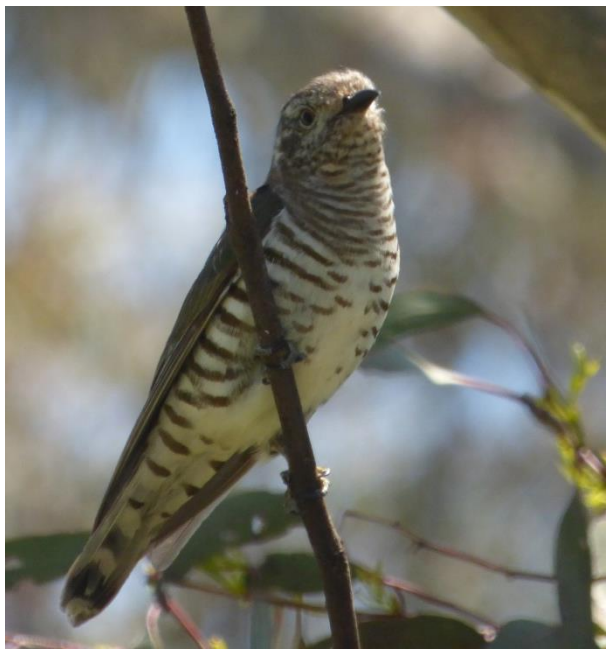
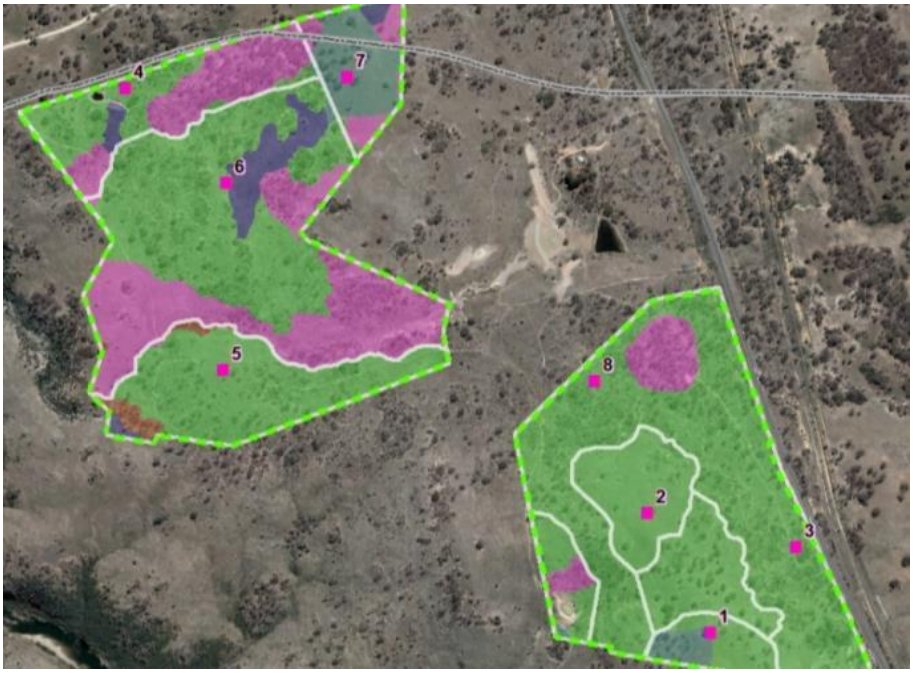
M2G Biodiversity Offset Monitoring Report

Spring 2014

Prepared for
ACTEW Water

January 2015





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ACKNOWLEDGEMENTS

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Contents

List of figures

List of tables

Abbreviations

ABBREVIATION	DESCRIPTION
BOM	Bureau of Meteorology
DBH	Diameter at Breast Height
DSE	Dry Sheep Equivalent
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
HBT	Hollow Bearing Tree
LMA	Land Management Agreement
LRMP	Landscape Rehabilitation Management Plan
M2G	Murrumbidgee to Googong Water Transfer Project
MU	Management Unit
ODP	Offset Delivery Plan
OEMP	Operation Environmental Management Plan
ORMP	Offset Rehabilitation Management Plan
PER	Public Environment Report
RFAC	Regional Feral Animal Control
TEMP	Terrestrial Ecology Management Plan
TSC Act	*Threatened Species Conservation Act 1995*

Executive summary

The Biodiversity Offset site was provided to compensate for impacts resulting from the development of the Murrumbidgee to Googong Water Transfer Project (M2G). The offset site was surveyed in spring 2014 as part of a twice-yearly monitoring program implemented to inform the management and implementation of the offset.

The spring 2014 surveys found that the offset site is in good condition and is responding well to management actions, such as the exclusion of stock, feral animal control and weed control works. Fauna habitat features are largely unchanged since the baseline surveys, and the site continues to support high biodiversity values including habitat for listed and declining woodland bird species, as well as populations of threatened and regionally significant flora species.

Weed control activities have been largely successful across the offset site, however, follow-up control, with an emphasis on *Rosa rubiginosa* (Sweet Briar) and management of bio-control of *Hypericum perforatum* (St. John's Wort) is recommended to further reduce the abundance and distribution of these key weed species across the site. The distribution and abundance of annual weeds across the offset site was high in spring 2014, and is considered likely to be an issue with may need addressing in the long term. The abundance of thistle species, particularly *Carthamus lanatus* (Saffron Thistle) requires attention to ensure that the species does not expand its distribution further within the offset sites. It is recommended that a series of trial plots be established to determine the appropriate control technique for the species on site. Should an appropriate technique be identified, this could then be rolled out throughout the affected areas.

The majority of erosion monitoring points have not shown signs of erosion since the baseline surveys, despite high rainfall events occurring during this time. The lack of erosion indicates that the soil is stable with a low risk of significant erosion occurring in the future. A high vegetation cover across the offset site and the continued exclusion of stock grazing further reduces the risk of erosion occurring.

Two erosion points within the main drainage line in the northern offset require some attention to stabilise the creek bank. It is recommended that various rehabilitation options be considered, however, options need to consider access, proximity to high voltage power lines, the local and downstream hydrology, as well as cost implications.

The overall incidence of pest species within the offset site was low in spring 2014, however, a higher abundance of Vulpes vulpes (European Fox) were observed that during previous surveys. It is recommended that Fox control be considered and the population be monitored following control.

Observations of the *Swainsona recta* (Small Purple-pea) plantings in spring 2014 showed a lower survivorship than in previous years. The plots show a high cover of perennial native grass species which may be competing with the plantings for resources. As grazing is currently excluded from the plots, there is no process of biomass control occurring within the plots. It is recommended that ACTEW Water trial opening one of the plots during the spring season to allow native herbivores the opportunity to control the biomass.

The condition of the offset boundary fencing is considered adequate to exclude stock from the offset site. No immediate management actions are required to be undertaken. However, maintenance at some locations is likely to be required in the future.

1 Introduction

1.1 Background

Eco Logical Australia Pty Ltd (ELA) was commissioned by ACTEW Water (ACTEW) 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 (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, ACTEW was required to provide compensatory habitat as an offset to compensate for vegetation and habitat losses arising from the construction activities associated with 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.l 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 under the approval conditions and commitments including the provision of monitoring actions (Eco Logical Australia 2012).

This report details the spring monitoring surveys for 2014 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 be read in context with the ODP. The purpose of this document is to report on the ecological condition of the site and management actions conducted throughout the previous year, in order to guide future actions within the offset site.

1.3 Study area

ACTEW own a land parcel in the 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 Box-Gum Woodland, threatened flora and fauna species and/or threatened species habitat.

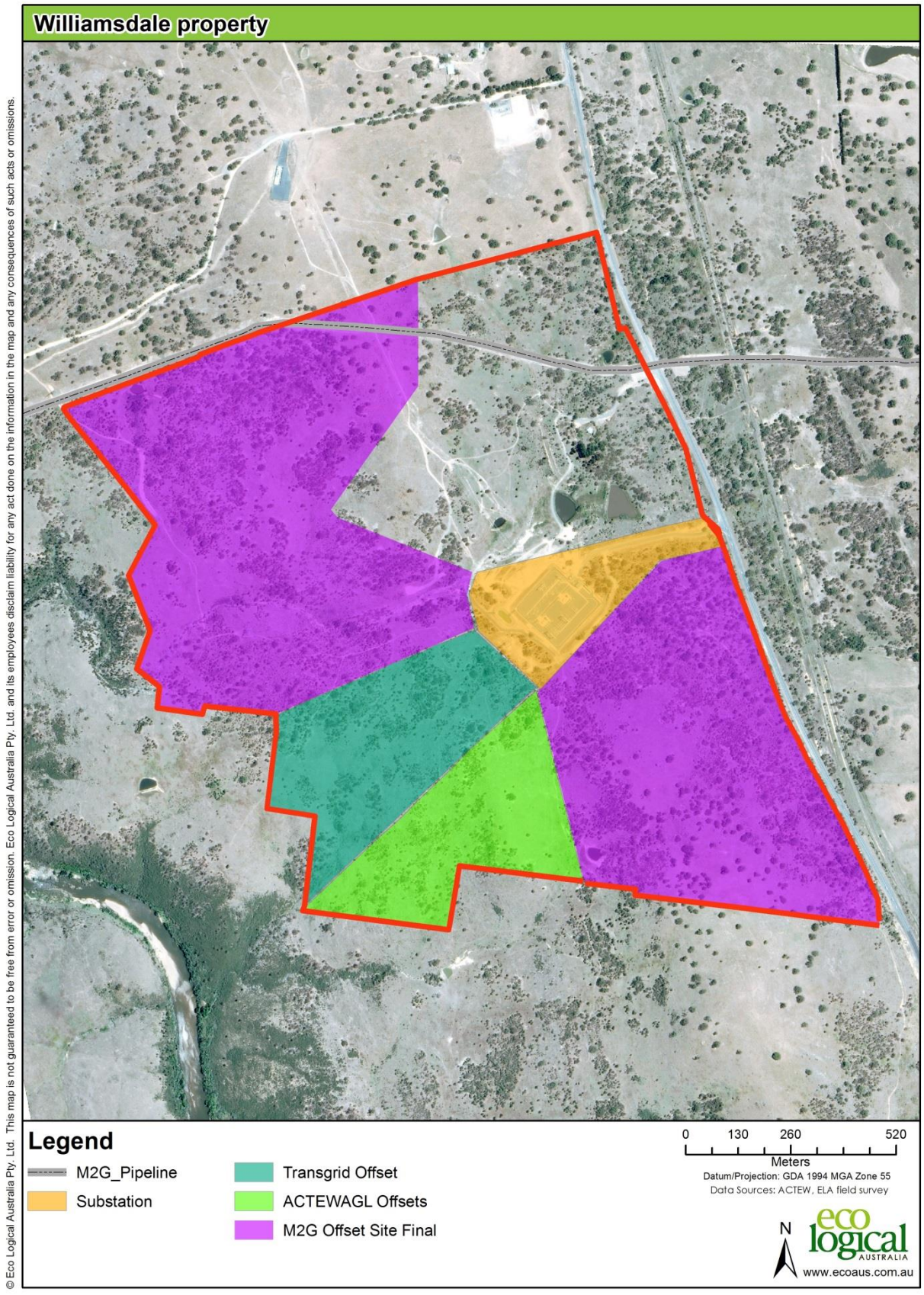


Figure 1: Study area

2 Field survey methods

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 is presented below, followed by the results of the spring 2014 monitoring surveys. The spring 2014 monitoring surveys were undertaken over several days between the 16th and 24th October.

2.1 Vegetation monitoring plot methodology

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 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 referenced using a GPS device (north-west corner) and their location plotted on a map (**Figure 2**).

Each quadrat was surveyed by walking back and forth along 10 parallel transects approximately 2 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 at the time of establishment were free from noxious weeds. 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 the monitoring program.

A description of the monitoring plots is provided in **Figure 6 - Figure** 13**.** 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 3 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 at each point was recorded. 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.

2.2 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, fenceline and erosion monitoring surveys. A species list for offset site is provided in **Appendix A**.

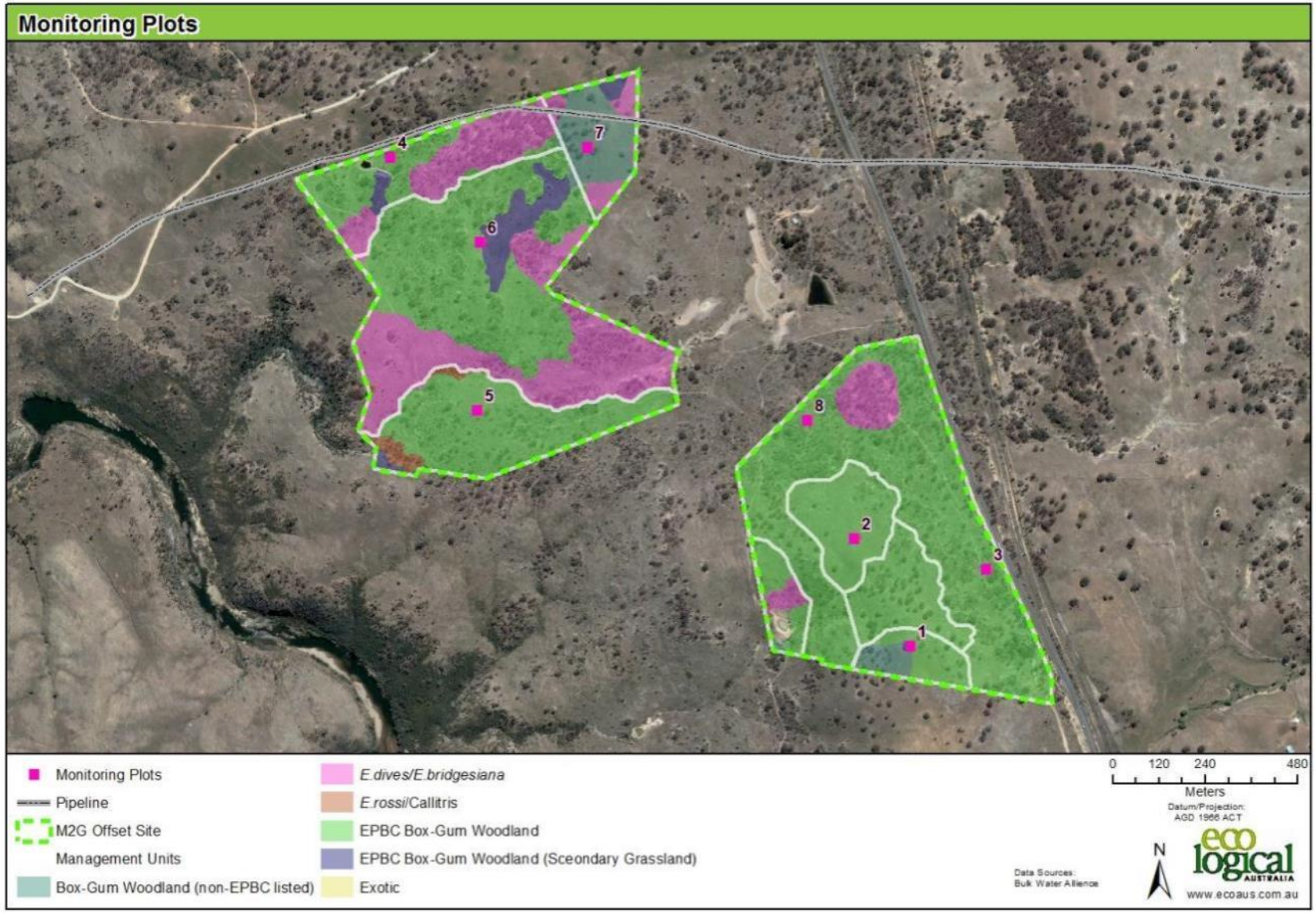


Figure 2: Monitoring plots, management units and baseline offset site ecological values

2.3 Swainsona recta monitoring

Monitoring of translocated *Swainsona recta* plants is conducted during the peak flowering period in October each year. The location of the three translocation plots is shown in Figure 3. 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.

