UCML Floristic Monitoring 2017

Annual Report

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Abbreviations

Abbreviation	Description
BMP	Biodiversity Management Plan
BOA	Biodiversity Offset Area
BOM	Bureau of Meteorology
DBH	diameter at breast height
EEC	Endangered Ecological Community
ELA	Eco Logical Australia
EPBC	Environment Protection and Biodiversity Conservation
FBS	Floristic-based Subsidence
HBT	Habitat Tree
LGA	Local Government Area
MOP	Mining Operations Plan
MZ	Management Zone
PC	Performance Criteria
SOA	Salinity Offset Area
UCML	Ulan Coal Mines Limited

1 Introduction

Eco Logical Australia (ELA) was engaged by Ulan Coal Mines Limited (UCML) to undertake floristic monitoring during autumn and spring 2017. Monitoring was undertaken in accordance with the requirements of the UCML Biodiversity Management Plan v3.9 (BMP) (UCML 2015), and recommendations outlined in ELA (2017).

1.1 Background

UCML is a joint venture between Glencore Coal Assets Australia Pty Limited (Glencore) (90%) and Mitsubishi Development (10%). Glencore maintains management responsibility for the UCML complex.

UCML is located approximately 1.5 kilometres from Ulan Village, within the Mid-Western Regional Council Local Government Area (LGA). The UCML complex is located 38 kilometres north-north-east of Mudgee and 19 kilometres north-east of Gulgong in New South Wales. UCML landholdings straddle the Great Dividing Range and are located at the headwaters of the Goulburn and Talbragar River Catchments.

The UCML complex comprises an approximate area of 13,700 hectares (ha), made up of:

- Open Cut Mining – approximately 239 ha of open cut operations.
- Previous Mining and Surface Infrastructure Areas – approximately 1,004 ha of previous open cut mining areas that have a combination of rehabilitation areas and final voids that remain to support future mining activities (water storage, tailings disposal, underground access etc.), the rehabilitation makes up 475 ha of this area.
- Residual Project Area – the remainder of the Project Area (approximately 10,711 ha) that is not subject to the current project. This includes large areas that have been previously undermined, agricultural grazing land, irrigation pivots and large areas of remnant native vegetation.
- Biodiversity Offset and Cliffline Management Areas, including:
    - Bobadeen Vegetation Offset Area – 992 ha
    - Bobadeen East Vegetation Offset Area – 124 ha
    - Brokenback Conservation Area – 58 ha
    - Spring Gully Cliffline Management Area – 273 ha
    - Bobadeen Vegetation Offset Corridor – 243 ha
    - Highett Road *Acacia ausfeldii* Management Area – 21 ha.
- Salinity Offset Area – 4465 ha which overlaps parts of the Biodiversity Offset Areas and Residual Project Area.

UCML developed a Biodiversity Management Plan (BMP) to satisfy the requirements of Condition 44, Schedule 3 of the Project Approval (PA 08_0184) and to satisfy the requirements of the Federal Approval (EPBC Ref: 2009/5252).

1.2 UCML Management Zones

The BMP divides the UCML complex into six Management Zones (MZs) (**Figure 1-1**) based on the vegetation condition and the management strategies to be undertaken within these areas. The Management Zones are:

- MZ1 (Benchmark Vegetation) – remnant woodland areas which are of benchmark condition and exhibit high native species richness and vegetation structure. Large areas of MZ1 have undergone some form of historical disturbance, mostly in the form of logging.
  MZ1 includes the Brokenback Conservation Area, Spring Gully Cliff Line Management Area and Highett Road *Acacia ausfeldii* Management Area, and areas of the wider UCML complex;
- MZ2 (Natural Regeneration) – previously cleared areas containing components of benchmark vegetation and often directly adjacent to remnant woodland (i.e. sources of natural recruitment). These areas are managed to avoid adverse disturbances and to maximise regeneration success;
- MZ3 (Assisted Revegetation) – disturbed areas within BOAs which require intervention to revegetate the structure and dominant species composition of disturbed vegetation to a condition similar to that of the corresponding benchmark community;
- MZ4a (Salinity Offset Area Regeneration/Revegetation) – disturbed areas within the Salinity Offset Areas (SOAs) which area managed to encourage natural regeneration of cleared areas in combination with continued grazing, on-going management includes;
- MZ4b (Salinity Offset Area Benchmark Vegetation) – remnant woodland areas of benchmark condition within SOAs which are managed to maintain or increase biodiversity values (as per MZ1);
- MZ5 (Operational Area) – includes areas of existing and previous mining operations including the former open cut rehabilitation areas and the Goulburn River diversion remediation area. These areas are subject to progressive rehabilitation with the primary objective of creating a stable landform comprising native vegetation communities characteristic of pre-mining compositions;
- MZ6 (Agricultural Leasehold and Private Property) – areas of agricultural leasehold and private property within the UCML complex which are utilised for cattle grazing. These lands are managed consistent with the relevant requirements of the Project Approval and the UCML Environmental Management Strategy.

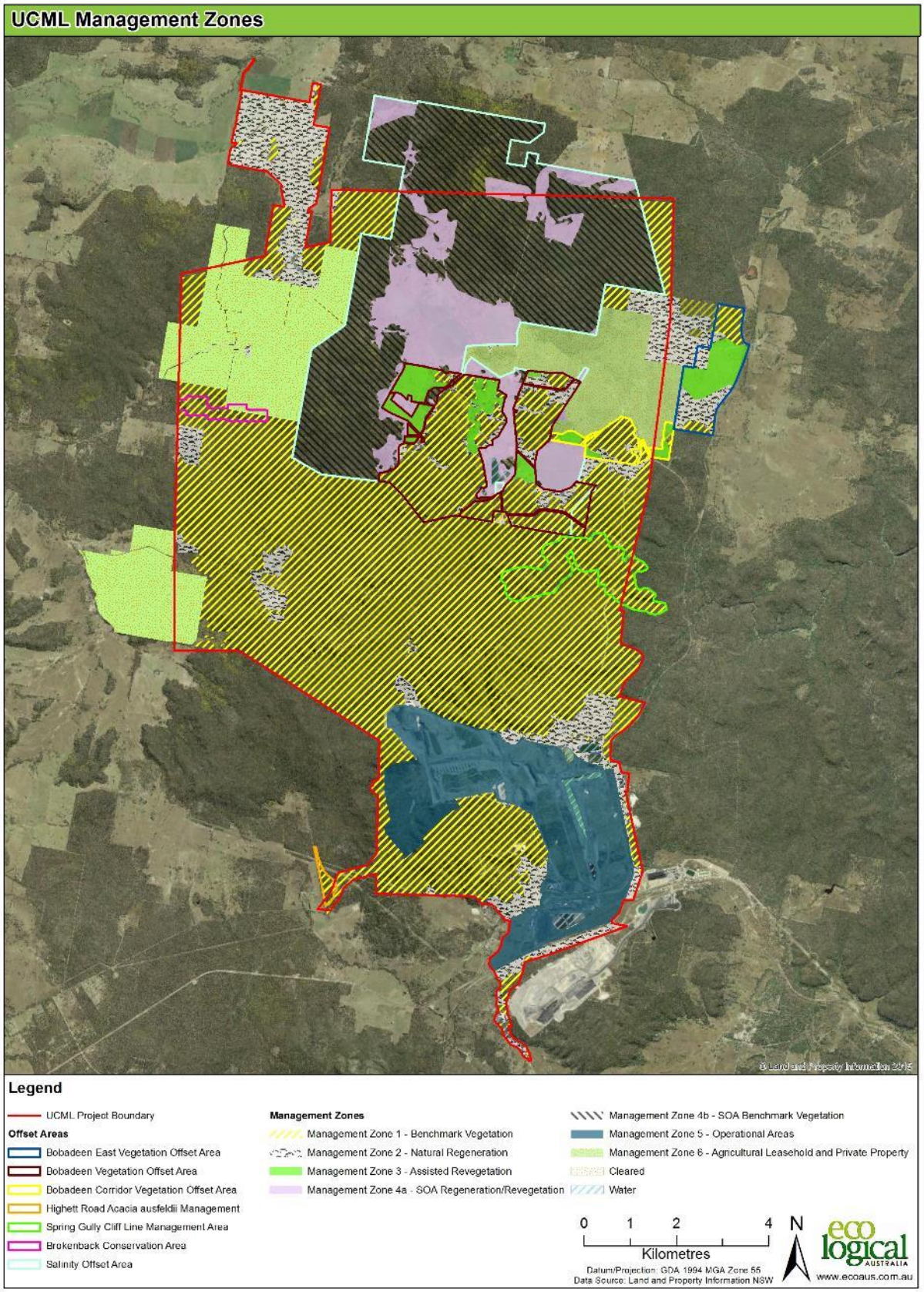


Figure 1-1: Management Zones within the UCML complex

2 Results and Discussion

2.1 Overview

A total of 78 sites underwent monitoring during the 2017 monitoring program (**Table A1, Appendix A**). Amongst these were 47 floristic sites, consisting of 23 full floristic and 24 rapid assessment sites. The data collected within these floristic sites during 2017 add to an already existing database of 373 plot surveys undertaken between 2011 and 2015 (**Appendix I**). This database is inclusive of both ongoing and discontinued monitoring sites.

The 2017 monitoring program (as outlined in the revised BMP) only covers a proportion of existing sites, particularly with regards to full floristic monitoring. The sites surveyed in 2017 have been added to previous years' data to update analysis of long term trends that are occurring within Management Zones, as well as the associated BioMetric Vegetation Types (BVTs).

BVT benchmarks used in the following analysis are those set out in the UCML BMP, which were specifically developed for the Ulan Project's revegetation and regeneration areas, and derived from MZ1 data. However, the benchmarks in the UCML BMP do not include habitat factors such as habitat trees (HBTs) and large woody debris. At this time Hunter-Northern Rivers BVT Benchmarks (OEH, 2008) are used in any analysis done of habitat.

2.2 Management Zone 1 (Benchmark Vegetation)

Forest or woodland vegetation communities that are relatively intact, in good condition and have high species richness (UCML, 2015). MZ1 provides benchmarks for revegetation, regeneration and rehabilitation of all remaining MZs at UCML. BVT benchmarks are not applied as performance criteria, but have been used as a useful tool to provide an insight into the nature of variation over the years.

Management aims for this MZ1 are:

- Protection from ongoing impacts, and
- The improvement of existing flora habitat, and
- The improvement of existing fauna habitat values, and
- Control noxious weeds.

Specific performance criteria relevant to MZ1 are:

- From Year 3 (2014): There is no significant weed infestation such that weeds do not comprise a significant proportion of species in any stratum
- Year 9 (2020): < 15% cover of weeds in each vegetation community*
- Year 15 (2026): < 5% cover of weeds in each vegetation community*.

**Excluding saffron thistle which is expected to decline naturally as a canopy cover develops*.

2.2.1 2017 monitoring results

Twenty-eight (28) monitoring sites located within MZ1 (comprising thirteen full floristic plots and fifteen rapid assessment sites) were surveyed during 2017 (**Table A1 - Appendix A**). Both total and native species richness within all MZ1 sites was above the average scores obtained during previous years.

Exotic plant species groundcover was <5% for the majority of MZ1 sites with the balance of sites having exotic groundcover less than 15%, the target for 2020. However, the exception to this was site RPA3A, which recorded an exotic cover (20%) which is in excess of the 2020 target.

Monitoring sites within MZ1 for 2017 recorded their respective BVT benchmark or exceeded it for structural diversity in term of logs (>10 cm diameter) and hollow-bearing trees. Vegetation stratum was present in the manner expected of different BVTs. Biometric data for all full floristic sites in MZ1 is presented in **Appendix D**, whilst rapid assessment data is presented in **Appendix E**.

2.2.2 Long term trends

Since commencement of surveys in 2011, plant species richness counts have fluctuated with change generally explained by seasonal variations and specific site conditions.

Each BVT in MZ1 has achieved its respective benchmark for native species richness when averaged across the years. Failure to achieve benchmark levels is concentrated in the years 2013 and 2014.

Table 2-1: **Averages of Native Species Richness by year per BVT – MZ1 (No HU608 sites surveyed in 2017)**

BVT	2011	2012	2013	2014	2015	2016	2017	Average	BVT Benchmark	No. of sites	Area (ha)
HU515	35	29	23	23	26	35	47	31	25	9	531.7
HU551	36	44	33	36	35	32	36.5	36	35	3	3.8
HU552	29	27	20	21	23	27	33	26	23	15	29.7
HU574	31	30	21	31	35	39	40	32	26	2	594.0
HU575	32	40	21	29	32	33	34.5	32	29	3	639.9
HU605	41	34	25	24	23	29	32.7	30	29	8	1252.8
HU608	48	42	29	30	31	17	N/A	35	25	5	1434.6
HU654	31.75	40.5	23.8	24.5	28.5	32	35	31	23	7	203.4

HU515: Blakely's Red Gum – Yellow Box grassy open forest or woodland of the New England Tablelands

Figure 2-1 displays native species richness on a site by site basis across all years for HU515 sites within MZ1. The results demonstrate variable scores, with no clear trend seen. As indicated in the 2016 UCML Annual Floristic Report (ELA, 2017a), the reasons for this variability are not known, but are likely related to ecological variation between sites of the same vegetation community. These results reflect the variation within woodlands observed during research when comparing the results of individual monitoring sites (Stol and Prober, 2014).

Six of the nine sites located within HU515 have achieved benchmark scores for native species richness on at least one occasion.

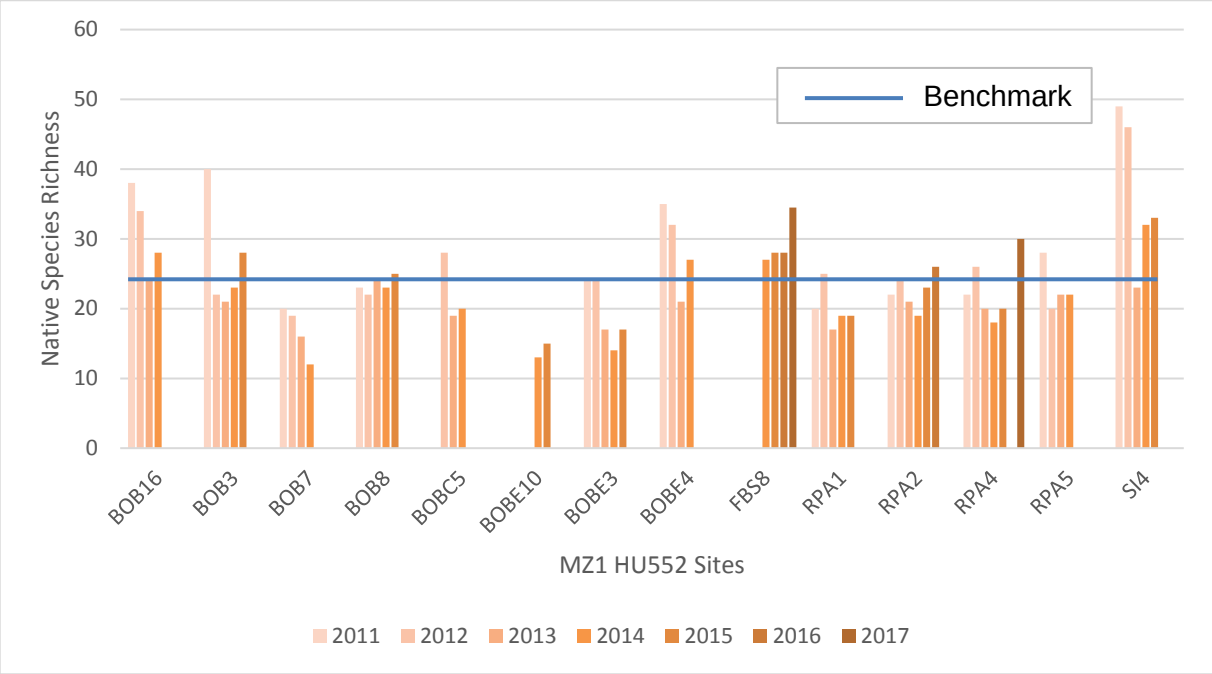


Figure 2-1: Native species richness in HU515 sites – MZ1

Exotic groundcover for HU515 sites in MZ1 across all years is displayed in **Figure 2-2**. All sites recorded <15% exotic cover, the performance target for 2020 (UCML, 2015). Only two sites have not recorded exotic covers within the 2026 target of <5%. The two sites that are exceptions to this are BOB11 and RPA13 which have a history of clearing in the past. Overall, HU515 sites within MZ1 are tracking positively in relation to the exotic cover performance criteria.

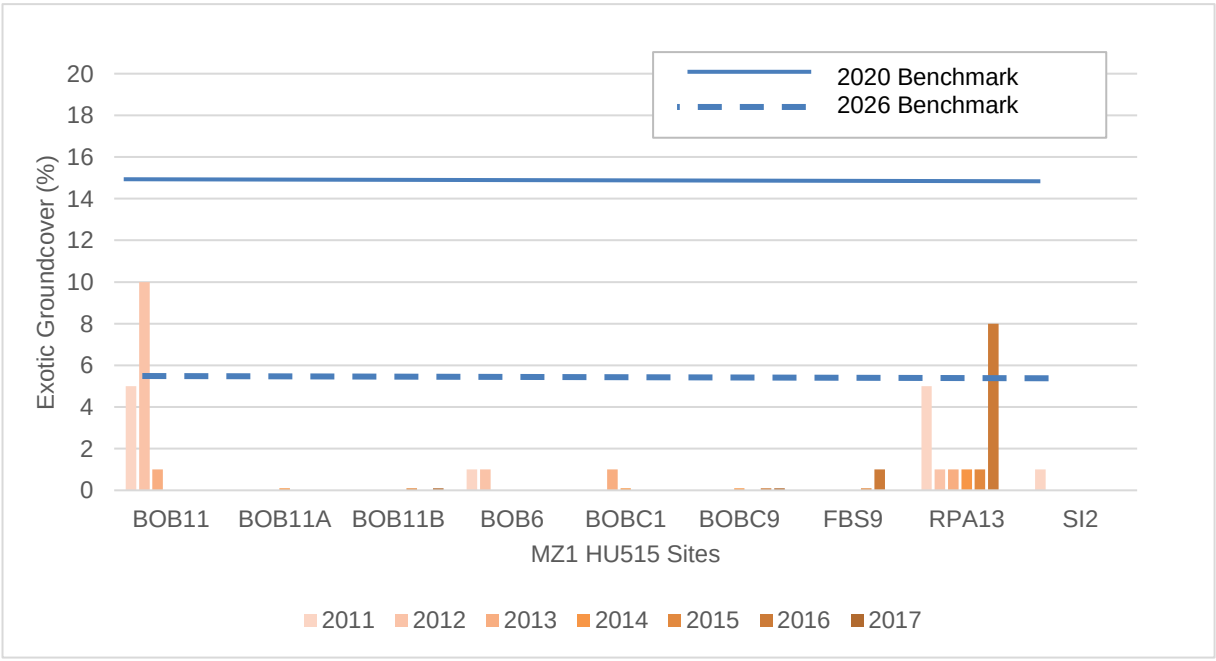


Figure 2-2: Exotic groundcover in HU515 sites - MZ1

HU515 sites within MZ1 contain a range of fauna habitat features including vegetation structural complexity, hollow-bearing trees (HBTs) and fallen logs. Two of three sites assessed for HBTs meet the benchmark (one HBT) for this community, whilst four of the six sites assessed for fallen logs also meet the relevant benchmark (5 metres). It is expected that fauna habitat values will continue to improve within this community over the medium to long term.

HU551: Grey Box – Narrow-leaved Ironbark shrubby woodland on hills of the Hunter Valley, North Coast and Sydney Basin

Figure 2-3 displays native species richness on a site by site basis across all years for HU551 sites within MZ1. The results demonstrate highly consistent scores both within and between sites, with all scores close to reaching the benchmark of 35 native species.

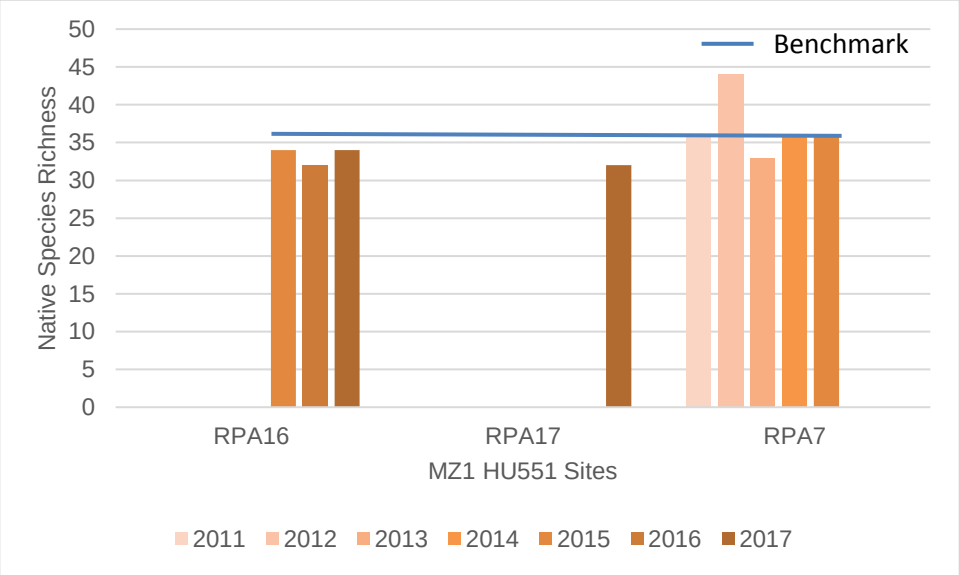


Figure 2-3: Native species richness in HU551 sites – MZ1

Exotic groundcover for HU551 sites in MZ1 across all years is displayed in **Figure 2-4**. These sites demonstrate exotic cover scores achieving the 2026 performance target of <5%. As such, these sites are tracking positively against the performance criteria for exotic groundcover.

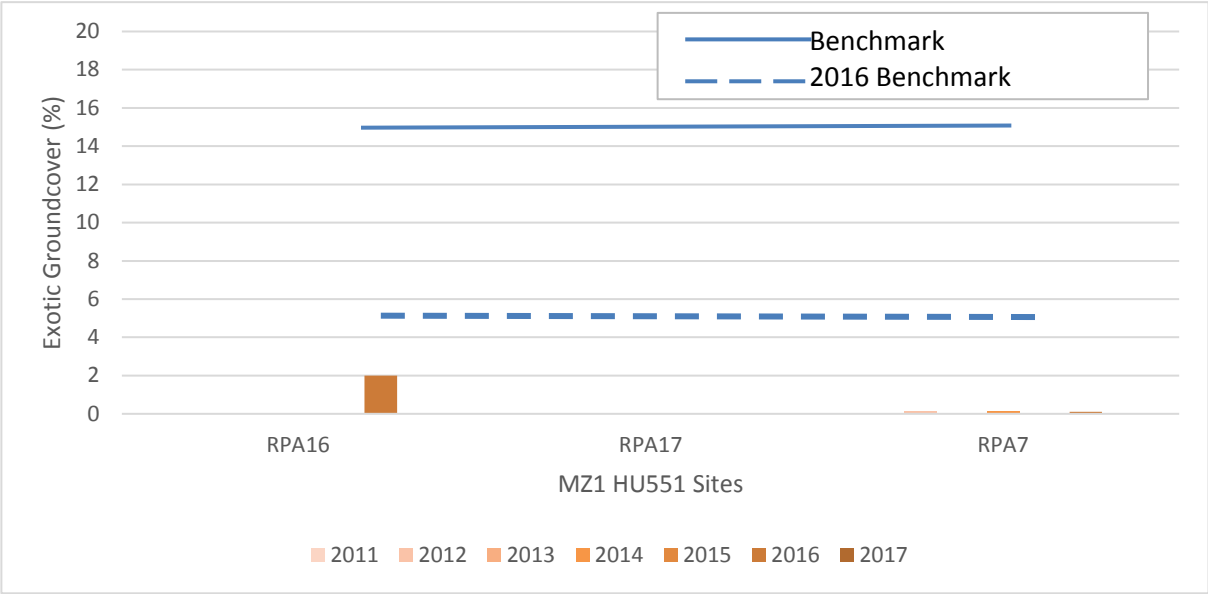


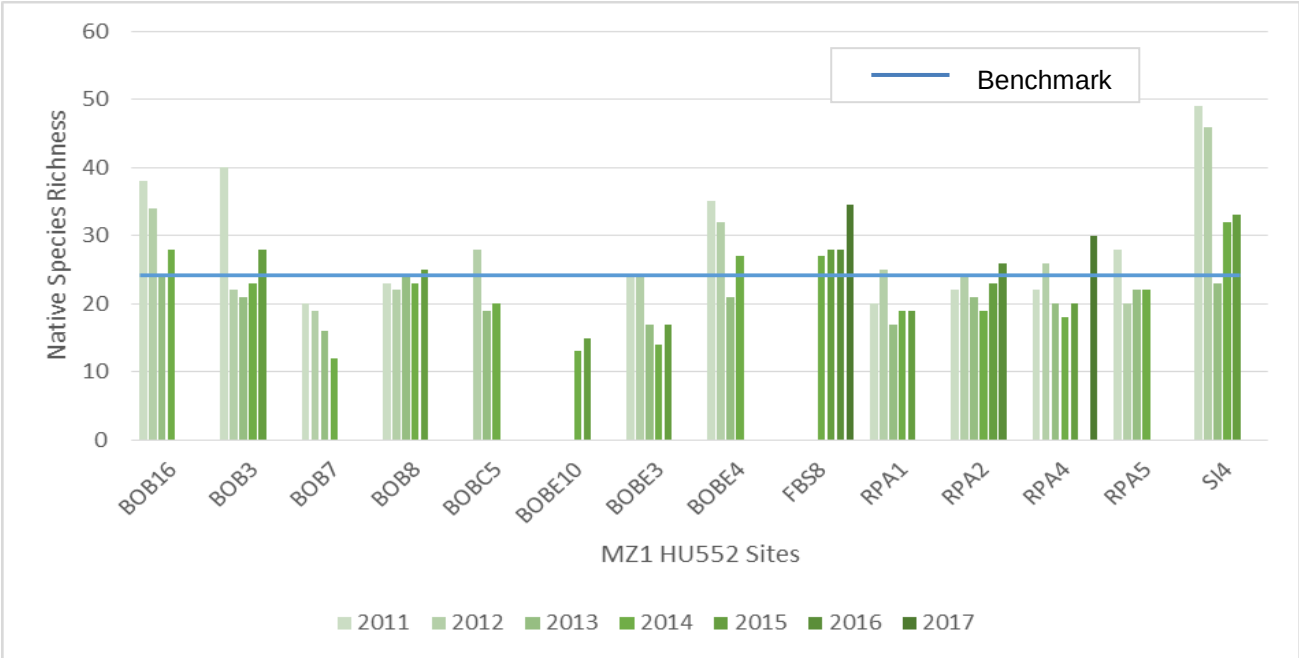
Figure 2-4: Exotic groundcover in HU551 sites - MZ1

HU551 sites within MZ1 contain a range of fauna habitat features including vegetation structural complexity and fallen logs. Neither of the two sites assessed for HBTs meet the benchmark (three HBTs) for this community, however, both sites assessed for fallen logs also meet the relevant benchmark (5 metres). It is expected that fauna habitat values will continue to improve within this community over the medium to long term.

HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin

Figure 2-5 displays native species richness on a site by site basis across all years for HU552 sites within MZ1. The results demonstrate variable scores, with no clear trend visible across years. The reasons for this variability are not known, but is likely related to seasonal differences in weather conditions and survey timing.

Figure 2-5: Native species richness in HU552 sites – MZ1



Twelve of the fourteen sites located within HU552 have achieved benchmark scores for native species richness on at least one occasion.

Exotic groundcover for HU552 sites in MZ1 across all years is displayed in **Figure 2-6**. These sites recorded exotic covers which met the 2026 performance target of <5%. As such, these sites are tracking positively with regards to this performance criteria.

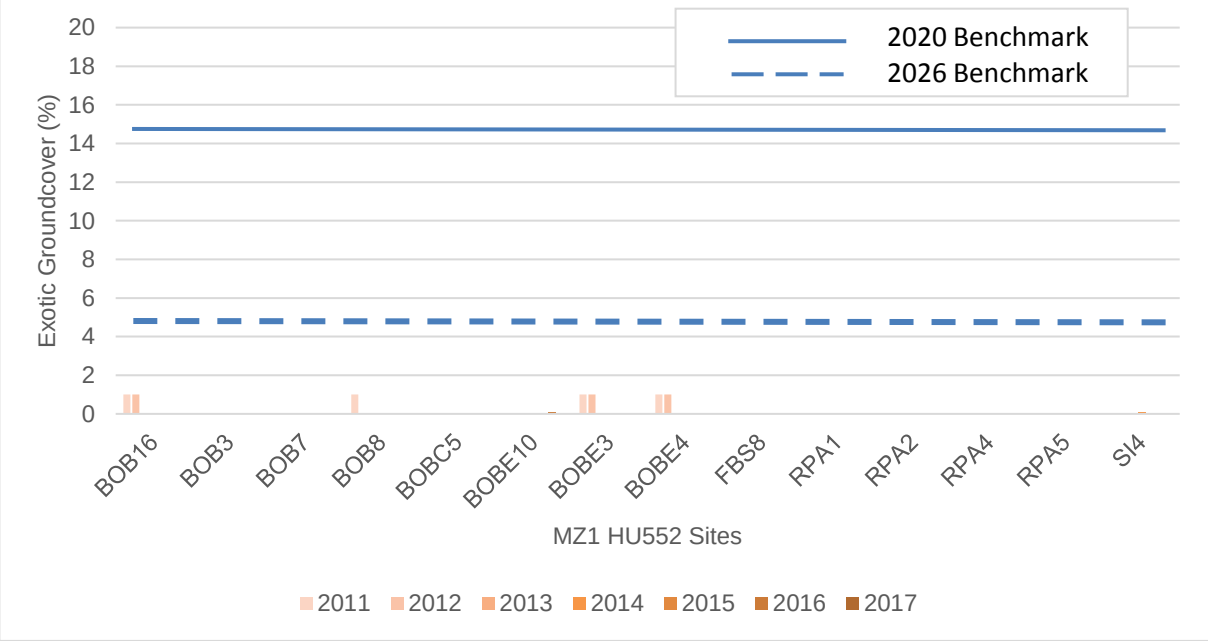


Figure 2-6: Exotic groundcover in HU552 sites - MZ1

HU552 sites within MZ1 contain a range of fauna habitat features including vegetation structural complexity and HBTs. It is expected that fauna habitat values will continue to improve within this community over the medium to long term, particularly with regards hollow bearing tree density.

