



M2G Biodiversity Offset Monitoring Report
Spring 2022

Icon Water

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Abbreviations

Abbreviation	Description
ACT PCS	Australian Capital Territory Parks and Conservation Service
DBH	Diameter at Breast Height
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
HBT	Hollow Bearing Tree
M2G	Murrumbidgee to Googong Water Transfer Project
MU	Management Unit
NC Act	<i>Nature Conservation Act 2014</i>
ODP	Offset Delivery Plan
RFAC	Regional Feral Animal Control

1. Introduction

1.1. Background

Eco Logical Australia Pty Ltd (ELA) was commissioned by Icon Water (formerly ACTEW Water) to deliver terrestrial ecology services as required by the environmental approval process for the Murrumbidgee to Googong Water Transfer Project (M2G).

The M2G projects falls under the jurisdiction of the Commonwealth (Department of the Environment and Energy, previously Department of Sustainability, Environment, Water, Population and Communities), NSW (Department of Planning), and ACT (ACT Planning and Land Authority) Governments and has been subject to assessment and environmental approval processes in all three jurisdictions. Project approval (granted in 2010) has been attained from all three governments, with a considerable number of approval conditions and commitments applied.

Under the environmental approvals process, Icon Water (conditioned as ACTEW Water) was required to provide compensatory habitat as an offset for vegetation and habitat losses arising from the construction activities for the M2G pipeline. The offset was required to be delivered to meet the conditions outlined in a range of documents, including but not limited to the Environmental Impact Statement (EIS) and Public Environment Report (PER) prepared for the development and relevant approval conditions.

1.2. Purpose of document

Under Condition 2.9b of the NSW Approval and Condition 3.1 of the Commonwealth approval conditions for the M2G Project (see Offset Delivery Plan (ODP) for further information), management and monitoring of the offset site is required. The ODP prepared by ELA (April 2012) describes the actions to be taken in establishing and managing the offset site according to the approval conditions and commitments, including the provision of monitoring actions (ELA, 2012).

This report details the spring monitoring surveys for 2022 that were undertaken in accordance with the methodology and aims established in the ODP. The purpose of this document is to report on the ecological condition of the site and the management actions conducted throughout the previous year/s in order to guide future actions within the offset site.

1.3. Study area

Icon Water own a land parcel in southern ACT (Block 1675), referred to here as the Williamsdale property (or 'the property'). The property is approximately 208 hectares in size and is located just south of Williamsdale. The property is bounded by the Monaro Highway to the east, the NSW border to the south, Angle Crossing Road to the north, and the Murrumbidgee River corridor to the west (Figure 1). The monitoring surveys were conducted within the offset site (study area of approximately 110 ha), which is wholly contained within the property.

The offset site has been set aside for conservation due to its high biodiversity value, including the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed White Box, Yellow Box, Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Woodland), threatened flora and fauna species, and/or threatened species habitat.

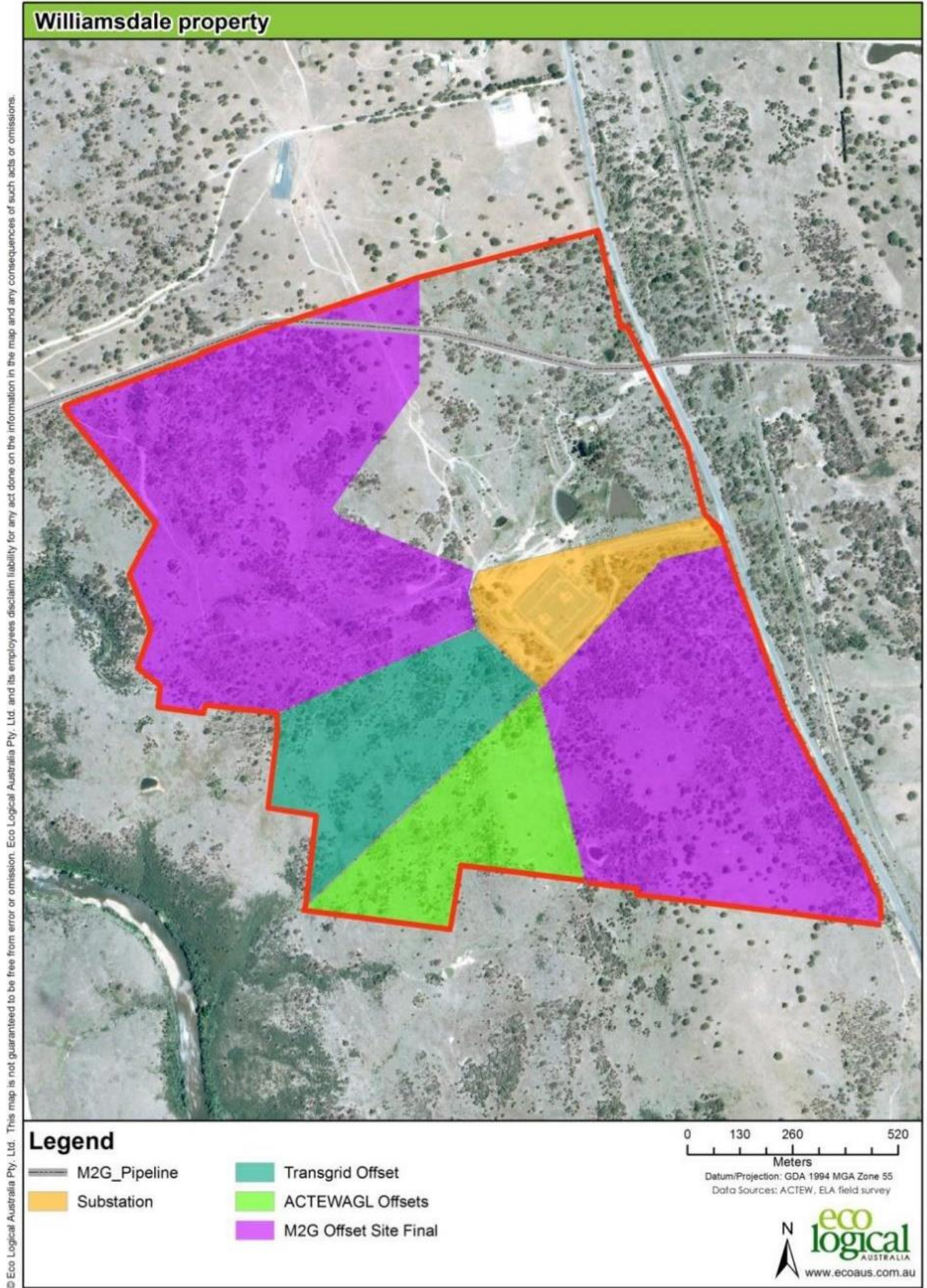


Figure 1: Study area.

2. Methodology

The native vegetation and biodiversity values present within the offset site are managed under the ODP and its sub-plans. The ODP establishes the monitoring methodology for each of these values. A summary of the monitoring methodology outlined in the ODP and previous monitoring reports (ELA, 2013; ELA, 2014; ELA, 2015; ELA, 2016; ELA, 2018; ELA, 2020) is presented below, and is followed by the results of the spring 2022 monitoring surveys. It is noted that biennial monitoring has occurred since 2016.

2.1. Vegetation plot monitoring

The monitoring methodology has been adapted from the NSW Biobanking methodology to suit the offset site management requirements. The modified Biobanking methodology proforma uses a combination of quadrat and transect surveys to establish vegetation condition, and this approach is mirrored under the monitoring methodology.

- Vegetation surveys have been designed to collect the following data:
- Species diversity, including native and exotic species.
- Cover abundance of native and exotic species.
- Identification of any threatened flora.
- Condition of the vegetation community.

2.1.1. Floristic quadrats

Eight 20 m x 20 m monitoring quadrats (plots) were established in 2011 and 2012 to collect baseline data on the condition and species composition of the offset site during autumn and spring each year (Figure 2). The quadrats are permanently erected and marked using a star picket at each corner tagged with flagging tape. The location of each quadrat has been recorded using a hand-held GPS device (north-west corner) (Table 1).

Each quadrat was surveyed by walking back and forth along 10 parallel transects approximately 2 metres (m) apart. A cumulative list of flora species within each quadrat was recorded and assigned a cover abundance score using the Braun-Blanquet scale.

Two of the eight plots (control plots) were chosen in order to observe natural changes in species composition over time. Both plots were located in areas of good quality EPBC Act listed Box-Gum Woodland and were free from noxious weeds at the time of establishment. Where possible, management actions, such as erosion control or rehabilitation will not occur within these monitoring plots over the duration of the monitoring period. It is noted that some actions such as feral animal control occurs on an offset site scale. Also, if noxious weeds are observed within the control plots during the biannual monitoring surveys, the weeds will be identified, recorded and then removed. The removal of noxious weeds from the control plots is required to maintain the overall conservation principles of the offset site. However, it noted that these control plots appear indistinguishable from the other monitoring plots, and that management actions are completed on the offset site scale.

The other six monitoring plots were located in units where management actions were planned or likely to occur as outlined in the management sub-plans, in order to observe the effect that the actions have on ecological values and species composition over the course of the monitoring program.

The GPS co-ordinates of the north-west corner of each monitoring plot are provided below in Table 1. A species list for each of the monitoring plots is included in Appendix A.

Table 1: Monitoring plot co-ordinates (GDA 1994 MGA Zone 55)

Monitoring plot	Plot location	Established	North-west corner		Transect	
			Easting	Northing	Easting	Northing
1	MU1A	October 2011	693669.49	6059272.51	693674.98	6059300.56
2	MU2B	March 2012	693529.99	6059555.34	693541.22	6059504.10
3	MU3	October 2011	693872.06	6059467.44	693874.65	6059490.73
4	MU4	October 2011	692349.35	6060568.08	692365.82	6060517.43
5	MU5	October 2011	692559.98	6059906.52	692526.40	6059902.85
6*	MU6	March 2012	692576.25	6060344.05	692622.53	6060358.54
7	MU7	March 2012	692860.59	6060583.39	692874.01	6060542.87
8*	MU3	October 2011	693414.37	6059863.02	693445.95	6059828.31

* Refers to the intended control plots

2.1.2. Point transects

A 50 m transect (50 m length of tape) was established at each of the monitoring plots to compliment the floristic quadrat surveys and to determine the projective foliage cover of various structural components of the community. Each transect was referenced using a GPS device and three photos were taken from the start of the transect (left side, centre, and right side). The 50 m transect was surveyed as follows:

At every 1 m along the 50 m tape, the understorey layer was assessed (50 survey points per transect). The presence of native grass, native shrubs (<1m high), native other or exotic species was recorded at each point. For each group the number of hits was then tallied and doubled, and presented as a percentage cover for the whole site.

At every 5 m along the 50 m tape, the percentage projective foliage cover of native and exotic species in the mid and overstorey layer was recorded (10 survey points per transect). For each group the cover values were then summed and divided by ten, and presented as a percentage cover for the whole site.

2.1.3. Flora inventory methodology

A cumulative list of species has been maintained since the initial baseline surveys were conducted. Species on the list include those recorded within the eight monitoring plots and those encountered whilst traversing the sites during the weed, fence line and erosion monitoring surveys. A species list for offset site is provided in Appendix A.

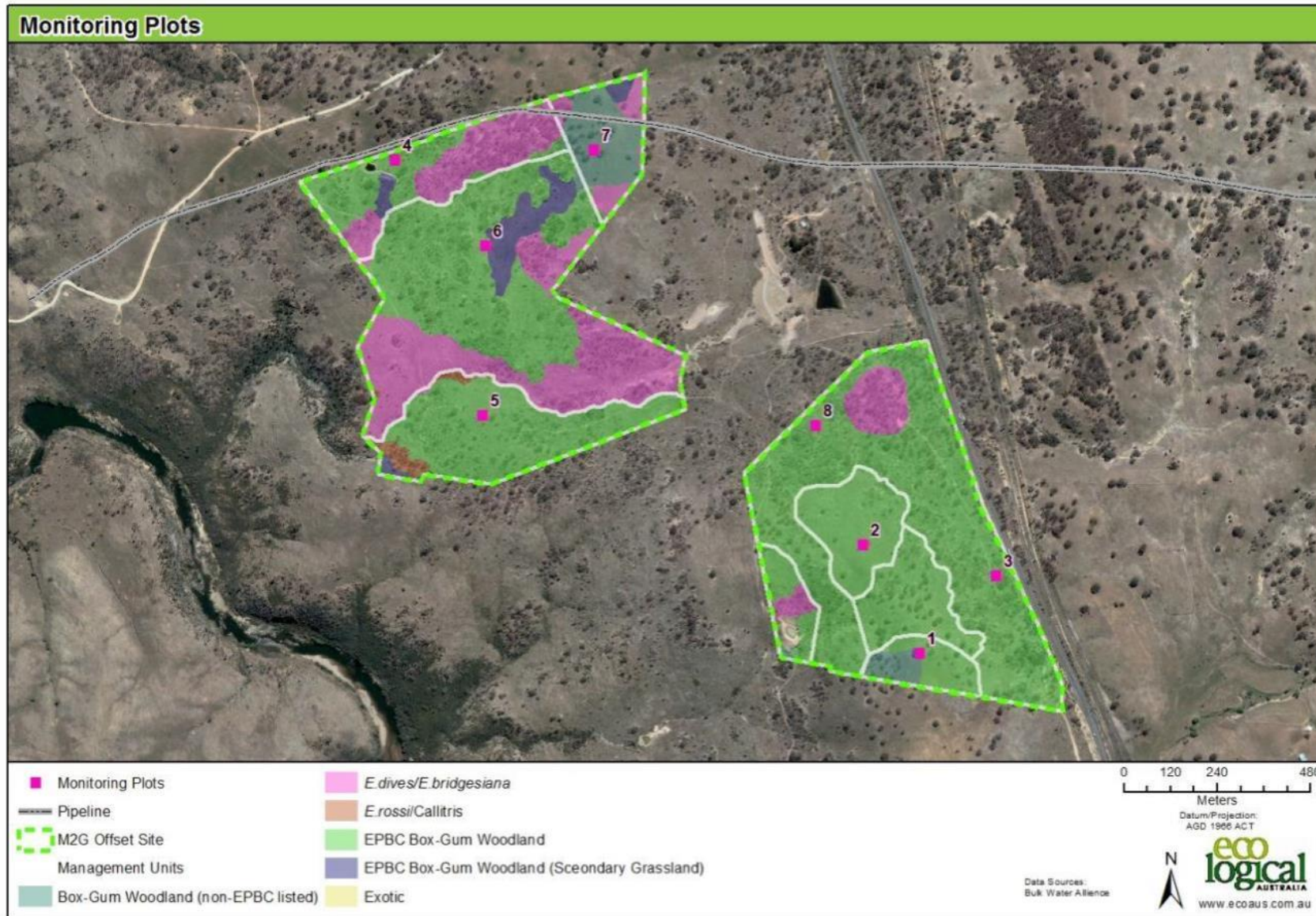


Figure 2: Monitoring plots, management units and baseline offset site ecological values.

2.2. Fauna monitoring

2.2.1. Bird surveys

A quantitative bird survey methodology was established in spring 2015 and was undertaken again in spring 2016, spring 2020 and again in spring 2022 to gather quantitative information on species abundance and species richness. Bird surveys were undertaken along two transects: one in each of the offset sites. Each transect comprised five points located approximately 100 m apart. The transects were oriented to follow areas of suitable habitat (Figure 3).

At each point along the transect the abundance and species richness of bird species was surveyed in a circle with a 50 m radius over a 10 minute survey period (total of 50 minutes per transect, covering an area of 0.07ha). Birds were recorded in the following distance classes from the survey point:

- 0-15 m
- 15-30 m
- 30-50 m

Any other species observed during the survey period either outside of 50 m, flying over the site or between points was recorded as opportunistic.