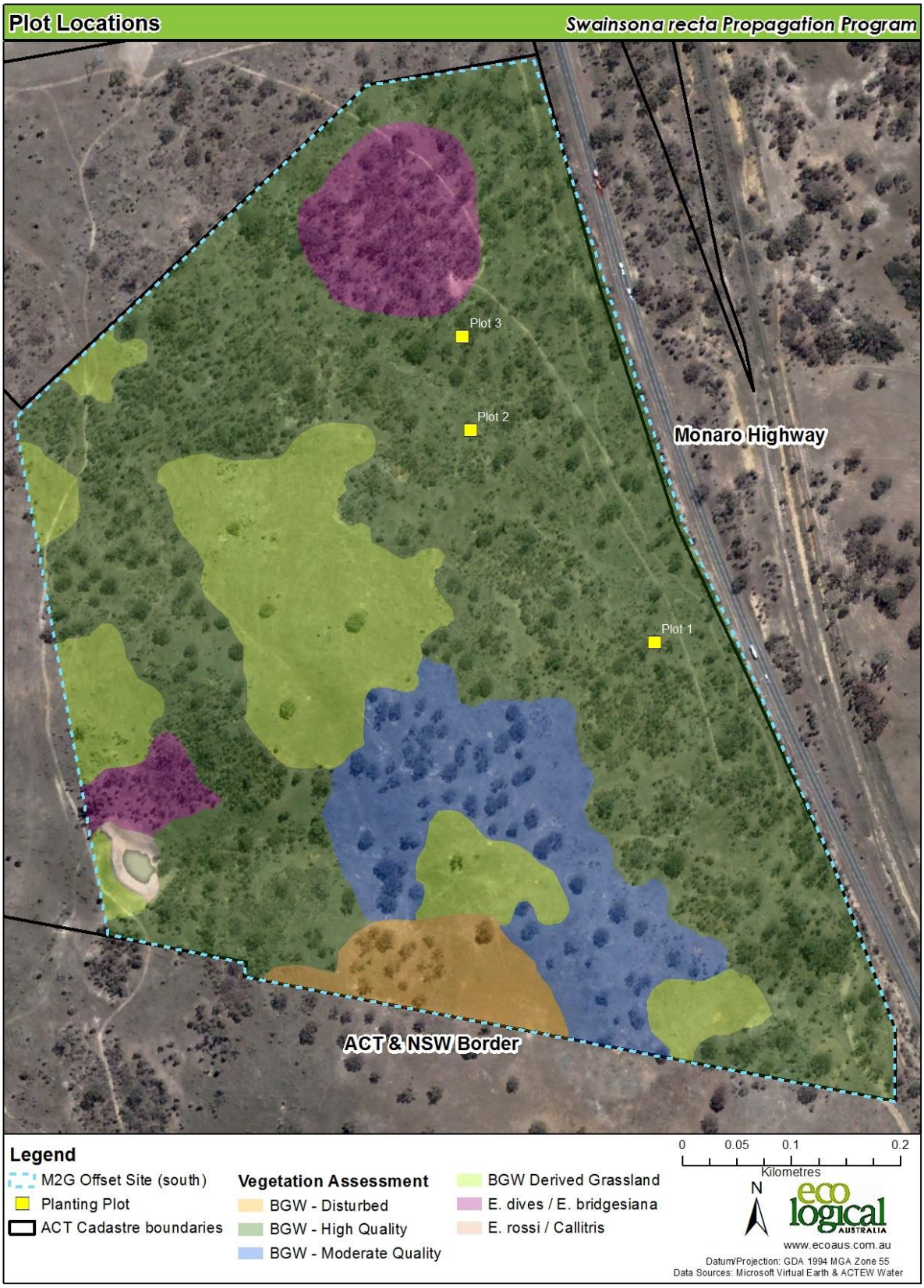


Figure 3: *Swainsona recta* translocation plot locations

2.4 Weed monitoring methodology

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 is undertaken in autumn and spring using random meander transects, covering both the northern and southern offset. Searches focused 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 previous recorded for the site. A GPS record was taken when individuals of these species were encountered. Each GPS record generally represents multiple individuals. For widely distributed species such as *Hypericum perforatum* the GPS records are only indicative of the distribution of the species on site.

2.5 Erosion monitoring methodology

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 significant rain events occurring over this two year period.

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 methodology

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 Fauna habitat, selective fauna surveys and feral animal monitoring methodology

Feral animal monitoring, fauna habitat and fauna surveys of selective groups have been undertaken using a combination of techniques, including:

- Fauna habitat assessment and random meander surveys.
- Infra-red cameras.
- Nocturnal surveys including Anabats, spotlighting and frog habitat surveys.
- Opportunistic observations.

The locations of the infra-red cameras, spot-light transects, frog surveys and Anabats are shown in **Figure 4**.

2.7.1 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 to ensure they remained applicable.

The fauna habitat assessments are outlined in Table 5 and Table 6

2.7.2 Infra-red camera surveys

The use of infra-red cameras was recommended as a monitoring method in the *Autumn 2012 Monitoring Report* (ELA 2012). Remote cameras have been used with success in detecting the presence of feral pigs and other exotic animals, estimating abundance, and determining trapping success (Hamrick et al., 2011).

Two infra-red camera locations were set-up within the offset site and left for a minimum of five days, one within the northern offset and the other in the southern offset. The locations of the infra-red cameras (**Figure 4**) were chosen based on fauna signs, access to water and fauna tracks, such as pig-rooting, wombat tracks and game trails.

2.7.3 Nocturnal surveys

Targeted nocturnal fauna surveys (**Figure 4**) were implemented for the first time during the 2013 spring monitoring surveys, and were conducted to further inform the list of fauna species present within the offset site. Surveys techniques included:

- *Spotlighting* – Two 30 minute transects were conducted across the offset site, one transect within the northern offset and one transect in the southern offset. Transect locations targeted stands of vegetation with a mixed-aged overstorey, hollow-bearing trees and flowering Eucalypts.
- *Frog habitat survey* – Active searches and frog call recordings were conducted at the two dams within the offset site for ten minutes each.
- *Anabat* – Two Anabat devices were put out for four nights between the 20th and 24th October to monitor bat activity through ultrasonic echolocation calls. One Anabat was set up near the southern dam and the other near the northern dam. Unfortunately, the data collected was unable to be analysed for the spring 2014 season due to technical difficulties.

2.7.4 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 (species list available in **Appendix B**). Locations of conservation significant fauna and signs of feral animal presence were referenced using a GPS device.

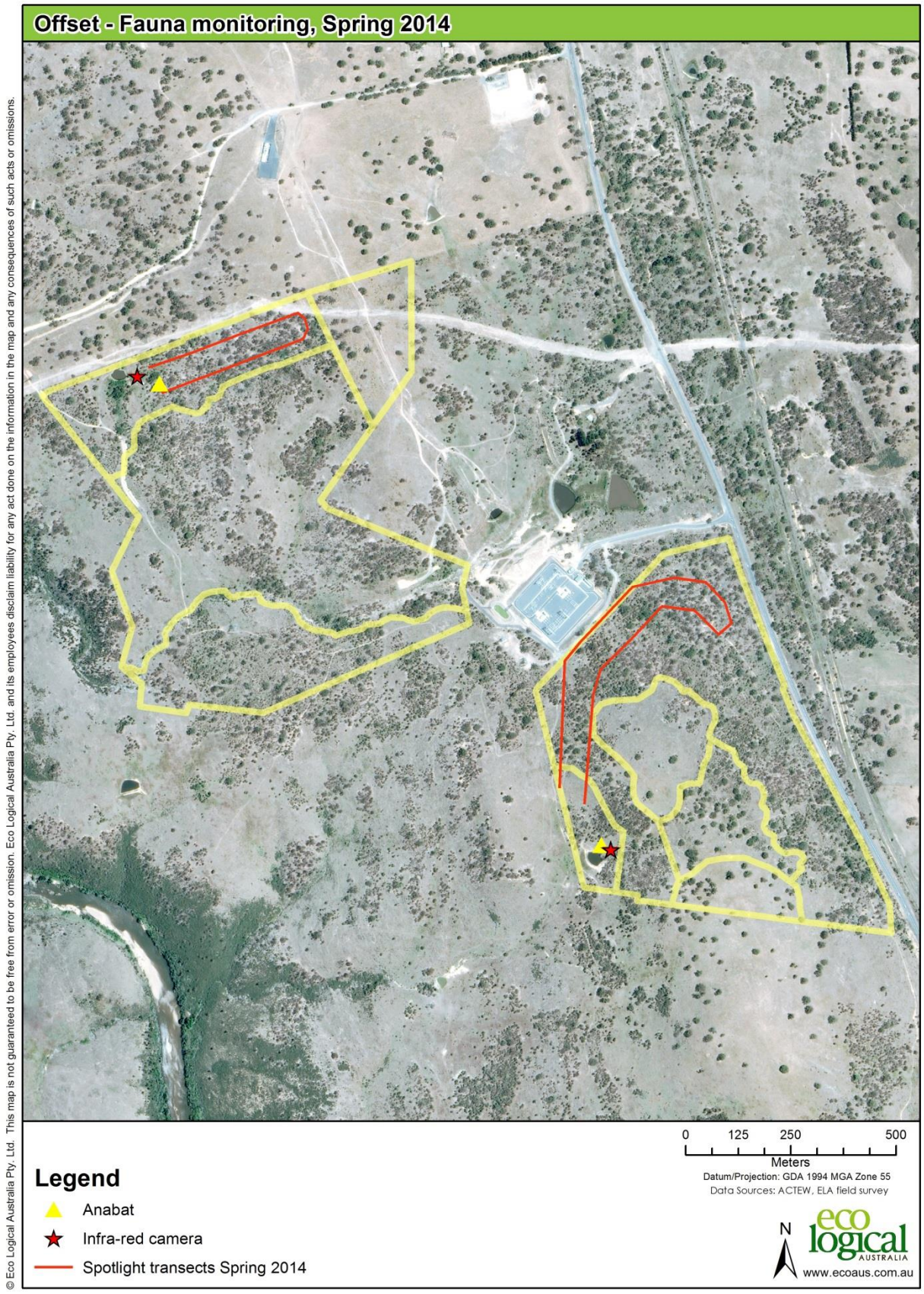


Figure 4: Fauna monitoring locations

3 Biodiversity values

3.1 Flora

Approximately 200 native plant taxa (species, subspecies and varieties) 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 meander routes chosen. The flora recorded includes a range of widely distributed characteristic woodland species, several rare and uncommon species in the ACT and three threatened species listed under the EPBC Act (Table 3, Table 4, and Figure 5).

Plates of some of the threatened, rare and uncommon species are included in Appendix B.

3.1.1 Threatened flora species

An annotated list nationally threatened species occurring 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. 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, surrounded by approximately 10 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 relocated since. Three translocation exclosure plots have been established on site. Details of this program are presented in Section 2.3.

3.1.2 Rare and uncommon ACT species

A number of species considered to be rare or uncommon within the ACT (ACT Government, pers. Comm.) 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. Dozens of plants recorded but extent of distribution on site not established.
Bossiaea prostrata (Creeping Bossiaea)	Prostrate perennial subshrub. Recorded in monitoring plot 5 in the northern offset and in the surrounding area. Relatively few localised patches known within offset.
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 in full flower in October.
Glossostigma elatinoides	Prostrate perennial wetland forb. Localised patch noted in spring 2014 on the banks of the dam in the northern offset. This species was in full flower in October.
Limosella australis (Australian Mudwort)	Diminutive perennial wetland forb. Localised plants noted in spring 2014 on the banks of the dam in the northern offset.
Microseris lanceolata (Yam Daisy)	Perennial forb with fleshy tuberous roots. Recorded in monitoring plot 3 in the southern offset. Generally occurs in better condition vegetation within the offset.
Plantago gaudichaudii (Narrow Plantain)	Perennial forb with thick fleshy taproot. Recorded in monitoring plots 3 (southern offset) and 4 (northern offset). Generally occurs in better condition vegetation within the 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.
Swainsona monticola (Notched Swainson-pea)	Low spreading herbaceous perennial. Noted in the south-eastern corner of the southern offset in spring 2014. Dozens of plants seen but extend 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 2014. This species was widely distributed across the north and southern offsets in spring 2014. Plants are difficult easily overlooked unless flowering.
Zornia dyctiocarpa	Low herbaceous perennial. Noted in the north eastern corner of the southern offset. Extend of distribution on site not established

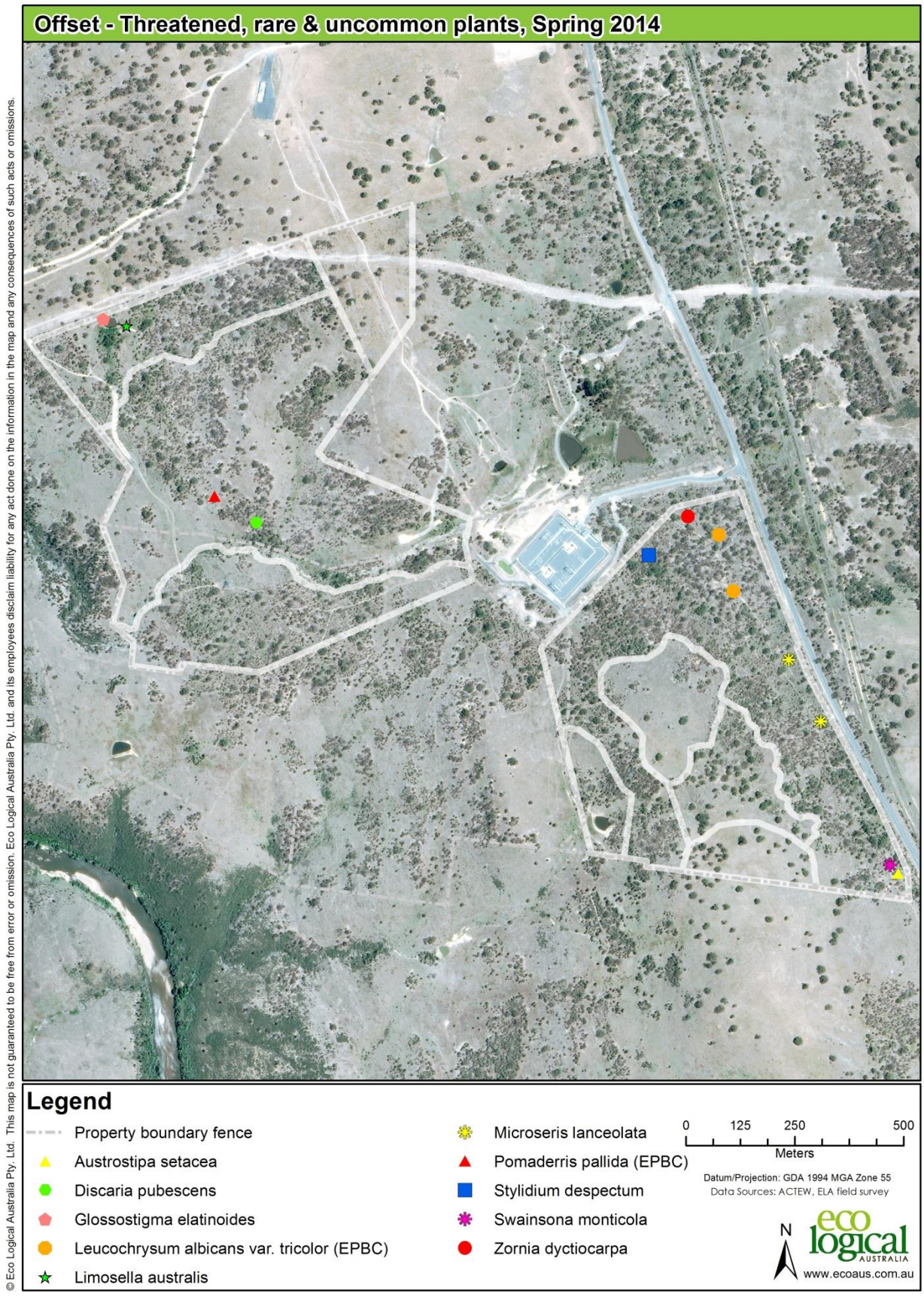


Figure 5 Opportunistic records of threatened, rare and uncommon flora species, Spring 2014

3.2 Fauna

Assessment of fauna present on the offset site is based on fauna habitat assessments, nocturnal surveys of arboreal mammals and frogs, Anabat surveys, infra-red camera surveys and opportunistic observations. A broad range of fauna species have been recorded within the offset site to date. Surveys have opportunistically recorded 63 bird species, 12 mammal species, 6 reptiles, and 6 amphibians. A cumulative list of species recorded is provided in **Appendix C**.