HU574: Narrow-leaved Ironbark – Grey Gum shrubby woodland on footslopes on the upper Hunter Valley, Sydney Basin / HU575: Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin

Figure 2-7 displays native species richness on a site by site basis across all years for HU574 and HU575 sites within MZ1. All five sites located within HU574 and HU575 have achieved above benchmark scores for native species richness for the majority of years surveyed. The results demonstrate slightly variable scores, with no clear trend discernible, other than that which can be explained by seasonal conditions.

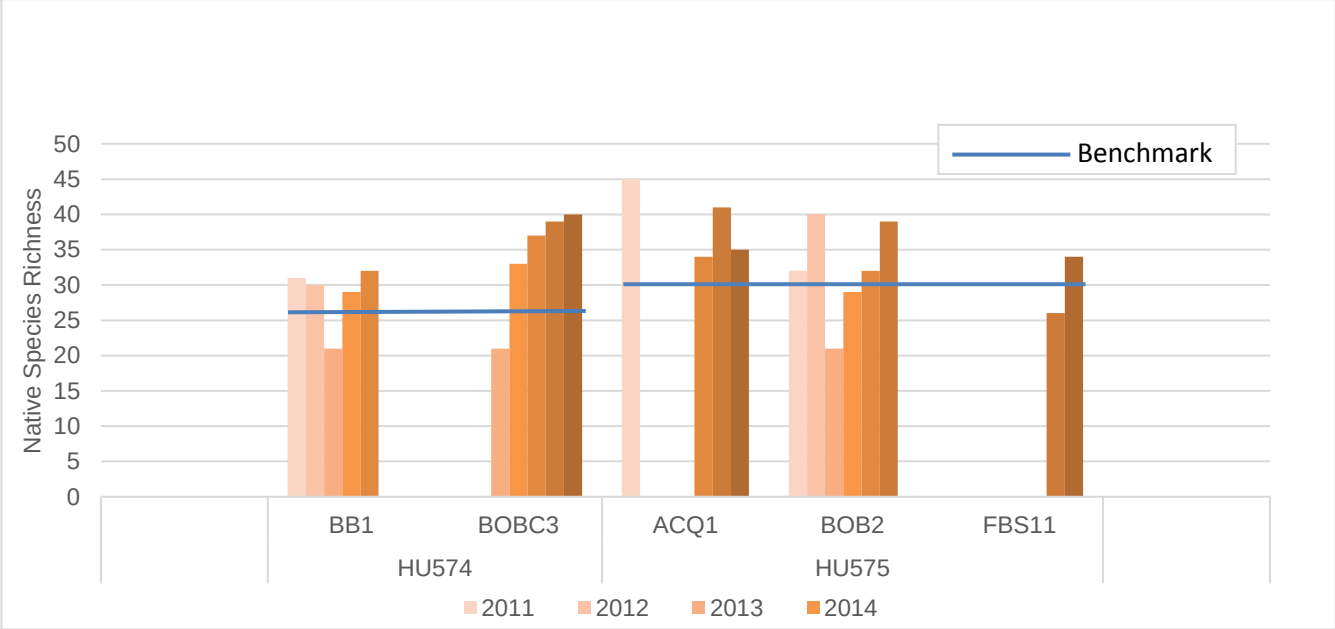


Figure 2-7: Native species richness in HU574 / HU575 sites – MZ1

Exotic groundcover for HU574 and HU575 sites in MZ1 across all years is displayed in **Figure 2-8**. These sites recorded exotic plant cover below both the 2020 and 2026 performance target of <15% and <5% respectively. As such, these sites are trending positively with regards to their respective performance criteria.

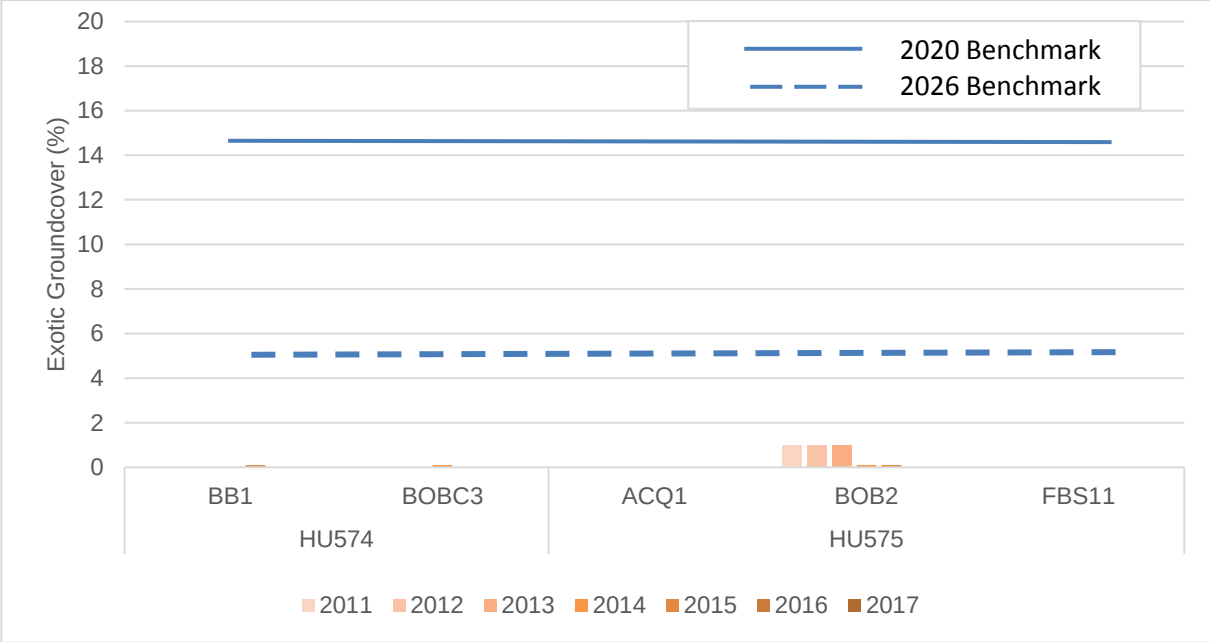


Figure 2-8: Exotic groundcover in HU574 / HU575 sites - MZ1

Despite containing a range of fauna habitat features, including both HBTs and fallen logs, the one site in HU574 (BOBC3) assessed for both of these features is currently below its respective benchmark values (3 HBTs and 70 metres). Of the three sites in HU575 assessed for HBTs and fallen logs, one site is currently meeting the benchmark for HBTs (3 HBTs), whilst two sites are meeting the benchmark for fallen logs (73 metres).

HU605: Rough-barked Apple grassy open forest on valley flats of the North Coast and Sydney Basin

Figure 2-9 displays native species richness on a site by site basis across all years for HU605 sites within MZ1. The results are again quite variable with no clear trend visible.

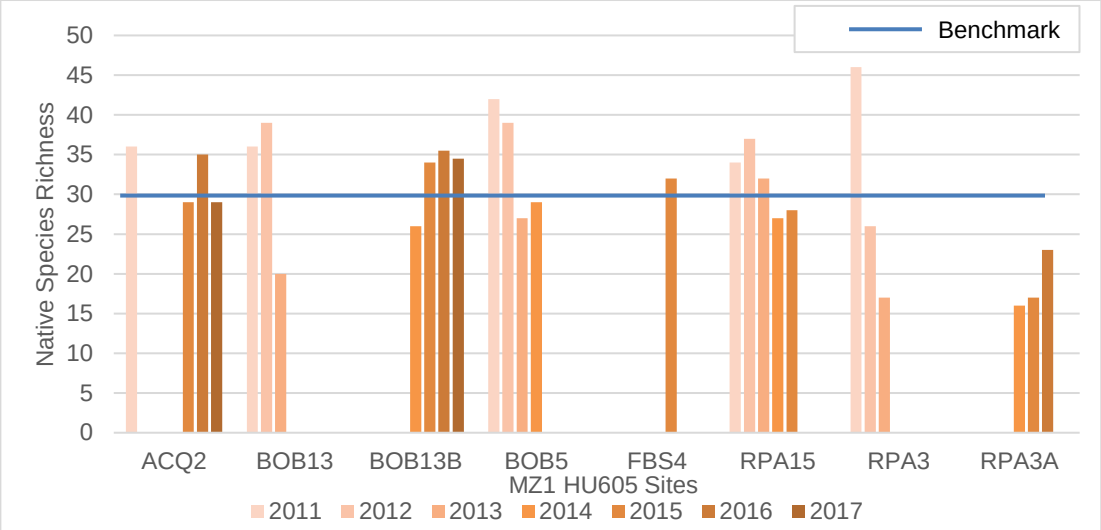


Figure 2-9: Native species richness in HU605 sites – MZ1

Seven of the eight sites within HU605 have exceeded the native species richness benchmark (29 species) in at least one year. The only site not to achieve the benchmark is RPA3A, which is located within a previously disturbed section of the Ulan Creek riparian corridor and contains significant annual exotic species in the groundcover.

Exotic groundcover for HU605 sites within MZ1 is displayed in **Figure 2-10**. Sites are performing well against the 2020 and 2026 performance targets of <15% and <5% respectively, with only the aforementioned site RPA3A recording a score in excess of the 2020 target. Two other sites (BOB13 and RPA3) with a history of clearing, have recorded scores for exotic groundcover in excess of the 2026 target, however, these were in the years 2011 to 2012, with their most recent scores falling well below the target of <5%.

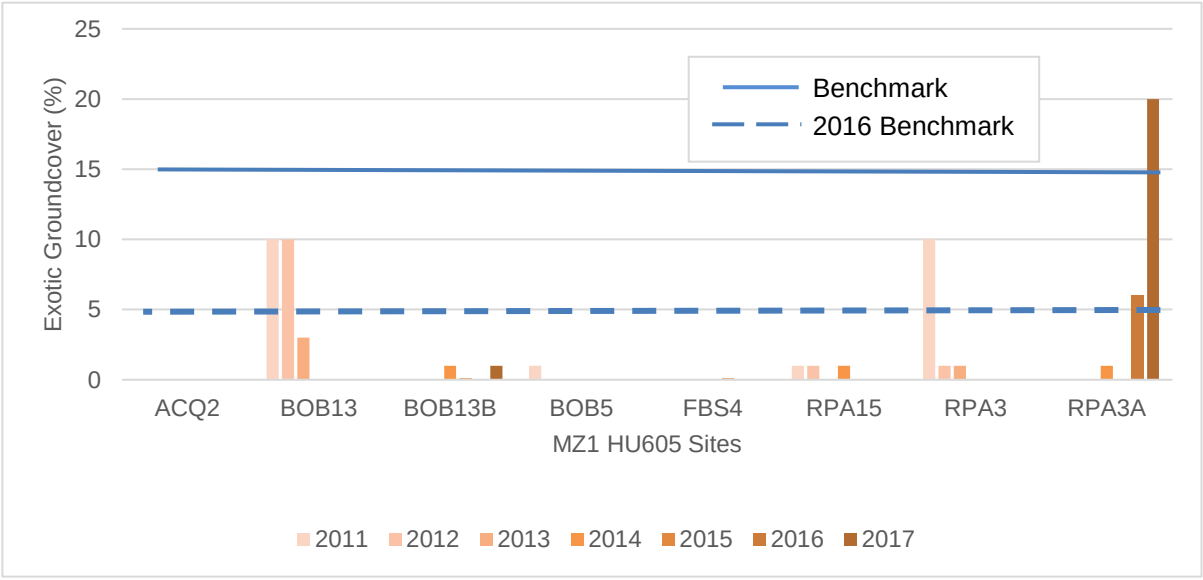


Figure 2-10: Exotic groundcover in HU605 sites – MZ1

HU605 sites within MZ1 contain a range of fauna habitat features including vegetation structural complexity and fallen logs. None of the two sites assessed for HBTs meet the benchmark (1.5 HBTs) for this community, whilst two of three sites assessed for fallen logs meet the relevant benchmark (10 metres). Past logging may help to explain the below benchmark HBT results. It is expected that fauna habitat values will continue to improve within this community over the medium to long term.

HU608: Scribbly Gum – Brown Bloodwood woodland on the southern Brigalow Belt South

Figure 2-11 displays native species richness on a site by site basis across all years for HU608 sites within MZ1. The results show the broad trend in **Table 2.1** of seasonal fluctuations across MZ1 sites.

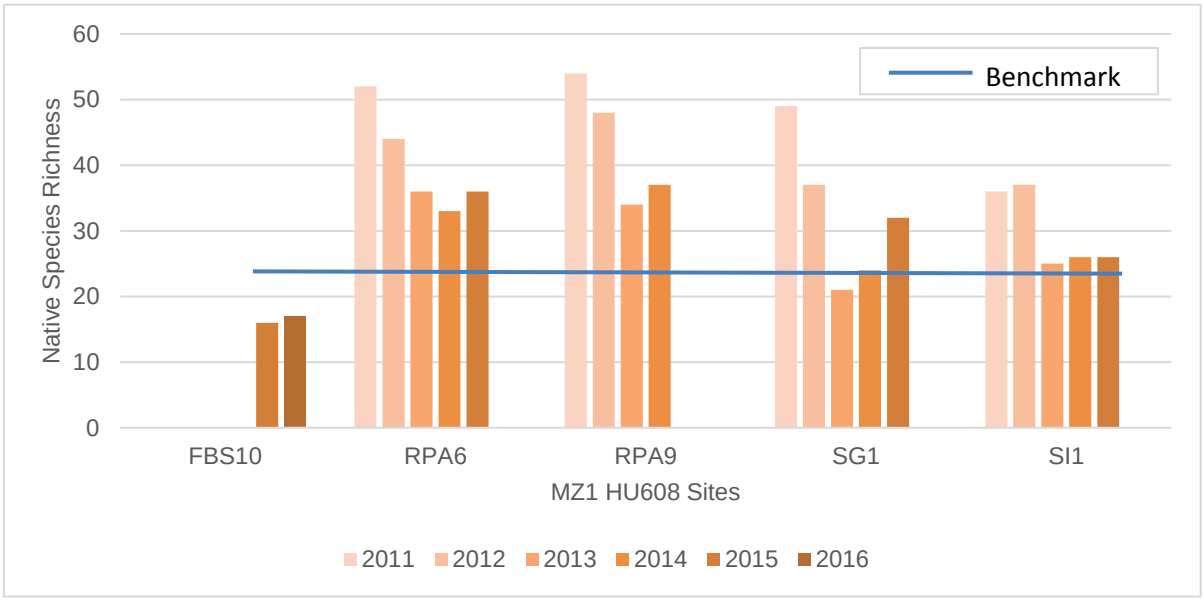


Figure 2-11: Native species richness in HU608 sites – MZ1

Four of the five sites have scores above the native species richness benchmark (25 species), with three of these sites meeting the benchmark for all survey years. The only site not to achieve benchmark is FBS10 which was cleared between 1964 and 1990. Overall, HU608 sites within MZ1 are generally achieving benchmark levels for native species richness.

Exotic groundcover for HU608 sites in MZ1 across all years is displayed in **Figure 2-12**. These sites all demonstrate low exotic covers, with all scores below both the 2020 and 2026 performance target of <15% and <5% respectively. As such, these sites are tracking positively with regards their respective performance criteria.

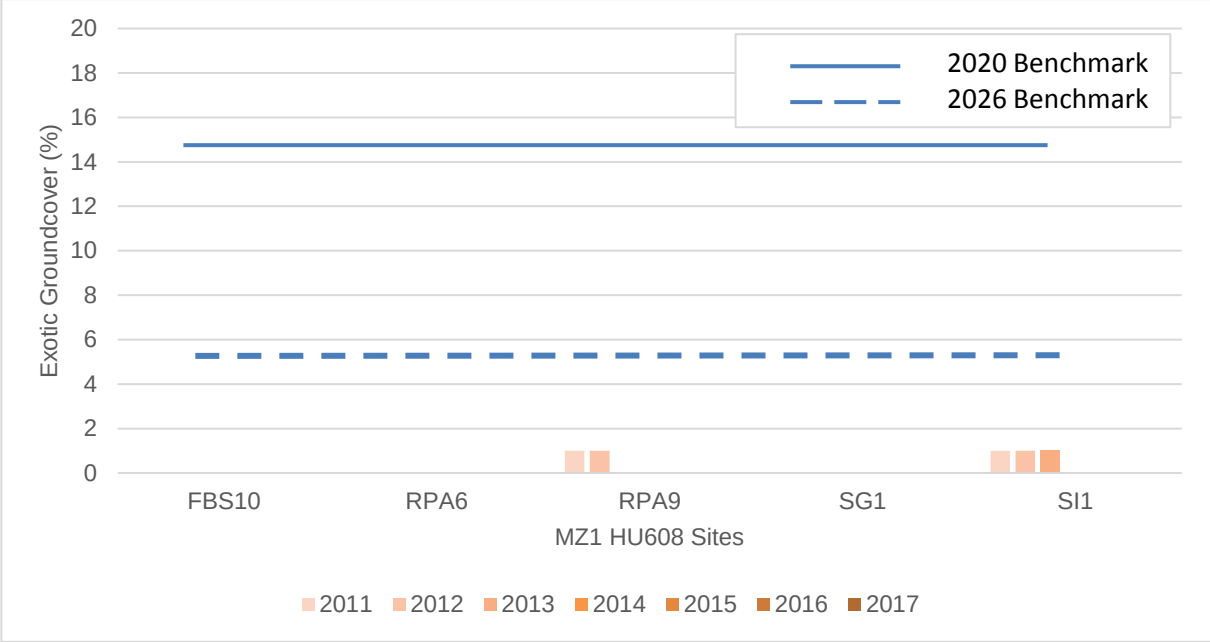


Figure 2-12: Exotic groundcover in HU608 sites – MZ1

Despite containing a range of fauna habitat features, including both vegetation structural complexity and fallen logs, only one (FBS10) of the three sites assessed for fallen logs meets the benchmark for the community of 66 metres. FBS10 was also assessed for HBTs (benchmark of 0.8) however, none were recorded for this site. The fallen logs are explained by previous clearing and the toppling over of the pioneer species *Acacia linearifolia*. Lack of HBTs is explained by the short period since commencement of regeneration of cleared lands.

HU654: White Box – Yellow Box grassy woodland on basalt sloped in the upper Hunter Valley, Brigalow Belt South

Figure 2-13 displays native species richness on a site by site basis across all years for HU654 sites within MZ1. The results are highly variable with no clear trend visible.

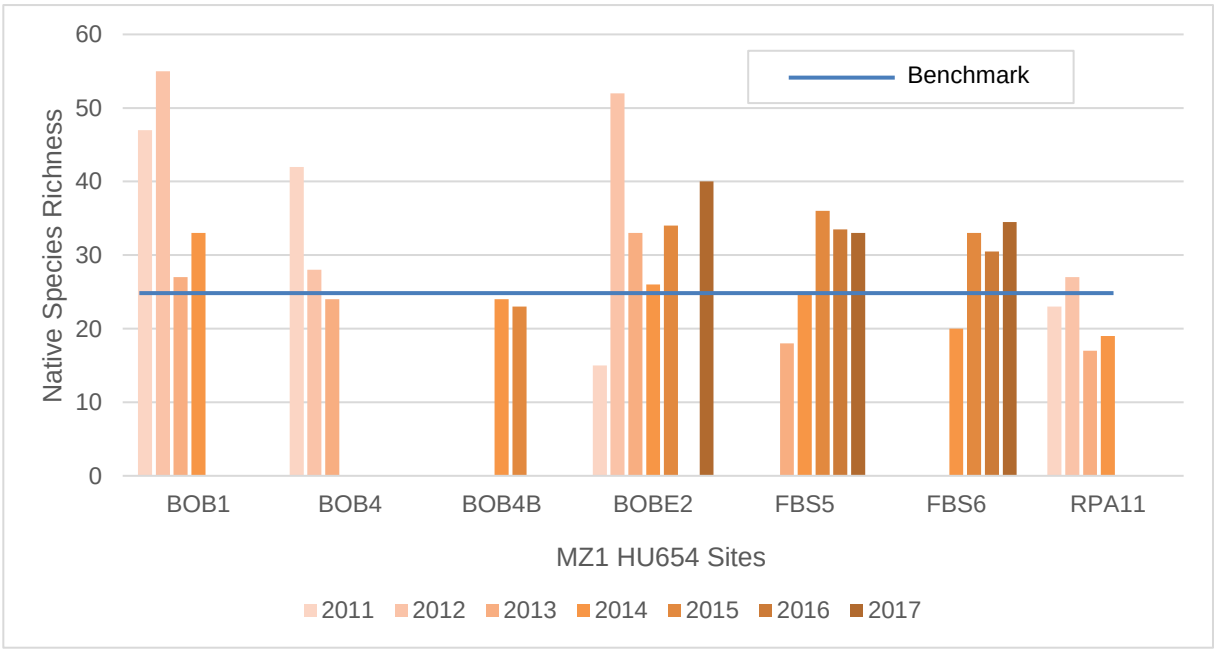


Figure 2-13: Native species richness in HU654 sites – MZ1

All seven sites within HU654 have achieved above the native species richness benchmark (23 species) for at least one year. Additionally, for those sites surveyed in the last three years, all scores have been at or above the benchmark level.

Exotic groundcover for HU654 sites within MZ1 is displayed below in **Figure 2-14**. Overall, these sites are performing well against the 2020 and 2026 performance targets of <15% and <5% respectively, with no sites in excess of the 2026 target and only three sites (BOBE2, FBS6 and RPA12) recording a score in excess of the 2020 target. Of these three sites, only one site (FBS6) surveyed in the last two years recorded a score in excess of the 2020 target. Site FBS6 is located adjacent to grassland, and is likely suffering edge effects.

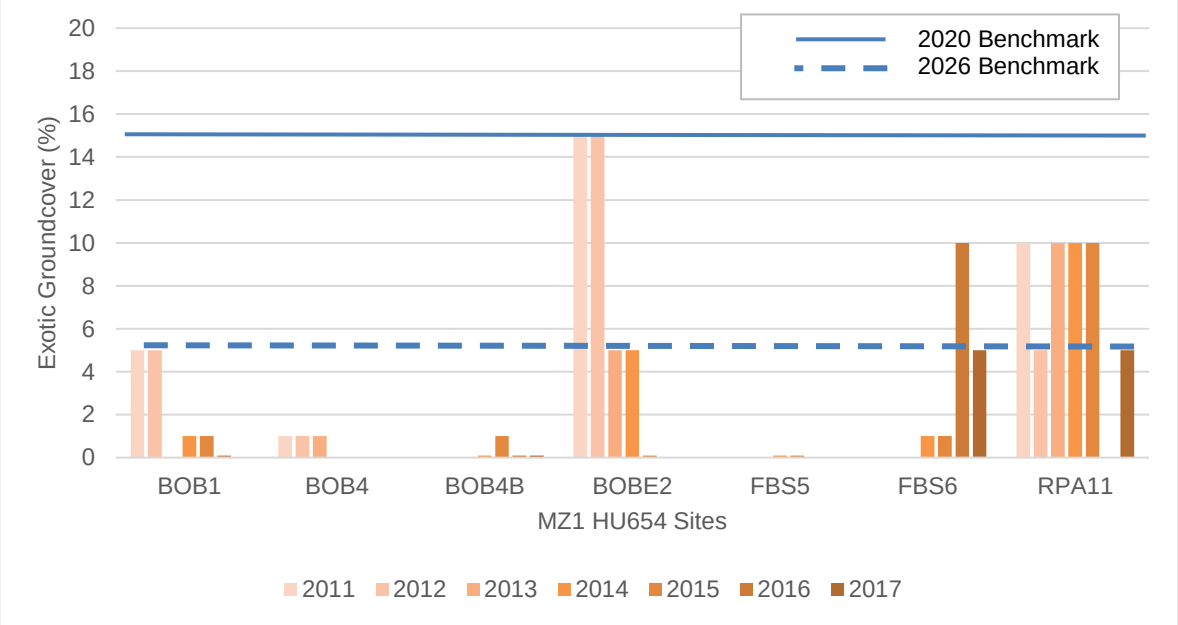


Figure 2-14: Exotic groundcover in HU654 sites – MZ1

HU654 sites within MZ1 contain a range of fauna habitat features including vegetation structural complexity and HBTs. With regards to fauna habitat features, one of the three HU654 sites in MZ1 sites assessed for HBTs meet the benchmark (2 HBTs) for this community, whilst none of the five sites assessed for fallen logs meet the relevant benchmark (50 metres). Aerial photography from 1964 and 1990 shows that these sites were previously cleared or heavily thinned, and these past land uses are likely contributing to the failure of these sites to meet the relevant benchmarks. It is expected that fauna habitat values will continue to improve within this community over the medium to long term, particulary in regards hollow bearing trees.

2.3 Management Zone 2 (Natural Regeneration)

MZ2 is comprised of previously cleared land that is expected to naturally regenerate to the vegetation communities that existed prior to disturbance/clearing. Areas of MZ2 are generally located adjacent to remnant woodland, which acts as a seed source and provides regrowth in the form of juvenile suckers. There are existing occurrences of natural regeneration already within MZ2.

The relevant Biometric benchmark values are used for each vegetation community to determine regeneration success within MZ2 as per Section 7.9 of the BMP.

Management aims for this MZ2 are:

- Protection from ongoing impacts, and
- Protect and improve of existing flora habitat,
- Protect and improve existing fauna habitat values, including connectivity,
- Determine the effectiveness of natural regeneration and identify areas of change where targeted plantings or seeding may be required, and
- Control noxious weeds

Specific performance criteria relevant to MZ2 (UCML BMP v3.9, Table8.1) are:

- From Year 6 (2017): species diversity and vegetation density trending towards each respective benchmark for the relevant vegetation community
- Year 9 (2020): < 15% cover of weeds in each vegetation community
- Year 9 (2020): Restore native groundcover to 75% benchmark condition (for those areas in BOA)
- Year 12(2023): Restore native mid-storey cover to 75% of BVT benchmark (for those areas in BOA)
- Year 15(2026): Restore canopy cover to 75% of BVT benchmark (for those areas in BOA)
- Year 15 (2026): < 5% cover of weeds in each vegetation community*.

* *Excluding saffron thistle which is expected to decline naturally as a canopy cover develops.*

Trigger values to investigate intervention for natural regeneration areas of Box-Gum Woodlands and habitat of threatened woodland birds that (UCML BMP v3.0, Table 20) are:

- A decrease in cover abundance of 10% or more when compared to analogue community variation,
- Presence of noxious weed species,
- Any factor likely to have a detrimental impact on vegetation condition or native fauna.

2.3.1 2017 monitoring results

Ten (10) monitoring sites located within MZ2 (comprising seven full floristic plots and three rapid assessment sites) were surveyed during 2017 (**Table A1 - Appendix A**). All sites recorded above average scores for native species richness compared to previous years. Exotic species richness and groundcover was low, with the exception of site RPA14A, and SI3B which recorded covers in excess of the <15% target for 2020. These results are consistent with those recorded in previous years for sites within MZ2.

Fauna habitat values within MZ2 sites remain limited, with HBTs and fallen logs (>10 cm diameter) only present at a select number of sites and in quantities below the respective benchmark values. Biometric data for all full floristic sites in MZ2 is presented in **Appendix D**, whilst rapid assessment data is presented in **Appendix E**.

2.3.2 Long term trends

An examination of trends in native species richness for MZ2 (**Table 2-2**) shows fluctuations between years. This trend was also observed in MZ1 and MZ3, and is likely due to seasonal variance.

When averaged across all years, each BVT present within MZ2 bar one (HU605) are currently meeting their respective BVT benchmarks for native species richness.

Table 2-2: Native species richness for each BVT in MZ2 across years

BVT	2011	2012	2013	2014	2015	2016	2017	Average	BVT Benchmark	No. of sites	Area (ha)
HU515					30	31	38	33	25	1	74.6
HU552					26	21	27	25	23	1	151.6
HU605	24	28	20	20	23	31	27	25	29	9	188.5
HU654	25	27	13	19	22	24	28	23	23	6	253.8

HU515: Blakely's Red Gum – Yellow Box grassy open forest or woodland of the New England Tablelands / HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin

Figure 2-15 displays native species richness on a site by site basis across all years for HU515 and HU552 sites within MZ2. Each site displays relatively consistent scores across the three years in which they have been surveyed. Site BOBC10 (HU515) has recorded a trend of increasing native species richness across successive years, with all years above the benchmark of 25 species. Site BOB22 (HU552) displays consistent scores which are all close the benchmark of 23 species for this community and above the 75% of benchmark target for 2023. No clear trend is currently visible for site BOB22 in regards to native species richness.