2.2.2. Fauna habitat assessment

During the baseline survey a fauna habitat assessment was conducted within each 20 m x 50 m vegetation monitoring plot to observe the number of hollow bearing trees, length of fallen logs (greater than 10 cm width) and dominant habitat features present. In addition, a qualitative assessment of fauna habitat features was undertaken for each of the northern and southern offsets. This assessment included features such as hollow-bearing trees, logs, litter, fallen timber, stags, surface or outcropping rocks, termite mounds, mistletoe presence, large trees, natural regeneration, and exotic or native shrub thickets. These features were checked during each monitoring period to ensure they remained applicable, as habitat features are unlikely to change significantly year to year.

The results of fauna habitat assessments are outlined in Section 5.2.

2.2.3. Opportunistic observations

Visual and aural observations of all vertebrate fauna species (including signs of feral animal activity) were recorded opportunistically whilst conducting targeted monitoring surveys across the offset site and using random meander techniques. A full list of all fauna observed during spring 2022 monitoring is presented in Appendix B. Locations of rare or threatened fauna and signs of feral animal presence were recorded using a handheld GPS device.

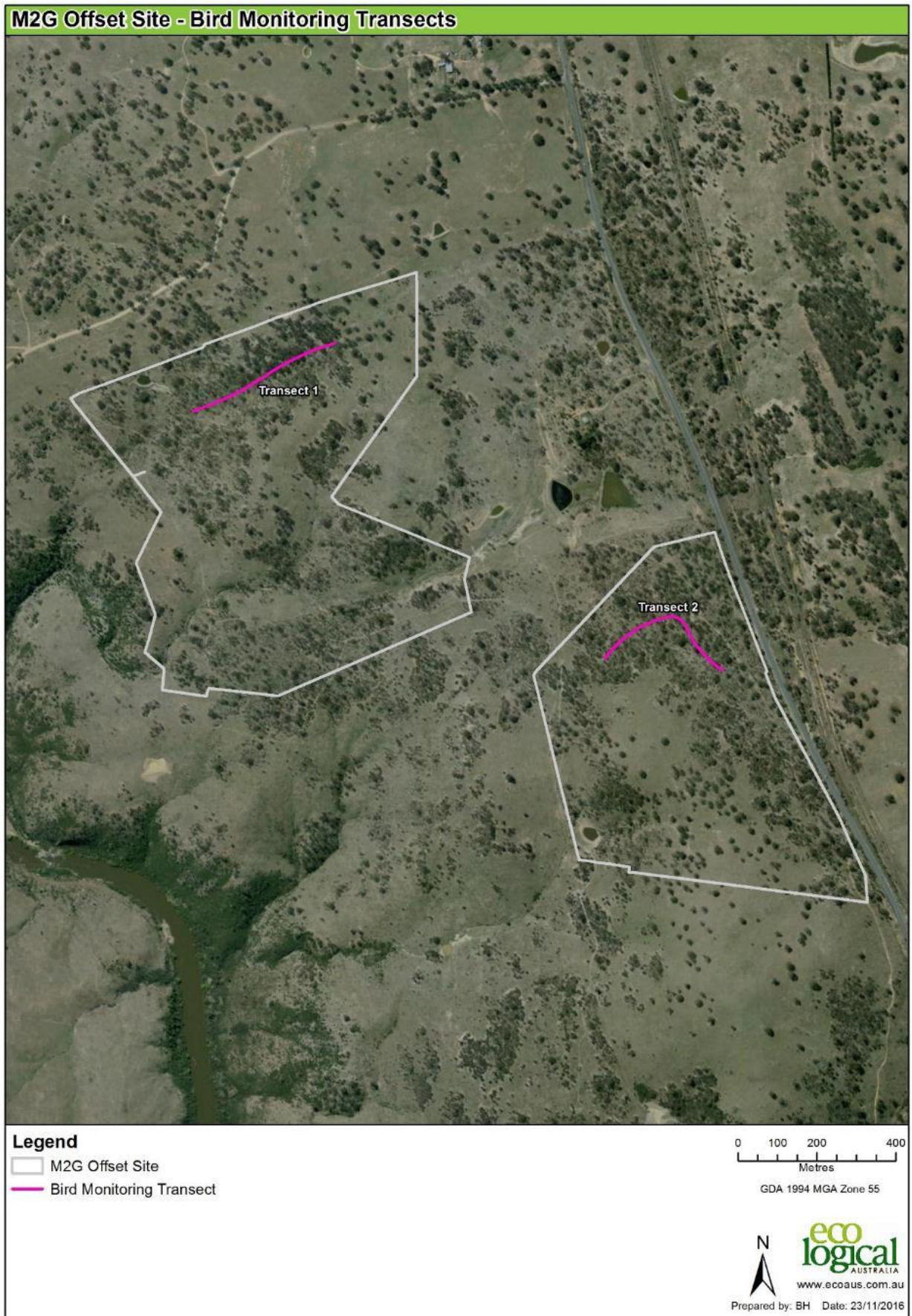


Figure 3: Bird monitoring transects.

2.3. *Swainsona recta* monitoring





Monitoring of translocated *Swainsona recta* plants is conducted during the peak flowering period in October to November each year. The location of the three translocation plots is shown in Figure 4. Full details of the propagation and translocation program are provided in ELA (2013). Information relevant to the interpretation of monitoring results is summarized below.

Plants translocated were initially raised from seed sourced from Mt. Taylor, Williamsdale and Burra, and grown in containers filled with either:

- Potting mix (standard nursery mix), or
- Soil mix containing a 1:1 ratio of potting mix and local soil from the seed collection sites.

A total of 112 individuals were planted across the three translocation plots, of which 66 were translocated in June 2012 and a further 46 translocated in September 2013. Each translocation plot was designed to accommodate up to 40 plants. Individuals were planted in blocks according to provenance and growing media to facilitate comparison. A key to the planting design and other relevant data is provided in Table 2.

Table 2: Planting key

Collection location	Growing media	Year planted	Water crystals	Key
Mt Taylor	Potting mix	2012	No	
Mt Taylor	Soil and potting mix	2012	No	
Williamsdale	Potting mix	2013	Yes	
Burra	Potting mix	2013	Yes	

Individuals were planted at one metre spacing in a grid format (8 x 5 plants) with a one metre buffer from the outer most plants. Plots were established with the longest axis orientated in a north-south direction. Fencing was erected around the plots to incorporate a one metre buffer from the outer most plants. Fencing consisted of rabbit proof fencing (1.2 m high) with steel pickets at least every three metres.

At planting, all competition (e.g. grasses and other forbs) was removed in the immediate area of each individual (creating a cleared patch approximately 20 cm in diameter). For the 2013 plantings, a small handful of water crystals were also planted with each individual. All plants were watered on the day of planting and subsequently watered one week after planting.

Each individual plant translocated is assessed annually for its survivorship and reproductive condition. The follow is recorded:

- Presence or absence of *Swainsona recta* at each planting location.
- Presence or absence of flowers or developing seed pods.

In addition, the translocation plots are inspected for signs of recruitment. The results allow a comparison of survivorship, condition and recruitment events at the end of each monitoring period and provide a picture of the overall success of the translocation program.

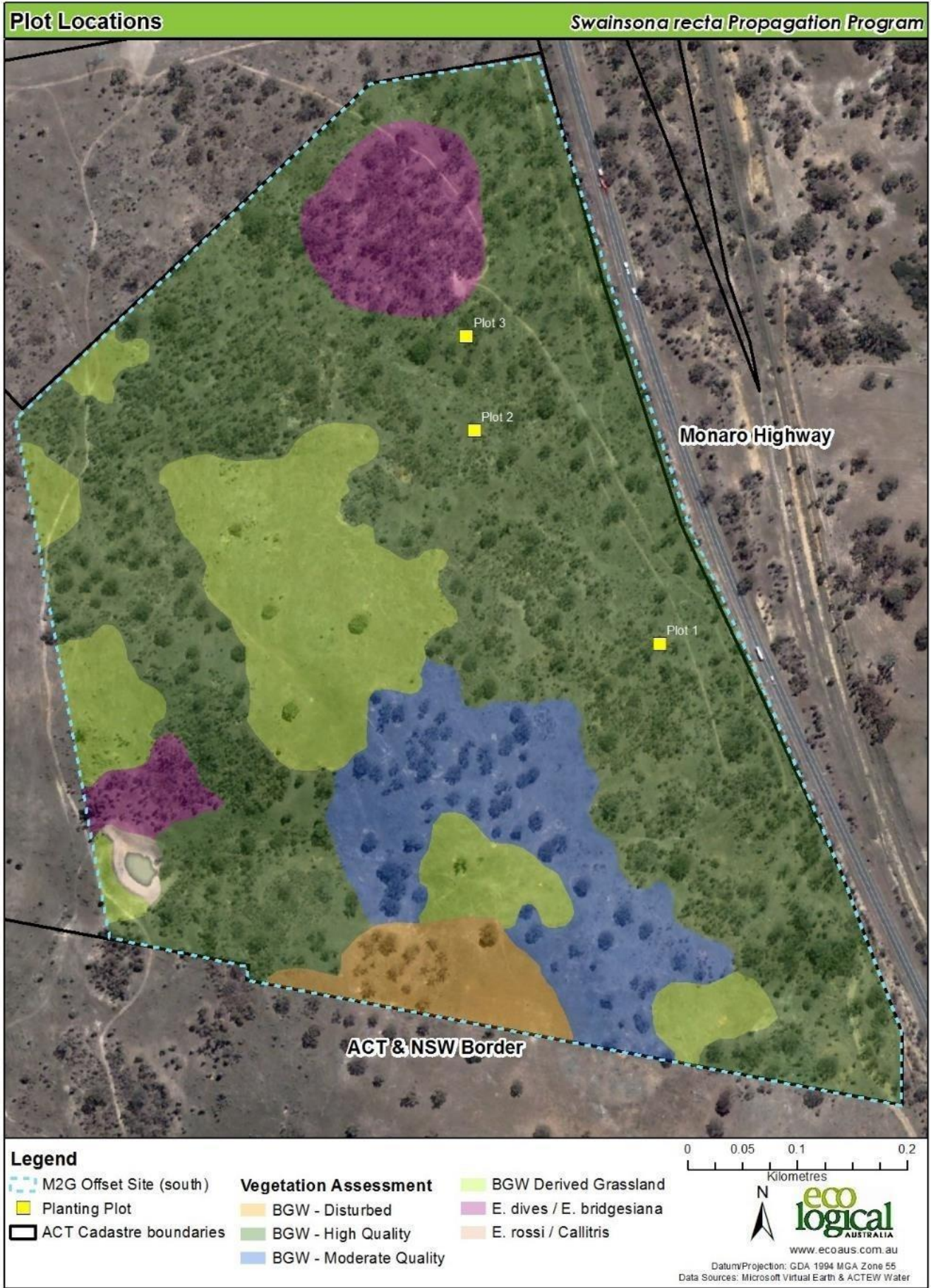


Figure 4: *Swainsona recta* translocation plots.

2.4. Weed monitoring

The management of weeds within the M2G offset site is undertaken in accordance with the Weed Monitoring Sub-Plan. The sub-plan outlines the weed management activities to be undertaken to satisfy relevant approval conditions and commitments. As an action under the sub-plan, the monitoring of weeds within the offset is required on a biannual basis to incorporate the seasonal changes in weed abundance and weed control activities.

Weed monitoring in spring 2022 was undertaken opportunistically with an overall assessment of each management unit focussed on occurrences of declared species (*Cotoneaster* spp., *Crataegus monogyna*, *Eragrostis curvula*, *Hypericum perforatum*, *Nassella trichotoma*, *Pyracantha* spp., *Rosa rubiginosa*, *Rubus fruticosus* and various species of thistle), non-declared woody weeds and species not previously recorded for the site.

2.5. Erosion monitoring

Erosion monitoring sites were established during autumn 2012 monitoring surveys. A representative sample of erosion points within each of the main drainage lines were selected for future monitoring. For each erosion point selected, notes were made on their size, their location was recorded using a GPS and a photo was taken in order to observe any changes over time. Several erosion monitoring points were discontinued from spring 2013 onwards, as these points did not show signs of erosion since the baseline surveys, despite large rain events occurring over this two-year period. Erosion monitoring point locations for the spring 2022 surveys are mapped in Figure 5 and Figure 6.

When each monitoring survey is undertaken, a set of baseline photographs are taken into the field to facilitate accurate relocation of erosion monitoring photo points and assessment of change.

2.6. Fencing monitoring

Fence monitoring was undertaken by traversing the Williamsdale property border and assessing the condition of the fence. Any damaged areas observed along the fence line were noted and a GPS point taken. Fence damage was categorised into three categories to represent the level of risk of unwanted grazers (such as cattle) entering the offset site:

- *Low risk*– Small holes observed at the bottom of the fence that do not require immediate attention and allows native fauna (e.g. wombats) to pass through.
- *Moderate risk* – Small to moderate sized holes or fence damage that require monitoring, but no immediate action.
- *High risk* – Represents points along the fence line requiring attention. These points represent a high risk of cattle and sheep entering the property.

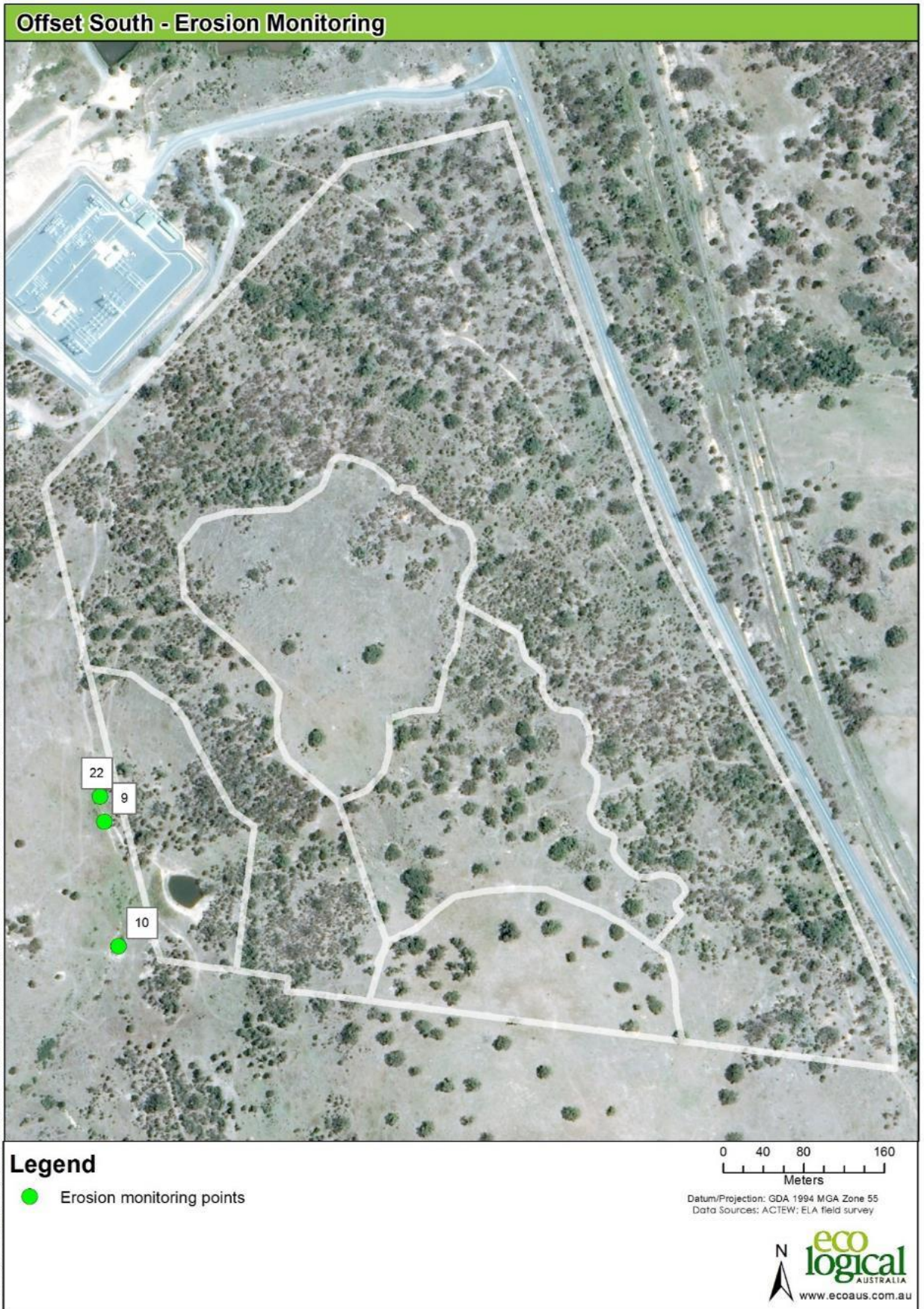


Figure 5: Erosion monitoring in southern offset.

