



**REVIEW OF ACT  
ENVIRONMENTAL OFFSETS  
CALCULATOR  
STAGE 2**

**FINAL**

November 2013

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Prepared by  
Umwelt (Australia) Pty Limited

on behalf of  
Land Development Agency (ACT Government)

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# 1.0 Introduction

## 1.1 Background

As part of a Council of Australian Government agreement, the ACT Government is seeking to modify its approach to assessing ecological impacts and offsets.

The aim has been to develop an Environmental Offsets Calculator (EOC) relevant to the ACT that is rigorous, consistent and credible which can be accredited by the Commonwealth to enable, in most circumstances, ACT and Commonwealth offset requirements to be addressed together.

It is understood that the EOC and supporting documentation has been developed by the Environment and Sustainable Development Directorate (ESDD). However, the Land Development Agency (LDA; part of the Economic Development Directorate, EDD) will be a key authority that has the responsibility of implementing, or overseeing the implementation of the calculator.

The EOC and supporting documentation has been based largely on the NSW BioBanking credit calculator and supporting documentation. The ESDD has taken the opportunity to simplify the calculator and documentation where possible, and to modify it to suit the ACT situation. Nonetheless the package still bears strong similarity to the NSW package, which has been in place for some 4 to 5 years.

## 1.2 Aims and Objectives

In October 2012, Umwelt undertook a preliminary review of the draft proposed ACT Environmental Offsets Calculator Operational Manual (EOCOM) and Environmental Offsets Assessment Methodology (EOAM) on behalf of the Land Development Agency (Umwelt 2012)<sup>1</sup>. This review highlighted a number of key issues related to the concept in addition to both the EOAM and EOCOM.

The aim of this project is to implement recommendations 19 to 26 of Umwelt (2012), to:

- Review EOC function in relation to the EOCOM.
- Undertake case studies to trial the applicability of the calculator and determine its consistency, or otherwise, with contemporary offset outcomes.
- Undertake a parallel trial of the new EPBC Offsets Calculator to relevant significant species and ecological communities to determine the similarity or dissimilarity in outcomes.
- Undertake a review of the equations in the EOAM.
- Review supporting databases.
- Undertake a review of the appropriateness and applicability of the survey methodology/effort documented in the EOCOM.

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<sup>1</sup> Umwelt (2012) Review of proposed ACT Environmental Offsets Operational Manual and Assessment Methodology. Draft October 2012. Prepared by Umwelt (Australia) Pty Limited on behalf of the ACT Land Development Agency. 3169/R01/V1.

- Review the definitions of red flags to ensure they are appropriate.
- Review the special offsets requirements applied to certain threatened species. Additionally, a review of the ACT Environmental Offsets Calculator Technical Review and modifications table completed by Eco Logical Australia (ELA 2012) is included.

The following resources were used in this review:

- Environmental Offsets Assessment Methodology (EOAM), version 20130301.
- Environmental Offsets Calculator Operational Manual (EOCOM), version 20130301.
- Environmental Offsets calculator (EOC), version 0.1.9.
- Databases: Vegetation Type, Significant Species, Benchmark datasets.
- Numerous survey literature and spatial resources (refer to References).
- Data collected in line with the EOAM for offset areas as part of the Molonglo Stage 3 development.

### 1.3 Assumptions and Limitations

Data used in developing case studies for existing developments has been derived from a number of sources including site specific environmental studies, ACTMAPi (ACT Government 2012)<sup>2</sup> and Commonwealth approval decisions. None of these data sources provide data in line with requirements of the EOAM. As such, information used to assess developments in the EOC was derived based on composite literature review, with floristic information estimated based on general vegetation condition description within environmental studies and the author's knowledge of grassy ecosystems in the ACT.

Data collected as part of this study in line with the EOAM for offset areas for the Molonglo Stage 3 development. Initial sampling requirements were determined through the use of existing vegetation mapping from ACT Government (2012) and ELA (2009). These products were developed prior to the EOAM, and do not include detailed condition information necessary for stratified sampling. Sampling was undertaken in July 2013, with additional sampling in September 2013 to satisfy EOAM requirements based on a more detailed understanding of individual Patches within Molonglo stage 3 and Kama Nature Reserve. Also, stratification rules in the EOAM are dictated by canopy tree structure rather than ground condition: while this allows for simplistic stratification it does not allow for separation based on understorey condition.

During the winter period, native floristic diversity is likely to be lower than that of spring and summer, when annual and dormant native forbs are easily identifiable. Even in early spring, while a greater diversity of native and exotic forbs are present, some grasses (in particular *Rytidosperma* spp.) are not readily identifiable to species level. As such, native floristic richness of plot data may be lower than if the data was collected in favourable conditions, and annual and short-lived perennial weed cover and abundance may be higher.

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<sup>2</sup> ACT Government (2012) *ACTMAPi Online interactive maps*, Environment and Sustainable Development Directorate, Canberra. Accessed online (18/06/13): [www.actmap.i.act.gov.au](http://www.actmap.i.act.gov.au)

## 1.4 Report Authorship

This review was undertaken by Rob Armstrong. Rob has considerable experience in flora survey across the ACT and Southern Highlands, including survey of grassy ecosystems across the northern ACT and Southern Tablelands to determine grassland condition. Rob is a Level 3 biodiversity accredited expert under the NSW *Native Vegetation Act 2003*, authorising operation and expert input into the property vegetation plan (PVP) tool. The PVP tool is highly similar to the BioBanking and EOC tools. Rob is also the lead author of the recently developed plant community classification for the ACT and surrounds (Armstrong *et al.* 2013). Rob's CV is provided in **Appendix 4**.

## 2.0 Application of EOC to Established Development and Offset Sites

### 2.1 Desktop Assessment Methodology

Based on advice from LDA, four recently approved developments and associated offset sites were selected to trial the draft ACT Environmental Offsets Calculator (EOC). As part of this, reports and spatial information for each site were reviewed, with information generated to feed into the EOC to compare outcomes generated by the EOC and the referral decision.

Generally, information relevant to sites, threatened species and ecological communities were gleaned from survey and impact assessment reports. However, where reports were unclear information was sourced from ACTMAPi (ACT Government 2012). Plot based information was derived from reports where possible, however as each site was assessed using methods that differ from what the EOAM specifies, much of the data is derived from the authors experience surveying grassy ecosystems across the northern ACT.

The EOC was trialled on data derived from reports on the following sites:

- Ngunnawal 2C development, and Bonner 4 East offset.
- Lawson development, and Jarramlee offset.
- Two confidential development sites and their associated proposed offsets.

#### 2.1.1 Sensitivity Analysis

The EOC and similar environmental assessment tools such as the BioBanking and Property Vegetation Plan tools (NSW) rely on a series of metric data collected at the plot, transect and site scale. When used in a decision support tool, metric data implies a level of accuracy and repeatability, although it is generally recognised that in ecology such data may contain some inconsistency due to variables including survey bias, timing (e.g. seasonality and precedence of wet/dry conditions) and species misidentification.

When undertaking a site assessment in line with the EOAM, field ecologists collect metric data on a series of variables related to vegetation condition, including:

- 20 x 20 metre (400 m<sup>2</sup>) plot data: native species richness.
- 20 x 50 metre (1000 m<sup>2</sup>) plot data: number of large trees, total length of fallen logs.
- 50 metre transect: native overstorey cover, native midstorey cover, native groundcover (grasses), native groundcover (shrubs), native groundcover (other), exotic plant cover.
- Vegetation zone: Overstorey regeneration.

These variables, and in particular 'native species richness' and cover estimates, may contain some inconsistency between observers and seasons at the same site or plot/transect location. Additionally, assessment of significant species population counts and habitat area, as well as ecological community (vegetation zone) areas may be subject to variability based on observer bias or survey conditions. For example, an observer may record 50 golden sun moths at Site 'A' in early January in optimal conditions, whereas the same observer may record a considerably lower population at the same site in suboptimal conditions or poorer seasons. Given the potential for variability in data fed into the EOC, it is necessary to test the

sensitivity of credit calculations in the EOC to fluctuations in datasets collected at a given site.

The two classes of credits are:

- Ecological community credits – these are created or required for all impacts on biodiversity values (including significant species) that can be reliably predicted by vegetation, except the significant species or populations that require species credits. Ecosystem credits are required for all ecosystems, including those which are not threatened, as they provide habitat.
- Species credits – these are created or required for impacts on significant species that cannot be reliably predicted to use an area of land based on vegetation alone.

For this report, analysis of credit requirements for each relevant development site was examined based on fluctuations in the following variables:

- species credits: +25 per cent, +50 per cent, -25 per cent, -50 per cent variance of golden sun moth population numbers;
- species credits: +25 per cent, +50 per cent, -25 per cent, -50 per cent variance of striped legless lizard habitat (hectares); and
- ecological community credits: +25 per cent, -25 per cent and -50 per cent variance on 'native species richness' of plots within vegetation types containing threatened ecological communities (i.e. ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland; grassland types including ACT01: Tableland Dry Tussock Grassland). The effect of a +50 per cent increase was not tested as higher values for species richness do not change the calculation once the count reaches the benchmark value.

These variables were chosen as they tested the performance of the EOC assessment of impacts on key species and ecological communities subject to development in the ACT lowlands.

## 2.2 Development and Offset Analysis

In order to assess the EOAM's application to contemporary development approvals, four recent development and offset sites were chosen to test approved outcomes using the EOC. Data was derived from each site based on several sources including site specific environmental studies, ACTMAPi and Commonwealth approval decisions.

### 2.2.1 Ngunnawal 2C Development / Bonner 4 East Offset

**Table 2.1** summarises the key environmental values of the Ngunnawal 2C and Bonner 4 east areas and is the basis for consideration in the EOC.

Table 2.1 – Ngunnawal 2C/Bonner 4 East Comparison

	Impact Site	Offset Site
<b>Name</b>	Ngunnawal 2C	Bonner 4 East.
<b>Location</b>	Between Horse Park Drive and Burrumurra Avenue, Ngunnawal.	Mulligan's Flat Road, adjacent to Mulligans Flat Nature Reserve.
<b>Vegetation</b>	<ul style="list-style-type: none"> <li>• 10 ha of ACT16 <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture);</li> <li>• 19.08 ha of ACT25 <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (native pasture);</li> <li>• 0.42 ha of ACT25 <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (moderate/good condition);</li> <li>• 2.5 ha of exotic pasture.</li> </ul>	<ul style="list-style-type: none"> <li>• 2.18 ha of ACT16 <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (moderate/good condition);</li> <li>• 12.24 ha of ACT16 <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture);</li> <li>• 5.28 ha of ACT25 <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (native pasture).</li> </ul>
<b>Endangered Ecological Communities</b>	10 ha of secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.	2.18 ha of woodland and 12.24 ha of secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.
<b>Threatened Species</b>	golden sun moth (24 Individuals, 15 ha).	golden sun moth (15 Individuals, 17.4 ha); perunga grasshopper (3 ha).
<b>Sources</b>	Moore <i>et al.</i> (2010) <sup>3</sup> , ACT Government (2012).	TaMS (2011) <sup>4</sup> , Rowell (2009) <sup>5</sup> , ACT Government (2012).

### Limitations with Datasets

The Ngunnawal 2C development site data used in the EOC was derived from a combination of descriptive and spatial information prepared by Moore *et al.* (2010). Based on suggestion that lower areas of native pasture were likely to have been Box-Gum woodland, an area of 10ha of this community was assumed as the ACT vegetation type varies in definition from the higher condition Commonwealth listing for this EEC. Transect information was not able to be directly transferred for use in the EOC, and plot information for all variables was largely derived from Umwelt's local experience surveying similar habitats, and comparisons between subjective condition information from Moore *et al.* (2010) and benchmark data.

The Bonner 4 East offset site vegetation data used in the EOC was based on information in TaMS (2011). The legend of the vegetation map within this report was corrupted, and the site was stratified based on a combination of information gleaned from the vegetation map, and mapping and imagery in ACTMAPi. golden sun moth counts from Rowell (2009) were from one day only, where conditions were not considered ideal. The area of habitat has not been quantified, so the area on ACTMAPi is assumed. There was no floristic data, so information is inferred from an ecological understanding of sites in similar condition in the northern ACT.

<sup>3</sup> Moore D, Nash K & Hogg D McC (2010) Ngunnawal 2C Ecological Assessment. Report to Land Development Agency, July 2010. David Hogg Pty Ltd Environmental Consultants, Macquarie, ACT.

<sup>4</sup> TaMS (2011) Plan to protect and manage the Offset Area at Block 13 Section 2 Bonner (Bonner 4 East) to protect Golden Sun Moth Habitat. Prepared by Territory and Municipal Services on Behalf of the Land Development Agency, September 2011.

<sup>5</sup> Rowell A (2009) Survey for Golden Sun Moth at East Bonner, December 2009. Unpublished survey data provided by David Hogg to LDA, 25 January 2010.

### 2.2.1.1 Environmental Offset Calculator

Data extracted from environmental assessment reports including Moore *et al.* (2010), TaMS (2011) and Rowell (2009), and analysis of ACTMAPi was fed into the EOC to determine decision consistency between contemporary approval outcomes and those suggested by the EOC. Credits generated for the development and offset site are shown in **Table 2.2**.

**Table 2.2 - Ngunnawal 2C Development and Offset Credits**

Ngunnawal 2C Development			Bonner 4 East Offset		
Entity	CT	CR	Entity	CT	CC
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture)	EC	115	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture)	EC	145
ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (moderate/good)	EC	20	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (moderate/good)	EC	33
ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (native pasture)	EC	148	ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (native pasture)	EC	67
golden sun moth	SC	1040	golden sun moth	SC	210
			perunga grasshopper	SC	19

CT = Credit type, CR = Credits required, CC = Credits created, EC = Ecosystem Credits, SC = Species Credits.

### Summary of Outcomes

#### Red Flags

Nil.

#### Ecosystem and Species Credits

The Bonner 4 East offset provides a net gain in conserving:

- ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (Moderate/Good condition): +33 Ecosystem Credits.
- ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (Native Pasture): +30 Ecosystem Credits.
- perunga grasshopper: 19 Species Credits.

However, under the EOC greater offset credits would have been required to enable development of Ngunnawal 2C for the following values:

- ACT25: *Eucalyptus macrorhyncha* Tableland Grass/Shrub Forest (Moderate/Good condition): +20 Ecosystem Credits required.
- ACT25: *Eucalyptus macrorhyncha* Tableland Grass/Shrub Forest (Native Pasture): +81 Ecosystem Credits required.
- Golden sun moth: +830 Species Credits required.

Assuming the original development approval satisfies 'no net loss' objectives, the EOC suggests that the development and offset measures are satisfactory *with the exception of*

loss of golden sun moth individuals and habitat, where a total of 830 additional Species Credits would have been required to ensure 'sustainable loss' of this species.

Complete data used for the calculations are shown in **Appendix 1**.

### Sensitivity Analysis

Sensitivity analysis was undertaken on listed entities with potential to significantly affect ecosystem and species credit calculations. For golden sun moth, sensitivity to the variation in moth numbers was tested. Whereas for the woodland community, sensitivity was tested for variation to the native species richness score. The results of this are shown in **Table 2.3**.

**Table 2.3 - Ngunnawal 2C Sensitivity Analysis**

Entity	Credits	Type	Variance	Credit Var.
Golden sun moth (24 moths over 15 ha).	1040	SC	+25% (30 moths)	+160
			+50% (36 moths)	+320
			-25% (18 moths)	-160
			-50% (12 moths)	-320
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture) – native species richness (mean native species richness = 27; 8 below benchmark).	115	EC	+25% (34)	0
			-25% (20)	0
			-50% (14)	-18

Type = Credit Type; EC = Ecosystem Credits, SC = Species Credits; Credit Var = Credit Variance.

Golden sun moth is particularly susceptible to variance in species credits, with a 25 per cent fluctuation in recorded moths (n=6) creating a credit variance of  $\pm 160$ . ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (native pasture) is far less susceptible to variance in native species richness, even though the site contains plots originally eight species below the benchmark native species richness value of  $\geq 35$ .

#### 2.2.1.2 EPBC Offsets Calculator

The EPBC Offsets Calculator was used to assess impacts on MNES relevant to the Ngunnawal 2C development, and determine whether the Bonner 4 East offset delivers a variable outcome for the affected MNES. At the Ngunnawal 2C development, the following MNES required offsetting using the EPBC Offsets Calculator:

- 10 hectares of secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland'; and
- 15 hectares of low quality golden sun moth habitat

In using the calculations shown in **Appendix 2**, the Bonner 4 East offset is considered to mitigate 126.13 per cent of 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC impacts, and of 45.19 per cent of golden sun moth impacts. This indicates an over-achievement of offsets for the woodland community while not meeting the minimum 90 per cent direct offset requirement for golden sun moth.

## 2.2.2 Approved Lawson South Development/Jarramlee Offset

Table 2.4 summarises the key environmental values of the Lawson South and Jarramlee areas and is the basis for consideration in the EOC.

**Table 2.4 – Lawson South/Jarramlee Comparison**

	Impact Site	Offset Site
<b>Name</b>	Lawson South	Jarramlee
<b>Location</b>	North of Ginninderra Drive, west of Baldwin Drive, Lawson.	In between the ACT/NSW border and Macgregor, ACT.
<b>Vegetation</b>	<ul style="list-style-type: none"> <li>• 26 ha of ACT01 Tableland Dry Tussock Grassland (native pasture);</li> <li>• 1 ha of ACT18 Tableland Dry Shrubby Woodland (native pasture);</li> <li>• 9 ha of ACT25 <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (native pasture);</li> <li>• 8 ha of ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (Moderate/Good condition);</li> <li>• 8.24 ha of ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture);</li> <li>• 3.27 ha <i>Casuarina cunninghamiana</i> Tableland Riparian woodland (native pasture)<sup>1</sup>; and</li> <li>• 20.21 ha of exotic pasture.</li> </ul> <p><sup>1</sup> assumed to be derived from this community. The remainder of vegetation is excluded from the development impact as they are either in the inner asset protection or golden sun moth habitat retention zones.</p>	<ul style="list-style-type: none"> <li>• 5.37 ha of ACT01 Tableland Dry Tussock Grassland (moderate/good condition);</li> <li>• 58.58 ha of ACT01 Tableland Dry Tussock Grassland (native pasture);</li> <li>• 9.61 ha of exotic pasture (Chilean Needle Grass); and</li> <li>• 42.44 ha of unclassified vegetation (assumed to be exotic pasture and planted eucalypts).</li> </ul>
<b>Endangered Ecological Communities</b>	<ul style="list-style-type: none"> <li>• 8 ha of open woodland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC; and</li> <li>• 8.24 ha of secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.</li> </ul>	<ul style="list-style-type: none"> <li>• 5.37 ha of 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory' EEC.</li> </ul>
<b>Threatened Species</b>	<ul style="list-style-type: none"> <li>• Golden sun moth (50<sup>1</sup> Individuals, 52.6 ha), perunga grasshopper (49 ha).</li> </ul> <p><sup>1</sup> estimated population in impact zone, 7.4 ha retention zone assumed to contain large portion of population.</p>	<ul style="list-style-type: none"> <li>• Golden sun moth (200 Individuals, 60 ha), perunga grasshopper (3 ha), hooded robin (2 ha).</li> </ul>
<b>Sources</b>	ELA (2008) <sup>6</sup> , Approval EPBC 2010/5549.	TaMS (2013) <sup>7</sup> , ACT Government (2012)..

<sup>6</sup> ELA (2008) Environmental Studies, Lawson Land Release. Project No. 205-001. Report prepared for ACT Planning and Land Authority, May 2008.

<sup>7</sup> TaMS (2013) Jarramlee Offset Management Plan, March 2013. Prepared by Territory and Municipal Services on behalf of ACT Government.

### Limitations with Datasets

The South Lawson data used in the EOC was derived from a composite of vegetation mapping limited plot survey (n=4) as part of ELA (2008), the refined development footprint as defined in Approval EPBC 2010/5549. Plot information for all variables was largely derived from Umwelt's local experience surveying similar habitats, and comparisons between subjective condition information from ELA (2008) and benchmark data. The impacted golden sun moth population was estimated at 50 based on the assumption that a significant proportion of the population is protected in the 7.4 hectares golden sun moth habitat protection zone.

The Jarramlee data used in the OEC was based on stratification from TaMS (2013), with data largely derived from Umwelt's local experience surveying similar habitats, and comparisons between subjective condition information from TaMS (2013) and benchmark data. There was no information on golden sun moth population size available, so this was estimated at 200. Little eagle is listed as being present at Jarramlee, however as it does not indicate if it is nesting, as such it is assumed to be present as a fly-over sighting only. A Little eagle nest known from the Dunlop area was abandoned in 2009 (Olsen *et al.* 2010)<sup>8</sup>, and site survey may be required to determine whether nesting areas are present.

#### 2.2.2.1 Environmental Offset Calculator

Data extracted from environmental assessment reports including ELA (2008), TaMS (2013) and analysis of ACTMAPi was fed into the EOC to determine decision consistency between contemporary approval outcomes and those suggested by the EOC. Credits generated for the development and offset site are shown in **Table 2.5**.

**Table 2.5 - Lawson South Development and Offset Credits**

Lawson South Development			Jarramlee Offset		
Entity	CT	CR	Entity	CT	CC
ACT01: Tableland Dry Tussock Grassland (native pasture)	EC	397	ACT01: Tableland Dry Tussock Grassland (moderate/good)	EC	54
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture)	EC	98	ACT01: Tableland Dry Tussock Grassland (native pasture)	EC	721
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (moderate/good)	EC	375	golden sun moth	SC	2,184
ACT18: Tableland Dry Shrubby Woodland (native pasture)	EC	8	perunga grasshopper	SC	25
ACT22: <i>Casuarina cunninghamiana</i> Tableland Riparian Woodland (native pasture)	EC	33	hooded robin	EC	17
ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest (native pasture)	EC	72			
golden sun moth	SC	2,730			
perunga grasshopper	SC	1,289			

CT = Credit type, CR = Credits required, CC = Credits created, EC = Ecosystem Credits, SC = Species Credits.

<sup>8</sup> Olsen J, Osgood M, Maconachie M, Dabb G and Butterfield M (2010) Little eagles, whistling kites and swamp harriers in the Australian Capital Territory 2009. *Canberra Bird Notes* 35 (2) June 2010.

## Summary of Outcomes

### *Red Flags*

Nil, as the golden sun moth population is 50 (and not greater than).

### *Ecosystem and Species Credits*

The Jarramlee offset provides a net gain in conserving:

- ACT01: Tableland Dry Tussock Grassland (moderate/good condition): +54 Ecosystem Credits.
- ACT01: Tableland Dry Tussock Grassland (moderate/good condition): +324 Ecosystem Credits.
- Hooded robin: 17 Species Credits (note: this species has been recorded in planted eucalypts within the grassland area).

However, under the EOC greater offset credits would have been required to enable development of Lawson South for the following values:

- ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (native pasture): +98 Ecosystem Credits required.
- ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (moderate/good): +375 Ecosystem Credits required.
- ACT18: Tableland Dry Shrubby Woodland (native pasture): +8 Ecosystem Credits required.
- ACT22: *Casuarina cunninghamiana* Tableland Riparian Woodland (native pasture): +33 Ecosystem Credits required.
- ACT25: *Eucalyptus macrorhyncha* Tableland Grass/Shrub Forest (native pasture): +72 Ecosystem Credits required.
- Golden sun moth: +546 Species Credits required.
- Perunga grasshopper: +1264 Species Credits required.

Assuming the original development approval satisfies 'no net loss' objectives, the EOC suggests that the development and offset measures are not satisfactory with the exception of the conservation of 'acceptable loss' of Tableland Dry Tussock Grassland from the Lawson South site.

Complete data used for the calculations are shown in **Appendix 1**.

### *Sensitivity Analysis*

Sensitivity analysis was undertaken on listed entities with potential to significantly affect ecosystem and species credit calculations. The results of this are shown in **Table 2.6**.

**Table 2.6 - Sensitivity Analysis, Lawson South**

Entity	Credits	Type	Variance	Credit Var.
golden sun moth (50 moths over 60 ha)	2,730	SC	+25% (63 moths)	+347
			+50% (75 moths)	+667
			-25% (38 moths)	-320
			-50% (25 moths)	-666
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (moderate/good) – native species richness (mean native species richness = 31.3; 3.7 below benchmark)	375	EC	+25% (39)	0
			-25% (23)	0
			-50% (16)	0
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture) – native species richness (mean native species richness = 27.5; 7.5 below benchmark)	98	EC	+25% (34)	0
			-25% (21)	0
			-50% (14)	-15
ACT01: Tableland Dry Tussock Grassland (native pasture) - native species richness (mean native species richness = 19; 11 below benchmark)	397	EC	+25% (24)	0
			-25% (14)	-84
			-50% (10)	-84

Type = Credit Type; EC = Ecosystem Credits, SC = Species Credits; Credit Var = Credit Variance.

Golden sun moth is particularly susceptible to variance in species credits, with a 25 per cent increase in recorded moths (n=13) creating a credit variance of +347. Ecosystem credits appear far less susceptible to variance native species richness, although where ACT01: Tableland Dry Tussock Grassland native species richness is considerably reduced, ecosystem credit requirements are reduced by 84.

### 2.2.2.2 EPBC Offsets Calculator

The EPBC Offsets Calculator was used to assess impacts on MNES relevant to the Lawson South development, and determine whether the Jarramlee offset delivers an overall conservation outcome that improves or maintains the viability of the MNES.

At the Lawson South development, the following MNES required offsetting using the EPBC Offsets Calculator:

- 52.6 hectares of low quality golden sun moth habitat; and
- 8 hectares of moderate/good and 8.24 hectares of secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.

In using the calculations shown in **Appendix 2**, the Jarramlee offset is considered to mitigate 39.19 per cent of golden sun moth impacts. Calculations were not made on the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC as it is not included in the offsets package, however this should be considered as part of offset considerations.

While costs (\$) may be factored into the Commonwealth assessment, these were not assessed as this information was not provided and the intent of the study is to assess the ability of the EPBC Offsets Calculator to assess environmental impacts relative to the EOC.

## 2.2.3 Confidential Development Site 1/Offset Site 1

**Table 2.7** summarises the key environmental values of Confidential Site 1 and associated offset areas and is the basis for consideration in the EOC.

**Table 2.7 – Confidential Site 1 Development/Offset**

	Impact Site	Offset Site
<b>Name</b>	Confidential development site 1	Confidential offset site 1
<b>Location</b>	Confidential.	Confidential.
<b>Vegetation</b>	<ul style="list-style-type: none"> <li>0.48 ha of ACT01 Tableland Dry Tussock Grassland (moderate/good);</li> <li>5.92 ha of ACT01 Tableland Dry Tussock Grassland (native pasture).</li> </ul>	<ul style="list-style-type: none"> <li>0.4 ha of ACT01 Tableland Dry Tussock Grassland (moderate/good);</li> <li>1.3 ha of ACT01 Tableland Dry Tussock Grassland (native pasture);</li> <li>Areas of Chilean Needle Grass, providing golden sun moth habitat.</li> </ul>
<b>Endangered Ecological Communities</b>	<ul style="list-style-type: none"> <li>0.48 ha of 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory' EEC.</li> </ul>	<ul style="list-style-type: none"> <li>0.4 ha of 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory' EEC.</li> </ul>
<b>Threatened Species</b>	Golden sun moth (11 Individuals, 0.8 ha).	<ul style="list-style-type: none"> <li>Golden sun moth (54 individuals, 4.6 ha)</li> </ul>
<b>Sources</b>	Confidential.	Confidential, ACT Government (2012).

### Limitations With Datasets

The Confidential development and offset site 1 data used in the EOC was derived from confidential references provided by LDA. Plot information for all vegetation variables were largely derived from Umwelt's local experience surveying similar habitats, and comparisons between subjective condition information from these reports.

#### 2.2.3.1 Environmental Offset Calculator

Data extracted from confidential environmental assessment reports and analysis of ACTMAPi was fed into the EOC to determine decision consistency between contemporary approval outcomes and those suggested by the EOC. Credits generated for the development and offset site are shown in **Table 2.8**.

**Table 2.8 - Development and Offset Credits for the Approved Confidential Site 1 Development and Offset**

Confidential development site 1			Confidential offset site 1		
Entity	CT	CR	Entity	CT	CC
ACT01: Tableland Dry Tussock Grassland (moderate/good)	EC	9	ACT01: Tableland Dry Tussock Grassland (moderate/good)	EC	3
ACT01: Tableland Dry Tussock Grassland (native pasture)	EC	84	ACT01: Tableland Dry Tussock Grassland (native pasture)	EC	9
golden sun moth	SC	314	golden sun moth	SC	352

CT = Credit type, CR = Credits required, CC = Credits created, EC = Ecosystem Credits, SC = Species Credits.

## Summary of Outcomes

*Red Flags*  
Nil.

### *Ecosystem and Species Credits*

Confidential offset site 1 provides a net gain in conserving:

- Golden sun moth: +38 Species Credits.

However, under the EOC greater offset credits are required to enable development of Confidential development site 1 for the following values:

- ACT01: Tableland Dry Tussock Grassland (moderate/good): +6 Ecological Credits required.
- ACT01: Tableland Dry Tussock Grassland (native pasture): +75 Ecological Credits required.

Assuming the original development approval satisfies 'no net loss' objectives, the EOC suggests that the development and offset measures are satisfactory in mitigating impacts on golden sun moth. However, further conservation measures are required for Tableland Dry Tussock Grassland.

