M2G Biodiversity Offset Monitoring Report

Spring 2016

Prepared for
Icon Water

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DOCUMENT TRACKING

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Contents

List of figures

List of tables

Abbreviations

Abbreviation	Description
DBH	Diameter at Breast Height
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
HBT	Hollow Bearing Tree
m	metres
M2G	Murrumbidgee to Googong Water Transfer Project
MU	Management Unit
ODP	Offset Delivery Plan
PER	Public Environment Report
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 2016 that were undertaken in accordance with the methodology and aims established in the ODP. It is designed to be a standalone monitoring report consistent with the format of the previous biannual monitoring reports, but also to relate to 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, 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.

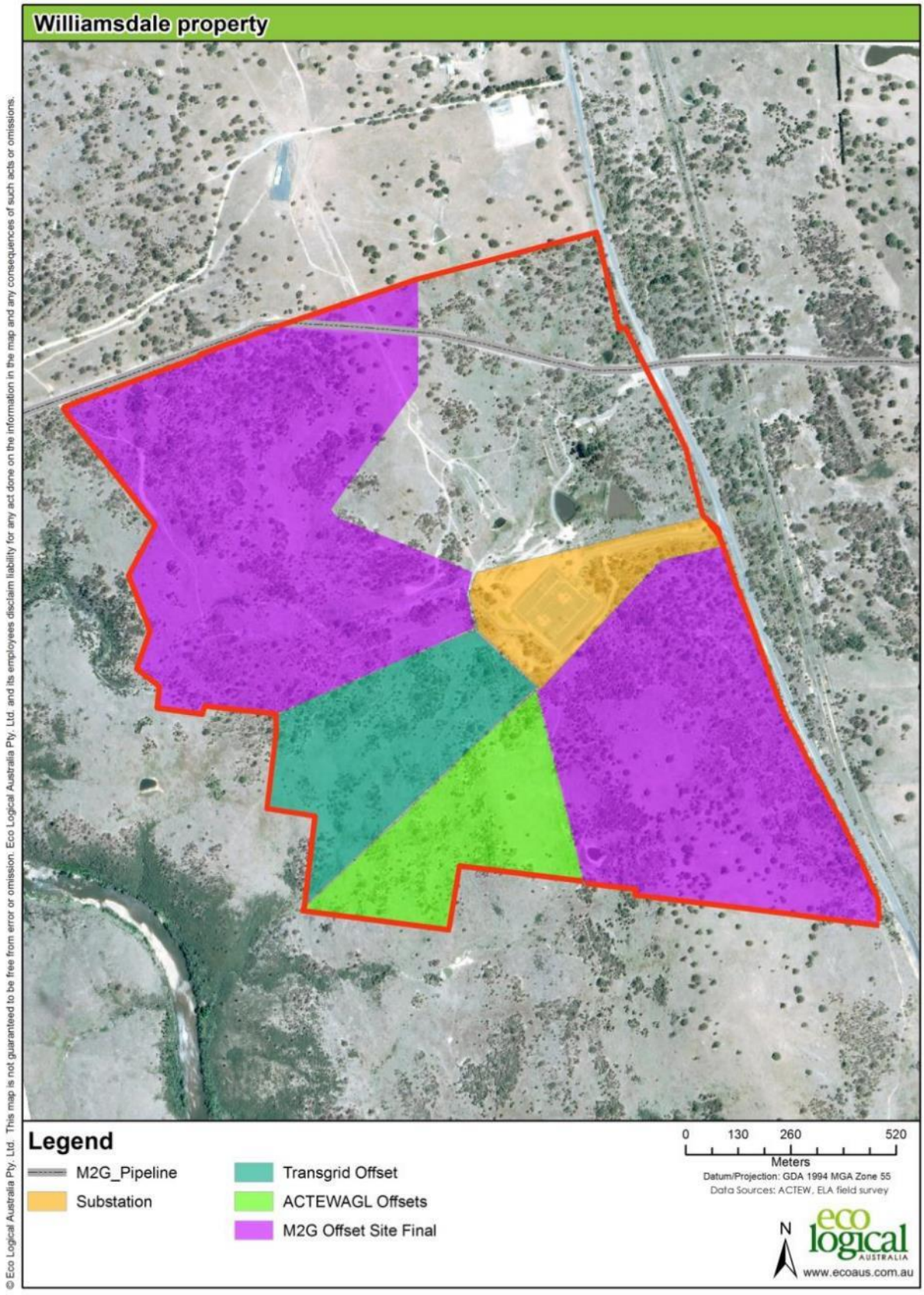


Figure 1: Study area

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), is presented below, and followed by the results of the spring 2016 monitoring surveys.

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 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) (**Figure 2**).

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. However, 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.

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 control plot

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 10, 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 included on the list included 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**.

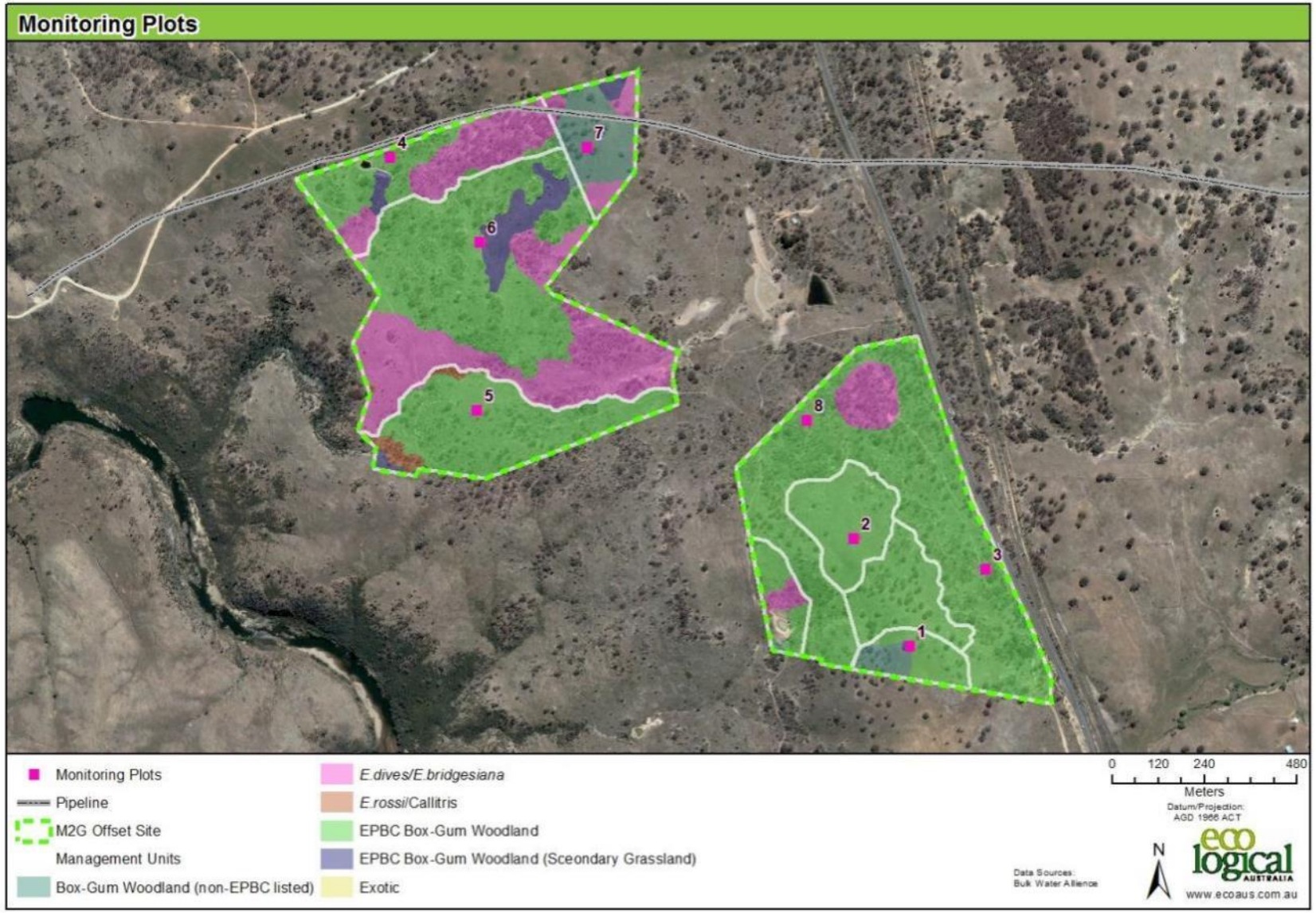


Figure 2: Monitoring plots, management units and baseline offset site ecological values

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 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 which covers 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.

The results of fauna habitat assessments are outlined in **Section 4.3.2**.

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 2016 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.

Opportunistic herpetology searches were also undertaken in areas of good quality habitat, such as partially embedded rock.

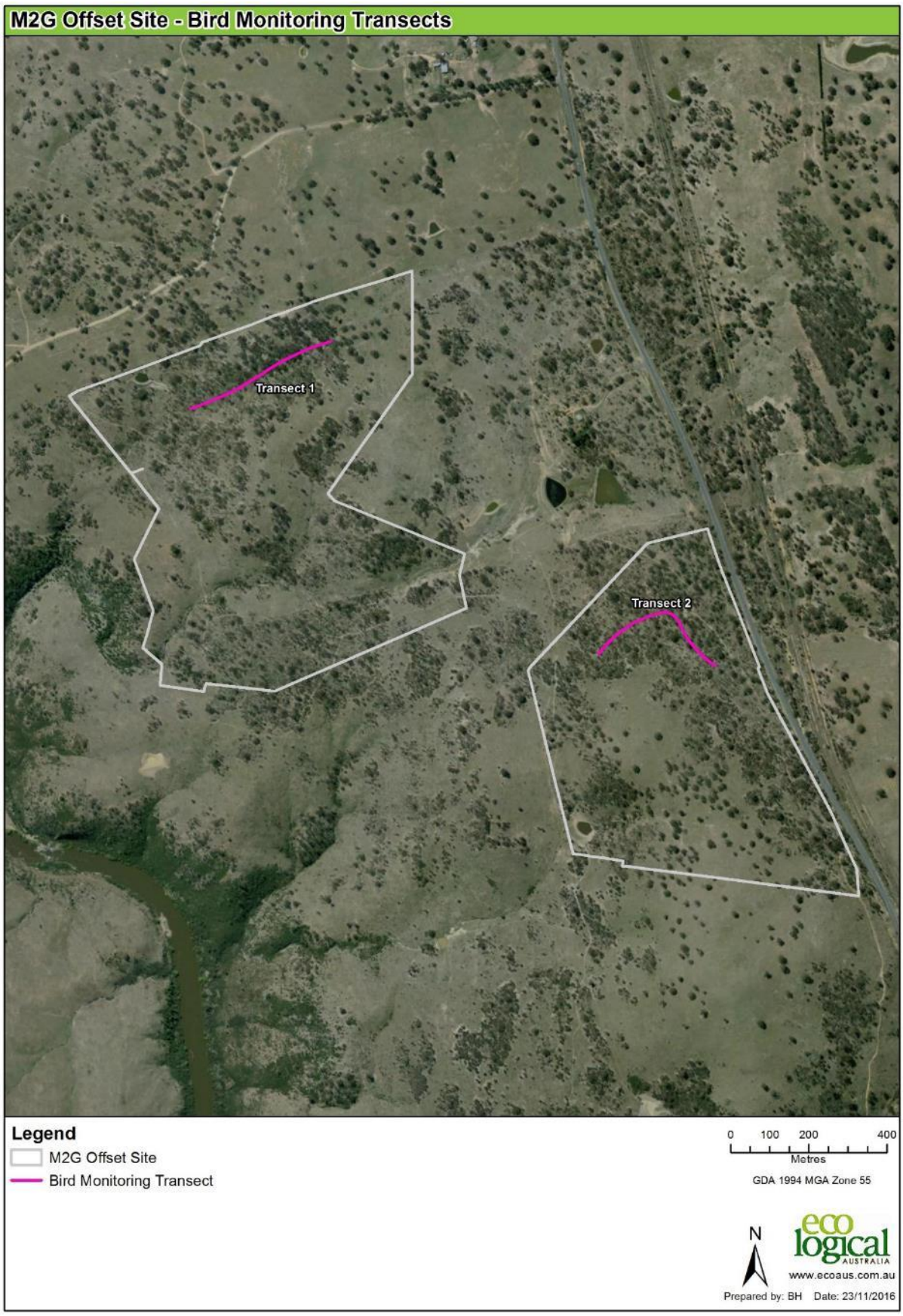


Figure 3: Bird monitoring transects

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 on 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	Key	Planted	Water crystals
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 patched approximately 20 cm in diameter). For the 2013 plantings, a small handful or 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.