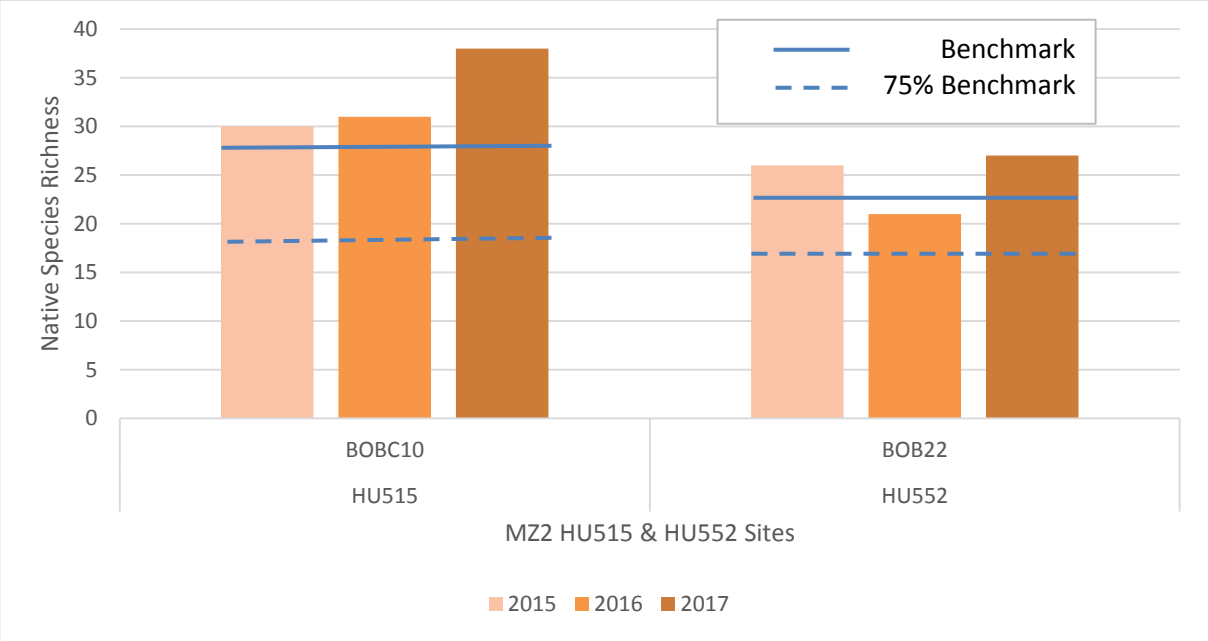


Figure 2-15: Native species richness for all HU515 / HU552 sites – MZ2

Exotic groundcover for HU515 and HU552 sites in MZ2 for all survey years is displayed in **Figure 2-16**. These sites have exotic covers achieving the 2026 performance target of <5%. As such, these sites are tracking positively with regards to their respective performance criteria.

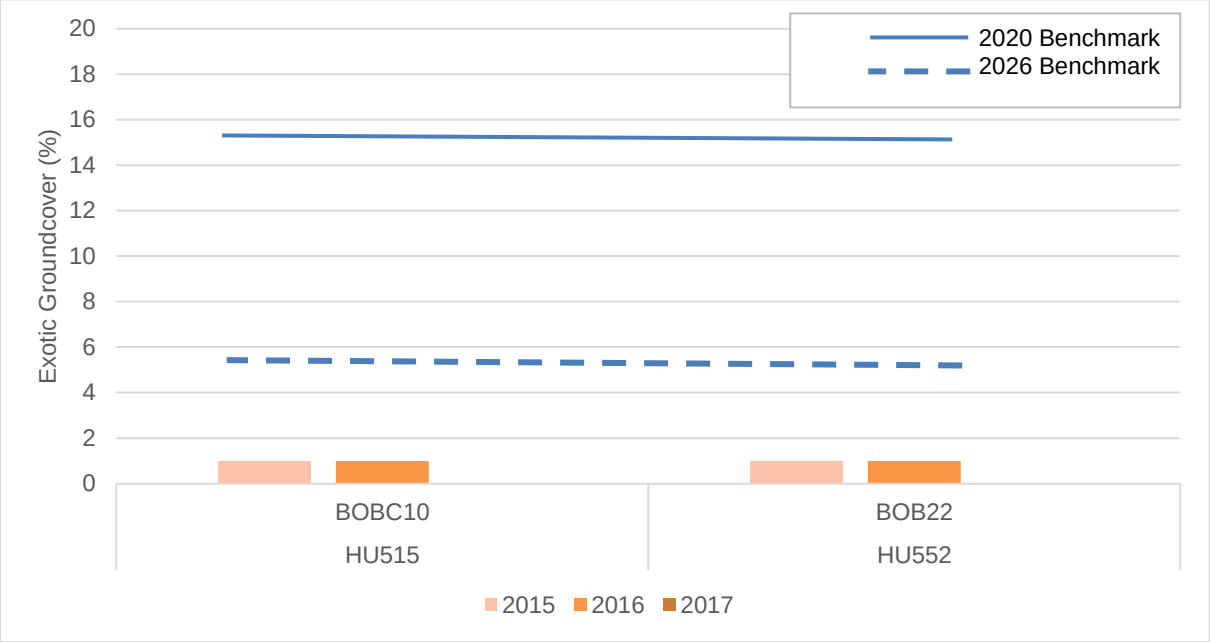


Figure 2-16: Exotic groundcover in HU515 / HU552 sites – MZ2

As a result of historical clearing, there are limited fauna habitat values within MZ2. No HBTs have been recorded within either BOBC10 or BOB22 and as such, these sites do not meet their respective benchmarks. Both sites do however, contain fallen logs, with site BOBC10 meeting the benchmark of 5 metres for HU515. It is expected that fauna habitat values will continue to improve within these communities over the medium to long term. As such, habitat augmentation measures should be considered to improve fauna habitat values in the short term (**Section 4.1**).

HU605: Rough-barked Apple grassy open forest on valley flats of the North Coast and Sydney Basin

Figure 2-17 displays native species richness on a site by site basis across all years for HU605 sites within MZ2. The results demonstrate fluctuating scores.

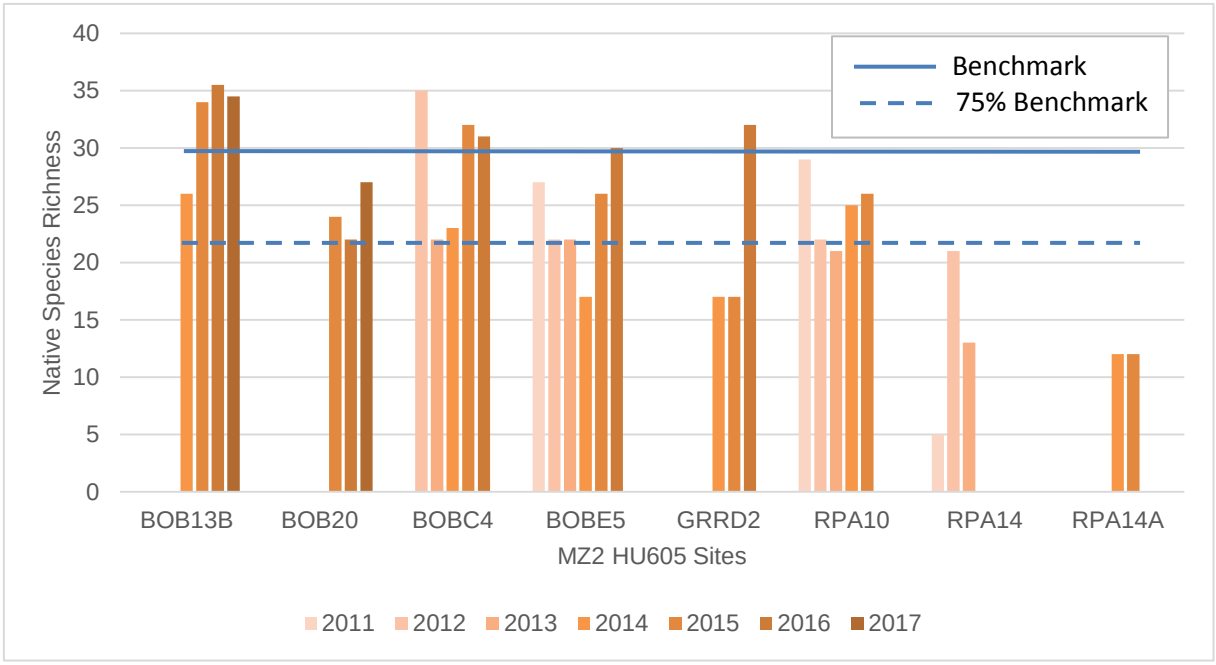


Figure 2-17: Native species richness for all HU605 sites – MZ2

Five of the eight HU605 sites within MZ2 have achieved the benchmark (29 species) for native species richness on at least one occasion, whilst six sites have achieved the 2023 target of 75% of benchmark. The two sites that have failed to reach the 2023 target of 75% of benchmark for native species diversity (RPA14 and RPA14A) are located within areas subject to cattle grazing and as such, consideration should be given to reclassifying this area to MZ6 (Agricultural Leasehold Land) or have the cattle excluded from these areas to ensure that the area meets the definition of MZ2.

Exotic groundcover for HU605 sites in MZ2 for all survey years is displayed below in **Figure 2-18**. Outside of site RPA14A (which exceeded the 2020 target of <15% exotic cover), all sites surveyed in 2017 have recorded scores achieving the 2026 target of <5% exotic cover. As such, HU605 sites in MZ2 are trending well with regards the exotic groundcover performance targets. The high exotic cover recorded at site RPA14A is likely due to it being located in an area that is grazed.

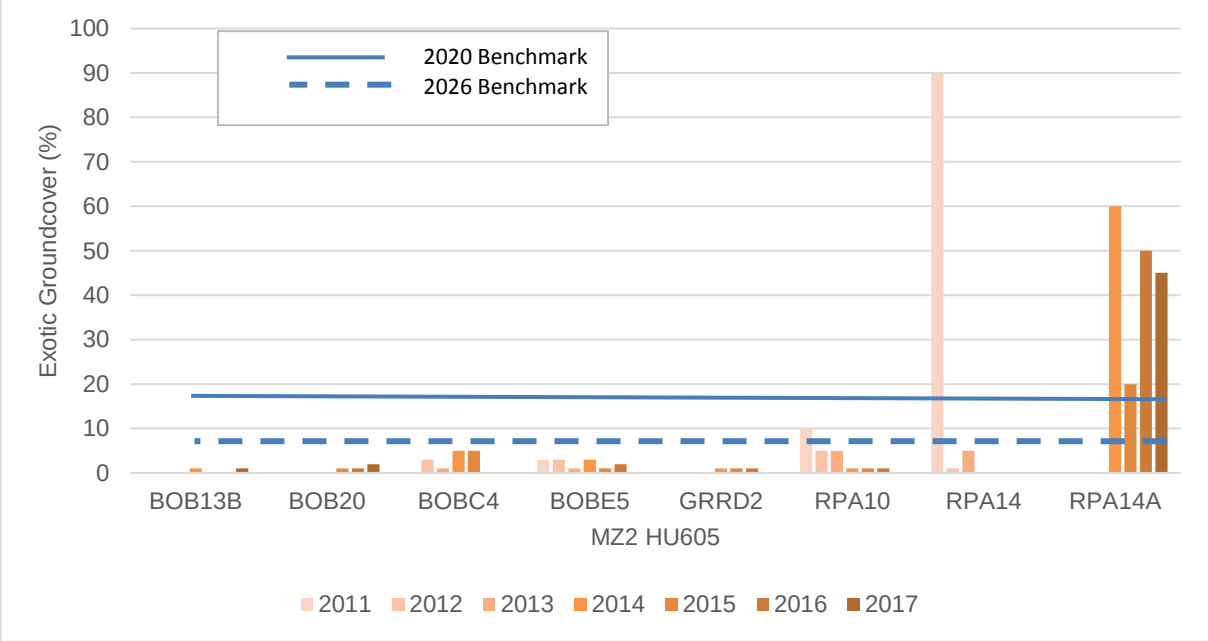


Figure 2-18: Exotic groundcover in HU605 sites – MZ2

None of the three HU605 sites within MZ2 assessed for HBTs have met the benchmark for this community (1.5 HBTs). Two of the four sites assessed for fallen logs do however, meet the benchmark of 10 metres.

HU654: White Box – Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South

Figure 2-19 displays native species richness on a site by site basis across all years for HU654 sites within MZ2. The results demonstrate quite variable scores, with no clear trend visible. Four of six sites have achieved the benchmark (23 species) for native species richness on at least one occasion, with all three sites surveyed in 2017, also recording above benchmark scores.

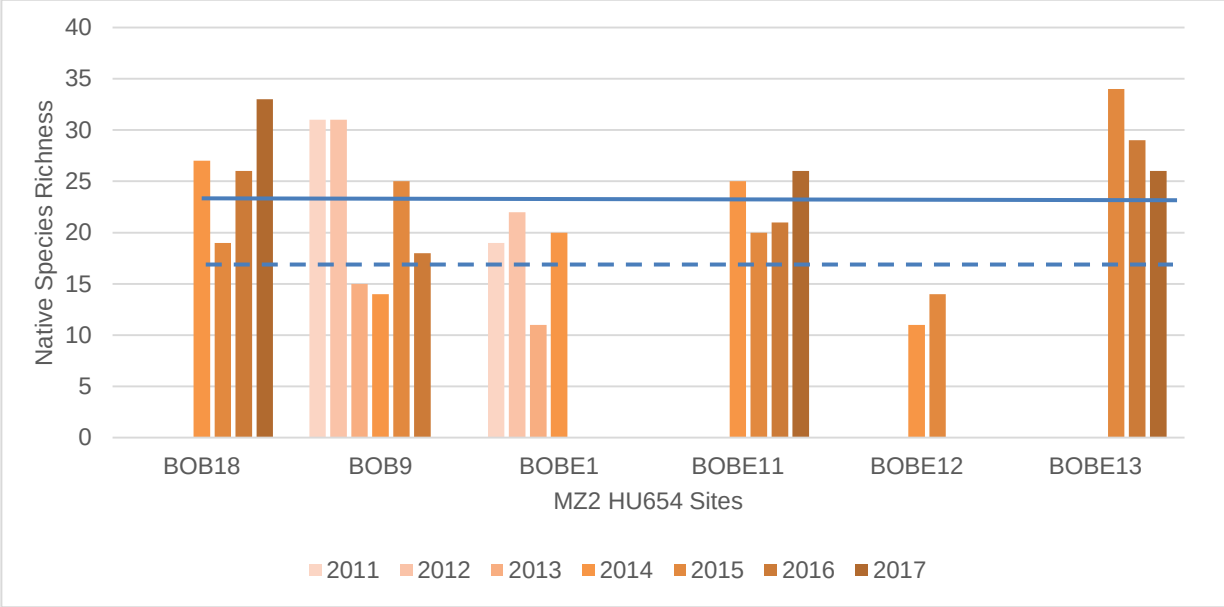


Figure 2-19: Native species richness for all HU654 sites – MZ2

Exotic groundcover for HU654 sites in MZ2 for all survey years is displayed below in **Figure 2-20**. The results across both sites and years are highly variable, with no clear trend visible. Three sites have exceeded the 2020 target of <15%, however, only one site (SI3B) has exceeded this target in the last two years. All sites have exceeded the 2026 target of <5% at some stage, with only one site (BOB9) achieving the 2026 target in the last two survey years. Overall, HU654 sites within MZ2 are tracking poorly with regard to the 2026 target for exotic groundcover.

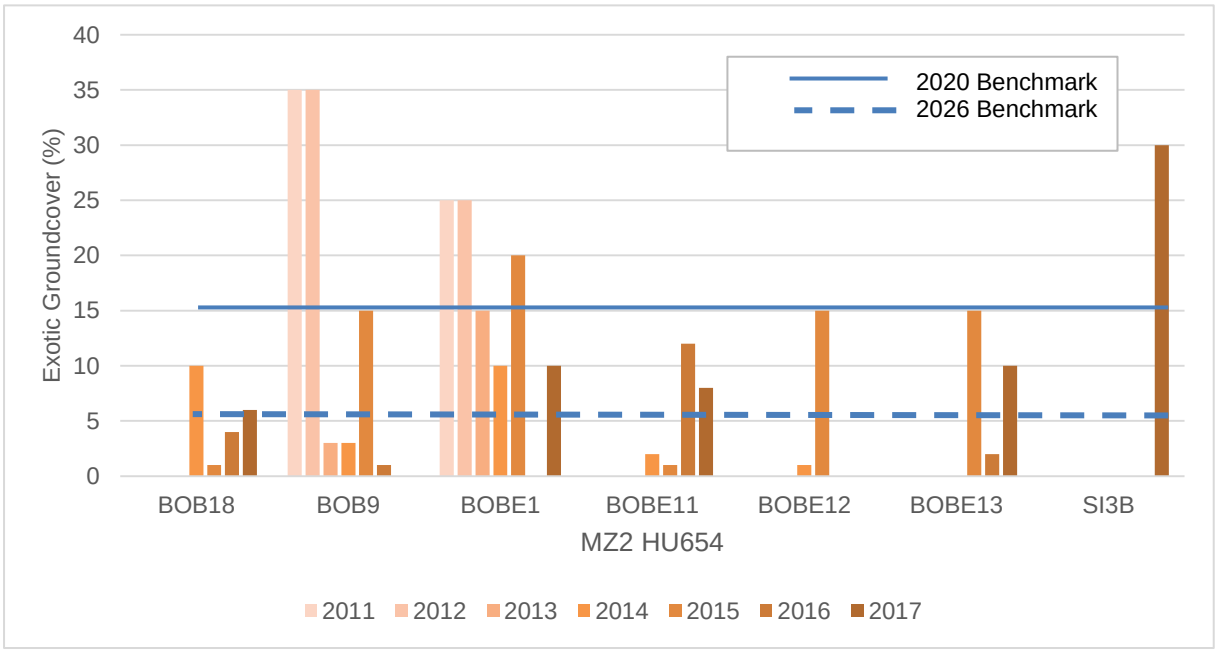


Figure 2-20: Exotic groundcover in HU654 sites – MZ2

HU654 sites occupy areas of basalt soils which comprise the better agricultural soils. These soils seem prone to supporting a strong presence of annual exotic species introduced through many decades of intensive agricultural usage.

No HU654 sites within MZ2 currently meet the benchmarks for HBTs (2 HBTs) or fallen logs (50 metres). Fauna habitat values are not expected to improve within these sites in the short to medium term without direct management intervention, such as habitat augmentation.

2.4 Management Zone 3 (Assisted Revegetation)

MZ3 is located on land that has been previously cleared and requires management intervention, particularly planting of tubestock and/or direct seeding.

Management aims for MZ3 are:

- Replanting of vegetation communities comparable to original type,
- Protection from ongoing impacts, and
- Protect and improve existing flora habitat,
- Protect and improve existing fauna habitat values, including connectivity, and
- Control noxious weeds

Specific performance criteria relevant to MZ3 (UCML BMP v3.9, Table8.1) are:

- From Year 6 (2017): species diversity and vegetation density trending towards each respective benchmark for the relevant vegetation community)
- Year 9 (2020): < 15% cover of weeds in each vegetation community
- Year 9 (2020): Restore native groundcover to 75% benchmark condition (for those areas in BOA)
- Year 12(2023): Restore native mid-storey cover to 75% of BVT benchmark(for those areas in BOA)
- Year 15(2026): Restore canopy cover to 75% of BVT benchmark (for those areas in BOA)
- Year 15 (2026): < 5% cover of weeds in each vegetation community*.

* *Excluding saffron thistle which is expected to decline naturally as a canopy cover develops.*

Trigger values to investigate intervention for revegetation areas of Box-Gum Woodlands (UCML BMP) are:

- A decrease in cover abundance of 10% or more when compared to analogue community variation,
- Presence of noxious weed species,
- Any factor likely to have a detrimental impact on vegetation condition or native fauna.

2.4.1 2017 monitoring results

Only one monitoring site located within MZ3 was surveyed during 2017 (**Table A1 - Appendix A**) in accordance with the site biodiversity monitoring schedule. BOB19 underwent rapid vegetation assessment (**Appendix E**), recording an increase in exotic groundcover and an associated decrease in native groundcover. The exotic groundcover of 45% recorded for this site is well in excess of the performance target of <15% for 2020. Fauna habitat features within BOB19 remain limited, with no HBTs or fallen logs recorded.

The results from BOBE19 are typical for the wider area of MZ3 in previous years, particularly in regards fauna habitat. Whilst fauna habitat values are expected to improve over the medium to long term, management intervention in the form of habitat augmentation is recommended across MZ3. A valuable starting point to consider what actions might give the best results is the recently issued publication *Wildlife Conservation in Farm Landscaspes* by Lindenmayer *et al* (2016).

2.4.2 Long term trends

Biometric benchmark values for each vegetation community are used to determine the success of revegetation for MZ3 and are listed in Table 7.8 of the BMP. Given the current absence of an overstorey layer in MZ3 and the length of time that it will take to form post revegetation, native species richness and exotic groundcover provide the most relevant current indication of how MZ3 is progressing towards achieving the performance criteria.

No MZ3 sites underwent full floristic monitoring in 2017 and as such, no additional data is available to further the analysis of trends in native species richness (**Table 2-3**). As detailed in the 2016 UCML Annual Floristic Report (ELA, 2017a), average native species richness results demonstrate a decline from 2011 to 2013, followed by an increase to 2016, which is best attributed to seasonal variation.

Table 2-3: Native species richness for each BVT in MZ3 across years

BVT	2011	2012	2013	2014	2015	2016	2017	Average	BVT Benchmark	No. of sites	Area (ha)
HU515	14.5	16.5	13.3	18.25	23.3	21	N/A	17.9	25	7	56.9
HU552					38		N/A	38	23	1	32.5
HU605	28	26	20	13	20		N/A	21.4	29	2	15.4
HU654	15.3	16	13.5	13.1	19.1	22.7	N/A	16.2	23	9	184.2

2.4.3 Exotic (weed cover) and listed (noxious) weeds across MZ3

A survey of weeds / exotic cover across MZ3 was undertaken in April 2017. The survey opportunistically located occurrences of listed weed species and made measures of groundcover in 24 1 m x 1 m plots (**Table 2-4**). Due to recent ground disturbance as part of a tree planting/direct seeding program, measures were made in both disturbed and undisturbed areas.

The survey of weeds provides the following further data to ascertain in MZ3 the;

1. Status of listed weed species;
2. Cover of exotic species; and
3. Progress in reaching BMP targets for exotic groundcover.

Consistent with other survey work, *Hypericum perforatum* (St John's Wort), was the only commonly occurring listed weed species occurring in local infestations. Other listed weeds species were limited to occurring as individuals or small populations and are mapped in **Figure F1** (**Appendix F**). These populations/individuals should feasibly be controlled by spot eradication, either spraying or chipping out.

The exotic covers in MZ3 showed a very distinct pattern between those areas that have been disturbed for tree planting and areas not disturbed. The scalping of topsoil in preparation for tree planting lowered exotic and native groundcover, a process which is required to ensure the success of direct seeding and tube stock planting. Undisturbed ground has an exotic cover that was three (3) times as great as tree planting areas, and native plant groundcover that was five (5) times as great as disturbed areas.

Table 2-4: Results of weed surveys

Survey area	Native (% cover)	Exotic (% cover)	Litter (% cover)	Bare soil (% cover)	Listed weeds (% cover)
Tree planting/direct seeding areas (11 plots)	6	8	15	70	0
Areas not disturbed for tree planting (13 plots)	32	26	33	8	0

The level of exotic groundcover in MZ3 is likely to achieve the 2020 target of <15%, but presents a significant challenge in terms of meeting the 2026 target for exotic groundcover <5%. Exclusion of grazing alone may not ensure native plants become dominant, and it is not clear whether the increased tree cover achieved through tree plantings will be enough to suppress annual exotic weeds.

HU515: Blakely's Red Gum – Yellow Box grassy open forest or woodland of the New England Tablelands

Figure 2-21 displays native species richness on a site by site basis across all years for HU515 sites within MZ3. The results demonstrate variable scores, with no clear trend visible. Three of seven sites have achieved the benchmark (25 species) for native species richness on one occasion, however, the remaining four sites have recorded scores well below benchmark. During the next monitoring event, survey effort should be determine what is driving the lower native plant species richness in this MZ.

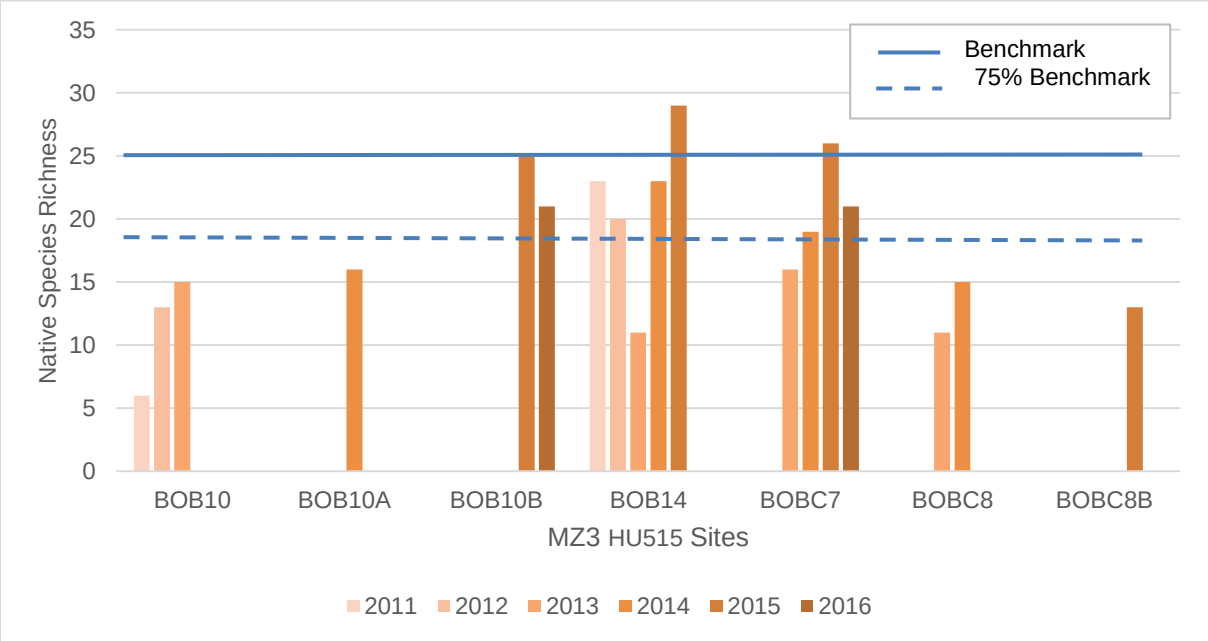


Figure 2-21: Native plant species richness in HU515 – MZ3

Exotic groundcover for HU515 sites in MZ3 for all survey years is displayed below in **Figure 2-22**. Three out of seven sites have exceeded the 2020 target of <15% exotic groundcover, whilst five of seven sites have exceeded 2026 target of <5%. No HU515 sites within MZ3 were surveyed during 2017.There is limited data available to determine trends for these sites.

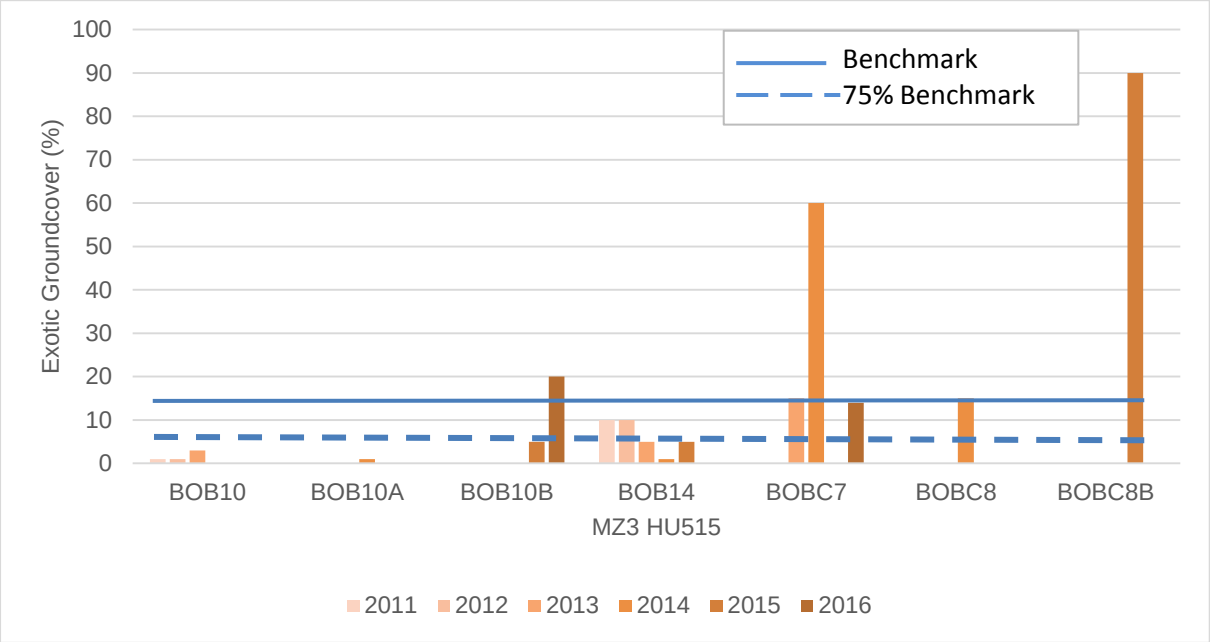


Figure 2-22: Exotic groundcover in HU515 sites – MZ3

HU552: Grey Gum – Narrow-leaved Stringybark – ironbark woodland on ridges of the upper Hunter Valley, Sydney Basin / HU575: Narrow-leaved Ironbark shrubby open forest on hills of the central Hunter Valley, Sydney Basin / HU605: Rough-barked Apple grassy open forest on valley flats of the North Coast and Sydney Basin

Figure 2-23 displays native species richness on a site by site basis across all years for HU552, HU575 and HU605 sites within MZ3. The results demonstrate variable scores which, combined with the limited data for most sites, makes trend analysis difficult. Two of four sites (BOB21 and BOB23) have achieved their respective benchmarks for native species richness, whilst one site (BOB15) has achieved the 2023 target of 75% of benchmark.