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

Results of the spring 2014 fauna surveys are outlined in the following subsections.

3.2.1 Fauna habitat assessment

During the baseline surveys a rapid assessment was made of the range of fauna habitat features present across the offset site and their abundance (**Table 5)**. 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.

The availability of fauna habitat features observed in spring 2014 was consistent with the baseline monitoring surveys.

Table 5: 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	Common	Common
Regenerating tree thickets	Abundant	Abundant
Native shrub thickets	Common	Occasional
Exotic shrub thickets	Occasional	Occasional
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

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 reassessed in spring 2014. No significant change was observed relative to the baseline condition (**Table 6).**

Table 6: 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 Spring 2014
1	0	0 m	No	Limited surface rocks; abundant exotic annuals
2	0	1 m	No	Surface and outcropping rocks abundant; course woody debris
3	0	11 m	No	Litter common; logs occasional; single ant's nest present
4	0	22 m	No	Developing canopy regeneration; occasional course woody debris
5	0	3 m	No	Developing canopy regeneration; ants nest; course woody debris; limited
6	0	0 m	No	Course woody debris common; developing canopy regeneration
7	0	8 m	No	Surface rocks and course woody debris uncommon; abundant exotic
8	0	14 m	No	Litter; course woody debris; bare ground; hollow logs; surface rocks

Key for table 6: *HBT's* = Hollow-bearing trees. *Logs* = length of fallen logs > 10 cm width. *Comment* = relates to whether a noticeable or significant change has occurred since the completion of the baseline surveys.

3.2.2 Nocturnal surveys

The results of the offset site nocturnal surveys are outlined in Table 7. A total of seven frog species were recorded (aural) during frog habitat surveys, including 5 species at the dam within the southern offset and 4 species at the dam within the northern offset.

A single arboreal mammal species, *Trichosurus vulpecula* (Common Brushtail Possum) was recorded during the spotlight surveys, however, the spot light surveys also recorded two nocturnal bird species, *Aegotheles cristatus* (Owlet Nightjar) & *Ninox novaeseelandiea* (Southern Boobook).

Table 7: Fauna species recorded during targeted nocturnal surveys

Frog habitat survey			
Common Name	Latin name	Threatened status	Observed
Eastern Common Froglet	*Crinia signifera*	Not listed	Northern and Southern Offset
Plains Froglet	*Crinia parinsignifera*	Not listed	Northern and Southern Offset
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	Not listed	Northern and Southern Offset
Whistling Treefrog	*Litoria verreauxii*	Not listed	Northern Offset
Peron's Treefrog	*Litoria peronii*	Not listed	Southern Offset
Smooth Toadlet	*Uperoleia* sp.	Not listed	Northern and Southern Offset
Pobblebonk Frog	*Limnodynastes dumerilii*	Not listed	Opportunistic - offsite
Spotlighting			
Common Name	Latin name	Threatened status	Observed
Common Brushtail Possum	*Trichosurus vulpecula*	Not listed	North and South transect

Owlet Nightjar	*Aegotheles cristatus*	Not listed	Northern Offset
Southern Boobook	*Ninox novaeseelandiae*	Not listed	Southern Offset

3.2.3 Infra-red camera surveys

All species detected by infra-red cameras have previously been recorded. A full list of fauna species observed during the monitoring surveys is outlined in **Appendix B**. Most commonly recorded species were *Macropus giganteus* (Eastern Grey Kangaroo), *Vulpes vulpes* (Fox) and *Vombatus ursinus* (Common Wombat).

4 Vegetation monitoring

A consistent trend observed in the floristic plot data is the increase in number of native species recorded across all plots in spring 2014 relative to the number recorded in the baseline. The only exception is plot 7, which remained stable. There has been a significant increase in species richness at some sites, plot 5 for example increasing from 29 species (baseline survey) to 52 species (spring 2014). Most plots showed a marked increase in native species richness in spring 2012 following the cessation of grazing. The number of native species in each plot has remained relatively stable in the spring surveys since 2012.

The other consistent trend observed is the increase in number of introduced species recorded across all plots in spring 2014 relative to the number recorded in the baseline, spring 2012 and spring 2013 surveys. This increase may be attributed to a range of factors, however a significant one may be the reduction in grazing pressure and corresponding increase in seeding events, which may have facilitated the spread of a range of introduced species already present on the greater site.

Native species richness varies between plots. Six plots have high species richness with 40 plus species recorded in the spring 2014 surveys. Plots 1 and 7 have contrasting lower native species richness, with 16 and 13 species recorded respectively in spring 2014.

All sites were below benchmark values established for the ACT (Sharp & Milner 2014) for overstorey cover and the total length of fallen logs. Saplings of overstorey species are present at most sites and in time will contribute to an increase in overstorey cover.

The results of the vegetation monitoring are provided in the following pages. A summary of each plot is provided in Figure 6 to Figure 13. The raw floristic data for each plot are provided in **Appendix A**.

4.1.1 Monitoring plot 1

Plot Description				
Management unit	MU1A		*Plot number*	1
Vegetation type	Box-Gum Woodland		*Condition*	Low-mod
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*40*	26	**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*	78		
Other (litter, bare, rock)	*N/R*	4		
Native species diversity	*14*	16		

Monitoring plot 1 is located within MU1A on the southern offset. The plot is composed of relatively lower condition Box-Gum Woodland. Few eucalypt saplings were observed (cf. none recorded during the baseline surveys) but none were recorded in the plot or along the transect. Native species diversity was low-moderate (16 species), marginally more than recorded in the baseline surveys. 23 introduced species were recorded, with the number of species and cover being considerably higher than recorded during the baseline survey. *Carthamus lanatus*, *Bromus hordeaceus* and *Trifolium subterraneum* dominate the plot. More frequent native species included *Austrostipa* scabra*, Bothriochloa macra* and *Carex inversa*. 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 are well below benchmark values (Sharp & Milner 2014).

Figure 6: Monitoring Plot 1. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo October 2014)

4.1.2 Monitoring plot 2

Plot Description				
Management unit	MU2B		*Plot number*	2
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	42	**Habitat features**	
Native understorey cover (other)	*4*	16	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	1 m
Exotic understorey plant cover	*6*	68		
Other (litter, bare, rock)	*7*	12		
Native species diversity	*30*	43		

Monitoring plot 2 is located within MU2B within the southern offset. It is situated on a rocky hill containing Pink-tailed Worm Lizard habitat. Outcropping and surface rocks constitutes over 10% of the ground cover. It contains relatively good condition mature Box-Gum Woodland with scattered eucalypt saplings present. A total of 43 native species were recorded within the plot, 13 more than during the baseline surveys. Frequent native species include *Chrysocephalum apiculatum, Austrostipa* bigeniculata and *Bothriochloa macra*. 22 introduced species were recorded, which was higher than the number recorded in the baseline survey (15). Fauna habitat features within MU2B 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 are well below.

Figure 7: Monitoring Plot 2. (Left: Baseline monitoring photo, March 2012. Right: Monitoring photo October 2014)

4.1.3 Monitoring plot 3

Plot Description				
Management unit	MU3		*Plot number*	3
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*3.7*	5	Regeneration	Yes
Native midstorey cover	*5.2*	5.2	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	58	**Habitat features**	
Native understorey cover (other)	*16*	22	Tree hollows	0
Exotic midstorey plant cover	*0.2*	0	Fallen logs	11 m
Exotic understorey plant cover	*10*	44		
Other (litter, bare, rock)	*N/R*	0		
Native species diversity	*27*	47		

Monitoring plot 3 is located within MU3 in the southern offset. The plot is located in moderate to good quality Box-Gum Woodland. A significant number of eucalypt saplings are present. A total of 47 native species were recorded within the plot, 20 more than during the baseline surveys. The understorey is dominated by *Themeda australis*, with co-occurring native species having significantly lower cover values. The native mid-storey species *Bursaria spinosa* was present but rare. 28 introduced species were recorded, which was much higher than the number recorded in the baseline survey (7). Frequent weeds include *Aira* spp. and *Hypochaeris glabra*. Fauna habitat features within MU3 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 are well below.

Figure 8: Monitoring Plot 3. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo October 2014)

4.1.4 Monitoring plot 4

Plot Description				
Management unit	MU4		*Plot number*	4
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*4.7*	10	Regeneration	Yes
Native midstorey cover	*11.5*	9	Species	*E. blakelyi*
Native understorey cover (grass)	*74*	68	**Habitat features**	
Native understorey cover (other)	*18*	36	Tree hollows	0
Exotic midstorey plant cover	*2*	0	Fallen logs	22 m
Exotic understorey plant cover	*28*	54		
Other (litter, bare, rock)	*N/R*	0		
Native species diversity	*24*	43		

Monitoring plot 4 is located in the northern offset in MU4. It is located in moderate to good quality Box-Gum Woodland dominated by *E. blakelyi*. Good numbers of eucalypt saplings are present compared to the baseline survey. A total of 43 native species were recorded within the plot, 19 more than during the baseline surveys. The understorey is dominated by *Themeda australis*, *Microlaena stipoides, Asperula conferta* and *Haloragis heterophylla*. 21 introduced species were recorded, slightly more than the number recorded in the baseline survey (16). Frequent weeds include *Bromus hordeaceus* and *Trifolium dubium*. Control of *R. rubiginosa* is less successful than originally thought with regrowth of many plants evident. Fauna habitat features within MU4 have not changed noticeably since the baseline surveys. Most site parameters are just below, within or above benchmark values (Sharp & Milner 2014), except for total length of fallen logs.

Figure 9: Monitoring Plot 4. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo October 2014)

4.1.5 Monitoring plot 5

Plot Description				
Management unit	MU5		*Plot number*	5
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*11*	19	Species	*E. blakelyi*
Native understorey cover (grass)	*76*	66	**Habitat features**	
Native understorey cover (other)	*14*	26	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	3 m
Exotic understorey plant cover	*4*	8		
Other (litter, bare, rock)	*16*	54		
Native species diversity	*29*	52		

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 dominated by *E. blakelyi* with a significant amount of natural regeneration present. The plot supports a highly diverse understorey of graminoids and forbs with 52 native species recorded in spring 2014, 23 species more than the baseline number. The understorey is dominated by *Themeda australis* and *Chrysocephalum apiculatum*. 20 introduced species were recorded, more than double the number recorded in the baseline survey (8). No weed species currently has a cover value exceeding 5%. Fauna habitat features within MU5 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 are well below.

Figure 10: Monitoring Plot 5. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo October 2014)

4.1.6 Monitoring plot 6

Plot Description				
Management unit *Vegetation type*	MU6 Box-Gum Woodland		*Plot number* *Condition*	6 Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*5.3*	4	Regeneration	yes
Native midstorey cover	*0*	0	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	44	**Habitat features**	
Native understorey cover (other)	*10*	12	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	0 m
Exotic understorey plant cover	*8*	94		
Other (litter, bare, rock)	*N/R*	0		
Native species diversity	*28*	43		

Monitoring plot 6 is located in MU6, along the central ridge line of the property, in moderate-good quality Box-Gum Woodland dominated by *E. blakelyi.* The plot is situated in an intersection between the woodland and derived grassland forms of the ecological community. The plot supports a diverse understorey of grasses and forbs with no species dominant. 43 native species were recorded in spring 2014, compared with 28 species in the baseline survey. 27 introduced species were recorded, 10 species more than the number recorded in the baseline survey (17). Frequent weeds include *Trifolium arvense* and *Vulpia spp.* 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 are well below.

Figure 11: Monitoring Plot 6. (Left: Baseline monitoring photo, March 2012. Right: Monitoring photo October 2014)

4.1.7 Monitoring plot 7

Plot Description				
Management unit	MU7		*Plot number*	7
Vegetation type	Box-Gum Woodland		*Condition*	low
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	No
Native midstorey cover	*0*	0	Species	*N/A*
Native understorey cover (grass)	*74*	0	**Habitat features**	
Native understorey cover (other)	*0*	20	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	8 m
Exotic understorey plant cover	*34*	100		
Other (litter, bare, rock)	*N/R*	0		
Native species diversity	*13*	13		

Monitoring plot 7 is located within MU7 in the northern offset. The management unit is composed of degraded Box-Gum Woodland with the overstorey dominated by *E. blakelyi.* Native species diversity in the plot was low (13 species), the same number recorded in the baseline surveys. Only *Carex inversa* was common, though with less than 5% cover. Introduced species dominate the site, with 32 species recorded in spring 2014, slightly more than recorded in the baseline surveys (26). Dominant weeds in spring 2014 were *Bromus hordeaceus* and *Trifolium subterraneum*. Fauna habitat features within MU7 have not changed noticeably since the baseline surveys. All site parameters were well below benchmark values (Sharp & Milner 2014), except for native understorey (other) cover.

Figure 12: Monitoring Plot 7. (Left: Baseline monitoring photo, March 2012. Right: Monitoring photo October 2014)

4.1.8 Monitoring Plot 8

Plot Description				
Management unit	MU3		*Plot number*	8
Vegetation type	Box-Gum Woodland		*Condition*	Mod-Good
Plot Statistics (%)	***Baseline***	**Spr. 2014**	**Overstorey**	
Native overstorey cover	*0*	0	Regeneration	Yes
Native midstorey cover	*8.5*	4	Species	*E. blakelyi*
Native understorey cover (grass)	*80*	66	**Habitat features**	
Native understorey cover (other)	*14*	14	Tree hollows	0
Exotic midstorey plant cover	*0*	0	Fallen logs	14 m
Exotic understorey plant cover	*4*	30		
Other (litter, bare, rock)	*N/R*	14		
Native species diversity	*26*	40		

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 good quality Box-Gum Woodland dominated by *E. blakelyi.* The understorey species is dominated by *Themeda australis* with a diverse range of co-occurring graminoids and forbs. 40 native species were recorded in spring 2014, an increase of 14 species since the baseline surveys. 18 introduced species were recorded, slightly more than the number recorded in the baseline survey (14). Fauna habitat features 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 are well below.

Figure 13: Monitoring Plot 8. (Left: Baseline monitoring photo, October 2011. Right: Monitoring photo October 2014)

5 Swainsona recta monitoring

5.1 Results summary

The spring 2014 *Swainsona recta* census was undertaken on the 20th October 2014. This was 28 months post translocation for individuals planted in 2012 and 13.5 months post translocated for individuals planted in 2013. A significant increase in plant mortality was observed during the spring 2014 survey. Of the 112 individuals planted within the three translocation plots, only 32 were present in spring 2014. This represents an overall survivorship of 28.5%, which is down significantly from the 79% overall survivorship recorded in spring 2013. All plots showed a similar marked reduction in survivorship, ranging from 25% (plot 2) to 32.5% (plot 1). Of those plants which were present, 65% were in flower or had immature fruits (Table 11). Many of the non-fertile plants appeared to have poor vigor (Table 11).