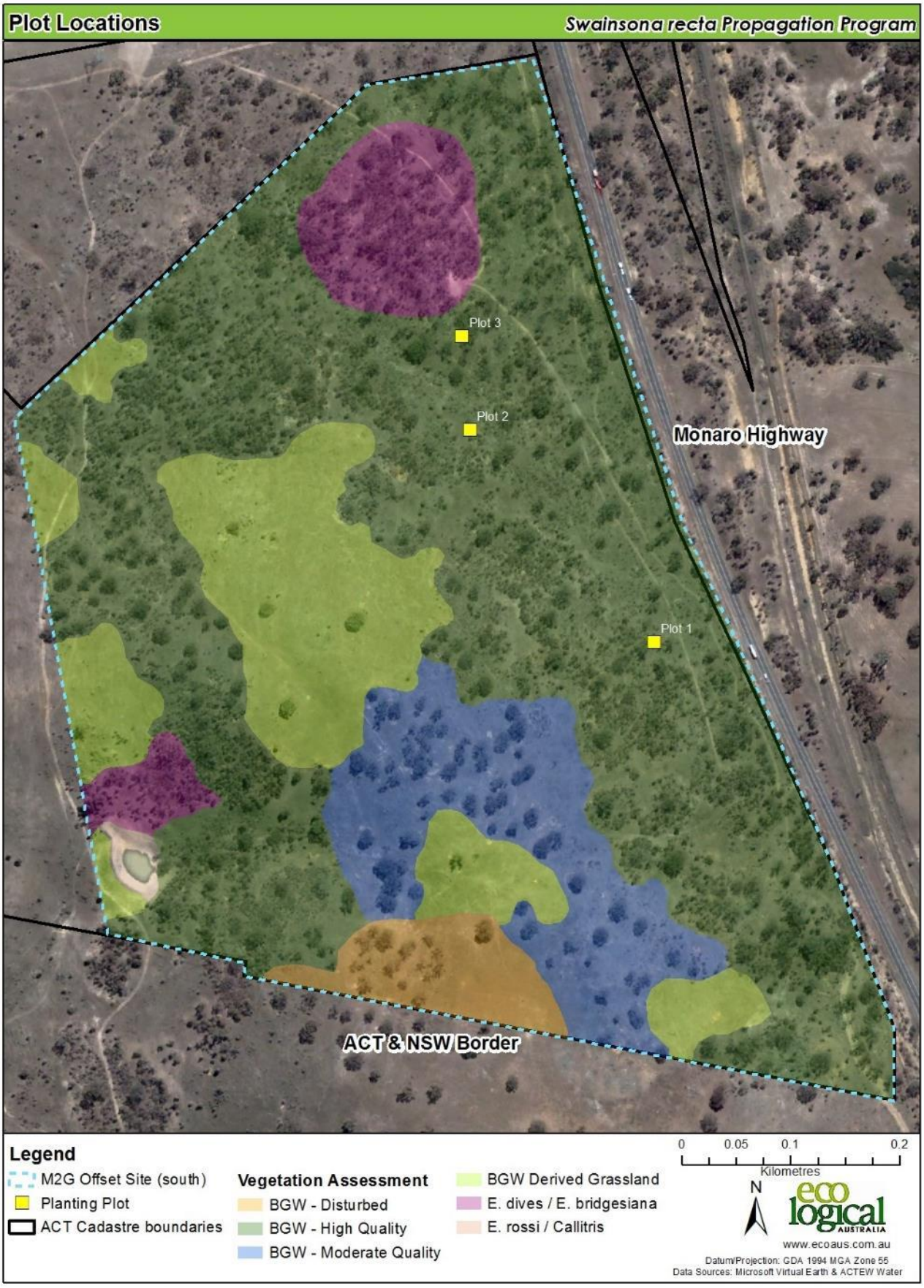


Figure 4: *Swainsona recta* translocation plots

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 in order 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 2016 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 the autumn 2012 monitoring surveys. During these baseline 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. A number of erosion monitoring points were discontinued from spring 2013 onwards, as these points did not shown signs of erosion since the baseline surveys, despite large rain events occurring over this two year period.

Erosion monitoring point locations included in the spring 2016 surveys are mapped in **Figure 6** and **Figure 5**.

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 does 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 requires monitoring, but no immediate action. Often observed along the fence line bordering the Murrumbidgee River corridor and represents a potential goat or sheep access point. Note; there can be a small difference between the low and moderate categories. However, other evidence such as tracks and scats that may represent feral presence was used to inform the level of risk.
- *High risk* – Represents points along the fence line requiring attention. These points represent a high risk of cattle and sheep entering the property.

2.7 Rehabilitation survival assessment

During winter 2016, 2,000 native shrubs were planted across two locations within the property (1,400 in the large gully near the TransGrid substation, and 600 along a smaller gully within the northern offset site. Rapid survival counts were undertaken in each of these locations, which involved walking down

the planting row from a random start point and assessing individuals, recording live (identified to genus) or dead. One hundred individuals were assessed across two survey points along the planting in the northern offset, and 50 individuals were assessed along the large gully near the substation.

Figure 5: Erosion monitoring points in southern offset

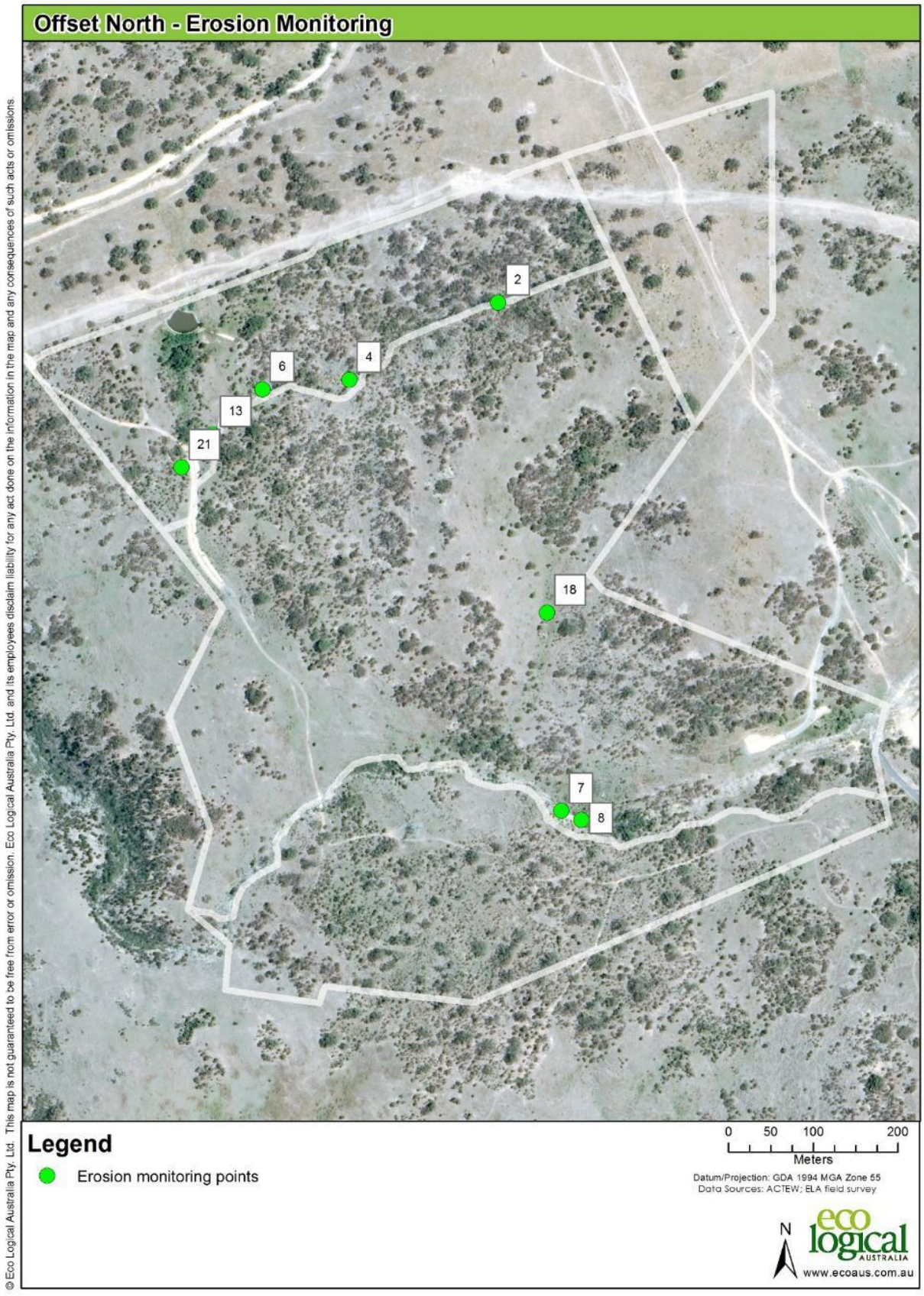


Figure 6: Erosion monitoring points in northern offset

3 Vegetation plots

Since the baseline monitoring was undertaken in 2011, species diversity has generally remained stable or increased across the majority of monitoring plots. The majority of plots, particularly in woodland sites, showed an increase in the diversity in native grass and forbs between baseline surveys and spring 2016 monitoring, likely due in part to the wet spring in 2016 and recent warm weather prior to monitoring. This demonstrates the influence of seasonal conditions on variation in floristic diversity, particularly in the ground layer, and is a major consideration when analysing trends in floristic data, particularly over a relatively short period. The cessation of grazing since offset site establishment may also have resulted in increased native grass and forb diversity.

Corresponding to this increase in native species was an increase in exotic species cover in all except one plot, compared to baseline conditions. Similarly, this is likely due to the favourable winter and spring conditions promoting growth of exotic annual grasses such as *Bromus* species, as well as thistles and other exotic annual forbs.

All monitoring plots remain below the overstorey cover and the total length of fallen logs benchmark values established for the ACT (Sharp & Milner 2014). This reflects the fact that sites are either in regenerating or cleared formations of Box-Gum Woodland, rather than mature remnants. 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 fuller canopies. However it should be noted that a decline in canopy cover was recorded across a number of sites, due to visible dieback of Blakely's Red Gum canopies (see Section 4.1 for further discussion).

The results of the vegetation monitoring are provided **Section 3.1.1** to **3.1.8** below. The raw floristic data for each plot are provided in **Appendix A**.

3.1.1 Monitoring plot 1

Plot Description				
Management unit	MU1A		*Plot number*	1
Vegetation type	Box-Gum Woodland		*Condition*	Low-Mod
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneratio	Yes
Native midstorey cover	*0*	0	Species	*E. melliodora*
Native understorey cover (grass)	*40*	28	**Habitat features**	
Native understorey cover (other)	*6*	14	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	0 m
Exotic understorey plant cover	*58*	64		
Native species diversity	*14*	12		

Monitoring plot 1 is located within MU1A in the southern offset area. The plot is composed of lower condition Box-Gum Woodland. A single eucalypt sapling was observed within the plot with several others also observed in the surrounding zone. Native species diversity was low (12 species) and down from 19 species recorded in spring 2015. Nineteen exotic species were recorded, with both the exotic species richness and cover increasing in comparison to baseline results. *Carthamus lanatus, Bromus hordeaceus* and *Trifolium subterraneum* were the dominant species within the plot. Fauna habitat features within MU1A have not changed noticeably since the baseline surveys. Native plant species richness, overstorey cover and the total length of fallen logs remain well below benchmark values (Sharp & Milner 2014).

Figure 7: Monitoring Plot 1. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2016)

3.1.2 Monitoring plot 2

Plot Description				
Management unit	MU2B		*Plot number*	2
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*0*	1	Regeneration	Yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	38	**Habitat features**	
Native understorey cover (other)	*4*	8	Tree hollows	1
Exotic midstorey plant cover	*0*	0	Fallen logs	1 m
Exotic understorey plant cover	*6*	46		
Native species diversity	*30*	41		

Monitoring plot 2 is located within MU2B within the southern offset area. It is situated on a rocky hill containing areas of potential Pink-tailed Worm Lizard habitat in the form of outcropping and surface rocks. It contains moderate-good condition mature Box-Gum Woodland with scattered eucalypt saplings present. A total of 41 native species were recorded within the plot, which is substantially greater than that recorded during baseline surveys. The plot is dominated by native grass species including *Austrostipa scabra, Bothriochloa macra* and *Themeda triandra*; the ground cover was heavily grazed in spring 2016. Seventeen exotic species were recorded within the plot which is a slight reduction on the twenty-two species recorded in spring 2015. Native plant species richness scores remain above benchmark values (Sharp & Milner 2014), however overstorey cover and the total length of fallen logs are both well below benchmark due to the partially cleared location.

Figure 8: Monitoring Plot 2. (Left: Baseline monitoring photo, March 2012. Right: monitoring photo November 2016)

3.1.3 Monitoring plot 3

Plot Description				
Management unit	MU3		*Plot number*	3
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*3.7*	2.5	Regeneration	Yes
Native midstorey cover	*5.2*	5.5	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	30	**Habitat features**	
Native understorey cover (other)	*16*	8	Tree hollows	0
Exotic midstorey plant cover	*0.2*	0	Fallen logs	2 m
Exotic understorey plant cover	*10*	32		
Native species diversity	*27*	35		

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 the plot and the surrounding zone. The understorey is dominated by exotic grass species including *Avena barbata*, *Briza minor* and *Bromus* spp., with a total of 22 exotic species recorded. It should be noted however, that the dominance of exotic grasses within the plot is not consistent with the surrounding areas which have a much higher proportion of native grass species and cover. A total of 35 native species were recorded within the plot, which is similar to the species richness recorded in spring 2015 (38 species), however native understorey covers were much lower compared to previous years. Native plant species richness for the plot remains above benchmark values (Sharp & Milner 2014), however overstorey cover and the total length of fallen logs remain well below benchmark.