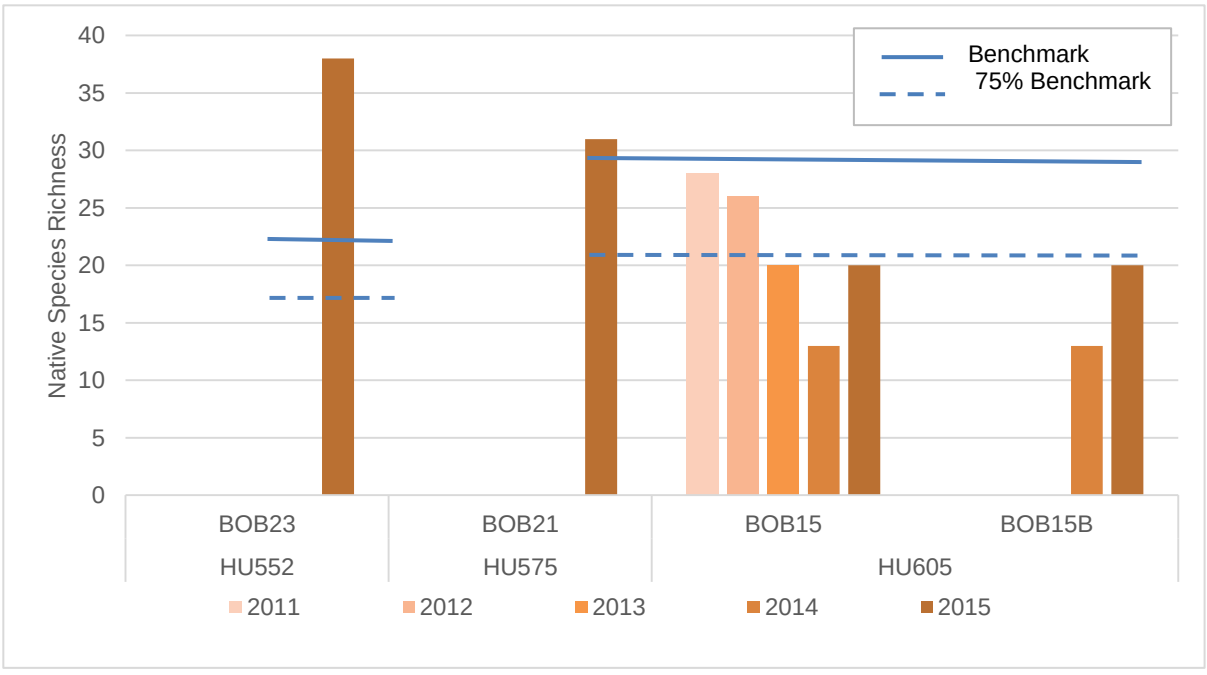


Figure 2-23: Native plant species richness in HU552, HU575 and HU605 sites – MZ3

Exotic groundcover for HU552, HU574 and HU605 sites in MZ3 across all years is displayed in **Figure 2-24**. Exotic covers for these sites, were all below the 2020 performance target of <15% and all bar one site (BOB15) was in line with the 2026 target of <5%. Due to the limited data available for these communities it is difficult to determine trends, however, to date these sites are performing well with respect their 2020 performance criterion.

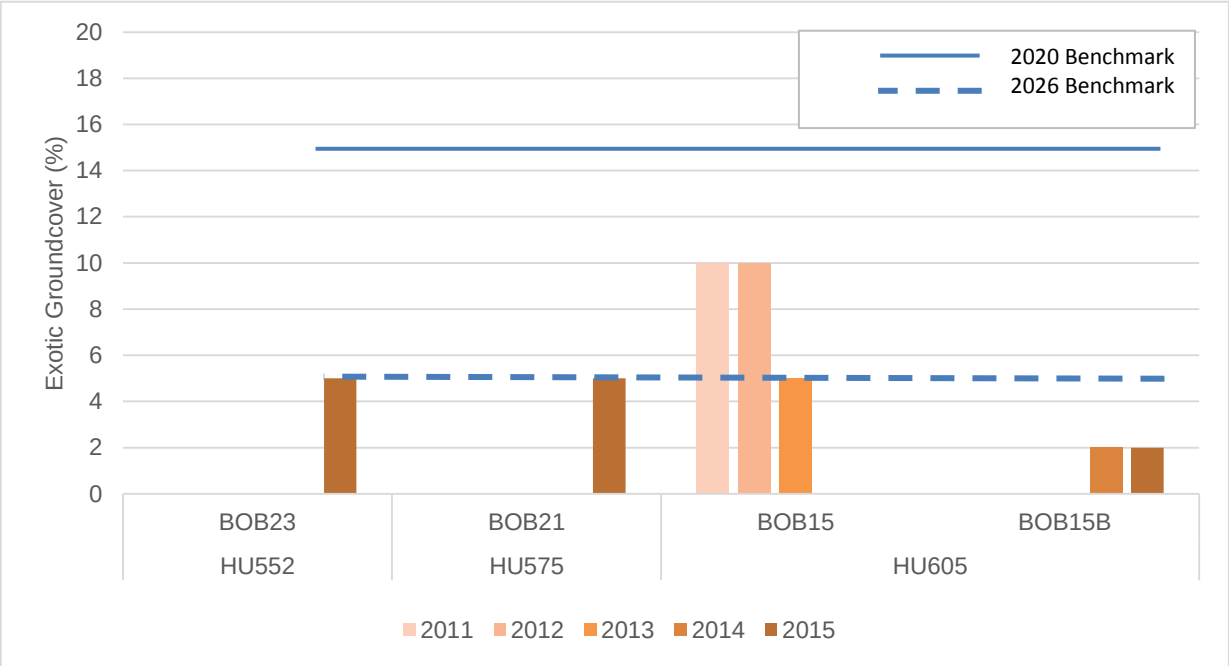


Figure 2-24: Exotic groundcover in HU552, HU575 and HU605 sites – MZ3

HU654: White Box – Yellow Box grassy woodland on basalt slopes in the upper Hunter Valley, Brigalow Belt South

Figure 2-25 displays native species richness on a site by site basis across all years for HU654 sites within MZ3. The results demonstrate quite variable scores, however, a broad trend of improving native species richness is visible across most sites. Four of nine sites have achieved the benchmark (23 species) for native species richness on at least one occasion, whilst eight of nine sites have achieved the 2023 target (75% of benchmark) on at least one occasion.

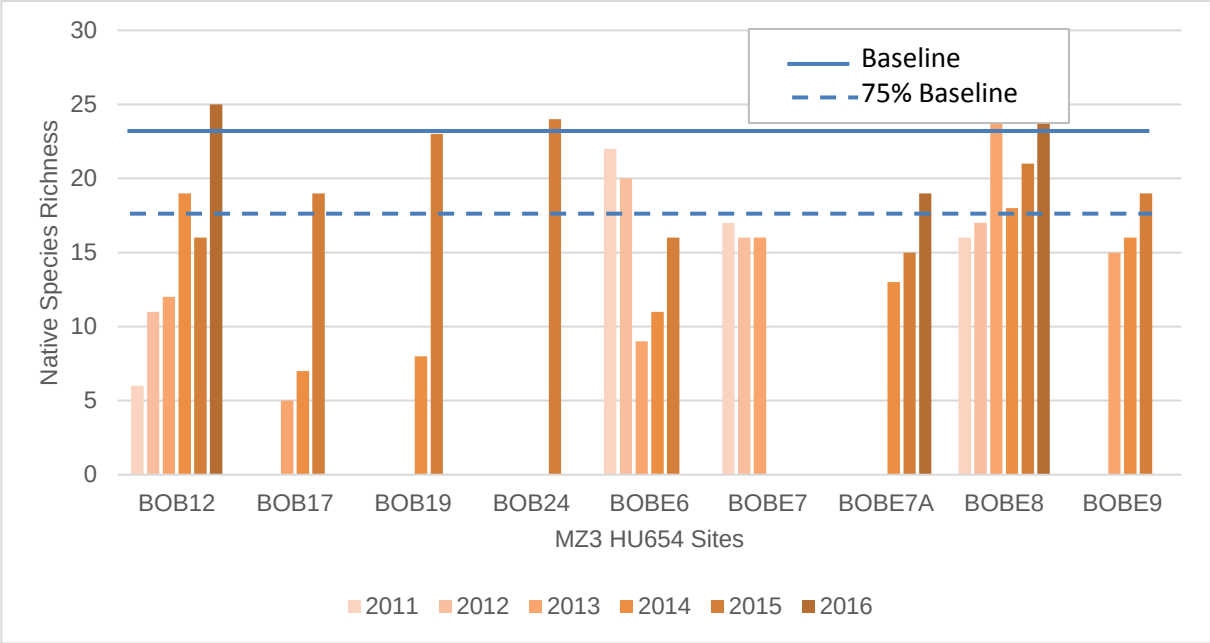


Figure 2-25: Native plant species richness in HU654 sites – MZ3

Exotic groundcover for HU654 sites in MZ3 across all years is displayed in **Figure 2-26**. The results are highly variable both within and across sites with covers ranging from 0% to 90%. All sites have exceeded the 2026 performance target of <5% on at least one occasion, whilst all but one site (BOB17) has exceeded the 2020 performance target of <15% on at least one occasion. Trend analysis is difficult however, overall performance in relation to the respective targets is moderate to poor.

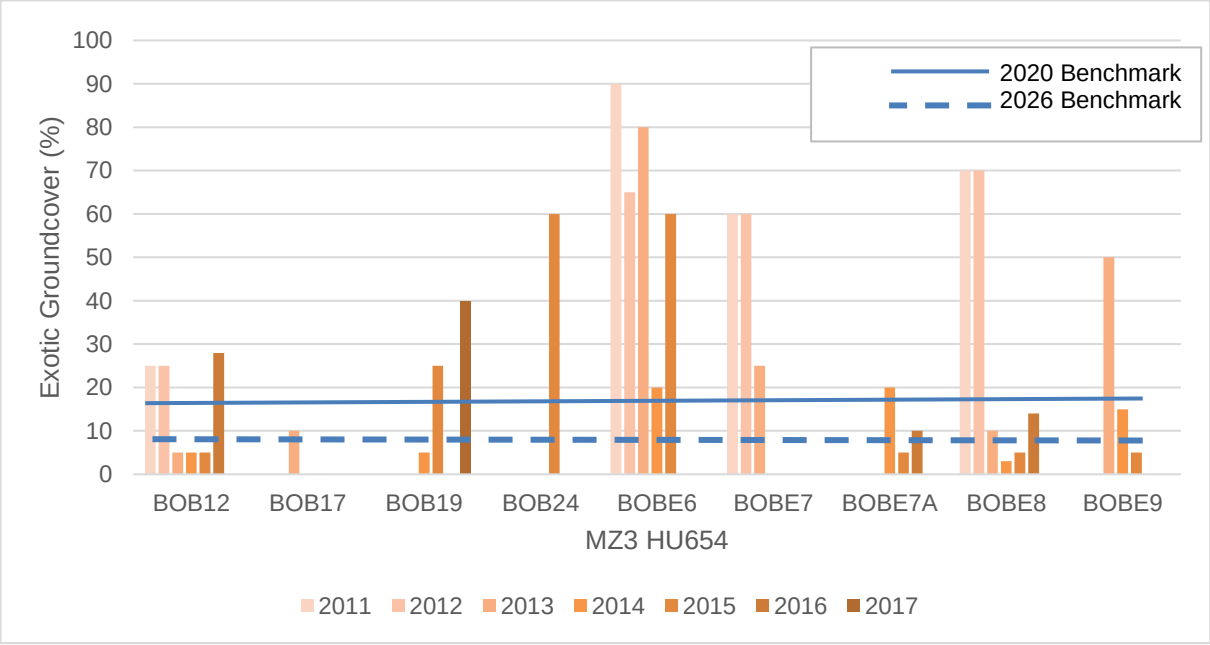


Figure 2-26: Exotic groundcover in HU654 sites – MZ3

The relatively productive soils of this community is likely to enhance the growth of exotic species during favourable climatic conditions. Additionally, as a result of previous clearing and agricultural activities throughout MZ3, there is likely to be a substantial exotic seedbank present. As such, weed management strategies (i.e. canopy competition) will be required in order to achieve the relevant performance targets in relation to exotic groundcover.

2.5 Management Zone 4a (Salinity Offset Area Regeneration/Revegetation)

MZ4a is located within the Salinity Offset Area (SOA) and has been previously cleared. Part of this area is dedicated to pivot irrigation and grazing, with the balance grassland with isolated trees.

The overall management aim of MZ4a outside of the pivot irrigation areas is to encourage natural regeneration of cleared areas in combination with continued rotational grazing.

Specific performance criteria related to MZ4a outside the pivot irrigation areas are:

- stable to increasing groundcover with a stable to increasing native diversity
- no significant erosion is present
- there are no significant noxious weed infestations and weeds do not comprise a significant proportion of the species in any stratum, and
- natural regeneration of the vegetation cover is occurring.

The BVT benchmarks applied to MZ2 and MZ3 do not apply to natural regeneration in MZ4a.

2.5.1 2017 monitoring results

Three sites (SOA4, SOA5 and SOA6) within MZ4a underwent rapid assessment monitoring during 2017. Sites SOA4 and SOA5 had groundcovers dominated by native species with only a very minor (0.1%) presence of exotic species. Site SOA5 had an equal proportion of native and exotic groundcover, with each comprising 15%. Litter and Bare Soil made up a high proportion of the groundcover at all three sites, with the dry seasonal conditions in the months preceding monitoring, likely to have contributed to these high covers. The results from MZ4a rapid assessment monitoring are presented in **Appendix E**.

Natural regeneration monitoring

Three natural regeneration monitoring transects (SOA4, SOA5, and SOA6) were established during 2017. Natural regeneration of multiple overstorey species was recorded at all three transects, with SOA4 and SOA6 recording natural regeneration in both seedling (<5 cm DBH) and sapling (5-15 cm DBH) forms. Both SOA4 and SOA5 recorded seedling densities well in excess of the 30-40 stems per hectare, which is considered typical of grassy woodlands (Kerle, 2005).

These results confirm that natural regeneration is occurring in MZ4a and is contributing to increasing structural diversity of vegetation cover. Results from natural regeneration monitoring are displayed below in **Table 2-5** and **Appendix G**.

Table 2-5: Natural regeneration densities within the SOA transects

Transect No.	Stems per hectare		Species composition (%)	
	<5 cm DBH	5-15 cm DBH	<5 cm DBH	5-15 cm DBH
SOA4	104	4	*E. fibrosa* (42%) *E. rossii* (58%)	*E. fibrosa* (100%)
SOA5	204	0	*E. crebra* (59%) *E. moluccana* (41%)	N/A
SOA6	16	4	*E. blakelyi* (50%) *E. melliodora* (50%)	*E. blakelyi* (100%)

2.5.2 Long term trends

A total of 24 floristic monitoring sites are located within MZ4a, 17 of which are also located within BOAs which overlap the SOA. In the floristic monitoring schedule detailed in Appendix F of the BMP (UCML, 2015), the 17 monitoring sites which coincide with BOAs are designated as being in either MZ2 or MZ3. Accordingly, these sites have been assessed against the relevant completion criteria above in **Section 2.3** and **Section 2.4** respectively. However, it is also relevant to assess these sites against management aims for MZ4a to determine the establishment of stable vegetation cover and increasing native plant species diversity.

Figure 2-27 and **Figure 2-28** display native and exotic groundcover for MZ4a monitoring sites respectively. Native groundcover scores range between 15% to 90% depending on year and site and no clear trend is discernible. Exotic groundcover scores demonstrate a higher degree of seasonal variability within individual sites. Whilst no clear trends are visible in relation to exotic groundcover, exotic species comprise a significant proportion of the ground layer at five of the twenty-four sites. Fluctuations of exotic cover is due to waxing and waning of annual weeds as the dominant component of exotic groundcover.

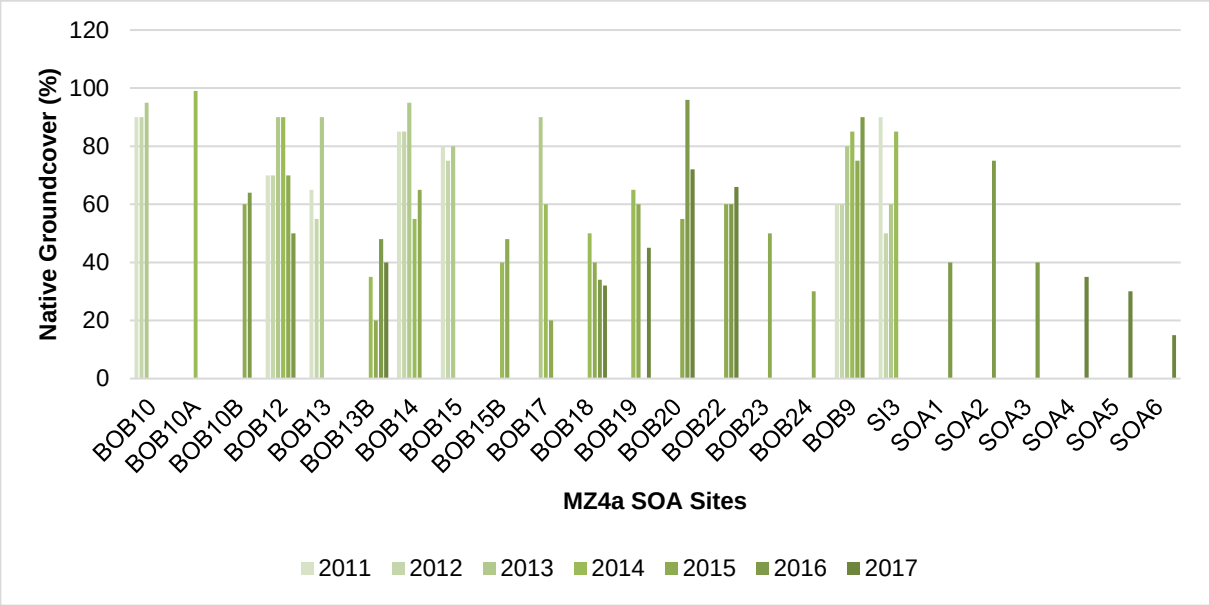


Figure 2-27: Native groundcover in SOA sites (2011 – 2017)

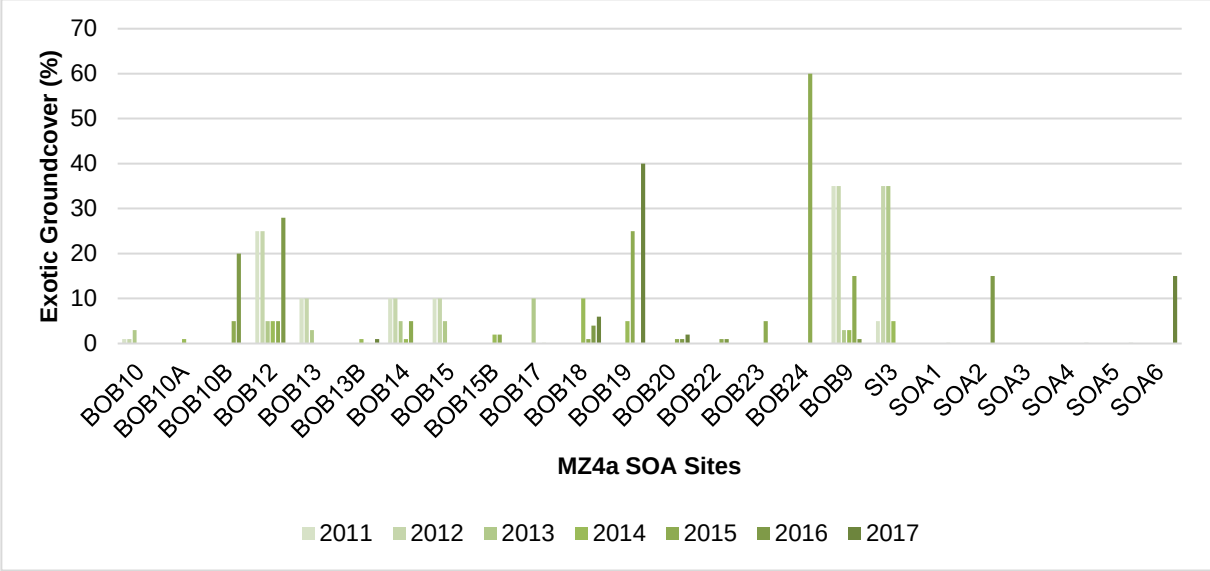


Figure 2-28: Exotic groundcover in SOA sites (2011 – 2017)

Groundcover in conjunction with litter has fluctuated, however it has provided reasonable soil stability. There are no significant areas of active erosion observed in the SOA.

Native species richness scores are presented in **Figure 2-29**. The results are variable across all sites and years with no clear overall trend of stability or increase.

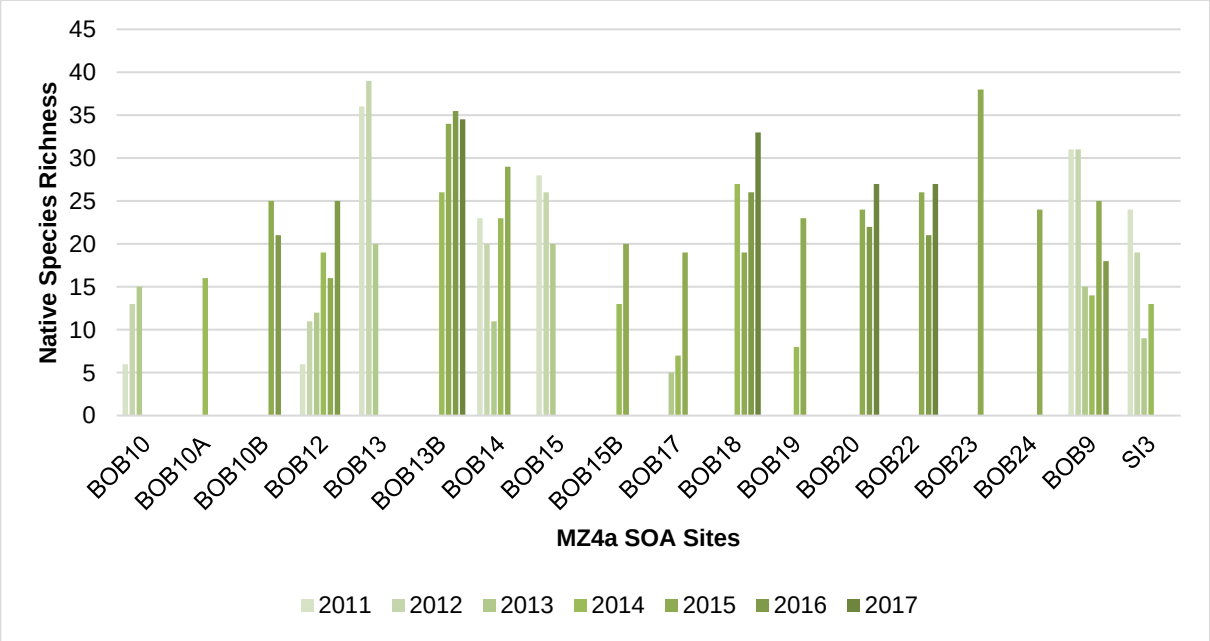


Figure 2-29: Native plant species richness in MZ4a SOA sites

2.6 Management Zone 4b – SOA Benchmark Vegetation

Benchmark vegetation in the SOA is managed in accordance with Management Zone 1 and as such, has been addressed in **Section 2.2**.

2.7 Management Zone 5 (Operational Area – Open Cut rehabilitation area)

Management actions for this MZ are provided in the Mining Operations Plan (MOP) (UCML, 2017) and include rehabilitation phases, maintenance (including the monitoring and remediation of subsidence cracking) rehabilitation objectives, completion criteria and final land use at mine closure. The primary objective is a stable final landform with post-mining landscape capable of self-sustaining native vegetation communities characteristic of the pre-mining compositions including Ironbark Open Forest Complex, Grey Box Woodland and Open Forest /Grassland. (UCML BMP, v3.9, Section 6.5).

The MOP also provides Completion / Success Criteria for the Open Cut rehabilitation area (UCML MOP, Appendix B). Relevant criteria which apply to the floristic monitoring program are as follows:

- Erosion: monitoring verifies there are no gully or erosion features, or rills >20 mm deep that are active, that pose a risk to the final land use;
- Vegetation density: the density of shrubs and trees is comparable to that of the analogue sites;
- Ecosystem structure: native rehabilitation areas provide a range of structural features (e.g. trees, shrubs, ground cover, developing leaf litter etc.)
- Ecosystem composition: revegetation areas contain a range of flora species consistent with the seed mix planted and flora assemblages characteristic of the surrounding native species;
- Reproduction: rehabilitation monitoring verifies second generation tree seedlings area present or likely to be, based on comparable older rehabilitation sites;
- Weed presence: weed presence does not pose a risk to the establishment of the revegetation area. Records indicate that noxious weeds are controlled in accordance with legislation;
- Presence of native fauna and a range of fauna habitats: monitoring confirms a range of fauna species are recorded utilising rehabilitation areas and a range of fauna habitat is available;
- Pest animal density; pest animal presence does not pose a risk to the establishment of the rehabilitation area.

2.7.1 2017 monitoring results

Floristic monitoring results

Four floristic monitoring sites (OC3D, OC4B, OC5B and OC6B) within MZ5 underwent monitoring during 2017. All four sites contain a complex vegetation structure with a diverse range of native canopy and mid-storey species successfully established. Sites OC5B and OC6B have a groundcover dominated by native species, whilst sites OC3D and OC4B have an even proportion of both native and exotic species in their groundcover.

Erosion transects monitoring results

Erosion transects (50 m) were established at each site to monitor landform stability. Sites OC3d, OC4B and OC5B recorded no erosion along the length of their respective transects. Minor sheet erosion was recorded in two small sections towards the end of the OC6B transect, however, this erosion did not appear to be still active. Overall, all three sites are considered to be stable and progressing well toward final land use objectives.

Habitat assessment monitoring results

Habitat assessments were also undertaken at all four sites, with the results presented below in **Table 2-5**. The habitat assessments focused on the availability of micro-habitat for threatened species likely or known to exist within the UCML complex. Only two micro-habitat features (diverse vegetation structure and flowering trees/shrubs) were found to be present within each site. As Open Cut rehabilitation progresses, it is expected that the habitat features within these sites will improve. Habitat augmentation (e.g. nest boxes and bush rock) should be considered as a means of providing immediate habitat for threatened species within MZ5.

Table 2-6: Habitat assessment results for MZ5 monitoring sites

Fauna micro-habitat present	OC3D	OC4B	OC5B	OC6B	Comment
Large-woody debris	No	No	No	No	
Small HBTs (microbat/glider)	No	No	No	No	
Medium HBTs (woodland birds/glider)	No	No	No	No	
Large HBTs (large bird e.g. owl)	No	No	No	No	
Koala feed trees	No	No	No	No	
Diverse veg. structure (GC, MS, OS)	Yes	Yes	Yes	Yes	Bird nests in canopy and mid-storey (OC3D & OC5B)
Bush-rock, rock outcrop	N0	No	No	No	
Flowering shrubs/trees	Yes	Yes	Yes	Yes	Mistletoe and *Acacia* spp. flowering
Surface water	No	No	No	No	

2.7.2 Long term trends

The aim of rehabilitation within the former Open Cut is to restore woodland communities in sub-domains 1 to 6 to Grey Box Woodland and Ironbark Open Forest on Sandstone.

Ironbark Open Forest on Sandstone fits closest to the BVT HU574 (Narrow-leaved Ironbark – Grey Gum on footslopes) and Grey Box Woodland is the equivalent of HU551 (Grey Box-Narrow-leaved Ironbark on hills). To date, only sites within Open Cut rehabilitation sub-domains 1 to 6 have undergone floristic monitoring. Sub-domains 7 to 9 which have only recently been rehabilitated, have undergone annual rehabilitation walk overs by UCML.

Whilst relevant completion criteria exist for MZ5 (addressed in **Table 3-6**), there are no quantitative criteria, such as meeting BVT benchmarks. Whilst these benchmarks are not applicable to MZ5 sites, they provide a useful tool of analysis to assess the progress of rehabilitation.

Native species richness for all MZ5 sites across all survey years is presented in **Figure 2-30**. The results are relatively varied across both sites and years, with no clear trend visible. With the exception of one site (OC4), all sites surveyed in the last three years have exceeded the benchmark (26 species) for HU574 and two sites have met the benchmark (35 species) for HU551. Whilst native species richness scores are comparable to the benchmark for the target vegetation communities, cover and abundance scores remain lower overall, as a result of high litter and bare soil / rock covers, which are typical of post-mining rehabilitation soils.