The Mt Taylor provenance 2012 plantings had consistently low survival rates across all plots (range 10%-19% survivorship). None of the plants originally grown in potting mix survived, whilst survival rates for those plants growing in a mixture of local soil and potting mix ranged from 18% (plot 3) to 31% (plot1). This may indicate that the species requires a mycorrhizal association to be able to thrive.

Higher survivorship rates were evident for the Williamsdale and Burra provenance 2013 plantings. Overall survivorship for the Williamsdale provenance stock was 46%, ranging from 33% (plot 3) to 71% (plot 1). Overall survivorship for the Burra provenance stock was 50%, ranging from 37.5% (plot 2) to 71% (plot 3). Given that survival rates for the Mt Taylor provenance 2012 plantings were significantly higher in the initial 16 months post translocation compared to 28 months post translocation, there is the possibility that survival rates for the Williamsdale and Burra provenance stock will decline over the next 12 month period.

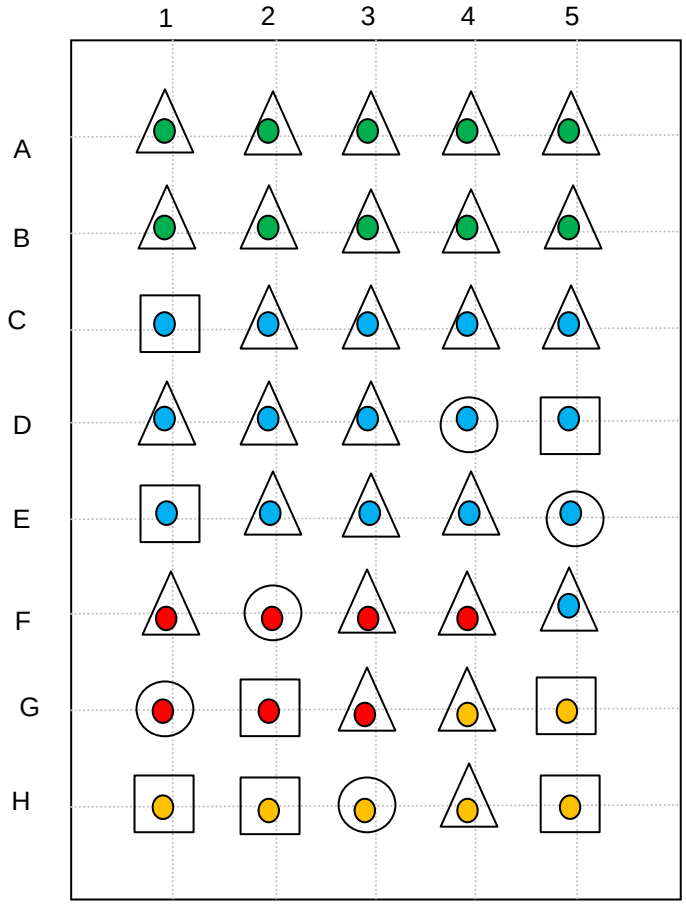
Some plant mortality is clearly related to initial transplant shock. In the spring 2013 monitoring report (ELA 2013) it was speculated that the small size of seedlings and the use of water crystals in the planting medium may have contributed to mortality shortly after planting. The factors driving mortality at longer periods post translocation are currently uncertain; however a key factor could be competition from native perennial grasses. The maintenance of inter-tussock gaps is known to be a critical factor in maintaining species richness in grasslands and grassy woodlands (Wong & Morgan 2007). It is recommended that ACTEW consider opening the fence surrounding the plots for a period of time to allow native grazers to enter the plot and reduce some of the perennial grass cover present. It is recommended that this occur during spring, while there is substantial forage around the offset site in general, to limit the likelihood of the plots being grazed more intensively than surrounding areas. It would be prudent to open the fence surrounding one plot initially to determine the effect that grazing has on the plantings prior to applying the same treatment to all three plots.

Annual monitoring should continue for as long as plants persist within the plots. Absent plants were treated as dead in this assessment, however there is evidence from 2013 and 2014 data that some plants recorded as absent in spring 2013 were alive (but had died back to a rootstock) as they were present in spring 2014. As such, the mortality figures presented in this report are based on those individuals present during Spring 2014 only. Longer term monitoring will provide a clearer picture of the success of the plantings.

5.1.1 Plot 1

Table 8: Plot 1 monitoring results

Key	Results	Comments
○	**Present** - in flower or immature fruit	5 plants fertile, from 2013 plantings
□	**Present** – lacking flowers and fruits	8 observed with leaf only, 2013 plantings
△	**Absent** - not observed	21 from 2012 & 6 from 2013 plantings not observed



Plot 1 - 2014

Plot 1 occurs within Box-Gum Woodland with a *Themeda australis* (Kangaroo Grass) dominated understorey. 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* (Blakely's Red Gum) 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 were from each of the Williamsdale and Burra populations.

Of the 40 plants, 13 were present in spring 2014 (5 from 2012 plantings and 8 from 2013 plantings), representing an overall survivorship of 32.5 % (Plot 1

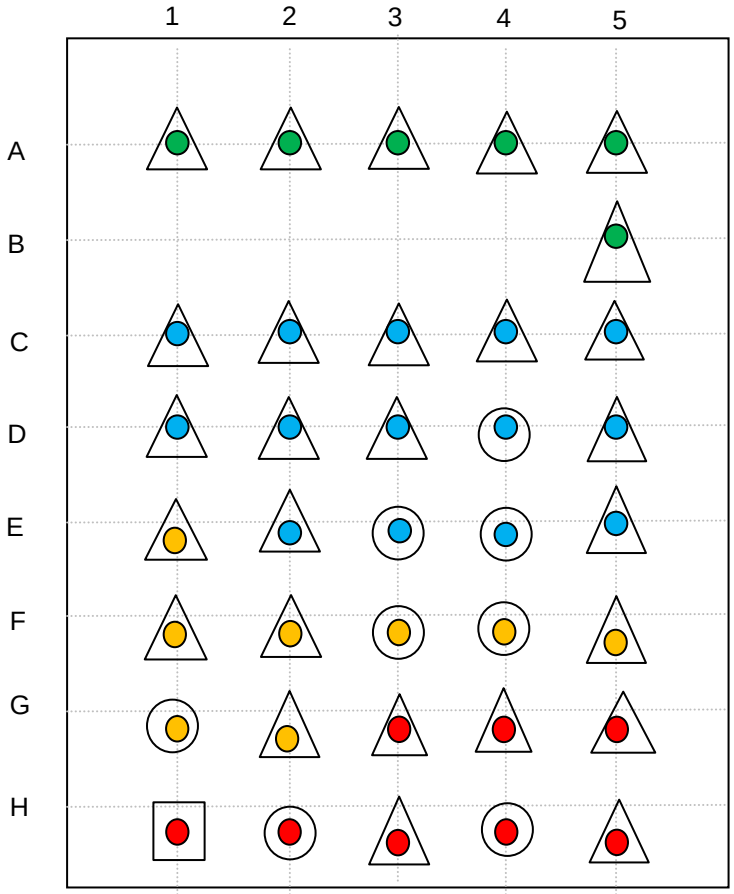
Table 8). No recruitment was observed within the plot.

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

5.1.2 Plot 2

Table 9: Plot 2 monitoring results

Key	Results	Comments
◯	**Present** - in flower or immature fruit	8 plants fertile, mostly 2013 plantings
□	**Present** - lacking flowers and fruits	1 observed with leaf only
△	**Absent** - not observed	17 from 2012 & 10 from 2013 plantings not observed



Plot 2 - 2014

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 have been 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.

Of the 36 individuals, 9 were present in spring 2014 (3 from 2012 plantings and 6 from 2013 plantings), representing an overall survivorship of 25 % (

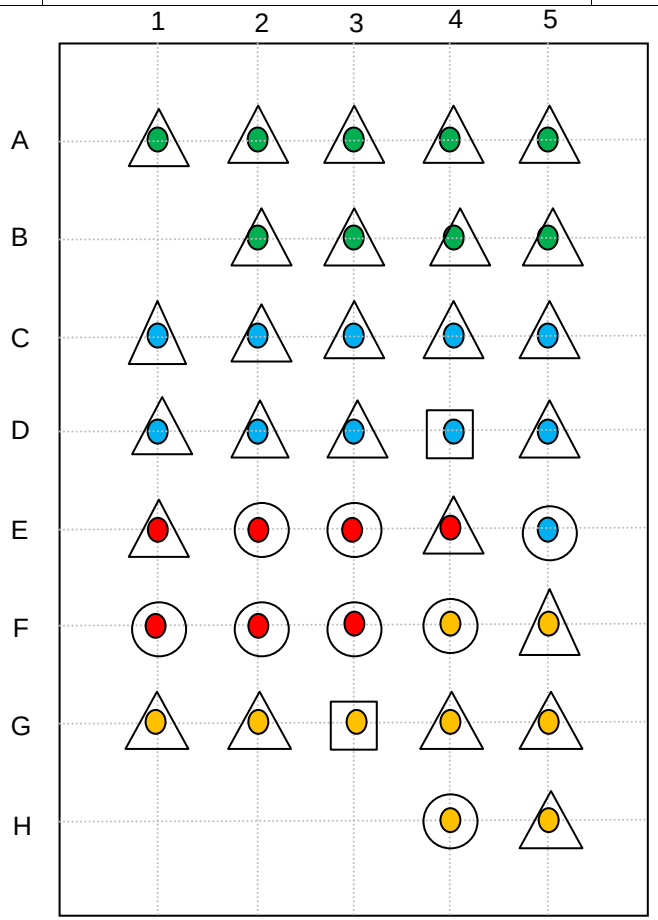
Plot 2

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	8 plants fertile, mostly 2013 plantings
□	**Present** - lacking flowers and fruits	2 sterile plants, 2013 & 2013 plantings
△	**Absent** - not observed	18 from 2012 & 8 from 2013 plantings not observed



Plot 3 - 2014

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 were from the Williamsdale population and 9 from the Burra population.

Of the 36 individuals, 10 were present in spring 2014 (2 from 2012 plantings and 8 from 2013 plantings), representing an overall survivorship of 27.7 % (Plot 3

Table 10**)**. 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

Table 11 *Swainsona recta* plates

Photo 1: *Swainsona recta* in flower (Plot 3)

Photo 2: *Swainsona recta* fruit maturing

Photo 3: Individual in leaf only. No evidence of flowering for the 2014 season.

Photo 4: Example of individual in poor condition

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. No control work has been undertaken since the offset sites were monitored in autumn 2014

Follow-up control for **all** weeds is scheduled for mid to late-2014 and the summer 2014 / 2015 period. The weed control will be consistent with previous efforts and timings. For further detail on the management actions recommended, refer to the ODP and sub-plans.

6.2 Weed monitoring results

A summary of the distribution and abundance of declared weed species across the offset site recorded during the baseline survey and spring 2014 monitoring survey is provided in Table 12 below.

The indicative distribution of declared weed species across the offset site is mapped in **Figure 14** and **Figure 15** .

Table 12: Summary of prior weed occurrence and spring 2014 monitoring results

Species	Weed occurrence prior to current surveys (baseline)	Spring 2014 monitoring results
African Lovegrass (*Eragrostis curvula*)	Low, localised areas of dominance. Present across the offset site in isolated patches. Where it occurs, it forms a dense mat of tussocks and dominates the understory.	Relatively few isolated individuals or small patches were observed across the offset site with some heavier infestations around the main drainage line. Control appears to have been successful in most areas, however isolated infestations are still present. **MU occurrence**: MU2A, 6, 7 **Recommendation**: Follow-up weed control required targeting drainage lines and isolated individuals.
Serrated Tussock (*Nassella trichotoma*)	Low, scattered individuals in some areas. Present in open areas of the offset site. Primarily present as a number of scattered individuals within MU1 along the southern boundary.	Scattered plants persist near the southern boundary of the southern offset. Control work undertaken in mid to late-2013 appears to have been less successful than previously reported. **MU occurrence**: MU1A, 2B **Recommendation**: Follow-up weed control required in accordance with weed control program outlined in the sub-plan.

Species	Weed occurrence prior to current surveys (baseline)	Spring 2014 monitoring results
Blackberry (*Rubus fruticosus*)	Low, localised areas of dominance. Predominantly found within the northern offset, and was more or less restricted to the drainage lines or moist areas.	Targeted control work has been highly successful. Occasional isolated patches and scattered young individuals were observed in spring 2014. **MU occurrence**: MU1A, 1B, 3, 4, 5, 6, 7 **Recommendation**: Follow-up control.
Woody Weeds (Hawthorn, *Prunus, Pyracantha & Cotoneaster*)	Very low, isolated individuals. Present within the study area as isolated individuals.	Scattered plants persist throughout the offset site as some individuals were missed during the spraying operations. **MU occurrence**: MU3, 4, 5, 6, 7 **Recommendation**: Targeted control of isolated individuals.
St John's Wort (*Hypericum perforatum*)	Scattered and moderate occurrence across the offset site.	Despite control efforts over summer 2012/2013 and 2013/2014, the species remains extensively distributed across both the northern and southern offsets. *Chrysolina* Beetles, one of the main biological control agents for the species, have naturally established on site but have a patchy distribution. Totally defoliation by *Chrysolina* Beetles was observed in some areas. **MU occurrence**: All units **Recommendation**: Closely monitor the distribution and abundance of *Chrysolina* Beetles across the offset sites. Physically redistributing beetles across the offset sites will maximise their effectiveness. Plants may recover if there is sufficient summer rain and if beetle populations are low (Briese et al 2000). Herbicide application may be required in shady areas under trees where *Chrysolina* Beetles are ineffective (Briese et al 2000).
Thistles (*Carthamus lanatus, Carduus* spp. & *Onopordum* spp.)	Moderate, localised areas of dominance.	Thistles were recorded predominantly in areas with significant history of disturbance. *Carduus* spp. were commonly encountered beneath the canopy of trees. MU1 has a substantial cover of young *Carthamus lanatus* that will become denser as the season progresses. The adjacent property to the south also has a high cover of thistles, which makes any corrective action within the offset site difficult. **MU occurrence**: MU1A, 1B, 3, 4, 6, 7 **Recommendation**: For *Carthamus lanatus* particularly, consider control options within a broader program encompassing the adjacent property.

Species	Weed occurrence prior to current surveys (baseline)	Spring 2014 monitoring results
Sweet Briar (*Rosa rubiginosa*)	Moderate, widely distributed at low density with scattered individuals, some areas of dominance. Present across the offset site, often with larger infestations under mature trees.	When assessed in autumn 2014 the control work appeared to have been largely successful, however re-assessment in Spring 2014 revealed that many more plants have re-sprouted than recorded in autumn 2014. The species is still broadly distributed across the offset sites, although at this stage primarily as resprouting individuals. **MU occurrence**: All units. **Recommendation**: Follow up spot spraying of individuals missed or re-sprouting.

A cumulative total of 105 introduced species have been recorded for the offset site. A breakdown of species by life form is provided in Table 13**.**

Table 13: Number of introduced species by life form

Life form	Number of species
Annual grasses	17
Annual sedges, rushes and irids	4
Perennial grasses	10
Perennial sedges and irids	2
Annual forbs (obligate)	41
Annual, biennial or short-loved perennial forbs	15
Perennial forbs (obligate)	10
Shrubs and trees	6

Of note is the large proportion of annual weed species occurring on site. A total of 41 species occurring on site are obligate annual forbs and a further 15 forb species may live for only a year if conditions are unfavourable. There are 17 species of annual grass occur on site.

A number of annual forbs and grasses are highly invasive and are well established across the offset site. Such species include *Aira* spp., *Briza minor*, *Bromus hordeaceus*, *Erodium cicutarium*, *Hypochaeris glabra*, *Linaria* spp., *Parentucellia latifolia*, *Pentaschistis airoides*, *Petrorhagia nanteuilii*, *Tolpis umbellata*, *Trifolium* spp. and *Vulpia* spp. Their impact on native flora can be significant if they occur at high densities, whether as individual species or as mixtures of multiple species. Several annual grasses including *Briza spp.*, *Bromus spp.* and *Vulpia* spp. are particularly problematic. To date annual weeds have not be included in the control program at M2G.

