Lindum Vale:

Golden Sun Moth survey and habitat assessment

DRAFT REPORT

Prepared for MAB Corporation

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1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by MAB Corporation to conduct targeted surveys and a habitat assessment for Golden Sun Moth *Synemon plana* within the proposed area of expansion of Melbourne's Urban Growth Boundary (UGB) to include the property known as Lindum Vale (Figure 1). This is a Logical Inclusion area, and therefore is not subject to the Melbourne Strategic Assessment.

Golden Sun Moth is listed as critically endangered under the *Environment and Protection Biodiversity Conservation Act 1999* (EPBC Act) and is therefore a matter of national environmental significance (MNES). Previous assessments of the study area (Biosis 2009) identified this species to be scattered over the site, particularly within areas of woodland within the south of the property. Targeted survey is required at this site because:

- The site contains known habitat for Golden Sun Moth.
- There is potential for loss or modification to this habitat as a result of the proposed residential development of the property as part of its inclusion within Melbourne's UGB.
- Targeted survey can help determine if the development is likely to have a significant impact on Golden Sun Moth.

This report presents the results of a targeted survey and habitat assessment for Golden Sun Moth during the 2014/15 survey season.

1.2 Objectives

The objectives of the targeted surveys are to:

- Determine the presence, distribution and relative abundance of Golden Sun Moth in the study area.
- Map the location and number of any Golden Sun Moth individuals recorded.
- Present the results of the survey program including pre-season checks, reference site checks, and weather conditions on survey days, survey methods and habitat characteristics of the study area.
- Map and score the Golden Sun Moth habitat within the study area and assess potential impacts of the proposed development.
- Determine any offsets for Golden Sun Moth which may be prescribed under the Department of the Environment offset policy (DSEWPaC 2012a).

1.3 Study area

The 141.75 ha site ('Lindum Vale') incorporates 1960 (Lot 1 on TP947284N / Vol 11252 Fol 194 with a total area of 78.83 ha) and 2040 (Lot 1 on PS947278H / Vol 11252 Vol 162 with a total area of 62.92 ha) Mickleham Road, Mickleham. It is approximately 5 kilometres north of Craigieburn and 25 kilometres north of the Melbourne Central Business District. It is bounded to the west by

Mickleham Road, to the south by Mount Ridley Road, to the north by high tension power-lines on private property and to the east by private rural residential lots.

Lindum Vale is currently zoned Green-Wedge A Zone and is also covered in part by Environmental Significance Overlay (ESO) ESO 5 and ESO 11.

The study area is a gently undulating volcanic plain used for cropping and the grazing of domestic stock. It supports areas of pasture generally dominated by exotic species and areas of grassy woodland consisting of scattered trees over a mixture of native and introduced understorey species. The site is on the northern margin of Melbourne's UGB with residential developments encroaching on the eastern and southern margin with land to the west and north still used for agriculture.

The study area is within the:

- Victorian Volcanic Plain bioregion
- Yarra River Basin
- Port Phillip and Westernport Catchment Management Authority (CMA)
- City of Hume.