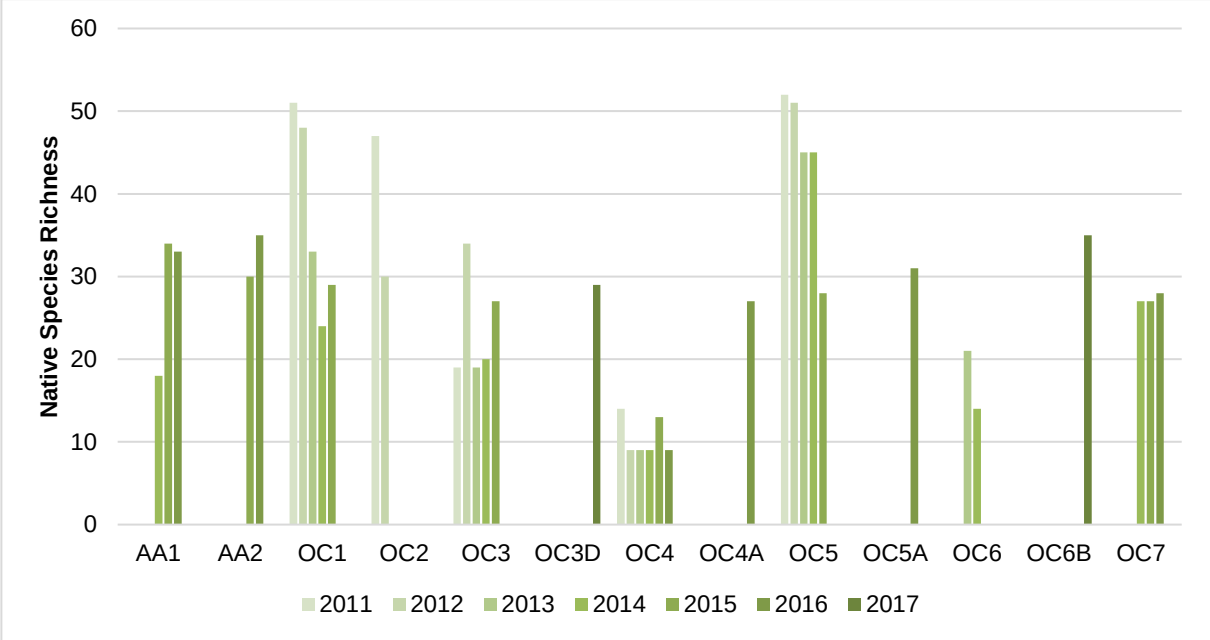


Figure 2-30: Native species richness in MZ5 sites

MZ5 sites contain a range of native flora species which are characteristic of the local region. Whilst many species found within MZ5 are also characteristic of the desired vegetation communities (HU552 and HU574), the total species assemblages recorded within monitoring sites are not specific to these vegetation communities.

Exotic groundcover for MZ5 sites is displayed below in **Figure 2-31**. Exotic covers are low, particularly for previously disturbed land and have remained relatively consistent, with the exception of sites AA1 and OC4. Using the performance targets for MZ2 and MZ3 of <15% exotic groundcover for 2020 and <5% for 2026, four and six out of a total of eighteen sites, have exceeded the 2020 and 2026 targets respectively. The majority of MZ5 sites are performing well (with the exception of OC4) with regards to exotic species, with these species limited to the ground layer and in insignificant proportions where present.

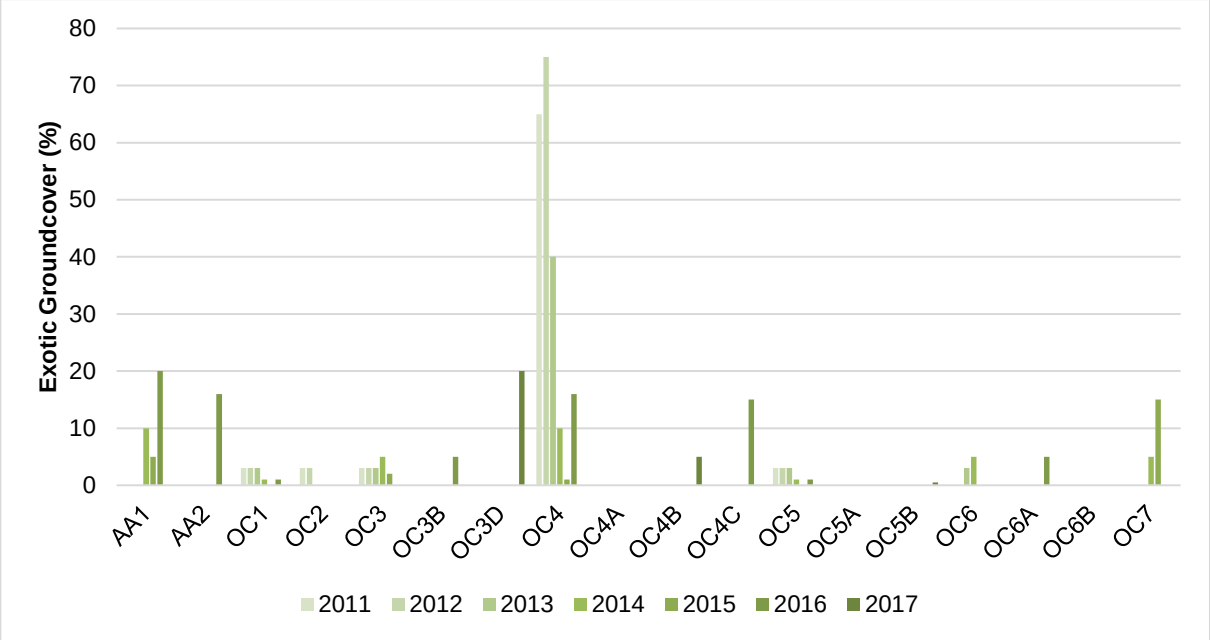


Figure 2-31: Exotic groundcover in MZ5 sites

Completion criteria for MZ5 includes the occurrence of second-generation regrowth of characteristic canopy species. Second-generation tree seedlings have been recorded at OC7 and OC3D, with regeneration of all three canopy species recorded within the surrounding vegetation zone of OC3D. These sites are located in rehabilitation of approximately 20 years age, and as such, provide a positive indication of the natural regeneration potential of MZ5 areas.

2.8 Management Zone 6 (Agricultural Leasehold Land)

These areas located within the UCML complex are used for cattle grazing. The key management goal within this MZ is to control weeds and feral animals.

2.8.1 2017 monitoring results

One floristic-based subsidence site located within MZ6 (RPA12) underwent monitoring during autumn 2017. RPA12 recorded results which were largely positive in relation to both previous years' data and the management aims for MZ6. Native species richness (33) was higher than both the average recorded for the site (29) and the benchmark (23) for the associated vegetation community (HU654). Similarly, exotic ground cover was also significantly lower (0.5%) than the average recorded for the site (4%).

These results indicate that the site is performing well relative to one of the key management goals for MZ6 - controlling weeds. The other key management goal for MZ6 is the control of feral animals. Extensive Feral Pig diggings and scats were observed adjacent to the site which indicates that additional management works are required to control feral pest species.

2.8.2 Long term trends

Figure 2-32 displays native species richness results for MZ6 floristic monitoring sites. With only two sites a very limited view is provided. Site RPA12 has recorded scores at or above the benchmark (23 species) for the HU654 vegetation community for all survey years, whilst site RPA8A has recorded scores below benchmark for all surveys years. No clear trends are visible in the data for either site.

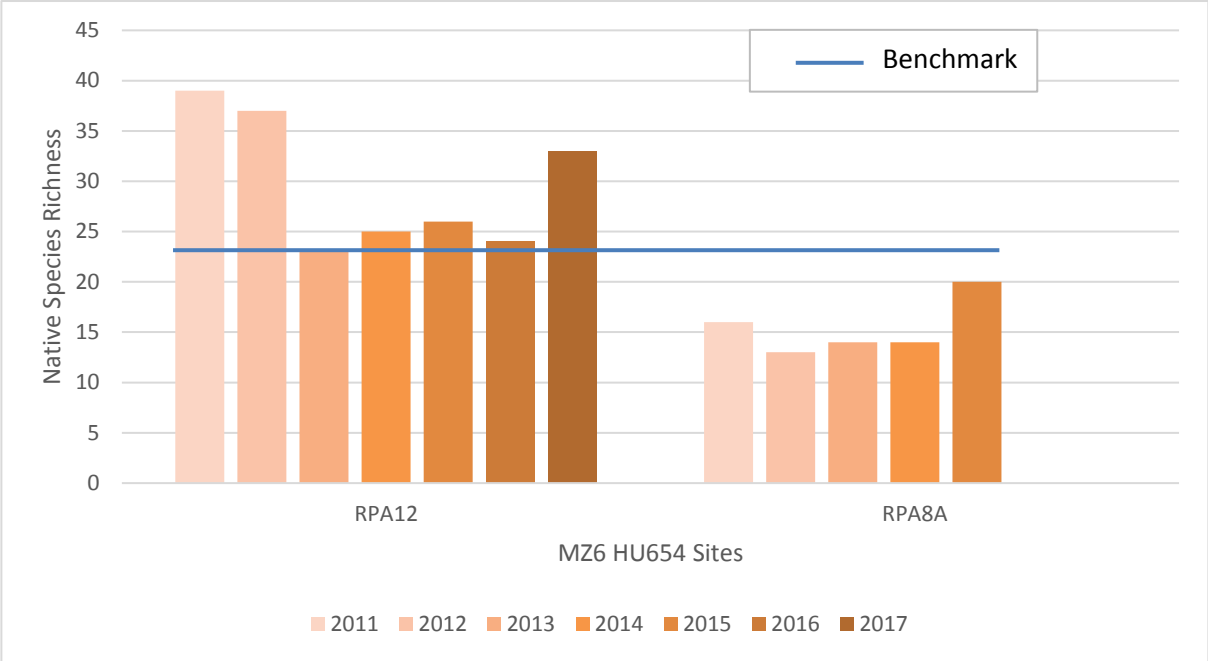


Figure 2-32: Native species richness in MZ6 sites

Exotic groundcover scores for MZ6 sites are displayed below in **Figure 2-33**. Site RPA12 demonstrates consistently low exotic groundcover scores across the survey years, whilst site RPA8A demonstrates highly variable scores. No clear trends are visible in the data for either site.

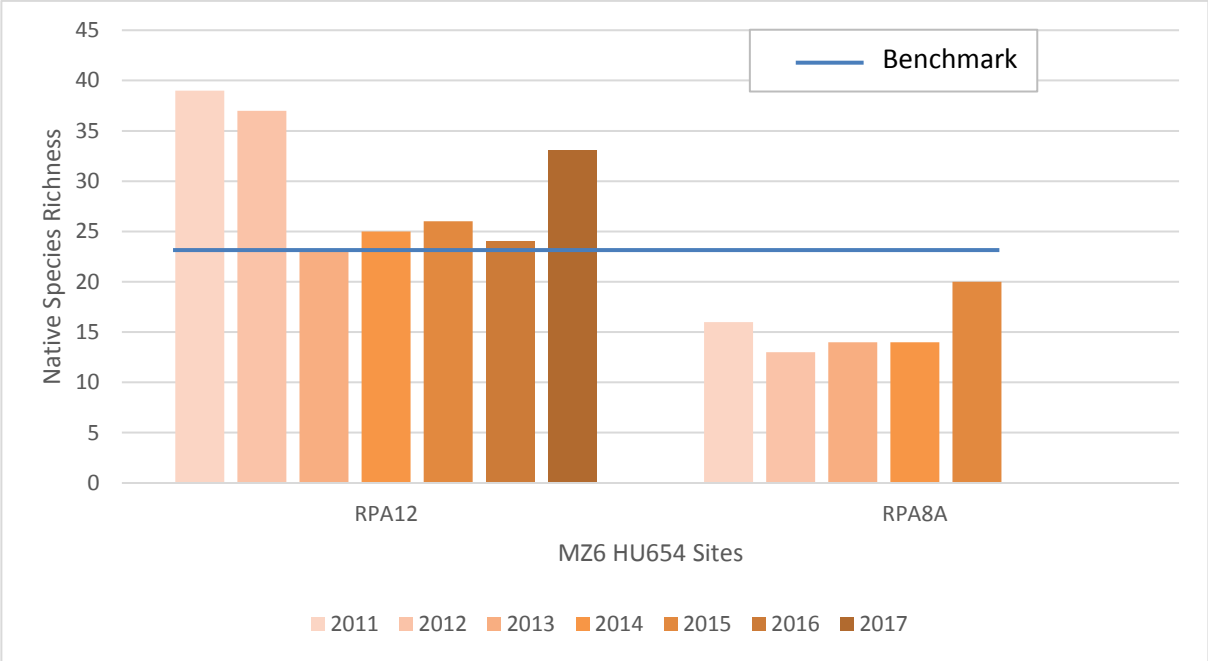


Figure 2-33: Exotic groundcover in MZ6 sites

2.9 *Acacia ausfeldii* monitoring

Acacia ausfeldii is a threatened species listed as vulnerable under the NSW BC Act and is known to occur in the Mudgee – Gulgong region, including within the UCML complex. UCML is required to undertake a number of activities to ensure the survival of the species, including;

- Translocation of the species from areas disturbed by mining activities to the Open Cut rehabilitation areas
- Protection of the species in its natural occurrence at the Highett Road property
- The trialling of direct seeding the species within Open Cut rehabilitation areas.

Performance criteria for areas of translocation requires the establishment of 150 individual stems, or a minimum of 1 stem for every 5 square metres. This performance criteria was deemed to have been met following the completion of monitoring in 2016 and as such, monitoring of translocation sites AA1 and AA2 has been discontinued.

Two *Acacia ausfeldii* monitoring sites located within the Highett Road property (ACQ1 and ACQ2) were surveyed during 2017. Methodology for this monitoring is found in **Section 1.2** of **Appendix A**.

2.9.1 2017 monitoring results

Floristic monitoring

Sites ACQ1 and ACQ2 underwent full floristic monitoring during spring 2017. Both sites scored high native species richness and groundcover scores and low exotic species richness and groundcover scores. Native species richness scores for both sites met the benchmark (29 species) for their respective vegetation communities (ACQ1 – HU575; ACQ2 – HU605). These results are consistent with those recorded in previous survey years.

Acacia ausfeldii remains present in its natural environment within the Highett Road property, with twenty (20) individuals recorded at site ACQ1 and eight (8) individuals recorded at site ACQ2, during 2017 monitoring.

Tagged Acacia ausfeldii condition monitoring

The condition, reproductive status and dimensions of 100 previously tagged *Acacia ausfeldii* plants were assessed during spring 2017. Forty-eight (48) of the plants assessed were dead, whilst a further 18 plants were not able to be located. All 34 living plants assessed were damaged to some degree, with a low to moderate reproductive capacity. These results follow the trend of declining health observed in these 100 plants, over successive survey years.

Acacia ausfeldii germination transects and quadrats

Germination assessments were undertaken across three previously established transects and 20 randomly placed quadrats. Four, two and eleven *Acacia ausfeldii* seedlings were recorded across the three respective transects, whilst four quadrats recorded one seedling each. The presence of these seedlings indicate that *Acacia ausfeldii* continues to reproduce within the Highett Road property. However, *Acacia ausfeldii* is a short-lived species that flourishes with disturbance, and without such disturbance it is likely it will have diminishing presence in this local area in the long term.

2.9.2 Long term trends

Native species richness trends for site ACQ1 and ACQ2 are displayed in **Figure 2-7** and **Figure 2-9** respectively. Both sites demonstrate consistently high scores that are at or above benchmark for their respective vegetation communities. Exotic groundcover trends for site ACQ1 and ACQ2 are displayed in **Figure 2-8** and **Figure 2-10** respectively. Both sites demonstrate consistently low scores, with 0% exotic groundcover recorded at both sites across all survey years.

The condition rating of the 100 tagged *Acacia ausfeldii* plants within the Highett Road property from 2011 to 2017 is displayed below in **Figure 2-34**. The results show a clear declining trend in the condition of the plants, evidenced by both the decline in the number of high condition rating (4 and 5) plants and the increase in dead (0 condition rating) plants, across the survey years. This trend is consistent with the natural senescence cycle of *Acacia ausfeldii*. The large number of dead plants, combined with the small number of high condition plants from 2013 onwards, indicates that the rate of senescence is relatively fast.

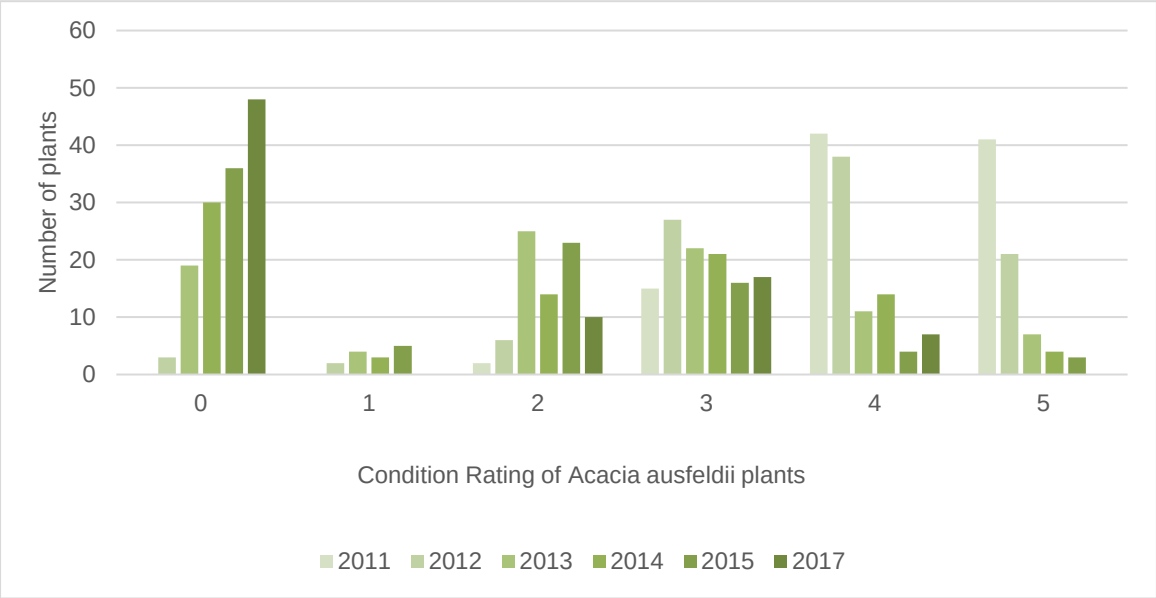


Figure 2-34: Condition rating of tagged *Acacia ausfeldii* plants within Highett Road property, 2011 to 2017

2.10 Floristic based subsidence monitoring

The performance criterion for subsidence in relation to biodiversity requires that mining operations are to have a negligible impact upon threatened species, populations, habitat or ecological communities. Condition 24 of the UCML Project Approval (08_0184) states that "The proponent shall ensure that the project does not cause any exceedances of the performance measures".

A new floristic-based subsidence (FBS) monitoring method was introduced during autumn 2017 for any news sites established after that date, replacing the previously utilised BioMetric methodology This new methodology focuses on canopy health and visual assessments to provide a more targeted assessment of potential subsidence impacts on overlying vegetation. A further description of the methodology is detailed in **Section 1.1.3** in **Appendix A**.

Consistent with previous years, previously established FBS sites (established before autumn 2017) were monitored in 2017 using the Biometric methodology of data collection, and this will continue for the term of the monitoring program,

2.10.1 2017 monitoring results

A total of thirty new FBS sites located across three longwall panels (UW LW4, UG LWW4, UG LWW5) were monitored during 2017. Sites UW LW4 L1 to L10 were established in autumn 2017 and monitored in both autumn (baseline monitoring) and spring. Sites UG LWW4 L1 to L10 and UW LWW5 L1 to L10 were established and monitored for the first time during spring and as such, form baseline data for these sites. The results from all 30 sites are displayed below in **Table 2-7** to **Table 2-10**

Table 2-7: FBS canopy health results for UW LW4 sites L1-L10 – autumn 2017

Site	Zone	PFC (%)	EF/TF (%)	PBCDB (%)	CCP/PC (%)	CFD (%)
L1	Transition	15	5	15	85	5
L2	Longwall	15	5	15	80	5
L3	Transition	20	5	10	90	5
L4	Longwall	15	5	10	85	5
L5	Transition	20	10	10	85	5
L6	Longwall	20	5	25	75	5
L7	Transition	20	5	5	90	5
L8	Longwall	10	5	15	80	5
L9	Transition	20	10	10	85	5
L10	Longwall	20	5	20	80	5

PFC = Percentage Foliage Cover of upper canopy; EF/TF = Epicormic Foliage in relation to Total Foliage; PBCDB = Primary Branches within the Canopy which have Died Back; CCF/PCF = Current Canopy Foliage as a proportion of Potential Canopy Foliage; CFD = Canopy Foliage Discolouration

Table 2-8: FBS canopy health results for UW LW4 sites L1-L10 – spring 2017

Site	Zone	PFC (%)	EF/TF (%)	PBCDB (%)	CCP/PC (%)	CFD (%)
L1	Transition	15	5	15	85	5
L2	Longwall	15	5	10	80	5
L3	Transition	20	5	15	90	5
L4	Longwall	15	5	15	80	5
L5	Transition	20	10	25	70	5
L6	Longwall	20	5	25	70	5

Site	Zone	PFC (%)	EF/TF (%)	PBCDB (%)	CCP/PC (%)	CFD (%)
L7	Transition	20	5	5	90	5
L8	Longwall	10	5	15	75	5
L9	Transition	20	5	30	80	5
L10	Longwall	20	5	15	75	5

PFC = Percentage Foliage Cover of upper canopy; EF/TF = Epicormic Foliage in relation to Total Foliage; PBCDB = Primary Branches within the Canopy which have Died Back; CCF/PCF = Current Canopy Foliage as a proportion of Potential Canopy Foliage; CFD = Canopy Foliage Discolouration

The results for sites UW LW4 L1-L10 in both autumn and spring 2017 are highly consistent, with only minor differences in scores recorded across the sites. The consistency of scores are to be expected as underground mining had not progressed to the location of these sites at the time of spring monitoring. The minor differences observed at several sites is likely due to seasonal and observer variations.

Table 2-9: FBS canopy health results for UG LWW4 sites L1-L10 – spring 2017

Site	Zone	PFC (%)	EF/TF (%)	PBCDB (%)	CCP/PC (%)	CFD (%)
L1	Transition	15	10	10	80	0
L2	Longwall	30	0	20	80	5
L3	Transition	10	5	30	80	5
L4	Longwall	15	10	40	70	5
L5	Transition	15	0	20	80	5
L6	Longwall	20	0	20	70	0
L7	Transition	15	5	40	85	5
L8	Longwall	10	10	30	70	5
L9	Transition	15	0	30	85	0
L10	Longwall	10	5	20	80	5

PFC = Percentage Foliage Cover of upper canopy; EF/TF = Epicormic Foliage in relation to Total Foliage; PBCDB = Primary Branches within the Canopy which have Died Back; CCF/PCF = Current Canopy Foliage as a proportion of Potential Canopy Foliage; CFD = Canopy Foliage Discolouration

Table 2-10: FBS canopy health results for UG LWW5 sites L1-L10 – spring 2017

Site	Zone	PFC (%)	EF/TF (%)	PBCDB (%)	CCP/PC (%)	CFD (%)
L1	Transition	5	0	5	80	0
L2	Longwall	30	5	5	85	5
L3	Transition	20	5	5	80	5
L4	Longwall	30	5	10	85	5
L5	Transition	30	10	15	80	5
L6	Longwall	25	10	10	80	5
L7	Transition	20	5	20	85	5
L8	Longwall	20	0	10	90	5
L9	Transition	20	5	15	80	5
L10	Longwall	15	0	30	75	5

PFC = Percentage Foliage Cover of upper canopy; EF/TF = Epicormic Foliage in relation to Total Foliage; PBCDB = Primary Branches within the Canopy which have Died Back; CCF/PCF = Current Canopy Foliage as a proportion of Potential Canopy Foliage; CFD = Canopy Foliage Discolouration

Monitoring using the Biometric methodology continued on seven previously established FBS sites in 2017 (see Table 2.11).

Figure 2.35 displays native species richness across years for the seven current FBS monitoring sites. The total number of native species shows no clear trends of decline across years that would indicate adverse subsidence-related impacts on plant biodiversity for any site. The variation in native plant species richness, both up and down between years is most likely explained by seasonal variation.

Table 2.11 Previously established FBS monitoring sites

Site	Longwall
BOB13B	LWW3
FBS5	UW LW1
FBS6	UW LW2
FBS8	LW29
FBS9	UW LW3
FBS11	UW LW4
RPA12	LW28

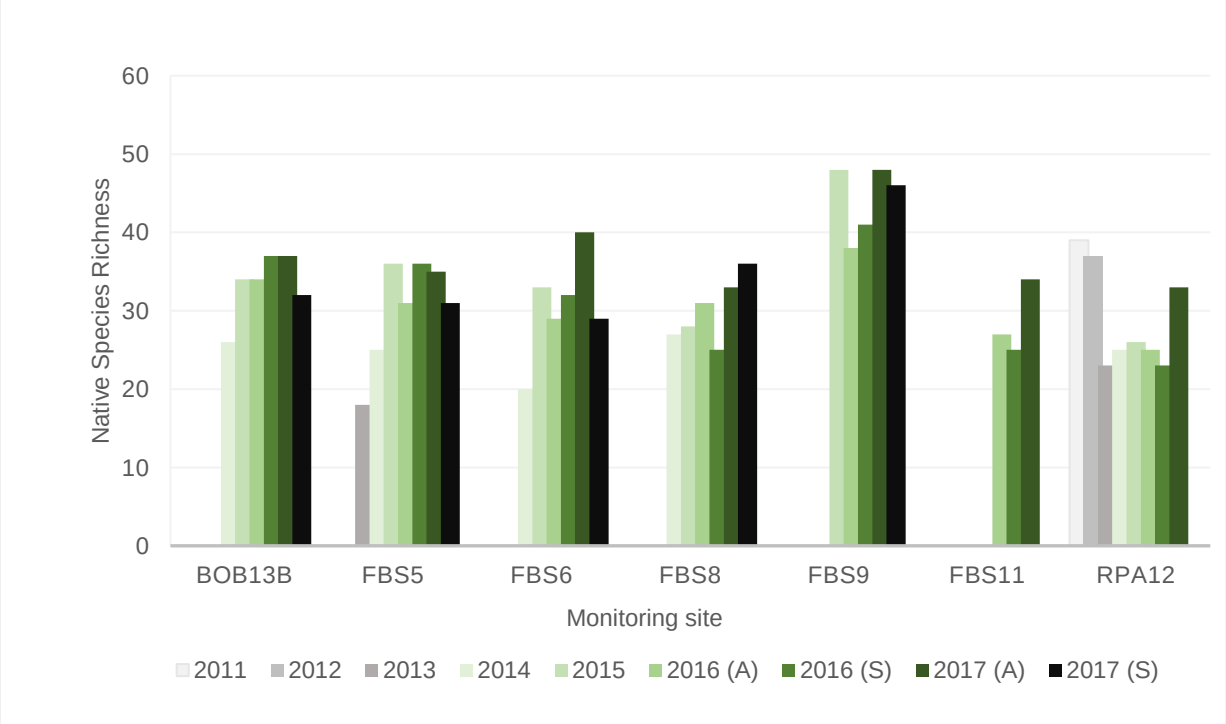


Figure 2.35: Native species richness results for previously established FBS monitoring sites (2011-2017)

The other factor that would indicate an adverse impact of subsidence is crown dieback which would manifest as reduced canopy cover. The percentage canopy cover of native species is variable across years for all the sites (Figure 2.36). There is no clear trend of canopy cover decline that would signal a possible adverse impact of subsidence on tree health.

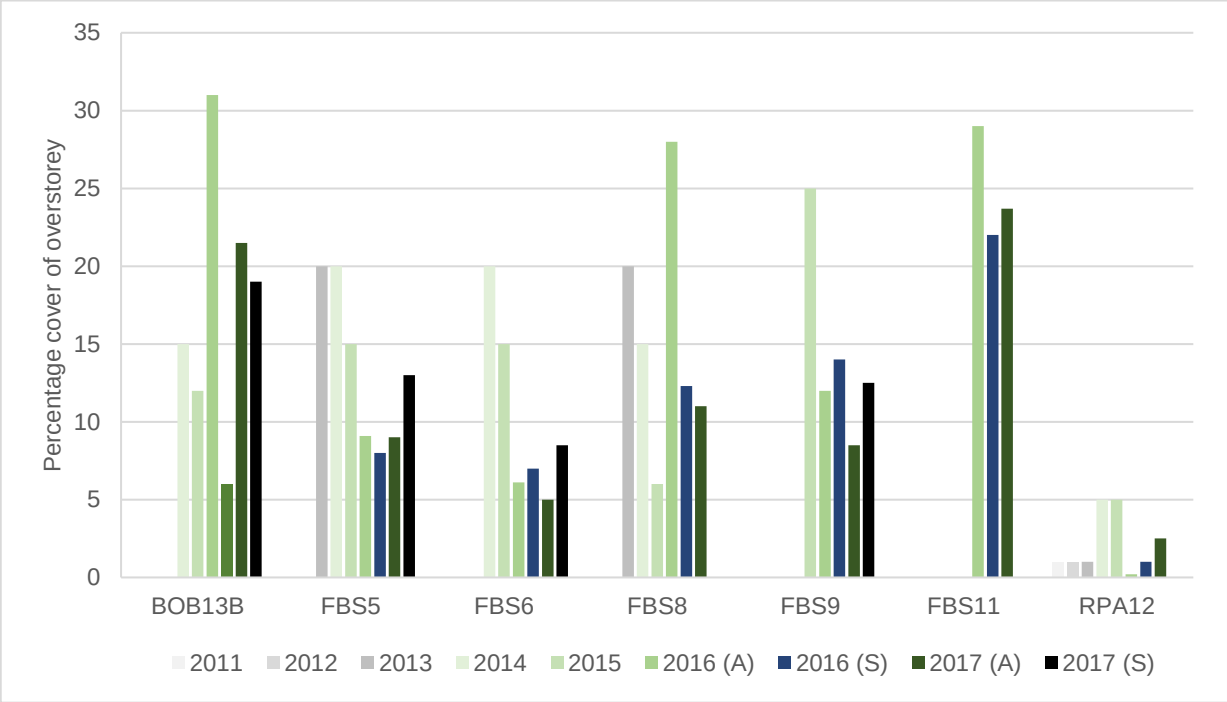


Figure 2.36: Percentage cover of native overstorey results for previously established FBS monitoring sites (2011-2017)

2.11 Natural Regeneration since 1964

Field observations during successive surveys have been that areas of reasonably mature open forest and woodland were once cleared. In particular, the presence of windrows of felled trees under a forest canopy indicated this situation. Understanding the occurrence of natural regeneration over past decades provides guidance as to the feasibility of the aspiration in the BMP for further natural regeneration to be achieved in MZ2 and MZ4a in particular.