Although it is impractical to attempt control of these species throughout the offset, their control in specific higher quality areas within the offset site could be considered. Control actions if undertaken should focus on the prevention of seed production in spring. Spring burning and the addition of carbon supplements have shown promise (Prober et al 2005). Weed burners, mowers or brush cutters are alternatives means of removing flowering parts before seed maturity. A specialist bush regeneration team may be required to undertake this work as it requires a good knowledge of plant identification, the ability to recognise optional timing for actions and familiarity with control techniques.

Prior to undertaking any weed control work of this nature it would be essential to identify the areas within the offset that have particular values to manage (e.g. high plant diversity, presence of threatened or rare species, lower densities of competitive weeds). Mapping the occurrence and density of the range of competitive weed species on site, not just those declared species, would assist in identifying areas on vegetation in better condition. A map of this type would assist in planning a weed management program that is based on maintaining or improving the condition of the better quality areas and working outwards into areas in poorer condition. Control of some annual grass species would need to be a component of an areas-based approach of this nature.

6.3 Adaptive management recommendations

ELA recommends that the follow-up control of African Lovegrass, Serrated Tussock, Sweet Briar, Blackberry, Hawthorn, *Prunus* sp., *Pyracantha* sp. & *Cotoneaster* sp. be undertaken, as outlined in the weed management sub-plan. ELA recommends that control work on Thistles be undertaken, especially in the southern offset (particularly MU1B). This work should not be limited to the offset site but include control within the adjacent southern property for maximum effectiveness.

ELA recommends that biological control should be the primary control method for St John's Wort. *Chrysolina* beetles, which are a biological control agent for St John's Wort have become established on the property through natural dispersion. It is recommended that the distribution and abundance of *Chrysolina* Beetles across the offset site be monitored and beetles redistributing to maximise their effectiveness. Herbicide application may be required in shady areas under trees where *Chrysolina* Beetles are ineffective.

ELA also recommends that surveys for new weed introductions be a more significant component of the biannual weed monitoring program. This would assist in the early detection of new weed outbreaks and facilitate early intervention whilst population numbers are still low. A relevant example is the occurrence of a small population of *Briza maxima* (Quaking Grass), an exotic annual grass found near the eastern boundary of the southern offset in autumn 2014.

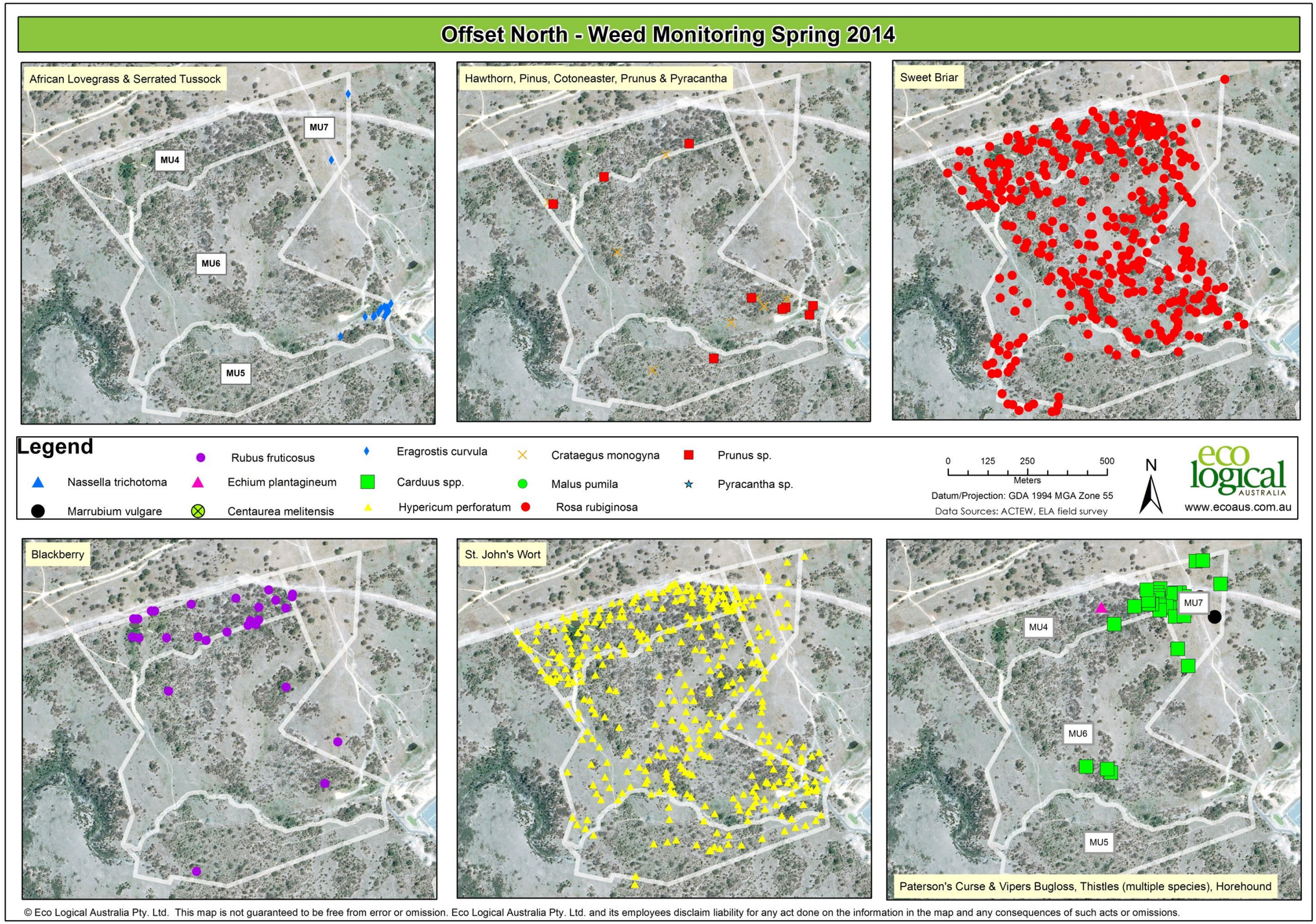


Figure 14: Relative weed distribution, northern offset

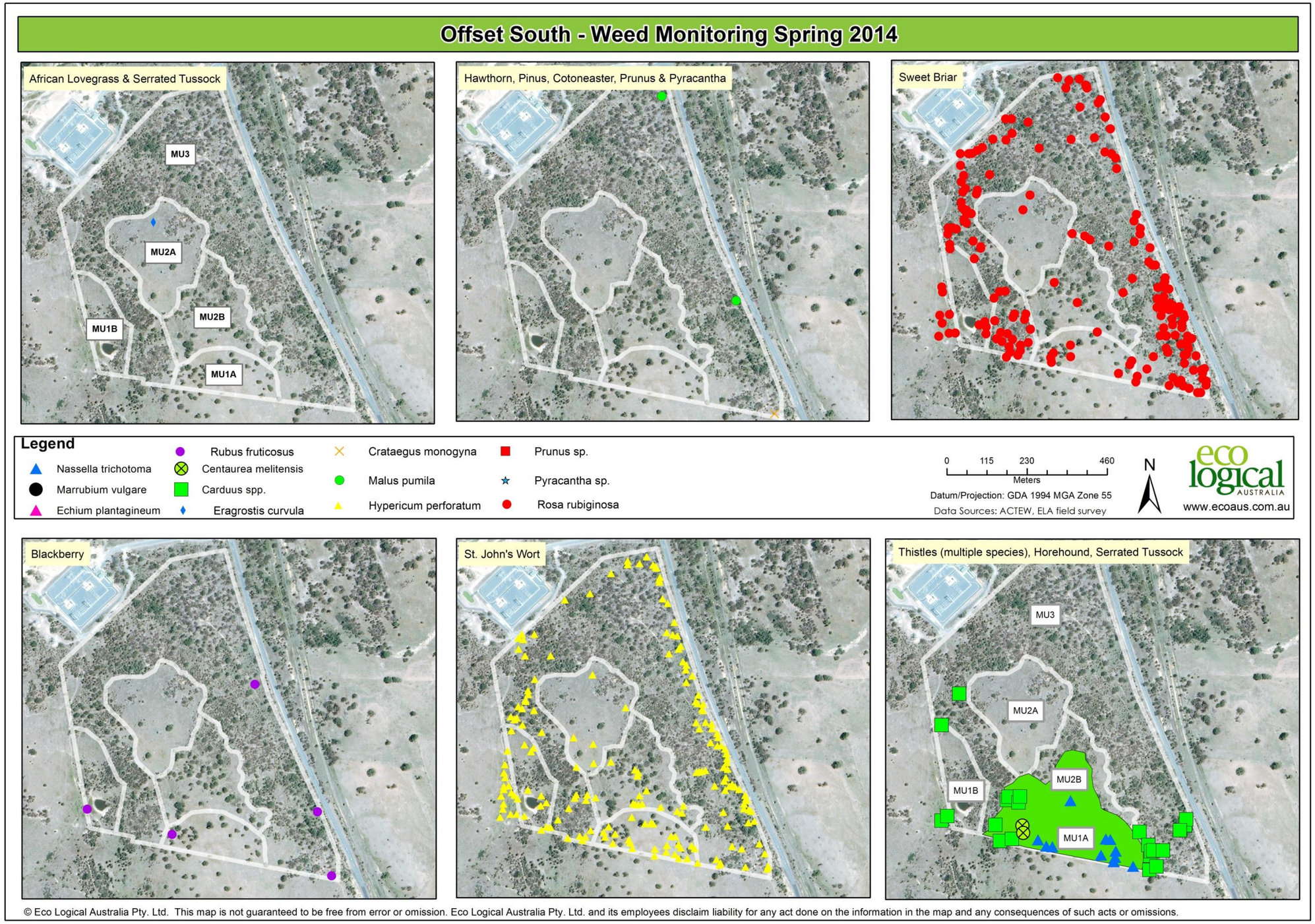


Figure 15: Relative weed distribution in the southern offset

7 Erosion monitoring

7.1 Erosion management actions undertaken to date

It should be noted that no on-ground erosion management activities have been undertaken to date. For further detail on management actions recommended refer to the ODP and Erosion Management Sub-plan.

7.2 Erosion monitoring point results

A total of 18 erosion monitoring points were recorded during the autumn 2012 surveys with all points falling within Erosion Management Zone 1 (see ODP). An additional three monitoring points were established in spring 2012, one in autumn 2013 and one in spring 2013. A number of erosion monitoring points (1, 3, 5, 11, 12, 14, 15, 16, 17, 19 and 20) were recommended to be discontinued after the spring 2013 surveys. This was due to a lack of erosion activity at these points and the large number of points used in the monitoring surveys.

Erosion monitoring point locations included in the spring 2014 surveys are mapped in Figure 16 and Figure 17.

The rainfall total over the six month period since the autumn 2014 surveys was approximately 207mm (BOM 2013; Tharwa General Store, station 70083, approx. 8 km north-west). During this period rainfall was below the long-term mean for all months except June. A total of 34mm of rain fell within the month leading up to the surveys, with 24mm of this recorded in the week prior to the monitoring surveys. No significant rainfall events occurred since the autumn 2014 monitoring surveys. The largest rainfall event occurred on September 10th with 20mm of rain recorded within 24 hours.

The majority of erosion monitoring points are located along ephemeral drainage lines in the northern offset. The erosion points are in a variety of conditions; however vegetative cover surrounding each point is generally very high. All of the points are currently stable, but some may require minor remediation works in the future if they are found to be continuously active and/or active following a significant rain event. To date (since baseline surveys), only very minor erosion activity has been observed across the offset site. 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.

Figure 16: Erosion monitoring points in northern offset

Figure 17: Erosion monitoring points in southern offset

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.

Action required: No works required at this stage. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Spring 2014

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: No significant change observed since baseline monitoring survey. Heighten animal activity (tracks) adjacent to the erosion point.

Action required: No works required at this stage. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Spring 2014

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: No change observed since baseline monitoring survey.

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

Autumn 2012

Spring 2014

Erosion Point 7:

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

Size: Approximately 20 m long and 1.0 m deep.

Change: No significant change observed since baseline monitoring period. However, low active erosion maybe occurring as water sheets off upslope area.

Action required: Targeted monitoring at photo point following extreme rainfall event and continue bi-annual monitoring.

Autumn 2012 (baseline)

Spring 2014

Erosion Point 8:

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

Size: Approximately 15 m long and 1.0 m deep.

Change: A small amount of erosion may be occurring on the northern bank.

Action required: Targeted monitoring at photo point following extreme rainfall event and continue bi-annual monitoring. Rehabilitation measures to increase bank stability such as plantings could be considered.

Autumn 2012 (baseline)

Spring 2014

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.

Action required: Continued bi-annual monitoring.

Autumn 2012 (baseline)

Spring 2014

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: Some minor erosion has occurred adjacent to the new fence line since the baseline surveys (this is within the neighbouring property to the south of the offset site).

Action required: No immediate action required. Continued bi-annual monitoring.

Autumn 2012 (baseline)

Spring 2014

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 2-3.5 m wide.

Change: Some minor slumping at gully head previously occurred. No change since spring 2012.

Action required: No immediate action required. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Spring 2014

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, 3.0 m wide, 4.0 m long.

Change: Some slumping and erosion activity evident (red circle) as per Autumn 2014 survey.

Action required: No ground works required at this stage. Continue bi-annual monitoring.

Autumn 2012 (baseline)

Autumn 2014 (Spring 2014 not available)

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, 0.6 m deep, 1.5-3 m long.

Change: No change since previous survey.

Action required: No action is required at this stage. Continual bi-annual monitoring.

Spring 2012 (baseline)

Spring 2014

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: 20 cm wide, 30 cm deep, 1.5 m long.

Change: Water flow previously caused the erosion point to deepen and widen. Although the depth has reduced this point remains susceptible to further erosion.

Action required: No works required at this stage. Continual bi-annual monitoring and if a similar change is observed, then action will be required to reduce the speed of water flow exiting the overflow pipe.

Spring 2013 (baseline)

Spring 2014

7.3 Additional erosion issues

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. These two sites were examined during the spring 2014 survey to ascertain whether there was insufficient vegetation cover and what species may be suitable for revegetation. The two sites are located along the main drainage line separating MU5 & MU6 within the northern offset.

7.3.1 Site 1

Active erosion of the creek bank was observed at the eastern end of the main drainage line within the northern offset, adjacent to the Transgrid Substation site.

Erosion of the bank appears to be occurring during periods of high flow and may be the result of water being channelled down the rock armoured channel from the substation detention pond. It is recommended that rehabilitation of this section of the drainage line be considered as the site is not stable in its current form and is contributing to the sediment load of the creek line.

Figure 18 Erosion occurring along main drainage line, northern offset

Rehabilitation options for this site require the establishment of a structurally stable bank and need to consider the proximity of the site to high voltage overhead powerlines, and appropriate access for plant. Access to the site for plant should be straight forward given the sites proximity to access tracks located upslope of the creekline.

Rehabilitation of this site will need to be informed by more detailed studies of the hydrology of the drainage line including flow velocities, frequency and volume to ensure that the rehabilitation method

selected is appropriate to the site conditions, the cause of the erosion, and appropriately addresses the issue without further affecting downstream hydrology. A study of the soil characteristics will also be required to be undertaken to ensure that the soils are suitable for rehabilitation works.

The rehabilitation method selected would need to consider the nature of the erosion occurring, the hydrology of the system as well as the cost implications of the different methodologies available. Rehabilitation options for the site could include the use a range of techniques including hard rehabilitation options such as rock armouring or softer rehabilitation options such as battering back of the slope and revegetation using shrubs and products such as ecoblanket. More complex rehabilitation options such as rock armouring are likely to have a high cost implication that softer options, however, the option selected needs to be appropriate to address the cause of the erosion occuring.

