in Rabbits within the ML and surrounding areas in 2011, when 38 were recorded, compared to the baseline of one and two in 2007. However this inference is limited as the number of Rabbits in 2008-2010 is unknown. Furthermore, as stated previously, the availability of food resources and the presence or absence of predator species are also likely to influence pest abundance.

Pest control, in the form of baiting targeting foxes, rabbits and hares, as well as fumigating rabbit warrens, has been undertaken at various times since 2007 to control existing pest species and prevent an increase in abundance of existing pest species. For example a fox baiting program was undertaken by Hillgrove in

2007 (sometime between February and June), which Ecological Associates reported at the time of the Spring Fauna Survey in September 2007 "*appears to have significantly reduced the fox population in the area*". Furthermore, rabbit control was undertaken by EBS Restoration in Autumn of 2015 and April 2016 (EBS Restoration 2016b) and resulted in a significant decrease in the number of rabbits observed from 2015 to 2016 (Table 4 and Figure 5).

3.3.3 Status of compliance

As there is no specific data on weed species and abundance since the 2007 baseline surveys by Ecological Associates (2007a; 2007b) it is not known if introduction of new weeds and plant pathogens, or increase in abundance of existing weed species in the lease area and adjacent areas has occurred or not. Therefore it is not known if this part of lease condition 15 and associated outcome 20 are currently being met.

Fauna monitoring data collected to date by EBS Ecology, confirms that there has been no introduction of new pests (including feral animals), nor increase in abundance of existing pest species in the lease area and adjacent areas caused by mining operations. As such, this part of lease condition 15 and outcome 22 have been and are being met.

3.4 Lease condition 27.3 and closure outcome 1 (ecosystem and landscape function)

Lease condition 27.3	Closure outcome 1
Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.	**Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.**

A long-term monitoring program using Landscape Function Analysis (LFA) has been implemented by Hillgrove since 2011 to measure the status of ongoing environmental management, rehabilitation and SEB offset program components within the ML and surrounding areas and to enable assessment and reporting against lease condition 27.3 and associated closure outcome 1.

Data collected by EBS Ecology during the annual LFA monitoring program has been reviewed to assess compliance with lease condition 27.3 and associated closure outcome 1. The key results from the annual LFA monitoring program to date are summarised below (refer to the *Kanmantoo Copper Mine: Landscape Function Analysis Report 2019* (EBS Ecology 2019b) for more detailed information).

Whilst the 24 LFA sites assessed in 2019 are at various stages of rehabilitation, with some only two or three years old, the vast majority are indicating successful germination and survival with positive trends toward analogue landscape function indices and restoration goals. In general, the LFA indicators have shown positive rehabilitation trends over the life of the monitoring program (2011-2019). Rehabilitation plots have typically reached a level of self-sustaining communities relative to analogue sites after a period of only three to four years. Based on the initial success rates of restoration activities within the ML and surrounding properties, it is likely that ongoing works will result in functional trends similar to those observed during LFA monitoring to date.

However, it should be noted that Western Grey Kangaroos (*Macropus fuliginosus*) grazing on understory forbs and shrubs within both remnant *Eucalyptus odorata* woodland and general revegetation areas, may be limiting regeneration (and/or revegetation success) and may be exacerbating or causing rehabilitation to be a drawn out process. A total of 34 Western Grey Kangaroos were observed during the 2019 fauna survey, including 28 within the ML and six in the SEB areas (off the ML) (EBS Ecology 2019a).

Graphs showing the landscape function indices change over time (2011 to 2019 as appropriate) with respect to mean analogue (i.e. target) values for each of the 24 LFA sites assessed in 2019 is provided in Table 9 in Appendix 3, while a summary of the status of LFA site landscape function indices and landscape organisation indices (LOI) with respect to analogue (target) values is provided in Table 10 in Appendix 3.

Importantly, four new analogue LFA sites were also established in 2019 on modified hillslope grasslands on and off the ML which are devoid of trees and shrubs, and either currently or historically grazed by sheep and/or cattle, to collect baseline LFA data representative of hillslopes in the surrounding landscape to provide target LFA indices against which to measure and compare future rehabilitation activities aimed at achieving and ecosystem and landscape function comparable to hillslope grasslands surrounding the ML.

3.4.1 Status of compliance

LFA monitoring data collected to date (2011-2019) demonstrates that rehabilitation plots have typically reached a level of self-sustaining communities, relative to analogue sites, after a period of only 3-4 years. Furthermore, it is anticipated that LFA index values will continue to meet or move towards target values. This suggests that at this point in time, the ML is on the right trajectory to achieve an ecosystem and landscape function that is resilient, self-sustaining and comparable to the surrounding areas. As such lease condition 27.3 and closure outcome 1 are considered to be on track for compliance.

4 SEB CONDITION RATING OF NATIVE VEGETATION PATCHES MANAGED BY EBS RESTORATION

Hillgrove engaged EBS Restoration to undertake management and restoration activities within patches of native vegetation located within the ML. Management activities have been undertaken since 2011 and have included:

- Woody and herbaceous weed control;
- Revegetation (including planting of *Lomandra effusa* tubestock and *Diuris behrii* orchid pots) at strategic locations; and
- Feral animal control (Rabbit and Hare).

This section provides an overview of an assessment of SEB ratio change over time as a result of removal of livestock grazing, restriction on access and management and restoration activities such as those listed above.

4.1 Vegetation Assessments at Kanmantoo Copper Mine

4.1.1 Ecological Associates Vegetation Assessment 2007

Vegetation within the ML was assessed and mapped by Ecological Associates in 2007 (Ecological Associates 2007a). A total of 113 hectares (ha) of native vegetation was identified across the following eight vegetation associations:

- *Eucalyptus odorata* Low woodland (54.1 ha);
- *Lomandra effusa* Open tussock grassland (23.3 ha);
- *Austrostipa sp*. Open tussock grassland (17 ha);
- *Acacia pycnantha* Low woodland (11.2 ha);
- *Eucalyptus gracilis +/- E. oleosa* Open mallee (4 ha);
- *Eucalyptus leucoxylon +/- Lomandra effusa* Woodland (1.3 ha);
- *Allocasuarina verticillata +/- Callitris gracilis +/- Lomandra effusa* Low woodland (1.8 ha); and
- *Callitris gracilis* Low woodland (0.2 ha).

Ecological Associates assessed the condition of native vegetation in accordance with the methodology outlined in the *Draft Guidelines for Native Vegetation Significant Environmental Benefit Under the Native Vegetation Act 1991 and Regulations 2003 for the Mineral and Petroleum Resources Industry* (DWLBC 2005 in Ecological Associates 2007a). Vegetation condition was reported as a significant environmental benefit (SEB) ratio and the ratios represent the area to be offset in compensation for impacted areas of native vegetation. The SEB ratios that could be assigned were 10:1 (highest quality vegetation), 8:1, 6:1, 4:1 and 2:1 (lowest quality vegetation) and are further described in Figure 7. Refer to Figure 8 for the location of the eight vegetation associations within the ML and their associated SEB condition ratings, and Figure 9 for the patch identification (ID) numbers (1-36) Hillgrove has applied to the patches of native vegetation mapped by Ecological Associates.

Vegetation Condition	Indicators for Condition	SEB Ratio
Poor. Weed-dominated with only scattered areas or patches of native vegetation	Vegetation structure no longer intact (e.g., removal of one or more vegetation strata).	2:1
	Scope for regeneration, but not to a state approaching good condition without intensive management.	
	Dominated by very aggressive weeds.	
	Partial or extensive clearing (greater than 50% of area).	
	Evidence of heavy grazing (tracks, browse lines, species changes, no evidence of solid surface crust).	
Moderate. Native vegetation with considerable disturbance	Vegetation structure substantially altered (e.g., one or more vegetation strata depleted).	4:1
	Retains basic vegetation structure or the ability to regenerate it.	
	Very obvious signs of long-term or severe disturbance.	
	Weed dominated with some very aggressive weeds.	
	Partial clearing (10 to 50% of area).	
	Evidence of moderate grazing (tracks, browse lines, soil surface crust extensively broken).	
Good. Native vegetation with some disturbance	Vegetation structure altered.	6:1
	Most seed sources available to regenerate original structure.	
	Obvious signs of disturbance.	
	Minor clearing (less than 10 % of area).	
	Considerable weed infestation with some aggressive weeds.	
	Evidence of some grazing (tracks, soil surface crust patchy).	
Very good. Native vegetation with little disturbance	Vegetation structure intact (e.g., all structure intact).	8:1
	Disturbance minor, only affecting individual species.	
	Only non-aggressive weeds present.	
	Some litter build-up.	
Intact vegetation	All strata intact and botanical composition close to original.	10:1
	Little or no signs of disturbance.	
	Little or no weed infestation.	
	Soil surface crust intact.	
	Substantial litter cover.	

Source: Table 1 of DWLBC (2005).

Figure 7. Vegetation condition and SEB ratio (Hillgrove Resources 2014).

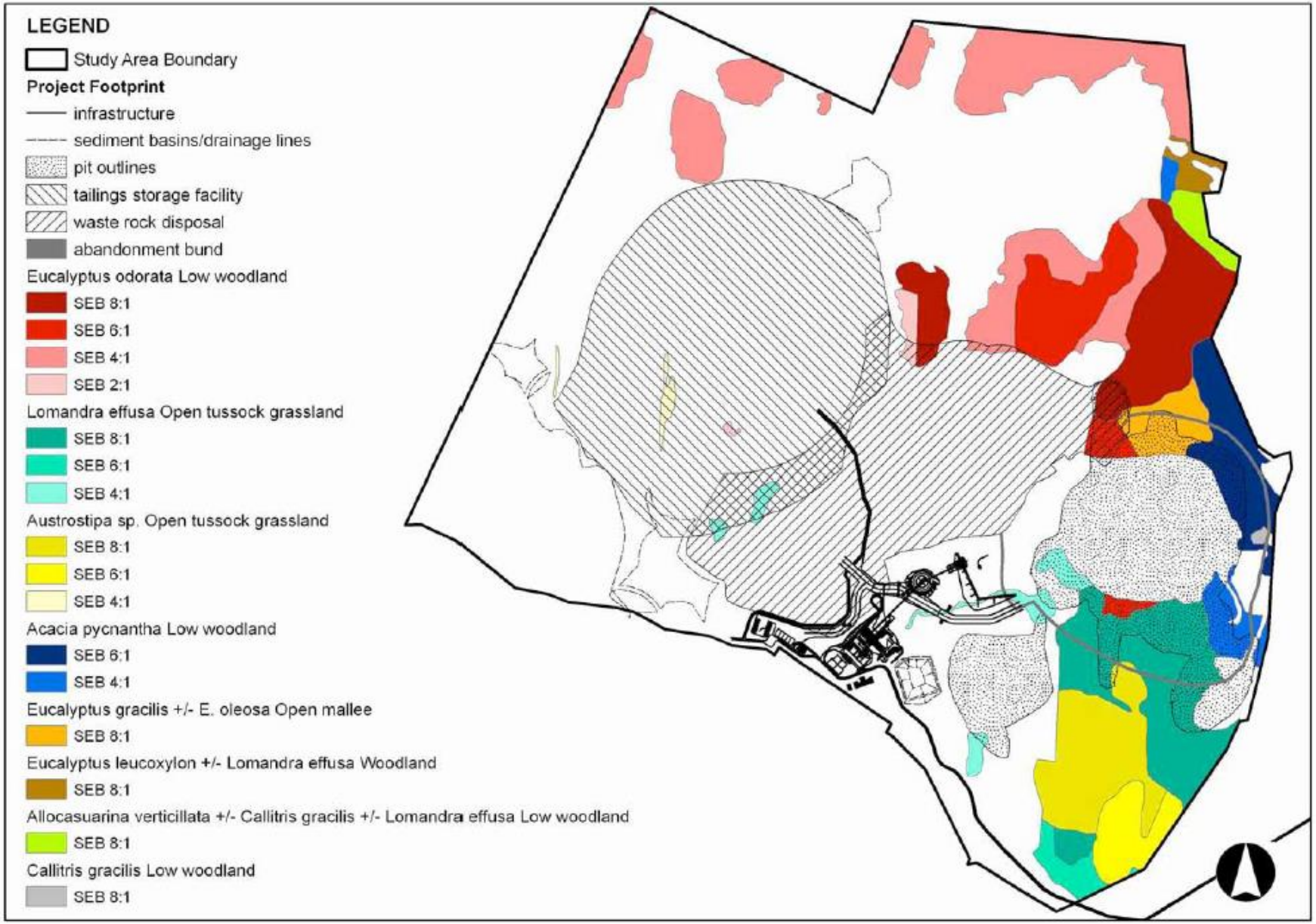

Figure 8. Location of the eight vegetation associations within the ML and their associated SEB ratings (Ecological Associates 2007a).