Air photographs from 1964 and 1990 were purchased to examine whether areas of previously cleared land have regenerated with some level of tree cover.

Comparing these air photographs with recent remote sensing shows that some 850 ha of previously cleared land now has substantial tree cover (**Figure G4**). The full extent of natural regeneration is likely to be greater, as analysis using remote sensing makes it difficult to determine the extent of very young trees, such as those being monitored in natural regeneration transects.

There are 20 existing floristic monitoring sites, covering six different BVTs within areas that have regenerated since being in a cleared state between 1964 and 1990. This allows some analysis (**Table 2-11**) of how advanced natural regeneration sites perform in relation to benchmarks for each respective BVT.

Table 2-11: Existing monitoring sites located within formerly cleared / regenerating areas

			Native species		Exotic ground cover %		Hollow-bearing trees	
BVT No.	BVT Name	No. of sites	Average for BVT	B'mark for BVT	Average for BVT	B'mark for 2026	Average for BVT	B'mark for BVT
HU515	Blakely's Red Gum – Yellow Box Grassy Woodland	6	28	25	1.8	<5	0.15	1
HU552	Ironbark Open Forest on sandstone	2	24	23	0.3	<5	0	0.8
HU575	Narrow-leaved Ironbark on colluvium	1	32	29	0.5	<5	0	3
HU605	Rough-barked Apple on colluvium/alluvium	5	30	29	1.2	<5	0.2	1.5
HU608	Scribbly Gum woodland – heathland on sandstone	1	17	25	0	<5	0	0.8
HU654	White Box – Yellow Box woodland on basalt	5	29	23	4.3	<5	0.2	2

The analysis shows that advanced natural regeneration sites:

- meet or outperform respective BVT benchmarks for native species richness, except for HU608 for which there is only one site in the sample;
- exotic groundcover is below the target limit set by the UCML BMP for 2026 of <5%. All BVTs with the exception of HU654 (White Box – Yellow Box on basalt) are below 1% exotic groundcover; and

- on the key habitat provision measure of number of HBTs, all sites fail to reach BVT benchmarks.

The failure to meet benchmarks for HBTs is explained by the fact that these advanced regeneration areas are less than 55 years old, whereas the process of trees forming hollows require over a century or more.

A key concern going forward for MZ3 is whether exotic groundcovers in the White Box – Yellow Box grassy woodland on basalt (HU654) can be reduced to <5% by 2026. The data indicates that once regeneration within HU654 is advanced, that exotic covers are approximately 5%. However, the HU654 sites that have experienced advanced natural regeneration are on rockier and shallower basalt soils, particularly when compared to those HU654 sites in MZ3 in Bobadeen East, and the north-western parts of Bobadeen. This difference in soil type and may provide an understanding of the differences in exotic groundcover.

HU551 (Grey Box Woodland) also occurs in areas of advanced regeneration, however, these areas do not contain any full floristic sites.

Of the 20 full floristic sites that are in areas of advanced natural regeneration, 12 are classed as being in MZ1 a zone deemed to be benchmark vegetation. Many of the anomalies seen in data from MZ1 can be explained by the sites being advanced regeneration rather than relatively intact forest or woodland (i.e. benchmark condition). Consideration could be given to reclassifying these sites into MZ2 (Natural Regeneration), or a sub-group of MZ1 or MZ2 sites. The relevant sites currently in MZ1 that could be reclassified are BOB1, BOB2, BOB4, BOB5, BOB6, BOB8, BOB11B, BOBC1, RPA13, FBS4, FBS5 and FBS10.

The occurrence of natural regeneration since 1964 to 1990 provides some level of confidence that pursuing a natural regeneration strategy to achieve increased open forest and woodland cover is feasible. However, the nature of natural regeneration appears episodic and moving from seedlings through to woodland or open forest structure can take 20 to 30 years or more.

2.12 Weeds and other disturbances

A map displaying the location of all disturbances recorded throughout 2017 monitoring is located in **Appendix F**.

2.12.1 Weeds

The categorisation and nomenclature of formerly declared noxious weeds underwent changes in 2017, following the repeal of the *Noxious Weeds Act 1993*, and the introduction of the *Biosecurity Act 2015*. The *Central Tablelands Regional Strategic Weed Management Plan* (Central Tablelands LLS, 2017) was introduced as a part of these changes and re-classifies exotic species based on their biosecurity risk.

Four species listed as regional priority weeds in the Central Tablelands *Asparagus asparagoides* (Bridal Creeper), *Hypericum perforatum* (St. John's Wort), *Olea europaea* spp. *africana* (African Olive) and *Rubus fruticosus* spp. agg. (Blackberry)) were recorded across the UCML complex in 2017. Additionally, three species listed as weeds of community concern *Heliotropium amplexicaule* (Blue Heliotrope), *Opuntia stricta* (Prickly Pear) and *Xanthium spinosum* (Bathurst Burr)) were also recorded. Community concern weed *Rosa rubiginosa* (Sweet Briar) which was recorded during 2016 monitoring, was not observed during 2017.

St John's Wort is the most common and widespread declared weed present within the UCML complex and was recorded at twelve monitoring sites. All other declared weed species were recorded in isolated occurrences and in relatively low abundance.

Table 2-12: Declared weed species recorded across the UCML complex throughout 2017

Scientific name	Common name	Weed Category	Site(s)	Cover (%)
Asparagus asparagoides	Bridal Creeper	Regional Priority Weed	N/A	N/A
Heliotropium amplexicaule	Blue Heliotrope	Community Concern Weed	N/A	N/A
Hypericum perforatum	St John's Wort	Regional Priority Weed	OC3D, OC4B, OC5B, OC6B, BOB18, BOB20, BOB22, FBS5, FBS6, BOBE11, BOBE13, SOA6	≤2
Olea europaea spp. *africana*	African Olive	Regional Priority Weed	N/A	N/A
Opuntia sp.	Prickly Pear	Community Concern Weed	ACQ2, OC3D	<1
Rubus fruticosus spp. agg.	Blackberry	Regional Priority Weed	OC4B	<1
Xanthium spinosum	Bathurst Burr	Community Concern Weed	N/A	N/A

The majority of declared weeds were recorded in previously disturbed areas within MZ2, MZ3, MZ4a and MZ5. The presence of declared weed (formerly noxious weeds as referred to in the UCML BMP) species within these Management Zones is contrary to their desired management aims. Intensive weed control was undertaken by UCML in the East Pit and Goulburn River Diversion areas targeting many of the species listed above in **Table 2-12**. It is recommended that this intensive weed control program be extended to additional areas of high weed abundance within the UCML complex, as identified in **Appendix F**.

2.12.2 Feral animals

Numerous direct sightings of the declared pest *Sus scrofa* (Feral Pig) were recorded during 2017 monitoring. Indirect observations, in the form of extensive diggings and scats, were also observed both within floristic sites and across the broader UCML complex (see **Appendix F**). Several direct sightings of the declared pests *Lepus capensis* (Brown Hare) and *Oryctolagus cuniculus* (European Rabbit) were also recorded, particularly within and adjacent to the Bobadeen Vegetation Offset Area.

Feral Pig and aerial Feral Dog baiting and targeted shooting programs were undertaken by UCML in 2017.

2.12.3 Other Disturbances

Subsidence cracks were observed over Ulan West longwall panels LW1, LW2 and LW3 (see **Appendix F**). An area of erosion was recorded within the Open Cut rehabilitation area. As per the management aims detailed in the UCML MOP (UCML, 2017), it is recommended that this erosion be addressed.

3 Overview and achievement of performance criteria

Below is a summary of the trends resulting from the examination of floristic data from 2011 to 2017. Following this general summary is an assessment against the specific completion criteria set out in the UCML BMP and MOP.

MZ 1 – Benchmark Vegetation: Across all survey years, species richness counts have fluctuated. There is no clear trend of consistent change visible which is not generally explained by seasonal variation. Each BVT within MZ1 on average, continues to meet or exceed native species richness benchmarks. Exotic ground cover remains very low (<1%), with the exception of a few sites where higher scores are explicable by virtue of edge effects and other disturbances.

The use of historical air photographs has identified a number of monitoring sites in MZ1 which are located in previously cleared areas. These sites should be considered for reclassification into a separate management zone sub-group, as the vegetation present is advanced regeneration rather than benchmark.

Each BVT present within MZ1 has its expected vegetation layers, with structural diversity scores remaining relatively consistent. Improvement in key habitat features such as HBTs trees will not occur until the long-term (decades to centuries).

MZ2 - Natural Regeneration: Since commencement of monitoring in 2011, species richness has fluctuated. There is no clear trend of consistent change visible which is not generally explained by seasonal variation. All BVTs (with the exception of HU605) in MZ2 on average, continue to meet or exceed native species richness benchmarks. Exotic groundcover demonstrates seasonal variation but overall, meet performance targets for 2020 and 2026, with the exception of HU654 (Gum-Box grassy woodland).

Structural diversity is not at benchmark levels, though it is increasing as evidenced by natural regeneration of overstorey species. Habitat features, including HBTs, are below benchmark with the appearance of these not likely in the short-term.

Natural regeneration of overstorey species has been recorded across MZ2 and monitoring sites have been established to record the rates of change. Given the time since commencement (spring 2015), there is insufficient data as of yet to determine rates of change. However, air photographs from 1964 and 1990 show there has been very substantial natural regeneration (approximately 850 ha) of previously cleared areas across the UCML complex.

With the exception of St. John's Wort, the occurrence of listed weeds is very limited and can be managed on a targeted control basis.

Until fauna surveys are undertaken in MZ2, the value of habitat being created in this zone is unable to be evaluated. Fauna is often an early indicator of structural and floristic change and as such, surveys should provide the means for evaluating the progression of fauna habitat values in MZ2.

MZ3 – Assisted Revegetation: On average all BVTs are below benchmark levels for native species diversity, with the exception of HU552, which is represented by one site in one year. Since

commencement of monitoring in 2011, species richness has fluctuated. There is no clear trend of consistent change visible which is not generally explained by seasonal variation.

Exotic groundcover also fluctuates between seasons, with no clear trend visible. With the exception of HU654, most sites are on average, below the 2020 target of <15% exotic groundcover. No clear downward trend in scores is currently visible which is problematic for determining the likelihood of achieving the 2026 target of <5% exotic groundcover.

The historical land uses within MZ3 will present a challenge to ensuring that benchmarks can be achieved in this management zone, particularly in relation to exotic ground cover. Management trials may provide some insight and it is proposed that annual monitoring include weed management trials and investigations.

Vegetation cover of overstorey species is improving as a result of tree planting works in MZ3. Over the next 5 years, improvements towards the desired overstorey cover benchmarks should become visually measurable.

The appearance of habitat features including HBTs and logs are not likely in the short-term.

Until fauna surveys are undertaken in MZ3, the value of habitat being created in this zone is unable to be evaluated. Fauna is often an early indicator of structural and floristic change and as such, surveys would provide the means for evaluating the progression of fauna habitat values in MZ3.

MZ4a – Salinity Offset Area Regeneration/Revegetation: MZ4a incorporates a range of sites overlapping other management zones and BOAs, with the majority of data occurring within areas subject to revegetation works (MZ3). To date only six rapid assessment sites (SOA 1-6) are located solely within MZ4a. This has implications for the overall data collected and analysed.

Groundcover provided by both native and exotic vegetation has ensured the zone is stable, with no large areas of active soil erosion present.

Both native and exotic groundcover levels have varied across sites and survey seasons with no clear trends. Much of the variation can be explained by seasonal conditions. Native groundcover scores range between 15% and 95%, whilst exotic groundcover ranges between 0.1% and 60%. There is no clear trend of increasing native plant species diversity.

With the exception of St. John's Wort, the occurrence of listed weeds is very limited and can be managed on a targeted control basis.

Natural regeneration of overstorey species has been recorded across MZ4a and monitoring sites have been established to record the rates of change. Given the time since commencement (spring 2016), there is insufficient data to determine rates of change. Air photographs from 1964 and 1990 show there has been very substantial natural regeneration of previously cleared areas across the UCML complex, indicating it can play a significant role in the future.

MZ4b – Salinity Offset Area Benchmark Vegetation: monitoring sites located within MZ4b comprise benchmark vegetation and as such, have been dealt with as part of MZ1.

MZ5 - Operational/Open Cut Rehabilitation: averaged across all survey years, native species richness of the rehabilitation areas is performing well in respects to benchmarks for BVTs HU552 and HU574. Many of the native plant species present are characteristic of the desired Ironbark and Grey Box woodlands. However, the overall species assemblages, as well as the cover and abundances vary from

those in MZ1. Overall exotic species richness and covers are relatively low with an average of 8 species per site and 7% groundcover. As such, weeds do not pose a risk to the establishment of the rehabilitation area. The rehabilitated landforms within MZ5 have good stability with minimal active erosion present.

MZ6 - Agricultural Land: only two sites are situated within MZ6, with no overall trends visible for these sites.

The UCML BMP provides a set of performance criteria to be achieved for the management of biodiversity within the UCML complex. These have been discussed within previous sections, however, the following section provides a specific summary of progress against each of the performance criteria for all MZs. A Trigger Action Response Plan has been developed and is presented below in **Table 3-1**.

Table 3-1: Trigger Action Response Plan for Management Zone performance criteria

Colour	Definition
	Trend positive, or performance criteria achieved.
	Some adaption of management maybe needed, or too early to make a judgement.
	Management intervention is required.

Table 3-2: Progress of performance criteria (PC) achievement – Weed Management

MZ	Year 6 Performance Criteria – 2017	Year 9 Performance Criteria - 2020	Year 15 Performance Criteria - 2026
	Different performance criteria for each MZ. Respective criteria for each MZ in bold.	**<15% cover of weeds (MZ1 – MZ3). No significant noxious weeds and weeds do not comprise a significant proportion / risk in any stratum (MZ4a, MZ5). Weeds are adequately controlled (MZ6)**	**<5% cover of weeds (MZ1 – MZ3). No significant noxious weeds and weeds do not comprise a significant proportion / risk in any stratum (MZ4a, MZ5). Weeds are adequately controlled (MZ6)**
MZ1/MZ4b	**No significant weed infestation** Exotic cover limited to the ground layer. Exotic groundcover averaging <1%.	Exotic groundcover, averaging <1%.	Exotic groundcover, averaging <1%.
MZ2	**No specific target** Exotic groundcover fluctuates, no clear trend but below 2020 target of <15%.	Exotic groundcover on average below 2020 target of <15%.	Current exotic groundcover on average achieving 2026 targets of <5% for all BVTs, excluding HU654.
MZ3	**No specific target** Exotic groundcover fluctuates on a seasonal basis with no clear trends visible.	Current exotic groundcover on average above the 2020 target of <15% for the majority of sites. In the last three years exotic cover has fluctuated between 10-20%.	Current exotic groundcover on average, well above the 2026 target of <5%, in the last three years exotic cover has fluctuated between 10-20%.

MZ	Year 6 Performance Criteria – 2017	Year 9 Performance Criteria - 2020	Year 15 Performance Criteria - 2026
			Reducing exotic groundcover remains a challenge.
MZ4a	**No significant declared (noxious) weed infestations**. No significant noxious weed infestations. Exotics comprise a significant proportion (>15%) of groundcover at 21% of sites.	No significant declared (noxious) weed infestations. Exotics comprise a significant proportion (>15%) of the groundcover at 21% of sites.	No significant declared (noxious) weed infestations. Exotics comprise a significant proportion (>15%) of the groundcover at 21% of sites.
MZ5	**Weeds do not pose a risk to establishment of revegetation area**. Noxious weeds occur only in isolated occurrences and are reported for eradication. Not a risk to revegetation.	Weeds do not pose a risk to the establishment of the revegetation area. Noxious weeds occur only in isolated occurrences and are reported for eradication.	Weeds do not pose a risk to the establishment of the revegetation area. Noxious weeds occur only in isolated occurrences and are reported for eradication.
MZ6	**Weeds controlled.** No populations of noxious weeds located, but limited sites surveyed.	No populations of noxious weeds located, but limited sites surveyed.	No populations of noxious weeds located, but limited sites surveyed.

Table 3-3: Progress of performance criteria achievement – BVT Benchmarks (MZ2 and MZ3)

Performance criteria	Species diversity and vegetation density trending towards each respective benchmark for the relevant vegetation community
MZ2	Native species richness has met benchmark for the majority of sites. Scores fluctuate across the seasons and no clear trends are visible. No trends available as of yet for overstorey and midstorey covers in floristic plots. But natural regeneration that is observed indicates an increasing overstorey cover in MZ2.
MZ3	Native species richness fluctuates across years and on average is below benchmark for most sites. Current over-storey cover is 2%, but will increase in the next 5 to 10 years as a result of tree plantings.

Table 3-4: Progress of performance criteria achievement – regeneration/revegetation Box Gum Woodland

Monitoring	Annual Indicator	Trigger Values to investigate intervention	Comments
Cover abundance of native species	Native species cover abundance maintained or improved or Where there is a decrease due to	A decrease in native species cover abundance of 10 % or more or A decrease in cover abundance of 10 % or	No decrease of ≥10% in native species richness in Box Gum Woodland sites between 2016 and 2017.

Monitoring	Annual Indicator	Trigger Values to investigate intervention	Comments
	environmental conditions (e.g. drought), decrease is in proportion to the analogue community.	more when compared to the analogue community.	
Revegetation tube stock survival rates (Box-Gum Woodland)	Tube stock survival rates – aim for > 50% of tube stock plantings to be healthy and growing as verified by monitoring.	A low survival rate of tube stock (< 50%) or Floristic composition not typical of Box-Gum Woodland	Revegetation areas not directly assessed in 2017. Most recent assessment indicates good success with a few gaps. Review need for replanting in coming seasons.
Weed invasion	A decrease in weed cover abundance and elimination of noxious weeds	An increase in weed invasion by 10 % or greater or Presence of noxious weed species.	Only one site has an increase of ≥10% exotic cover. Discrete occurrence of declared (noxious) weeds present at several sites.
Other factors (e.g. feral animals, disturbance, fire, erosion).	Maintain and improve condition and health of vegetation.	If monitoring indicates that any factors being monitored are likely to be having a detrimental influence on vegetation condition or native fauna.	Minor occurrences of feral animal activity which have been reported for appropriate action.

Table 3-5: Progress of performance criteria achievement – Revegetation and Regeneration Management (MZ2, MZ3 and MZ4a)

Criteria: Monitoring natural regeneration occurring within BOAs and update mapping with changes identified. Second generation tree seedlings are present or likely to be, based on monitoring results	
MZ2	Second-generation natural regeneration seedlings are present, and monitoring transects set up. No discernible changes in area of natural regeneration that can be mapped. Natural regeneration is a slow and patchy process as evidenced by historical air photographs. Consideration could be given to plantings in some areas of MZ2.
MZ3	Some natural regeneration of second generation seedlings. No seedlings forming from plantings as of yet, due to the relatively young age of these plants. Some plantings gaps exist amongst a generally successful planting program. These should be reviewed in coming year or two, and decision made as whether replanting is warranted.
MZ4a	Examples of natural regeneration present. Natural regeneration transects established.

Table 3-6: Progress of performance criteria / TARP – Open Cut Rehabilitation (MZ5)

Performance criteria	Management aim / Trigger	Comments
Erosion control	No gully or tunnel erosion. No rilling present.	No active erosion present at monitoring sites however, gully erosion identified elsewhere which requires management (see **Appendix F**).
Vegetation density	Five years following revegetation the rehabilitation area has not achieved Vegetation Density Criteria for Phase 4 of rehabilitation.	The density of trees and shrubs is not within the range recorded at analogue sites. Overall, shrub density is higher and tree density is lower than that observed at Analogue sites. Densities unlikely to change over the short term.
Ecosystem composition	Rehabilitation area achieving the Ecosystem Composition Criteria for Phase 4 of rehabilitation.	Revegetation areas contain flora species assemblages' characteristic of the surrounding native vegetation communities.
Weed presence	Weed presence does not pose a risk to the establishment of the rehabilitation area.	Overall, exotic species occur in relatively low proportions which do not pose a threat to the function of the rehabilitating woodland communities. Minor occurrences of declared (formerly noxious) species have been reported for eradication.
Pest Fauna presence	Pest animal presence does not pose a risk to the establishment of the rehabilitation area.	Pest fauna species have been recorded in rehabilitation areas however, do not pose a risk to the establishment or functioning of these areas. Recordings of pest species have been reported for eradication.
Native Fauna	Monitoring indicates a lack of variety in native fauna species utilising the rehabilitation area and/or a lack of suitable habitat is available.	Rehabilitation areas contain limited habitat features for a variety of fauna groups. Habitat values unlikely to improve until the medium to long term.

4 Conclusions and Recommendations

4.1 Management recommendations

Reducing exotic groundcover remains a challenge for areas that have been cleared historically, particularly within MZ2, MZ3, and MZ4a. In order to meet the 2026 performance target of <5% cover, management trials including options such as ecological burning, seeding, slashing and herbicide application may be required. It is possible that increasing overstorey cover will improve native groundcover and reduce exotic groundcover (dominated by open paddock annual exotic species). Low exotic groundcovers found within advanced regeneration sites provide an indication that increased overstorey and midstorey cover may reduce exotic cover.

St. John's Wort continues to be the most common and abundant declared weed across the UCML complex. Control is difficult. Literature indicates that strong pasture growth helps control its occurrence, but its presence within pasture areas not recently grazed challenges this concept. Trials and investigations of the role of canopy and pasture should be considered in order to determine the best way forward for management of this species.

Feral animals have a presence across the parts of the UCML project area, and as such controls programs are still warranted.

Fauna habitat value across regenerating and rehabilitating lands (MZ2, MZ3, MZ4a and MZ5) remains low and will not significantly improve until the medium to long term. Habitat augmentation including large woody debris and boulder placement is recommended to provide habitat features in the short term.

4.2 Floristic monitoring recommendations

Areas within MZ2 that are currently subject to cattle grazing should either be reclassified as MZ6 to better reflect their current land use, or grazing be excluded to better reflect the mapped MZ.

A total of 12 monitoring sites within MZ1 are located in areas that have regenerated from cleared land since 1964 and hence are not fully reflective of areas of remnant vegetation. These sites should be considered for reclassification in a separate management zone, to allow insight into the nature of advanced natural regeneration at UCML.

Natural Regeneration: Currently, natural regeneration is monitored by assessing the change in density and extent of regeneration within monitoring plot transects. This is done every two years, however, given the slow rate at which natural regeneration occurs, it is recommended that the monitoring be undertaken every 4 years within the existing monitoring plot transects. In addition to the existing monitoring plot transects, mapping of new occurrences of natural regeneration using the ArcCollector application should be undertaken.

During previous monitoring, young seedlings have generally been observed to sporadically appear adjacent to existing vegetation. Neither the use of remote sensing or the natural regeneration transects (focussed on rates of change) effectively monitor these new occurrences of young seedlings which constitute natural regeneration. Monitoring of such occurrences could be achieved through establishing a program which includes noting observations whilst driving the boundaries of blocks of remnant

vegetation, which can be undertaken concurrently with the current monitoring program as personnel move between floristic monitoring sites.

Natural regeneration mapping created through this program would complement a visual record of natural regeneration, gained through review of historical remote sensing, and monitoring information from natural regeneration transects providing rates of advance and increase in density.

Floristic monitoring: Most sites in MZ1 have now been monitored for five years. The current program involves a rolling program of rapid assessment and full floristic assessment on an alternating two year rotation. Consideration could be given to the recommendation that this monitoring frequency be increased to four years, instead redirecting resources towards monitoring in the more actively changing MZs.

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Appendix A: Methodology

Monitoring was undertaken by ELA ecologists David Allworth, Tomas Kelly, Cassandra Holt and Jessica Southgate between the 28th of March and 6th of April and the 14th and 24th of August 2017. The full list of sites which underwent monitoring throughout 2017 is presented in **Table A1** below.

Table A1: 2017 floristic monitoring program sites

Site	MZ	BVT	Methodology	Season
ACQ1	MZ1	HU575	Full floristic	Spring
ACQ2	MZ1	HU605	Full floristic	Spring
BB1	MZ1	HU574	Rapid Assessment Plot	Spring
BOB11B	MZ1	HU515	Rapid Assessment Plot	Autumn
BOB16	MZ1	HU552	Rapid Assessment Plot	Spring
BOB3	MZ1	HU552	Rapid Assessment Plot	Autumn
BOB4B	MZ1	HU654	Rapid Assessment Plot	Autumn
BOB6	MZ1	HU515	Rapid Assessment Plot	Autumn
BOB8	MZ1	HU552	Rapid Assessment Plot	Autumn
BOBC1	MZ1	HU515	Full floristic	Autumn
BOBC3	MZ1	HU574	Full floristic	Autumn
BOBC9	MZ1	HU515	Rapid Assessment Plot	Autumn
BOBE2	MZ1	HU654	Rapid Assessment Plot	Autumn
BOBE3	MZ1	HU552	Rapid Assessment Plot	Autumn
FBS5	MZ1	HU654	Full floristic/Floristic based subsidence	Autumn/Spring
FBS6	MZ1	HU654	Full floristic/Floristic based subsidence	Autumn/Spring
FBS8	MZ1	HU552	Full floristic/Floristic based subsidence	Autumn/Spring
FBS9	MZ1	HU515	Full floristic/Floristic based subsidence	Autumn/Spring
FBS11	MZ1	HU575	Full floristic/Floristic based subsidence	Autumn
HR	MZ1	HU605	*Acacia ausfeldii* population monitoring	Spring
RPA11	MZ1	HU654	Rapid Assessment Plot	Spring
RPA16	MZ1	HU551	Full floristic	Spring
RPA17	MZ1	HU551	Full floristic	Autumn
RPA3A	MZ1	HU605	Rapid Assessment Plot	Autumn
RPA4	MZ1	HU552	Rapid Assessment Plot	Autumn
RPA5	MZ1	HU608	Rapid Assessment Plot	Spring

Site	MZ	BVT	Methodology	Season
RPA6	MZ1	HU608	Rapid Assessment Plot	Autumn
RPA9	MZ1	HU608	Rapid Assessment Plot	Spring
SI3B	MZ1	HU654	Rapid Assessment Plot	Autumn
UG LWW4 L1-10	MZ1	N/A	Floristic-based subsidence	Spring
UG LWW5 L1-10	MZ1	N/A	Floristic-based subsidence	Spring
UW LW4 L1-10	MZ1	N/A	Floristic-based subsidence	Autumn
BOB13B	MZ2	HU605	Full floristic/Floristic based subsidence	Autumn/Spring
BOB18	MZ2	HU654	Full floristic	Autumn
BOB20	MZ2	HU605	Full floristic	Autumn
BOB22	MZ2	HU552	Full floristic	Spring
BOBC10	MZ2	HU515	Full floristic	Autumn
BOBE1	MZ2	HU654	Natural regeneration	Autumn
BOBE11	MZ2	HU654	Full floristic	Autumn
BOBE13	MZ2	HU654	Full floristic	Spring
BOBE5	MZ2	HU605	Full floristic	Autumn
RPA14A	MZ2	HU605	Rapid Assessment Plot	Autumn
BOB19	MZ3	HU515	Full floristic	Spring
SOA4	MZ4a	HU515	Rapid Assessment Plot and Natural regeneration	Spring
SOA5	MZ4a	HU575	Rapid Assessment Plot and Natural regeneration	Spring
SOA6	MZ4a	HU654	Rapid Assessment Plot and Natural regeneration	Spring
OC3D	MZ5	N/A	Full floristic, erosion transect and habitat assessment	Spring
OC4B	MZ5	N/A	Rapid assessment, erosion and habitat assessment	Autumn
OC5B	MZ5	N/A	Rapid assessment, erosion and habitat assessment	Autumn
OC6B	MZ5	N/A	Full floristic, erosion transect and habitat assessment	Autumn
RPA12	MZ6	HU654	Full floristic/Floristic based subsidence	Autumn

1.1 Floristic monitoring

Floristic monitoring during 2017 was undertaken in accordance with the revised methodology outlined in Section 8 of the UCML BMP (2015). Monitoring was undertaken at 47 sites (autumn and spring) across the UCML complex consisting of:

- 11 full floristic sites (biometric plots) and 18 rapid assessment sites surveyed in autumn 2017
- 7 full floristic sites and 6 rapid assessment sites surveyed in spring 2017
- 5 full floristic sites (floristic-based subsidence biometric plots) surveyed in both autumn and spring.

1.1.1 Full floristic (biometric) monitoring

Full floristic monitoring involved monitoring of floristic quadrats (20 m x 20 m) and collection of cover (from 1-5% and then to nearest 5%) and abundance (1-10, 20, 50, 100, 500, 1000 or specified greater number of individuals) for each species. Biometric plot data was also collected using the BioBanking assessment methodology (OEH, 2014) within a 20 m x 50 m plot.

In addition, within the permanent 20 m x 20 m quadrats, the following data was collected:

- floristic composition and structure
- progress of revegetation/regeneration towards target native vegetation community
- general health of vegetation
- evidence of natural regeneration
- requirements for species-specific planting or thinning
- success of management actions implemented following previous monitoring inspections;
- non-vascular ground cover (litter, cryptogam, logs >10 cm diameter, rocks >5 cm diameter, bare soil) (% cover)
- the occurrence and abundance of weeds, evidence of animal disturbance and observable impacts.

