Appendix O

Golden Sun Moth survey report

Googong Township water cycle project

Environmental Assesment

November 2010

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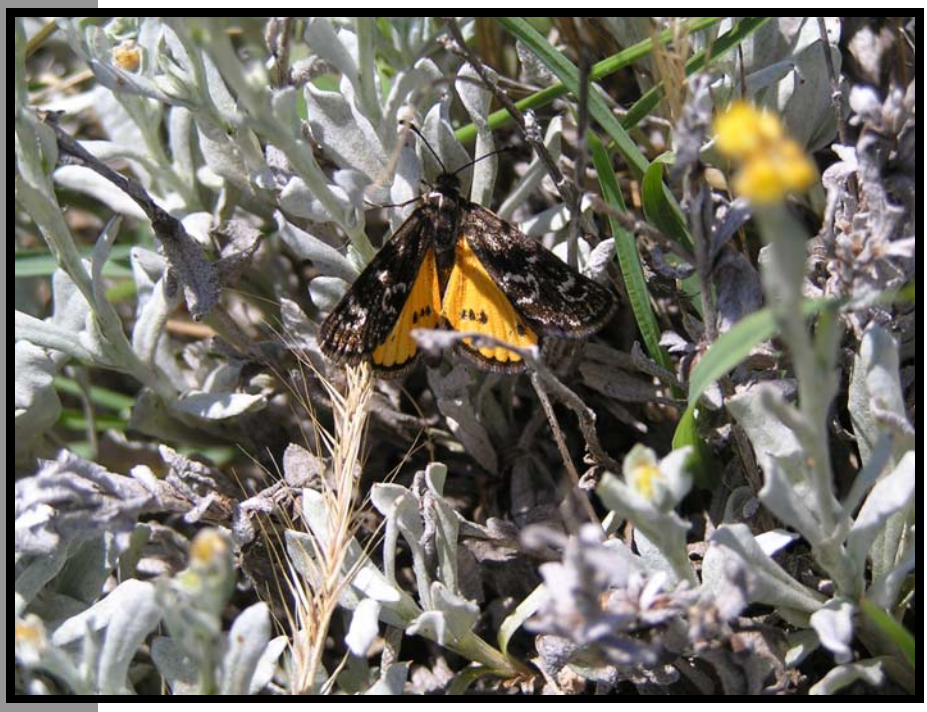

Targeted surveys for Golden Sun Moth *Synemon plana*: Googong Township

May 2010

Biosis Research Pty Ltd

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Report prepared for CIC Australia.

Targeted surveys for Golden Sun Moth *Synemon plana*: Googong Township

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Cover Photo: Female Golden Sun Moth on Common Everlasting *Chrysocephalum apiculatum* within the eastern grasslands of the Canberra International Airport.

CONTENTS

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1.0 SUMMARY

Biosis Research Pty. Ltd (Biosis Research) was commissioned by CIC Australia (CIC) to undertake additional targeted surveys for Golden Sun Moth (GSM) *Synemon plana* within the proposed water cycle project for the Googong Township (Figure 1). The surveys were recommended to determine the presence of the GSM and the need for a Referral to the Commonwealth Minister for the Environment.

Potential habitat for the GSM within the study area is considered to be poor condition. Despite containing some native species such as the preferred host plant *Austrodanthonia* sp., it has been heavily grazed and contains a number of weeds. The water reticulation system and associated infrastructure area for the Googong Township would impact 7.33 ha of potential habitat for the GSM.

Based on discussion with Department of the Environment, Water, Heritage and the Art (Tess Ward, DEWHA. *pers com* 2009), it was considered that two surveys season would be adequate in determining the presence /absence of the Golden Sun Moth. Targeted surveys for the GSM were conducted at the Googong Township in late 2008 as part of the original surveys, and in late 2009 for the follow up surveys. No GSM were recorded within the study area during either the current or previous surveys, although GSM were found to be flying in relative high numbers at other known sites in the ACT and surrounding areas.

Given that surveys were undertaken at the peak time and weather conditions were optimum and no moths were observed in the surveys, it is unlikely that GSM are present within the study area. A referral under the EPBC Act is not considered necessary.

2.0 INTRODUCTION

2.1 Background

Biosis Research Pty. Ltd (Biosis Research) was commissioned by the CIc Australia (CIC) to undertake additional targeted surveys for Golden Sun Moth (GSM) *Synemon plana* within the proposed water reticulation system and associated infrastructure area for the Googong Township (Figure 1). The surveys were recommended to determine the presence of the GSM and the need for a Referral to the Commonwealth Minister for the Environment.