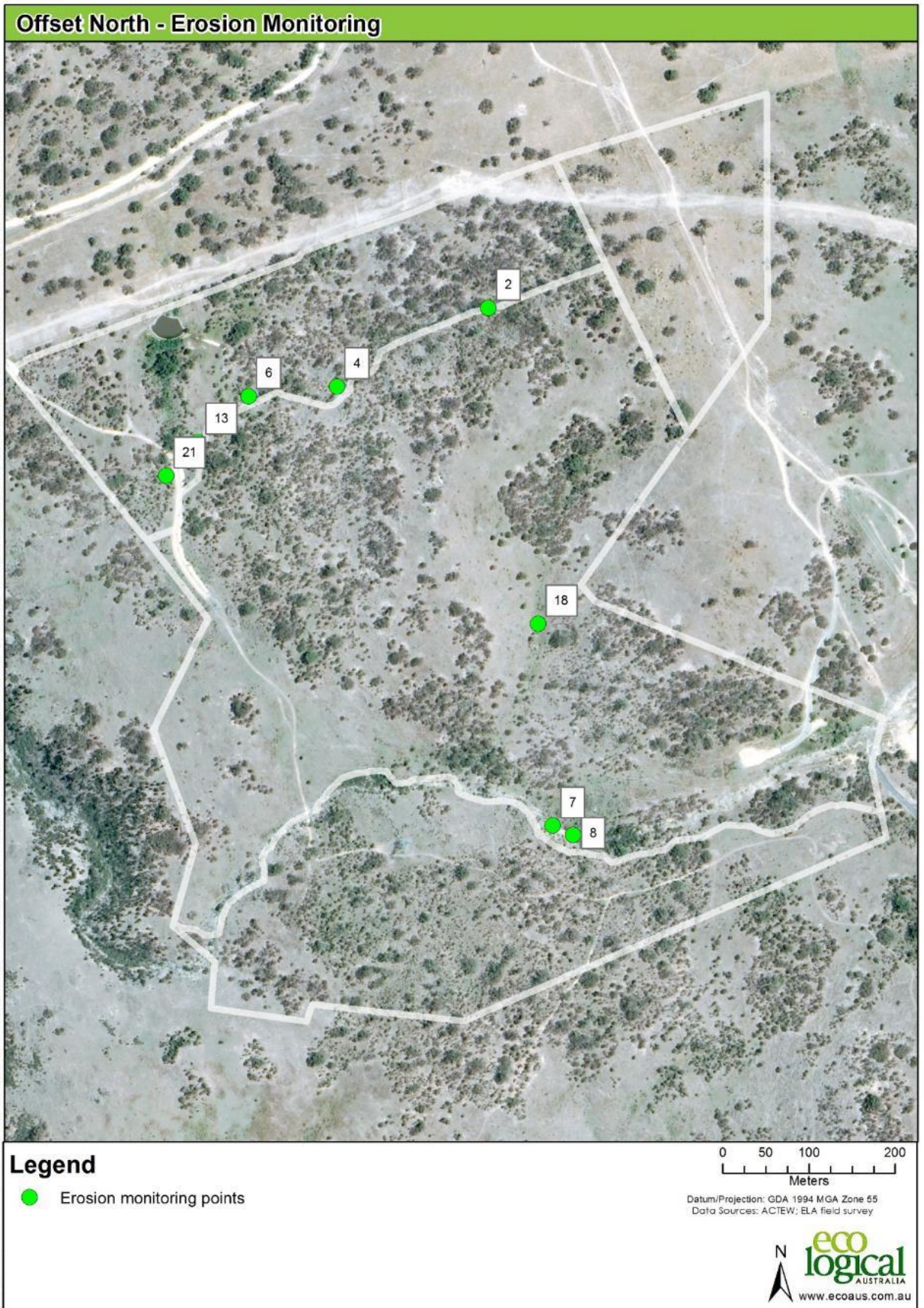


Figure 6: Erosion monitoring points in northern offset.

3. Vegetation plots

Similar to 2020 monitoring, rainfall for the region has been above average over 2022 (BOM 2022a) and average daily temperatures were lower than the historical average (BOM 2022b). These wet conditions would have contributed to the boom in growth for both native and exotic species, especially in the ground layer, recorded in 2020 and 2022 monitoring.

Species diversity remains relatively stable across most monitoring plots since the baseline monitoring undertaken in 2011. Native species diversity has increased in all plots surveyed in 2022 in comparison with the baseline data, with the exception of plot 6 (Figure 7). However, when compared to spring 2020, almost all plots have reduced in native species diversity. Plots 3, 5 and 8 remain on or above the benchmark values for native species richness in Box-Gum Woodland for the region (Sharp & Milner 2014).

Since monitoring began, exotic cover has fluctuated between years (Figure 8). It should be noted that some of this variation can likely be attributed to observer bias. Spring 2022 surveys recorded exotic cover (ranging between 32% and 86%) substantially higher than the baseline surveys (2011) in all plots, and higher than 2020 results in plot 1, 7 and 8. Exotic understory cover was higher than native understory cover in three of the eight plots surveyed in 2022.

Plots 3, 4 and 5 have reached benchmark values for overstorey cover established for the ACT (11%) (Sharp & Milner 2014). The generally low canopy cover across the plots reflects the fact that these sites are either regenerating or cleared occurrences of Box-Gum Woodland, rather than mature remnants. Canopy cover remains comparable to that recorded in 2020, with a few plots increasing slightly. Saplings of overstorey species are present at most sites and in time will likely contribute to an increase in overstorey cover as they grow and develop larger and denser canopies. Native midstorey cover remains at the lower end of the benchmark range.

It should be noted that cattle disturbance and grazing was evident in the southern offset, especially in plot 1 and plot 8. Cattle had been present in the southern offset for a number of weeks before and during the 2022 monitoring period due to a gate being left open (Icon Water pers. comm.).

The results of vegetation monitoring are provided in Section 3 and raw floristic data for each plot are provided in Appendix A.

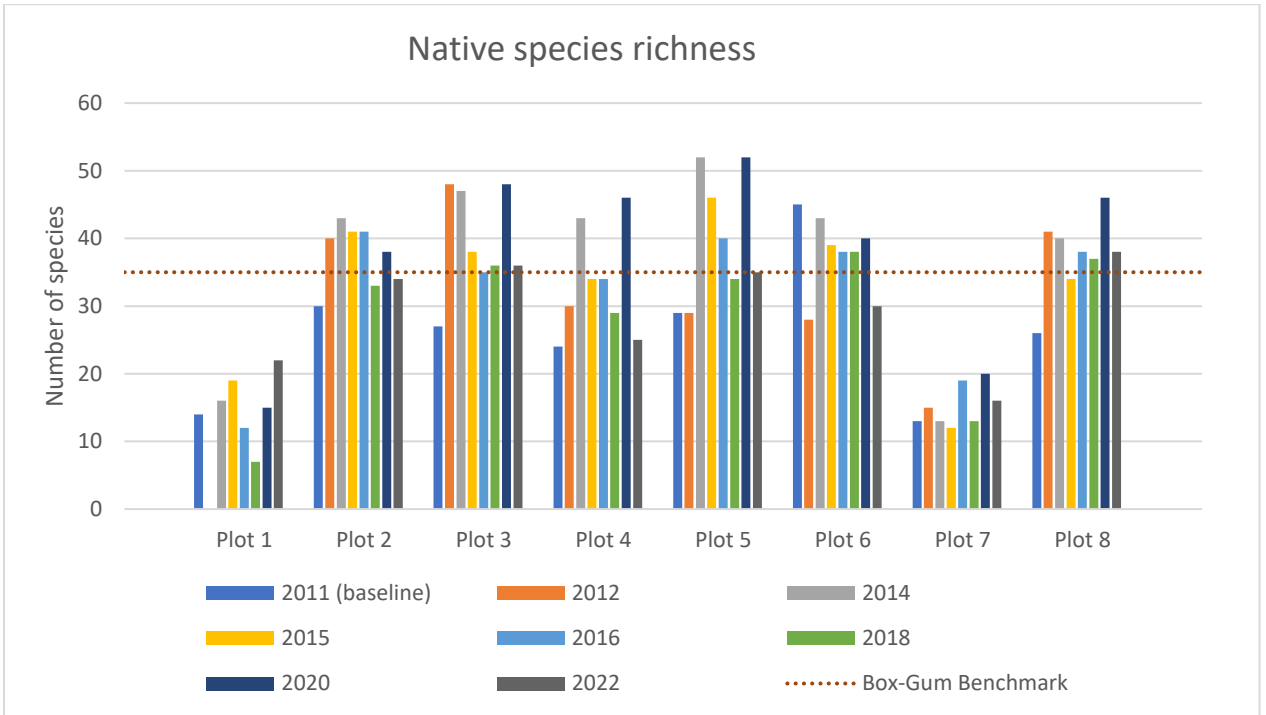


Figure 7: Native species richness (diversity) within the floristic monitoring plots, 2011 - 2022.

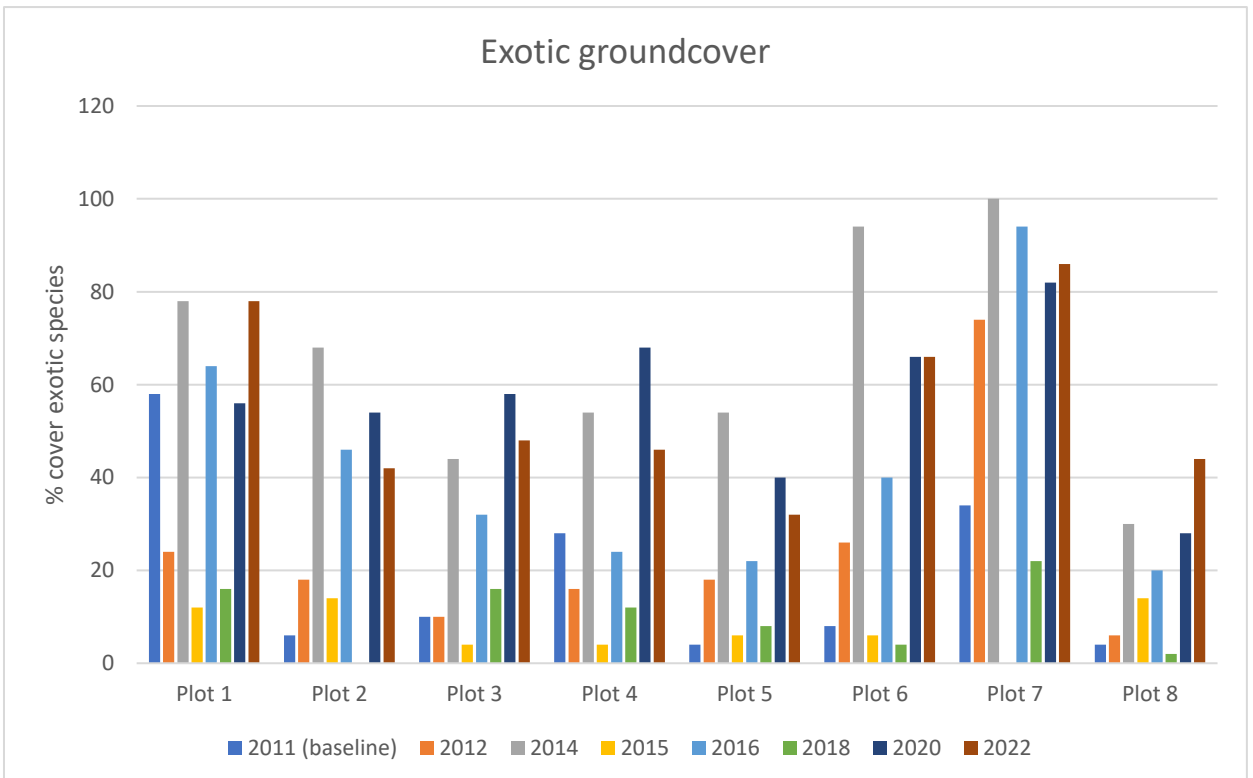


Figure 8: Ground cover of exotic species within the floristic monitoring plots, 2011-2022.

3.1. Monitoring plot 1

Monitoring plot 1 is located within MU1A in the southern offset area and is composed of lower condition Box-Gum Woodland. Native species diversity was higher in 2022 than any previous years (22 native species recorded). The dominant native species were *Microlaena stipoides* var. *stipoides* (Weeping Grass) and *Oxalis perennans*. Exotic cover was high (71%), which is the highest recorded since 2015 (80%). There were 39 exotic species recorded, of which *Vulpia muralis* (Wall Fescue) was dominant. Other high cover exotic species were *Carthamus lanatus* (Saffron Thistle), *Hypericum perforatum* (St. Johns Wart) and *Hypochaeris glabra* (Smooth Catsear). No regeneration was recorded. Native plant species richness and overstorey cover remain below benchmark values (Sharp & Milner 2014). There was evidence of cattle disturbance within the plot.



Figure 9: Monitoring Plot 1. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2022)

Table 3: Summary statistics for spring 2022 floristic surveys within Plot 1

Plot Description		
Management unit	MU1A	
Vegetation type	Box-Gum Woodland	
Plot number	1	
Condition	Low-Mod	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	0	0
Native midstorey cover	0	0
Native understorey cover (grass)	40	12
Native understorey cover (other)	6	16
Exotic midstorey plant cover	0	0
Exotic understorey plant cover	58	78
Native species diversity	14	22
Regeneration	No	
Species	-	
Leaf litter	11%	

3.2. Monitoring plot 2

Monitoring plot 2 is located within MU2B in the southern offset area. It is situated on a rocky hill containing areas of potential Pink-tailed Worm Lizard habitat. It contains moderate-good condition mature Box-Gum Woodland with scattered eucalypt saplings present. Native species richness has declined from 38 in 2020 to 34 in 2022. The dominant native species included *Austrostipa scabra* subsp. *scabra* (Rough Speargrass), *Chrysocephalum apiculatum* (Common Everlasting), and *Schoenus apogon* (Fluke Bogrush). Exotic ground cover was 42% with 26 exotic species recorded. *Vulpia muralis* (Wall Fescue) was the dominant exotic species. Native plant species richness has dropped below the benchmark (35) and overstorey cover remains below benchmark values (Sharp and Milner, 2014).