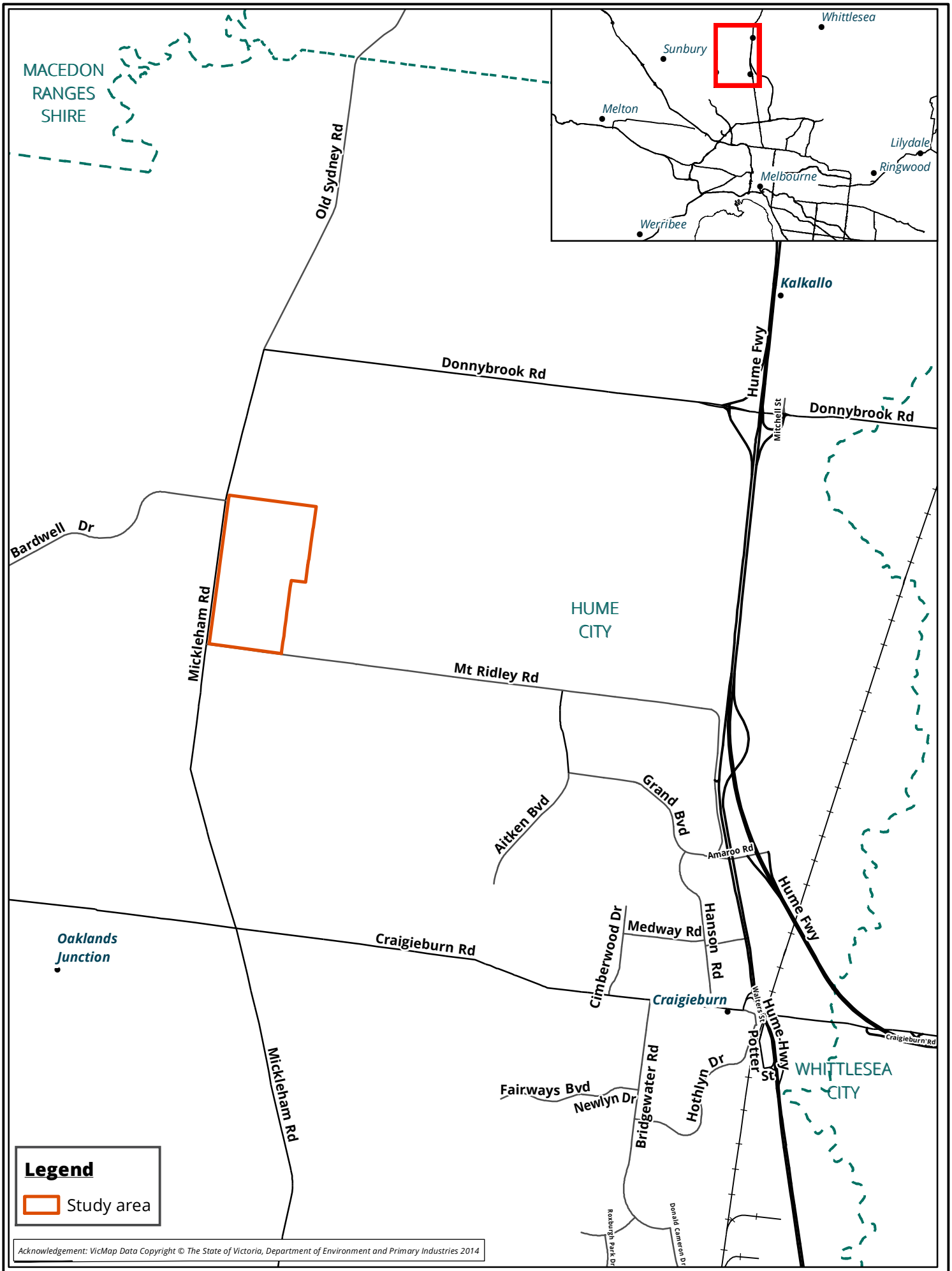

Figure 1: Location of the Study Area - 1969-2040
Mickleham Road, Mickleham, Victoria

Matter: 19308,
Date: 16 January 2015,
Checked by: SGM, Drawn by: LDM, Last edited by: lmilne
Location:P:\19300s\19308\Mapping\

Scale 1:52,435 @ A4, GDA 1994 MGA Zone 55

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2 Methods

2.1 Golden Sun Moth Survey

Survey was undertaken during the 2014–15 flight season. As the timing of the flight season varies annually and geographically, commencement of the flight season needed to be determined before survey could be undertaken. A previous Golden Sun Moth survey was carried out on the site in November 2008 and the results of this survey have been incorporated into this report.