Complete data used for the calculations are shown in **Appendix 1**.

### *Sensitivity Analysis*

Sensitivity analysis was undertaken on listed entities with potential to significantly affect ecosystem and species credit calculations. The results of this are shown in **Table 2.9**.

**Table 2.9 - Sensitivity Analysis, Confidential Development Site 1**

Entity	Credits	Type	Variance	Credit Var.
golden sun moth (11 moths over 0.8 ha)	314	SC	+25% (14 moths)	+80
			+50% (17 moths)	+160
			-25% (8 moths)	-80
			-50% (6 moths)	-133
ACT01: Tableland Dry Tussock Grassland (moderate/good) - native species richness (mean) = 31; 1 above benchmark	9	EC	+25% (39)	0
			-25% (23)	0
			-50% (16)	-2
ACT01: Tableland Dry Tussock Grassland (native pasture) - native species richness (mean) = 16; 14 below benchmark	84	EC	+25% (20)	0
			-25% (12)	-19
			-50% (8)	-19

Type = Credit Type; EC = Ecosystem Credits, SC = Species Credits; Credit Var = Credit Variance.

Golden sun moth is particularly susceptible to variance in species credits, with a 25 per cent variance in recorded moths ( $n \pm 3$ ) creating a credit variance of  $\pm 80$ . Ecosystem credits appear far less susceptible to variance native species richness, although where ACT01: Tableland Dry Tussock Grassland (native pasture) native species richness is reduced below the 50 per cent of benchmark value, ecosystem credit requirements are reduced by 19.

### 2.2.3.2 EPBC Offsets Calculator

The EPBC Offsets Calculator was used to assess impacts on MNES relevant to Confidential development site 1, and determine whether Confidential offset site 1 delivers an overall conservation outcome that improves or maintains the viability of the MNES.

At Confidential development site 1, the following MNES required offsetting using the EPBC Offsets Calculator:

- 0.48 hectare of moderate quality 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory' EEC.
- 0.8 hectare of moderate quality golden sun moth habitat.

In using the calculations shown in Appendix 2, Confidential offset site 1 is considered to mitigate 104.95 per cent of golden sun moth impacts, but only 20.7 per cent of 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory' EEC.

While costs (\$) may be factored into the Commonwealth assessment, these were not assessed as this information was not provided and the intent of the study is to assess the ability of the EPBC Offsets Calculator to assess environmental impacts relative to the EOC.

### 2.2.4 Confidential Development Site 2/Offset Site 2

**Table 2.10** summarises the key environmental values of Confidential development site 2 and Confidential offset site 2 areas and is the basis for consideration in the EOC.

**Table 2.10 – Confidential Development Site 2/Offset Site 2 Comparison**

	<b>Impact Site</b>	<b>Offset Site</b>
<b>Name</b>	Confidential development site 2	Confidential offset site 2
<b>Location</b>	Confidential.	Confidential.
<b>Vegetation</b>	<ul style="list-style-type: none"> <li>• 14.65 ha of ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture).</li> </ul>	<ul style="list-style-type: none"> <li>• 5 ha of ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (moderate/good);</li> <li>• 20 ha of ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture); and</li> <li>• 27.09 ha of ACT01 Tableland Dry Tussock Grassland (moderate/good).</li> </ul>
<b>Endangered Ecological Communities</b>	<ul style="list-style-type: none"> <li>• 14.65 ha of low condition secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.</li> </ul>	<ul style="list-style-type: none"> <li>• 5 ha of woodland and 20 ha of secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC; and</li> <li>• 27.09 ha of 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory' EEC.</li> </ul>

<b>Threatened Species</b>	Striped legless lizard habitat (6 ha).	<ul style="list-style-type: none"> <li>Striped legless lizard (52 ha), perunga grasshopper (2 ha), golden sun moth (20 individuals, 3 ha).</li> </ul>
<b>Sources</b>	Information in the Referral, ACTMAPi, knowledge of derived vegetation types of the local area.	ACTMAPi.

### Limitations with Datasets

Apart from information on the presence of striped legless lizard on site, there was little information on the ecology of Confidential development site 2. The area contains native pasture, and based on analysis of imagery and an understanding of the local area, it is likely to be derived from ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland.

Vegetation and habitat information for Confidential offset site 2 was derived from ACTMAPi, with high condition assumed based on its presence in the reserve system and the authors knowledge of grassland condition across parts of the offset area. Within this area there is low confidence on the accuracy of natural temperate grassland mapping, and much of the area is likely to be secondary woodland. As such, the ratio of woodland and grassland was estimated based in visualisation of ACTMAPi, and the author’s knowledge of the area.

#### 2.2.4.1 Environmental Offset Calculator

Data extracted from environmental assessment reports including the development Referral and analysis of ACTMAPi was fed into the EOC to determine decision consistency between contemporary approval outcomes and those suggested by the EOC. Credits generated within the development and offset sites are shown in **Table 2.11**.

**Table 2.11 - Development and Offset Credits for the Approved Confidential Development Site 2 and Confidential Offset Site 2**

Confidential development site 2			Confidential offset site 2		
Entity	CT	CR	Entity	CT	CC
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture)	EC	157	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (moderate/good)	EC	48
Striped legless lizard	SC	150	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture)	EC	199
			ACT01: Tableland Dry Tussock Grassland (moderate/good)	EC	329
			striped legless lizard	SC	437
			perunga grasshopper	SC	17
			golden sun moth	SC	193

CT = Credit type, CR = Credits required, CC = Credits created, EC = Ecosystem Credits, SC = Species Credits.

## Summary of Outcomes

### Red Flags

The development highlights a flag for striped legless lizard. This is despite the development being consistent with the Special Offset Requirement for 'No loss of known habitat within Priority 1 and Priority 2 grasslands'. This glitch may require further examination by database developers.

### Ecosystem and Species Credits

Confidential offset site 2 provides a net gain in conserving:

- ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (moderate/good): +48 Ecosystem Credits.
- ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (native pasture): +42 Ecosystem Credits.
- ACT01: Tableland Dry Tussock Grassland (moderate/good): +329 Ecosystem Credits.
- Striped legless lizard: +287 Species Credits.
- Perunga grasshopper: +17 Species Credits.
- Golden sun moth: +193 Species Credits.

Assuming the original development approval satisfies 'no net loss' objectives, the EOC suggests that the development and offset measures satisfy all objectives in the protection of the above entities.

Complete data used for the calculations are shown in **Appendix 1**.

### Sensitivity Analysis

Sensitivity analysis was undertaken on listed entities with potential to significantly affect ecosystem and species credit calculations. The results of this are shown in **Table 2.12**.

**Table 2.12 - Sensitivity Analysis, Confidential Development Site 2**

Entity	Credits	Type	Variance	Credit Var.
ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland (native pasture): native species richness (mean) = 26; 9 below benchmark	157	EC	+25% (33)	0
			-25% (20)	0
			-50% (13)	-26
Striped legless lizard (6 ha)	150	SC	+25% (7.5)	+37
			+50% (9)	+75
			-25% (4.5)	-38
			-50% (3)	-75

Type = Credit Type; EC = Ecosystem Credits, SC = Species Credits; Credit Var = Credit Variance.

Striped legless lizard is susceptible to variance in species credits, with a 25 per cent increase in habitat area moths (n=1.5 hectares) creating a credit variance of +37. Ecosystem credits appear far less susceptible to variance native species richness, although where ACT01:

Tableland Dry Tussock Grassland native species richness is considerably reduced, ecosystem credit requirements are reduced by 26.

#### **2.2.4.2 EPBC Offsets Calculator**

The EPBC Offsets Calculator was used to assess impacts on MNES relevant to the Confidential development site 2, and determine whether Confidential offset site 2 delivers an overall conservation outcome that improves or maintains the viability of the MNES.

At Confidential development site 2, six hectares of striped legless lizard habitat would require offsetting using the EPBC Offsets Calculator.

Confidential development site 2 is not likely to contain secondary grassland as part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC due to the likelihood of not having the number of requisite native understorey species (excluding grasses) or important species.

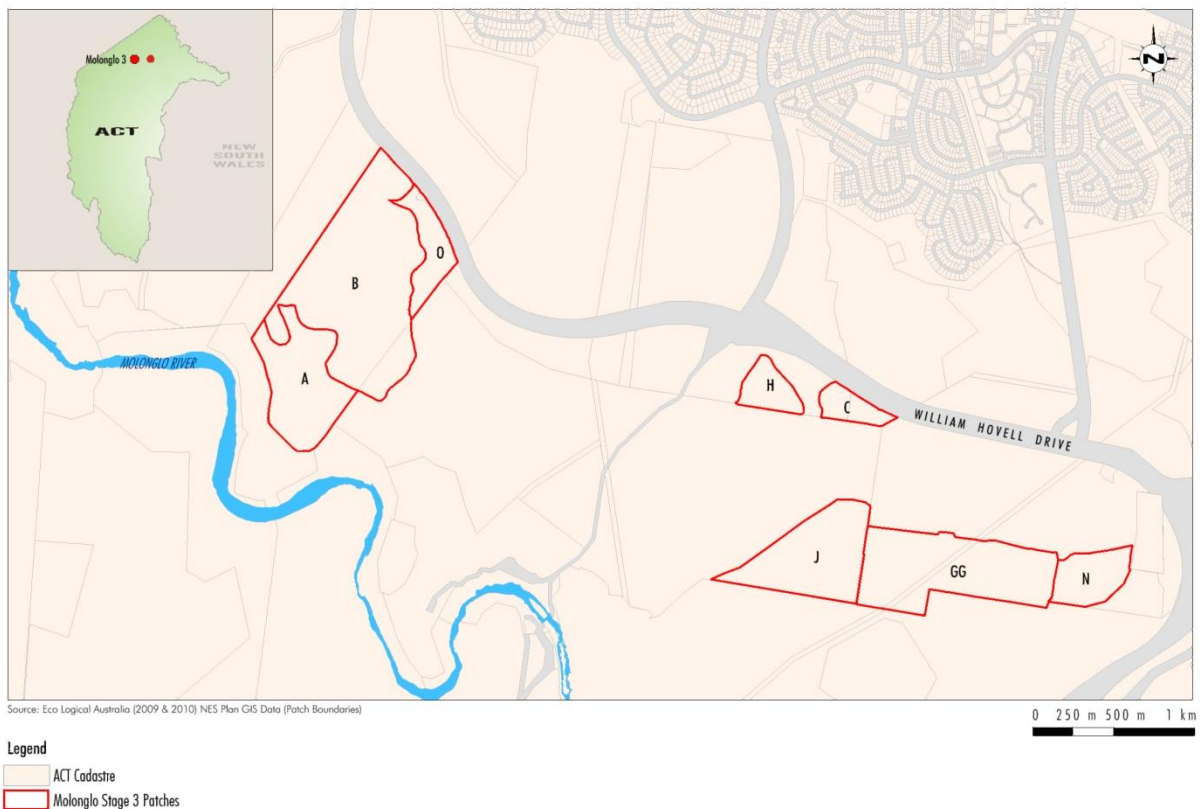
In using the calculations shown in Appendix 2, the Confidential offset site 2 is considered to mitigate 234.72 per cent of striped legless lizard habitat impacts.

While costs (\$) may be factored into the Commonwealth assessment, these were not assessed as this information was not provided and the intent of the study is to assess the ability of the EPBC Offsets Calculator to assess environmental impacts relative to the EOC.

## 3.0 Real Data Example: Molonglo Stage 3

### 3.1 Methodology

In order to determine the offset credit value for offsets identified in the Molonglo Valley Plan for the Protection of Matters of National Environmental Significance (the 'NES Plan') (ACT Government 2011)<sup>9</sup>, floristic plot and habitat feature field data was collected in offset patches A, B, C, GG, H, N and O, as well as patch J in the development zone. The location of these patches is shown in **Figure 3.1**. Note that the configuration of patches A, B and O were refined based on vegetation mapping done by Umwelt (2013)<sup>10</sup> supplementary to this study; these areas are described in the context of updated information. Despite this, **Figure 3.1** retains the original polygon configuration as presented in the NES Plan. Other areas within the Molonglo stage 3 development were not assessed, and for the purpose of this study are presumed to be generally consistent with vegetation mapping prepared as part of the Molonglo Valley strategic assessment (ELA 2009).



**Figure 3.1. Areas assessed as part of Molonglo Stage 3 development and offset package.**

Information within these patches was assessed in line with Appendix 10 of the EOCOM, shown in **Table 3.1** (ACT Government 2013b)<sup>11</sup>.

<sup>9</sup> ACT Government (2011) Molonglo Valley plan for the protection of matters of national environmental significance. NES plan, September 2011. ACT Planning and Land Authority.

<sup>10</sup> Umwelt (2013) Briefing note: vegetation mapping for Kama Nature Reserve, Molonglo. Prepared by Umwelt Pty Limited for Daniel Santosuosso, ACT Land Development Agency. 11 October 2013.

<sup>11</sup> ACT Government (2013b) Environmental Offsets Calculator Operational Manual. ACT Environment and Sustainable Development Directorate. Version 20130301.

**Table 3.1 – Field Survey Variables Collected in Molonglo Stage 3 Offset Areas.**

Variable	Plot or transect type	Method
Native plant species richness	20m x 20m plot	Native plant species refers to vascular species local to the area which, if planted, come from a local seed source. Systematically walk the plot counting the number of native plant species for all vascular plants (i.e. the species do not have to be identified).
Native overstorey cover	At 10 points along 50m transects	<p>Native over-storey is the tallest woody stratum present (including emergents) above 1m and includes all species native to the ACT (i.e. native species not local to the area can contribute to overstorey structure). In a woodland community the over-storey stratum is the tree layer, and in a shrubland community the over-storey stratum is the tallest shrub layer. Some vegetation types (e.g. grasslands) may not have an over-storey stratum.</p> <p>Over-storey cover is estimated as per cent foliage cover, which is equivalent to the amount of shadow that would be cast on the ground if there were a light source directly overhead and can be estimated using the following method: At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover directly overhead using the images provided on Page 4. Divide the total by the number of points (i.e. 10) measured along the transect (e.g. 50%, 0%, 0%, 40%, 0%, 45%, 50%, 55%, 0%, 0% = <math>240/10 = 24\%</math> foliage cover).</p>
Native midstorey cover	At 10 points along 50m transects	<p>The mid-storey contains all vegetation between the overstorey stratum and 1m in height (typically tall shrubs, under-storey trees and tree regeneration) and includes all species native to the ACT (i.e. native species not local to the area can contribute to mid-storey structure). Foliage cover of the mid-storey is expressed as a % and can be measured using the following method:</p> <p>At 10 points along the 50m transect (i.e. every 5m) estimate per cent foliage cover in the mid-storey. Divide the total by the number of points (i.e. 10) measured along the transect (e.g. 50%, 0%, 0%, 40%, 0%, 45%, 50%, 55%, 0%, 0% = <math>240/10 = 24\%</math> foliage cover).</p>
Native ground cover (grasses)	At 50 points along 50m transects	The ground stratum contains all native vegetation below 1m in height and includes all species native to the ACT (i.e. is not confined to species indigenous to the area). The ground stratum (grasses) refers to native grasses (i.e. plants belonging to the family Poaceae). Foliage cover of the ground stratum (grasses) is expressed as a % and can be measured using the following method: At 50 points along the 50m transect (i.e. every 1m) record whether native grass intersects that point. Divide the total of 'hits' by the number of points measured along the transect (i.e. 50).
Native ground cover (shrubs)	At 50 points along 50m transects	The ground stratum contains all native vegetation below 1m in height and includes all species native to the ACT (i.e. is not confined to species indigenous to the area). The ground stratum (shrubs) refers to native woody vegetation <1m. It is measured in the same way as for native ground cover (grasses) (see above)
Native ground cover (other)	At 50 points along 50m transects	The ground stratum contains all native vegetation below 1m in height and includes all species native to the ACT (i.e. is not confined to species indigenous to the area). The ground stratum (other) refers to non-woody native vegetation (vascular plants only) <1m that is not grass (e.g. herbs, ferns). It is measured in the same way as for native ground cover (grasses) (see above)
Exotic plant cover	At 50 points along 50m	Exotic plants are vascular plants not native to Australia. Exotic cover is measured as a % of total ground cover vegetation.

	transects	
Number of large trees	50m x 20m plot	This is a count of the number of living and dead trees within a 50mx20m plot which have a circumference of 150cm, 1m above ground height.
Over-storey regeneration	Entire zone	Regeneration is measured as the proportion of over-storey species present at the site that are regenerating (i.e. with dbh < 5cm). For example if there are three tree species present at the site but only one of these species is regenerating, then the value is 0.33. The maximum value for this measure is 1.
Total length of fallen logs	50m x 20m plot	This is the total length of logs at least 10cm diameter and at least 0.5m long. The diameter is estimated with a measuring tape (or callipers if available) held horizontally immediately above the log and the length is estimated to the nearest metre by measuring with a tape, or pacing, along the part of the log that is at least 10cm diameter. If estimating length by pacing then the actual length of a sample of logs should be measured regularly with a tape so the assessor can calibrate their estimate derived from pacing. Only those parts of logs lying within the plot are measured.

The minimum number of transects/plots required in each vegetation zone is dependent on the size and condition of the zone (**Table 3.2**). Zones are delineated based on vegetation type and condition assessment which relies on detailed existing information and/or on-site investigation which was not available when scoping this project. However, information was collected to satisfy these requirements as much as practicable, as guided by additional mapping and survey. In some instances where canopy cover was relatively open but still considered in moderate/good condition in the EOCOM (for example, in patch 'H'), some sampling of low condition (i.e. paddock tree) vegetation was undertaken in areas mapped as being moderate/good condition. This was due to site assessment determining that, on a finer scale, the quadrat and transect area were assessed as being in low condition. This is not expected to affect outcomes of the EOC calculations.

**Table 3.2 – Minimum Number of Transects/plots Required Per Zone Area.**

Vegetation zone area (ha)	Minimum number of transects/plots
0 – 4	1 transect/plot per 2 ha (or part thereof) or 1 transect/plot if vegetation is in low condition.
>4 – 20	3 transects/plots or 2 transects/plots if vegetation is in low condition.
>20 – 50	4 transects/plots or 3 transects/plots if vegetation is in low condition.
>50 – 100	5 transects/plots or 3 transects/plots if vegetation is in low condition.
>100 – 250	6 transects/plots or 4 transects/plots if vegetation is in low condition.
>250 – 1000	7 transects/plots or 5 transects/plots if vegetation is in low condition.
>1000	8 transects/plots or 5 transects/plots if vegetation is in low condition. <i>More transects/plots may be needed if the condition of the vegetation is variable across the zone.</i>

As part of this study, vegetation within the Molonglo stage 3 development mapped by ELA (2009) was delineated based on vegetation condition criteria in the EOAM. Additionally, vegetation type attributes and patch boundaries within Kama Nature Reserve were amended and remapped based on the presence of areas of scribbly gum grassy open forest in both its extant and derived state; these areas were previously mapped as box-gum woodland and derived grassland.

The plot counts for each patch within the Molonglo Stage 3 development were as follows:

- Patch C (6.9 hectares): 4 plots across two vegetation zones
- Patch GG (46.3 hectares): 6 plots across two vegetation zones
- Patch H (8.6 hectares): 4 plots across two vegetation zones
- Patch J (2.4 hectares): 1 plot (note the remaining 30.6 hectares is dominated by exotic pastures)
- Patch N (13.4 hectares): 2 plots

Within Kama Nature Reserve, three vegetation types (zones) were assessed, with two of these zones delineated into two condition classes:

- Zone 1 (44.6 hectares): 4 plots. This zone represents natural temperate grassland [Patch A in ELA (2009)].
- Zones 2/3 (77.3 hectares): 9 plots across two condition classes. These zones are a refinement of Patch B in ELA (2009), with exclusion of areas dominated by scribbly gum.
- Zones 4/5 (23.2 hectares): 5 plots across two condition classes. These zones are a refinement of Patch O in ELA (2009), with a change in vegetation type based on the dominance of scribbly gum. An additional plot was also completed in this community within the Molonglo Stage 3 development outer asset protection zone.

Raw data collected in each patch used for EOC calculations are shown in **Appendix 1**. Field datasheets developed as part of the EOCOM were also trialled, to determine their utility in the field and appropriateness of the format to collect data for the EOC. A critique of the field survey proformas is outlined in **Section 4.8.1**.

## 3.2 Results

Field survey was undertaken over a total of four days between July 9 and July 22, 2013, during a survey period when floristic diversity is at its lowest as many annual native forbs are absent. Supplementary survey to satisfy the minimum number of transects/plots required in each vegetation zone (**Table 3.2**) was completed on 25 September 2013. Species recorded in each plot are shown in **Appendix 3**. Although survey timing may affect offset credit calculations to some extent, the influence is likely to be minor due to the low sensitivity of ecological community credit calculations to variance in species richness values (refer to **section 4.1.1**), which are partially nullified by other equally weighted variables within the EOC equation including native overstorey cover, native midstorey cover, native groundcover (grasses), native groundcover (shrubs), native groundcover (other), number of trees with hollows, overstorey regeneration and total length of fallen logs.

Species richness, and in particular non-grass understorey species, is an important determinant of whether a 'box-gum woodland' meets requisite condition criteria to be considered part of the 'white box – yellow box – Blakely's red gum grassy woodland and derived native grassland' critically endangered ecological community (CEEC) under the EPBC Act. Under these criteria, within the entire remnant a total of 12 non-grass understorey and at least one "important" species as defined by Australian Government (2006)<sup>12</sup> need to be present for the remnant to be considered part of the CEEC. While this study did not have access to raw data collected as part of ELA (2009)<sup>13</sup>, cited in ELA (2010)<sup>14</sup>, non-grass

<sup>12</sup> Australian Government (2006) *White box – yellow box – Blakely's red gum grassy woodlands and derived native grasslands. EPBC Act Policy Statement*. Department of Environment and Heritage, 2006. Accessed online (04/07/2013): <http://www.environment.gov.au/epbc/publications/box-gum.html>.

<sup>13</sup> ELA (2009) EPBC Listed Flora Community and Species Mapping in the Molonglo Valley. A report prepared for ACT Planning and Land Authority.

understorey revealed a significantly lower count in some patches. It is not known how much of this relates to seasonality, site degradation and sampling variance: it may be a combination of all three factors. With the exception of patch A and parts of patch B, all other sites were observed to be significantly degraded. Rapid appraisal and additional plots during an appropriate time of year (i.e. late Spring) revealed additional native non-grass understorey species in Patch GG in particular, and in higher condition areas within Patches C and H. However, at this time late spring forbs and summer grasses were not always readily identifiable to species level. Information on the current condition pertaining to each patch is outlined in relevant sections below.

Vegetation type and ecological community credits generated within Molonglo stage 3 offset areas found as part of this study is shown in **Table 3.3**, along with vegetation type and condition attribution from the ELA (2009) assessment. Further discussion and maps of each patch is provided in sections below the table.

**Table 3.3 – Vegetation Types and Ecological Communities Generated Within Molonglo Stage 3 Offset Areas**

Patch	Vegetation		Ecological community credits <sup>1</sup>	Credit type (condition)
	ELA (2009)	This study		
<b>Development</b>				
<b>J</b>	Box-Gum woodland (16-20 species)	Degraded native pasture; Approximately 2.4 ha of potential Box-Gum woodland (derived)	22 (debit)	Native pasture
<b>Offset (Molonglo Stage 3)</b>				
<b>C</b>	Box-Gum woodland (21+ species)	Potential box-gum woodland (partially derived)	31 14	Native pasture Moderate/good
<b>GG</b>	Box-Gum woodland (12-15 species)	Potential box-gum woodland	286 155	Moderate/good Native pasture
<b>H</b>	Box-Gum woodland (16-20 species)	Potential box-gum woodland (partially derived)	39 32	Moderate/good Native pasture
<b>N</b>	Box-Gum woodland (12-15 species)	Potential box-gum woodland (derived)	62	Native pasture
<b>Offset (Kama Nature Reserve)</b>				
<b>Zone 1</b>	Patch A: Natural temperate grassland	Natural temperate grassland	577	Moderate/good
<b>Zones 2/3</b>	Patch B: Box-Gum woodland (21+ species)	Box-gum woodland	1,047 229	Moderate/good Native pasture
<b>Zones 4/5</b>	Patch O: Box-Gum woodland (12-15 species)	Scribbly gum woodland	234 132	Moderate/good Native pasture

<sup>1</sup> Note that species credits have not been calculated due to a lack of information on threatened species impacts. There is potential for pink-tailed worm lizard to occur in suitable habitat in the outer asset protection zone adjacent to Kama Nature Reserve; however these have not been surveyed to determine presence or absence.

Additionally, the known presence of brown treecreeper (*Climacteris picumnus victoriae*) in Kama Nature Reserve generated 496 species credits for this species.

<sup>14</sup> ELA (2010) Draft strategic assessment report for the Molonglo Valley plan for the protection of matters of national environmental significance. Prepared for ACT Planning and Land Authority, March 2010.

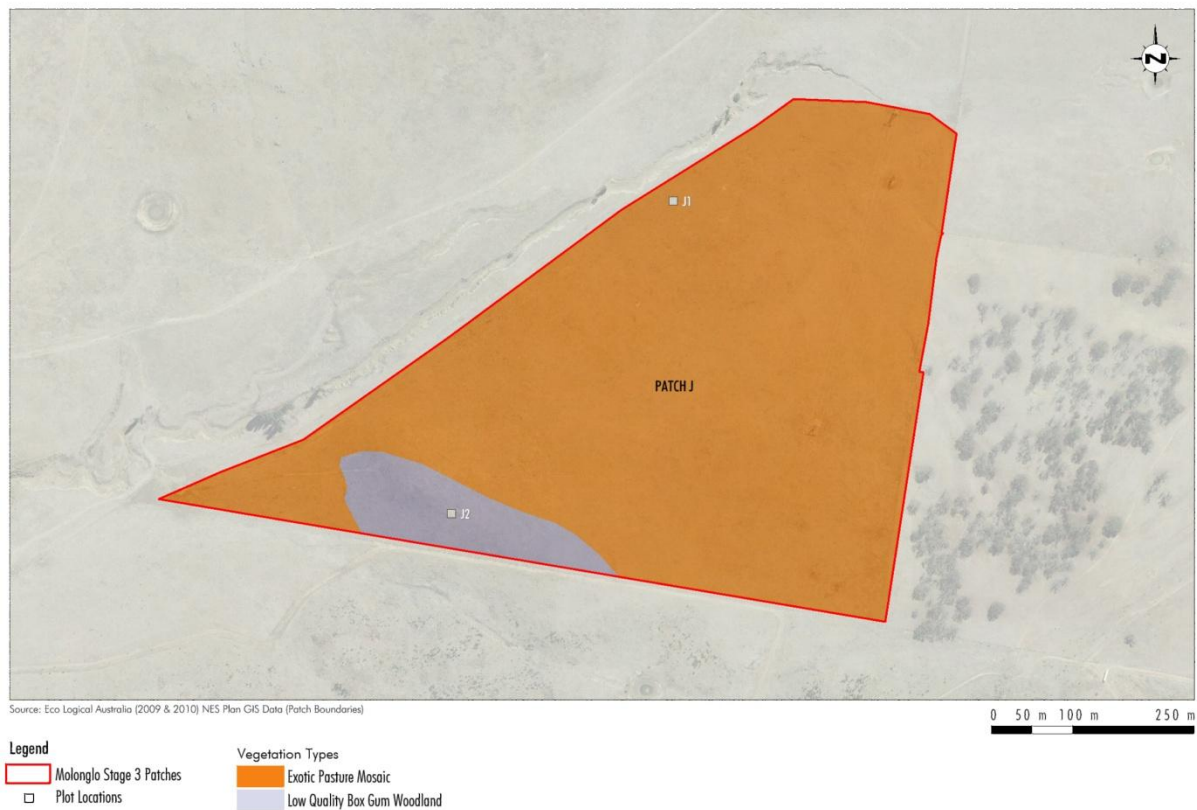
### 3.2.1 Development areas

The following sections present findings of the assessment of development areas in Molonglo stage 3 as text rather than tabular format (as per **Section 2.2**) as there is no apparent direct comparison of development and offset areas.

#### 3.2.1.1 Patch J

Patch 'J' is located directly west of patch 'GG', and adjacent to the Arboretum, within the central-northern section of the Molonglo stage 3 development (**Figure 3.2**). Previously, it has been mapped as containing 32.97 hectares of 'box-gum woodland (16-20 species)' (ELA 2009 & 2010). Assessment undertaken as part of this current study suggests that this condition rating is not warranted in its current state. The patch is cleared and dominated by phalaris over the majority of its extent, usually occurring with native tall speargrass as a subdominant grass (**Figure 3.3**). **Figure 3.4** shows the fence line effect between the native tussock understorey of patch 'GG' and the greener annual and perennial exotic grasses within patch 'J'. Tall speargrass is the dominant grass in patches, but these patches are too small to constitute a distinct vegetation type as defined by the EOCOM (i.e. less than 0.25 hectares in extent), or the box-gum definition under the EPBC Act (i.e. less than 0.1 hectares in extent). One area of approximately 2.4 hectares in the south of the patch is considered native, as shown in **Figure 3.5**. Survey within one 20x20 metre plot recorded 12 non-grass native understorey species, including 'important' species such as blue devil (*Eryngium ovinum*), early nancy (*Wurmbea dioica* subsp. *dioica*) and slender tick-trefoil (*Desmodium varians*). As such, the 2.4 hectare area within patch 'J' represents derived grassland as part of the EPBC Act 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.