Figure 10: Monitoring Plot 2. (Left: Baseline monitoring photo, March 2012. Right: monitoring photo November 2022)

Table 4: Summary statistics for spring 2022 floristic surveys within Plot 2

Plot Description		
Management unit	MU2B	
Vegetation type	Box-Gum Woodland	
Plot number	2	
Condition	Mod-Good	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	0	1
Native midstorey cover	0	3.9
Native understorey cover (grass)	80	38
Native understorey cover (other)	4	28
Exotic midstorey plant cover	0	0
Exotic understorey plant cover	6	42
Native species diversity	30	34
Regeneration	Yes	
Species	<i>E. blakelyi</i>	
Leaf litter	8	

3.3. Monitoring plot 3

Monitoring plot 3 is located within MU3 in the southern offset. The plot is located in moderate to good quality Box-Gum Woodland. A large number of eucalypt saplings are present both within and adjacent to the plot. Native species richness was 36, a decrease from 48 in 2020. The dominant native species were *Schoenus apogon* (Fluke Bogrush) and *Haloragis heterophylla* (Variable Raspwort). Exotic groundcover was 48%, the same as 2020 monitoring. Dominant exotic species were *Vulpia muralis* (Wall Fescue) and *Cynosurus echinatus* (Rough Dog's Tail). Native plant species richness and canopy cover are above benchmark values (Sharp & Milner 2014).



Figure 11: Monitoring Plot 3. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2022)

Table 5: Summary statistics for spring 2022 floristic surveys within Plot 3

Plot Description		
Management unit	MU3	
Vegetation type	Box-Gum Woodland	
Plot number	3	
Condition	Mod-Good	
Plot Statistics (%)	Baseline	Spring 2022
Native overstorey cover	3.7	12.5
Native midstorey cover	5.2	11
Native understorey cover (grass)	80	42
Native understorey cover (other)	16	36
Exotic midstorey plant cover	0.2	0.5
Exotic understorey plant cover	10	48
Native species diversity	27	36
Regeneration	Yes	
Species	<i>E. blakelyi</i>	
Leaf litter	26	

3.4. Monitoring plot 4

Monitoring plot 4 is located in the northern offset in MU4. It is located in moderate to good quality Box-Gum Woodland with an overstorey dominated by *Eucalyptus blakelyi* (Blakely's Red Gum). Native diversity has dropped from 46 species in 2020 to 24 in 2022. The dominant native species were *Haloragis heterophylla* (Variable Raspwort) and *Schoenus apogon* (Fluke Bogrush). There were 12 exotic species present, the most common being *Plantago lanceolata* (Lamb's Tongues) and *Vulpia muralis* (Wall Fescue). *Rosa rubiginosa* (Sweet Briar) was present with a cover of less than 5%. The native overstorey cover remains in the benchmark range at 11%, however native plant diversity is below the benchmark value (Sharp and Milner, 2014).



Figure 12: Monitoring Plot 4. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2022)

Table 6: Summary statistics for spring 2022 floristic surveys within Plot 4

Plot Description		
Management unit	MU4	
Vegetation type	Box-Gum Woodland	
Plot number	4	
Condition	Mod-Good	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	4.7	11
Native midstorey cover	11.5	4.2
Native understorey cover (grass)	74	34
Native understorey cover (other)	18	52
Exotic midstorey plant cover	2	0
Exotic understorey plant cover	28	46
Native species diversity	24	25
Regeneration	Yes	
Species	<i>E. blakelyi</i>	
Leaf litter	24	

3.5. Monitoring plot 5

Monitoring plot 5 is a plot located in MU5 in moderate-good quality Box-Gum Woodland with an overstorey dominated by *Eucalyptus blakelyi*. Native species diversity was 35, a decrease from 56 in 2020 but remains within benchmark values. The dominant native species were *Poa sieberiana* var. *sieberiana* (Snowgrass) and *Themeda triandra* (Kangaroo Grass), while the annual *Hypericum perforatum* (St Johns Wort) made up a large proportion of the exotic cover. The number of exotic species was lower than in 2020 (23 and 15 respectively). Regeneration of *Eucalyptus blakelyi* is present.

Table 7: Summary statistics for spring 2022 floristic surveys within Plot 5



Figure 13: Monitoring Plot 5. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2022)

Plot Description		
Management unit	MU5	
Vegetation type	Box-Gum Woodland	
Plot number	5	
Condition	Mod-Good	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	0	11
Native midstorey cover	11	14.5
Native understorey cover (grass)	76	54
Native understorey cover (other)	14	18
Exotic midstorey plant cover	0	0
Exotic understorey plant cover	4	32
Native species diversity	29	35
Regeneration	Yes	
Species	<i>E. blakelyi</i>	
Leaf litter	8.2	

3.6. Monitoring plot 6

Monitoring plot 6 is a control plot located in MU6, in moderate-good quality Box-Gum Woodland with an overstorey dominated by *E. blakelyi*. The plot is situated in a transition zone between the woodland and derived grassland forms of the ecological community. No management actions are meant to be undertaken within the boundaries of the plot. Native species richness has decreased (38 species in 2018, 40 species in 2020 and 30 in 2022). Exotic groundcover remains high at 66%, with high cover of *Hypericum perforatum* (St Johns Wart) and *Vulpia muralis* (Wall Fescue). Scattered *E. blakelyi* saplings were recorded.



Figure 14: Monitoring Plot 6. (Left: Baseline monitoring photo, March 2012. Right: monitoring photo November 2022)

Table 8: Summary statistics for spring 2022 floristic surveys within Plot 6

Plot Description		
Management unit	MU6	
Vegetation type	Box-Gum Woodland	
Plot number	6	
Condition	Mod-Good	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	5.3	5
Native midstorey cover	0	1.3
Native understorey cover (grass)	80	28
Native understorey cover (other)	10	28
Exotic midstorey plant cover	0	0
Exotic understorey plant cover	8	66
Native species diversity	28	30
Regeneration	Yes	
Species	<i>E. blakelyi</i>	
Leaf litter	12	

3.7. Monitoring plot 7

Monitoring plot 7 is located within MU7 in the northern offset area. The management unit is composed of degraded Box-Gum Woodland with the overstorey dominated by scattered remnant *E. blakelyi*. No recruitment of *E. blakelyi* was observed within the plot. Exotic groundcover was the highest of any site at 88%, up from 82% in 2020. *Vulpia muralis* (Wall Fescue) was the most dominant species, followed by *Trifolium repens* (White Clover) and *Bromus hordeaceus* (Soft Brome). Native species richness showed a decrease since 2020 monitoring, with 16 species recorded. *Rumex brownii* (Swamp Dock) was the dominant native species.



Figure 15: Monitoring Plot 7. (Left: Baseline monitoring photo, March 2012. Right: monitoring photo November 2022)

Table 9: Summary statistics for spring 2022 floristic surveys within Plot 7

Plot Description		
Management unit	MU7	
Vegetation type	Box-Gum Woodland	
Plot number	7	
Condition	Low	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	0	1
Native midstorey cover	0	0
Native understorey cover (grass)	74	24
Native understorey cover (other)	0	16
Exotic midstorey plant cover	0	0
Exotic understorey plant cover	34	86
Native species diversity	13	16
Regeneration	Yes	
Species	<i>E. melliodora</i>	
Leaf litter	10	

3.8. Monitoring Plot 8

Monitoring plot 8 is a control plot located in MU3. No management actions are proposed to occur within the bounds of the plot. The plot is located in moderate-good quality Box-Gum Woodland with an overstorey dominated by regenerating *E. blakelyi*. *E. blakelyi* regeneration is present within the plot. As with the other sites, the number of native species decreased between 2020 and 2022. Native species diversity was recorded at 38, while 20 exotic species were recorded within the plot. A high cover of *Themeda triandra* (Kangaroo Grass) was present, and moderate cover of *Haloragis heterophylla* (Variable Raspwort), *Poa sieberiana* var. *sieberiana* (Snowgrass) and *Schoenus apogon* (Fluke Bogrush). *Vulpia muralis* (Wall Fescue) was the dominant exotic species. There was evidence of grazing and disturbance by cattle within the plot.



Figure 16: Monitoring Plot 8. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2022)

Table 10: Summary statistics for spring 2022 floristic surveys within Plot 8

Plot Description		
Management unit	MU3	
Vegetation type	Box-Gum Woodland	
Plot number	8	
Condition	Mod-Good	
Plot Statistics (%)	Baseline	2022
Native overstorey cover	0	9
Native midstorey cover	8.5	5.3
Native understorey cover (grass)	80	40
Native understorey cover (other)	14	38
Exotic midstorey plant cover	0	0
Exotic understorey plant cover	4	44
Native species diversity	26	38
Regeneration	Yes	
Species	<i>E. blakelyi</i>	
Leaf litter	21	

4. Biodiversity values

4.1. Ecosystem health

The offset site supports a diverse range of flora, fauna, and habitats with diverse functional ecosystems. It is considered to be in good health and likely to be resistant to disturbance events due to its diversity. Overall plant growth was good across the site, this is evident in the vegetation change at photo points and the large areas of regeneration of canopy species (particularly *E. blakelyi*) across both offset areas (Figure 17), however native species richness has reduced across both offset areas since 2020 monitoring. While dense patches of St Johns Wort were present (Figure 17), they were limited to open areas. Native species diversity for both birds and flora remain higher than baseline surveys, however exotic cover is also substantially higher.



Figure 17: *Eucalyptus blakelyi* regeneration (left) and dense patches of St. Johns Wort in open areas, northern offset 2022.

4.2. Flora

A total of 235 native plant species and 142 exotic species have been recorded for the M2G offset site since the baseline surveys were undertaken, including those observed opportunistically, not within plots. The list has continued to grow with each survey. The detection of new records for the site is influenced by factors such as time since cessation of grazing, seasonal conditions, and the varying meander routes chosen by the ecologists undertaking the surveys. A total of 124 flora species (66 native and 58 exotic) were recorded in monitoring plots during spring 2022 surveys (Appendix A).

The flora recorded since baseline surveys includes a range of widely distributed characteristic woodland species, several rare and uncommon species in the ACT, and four threatened species listed under the EPBC Act (Table 11 and Table 12).

4.2.1. Threatened flora species

An annotated list of nationally threatened species occurring, or known to have occurred on the offset, is provided in Table 11 below. A number of species that have previously been observed within the offset area have not been observed for a number of years. This is likely due to the opportunistic nature of these observations. It is recommended that 2024 monitoring attempts to locate previous records of these species to confirm presence and update mapping to ensure they can be monitored overtime.

Table 11: Threatened flora species within the offset site

Species	EPBC Act Status	NC Act Status	Notes
<i>Leucochrysum albicans</i> var. <i>tricolor</i> (Hoary Sunray)	Endangered	Not listed	Endangered herbaceous perennial. Noted as rare in the offset site in spring 2014. The species is abundant within the offset site. It is also present in the adjacent land managed by Transgrid, where it was planted in 2010 on the batters and has been noted as growing profusely. It is considered likely that the individuals within the offset site have originated from the adjacent population. This species was observed within plot 8 and opportunistically across the site during the 2022 survey. (Figure 18)
<i>Pomaderris pallida</i> (Pale Pomaderris)	Vulnerable	Not listed	Vulnerable shrub to about 1.5 m high. Located in the central western part of the northern offset. A solitary flowering adult plant approximately 90 cm high was found in spring 2014 and was again located in spring 2016, along with approximately 5 juveniles and 2 sub-adults (flowering but only about 30-40 cm high). Multiple individuals were again observed during the 2020 survey. None were observed during the 2022 survey. The species is known to occur within the Murrumbidgee River corridor, and it appears that the population within the offset site has established as an outlier.
<i>Swainsona recta</i> (Small Purple-pea)	Endangered	Endangered	Endangered herbaceous perennial. This species was found on the M2G offset site during initial surveys of the site in 2010 but has not been encountered since. Three translocation enclosure plots have been established on site (refer to Section 5.1).
<i>Thesium australe</i> (Austral Toadflax, Toadflax)	Vulnerable	Not listed	Austral Toadflax is a hairless, yellowish-green perennial herb with slender, wiry stems to 40 cm high. The species is semi-parasitic on roots of a range of grass species, notably <i>Themeda triandra</i> (Kangaroo Grass). Approximately 4 individuals were recorded in spring 2015 within the northern offset but have not been recorded since. The species is only known from a few records within the Canberra region.

4.2.2. Rare and uncommon ACT species

A number of species considered to be rare or uncommon within the ACT have also been recorded within the offset site to date. These species are outlined in Table 12 below. The detection of these species in some years and not others is likely due to a number of factors including, but not limited to,

preceding environmental conditions, flowering period, timing of monitoring surveys and competition for space with other plants.

Table 12: Rare and uncommon species recorded within the offset site

Species	Notes
<i>Austrostipa setacea</i> (Corkscrew Grass)	Tufted perennial grass. Noted in the south-eastern corner of the southern offset in spring 2014, and was observed again during the 2020 and 2022 survey.
<i>Bossiaea prostrata</i> (Creeping Bossiaea)	Prostrate perennial subshrub. This species has been recorded in monitoring plot 5 in the northern offset in 2018 and 2020, but not in 2022.
<i>Desmodium brachypodum</i> (Large Tick-trefoil)	Large pea-flowered herb. Although it was previously recorded in the south-eastern part of the southern offset, it was not observed in 2022.
<i>Dillwynia</i> sp. <i>Yetholme</i>	Decumbent to erect shrub. This species has been recorded previously but was not seen during the 2022 survey.
<i>Discaria pubescens</i> (Australian Anchor Plant)	Rigid shrub with prominent paired stem spines. A localised patch of approximately 26 plants occurs in the northern offset. Observed in the 2020 surveys but not in 2022.
<i>Glossostigma elatinoides</i>	Prostrate perennial wetland forb. A localised patch was noted in spring 2014 on the banks of the dam in the northern offset but was not seen in 2022.
<i>Limosella australis</i> (Australian Mudwort)	Diminutive perennial wetland forb. Localised plants were noted in spring 2014 on the banks of the dam in the northern offset. It was not recorded in 2022.
<i>Microseris lanceolata</i> (Yam Daisy)	Perennial forb with fleshy tuberous roots. Previously recorded in monitoring plot 3 in the southern offset and present in high abundance (patches of greater than 100 individuals) at various locations throughout the southern offset in 2016. This species was recorded in 2020 and 2022, but in low numbers (possibly due to surveys conducted late in the flowering season).
<i>Plantago gaudichaudii</i> (Narrow Plantain)	Perennial forb with thick fleshy taproot. Recorded in monitoring plot 3 (southern offset) in 2022.
<i>Stylidium despectum</i> (Dwarf Triggerplant)	Erect diminutive annual forb occurring in moist situations. Localised plants were noted in spring 2014 along a moist drainage line in the northern part of the southern offset. It was not recorded in 2022.
<i>Swainsona monticola</i> (Notched Swainson-pea)	Low spreading herbaceous perennial. Noted in the south-eastern corner of the southern offset in spring 2014 and recorded again in 2016 and 2020. It was not recorded in 2022.
<i>Swainsona sericea</i> (Silky Swainson-pea)	Low spreading herbaceous perennial. Recorded in monitoring plots 3 (southern offset) and 5 (northern offset) since spring 2016, occurring at these sites again in 2020 and opportunistically elsewhere. In 2022, the species was not recorded in any plots but was recorded along tracks in the northern offset. (Figure 18)
<i>Zornia dyctiocarpa</i>	Low herbaceous perennial. Previously noted in the north eastern corner of the southern offset but not recorded in 2022.



Figure 18: *Swainsona sericea* (left) and *Leucochrysum albicans* var. *tricolor* (right) observed during monitoring 2022.

5. Fauna

A broad range of fauna species have been recorded within the offset site since establishment, including 92 bird species, 15 mammal species, 10 reptiles, and 6 amphibians. A cumulative list of species recorded is provided in Appendix B. A total of 39 fauna species were recorded, either opportunistically or through bird surveys, across the offset site in spring 2022. This consisted of 38 bird species, one native mammal, and two amphibian species.

5.1. Bird monitoring

During bird surveys, a total of 28 species were recorded (Table 13). A further ten species were recorded opportunistically across the study area. Australian magpie (*Cracticus tibicen*) was the most abundant and commonly occurring species. Other species frequently recorded during surveys included Crimson Rosella (*Platycercus elegans*), Noisy Friarbird (*Philemon corniculatus*), Noisy Miner (*Manorina melanocephala*), Rufous Whistler (*Pachycephala rufiventris*), and Red Wattlebird (*Anthochaera carunculata*).