The proposed water reticulation system and associated infrastructure to support the Googong Township is being assessed via Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (Ecowise Environmental and Biosis Research 2009).

The following components and activities were assessed in the 2009 report:

- Clearing and grubbing of land, stripping and stockpiling topsoil;
- Bulk earthworks (cut to fill) to design levels, including re-grading;
- Trench excavation for sewer, stormwater, potable water main, recycled water main services and backfill of all underground services;
- Construction of the Water Recycling Plant and pumping stations;
- Construction of rip rap and placement of other erosion protection material;
- Excavation for and planting of trees, shrubs, grasses and for dry mulches; and
- Rehabilitation and re-installation of all disturbed and/or re-graded areas.

A number of these components occur in the area where potential GSM habitat was located, and could impact on this potential habitat. Initial surveys did not detect any GSM, and it was recommended that additional surveys be undertaken to better assess the potential impacts.

2.2 Aims of the Assessment

The specific aims of the assessment were to:

- Assess the extent of potential Golden Sun Moth habitat within the proposed study area;
- Undertake targeted surveys to determine the presence /absence of the Golden Sun Moth within the study area; and,
- Determine whether a Referral under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is required.

2.3 Location and Description

2.3.1 Study Area

The study area is located 8 km south of the Queanbeyan CBD, within the Queanbeyan Local Government Area (LGA), the Monaro subregion of the Murrumbidgee Catchment Management Authority and the South-eastern Highlands Bioregion. The study area falls entirely within the Tuggeranong 8727-3S 1:25,000 Topographic Map Sheet (Figure 2).

The study area is bounded by Old Cooma Road to the west, Googong Foreshores (associated with Googong Dam) to the east, Googong Road to the north and farming land to the south. Most of the study area is located on grazing land (sheep and cattle).

The study area is at an elevation of over 700 m above sea level. The topography is gently undulating hills. The majority of the land has been cleared for grazing. There are occasional trees (generally as windbreaks) and a small number of farm dams.

2.3.2 Vegetation

Prior to this survey detailed vegetation assessments were undertaken across the study area by Ecowise Environmental Pty Ltd in 2009 for the Googong Township Water Cycle Project (Ecowise Environmental and Biosis Research 2009).

The vegetation of the Googong Township area is greatly changed from what would have been present at the time of European settlement. Previously, the area would have been dominated by Temperate Montane Grasslands, Tableland Grassy Woodlands and/or Southern Tableland Dry Sclerophyll Forests (ACT Government 2007; Keith 2004). Since this time, the area has been cleared and heavily grazed. Vegetation mapping of the Googong Township area by the Johnstone Centre showed the majority of it to be non-native grassland and agricultural land, with a small area of native grassland along the eastern side of Old Cooma Road (Johnstone Centre 2004). This was confirmed in field surveys undertaken by Biosis Research and Ecowise Environmental in 2008 and 2009.

The study area for the GSM surveys is this latter area alongside the Old Cooma Road (Figure 2). Although this area is heavily grazed, largely degraded pasture, it contains some native species, including *Austrodanthonia carphoides*, *Austrostipa* spp., *Chrysocephalum apiculatum*, *Convolvulus erubescence* and *Leptorhynchos squamosus*, which are considered to be preferred host plants for

the Golden Sun Moth (eggs are laid at the base of the plants and larvae feed on the roots).

2.3.3 Landform

The study area occurs along the Old Cooma Road border on the western side of the Googong property (Figure 1 and 2). The Googong property is bounded by the Queanbeyan River 300 m to the east and Barracks Creek 400 m to the west, with Mount Jerrabomberra (779 m), 1.5 km further to the north-west. The suburb of Karabar and Queanbeyan lie to the north of the study area, while Cooma Road Quarry lies 2 km to the south-west.

The study area is at an elevation of over 700 m above sea level. The topography is gently undulating hills. Most of the study area is located on grazing land (sheep and cattle). The vegetation is mainly degraded grassland with the occasional paddock trees. There are also areas of better patches of grassland containing a number of native grasses and forbs.

2.3.4 Climate

Queanbeyan generally has a cool, dry climate. Summers tend to be warm and winters are cool (BOM Website accessed 15 October 2009). Based on weather records taken at Queanbeyan Bowling Club Weather Station since 1870, the hottest month on average is January, with a mean of 29° C. July is the coldest month with a mean of 11.8° C. The minimum mean in July is -0.1° C. Rainfall is low, with an annual mean of 591.8 mm. July is the driest month with average rainfall of 39.5 mm and the wettest is 59.4 mm in October. Across the region, however, rainfall is variable with more rain falling in the Brindabella ranges west of Canberra than does in the east, closer to Googong.