7.3.2 Site 2

Site 2 is located in the mid-section of the same drainage line and is the result of water sheeting off the upslope area creating a broad head cut along a section of the creek line. Rehabilitation of this section requires reducing the velocity of water sheeting off the upper slope area. It is considered that the spraying of eucalypt seedlings under the power line easement may have increased the rate of runoff along this area, further contributing to this issue. The site does not appear to have changed substantially in the last four years, and erosion is likely to be low to moderate only. However, it is recognised that without management, the site may continue to worsen over time, particularly following large storm events where there is increased surface run off.

Figure 19 Erosion occurring as a result of surface runoff from upslope area

Rehabilitation options for site 2 likewise need to consider access to the site for plant, cost implications and the nature of the erosion occurring on site. One potential option for rehabilitation could be to batter back the edge of the creek line and dig in jute matting to stabilise the creek bank. Plantings of appropriate shrubs and sedges such as *Carex appressa* could be undertaken into the jute matting to further add stabilisation to the bank (Figure 20). An indicative planting density of 6 plants per m^2 is recommended. Placement of coir logs upslope of the planting/jute matting would assist in decreasing the rate of the runoff an

Potential species for use in rehabilitation along the main drainage line are outlined in the table below.

Table 14 Potential species for use in rehabilitation of drainage channel

Species	Life form
Bothriochloa macra	Perennial grass
Carex appressa	Perennial sedge
Cyperus lhotskyanus	Perennial sedge
Eragrostis brownii	Perennial grass
Eucalyptus bridgesiana	Tree
Rytidosperma carphoides	Perennial grass
Themeda australis	Perennial grass
Leptospermum continentale	Shrub
Kunzea ericoides	Shrub

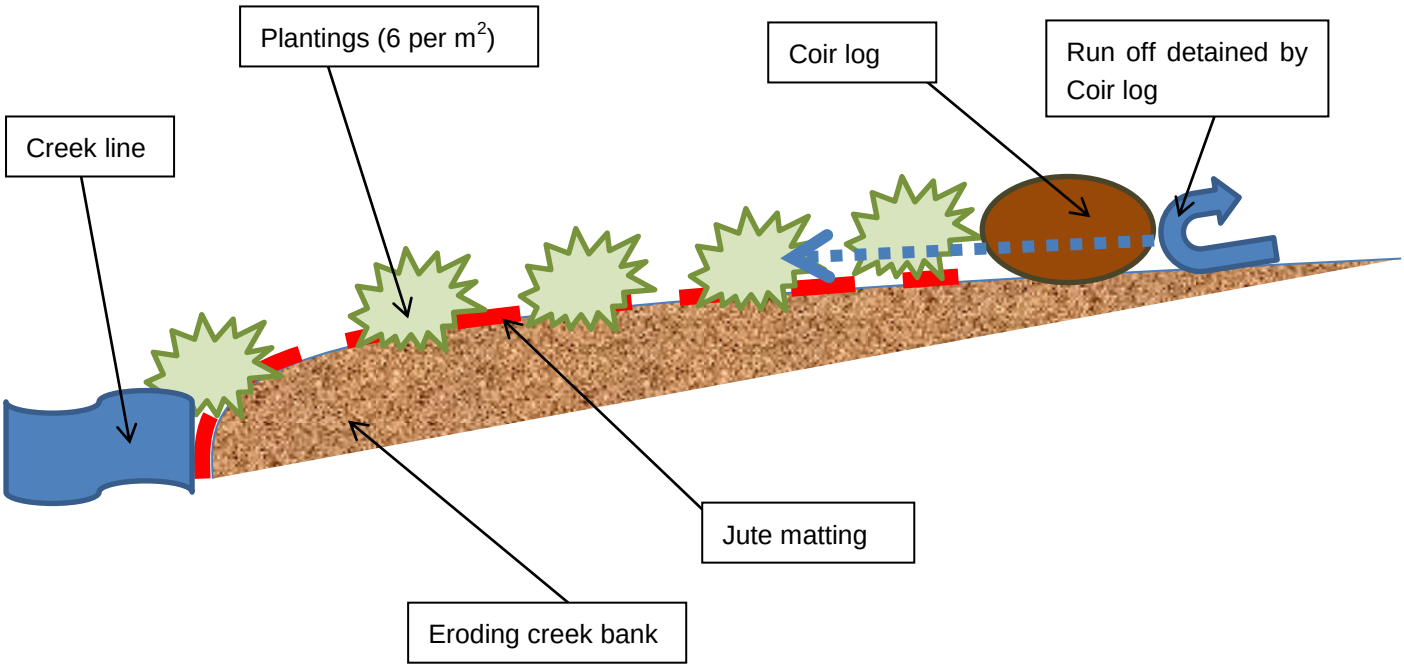


Figure 20 Potential rehabilitation option

8 Feral animal monitoring

In accordance with the Feral Animal Sub-plan (see ODP) monitoring of the offset site for feral animal activity is being undertaken on a biannual basis to inform feral animal control actions.

8.1 Management actions to date

8.1.1 Feral pigs

The autumn and spring 2012 monitoring surveys identified *Sus scrofa* (feral pigs) 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 significantly. In response to the recommendation, Regional Feral Animal Control (RFAC) was engaged to conduct control activities at the M2G offset site from 11th September 2012 to 3rd October 2012. A total of 21 pigs were trapped and destroyed over the control period. Follow-up monitoring conducted by RFAC two weeks following control period did not record any fresh signs of feral pigs.

During the autumn 2014 monitoring surveys a small group of pigs were observed and widespread minor pig damage noted. In response ACTEW Water engaged RFAC to conduct further control activities at the M2G offset site. Over the control period between 16th June and 4th July 2014, a total of nine pigs were removed from the site.

8.1.2 Feral goats

Two herds of 60+ *Capra hircus* (Feral goats) were observed within the offset site (also within adjacent property to the south) 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 impacted significantly.

As a proactive measure ACTEW 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.

During the pig control and monitoring program undertaken by RFAC between 16th June and 4th July 2014, 28 feral goats were recorded within the offset site. The species is considered likely to be utilising a large area, including the offset site, neighbouring properties and Murrumbidgee River corridor and is likely to be present within the offset site intermittently.

8.2 Feral animal monitoring results – spring 2014

Monitoring of feral animals using infra-red cameras (Figure 4) and opportunistic observations was conducted as part of the monitoring surveys. Targeted searches were undertaken around drainage

lines, permanent water sources and along animal tracks for fresh signs (scats & tracks) of feral animal activity.

8.2.1 *Vulpes vulpes* (European Fox)

A total of four Foxes were observed within the offset site. The number of observations is higher than in previous years. Individuals were also regularly recorded on remote cameras.

8.2.2 Oryctolagus cuniculus (European Rabbits) and Lepus europaeus (Hares)

Rabbits were observed infrequently within the offset site. No warrens were observed and individuals appear to be free living. A single hare was observed in the northern offset.

8.2.3 *Dama dama* (Feral Fallow Deer)

No fallow deer were recorded during the spring 2014 surveys. The species may be present in low numbers as one individual was opportunistically observed within the offset site in December 2013 and two individuals were observed by RFAC between 16th June and 4th July 2014.

8.2.4 *Bos Taurus* (Cattle)

No recent signs of cattle were observed during the spring 2014 surveys. It is possible that an individual or two occurs on the offset site as recent evidence was noted in the southern offset during the autumn 2014 survey.

8.3 Recommendations and actions

8.3.1 Foxes

Given the number of foxes observed within the offset site, it is recommended that action be taken to limit and/or control the number of foxes within the offset site. It is also recommended that a monitoring survey for this species be undertaken, one-month from the conclusion of the control activities to determine if follow-up control is required. As foxes may be limiting rabbit abundance, monitoring rabbit numbers should be undertaken alongside fox control.

8.3.2 Other species

With the exception of foxes the overall incidence of feral animals within the offset site is presently low. However abundance levels can shift in short time frames and reinvasion may occur relatively soon after control efforts, as has possibly been the case with feral goats and pigs on site. It is recommended to continue biannual monitoring as outlined in the Feral Animal Management Sub-Plan. If an increase in abundance is observed through-out the year, it is recommended that control be undertaken. This is of particular importance if dry weather is experienced as some species have the ability to heavily impact on vegetation suffering from water stress. It is recommended that any control undertaken within the offset site be combined with control programs undertaken for adjacent ACTEW lands.

In addition, reporting of feral animal activity (for goat, pig and deer) to the local control agencies is recommended. This will assist with information that may guide any broad or landscape scale control activities.

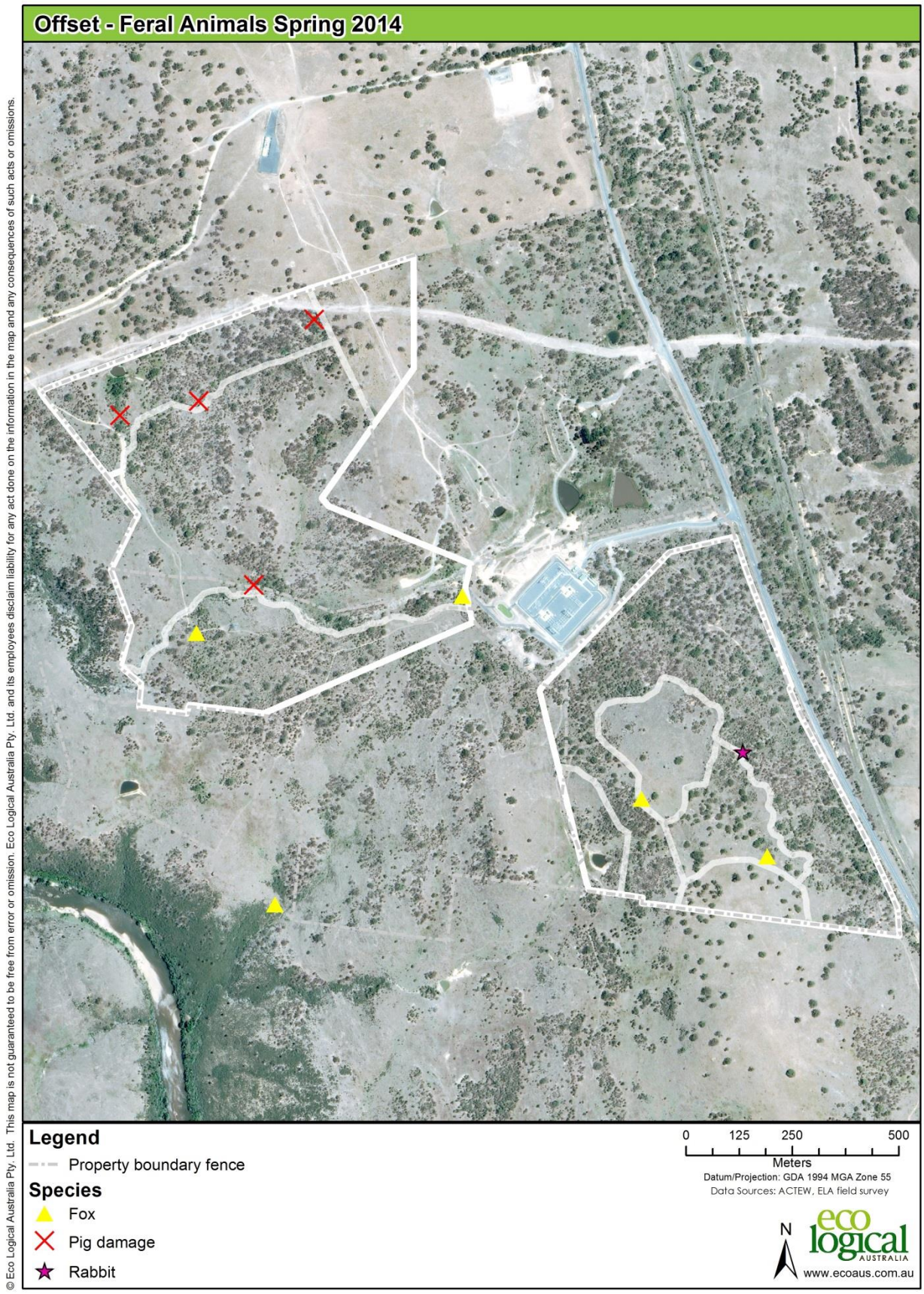


Figure 21: Feral animal observations

9 Fencing monitoring

9.1 Management actions to date

Fencing of the offset site was one of the actions highlighted to be undertaken in the ODP. Fencing is required to prevent grazers, such as sheep and cattle 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 (including 2 or 3 barbed wire strands) with wooden posts and/or star-pickets, approximately 1.2 m high.

In July 2012, Tennant Rural undertook works to remove the existing fence and erect a new fence along the southern boundary of the Williamsdale property (Figure 22). The fence was built to specifications to exclude both cattle and sheep (5 wires and 2 barbed wires). The fence was approximately 1.6km in length and included the replacement of 3 gateways.

In June 2013, the erection of new fencing along the eastern border of MU7 in the northern offset was undertaken. This completed the fencing requirements of the offset site (fully enclosed within the Williamsdale property). The fencing arrangements has enabled low intensity grazing to occur within a small proportion of the Williamsdale property, whilst excluding grazing within the offset site in order to satisfy the ACT Government Land Management Agreement (LMA).

In response to recommendations in previous monitoring reports, all internal fencing within the offset site was removed in June 2013 to enhance the wildlife friendly nature of the offset site, and be consistent with the biodiversity conservation ideals of the ODP and associated sub-plans.

No fence maintenance has been undertaken in the period since the autumn 2014 monitoring survey.

9.2 Fencing monitoring results

The results of the spring 2014 fencing monitoring survey are outlined below based on the main boundaries:

- *Northern boundary*: The northern boundary fence is considered adequate along its length. Small holes at the base of the northern boundary fence were recorded and require continued monitoring. The small holes allow the free movement of wombats and small kangaroos across property boundaries. Minor maintenance maybe required at these points once the pipeline fence has been removed (currently acting as an additional barrier), if sheep are grazed in the paddock north of the Williamsdale property and holes become large enough for individuals to enter the offset site.
- *Eastern boundary*: The eastern boundary fence of the Williamsdale property, adjacent to the Monaro Highway is mostly considered adequate. One section approximately five metres in length where the fence crosses a drainage line (north of the entrance to the sub-station) requires replacing (refer to Figure 22). However, it does not pose an immediate risk to stock entering the offset site. Grazing of stock does not occur along the Monaro Highway and other internal fencing within the Williamsdale property (e.g. boundary of the sub-station and newly erected section along MU7) provide a barrier to the offset site. Small holes similar to those observed along the northern boundary were also recorded at points on the eastern boundary and require continued monitoring.

- *Western boundary*: The western boundary fence is adequate to exclude stock. However, minor maintenance is recommended for consideration for a few points where animals (e.g. wombats, kangaroos and potentially goats) have created small to moderate sized holes. These points are identified as low risk damage in Figure 22. There is no risk of stock entering the offset site at these points as the western boundary borders the Murrumbidgee River corridor where grazing does not occur. However, some of these points may be used by goats to enter the property and should be considered as an additional action following the removal of the goats from the offset site. A gate leading to the Murrumbidgee River corridor was observed open during the monitoring surveys.
- *Southern boundary*: The southern boundary fence is adequate to exclude stock. However, Small holes at the base of the southern boundary fence were recorded and require continued monitoring. Two gates along the southern boundary fence were observed to be open during the monitoring surveys.

9.3 Recommendations

The overall condition of the Williamsdale property and offset boundary fencing is considered adequate to exclude grazing by stock within the offset site. However, the gates along the southern boundary and adjacent to the Murrumbidgee River corridor provide an access point for stock and feral animals such as pigs and goats.

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 remain closed to minimise the number of access points to the property.