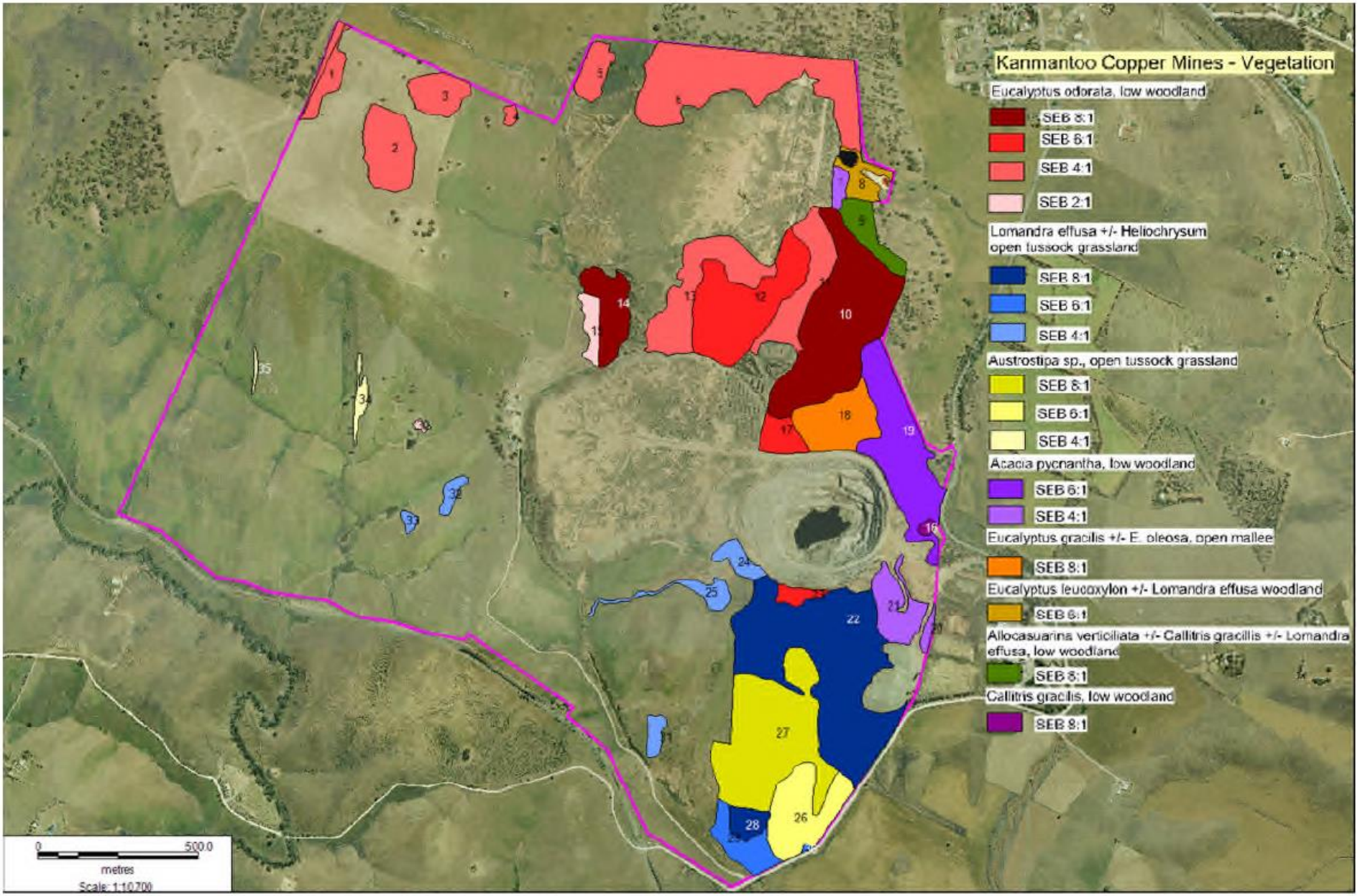

Figure 9. Patch ID numbers (1-36) applied to native vegetation patches mapped by Ecological Associates (Hillgrove Resources 2014).

It should be noted that a discrepancy has been identified with the SEB ratio for two vegetation patches, between the mapping (i.e. Figure 8) and elsewhere in the Ecological Associates *Flora Assessment* report (2007a). As shown in Figure 10 below, the SEB ratio for both *Allocasuarina verticillata +/- Callitris gracilis +/- Lomandra effusa* Low woodland and *Eucalyptus leucoxylon ssp. leucoxylon +/- Lomandra effusa* Open Woodland is listed as 6:1. However, in the mapping (i.e. Figure 8) and general text within the Ecological Associates *Flora Assessment* report (2007a) both of these SEB ratios are identified as 8:1. It is uncertain which SEB value for each of the two vegetation associations is correct, but EBS Ecology has noted that the SEB value for both vegetation associations is listed as 8:1 in mapping provided by Hillgrove (such as Figure 9 on the previous page).

Table 2. Area and conservation significance of surveyed vegetation communities.

Vegetation Community	SEB Ratio	Area (ha)	Conservation Significance		
			National	State	Regional
Eucalyptus odorata Low woodland	8:1	14.9	✓	✓	✓
	6:1	9.7			
	4:1	28.5			
	2:1	1.0			
Lomandra effusa ± *Heliochrysum leucopsideum* Open tussock grassland	8:1	17.8	✓	✓	✓
	6:1	2.1			
	4:1	3.5			
Austrostipa sp. Open tussock grassland	8:1	11.6			✓
	6:1	4.7			
	4:1	0.7			
Acacia pycnantha Low woodland	6:1	7.7			
	4:1	3.5			
Eucalyptus gracilis ± *E. oleosa* Open mallee	8:1	4.0			
Allocasuarina verticillata ± *Callitris gracilis* ± *Lomandra effusa* Low woodland	6:1	1.8			
Eucalyptus leucoxylon ssp. *leucoxylon* ± *Lomandra effusa* Open woodland	6:1	1.3			✓
Callitris gracilis Low woodland	8:1	0.2			✓

Figure 10. Table 2 from Ecological Associates (2007a) report with the two SEB ratios of interest highlighted.

4.1.2 2013 EBS Ecology SEB Ratios

EBS Ecology undertook field survey work on 25 June 2013 to determine whether remnant patches of *Eucalyptus odorata* Low woodland and *Lomandra effusa +/- Helichrysum* Open tussock grassland within the ML qualified as nationally threatened ecological communities (TEC) in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EBS Ecology 2013a). Vegetation associations and patches and their boundaries previously mapped by Ecological Associates were also checked and adjusted by EBS Ecology where required, with the revised patch boundaries and IDs shown in Figure 11 and summarised in Table 5.

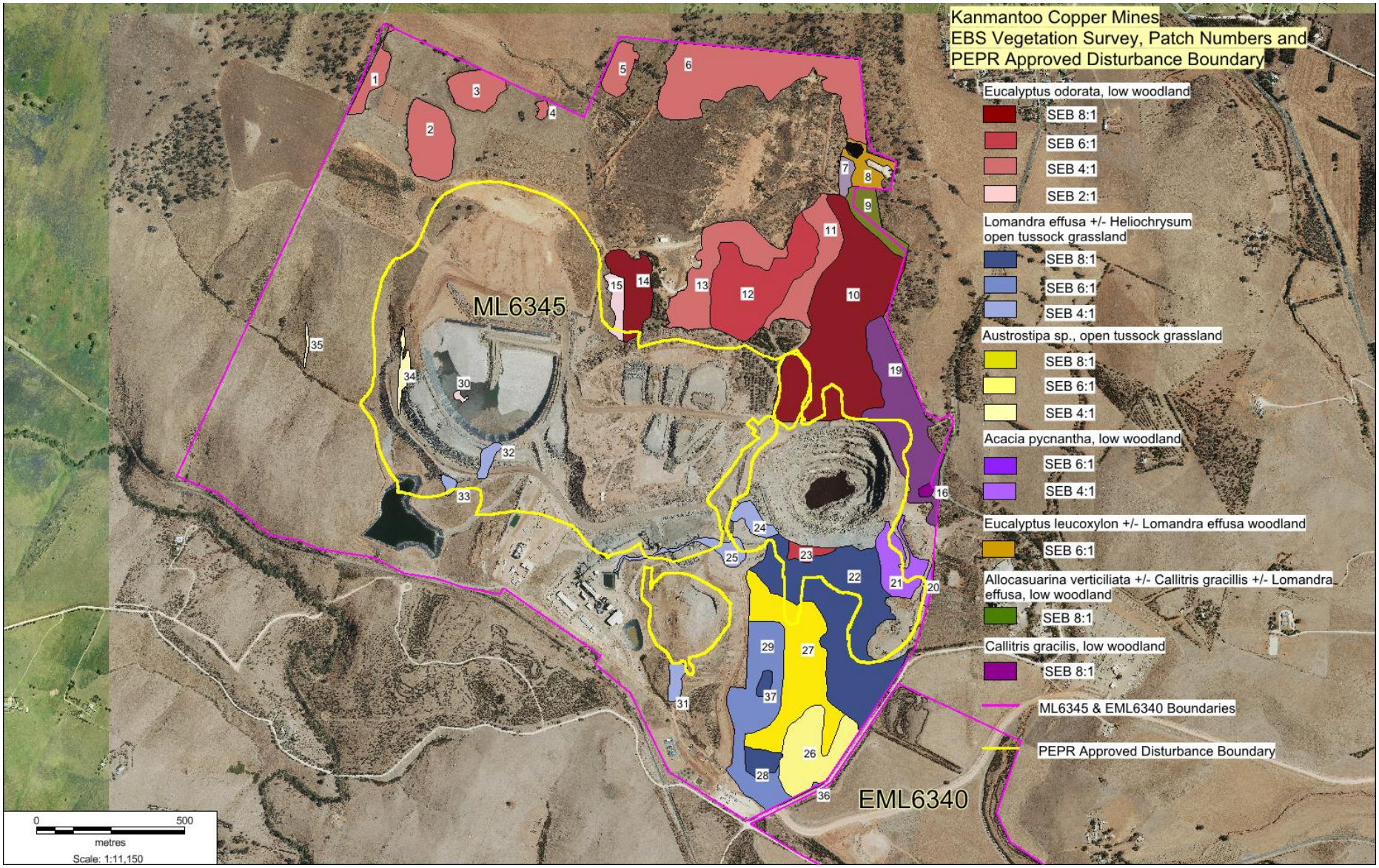

Figure 11. Patch numbers (1-37) applied to native vegetation associations within the ML as mapped by EBS Ecology 2013 (supplied by Hillgrove Resources 2019).

4.1.3 EBS SEB Assessment 2019

As requested by Hillgrove, EBS Ecology assessed the condition of the native vegetation patches within the ML more recently on 8 – 11 October 2019, and classified them in accordance with the same vegetation condition and SEB ratio outlined in Figure 7, which originates from the *Draft Guidelines for Native Vegetation Significant Environmental Benefit Under the Native Vegetation Act 1991 and Regulations 2003 for the Mineral and Petroleum Resources Industry* (DWLBC 2005), to determine their current SEB ratio. The results of this assessment are presented in Table 5.

Out of the 37 patches of native vegetation mapped within the ML (Figure 11) 20 were assessed for SEB condition ratio, eight patches had been cleared for mining works, two patches (17 and 18) had been wholly incorporated into patch 10 and seven patches were not assessed in 2019. Out of the 20 native vegetation patches assessed for SEB ratio, only two patches, patch 3 and patch 7, were considered to have experienced enough improvement in condition to be elevated to a 6:1 SEB ratio (from 4:1 SEB ratio). No patches were considered to have decreased in SEB ratio.

As stated previously in this report, Western Grey Kangaroos (*Macropus fuliginosus*) grazing on understory forbs and shrubs within both remnant *Eucalyptus odorata* woodland and general revegetation areas, may be limiting regeneration (and/or revegetation success) and may be exacerbating or causing rehabilitation to be a drawn out process. This is particularly the case for patches 2, 4, 5 and 6, located in the northern section of the ML.

4.1.4 Limitations

All SEB ratios presented in this report have been assessed based on the methodology outlined in the *Draft Guidelines for Native Vegetation Significant Environmental Benefit Under the Native Vegetation Act 1991 and Regulations 2003 for the Mineral and Petroleum Resources Industry* (DWLBC 2005) (i.e. Figure 7) for consistency of comparison. It should be noted that the method for assessing and assigning vegetation condition (SEB ratio) and calculating the required SEB has changed over time, particularly with the implementation of the *Native Vegetation Regulations 2017.* Refer to the *Guide for calculating a Significant Environmental Benefit Under the Native Vegetation Act 1991 and Native Vegetation Regulations 2017* (NVC 2017a) and the *Guide for a Significant Environmental Benefit for the clearance of native vegetation associated with the Minerals and Petroleum Industry* (NVC 2017b) for more information.