2.1.1 Determining flight season commencement

The best indicator of the key survey period for Golden Sun Moth is the presence of flying males at known local sites. Pre-season checks were undertaken by Biosis and other ecological consultants at various known sites ('reference' sites) around Melbourne from mid November to collaboratively determine the commencement of the Golden Sun Moth flight season for 2014–15. Golden Sun Moths began being reliably recorded flying at Melbourne reference sites from 12 November 2014. Lindum Vale is itself a reference site since it is known to support a Golden Sun Moth population. The area of grassy woodland adjacent to Mount Ridley Road was used as a reference site as this area is known to support a population of Golden Sun Moth. Survey of the study area only commenced once males were recorded flying within this woodland reference site.

2.1.2 Targeted survey

Surveys were undertaken in accordance with the *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth* (DEWHA 2009).

Survey was undertaken on 28 November 2014. The survey took place when conditions were suitable for male flight (generally >20^{o}C, bright, clear days, full sun, absence of rain and wind other than a light breeze) between 10:00 hrs and 15:00 hrs (see Appendix 1 for weather data for the day on which survey was undertaken).

During the survey, the site was surveyed systematically by three zoologists walking the site in a series of transects spaced approximately 50m apart. Tracks were recorded using a Garmin GPS and a waypoint was taken for each location where Golden Sun Moths were observed. The survey took approximately 4 hours to complete. General habitat characteristics of the study area were recorded during Golden Sun Moth survey. Areas of cereal crop were not surveyed as these were areas were not considered to be habitat for Golden Sun Moth. Some paddocks within the study area were not surveyed due to presence of aggressive bulls but Golden Sun Moth habitat in these areas was mapped and scored.

2.2 Weather Conditions

Weather conditions, including temperature, humidity and wind speed, were measured on site using a Kestrel Weather Meter (Model 4000). Weather data collected on site is provided in Appendix 1.

2.3 Mapping

Mapping was conducted using hand-held (uncorrected) GPS units (WGS84) and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units

(generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Mapping has been produced using a Geographic Information System (GIS).

2.4 Habitat Quality Assessment

A habitat quality assessment is required to define any offsets to be prescribed under the EPBC Act offset policy (DSEWPaC 2012a). The offset calculator provided as part of this policy requires habitat quality to be allocated an integer score between 0 and 10 (DSEWPaC 2012b).

The habitat quality assessment was based on the criteria noted by the offset assessment guidelines (DSEWPaC 2012c) including:

- Site Condition: The condition of a site in relation to the ecological requirements for a threatened species
- Site Context: The relative importance of a site in terms of its position in the landscape taking into account the connectivity needs of a threatened species. This includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species
- Species stocking rate: This is the usage and/or density of a species at a particular site. This component acknowledges that a particular site may have a high value for a particular threatened species, despite appearing to have poor condition and/or context. It also includes consideration of the role of the site population in regards to the overall species population viability.

Each of these components was allocated an integer score out of ten. This provides a total habitat score out of 30. This total score was then divided by three to provide a score out of ten.

This final habitat score was then used as input to the EPBC Act offset calculator

2.4.1 Site condition

The relative condition of habitat was based on the abundance of known food plants (Richter et al. 2010). The woodland reference area within Lindum Vale was taken as the highest quality habitat within the site and allocated a site condition score of 10/10. GSM has consistently been recorded at this location. This section of the study area is dominated by either native food plants such as wallaby-grasess *Rytidosperma* spp. and spear-grasses *Austrostipa* spp. or exotic stipoid grasses such as Chilean Needle-grass *Nassella neesiana*.

Patches of habitat within the balance of the study area were then given a site condition score based on the cover of known food plants, either native or exotic, relative to the reference area. Therefore, an area with about 10% of the cover known food plants relative to the reference site was allocated a habitat condition score of 1/10, while an area with 50% of the cover known food plants relative to the reference site was allocated a habitat condition score of 5/10.