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Figure 22: Williamsdale property fence with points recommended for repair

10 Summary

10.1 General summary

The offset site is considered to be in good condition and is providing habitat for a range of threatened, rare and uncommon flora and fauna species. The management actions implemented to date appear to be working satisfactorily; however, some attention is required in a small number of areas. A summary of the recommendations following the Spring 2014 monitoring is outlined in the following sections. A number of management actions have been undertaken across the offset site to date, including:

- Primary on-ground works and actions undertaken in 2012:
    - Erection of new Williamsdale property southern boundary fence (July 2012).
    - Feral pig control (September 2012).
    - Weed Control for African Lovegrass and Serrated Tussock (July 2012).
    - Weed Control for other weed species (late 2012- early 2013).
- Primary on-ground works and actions undertaken in 2013:
    - Erection of new fence bordering MU7 of the northern offset (June/July 2013).
    - Removal of internal fencing within the offset site (June/July 2013).
    - Weed control targeting African Lovegrass and Serrated Tussock (spring 2013).
    - Weed control targeting Sweet Briar, Blackberry, St. John's Wort and Thistle species (late spring 2013 with follow up control in early 2014).
    - Bushfire track maintenance.
    - *Swainsona recta* planting of 46 individuals (September 2013).
    - Control for feral goats and aerial surveys of property (December 2013).
    - Feral pig monitoring in December 2013 (control scheduled for winter 2014).

- Primary on-ground works and actions undertaken in 2014:
    - Feral pig control (June/July 2014).

10.2 Bushfire

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

During the ERG site visit, it was noted that there is a substantial amount of natural regeneration occurring throughout the property. The removal of stock from the property in addition to some favourable growing conditions over the last few years has resulted in a large recruitment event. The regeneration present on site is considered likely to self-limit over the next few years, and is not considered likely to pose a substantially increase the bushfire threat. Grazing levels across the property are moderate which is controlling the ground layer and preventing a build-up of biomass occurring.

10.3 Rehabilitation works

No rehabilitation works have been undertaken to date. The 2014 surveys have recorded a consistently low diversity of native species and lack of natural regeneration of the canopy or midstory within MU7. The vegetation within MU7 is dominated by exotic species.

10.4 Threatened, rare and uncommon plant species

Three nationally threatened, and 11 rare and uncommon ACT plant species occur on the offset site. Although no species is imminently threatened within the offset site it is recommended that basic periodic monitoring be undertaken to ensure that the population of these species on site are maintained over time. 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 to minimise inadvertent damage to populations. This is particularly important for personnel involved in spraying herbicides.

10.5 Swainsona recta translocation program

A total of 112 individuals have been planted across three translocation plots (66 in July 2012 and 46 in September 2013). A significant increase in plant mortality was observed during the spring 2014 survey, with only 32 individuals present in spring 2014. This represents an overall survivorship of 28.5%, which is down significantly from the 79% overall survivorship recorded in spring 2013. Of the plants present 65% were in flower or had immature fruits. Many of the non-fertile plants appeared to have poor vigor.

10.6 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. Weeds which still require control within the offset site include African Lovegrass, Serrated Tussock, Sweet Briar, Blackberry, Hawthorn, Prunus sp., and Pyracantha sp.

10.7 Erosion

The majority of erosion points are generally considered stable and do not require active works at this stage.

Two sites located along the main drainage line that separates MU5 & MU6 in the northern offset require some attention (section 7)

10.8 Feral animal

The overall incidence of feral animals within the offset site was low. Foxes were observed at a number of points within the offset in higher numbers than in previous years. Rabbits and Hares were observed on occasion.

10.9 Fencing

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

10.10 Grazing

Regular counts of 10-20 Kangaroos were made during the 2014 surveys. However, it is estimated that up to 100 kangaroos maybe utilising the offset site and surrounding properties at any one time.

The 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. Current Kangaroo densities are considered to be appropriate to the management objectives of the site.

Opportunistic observations of grazing pressure within and adjacent to the *Swainsona recta* exclosure plots indicate that the offset site is grazed at low-moderate intensity, consistent with the conservations principles outlined in the ODP. The diversity of native herbs and forbs has increased substantially since the baseline surveys, supporting the continuation of current grazing levels. The current level of grazing appears to be preventing perennial native grasses from becoming too dense, thus allowing a range of other ground storey species to co-exist with the dominant grasses. In the absence of fire, appropriate levels of grazing are critical for maintaining species diversity in grassy woodlands.

11 Management recommendations

A summary of the recommended adaptive management actions relating to the offset site is provided in Table 15 below. The actions relate to the appropriate ODP sub-plan and are based on the results presented in the above sections.

Table 15: Summary of proposed actions relating to the ODP

ODP Sub-Plan	Action status	Recommended management actions
Weed	On-going control and monitoring.	Maintain weed control program as outlined in ODP and weed sub-plan. Follow-up control of African Lovegrass, Serrated Tussock, Sweet Briar, Blackberry, Hawthorn, Prunus sp., and Pyracantha sp. should be undertaken to maximise the effectiveness of the primary control work completed. Thistles (predominantly *Carthamus lanatus*) are abundant near the southern edge of the southern offset and it is recommended that steps be taken to contain their spread throughout the remainder of the property. This work should not be limited to the offset site but include control within the adjacent southern property for maximum effectiveness if possible. It is recommended that trial plots (e.g. 5x5m) be established to ascertain the most appropriate treatment for the thistles. Trials could include the following treatments: • Application of sugar or sawdust (to bind nitrogen and limit growth of species such as thistles which require high nitrogen levels) • Application of broadleaf herbicide • Controlled burn • Application of Kangaroo grass mulch (including seed heads) It is recommended that biological control, rather than herbicides be utilised as the principal control method for St John's Wort. The *Chrysolina* beetle is the primary biological control agent, and is already present on the offset site having naturally dispersed into the property from the surrounding lands. The distribution and abundance of *Chrysolina* Beetles across the offset site should be monitored and beetles redistributing to maximise their effectiveness. Herbicide application may be required in shady areas under trees where *Chrysolina* Beetles are ineffective. As the issue of exotic annual grasses has become more significant over the monitoring period, it would be beneficial to investigate the implementation of a strategic small scale control of competitive exotic annual grasses in the high value parts of the offset. This is consistent with adaptive management approach to weed control. A specialist bush regeneration team may be required to undertake this work. Mapping vegetation condition, including the occurrence and density of the range of competitive weed species would be an essential precursor to any control work of this nature. Biannual weed monitoring program should be continued with greater emphasis placed on the detection of new weeds to the site. This would assist in the early detection of new weed outbreaks and facilitate early intervention whilst population numbers are still low. Monitor Weed management activities are applicable to all Management Units.
Rehabilitation	To be considered.	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.

ODP Sub-Plan	Action status	Recommended management actions
Sediment and erosion Control	Action required.	The majority of sites within the offset are considered to be stable and no immediate action is required. It is recommended that biannual monitoring of these sites continues. Applicable to MU's 1B, 3, 4 & 6. Potential remediation work to be considered along main drainage line within MU 5 & 6. It is recommended that further investigations of the hydrology and soils within the drainage line be undertaken to inform potential rehabilitation options. Rehabilitation options should utilise local provenance in plantings, and species selected should be appropriate to the landscape position and reflect those species which currently occur on site. Rehabilitation options will need to consider the underlying cause behind the erosion occurring, cost estimates, access and appropriateness of undertaking control works.
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. Applicable to MU's 3, 4 & 6.
Feral animal control	Action and on-going monitoring required.	Control of foxes within the offset site is recommended given the number of individuals observed during the surveys. Rabbit numbers are currently low, but they could increase with fox control. It is recommended that both species are monitored post control. Continue biannual monitoring of all feral animals to establish if control activities are required in the future. Applicable to all Management Units.
Fencing	Completed in August 2012 and June 2013. On-going maintenance and monitoring	No immediate major actions required. However, replacement of a small section of fence along the eastern boundary is required and maintenance of moderate damaged points should be considered. Continue biannual monitoring at all fence lines. In addition, keep all boundary gates closed.
Grazing	On-going monitoring	No immediate actions required. 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.
Swainsona recta propagation program	On-going monitoring	Competition from perennial native grasses (primarily *Themeda australis*) may be limiting the growth of some individuals and is limiting inter-tussock spacing within the plots. It is recommended that ACTEW trial opening one of the plots during spring to allow native grazers the opportunity to reduce some of the perennial grass cover. The effect of the grazing on planted individuals should be monitored closely. Spring monitoring each year should continue for a long as plants persist within the plots.

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Appendix A: Flora species list

+ = 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							
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Acacia dealbata	◆								
Acacia mearnsii	▪								
Acacia rubida	◆								
Acaena novae-zelandiae	▪								
Acaena echinata	◆						+	r	
Acaena ovina	◆		+	+	+	+	+		+
Acrotriche serrulata	◆								
Ajuga australis	◆								
Alternanthera denticulata	◆								
Alternanthera sp. A	◆								
Amphibromus nervosus	◆								
Amyema pendula subsp. *pendula*	◆								
Aphanes australiana	◆				r				
Aristida ramosa	◆		+	r		r			+
Arthropodium minus	◆		1	r	+	1			r
Arthropodium sp.	▪		r	r	+				r
Asperula conferta	◆		+	1	2	+	r		+
Asplenium flabellifolium	▪								
Astroloma humifusum	▪								
Austrostipa bigeniculata	◆		1						
Austrostipa densiflora	◆								
Austrostipa scabra	◆	1	+		+	1	1		2
Austrostipa setacea	◆								

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Austrostipa sp.	◆								
Bossiaea buxifolia	◆						r		
Bossiaea prostrata	◆					1			
Bothriochloa macra	◆	1	1		+	+	1		
Brachycome sp.	◆								
Brachyloma daphnoides	◆								
Brachyscome dentata	◆								
Bulbine bulbosa	◆		+	r	r	1			+
Bursaria spinosa subsp. lasiophylla	◆			r					
Calllistemon sieberi	◆								
Callitris endlicheri	◆								
Calocephalus citreus	◆			r					
Calotis scabiosifolia var. integrifolia	◆								
Carex appressa	◆							r	
Carex breviculmis	◆					+		r	+
Carex inversa	◆	1	+	+	1	1	1	1	
Carex sp.	◆								
Cassinia aculeata	◆								
Cassinia quinquefaria	◆						r		
Cassinia longifolia	◆								
Centipeda cunninghamii	◆								
Cheilanthes sieberi	◆	r	+	r		+	1		1
Chrysocephalum apiculatum	◆		2	1		2	1		1
Chrysocephalum semipapposum	◆						r		
Clematis leptophylla	◆			+			r		
Convolvulus angustissimus	◆	r	+	+		r	r		r
Cotula australis	◆	+							
Craspedia variabilis	◆				1				
Crassula helmsii	◆								
Crassula peduncularis	◆				r				
Crassula sieberana	◆	1	1	1	r		1	1	1
Cryptandra amara	◆					+	r		
Cymbonotus lawsonianus	◆		+		r	1	+		+
Cymbonotus preissianus	◆			+					
Cymbopogon refractus	◆		+				r		
Cynoglossum suaveolens	◆								

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Cyperus lhotskyanus	◆								
Daucus glochidiatus	◆			+	+	+	1		+
Desmodium varians	◆	r	+			+	+		+
Dianella revoluta	◆								
Dichelachne sp.	◆						r		
Dichondra repens	◆		+			+			
Dichopogon fimbriatus	▪								
Dillwynia sp. Yetholme	◆								
Discaria pubescens	◆								
Diuris semilunulata	◆								
Dodonea viscosa subsp. angustissima	◆								
Drosera peltata	◆								1
Dysphania pumilio	▪								
Einadia nutans subsp. *nutans*	◆						r		
Elatine gratioloides	◆								
Eleochaeris acuta	◆								
Elymus scaber	◆	r	+	+	+	+	+	r	
Enneapogon nigricans	◆						r		r
Epilobium billardiereanum	◆								
Epilobium hirtigerum	◆								
Eragrostis brownii	◆				+				
Erodium crinitum	◆	+						+	
Eryngium ovinum	◆			1	r				
Eucalyptus blakelyi	◆		2	2	2	2	2		2
Eucalyptus bridgesiana	◆								
Eucalyptus dives	◆								
Eucalyptus mannifera	◆								
Eucalyptus melliodora	◆								
Eucalyptus rossii	◆								
Euchiton japonicus	◆		r	r			r		
Euchiton sphaericus	◆	1							1
Euchiton sp.	◆								
Euphorbia dallachyana	◆								r
Fimbristylis dichotoma	◆								
Galium gaudichaudii	◆								
Geranium retrorsum	◆		r	r	+	+	+	+	
Geranium solanderi	◆		+	1	+	+	r		

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Geranium sp.	◆								
Glossostigma elatinoides	◆								
Glycine clandestina	◆								
Glycine tabacina	◆		r			r			
Gonocarpus tetragynus	◆			r		+			+
Goodenia hederacea	·								
Goodenia pinnatifida	·			+					
Haloragis heterophylla	◆			+	2				r
Hibbertia obtusifolia	◆								
Hydrocotyle laxiflora	◆		+	1	+	1	+	+	
Hymenochilus cynocephalus	◆								
Hypericum gramineum	◆			+	1	+			+
Hypoxis hygrometrica	◆								
Indigofera australis	◆								
Isoetopsis graminifolia	◆						1		+
Isolepis hookeriana	◆				r				
Isotoma fluvialitis subsp. *australis*	◆								
Juncus australis	◆							+	
Juncus bufonius	◆								
Juncus filicaulis	·								
Juncus homalocaulis	◆								
Juncus subsecundis	◆		r		1			+	
Juncus ?usitatus	·								
Kunzea ericoides	◆								
Kunzea parvifolia	◆								
Lachnagrostis filiformis	◆								
Leptorhynchos squamatus	◆			1	+	1			1
Leptospermum continentale	◆								
Leucochrysum albicans var. *tricolor*	◆								
Limosella australis	◆								
Linum marginale	◆								
Lomandra bracteata	·								
Lomandra filiformis subsp. *coriacea*	◆		r	+	+	+	+		+
Lomandra filiformis subsp. *filiformis*	·								
Lomandra longifolia	◆								
Lomandra multiflora	◆								

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Luzula densiflora	◆		r	+	+	+			+
Lythrum hyssopifolia	◆								
Melichrus urceolatus	◆					+			r
Microlaena stipoides	◆	+	+	+	2	1	1	+	
Microseris lanceolata	◆			r					
Microtis sp.	◆		1		+	+			
Montia fontana subsp. chondrosperma	◆				r				
Myosotis australis	◆			+	+	+	+		
Ophioglossum lustanicum	.								
Oreomyrrhis eriopoda	◆		+						
Oxalis perennans	◆				r	r	+		
Oxalis radicosa	◆								
Oxalis thompsoniae	◆	+							
Panicum effusum	◆		r						
Pellaea calidirupium	◆								
Persicaria prostrata	◆								
Pimelea curviflora	◆								
Plantago gaudichaudii	◆			1	r				
Plantago varia	◆	r		1		+			
Poa labillardieri	◆			r	1				
Poa sieberiana var. hirtella	◆								
Poa sieberiana var. *sieberiana*	◆			1		+			+
Poa sp.	.								
Pomaderris angustifolia	◆								
Pomaderris pallida	◆								
Poranthera microphylla	◆								
Potamogeton ochreatus	◆								
Pseudognaphalium luteoalbum	◆								
Pultenaea procumbens	◆								
Ranunculus lappaceus	◆								
Ranunculus pumilio var. *pumilio*	◆				1				
Ranunculus sessiliflorus var. *sessiliflorus*	◆								
Rhodanthe anthemoides	◆								
Rubus parvifolius	◆								
Rumex brownii	◆	+		+	r	r	r	+	
Rytidosperma	◆						+		