Weather data for the month of November/December 2009 is provided in Table 1 in Appendix B.

2.4 Golden Sun Moth Conservation Status and Ecology

2.4.1 Status

Golden Sun Moth is listed as: 'critically endangered' under Section 179 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*; 'endangered' under the NSW *Threatened Species Conservation Act 1995* and ACT *Nature Conservation Act 1980*; and 'threatened' under the Victorian *Flora and Fauna Guarantee Act 1988*.

2.4.2 Diet and Habitat

The adult moth is diurnal (day active) and has no functional mouth parts and therefore does not eat during its short life stage. Whereas, the larval form possess functional mouthparts and is presumed to feed on the roots of native grasses. There are virtually no data on the gut contents of larval stages of GSM and the literature on food preferences has been inferred from observations of female ovipositing sites and *in situ* pupal cases.

Previous studies by O'Dwyer & Attiwill (1999) regard *Austrodanthonia* spp. as the preferred larval food and consider that the density of *Austrodanthonia* may be one of the major limiting factors affecting GSM distribution. In the ACT, the GSM larval food preference was considered to be *Austrodanthonia carphoides* (Edwards 1990 & 1993 in Braby & Dunford (2006)), but the selection of a wider range of grass species is suspected (Braby and Dunford 2006). Furthermore, Braby & Dunford (2006) suggest that GSM may have the capacity to supplement or even switch its diet to another non-native grass, Chilean Needle Grass *Nassella neesiana*, when native grasses have been significantly depleted. However, they make the point that, until otherwise determined, the GSM should be regarded an ecological specialist dependant upon a narrow range of native grass taxa - *Austrodanthonia*, *Austrostipa* and *Bothriochloa*.

2.4.3 Life History

The life cycle of the Golden Sun Moth is relatively well understood. The flying season is relatively short, typically lasting from six to eight weeks (during November and December in the ACT region). Males fly only in bright sunshine during the warmest part of the day. Adults emerge continuously throughout the flying season (DECC 2005), but only live for two to five days, as they cannot feed (DEWHA 2008b). The commencement of the breeding season is probably influenced by Winter - Spring weather patterns.

After mating, it is believed that the females lay up to 200 eggs at the base of the *Austrodanthonia* tussocks. The eggs hatch after 21 days. The larvae tunnel underground where they remain feeding on the roots of *Austrodanthonia* before digging a vertical tunnel to the surface where the pupa remains for six weeks until the adult moths emerge (DEWHA 2008b). Larval development could range between one and three years, although the exact duration is not known (Annet Richter *pers comm.* University of Canberra). The number of emergent adults in any given season may vary widely, depending upon concurrent weather patterns and cohort fecundity.

Female Golden Sun Moths have reduced hind wings and are reluctant to fly, even when disturbed. Males, which are capable of flight, will not fly greater than 100 m away from areas of suitable habitat. Thus populations separated by distances of greater than 200 m can be considered effectively isolated and populations which have gone extinct, or vacant patches of suitable habitat, are highly unlikely to be recolonised (DECC 2005).

2.4.4 Geographic Distribution

Golden Sun Moth was previously widespread throughout south-eastern Australia, but due to the loss and fragmentation of natural temperate grasslands and grassy woodlands, the species is now largely restricted to isolated fragments in Victoria, NSW and the ACT. The GSM is known from 125 sites across its range, including at least 48 sites in NSW and 32 in the ACT (DEWHA 2009a). Twelve new sites were identified in Victoria by Biosis Research during the 2006-2007 flight season (Biosis Research, 2007). The 2009 flight season was also significant in Victoria, with new locations found.

Although some sites containing GSM are moderately large (eg. 10-100 ha) with relatively large populations, many others are small (<10 ha) and may comprise populations that are in decline. Many other sites containing GSM are located on private land or land with tenures that may not be compatible with conservation (DEWHA 2009a).

2.4.5 Genetic Distribution

Genetic studies of 46 GSM populations resulted in the grouping of these populations into five major genetic clusters or groups across the species' known geographic range (Clarke and Whyte 2003; Clarke 2001). These are:

- Group 1 (4 Victorian populations);
- Group 2 (2 NSW populations – Washpen Creek and Grace's Flat);
- Group 3 (15 populations between Yass and Boorowa);

- Group 4 (6 populations around Murrumbateman); and,
- Group 5 (16 populations in ACT and immediate environs).