Based on plot assessment undertaken as part of this study, native areas within patch 'J' generated 22 ecological community credits for vegetation type ACT16: '*Eucalyptus melliodora* – *E. blakelyi* tableland grassy woodland' in native pasture condition; these credits require offsetting if the area is developed.



**Figure 3.2. Patch J, including plot locations.**

It is likely that the patch has been historically subjected to improved pasture treatment, and this observation is supported by the dominance of native grasses in small patches of rocky outcrops which tend to be excluded from cultivation. These small rocky outcrops may contain low-quality habitat for pink-tailed worm lizard (*Aprasia parapulchella*), which is listed as vulnerable under the EPBC Act.



**Figure 3.3. Exotic pasture dominated by phalaris, plot J1.**



**Figure 3.4. Fence line effect between the native tussock understorey of patch GG (right of fence) and greener annual and perennial exotic grasses within patch J (left).**



Figure 3.5. Area of native grassland within the southern portion of Patch J, plot J2.

### 3.2.2 Offset Areas Within Molonglo Stage 3 Area

#### 3.2.2.1 Patch C

Located in the central-northern section of the Molonglo stage 3 development, adjacent to William Hovell Drive, patch 'C' was mapped by ELA (2009) as containing 6.9 hectares of 'box-gum woodland (21+ species). Assessment undertaken as part of this current study confirmed this, with 21 non-grass native understorey species recorded primarily in treed areas. The floristic diversity in derived grassland areas is generally low, forming a mosaic of low diversity grassland and patched dominated by exotic pasture grasses. It is estimated that exotic pastures are dominant across 30% of this patch.

**Figure 3.6** shows the distribution of woodland and secondary grassland structure, and plots, within patch 'C'. A total of 73 species were recorded in patch 'C', 31 of which were native. Areas beneath and adjacent to remnant yellow box (*Eucalyptus melliodora*) and Blakely's red gum (*E. blakelyi*) are considered to contain a high native floristic diversity (albeit with a significant exotic component), with the presence of a suite of palatable herbs including 'important' species such as kangaroo grass, yellow burr-daisy (*Calotis lappulacea*), slender tick-trefoil (*Desmodium varians*) and twining glycine (*Glycine clandestina*) (**Figure 3.7**). As such, areas with a native understorey within patch 'C' may be considered part of the EPBC Act 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC.

Within the derived grassland area, patch 'C' is largely characterised by low diversity secondary grassland dominated by red-leg grass (*Bothriochloa macra*) and tall speargrass

(*Austrostipa bigeniculata*), with only six common non-grass native understorey recorded within two 20 x 20 metre plots. Low diversity secondary grassland forms a mosaic with areas dominated by exotic pasture grasses including phalaris (*Phalaris aquatica*), brome (*Bromus* spp.), and exotic forbs characteristic of heavily grazed pastures including white horehound (*Marrubium vulgare*), St Johns wort (*Hypericum perforatum*), Patterson’s curse (*Echium plantagineum*) and saffron thistle (*Carthamus lanatus*), and exotic shrubs including sweet briar (*Rosa rubiginosa*) and blackberry (*Rubus fruticosus* agg.) (Figure 3.8).

Based on plot assessment undertaken as part of this study, patch ‘C’ generated 14 ecological community credits for ‘vegetation type ACT16: *Eucalyptus melliodora* – *E. blakelyi* tableland grassy woodland’ in ‘moderate/good’ condition, and an additional 31 ecological community credits for this community in ‘native pasture’ condition.

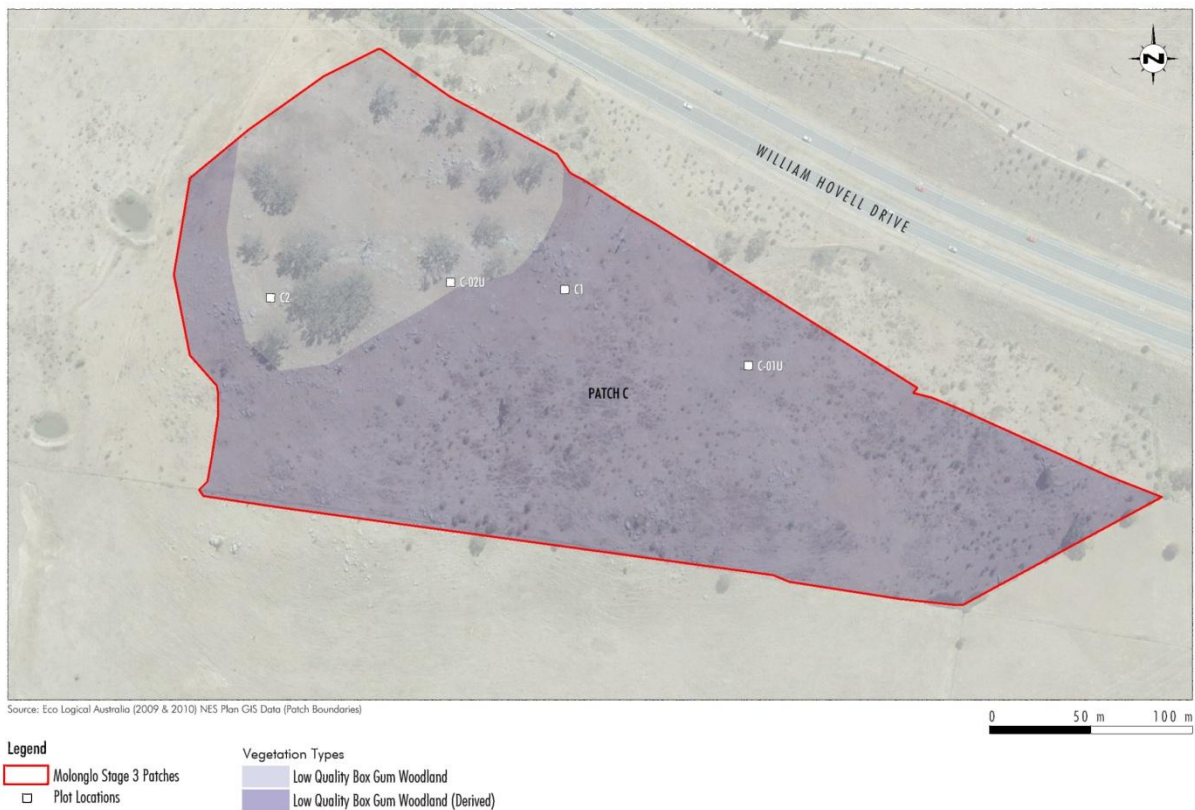


Figure 3.6. Patch C, including plot locations.



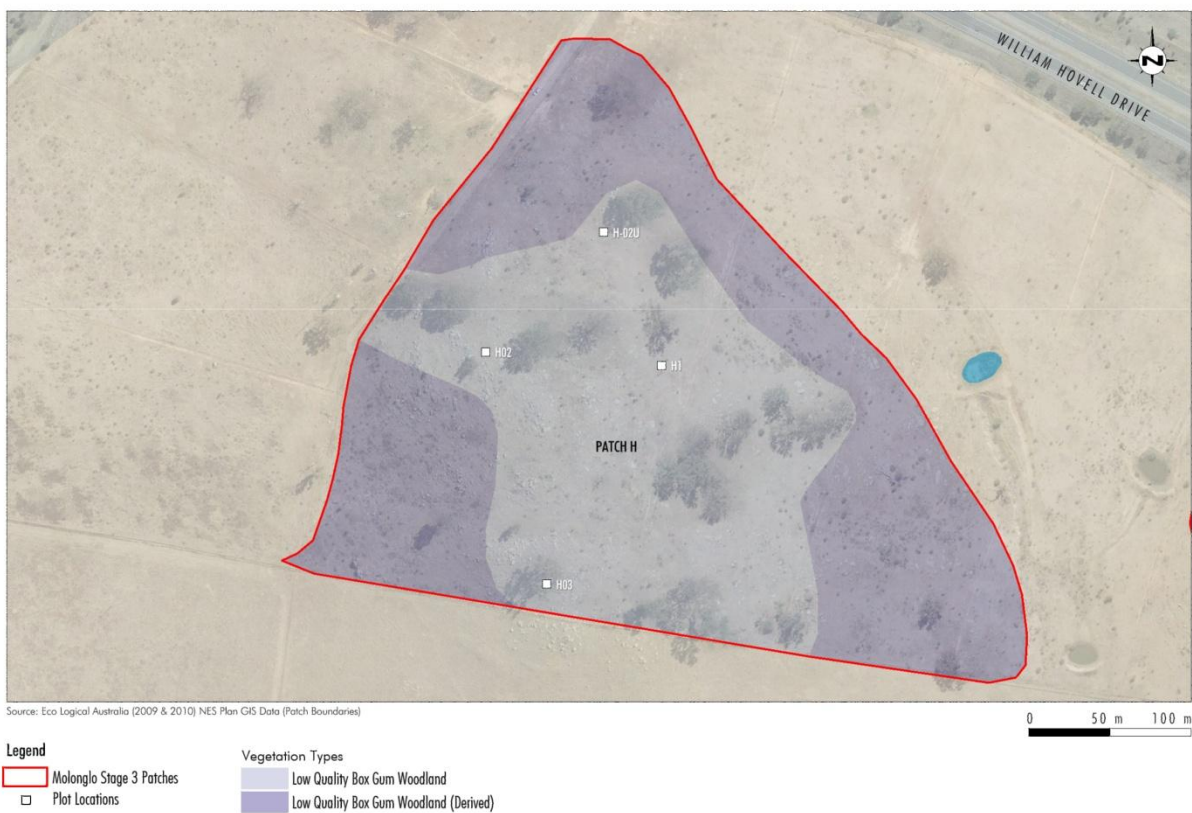
**Figure 3.7. Plot C2, with a high diversity of both native and exotic flora.**



**Figure 3.8. Low quality secondary grassland remnant, plot C1.**

### 3.2.2.2 Patch H

Patch 'H' is located west of patch 'C' within the central-northern section of the Molonglo stage 3 development (**Figure 3.9**). The two patches are separated by a drainage line containing non-native vegetation. Previously, it has been mapped as containing 8.6 hectares of 'box-gum woodland (16-20 species)' (ELA 2009). As was found with patch 'C', assessment undertaken as part of this current study suggests that condition is variable, with high quality areas confined to high ridge patches and steeper slopes of lower fertility. However, a total of 24 non-grass native understorey were recorded, suggesting that despite variability in condition, it belongs in the 21+ species category. The patch is currently being used as a horse grazing paddock, and while it contains high condition values in patches, there are also areas dominated by annual and perennial weeds. It is estimated that approximately 30% of this patch is dominated by exotic forbs and pasture grasses.



**Figure 3.9. Patch H, including plot locations.**

A total of 65 species were recorded in patch 'H', 35 of which were native. Areas in less fertile ridges and steeper slopes are considered to contain a high native floristic diversity (albeit with a significant exotic component), with the presence of a suite of 'important' species such as kangaroo grass, blue devil (*Eryngium ovinum*), variable Glycine (*Glycine tabacina*), purple coral-pea (*Hardenbergia violacea*), variable plantain (*Plantago varia*), and early nancy (*Wurmbea dioica* subsp. *dioica*). As such, areas with a native understorey within patch 'C' may be considered part of the EPBC Act 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland' CEEC. An example of higher condition areas within patch 'H' is shown in **Figure 3.10**.

Within the derived grassland area, patch 'H' is largely characterised by low diversity secondary grassland dominated by tall speargrass (*Austrostipa bigeniculata*) and red-leg grass (*Bothriochloa macra*), with nine common non-grass native understorey recorded within

two 20 x 20 metre plots. Low diversity secondary grassland forms a mosaic with areas dominated by exotic pasture grasses including barley grass (*Hordeum* spp.), wild oats (*Avena* spp.), brome (*Bromus* spp.) and exotic forbs characteristic of heavily grazed pastures including white horehound (*Marrubium vulgare*), wild sage (*Salvia verbenaca*), small-flowered mallow (*Malva parviflora*), Buchan weed (*Hirschfeldia incana*), Patterson's curse (*Echium plantagineum*) and saffron thistle (*Carthamus lanatus*), and exotic shrubs including sweet briar (*Rosa rubiginosa*), St Johns wort (*Hypericum perforatum*) and African boxthorn (*Lycium ferocissimum*) (**Figure 3.11**).

Based on plot assessment undertaken as part of this study, patch 'H' generated 39 ecological community credits for 'vegetation type ACT16: *Eucalyptus melliodora* – *E. blakelyi* tableland grassy woodland' in 'moderate/good' condition, and an additional 32 ecological community credits for this community in 'native pasture' condition.



**Figure 3.10. Box-gum woodland with moderate floristic diversity (including weeds), plot H3.**



Figure 3.11. Low quality box-gum woodland, plot H1.

### 3.2.2.3 Patch GG

Located in the south-eastern section of the Molonglo stage 3 development and adjacent to the Arboretum cafe site, patch 'GG' was mapped by ELA (2009) as containing 43.9 hectares of 'box-gum woodland (12-15 species). Additional to this patch, an area defined as patch 'GG2' in ELA (2013)<sup>15</sup> was included in this study, bringing the area to 47.6 hectares.

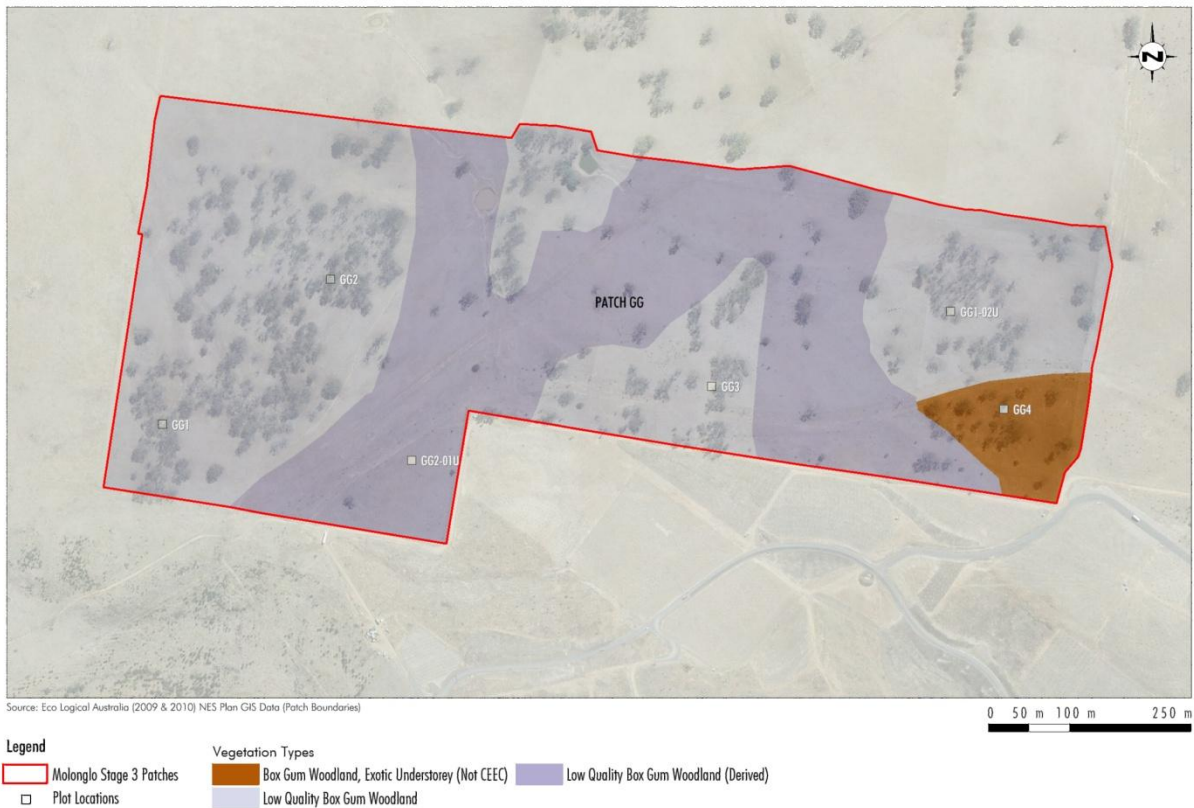
The condition within patch 'GG' is variable, with a mosaic of woodland structure and derived grassland. The majority of trees areas within the patch contains a moderate to low diversity of native understorey species; south-eastern areas have a higher prevalence of barley grass (*Hordeum* spp.). African boxthorn (*Lycium ferocissimum*) is found across the site. A total of 18 non-grass native understorey were recorded in both plot and meandering surveys, suggesting that it may belong in the 15-20 species category. While it contains moderate condition values in patches, there are also areas dominated by annual and perennial weeds. In the south-east of the patch, there is an area of approximately two hectares which is not considered CEEC due to a dominance of exotic pastures, however with active management it is likely to be recoverable. The entire patch contains a range of habitat values found in large woodland remnants including a range of tree size classes and some structural diversity.

A total of 77 species were recorded in patch 'GG', 34 of which were native. 'Important' species include kangaroo grass, common woodruff (*Asperula conferta*), slender tick-foil (*Desmodium varians*) and variable glycine (*Glycine tabacina*), which were all recorded through meander survey. **Figure 3.12** shows the distribution of plots, as well as woodland

<sup>15</sup> Eco Logical (2013) Molonglo valley vegetation survey: baseline condition assessment. Prepared for Design and Development, Territory and Municipal Services Directorate (ACT Government),

and secondary grassland structure. An example of low condition box-gum woodland within patch 'GG' is shown in **Figure 3.13**.

Based on plot assessment undertaken as part of this study, patch 'GG' generated 286 ecological community credits for 'vegetation type ACT16: *Eucalyptus melliodora* – *E. blakelyi* tableland grassy woodland' in 'moderate/good' condition, and an additional 155 ecological community credits for this community in 'native pasture' condition.



**Figure 3.12. Patch GG, including plot locations.**



Figure 3.13. Low quality box-gum woodland, plot GG1.

#### 3.2.2.4 Patch N

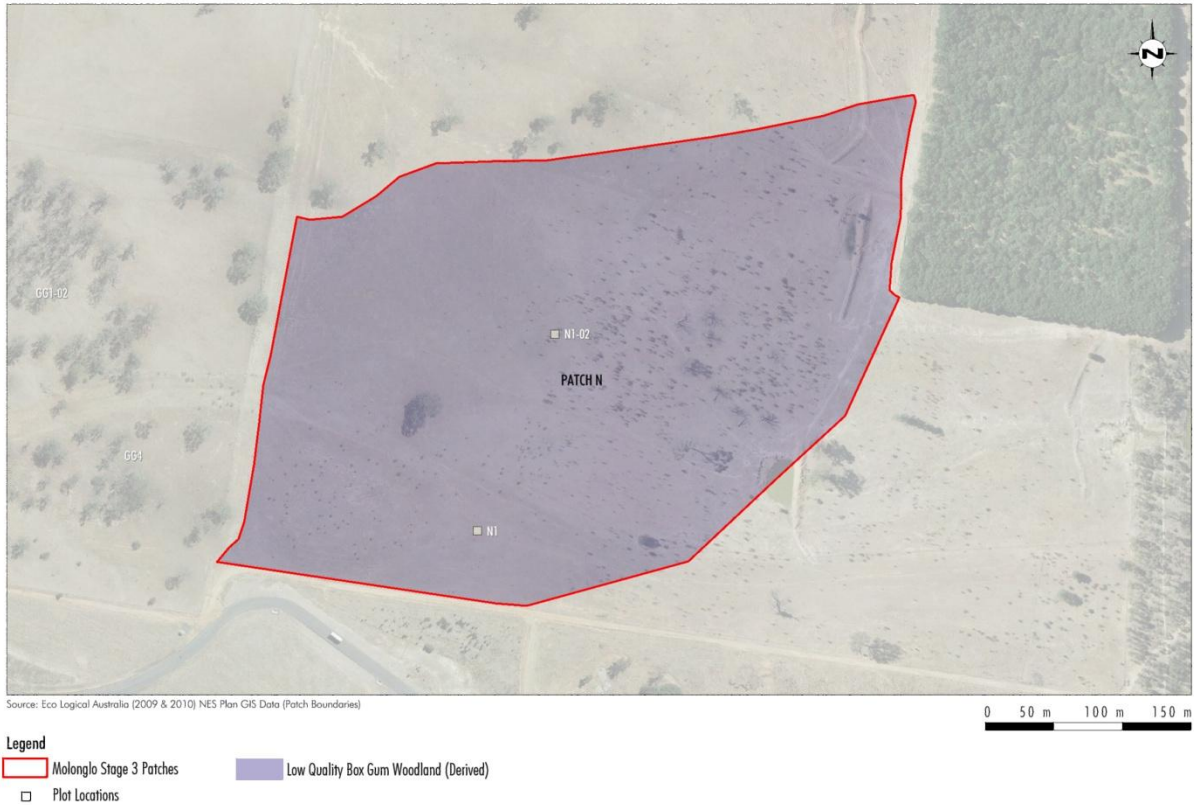
Patch 'N' is located in the south-eastern section of the Molonglo stage 3 development, east of patch 'GG', and was mapped by ELA (2009) as containing 13.36 hectares of 'box-gum woodland (12-15 species). Assessment undertaken as part of this current study revealed that patch 'N' represents secondary box-gum woodland, having been historically cleared.

Patch 'N' is dominated by tall speargrass (*Austrostipa bigeniculata*), especially in the central third of the site where it represents approximately 50-70% of plant cover. In western and eastern portions, perennial exotic grasses such as wild oats (*Avena* spp.), ryegrass (*Lolium* spp.), prairie grass (*Bromus catharticus*) are more prominent, tending to dominate across approximately 30% of this patch. Exotic annual grasses such as hairgrass (*Aira* spp.) and rat's-tail fescue (*Vulpia myuros*) are seasonally prominent, along with exotic forbs such as Patterson's curse (*Echium plantagineum*), St John's wort (*Hypericum perforatum*), flatweed (*Hypochaeris radicata*), saffron thistle (*Carthamus lanatus*) and shepherds purse (*Capsella bursa-pastoralis*).

A total of 39 species were recorded in patch 'N', 17 of which were native. Floristic diversity was considered low, recording eleven non-grass native understorey species. Examination of floristic tables in ELA (2013) indicates that 10 non-native understorey species were recorded in plots although it is probable that more may have been recorded though meander surveys. However given that patch 'N' links to patch 'GG' these two patches are considered part of the one remnant and as such, patch 'N' is considered CEEC. Variable glycine (*Glycine tabacina*) was the only 'important' species recorded in surveys as part of this current study.

**Figure 3.14** shows the distribution of plots, as well as woodland and secondary grassland structure. An example of low condition derived box-gum woodland within patch N is shown in **figure 3.15**.

Based on plot assessment undertaken as part of this study, patch 'N' generated 62 ecological community credits for 'vegetation type ACT16: *Eucalyptus melliodora* – *E. blakelyi* tableland grassy woodland' in 'native pasture' condition.



**Figure 3.14. Patch N, including plot locations.**



Figure 3.15. Potential low quality secondary box-gum woodland, plot N1.

### 3.2.3 Advanced Offset Areas Within Kama Nature Reserve

Based on review of vegetation mapping undertaken as part of ELA (2009), vegetation type attributes and patch boundaries within Kama Nature Reserve were amended and remapped for the following reasons:

- Areas of scribbly gum grassy open forest in both its extant and derived state were present;
- This study required delineating areas based on condition classes as defined by the EACOM (which was not required as part of ELA [2009]); and
- The ELA (2009) study was not required to map western portions of Kama Nature Reserve.

As indicated in **Table 3.3**, these areas have been renamed as 'Zone 1', 'Zones 2/3' and 'Zones 4/5' to avoid confusion. When describing zones 2/3 and 4/5, these are grouped together as they represent the same vegetation type across two ecological condition classes.

**Figure 3.16** shows a plot surveyed within across all vegetation zones, as well as the distribution of plant communities and plots within Kama Nature Reserve.

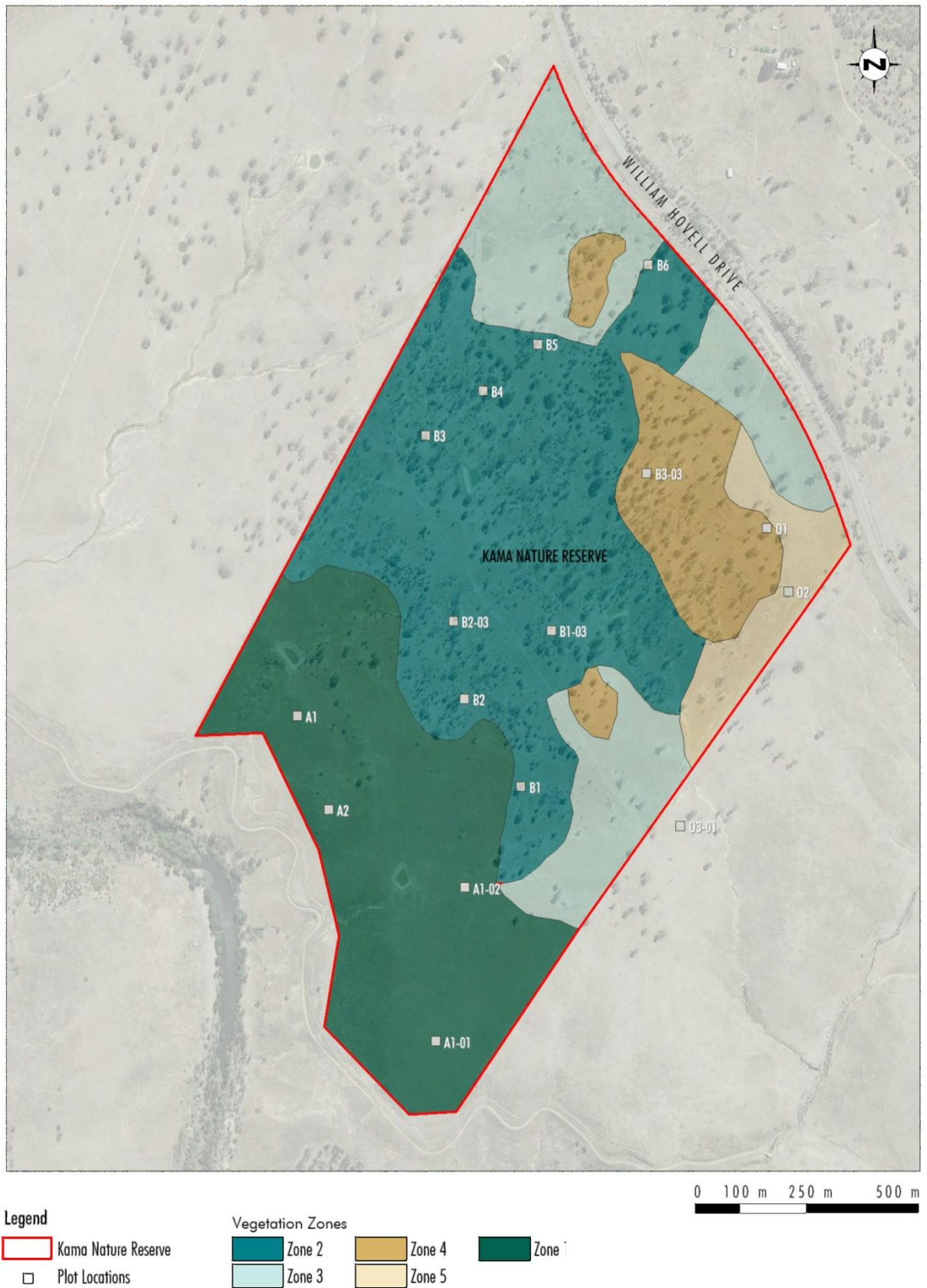


Figure 3.16. Vegetation zones in Kama Nature Reserve, including plot locations.

### 3.2.3.1 Zone 1

Located in the southern portion of Kama Nature Reserve, Zone '1' contains 44.6 hectares of 'natural temperate grassland'. This area is similar to patch 'A' as mapped by ELA (2009). This area is considered part of the 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory EEC' under the EPBC Act. An example of the natural temperate grassland at Kama Nature Reserve is shown in **Figure 3.17**.



**Figure 3.17. Natural temperate grassland, plot A2.**

Within two plots surveyed in July 2013 within this zone as part of this study, a mean native species richness of 18 was recorded within each 20 x 20 metre plot area. In November 2012, Armstrong (2013)<sup>16</sup> assessed two plots in the same vegetation type within Kama Nature Reserve recording a mean native species richness of 23. In order to compare species richness data between survey seasons, one plot assessed by Armstrong (2013) was surveyed in the exact same plot location as part of this study. In November 2012 this plot contained 24 native species, compared to 19 recorded in July 2013 by the same observer. Exotic species richness was also reduced from 15 to 9 species. This comparison suggests that native species composition is reduced within this area during winter months.

In order to satisfy sampling criteria in the EOAM, an additional two plots were surveyed during September 2013. Both of these plots contained a relatively low species diversity due to dominant tussock grasses reducing opportunities for native forb germination. Based on plot assessment undertaken as part of this study, zone '1' generated 577 ecological

<sup>16</sup> Armstrong R (2013) Interim analysis of relationships between vegetation condition and kangaroo density in grassy ecosystems of the northern ACT: Data collected in Spring – Summer 2009/2012. A report for ACT Government, Environment & Sustainable Development Directorate, Canberra, February 2013.

community credits for vegetation type ACT01: 'tablelands dry tussock grassland' in 'moderate/good' condition. The area is considered to have a botanical significance rating (BSR) of 4, with moderate disturbance. There are patches within the grassland area that have a BSR of 5 (high disturbance, few native forbs present), as well as patches of BSR 2 (low disturbance, contains some disturbance tolerant species (ACT Government 2004).