Furthermore, the assessment undertaken in October 2019 was carried out very quickly during field work for the 2019 LFA monitoring. It is possible that a further detailed field assessment may potentially identify more remnant native vegetation patches with an increase in SEB ratio.

4.2 Vegetation photo points

EBS Restoration installed photo point locations in the north-west corner of the mine lease in 2012 to create a visual record for remnant native vegetation areas and proposed SEB areas located in this part of the ML. In 2019 these photo point locations were revisited. Remnant native vegetation patches showed minimal change in structure and diversity. However, it is evident that revegetated SEB areas have experienced significant growth of overstory species with strips of native grass understory species prevalent. Refer to EBS Restoration (2019b) for photos and more information.

Table 5. Change in SEB Condition rating of remnant Vegetation Associations from 2007 until 2019.

ID	Vegetation Association[1]	SEB ratio			Comments
		2007[2]	2013[3]	2019[4]	
1	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	Some additional native species, but not good enough to increase to next SEB ratio.
2	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	Native species scattered throughout but exotics still dominate. **Kangaroos are significantly impacting this patch.**
3	*Eucalyptus odorata* Low woodland	4:1	4:1	6:1	SEB ratio is likely to have increased slightly.
4	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	Native species scattered throughout but exotics still dominate. **Kangaroos are significantly impacting this patch.**
5	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	More degraded than "1", "2" and "3" but still meets 4:1 ratio. **Kangaroos are significantly impacting this patch.**
6	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	More degraded than "1", "2" and "3" but still meet 4:1 ratio. **Kangaroos are significantly impacting this patch.**
7	*Acacia pycnantha* Low woodland	4:1	4:1	6:1	SEB ratio is likely to have increased slightly.
8	*Eucalyptus leucoxylon* woodland	8:1 / 6:1	6:1	6:1	Originally mapped by Ecological Associates (2007) as *Eucalyptus leucoxylon +/- Lomandra effusa* Open woodland, but revised to *Eucalyptus leucoxylon* woodland by EBS Ecology (2013). Also, Ecological Associates (2007) mapping shows SEB condition as 8:1 and text on page 3-11 states 8:1 but Table 2 states 6:1. EBS Ecology (2013) and 2019 consider SEB ratio to be 6:1.
9	*Allocasuarina verticillata +/- Callitris gracilis +/- Lomandra effusa* Low woodland	8:1 / 6:1	8:1	8:1	Ecological Associates (2007) mapping shows 8:1 and text on page 3-11 states 8:1 but Table 2 states 6:1. EBS (2013) stated 8:1.
10	*Eucalyptus odorata* Low woodland	8:1	8:1	8:1	A small part of this vegetation association was originally mapped by Ecological Associates (2007) as *Eucalyptus gracilis +/- E. oleosa* Open mallee (patch 18; 8:1), but was revised to *Eucalyptus odorata* Low woodland in 2013 by EBS Ecology. Some of this vegetation cleared for mining works.
11	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	
12	*Eucalyptus odorata* Low woodland	6:1	6:1	6:1	
13	*Eucalyptus odorata* Low woodland	4:1	4:1	4:1	
14	*Eucalyptus odorata* Low woodland	8:1	8:1	8:1	
15	*Eucalyptus odorata* Low woodland	2:1	2:1	2:1	
16	*Callitris gracilis* Low woodland	8:1	8:1	6:1	Some of this vegetation association cleared for mining works.
17	*Eucalyptus odorata* Low woodland	6:1	N/A	N/A	This patch was originally mapped by Ecological Associates in 2007, but was incorporated into patch 10 in 2013 by EBS Ecology.
18	*Eucalyptus gracilis +/- E. oleosa Open mallee*	8:1	N/A	N/A	This vegetation association was revised to be *Eucalyptus odorata* Low woodland in 2013 by EBS Ecology and incorporated into patch 10.
19	*Acacia pycnantha* Low woodland	6:1	6:1	6:1	Some of this vegetation association cleared for mining works.

ID	Vegetation Association[1]	SEB ratio			Comments
		2007[2]	2013[3]	2019[4]	
20	*Acacia pycnantha* Low woodland	4:1	4:1	N/A	Cleared for mining works.
21	*Acacia pycnantha* Low woodland	4:1	4:1	4:1	More than half of this vegetation association cleared for mining works.
22	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	8:1	8:1	8:1	More than half of this vegetation association cleared for mining works.
23	*Eucalyptus odorata* Low woodland	6:1	6:1	N/A	Cleared for mining works.
24	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	4:1	4:1	N/A	Cleared for mining works.
25	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	4:1	4:1	N/A	Cleared for mining works.
26	*Austrostipa* sp. Open tussock grassland	6:1	6:1	-	Not assessed in 2019.
27	*Austrostipa* sp. Open tussock grassland	8:1	8:1	8:1	Very small amount cleared for mining works.
28	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	8:1	8:1	-	Not assessed in 2019.
29	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	8:1 & 6:1	6:1	-	Originally mapped by Ecological Associates as 2 patches: 1. *Austrostipa sp*. Open tussock grassland; and 2. *Lomandra effusa* Open tussock grassland. Mapped by EBS Ecology (2013) as just *Lomandra effusa grassland +/- Helichrysum* open tussock grassland. SEB condition ratio not assessed in 2019.
30	*Eucalyptus odorata* Low woodland	2:1	2:1	N/A	Cleared for mining works.
31	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	4:1	4:1	-	Approximately half of this vegetation association cleared for mining works. Not assessed in 2019.
32	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	4:1	4:1	N/A	Cleared for mining works.
33	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	4:1	4:1	N/A	Cleared for mining works.
34	*Austrostipa* sp. Open tussock grassland	4:1	4:1	N/A	Cleared for mining works.
35	*Austrostipa* sp. Open tussock grassland	4:1	4:1	-	Not assessed in 2019.
36	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	6:1	6:1	-	Not assessed in 2019.
37	*Lomandra effusa* grassland +/- *Helichrysum* open tussock grassland	8:1	8:1	-	Originally mapped by Ecological Associates as *Austrostipa sp*. Open tussock grassland (8:1) in 2007. Mapped by EBS Ecology as *Lomandra effusa grassland +/- Helichrysum* open tussock grassland in 2013. Not assessed in 2019.

[1] EBS Ecology 2013a; [2] Ecological Associates 2007; [3] EBS Ecology 2013a; [4] EBS Ecology SEB survey 2019 (this report).

5 STATUS OF COMPLIANCE AND RECOMMENDATIONS

A summary of the current status of compliance with Schedule 2 ML 6345 lease conditions 13, 14, 15 and 27.3, and associated outcomes 21, 18, 20 and 22, as well as closure outcome 1, associated with the PEPR for Kanmantoo Mine is presented in Table 6.

Table 6. Summary of status of compliance with Schedule 2 ML6345 lease conditions and outcomes.

Schedule 2 Lease Condition	Outcome	Comments on status of compliance
Fauna 13. The Lessee must in constructing and operating the Lease, ensure that there are no net adverse impacts from the site operations on the native fauna abundance or diversity in the Lease area and in adjacent areas.	Outcome 21 No net adverse impacts from the site operations on native fauna abundance or diversity in the lease area and in adjacent areas.	**Lease condition 13 and outcome 21 have been and are being met.**
Flora 14. The Lessee must, in constructing and operating the Lease, ensure that all clearance of native vegetation is authorised under appropriate legislation and ensure no permanent loss of abundance or diversity on or off the Lease.	Outcome 18 All clearance of native vegetation is authorised under appropriate legislation and no permanent loss of abundance or diversity on or off the lease due to operations.	**It is unknown if lease condition 14 and outcome 18 are currently being met as more investigation is required.**
Weeds and Pests 15. The Lessee must in constructing and operating the Lease ensure no introduction of new weeds, plant pathogens or pests (including feral animals), nor increase in abundance of existing weed or pest species in the Lease area and adjacent areas caused by mining operations.	Outcome 20 No introduction of new weeds and plant pathogens, nor increase in abundance of existing weed species in the lease area and adjacent areas caused by mining operations. Outcome 22 No introduction of new pests (including feral animals), nor increase in abundance of existing pest species in the lease area and adjacent areas caused by mining operations.	**It is unknown if lease condition 15 and outcome 20 are currently being met as more investigation is required.** **Lease condition 15 and outcome 22 have been and are being met.**
Rehabilitation 27.3 Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.	Closure Outcome 1 Ecosystem and landscape function is resilient, self-sustaining and indicating that an ecosystem and landscape function comparable to the surrounding areas will ultimately be achieved.	**Lease condition 27.3 and closure outcome 1 are considered to be on track for achieving compliance in the future.**

The following recommendations are provided to further assess compliance:

- Continue to undertake annual fauna monitoring to enable assessment of compliance with lease condition 13 and associated outcome 21;
- Undertake a review of native vegetation clearance approval documentation together with an on-ground audit of native vegetation clearance to enable assessment of compliance with lease condition 14 and associated outcome 18;
- Undertake an annual flora survey within the ML and adjacent areas to measure native flora abundance and diversity on and off the lease to enable assessment of compliance with lease condition 14 and associated outcome 18;

- Undertake an annual weed survey within the ML and adjacent areas to identify any introduction of new weeds and/or plant pathogens and measure abundance of existing weeds to enable assessment of compliance with lease condition 15 and associated outcome 20;
- Continue to monitor pests as part of the annual fauna monitoring program to continue to enable assessment of compliance with lease condition 15 and associated outcome 22; and
- Continue to undertake annual LFA monitoring to enable assessment of compliance with lease condition 27.3 and closure outcome 1. However, flora species composition and germination success should be considered as part of ongoing monitoring to provide information on how species respond to specific restoration methods, thus informing future rehabilitation activities. Such information would also be useful for assessing:
    3. Overall trends in plant species abundance and diversity, and
    4. Impacts on vegetation from threats such as total grazing pressure.

The SEB assessment only identified two patches of remnant native vegetation (patch 3 and patch 7), which are considered to have improved in SEB ratio (from 4:1 to 6:1). While a more thorough native vegetation condition assessment may potentially identify more remnant native vegetation patches with an increase in SEB ratio, SEB rehabilitation efforts and natural regeneration within other remnant native vegetation patches, particularly *Eucalyptus odorata* Low woodland patches 2, 4, 5 and 6, are considered to be significantly impacted by the high number of Western Grey Kangaroos grazing on understory forbs and shrubs. As such, it is recommended that Hillgrove consider undertaking a control program to reduce the impact of grazing by Western Grey Kangaroos.

6 REFERENCES

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7 APPENDICES

Appendix 1

Table 7. Kanmantoo ML and surrounding properties flora species list and additional species used in revegetation works. (Species used in revegetation works are identified by text in red.)

Species recorded in the ML and surrounding properties.[1]		Additional revegetation species.	
Scientific name	**Common name**	**Scientific name**	**Common name**
Acacia acinacea	Wreath Wattle		
Acacia argyrophylla	Silver Mulga-bush		
Acacia halliana	Hall's Wattle		
Acacia ligulata	Umbrella Bush		
Acacia melanoxylon	Blackwood		
Acacia menzelii	Menzel's Wattle		
Acacia microcarpa	Manna Wattle		
Acacia paradoxa	Kangaroo Thorn		
Acacia pycnantha	Golden Wattle		
Acaena echinata	Sheep's Burr		
Ajuga australis f. A (A. G. Spooner 9058)	Australian Bugle		
Allocasuarina verticillata	Drooping Sheoak		
Amphipogon sp.	Grey-beard Grass		
Amphipogon strictus	Spreading Grey-beard Grass		
Amyema miquelii	Box Mistletoe		
Aristida behriana	Brush Wire-grass		
Aristida contorta	Curly Wire-grass		
Arthropodium fimbriatum	Nodding Vanilla-lily	*Arthropodium sp.*	Vanilla-lily
Arthropodium strictum	Common Vanilla-lily		
Asperula conferta	Common Woodruff		
Asperula sp.	Woodruff		
Astroloma humifusum	Cranberry Heath		
Atriplex semibaccata	Berry Saltbush		
Austrodanthonia auriculata	Lobed Wallaby-grass		
Austrodanthonia caespitosa (now *Rytidosperma caespitosum)*	Common Wallaby-grass		
Austrodanthonia pilosa (now *Rytidosperma pilosum)*	Velvet Wallaby-grass		
Austrodanthonia setacea (now *Rytidosperma setaceum)*	Small-flower Wallaby-grass		
Austrodanthonia sp. (now *Rytidosperma sp.)*	Wallaby Grass		
Austrostipa blackii	Crested Spear-grass		
Austrostipa elegantissima	Feather Spear-grass		
Austrostipa eremophila	Rusty Spear-grass		
Austrostipa nodosa	Tall Spear-grass		
Austrostipa scabra group	Falcate-awn Spear-grass		
Austrostipa scabra ssp. scabra	Rough Spear-grass		