1.1.2 Rapid assessment monitoring

Rapid assessments were undertaken at residual monitoring sites that had previously been identified as being in good and stable condition and therefore no longer requiring full floristic monitoring. Rapid assessment involved recording the following characteristics:

- floristic composition (including cover and abundance of up to three dominant species in each stratum) and structure
- general health of vegetation
- evidence of natural regeneration
- occurrence and abundance of weed species
- presence of threatened or other significant species
- signs of disturbance, either by stock or humans
- evidence of feral animals
- any observable impacts of the Project, such as the effectiveness of fencing and weed control.

1.1.3 Floristic based subsidence monitoring

A new floristic-based subsidence monitoring method was introduced during autumn 2017, which involved the establishment of five transects across the width of the longwall (LW) panel. Two monitoring sites were established for each transect (a total of ten sites per LW), with one site located within the transition zone and one site within the LW zone. Each monitoring site, comprising a 20 m x 20 m quadrat, was permanently marked with four metal star pickets. Sites were established at Ulan West LW4 (autumn), Ulan No. 3 LWW4 (spring) and Ulan No. 3 LWW5 (spring). The following data was collected from each site:

- Projected foliage cover (5% increments) of upper canopy;
- Canopy health and defoliation (all in 5% increments):
  - Percentage of epicormic foliage in relation to total tree foliage;
  - Proportion of primary branches within canopy that have died back;
  - Percentage of current canopy foliage as a proportion of the estimated canopy foliage volume/potential canopy; and
  - Percentage of canopy foliage discoloured.
- Photograph of the canopy (camera placed on top of the star picket, facing up); photograph facing due north, south, east and west from the north-west star picket.

Any evidence of subsidence opportunistically observed was also recorded with a handheld GPS.

Table A2: Floristic-based subsidence monitoring sites

Site Number	Longwall Panel	Survey Season
Ulan No. 3 Underground Mine		
UG LWW4 Sites L1-10	Ulan No. 3 LWW4	Spring
UG LWW5 Sites L1-10	Ulan No. 3 LWW5	Spring
Ulan West Underground Mine		
UW LW4 Sites L1-10	Ulan West LW4	Autumn / Spring

1.2 Targeted *Acacia ausfeldii* monitoring

Floristic monitoring was undertaken at two monitoring sites (ACQ1 and ACQ2) within the Highett Road Offset Area. Monitoring within sites ACQ1 and ACQ2 was conducted during spring 2017 and followed the full floristic methodology outlined above and in Section 8 of the UCML BMP (2015).

Targeted surveys of 100 tagged individuals and germination transect surveys were also undertaken. These surveys targeted 100 previously tagged *A. ausfeldii* individuals and recorded the height, diameter at base and growth stage (seedling, sapling or mature shrub). Additional information was collected for each individual, including reproductive ratings and condition ratings. **Table A3** below outlines the definition of the ratings.

Germination transect surveys were also undertaken along three previously established 50 m transects and 20 randomly places 1m x 1m quadrats. All occurrences of *A. ausfeldii* seedlings along each transect and within the quadrats were recorded using a handheld GPS.

Table A3: *Acacia ausfeldii* condition rating definitions

	Condition Rating				
	1	**2**	**3**	**4**	**5**
Condition Rating	Severe damage/dieback	Many dead stems	Some dead branches	Minor damage	Healthy
Reproductive Rating	Nil	Sparse - occasional flowers/fruit only)	Low – under 25% of potential	Moderate – 25 – 75% of potential	High – 75 – 100% of potential

1.3 Natural regeneration monitoring

Monitoring of natural regeneration continued with the MZ4a areas of the SOAs with three new 100 m transects established.

Each transect was traversed, with occurrences of canopy regeneration recorded with a handheld GPS unit 20 m either side of the transect.

Individual plants were recorded in two categories, <5 cm diameter at breast height (DBH) and 5-15 cm DBH, with the species of the plant also noted.

This methodology allows for the calculation of natural regeneration density and the spatial representation of natural regeneration progression over successive years.

Assessment of natural over the past decades was undertaken by:

- Obtaining air photos from 1964 and 1990 of the northern part of the Ulan Project Area,
- The comparing where cleared areas occurred in either 1964 or 1990 that in recent remote sensing are now either woodland or open forest.
- Drawing of polygons around woodland or open forest that were once cleared areas to determine amount of natural regeneration in the project area,
- Using data from any existing full floristic sites that are located in the natural regeneration to analyse how these natural regeneration areas have performed in terms of native species richness and exotic cover versus benchmarks.

1.4 Open Cut rehabilitation monitoring

Open Cut rehabilitation monitoring was undertaken at four newly established sites and utilised both the Biometric plot methodology and Rapid assessment methodology detailed above. Additional information was collected at each plot with regards to erosion and landform stability and fauna habitat values, including the following:

- Slope and land use;
- Photographs along the transect;
- Erosion - including the type, width, depth and position (distance from start, m) along the transect. Erosion identified will be rated using the following:
    - 1 – no erosion
    - 2 – sheet erosion
    - 3 – rill erosion < 0.3 m deep

- 4 – gully erosion > 0.3 m, < 1 m deep
- 5 – gully

Observations relating to fauna habitat were recorded at each monitoring site, including:

- Opportunistic fauna observations
- Habitat features, including micro-habitat present for threatened species. Examples of micro-habitat include large woody debris, hollow-bearing trees, rock outcrops/caves and Koala feed trees.

1.5 Weather conditions

Temperatures recorded during the monitoring periods are found below in **Table A5**. Data used for analysis of weather was supplied from the UCML weather station.

During autumn, temperatures were highly variable with minimum and maximum temperatures ranging from 5.7°C to 20.2°C and 20.1°C to 33.6°C respectively. Overall, these temperatures are largely consistent with the long term averages for the region (BOM, 2018). Rainfall was recorded during two days of the autumn monitoring period, with 32.6 mm falling on the 30/03/2017. Total rainfall in the months preceding monitoring was varied, with well above average rainfall falling during March 2017, which followed rainfall below the long term averages for both January and February 2017 (BOM, 2018).

The spring monitoring period was characterised by largely consistent minimum and maximum temperatures, which ranged from -3.4°C to 0.9°C and 17.0°C to 23.8°C respectively. Overall, the minimum temperatures recorded during the monitoring period are well below long term averages, whilst maximum temperatures are well above long term averages (BOM, 2018). This is likely due to the clear and sunny conditions experienced throughout the survey period. Only 0.3 mm of rainfall was recorded during the spring monitoring period, which is consistent with the well below average rainfall recorded in the months preceding monitoring (BOM, 2018).

Table A5: Weather conditions

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
Autumn surveys			
28/03/2017	17.0	32.3	1.3
29/03/2017	20.2	33.6	0
30/03/2017	15.0	26.2	32.6
31/03/2017	13.9	23.3	0
03/04/2017	8.2	20.2	0
04/04/2017	5.7	21.1	0
05/04/2017	8.4	20.1	0
06/04/2017	9.1	21.5	0
Spring surveys			
14/08/2017	-3.4	20.7	0
15/08/2017	0.9	23.8	0
16/08/2017	0.2	18.5	0
17/08/2017	-2.7	18.5	0

Date	Min Temp (°C)	Max Temp (°C)	Rainfall (mm)
22/08/2017	-1.0	21.4	0
23/08/2017	-3.2	22.2	0
24/08/2017	-2.4	17.0	0.3

Appendix B: 2017 monitoring sites

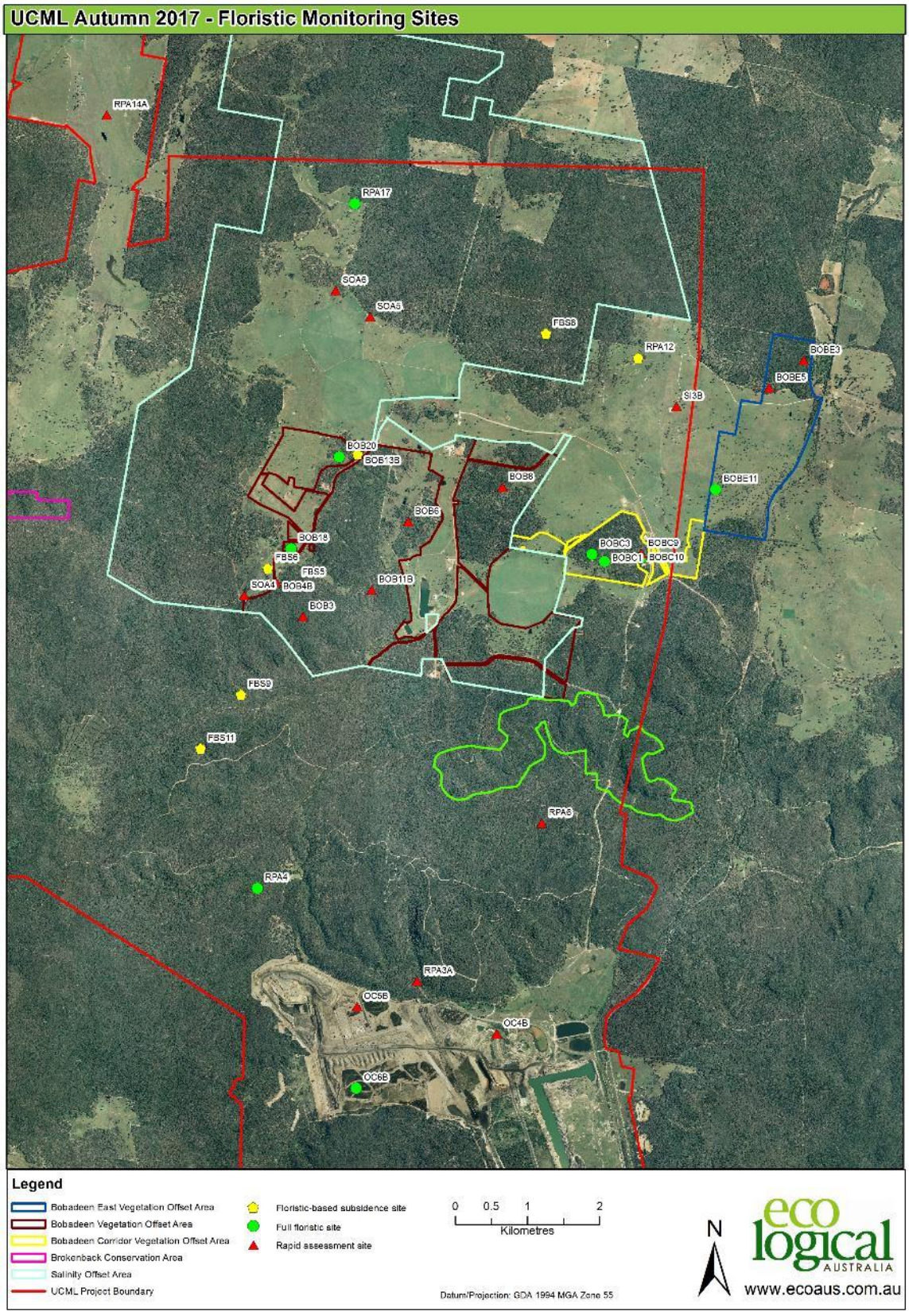

Figure B1: Floristic monitoring sites - autumn 2017

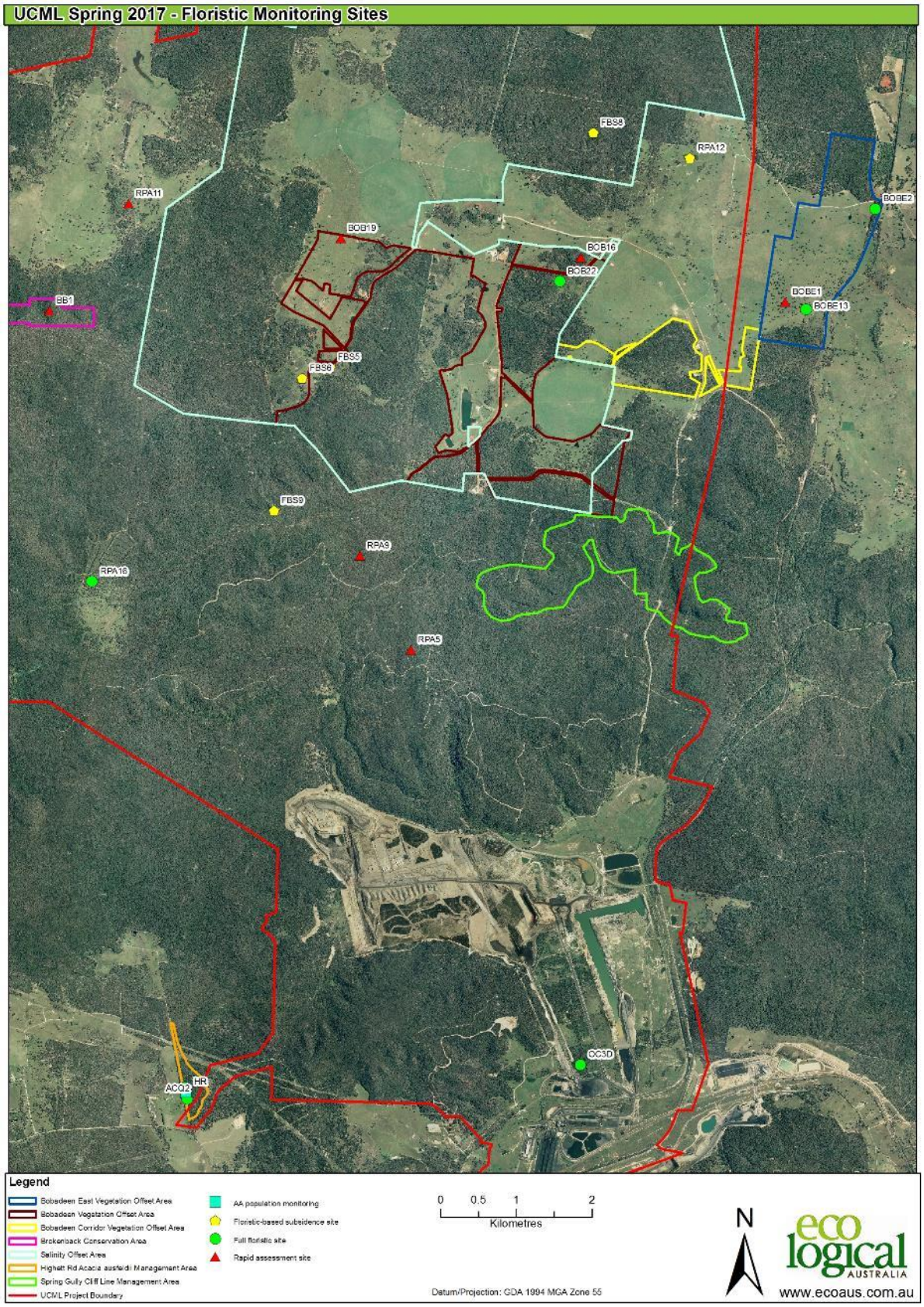

Figure B2: Floristic monitoring sites – spring 2017

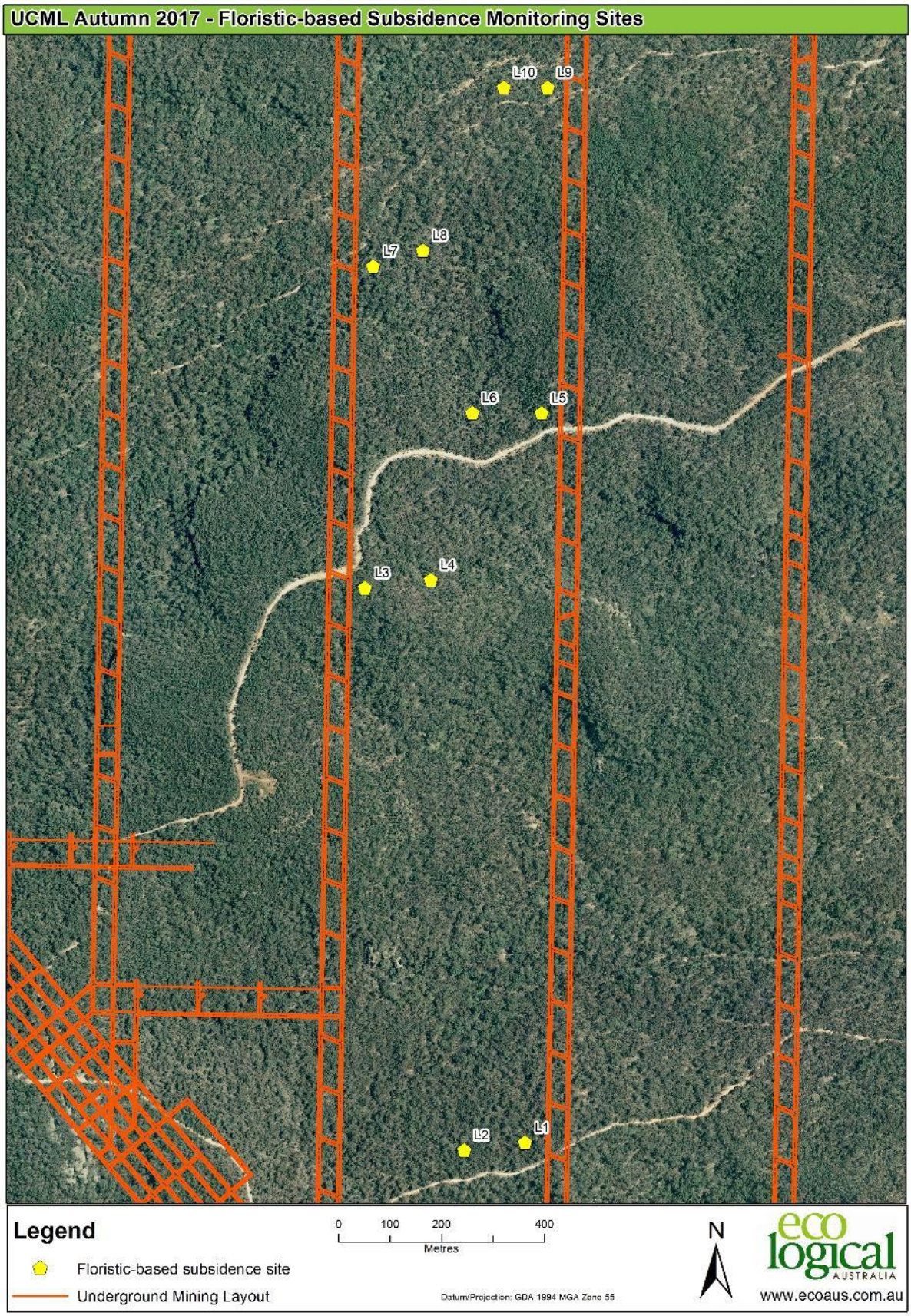

Figure B3: Floristic-based subsidence monitoring sites - established autumn 2017

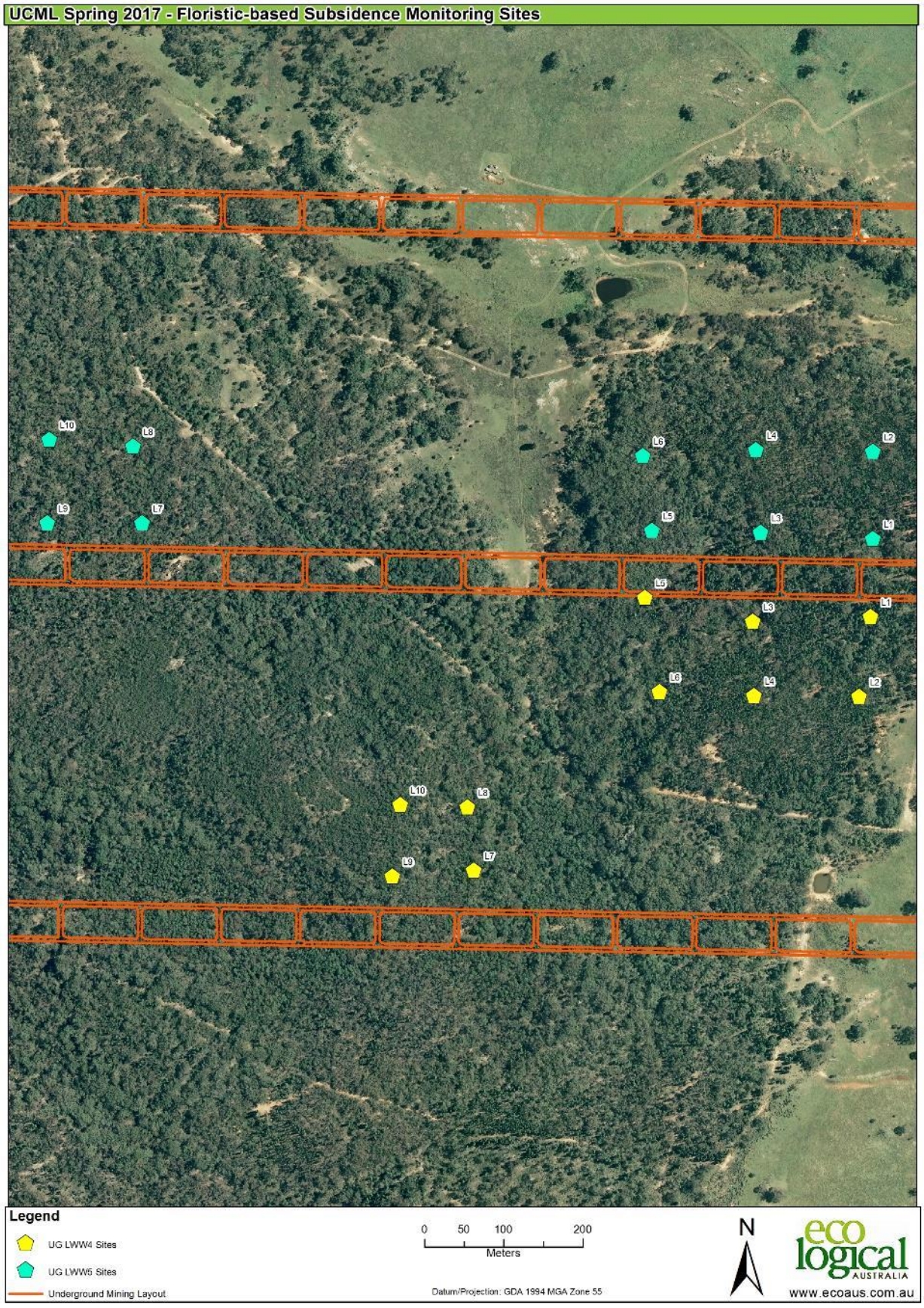

Figure B4: Floristic-based subsidence monitoring sites - established spring 2017

Appendix C: Flora species list

Family	Scientific Name	Native/Exotic
Adiantaceae	*Cheilanthes sieberi*	Native
Anthericaceae	*Laxmannia gracilis*	Native
Apiaceae	*Cyclospermum leptophyllum*	Exotic
Apiaceae	*Daucus glochidiatus*	Native
Apiaceae	*Hydrocotyle laxiflora*	Native
Apiaceae	*Platysace ericoides*	Native
Apocynaceae	*Gomphocarpus sp.*	Exotic
Asteraceae	*Asteraceae sp.*	Native/Exotic
Asteraceae	*Bidens subalternans*	Exotic
Asteraceae	*Calotis cuneifolia*	Native
Asteraceae	*Calotis lappulacea*	Native
Asteraceae	*Carthamus lanatus*	Exotic
Asteraceae	*Cassinia arcuata*	Native
Asteraceae	*Cassinia quinquefaria*	Native
Asteraceae	*Centipeda sp.*	Native
Asteraceae	*Chondrilla juncea*	Exotic
Asteraceae	*Chondrilla sp.*	Exotic
Asteraceae	*Chrysocephalum apiculatum*	Native
Asteraceae	*Chrysocephalum semipapposum*	Native
Asteraceae	*Cirsium vulgare*	Exotic
Asteraceae	*Conyza bonariensis*	Exotic
Asteraceae	*Conyza sp.*	Exotic
Asteraceae	*Cotula australis*	Native
Asteraceae	*Cymbonotus lawsonianus*	Native
Asteraceae	*Euchiton sphaericus*	Native
Asteraceae	*Gamochaeta calviceps*	Exotic
Asteraceae	*Gamochaeta coarctata*	Exotic
Asteraceae	*Gamochaeta sp.*	Exotic
Asteraceae	*Hypochaeris radicata*	Exotic
Asteraceae	*Lagenophora stipitata*	Native
Asteraceae	*Olearia elliptica*	Native
Asteraceae	*Podolepis neglecta*	Native
Asteraceae	*Podolepis* sp.	Native
Asteraceae	*Senecio madagascariensis*	Exotic
Asteraceae	*Senecio quadridentatus*	Native
Asteraceae	*Senecio sp.*	Native
Asteraceae	*Sigesbeckia orientalis*	Native
Asteraceae	*Silybum marianum*	Exotic
Asteraceae	*Solenogyne bellioides*	Native
Asteraceae	*Solenogyne gunnii*	Native

Family	Scientific Name	Native/Exotic
Asteraceae	*Solenogyne sp.*	Native
Asteraceae	*Sonchus oleraceus*	Exotic
Asteraceae	*Sonchus sp.*	Exotic
Asteraceae	*Tagetes minuta*	Exotic
Asteraceae	*Taraxacum officinale*	Exotic
Asteraceae	*Vittadinia cuneata*	Native
Asteraceae	*Vittadinia muelleri*	Native
Asteraceae	*Vittadinia sp.*	Native
Asteraceae	*Vittadinia sulcata*	Native
Asteraceae	*Vittadinia triloba*	Native
Asteraceae	*Xanthium spinosum*	Exotic
Boraginaceae	*Cynoglossum australe*	Native
Boraginaceae	*Echium plantagineum*	Exotic
Boraginaceae	*Echium vulgare*	Exotic
Brassicaceae	*Brassicaceae sp.*	Exotic
Brassicaceae	*Capsella bursa-pastoris*	Exotic
Brassicaceae	*Lepidium* sp.	Exotic
Cactaceae	*Opuntia stricta*	Exotic
Campanulaceae	*Wahlenbergia sp.*	Native
Caryophyllaceae	*Cerastium glomeratum*	Exotic
Caryophyllaceae	*Paronychia brasiliana*	Exotic
Caryophyllaceae	*Stellaria media*	Exotic
Caryophyllaceae	*Stellaria pungens*	Native
Casuarinaceae	*Allocasuarina diminuta*	Native
Casuarinaceae	*Allocasuarina gymnanthera*	Native
Casuarinaceae	*Casuarina cunninghamiana*	Native
Chenopodiaceae	*Chenopodium carinatum*	Native
Chenopodiaceae	*Chenopodium sp.*	Native
Chenopodiaceae	*Einadia hastata*	Native
Chenopodiaceae	*Einadia nutans*	Native
Chenopodiaceae	*Einadia polygonoides*	Native
Chenopodiaceae	*Einadia sp.*	Native
Chenopodiaceae	*Einadia trigonos*	Native
Chenopodiaceae	*Maireana decalvans*	Native
Clusiaceae	*Hypericum gramineum*	Native
Clusiaceae	*Hypericum perforatum*	Exotic
Convolvulaceae	*Dichondra repens*	Native
Convolvulaceae	*Dichondra sp.* A	Native
Crassulaceae	*Crassula sp.*	Native
Cupressaceae	*Callitris endlicheri*	Native
Cyperaceae	*Carex appressa*	Native
Cyperaceae	*Carex sp.*	Native
Cyperaceae	*Cyperus sp.*	Native/Exotic

Family	Scientific Name	Native/Exotic
Cyperaceae	*Fimbristylis dichotoma*	Native
Cyperaceae	*Gahnia aspera*	Native
Cyperaceae	*Lepidosperma laterale*	Native
Cyperaceae	*Schoenus apogon*	Native
Dennstaedtiaceae	*Pteridium esculentum*	Native
Dilleniaceae	*Hibbertia circumdans*	Native
Dilleniaceae	*Hibbertia obtusifolia*	Native
Droseraceae	*Drosera sp.*	Native
Ericaceae	*Acrotriche rigida*	Native
Ericaceae	*Leucopogon muticus*	Native
Ericaceae	*Lissanthe strigosa*	Native
Ericaceae	*Monotoca scoparia*	Native
Ericaceae	*Styphelia triflora*	Native
Ericaceae - Styphelioideae	*Astroloma humifusum*	Native
Ericaceae - Styphelioideae	*Brachyloma daphnoides*	Native
Ericaceae - Styphelioideae	*Melichrus erubescens*	Native
Ericaceae - Styphelioideae	*Melichrus urceolatus*	Native
Euphorbiaceae	*Chamaesyce sp.*	Native
Euphorbiaceae	*Chamaesyce drummondii*	Native
Euphorbiaceae	*Euphorbia sp.*	Exotic
Fabaceae - Faboideae	*Daviesia genistifolia*	Native
Fabaceae - Faboideae	*Daviesia ulicifolia*	Native
Fabaceae - Faboideae	*Desmodium brachypodum*	Native
Fabaceae - Faboideae	*Desmodium sp.*	Native
Fabaceae - Faboideae	*Desmodium varians*	Native
Fabaceae - Faboideae	*Glycine clandestina*	Native
Fabaceae - Faboideae	*Glycine tabacina*	Native
Fabaceae - Faboideae	*Indigofera australis*	Native
Fabaceae - Faboideae	*Podolobium aciculiferum*	Native
Fabaceae - Faboideae	*Podolobium ilicifolium*	Native
Fabaceae - Faboideae	*Pultenaea microphylla*	Native
Fabaceae - Faboideae	*Swainsona galegifolia*	Native
Fabaceae - Faboideae	*Trifolium arvense*	Exotic
Fabaceae - Faboideae	*Trifolium campestre*	Exotic
Fabaceae - Faboideae	*Trifolium repens*	Exotic
Fabaceae - Faboideae	*Trifolium scabrum*	Exotic
Fabaceae - Faboideae	*Trifolium sp.*	Exotic
Fabaceae - Mimosoideae	*Acacia ausfeldii*	Native
Fabaceae - Mimosoideae	*Acacia baileyana*	Native
Fabaceae - Mimosoideae	*Acacia buxifolia*	Native
Fabaceae - Mimosoideae	*Acacia caesiella*	Native
Fabaceae - Mimosoideae	*Acacia deanei*	Native
Fabaceae - Mimosoideae	*Acacia decora*	Native