Table 13: Bird species abundance index (highest to lowest).

Species	Scientific name	No. sites recorded	Total abundance	Abundance index
Australian Magpie	<i>Cracticus tibicen</i>	6	9	0.30
Crimson Rosella	<i>Platycercus elegans</i>	4	8	0.27
Noisy Friarbird	<i>Philemon corniculatus</i>	5	8	0.27
Noisy Miner	<i>Manorina melanocephala</i>	4	6	0.20
Rufous Whistler	<i>Pachycephala rufiventris</i>	5	6	0.20
Red Wattlebird	<i>Anthochaera carunculata</i>	5	6	0.20
White-throated Gerygone	<i>Gerygone olivacea</i>	4	5	0.17
Willy Wagtail	<i>Rhipidura leucophrys</i>	5	5	0.17
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	1	4	0.13
Magpie Lark	<i>Grallina cyanoleuca</i>	2	4	0.13
Spotted Pardolote	<i>Pardalotus punctatus</i>	3	4	0.13
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	3	3	0.10
Eastern Rosella	<i>Platycercus adscitus</i>	1	3	0.10
Horsefield Bronze Cuckoo	<i>Chrysococcyx basalis</i>	3	3	0.10
Striated Pardolote	<i>Pardalotus striatus</i>	3	3	0.10
Dusky Woodswallow	<i>Artamus cyanopterus</i>	1	2	0.07
Galah	<i>Eolophus roseicapillus</i>	1	2	0.07
Grey Fantail	<i>Rhipidura albiscapa</i>	1	2	0.07
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	1	2	0.07
Weebill	<i>Smicrornis brevirostris</i>	1	2	0.07
White-throated treecreeper	<i>Cormobates leucophaeus</i>	2	2	0.07
Australian Raven	<i>Corvus coronoides</i>	1	1	0.03

Species	Scientific name	No. sites recorded	Total abundance	Abundance index
Grey Butcherbird	<i>Cracticus torquatus</i>	1	1	0.03
Olive-backed Oriole	<i>Oriolous sagittatus</i>	1	1	0.03
Shining Bronze cuckoo	<i>Chrysococcyx lucidus</i>	1	1	0.03
White-eared Honeyeater	<i>Lichenostomus penicillatus</i>	1	1	0.03
Lewins Honeyeater	<i>Meliphaga lewinii</i>	1	1	0.03
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	1	1	0.03

Bird diversity recorded during surveys has varied between 15 and 28 species since 2015 (Figure 19) and appears to be increasing over time. Transect 1 in the northern offset has recorded slightly higher diversity in 2018, 2020 and 2022, although overall the two transects record similar changes between monitoring years (Figure 19).

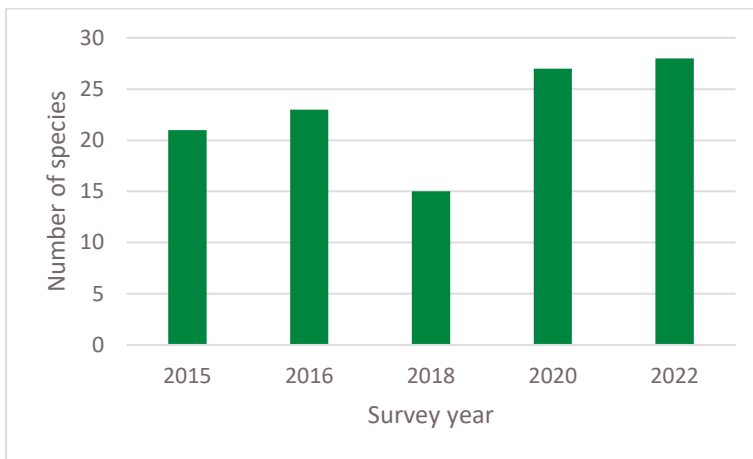


Figure 19: Bird species diversity recorded during monitoring between 2015 and 2022.

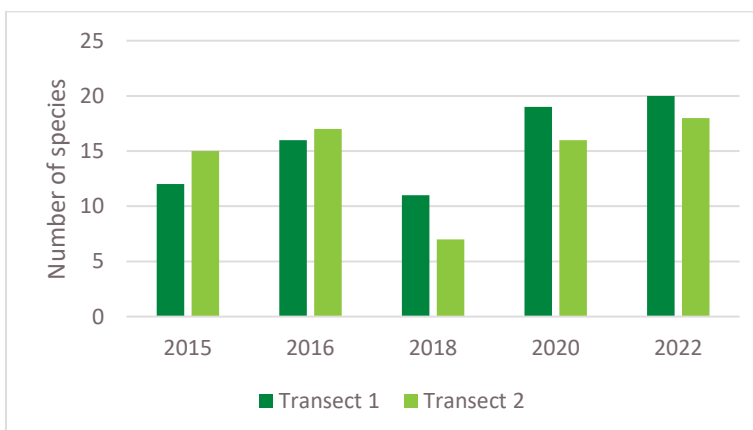


Figure 20: Bird species diversity for transect 1 and 2, 2015 - 2022.

5.2. Fauna habitat assessment

A rapid assessment of the range of fauna habitat features present across the offset site and their abundance was undertaken during the baseline surveys. These values were subsequently confirmed during surveys in spring 2022 and are presented below in Table 14. Only minor changes in habitat features were observed in comparison to 2020. It is noted these features are unlikely to change in the short to medium term. The following categories were used to identify abundance or frequency of each feature:

- *Abundant* = feature occurs in an almost continuous manner.
- *Common* = feature encountered commonly, i.e. without having to search for it.
- *Occasional* = feature occurs in more than a few cases, but not encountered frequently.
- *Rare* = feature observed very infrequently, one to a few cases at most.

Table 14: Fauna habitat features observed across the offset site in 2022.

Fauna habitat feature	Northern	Southern
Tree hollows	Occasional	Occasional
Large trees > 60 cm DBH	Occasional	Occasional
Dead standing trees	Occasional	Occasional
Stumps (<2 m)	Rare	Rare
Mistletoes	Occasional	Occasional
Regenerating tree thickets	Abundant	Abundant
Native shrub thickets	Occasional	Occasional
Exotic shrub thickets	Rare	Rare
Logs (fallen)	Common	Common
Timber (fallen)	Common	Common
Litter (leaf, twig, bark)	Common	Common
Loose rocks	Common	Common
Outcropping rocks	Common	Common
Termite mounds	Rare	Rare
Meat ant nests	Occasional	Occasional
Earth banks/deep gully walls	Rare	Rare

The plantings of mixed native shrubs, along the gullies within the northern offset will further enhance habitat values for a range of native woodland birds that forage and nest in mid-canopies of forests and woodlands.

An assessment of the dominant habitat features recorded within each 50 m x 20 m vegetation monitoring plot was also undertaken during the baseline surveys (Table 15). No substantial change in these features relative to the baseline conditions are expected to occur over the short to medium term. For example, the establishment of hollows and maturity of regenerating eucalypts will take tens of years. However, in a number of plots coarse woody debris has increased and regeneration of canopy species has been recorded where it had not been noted previously.

Table 15: Habitat assessment within 50 m x 20 m vegetation monitoring plots.

Plot	HBT	Logs	Comment	Dominant habitat features present within each 50 m x 20 m plot
1	0	0 m	No change	Limited surface rocks; abundant exotic annuals
2	1	2 m	Regeneration present	Surface and outcropping rocks abundant; minor coarse woody debris, developing canopy regeneration
3	0	3 m	No change	Litter common; minor coarse woody debris, developing canopy regeneration
4	0	28 m	Increased logs	Developing canopy regeneration, coarse woody debris
5	0	30 m	Increased logs	Developing canopy regeneration; limited surface rock, coarse woody debris
6	0	8 m	Increased logs	Developing canopy regeneration
7	0	2 m	No change	Minor surface rocks and coarse woody debris; abundant exotic annuals
8	0	17 m	Increased logs	Litter; coarse woody debris; hollow logs; surface rocks

5.3. Threatened fauna

The Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) was recorded during bird surveys and opportunistically in the northern offset. This is the first time Dusky Woodswallow has been seen in the study area since monitoring began. It is listed as vulnerable in NSW, but not listed in the ACT.

6. *Swainsona recta* monitoring

The spring 2022 *Swainsona recta* census was undertaken on 23 November 2022. Of the 112 individuals planted within the three translocation plots, 14 were present in spring 2020 and none were recorded in spring 2022. No recruitment has been observed since monitoring began.

Six of the 14 individuals recorded during spring 2020 were not recorded in the 2018 surveys. As discussed in previous monitoring reports (ELA, 2014; ELA, 2015; ELA 2016; ELA 2018; ELA 2020), and as demonstrated by these fluctuating year-on-year results, it is difficult to accurately quantify survivorship in planted *Swainsona recta* individuals in only a single season, due to the species' ability to die back to below ground root stock and develop above ground growth only when conditions are favourable.

The lifespan of the species is unknown, however individuals have been monitored for over 30 years and it is estimated they may live up to 50 years. Given it has only been ten years since planting, it is unlikely the planted individuals have reached the end of their lifespan. Peak flowering for the species occurs in October over a 2 – 3 week period (EPSD, 2019). As monitoring occurred in late November most of the flowering/fruiting season had passed when *S. recta* plots were surveyed. It is possible a number of individuals finished flowering before surveys took place. However, it is expected the plants that weren't flowering would have been recorded given the time spent searching each plot.

Research undertaken on the Mt Taylor *S. recta* population suggests there is a relationship between the number of frost nights in the preceding year and the likelihood an individual will flower (Wilson et al. 2016). The research suggests a plant is most likely to flower when there are between 7 and 15 nights equal to or less than -4°C. During 2022, ten days recorded temperatures equal to or less than -4°C at the Tuggeranong weather station, (BOMc 2022), suggesting conditions were favourable to flowering this year. There is some evidence of a linear decline in the proportion of flowering individuals with increasing time since fire (Wilson et al. 2016) which could be a contributing factor to the results of 2022 surveys.

It is recommended that spring monitoring in 2024 be undertaken earlier (late October) to better coincide with the peak flowering window of the species.

6.1. Plot 1

Plot 1 occurs within Box-Gum Woodland with a *Themeda triandra* (Kangaroo Grass) dominated groundcover. The plot had high native species cover and a low abundance of exotic species. The plot contains some open ground and inter-tussock spacing between *Themeda* tussocks and is on a slight east facing slope. *Eucalyptus blakelyi* surrounds the plot as the dominant overstorey with natural regeneration present. Shading from the overstorey is low.

Forty individuals were planted within plot 1, of which 26 were from Mt. Taylor (ten potting mix and 16 soil plus potting mix) and seven each were from the Williamsdale and Burra populations.

Of the 40 plants, ten were present in spring 2020 and none were present in 2022 (Table 16). No recruitment was observed within the plot. A high percentage of grass cover was observed within the plot (Figure 21).

Table 16: Plot 1 monitoring results.

Key	Results	Comments
○	Present - in flower or immature fruit	None
□	Present – lacking flowers and fruits	None
△	Absent - not observed	40 plants recorded as absent



Figure 21: Swainsona recta plot 1 in spring 2022, from the north.

6.2. Plot 2

Plot 2 occurs within *E. blakelyi* dominated Box-Gum Woodland with the understorey dominated by *Austrostipa* spp. (Speargrass) and *Themeda triandra* (Kangaroo Grass). A high diversity of native species and a low abundance of exotic species was present within the plot. The plot is established on a slight northeast facing slope. Natural regeneration is present in the general area, but no shading of the overstorey trees is likely to occur. Some rocky habitat occurs adjacent to the plot, but not within the plot. *Leucochrysum albicans* var. *tricolor* was recorded within the plot and inter tussock spaces were present.

Thirty-six individuals were planted within plot 2, of which 20 were from Mt. Taylor (six potting mix and 14 soil plus potting mix) and eight were from each of the Williamsdale and Burra populations.

Of the 36 individuals planted, three were present in spring 2020, and none were present in 2022. No recruitment was observed within the plot (Table 17; Figure 22).

Table 17: Plot 2 monitoring results

Key	Results	Comments
○	Present - in flower or immature	None
□	Present - lacking flowers and fruits	None
△	Absent - not observed	36 recorded as absent



Figure 22: *Swainsona recta* plot 2 in spring 2022, from the north.

6.3. Plot 3

Plot 3 occurs in *Eucalyptus bridgesiana* (Apple-box) / *E. dives* (Peppermint) woodland with an understorey dominated by *Themeda triandra*. A high diversity of native species and a low abundance of exotic species were present in the plot. The plot was established on a flat area on top of a small knoll. Limited surface rocks were observed within and immediately adjacent to the plot. Plot 3 is likely to experience moderate shading throughout the day from surrounding overstorey. High cover of *Themeda triandra* was observed in the plot, as well *Leucochrysum albicans* var. *tricolor* (Hoary Sunray) and *Microseris lanceolata* (Yam daisy).

Thirty-six individuals have been planted within plot 2, of which 20 were from Mt. Taylor (nine potting mix and 11 soil plus potting mix), seven of which were from the Williamsdale population and nine of which were from the Burra population.

Of the 36 individuals, one was present in spring 2020 and none were recorded in spring 2022 (Table 18). No recruitment was observed within the plot.

Table 18: Plot 3 monitoring results

Key	Results	Comments
○	Present - in flower or immature	None
□	Present - lacking flowers and fruits	None
△	Absent - not observed	36 recorded as absent



Figure 23: *Swainsona recta* plot 3 in spring 2022, from the north.

7. Weed monitoring

7.1. Priority areas for weed control works

Priority areas for weed control works have also been identified across the offset site, with priority areas defined by management units. The priority areas for works have been assessed for six different species or groups of species as shown in Figure 24 and Figure 25, with the overall priority for each species across the offset site summarised in Table 19. The entire property is weed sprayed twice yearly, including the entire property outside the designated offset areas.

Table 19: Summary of prior weed occurrence and spring 2022 monitoring results.