Species recorded in the ML and surrounding properties.[1]		Additional revegetation species.	
Scientific name	**Common name**	**Scientific name**	**Common name**
Austrostipa sp.	Spear-grass		
Blennospora drummondii	Dwarf Button-flower	*Bothriochloa macra*	Red-leg Grass
Bromus sp.	Brome		
Bulbine bulbosa	Bulbine-lily		
Burchardia umbellata	Milkmaids		
Bursaria spinosa	Bursaria		
Bursaria spinosa ssp. lasiophylla	Downy Bursaria		
Caesia calliantha	Blue Grass-lily		
Calandrinia eremaea	Dryland Purslane		
Callistemon sp.	Bottlebrush		
Callitris gracilis	Southern Cypress Pine		
Calostemma purpureum	Pink Garland-lily		
Centrolepis aristata	Pointed Centrolepis		
Chamaesyce drummondii	Caustic Weed/Spurge		
Cheilanthes austrotenuifolia	Annual Rock-fern		
Chenopodium desertorum	Desert Goosefoot		
Chenopodium desertorum ssp. microphyllum	Small-leaf Goosefoot		
Chloris truncata	Windmill-grass		
Chrysocephalum apiculatum	Common Everlasting		
Chrysocephalum baxteri	White Everlasting	*Chrysocephalum semipapposum*	Clustered Everlasting
Clematis micrphylla var. microphylla	Old Man's Beard		
Compositae sp.	(Daisy Family)		
Convolvulus angustissimus	Australian Bindweed		
Convolvulus erubescens complex	Blushing Bindweed		
Convolvulus remotus	Grassy Bindweed		
Convolvulus sp.	Bindweed		
Correa glabra var.	Rock Correa		
Crassula colorata	Dense Crassula		
Crassula sieberiana complex	Australian Stonecrop		
Cryptandra amara var.	Cryptandra		
Cryptandra sp.	Cryptandra		
Cryptandra tomentosa	Heath Cryptandra		
Cullen australasicum	Tall Scurf-pea	*Cymbopogon ambiguus*	Scented Lemon Grass
Cynoglossum suaveolens	Sweet Hound's-tongue	*Cyperus gymnocaulos*	Spiny Flat-sedge
Dampiera rosmarinifolia	Rosemary Dampiera		
Daucus glochidiatus	Native Carrot		
Dampiera rosmarinifolia	Rosemary Dampiera		
Dianella revoluta var. revoluta	Black-anther Flax-lily	*Dichanthium sericeum*	Silky Blue-grass
Dichondra repens	Kidney Weed		
Diuris behrii	Behr's Cowslip Orchid		
Diuris sp.	Donkey Orchid		

Species recorded in the ML and surrounding properties.[1]		Additional revegetation species.	
Scientific name	**Common name**	**Scientific name**	**Common name**
Dodonaea viscosa ssp. cuneata	Wedge-leaf Hop-bush		
Dodonaea viscosa ssp. spathulata	Sticky Hop-bush		
Drosera macrantha ssp. planchonii	Climbing Sundew		
Einadia nutans ssp. nutans	Climbing Saltbush		
Elymus scaber var. scaber	Native Wheat-grass		
Enchylaena tomentosa var. tomentosa	Ruby Saltbush		
Enneapogon nigricans	Black-head Grass		
Enneapogon polyphyllus	Leafy Bottle-washers		
Enneapogon sp.	Bottle-washers / Nineawn		
Epilobium billardierianum	Robust Willow-herb		
Eremophila longifolia	Weeping Emubush		
Erodium sp.	Heron's-bill/Crowfoot		
Eucalyptus calycogona ssp. calycogona	Square-fruit Mallee		
Eucalyptus camaldulensis ssp. camaldulensis	River Red Gum		
Eucalyptus cladocalyx	Sugar Gum		
Eucalyptus conglobata ssp. conglobata	Port Lincoln Mallee		
Eucalyptus fasciculosa	Pink Gum		
Eucalyptus gracilis	Yorrell		
Eucalyptus leucoxylon ssp. leucoxylon	South Australian Blue Gum		
Eucalyptus odorata	Peppermint Box		
Eucalyptus oleosa ssp. oleosa	Red Mallee		
Eucalyptus phenax ssp. phenax	White Mallee		
Eucalyptus porosa	Mallee Box		
Eucalyptus rugosa	Coastal White Mallee		
Eucalyptus socialis	Pointed Mallee		
Eutaxia microphylla	Common Eutaxia	*Ficinia nodosa*	Knobby Club-rush
Glycine rubiginosa	Twining Glycine		
Glycine sp.	Glycine		
Gonocarpus elatus	Hill Raspwort		
Gonocarpus tetragynus	Small-leaf Raspwort		
Goodenia pinnatifida	Cut-leaf Goodenia		
Goodenia pusilliflora	Small-flower Goodenia		
Goodenia robusta	Woolly Goodenia		
Gramineae sp.	Grass Family		
Halgania cyanea	Rough Blue-flower		
Haloragis aspera	Rough Raspwort		
Hardenbergia violacea	Native Lilac		
Helichrysum leucopsideum	Satin Everlasting		
Hibbertia crinita	Long-hair Guinea-flower		
Hydrocotyle callicarpa	Tiny Pennywort		
Hypoxis glabella var. glabella	Tiny Star		

Species recorded in the ML and surrounding properties.[1]		Additional revegetation species.	
Scientific name	**Common name**	**Scientific name**	**Common name**
Juncus bufonius	Toad Rush		
Juncus flavidus	Yellow Rush		
Juncus pallidus	Pale Rush		
Juncus subsecundus	Finger Rush		
Kennedia prostrata	Scarlet Runner		
Lagenophora huegelii	Coarse Bottle-daisy		
Lagenophora sp.	Bottle-daisy		
Liliaceae sp.	(Lily Family)		
Lepidosperma viscidum	Sticky Sword-sedge		
Leptorhynchos squamatus ssp. squamatus	Scaly Buttons		
Levenhookia dubia	Hairy Stylewort		
Lomandra densiflora	Soft Tussock Mat-rush		
Lomandra effusa	Scented Mat-rush		
Lomandra micrantha ssp. micrantha	Small-flower Mat-rush		
Lomandra multiflora subsp. Dura	Hard Mat-rush		
Lomandra nana	Small Mat-rush		
Lotus australis	Austral Trefoil		
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe		
Maireana brevifolia	Short-leaf Bluebush		
Maireana enchylaenoides	Wingless Fissure-plant		
Maireana georgei	Satiny Bluebush		
Maireana sp.	Bluebush / Fissure-plant		
Melaleuca lanceolata	Dryland Tea-tree		
Melaleuca uncinata	Broombush		
Microtis parviflora	Slender Onion-orchid		
Microtis unifolia complex	Onion-orchid		
Millotia myosotidifolia	Broad-leaf Millotia		
Myoporum platycarpum ssp.	False Sandalwood		
Neurachne alopecuroidea	Fox-tail Mulga-grass		
Olearia axillaris	Coast Daisy-bush		
Olearia pannosa	Silver Daisy-bush		
Olearia ramulosa	Twiggy Daisy-bush		
Oxalis perennans	Native Sorrel		
Panicum effusum var. effusum	Hairy Panic		
Persicaria prostrata	Creeping Knotweed		
Pheladenia deformis	Bluebeard Orchid		
Phyllangium divergens	Wiry Mitrewort		
Pimelea curviflora var. gracilis	Curved Riceflower		
Pimelea micrantha	Silky Riceflower		
Pittosporum angustifolium	Native Apricot		
Plantago drummondii	Dark Plantain		
Plantago gaudichaudii	Narrow-leaf Plantain		
Plantago sp.	Plantain		

Species recorded in the ML and surrounding properties.[1]		Additional revegetation species.	
Scientific name	**Common name**	**Scientific name**	**Common name**
Plantago varia	Variable Plantain		
Podolepis tepperi	Delicate Copper-wire Daisy	*Podolepis rugata*	(a type of Daisy)
Pogonolepis muelleriana	Stiff Cup-flower		
Pomaderris paniculosa ssp. paniculosa	Mallee Pomaderris		
Poranthera microphylla	Small Poranthera		
Prasophyllum sp.	Leek-orchid		
Pteridium esculentum	Bracken Fern		
Pterostylis sp.	Greenhood		
Ptilotus erubescens	Hairy-tails		
Ptilotus parvifolius	Small-leaf Mulla Mulla		
Ptilotus sp.	Mulla Mulla		
Ptilotus spathulatus f. spathulatus	Pussy-tails		
Rhagodia candolleana ssp. candolleana	Sea-berry Saltbush	*Rhagodia crassifolia*	Fleshy Saltbush
Rhagodia sp.	Saltbush		
Rhamnaceae sp.	(Buckthorn family)		
Rhodanthe floribunda	White Everlasting		
Rytidosperma caespitosum	Common Wallaby-grass		
Rytidosperma setaceum	Small-flower Wallaby-grass		
Rytidosperma sp.	Wallaby Grass		
Rytidosperma tenuius	Short-awn Wallaby-grass		
Salsola australis	Buckbush		
Salsola kali	Buckbush		
Santalum acuminatum	Quandong		
Scaevola aemula	Fairy Fanflower		
Scaevola albida	Pale Fanflower		
Scaevola sp.	Fanflower		
Sebaea ovata	Yellow Sebaea		
Senecio picridioides	Purple-leaf Groundsel		
Senecio pinnatifolius	Variable Groundsel		
Senecio quadridentatus	Cotton Groundsel		
Senecio sp.	Groundsel		
Senecio spanomerus	Cotton Groundsel		
Senna artemisioides	Desert Senna		
Senna sp.	Senna		
Solenogyne dominii	Smooth Solenogyne		
Stackhousia monogyna	Creamy Candles		
Swainsona sp.	Swainson-pea		
Themeda triandra	Kangaroo Grass		
Thysanotus patersonii	Twining Fringe-lily		
Tricoryne elatior	Yellow Rush-lily		
Triptilodiscus pygmaeus	Small Yellow-heads		
Velleia arguta	Toothed Velleia		
Velleia paradoxa	Spur Velleia		
Velleia sp.	Velleia		

Species recorded in the ML and surrounding properties.[1]		Additional revegetation species.	
Scientific name	**Common name**	**Scientific name**	**Common name**
Vittadinia blackii	Narrow-leaf New Holland Daisy		
Vittadinia cervicularis var. cervicularis	Waisted New Holland Daisy		
Vittadinia cuneata	Fuzzy New Holland Daisy		
Vittadinia gracilis	Woolly New Holland Daisy		
Vittadinia megacephala	Giant New Holland Daisy		
Vittadinia sp.	New Holland Daisy		
Wahlenbergia luteola	Yellow-wash Bluebell		
Wahlenbergia sp.	Native Bluebell		
Wahlenbergia stricta ssp. stricta	Tall Bluebell		
Wurmbea dioica	Early Nancy		
Wurmbea sp.	Nancy		

1: Source: Ecological Associates 2007a; Ecological Associates 2007b; EBS Ecology 2013a; EBS Ecology 2015c; EBS Ecology 2019c.

Notes:

1. The genus *Austrodanthonia* is now referred to as *Rytidosperma*; and
2. The genus *Danthonia* is now referred to as *Rytidosperma*.

Appendix 2

Table 8. Weed species known to occur within the ML and surrounding areas.