Family	Scientific Name	Native/Exotic
Fabaceae - Mimosoideae	*Acacia doratoxylon*	Native
Fabaceae - Mimosoideae	*Acacia flexifolia*	Native
Fabaceae - Mimosoideae	*Acacia implexa*	Native
Fabaceae - Mimosoideae	*Acacia linearifolia*	Native
Fabaceae - Mimosoideae	*Acacia paradoxa*	Native
Fabaceae - Mimosoideae	*Acacia sp.*	Native
Fabaceae - Mimosoideae	*Acacia ulicifolia*	Native
Fabaceae - Mimosoideae	*Acacia verniciflua*	Native
Gentianaceae	*Centaurium sp.*	Exotic
Geraniaceae	*Erodium cicutarium*	Exotic
Geraniaceae	*Geranium solanderi*	Native
Geraniaceae	*Geranium sp.*	Native
Goodeniaceae	*Goodenia hederacea*	Native
Haloragaceae	*Gonocarpus elatus*	Native
Haloragaceae	*Gonocarpus tetragynus*	Native
Haloragaceae	*Haloragis heterophylla*	Native
Iridaceae	*Patersonia sericea*	Native
Juncaceae	*Juncus* sp.	Native/Exotic
Lamiaceae	*Ajuga australis*	Native
Lamiaceae	*Marrubium vulgare*	Exotic
Lamiaceae	*Mentha satureioides*	Native
Lamiaceae	*Oncinocalyx betchei*	Native
Lamiaceae	*Salvia sp.*	Exotic
Lamiaceae	*Salvia verbenaca*	Exotic
Lobeliaceae	*Isotoma axillaris*	Native
Lomandraceae	*Lomandra confertifolia*	Native
Lomandraceae	*Lomandra filiformis*	Native
Lomandraceae	*Lomandra filiformis subsp. coriacea*	Native
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Native
Lomandraceae	*Lomandra glauca*	Native
Lomandraceae	*Lomandra longifolia*	Native
Lomandraceae	*Lomandra multiflora*	Native
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Native
Loranthaceae	*Amyema miquelii*	Native
Loranthaceae	*Amyema sp.*	Native
Malvaceae	*Malva parviflora*	Exotic
Malvaceae	*Modiola caroliniana*	Exotic
Malvaceae	*Sida corrugata*	Native
Malvaceae	*Sida sp.*	Native
Myrsinaceae	*Anagallis arvensis*	Exotic
Myrtaceae	*Angophora floribunda*	Native
Myrtaceae	*Baeckea* sp.	Native
Myrtaceae	*Corymbia maculata*	Native

Family	Scientific Name	Native/Exotic
Myrtaceae	*Eucalyptus albens*	Native
Myrtaceae	*Eucalyptus blakelyi*	Native
Myrtaceae	*Eucalyptus bridgesiana*	Native
Myrtaceae	*Eucalyptus crebra*	Native
Myrtaceae	*Eucalyptus dwyeri*	Native
Myrtaceae	*Eucalyptus fibrosa*	Native
Myrtaceae	*Eucalyptus macrorhyncha*	Native
Myrtaceae	*Eucalyptus melliodora*	Native
Myrtaceae	*Eucalyptus moluccana*	Native
Myrtaceae	*Eucalyptus punctata*	Native
Myrtaceae	*Eucalyptus rossii*	Native
Myrtaceae	*Eucalyptus sparsifolia*	Native
Myrtaceae	*Eucalyptus viminalis*	Native
Myrtaceae	*Kunzea ambigua*	Native
Myrtaceae	*Kunzea parvifolia*	Native
Myrtaceae	*Leptospermum polygalifolium*	Native
Myrtaceae	*Melaleuca thymifolia*	Native
Myrtaceae	*Sannantha cunninghamii*	Native
Nyctaginaceae	*Boerhavia dominii*	Native
Orchidaceae	*Diuris sp.*	Native
Orchidaceae	*Microtis sp.*	Native
Orchidaceae	*Orchidaceae sp.*	Native
Oxalidaceae	*Oxalis perennans*	Native
Oxalidaceae	*Oxalis sp.*	Native
Phyllanthaceae	*Phyllanthus hirtellus*	Native
Phyllanthaceae	*Phyllanthus occidentalis*	Native
Phyllanthaceae	*Phyllanthus* sp.	Native
Phyllanthaceae	*Poranthera corymbosa*	Native
Phyllanthaceae	*Poranthera microphylla*	Native
Pittosporaceae	*Bursaria spinosa*	Native
Plantaginaceae	*Plantago debilis*	Native
Plantaginaceae	*Plantago lanceolata*	Exotic
Plantaginaceae	*Veronica plebeia*	Native
Poaceae	*Aira sp.*	Exotic
Poaceae	*Aristida ramosa*	Native
Poaceae	*Aristida vagans*	Native
Poaceae	*Arundinella nepalensis*	Native
Poaceae	*Austrodanthonia* sp.	Native
Poaceae	*Austrostipa aristiglumis*	Native
Poaceae	*Austrostipa genistifolia*	Native
Poaceae	*Austrostipa scabra*	Native
Poaceae	*Austrostipa sp.*	Native
Poaceae	*Bothriochloa macra*	Native

Family	Scientific Name	Native/Exotic
Poaceae	*Briza minor*	Exotic
Poaceae	*Chloris sp.*	Native
Poaceae	*Chloris truncata*	Native
Poaceae	*Chloris ventricosa*	Native
Poaceae	*Cleistochloa rigida*	Native
Poaceae	*Cymbopogon refractus*	Native
Poaceae	*Cynodon dactylon*	Native
Poaceae	*Dichanthium sericeum*	Native
Poaceae	*Dichelachne micrantha*	Native
Poaceae	*Digitaria brownii*	Native
Poaceae	*Digitaria parviflora*	Native
Poaceae	*Digitaria sp.*	Native
Poaceae	*Echinochloa crus-galli*	Exotic
Poaceae	*Echinopogon ovatus*	Native
Poaceae	*Echinopogon sp.*	Native
Poaceae	*Eleusine tristachya*	Exotic
Poaceae	*Elymus scaber*	Native
Poaceae	*Enteropogon acicularis*	Native
Poaceae	*Entolasia sp.*	Native
Poaceae	*Entolasia stricta*	Native
Poaceae	*Eragrostis brownii*	Native
Poaceae	*Eragrostis cilianensis*	Exotic
Poaceae	*Eragrostis curvula*	Exotic
Poaceae	*Eragrostis leptostachya*	Native
Poaceae	*Eragrostis sp.*	Native
Poaceae	*Eriochloa procera*	Native
Poaceae	*Holcus lanatus*	Exotic
Poaceae	*Lachnogrostis filiformis*	Native
Poaceae	*Lolium perenne*	Exotic
Poaceae	*Microlaena stipoides*	Native
Poaceae	*Panicum effusum*	Native
Poaceae	*Paspalum dilatatum*	Exotic
Poaceae	*Phragmites australis*	Native
Poaceae	*Poaceae sp.*	Native
Poaceae	*Setaria parviflora*	Exotic
Poaceae	*Setaria pumila*	Exotic
Poaceae	*Setaria sp.*	Exotic
Poaceae	*Sporobolus creber*	Native
Poaceae	*Sporobolus elongatus*	Native
Poaceae	*Sporobolus sp.*	Native
Poaceae	*Themeda australis*	Native
Poaceae	*Vulpia bromoides*	Exotic
Poaceae	*Vulpia* sp.	Exotic

Family	Scientific Name	Native/Exotic
Polygonaceae	*Acetosella vulgaris*	Exotic
Polygonaceae	*Rumex brownii*	Native
Polygonaceae	*Rumex sp.*	Native/Exotic
Portulacaceae	*Portulaca oleracea*	Native
Proteaceae	*Grevillea sericea*	Native
Proteaceae	*Persoonia curvifolia*	Native
Proteaceae	*Persoonia linearis*	Native
Pteridaceae	*Adiantum aethiopicum*	Native
Rosaceae	*Acaena echinata*	Native
Rosaceae	*Acaena novae-zelandiae*	Native
Rosaceae	*Acaena ovina*	Native
Rosaceae	*Acaena sp.*	Native
Rosaceae	*Rubus sp.*	Exotic
Rubiaceae	*Asperula conferta*	Native
Rubiaceae	*Galium sp.*	Native
Rubiaceae	*Opercularia diphylla*	Native
Rubiaceae	*Opercularia hispida*	Native
Rubiaceae	*Opercularia sp.*	Native
Rubiaceae	*Pomax umbellata*	Native
Rubiaceae	*Richardia stellaris*	Exotic
Rutaceae	*Correa reflexa*	Native
Rutaceae	*Zieria sp.*	Native
Santalaceae	*Exocarpos strictus*	Native
Sapindaceae	*Dodonaea triangularis*	Native
Sapindaceae	*Dodonaea viscosa*	Native
Sapindaceae	*Dodonaea boroniifolia*	Native
Solanaceae	*Solanum nigrum*	Exotic
Solanaceae	*Solanum sp.*	Native/Exotic
Stackhousiaceae	*Stackhousia monogyna*	Native
Stackhousiaceae	*Stackhousia sp.*	Native
Stackhousiaceae	*Stackhousia viminea*	Native
Sterculiaceae	*Brachychiton populneus*	Native
Thymelaeaceae	*Pimelea linifolia*	Native
Urticaceae	*Urtica incisa*	Native
Verbenaceae	*Verbena bonariensis*	Exotic
Xanthorrhoeaceae	*Xanthorrhoea johnsonii*	Native
Zamiaceae	*Macrozamia secundus*	Native

Appendix D: 2017 Biometric plot data

Plot No.	MZ	Total sp. #	N sp. #	E sp. #	NOS	NMS	NGC	EGC	Litter	Bare Soil / Rock	Crypto-gam	Log(m)	#HBT	Regen (plot)	Regen (zone)
ACQ1	MZ1	36	35	1	26	5	16	0	84	0	0	125	1	0.8	1
ACQ2	MZ1	31	29	2	25.5	2	14	0	72	10	4	48	0	0.66	1
BOB13B (A)	MZ1	40	37	3	21.5	5	42	2	52	4	0	6	0	0.75	1
BOB13B (S)	MZ1	36	32	4	19	15	38	0	54	8	0	5	0	0.5	1
BOBC1	MZ1	49	47	2	16.6	4.3	40	0	58	2	0	20	2	1	1
BOBC3	MZ1	43	40	3	20.5	5.5	36	0	56	8	0	18	0	0.66	1
BOBE2	MZ1	49	40	9	21.5	3	46	0	48	6	0	48	6	0.8	1
FBS11	MZ1	38	34	4	23.7	5.9	26	0	70	4	0	72	4	0.66	1
FBS5 (A)	MZ1	39	35	4	9	0	32	0	32	22	14	25	1	1	1
FBS5 (S)	MZ1	38	31	7	13	0	16	0	46	28	10	26	1	1	1
FBS6 (A)	MZ1	49	40	9	5	0.5	40	8	36	16	0	3	1	1	1
FBS6 (S)	MZ1	35	29	6	8.5	0	36	2	40	22	0	3	1	1	1
FBS8 (A)	MZ1	33	33	0	12.3	3.9	12	0	64	24	0	72	1	0.8	1
FBS8 (S)	MZ1	36	36	0	11	6.5	16	0	76	8	0	60	1	0.75	1
FBS9 (A)	MZ1	51	48	3	8.5	6.2	22	0	72	6	0	78	3	1	1
FBS9 (S)	MZ1	50	46	4	12.5	6.5	20	0	70	10	0	80	3	1	1
RPA16	MZ1	35	34	1	3	10	10	0	74	16	0	2	0	0.25	1
RPA17	MZ1	38	32	6	21.5	0.2	16	0	66	18	0	14	1	1	1
RPA4	MZ1	31	30	1	11.7	3	18	0	66	16	0	22	3	1	1
BOB18	MZ2	40	33	7	8.7	0.5	32	6	48	14	0	7	0	1	1
BOB20	MZ2	31	27	4	0	0.5	72	2	14	12	2	0	0	0	1
BOB22	MZ2	32	27	5	0	4	66	0	24	10	0	0	0	0.5	1
BOBC10	MZ2	42	38	4	0	10	66	0	22	6	6	4	0	1	1

Plot No.	MZ	Total sp. #	N sp. #	E sp. #	NOS	NMS	NGC	EGC	Litter	Bare Soil / Rock	Crypto-gam	Log(m)	#HBT	Regen (plot)	Regen (zone)
BOBE11	MZ2	32	26	6	0	0	58	8	24	8	0	23	0	0	1
BOBE13	MZ2	35	26	9	11.5	0	70	10	16	4	0	6	1	1	1
OC3D	MZ5	37	29	8	0	15.5	26	20	42	2	10	2	0	0.33	1
OC6B	MZ5	38	35	3	22	6	4	0	76	26	0	0	0	0	0
RPA12	MZ6	36	33	3	2.5	0	38	0	34	28	0	4	0	1	1

(A) = autumn; (S) = spring; N = native; E = exotic

Appendix E: 2017 Rapid assessment data

Site	MZ	Structural layer	Total stratum cover (%)		Dominant species	Other ground cover	Cover (%)
			N	E			
BOB3	MZ1	Canopy	5	0	*E. fibrosa*	Bare Soil / Rock	5
		Mid-storey 1	15	0	*A. gymnanthera, E. dwyeri*		
		Mid-storey 2	2	0	*L. muticus, P. linearis*	Litter	90
		Ground	3	0	*L. filiformis, M. stipoides, G. tetragynus*	Cryptogam	0.5
BOB4B	MZ1	Canopy	20	0	*E. albens*	Bare Soil / Rock	32
		Mid-storey 1	2	0	*E. albens*	Litter	60
		Mid-storey 2	0.5	0	*E. albens*	Cryptogam	1
		Ground	7	0.1	*Rytidosperma sp. M. stipoides, Senecio sp.*		
BOB6	MZ1	Canopy	10	0	*E. crebra*	Bare Soil / Rock	30
		Mid-storey 1	3	0	*E. crebra, E. blakelyi, A. gymnanthera*		
		Mid-storey 2	5	0	*C. arcuata, L. strigosa, Acacia spp.*	Litter	35
		Ground	3	0	*A. vagans, L. filiformis, G. aspera*	Cryptogam	35
BOB8	MZ1	Canopy	20	0	*E. macrorhyncha*	Bare Soil / Rock	25
		Mid-storey 1	5	0	*A. gymnanthera, E. macrorhyncha, A. linearifolia, A. implexa*		
		Mid-storey 2	2	0	*A. rigida, C. arcuata*	Litter	60
		Ground	10	0	*A. vagans, G. aspera, M. stipoides*	Cryptogam	0.1
BOB11B	MZ1	Canopy	10	0	*E. blakelyi*	Bare Soil / Rock	35
		Mid-storey	1	0	*C. arcuata*	Litter	40
		Ground	25	0.1	*A. vagans, A. nepalensis, M. stipoides*	Cryptogam	0.1
BOB16	MZ1	Canopy	25	0	*E. fibrosa, E. sparsifolia*	Bare Soil / Rock	70
		Mid-storey 1	0.1	0	*E. sparsifolia, A. linearifolia*		
		Mid-storey 2	2	0	*A. rigida*	Litter	25
		Ground	2	0	*J. pallida, G. hederacea, Lomandra spp.*	Cryptogam	1
BOBC9	MZ1	Canopy	20	0	*E. blakelyi*	Bare Soil / Rock	0.5
		Mid-storey 1	2	0	*E. blakelyi*	Litter	39

Site	MZ	Structural layer	Total stratum cover (%)		Dominant species	Other ground cover	Cover (%)
			N	E			
		Mid-storey 2	0.1	0	*C. arcuata, H. denticulata*	Cryptogam	0
		Ground	60	0.1	*A. vagans, C. appressa, M. stipoides, G. aspera*		
BOBE3	MZ1	Canopy	15	0	*E. crebra, A. linearifolia*	Bare Soil / Rock	35
		Mid-storey 1	0.3	0	*E. crebra*		
		Mid-storey 2	8	0	*C. quinquefaria*	Litter	60
		Ground	3	0	*C. cuneifolia, C. sieberi, M. stipoides*	Cryptogam	2
BOBE5	MZ1	Canopy	20	0	*E. sparsifolia, A. linearifolia*	Bare Soil / Rock	35
		Mid-storey	1	0	*E. sparsifolia*	Litter	60
		Ground	<1	<1	*Echinopogon sp., C. arcuata, G. hederacea*	Cryptogam	5
RPA5	MZ1	Canopy	20	0	*E. sparsifolia, E. dwyeri, E. crebra*	Bare Soil / Rock	25
		Mid-storey 1	5	0	*E. dwyeri, E. crebra, E. doratoxylon, P. linearis*	Litter	65
		Mid-storey 2	10	0	*L. muticus, P. linearis, C. tetragona*	Cryptogam	1
		Ground	6	0	*C. rigida, L. confertifolia*		
RPA9	MZ1	Canopy	10	0	*E. parramattensis, E. rossii, E. crebra*	Bare Soil / Rock	32
		Mid-storey 1	8	0	*E. rossii, E. crebra*	Litter	40
		Mid-storey 2	20	0	*P. linearis, C. tetragona, S. cunninghamii, H. circumdans*	Cryptogam	5
		Ground	10	0	*A. humifusum, A. ramosa, B. daphnoides, G. aspera*		
RPA11	MZ1	Canopy	5	0	*E. albens*	Bare Soil / Rock	19
		Ground	60	5	*A. scabra, B. macra, C. lanatus, E. botrys*	Litter	10
RPA3	MZ1	Canopy	7	0	*E. blakelyi*	Bare Soil / Rock	0.5
		Mid-storey 1	4	0	*E. blakelyi, A. linearifolia*		
		Mid-storey 2	15	0	*P. esculentum*	Litter	1.5
		Ground	75	20	*M. stipoides, G. solanderi, Conyza sp., H. radicata*	Cryptogam	0
RPA6	MZ1	Canopy	15	0	*E. crebra*	Bare Soil / Rock	20
		Mid-storey 1	3	0	*P. linearis, A. gymnanthera*	Litter	60
		Mid-storey 2	30	0	*B. daphnoides, C. arcuata, L. muticus*	Cryptogam	10
		Ground	10	0	*A. humifusum, A. ramosa, G. Aspera, P. umbellata*		

Site	MZ	Structural layer	Total stratum cover (%)		Dominant species	Other ground cover	Cover (%)
			N	E			
BB1	MZ1	Canopy	10	0	*E. fibrosa*	Bare Soil / Rock	20
		Mid-storey 1	10	0	*A. gymnanthera, P. linearis*	Litter	75
		Mid-storey 2	20	0	*C. arcuata, C. quinquefaria, L. muticus*	Cryptogam	0.5
		Ground	2	0	*Digitaria spp. L. filiformis, C. arcuata, Hibbertia spp.*		
		Ground	1	0	*G. hederacea, J. pallida*		
BOBE1	MZ2	Ground	70	10	*C. lanatus, C. lawsonianus, A. scabra, A. ramosa*	Bare Soil / Rock	9
						Litter	10
						Cryptogam	0
RPA14A	MZ2	Ground	20	45	*Aristida spp., H. radicata, T. repens, E. plantagineum*	Bare Soil / Rock	10
						Litter	25
						Cryptogam	0
BOB19	MZ3	Mid-storey	3	0	*E. albens*	Bare Soil / Rock	1.5
						Litter	20
		Ground	45	40	*Aristida spp., C. lanatus, S. verbenaca*	Cryptogam	0
SI3B	MZ2	Canopy	7	0	*E. albens*	Bare Soil / Rock	0
		Ground	55	30	*D. sericeum, A. aristiglumis, C. vulgare*	Litter	15
						Cryptogam	0
SOA4	MZ4a	Canopy	0.5	0	*E. fibrosa*	Bare Soil / Rock	35
		Mid-storey	10	0	*Acacia spp., C. arcuata*		
		Ground	35	0.1	*M. stipoides, Digitaria sp.*	Litter	30
						Cryptogam	0
SOA5	MZ4a	Mid-storey	1	0	*E. crebra, E. moluccana*	Bare Soil / Rock	50
						Litter	15
		Ground	30	0.1	*Aristida spp., M. stipoides, H. radicata*	Cryptogam	5
SOA6	MZ4a	Canopy	1	0	*E. blakelyi*	Bare Soil / Rock	57
		Ground	15	15	*Aristida spp., M. stipoides, H. radicata, H. perforatum*	Litter	20
						Cryptogam	3
OC4B	MZ5	Mid-storey 1	25	0	*E. melliodora, A. linearifolia*	Bare Soil / Rock	7
		Mid-storey 2	1	0	*A. decora, C. arcuata*	Litter	85

Site	MZ	Structural layer	Total stratum cover (%)		Dominant species	Other ground cover	Cover (%)
			N	E			
		Ground	2	5	*A. scabra, E. nutans, H. perforatum, E. plantagineum*	Cryptogam	0
OC5B	MZ5	Mid-storey 1	30	0	*E. blakelyi, E. crebra, E. melliodora, E. moluccana*	Bare Soil / Rock	48
		Mid-storey 2	8	0	*A. decora, A. linearifolia, C. arcuata, A. spectabilis*	Litter	50
		Ground	1	0.5	*A. scabra, Eragrostis sp., H. radicata, Conyza sp.*	Cryptogam	1

Appendix F: Disturbance observations 2017

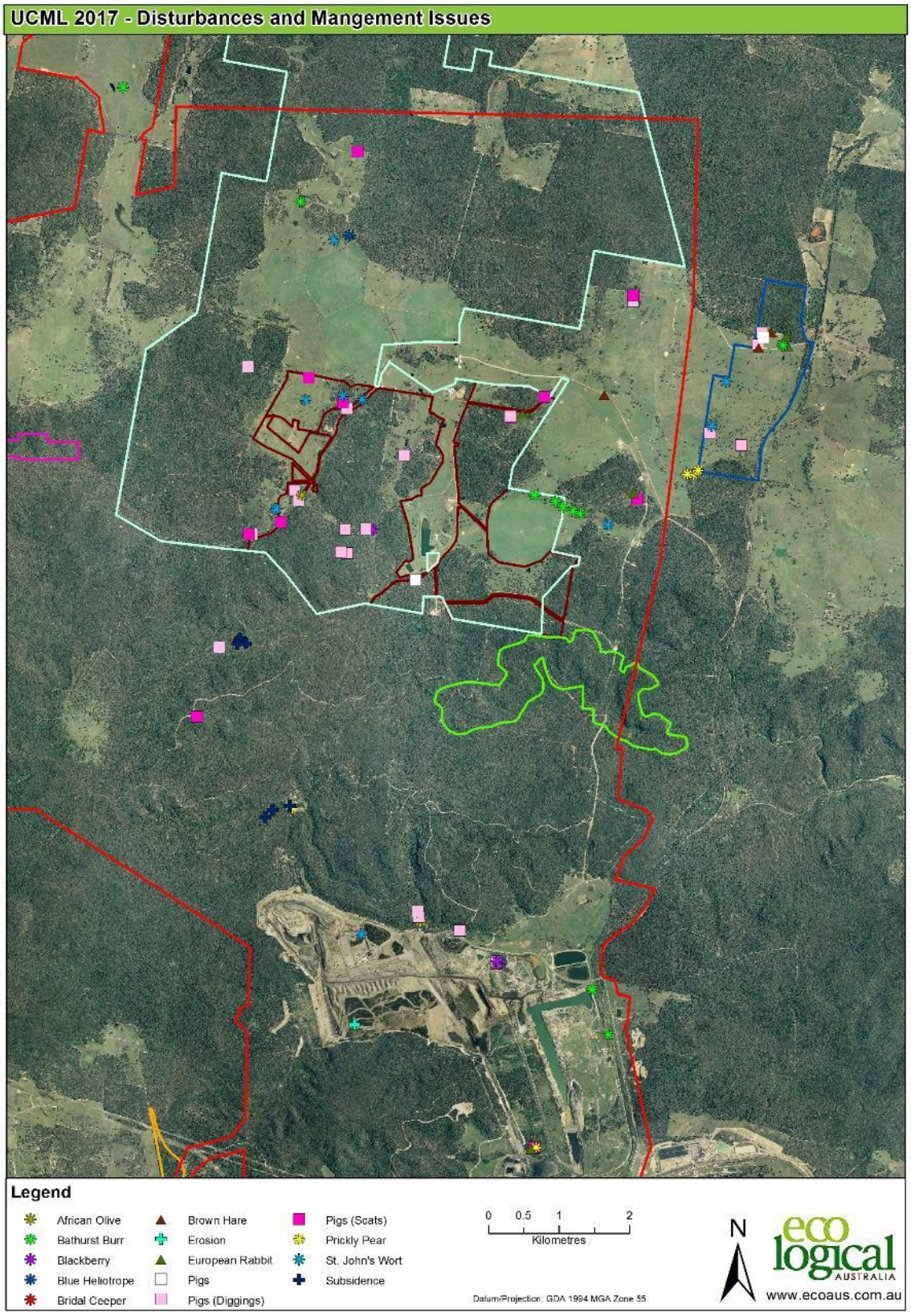

Figure F1: Disturbance observations 2017

Appendix G: Natural regeneration mapping

Figure G1: SOA natural regeneration transect results

Figure G2: SOA5 natural regeneration transect results

Figure G3: SOA6 natural regeneration transect results

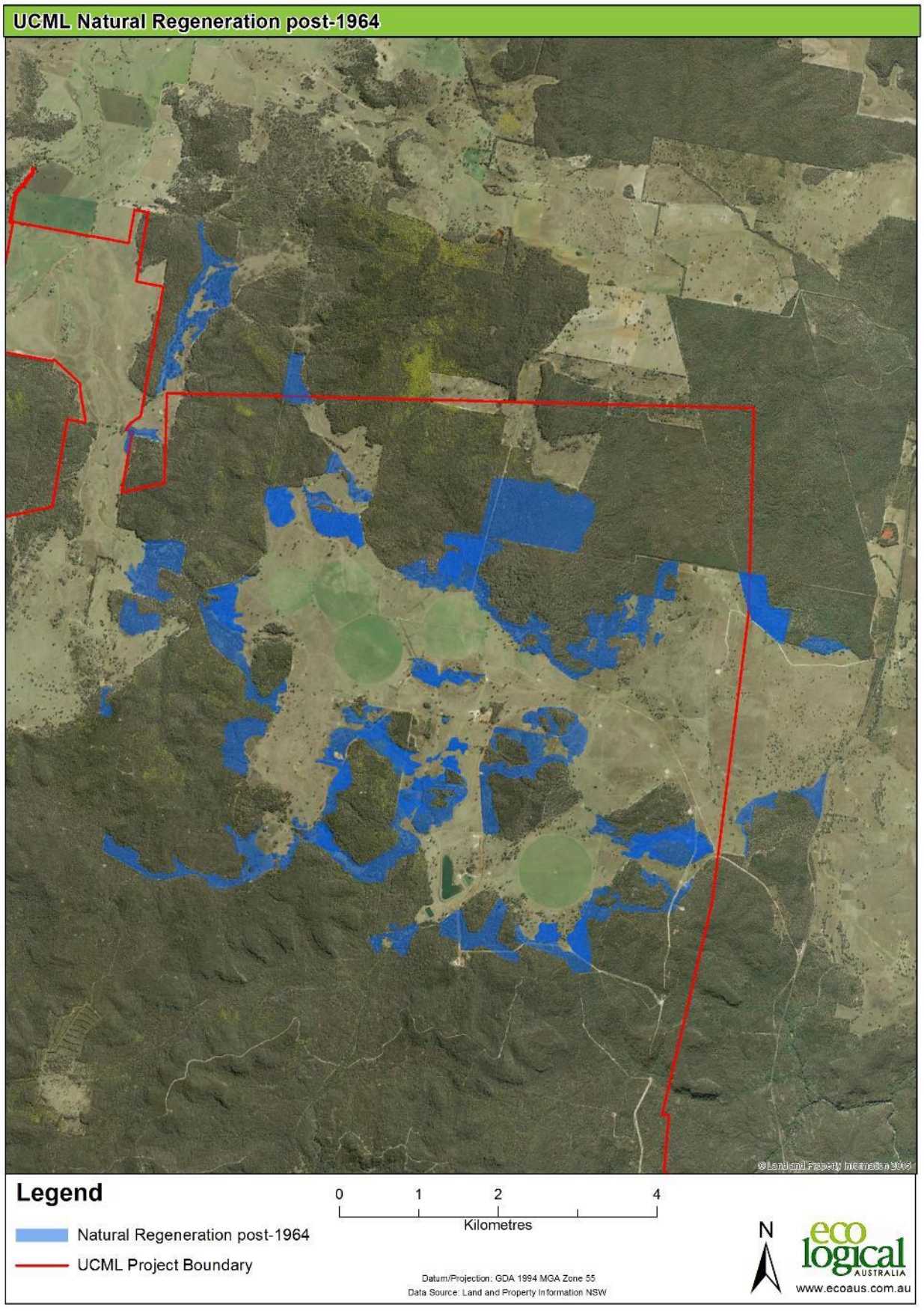

Figure G4: Natural regeneration across the UCML complex post-1964

Appendix H: Floristic data for all sites 2011 to 2017 – supplied electronically

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