### 3.2.3.2 Zones 2/3

Located across most of the woodland area of Kama Nature Reserve, zones '2/3' is considered a high quality part of the 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland CEEC' under the EPBC Act. Much of this was mapped as patch 'B' was mapped by ELA (2009) as 'box-gum woodland (21+ species)', and while vegetation boundaries have changed the extent of this community, the species richness was confirmed as part of this study. Two condition classes exist within these zones, with zone '2' (moderate/good condition) being 58.7 hectares and zone '3' (native pasture) being 18.6 hectares. **Figure 3.16** (above) shows the distribution of plant communities and plots within Kama Nature Reserve. **Figure 3.18** and **Figure 3.19** show a plot surveyed within zone '2' and zone '3' respectively.

Within eight plots surveyed across two condition classes within zones '2/3' as part of this study, a mean native species richness of 20.5 was recorded within each 20 x 20 metre plot area. In November 2012, Armstrong (2013) assessed two plots in the same vegetation type within Kama Nature Reserve with a mean native species richness of 24. This comparison suggests that native species composition is reduced within this area during winter months. However, across eight plots a total of 48 non-grass understorey species, including 16 'important' species, were still recorded during the current study.

Based on plot assessment undertaken as part of this study, zones '2/3' generated 1,047 ecological community credits for 'vegetation type ACT16: *Eucalyptus melliodora* – *E. blakelyi* tableland grassy woodland' in 'moderate/good' condition, and an additional 299 ecological community credits for this community in 'native pasture' condition.

Additionally, brown treecreeper (*Climacteris picumnus victoriae*) is known to occur within zones 2/3 within Kama Nature Reserve, generating 496 species credits for this species.



**Figure 3.18. Moderate/good condition box-gum woodland, plot B4 (zone 2).**



**Figure 3.19. Native pasture condition box-gum woodland, plot B6 (zone 3; note that a few small remnant trees were present in this plot).**

### 3.2.3.3 Zones 4/5

Located in the north-eastern section of Kama Nature Reserve, zones '4/5' were mapped by ELA (2009) as 'box-gum woodland (12-15 species)'. Upon surveying this area, remnant vegetation within zone '4' was found to be dominated by scribbly gum, with occasionally occurring Blakely's red gum with a grassy understorey. In cleared areas within zone '5', scribbly gum is still the dominant tree along with isolated Blakely's red gum, red stringybark (*E. macrorhyncha*) and broad-leaved peppermint (*E. dives*) and an understorey mosaic of native and exotic perennial grasses. This vegetation association is consistent with the dominant eucalypts in similar patches directly north of Kama Nature Reserve, and is not considered to be box-gum woodland or 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland CEEC' under the EPBC Act.

Two condition classes exist within these zones, with zone '4' (moderate/good condition) being 15.5 hectares and zone '5' (native pasture) being 7.7 hectares. **Figure 3.16** (above) shows the distribution of plant communities and plots within Kama Nature Reserve. **Figure 3.20** and **Figure 3.21** show a plot surveyed within zone '4' and zone '5' respectively.

In unmodified condition, the vegetation found within this zone usually occurs in a shrub/grass mosaic. These features are absent in this community within Kama Nature Reserve, and given the absence of shrubs and low floristic diversity, it is likely to have been partially cleared, under-scrubbed and grazed prior to the gazettal of the reserve.

Based on plot assessment undertaken as part of this study, zones '4/5' generated 234 ecological community credits for 'vegetation type ACT25: *Eucalyptus macrorhyncha* tableland grass/shrub forest' in 'moderate/good' condition, and an additional 132 ecological community credits for this community in 'native pasture' condition. Note that this community includes scribbly gum forest types.



**3.20. Scribbly gum grassy woodland, plot B103U (zone 4).**



**Figure 3.21. partially cleared scribbly gum grassy woodland, plot O1 (zone 5).**

## 4.0 Review of EOC

### 4.1 Equations

With the exception of Landscape Value Scores, the EOAM and EOC appears to have adopted equivalent equations to the NSW BioBanking Assessment Methodology (DECC 2008)<sup>17</sup>. Considering this, it was important to focus on testing metrics around ecological communities and significant species found in the ACT within the EOC, and look for perverse outcomes.

Outputs of Ecosystem and Species Credit equations for identified sensitive variables (native species richness and golden sun moth population size) were reviewed in the context of specific approved developments as part of the 'Sensitivity Analysis' for development sites. To comprehensively test equations, further examination was required to consider variance of field and map data on Ecosystem and Species credit requirements by isolating individual variables.

To enable this, a mock simple development containing one vegetation zone of 1 hectare (requiring one plot) of ACT16: *Eucalyptus melliodora* – *E. blakelyi* Tableland Grassy Woodland (moderate/good condition) was generated.

#### 4.1.1 Ecosystem Credits

Ecosystem Credits are calculated based on a function of vegetation condition and landscape value scores. As a basis for testing variance in Ecosystem Credits calculations, mock site variables were selected based on the median of the benchmark value for vegetation type ACT16, or where a value is  $\geq x$ ,  $x$  was chosen as per **Table 4.1**.

Each mock integer value was independently altered by a factor of +50 per cent (rounded to the nearest integer) and the highest accepted option (usually a value or percentage of 99) to explore the stability of each variable independently. Landscape Value scores were assumed at 50 per cent high/50 per cent low for Neighbourhood Habitat Context value and Link Value respectively.

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<sup>17</sup> DECC (2008) Biobanking Assessment Methodology. NSW Department of Environment and Climate Change. DECC 2008/385. July 2008.

**Table 4.1 - Mock Vegetation Condition Variables Used To Test Equations**

Variable	Benchmark	MV	C MV	MV lowest value	C MV lowest value	MV + 50%	C MV + 50%	MV highest value	C MV + highest value
Sp.R.	≥35	35	59	1	59	53	59	99	59
NOSc	11-32	21		0	59	32		99	46
NMSc	0-12.5	6		0	59	9		99	46
NGcG	23-63	43		0	59	65		99	59
NGcS	0-4.5	2		0	59	3		99	47
NGcO	8-16.5	12		0	59	18		99	59
EPc	n/a	5		0	59	8		99	59
#holl.	≥5	5		0	47	8		99	59
Reg.	1	1		0	59	1		1	59
FL	35	35		0	59	70		99	59

MV = Mock value; C = Credits; MV = Mock Value; lowest value = lowest value selected for independently changed variable; +50% = MV + 50%; highest value = highest value selected for independently changed variable.

Sr.R. = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

## Landscape Value Scores

While maintaining the mock values as per **Table 4.1**, Landscape Value Scores were individually adjusted 100 per cent within each zone (and all others to zero) to test the sensitivity of this variable. Scenario tests and ecosystem credit changes revealed negligible variation, with between 54 and 65 Ecosystem Credits required when comparing the lowest possible Neighbourhood Habitat Context and Link Values scenario with the highest possible value scenario.

This did not review the merits of the Landscape Value Score algorithm concept, which has been used to produce a GIS layer of Neighbourhood Habitat Context value and Link Value available to all users of the EOC. While a layer provides repeatability for all assessors and reduces observer bias, it should be examined to determine its utility at a development site scale (Note: this may have happened in the development phase). It is not clear whether this layer is able to consider loss of connectivity on a fine scale.

### 4.1.2 Species Credits

Species Credits at a development site are calculated based on a function of area of habitat, and for certain species, numbers of individuals, number of hollow-bearing trees, habitat trees or camp sites likely to be affected by the development. In order to test the calculator's sensitivity to variation in observer and survey results, golden sun moth was selected as a species that is highly susceptible to varied survey results based on differences in habitat condition, methodology and survey conditions. In varying the count of golden sun moths within the 1 hectare mock site, variance in Significant Species Credits is outlined in **Table 4.2**. Additionally, **Table 4.2** outlines Species Credit Requirements for hectares of habitat; this calculation is independent of population size.

**Table 4.2 - Variance in Golden Sun Moth Significant Species Credit Requirements Based On Varying Population Counts and Area Of Habitat**

Population Variance		Habitat (ha) Variance	
Golden sun moth Individuals	Species Credit Requirements	Golden sun moth Habitat (ha)	Species Credit Requirements
5	133	1	27
10	267	2	53
20	533	5	133
50	1,333	10	267
100	2,667	20	533

Species credit requirements (based on individuals) is calculated as:

Number of species credits required for a significant species at a development site	$= (H_{\text{loss}} / T_{G \text{ spp1}}) \times 10$
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Where the Significant Species Database indicates that the unit of measurement of impact for a species is the area of habitat (mostly fauna), then:

- $H_{\text{loss}}$  is the area of habitat in hectares to be lost at the development site, as determined in accordance with Section 4.4.1 of the EOAM.
- $T_{G \text{ spp1}}$  is the ability of the species to respond to improvement in Site Value with management actions at the offset site.  $T_{G \text{ spp1}}$  is a value identified for each species in the Significant Species Database and has values between 0.1 and 1.

Additionally, where species loss is also calculated for individuals, the calculation is repeated with  $H_{\text{loss}}$  being the number of individuals to be lost at the development site.

Testing this on the golden sun moth, for 20 individuals lost over 5ha, using the  $T_{G \text{ spp1}}$  value of 0.375 as per the Significant Species database, the calculations are as follows:

Number of species credits required for a significant species at a development site	$  \begin{aligned}  &= \overset{\text{Habitat}}{[(H_{\text{loss}} / T_{G \text{ spp1}}) \times 10]} + \overset{\text{Individuals}}{[(H_{\text{loss}} / T_{G \text{ spp1}}) \times 10]} \\  &= [(5 / 0.375) \times 10] + [(20 / 0.375) \times 10] \\  &= 133 + 533 = 666 \text{ Species credits}  \end{aligned}  $
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Referring back to tests on golden sun moth populations and habitat areas in **Table 3.2**, the equation provides true results in the EOC.

The same test was undertaken for representative selected species [striped legless lizard (ha), perunga grasshopper (ha), *Leucochrysum albicans* var. *tricolor* (individuals), *Rutidosia leptorrhynchoides* (individuals) and *Swainsona sericea* (individuals)], with results from the EOC and mathematical formula providing a consistent outcome.

## Target Values

Results in the Species Credit calculation are strongly driven by the species target ( $T_G$ ) value. The  $T_G$  value represents the ability of a species to respond to improvement in Site Value or other habitat improvement at an offset site due to management actions. Using the Species Credit equation, higher  $T_G$  values lead to less Species Credits generated or required.

There are several species with relatively high target values, including those with low known populations [e.g. *Lepidium ginninderrense* (130 known individuals,  $T_G$  value = 0.75), *Muehlenbeckia tuggeranong* (32 known individuals,  $T_G$  value = 0.9)]. However, it is considered that all species with high target values are inherently rare and hence difficult to offset, or respond well to management actions. As indicated in the database, flora with high  $T_G$  are not able to withstand loss, however fauna may be offset subject to significant management actions.

Conversely, species with low  $T_G$  values are all either rare and require significant offsets (e.g. grassland earless dragon – hectares of habitat), or relatively common (e.g. *Leucochrysum albicans* var. *tricolor* – individuals = 100,000) and therefore easy to find adequate individuals to offset.

## 4.2 Supporting Databases

### 4.2.1 Significant Species Database

Review of the Significant Species database revealed that all threatened species and ecological communities occurring below 750 metres above sea level (asl.) in the ACT are incorporated into the Significant Species database.

Subject to consultation with ESDD, Umwelt notes the following considerations to refine the database:

- It appears that some recent records or known locations may not be incorporated into the distribution information, including the recent discovery of a population of *Lepidium ginninderrense* at North Mitchell.
- Review of the ability of plants to colonise disturbed sites may be required. For example, *Rutidosia leptorrhynchoides* is known to colonise disturbed sites in NSW (OEH 2013)<sup>18</sup>, and this may be relevant to this species in the ACT also.
- *Arachnorchis actensis* is the only plant which has a >5 hectare landscape requirement. Consider changing the required landscape size to <5 hectare based on the assumption that this species may persist at smaller sites in favourable conditions (unless ESDD has justified this).
- Consider adding *Eucalyptus macrorhyncha* Tableland Grass/Shrub Forest as an associated vegetation type for hooded robin.

Umwelt notes that the EOAM indicated that the databases used in the EOAM are periodically updated in response to improvements in knowledge about biodiversity values and the availability of new data, however there is no timeframe for this. The Environment and Sustainable Development Directorate Conservation Planning and Research Group will have

<sup>18</sup> OEH (2013) *Rutidosia leptorrhynchoides* Threatened Species Profile. NSW Office of Environment and Heritage. [URL: <http://www.environment.nsw.gov.au/threatened/SpeciesApp/profile.aspx?id=10739> accessed 30/05/2013].

the most up to date information on species specific information including discovery of new populations. It is suggested that the database be reviewed at least every six months (or less if new information comes to hand), although this may not lead to the release of new information.

#### 4.2.2 Vegetation Types database

The vegetation types database is based on a study undertaken by Sharp *et al.* (2007)<sup>19</sup> with subsequent refinements from specific studies including Johnston *et al.* (2009)<sup>20</sup>, and provides a comprehensive description of lowland vegetation types for areas below 750 metres above sea level (asl.) where the EOC is envisaged to operate.

However, OEH undertook a study in 2010/11 to classify vegetation across parts of the Southern Highlands and Australian Alps, including the entire ACT jurisdiction (Armstrong *et al.* 2013)<sup>21</sup>. ACT ESDD Conservation Planning and Research Group have adopted this new classification to produce fine-scale mapping of vegetation in the north-east of the ACT, and it is also being used for a recently commissioned project to map vegetation across Namadji National Park. It is envisaged that the entire jurisdiction will be mapped using this new classification, thus providing a powerful supporting tool for the EOAM.

Discussion is required with ESDD as to whether the more recent classification is to be adopted for the EOAM for incorporation into the EOC. If so, the Vegetation Benchmarks dataset will require refinement (refer to **Section 4.2.3**).

#### 4.2.3 Vegetation Benchmarks Database

Based on desktop review of benchmark data, the benchmark data appear reasonable. In most instances, the data has been derived from existing datasets such as the NSW BioBanking dataset and ACT Government vegetation survey projects. To undertake comprehensive and systematic review, plot data analysis and potentially site testing for structural components may be required, which is outside the scope of this study. Regular review of the benchmarks database should be undertaken based on provision of new data, and mechanisms should be in place for assessors to provide new data and make recommendations.

The dataset is missing Percent Cleared (%) values for 'ACT8: Tableland Wetland Fringing Aquatic Vegetation' and 'ACT9: Tableland Riparian Floating and Submerged Vegetation'. Given that the *Nature Conservation Act 1980* definition of clearing includes 'anything else that kills or is likely to kill native vegetation', draining of swamps is likely to have partially cleared these communities. However, as assessment of aquatic vegetation types are outside the scope of the EOAM, these vegetation types should be removed. If there is a reason they are to remain in the dataset, discussion is required with ESDD to determine appropriate clearing levels for these vegetation types.

Depending on whether the ACT Government adopts the recent vegetation classification developed for the ACT and surrounds (refer to **Section 4.2.2**), further analysis of existing datasets and potentially site testing for habitat variables may be required. As the new classification is based on numerical plot analysis, information on benchmark data related to

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<sup>19</sup> Sharp S, Macdonald T, Kitchin M and Dunford M (2007), Setting conservation targets for vegetation communities in the ACT, Final report to the Natural Resource Management Council, ACT Parks Conservation and Lands.

<sup>20</sup> Johnston L, Skinner S, Ishiyama [Peden] L and Sharp S (2009). Survey of vegetation and habitat in key riparian zones: Murrumbidgee River, ACT. Department of Territory and Municipal Services, Canberra.

<sup>21</sup> Armstrong R, Turner K, McDougall KL, Rehwinkel R and Crooks J (2013) Plant communities of the upper Murrumbidgee catchment in New South Wales and the Australian Capital Territory. *Cunninghamia* 13(1), pp. 125 - 265.

species richness and cover variables can be easily generated, however site testing or, at a minimum, correlation with existing benchmarks and expert peer review.

### 4.3 Flag Definitions

A flag area is an area of land that is identified by the EOAM database as having high biodiversity conservation values which should be protected. An area of land is regarded as having high biodiversity conservation values if it contains one or more of the following:

- One or more significant species identified in the Significant Species database that cannot withstand further loss in the ACT (i.e. presently *Arachnorchis actensis*, *Bossiaea grayi*, *Calotis glandulosa*, *Lepidium ginninderrense*, *Muehlenbeckia tuggeranong*, *Prasophyllum petilum*, *Rutidosis leiolepis*, *Swainsona recta*, *Thesium australe*, glossy black-cockatoo and grassland earless dragon).
- The woodland/forest present is in an 'old growth' condition. Old growth forest/woodland is ecologically mature forest/woodland where the effects of disturbance are now negligible.
- Category 1 or Category 2 grassland as described and mapped in Action Plan No. 28 (ACT Government 2005)<sup>22</sup>.
- Partially modified or moderately modified lowland woodland of high connectivity as described in Action Plan 27 (ACT Government 2004)<sup>23</sup>.

If any development has the potential to impact on the above values, the development is referred to the Conservator for Flora and Fauna to determine whether it is possible for the development to be regarded as improving or maintaining significant biodiversity values. The heads of consideration (HoC) are:

- all prudent and feasible measures have been taken to avoid and minimise impacts on the flag features (including indirect impacts); and
- if the vegetation is of a type that has suffered greater than a 90 per cent level of clearance in the ACT, approval to offset cannot be issued for a development proposal which will result in more than 4 hectares of this vegetation type being cleared; and
- approval to offset cannot be issued for a development that is clearing more than 10 per cent of the total number of known individuals, within the ACT, of a plant species identified in the Significant Species Database as requiring species credits; and
- offset requirements as determined by the ACT Environmental Offsets Calculator have been met, and any additional conservation benefits, such as funding for research or intensive restoration management related to the flag feature being impacted are documented; or
- the proposal to clear a flag feature is consistent with a Strategic Assessment or other plan endorsed by the Conservator as maintaining significant biodiversity values.

Umwelt considers the flag definitions to be adequate, however recommends an additional HoC. It is suggested to add a clause such as:

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<sup>22</sup> ACT Government (2005) A vision splendid of the grassy plains extended: ACT lowland native grassland conservation strategy. Action Plan No. 28 (Arts, Heritage and Environment, Canberra).

<sup>23</sup> ACT Government (2004) Woodlands for wildlife: ACT lowland woodland conservation strategy. Action Plan No. 27. (Environment ACT, Canberra).

- The 4 hectares consideration will not be applied to such vegetation types where  $\leq 20$  hectares (or  $x$  ha) of extant vegetation remains in areas below 750 metres asl where the EOAM applies.

Such a condition will ensure that highly cleared vegetation types of very restricted distribution are assessed with greater consideration.

#### 4.4 Special Offset Requirements

Special Offset Requirements are provisions to ensure that development in habitat for particular Significant Species (generally fauna) does not impact beyond an important threshold such as habitat/patch size, buffer zones for roosting and nest sites, and breeding events for nesting sites. Special Offset Requirements form a similar function to flagged areas (**Section 3.3**) as they are a trigger for referral to the Conservator for Flora and Fauna for further assessment. Current special offset requirements are shown in **Table 3.3**.

**Table 4.3 - Special Offset Requirements for Significant Species**

Common Name	Special Offset Requirement
Brown treecreeper	No loss of a woodland patch >100 ha of at least partially or moderately modified condition that is historically known to have supported brown treecreeper. The woodland patch can extend beyond the development site and consist of several vegetation types in which brown treecreepers can be found.
Eastern bentwing bat	No loss of vegetation within 50 m of Cotter Caves (survey may consider on site vegetation only when access to adjacent sites is not possible).
Golden sun moth	No loss of habitat patches >50 ha AND supporting populations of more than 50 moths (population must be counted at a time when large populations are observed at nearby known sites).
Grey-headed flying fox (roosting)	No clearing of roosting trees, except if expert advice has been obtained and tree removal is justified on safety grounds.
Hooded robin	No loss of a woodland patch >100 ha of at least partially or moderately modified condition that is historically known to have supported hooded robin. The woodland patch can extend beyond the development site and consist of several vegetation types in which hooded robins can be found.
Large-footed myotis (roosting)	No loss of roost tree and vegetation within 50 m (survey may consider on site vegetation only when access to adjacent sites is not possible).
Little eagle (nesting)	No loss of nest and vegetation within 300 m of a nest tree or if clearance will occur during breeding event (September to December) then no loss of vegetation within 800 m of nest (survey may consider on site vegetation only when access to adjacent sites is not possible).
Pink-tailed worm-lizard	Up to 10% of a habitat patch may be cleared if habitat patch is greater than 5 ha and clearance does not result in increase in the number of patches.
Regent honeyeater (habitat tree)	No loss of active habitat tree and native trees and shrubs within 200 m (survey may consider on site vegetation only when access to adjacent sites is not possible).
Rosenberg's monitor	No loss of known breeding locations (termite mounds in which eggs are laid) and vegetation for 250 m around each termite mound (survey may consider on site vegetation only when access to adjacent sites is not possible).
Striped legless lizard	No loss of known habitat within Priority 1 and Priority 2 grasslands.

Common Name	Special Offset Requirement
Superb parrot	No loss of known habitat tree and trees within surrounding 50 m, or within 100 m during a breeding event (breeding season September to January) (survey may consider on site vegetation only when access to adjacent sites is not possible).

Clarification is required around the Special Offset Requirements for brown treecreeper and hooded robin. The terminology 'No loss of a woodland patch >100ha of at least partially or moderately modified condition that is historically known to have supported...' may be determined in several ways:

- not being able to clear a patch of more than 100 hectares;
- not being able to clear any vegetation that is part of a patch greater than 100 hectares; or
- not being able to reduce or fragment an existing patch such that the residual area(s) is less than 100 hectares.

In the context of the EOAM, Umwelt considers that while clearing of a patch of greater than 100 hectares should not be permitted, it is plausible that a smaller amount of vegetation on the edge of a large patch could be removed provided associated actions appropriate management results in a net environmental gain for these species elsewhere.

## 4.5 General Offset Requirements

In situations where no significant species requiring ecological community credits are predicted to be impacted by the development, the ecological community credits obtained from an offset site are determined to be compatible with those required at the development site where all of the following conditions are met:

- The number of ecological community credits obtained and retired from the offset site is equal to or greater than the number required at the development site.
- The vegetation type at the offset site is the same as the vegetation type(s) impacted at the development site.

The concept of 'like for like' offsetting for vegetation in moderate to good condition is considered appropriate. However, where ecological community credits are generated from a vegetation type in low condition (paddock trees or native pasture), it is suggested an option is required to either use the credits generated to offset with:

- the same vegetation type in moderate/good condition; and/or
- a vegetation type (in moderate/good or low condition) within the same Vegetation Class. However, this option should not be considered for threatened ecological communities.

## 4.6 Condition Definitions

For each vegetation zone, an assessment of condition is required to link in with habitat requirements for Significant Species in the Significant Species database. Condition classes are defined in **Table 4.4**.

**Table 4.4 - Vegetation Condition Classes**

Paddock Trees	Native over-storey percent foliage cover is less than 25% of the lower value of the overstorey percent foliage cover benchmark for that vegetation type and less than 50% of ground cover perennial vegetation is indigenous species.
Native Pasture	Trees are absent or form less than 1% cover. The understorey is predominately comprised of native grasses, and there are five or less native herbs within the most diverse 20x20 m of the area of investigation.
Moderate/Good	If vegetation is not in low condition (paddock trees or native pasture) then it is in moderate to good condition.

Further clarification is required around the application of condition classes outlined in **Table 4.4** to grassland vegetation types. Interpreting the above, Umwelt believes that grasslands are considered native pasture *unless* they contain >5 native forbs within the most diverse 20 x 20 metres of the investigation area, in which case they are considered to be in moderate/good condition (this interpretation has been assumed for the EOC tests - refer to **Section 2.0**). Additionally, the term 'herb' should be changed to 'forb', as in a botanical sense, grasses are also considered herbs.

Clear guidance on how to assess derived native grasslands is critical. It is understood that they need to be assessed as a lower condition version of their parent community (i.e. native pasture or paddock trees), however this should be asserted in the EOAM.

## 4.7 Evaluation of Previous Reviews

### 4.7.1 Technical Review

In 2012, ELA (2012)<sup>24</sup> undertook a technical review of the draft EOC, considering the implications of modifications from the NSW BioBanking tool. As part of this, a series of recommendations were made to reduce complexity, increase utility and seek clarification. Umwelt (2012) reviewed the EOAM and Assessment Methodology, but without the benefit of the draft EOC. The aim of this review was to provide strategic review of the EOC and supporting documents, and provide a summary of identified and potential issues or shortcomings. The two reviews were mutually exclusive.

**Table 4.5** provides a summary of ELA (2012) recommendations, indicated equivalency with Umwelt (2012) recommendations, and provides comment on ELA (2012) recommendations based on lessons learnt as part of the current study (this project). Note that there is little correlation between recommendations of ELA (2012) and Umwelt (2012) due to different project briefs and materials reviewed.

<sup>24</sup> ELA (2012) ACT Environmental Offsets Calculator: Technical Review. Prepared for Environment and Sustainable Development Directorate, November 2012.

Table 4.5 - Review of ELA (2012) Recommendations

ELA (2012) recommendation	Umwelt (2012) corresponding recommendation / comment
<b>Clearly Delineating EOC Differences from Biobanking</b>	
1. Include a summary of the modifications made to the EOC tool from BioBanking, and reference the version of the BioBanking tool / methodology that is used as a comparison, as it is likely that both tools will continue to evolve.	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> . With similar co-evolving databases, version control and evolutionary understanding is critical, especially for those using both tools.
2. Include 'special offset' and 'special credit report' requirement process in the list of changes (if retained), and include guidance on these processes in the Operational Manual or Methodology.	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> . While formulae are provided in the EOAM, for transparency, users of the tool need to understand the process of generating values for each species and ecological community. As part of this, where values in the EOC databases differ from Biobanking (such as T <sub>G</sub> ), these should be identified with supporting information.
3. Amend definition for 'special offset requirement' and/or amend relevant threatened species 'negligible loss' values.	Umwelt (2012): No equivalent recommendation. Comment: <b>Disagree</b> . These definitions may be used mutually exclusive. There are several 'relatively common' species which can withstand negligible loss but are not subject to special offset requirements. (Note: definitions may have changed since the previously reviewed version).
4. Provide clarity whether 'local benchmark data' can be used as under Biobanking (NSW).	Umwelt (2012): No equivalent recommendation. Comment: <b>Partially Agree</b> . Clarification is required. However, as benchmark data has mostly been derived from local datasets, this may be a negligible issue.
5. Patch size including low condition component has been removed from EOC. It is not clear what the rationale is for having 2 types of "low" condition definitions, if patch size including low condition has been removed? Consideration could be given to whether one type of 'low' condition would be adequate.	Umwelt (2012): No equivalent recommendation. Comment: <b>Disagree</b> . Conservation Planning and Research (CPR) has advised that all three classes (including both low condition classes of native pasture and paddock trees) should be retained as they are quite easy to distinguish and will reduce survey requirements as it provides an additional filter (anon 2013). <b>Clarification is required</b> to delineate condition classes within natural temperate grassland vegetation types. For example, is a grassland containing more than five native herbs in the most diverse 20x20m area considered to be in moderate/high condition (as per category 1 and category 2 Definitions of red flag areas)? If so, this should be made clearer in the Condition Classes table (Table 1 of the EOCCOM).

ELA (2012) recommendation	Umwelt (2012) corresponding recommendation / comment
<b>Clarity for Definitions</b>	
6. Provide a definition of 'cleared land'. This is a key item to delineate the vegetation which does not need to be assessed.	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> .
7. Red flags. ESDD to consider comments in section 2.2 of ELA (2012). Consideration to be given to simplification of current red flag rules and variation processes, and/or clarifying the rules.	Umwelt (2012): Partial correlation with Umwelt recommendation 25 from Umwelt (2012): Review the definitions of red flags to ensure they are appropriate. Comment: <b>Agree</b> . ELA (2012) has provided a comprehensive review of red flags within the EOC/EOAM. Additional suggestions are provided in Section 3.3 of this report.
8. Seek to clarify definitions noted in ELA (2012), including those within the Methodology, Operational Manual, and Significant Species database (also see recommendation 18 below). Also ensure that previous BioBanking definitions that are not utilised in the EOC are removed (e.g. BioBanking definition for 'low condition vegetation' is provided in the Operational Manual).	Umwelt (2012): Partial correlation with Umwelt recommendation 12 from Umwelt (2012): A careful review of appropriate terms and definitions should be undertaken. As a minimum the following terms require appropriate definitions: 'naturally very rare', 'few populations', 'restricted distribution' and 'regionally rare plant'. Comment: <b>Agree</b> . However, apart from clarifications sought on terms in points 6, 7 and 18, we could not find any <i>specific</i> points where ELA (2012) sought clarification. It is recommended to review ELA (2012) and extract all potential questions, which is outside the scope of this study. Further consideration is required of changes between Biobanking and EOAM to audit definitions which should be removed, which is outside the scope of this study.
<b>EOC Functionality</b>	
9. Consider either: (a) retaining management zones, or (b) completely removing them from the methodology.	Umwelt (2012): Strong correlation with Umwelt recommendation 17 from Umwelt (2012): The ESDD should reconsider the need for the inclusion of Significant Species Sub Zones in the assessment process. Comment: <b>Disagree</b> . Particularly in grassy ecosystems in the ACT, Umwelt considers it important to recognise Significant Species Sub Zones (condition classes within vegetation types). This is because much of the remaining areas for development contain TECs in various condition states, and while adding complexity to the assessment, it is important to distinguish between these to assist with (and potentially reduce) survey requirements for both community condition and threatened species. This may be different for ecosystems of lower fertility where there is increased homogeneity in structure and condition.
10. Consider review and possible modification of the landscape section of the	Umwelt (2012): No equivalent recommendation.