Species	Common name
Acacia cyclops	Western Coastal Wattle
Acacia iteaphylla	Flinders Ranges Wattle
Agave sp.	Century Plant
Aira caryophyllea	Silvery Hair-grass
Aira elegantissima	Delicate Hair-grass
Aira sp.	Hair-grass
Amsinckia calycina	Hairy Fiddle-neck
Anagallis arvensis	Pimpernel
Arctotheca calendula	Cape Weed
Asclepias curassavica	Red-head Cotton-bush
Asparagus aspargoides	Bridal Creeper
Asphodelus fistulosis	Onion Weed
Avena barbata	Bearded Oat
Brassica tournefortii	Wild Turnip
Briza maxima	Large Quaking-grass
Briza minor	Lesser Quaking-grass
Bromus diandrus	Great Brome
Bromus hordeaceus ssp. hordeaceus	Soft Brome
Bromus madritensis	Compact Brome
Bromus rubens	Reb Brome
Carduus pycnocephalus	Shore Thistle
Centaurea melitensis	Malta Thislte
Centaurium erythraea	Common Centaury
Chenopodium album	Fat Hen
Chondrilla juncea	Skeleton Weed
Chrysanthemoides monilifera ssp. monilifera	Boneseed
Corymbia maculata	Spotted Gum
Cynara cardunculus ssp. flavescens	Artichoke Thistle
Cynodon dactylon var. dactylon	Couch
Disa brachteata	South African Weed Orchid
Echium plantagineum	Salvation Jane
Ehrharta loniflora	Annual Veldt Grass
Erodium botrys	Long Heron's-bill
Erodium brachycarpum	Short-fruit Heron's-bill
Euphorbia terracina	False Caper
Ficus carica	Edible Fig
Freesia cultivar	Freesia
Fumaria officinalis ssp. officinalis	Common Fumitory
Galenia pubescens var. pubescens	Coastal Galenia
Galium murale	Small Bedstraw
Glycyrrhiza glabra	Liquorice
Gomphocarpus cancellatus	Broad-leaf Cotton-bush
Hirschfeldia incana	Hoary Mustard

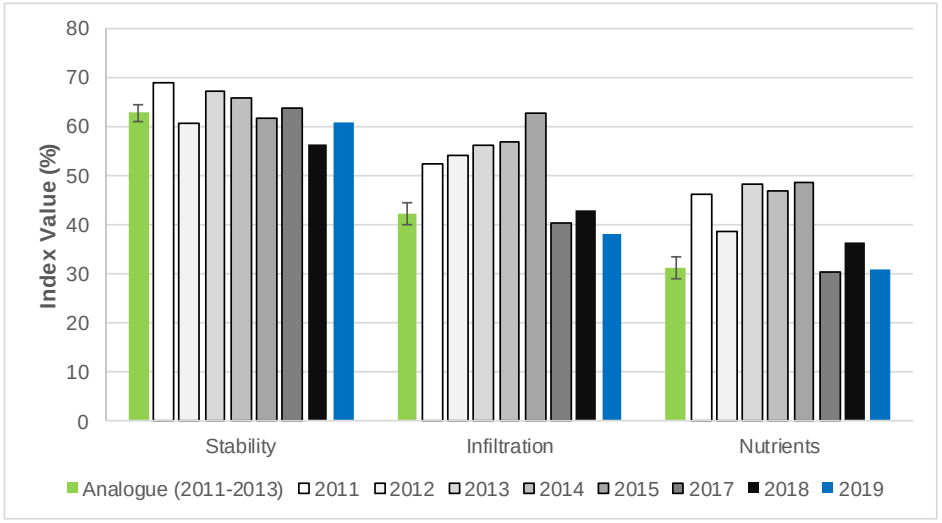
Hordeum hystrix	
Hordeum vulgare	Barley
Hypochaeris glabra	Smooth Cat's Ear
Hypochaeris radicata	Rough Cat's Ear
Juncus acutus	Sharp Rush
Lolium rigidum	Wimmera Ryegrass
Lolium sp.	Ryegrass
Lycium ferocissimum	African Boxthorn
Malva sp.	Mallow
Marrubium vulgare	Horehound
Medicago minima var. minima	Little Medic
Moraea setifolia	Thread Iris
Nicotiana glauca	Tree Tobacco
Olea europaea ssp. europaea	Olive
Opuntia sp.	Prickly Pear
Oxalis pes-caprae	Soursob
Panicum hillmanii	Witch-grass
Parentucellia latifolia	Red Bartsia
Pentaschistis pallida	Pussy Tail
Petrorhagia dubia	Velvet Pink
Pinus halepensis	Aleppo Pine
Pinus radiata	Radiata Pine
Plantago bellardii	Hairy Plantain
Poa bulbosa	Bulbous Meadow-grass
Polypogon monspeliensis	Annual Beard-grass
Romulea minutiflora	Small-flower Onion-grass
Romulea rosea var. australis	Common Onion-grass
Rosa canina	Dog Rose
Rumex sp.	Dock
Salvia verbenaca form	Wild Sage
Scabiosa artopurpurea	Pincushion
Schinus molle	Pepper-tree
Senecio pterophorus	African Daisy
Silene gallica var. gallica	French Catchfly
Sisymbrium erysimoides	Smooth Mustard
Sisymbrium sp.	Wild Mustard
Solanum nigrum	Black Nightshade
Sonchus oleraceus	Common Sow-thistle
Spergularia sp.	Sand-spurrey
Tolpis barbata	Yellow Hawkweed
Trifolium angustifolium	Narrow-leaf Clover
Trifolium arvense var. arvense	Hare's-foot Clover
Trifolium campestre	Hop Clover
Trifolium repens	White Clover
Trifolium sp.	Clover
Trifolium subterraneum	Subterranean Clover

Triticum aestivum	Wheat
Vicia sativa ssp. nigra	Narrow-leaf Vetch
Vulpia ciliata	Fringed Fescue
Vulpia myuros	Fescue
Zaluzianskya divaricata	Spreading Night-phlox

Source: Ecological Associates 2007a; Ecological Associates 2007b; EBS Ecology 2015c; EBS Ecology 2019c.

Appendix 3

Table 9. Landscape function indices change over time (from 2011 to 2019 as applicable) with respect to mean analogue (i.e. target) site values.



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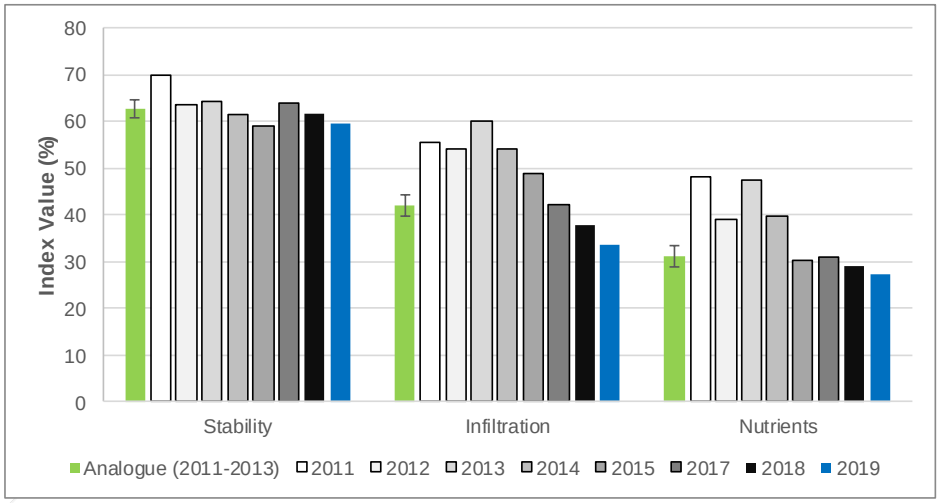

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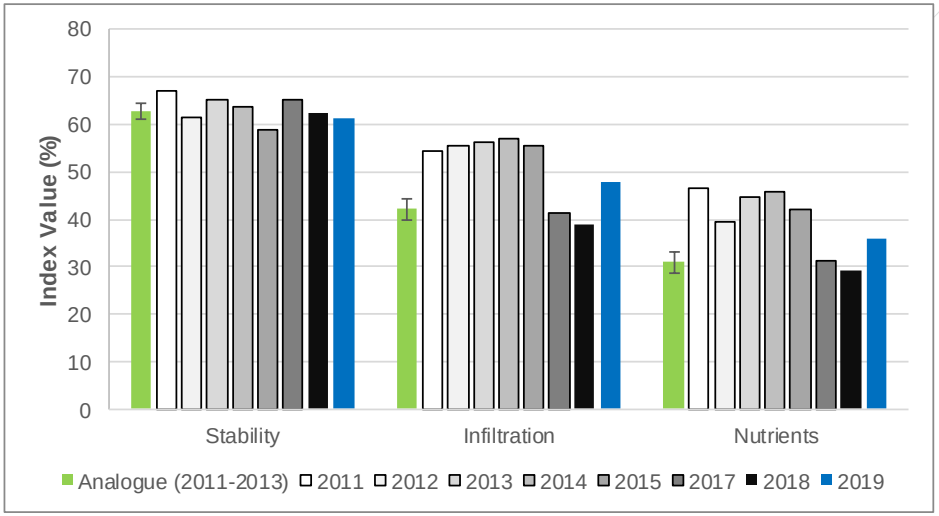
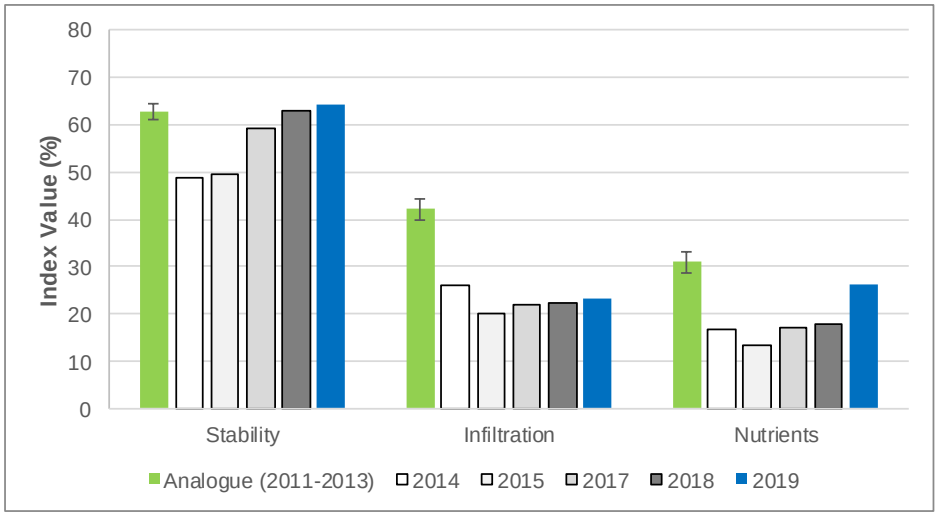


KANODO 06



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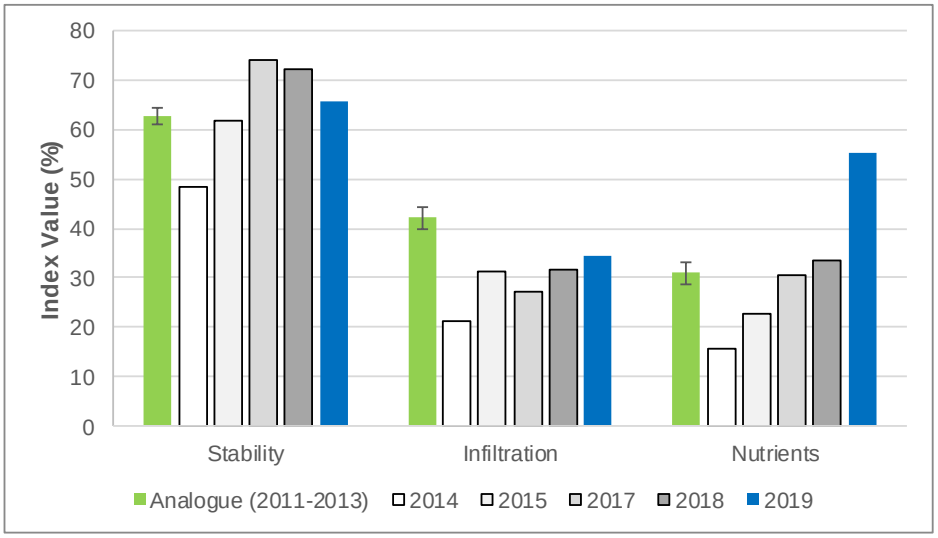

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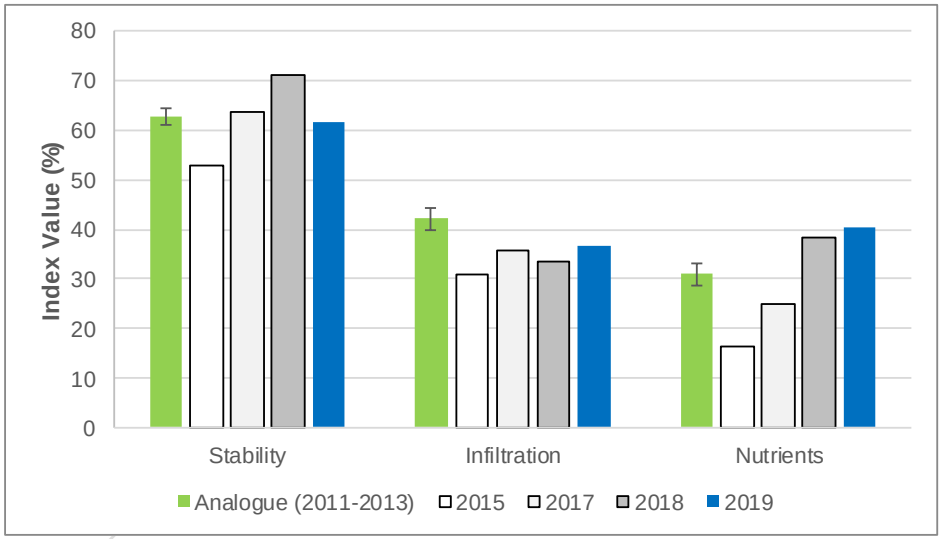
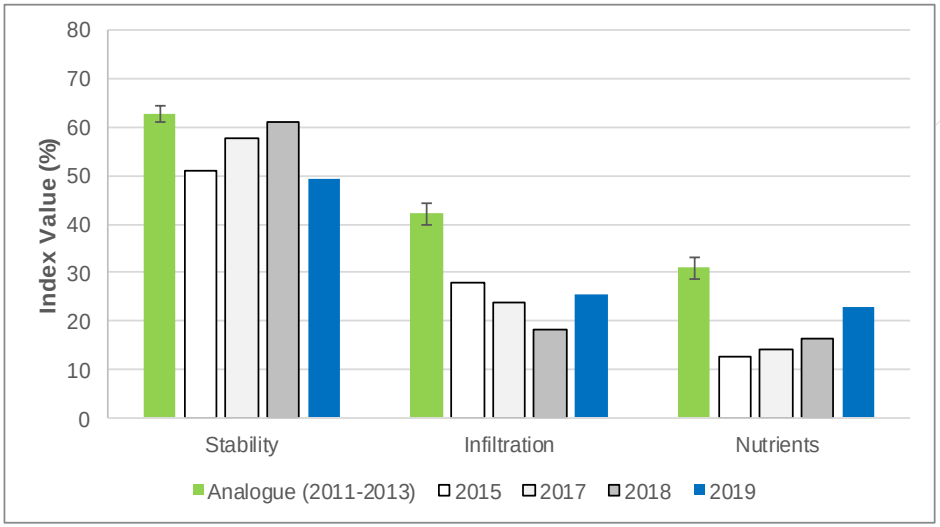