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
caespitosum									
Rytidosperma carphoides	◆					+			+
Rytidosperma laeve	·								
Rytidosperma pallidum	◆								
Rytidosperma racemosum	·								
Rytidosperma sp.	·		+						
Schoenus apogon	◆		r	r	2	r			
Scleranthus diander	◆								
Scleranthus fascicularis	◆						r		
Sebaea ovata	◆			r		+	r		
Senecio phelleus	◆								
Senecio quadridentatus	◆						r		
Solanum linearifolium	◆								
Solenogyne dominii	◆		r		1	r			1
Solenogyne gunnii	◆				+				
Sporobolus sp.	·								
Stackhousia monogyna	◆			1		+			1
Stylidium despectum	◆								
Swainsona monticola	◆								
Swainsona recta (propagated)	◆								
Swainsona sericea	◆			+		+			
Thelymitra pauciflora	·								
Thelymitra sp.	·								
Themeda australis	◆		r	3	2	3			3
Thysanotus patersonii	·								
Thysanotus tuberosus	·								
Tricoryne elatior	◆					r			
Tripogon loliiformis	◆		+						1
Triptilodiscus pygmaeus	◆	r	1	1	r	1	1		1
Veronica calycina	◆		+			r			
Veronica sp.	·								
Vittadinia cuneata	◆		+			+			
Vittadinia gracilis	◆								
Vittadinia muelleri	◆		r			+	+		r
Wahlenbergia communis	◆		1	r		r	+		+
Wahlenbergia gracilenta	◆						+		
Wahlenbergia gracilis	◆								r

Native									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3**
Wahlenbergia multicaulis	◆			r		r			r
Wahlenbergia sp.	◆								
Wahlenbergia stricta	◆								
Wurmbea dioica	◆		+	r	1	1	+		1
Xerochrysum viscosum	◆								
Zornia dyctiocarpa	◆								

Exotic									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3B**
Acetosella vulgaris	◆		+				+	+	
Aira caryophyllea	◆								
Aira elegantissima	◆								
Aira sp.	·		1	2	1	1	1		1
Anagallis arvensis	◆			r	+		r		
Arctotheca calendula	·								
Avena barbata	◆			+					
Briza maxima	·								
Briza minor	◆			1	1	1			1
Bromus diandrus	◆			+	r		+	1	
Bromus hordeaceus	◆	2			2		1	2	
Bromus rubens	◆						+		
Bromus sp.	·								
Capsella bursa-pastoris	◆	r						1	
Carduus pycnocephalus	◆							1	
Carduus tenuiflorus	◆					r			
Carduus sp.	·								
Carthamus lanatus	◆	3	r						
Centaurea melitensis	◆								
Centaurium erythraea	·								
Cerastium glomeratum	◆			1					
Chondrilla juncea	◆						+		
Cicendia quadrangularis	◆			r					
Cirsium vulgare	◆	r		1	r	r	r	r	
Conyza sp.	◆								
Cotoneaster sp.	·								
Crataegus monogyna	◆								
Cynodon dactylon	◆								
Cynosurus echinatus	◆			1					
Cyperus eragrostis	◆							r	
Cyperus sp.	·								
Echium plantagineum	◆								
Eragrostis cilianensis	·								
Eragrostis curvula	◆								
Erodium botrys	·								

Exotic									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3B**
Erodium cicutarium	◆	1			r		+	1	
Erodium moschatum	·							+	
Erodium sp.	·								
Festuca arundinacea	◆								
Galium aparine	◆					+			
Galium divaricatum	◆	+	+	1		1	+		1
Geranium molle	◆							+	
Hedypnois rhagadioloides subsp. cretica	◆								
Hirschfeldia incana	◆								
Holcus lanatus	◆								
Hordeum glaucum	·								
Hordeum leporinum	◆	1						1	
Hypericum perforatum	◆	+	+	1	1	1	1	+	+
Hypochaeris glabra	◆		1	2	1	1	1		1
Hypochaeris radicata	◆	1	r			+	1	1	
Isolepis levynsiana	◆								
Isolepis marginata	◆			+					+
Juncus capitatus	◆				+				1
Lactuca serriola	◆								
Lepidium sp.	·								
Linaria arvense	◆	+	1	1		+	1		
Linaria pelisseriana	◆		r	+		+			1
Lolium perenne	◆							+	
Lolium rigidum	·								
Malva nicaeensis	·								
Malva parviflora	◆	r						+	
Marrumbium vulgare	◆								
Medicago arabica	◆							+	
Modiola caroliniana	◆								
Moenchia erecta	◆								
Nassella trichotoma	◆	r							
Onopordum acanthium	·								
Orobanche minor	◆								
Parentucellia latifolia	◆		r		r				r
Paronychia brasiliana	◆	1	+				+	+	
Paspalum ?dilatatum	◆				r				

Exotic									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3B**
Pentaschistis airoides	◆	1					1	r	
Petrorhagia nanteuilii	◆	+	1	+	r	+	1		+
Phalaris aquatica	·								
Plantago lanceolata	◆		+		1	1	1	r	
Poa pratensis	◆			+	+				
Polygonum aviculare	◆							+	
Prunus sp.	◆								
Pyracantha sp.	◆								
Rosa rubiginosa	◆	r		+	1		r	+	r
Romulea rosea var. *australis*	◆								
Rubus fruticosus	◆	r	r						
Sanguisorba minor	◆								
Sherardia arvensis	◆								
Sisymbrium orientale	◆								
Sisyrinchium sp. A	◆								
Solanum nigrum	◆								
Sonchus asper	◆			+					
Sonchus oleraceus	◆					r		r	
Spergularia rubra	◆							r	
Stellaria media	◆							1	
Taraxacum officinale	◆							r	
Tolpis umbellata	◆		+	r			r		1
Tragopogon dubius	◆		r	r			r		
Trifolium arvense	◆	1	1	+		1	2		1
Trifolium angustifolia	◆			+	1	+	r	r	+
Trifolium campestre	◆	+		+	+	1	1		1
Trifolium cernuum	◆								
Trifolium dubium	◆	+	+	1	2	1		1	1
Trifolium glomeratum	◆	+		+	1	r	1	+	1
Trifolium repens	◆							+	
Trifolium sp.	·		1						
Trifolium subterraneum	◆	2	+				+	2	
Urtica urens	◆							r	
Verbascum thapsus	◆		r						
Verbena ?incompta	◆				r				
Veronica anagallis-aquatica	◆								
Veronica arvensis	◆			+					

Exotic									
Plot Number	**Opportunistic**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Species (cumulative list)	**Spring 2014**	**MU1A**	**MU2B**	**MU3**	**MU4**	**MU5**	**MU6**	**MU7**	**MU3B**
Vicia sativa	◆								
Vulpia bromoides	◆							1	
Vulpia muralis	◆								
Vulpia myuros	◆								
Vulpia sp.	·	2	1	1		1	2		+

Appendix B: Flora plates – Rare and uncommon species

Photo 1: Hoary Sunray (*Leucochrysum albicans var. tricolor*)

Photo 2: Pale Pomaderris (*Pomaderris pallida*)

Photo 3: Hairy Anchor Plant (*Discaria pubescens*)

Photo 4: *Swainsona monticola*

Photo 5: *Zornia dyctiocarpa*

Photo 6: *Bossiaea prostrata*

Photo 7: *Stylidium despectum*

Photo 8: *Glossostigma elatinoides*

Appendix C: Fauna lists

Fauna observations

Fauna species recorded during the biannual monitoring surveys from spring 2011 to spring 2014, either through opportunistic observations or targeted survey are outlined below.

A = autumn, B = spring.

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B
Australasian Grebe	*Tachybaptus novaehollandiae*	.	✓	.	✓	✓	✓	.
Australian Magpie	*Gymnorhina tibicen*	✓	✓	✓	✓	✓	✓	✓
Australian Raven	*Corvus coronoides*	✓	✓	✓	✓	✓	✓	✓
Australian Wood Duck	*Chenonetta jubata*	.	.	✓	✓	✓	.	.
Black-faced Cuckoo-Shrike	*Coracina novaehollandiae*	.	✓	✓	.	✓	.	✓
Brown Falcon	*Falco berigora*	.	.	.	.	✓	.	✓
Common Bronzewing	*Phaps chalcoptera*	✓	.	.	✓	.	✓	.
Crested Pigeon	*Ocyphaps lophotes*	.	.	.	✓	✓	✓	.
Diamond Firetail	*Stagonopleura guttata*	✓	.	.	✓	.	.	.
Double Barred Finch	*Taeniopygia bichenovii*	.	.	.	✓	.	.	.
European Goldfinch	*Carduelis carduelis*	.	.	.	✓	.	.	.
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	.	.	.	.	✓	.	✓
Galah	*Eolophus roseicapillus*	✓	.	✓	.	✓	.	✓
Grey Butcherbird	*Cracticus torquatus*	.	✓	✓	.	.	.	.
Grey Fantail	*Rhipidura albiscapa*	✓	✓	✓	.	✓	✓	✓
Grey Shrike-Thrush	*Colluricincla harmonica*	.	✓	.	✓	✓	✓	✓
Hard Head	*Aythya australis*	.	.	✓	✓	.	.	.
Honeyeater, White-Eared	*Lichenostomus penicillatus*	✓	✓	.	✓	.	.	.
Honeyeater, White-Plumed	*Lichenostomus penicillatus*	.	.	.	✓	✓	.	.
Honeyeater, Yellow Faced	*Lichenostomus chrysops*	.	.	✓	.	.	.	✓
Horsfield's Bronze Cuckoo	*Chrysococcyx basalis*	.	.	.	.	.	.	✓
Jacky Winter	*Microeca fascinans*	✓	.	✓	.	✓	.	.
Kookaburra	*Dacelo novaeguineae*	✓	.	✓	.	.	.	.
Leaden Flycatcher	*Myiagra rubecula*	.	.	✓	.	.	.	.
Magpie Lark	*Grallina cyanoleuca*	✓	✓	✓	✓	✓	✓	✓
Masked Lapwing	*Vanellus miles*	.	.	.	.	✓	.	✓
Nankeen Kestral	*Falco cenchroides*	.	.	.	.	✓	.	✓
Noisy Friarbird	*Philemon corniculatus*	.	.	✓	.	✓	.	✓
Noisy Miner	*Manorina melanocephala*	✓	✓	✓	✓	✓	✓	✓
Pacific Black Duck	*Anas superciliosa*	.	.	✓	✓	✓	.	✓
Pardalote, Spotted	*Pardalotus punctatus*	✓	✓	✓	✓	.	✓	✓
Pardalote, Striated	*Pardalotus striatus*	✓	.	✓	✓	✓	✓	✓
Pied Butcherbird	*Cracticus nigrogularis*	.	.	.	.	.	.	✓

Common Name	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B
Pied Currawong	*Strepera graculina*	✓	✓	✓	✓	✓	✓	✓
Quail	*Coturnix sp.*	✓	.	.	.	✓	.	.
Red-Browed Finch	*Neochmia temporalis*	.	.	✓	✓	✓	.	✓
Red Wattlebird	*Anthochaera carunculata*	.	.	.	.	✓	.	✓
Robin, Eastern Yellow	*Eopsaltria australis*	.	.	.	.	.	✓	.
Robin, Flame	*Petroica phoenicea*	✓	.	.	.	.	✓	.
Robin, Hooded	*Melanodryas cucullata cucullata*	✓	.	.	.	.	.	.
Robin, Scarlet	*Petroica boodang*	.	✓	.	✓	.	✓	.
Rosella, Crimson	*Platycercus elegans*	✓	✓	✓	✓	✓	✓	✓
Rosella, Eastern	*Platycercus adscitus*	✓	✓	✓	✓	✓	.	✓
Sacred Kingfisher	*Todiramphus sanctus*	.	.	✓	.	.	.	.
Shining Bronze Cuckoo	*Chrysococcyx lucidus*	.	.	.	.	.	.	✓
Southern White-face	*Aphelocephala leucopsis*	.	.	.	.	.	✓	.
Speckled Warbler	*Chthonicola sagittatus*	.	.	.	✓	.	✓	.
Sulphur-Crested Cockatoo	*Cacatua galerita*	✓	.	.	.	✓	✓	✓
Superb Fairy Wren	*Malurus cyaneus*	✓	✓	✓	✓	✓	✓	✓
Thornbill, Brown	*Acanthiza pusilla*	✓	.	✓	✓	✓	.	✓
Thornbill, Yellow-Rumped	*Acanthiza chrysorrhoa*	✓	✓	✓	✓	✓	✓	✓
Tree Martin	*Petrochelidon nigricans*	.	.	.	.	✓	.	.
Wedge-Tailed Eagle	*Aquila audax*	✓	✓	.	✓	.	✓	.
Weebill	*Smicrornis brevirostris*	.	.	.	✓	.	.	✓
Whistler, Golden	*Pachycephala pectoralis*	✓	✓	.	.	✓	.	.
Whistler, Rufous	*Pachycephala rufiventris*	.	.	✓	✓	✓	.	✓
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	.	.	.	.	✓	.	.
White Throated Tree Creeper	*Cormobates leucophaeus*	✓	✓	✓	✓	✓	✓	✓
White-fronted Gerygone	*Gerygone olivacea*	.	.	✓	.	✓	.	✓
White-winged Chough	*Corcorax melanorhamphos*	.	✓	✓	.	✓	.	✓
White-winged Triller	*Lalage sueurii*	.	.	.	.	.	.	✓
Willie Wagtail	*Rhipidura leucophrys*	✓	✓	.	✓	✓	.	✓
Yellow Tailed Black Cockatoo	*Calyptorhynchus funereus*	.	.	.	✓	.	.	.

Mammals	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B
Brushtail Possum	*Trichosurus vulpecula*	.	.	.	.	✓	✓	✓
Cow	*Bos Taurus*	✓	.	.	.	.	✓	.
European Rabbit	*Oryctolagus cuniculus*	✓	✓	✓	✓	✓	✓	✓
Feral Goat	*Capra aegagrus hircus*	.	✓	✓	✓	✓	✓	.
Feral Pig	*Sus scrofa*	.	✓	.	.	✓	✓	.
Fox	*Vulpes vulpes*	✓	✓	✓	✓	✓	✓	✓
Kangaroo	*Macropus giganteus*	✓	✓	✓	✓	✓	✓	✓
Sheep	*Ovis aries*	.	.	.	✓	✓	.	.
Sugar Glider*	*Petaurus breviceps*	.	.	.	.	✓	✓	.

Mammals	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B
Swamp Wallaby	*Wallabia bicolor*	.	.	.	.	✓	✓	✓
Wallaroo, Common	*Macropus robustus*	.	.	.	.	.	.	✓
Wombat	*Vombatus ursinus*	✓	✓	✓	✓	✓	✓	✓

Other	Latin Name	2011	2012A	2012B	2013A	2013B	2014A	2014B
Delicate skink	*Lamphrolis delicata*	.	.	.	.	.	.	✓
Eastern Bearded Dragon	*Pogona barbata*	.	.	✓	.	.	.	.
Eastern Common Froglet	*Crinia signifera*	.	✓	✓	✓	✓	✓	✓
Eastern Long-necked Tortoise	*Chelodina longicollis*	.	✓	.	✓	✓	✓	.
Eastern Water Dragon	*Intellagama lesueurii*	.	.	.	.	.	.	.
Echidna	*Tachyglossus aculeatus*	.	.	.	.	✓	.	.
Mountain Dragon	*Rankinia diemensis*	✓	.	.	.	.	.	.
Peron's Tree Frog	*Litoria peronii*	.	.	.	.	✓	.	✓
Plains Froglet	*Crinia parainsignifera*	.	.	✓	✓	✓	✓	✓
Red Bellied Black Snake	*Pseudechis porphyriacus*	.	.	.	.	.	.	✓
Smooth Toadlet	*Uperolia laevigata*	.	.	.	.	✓	.	✓
Spotted Marsh Frog	*Limnodynastes tasmaniensis*	.	.	✓	✓	✓	✓	✓
Whistling Tree Frog	*Litoria verreauxii*	.	.	✓	.	✓	.	✓

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