Species	Prior weed occurrence	Current status
African Lovegrass (<i>Eragrostis curvula</i>)	Low, relatively few isolated individuals or small patches along tracks across the offset site with some heavier infestations around the main drainage line around MU5/6.	Rare, but may occur outside of the offset site within the broader Williamsdale property. MU occurrence: MU1A and MU2B Recommendation: Continue monitoring Priority: Low/Moderate
Serrated Tussock (<i>Nassella trichotoma</i>)	Low, scattered individuals in some areas. Scattered plants persist within MU1 near the southern boundary of the southern offset.	Rare, but similar to African Lovegrass, may occur within the Williamsdale property. MU occurrence: N/A Recommendation: Continue monitoring Priority: Low/Moderate
Blackberry (<i>Rubus fruticosus</i>)	Low, localised areas of dominance. Occasional isolated patches and scattered young individuals, particularly in MU4 along the drainage line. The species is abundant in the broader Williamsdale property, particularly close to the river corridor.	A few isolated patches and scattered individuals were observed in 2022, predominantly along drainage lines in the northern offset. MU occurrence: MU4 and MU6 Recommendation: Follow-up control required. Priority: Moderate
Woody Weeds (Hawthorn, Prunus, Pyracantha & Cotoneaster)	Very low, isolated individuals. Present within the study area as isolated individuals.	Very few scattered plants persist the study area. MU occurrence: N/A Recommendation: Continue monitoring Priority: Low

Species	Prior weed occurrence	Current status
St John's Wort (<i>Hypericum perforatum</i>)	Scattered and moderate occurrence across the offset site. Widely distributed across both the northern and southern offset sites, however typically with low cover.	The species remains widely distributed across both the northern and southern offsets. The species is particularly prevalent in open areas of the site where it occurs in dense patches. MU occurrence: All MUs Recommendation: Continued spraying in conjunction with the ongoing biological control program by ACT PCS. If extent of St John's Wort on the property becomes more of a concern, discussion should be had with ACT around additional control measures. Priority: Moderate-High
Thistles (<i>Carthamus lanatus</i> , <i>Carduus</i> spp., <i>Cirsium vulgare</i> & <i>Onopordum</i> spp.)	Moderate, localised areas of dominance, predominantly in areas with significant history of disturbance.	Thistles were more prevalent in areas with a strong history of grazing disturbance. <i>Carduus</i> spp. <i>Onopordum</i> spp. were observed in scattered patches. <i>Carthamus lanatus</i> (Saffron Thistle) were commonly encountered, especially in MU1a and the southern portion of MU3. <i>Cirsium vulgare</i> (Spear Thistle) was recorded as scattered patches in open areas. MU occurrence: All MUs Recommendation: For <i>Carthamus lanatus</i> particularly, consider control options within a broader program encompassing the adjacent property to the south. This species was common in MU1a and has infested much of the management unit. Priority: Moderate
Sweet Briar (<i>Rosa rubiginosa</i>)	Isolated presence scattered throughout offset site, largely present as re-sprouting or juvenile individuals.	Weed control work on <i>Rosa rubiginosa</i> appears to have been largely successful. However, some re-sprouting or recruitment from soil seed stores was observed in most MUs and it is expected that continued follow up work for the species will be necessary, but is not considered a priority at this point in time MU occurrence: MU1a, MU1b, MU2a, MU2b, MU3, MU4, MU5, MU7 Recommendation: Further spot spraying of individuals missed or re-sprouting. Priority: Low-Moderate
Patterson's Curse (<i>Echium plantagineum</i>)	Scattered occurrence across the offset site. Low level of dominance.	Occurrences within the offset were isolated and mostly around the boundaries. MU occurrence: MU1a, MU4, MU7 Recommendation: Spot spraying of individuals. Priority: Low

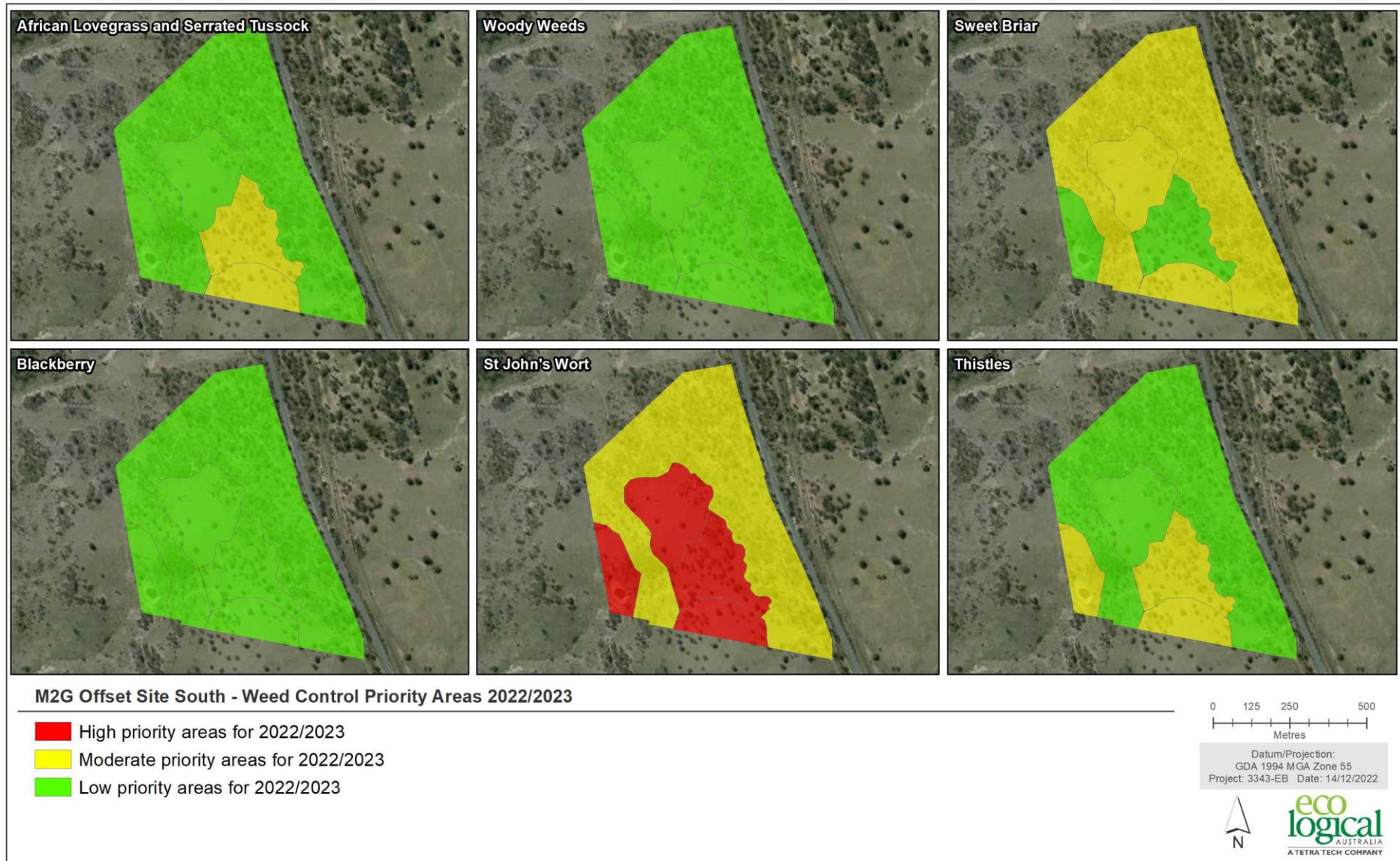


Figure 24: Relative weed distribution within the southern offset site, spring 2022.

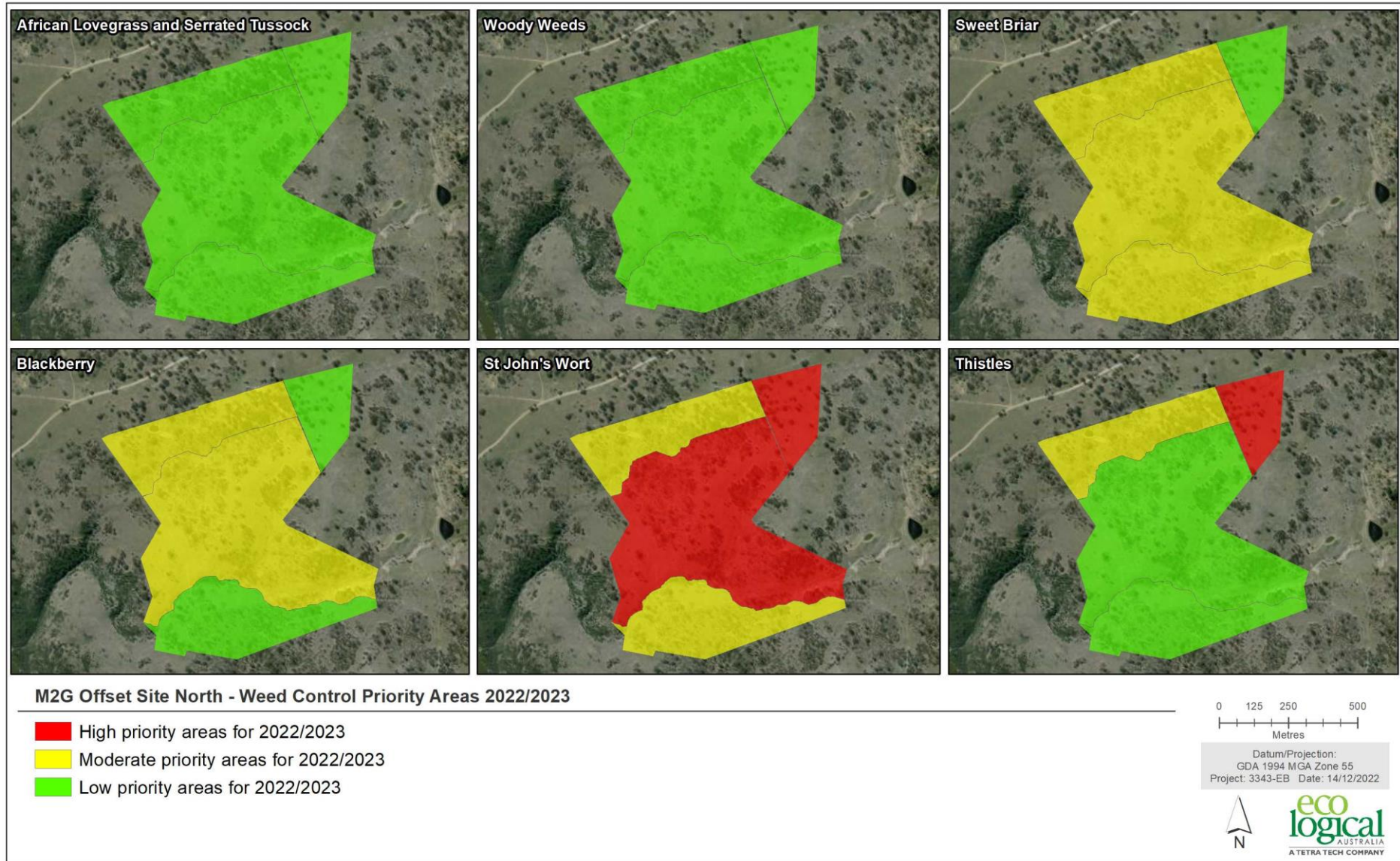


Figure 25: Relative weed distribution within the northern offset site, spring 2022.

8. Erosion monitoring

8.1. Erosion management actions undertaken to date

During the ERG site visit to the M2G Biodiversity Offset on 22 October 2014, concern was expressed over potential erosion problems in two areas adjacent to the main drainage channel in the northern offset. The two sites are located along the main drainage line separating MU5 & MU6 within the northern offset. Recommendations around rehabilitation options were presented in the spring 2014 monitoring report.

On-ground erosion management activities were undertaken during winter 2016 in the form of placement of woody debris piles in active gullies in an attempt to slow erosion at the gully heads. For further detail on management actions recommended refer to the ODP and Erosion Management Sub-plan.

Furthermore, additional erosion control has been undertaken in the small drainage line in MU6 (flowing into the main drainage line) in the form of rocky debris and MU4 at the overflow point south of the dam (see erosion point 18 and 22 below). This management appears to have been effective in stabilising the two areas, and with plantings that were previously implemented in the upper drainage line in 2016, an erosion rehabilitation concept plan is no longer required.

8.2. Erosion monitoring point results – spring 2022

The majority of erosion monitoring points are located along ephemeral drainage lines in the northern offset. Vegetative ground cover has increased in many locations since spring 2020 monitoring, and this fluctuation is expected to continue with rainfall trends in future monitoring seasons. Active (minor) erosion at or adjacent to three of the erosion monitoring points was observed in the current monitoring period. Remediation works appear to have been successful in stabilising gully heads; further works of similar scope are recommended for consideration at a number of other points.

It should be noted that approval is required to undertake any remediation works within a drainage line (see Erosion Management Sub-plan) and may influence the type of work to be undertaken. A summary of the erosion points monitored within the offset property is provided below with a detailed description of each point and an accompanying photo.

Where erosion points have been noted as stable over multiple monitoring periods, or have had remediation works, it is recommended that monitoring is no longer required. A number of erosion points have been removed from monitoring following the recommendations of ELA's 2020 report. No further change is expected at these locations, but this decision will be reviewed as necessary.

8.2.1. Erosion Point 2

Description: Situated within an ephemeral drainage line in MU4, northern offset.

Size: Approximately 4 m across, 0.8 m deep and 2.0 m in length.

Change: Banks and channel base have significantly more vegetation present since 2012 (Figure 26Figure 26) and since 2020 monitoring, providing stabilisation and flow speed reduction.

Action required: None. Continue to monitor.



Figure 26: Erosion point 2; as observed during baseline surveys in 2012 (top) and in 2022 (bottom).

8.2.2. Erosion Point 4

Description: Located within an ephemeral drainage line within MU4, northern offset.

Size: Approximately 2.0 m wide, 0.5 m deep, 2.5 m long.

Change: More vegetation is present compared with baseline surveys and 2020 monitoring (Figure 27), providing stabilisation and reducing flow speed.

Action required: No works required at this stage. Continue to monitor.



Figure 27: Erosion point 4; as observed during baseline surveys in 2012 (top) and in 2022 (bottom).

8.2.3. Erosion Point 7

Description: Located along the main creek line within northern offset. Photo taken from Photo Point 1 (co-ordinates; 6059835, 692700) looking north-west (315°) and showing the north bank.

Size: Approximately 20 m long and 1.0 m deep.

Change: The bank is steeper and moved backwards since 2012 and 2020 monitoring (Figure 28). Erosion remains active. More vegetation is present in the channel and on the banks.

Action required: Remediation measures to slow surface water flow and stop progression of head cut could be considered, however additional vegetation in the channel (see erosion point 6) may act to reduce flow.



Figure 28: Erosion point 6; as observed during baseline surveys in 2012 (top) and in 2022 (bottom).

8.2.4. Erosion Point 8

Description: Located along the main creek line within northern offset. Photo taken from Photo Point 1 (co-ordinates; 6059835, 692700) looking north-east (45°) and showing the north bank (upstream from erosion point 7).

Size: Approximately 15 m long and 1.0 m deep.

Change: Banks have undercut and are now deeper. Erosion point remains active. More vegetation is present within the channel than in previous years (Figure 29), which may reduce flow.

Action required: None. Expected to grade out over time and naturally revegetate



Figure 29: Erosion point 7; as observed during baseline surveys in 2012 (top) and in 2022 (bottom).

8.2.5. Erosion Point 13

Description: Moderately sized erosion point in northern offset. Evidence of existing slumping.

Size: Approximately 4.0 m long, 1.5 m deep and approximately 3 m wide.

Change: Vegetation now present in channel and on banks (Figure 30), providing stabilisation and reducing flow speed.

Action required: Continue to monitor.



Figure 30: Erosion point 13; as observed during baseline surveys in 2012 (top) and in 2022 (bottom).

8.2.6. Erosion Point 21

Description: Located west (just downstream) from the access track running along the western boundary in the northern offset. The site has developed a plunge pool, which has exposed the bedrock in some parts.

Size: 1-2 m wide, 0.5 m deep, 2 m long.

Change: Erosion remains active, head cut has moved back. More channel vegetation in present compared with 2012 and 2020 (Figure 31).

Action required: No action required, continue to monitor.



Figure 31: Erosion point 21; as observed during baseline surveys in 2012 (top) and in 2022 (bottom).

9. Feral animals

Observations of feral animals over the course of the monitoring program are listed in Table 20. Previous management by Regional Feral Animal Control (RFAC) has targeted European Fox (*Vulpes vulpes*), Feral Goat (*Capra hircus*) and Feral Pig (*Sus scrofa*). Currently, feral animal control is conducted yearly by Strathbogie Wildlife and focuses on Deer (*Dama dama*), European Fox (*Vulpes vulpes*), Feral Pig (*Sus scrofa*) and Feral Goat (*Capra hircus*). European Rabbi (*Oryctolagus cuniculus*) across the site were fumigated and their warrens ripped in 2020, which has been very effective. No feral animals were observed opportunistically during 2022 monitoring, however it should be noted that feral animals were not targeted in the biodiversity monitoring of this project. Continued monitoring is recommended, implementing timely control measures when necessary.

Table 20: Feral animal observations for the 2022 monitoring period, and previous sightings and management actions.