KANODO RT 07



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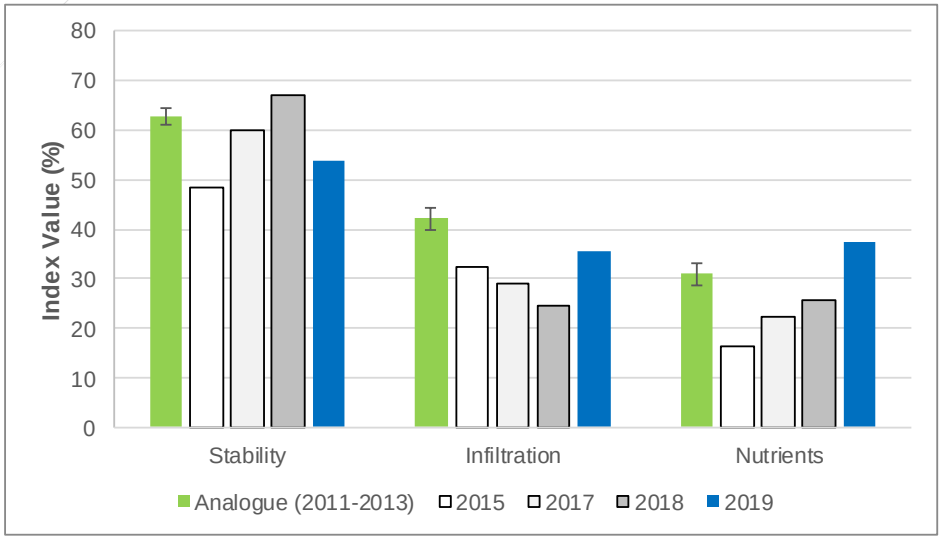

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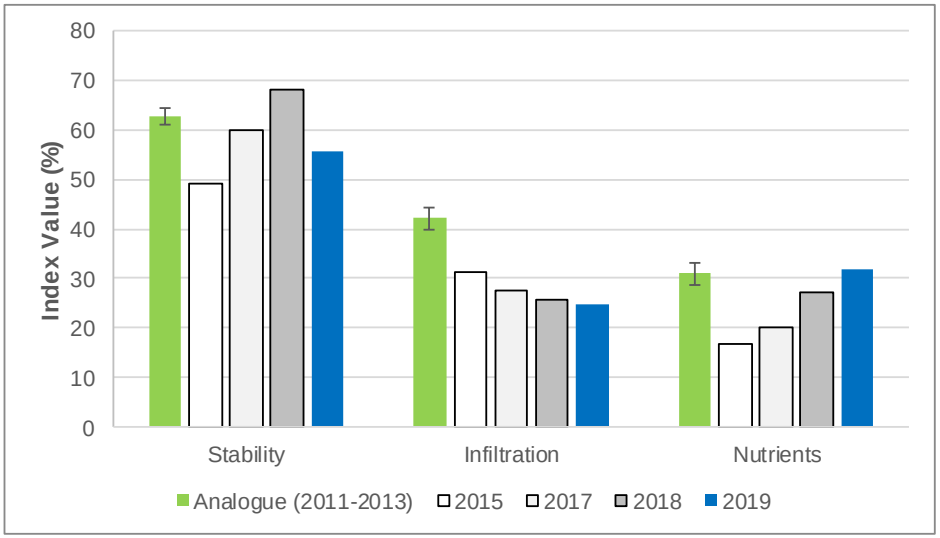

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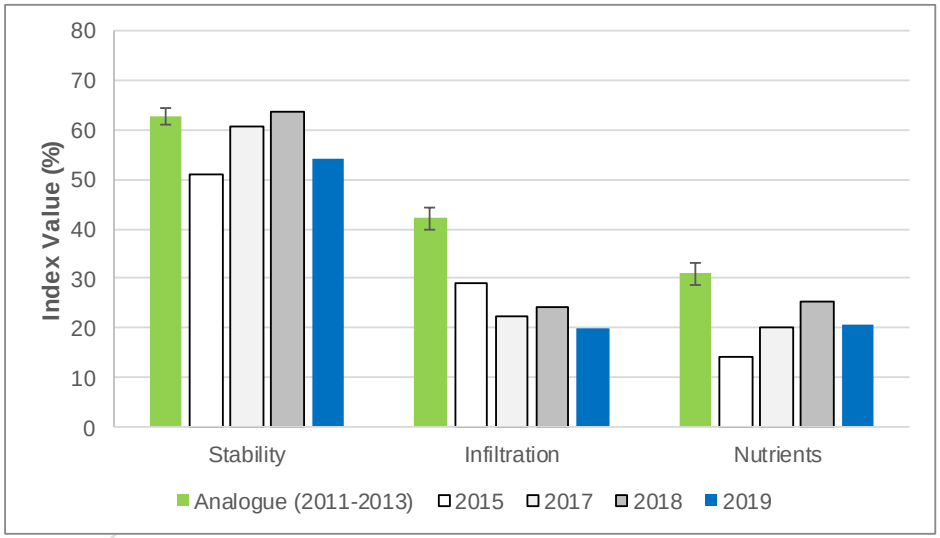

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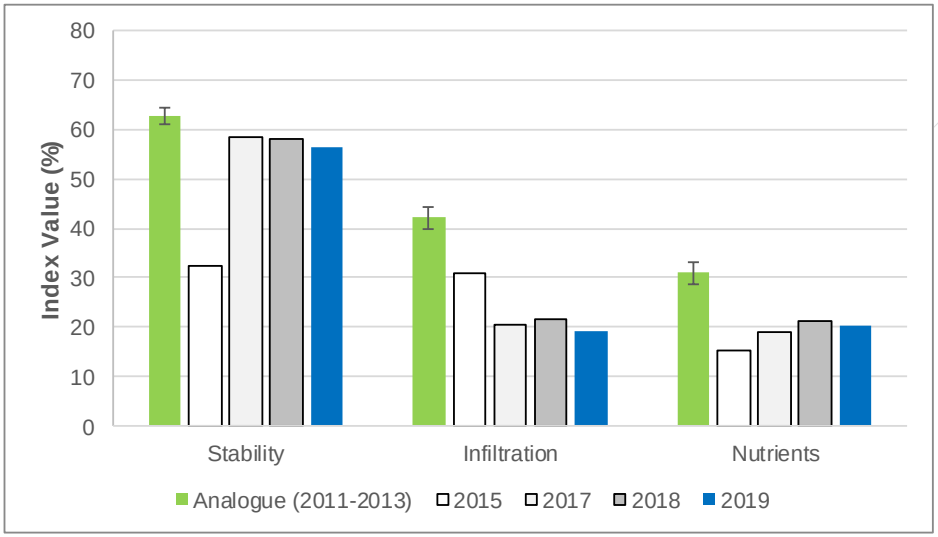

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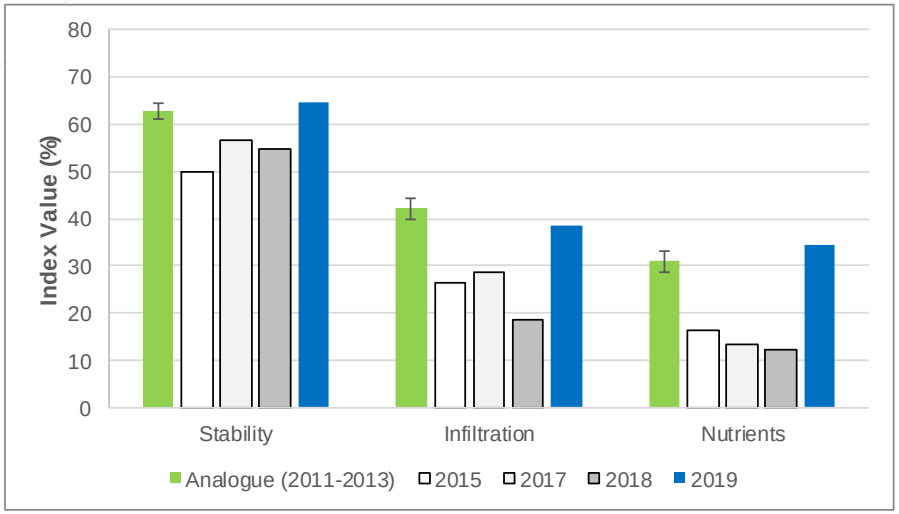

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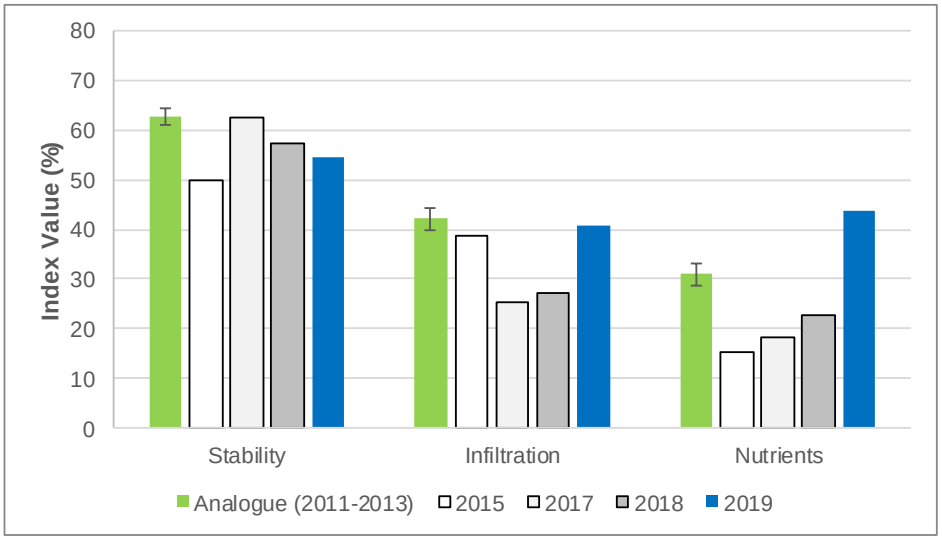

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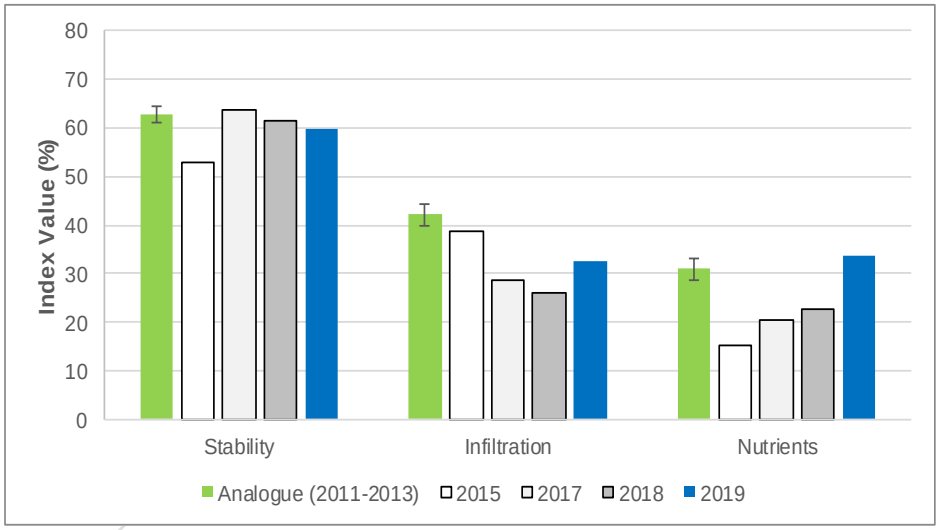