ELA (2012) recommendation	Umwelt (2012) corresponding recommendation / comment
methodology due to potentially counterintuitive outcomes (see discussion in section 2.3 of ELA 2012).	<p>Comment: <b>Agree</b>. Landscape connectivity is complex and under the Biobanking methodology of 100 and 1,000 ha habitat circles, is likely to produce varying results depending on observer bias (as per any vegetation mapping without strongly defined rule sets). Umwelt considers a well developed GIS layer for all assessors to use consistently will provide greater consistency of outcomes.</p> <p>ACT Government has assessed the layer and maintained the current concept. Prior to release, it would be useful to document review of the concept (including source), and justify in the context of other methods for assessing landscape connectivity values.</p> <p>As part of this, it would be necessary to understand how the landscape values relate to movement ability for significant species, or groups of significant species.</p>
11. Resolve the five “bugs” detected prior to release.	<p>Umwelt (2012): No equivalent recommendation.</p> <p>Comment: No bugs were encountered in testing undertaken by Umwelt. It is likely that these bugs have been repaired, however this should be confirmed prior to release of the EOC.</p>
12. Remove the “Import all data” button from Step 4a.	<p>Umwelt (2012): No equivalent recommendation.</p> <p>Comment: As Step 4a contains no such button, this appears to have been done.</p>
13. Reconfigure the “export all data” button exports to more user friendly file format (e.g. excel, csv, or dbf formats), rather than the current xml export format	<p>Umwelt (2012): No equivalent recommendation.</p> <p>Comment: <b>Agree</b>. Friendly file formats are available for export in most tabs, however the final query exports in Step 5 require an additional step (&gt;External data&gt;saved Exports&gt;Excel for example) to export data. This is despite the suggestion that Queries may be exported as a csv file when the export buttons are selected.</p>
14. For step 1b (entry of Significant Species Sub Zones) consider simplifying the calculator by removing the vegetation formation drop down menu. Should this be done, it is recommended that the vegetation formation for each vegetation type is shown (i.e. auto-complete field) to facilitate matching with NSW vegetation types where appropriate.	<p>Umwelt (2012): No equivalent recommendation.</p> <p>Comment: <b>Disagree</b>. The step of filtering via Formation eliminates the potential of increased scrolling of lists for vegetation types lower down on the list. We note that this is not as logical in NSW</p>
<b>Significant Species Database</b>	
15. Consider removal of a tab for Vegetation Types in the Significant Species Database, or removal of the Vegetation Types Database to avoid duplication	<p>Umwelt (2012): No equivalent recommendation.</p> <p>Comment: <b>No action</b>. The Significant Species Database provided for this study</p>

ELA (2012) recommendation	Umwelt (2012) corresponding recommendation / comment
and confusion. Should vegetation types be retained within the Significant Species Database rename this for greater clarity.	did not have a Vegetation Types tab, so perhaps this recommendation has been implemented.
16. Consider removal of requirement for survey of habitat trees, and relevant associated special offset requirements.	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> . As advised by CPR, the vegetation type and quality predicts the occurrence of ecological community credits for these species (Anon 2013) <sup>25</sup> . Umwelt notes that for colonial / intensive nesting / roosting species, it is unlikely that the habitat loss can be offset.
17. Consider whether it is necessary to have the many different units of measurement. If retained, make the triggers for these surveys clear in the Operational Manual, as well as the data and methodologies that will need to be used.	Umwelt (2012): No equivalent recommendation. Comment: <b>Disagree</b> . Umwelt does not consider the units of measure onerous. However, the Operational Manual would benefit from a more concise structure lending more to operational guidelines (i.e. clearly articulated steps with dot points, tables etc.).
18. For clarity, definition(s) of 'competent' and 'recognised expert' should be provided to meet special offset requirements.	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> . Clarification is required as to what constitutes competency and being a recognised expert, and whether this applies to both ACT government and external assessors.
19. Review of the assigned negligible loss levels for species is conducted, to more closely reflect its current ACT listing and NSW / Commonwealth listing status (e.g. Vulnerable Mauve Burr-daisy = 0 negligible loss, whereas endangered Button Wrinklewort = 40 negligible loss).	Umwelt (2012): No equivalent recommendation. Comment: <b>Partially Disagree</b> . Negligible loss is complex and relates to a number of other factors including genetic variability, number of populations, population size, fecundity, ability to benefit from conservation actions etc. In an area the size of the ACT, there is a luxury of considering these concepts in deriving negligible loss figures. It is unknown as to how far such concepts were considered in developing negligible loss figures. Perhaps this was done, but if not further consideration is required of this concept.
20. For White-winged Triller, Latham's Snipe, Rainbow Bee-eater, Varied Sittella, Little Eagle (foraging), Grey-headed Flying-fox (foraging), Painted Snipe, Superb Parrot (foraging), and Eastern Long-eared Bat, either remove survey requirements (as they are part of ecological community credits), or note	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> . Unless otherwise quantified to be absent through additional survey / expert report, these species should be included under Ecological Community Credits.

<sup>25</sup> Anon (2013) Environmental Offsets Calculator technical review – modifications table. ACT Government Environment and Sustainable Development Directorate response to ELA (2012) recommendations.

ELA (2012) recommendation	Umwelt (2012) corresponding recommendation / comment
that these are covered under the ecological community credits and do not require specific surveys.	Umwelt notes that Latham's snipe has been removed from the Significant Species database. Assumingly, this is because it is listed as an EPBC Act migratory species, but is not listed as being threatened either in the ACT or nationally.
21. Clearly set out the trigger(s) and operation of the detailed survey requirements in the Methodology and/or Operational Manual.	Umwelt (2012): Partial correlation with Umwelt recommendation 24 from Umwelt (2012): Undertake a review of the appropriateness and applicability of the survey methodology/effort documented in the EOCOM. Comment: <b>Agree</b> . Currently, users are required to refer to both documents to understand survey requirements. Umwelt considers that the Operational Manual would benefit from a more concise structure lending more to operational guidelines (i.e. clearly articulated steps with dot points, tables etc.).
22. Provide threatened species associations with various vegetation condition categories within the significant species database (for ecological community credits).	Umwelt (2012): No equivalent recommendation. Comment: This has been done for the latest version.
<b>Relationship to Current ACT Approvals</b>	
23. The EOC should be clear as to the legislative process and how this 'switches off' the need for other assessments. Alternatively, if the EOC is to be delivered via a policy rather than legislative change, the EOC should clearly state that it replaces previous ACT survey and impact assessment policies.	Umwelt (2012): Strong correlation with Umwelt recommendation 3 from Umwelt (2012): The EOAM and other relevant documentation should clearly indicate whether or not the EOC is mandatory in the ACT. Comment: <b>Agree</b> , this needs to be addressed.
24. The EOC survey methodology collects detailed vegetation and habitat information which is similar to current survey guidelines for approvals under the EIS detailed assessment pathway. It is assumed that the EOC will be applicable for assessments at the EIS level, as this is generally where offsets are considered. However, this should be clarified, particularly if the EOC is going to be compulsory.	Umwelt (2012) from Umwelt (2012): Strong correlation with Umwelt recommendation 3: The EOAM and other relevant documentation should clearly indicate whether or not the EOC is mandatory in the ACT. Comment: <b>Agree</b> , this needs to be addressed.
25. Clarify whether the EOC methodology will not (or will) be applicable to ESO assessment, Code Assessments, and ACT Strategic Assessments.	Umwelt (2012): Strong correlation with Umwelt recommendation 3 from Umwelt (2012): The EOAM and other relevant documentation should clearly indicate whether or not the EOC is mandatory in the ACT. Comment: <b>Agree</b> , this needs to be addressed.
26. The EOC should be clear on whether assessment fees will be charged. Note that ELA is not advocating charging of assessment fees, simply that the situation with regards to assessment fees for the EOC should be clear.	Umwelt (2012): No equivalent recommendation. Comment: <b>Agree</b> .
<b>Interoperability with NSW Biobanking Scheme</b>	
27. ....should the EOC seek to utilise credits generated by the NSW BioBanking	Umwelt (2012): Partial correlation with Umwelt recommendation 8 from Umwelt

ELA (2012) recommendation	Umwelt (2012) corresponding recommendation / comment
<p>scheme then it is recommended that ESDD develop 'trading rules' for the use of BioBanking credits, as the EOC and BioBanking credit calculation processes have a number of differences.</p>	<p>(2012): All relevant supporting documentation should clearly emphasise that the ESDD does not propose to establish an open credit market: rather, the assessment of development and offset credits is undertaken purely as part of an accounting exercise to determine the suitability of proposed development and offset sites.</p> <p>Comment: <b>Agree</b>, the intent should be articulated. If the EOC seeks to utilise credits generated by the NSW Biobanking scheme, trading rules should consider methods for addressing species that occur across jurisdictions but have different credit requirements under each tool.</p>
<p>28. ....It is recommended that awarding these additional credits (for conversion of sites to the ACT reserve system) is reviewed.</p>	<p>Umwelt (2012): No equivalent recommendation.</p> <p>Comment: <b>Agree</b>. The concept of biodiversity credits is outcome focused. There will be a public expectation that offset sites which are not part of the ACT reserve system should be managed with the same rigour, and therefore the tenure should be irrelevant.</p> <p>However, Umwelt notes that delivery of offsets on 'private' land will be more challenging, and this concept requires further consideration.</p>
<b>Functioning with Regard to Draft EPBC 'Offset Assessment Guide'</b>	
<p>29. Seek to discuss with SEWPaC how it may be possible to align the EOC and Commonwealth Offset assessment guide. This review may provide a useful starting point in this regard.</p>	<p>Umwelt (2012): Partial correlation with Umwelt recommendation 9 from Umwelt (2012): The EOC documentation should include some guidance on the relevance of the Commonwealth offsets calculator, and recommendation 21: Undertake a parallel trial of the new EPBC Offsets Calculator to relevant significant species and ecological communities to determine the similarity or dissimilarity in outcomes.</p> <p>Comment: <b>Agree</b>. As both tools will be used to assess developments on some level, the results of this report and ELA (2012) should be used as a basis of discussion with the Commonwealth.</p> <p>Ideally, a robust series of case studies involving data collection with the purpose of operating both tools should be undertaken to enable closer comparison of both calculators.</p>

## 4.7.2 Technical Review – Modifications Table

Additional to recommendations in **Section 4.7.1**, ELA (2012) suggested a series of modifications. Review of the suggested modifications to the EAOM, EOCOM, EOC and associated databases reveals that changes outlined in Table 14 are still required. Additional changes requiring further policy work were also suggested, however as additional policy has not been provided these were unable to be reviewed.

**Table 4.6 – Changes and clarifications required from modification table.**

Document	Suggested Change (ELA 2012)	Change still required
EOAM (p16) / EOCAM (Appendix 9)	Consider review and possible modification of the landscape section of the methodology due to potentially counterintuitive outcomes.	The ACT Government has assessed this and maintained the current concept. For transparency, it would be useful to document review of the concept, and justify in the context of other methods for assessing landscape connectivity values.
EOC	'export all data' button exports to a more user friendly file format (e.g. excel, csv or dbf formats) rather than the current xml export formats.	Friendly file formats are available for export in most tabs, however the final query exports in Step 5 require an additional step (>External data>saved Exports>Excel for example) to export data. This is despite the suggestion that Queries may be exported as a csv file when the export buttons are selected.
EOCOM (p34)	It is understood that a 99 year leasehold system is the reason for the 10% (private) and 40% (government reward system... the logic why these types of conservation will be more secure and thus should receive more credits is unclear.	A guideline is currently being developed by ACT Government. This guideline was not reviewed as part of this project. Umwelt considers the concept of biodiversity credits to be outcome focused. There will be a public expectation that offset sites which are not part of the ACT reserve system should be managed with the same rigour, and therefore the tenure should be irrelevant. However, Umwelt notes that delivery of offsets on 'private' land will be more challenging, and this concept requires further consideration.
EOCOM (p53)	'Relatively large old trees' changes to 'large old trees'.	Remove 'relatively' from the definition of 'Late to over-mature growth stage'.
Significant Species database	....Similarly, .... Ginninderra Peppercress ( <i>Lepidium ginninderrense</i> ) are also designated for hectares of loss.	<i>Lepidium ginninderrense</i> has been retained as hectares of loss based on the assumption that the distribution is known and a habitat map is available. This should be reviewed in light of the recent discovery of a population at North Mitchell.
Significant Species database	A number of significant species do not have T <sub>G</sub> values provided in the "Significant Species database".	Eastern Bentwing Bat, Grey-headed Flying Fox (Roosting), Large-footed Myotis (Roosting), Little Eagle (Nesting) and Little Eagle (Nesting) still require T <sub>G</sub> values.

Vegetation Types database	For wetlands, it has not been identified what a wetland is in either the red flag or the glossary (Umwelt comment: addressed, but relates to issue highlighted).	Wetlands will not be assessed under the EAOM as they will be referred to the Conservator for Flora and Fauna. However, two wetland vegetation types remain in the Vegetation Types database and should be removed.  Umwelt notes that amphibians and their habitat are not assessed as part of the EOC. There are no threatened amphibians in the ACT lowlands where the calculator applies.
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## 4.8 Appropriateness and applicability of method

### 4.8.1 Field survey methodology

The utility of field survey datasheets provided in Appendix 10 of the EOCOM (ACT Government 2013b) were tested as part of the Molonglo stage 3 surveys (**Section 3**). As the methodology is based on the BioBanking methodology (DECC 2008), it is relatively easy to apply in the field. The following changes are required:

1. The 'Site value: Transect plot data sheet' requires a field to capture the 'number of trees with hollows', which is required in Step 4b the EOC. Alternatively, Step 4b of the EOC database should be changed to provide a data entry field for 'number of large trees', if the intent of this variable is the same.
2. Considering the need to make observations at either 1 or 5 metre intervals along the transect depending on the variable assessed, the 'transect tally table' within the 'Site value: Transect plot data sheet' and the 'native species list worksheet' do not lend well to making observations at defined intervals. Consider refining the layout to facilitate this for ease of use.
3. Particularly in more open woodland environments, or where the distribution of growth forms in any strata is patchy, the transect method is rarely effective in providing an accurate account of cover relative to associated plot/quadrat observations. It would be beneficial to have a field on the proforma for observers to record the estimated Projected Foliage Cover (not withstanding point 5 below) within the plot area. In instances where the transect fails to capture representative cover information, this would allow a subjective assessment by observers to more appropriately describe vegetation community structure.
4. An additional datasheet is required to enable collection of full-floristic data to assist in generating species richness data. As part of our study we used Umwelt datasheets which allow for individual species identification, and information on the cover and abundance of each species (i.e. Braun-blaunquet scaling, derived from Braun-blaunquet 1932)<sup>26</sup>. The survey effort required to collect additional information is minimal in comparison to the great expense of undertaking additional floristic survey to gather small amounts of additional data which is critical for a range of other purposes of use of ACT Government, including vegetation monitoring and plant community classification.
5. An issue which has been carried over from the BioBanking methodology is apparent in that field data and benchmark data for crown cover is collected using an assessment of

<sup>26</sup> Braun-blaunquet J (1932) Plant sociology. McGraw Hill, New York.

'Percent Foliage Cover' (PFC). PFC is an assessment of crown cover based on the percentage of ground that would be covered by a vertical projection of the foliage, and braches and trunk of a plant or plants. This method has been unpopular with ecologists in NSW as it provides a level of subjectivity beyond that of standard (opaque) crown cover as observers need to estimate the percentage of projected cover within an opaque crown. Through testing with numerous ecologists in NSW, it is considered that such secondary estimation leads to a greater level of subjectivity and variability in assessment, and should be avoided where possible. Additionally, it is far more difficult to relate to remotely-sensed vegetation condition assessment undertaken through aerial photograph interpretation.

#### 4.8.1.1 Grasslands

Condition assessment of native grassland vegetation types is widely considered to be poor under the BioBanking methodology, and hence also the EOAM. Grassland condition is closely related to the presence of a variety of palatable herbs (or 'decreaser' species) rather than high species richness *per se*, which can be achieved in a disturbed grassland site dominated by 'increaser' species. A method has been developed by grassland ecologists including those across the ACT to determine grassland condition based on 'Floristic Value Scores' or sites/plots based on the abundance of 'decreaser' species identified from comprehensive local datasets (Rehwinkel 2007)<sup>27</sup>, and has been used to assess grassland condition across the ACT and surrounds (e.g. Armstrong 2013; numerous government and development studies across the ACT and Southern Tablelands).

Discussions between Rainer Rehwinkel of the NSW Office of Environment and Heritage, other leading grassland ecologists and SEWPaC are progressing with a view to incorporating the method into assessing natural temperate grassland condition under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Rainer Rehwinkel pers. comm. 2013)<sup>28</sup>. Consideration should be given to applying this method to the EOC, perhaps through relating the 'Floristic Value Score' to a benchmark value.

### 4.8.2 Desktop methodology

#### 4.8.2.1 Environmental offsets calculator operation

The EOC has now been developed and refined to a point where it is highly functional and easy to use. Umwelt can see no issues with the operation of the tool.

The EOCOM Operational Manual would benefit from a more concise structure lending more to operational guidelines (i.e. clearly articulated steps with dot points, tables etc.). While this is the case for much of the document, some steps are not clearly articulated, or contain large amounts of contextual information in between operational steps. If this structure is preferred, operational steps would ideally be highlighted.

#### 4.8.2.2 Landscape Value scores

After considering the concept, issues raised by ELA (2012) and the response of ESDD (Anon 2013), Umwelt remains uncertain as to the applicability of the Landscape Value Scores concept. It is not clear how the composite Habitat Context (Nearest Neighbour) Value and Link Value relate to specific significant species, or groups of significant species. Such concerns may have been considered in developing the layer, however prior to release a

<sup>27</sup> Rehwinkel R (2007) A method to assess grassy ecosystem sites: using floristic information to assess a site's quality. Version 2, November 2007. NSW Department of Environment and Climate Change, Queanbeyan.

<sup>28</sup> Rehwinkel R (2013) Senior Threatened Species Officer and recognised grassland ecology expert, NSW Office of Environment and Heritage.

guiding document outlining the concept (including source), GIS methods, consideration of specific significant species (or groups of significant species) and comparison with other methods for assessing landscape connectivity issues may provide greater clarity. Additionally, it is recommended that guidelines be developed for amendments in the event of a site assessment revealing a significant error in base information used to derive the Habitat Context (Nearest Neighbour) Value and Link Value models.

The assumption that one habitat and link model can provide meaningful value to a range of species with different movement abilities and lifecycles requires further consideration. It is likely that different groups of species will have different requirements. For example, the movement ability of grassland reptiles is significantly less than woodland birds. Further investigation needs to be done into refining this concept, however Habitat Context (Nearest Neighbour) Value and Link Value algorithms should be developed with such issues in mind.

As the layer is being produced over a relatively small area relative to most regional connectivity models, it may be of a scale where remotely sensed spot validation may be rigorously undertaken to quantify accuracy of the layer. This is also important as regional connectivity models are rarely used at the site scale, whereas this one will be incorporated finer scale into environmental assessment using the EOC.

#### **4.8.2.3 Credit requirements for offsetting low condition vegetation types**

When generating credits, there doesn't appear to be clear guidance as to the credit accounting and offsetting of vegetation types in low condition (paddock trees or native pasture). If the concept of "like for like" holds true, areas in low condition will need to be offset with the equivalent vegetation type in low condition. Ideally, vegetation in low condition could be offset with vegetation in high condition, however the reverse should not apply where high condition vegetation is offset with low condition vegetation.

#### **4.8.2.4 Golden Sun Moth**

The EOC allows for entry of both population counts and area of habitat for the golden sun moth. To some extent, this can be used as a predictor of habitat quality, but does not recognise the variable quality within habitat patches. Traditionally, when a site is assessed for Golden Sun Moth habitat, the area is delineated into high, moderate and poor quality based on the presence of wallaby grass (*Rytidosperma* spp.) and population density.

There is no mechanism in the EOC to recognise this. Ideally, areas of low quality would generate fewer credits than those of moderate and high quality, thus encouraging development outside of better habitat, and focusing offset measures in areas of better habitat. Also, Golden Sun Moth population counts can vary greatly based on survey factors including year of survey, weather conditions and survey effort. The sensitivity analysis suggests that if the survey effort at either the development or offset site is not comprehensive, calculations can lead to perverse outcomes.

### **4.8.3 Applicability to environmental outcomes delivery**

Assessment of four development and associated offset sites assessed as part of this project has provided a valuable insight into the applicability of the EOAM to environmental outcomes associated with key development issues in the ACT including 'white box-yellow box-Blakely's red gum grassy woodland and derived native grassland', 'natural temperate grassland of the Southern Tablelands of NSW and the Australian Capital Territory', golden sun moth and striped legless lizard.

There is a strong likelihood that development and offset packages may have had a different outcome if they were assessed and approved under a tool like the EOC. However, in most instances as tested, it would not have resulted in a significantly larger offset, and the offset site would be more closely tailored to mitigating impacts of the development. The ratio of development to offset also appears to be in line with contemporary offset decisions.

## 5.0 Recommendations

Based on the experience of trialling the EOC on four existing development and associated offset sites, Umwelt believes the following changes should be considered for the EAOM prior to progressing:

### Finalising EACOM, EOAM, EOC and databases (general)

1. Consider points in **Table 4.5** (refer to **Section 4.7.1**) and **Table 4.6** (refer to **Section 4.7.2**) and address if required.
2. Review the EOCAM and EOAM, and consider adding increased structure to ensure that key operational steps are highlighted (refer to **Section 4.8.2.1**).
3. Consider adding information to the Significant Species database (refer to **Section 4.2.1**), specifically related to *Lepidium ginninderrense*, *Rutidosia leptorrhynchoides*, *Arachnorchis actensis* and hooded robin.
4. Examine the background links in the EOC for striped legless lizard Special Offset Requirements as it was revealed in through trial that a red flag was highlighted when this should not have been the case (refer to **Section 2.2.4.1**).
5. Remove reference to wetland vegetation types from the Vegetation Types and Benchmarks dataset (refer to **Section 4.2.3**).
6. Discuss with ESDD Conservation Planning and Research the potential for adopting the recent vegetation classification produced by OEH for the ACT and surrounds, which they are using as a base classification to map vegetation across the ACT. If agreed, amend EOC and databases to accommodate this moving forward (refer to **Section 4.2.2**).
7. Consider adding the clause “*the 4 ha consideration will not be applied to such vegetation types where  $\leq 20$  ha (or  $x$  ha) of extant vegetation remains in areas below 750m asl. where the EOAM applies*” to the Heads of Consideration for the Flora and Fauna Conservator for assessing developments with red flags.
8. Clarify terminology around Special Offset requirements for the brown tree creeper and hooded robin (refer to **Section 4.4**).
9. Clear guidance on how to assess derived native grasslands is critical. It is understood that they need to be assessed as a lower condition version of their parent community (i.e. native pasture or paddock trees), however this should be asserted in the EOAM (refer to **Section 4.6**).

### Policy

10. Develop a policy/guideline for general offsetting requirements for vegetation types in low condition (paddock trees or native pasture). Ideally, vegetation in low condition could be offset with vegetation in high condition, but not visa-versa (refer to **Section 4.5**).
11. Allow peer review of the policy guideline for allowing greater credit for offset sites managed as part of the ACT reserve system (refer to **Section 4.7.2**).

## Golden Sun Moth

12. Consideration should be given to factoring in Golden Sun Moth habitat condition classes. Where impacts are unavoidable, this will increase the likelihood of focusing development in areas of low quality, and offsetting in areas of higher quality (refer to **Section 4.8.2.3**);
13. Ensure quality control measures are in place to that Golden Sun Moth survey data can only be incorporated if it meets strict survey guidelines related to effort and weather conditions (refer to **Section 4.8.2.3**).

## Grassland assessment

14. Consider replacing native species richness with a 'Floristic Value Score' benchmark to reflect the importance of 'decreaser' species in grassy ecosystems (refer to **Section 3.8.1.1**);
15. Clarify the application of condition classes outlined in Table 12 to grassland vegetation types (refer to **Section 4.6**). Additionally, the term 'herb' should be changed to 'forb'. In a botanical sense, grasses are also considered herbs.

## Field methodology

16. Consider results of the review of the field survey methodology undertaken by Umwelt (refer to **Section 4.8.1**).

## Landscape Value Scores

17. For Landscape Value Score layers, prepare a guiding document outlining the concept (including source), GIS methods, consideration of specific significant species (or groups of significant species) and comparison with other methods for assessing landscape connectivity issues may provide greater clarity (refer to **Section 4.8.2.2**).
18. For the Landscape Value Score layers, consider developing guidelines for amendments in the event of a site assessment revealing a significant error in base information used to derive the Habitat Context (Nearest Neighbour) Value and Link Value models (refer to **Section 4.8.2.2**).
19. For the Landscape Value Score layers, consider undertaking remotely sensed spot validation may be rigorously undertaken to quantify accuracy of the layer (we note that this may have happened in the development phase) (refer to **Section 4.8.2.2**).

Additionally, the following recommendations from Umwelt (2012) may be considered (those which have been addressed already are not included):

20. An overarching guidance document would generally assist in the understanding of the EOC.

21. The ESDD should take into consideration the outcomes of a review of BioBanking that was completed several months ago. A number of the outcomes would benefit the ACT EOC (note: OEH is currently considering the review and changes are yet to be released)
22. The EOAM and other relevant documentation should clearly indicate whether or not the EOC is mandatory in the ACT.
23. The EOAM and other relevant documentation should clearly indicate which organisation has responsibility for its operation and maintenance (note: ESDD is assumed but this has not been clarified).
24. A framework for thorough peer review and public exhibition should be considered and documented, to provide transparency on when and how the public can review the operation of the scheme and its databases. Likewise a process for inviting periodic peer review and update of databases should be documented (note: this may be useful on the live website).
25. Simple training modules should be developed and delivered to support the rollout and use of the EOC.
26. All relevant supporting documentation should clearly emphasize that the ESDD does not propose to establish an open credit market; rather, the assessment of development and offset credits is undertaken purely as part of an accounting exercise to determine the suitability of proposed development and offset sites.
27. A careful review of appropriate terms and definitions should be undertaken. As a minimum the following terms require appropriate definitions: 'naturally very rare'; 'few populations'; and 'restricted distribution'.
28. The layout, and precise wording, of the text in Section 6.1 of the EOAM should be reconsidered to simplify the message.
29. The inclusion of the fourth point in relation to vegetation formations in Section 6.1 should be reconsidered (as related to offsetting rules within the same formation) (note: strict rules may be developed which may include: geographic constraints; offsetting EECs with highly similar EECs or CEECs that are more highly cleared or under greater threat than the one proposed for offsetting; rules around irreplaceability, e.g. a CEEC could not be traded).
30. The ESDD give consideration to the possibility of allowing limited trading between vegetation types and subregions.
31. Consideration should be given to developing a web-based version of the EOC (as it eliminates the possibility of using superseded versions).
32. The ESDD should reconsider the need for the inclusion of Significant Species Sub Zones in the assessment process.

## 6.0 References

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### Personal communications

- Rehwinkel R (2013) Senior Threatened Species Officer and recognised grassland ecology expert, NSW Office of Environment and Heritage.



## APPENDIX 1

Site Data

## Appendix 1 - Site Data

### Ngunnawal 2C Development

#### *Development Site data summary*

##### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
<i>% Development within Zone</i>	<i>Zone Type</i>	<i>% Development within Zone</i>	<i>Zone Type</i>
79	Very Low	65	Low Linkage
20	Low	35	High Linkage
1	Moderate	<b>Landscape score</b>	<b>10.67</b>
0	High		
0	Very High		

##### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest	Moderate/good	0.42
2	ACT16: <i>Eucalyptus melliodora</i> – <i>Eucalyptus blakelyi</i> Tableland Grassy Woodland	Native pasture	10.00
3	ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest	Native pasture	19.08

##### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

##### Step 3: Undertake Site Survey

Survey period: November. December
Species Targeted: Little Eagle (nesting), Perunga Grasshopper, Regent Honeyeater (habitat tree), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , <i>Swainsona sericea</i>
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (expert report assumed species to be absent).