Areas with a complete cover of cereal crop or pasture grasses such as Toowomba Canary Grass *Phalaris aquatica* and Cocksfoot *Dactylis glomerata*, with no visible known Golden Sun Moth food plants, were allocated a score of 0/10.

The condition assessment was conducted on 23 December 2014.

2.4.2 Site Context

This component of the habitat score was subjectively determined based on the size of the habitat zone, the context of that zone in respect to the broader distribution of Golden Sun Moth within the site and knowledge of distribution and condition of Golden Sun Moth habitat in the local area.

2.4.3 Species Stocking Rate

This component of the habitat score was based on the comparative density of individuals. Measuring stocking rate/density for Golden Sun Moth is difficult, as the number of individuals recorded at sites is known to vary enormously both spatially and temporally (see Gibson and New 2007). Numbers of moths observed at sites, and their distribution within sites, varies within and between seasons making an assessment of true densities virtually impossible. For the purpose of this assessment, a relative stocking rate was calculated so as to include all of the components identified by the EPBC Act offsets assessment guide.

Initially, the highest density recorded within a defined habitat zone was allocated a density score of 10/10. The density recorded in other habitat zones was then assessed a proportion of this highest density. The scores for sites with higher densities (Habitat Zones 1 and 3) were then revised based on the experience of Biosis zoologist Daniel Gilmore. All scores were expressed as a score out of 10 rounded to the nearest integer.

2.5 Permits

Biosis undertook the targeted surveys under the following permit and approval:

- Research Permit/Management Authorisation and Permit to Take Protected Flora & Protected Fish issued by the Department of Environment and Primary Industries under the *Wildlife Act 1975, Flora and Fauna Guarantee Act 1988* and *National Parks Act 1975* (Permit number 10006240, expiry date 9 May 2015).
- Approvals 04.12 and 14.12 from the DEPI Wildlife and Small Institutions Animal Ethics Committee.

3 Results

3.1 Golden Sun Moth

3.1.1 Survey results

A total of 226 Golden Sun Moth (all males) were recorded during the 2014 targeted survey (Figure 2). Based on these numbers, and the results from previous surveys in 2008, no additional surveys were considered necessary as the species was considered to be widespread within apparently suitable habitat. While further survey may have yielded additional individuals, we do not believe it would have resulted in a marked change in the distribution of the species across the site or altered our assessment of the quality of the habitat. In November 2008, 45 males were recorded across the site, with records being concentrated in areas where they were found in 2014.

The conditions under which the survey was undertaken was suitable as outlined in the guidelines (Appendix 1).

The search transects for Golden Sun Moth for the 2014 survey are shown in Figure 2.

3.1.2 Habitat Quality Assessment

Golden Sun Moth habitat at Lindum Vale was divided into seven habitat quality zones (Figure 3). The habitat quality scores allocated to each habitat zone (Site Condition, Context and Stocking Rate) are provided in Table 1.

Table 1: Habitat Condition scores for each habitat zone identified within Lindum Vale

Habitat Zone	Area (ha)	Number of GSM recorded*	GSM density (No./ha)	Site Condition Score	Site Contex Score	Stocking Rate Score	Habitat Score (rounded)
1	12.19	87	7.1	10	5	8	8
2	11.10	9	0.8	10	3	1	5
3	7.40	81	10.9	1	5	8	5
4	8.03	10	1.3	5	5	2	4
5	28.03	24	0.9	2	3	1	2
6	38.12	15	0.4	1	3	1	2
7	36.88	Not Surveyed	Not Applicable	0	0	0	0
Total	141.75	226					

* Number of moths recorded during the 2014 survey only

Bardwell Dr
Callaway Dr
Dairy St
Mickleham Rd
Crayridge Ct
Rigg View Av
Cooinda Av
Billabong Cl
Nicola Ct
Vanessa Dr
Lindum Vale Byd
Mt Ridley Rd
Mt Ridley Rd

Legend

- Study Area
- GSM survey tracks

Golden Sun Moth (No. observed)