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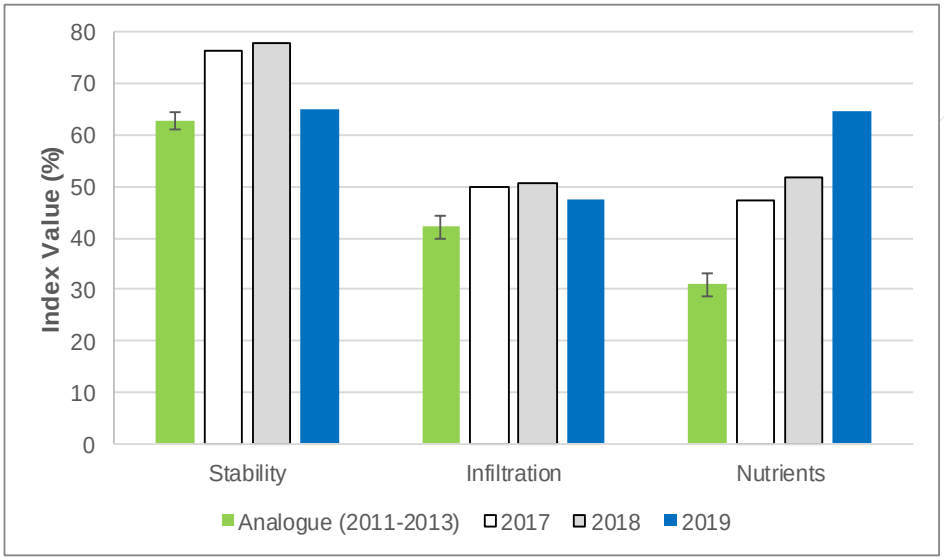

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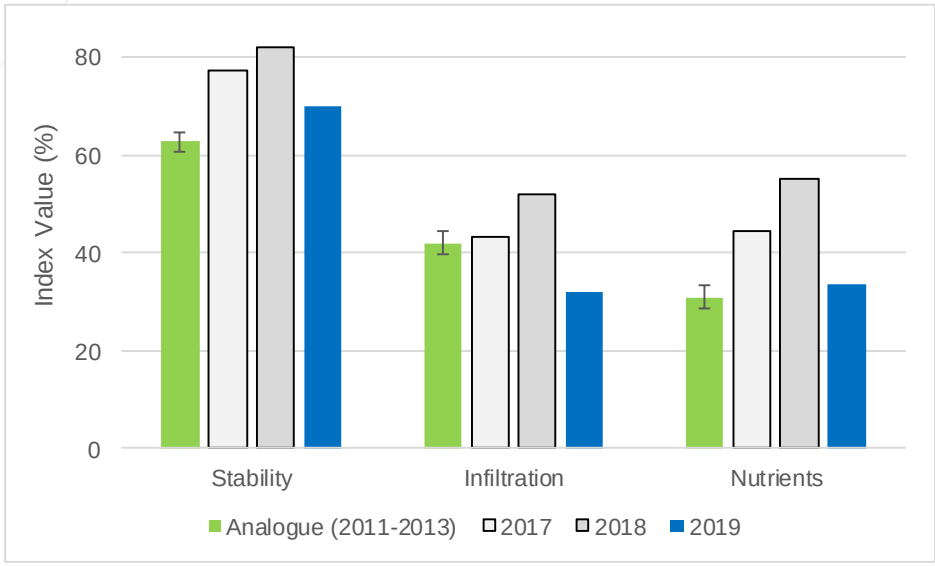

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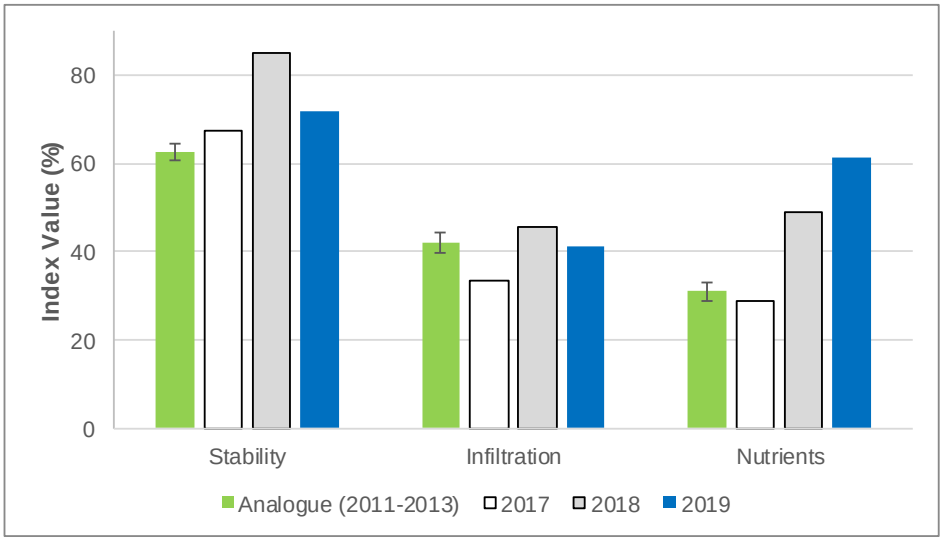

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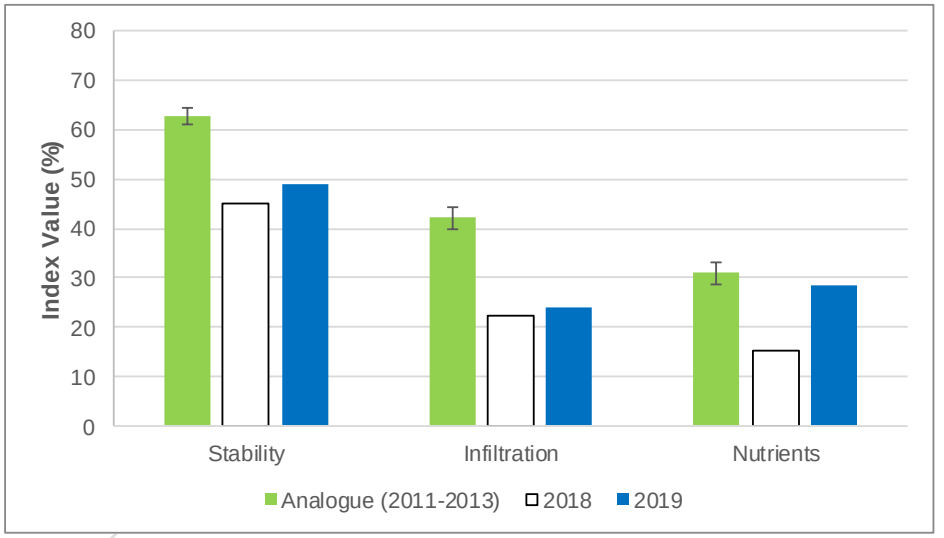

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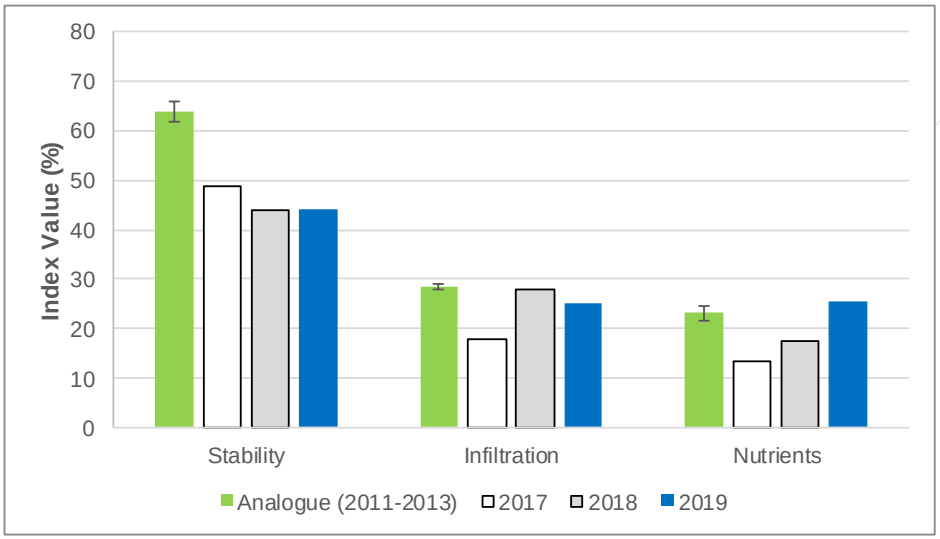

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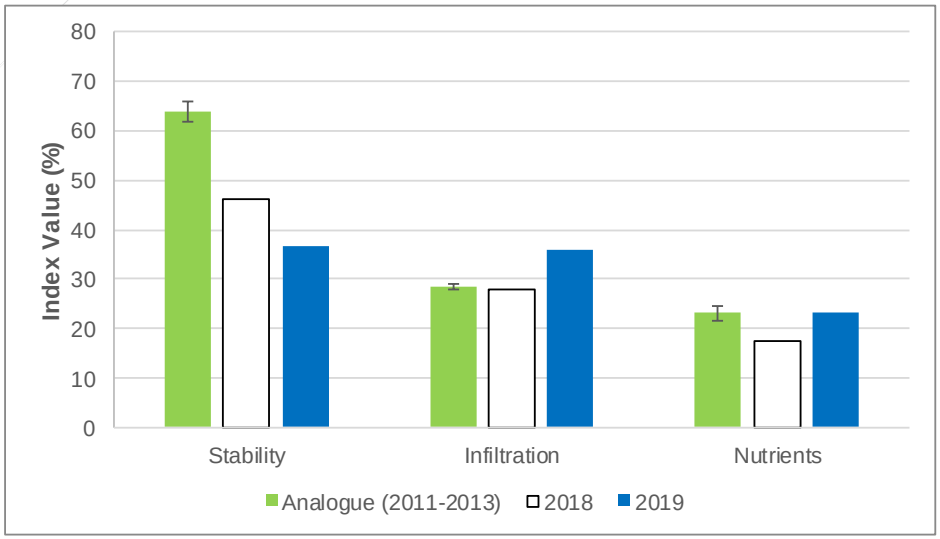

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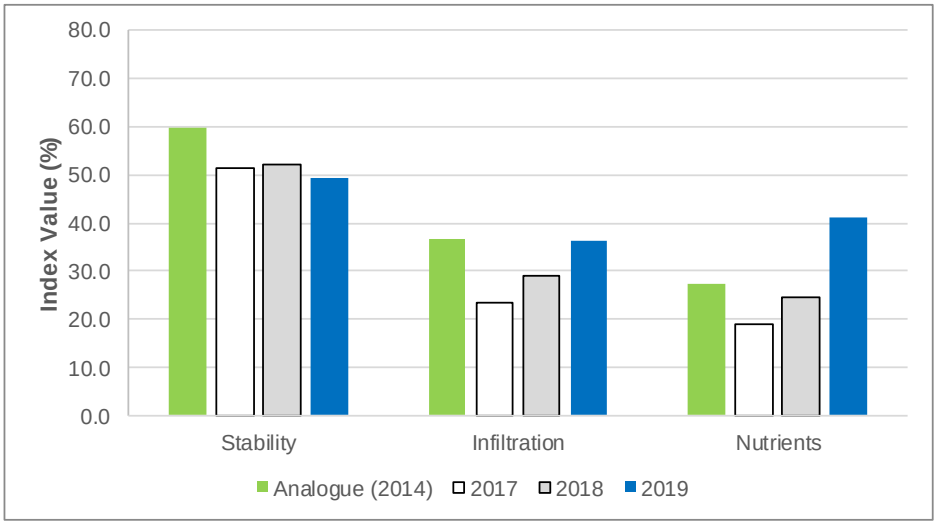

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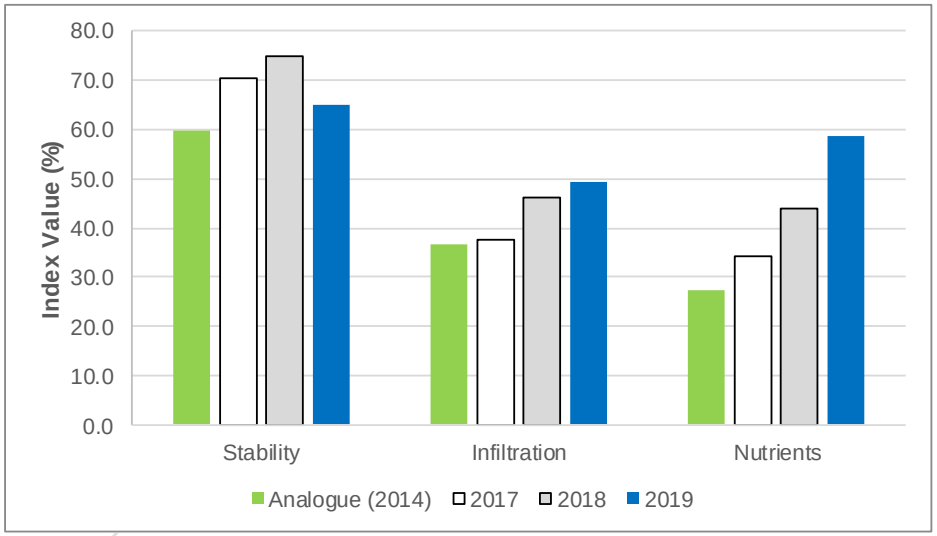