Species	Prior occurrence/management	Current status
European Fox (<i>Vulpes vulpes</i>)	Individuals have been observed within the offset area in previous years. Control is conducted yearly. Foxes appear to be in low numbers, but nocturnal surveys would be needed to be certain.	Not observed during spring 2022 monitoring. MU occurrence: N/A Recommendation: Continue monitoring Priority: Low
European Rabbit (<i>Oryctolagus cuniculus</i>) and European Hare (<i>Lepus europaeus</i>)	Rabbit warrens have previously been recorded across the wider Williamsdale property but are not prolific. Other signs of rabbits in the form of scat have also been observed. Extensive fumigation and ripping of warrens occurred during 2020 (Icon Water pers. comm.)	Rabbit scat was observed opportunistically across the site. MU occurrence: N/A Recommendation: Continue monitoring and perform further control measures as needed. Priority: Low
Fallow Deer (<i>Dama dama</i>)	Fallow Deer were sighted in 2016 but not in 2018. They are likely present in low numbers. Control is conducted yearly.	Not observed during spring 2022 monitoring, however they are known to be present in the area (Icon Water pers. comm.). MU occurrence: N/A Recommendation: Continue monitoring Priority: Low
Feral Goat (<i>Capra hircus</i>)	Regional Feral Animal Control removed 150 Feral Goats from the property in 2013, and further removal activities were undertaken in 2015 and 2017. Large herds of goats (approx. 40-70) were sighted opportunistically in 2016 and 2018. Control is conducted yearly.	Not observed during spring 2022 monitoring. MU occurrence: N/A Recommendation: Continue monitoring Priority: Low
Feral Pig (<i>Sus scrofa</i>)	Pig diggings have been recorded in previous monitoring seasons. Control is conducted yearly in winter.	Not observed during spring 2022 monitoring. MU occurrence: N/A Recommendation: Continue monitoring Priority: Low

10. Fencing monitoring

Fencing of the offset site was one of the required actions highlighted in the ODP. Fencing is required to prevent grazers such as sheep and cattle from entering the offset site from the neighbouring properties. The primary aim of a stock proof fence is to keep grazing stock out of an area (e.g. conservation area) where it is bordered by a private rural property. This type of fencing generally consists of 4 or 5 stranded wire with wooden posts and/or star-pickets, approximately 1.2 m high. In response to recommendations in previous monitoring reports (ELA, 2012), all internal fencing within the offset site was removed in June 2013 to enhance the wildlife friendly nature of the offset site and to be consistent with the biodiversity conservation ideals of the ODP and associated sub-plans.

10.1. Fence condition spring 2022

The overall condition of the Williamsdale property and offset boundary fencing is considered good and adequate to exclude grazing by stock within the offset site. No areas of major damage (moderate or high risk) were recorded during the spring 2022 survey.

It is recommended that the fence continue to be monitored to ensure that it is maintained as an effective barrier to the movement of stock, and that boundary fencing with rabbit netting along the bottom is removed. However, no immediate action is required.

11. Summary

11.1. General

In general, the offset site is in good condition, with a relatively good diversity of native vegetation (species and cover) and habitat features providing habitat for a range of threatened, rare and uncommon flora and fauna species. The highest diversity of native birds was recorded during the spring 2022 surveys, compared to previous years, with native birds occupying a range of habitats including regenerating and remnant woodland, open grassland, standing water, riparian corridors and standing and fallen dead timber. Flora species diversity remains above baseline monitoring.

11.2. Threatened, rare and uncommon plant species

Four nationally threatened and 12 rare and uncommon ACT plant species occur or have been known to occur on the offset site. Although no species is imminently threatened within the offset site, it is recommended that periodic monitoring be undertaken to ensure that the populations of these species within the site are at a minimum maintained over time, and ideally expanded. Some of these species have not been opportunistically recorded during monitoring for a number of years. It is therefore recommended that future monitoring includes additional searches to attempt to locate previous records of these species to determine if they remain present within the offset areas and update mapping to ensure they can be better monitored overtime. Factors to consider monitoring include:

- population numbers
- evidence of recruitment
- potential threats such as grazing or browsing and weed competition. This is particularly relevant for the *Swainsona recta* plots

Staff and contractors should be made aware of these species and their locations on site (i.e. provided with maps and photographs) to minimise inadvertent damage to populations. This is particularly important for personnel involved in spraying herbicides.

11.3. Weeds

Primary control of weeds across the site has reduced the abundance and distribution of key weed species such as Sweet Briar and Blackberry. However, follow up control is required to target any individuals missed or those that are re-sprouting. On-going weed control should be prioritised for St. John's Wort and Thistle species, with other weeds considered a low priority. St. John's Wort should continue to be monitored closely to determine if additional controls are needed. This should be discussed with ACT PCS due to biological control of St. John's Wort that is being conducted in the region. It is noted that the entire property is weed sprayed twice annually, including the entire property outside of the designated offset areas.

11.4. Erosion

Following recommendations from previous reports, a number of erosion points are no longer being monitored. Six erosion points remain, these have been largely stabilised by vegetation in the channel and on the banks, but it is recommended monitoring of these remain points are continued.

11.5. Feral animals

The overall incidence of feral animals within the offset site was very low, with no feral animals being opportunistically observed during surveys. Previous control methods appear to have been effective, but continued monitoring is recommended. It is noted that control of feral pigs, deer, goats and rabbits is conducted annually by Strathbogie Wildlife.

11.6. Fencing

The condition of the Williamsdale property and offset boundary fencing is considered good and adequate to exclude stock grazing from the offset site. No areas of major or moderate damage were observed with only a few points of minor damage. However, no immediate action is required. Some sections of the fence may require replacing in the future with a five-strand plain wire fence.

11.7. Grazing

Grazing pressure by Eastern Grey Kangaroos appeared to be low. This is evidenced by high diversity and cover of native grasses within floristic monitoring plots, and high cover of exotic annuals. At the *Swainsona recta* plots and grazing exclusion plots, little difference in groundcover was observed between inside and outside the fences, again indicating lowered grazing pressure. The native grass *Themeda triandra* (Kangaroo Grass) was especially prolific in these areas.

Opportunistic observations of kangaroos were also less frequent than in previous seasons, and the size of mobs smaller. Grazing pressure is at a level that can be sustained by the ecosystem, and it is likely that a small-moderate increase in pressure could also be sustained.

11.8. Additional recommendations

A number of star pickets that mark plot boundaries have become loose or are missing, it is recommended that this is addressed during the 2024 monitoring. Additionally, 2024 spring monitoring should be moved forward to late October to better coincide with *Swainsona recta* peak flowering.

It is noted that management of the kangaroo population is conducted annually in the neighbouring NSW Williamsdale property in line with the numbers and licencing provided by the NSW Parks and Wildlife Service, usually a number of 125 individuals.

12. Management recommendations

A summary of the recommended adaptive management actions relating to the offset site is provided in Table 21 below. The actions relate to the appropriate ODP sub-plan and are based on the results presented in the above sections.

Table 21: Summary of proposed actions relating to the ODP.

ODP Sub-Plan	Action status	Recommended management actions
Weed	On-going control and monitoring.	<p>As per previous recommendations:</p> <ul style="list-style-type: none"> • Target priority species and priority areas as identified in Section 6 (St John's Wort and Thistle species). An adaptive management approach may be required in priority areas to promote growth of native grasses as competition with exotic annuals. This may include a combination of one or more of the following control measures (Prober <i>et. al.</i>, 2005; Cole <i>et. al.</i>, 2016). Note that seeding with native grass species should follow any control measure taken, as per the Weed Management Sub-plan. <ul style="list-style-type: none"> ○ Crash/pulse grazing with livestock. Timing is critical to ensure maximum palatability of target species, ie. Saffron thistle in early growth stages, St John's Wort in non-toxic pre-flowering phase. Fencing is also a consideration for use of this control method to limit grazing to weed-dominated areas and prevent spread of propagules to areas dominated by native species. ○ Burning. A spring burn of priority areas may create a window for establishment of native grasses that will outcompete exotic annuals, although this method is generally understood to be more effective at reducing exotic grass cover. ○ Sugar application. Application of sugar on the topsoil can be used to reduce soil nutrients that are necessary for growth of exotic broadleaf species. This method should not be used near waterways. • Continue to undertake follow up weed control as required on persistent species such as St John's Wort, Thistle species, Sweet Briar and Blackberry after priority control. • On-going weed management will be required at the site to combat the introduction of propagules from adjacent rural areas.
Sediment and erosion Control	Partially complete, ongoing monitoring required.	<ul style="list-style-type: none"> • The majority of sites within the offset are considered to be stable and no immediate action is required. • Ongoing monitoring of sites 2, 4, 7, 8, 13 and 21. • Where remaining sites are remediated in the future, monitoring of these sites will also cease.
Bushfire	Complete. On-going monitoring.	As per previous recommendations:

ODP Sub-Plan	Action status	Recommended management actions
		<ul style="list-style-type: none"> It is recommended that the track continues to be maintained in a condition to facilitate bush fire management. If track management is required in the future, it is recommended that care is taken to ensure that the track remains in good condition and does not widen due to overuse, incorrect maintenance, or result in erosion. The track would ideally remain in a grassed condition. Consider developing and implementing an improved bushfire management plan which specifically manages the site for conservation (in consultation with NSW and ACT Rural Fire Services). The plan should include consideration of fire as a tool to manage invasive species, increase native species diversity, maintain an open structure to the woodland and enable a mosaic of fire classes to be established across the site.
Feral animal control	Action and on-going monitoring required.	<ul style="list-style-type: none"> Continue monitoring through opportunistic observation and camera trapping. No targeted survey is required at this time.
Fencing	On-going maintenance and monitoring	<ul style="list-style-type: none"> No immediate major actions required. Minor repair actions are likely to be needed in the future. Continue the replacement of older style boundary fence (rabbit netting) with a 5 strand plain wire fence. Ensure gates are closed to avoid cattle entering the offset area by accident.

13. References

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Appendix A Flora species list 2022

D = dead
 + = few, small cover (<5%)
 r = solitary, small cover (<5%)
 1 = numerous (up to 5%)

2 = 5-25%
 3= 25-50%
 4= 50-75%
 5=>75%

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
<i>Acaena ovina</i>	Acaena		p	p	p	p	p	r	r	p
<i>Acetosella vulgaris</i>	Sheep Sorrel	*	r	p		r	r	p	p	
<i>Aira</i> spp.	A Hairgrass	*	p	p	r			1		p
<i>Anthosachne scabra</i>	Wheatgrass, Common Wheatgrass			r	p		r	r	r	p
<i>Arctotheca calendula</i>	Capeweed	*	r							
<i>Arthropodium milleflorum</i>	Pale Vanilla-lily					r				
<i>Asperula conferta</i>	Common Woodruff				1	1	r	r		p
<i>Austrostipa bigeniculata</i>	Yanganbil		r	p			1			1
<i>Austrostipa rudis</i> subsp. <i>rudis</i>				r			p			p
<i>Austrostipa scabra</i> subsp. <i>scabra</i>	Rough Speargrass		p	2			p	3		
<i>Austrostipa setacea</i>	Corkscrew Grass					p				
<i>Avena barbata</i>	Bearded Oats	*			1					
<i>Briza minor</i>	Shivery Grass	*	r		r		r			r
<i>Bromus brevis</i>		*	p					r		
<i>Bromus catharticus</i>	Praire Grass	*			r					
<i>Bromus diandrus</i>	Great Brome	*			p			r	2	

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
<i>Bromus hordeaceus</i>	Soft Brome	*	2	r	p	r	p	p	3	
<i>Bulbine bulbosa</i>	Bulbine Lily					r	p			p
<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Native Blackthorn			r	r		r			
<i>Calocephalus citreus</i>	Lemon Beauty-heads				r					
<i>Carduus pycnocephalus</i>	Slender Thistle	*	p						p	
<i>Carex appressa</i>	Tall Sedge								p	
<i>Carex breviculmis</i>			p							
<i>Carex inversa</i>	Knob Sedge		p	p	p	1	p	r	r	
<i>Carthamus lanatus</i>	Saffron Thistle	*	1							
<i>Cassinia aculeata</i> subsp. <i>aculeata</i>				r	r					
<i>Centaureum erythraea</i>	Common Centaury	*	r	p			r	r		r
<i>Cerastium vulgare</i>	Mouse-ear Chickweed	*	p							
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Rock Fern			p						r
<i>Chrysocephalum apiculatum</i>	Common Everlasting			2			1	r		p
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting							r	r	
<i>Cirsium vulgare</i>	Spear Thistle	*	p	r	p	r	p	r	p	
<i>Clematis leptophylla</i>					r			r		
<i>Conyza</i> spp.	A Fleabane	*	p	r				r		r
<i>Craspedia variabilis</i>	Common Billy-buttons					1				
<i>Crassula</i> spp.	Stonecrop		r							
<i>Cryptandra amara</i> var. <i>floribunda</i>	Pretty Cryptandra						p	r		
<i>Cymbonotus lawsonianus</i>	Bear's Ear		r	p	r	r	p	p		r
<i>Cynoglossum australe</i>								r		

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
<i>Cynosurus echinatus</i>	Rough Dog's Tail	*			2			r		r
<i>Cyperus eragrostis</i>	Umbrella Sedge	*							p	
<i>Cyperus</i> spp.									p	
<i>Daucus glochidiatus</i>	Native Carrot							r		
<i>Desmodium varians</i>	Slender Tick-trefoil			r			r	r		r
<i>Dichelachne micrantha</i>	Shorthair Plumegrass					r				
<i>Dichelachne</i> spp.	A Plumegrass				p	p	p			
<i>Dichondra repens</i>	Kidney Weed							p		
<i>Dichopogon fimbriatus</i>	Nodding Chocolate Lily									r
<i>Drosera peltata</i>	A Sundew									r
<i>Echium vulgare</i>	Viper's Bugloss	*	p							
<i>Epilobium billardierianum</i> <i>subsp. cinereum</i>									r	
<i>Epilobium billardierianum</i> <i>subsp. hydrophilum</i>						r				
<i>Eragrostis curvula</i>	African Lovegrass	*	r	r						
<i>Erodium cicutarium</i>	Common Crowfoot	*	p							
<i>Erodium crinitum</i>	Blue Crowfoot		p						r	
<i>Eryngium ovinum</i>	Blue Devil				p	r				
<i>Eucalyptus blakelyi</i>	Blakely's Red Gum			2	3	2	3	2		3
<i>Eucalyptus bridgesiana</i>	Apple Box			2	r					
<i>Eucalyptus melliodora</i>	Yellow Box		r		r				2	
<i>Euchiton japonicus</i>				r	p		p	p		p
<i>Euchiton sphaericus</i>	Star Cudweed		p							

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
<i>Galium gaudichaudii</i> subsp. <i>gaudichaudii</i>				r						
<i>Gamochaeta calviceps</i>	Cudweed	*	r					r		
<i>Gamochaeta purpurea</i>	Purple Cudweed	*		r						r
<i>Geranium potentilloides</i> var. <i>potentilloides</i>			r					r		
<i>Geranium retrorsum</i>	Cranesbill Geranium			1	p	1	1		p	
<i>Geranium solanderi</i> var. <i>solanderi</i>								p		p
<i>Gonocarpus tetragynus</i>	Poverty Raspwort				p		p			1
<i>Goodenia pinnatifida</i>	Scrambles Eggs				r					
<i>Haloragis heterophylla</i>	Variable Raspwort			p	2	3	p			2
<i>Holcus lanatus</i>	Yorkshire Fog	*				r		r		r
<i>Hordeum glaucum</i>	Northern Barley Grass	*	p						1	
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort		r	p	p	p	p	p		p
<i>Hypericum gramineum</i>	Small St John's Wort				p					p
<i>Hypericum perforatum</i>	St. Johns Wort	*	1	p	p	r	2	2	p	r
<i>Hypochaeris glabra</i>	Smooth Catsear	*	1							
<i>Hypochaeris radicata</i>	Catsear	*	p	p	1	r	1	p	p	p
<i>Juncus australis</i>	Rush								p	
<i>Juncus bufonius</i>	Toad Rush	*	p		p					p
<i>Juncus filicaulis</i>			p		p	p			p	r
<i>Juncus homalocaulis</i>										p
<i>Kunzea ericoides</i>	Burgan			r						
<i>Leptorhynchus squamatus</i>					p		1			1