- 1 - 2
- 3 - 4
- 5 - 7
- 8 - 12
- 13 - 17

Figure 2: The distribution of Golden Sun Moth recorded at Lindum Vale

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Matter: 19308,
Date: 16 January 2015,
Checked by: SGM, Drawn by: LDM, Last edited by: lmilne
Location:P:\19300s\19308\Mapping\
19308_F2_GSM_Distribution

0 50 100 150 200 250
Metres
Scale 1:5,000 @ A3
Coordinate System: GDA 1994 MGA Zone 55

N

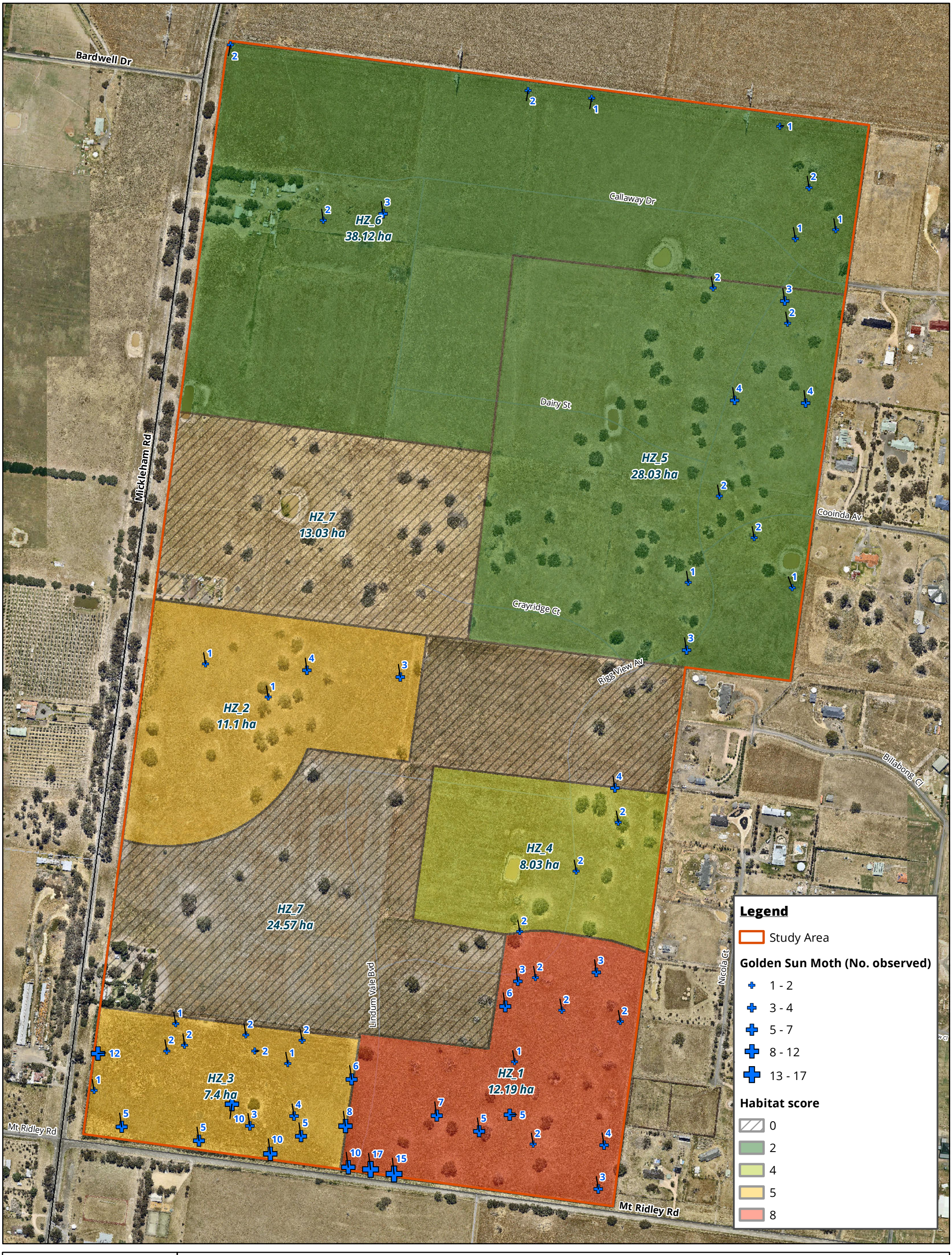

Figure 3: The distribution of habitat zones for Golden Sun Moth at Lindum Vale

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 19308,
Date: 16 January 2015,
Checked by: SGM, Drawn by: LDM, Last edited by: lmilne
Location:P:\19300s\19308\Mapping\
19308_F3_GSM_HabitatZones

0 50 100 150 200 250

Metres
Scale 1:5,000 @ A3
Coordinate System: GDA 1994 MGA Zone 55

N

The following plates show condition of each habitat zone identified.

Plate 1: Habitat Zone 1. Note the extensive cover of Wallaby-grasses.

Plate 2: Habitat Zone 2. Note the extensive cover of Wallaby-grasses.

Plate 3: Habitat Zone 4. Note the very poor cover of Wallaby-grasses.

Plate 4: Habitat Zone 5. Note the poor cover of Wallaby-grasses.

Plate 5: Habitat Zone 6. Note the scattered cover of Wallaby-grasses.

Plate 6: Habitat Zone 7. Note the complete dominance of exotic grasses such as *Phalaris*.

Plate 7: Habitat Zone 7. Note the complete dominance of cereal crop.

4 Discussion

The number of Golden Sun Moth recorded within Habitat Zone 3 is difficult to explain. This area has been heavily disturbed by past cultivation and was largely dominated by exotic pasture grasses. Only a very low cover and abundance of wallaby-grass was observed in this area. However, this zone supported the highest density of Golden Sun Moth recorded on the property at the time of assessment. Golden Sun Moth had previously been recorded in this area by Biosis during the 2008-09 flight season although, only 4 moths were recorded in this area during that season (Biosis Research 2009). One explanation is that the male moths observed in this area flew there after having pupated in