Figure 9: Monitoring Plot 3. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2016)

3.1.4 Monitoring plot 4

Plot Description				
Management unit	MU4		*Plot number*	4
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*4.7*	7	Regeneration	Yes
Native midstorey cover	*11.5*	4.5	Species	*E. blakelyi*
Native understorey cover (grass)	*74*	62	**Habitat features**	
Native understorey cover (other)	*18*	28	Tree hollows	0
Exotic midstorey plant cover	*2*	0	Fallen logs	15 m
Exotic understorey plant cover	*28*	24		
Native species diversity	*24*	34		

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*. A total of 34 native species were recorded within the plot which is the same number of species recorded in spring 2015. 20 exotic species were recorded within the plot which is also comparable to the 21 species recorded in spring 2015. The understorey is dominated by both native and exotic grass species including *Aira sp., Bothriochloa macra and Bromus hordeaceus*. Control of the noxious weed *Rosa rubiginosa* has been largely effective, with cover of this species much reduced compared to earlier years. However, seedlings are beginning to re-emerge and follow up control may be required. Fauna habitat features within MU4 have not changed noticeably since the baseline surveys.

Figure 10: Monitoring Plot 4. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2016)

3.1.5 Monitoring plot 5

Plot Description				
Management unit	MU5		*Plot number*	5
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*11*	6.2	Species	*E. blakelyi*
Native understorey cover (grass)	*76*	52	**Habitat features**	
Native understorey cover (other)	*14*	20	Tree hollows	0
Native understorey cover (shrub)	*0*	18	Fallen logs	0 m
Exotic understorey plant cover	*4*	22		
Native species diversity	*29*	40		

Monitoring plot 5 is a control plot located in MU5. No management actions will occur within the boundaries of the plot. Plot 5 is located in moderate-good quality Box-Gum Woodland with an overstorey dominated by *Eucalyptus blakelyi*. This overstorey species is also undergoing considerable natural regeneration. However, extensive eucalypt defoliation and dieback, potentially associated with psyllid infestation, was observed in spring 2016. The plot supports a high diversity of native understorey species with a total of 40 species recorded, comparable to the 46 species recorded in spring 2015. *Themeda triandra* and *Chrysocephalum apiculatum* are the most common understorey species within the plot. Fourteen exotic species were recorded, which is comparable to the 15 species recorded in spring 2015, however the cover of exotic species along the 50 m transect has reduced considerably since last spring, down from 60% to 22%. Native plant species richness is above benchmark values (Sharp & Milner 2014), however overstorey cover and the length of fallen logs remain below benchmark, reflective of the regenerating rather than mature woodland stage of this vegetation.

Figure 11: Monitoring Plot 5. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2016)

3.1.6 Monitoring plot 6

Plot Description				
Management unit *Vegetation type*	MU6 Box-Gum Woodland		*Plot number* *Condition*	6 Mod-Good
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*5.3*	5	Regeneration	Yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	36	**Habitat features**	
Native understorey cover (other)	*10*	10	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	0 m
Exotic understorey plant cover	*8*	40		
Native species diversity	*28*	38		

Monitoring plot 6 is located in MU6, along the central ridge line of the property, in moderate-good quality Box-Gum Woodland with an overstorey dominated by *Eucalyptus blakelyi.* The plot is situated in a transition zone between the woodland and derived grassland forms of the ecological community. Abundant *E. blakelyi* regeneration is present within the plot. The plot supports a diverse understorey of both native and exotic grasses and forbs. The most dominant species observed were the exotic grasses *Aira sp.* and *Bromus hordeaceus*. 38 native and 24 exotic species were recorded, highly comparable with the 39 and 24 respective species recorded in spring 2015. Fauna habitat features within MU6 have not changed noticeably since the baseline surveys. Native plant species richness is above benchmark values (Sharp & Milner 2014), however overstorey cover and the total length of fallen logs remain well below benchmark.

Figure 12: Monitoring Plot 6. (Left: Baseline monitoring photo, March 2012. Right: monitoring photo November 2016)

3.1.7 Monitoring plot 7

Plot Description				
Management unit	MU7		*Plot number*	7
Vegetation type	Box-Gum Woodland		*Condition*	Low
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	No
Native midstorey cover	*0*	0	Species	*N/A*
Native understorey cover (grass)	*74*	4	**Habitat features**	
Native understorey cover (other)	*0*	14	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	2.5 m
Exotic understorey plant cover	*34*	94		
Native species diversity	*13*	19		

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 *Eucalyptus blakelyi.* No recruitment of *E. blakelyi* was observed within the plot. Native species diversity in the plot was relatively low for this ecological community (19 species) but higher than recorded during both baseline and spring 2015 surveys (13 and 12 respectively). The plot is dominated by exotic species with less than 5% of the groundcover comprising native perennial grass species. Dominant exotic species include *Bromus hordeaceus*, *Hordeum glaucum* and *Trifolium subterraneum*. Fauna habitat features within MU7 remain consistent with those recorded during baseline surveys. All site parameters were well below benchmark values (Sharp & Milner 2014), with the exception of native understorey (other) cover.

Figure 13: Monitoring Plot 7. (Left: Baseline monitoring photo, March 2012. Right: monitoring photo November 2016)

3.1.8 Monitoring Plot 8

Plot Description				
Management unit	MU3		*Plot number*	8
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**spring 2016**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*8.5*	3.5	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	44	**Habitat features**	
Native understorey cover (other)	*14*	16	Tree hollows	0
Native understorey cover (shrubs)	*0*	2	Fallen logs	12 m
Exotic understorey plant cover	*4*	20		
Native species diversity	*26*	38		

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 *Eucalyptus blakelyi.* Considerable *E. blakelyi* regeneration is present within the plot. Native species richness remains high (38 species) and is comparable with species numbers recorded during spring 2015 (34 species). The understorey is largely dominated by native grass species, most notably *Themeda triandra*. Twelve exotic species were recorded in spring 2016, representing a substantial decline in the numbers recorded in during both baseline and spring 2015 surveys (28 and 29 respectively). Fauna habitat features remain consistent with those recorded during baseline surveys. Native plant species richness is above benchmark values (Sharp & Milner 2014), however overstorey cover and the total length of fallen logs remain well below benchmark.

Figure 14: Monitoring Plot 8. (Left: Baseline monitoring photo, October 2011. Right: monitoring photo November 2016)

4 Biodiversity values

4.1 Ecosystem health

As noted during autumn 2015 surveys, a large proportion of the *Eucalyptus blakelyi* (Blakely's Red Gum) within the offset site have been subject to leaf attack psyllids, as evidenced by the presence of lerps on leafs, and extensive defoliation and dieback in some areas. Severe infestations by lerps can be detrimental to trees resulting in leaf-drop, defoliation and subsequently die-back if the lerps are present over several seasons (Stone and Urquhart, 1995). Anecdotal evidence suggests that psyllid infestations occur broadly across the ACT region with infestations also noted in the broader region and not currently confined to the M2G offset site.

Outbreaks of lerps are known to be associated with the presence of *Manorina melanocephala* in some areas. However, bird surveys conducted within the offset site in spring 2015, indicate that the population of Noisy Miners (*Manorina melanocephala*) within the offset site preferentially occurs in some areas over others such as the drainage line along the northern side of the north offset. However the incidence of lerp is widespread across the site and surrounding areas and appears to be higher in areas of the Southern Offset site, where bird surveys recorded a lower abundance of Noisy Miners and a higher abundance of smaller woodland bird species. As such, it does not appear likely that these outbreaks are strongly related to Noisy Miner populations. This is supported by the fact that similar widespread dieback and associated psyllid infestations have been observed throughout the ACT and NSW tablelands over the course of 2016.

4.2 Flora

Two hundred and eighteen native plant species and 123 exotic species have been recorded for the M2G offset site since the baseline surveys were undertaken (**Appendix A**). 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 143 flora species (93 native and 50 exotic) were opportunistically recorded during spring 2016 surveys.

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 3**, **Table 4**, and **Figure 15**). The spring 2016 surveys recorded the presence of three EPBC Act listed species (including translocated *Swainsona recta,* located outside the fenced exclosure area), and five species considered rare or uncommon in the ACT. The locations of opportunistic observations of threatened, rare or uncommon flora are presented in **Figure 15**.

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 3** below.

Table 3: Threatened flora species within the offset site

Species	EPBC Act Status	NC Act Status	Notes
Leucochrysum albicans var. *tricolor* (Hoary Sunray)	Endangered	Not listed	Endangered herbaceous perennial. Noted as rare in the offset site in spring 2014. The species is abundant within adjacent land managed by Transgrid where it is growing profusely on batters surrounding the substation, and was recorded at multiple locations within the southern offset (including monitoring plot 8) up to approximately 300 m from the Transgrid land. It is unclear whether Hoary Sunray has seeded naturally onto the batters or whether it has been planted. It is considered likely that the individuals within the offset site have originated from the adjacent population.
Pomaderris pallida (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). 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.
Swainsona recta (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 exclosure plots have been established on site (refer to Section 5.1).
Thesium australe (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 *Themeda triandra* (Kangaroo Grass). Approximately 4 individuals were recorded in spring 2015 within the northern offset, however these were not re-located during spring 2016. 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 4** below.

Table 4: Rare and uncommon species recorded within the offset site

Species	Notes
Austrostipa setacea (Corkscrew Grass)	Tufted perennial grass. Noted in the south-eastern corner of the southern offset in spring 2014, however not observed during 2016.
Bossiaea prostrata (Creeping Bossiaea)	Prostrate perennial subshrub. Previously recorded in monitoring plot 5 in the northern offset and in the surrounding area however not recorded during 2016.
Desmodium brachypodum (Large Tick-trefoil)	Large pea-flowered herb. Previously recorded in the south-eastern part of the southern offset, however not observed during 2016.
Discaria pubescens (Australian Anchor Plant)	Rigid shrub with prominent paired stem spines. A localised patch of approximately 26 plants occurs in the northern offset. This species was observed again in 2016.
Glossostigma elatinoides	Prostrate perennial wetland forb. Localised patch noted in spring 2014 on the banks of the dam in the northern offset, however not recorded during 2016.
Limosella australis (Australian Mudwort)	Diminutive perennial wetland forb. Localised plants noted in spring 2014 on the banks of the dam in the northern offset, however not recorded during 2016.
Microseris lanceolata (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. Generally occurs in better condition vegetation within the offset.
Plantago gaudichaudii (Narrow Plantain)	Perennial forb with thick fleshy taproot. Recorded in monitoring plot 3 (southern offset) in spring 2016, and has previously been recorded in monitoring plot 4 (northern offset).
Stylidium despectum (Dwarf Triggerplant)	Erect diminutive annual forb occurring in moist situations. Localised plants noted in spring 2014 along moist drainage line in the northern part of the southern offset., however not recorded in 2016.
Swainsona monticola (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. Dozens of plants seen but extent of distribution on site not established. Plants probably die back to a rootstock in summer and are difficult to detect unless flowering.
Swainsona sericea (Silky Swainson-pea)	Low spreading herbaceous perennial. Recorded in monitoring plots 3 (southern offset) and 5 (northern offset) in spring 2016. This species was abundant and widely distributed across both the north and southern offsets in spring 2014, 2015 and 2016. Plants are easily overlooked unless flowering.
Zornia dyctiocarpa	Low herbaceous perennial. Previously noted in the north eastern corner of the southern offset but not recorded during 2016 despite detailed searches.