Step 4a: Vegetation Zone – Community Type or Condition and Flag Status

Zone	Flag
1	No
2	No
3	No

Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	3	27	45	5	25	10	10	5	2	1	48
2	1	27	0	0	50	2	10	20	0	0	0
2	2	27	0	0	60	1	5	20	0	0	0
3	4	25	0	0	55	3	10	10	0	0	0
3	5	31	0	0	50	5	10	5	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.
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Step 4d: Management Zones Attribute Score with Development

	Zone: 1		Zone: 2		Zone: 3	
	Current	W. Dev.	Current	W. Dev.	Current	W. Dev.
<b>Sp.R</b>	2	0	2	0	2	0
<b>NOSc</b>	2	0	0	0	0	0
<b>NMSc</b>	3	0	3	0	0	0
<b>NGcG</b>	3	0	3	0	2	0
<b>NGcS</b>	3	0	3	0	2	0
<b>NGcO</b>	3	0	2	0	3	0
<b>EPc</b>	2	0	2	0	2	0
<b>#holl.</b>	2	0	0	0	0	0
<b>FL</b>	3	0	0	0	0	0
<b>Site Sc.</b>	2	0	0	0	0	0
<b>Site Sc.</b>	<b>72</b>	<b>0</b>	<b>35</b>	<b>0</b>	<b>20</b>	<b>0</b>
<b>Decrease</b>	<b>72</b>		<b>35</b>		<b>20</b>	

Current = Current Score (0-3); W. Dev = Score with development (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

Step 4e: Significant Species – Survey Results

Species	Impacted	ID Method	Loss	Units	Negligible Loss #
Regent Honeyeater	No	Assumed	0	Habitat trees	N/A
Golden Sun Moth	Yes	Survey	24	Individuals	N/A
Golden Sun Moth	Yes	Survey	15	Ha	N/A
Perunga Grasshopper	No	Expert Report	0	Ha	N/A
Little Eagle (nesting)	No	Assumed	0	Habitat trees	N/A
<i>Swainsona sericea</i>	No	Assumed	0	Individuals	100
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Assumed	0	Individuals	100

Step 4f: Significant Species – Special Offset Requirements

Golden Sun Moth: compliant with special offset requirements

Step 4g: Significant Species – Loss Summary

Refer to Step 4e.

**Offset Site data summary**

Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
63	Very Low	46	Low Linkage
29	Low	54	High Linkage
8	Moderate	<b>Landscape score</b>	<b>13.85</b>
0	High		
0	Very High		

Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Moderate/Good	2.18
2	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Native Pasture	12.24
3	<i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest	Native Pasture	5.28

## Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	Yes
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

## Step 3: Undertake Site Survey

Survey period: December
Species Targeted: Brown Treecreeper, Little Eagle (Nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Hooded Robin, Perunga Grasshopper, <i>Rutidosis leiolepis</i> , <i>Rutidosis leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Regent Honeyeater (habitat tree),
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (present), <i>Swainsona recta</i> (expert report assumed species to be absent).

## Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
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## Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPC	#holl.	Reg.	FL
1	1	29	30	10	60	2	20	10	2	1	29
1	2	33	30	8	45	1	25	10	4	1	26
2	3	29	0	0	70	0	10	8	0	0	0
2	4	31	0	0	75	1	10	8	0	0	0
3	5	26	0	0	60	15	10	5	0	0	0
3	6	24	0	0	55	5	15	5	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPC = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

## Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.
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Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2		Zone 3	
	Current	Increase	Current	Increase	Current	Increase
<b>Sp.R</b>	2	3	2	3	2	3
<b>NOSc</b>	3	3	0	1	0	1
<b>NMSc</b>	3	3	3	3	0	1
<b>NGcG</b>	3	3	2	3	2	3
<b>NGcS</b>	3	3	3	3	3	3
<b>NGcO</b>	2	3	3	3	3	3
<b>EPc</b>	2	3	2	3	2	3
<b>#holl.</b>	2	2.5	0	0	0	0
<b>Regen.</b>	3	3	0	0.5	0	0.5
<b>FL</b>	2	3	0	0	0	0
<b>Site Sc.</b>	<b>74</b>	<b>96</b>	<b>35</b>	<b>52</b>	<b>21</b>	<b>41</b>
<b>Increase</b>	<b>22</b>		<b>16</b>		<b>20</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
Brown Treecreeper	No	Expert report		
Little Eagle (nesting)	No	Expert report		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Expert report		
Hooded Robin	No	Expert report		
Perunga Grasshopper	Yes	Survey	3	Ha
<i>Rutidosis leiolepis</i>	No	Expert report		
<i>Rutidosis leptorrhynchoides</i>	No	Expert report		
<i>Swainsona recta</i>	No	Expert report		
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	Yes	Survey	17.4	Ha
Golden Sun Moth	Yes	Survey	15	Individuals
<i>Thesium australe</i>	No	Expert report		
Regent Honeyeater (habitat tree)	No	Expert report		

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.

## Lawson South Development

### Development Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
32	Very Low	100	Low Linkage
42	Low	0	High Linkage
26	Moderate	<b>Landscape score</b>	<b>12.06</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone <sup>1</sup>	Vegetation Type	Condition	Hectares
3	ACT25: <i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest	Native pasture	9.00
4	ACT16: <i>Eucalyptus melliodora</i> – <i>Eucalyptus blakelyi</i> Tableland Grassy Woodland	Moderate/good	8.00
5	ACT16: <i>Eucalyptus melliodora</i> – <i>Eucalyptus blakelyi</i> Tableland Grassy Woodland	Native pasture	8.24
6	ACT18: Tableland Dry Shrubby Woodland	Native pasture	1.00
7	ACT22: <i>Casuarina cunninghamiana</i> Tableland Riparian Woodland	Native pasture	3.27
8	ACT01: Tablelands Dry Tussock Grassland	Native pasture	26.00

<sup>1</sup> Zones 1 and 2 removed.

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: November. December
Species Targeted: Brown Tree creeper, Striped Legless Lizard, Little Eagle (nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosia leiolepis</i> , <i>Rutidosia leptorrhynchoidea</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Grassland earless Dragon, Regent Honeyeater (habitat tree)
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (present), Grassland Earless Dragon (expert report assumed species to be absent).

Step 4a: Vegetation Zone – Community Type or Condition and Flag Status

Zone	Flag
3	No
4	No
5	No
6	No
7	No
8	No

Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
8	1	20	0	0	60	0	5	15	0	0	0
8	2	19	0	0	50	2	10	10	0	0	0
8	3	18	0	0	660	3	8	15	0	0	0
4	4	34	15	0	45	2	10	10	2	0	27
4	5	32	10	1	65	2	10	10	1	0	21
4	6	28	15	0	55	1	5	15	2	0	12
5	7	26	0	0	60	1	5	10	0	0	0
5	8	29	0	0	50	0	10	5	0	0	0
6	9	21	0	0	50	10	5	5	0	0	0
7	10	15	0	0	60	0	5	20	0	0	0
3	11	20	0	0	50	2	8	5	0	0	0
3	12	22	0	0	60	0	5	10	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone: 3		Zone: 4		Zone: 5		Zone: 6		Zone: 7		Zone: 8	
	Cur.	W. Dev.	Cur.	W. Dev.	Cur.	W. Dev.	Cur.	W. Dev.	Cur.	W. Dev.	Cur.	W. Dev.
<b>Sp.R</b>	2	0	2	0	2	0	2	0	3	0	2	0
<b>NOSc</b>	0	0	3	0	0	0	0	0	0	0	3	0
<b>NMSc</b>	0	0	3	0	3	0	0	0	0	0	0	0
<b>NGcG</b>	2	0	3	0	3	0	3	0	2	0	3	0
<b>NGcS</b>	1	0	3	0	3	0	3	0	3	0	3	0
<b>NGcO</b>	3	0	3	0	2	0	2	0	3	0	3	0
<b>EPc</b>	2	0	2	0	2	0	2	0	2	0	2	0
<b>#holl.</b>	0	0	1	0	0	0	0	0	0	0	0	0
<b>Regen.</b>	0	0	0	0	0	0	0	0	0	0	0	0
<b>FL</b>	0	0	2	0	0	0	0	0	0	0	0	0
<b>Site Sc.</b>	20	0	58	0	35	0	21	0	28	0	49	0
<b>Decrease</b>	<b>20</b>		<b>58</b>		<b>35</b>		<b>21</b>		<b>28</b>		<b>49</b>	

Cur. = Current Score (0-3); W. Dev = Score with development (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen = Overstorey regeneration; FL = Total length of fallen logs.

#### Step 4e: Significant Species – Survey Results

Species	Impacted	ID Method	Loss	Units	Negligible Loss #
Regent Honeyeater	No	Assumed	0	Habitat trees	N/A
Grassland Earless Dragon	No	Expert Report	0	Ha	0
<i>Thesium australe</i>	No	Assumed	0	Individuals	0
Golden Sun Moth	yes	Survey	25	Individuals	N/A
Golden Sun Moth	yes	Survey	52.4	Ha	N/A
<i>Swainsona sericea</i>	No	Assumed	0	Individuals	100
<i>Swainsona recta</i>	No	Assumed	0	Individuals	0
<i>Rutidosia leptorrhynchoides</i>	No	Assumed	0	Individuals	10
<i>Rutidosia leiolepis</i>	No	Assumed	0	Individuals	0
Perunga Grasshopper	Yes	Survey	49	Ha	N/A
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Assumed	0	Individuals	100
Little Eagle (nesting)	No	Assumed	0	Habitat trees	N/A
Striped Legless Lizard	No	Assumed	0	Ha	N/A
Brown Treecreeper	No	Assumed	0	Ha	N/A

#### Step 4f: Significant Species – Special Offset Requirements

Golden Sun Moth: compliant with special offset requirements
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#### Step 4g: Significant Species – Loss Summary

Refer to Step 4e.
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## Offset Site data summary

### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
27	Very Low	100	Low Linkage
38	Low	0	High Linkage
35	Moderate	<b>Landscape score</b>	<b>12.86</b>
0	High		
0	Very High		

### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT01: Tablelands Dry Tussock Grassland	Native pasture	58.58
2	ACT01: Tablelands Dry Tussock Grassland	Moderate/good	5.37

### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

### Step 3: Undertake Site Survey

Survey period: November, December
Species Targeted: Striped Legless Lizard, <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosia leiolepis</i> , <i>Rutidosia leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Grassland Earless Dragon.
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (present), Grassland Earless Dragon (expert report assumed species to be absent).

### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
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#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	4	20	0	0	50	0	5	30	0	0	0
1	5	14	0	0	40	1	3	40	0	0	0
1	6	16	0	0	45	0	2	30	0	0	0
2	1	36	0	0	50	1	1	2	0	0	0
2	2	32	0	0	45	1	15	5	0	0	0
2	3	34	0	0	50	2	10	5	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2	
	Current	Increase	Current	Increase
Sp.R	2	3	3	3
NOSc	3	3	3	3
NMSc	0	0	0	0
NGcG	3	3	3	3
NGcS	3	3	3	3
NGcO	2	3	3	3
EPc	1	1.5	2	3
#holl.	0	0	0	0
Regen.	0	0.5	0	0.5
FL	0	0	0	0
Site Sc.	<b>43</b>	<b>61</b>	<b>62</b>	<b>72</b>
Increase	<b>18</b>		<b>10</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
Striped Legless Lizard	No	Survey		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Survey		
Perunga Grasshopper	Yes	Survey	3	Ha
<i>Rutidosis leiolepis</i>	No	Survey		
<i>Rutidosis leptorrhynchoides</i>	No	Survey		
<i>Swainsona recta</i>	No	Survey		
<i>Swainsona sericea</i>	No	Survey		
Golden Sun Moth	Yes	Survey	60	Ha
Golden Sun Moth	Yes	Survey	200	Individuals
<i>Thesium australe</i>	No	Survey		
Grassland Earless Dragon	No	Survey		
Hooded Robin	Yes	Survey	2	Ha

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.

## Confidential Development Site 1

### Development Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Development within Zone	Zone Type	% Development within Zone	Zone Type
60	Very Low	100	Low Linkage
40	Low	0	High Linkage
0	Moderate	<b>Landscape score</b>	<b>8.8</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT01: Tableland Dry Tussock Grasslands	Moderate/good	0.48
2	ACT01: Tableland Dry Tussock Grasslands	Native pasture	5.92

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: November.
Species Targeted: <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosia leiolepis</i> , <i>Rutidosia leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> .
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (expert report assumed species to be absent).

#### Step 4a: Vegetation Zone – Community Type or Condition and Flag Status

Zone	Flag
1	No
2	No

#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	2	17	15	0	60	0	3	15	0	0	0
1	3	15	0	0	55	0	2	15	0	0	0
2	1	31	0	0	50	1	10	5	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone: 1		Zone: 2	
	Cur.	W. Dev.	Cur.	W. Dev.
Sp.R	2	0	3	0
NOSc	3	0	3	0
NMSc	0	0	0	0
NGcG	3	0	3	0
NGcS	3	0	3	0
NGcO	2	0	3	0
EPc	2	0	2	0
#holl.	0	0	0	0
Regen.	0	0	0	0
FL	0	0	0	0
Site Sc.	48	0	62	0
<b>Decrease</b>	<b>48</b>		<b>62</b>	

Cur. = Current Score (0-3); W. Dev = Score with development (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen = Overstorey regeneration; FL = Total length of fallen logs.

#### Step 4e: Significant Species – Survey Results

Species	Impacted	ID Method	Loss	Units	Negligible Loss #
<i>Thesium australe</i>	No	Assumed	0	Individuals	0
Golden Sun Moth	Yes	Survey	11	Individuals	N/A
Golden Sun Moth	Yes	Survey	0.8	Ha	N/A
<i>Swainsona sericea</i>	No	Assumed	0	Individuals	100
<i>Swainsona recta</i>	No	Assumed	0	Individuals	0
<i>Rutidosia leptorrhynchoides</i>	No	Assumed	0	Individuals	10
<i>Rutidosia leiolepis</i>	No	Assumed	0	Individuals	0
Perunga Grasshopper	No	Assumed	0	Ha	N/A
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Assumed	0	Individuals	100

#### Step 4f: Significant Species – Special Offset Requirements

Golden Sun Moth: compliant with special offset requirements

#### Step 4g: Significant Species – Loss Summary

Refer to Step 4e.

### **Offset Site data summary**

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
0	Very Low	100	Low Linkage
44	Low	0	High Linkage
56	Moderate	<b>Landscape score</b>	<b>15.8</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT01: Tablelands Dry Tussock Grassland	Moderate/good	0.40
2	ACT01: Tablelands Dry Tussock Grassland	Native pasture	1.30

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: November, December
Species Targeted: <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosia leiolepis</i> , <i>Rutidosia leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> .
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (expert report assumed species to be absent).

#### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.

#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	1	30	0	0	50	1	10	5	0	0	0
2	2	14	0	0	45	0	5	25	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2	
	Current	Increase	Current	Increase
<b>Sp.R</b>	3	3	1	1.5
<b>NOSc</b>	3	3	3	3
<b>NMSc</b>	0	0	0	0
<b>NGcG</b>	3	3	3	3
<b>NGcS</b>	3	3	3	3
<b>NGcO</b>	3	3	3	3
<b>EPc</b>	2	3	1	1.5
<b>#holl.</b>	0	0	0	0
<b>Regen.</b>	0	0.5	0	0.5
<b>FL</b>	0	0	0	0
<b>Site Sc.</b>	<b>62</b>	<b>72</b>	<b>32</b>	<b>43</b>
<b>Increase</b>	<b>10</b>		<b>10 (11)</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

#### Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Survey		
Perunga Grasshopper	No	Survey		
<i>Rutidosis leiolepis</i>	No	Survey		
<i>Rutidosis leptorrhynchoides</i>	No	Survey		
<i>Swainsona recta</i>	No	Survey		
<i>Swainsona sericea</i>	No	Survey		
Golden Sun Moth	Yes	Survey	4.6	Ha
Golden Sun Moth	Yes	Survey	54	Individuals
<i>Thesium australe</i>	No	Survey		

#### Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.

## Confidential Development Site 2

### Development Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Development within Zone	Zone Type	% Development within Zone	Zone Type
100	Very Low	100	Low Linkage
0	Low	0	High Linkage
0	Moderate	<b>Landscape score</b>	<b>6</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>Eucalyptus blakelyi</i> Tableland Grassy Woodland	Native pasture	14.65

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: November.
Species Targeted: Perunga Grasshopper, <i>Swainsona sericea</i> , Golden Sun Moth. Striped Legless Lizard added as it has been found through survey.
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper (expert report assumed species to be absent).

#### Step 4a: Vegetation Zone – Community Type or Condition and Flag Status

Zone	Flag
1	No

#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	1	26	0	0	65	2	10	5	0	0	0
1	2	26	0	0	60	1	10	5	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone: 1	
	Cur.	W. Dev.
<b>Sp.R</b>	2	0
<b>NOSc</b>	0	0
<b>NMSc</b>	3	0
<b>NGcG</b>	3	0
<b>NGcS</b>	3	0
<b>NGcO</b>	3	0
<b>EPc</b>	2	0
<b>#holl.</b>	0	0
<b>Regen.</b>	0	0
<b>FL</b>	0	0
<b>Site Sc.</b>	37	0
<b>Decrease</b>	<b>37</b>	

Cur. = Current Score (0-3); W. Dev = Score with development (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen = Overstorey regeneration; FL = Total length of fallen logs.

#### Step 4e: Significant Species – Survey Results

Species	Impacted	ID Method	Loss	Units	Negligible Loss #
Perunga Grasshopper	No	Expert report	0	Ha	N/A
Golden Sun Moth	No	Assumed	0	Individuals	N/A
Golden Sun Moth	No	Assumed	0	Ha	N/A
<i>Swainsona sericea</i>	No	Assumed	0	Individuals	100
Striped Legless Lizard	Yes	Survey	6	Ha	0

#### Step 4f: Significant Species – Special Offset Requirements

Striped Legless Lizard: compliant with special offset requirements.

#### Step 4g: Significant Species – Loss Summary

Refer to Step 4e.

## Offset Site data summary

### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
84	Very Low	100	Low Linkage
16	Low	0	High Linkage
0	Moderate	<b>Landscape score</b>	<b>7.12</b>
0	High		
0	Very High		

### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>Eucalyptus blakelyi</i> Tableland Grassy Woodland	Moderate/good	5.00
2	ACT16: <i>Eucalyptus melliodora</i> – <i>Eucalyptus blakelyi</i> Tableland Grassy Woodland	Native pasture	20.00
3	ACT01: Tablelands Dry Tussock Grassland	Moderate/good	27.09

### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

### Step 3: Undertake Site Survey

Survey period: November.
Species Targeted: Brown Treecreeper, Striped Legless Lizard, Little eagle (nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Hooded Robin, Perunga Grasshopper, <i>Rutidosia leiolepis</i> , <i>Rutidosia leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Grassland earless Dragon, Regent Honeyeater (habitat tree).
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper, Grassland Earless Dragon (expert report assumed species to be absent).

### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
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### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	5	33	10	0	55	0	10	10	1	0	16
1	6	38	15	0	70	1	15	5	2	0	22
1	7	34	20	2	60	1	10	2	3	0	28
2	8	24	0	0	60	0	10	10	0	0	0
2	9	29	0	0	70	1	7	5	0	0	0
2	10	31	0	0	65	5	5	5	0	0	0
3	1	26	0	0	50	1	15	5	0	0	0
3	2	33	0	0	60	2	10	5	0	0	0
3	3	29	0	0	55	1	20	3	0	0	0
3	4	30	0	0	60	0	10	10	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

### Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2		Zone 3	
	Current	Increase	Current	Increase	Current	Increase
Sp.R	3	3	2	3	2	3
NOSc	3	3	0	1	3	3
NMSc	3	3	3	3	0	0
NGcG	3	3	2	3	3	3
NGcS	3	3	3	3	3	3
NGcO	3	3	2	3	3	3
EPc	2	3	2	3	2	3
#holl.	1	1.5	0	0	0	0
Regen.	0	0.5	0	0.5	0	0.5
FL	2	3	0	0	0	0
Site Sc.	65	79	34	52	49	72
Increase	14		18		23	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
Brown Treecreeper	No	Survey		
Striped Legless Lizard	Yes	Survey	52	Ha
Little Eagle (nesting)	No	Survey		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Survey		
Hooded Robin	No	Survey		
Perunga Grasshopper	Yes	Survey	2	Ha
<i>Rutidosis leiolepis</i>	No	Survey		
<i>Rutidosis leptorrhynchoides</i>	No	Survey		
<i>Swainsona recta</i>	No	Survey		
<i>Swainsona sericea</i>	No	Survey		
Golden Sun Moth	Yes	Survey	3	Ha
Golden Sun Moth	Yes	Survey	20	Individuals
<i>Thesium australe</i>	No	Survey		
Grassland Earless Dragon	No	Survey		
Regent Honeyeater (habitat tree)	No	Survey		

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.

## Patch A, B and O (Kama Nature Reserve) Offset:

### Offset Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
25	Very Low	44	Low Linkage
19	Low	56	High Linkage
56	Moderate	<b>Landscape score</b>	<b>19.09</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1 Patch A	ACT01: Tableland Dry Tussock Grasslands	Moderate/good	44.57
2 Patch B	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Moderate/Good	58.68
3 Patch B	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Native pasture	18.57
4 Patch O	<i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest	Moderate/Good	15.48
5 Patch O	<i>Eucalyptus macrorhyncha</i> Tableland Grass/Shrub Forest	Native pasture	7.71

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	Yes
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: July, September
Species Targeted: Brown Treecreeper, Striped Legless Lizard, Little Eagle (Nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosia leiolepis</i> , <i>Rutidosia leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Grassland Earless Dragon, Regent Honeyeater (habitat tree),
Significant species requiring an expert report or assumed to be present: Striped Legless Lizard, Perunga Grasshopper, Golden Sun Moth, Grassland earless Dragon (all assumed absent).

Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.

Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	A2	17	0	0	88	0	4	8	0	0	0
1	A1	19	0	0	90	0	10	0	0	0	0
1	A101U	11	0	0	46	0	0	36	0	0	0
1	A102U	10	0	0	48	0	4	30	0	0	0
2	B1	20	25	1	70	0	16	10	0	1	0
2	B2	21	8	9	90	0	8	2	0	1	0
2	B3	21	7	0	84	0	2	2	4	1	25
2	B4	17	16	2	36	0	36	24	5	1	74
2	B103U	40	10	3.5	60	0	20	8	0	0.5	26
2	B5	10	12	1	74	4	0	0	0	1	1
2	B203U	17	15	0	72	0	8	16	1	1	4
3	B6	18	5	0	54	0	4	34	0	1	0
3	B6x	18	5	0	54	0	4	34	0	1	0
4	B303U	28	20	0	35	2	8	20	3	1	80
4	B303Ux	28	20	0	35	2	8	20	3	1	80
4	B303Uy	28	20	0	35	2	8	20	3	1	80
5	O1	6	5	0	76	0	0	12	1	1	2
5	O2	11	4	0	36	0	0	62	2	0	69

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2		Zone 3		Zone 4		Zone 5	
	Curr-ent	Incre-ase	Curr-ent	Incre-ase	Curr-ent	Incre-ase	Curr-ent	Incre-ase	Curr-ent	Incre-ase
<b>Sp.R</b>	1	1.5	2	3	2	3	2	3	1	1.5
<b>NOSc</b>	3	3	3	3	1	2	3	3	1	2
<b>NMSc</b>	0	0	3	3	3	3	0	1	0	1
<b>NGcG</b>	2	3	2	3	3	3	3	3	2	3
<b>NGcS</b>	3	3	3	3	3	3	1	2	0	1
<b>NGcO</b>	3	3	3	3	2	3	3	3	0	1
<b>EPc</b>	2	3	2	3	1	1.5	2	3	1	1.5
<b>#holl.</b>	0	0	1	1.5	0	0	3	3	2	2.5
<b>Regen.</b>	0	0.5	2	3	3	3	3	3	2	3
<b>FL</b>	0	0	2	3	0	0	3	3	2	3
<b>Site Sc.</b>	<b>35</b>	<b>50</b>	<b>64</b>	<b>89</b>	<b>42</b>	<b>54</b>	<b>72</b>	<b>89</b>	<b>34</b>	<b>61</b>
<b>Increase</b>	<b>15</b>		<b>25</b>		<b>12</b>		<b>17</b>		<b>27</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
Brown Treecreeper	Yes	Survey	59	Ha
Striped Legless Lizard	No	Expert report		
Little Eagle (nesting)	No	Expert report		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Expert report		
Perunga Grasshopper	No	Expert report		
<i>Rutidosia leiolepis</i>	No	Expert report		
<i>Rutidosia leptorrhynchoides</i>	No	Expert report		
<i>Swainsona recta</i>	No	Expert report		
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	No	Expert report		
Golden Sun Moth	No	Expert report		
<i>Thesium australe</i>	No	Expert report		
Grassland Earless Dragon	No	Expert report		
Regent Honeyeater (habitat tree)	No	Expert report		

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.

## Patch C Offset:

### Offset Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
38	Very Low	100	Low Linkage
27	Low	0	High Linkage
35	Moderate	<b>Landscape score</b>	<b>12.09</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Native pasture	5.19
2	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Moderate/good	1.72

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: July
Species Targeted: Brown Treecreeper, Little Eagle (Nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosis leiolepis</i> , <i>Rutidosis leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Regent Honeyeater (habitat tree).
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper, Golden Sun Moth. (all assumed absent).

#### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
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#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	C1	6	0	0	52	0	2	38	0	0	0
1	C102U	10	0	0	32	0	2	58	0	0	0
1	C101U	7	0	0	28	0	4	68	0	0	0
2	C2	26	20	0	40	0	2	30	1	0	105

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2	
	Current	Increase	Current	Increase
Sp.R	1	1.5	2	3
NOSc	0	1	3	3
NMSc	3	3	3	3
NGcG	3	3	3	3
NGcS	3	3	3	3
NGcO	1	2	1	2
EPc	1	1.5	1	1.5
#holl.	0	0	1	1.5
Regen.	0	0.5	0	0.5
FL	0	0	3	3
Site Sc.	<b>24</b>	<b>34</b>	<b>57</b>	<b>71</b>
Increase	<b>10</b>		<b>14</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

#### Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
Brown Treecreeper	No	Expert report		
Little Eagle (nesting)	No	Expert report		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Expert report		
Perunga Grasshopper	No	Expert report		
<i>Rutidosia leiolepis</i>	No	Expert report		
<i>Rutidosia leptorrhynchoides</i>	No	Expert report		
<i>Swainsona recta</i>	No	Expert report		
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	No	Expert report		

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<i>Thesium australe</i>	No	Expert report		
Regent Honeyeater (habitat tree)	No	Expert report		

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.
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## Patch H Offset:

### Offset Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
4	Very Low	100	Low Linkage
31	Low	0	High Linkage
65	Moderate	<b>Landscape score</b>	<b>15.97</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Moderate/Good	3.97
2	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Paddock Trees	4.63

Note: Patch H is 8.6 hectares, however 3.6 hectares was estimated to be exotic.

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: July
Species Targeted: Brown Treecreeper, Little Eagle (Nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosis leiolepis</i> , <i>Rutidosis leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Grassland Earless Dragon, Regent Honeyeater (habitat tree).
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper, Golden Sun Moth (all assumed absent).

#### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
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#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	H1	8	5	0	62	0	2	22	0	0	5
1	H3	17	10	0	68	0	8	22	2	0	26
2	H02U	10	0	0	25	0	0	60	0	0	0
2	H2	23									

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2	
	Current	Increase	Current	Increase
Sp.R	1	1.5	1	1.5
NOSc	2	3	0	1
NMSc	3	3	3	3
NGcG	2	3	3	3
NGcS	3	3	3	3
NGcO	2	3	0	1
EPc	2	3	1	1.5
#holl.	1	1.5	0	0
Regen.	0	0.5	0	0.5
FL	1	1.5	0	0
Site Sc.	<b>39</b>	<b>58</b>	<b>23</b>	<b>32</b>
Increase	<b>19</b>		<b>9</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

Step 4f: Significant Species – Survey Results

<b>Common Name</b>	<b>Present</b>	<b>ID Method</b>	<b>Gain</b>	<b>Units</b>
Brown Treecreeper	No	Expert report		
Little Eagle (nesting)	No	Expert report		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Expert report		
Perunga Grasshopper	No	Expert report		
<i>Rutidosia leiolepis</i>	No	Expert report		
<i>Rutidosia leptorrhynchoides</i>	No	Expert report		
<i>Swainsona recta</i>	No	Expert report		
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	No	Expert report		
<i>Thesium australe</i>	No	Expert report		
Grassland Earless Dragon	No	Expert report		
Regent Honeyeater (habitat tree)	No	Expert report		

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.
---

## Patch GG Offset:

### Offset Site data summary

#### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
2	Very Low	52	Low Linkage
29	Low	48	High Linkage
69	Moderate	<b>Landscape score</b>	<b>20.63</b>
0	High		
0	Very High		

#### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Moderate/Good	43.9

Note: Patch H is 8.6 hectares, however 3.6 hectares was estimated to be exotic.

#### Step 2: Geographic and Habitat Features

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	Yes
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

#### Step 3: Undertake Site Survey

Survey period: July
Species Targeted: Brown Treecreeper, Little Eagle (Nesting), <i>Leucochrysum albicans</i> var. <i>tricolor</i> , Perunga Grasshopper, <i>Rutidosis leiolepis</i> , <i>Rutidosis leptorrhynchoides</i> , <i>Swainsona recta</i> , <i>Swainsona sericea</i> , Golden Sun Moth, <i>Thesium australe</i> , Regent Honeyeater (habitat tree).
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper, <i>Swainsona recta</i> , Golden Sun Moth, <i>Thesium australe</i> (all assumed absent).

#### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
--

#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	GG01	11	20	0	76	0	0	16	2	0	84
1	GG02	11	30	0	54	0	0	18	4	0	42
1	GG03	10	12	0	70	0	0	20	2	1	43
1	GG04	7	10	0	14	0	0	66	8	0	75
1	GG102U	9	11	0	50	0	12	24	4	0	146
2	GG201U	7	0	0	56	0	0	44	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.
---

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1		Zone 2	
	Current	Increase	Current	Increase
Sp.R	1	1.5	1	1.5
NOSc	3	3	0	1
NMSc	3	3	3	3
NGcG	3	3	3	3
NGcS	3	3	3	3
NGcO	0	1	0	1
EPc	2	3	1	1.5
#holl.	2	2.5	0	0
Regen.	1	2	0	0.5
FL	3	3	0	0
Site Sc.	<b>60</b>	<b>76</b>	<b>23</b>	<b>32</b>
<b>Increase</b>	<b>16</b>		<b>9</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

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Step 4f: Significant Species – Survey Results

<b>Common Name</b>	<b>Present</b>	<b>ID Method</b>	<b>Gain</b>	<b>Units</b>
Brown Treecreeper	No	Expert report		
Little Eagle (nesting)	No	Expert report		
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	No	Expert report		
Perunga Grasshopper	No	Expert report		
<i>Rutidosia leiolepis</i>	No	Expert report		
<i>Rutidosia leptorrhynchoides</i>	No	Expert report		
<i>Swainsona recta</i>	No	Expert report		
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	No	Expert report		
<i>Thesium australe</i>	No	Expert report		
Regent Honeyeater (habitat tree)	No	Expert report		

Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.
---

## Patch J Development:

Note: Most of Patch J is exotic, dominated by Phalaris (*Phalaris aquatica*), with some minor native areas dominated by tall speargrass (*Austrostipa bigeniculata*). An area of approximately 2.4 hectares in the southern section of this Patch is considered native vegetation.

### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
100	Very Low	100	Low Linkage
0	Low	0	High Linkage
0	Moderate	<b>Landscape score</b>	<b>6</b>
0	High		
0	Very High		

### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Native pasture	2.4

Note: Patch H is 8.6 hectares, however 3.6 hectares was estimated to be exotic.

### Step 2: Geographic and Habitat Features

*Not required*

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

### Step 3: Undertake Site Survey

Survey period: September
Species Targeted: <i>Swainsona sericea</i> , Golden Sun Moth.
Significant species requiring an expert report or assumed to be present: Golden Sun Moth (assumed absent).

### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
--

#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	J2	20	0	0	50	0	2	34	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1	
	Current	Decrease
<b>Sp.R</b>	2	0
<b>NOSc</b>	0	0
<b>NMSc</b>	3	0
<b>NGcG</b>	3	0
<b>NGcS</b>	3	0
<b>NGcO</b>	1	0
<b>EPc</b>	1	0
<b>#holl.</b>	0	0
<b>Regen.</b>	0	0
<b>FL</b>	0	0
<b>Site Sc.</b>	<b>31</b>	<b>0</b>
<b>Increase</b>	<b>31</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

Site Sc. = Site score (out of 100)

#### Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	No	Expert report		

#### Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.

## Patch N Offset:

### Step 1a: Landscape Value Scores

Neighbourhood Habitat Context Value		Link Value	
% Offset within Zone	Zone Type	% Offset within Zone	Zone Type
88	Very Low	100	Low Linkage
12	Low	0	High Linkage
0	Moderate	<b>Landscape score</b>	<b>6.84</b>
0	High		
0	Very High		

### Step 1b: Significant Species Sub Zones

Zone	Vegetation Type	Condition	Hectares
1	ACT16: <i>Eucalyptus melliodora</i> – <i>E. blakelyi</i> Tableland Grassy Woodland	Native pasture	13.4

Note: Patch H is 8.6 hectares, however 3.6 hectares was estimated to be exotic.

### Step 2: Geographic and Habitat Features

*Not required*

Dense mid-storey present in at least patches	No
Hollow-bearing trees, coarse woody debris, stumps or dead	No
Superb Parrot habitat tree; hollow bearing tree, >6cm diameter, >4m off ground	No
Termite mounds and coarse woody debris	No
Hall cemetery	No
Majura Firing Range	No
North Lawson	No

### Step 3: Undertake Site Survey

Survey period: July
Species Targeted: Perunga Grasshopper, <i>Swainsona sericea</i> , Golden Sun Moth.
Significant species requiring an expert report or assumed to be present: Perunga Grasshopper, Golden Sun Moth (all assumed absent).

### Step 4a: Vegetation Zone – Plot and Community Type of Condition that cannot be cleared

Not presented as this is a function of Step 1b, and all offset areas are retained.
--

#### Step 4b: Vegetation Transect/Plot Information

Zone	Plot	Sp.R	NOSc	NMSc	NGcG	NGcS	NGcO	EPc	#holl.	Reg.	FL
1	N1	4	0	0	76	0	0	24	0	0	0
1	N102U	9	0	0	40	0	0	55	0	0	0

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; FL = Total length of fallen logs.

#### Step 4c: Management Zones

Not presented as this is a function of Step 1b unless areas with the development zone are retained.

#### Step 4d: Management Zones Attribute Score with Development

	Zone 1	
	Current	Increase
Sp.R	1	1.5
NOSc	0	1
NMSc	3	3
NGcG	3	3
NGcS	3	3
NGcO	0	1
EPc	1	1.5
#holl.	0	0
Regen.	0	0.5
FL	0	0
Site Sc.	23	32
<b>Increase</b>	<b>9</b>	

Current = Current Score (0-3); Increase = Default Increased Score (0-3)

Sr.R = Species richness; NOSc = Native overstorey cover; NMSc = Native midstorey cover; NGcG = Native groundcover grasses; NGcO = Native groundcover other; EPc = Exotic plant cover; #holl. = Number of trees with hollows; Regen. = Overstorey regeneration; FL = Total length of fallen logs.

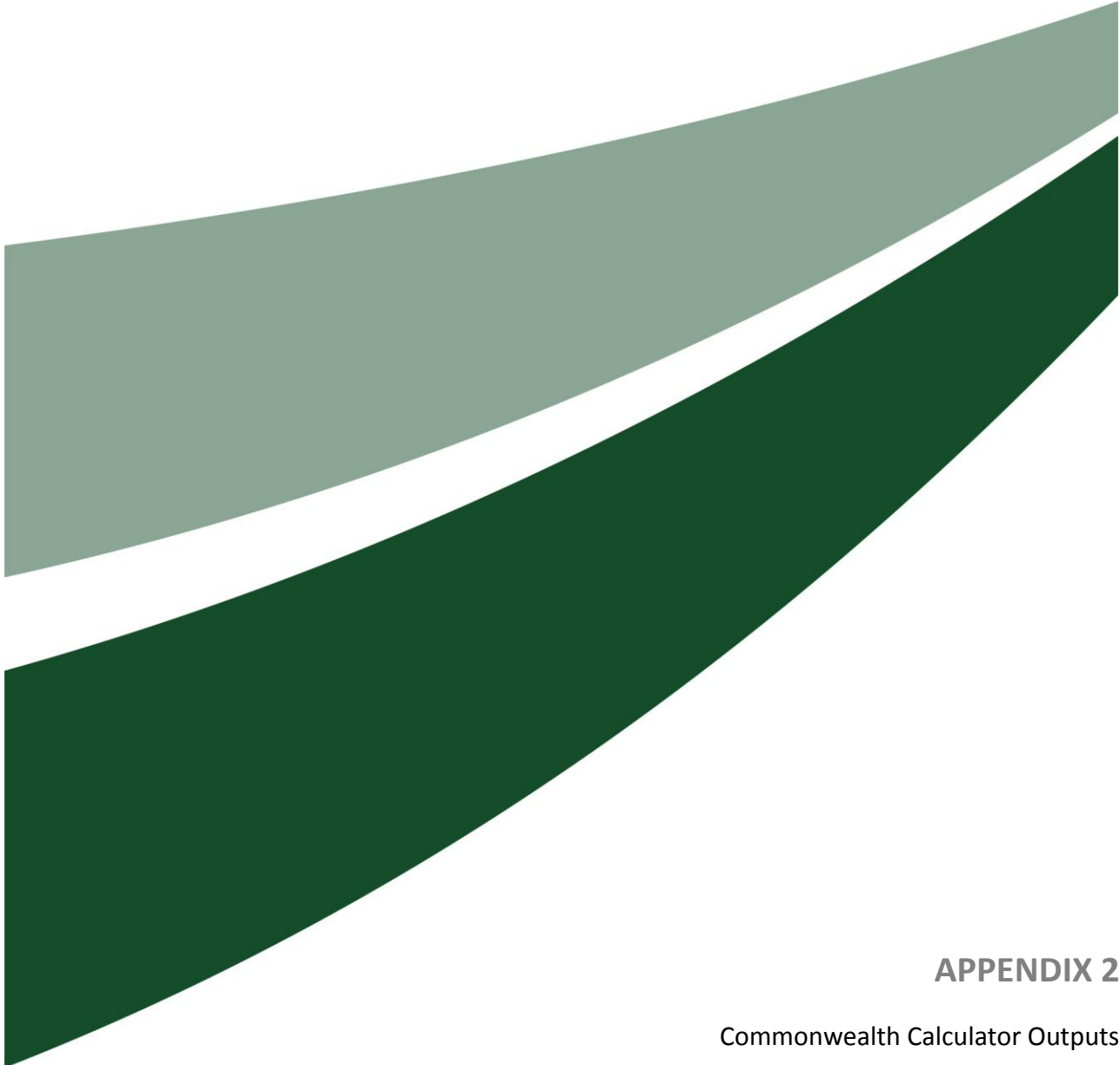
Site Sc. = Site score (out of 100)

#### Step 4f: Significant Species – Survey Results

Common Name	Present	ID Method	Gain	Units
Perunga Grasshopper	No	Expert report		
<i>Swainsona sericea</i>	No	Expert report		
Golden Sun Moth	No	Expert report		

#### Step 4f: Significant Species – Summary

Not presented as this is a summary of the table presented in Step 4f.



## APPENDIX 2

Commonwealth Calculator Outputs

**NGUNNAWAL 2C  
DEVELOPMENT / BONNER 4  
EAST OFFSET**

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Box Gum
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
<i>Ecological communities</i>						
Area of community	Yes	Secondary Grassland	Area	10	Hectares	Ngunnawal 2C
			Quality	3	Scale 0-10	
			Total quantum of impact	3.00	Adjusted hectares	
<i>Threatened species habitat</i>						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
<i>Threatened species</i>						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	Yes	male	24	Count		

Offset calculator																									
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source					
<i>Ecological Communities</i>																									
Area of community	Yes	3.00	Adjusted hectares	Bonner 4 East. 2.18ha in mod/good condition, 12.24ha secondary grassland	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	42.42	Risk of loss (%) without offset	100%	Risk of loss (%) with offset	5%	Raw gain	40.30	Confidence in result (%)	70%	Adjusted gain	28.21	Net present value (adjusted hectares)	7.57	3.78	126.13%	Yes		
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	40.3	Raw gain	5.00	Confidence in result (%)	70%	Adjusted gain	3.50	Net present value (adjusted hectares)	2.52									
					Time until ecological benefit	5	Start quality (scale of 0-10)	4	Future quality without offset (scale of 0-10)	0	Future quality with offset (scale of 0-10)	5													
<i>Threatened species habitat</i>																									
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset		Raw gain		Confidence in result (%)		Adjusted gain		Net present value (adjusted hectares)						
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0	Raw gain		Confidence in result (%)		Adjusted gain		Net present value (adjusted hectares)										
					Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)														
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start value	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source									
Number of features e.g. Nest hollows, habitat trees	No																								
Condition of habitat Change in habitat condition, but no change in extent	No																								
<i>Threatened species</i>																									
Birth rate e.g. Change in nest success	No																								
Mortality rate e.g. Change in number of road kills per year	No																								
Number of individuals e.g. Individual plants/animals	No	24																							

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	24				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	0				\$0.00		\$0.00
Area of community	3	3.78	126.13%	Yes	\$0.00	N/A	\$0.00
					<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Golden Sun Moth
EPBC Act status	Critically Endangered
Annual probability of extinction <small>Based on IUCN category definitions</small>	6.8%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
<i>Ecological communities</i>						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
<i>Threatened species habitat</i>						
Area of habitat	Yes	24 individuals over 15ha	Area	15	Hectares	Ngunawal 2C Moore et al. (2010)
			Quality	2	Scale 0-10	
			Total quantum of impact	3.00	Adjusted hectares	
<i>Threatened species</i>						
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	Yes	male	24		Count	

Offset calculator																														
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source														
<i>Ecological Communities</i>																														
Area of community	No				Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset	Risk of loss (%) with offset																						
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0																						
					Time until ecological benefit	Start quality (scale of 0-10)	Future quality without offset (scale of 0-10)	Future quality with offset (scale of 0-10)																						
<i>Threatened species habitat</i>																														
Area of habitat	Yes	3.00	Adjusted hectares	Bonner 4 East	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	19	Risk of loss (%) without offset	100%	Risk of loss (%) with offset	5%	Raw gain	18.05	Confidence in result (%)	70%	Adjusted gain	12.64	Net present value	3.39	% of impact offset	1.36	45.19%	Minimum (90%) direct offset requirement met?	No	Cost (\$ total)		Information source		
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	18.1																						
					Time until ecological benefit	5	Start quality (scale of 0-10)	2	Future quality without offset (scale of 0-10)	0	Future quality with offset (scale of 0-10)	4	Raw gain	4.00	Confidence in result (%)	70%	Adjusted gain	2.80	Net present value	2.02										
<i>Threatened species</i>																														
Number of features e.g. Nest hollows, habitat trees	No																													
Condition of habitat Change in habitat condition, but no change in extent	No																													
Birth rate e.g. Change in nest success	No																													
Mortality rate e.g. Change in number of road kills per year	No																													
Number of individuals e.g. Individual plants/animals	No	24																												

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	24				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	3	1.36	45.19%	No	\$0.00	#DIV/0!	#DIV/0!
Area of community	0				\$0.00		\$0.00
					\$0.00	#DIV/0!	#DIV/0!

**APPROVED LAWSON SOUTH  
DEVELOPMENT/JARRAMLEE  
OFFSET**

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	GSM
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
<i>Ecological communities</i>						
Area of community	No		Area			
			Quality	0		
			Total quantum of impact	0.00		
<i>Threatened species habitat</i>						
Area of habitat	Yes	50 individuals. Quality based on comparison of population/area/survey effort/survey conditions data across development and offset sites	Area	52.6	Hectares	Lawson South Development ACT TaMS (2013)
			Quality	3	Scale 0-10	
			Total quantum of impact	15.78	Adjusted hectares	
<i>Threatened species</i>						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator																			
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source
<i>Ecological Communities</i>																			
Area of community	No					Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset		Risk of loss (%) with offset									
						Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0										
						Time until ecological benefit	Start quality (scale of 0-10)	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)									
<i>Threatened species habitat</i>																			
Area of habitat	Yes	15.78	Adjusted hectares	Jerramlee. GSM habitat: high quality = 1.7879 ha; med quality = 27.9363 ha; low quality = 21.2029 ha. Quality stable without management based on presence of Chilean Needlegrass (exotic beneficial species)	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	50.9	Risk of loss (%) without offset	70%	Risk of loss (%) with offset	5%							
						Future area without offset (adjusted hectares)	15.3	Future area with offset (adjusted hectares)	48.4	33.09	70%	23.16	6.21						
						Time until ecological benefit	5	Start quality (scale of 0-10)	3	Future quality without offset (scale of 0-10)	1	Future quality with offset (scale of 0-10)	5	4.00	70%	2.80	2.02	6.18	39.19%
<i>Threatened species</i>																			
Birth rate e.g. Change in nest success	No																		
Mortality rate e.g. Change in number of road kills per year	No																		
Number of individuals e.g. Individual plants/animals	No																		

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	0				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	15.78	6.18	39.19%	No	\$0.00	#DIV/0!	#DIV/0!
Area of community	0				\$0.00		\$0.00
					\$0.00	#DIV/0!	#DIV/0!

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	NTG
EPBC Act status	Endangered
Annual probability of extinction <small>Based on IUCN category definitions</small>	1.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
<i>Ecological communities</i>						
Area of community	Yes	NTG. Mostly low quality with a small patch (1.35ha in good condition)	Area	29.82	Hectares	Lawson South Development EcoLogical (2008)
			Quality	4	Scale 0-10	
			Total quantum of impact	11.93	Adjusted hectares	
<i>Threatened species habitat</i>						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
<i>Threatened species</i>						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator																					
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source	
<i>Ecological Communities</i>																					
Area of community	Yes	11.93	Adjusted hectares	Jarramlee	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	63.95	Risk of loss (%) without offset	70%	Risk of loss (%) with offset	5%	41.57	70%	29.10	22.92	14.17	118.81%	Yes		
						Future area without offset (adjusted hectares)	19.2	Future area with offset (adjusted hectares)	60.8	3.00	50%	1.50	1.41								
						Time until ecological benefit	5	Start quality (scale of 0-10)	3	Future quality without offset (scale of 0-10)	2	Future quality with offset (scale of 0-10)	5								
<i>Threatened species habitat</i>																					
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset										
						Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0												
						Time until ecological benefit		Start quality (scale of 0-10)		Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)									
<i>Threatened species</i>																					
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start value	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source					
Number of features e.g. Nest hollows, habitat trees	No																				
Condition of habitat Change in habitat condition, but no change in extent	No																				
Birth rate e.g. Change in nest success	No																				
Mortality rate e.g. Change in number of road kills per year	No																				
Number of individuals e.g. Individual plants/animals	No																				

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	0				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	0				\$0.00		\$0.00
Area of community	11.928	14.17	118.81%	Yes	\$0.00	N/A	\$0.00
					<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>

**CONFIDENTIAL**  
**DEVELOPMENT SITE 1/OFFSET**  
**SITE 1**

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	GSM
EPBC Act status	Critically Endangered
Annual probability of extinction <small>Based on IUCN category definitions</small>	6.8%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	
<i>Ecological communities</i>						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
<i>Threatened species habitat</i>						
Area of habitat	Yes	1 hectare of habitat supporting 11 observed individuals	Area	1	Hectares	Confidential development 1
			Quality	6	Scale 0-10	
			Total quantum of impact	0.60	Adjusted hectares	
<i>Threatened species</i>						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator																							
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source							
<i>Ecological Communities</i>																							
Area of community	No				Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset	Risk of loss (%) with offset															
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0															
					Time until ecological benefit	Start quality (scale of 0-10)	Future quality without offset (scale of 0-10)	Future quality with offset (scale of 0-10)															
<i>Threatened species habitat</i>																							
Area of habitat	Yes	0.60	Adjusted hectares	Confidential Offset 1	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	4.6	Risk of loss (%) without offset	90%	Risk of loss (%) with offset	0%	Raw gain	4.14	Confidence in result (%)	70%	Adjusted gain	2.90	Net present value (adjusted hectares)	0.78			
					Future area without offset (adjusted hectares)	0.5	Future area with offset (adjusted hectares)	4.6															
					Time until ecological benefit	5	Start quality (scale of 0-10)	4	Future quality without offset (scale of 0-10)	3	Future quality with offset (scale of 0-10)	7	Raw gain	4.00	Confidence in result (%)	70%	Adjusted gain	2.80	Net present value (adjusted hectares)	2.02	% of impact offset	106.15%	Minimum (90%) direct offset requirement met?
<i>Threatened species</i>																							
Birth rate e.g. Change in nest success	No																						
Mortality rate e.g. Change in number of road kills per year	No																						
Number of individuals e.g. Individual plants/animals	No																						

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	0				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	0.6	0.64	106.15%	Yes	\$30,000.00	N/A	\$30,000.00
Area of community	0				\$0.00		\$0.00
					<b>\$30,000.00</b>	<b>\$0.00</b>	<b>\$30,000.00</b>

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	NTG
EPBC Act status	Critically Endangered
Annual probability of extinction <small>Based on IUCN category definitions</small>	6.8%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator																																																	
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source																																											
			Area	Quality																																													
<i>Ecological communities</i>																																																	
Area of community	Yes	NTG, small isolated patch	Area	0.8	Hectares	Confidential development 1																																											
			Quality	5	Scale 0-10																																												
			Total quantum of impact	0.40	Adjusted hectares																																												
<i>Threatened species habitat</i>																																																	
Area of habitat	Yes		Area		Hectares																																												
			Quality		Scale 0-10																																												
			Total quantum of impact	0.00	Adjusted hectares																																												
<i>Threatened species</i>																																																	
<table border="1"> <thead> <tr> <th>Protected matter attributes</th> <th>Attribute relevant to case?</th> <th>Description</th> <th>Quantum of impact</th> <th>Units</th> <th>Information source</th> </tr> </thead> <tbody> <tr> <td>Number of features e.g. Nest hollows, habitat trees</td> <td>No</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Condition of habitat Change in habitat condition, but no change in extent</td> <td>No</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="7"><i>Threatened species</i></td> </tr> <tr> <td>Birth rate e.g. Change in nest success</td> <td>No</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Mortality rate e.g. Change in number of road kills per year</td> <td>No</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Number of individuals e.g. Individual plants/animals</td> <td>No</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>							Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source	Number of features e.g. Nest hollows, habitat trees	No					Condition of habitat Change in habitat condition, but no change in extent	No					<i>Threatened species</i>							Birth rate e.g. Change in nest success	No					Mortality rate e.g. Change in number of road kills per year	No					Number of individuals e.g. Individual plants/animals	No				
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source																																												
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Offset calculator																																																																																																																																													
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality		Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source																																																																																																																									
					Risk-related time horizon (max. 20 years)	20	Start area (hectares)	0.4	Risk of loss (%) without offset	90%	Risk of loss (%) with offset	0%																																																																																																																																	
<i>Ecological Communities</i>																																																																																																																																													
Area of community	Yes	0.40	Adjusted hectares	Confidential offset 1	5	20	Start area (hectares)	0.4	Risk of loss (%) without offset	90%	Risk of loss (%) with offset	0%	0.36	70%	0.25	0.07	0.06	16.04%	No																																																																																																																										
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.4																																																																																																																																	
									Time until ecological benefit	5	Start quality (scale of 0-10)	5									Future quality without offset (scale of 0-10)	3	Future quality with offset (scale of 0-10)	8	5.00	70%	3.50	2.52																																																																																																																	
<i>Threatened species habitat</i>																																																																																																																																													
Area of habitat	No						Start area (hectares)		Risk of loss (%) without offset		Risk of loss (%) with offset																																																																																																																																		
									Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0																																																																																																																																	
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Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start value	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source																																																																																																																													
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Number of individuals e.g. Individual plants/animals	No																																																																																																																																												

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	0				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	0				\$0.00		\$0.00
Area of community	0.4	0.06	16.04%	No	\$0.00	#DIV/0!	#DIV/0!
					\$0.00	#DIV/0!	#DIV/0!

**CONFIDENTIAL OFFSET SITE  
2/OFFSET SITE 2**

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

Matter of National Environmental Significance	
Name	Golden sun moth
EPBC Act status	Critically Endangered
Annual probability of extinction <small>Based on IUCN category definitions</small>	6.8%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
<i>Ecological communities</i>						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
<i>Threatened species habitat</i>						
Area of habitat	Yes	poor quality GSM habitat	Area	2.4	Hectares	Confidential Development 2
			Quality	1	Scale 0-10	
			Total quantum of impact	0.24	Adjusted hectares	
<i>Threatened species</i>						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator																				
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source				
<i>Ecological Communities</i>																				
Area of community	No				Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset	Risk of loss (%) with offset												
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0												
					Time until ecological benefit	Start quality (scale of 0-10)	Future quality without offset (scale of 0-10)	Future quality with offset (scale of 0-10)												
<i>Threatened species habitat</i>																				
Area of habitat	Yes	0.24	Adjusted hectares	Confidential Offset 2	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	20.3	Risk of loss (%) without offset	40%	Risk of loss (%) with offset	5%	7.11	70%	4.97	1.33	1.89	789.31%	Yes	
					Future area without offset (adjusted hectares)	12.2	Future area with offset (adjusted hectares)	19.3	7.11	70%	4.97	1.33	1.89	789.31%	Yes					
					Time until ecological benefit	5	Start quality (scale of 0-10)	4	Future quality without offset (scale of 0-10)	3	Future quality with offset (scale of 0-10)	5	2.00	70%	1.40	1.01				
<i>Threatened species</i>																				
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g. Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	0				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	0.24	1.89	789.31%	Yes	\$0.00	N/A	\$0.00
Area of community	0				\$0.00		\$0.00
					<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*  
2 October 2012

This guide relies on Macros being enabled in your browser.

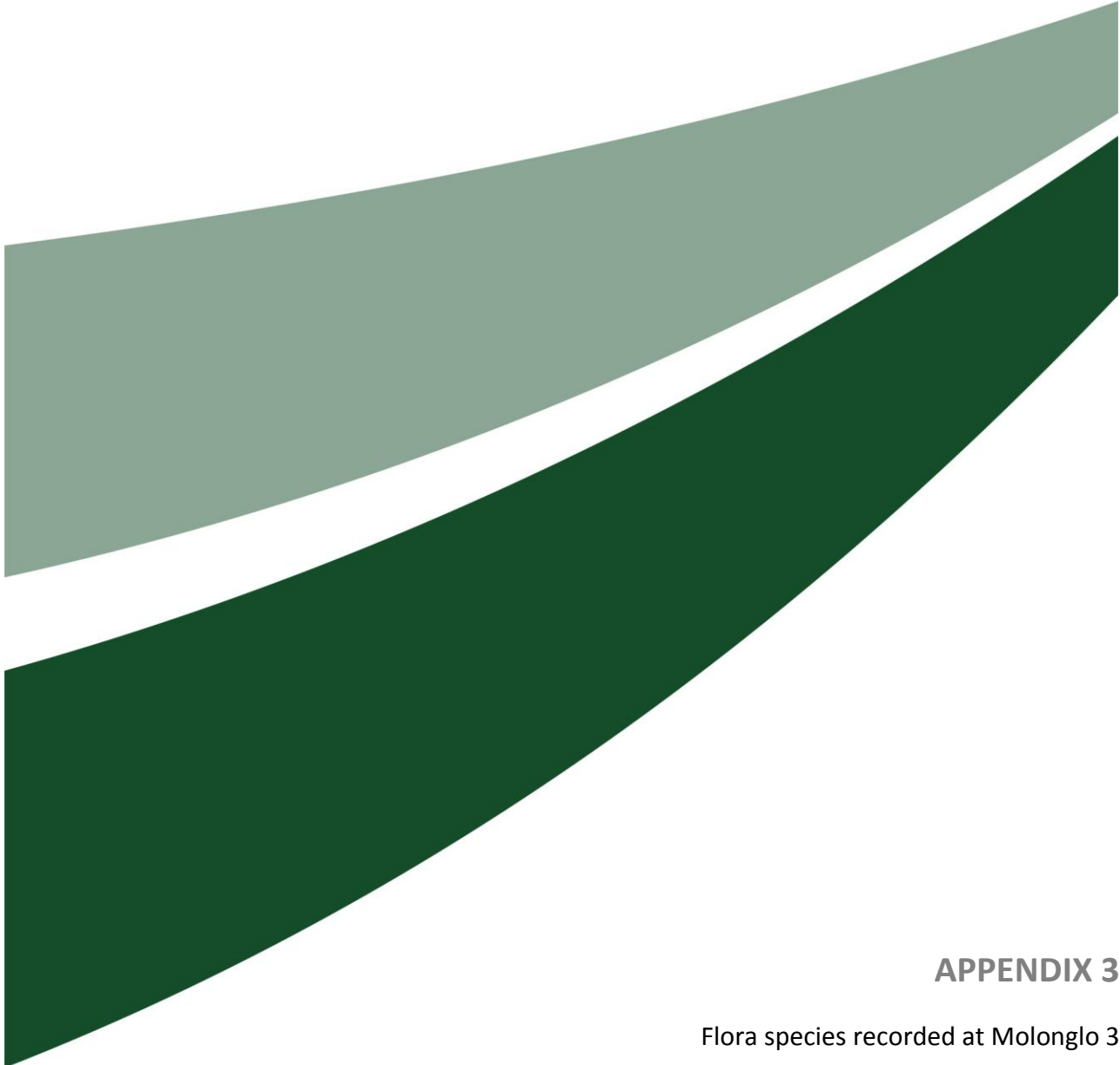
Matter of National Environmental Significance	
Name	striped legless lizard
EPBC Act status	Vulnerable
Annual probability of extinction <small>Based on IUCN category definitions</small>	0.2%

Key to Cell Colours
User input required
Drop-down list
Calculated output
Not applicable to attribute

Impact calculator						
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
<i>Ecological communities</i>						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
<i>Threatened species habitat</i>						
Area of habitat	Yes	med-low quality habitat	Area	14.15	Hectares	Confidential development 2
			Quality	3	Scale 0-10	
			Total quantum of impact	4.25	Adjusted hectares	
<i>Threatened species</i>						
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Birth rate e.g. Change in nest success	No					
Mortality rate e.g. Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator																				
Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)	Start area and quality	Future area and quality without offset	Future area and quality with offset	Raw gain	Confidence in result (%)	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost (\$ total)	Information source				
<i>Ecological Communities</i>																				
Area of community	No				Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset	Risk of loss (%) with offset												
					Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0												
					Time until ecological benefit	Start quality (scale of 0-10)	Future quality without offset (scale of 0-10)	Future quality with offset (scale of 0-10)												
<i>Threatened species habitat</i>																				
Area of habitat	Yes	4.25	Adjusted hectares	Confidential offset 2	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	44.4	Risk of loss (%) without offset	40%	Risk of loss (%) with offset	5%	15.54	70%	10.88	10.45	9.96	234.72%	Yes	
					Future area without offset (adjusted hectares)	26.6	Future area with offset (adjusted hectares)	42.2	2.00	70%	1.40	1.39								
					Time until ecological benefit	5	Start quality (scale of 0-10)	5	Future quality without offset (scale of 0-10)	4	Future quality with offset (scale of 0-10)	6								
<i>Threatened species</i>																				
Number of features e.g. Nest hollows, habitat trees	No																			
Condition of habitat Change in habitat condition, but no change in extent	No																			
Birth rate e.g. Change in nest success	No																			
Mortality rate e.g. Change in number of road kills per year	No																			
Number of individuals e.g. Individual plants/animals	No																			