higher quality habitat elsewhere (e.g. the woodland to the east). However, the number of moths observed suggests this is unlikely and that this area is suitable habitat and that the moths observed are from *in situ* emergence. Our assessment did not include surveys for pupal cases. If these were observed then this would provide conclusive evidence of the latter. It is possible that some other aspect of this area makes it attractive to Golden Sun Moth. This area still supported a sparse cover of presumed larval food plants so it is not unreasonable to assume that some level of breeding does occur in this habitat zone. Clearly, the current results suggest our understanding of some components of Golden Sun Moth ecology is still poorly understood.

On the basis of criteria outlined in the relevant Significant Impact Guidelines under the EPBC Act, it is considered highly likely that a significant impact on Golden Sun Moth would result from the proposed subdivision of Lindum Vale. The development is therefore likely to be defined as a controlled action upon submission of a referral under the EPBC Act. However, the extent of Golden Sun Moth and associated habitat is consistent with other areas developed under the Melbourne Strategic Assessment (DSE 2009). The extent to which this MNES would need to be protected on site is therefore uncertain.

Offsets for impacts to the habitat present within Lindum Vale were calculated using the Department of the Environment Offset Assessment Guide. These calculations are based on the habitat condition scores identified by this assessment and have assumed the removal of all habitat on the site. This is considered consistent with the approach taken under the Biodiversity Conservation Strategy (DEPI 2013) which applies to large tracts of land immediately adjacent to Lindum Vale.

Offsets prescribed for the loss of each habitat zone are provided in Appendix 2 and summarised in Table 2. Based on this data the removal of all habitat on the site for residential subdivision would require an offset protecting at least 231.8 ha of Golden Sun Moth Habitat.