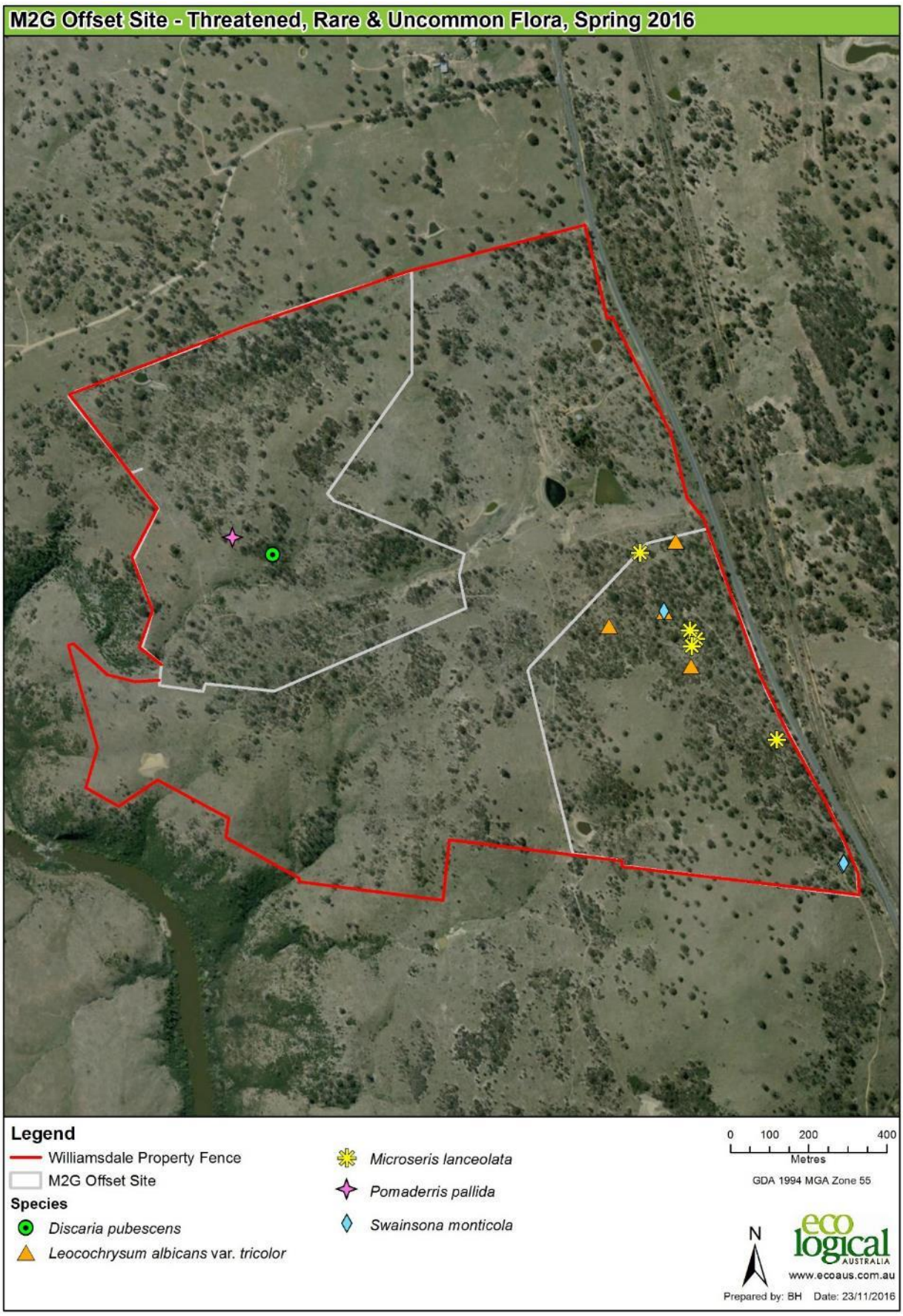


Figure 15: Opportunistic records of threatened, rare and uncommon flora species within the offset site, spring 2016

4.3 Fauna

A broad range of fauna species have been recorded within the offset site since the offset was established including 77 bird species, 14 mammal species, 9 reptiles, and 6 amphibians. A cumulative list of species recorded is provided in **Appendix B**. A total of 56 fauna species were recorded, either opportunistically or through bird surveys, across the offset site in spring 2016. This consisted of 41 bird species, seven mammal species (of which three were feral/exotic) and eight reptile or amphibian species. This represents the greatest total and bird fauna species richness, and equal greatest reptile species richness, recorded in any one season since monitoring commenced.

4.3.1 Bird monitoring

Previous monitoring on the offset site has recorded a number of woodland bird species recognised as being in decline throughout their range including Diamond Firetail (*Stagonopleura guttata*), Jacky Winter (*Microeca fascinans*), Southern White-face (*Aphelocephala leucopsis*), Speckled Warbler (*Chthonicola sagittatus*), Eastern Yellow Robin (*Eopsaltria australis*), White-winged Triller (*Lalage tricolor*) and Hooded Robin (*Melanodryas cucullata cucullata*).

Bird monitoring undertaken during spring 2016 recorded 41 species of which 18 were opportunistic records. The transect monitoring recorded 128 individuals across 23 species. An abundance index was generated and is outlined in **Table 5** below.

The monitoring identified that the Noisy Miner (*Manorina melanocephala*) was by far the most abundant species recorded within the offset property. Interestingly, Noisy Miners were only recorded in the northern offset site, which provides favourable open woodland habitat for this species. However, it should be noted that this species was also recorded opportunistically in lower numbers in the southern offset site.

The Yellow-faced Honeyeater (*Lichenostomus chrysops*) and Striated Pardalote (*Pardalotus striatus*) were the equally second most abundant species recorded during monitoring. The strong presence of psyllid insects and associated lerps on the foliage of Blakely's Red Gum trees throughout the offset site presents a key food resource for both of these species and is likely contributing to their relative abundance.

Table 5: Species abundance index (highest to lowest)

Common Name	Latin Name	No. of records	No. of individuals	Abundance index
Noisy Miner	*Manorina melanocephala*	10	26	0.87
Honeyeater, Yellow Faced	*Lichenostomus chrysops*	6	11	0.37
Pardalote, Striated	*Pardalotus striatus*	8	11	0.37
White-winged Chough	*Corcorax melanorhamphos*	4	10	0.33
Rosella, Eastern	*Platycercus eximius*	5	9	0.30
Australian Magpie	*Gymnorhina tibicen*	4	8	0.27
Weebill	*Smicrornis brevirostris*	6	8	0.27
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*	4	7	0.23
Magpie Lark	*Grallina cyanoleuca*	4	7	0.23
Galah	*Eolophus roseicapillus*	3	5	0.17
Red Wattlebird	*Anthochaera carunculata*	4	4	0.13
Thornbill, Yellow-Rumped	*Acanthiza chrysorrhoa*	3	4	0.13
Pied Currawong	*Strepera graculina*	2	3	0.10
Whistler, Rufous	*Pachycephala rufiventris*	3	3	0.10
Grey Fantail	*Rhipidura albiscapa*	2	2	0.07

Common Name	Latin Name	No. of records	No. of individuals	Abundance index
Honeyeater, White-Eared	*Lichenostomus penicillatus*	2	2	0.07
Noisy Friarbird	*Philemon corniculatus*	2	2	0.07
Australian Raven	*Corvus coronoides*	1	1	0.03
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	1	1	0.03
Kookaburra	*Dacelo novaeguineae*	1	1	0.03
Pied Butcherbird	*Cracticus nigrogularis*	1	1	0.03
Superb Fairy Wren	*Malurus cyaneus*	1	1	0.03
Willie Wagtail	*Rhipidura leucophrys*	1	1	0.03

4.3.2 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 in 2010. These values were subsequently confirmed during surveys in spring 2016 and are presented below in **Table 6**. The following categories were used to identify abundance or frequency of each feature:

- *Abundan*t = 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 6: Fauna habitat features observed across the offset site

Fauna habitat feature	Northern	Southern
Tree hollows	Occasional	Occasional
Large trees > 60 cm DBH	Occasional	Occasional
Dead standing trees	Occasional	Rare
Stumps (<2 m)	Rare	Rare
Mistletoes	Occasional	Occasional
Regenerating tree thickets	Abundant	Abundant
Native shrub thickets	Common	Occasional
Exotic shrub thickets	Rare	Rare
Logs (fallen)	Occasional	Occasional
Timber (fallen)	Occasional	Occasional
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, particularly *Acacia* species, 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. These features were again reassessed in spring 2016. No substantial change was observed amongst these features relative to the baseline conditions.

Table 7: Habitat assessment within 50 m x 20 m vegetation monitoring plots

Plot	HBT	Logs	Comment	Dominant habitat features present within 50 m x 20 m plot Autumn 2015
1	0	0 m	No	Limited surface rocks; abundant exotic annuals
2	1	1 m	No	Surface and outcropping rocks abundant; minor course woody debris
3	0	2 m	No	Litter common; minor coarse woody debris
4	0	15 m	No	Developing canopy regeneration; course woody debris
5	0	0 m	No	Developing canopy regeneration; limited surface rocks
6	0	0 m	No	Developing canopy regeneration
7	0	2.5 m	No	Minor surface rocks and course woody debris; abundant exotic annuals
8	0	12 m	No	Litter; course woody debris; hollow logs; surface rocks

4.3.3 Threatened fauna

In addition to the fauna species summarised in Section 4.3 and **Appendix B**, two species of threatened fauna were recorded within the broader Williamsdale property during the course of monitoring. These were Pink-tailed Worm Lizard (*Aprasia parapulchella*) and Rosenberg's Goanna (*Varanus rosenbergi*), with one individual of each directly observed (**Figure 16**).

While these species were not recorded within the M2G offset site itself, the mobile nature of the Rosenberg's Goanna means that it is likely that this species utilises the offset site for foraging or nesting habitat. Furthermore, it is considered likely that individuals of the Pink-tailed Worm Lizard are still present in areas of similarly suitable habitat within the offset site.

Figure 16: Opportunistic records of threatened fauna within the Williamsdale property, spring 2016

5 *Swainsona recta* monitoring

5.1 Results summary

The spring 2016 *Swainsona recta* census was undertaken on 31 October 2015. Of the 112 individuals planted within the three translocation plots, 36 were present in spring 2016, an increase of three compared to spring 2015. This represents an overall survivorship of 32%, which is down substantially from the 79% overall survivorship recorded in spring 2013, however is a slight increase compared to both 2014 and 2015.

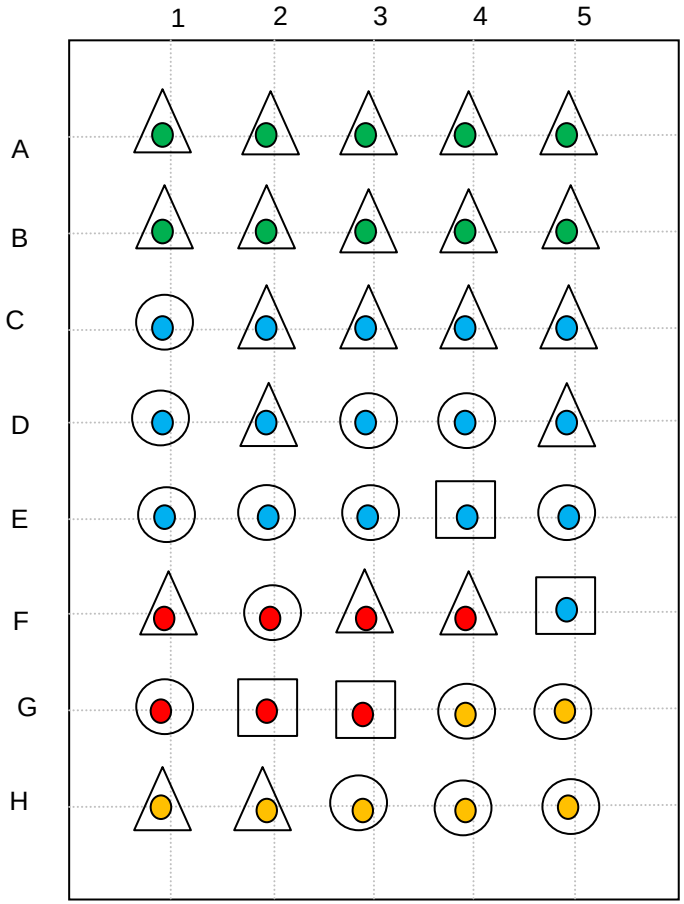
All 36 plants present in spring 2016 were in flower or fruit. The vast majority (81%) of these plants were of Mt Taylor provenance. This represents 44% of total Mt Taylor plantings, compared to only 19% of Mt Taylor plantings present in 2015. These results contrast with the results of previous monitoring, which indicated a stronger survival of Burra and Williamsdale individuals.

Twenty-three of the 36 individuals recorded during spring 2016 were not recorded in the 2015 surveys. As discussed previous monitoring reports (ELA, 2014; ELA, 2015), and as demonstrated by these fluctuating year-on-year results, the spring 2016 surveys demonstrate the difficulty in accurately quantifying survivorship in planted *S. recta* individuals in only a single season, due to the species ability to die back to below ground root stock, and only develop above ground growth when conditions are favourable.

5.1.1 Plot 1

Table 8: Plot 1 monitoring results

Key	Results	Comments
○	**Present** - in flower or immature fruit	8 fertile plants from 2012 plantings and 7 from 2013 plantings
□	**Present** – lacking flowers and fruits	4 observed with leaf only, 2 from each of the 2012 and 2013 plantings
△	**Absent** - not observed	16 from 2012 and 5 from 2013 plantings not observed



Plot 1 - 2015

Plot 1 occurs within Box-Gum Woodland with a *Themeda triandra* dominated groundcover. A high diversity of native species and a low abundance of exotic species have been recorded within the surrounding area. 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 relatively low.

Forty individuals were planted within plot 1, of which 26 were from Mt. Taylor (10 potting mix & 16 soil plus potting mix) and 7 each were from the Williamsdale and Burra populations.