Summary							
Protected matter attributes	Quantum of impact	Net present value of offset	% of impact offset	Direct offset adequate?	Cost (\$)		
					Direct offset (\$)	Other compensatory measures (\$)	Total (\$)
Birth rate	0				\$0.00		\$0.00
Mortality rate	0				\$0.00		\$0.00
Number of individuals	0				\$0.00		\$0.00
Number of features	0				\$0.00		\$0.00
Condition of habitat	0				\$0.00		\$0.00
Area of habitat	4.245	9.96	234.72%	Yes	\$0.00	N/A	\$0.00
Area of community	0				\$0.00		\$0.00
					<b>\$0.00</b>	<b>\$0.00</b>	<b>\$0.00</b>



## APPENDIX 3

Flora species recorded at Molonglo 3

Plot	Kama Nature Reserve														Molonglo 3																					
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U		
<i>Acaena agnipila</i>							1																				1	2								
<i>Acaena ovina</i>	1			2				2								1		2	2							2	2									
<i>Amyema miquelii</i>																						1														
<i>Aphanes australiana</i>																										2										
<i>Aristida ramosa</i>																										2										
<i>Aristida vagans</i>				2		3			2	2			1																							
<i>Arthropodium spp.</i>						2																														
<i>Asperula conferta</i>	1			1	1		2	2														1														
<i>Austrostipa bigeniculata</i>		3	4			2	2		3		3				1	3	3	4	2	3	3	3	6	3		4	2	4	4	4	4	3	5	4	2	
<i>Austrostipa scabra</i> subsp. <i>falcata</i>						2				4			1	2																			2			
<i>Austrostipa spp.</i>										1								2															4			
<i>Bothriochloa macra</i>		1		2		2						2	2	5	4	4	2	1	4				2	3	2	3	3	3	4				3			
<i>Brachyloma daphnoides</i>						1																														
<i>Bulbine bulbosa</i>								1																												
<i>Calotis lappulacea</i>																		1	2																	
<i>Carex appressa</i>								2		2		2													1											
<i>Carex bichenoviana</i>								2																												
<i>Carex inversa</i>									1	2						1		2	1			2				3	2	2				2				
<i>Carex spp.</i>																																	1			
<i>Cheilanthes austrotenuifolia</i>	2		2	1		2				2			2																							
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>																		2	2							2		2	2							
<i>Cheilanthes spp.</i>							1																													
<i>Chloris truncata</i>																																			1	
<i>Chrysocephalum apiculatum</i>	2		1	2	1	3				2	2							2																		

Plot	Kama Nature Reserve														Molonglo 3																						
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U			
<i>Chrysocephalum semipapposum</i>								1																													
<i>Convolvulus angustissimus</i>						2	1										1															1					
<i>Cotula australis</i>										2												1		2												1	
<i>Crassula sieberiana</i>										2									2					2			2				2					2	
<i>Cymbonotus lawsonianus</i>		1	2	1	1	2	2	1	2					1														1								1	
<i>Cynoglossum australe</i>																			1																		
<i>Dactyloctenium radulans</i>																																					1
<i>Desmodium varians</i>						1												1	1													1					
<i>Dichelachne</i> spp.					3							1		2																							
<i>Dichondra repens</i>								2																													
<i>Diuris chryseopsis</i>						1																															
<i>Drosera peltata</i>						2																															
<i>Einadia nutans</i> subsp. <i>linifolia</i>																				1																	
<i>Einadia nutans</i> subsp. <i>nutans</i>								1	1									1	2			1	2					2									
<i>Elymus scaber</i>	1		1		2	2		1		2	1	2			1				2	2		2	1	2		2	2					2	2				
<i>Epilobium billardierianum</i> subsp. <i>cinereum</i>																												1									
<i>Eragrostis</i> spp.					2									1												1						1					
<i>Erodium crinitum</i>														2																		2					
<i>Eryngium ovinum</i>	1					2	1																					2			2						
<i>Eucalyptus blakelyi</i>					3	4	4	3	3		4	4	3							3	4	3		4	4											1	
<i>Eucalyptus dives</i>															3																						
<i>Eucalyptus melliodora</i>					4				4										3	2		3				2		4	2								

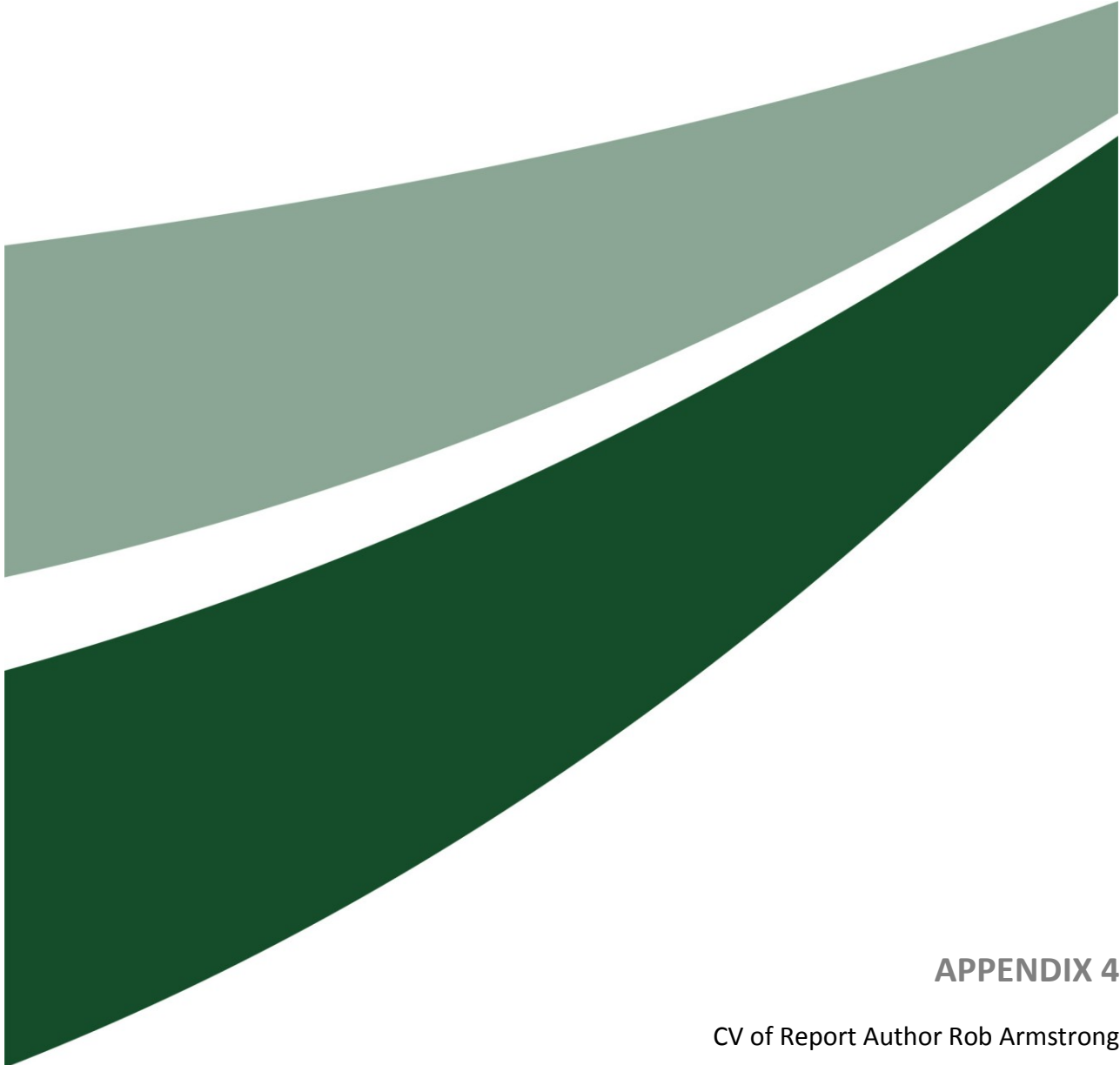
Plot	Kama Nature Reserve													Molonglo 3																						
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U		
<i>Eucalyptus rossii</i>						2			2				3																							
<i>Euchiton sphaericus</i>		2						1	2																						1					
<i>Exocarpos</i> spp. (juvenile)																		1																		
<i>Geranium solanderi</i> var. <i>solanderi</i>		1						2	1	2		2						1		2	2		2		2	2	2									
<i>Geranium</i> spp.																													2							
<i>Glycine clandestina</i>																		2																		
<i>Glycine tabacina</i>																										1										
<i>Gonocarpus tetragynus</i>	2			2	1	1			1																											
<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	2			2		2				1																										
<i>Haloragis heterophylla</i>					2			2			2		2																							
<i>Hardenbergia violacea</i>																													1							
<i>Hibbertia obtusifolia</i>				1																																
<i>Hibbertia riparia</i>	1					1																														
<i>Hydrocotyle laxiflora</i>					2	2	2	2	2	2	2			2				2	2	2	2					2	2									
<i>Hypericum gramineum</i>						1																														
<i>Juncus ?usitatus</i>											1																									
<i>Juncus filicaulis</i>														1																						
<i>Juncus</i> spp.					2										1									2												
<i>Juncus subsecundus</i>								1																												
<i>Leptorhynchus squamatus</i>						2				2																										
<i>Lomandra bracteata</i>																										1					1			1		
<i>Lomandra filiformis</i>	1			2			2																													
<i>Lomandra filiformis</i> subsp. <i>coriacea</i>			1		1	2			1	2	2	2					1									2		1			1					
<i>Lomandra filiformis</i> subsp. <i>filiformis</i>									1			2	1		2				1							1										

Plot	Kama Nature Reserve														Molonglo 3																				
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U	
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	1	1	1	1	1	1	1	1	1	1	1	1				1			1							1		1	1						
<i>Luzula densiflora</i>						1			1																										
<i>Melichrus urceolatus</i>	1					1																													
<i>Microlaena stipoides</i> var. <i>stipoides</i>						2				1							2		2	5	3			3	2	2									
<i>Oxalis perennans</i>						2				2							1		2				2			2	2						2	2	
<i>Panicum effusum</i>	1			2	2		2				1				2										1										
<i>Plantago</i> spp.																													1						
<i>Plantago varia</i>							2				1																	2							
<i>Poa sieberiana</i>	3		2	3	2		3	1	2		2	3	3	3	3			1																2	
<i>Rumex ?brownii</i>									1		1								4		2			1	1				1						
<i>Rumex brownii</i>		1						1									1	1			2					1	2	1					2		
<i>Rytidosperma</i> <i>caespitosum</i>										2																									
<i>Rytidosperma</i> <i>carphoides</i>										3																									
<i>Rytidosperma</i> <i>?carphoides</i>																															2				
<i>Rytidosperma</i> <i>racemosum</i>																																		2	
<i>Rytidosperma</i> spp.		2		2	2	5	2		2		2	2		2	1	2	2	3		6	2	5		6	3	3	2	2	3				2	2	
<i>Rytidosperma</i> spp. 2																														2					
<i>Senecio quadridentatus</i>	1	1	1		1	1	2	1	1		1		1																					1	
<i>Solenogyne dominii</i>					2	1		1	2						2																				
<i>Sporobolus creber</i>													1																						
<i>Stuartina muelleri</i>										2																									
<i>Themeda triandra</i>	6	6	5	5	5	5	5	6	4	2	4	5	4		4	1		2											2						
<i>Tricoryne elatior</i>							1																												
<i>Triptilodiscus pygmaeus</i>						1																													

Plot	Kama Nature Reserve														Molonglo 3																								
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U					
<i>Vittadinia cuneata</i> var. <i>cuneata</i>	1					1	1			1									2																				
<i>Vittadinia muelleri</i>	1			1		1													2																				
<i>Wahlenbergia communis</i>						2													2							1													
<i>Wahlenbergia</i> spp.	1			1			1			1																											2		
<i>Wurmbea dioica</i> subsp. <i>dioica</i>		1				2				2																2													
* <i>Acetosella vulgaris</i>		2	2	2	2	2		2		2	2		2		2	2	2	2	2		2			2		2		2	2	2		2	2	2	2	2	2	2	
* <i>Aira</i> spp.								2	2	2	2							2										2											
* <i>Arctotheca calendula</i>										2											2		2																
* <i>Avena</i> spp.														2	2		4	4	2					3		3	4	4		2	3			3		5			
* <i>Briza minor</i>							1										1																						
* <i>Bromus ?catharticus</i>													4																										
* <i>Bromus catharticus</i>											4	2			2		1			2	2			2										2			2		
* <i>Bromus diandrus</i>											3						2				2				1														
* <i>Bromus molliformis</i>											3																												
* <i>Bromus</i> spp.															4			2				2							3	1							2		
* <i>Capsella bursa-pastoris</i>		1															2	1			2													1		2	2		
* <i>Carthamus lanatus</i>														2	2	2		2					2			1	2	2	2					2					
* <i>Centaureum erythraea</i>	2		2		2	2		1		1																													
* <i>Chondrilla juncea</i>																		1																					
* <i>Cirsium vulgare</i>	1				1		1	1	2		1	1			1		2	2		2	1	1		2			1							1	1				
* <i>Coryza</i> spp.	2		1		2	1		1	2	1	1			2	1		1						1												1			1	
* <i>Crataegus monogyna</i>																						1			1														
* <i>Dactylis glomerata</i>												1																											
* <i>Echium plantagineum</i>	2			2									2	2		2	2	2	2	1	2		2	2	4	2	2		2						2		2		
* <i>Echium vulgare</i>				2																																			
* <i>Erodium botrys</i>																	1				1		1			2	2												

Plot	Kama Nature Reserve														Molonglo 3																						
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U			
<i>*Erodium cicutarium</i>				2					1			2							1					1	1	1					1						
<i>*Hirschfeldia incana</i>																2		1	1	1	1		1	2	1	2		2									
<i>*Holcus lanatus</i>			1					2									2																				
<i>*Hordeum leporinum</i>														3	2														2								
<i>*Hordeum spp.</i>								2	2								2	3							4		4	2									
<i>*Hypericum perforatum</i>	2	3	2	2	2	2	2	2	2	2	3	2		4	3	3	2	2					2	1		2	3		1			2	2	1			
<i>*Hypochaeris glabra</i>														2	2									2													
<i>*Hypochaeris radicata</i>	2	1	1	2	2	2	2	2		2	2		2					2	2	2					2	1		1	2	2	2	2	2	2			
<i>*Lactuca serriola</i>																	1						1											2			
<i>*Lepidium africanum</i>																									1												
<i>*Linaria pelisseriana</i>																		2								1											
<i>*Lolium spp.</i>																																		3			
<i>*Lycium ferocissimum</i>																		1	2	1	2				1			1									
<i>*Malva parviflora</i>																	1	1							1		2										
<i>*Marrubium vulgare</i>																2		1	2	1	1	1			1		2										
<i>*Medicago arabica</i>																						2															
<i>*Medicago spp.</i>									2			2		2					1	2			2	2		2	2	2			2		2	2	2	2	
<i>*Modiola caroliniana</i>																	1		1		1			1	1		2				2			2	2	2	
<i>*Moenchia erecta</i>																							2												2		
<i>*Onopordum acanthium</i>								1										2									1									2	
<i>*Orobanche minor</i>							2											1																			
<i>*Paronychia brasiliiana</i>									2	2		1					2				2					2			1							2	
<i>*Paspalum dilatatum</i>				2																																	
<i>*Petrorhagia nanteuilii</i>		2	2	2		2			2									1	2							1											
<i>*Phalaris aquatica</i>			1		2		2	2		1		2				3	1	2		2		2		2	2					5					3		
<i>*Plantago lanceolata</i>		2	2		2	1	2	2	2	1	2	2	2	2			2		2					2	2			2					2	2	2	2	
<i>*Poa annua</i>												1																			1						
<i>*Prunus spp.</i>																	1																				

Plot	Kama Nature Reserve														Molonglo 3																						
	A1	A101U	A102U	A2	B1	B103U	B2	B203U	B3	B303U	B4	B5	B6	O1	O2	C1	C101U	C102U	C2	GG1	GG102U	GG2	GG201U	GG3	GG4	H02	H02U	H03	H1	J1	J2	N1	N102U	O301U			
<i>*Rosa rubiginosa</i>								1	1	1					2	2	1	2				1	1		1	1	1	2				3	1				
<i>*Rubus fruticosus</i> agg.					2											1		1	1		1													1			
<i>*Salvia verbenaca</i>												1				1	1		2		2	1	2		1	2	3	2	2		2	1	2				
<i>*Sisymbrium irio</i>																											1										
<i>*Solanum nigrum</i>																						1															
<i>*Sonchus</i> spp.	2	2	2						1								2	2					1		1	2	1	2		1			2				
<i>*Stellaria media</i>																					2		2											2			
<i>*Tolpis barbata</i>									2		1											1													1		
<i>*Tragopogon dubius</i>	1															1																					
<i>*Trifolium angustifolium</i>							2		2																												
<i>*Trifolium arvense</i>																		2		2		2		2				2			2						
<i>*Trifolium</i> spp.		1						2							2															2							
*Unknown exotic (no diagnostic features)	2							2				2		1					2																		
<i>*Urtica incisa</i>																			2	1	2			1													
<i>*Verbascum thapsus</i>			1	1																																	
<i>*Verbascum virgatum</i>												1																									
<i>*Vulpia myuros</i>																2								2													
<i>*Vulpia</i> spp.						2	2	2		2							2					2		2	3	2			3	2	2	2	2	2			
<i>*Xanthium spinosum</i>																						1			1												



## APPENDIX 4

CV of Report Author Rob Armstrong

**ROB ARMSTRONG**  
Bachelor of Science (Forestry)



## **STATEMENT OF EXPERIENCE AND EXPERTISE**

### **ACADEMIC QUALIFICATIONS**

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- Bachelor of Science (Forestry), Australian National University, 2000
- Master of Science (botany major), University of New England (current)

### **PROFESSIONAL AFFILIATIONS**

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- Member, Australian Network for Plant Conservation
- Member, Friends of Grasslands Inc.

### **OTHER RELEVANT QUALIFICATIONS & TRAINING**

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- Stereo Analyst for ArcGIS operation (author and presenter)
- Statistical Analysis (PATN and S-Plus), 2002
- Marxan Conservation Planning, 2012
- Managing External Grants, 2010
- Contract Management, 2009
- Community Consultation (six days), 2008
- Developing Successful Grant Submissions, 2008
- Improved Workplace Effectiveness, 2008
- Writing Submissions and Briefings, 2007
- Cultural Awareness, 2007
- 4WD operation and roadcraft, 2007

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## SUMMARY OF EXPERIENCE AND EXPERTISE

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Rob is a vegetation ecologist with over 12 years of experience, focusing primarily on vegetation and habitat survey, mapping and classification across southern, central and western NSW and the ACT. Rob has recently joined Umwelt Australia, bringing experience from NSW and ACT Government (the NSW Office of Environment & Heritage and predecessors including the NSW Department of Environment, Climate Change & Water and the NSW Department of Land & Water Conservation; ACT Environment & Sustainable Development Directorate).

Rob is familiar with the flora of NSW and has extensive experience in botanical survey techniques and plant identification. He is also experienced in the identification of vegetation communities in respect of published regional community descriptions in addition to determinations for endangered communities under NSW, ACT and Commonwealth legislation.

Rob is highly experienced in utilising statistical analysis techniques (e.g. PATN multivariate association analysis) and spatial technology (e.g. Stereo Analyst to interpret high resolution imagery within a 3-dimensional digital platform) to describe and map vegetation communities for conservation management purposes. Rob has also worked on a range of projects related to environmental impact assessment, conservation planning and community engagement to deliver on-ground environmental outcomes.

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## LIST OF CURRENT AND PREVIOUS POSITIONS

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2013 – present	<b>Senior Ecologist.</b> Umwelt Australia (Pty. Ltd.)
2012	<b>Research Officer (Kangaroo Impacts).</b> ACT Conservation Planning and Research Group, Environment and Sustainable Development Directorate, Canberra, ACT
2010 – 2012	<b>Conservation Assessment Officer (Vegetation).</b> NSW Office of Environment & Heritage, Queanbeyan, NSW
2009 – 2010	<b>Conservation Assessment Officer (Reserve Acquisition).</b> NSW Department of Environment, Climate Change & Water, Dubbo, NSW
2007 – 2009	<b>Senior Threatened Species Officer.</b> NSW Department of Environment, Climate Change & Water, Dubbo, NSW
2005 – 2007	<b>Senior Project Officer (Catchment Management Authority).</b> NSW Department of Environment, Climate Change and Water, working with the Western Catchment Management Authority, Dubbo, NSW
2002 – 2004	<b>Vegetation Management Officer.</b> NSW Department of Land and Water Conservation, Leeton, NSW
2001 – 2002	<b>Natural Resource Officer (Vegetation and Landscape Assessment) – Native Vegetation Mapping Program.</b> NSW Department of Land and Water Conservation, Dubbo, NSW

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**REPRESENTATIVE LIST OF EXPERIENCE**

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**Mar 2013 – present: Senior Ecologist. Umwelt Australia Pty Ltd., Canberra, ACT.**

**Oct 2012 – Feb 2013: Research Officer (Kangaroo Impacts). ACT Conservation Planning & Research Group, Environment & Sustainable Development Directorate, Canberra, ACT**

Rob was engaged by the ACT Government to undertake full-floristic and structural survey of Lowland Natural Temperate Grassland and Yellow Box – Red Gum endangered ecological communities occurring within ACT conservation reserves. This was part of an ongoing project in the ACT to assess the impact of grazing by native herbivores. The objective of the monitoring was to provide advice as to optimal kangaroo densities within the reserve system to enhance vegetation condition in grassy ecosystems through analysis of floristic data relative to kangaroo densities.

**Jan 2010 – Sept 2012: Conservation Assessment Officer (Vegetation). NSW Office of Environment & Heritage, Queanbeyan, NSW**

Over the period Rob was engaged in this role he undertook a variety of tasks generally in support of state efforts to conserve and manage native vegetation, threatened species and endangered communities. Key elements of this role included:

- Project coordination, technical input and reporting (scientific and administrative) for major botanical assessment projects including the:
  - Digital high-resolution 3-D vegetation mapping program, covering 2.5 million hectares of central-southern NSW, including project coordination, botanical guidance, quality assurance, and technical report / peer reviewed scientific journal article authorship;
  - Numerical plant community classification for the upper Murrumbidgee catchment (NSW/ACT), including project coordination, multivariate floristic data analysis, botanical survey, and technical report / peer reviewed scientific journal article authorship; and
  - Compilation map of BioMetric vegetation types of the South Coast of NSW for local government clients (Bega Valley, Eurobodalla and Shoalhaven) and the Southern Rivers Catchment Management Authority. This included extensive spatial data review, vegetation classification transformation, GIS and technical report writing.
- Supervision and direction for contract staff across two projects; managing project budgets and leading external and internal project stakeholder liaison.
- Developing innovations to utilise technological advances using GIS and statistical analysis packages to enhance current programs.
- Providing advice to other staff within the Branch regarding conservation assessment.

**May 2009 –Jan 2010: Conservation Assessment Officer (Reserve Acquisition). NSW Department of Environment, Climate Change & Water, Dubbo, NSW**

- Providing advice on the values of potential properties to add to the National Reserve System in line with various legislative and policy objectives.
- Playing a key role in the acquisition of over 40,000 hectares of high conservation value land, including areas of high Aboriginal cultural heritage significance and a key Ramsar site.

**December 2007 – May 2009: Senior Threatened Species Officer. NSW Department of Environment, Climate Change & Water, Dubbo, NSW**

- Leading a large complex conservation site prioritisation project, including stakeholder liaison, project/survey design, budgeting, full-floristic survey, data analysis, report writing (technical and conservation management recommendations) and contractor management.
- Designing and leading vegetation surveys and making conservation management recommendations for high conservation value sites and threatened flora populations in western NSW.
- Providing expert advice to staff on vegetation conservation within an area covering approximately 60 per cent of NSW.

**Nov 2005 – Dec 2007: Senior Project Officer (Catchment Management Authority). NSW Department of Environment, Climate Change and Water, working with the Western Catchment Management Authority, Dubbo, NSW**

- Working with landholders and Aboriginal groups to develop site-based conservation projects, and consult on broader program priorities.
- Providing direction in developing a strategic conservation framework for private land in western NSW.
- Conservation program development, technical advice, management and administration [including managing three programs and being on steering committees for a further four].
- Developing and linking several conservation program initiatives between the NSW Department of Environment, Climate Change and Water, the Western CMA and other State and Commonwealth natural resource agencies.

**Nov 2002 – Dec 2004: Vegetation Management Officer. NSW Department of Land and Water Conservation, Leeton, NSW**

- Liaising and negotiating with landholders regarding flora and fauna ecology, the *Native Vegetation Act 2003*, *Native Vegetation Conservation Act 1997* and related legislation managed by other state and federal government agencies.
- Providing advice to landholders and other government departments on vegetation and legislative issues, targeted and general flora and fauna survey.

**Jul 2001 – Nov 2002: Natural Resource Officer (Vegetation and Landscape Assessment) – Native Vegetation Mapping Program. NSW Department of Land and Water Conservation, Dubbo, NSW**

- Coordinating and undertaking full-floristic vegetation assessment.
- Vegetation survey data management and interpretation.

## SELECTED PUBLICATIONS

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**Armstrong, R.C.**, Turner, K., McDougall, K., Rehwinkel, R. & Crooks, J. (2013) Plant Communities of the South Eastern Highlands and Australian Alps within the Murrumbidgee catchment of New South Wales. *Cunninghamia* 13(1), pp. 125-265.

**Armstrong, R.C.** (2013) Interim analysis of relationships between vegetation condition and kangaroo density in grassy ecosystems of the northern ACT: data collected in Spring – Summer 2009 / 2012. A report prepared for ACT Government, Environment & Sustainable Development Directorate, Canberra. February 2013. 74 pp.

**Armstrong, R.C.** & Edmonds, T. (2012) User guide: basic operation of Stereo Analyst 9.2 for ArcGIS 9.2. Prepared for the NSW Office of Environment & Heritage, September 2012.

Maguire, O., **Armstrong, R.C.**, Benson, J.S., Streeter, R., Paterson, C., McDonald, P., Salter, N., East, M., Webster, M., Sheahan, M., & Young, D. (2012) Using high resolution digital aerial imagery interpreted in a 3-D digital GIS environment to map plant communities in central-southern New South Wales. *Cunninghamia* 12(4), pp. 247-266.

**Armstrong, R.C.** (2012) BioMetric vegetation types of the south coast of New South Wales. Technical Report. NSW Office of Environment & Heritage, Queanbeyan. 123 pp.

**Armstrong, R.C.** (2011) Developing GIS models to quantify crown separation ratio in woodland environments in southern NSW and the ACT. NSW Office of Environment & Heritage, Queanbeyan.

**Armstrong, R.C.**, Porteners, M.F. & Koen, T. (2009) Condition Assessment, Prioritisation and Conservation Management Recommendations for Endangered Ecological Communities in the Narromine, Dubbo and Wellington Local Government Areas. A report produced for the Central West Catchment Management Authority. NSW Department of Environment and Climate Change, Dubbo.

Thompson, P., Baigent, E., Mazzer, L., **Armstrong, R.C.**, Germon, G., Taylor, R., Egan, D., Berry, S. & Mackey, B. (2009) Identification of Areas of High Conservation Value for Biodiversity, Aboriginal Cultural Heritage and Geodiversity for Investment by the Western Catchment Management Authority. A report to the Western Catchment Management Authority by the NSW Department of Environment, Climate Change and Water. December 2009. 256 pp.

**Armstrong, R.C.** (2008) Information review and survey for threatened flora and algae of the Paroo River and associated wetlands, north-western New South Wales. *Aponogeton queenslandicus*, *Dentella minutissima*, *Goodenia nocoleche* and *Nitella partita*. NSW Department of Environment and Climate Change.

**Armstrong R.C.** & Bollard, K.B. (2008) Taxonomic notes on recently discovered and extant populations of *Calotis moorei* P.S. Short (*Asteraceae*). A comparison with taxonomically similar *Calotis* species. New South Wales Department of Environment and Climate Change. November 2008.

Lewer, S., Ismay, K., Grounds, S., **Armstrong, R.C.**, Gibson, R., Harris, M., Deluca, S. & Ryan, C. (2003) Native Vegetation Map Report: Bogan Gate, Boona Mount, Condobolin, Dandaloo, Tottenham and Tullamore 1:100,000 Map Sheets. NSW Department of Land and Water Conservation. 251 pp.

\* Numerous commercial in confidence and internal reports associated with technical and policy advice, native vegetation approval and compliance/survey, Statements of Conservation Significance etc.



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