Table 2: Offsets calculated using the EPBC Act offset calculator and the results of this survey

Habitat Zone	Area (ha)	Prescribed offset (ha)
1	12.19	64
2	11.10	36.2
3	7.40	24.2
4	8.03	21
5	28.03	36.6
6	38.12	49.8
7	36.88	0
Total	141.75	231.8

References

Biosis Research 2009. Survey of the Golden Sun Moth at Lindum Vale, Mickleham, Victoria. A report for MAB Corporation. Authors M. Venosta, D. Gilmore and N. Garvey. Biosis Research, Melbourne. Project No. 7564.

DEPI 2013. Biodiversity Conservation Strategy for Melbourne's Growth Corridors. Victorian Government Department of Environment and Primary Industries, Melbourne.

DEWHA 2009. *Significant impact guidelines for the critically endangered golden sun moth* (Synemon plana). Nationally threatened species and ecological communities EPBC Act policy statement 3.12, Department of the Environment, Water, Heritage & the Arts. Australian Government, Canberra.

DSEWPaC 2012a. Environment Protection and Biodiversity Conservation Act1999 *Environmental Offsets Policy*. Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra.

DSEWPaC 2012b. *Offsets Assessment Guide*. An excel spreadsheet For use in determining offsets under the Environment Protection and Biodiversity Conservation Act1999 (2 October 2012). Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra.

DSEWPaC 2012c. *How to use the offsets assessment guide*. Department of Sustainability, Environment, Water, Population and Communities, Australian Government, Canberra.

Richter, A., Osborne, W. and Traugott, M. 2010. *Critical Conservation Research on the Golden Sun Moth* Synemon plana*: Establishing an understanding of the extent of dietary specialisation.* Report to Toll Properties and Commercial & Industrial Property. University of Canberra

Appendices

Appendix 1 – Golden Sun Moth survey data

Date	Survey No.	Time Start	Time Finish	GSM observed at reference site?	GSM observed on site?	Temp on site (°C)	Cloud cover (%)	Wind direction	Average wind speed (km/hr)	Humidity (%)	Ground conditions
28/11/2014	1	12:00	16:00	Yes	Yes	17 / 20	0 / 0	S / SE	9 / 13	57 / 50	Soil dry

Note: Weather information recorded at start and end of survey (start and end data shown for temperature, cloud cover, wind speed and humidity).

Appendix 2 – Golden Sun Moth offset calculations

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 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
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat Zone 1	**Area**	12.19	Hectares	Survey and on site assessment
			Quality	**8**	Scale 0-10	
			Total quantum of impact	9.75	Adjusted hectares	
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					
Threatened species						
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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	9.75	Adjusted hectares	64	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	64	**Risk of loss (%) without offset**	80%	**Risk of loss (%) with offset**	10%	44.80	80%	35.84	9.61	9.81	100.63%	Yes	
									Future area without offset (adjusted hectares)	12.8	**Future area with offset (adjusted hectares)**	57.6								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	6	**Future quality without offset (scale of 0-10)**	4	**Future quality with offset (scale of 0-10)**	8	4.00	80%	3.20	1.66				
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																			
Threatened species																				
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	9.752	9.81	100.63%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

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

Impact calculator

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat Zone 2	**Area**	11.1	Hectares	Survey and on site assessment
			Quality	**5**	Scale 0-10	
			Total quantum of impact	5.55	Adjusted hectares	
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					
Threatened species						
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

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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	5.55	Adjusted hectares	36.2	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	36.2	**Risk of loss (%) without offset**	80%	**Risk of loss (%) with offset**	10%	25.34	80%	20.27	5.44	5.55	100.01%	Yes	
									Future area without offset (adjusted hectares)	7.2	**Future area with offset (adjusted hectares)**	32.6								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**8**	4.00	80%	3.20	1.66				
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																			
Threatened species																				
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

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	5.55	5.55	100.01%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