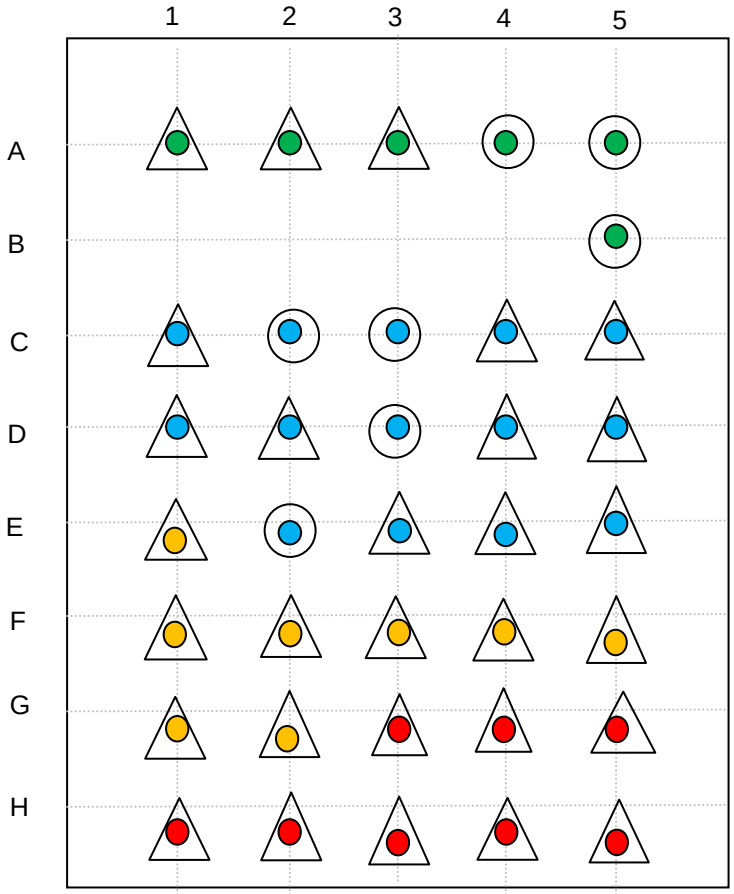
Of the 40 plants, 19 were present in spring 2016 (8 from 2012 plantings and 111 from 2013 plantings). No recruitment was observed within the plot, however the majority of the plants observed were in flower and/or fruit.

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

5.1.2 Plot 2

Table 9: Plot 2 monitoring results

Key	Results	Comments
○	**Present** - in flower or immature fruit	7 plants fertile, all from 2012 plantings
□	**Present** - lacking flowers and fruits	None
△	**Absent** - not observed	13 from 2012 & 16 from 2013 plantings not observed



Plot 2 - 2015

Plot 2 occurs within *E. blakelyi* dominated Box-Gum Woodland with the understorey dominated by *Austrostipa* spp. (Speargrass). A high diversity of native species and a low abundance of exotic species have been recorded within the surrounding area. The plot is established on a slight north-east 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.

Thirty-six individuals were planted within plot 2, of which 20 were from Mt. Taylor (6 potting mix & 14 soil plus potting mix) and 8 were from each of the Williamsdale and Burra populations. Fourteen individuals are located outside the fenced boundary of the plot (columns one and two).

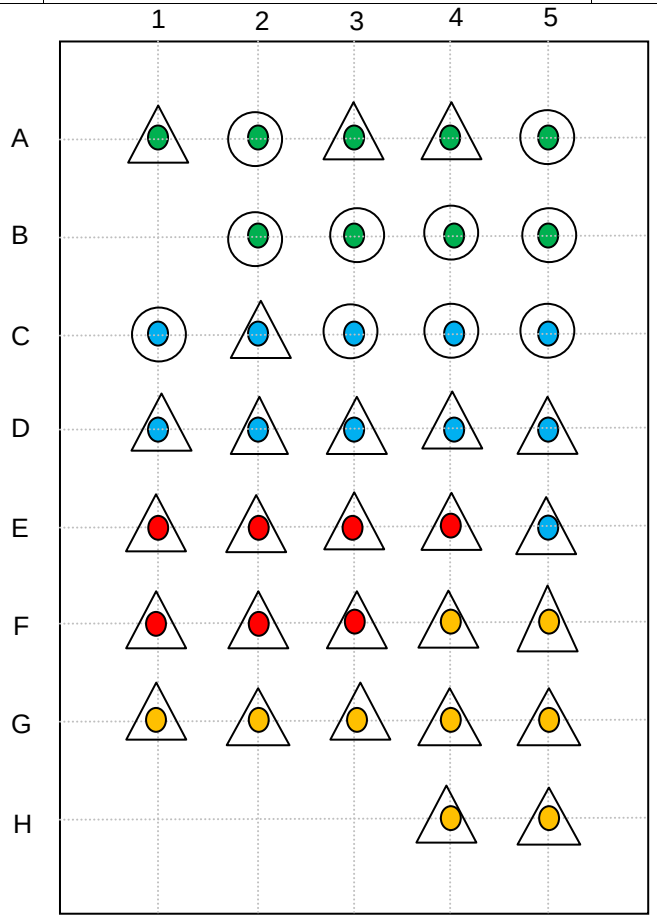
Of the 36 individuals planted, 7 were present in spring 2016, all from 2012 plantings. No recruitment was observed within the plot.

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

5.1.3 Plot 3

Table 10: Plot 3 monitoring results

Key	Results	Comments
◯	**Present** - in flower or immature fruit	10 plants fertile, all from 2012 plantings
□	**Present** - lacking flowers and fruits	None
△	**Absent** - not observed	10 from 2012 & 16 from 2013 plantings not observed



Plot 3 - 2015

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 have been recorded within the surrounding area. The plot is 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.

Thirty-six individuals have been planted within plot 2, of which 20 were from Mt. Taylor (9 potting mix & 11 soil plus potting mix), 7 of which were from the Williamsdale population and 9 of which were from the Burra population.

Of the 36 individuals, 10 were present in spring 2012, all from 2012 plantings. No recruitment was observed within the plot.

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

6 Weed monitoring

6.1 Weed management actions undertaken to date

Weed management on site has included control of the perennial grasses *Eragrostis curvula* (African Lovegrass) and *Nassella trichotoma* (Serrated Tussock) in mid-2012 and mid to late-2013, and control of the perennial broad-leaved species *Rosa rubiginosa* (Sweet Briar), *Rubus* sp. (Blackberry), and *Hypericum perforatum* (St. John's Wort) over the summer 2012 / 2013 and summer 2013 / 2014 periods. Follow up control was also undertaken in December 2014.

Additional weed spraying operations targeting Sweet Briar and Blackberry were undertaken during the spring 2015; these predominantly involved spot spraying of re-shooting Sweet Briar.

In 2015, Icon Water were advised by the ACT Parks and Conservation Service (PSC) to not conduct any spraying of St John's Wort within the offset site until further notice, as a biological control program for this species is being implemented in the region.

A weed management program is planned for summer 2016/2017 based on the results of this monitoring report.

6.2 Priority areas for weed control works

A summary of weed occurrences across the offset site, comparison with prior weed occurrence, and a summary of priorities for weed control works in 2017/2018 is provided in **Table 11**.

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 17** and **Figure 18**, with the overall priority for each species across the offset site summarised in **Table 11**.

Table 11: Summary of prior weed occurrence and spring 2016 monitoring results

Species	Prior weed occurrence	Current status
African Lovegrass (*Eragrostis curvula*)	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.	Scattered individuals recorded along the eastern boundary of MU3. **MU occurrence**: MU3 **Recommendation**: Follow-up weed control required targeting isolated individuals to avoid spread. **Priority**: Low
Serrated Tussock (*Nassella trichotoma*)	Low, scattered individuals in some areas. Scattered plants persist within MU1 near the southern boundary of the southern offset.	This species persists near the southern boundary of the southern offset, with approximately 100 individuals recorded in MU1A. Scattered individuals were also recorded across MU2, suggesting that this species may be increasing in extent. Given the isolated nature of the species within the offset site, control should be a high priority. **MU occurrence**: MU1A, 1B, 2A, 2B **Recommendation**: Follow-up weed control required in accordance with weed control program outlined in the sub-plan. **Priority**: High
Blackberry (*Rubus fruticosus*)	Low, localised areas of dominance. Occasional isolated patches and scattered young individuals are present, particularly in MU4 along the drainage line. The species is abundant in the broader Williamsdale property, particularly close to the river corridor.	Targeted control work has been largely successful. Occasional isolated patches and scattered young individuals were observed in 2016, predominantly as reshooting from sprayed individuals but also as one larger patch in the north-east corner of MU4. The species remains abundant in the broader Williamsdale property, particularly close to the river corridor and in drainage lines. **MU occurrence**: MU2B, MU3, MU4, MU5, MU6, MU7 **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 within MU5 and MU6 and should be removed. Plants are typically in difficult to access areas. **MU occurrence**: MU5, MU6 **Recommendation**: Targeted control of isolated individuals using cut and paint or manual removal of the tree. **Priority**: Moderate

Species	Prior weed occurrence	Current status
St John's Wort (*Hypericum perforatum*)	Scattered and moderate occurrence across the offset site. Widely distributed across both the northern and southern offset sites, however typically with low cover.	Despite previous control efforts, the species remains widely distributed across both the northern and southern offsets and appears to have increased in both extent and abundance. While covers of this species had previously been low, dense patches were recorded in the majority of MUs. The species is particularly prevalent in open areas of the site. **MU occurrence**: All units **Recommendation**: Investigate control options through discussion with ACT parks and conservation. **Priority**: High
Thistles (*Carthamus lanatus, Carduus* spp. & *Onopordum* spp.)	Moderate, localised areas of dominance, predominantly in areas with significant history of disturbance.	Thistles were most prevalent in areas with a strong history of grazing disturbance. *Carduus* spp. and *Carthamus lanatus* (Saffron Thistle) were commonly encountered beneath the canopy of trees, and both were present, along with *Cirsium vulgare* (Spear Thistle) as scattered patches in open areas, particularly within MU1 and MU4. **MU occurrence**: All units **Recommendation**: For *Carthamus lanatus* particularly, consider control options within a broader program encompassing the adjacent property. **Priority**: Moderate
Sweet Briar (*Rosa rubiginosa*)	Isolated presence scattered throughout offset site, largely present as re-sprouting or juvenile individuals.	Weed control work on *Rosa rubiginosa* appears to have been largely successful. However, as in 2015, some re-sprouting or recruitment from soil seed stores was observed and it is expected that continued follow up work for the species will be necessary **MU occurrence**: MU2A, 2B, 3, 4, 5, 6, 7 **Recommendation**: Further spot spraying of individuals missed or re-sprouting. **Priority**: Moderate

Figure 17: Relative weed distribution within the southern offset site, spring 2016

Figure 18: Relative weed distribution within the northern offset site, spring 2016

7 Erosion monitoring

7.1 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. As recommended in the report, options to rehabilitate these points should be investigated.

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.

The spring 2015 monitoring report (ELA, 2015) recommended that an erosion rehabilitation concept plan be developed, with a particular focus on the main drainage line. While the small-scale erosion management activities undertaken in winter 2016 appear to have been effective, it is still recommended that the cost of more wide-scale rehabilitation be investigated and the development of an over-arching concept plan be considered.

7.2 Erosion monitoring point results – spring 2016

The majority of erosion monitoring points are located along ephemeral drainage lines in the northern offset. While these points remain in a diversity of conditions and severities, on the whole vegetative ground cover appears to be increasing, generally limiting ongoing active erosion. Remediation works appear to have been successful in stabilising gully heads; further works of similar scope are recommended for a number of other points.

It should be noted that approval is required to undertake any remediation works within a drainage line (see erosion 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.

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: No significant change observed since baseline monitoring survey, however there does appear to have been some increases in ground cover and a stabilising of the steeper slopes.

Action required: Consider placement of woody debris to prevent further erosion at gully head.

Autumn 2012 (baseline)

Spring 2016

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: An increase in ground cover growth was observed on the bank above, which appears to be stabilising.

Action required: No works required at this stage.

Autumn 2012 (baseline)

Spring 2016

Erosion Point 6:

Description: Located within an ephemeral drainage line within MU4, northern offset. Evidence of sheet erosion along bank and some rilling.

Size: Approximately 6 m long, 1.5 m deep and 2.5 m wide.

Change: Increasing ground cover on the bank slope and base. This relatively gentle slope appears to be grading out and be moderately stable.

Action required: Consider removing erosion point from future monitoring surveys.

Autumn 2012

Spring 2016

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 (315º) and showing the north bank.

Size: Approximately 20 m long and 1.0 m deep.

Change: Minor active erosion along the banks. The southern side is moderately well vegetated.

Action required: Remediation measures to slow surface water flow and stop progression of head cut should be considered.

Autumn 2012 (baseline)

Spring 2016

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 (45º) and showing the north bank (upstream from erosion point 7).

Size: Approximately 15 m long and 1.0 m deep.

Change: Minor active erosion on the northern side, however there has been an increase in ground cover on the bank top.