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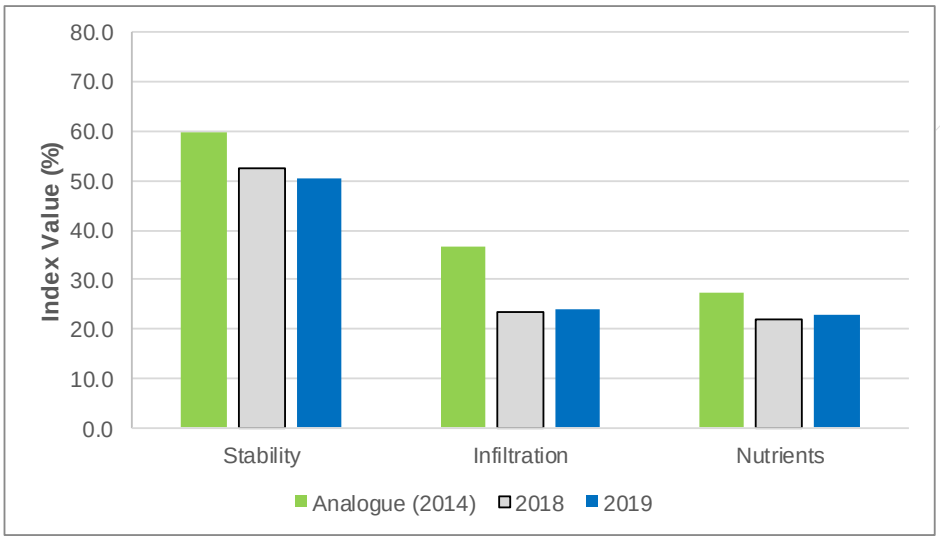

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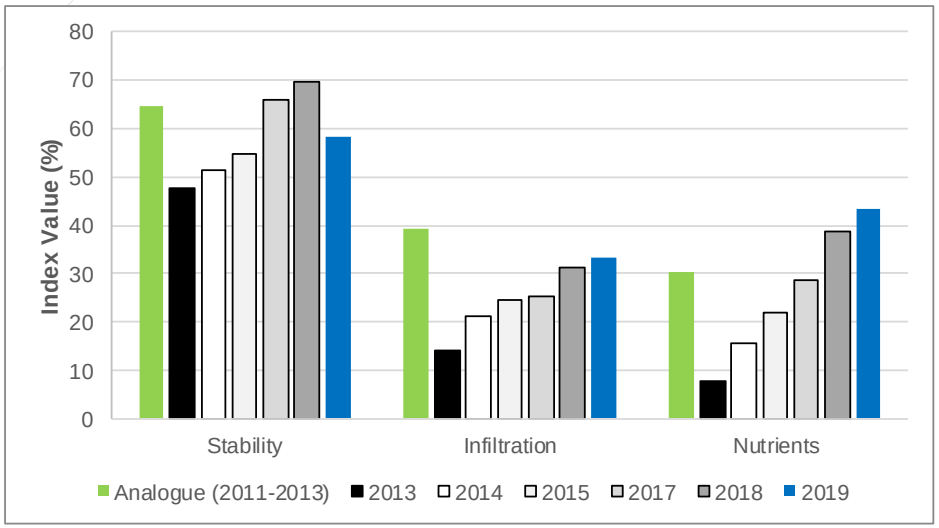

KANGRA 01

Table 10. Summary of the status of LFA site Landscape Function Indices and Landscape Organisation Indices (LOI) with respect to reaching analogue (i.e. target) values.

Site	Year LFA started	Landscape Function Indices			Analogue LOI	Highest LOI recorded (and year)	Comments
		Stability	Infiltration	Nutrients			
KANODO 04	2011	Hovering around (above/below) analogue	Generally higher than analogue	Generally higher than analogue	0.6	0.75 (2019)	Structural changes such as fallen limbs and increased shrub size are slowly adding to the complexity of this site. Evidence of kangaroo grazing impacts on shrubs.
KANODO 05	2011	Hovering around (above/below) analogue	Generally higher than analogue	Hovering around (above/below) analogue	0.6	0.58 (2014)	Structural changes such as fallen limbs and increased shrub size are slowly adding to the complexity of this site. Evidence of kangaroo grazing impacts on shrubs.
KANODO 06	2011	Generally higher than analogue	Generally higher than analogue	Generally higher than analogue	0.6	0.53 (2018 & 2019)	Landscape function indices and landscape organisation indices values show small variability over the monitoring period, demonstrating low rates of change within the remnant communities. It is possible that the high numbers of kangaroos do not allow very rapid recolonisation and establishment of herbaceous species.
KANODO 08	2014	Recently reached analogue	Below analogue	Below analogue	0.6	0.65 (2019)	This site has performed well with a transition from an exotic grassland into a moderately complex restored area. All functional indices increased in 2019 with gradual increases in the stability indicator evident each year since monitoring began.
KANODO 09	2014	Generally higher than analogue	Below analogue but upwards trend	Recently reached analogue with increasing trend	0.6	0.90 (2015)	This site is a good example of a successful restoration area, with soil surface indicators all close to or exceeding analogue values. Trees and shrubs are starting to establish, with shrubs detected (in the transect) for the first time in 2019, resulting in an increase in patchiness as the structural complexity of the vegetation increases.
KANODO RT 07	2015	Recently reached analogue	Below analogue but upwards trend	Recently reached analogue	0.6	0.73 (2018)	This site shows increases in soil infiltration and nutrients and stabilisation towards analogue value for soil stability as chenopod groundcover shrubs and native perennial grasses continue to establish.
KANODO RT 10	2015	Below analogue	Below analogue	Below analogue but upwards trend	0.6	0.29 (2018)	Although this site remains below analogue landscape function indices values, infiltration and nutrients are increasing from previous years. This site is expected to continue to develop as the overstory begins to have an influence on the understory and ground layer.
KANODO RT 11	2015	Hovering around (above/below) analogue	Below analogue	Recently reached analogue with increasing trend	0.6	0.73 (2017)	Similar to KANODO RT 10, the soil surface values for this site continue to trend towards analogue values.

Site	Year LFA started	Landscape Function Indices			Analogue LOI	Highest LOI recorded (and year)	Comments
		Stability	Infiltration	Nutrients			
KANODO RT 12	2015	Hovering around (above/below) analogue	Below analogue	Recently reached analogue with increasing trend	0.6	0.67 (2018)	This site has similar soil surface trends as KANODO RT 10 and 11, except that infiltration has continued to decrease.
KANODO RT 13	2015	Hovering around (above/below) analogue	Below analogue	Below analogue but upwards trend	0.6	0.59 (2017)	All soil surface indices values decreased in 2019 (compared with 2018), with stability moving back to below analogue. This is possibly due to the drier conditions in this harsh environment (north facing batter slope).
KANODO RT 14	2015	Almost reached analogue	Below analogue	Below analogue but upwards trend	0.6	0.47 (2017 & 2018)	Similar to KANODO RT 13, all soil surface indices values decreased in 2019 (compared with 2018), which is also possibly due to the drier conditions in this harsh environment (north facing batter slope).
KANODO RT 15	2015	Recently reached analogue with increasing trend	Almost reached analogue	Recently reached analogue	0.6	0.43 (2018)	All soil surface indices values increased at this site in 2019 (compared with 2018).
KANODO RT 16	2015	Almost reached analogue	Almost reached analogue	Recently reached analogue	0.6	0.69 (2017)	Grass cover continues to increase at this site as the vegetation matures and grass tussock size increases. As such stability and infiltration values are expected to reach analogue values in the near future.
KANODO RT 17	2015	Hovering around (above/below) analogue	Below analogue	Recently reached analogue	0.6	0.54 (2017)	Both infiltration and nutrients increased substantially in 2019 (compared to 2018), most likely due to dead and decaying plant litter.
KANODO RT 18	2017	Above analogue	Above analogue	Above analogue	0.6	1.00 (2017, 2018 & 2019)	KANODO RT 18, 19, 20 and 21 all show similar trajectories towards analogue values for soil surface values as a dense tussock grass sward develops at each site. From a visual perspective, there is an obvious increase in grass tussock size, spread of chenopod groundcovers and early stages of *Acacia* / shrub emergence. A gradual transition is expected within these communities as overstory components begin to develop.
KANODO RT 19	2017	Above analogue	Hovering around (above/below) analogue	Above analogue	0.6	1.00 (2017, 2018 & 2019)	
KANODO RT 20	2017	Above analogue	Hovering around (above/below) analogue	Above analogue	0.6	1.00 (2017, 2018 & 2019)	
KANODO RT 21	2018	Below analogue	Below analogue	Below analogue	0.6	1.00 (2018 & 2019)	
KANLOM RT 01	2017	Below analogue	Almost reached analogue	Recently reached analogue	0.7	0.51 (2019)	Structural complexity has increased significantly since 2017, with shrub and grass cover increasing substantially. At this early stage landscape organisational values are trending well towards analogue values.

Site	Year LFA started	Landscape Function Indices			Analogue LOI	Highest LOI recorded (and year)	Comments
		Stability	Infiltration	Nutrients			
KANLOM RT 02	2018	Below analogue	Recently reached analogue	Recently reached analogue	0.7	0.53 (2019)	Below analogue soil stability values are likely due to the physical properties of the soil at this site. However, infiltration and nutrients now exceed analogue values. At this early stage, landscape organisation indices are all trending towards analogue values.
KANACA RT 01	2017	Below analogue	Recently reached analogue	Recently reached above analogue	0.7	0.79 (2018)	Although this site is only approximately three years old, it is approaching analogue composition and cover values as vegetation continues to develop and transform.
KANACA RT 02	2017	Above analogue	Above analogue	Above analogue	0.7	1.00 (2017, 2018 & 2019)	All landscape function indices and the LOI for this site are above analogue. The site will continue to be dominated by a near monoculture of native grass species until overstory vegetation components (trees) mature and compete with the grasses.
KANACA RT 03	2018	Below analogue	Below analogue	Almost reached analogue	0.7	1.00 (2019)	Although all landscape function indices are below analogue, this is a newly rehabilitated site and is therefore expected to improve over time.
KANGRA RT 01	2013	Hovering around (above/below) analogue	Below analogue but upwards trend	Recently reached above analogue	0.74	0.85 (2018)	Although soil stability and infiltration values are below analogue, they are trending towards analogue values.

Notes: Landscape function indices and landscape organisation indices (LOI) values that have reached or exceeded analogue values are highlighted in green, while values that have almost reached analogue values are highlighted in yellow and values that are below analogue values are highlighted in orange.

Appendix 4.

Vegetation Condition	Indicators for Condition	SEB Ratio
Poor. Weed-dominated with only scattered areas or patches of native vegetation	Vegetation structure no longer intact (e.g., removal of one or more vegetation strata).	2:1
	Scope for regeneration, but not to a state approaching good condition without intensive management.	
	Dominated by very aggressive weeds.	
	Partial or extensive clearing (greater than 50% of area).	
	Evidence of heavy grazing (tracks, browse lines, species changes, no evidence of solid surface crust).	
Moderate. Native vegetation with considerable disturbance	Vegetation structure substantially altered (e.g., one or more vegetation strata depleted).	4:1
	Retains basic vegetation structure or the ability to regenerate it.	
	Very obvious signs of long-term or severe disturbance.	
	Weed dominated with some very aggressive weeds.	
	Partial clearing (10 to 50% of area).	
	Evidence of moderate grazing (tracks, browse lines, soil surface crust extensively broken).	
Good. Native vegetation with some disturbance	Vegetation structure altered.	6:1
	Most seed sources available to regenerate original structure.	
	Obvious signs of disturbance.	
	Minor clearing (less than 10 % of area).	
	Considerable weed infestation with some aggressive weeds.	
	Evidence of some grazing (tracks, soil surface crust patchy).	
Very good. Native vegetation with little disturbance	Vegetation structure intact (e.g., all structure intact).	8:1
	Disturbance minor, only affecting individual species.	
	Only non-aggressive weeds present.	
	Some litter build-up.	
Intact vegetation	All strata intact and botanical composition close to original.	10:1
	Little or no signs of disturbance.	
	Little or no weed infestation.	
	Soil surface crust intact.	
	Substantial litter cover.	

Source: Table 1 of DWLBC (2005).

Figure 12. Vegetation condition and SEB ratio (Hillgrove Resources 2014).

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