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 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
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat Zone 3	**Area**	7.4	Hectares	Survey and on site assessment
			Quality	**5**	Scale 0-10	
			Total quantum of impact	3.70	Adjusted hectares	
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					
Threatened species						
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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	3.70	Adjusted hectares	24.2	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	24.2	**Risk of loss (%) without offset**	80%	**Risk of loss (%) with offset**	10%	16.94	80%	13.55	3.64	3.71	100.29%	Yes	
									Future area without offset (adjusted hectares)	4.8	**Future area with offset (adjusted hectares)**	21.8								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**8**	4.00	80%	3.20	1.66				
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																			
Threatened species																				
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	3.7	3.71	100.29%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

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Matter of National Environmental Significance	
Name	Golden Sun Moth
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
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat Zone 4	**Area**	8.03	Hectares	Survey and on site assessment
			Quality	**4**	Scale 0-10	
			Total quantum of impact	3.21	Adjusted hectares	
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					
Threatened species						
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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	3.21	Adjusted hectares	21	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	21	**Risk of loss (%) without offset**	80%	**Risk of loss (%) with offset**	10%	14.70	80%	11.76	3.15	3.22	100.25%	Yes	
									Future area without offset (adjusted hectares)	4.2	**Future area with offset (adjusted hectares)**	18.9								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**8**	4.00	80%	3.20	1.66				
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																			
Threatened species																				
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	3.212	3.22	100.25%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**

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Matter of National Environmental Significance	
Name	Golden Sun Moth
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

Impact calculator	Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
	Ecological communities						
	Area of community	No		**Area**			
				Quality			
				Total quantum of impact	0.00		
	Threatened species habitat						
	Area of habitat	Yes	Habitat Zone 5	**Area**	28.03	Hectares	Survey and on site assessment
				Quality	**2**	Scale 0-10	
				Total quantum of impact	5.61	Adjusted hectares	
	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					
	Threatened species						
	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

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
	Ecological Communities																				
	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)**									
	Threatened species habitat																				
	Area of habitat	Yes	5.61	Adjusted hectares	36.6	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	36.6	**Risk of loss (%) without offset**	80%	**Risk of loss (%) with offset**	10%	25.62	80%	20.50	5.50	5.61	100.11%	Yes	
										Future area without offset (adjusted hectares)	7.3	**Future area with offset (adjusted hectares)**	32.9								
						Time until ecological benefit	10	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**8**	4.00	80%	3.20	1.66				
	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																			
	Threatened species																				
	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

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	5.606	5.61	100.11%	**Yes**	$0.00	N/A	$0.00
	Area of community	0				$0.00		$0.00
						$0.00	**$0.00**	**$0.00**

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Name	Golden Sun Moth
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
Ecological communities						
Area of community	No		**Area**			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Habitat Zone 6	**Area**	38.12	Hectares	Survey and on site assessment
			Quality	**2**	Scale 0-10	
			Total quantum of impact	7.62	Adjusted hectares	
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					
Threatened species						
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
Ecological Communities																				
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)**									
Threatened species habitat																				
Area of habitat	Yes	7.62	Adjusted hectares	49.8	**Time over which loss is averted (max. 20 years)**	20	**Start area (hectares)**	49.8	**Risk of loss (%) without offset**	80%	**Risk of loss (%) with offset**	10%	34.86	80%	27.89	7.48	7.64	100.16%	Yes	
									Future area without offset (adjusted hectares)	10.0	**Future area with offset (adjusted hectares)**	44.8								
					Time until ecological benefit	10	**Start quality (scale of 0-10)**	**6**	**Future quality without offset (scale of 0-10)**	**4**	**Future quality with offset (scale of 0-10)**	**8**	4.00	80%	3.20	1.66				
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																			
Threatened species																				
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	7.624	7.64	100.16%	**Yes**	$0.00	N/A	$0.00
Area of community	0				$0.00		$0.00
					$0.00	**$0.00**	**$0.00**