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

Autumn 2012 (baseline)

Spring 2016

Erosion Point 9:

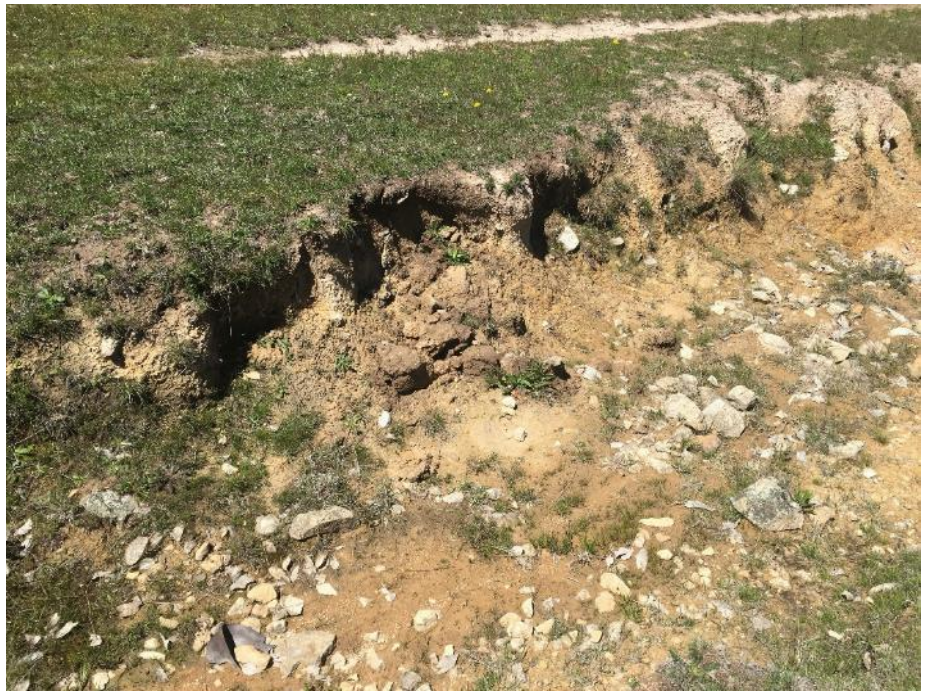
Description: Situated near the western boundary of the southern offset.

Size: Approximately 20 m long and 1 m deep.

Change: No significant change observed since baseline monitoring survey. Side walls and head show signs of minor ongoing erosion.

Action required: Consider remediation of head cut to stop progress of gully.

Autumn 2012 (baseline)



Spring 2016

Erosion Point 10:

Description: Situated along the western fence line of the southern offset. Small area of erosion due to upslope runoff.

Size: Approximately 5.0 m long and 0.5 m deep.

Change: This point appears to be grading out and stabilising, with no signs of active erosion.

Action required: No immediate action required.

Autumn 2012 (baseline)

Spring 2016

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: Some further slumping at the gully head observed, with roots remaining exposed.

Action required: Consider placement of woody debris or other stabilising materials to remediate and prevent further erosion.

Autumn 2012 (baseline)

Spring 2016

Erosion Point 18:

Description: Located along an ephemeral drainage line within the northern offset. Evidence of stream bed exposure, pooling and in-stream vegetation.

Size: Approximately1.5 m deep, 2.5 m wide, 3 m long.

Change: Woody debris placed at gully head; this erosion point now appears to be fully stabilising and increasing in vegetative cover.

Action required: Continue to monitor and supplement woody debris if required.

Autumn 2012 (baseline)

Spring 2016

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: No change since previous survey, with this point appearing moderately stable.

Action required: No action is required at this stage.

Spring 2012 (baseline)

Spring 2016

Erosion Point 22: Point established at overflow point of southern dam during the spring 2013 monitoring surveys.

Description: Southern dam overflow – flowing water causing erosion at exit point.

Size: 50 cm wide, 20 cm deep, 1.5 m long.

Change: Water over-flow from the dam appears to be causing continued active erosion.

Action required: No immediate works required at this stage.

Spring 2013 (baseline)

Spring 2016

8 Feral animals

The autumn and spring 2012 monitoring surveys identified *Sus scrofa* (Feral Pig) within the offset property. Prior to the autumn 2012 monitoring, this species had not been observed. Disturbance within the offset included pig rooting, often in areas associated with a forage source, and tracks through boggier areas of the site. The disturbance caused by the pigs was locally significant, but pig activity was at a low density across the whole of the offset. It was recommended that the level of disturbance be monitored and appropriate action taken if the level of disturbance increased substantially. In response to the recommendation, Regional Feral Animal Control (RFAC) was engaged to conduct control activities at the M2G offset site during 2012 and 2014.

Feral Goats (*Capra hircus*) were observed within the offset site during the spring 2013 monitoring surveys. The species was considered likely to be utilising a large area, including the offset site, neighbouring properties and Murrumbidgee River corridor. The lack of disturbance (agriculture activities) within the offset site is likely to provide a refuge for the goats. The spring 2013 monitoring surveys observed localised goat camps (e.g. under a stand of trees) and increased grazing pressures at these points. However, the overall quality and condition of the offset site did not appear to be greatly impacted. As a proactive measure Icon Water undertook goat control activities in December 2013. A total of 150 feral goats were removed from the offset site. Subsequent aerial monitoring did not record any goats within the offset site. RFAC observed goats within the offset site during July 2014.

Further feral animal control measures were undertaken during spring 2015 (feral pig trapping) and winter 2016 (feral goat removal and fox shooting). Further operations to remove the large population of feral goats present on site are planned for 2017.

8.1 Feral animal monitoring results (opportunistic observations) – spring 2016

Opportunistic records (direct and indirect) of feral animals are presented in **Figure 19**.

8.1.1 *Vulpes vulpes* (European Fox)

A single fox was observed within the Williamsdale property during the course of fencing monitoring during spring 2016. While this was located outside the M2G offset site, it is likely that this species utilises the offset site.

8.1.2 *Oryctolagus cuniculus* (European Rabbits) and *Lepus europaeus* (Hares)

One active rabbit warren were observed within the offset site, and an additional warren and one rabbit were observed within the Williamsdale property during the course of monitoring. This is the first record of rabbit warrens within the offset site.

Hares have previously been recorded, however not for the past two monitoring periods.

8.1.3 *Dama dama* (Feral Deer)

Two feral deer were recorded within the Williamsdale property during the spring 2016 surveys. The species is considered likely to utilise the offset site periodically.

8.1.4 *Capra hircus* (Feral Goat)

Large numbers of feral goats (up to 70 in one single herd) were observed within the offset site. This indicates an increase in population compared to the previous year, during which no feral goats were

directly observed. At the time of preparing this report, a project to round up and remove feral goats from the property was being planned for early 2017.

8.1.5 *Sus scrofus* (Feral Pig)

Pig diggings were observed within the offset site during spring 2016. The diggings do not appear to be recent. It is likely that the species utilises the offset site and adjacent areas including the broader Murrumbidgee River corridor on a seasonal basis to escape cold weather at higher altitudes.

8.2 Recommendations and actions

- Undertake control of feral goats across the property.
- Liaise with Parks and Conservation Service to expand existing fox baiting programs during 2016 to include the offset site.
- Report presence of feral animal activity (for goat, pig and deer) to the local control agencies. This will assist with information that may guide any broad or landscape scale control activities.

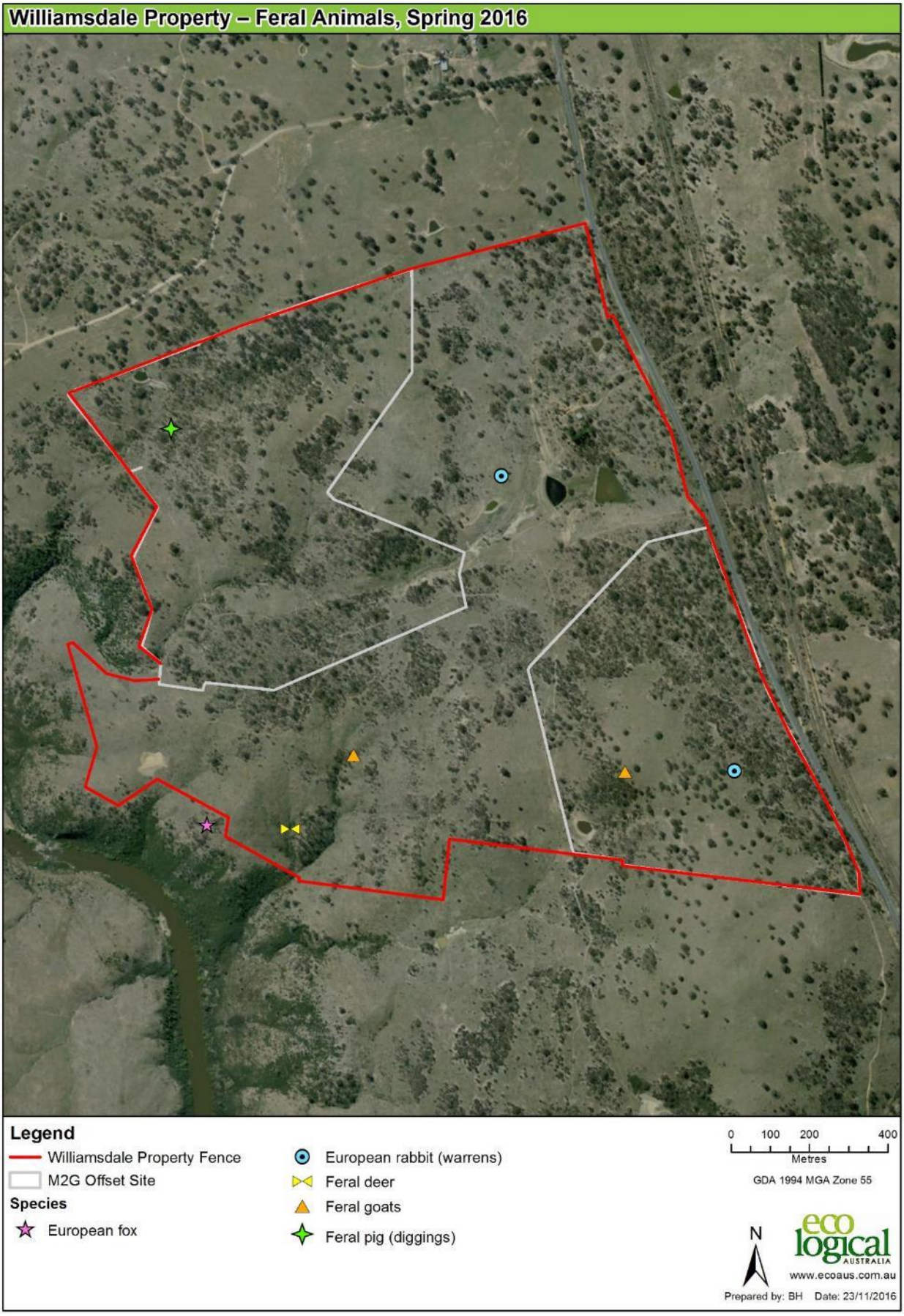


Figure 19: Opportunistic records of feral animals within the Williamsdale property, spring 2016

9 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.

9.1 Fence condition spring 2016

The overall condition of the Williamsdale property and offset boundary fencing is considered adequate to exclude grazing by stock within the offset site.

The exceptions to this are two areas of more major damage ("high risk") along the eastern boundary fence. However as this fence directly borders the Monaro Highway, it is not considered likely that these areas will provide access to stock and as such are not considered a priority.

An open gate was recorded along the boundary fence of the southern offset site, in the south-west corner.

Older style boundary fencing comprising a rabbit netting base with plain wires along the top is still present along some sections of the offset site boundary. As highlighted in previous monitoring reports (ELA, 2013; ELA, 2014; ELA, 2015), this style of fencing is not wildlife friendly and can require considerable ongoing maintenance as a result of damage by fauna (wombats etc.). Minor damage to fence sections of this style along the boundary has occurred where native fauna have pushed up existing rabbit netting to gain access to the offset site. It is recommended that eventual replacement of this style of fencing be considered to minimise impacts to fauna and reduce management costs and maintenance required in the long term.

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. It is also recommended that the gate to the Gigerline Nature Reserve remains closed to minimise the number of access points to the property.

Figure 20: Williamsdale property fence with points recommended for repair

10 Rehabilitation survival assessment

A summary of the rehabilitation survival assessment is presented in **Table 12** below. Survival percentages varied from 70% in the planting near the substation, to 82% in the smaller gully in the northern offset. However, a number of live individuals were observed as being in poor health, with discoloured foliage or dieback. There was evidence of waterlogging along the larger gully near the substation, which may have contributed to plant deaths.

Table 12: Rehabilitation survival counts

Location	Alive					Dead
	Acacia sp.	*Dodonaea* sp.	*Cassinia* sp.	*Bursaria* sp.	Total	
Northern offset, point 1	18	9	13	0	40	10
Northern offset, point 2	15	17	9	0	41	9
Large gully near substation	19	14	1	1	35	15

11 Summary

11.1 General

Despite the levels of dieback and psyllid infestations, on the whole offset site is considered to be in good condition, with a diversity of native vegetation and habitat features providing habitat for a range of threatened, rare and uncommon flora and fauna species. A diversity of native birds, mammals and reptiles were recorded across the offset site, occupying a range of habitat including regenerating and remnant woodland, open grassland, outcropping rocks, standing water, riparian corridors and standing and fallen dead wood.

11.2 Bushfire

The access track through the offset site is in a satisfactory condition.

Ongoing grazing by macropods across the property appear to be sufficient in controlling the growth of the ground cover vegetation and preventing excessive build up of surface fine fuels.

11.3 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. Factors to consider monitoring include:

- population numbers
- evidence of recruitment
- potential threats such as grazing or browsing and weed competition.

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.

11.4 Weeds

Primary control of weeds across the site has reduced the abundance and distribution of key weed species, however, follow up control is required to target any individuals missed or those that are resprouting. On-going weed control should be prioritised for Serrated Tussock and for reshooting Sweet Briar and Blackberry. The increase in extent and abundance of St John's Wort is of particular concern and further discussions with ACT PCS should be prioritised.

It is recommended that weed control within the broader Williamsdale property be considered to minimise the chance of weed propagules from surrounding land becoming established within the offset site.