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
subsp. <i>squamatus</i>										
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	Hoary Sunray									r
<i>Lolium perenne</i>	Perennial Ryegrass	*							r	
<i>Lomandra filiformis</i> subsp. <i>coriacea</i>	Wattle Matt-rush				r	r	r	r		r
<i>Luzula densiflora</i>	Woodrush				r		p			p
<i>Lysimachia arvensis</i>	Scarlet Pimpernel	*	p		r		r			
<i>Lythrum hyssopifolia</i>	Hyssop Loosestrife					r				
<i>Malva neglecta</i>	Dwarf Mallow	*	r							
<i>Medicago arabica</i>	Spotted Burr Medic	*							r	
<i>Melichrus urceolatus</i>	Urn Heath			r			p			r
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass		1	1					p	
<i>Microtis unifolia</i>	Common Onion Orchid						r			p
<i>Nassella neesiana</i>	Chilean Needle Grass	*	p		p					
<i>Nassella trichotoma</i>	Serrated Tussock	*	r							
<i>Oreomyrrhis eriopoda</i>	Australian Carraway			r						
<i>Orobanche minor</i>	Broomrape	*		p	r					
<i>Oxalis perennans</i>			1	p			r		r	
<i>Panicum effusum</i>	Hairy Panic			r						
<i>Parentucellia latifolia</i>	Red Bartsia	*		r						
<i>Paronychia brasiliiana</i>	Chilean Whitlow Wort, Brazilian Whitlow	*	p	r				r		
<i>Paspalum dilatatum</i>	Paspalum	*				r				
<i>Petrorhagia dubia</i>		*		p				r		r
<i>Plantago gaudichaudii</i>	Narrow Plantain					p				

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
<i>Plantago lanceolata</i>	Lamb's Tongues	*	p	p	r	1	p	p	2	p
<i>Plantago varia</i>					r					
<i>Poa sieberiana</i> var. <i>sieberiana</i>	Snowgrass		r	1	1	1	3	p		2
<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed		p		r					
<i>Ranunculus lappaceus</i>	Common Buttercup						r			
<i>Rosa rubiginosa</i>	Sweet Briar	*	r	p	r	r	r	r	r	r
<i>Rubus anglocandicans</i>	Blackberry	*	r	r						
<i>Rubus parvifolius</i>	Native Raspberry					r				
<i>Rumex brownii</i>	Swamp Dock		p		r	p		r	1	
<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass							p		
<i>Rytidosperma carphoides</i>	Short Wallaby Grass			p				r		r
<i>Rytidosperma pilosum</i>	Smooth-flowered Wallaby Grass									p
<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	Wallaby Grass			1			p			p
<i>Rytidosperma setaceum</i>	Small-flowered Wallaby-grass		p		1					
<i>Schoenus apogon</i>	Fluke Bogrush		p	2	3	2	2			2
<i>Senecio quadridentatus</i>	Cotton Fireweed		r		p	r		r		r
<i>Sisyrinchium rosulatum</i>	Scourweed	*		p	p		r			r
<i>Solanum nigrum</i>	Black-berry Nightshade	*						r	r	
<i>Solenogyne dominii</i>										r
<i>Sonchus aspera</i>	Prickly Sowthistle	*	p	r	r	r	p	p	p	r
<i>Stackhousia monogyna</i>	Creamy Candles						r			r
<i>Stellaria media</i>	Common Chickweed	*							r	
<i>Taraxacum officinale</i>	Dandelion	*			r			r		

Species	Common Name	Exotic	1 MU1a	2 MU2b	3 MU3	4 MU4	5 MU5	6 MU6	7 MU7	8 MU3
<i>Themeda triandra</i>				p	1	1	3			3
<i>Tolpis barbata</i>	Yellow Hawkweed	*	r	p				p		r
<i>Trifolium angustifolium</i>	Narrow-leaved Clover	*		p	r			r		p
<i>Trifolium arvense</i>	Haresfoot Clover	*	p	p	p			p	2	r
<i>Trifolium campestre</i>	Hop Clover	*	p	p	p		r	p		p
<i>Trifolium repens</i>	White Clover	*	r						3	
<i>Trifolium subterraneum</i>	Subterranean Clover	*		r					p	
<i>Triptilodiscus pygmaeus</i>	Common Sunray		r	p				r		
<i>Ulmus</i> spp.		*	r							
<i>Verbascum thapsus</i> subsp. <i>thapsus</i>	Great Mullein	*	p	r			r	r		
<i>Verbena rigida</i> var. <i>rigida</i>	Veined Verbena	*	r			r			r	
<i>Veronica persica</i>	Creeping Speedwell	*	r							
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy			p			p	r		
<i>Vittadinia muelleri</i>	A Fuzzweed			p				p		
<i>Vulpia muralis</i>	Wall Fescue	*	3	3	2	p	p	2	4	1
<i>Wahlenbergia communis</i>	Tufted Bluebell				r					
<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	Tall Bluebell			p			p	p	r	
<i>Xerochrysum viscosum</i>	Sticky Everlasting							r		r
Total (124 species total)		58	61	60	59	37	51	56	37	58

Appendix B: Fauna lists

Fauna species recorded during monitoring surveys from spring 2011 to spring 2022, either through opportunistic observations or targeted survey are outlined below

A = autumn, B = spring.

Cumulative bird species

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>		x		x	x	x		x		x	x		x
Australasian Pipit	<i>Anthus australis</i>											x		
Australian King Parrot	<i>Alisterus scapularis</i>								x					
Australian Magpie	<i>Gymnorhina tibicen</i>	x	x	x	x	x	x	x	x	x	x	x	x	x
Australian Raven	<i>Corvus coronoides</i>	x	x	x	x	x	x	x	x		x	x	x	x
Australian Reed Warbler	<i>Acrocephalus australis</i>											x		
Australian Wood Duck	<i>Chenonetta jubata</i>			x	x	x			x	x		x	x	x
Black-chinned Honeyeater	<i>Melithreptus gularis</i>												x	
Black-faced Cuckoo-Shrike	<i>Coracina novaehollandiae</i>		x	x		x		x		x	x	x	x	x
Black-shouldered Kite	<i>Elanus axillaris</i>										x			
Brown Falcon	<i>Falco berigora</i>					x		x	x					
Brown Thornbill	<i>Acanthiza pusilla</i>	x		x	x	x		x	x					
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>											x		
Buff-rumped thornbill	<i>Acanthiza reguloides</i>													x

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Common Blackbird	<i>Turdus merula</i>											X		
Common Bronzewing	<i>Phaps chalcoptera</i>	X			X		X					X	X	
Common Starling	<i>Sturnus vulgaris</i>									X	X	X		X
Crested Pigeon	<i>Ocyphaps lophotes</i>				X	X	X		X		X	X	X	
Crimson Rosella	<i>Platycercus elegans</i>	X	X	X	X	X	X	X	X	X	X	X	X	X
Diamond Firetail	<i>Stagonopleura guttata</i>	X			X									
Dollarbird	<i>Eurystomus orientalis</i>										X			
Double Barred Finch	<i>Taeniopygia bichenovii</i>				X									
Dusky Woodswallow	<i>Artamus cyanopterus</i>													X
Eastern Rosella	<i>Platycercus adscitus</i>	X	X	X	X	X		X	X	X	X	X	X	X
Eastern Yellow Robin	<i>Eopsaltria australis</i>						X			X	X	X		
Eurasian Coot	<i>Fulica atra</i>										X	X		
European Goldfinch	<i>Carduelis carduelis</i>				X					X		X		
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>					X		X		X		X		
Flame Robin	<i>Petroica phoenicea</i>	X					X							
Galah	<i>Eolophus roseicapillus</i>	X		X		X		X	X	X	X	X	X	X
Golden Whistler	<i>Pachycephala pectoralis</i>	X	X			X								
Grey Butcherbird	<i>Cracticus torquatus</i>		X	X					X	X		X		X
Grey Currawong	<i>Strepera versicolor</i>									X	X	X		
Grey Fantail	<i>Rhipidura albiscapa</i>	X	X	X		X	X	X	X	X	X	X	X	X
Grey Shrike-Thrush	<i>Colluricincla harmonica</i>		X		X	X	X	X	X			X		
Hardhead	<i>Aythya australis</i>			X	X							X		

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Hooded Robin	<i>Melanodryas cucullata</i>	x								x				
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>							x			x			x
Jacky Winter	<i>Microeca fascians</i>	x		x		x				x				
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	x		x					x	x	x	x	x	
Lewins Honeyeater	<i>Meliphaga lewinii</i>													x
Leaden Flycatcher	<i>Myiagra rubecula</i>			x								x	x	
Little Corella	<i>Cacatua sanguinea</i>											x		x
Magpie-lark	<i>Grallina cyanoleuca</i>	x	x	x	x	x	x	x	x	x	x	x	x	x
Masked Lapwing	<i>Vanellus miles</i>					x		x			x			
Nankeen Kestrel	<i>Falco cenchroides</i>					x		x				x	x	
Noisy Friarbird	<i>Philemon corniculatus</i>			x		x		x		x	x		x	x
Noisy Miner	<i>Manorina melanocephala</i>	x	x	x	x	x	x	x	x	x	x	x	x	x
Olive-backed Oriole	<i>Oriolous sagittatus</i>											x	x	x
Owlet Nightjar	<i>Aegotheles cristatus</i>										x			
Pacific Black Duck	<i>Anas superciliosa</i>			x	x	x		x	x			x		
Pallid Cuckoo	<i>Cuculus pallidus</i>									x		x	x	
Pied Butcherbird	<i>Cracticus nigrogularis</i>							x		x	x			
Pied Currawong	<i>Strepera graculina</i>	x	x	x	x	x	x	x	x	x	x	x		
Quail	<i>Coturnix sp.</i>	x				x								
Red Wattlebird	<i>Anthochaera carunculata</i>					x		x	x	x	x	x	x	x
Red-browed Finch	<i>Neochmia temporalis</i>			x	x	x		x						

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Red-rumped Parrot	<i>Psephotus haematonotus</i>								x				x	x
Rufous Songlark	<i>Megalurus mathewsi</i>												x	
Rufous Whistler	<i>Pachycephala rufiventris</i>			x	x	x		x		x	x	x	x	x
Sacred Kingfisher	<i>Todiramphus sanctus</i>			x								x		
Satin Flycatcher	<i>Myiagra cyanoleuca</i>												x	x
Scarlet Robin	<i>Petroica boodang</i>		x		x		x		x					
Shining Bronze Cuckoo	<i>Chrysococcyx lucidus</i>							x						x
Silvereye	<i>Zosterops lateralis</i>								x			x		
Southern White-face	<i>Aphelocephala leucopsis</i>						x							
Speckled Warbler	<i>Chthonicola sagittatus</i>				x		x							
Spotted Pardalote	<i>Pardalotus punctatus</i>	x	x	x	x		x	x	x	x	x	x	x	x
Striated Pardalote	<i>Pardalotus striatus</i>	x		x	x	x	x	x	x	x	x	x	x	x
Striated Thornbill	<i>Acanthiza lineata</i>											x	x	
Sulphur-Crested Cockatoo	<i>Cacatua galerita</i>	x				x	x	x		x	x	x		
Superb Fairy Wren	<i>Malurus cyaneus</i>	x	x	x	x	x	x	x	x	x	x	x		x
Tree Martin	<i>Petrochelidon nigricans</i>					x						x		
Wedge-tailed Eagle	<i>Aquila audax</i>	x	x		x		x		x			x	x	x
Weebill	<i>Smicrornis brevirostris</i>				x			x	x	x	x	x	x	x
Welcome Swallow	<i>Hirundo neoxena</i>								x		x	x		x
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>					x								
White-browed Scrubwren	<i>Sericornis frontalis</i>											x		
White-browed Woodswallow	<i>Artamus superciliosus</i>											x		

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
White-eared Honeyeater	<i>Lichenostomus penicillatus</i>	x	x		x				x		x	x		x
White-faced Heron	<i>Egretta novaehollandiae</i>								x	x				x
White-naped Honeyeater	<i>Melithreptus lunatus</i>								x					
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>				x	x					x			
White-throated Gerygone	<i>Gerygone olivacea</i>			x		x		x		x	x	x	x	x
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	x	x	x	x	x	x	x	x		x	x		x
White-winged Chough	<i>Corcorax melanorhamphos</i>		x	x		x		x	x	x	x	x	x	
White-winged Triller	<i>Lalage sueurii</i>							x						
Willie Wagtail	<i>Rhipidura leucophrys</i>	x	x		x	x		x	x	x	x	x	x	x
Yellow Thornbill	<i>Acanthiza nana</i>								x					
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>			x				x	x	x	x	x	x	x
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	x	x	x	x	x	x	x	x	x	x	x		x
Yellow-tailed Black-cockatoo	<i>Calyptorhynchus funereus</i>				x						x	x		
Total		27	21	30	32	37	22	36	35	35	41	57	33	38

Opportunistic mammal records (cumulative)

Mammals	Scientific name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Brush-tail Possum	<i>Trichosurus vulpecula</i>					x	x	x		x				
Cow	<i>Bos Taurus</i>	x					x		x	x				
Echidna	<i>Tachyglossus aculeatus</i>					x			x	x	x	x	x	
European Rabbit	<i>Oryctolagus cuniculus</i>	x	x	x	x	x	x	x		x	x		x	

Mammals	Scientific name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Fallow Deer	<i>Dama dama</i>												x	
Feral Goat	<i>Capra aegagrus hircus</i>		x	x	x	x	x		x	x	x			
Feral Pig	<i>Sus scrofa</i>		x			x	x		x					
Fox	<i>Vulpes vulpes</i>	x	x	x	x	x	x	x	x	x	x	x	x	
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	x	x	x	x	x	x	x	x	x	x	x	x	x
Red-necked Wallaby	<i>Macropus rufogriseus</i>										x			
Sheep	<i>Ovis aries</i>				x	x								
Sugar Glider	<i>Petaurus breviceps</i>					x	x							
Swamp Wallaby	<i>Wallabia bicolor</i>					x	x	x						
Wallaroo, Common	<i>Macropus robustus</i>							x	x		x			
Wombat	<i>Vombatus ursinus</i>	x	x	x	x	x	x	x	x	x	x	x		

Opportunistic reptile and frog records (cumulative)

Reptiles and Frogs	Scientific name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Delicate skink	<i>Lamprolis delicata</i>							x			x			
Eastern Bearded Dragon	<i>Pogona barbata</i>			x							x			
Eastern Common Froglet	<i>Crinia signifera</i>		x	x	x	x	x	x	x	x	x			x
Eastern Long-necked Tortoise	<i>Chelodina longicollis</i>		x		x	x	x		x	x	x			
Eastern Water Dragon	<i>Intellagama lesueurii</i>													
Jacky Lizard	<i>Amphibolurus muricatus</i>	x							x	x	x			
Peron's Tree Frog	<i>Litoria peronii</i>					x		x						
Pink-tailed Worm Lizard	<i>Aprasia parapulchella</i>												x	

Reptiles and Frogs	Scientific name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B	2018B	2020B	2022B
Plains Froglet	<i>Crinia parainsignifera</i>			x	x	x	x	x	x					
Red Bellied Black Snake	<i>Pseudechis porphyriacus</i>							x						
Rosenberg's Goanna	<i>Varanus rosenbergi</i>													
Smooth Toadlet	<i>Uperolia laevigata</i>					x		x	x		x			
Southern Rainbow Skink	<i>Carlia tetradactyla</i>											x		
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>			x	x	x	x	x	x	x				x
Three-toed Skink	<i>Hemiergis decresiensis</i>											x		
Whistling Tree Frog	<i>Litoria verreauxii</i>			x		x		x						