11.5 Erosion

Four erosion points show signs of active gully erosion or slumping, possibly as a result of recent heavy rains, and will require remediation work in the future. Placement of woody debris in gully heads appears to have been successful in stabilising these areas. It is recommended that concept plans to undertake remediation of these sites be developed and the cost of rehabilitation works be investigated.

11.6 Feral animal

The overall incidence of feral animals within the offset site was low, with the exception of feral goats, which were observed in high numbers. The presence of feral pigs, foxes, rabbits and deer was also recorded, however it is considered likely that deers and pigs utilise the site on a seasonal basis. Continued monitoring and management control is recommended.

11.7 Fencing

The condition of the Williamsdale property and offset boundary fencing is considered adequate to exclude stock grazing from the offset site, however, some minor repairs are likely to be required. Some sections of the fence may require replacing in the future with a five strand plain wire fence.

11.8 Grazing

It has been estimated that up to 100 kangaroos may be utilising the offset site and surrounding properties at any one time. The Land Management Agreement (LMA) (ACT Government) for the Williamsdale property does not outline a suitable grazing level for the 'Active Conservation' rural enterprise. Previously, the grazing intensity for the Williamsdale property was set at a Dry Sheep Equivalent (DSE) of 600.

The ACT Kangaroo Management Plan (ACT Government, 2010) indicates that a direct comparison between sheep and kangaroos in terms of DSE is inaccurate due to inherent ecological differences between the two species. However, the Kangaroo Management Plan (KMP) suggests that a DSE of 0.6 per kangaroo for an unharvested population is probably a reasonable comparison for the ACT region. Using this DSE, the Williamsdale property has the capacity to support up to 360 kangaroos. An alternative measure to calculate the number of kangaroos that a property can support is to look at the relative density. The KMP suggests a density of between 0.6 and 1.5 Kangaroos per hectare. The Williamsdale property is approximately 208 ha in size, which means that using the density calculation, the property could support between 124 – 312 kangaroos in total.

Opportunistic observations of grazing pressure within and adjacent to the *Swainsona recta* exclosure plots continue to indicate that the offset site is currently grazed at moderate to high intensity, which is broadly consistent with the conservations principles outlined in the ODP.

12 Management recommendations

A summary of the recommended adaptive management actions relating to the offset site is provided in **Table 13** below. The actions relate to the appropriate ODP sub-plan and are based on the results presented in the above sections.

Table 13: Summary of proposed actions relating to the ODP

ODP Sub-Plan	Action status	Recommended management actions
Weed	On-going control and monitoring.	• Target priority species and priority areas over the 2017/2018 period. • Continue to undertake follow up weed control as required on persistent species such as Sweet Briar and Blackberry. • On-going weed management will be required at the site to combat the introduction of propagules from adjacent rural areas.
Rehabilitation	To be considered.	Supplementary plantings should be considered along the two gullies assessed in this report (Section 10). No additional recommendations follow from this report. The spring 2015 and 2014 reports recommended the following: • It is recommended that consideration be given to low density scattered plantings in MU7. Plantings should include over storey (*Eucalyptus blakelyi, E. melliodora*) and shrubs such as, *Bursaria spinosa, Acacia spp., Cassinia sp., and Dodonaea sp*. Plantings need to consider the proximity to the powerlines and need to maintain an appropriate easement. Within the powerline easement consideration could be given the plantings of low shrubs, forbs and native grasses. Rehabilitation works could trial the use of Kangaroo Grass mulch to suppress weeds and introduce seed into the site. • Prior to any planting works, weed control needs to be undertaken, particularly for broad leaf exotic species. Plantings should be monitored to ensure that they are not outcompeted by exotic annual grass growth during the growing season. • Box-Gum Woodland, the dominant vegetation community within MU7 is an open woodland community with a typically absent or scattered mid-storey of native shrubs. Any plantings considered should mimic the structure and species diversity present in the remainder of the offset site. There are likely to be suitable locations to collect seed within the offset site to ensure that local provenance is preserved.
Sediment and erosion Control	Action required.	• The majority of sites within the offset are considered to be stable and no immediate action is required. • Minor remediation works, such as placement of woody debris, should be considered at points 2, 9 and 13. • Concept plans should be developed for any larger remediation works, for example at points 7 and 8.
Bushfire	Complete. On-going monitoring.	• 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. 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.	• Implement a follow up fox baiting program in 2017. • The greater number of direct rabbit sightings in 2016 may indicate that this species has increased in abundance following fox control programs. Should future monitoring indicate a further increase in abundance, control measures may be required. • Undertake feral animal monitoring utilising remote cameras in spring 2017. • Undertake feral goat control.
Fencing	Completed in August 2012 and June 2013. On-going maintenance and monitoring	• No immediate major actions required. • Replacement of older style boundary fence (rabbit netting) with a 5 strand plain wire fence should be considered.
Grazing	On-going monitoring	• Grazing level is considered to be appropriate to the management objectives of the site. Grazing should be continually monitored and control measures considered if necessary. • It is recommended that advice be sought from ACT government regarding grazing pressure and the potential control options for native herbivores.

References

ACT Government, 2010, ACT Kangaroo Management Plan, Prepared by Territory and Municipal Services, ACT Government.

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Sharp, S. and Milner, R. 2014. *Procedures Manual for Monitoring Matters of National Environmental Significance in the Molonglo Conservation Areas*. Territory and Municipal Services, ACT Government.

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Appendix A: Flora species list – monitoring plots

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%

Note: The species cumulative list includes all species observed over all monitoring surveys.

Native species, spring 2016

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Acacia dealbata	x								
Acacia mearnsii									
Acacia rubida									
Acaena novae-zelandiae									
Acaena echinata									
Acaena ovina	x		1	1	1	+	1	1	1
Acrotriche serrulata	x								
Ajuga australis	x								

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Alternanthera denticulata									
Alternanthera sp. A									
Amphibromus nervosus									
Amyema pendula subsp. *pendula*	x								
Aphanes australiana									
Aristida ramosa	x		1		1				1
Aristida vagans	x								+
Arthropodium minus	x		+			+			+
Arthropodium sp.									
Asperula conferta	x		+	1	1	1			1
Asplenium flabellifolium									
Astroloma humifusum	x								
Austrostipa bigeniculata	x								
Austrostipa densiflora									
Austrostipa scabra	x		1			1	1		+
Austrostipa setacea									
Austrostipa sp.									
Bossiaea buxifolia									
Bossiaea prostrata									
Bothriochloa macra	x	2	2		+	1	2	1	+
Brachycome sp.	x								
Brachyloma daphnoides	x								
Brachyscome dentata									
Bulbine bulbosa	x			+	+	+			+
Bursaria spinosa subsp. lasiophylla	x			+					

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Callistemon sieberi									
Callitris endlicheri	x								
Calocephalus citreus	x								
Calotis scabiosifolia var. integrifolia									
Carex appressa	x							r	
Carex breviculmis									
Carex inversa	x	1	r	+	+		+	1	
Carex sp.									
Cassinia aculeata									
Cassinia quinquefaria	x						+		
Cassinia longifolia									
Centipeda cunninghamii									
Cheilanthes sieberi	x		1	+		+	+		1
Chrysocephalum apiculatum	x		1	1		2	1		1
Chrysocephalum semipapposum									
Clematis leptophylla							r		
Convolvulus angustissimus	x		r						r
Cotula australis	x	+						1	
Craspedia variabilis	x				1				
Crassula helmsii									
Crassula peduncularis									
Crassula sieberana	x	1	+		+		+	+	+
Cryptandra amara	x					+	+		
Cymbonotus lawsonianus			+	+			+		
Cymbonotus preissianus									

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Cymbonotus sp.	x				r	+		+	+
Cymbopogon refractus	x		+		r				
Cynoglossum suaveolens	x								
Cynoglossum sp.						r			
Cyperus lhotskyanus									
Daucus glochidiatus	x					r	r		+
Desmodium brachypodum									
Desmodium varians	x		r			+	+		
Dianella revoluta	x								
Dichelachne sp.									
Dichelachne micrantha	x								
Dichondra repens	x		1		+	+			
Dichopogon fimbriatus	x								
Dillwynia sp. Yetholme									
Discaria pubescens	x								
Diuris semilunulata									
Dodonaea viscosa subsp. angustissima	x								
Drosera peltata	x					+			+
Dysphania pumilio									
Einadia nutans subsp. *nutans*							+		
Elatine gratioloides									
Eleocharis acuta									
Elymus scaber	x		+	+			+		
Enneapogon nigricans									
Epilobium billardiereanum									

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Epilobium hirtigerum									
Eragrostis brownii									
Erodium crinitum	x	1						+	
Eryngium ovinum	x			+	+				
Eucalyptus blakelyi	x		2	2	1	2	2		1
Eucalyptus bridgesiana	x								
Eucalyptus dives	x								
Eucalyptus mannifera									
Eucalyptus melliodora	x	r							
Eucalyptus rossii	x								
Euchiton japonicus	x		+	+			+		+
Euchiton sphaericus					+	+	+		
Euchiton sp.								+	
Euphorbia drummondii							r		
Fimbristylis dichotoma									
Galium sp.				r	+				
Galium gaudichaudii									
Geranium retrorsum			+			+	+		
Geranium solanderi	x	+	+	1	1	+	1	+	
Geranium sp.									
Glossostigma elatinoides									
Glycine clandestina							+		
Glycine tabacina		+	+				+		+
Gonocarpus tetragynus	x			1		+			+
Goodenia hederacea	x								

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Goodenia pinnatifida				+					
Haloragis heterophylla									
Hibbertia obtusifolia	x								
Hydrocotyle laxiflora	x	+	1	1	1	+	1	+	
Hymenochilus cynocephalus									
Hypericum gramineum				+	+				+
Hypoxis hygrometrica	x								
Indigofera australis									
Isoetopsis graminifolia									
Isolepis hookeriana									
Isotoma fluviatilis subsp. *australis*									
Juncus australis									
Juncus bufonius									
Juncus filicaulis				+	+				
Juncus homalocaulis									
Juncus subsecundus	x							+	
Juncus usitatus									
Kunzea ericoides	x		r						
Kunzea parvifolia									
Lachnagrostis filiformis									
Leptorhynchos squamatus	x			1	+	1			1
Leptospermum continentale	x								
Leucochrysum albicans var. *tricolor*	x								+
Limosella australis									
Linum marginale									

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Lomandra bracteata					+	r	r		r
Lomandra filiformis subsp. *coriacea*	x						+		+
Lomandra filiformis subsp. *filiformis*						r			
Lomandra longifolia									
Lomandra multiflora	x								
Luzula densiflora	x		+	+	+	1			+
Lythrum hyssopifolia									
Melichrus urceolatus	x		r			+			r
Microlaena stipoides	x		1	+	1	+	+	1	
Microseris lanceolata	x								
Microtis sp.	x				+	+			
Montia fontana subsp. chondrosperma									
Myosotis australis	x		+	+	+		+	1	+
Ophioglossum lusitanicum									
Oreomyrrhis eriopoda									
Oxalis sp.									
Oxalis perennans	x	1	+	+	+		1	+	
Oxalis radicosa									
Oxalis thompsoniae									
Panicum effusum			+					r	
Pellaea calidirupium									
Persicaria prostrata									
Pimelea curviflora	x								
Plantago gaudichaudii				+					
Plantago varia				+		+			

Plot Number Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Poa labillardieri	x								
Poa sieberiana var. hirtella									
Poa sieberiana var. *sieberiana*	x			+			r		+
Poa sp.									
Pomaderris angustifolia									
Pomaderris pallida	x								
Poranthera microphylla									
Potamogeton ochreatus									
Pseudognaphalium luteoalbum									
Pultenaea procumbens	x		r						
Ranunculus lappaceus	x								
Ranunculus pumilio var. *pumilio*									
Ranunculus sessiliflorus var. *sessiliflorus*									
Rhodanthe anthemoides									
Rubus parvifolius	x								
Rumex brownii	x	1	r	+	+		+	1	
Rytidosperma caespitosum									
Rytidosperma carphoides									
Rytidosperma laeve									
Rytidosperma pallidum									
Rytidosperma racemosum		+	+						
Rytidosperma sp.	x				+	+			
Schoenus apogon				1	2	+		1	+
Scleranthus diander								r	
Scleranthus fascicularis							r		

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Sebaea ovata									
Senecio phelleus									
Senecio quadridentatus	x						+		
Solanum linearifolium									
Solenogyne dominii			r		+				+
Solenogyne gunnii					+				
Sporobolus sp.									
Stackhousia monogyna	x			+		+			+
Stellaria pungens									
Stylidium despectum									
Swainsona monticola	x								
Swainsona recta (propagated)									
Swainsona sericea	x			+		+			
Thelymitra pauciflora									
Thelymitra sp.									
Themeda triandra	x		2	1	3	3	+		3
Thysanotus patersonii	x								
Thysanotus tuberosus									
Tricoryne elatior	x								
Tripogon loliiformis									
Triptilodiscus pygmaeus	x		1	1	1	+	1		1
Veronica calycina	x		+			+			
Veronica sp.									
Vittadinia cuneata			+						
Vittadinia gracilis									

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Vittadinia muelleri	x		1			r	1		+
Wahlenbergia communis	x		1	+		+	+		+
Wahlenbergia gracilenta									
Wahlenbergia gracilis	x		1			+	+		r
Wahlenbergia multicaulis									
Wahlenbergia sp.									
Wahlenbergia stricta									
Wurmbea dioica	x		1	+	1	+			1
Xerochrysum viscosum	x								+
Zornia dyctiocarpa									
Total number	**93**	**12**	**41**	**35**	**34**	**40**	**38**	**19**	**38**

Exotic species, spring 2016

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Acetosella vulgaris	x		+				1	+	
Aira caryophyllea									
Aira elegantissima									
Aira sp.	x	+	2	2	1	1	2	1	1
Anagallis arvensis	x		+	+	+		+		
Arctotheca calendula									
Avena barbata	x			2					
Briza maxima									
Briza minor	x			2	+	+			+

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Bromus diandrus	x			2	+		1		
Bromus hordeaceus	x	2	+	2	1		2	2	+
Bromus rubens									
Bromus sp.									
Capsella bursa-pastoris	x	+					+	1	
Carduus pycnocephalus									
Carduus tenuiflorus									
Carduus sp.	x	r						1	
Carthamus lanatus	x	2					r		
Centaurea melitensis									
Centaurium erythraea	x			1				1	+
Cerastium glomeratum		1						1	
Chondrilla juncea									
Cicendia quadrangularis									
Cirsium vulgare		+		+	+	+	+	+	
Conyza sp.	x			+		+			
Conyza bonariensis									
Conyza sumatrensis									
Cotoneaster sp.									
Crataegus monogyna									
Cynodon dactylon									
Cynosurus echinatus	x								
Cyperus eragrostis									
Cyperus lhotskyanus									
Cyperus sp.									

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Echium plantagineum	x			1	+	+	r		
Eleusine tristachya									
Eragrostis cilianensis									
Eragrostis minor									
Eragrostis curvula	x								
Erodium botrys									
Erodium cicutarium	x							1	
Erodium moschatum									
Erodium sp.									
Festuca arundinacea									
Galium aparine									
Galium divaricatum									
Geranium molle									
Hedypnois rhagadioloides subsp. cretica									
Hirschfeldia incana									
Holcus lanatus	x								
Hordeum glaucum	x	1						2	
Hordeum leporinum									
Hypericum perforatum	x	+	+	1	1	1	1		+
Hypochaeris glabra									
Hypochaeris radicata	x	1	1	1	1	+	1	1	1
Isolepis levynsiana									
Isolepis marginata									
Juncus capitatus									
Lactuca serriola	x				+				

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Lepidium sp.									
Linaria arvense	x		+	r		+	+		
Linaria pelisseriana	x			+		+			1
Linum trigynum									
Lolium perenne									
Lolium rigidum									
Malva nicaeensis									
Malva parviflora	x								
Marrubium vulgare	x								
Medicago arabica									
Modiola caroliniana	x								
Moenchia erecta	x							+	
Nassella trichotoma	x	+							
Onopordum acanthium									
Orobanche minor									
Parentucellia latifolia	x		+		+	r	+	+	
Paronychia brasiliana	x	1	+				+	1	
Paspalum dilatatum	x								
Pentaschistis airoides									
Petrorhagia nanteuilii	x	+		+	+		+		
Phalaris aquatica									
Plantago lanceolata	x		+	1	1	+	1	1	
Poa annua	x				1				
Poa pratensis									
Polygonum aviculare									

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Prunus sp.									
Pyracantha sp.									
Reseda luteola									
Rosa rubiginosa	x	+	r		+	r	r		r
Romulea rosea var. *australis*									
Rubus fruticosus	x		r						
Sanguisorba minor									
Setaria parviflora	x								
Sherardia arvensis									
Sisymbrium orientale									
Sisyrinchium sp. A									
Solanum nigrum									
Sonchus asper									
Sonchus oleraceus	x					+			
Spergularia rubra									
Stellaria media									
Taraxacum officinale	x						r		
Tolpis barbata	x		+				r		+
Tragopogon dubius									
Trifolium arvense	x	r			+		1		
Trifolium angustifolium	x		+	+	+		+		1
Trifolium campestre	x	r	+	+		+	1		1
Trifolium cernuum									
Trifolium dubium		r	+	1	1				
Trifolium glomeratum	x			r					+

Plot Number / Species (cumulative list)	Opportunistic	1 (MU1A)	2 (MU2B)	3 (MU3)	4 (MU4)	5 (MU5)	6 (MU6)	7 (MU7)	8 (MU3)
Trifolium repens	x								
Trifolium sp.									
Trifolium subterraneum	x	2	r					2	
Urtica urens	x							1	
Verbascum thapsus	x						r	r	
Verbena incompta									
Verbena sp.	x				r				
Veronica anagallis-aquatica									
Veronica arvensis									
Vicia sativa									
Vulpia bromoides									
Vulpia muralis									
Vulpia myuros									
Vulpia sp.	x	1			1		1		
Total number	**50**	**12**	**5**	**13**	**9**	**4**	**16**	**14**	**6**

Appendix B: Fauna lists

Fauna observations

Fauna species recorded during the biannual monitoring surveys from spring 2011 to autumn 2015, either through opportunistic observations or targeted survey are outlined below.

A = autumn, B = spring.

Birds species, spring 2016

Common Name	Scientific Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B
Australasian Grebe	*Tachybaptus novaehollandiae*		x		x	x	x		x		x
Australian Magpie	*Gymnorhina tibicen*	x	x	x	x	x	x	x	x	x	x
Australian Raven	*Corvus coronoides*	x	x	x	x	x	x	x	x		x
Australian Wood Duck	*Chenonetta jubata*			x	x	x			x	x	
Australian King-Parrot	*Alisterus scapularis*								x		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		x	x		x		x		x	x
Black-shouldered Kite	*Elanus axillaris*										x
Brown Falcon	*Falco berigora*					x		x	x		
Common Bronzewing	*Phaps chalcoptera*	x			x		x				
Common Starling	*Sturnus vulgaris*									x	x
Crested Pigeon	*Ocyphaps lophotes*				x	x	x		x		x
Diamond Firetail	*Stagonopleura guttata*	x			x						
Dollarbird	*Eurystomus orientalis*										x
Double-barred Finch	*Taeniopygia bichenovii*				x						
Eurasian Coot	*Fulica atra*										x
European Goldfinch	*Carduelis carduelis*				x					x	
Fan-tailed Cuckoo	*Cacomantis flabelliformis*					x		x		x	
Galah	*Eolophus roseicapillus*	x		x		x		x	x	x	x
Grey Butcherbird	*Cracticus torquatus*		x	x					x	x	
Grey Currawong	*Strepera versicolor*									x	x

Grey Fantail	*Rhipidura albiscapa*	x	x	x		x	x	x	x	x	x
Grey Shrike-thrush	*Colluricincla harmonica*		x		x	x	x	x	x		
Hard Head	*Aythya australis*			x	x						
Honeyeater, White-eared	*Lichenostomus penicillatus*	x	x		x				x		x
Honeyeater, White-plumed	*Lichenostomus penicillatus*				x	x					x
Honeyeater, Yellow-faced	*Lichenostomus chrysops*			x				x	x	x	x
Honeyeater, White-naped	*Melithreptus lunatus*								x		
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*							x			x
Jacky Winter	*Microeca fascinans*	x		x		x				x	
Kookaburra	*Dacelo novaeguineae*	x		x					x	x	x
Leaden Flycatcher	*Myiagra rubecula*			x							
Magpie Lark	*Grallina cyanoleuca*	x	x	x	x	x	x	x	x	x	x
Masked Lapwing	*Vanellus miles*					x		x			x
Nankeen Kestral	*Falco cenchroides*					x		x			
Noisy Friarbird	*Philemon corniculatus*			x		x		x		x	x
Noisy Miner	*Manorina melanocephala*	x	x	x	x	x	x	x	x	x	x
Owlet Nightjar	*Aegotheles cristatus*										x
Pacific Black Duck	*Anas superciliosa*			x	x	x		x	x		
Pardalote, Spotted	*Pardalotus punctatus*	x	x	x	x		x	x	x	x	x
Pardalote, Striated	*Pardalotus striatus*	x		x	x	x	x	x	x	x	x
Pallid Cuckoo	Cuculus pallidus									x	
Pied Butcherbird	*Cracticus nigrogularis*							x		x	x
Pied Currawong	*Strepera graculina*	x	x	x	x	x	x	x	x	x	x
Quail	*Coturnix sp.*	x				x					
Red-browed Finch	*Neochmia temporalis*			x	x	x		x			
Red Wattlebird	*Anthochaera carunculata*					x		x	x	x	x
Robin, Eastern Yellow	*Eopsaltria australis*						x			x	x
Robin, Flame	*Petroica phoenicea*	x					x				
Robin, Hooded	*Melanodryas cucullata cucullata*	x								x	
Robin, Scarlet	*Petroica boodang*		x		x		x		x		
Rosella, Crimson	*Platycercus elegans*	x	x	x	x	x	x	x	x	x	x

Rosella, Eastern	*Platycercus eximius*	x	x	x	x	x		x	x	x	x
Red-rumped Parrot	*Psephotus haematonotus*								x		
Sacred Kingfisher	*Todiramphus sanctus*			x							
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*							x			
Silvereye	*Zosterops lateralis*								x		
Southern White-face	*Aphelocephala leucopsis*						x				x
Speckled Warbler	*Chthonicola sagittatus*				x		x				
Sulphur-Crested Cockatoo	*Cacatua galerita*	x				x	x	x		x	x
Superb Fairy Wren	*Malurus cyaneus*	x	x	x	x	x	x	x	x	x	x
Thornbill, Brown	*Acanthiza pusilla*	x		x	x	x		x	x		
Thornbill, Yellow-rumped	*Acanthiza chrysorrhoa*	x	x	x	x	x	x	x	x	x	x
Thornbill, Yellow	*Acanthiza nana*								x		
Tree Martin	*Petrochelidon nigricans*					x					
Wedge-tailed Eagle	*Aquila audax*	x	x		x		x		x		
Weebill	*Smicrornis brevirostris*				x			x	x	x	x
Welcome Swallow	*Hirundo neoxena*								x		x
Whistler, Golden	*Pachycephala pectoralis*	x	x			x					
Whistler, Rufous	*Pachycephala rufiventris*			x	x	x		x		x	x
White-bellied Sea-Eagle	*Haliaeetus leucogaster*					x					
White-faced Heron	*Egretta novaehollandiae*								x	x	
White-throated Treecreeper	*Cormobates leucophaeus*	x	x	x	x	x	x	x	x		x
White-fronted Gerygone	*Gerygone olivacea*			x		x		x		x	x
White-winged Chough	*Corcorax melanorhamphos*		x	x		x		x	x	x	x
White-winged Triller	*Lalage sueurii*							x			
Willie Wagtail	*Rhipidura leucophrys*	x	x		x	x		x	x	x	x
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*				x						x

Mammals

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B
Brushtail Possum	*Trichosurus vulpecula*					x	x	x		x	
Cow	*Bos Taurus*	x					x		x	x	
Echidna	*Tachyglossus aculeatus*					x			x	x	
European Rabbit	*Oryctolagus cuniculus*	x	x	x	x	x	x	x		x	x
Feral Goat	*Capra aegagrus hircus*		x	x	x	x	x		x	x	x
Feral Pig	*Sus scrofa*		x			x	x		x		
Fox	*Vulpes vulpes*	x	x	x	x	x	x	x	x	x	x
Eastern Grey Kangaroo	*Macropus giganteus*	x	x	x	x	x	x	x	x	x	x
Red-necked Wallaby	*Macropus rufogriseus*										x
Sheep	*Ovis aries*				x	x					
Sugar Glider*	*Petaurus breviceps*					x	x				
Swamp Wallaby	*Wallabia bicolor*					x	x	x			x
Wallaroo, Common	*Macropus robustus*							x	x		x
Common Wombat	*Vombatus ursinus*	x	x	x	x	x	x	x	x	x	x

Reptiles

Reptiles	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B	2015A	2015B	2016B
Delicate Skink	*Lamphrolis delicata*							x			x
Eastern Bearded Dragon	*Pogona barbata*			x							x
Eastern Common Froglet	*Crinia signifera*		x	x	x	x	x	x	x	x	x
Eastern Long-necked Tortoise	*Chelodina longicollis*		x		x	x	x		x	x	x
Eastern Water Dragon	*Intellagama lesueurii*										
Jacky Lizard	*Amphibolurus muricatus*	x							x	x	x
Peron's Tree Frog	*Litoria peronii*					x		x			
Pink-tailed Worm Lizard	*Aprasia parapulchella*										x
Plains Froglet	*Crinia parainsignifera*			x	x	x	x	x	x		
Red-bellied Black Snake	*Pseudechis porphyriacus*							x			
Rosenberg's Goanna	*Varanus rosenbergi*										x
Smooth Toadlet	*Uperolia laevigata*					x		x	x		x

Southern Rainbow Skink	*Carlia tetradactyla*										x
Spotted Marsh Frog	*Limnodynastes tasmaniensis*			x	x	x	x	x	x	x	
Whistling Tree Frog	*Litoria verreauxii*			x		x		x			

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