All the GSM sites within the ACT fall within one genetically related population (Group 5), indicated by the low level of genetic variability across this group. The fragmentation of the ACT populations is considered to be a relatively recent phenomenon (within the last 30 - 40 years), and these populations were once joined by near contiguous habitat (Clarke 2001).

3.0 METHODS

3.1 Taxonomy

The plant taxonomy (method of classification) used in this report follows Harden (1990, 1992, 1993, 2002) and subsequent advice from the National Herbarium of NSW. In the body of this report plants are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the scientific name only. Common names where available have been included in the Appendices.

Names of vertebrates follow the Australian Faunal Directory (AFD) maintained by the Department of the Environment, Water, Heritage and the Arts (DEWHA). In the body of this report animals are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only. Common and scientific names are included in the Appendices.

3.2 Literature and Database Review

A desk-top review of GSM biology and geographic distribution was undertaken (see Section 2.4, above). Documents describing the type and distribution of grassland habitats within the study area were reviewed prior to the field surveys.

3.3 Survey Methodology

Based on discussion with DEWHA (Tess Ward, DEWHA. *pers com.* 2009), it was considered that two surveys season would be adequate in determining the presence /absence of the Golden Sun Moth. Initial surveys were also undertaken to support the assessment for the Googong Township Neighbourhood 1A subdivision in November 2008. A second season of surveys was undertaken in 2009, timing of these surveys is discussed further below.

3.3.1 Timing

The GSM flight season can occur anytime between mid October and January. Regular visits to known GSM sites during mid to late October were necessary to determine when flying has commenced. Formal surveys were undertaken between 29 October and 16 November, 2008, and, 18 November and 7 December 2009; during this time the weather was sunny with temperatures ranging from 17.9 ºC to 32.8 ºC and light to moderate wind (Appendix B).

3.3.2 Field Surveys

Potential habitat for the GSM is present within the study area, although no GSMs have been previously recorded. As such, the methodology for this project was to first determine if the GSMs occurred within the study area by using the meander technique and points counts. If present, structure transect such as those described in Clarke (1999) would be undertaken.

Meander technique involved surveying areas of GSM habitat on foot by a single observer at a walking rate of about 1 pace/sec. Flying male GSMs would be recorded within predetermined forward visual fields (i.e. the observer, whilst moving forward, is required to repeatedly scan 45^{o} either side of the transect centre line and maintain a viewing distance of about 20 m from the point of observation). Moth counts are made using hand tally-counters and the total number moths recorded (Figure 3).

Point counts were also made in pockets of potential GSM habitat within the study area (Figure 3). Point counts involve using a hand counter and stopwatch to record the number of moths seen in a given time period (typically 3 minutes). The observer stands at a certain point and rotates the body over a set period (30 sec), counting the number of moths for a distance of 30 m taking care not to record the same individual twice. This is repeated as many times as necessary (3-5) with a 5 minute interval between counts. This method is useful for indicating presence or absence (Clarke 1999; DEWHA 2009b).

Searches for GSM pupae cases were also undertaken within the study area and involved a random meander technique or focused searches within a defined search area, usually 20 m x 20 m quadrats. Although it is not considered to be enough reliable data from pupal case count techniques to show meaningful data for assessing GSM activity on a semi-quantitative basis, the presence of pupal cases can be used as an indicator as a likely breeding site (Hogg 2010).

4.0 RESULTS

4.1 Golden Sun Moth Habitat

Potential habitat for the GSM was identified and mapped during the current season. Vegetation within the study area is considered to be secondary grassland probably derived from a Yellow Box/Apple Box dominated woodland. The study area has been previously grazed, contains a mixture of native and exotic species. Native plant species include *Austrodanthonia* sp. Wallaby Grass, *Austrodanthonia carphoides* Short Wallaby Grass, *Austrostipa scabra* Slender Speargrass, *Austrostipa bigeniculata* Tall Speargrass, *Panicum effusum* Hairy Panic, *Themeda australis* Kangaroo Grass, and *Rumex brownii* Slender Dock. A number of weed species do occur on site including *Carthamus lanatus* Saffron Thistle, *Cirsium vulgare* Spear Thistle, *Conyza* sp. a Fleabane, *Trifolium repens* White Clover, *Trifolium subterraneum* Subterranean Clover, *Erodium cicutarium* Common Storks-bill, and *Romulea rosea* Onion Grass.

Potential habitat within the study area contains some native species such as the preferred host plant *Austrodanthonia* sp. but is considered to be poor condition as it has been heavily grazed and contains a number of weeds.

4.2 Golden Sun Moth Observations

No GSM were recorded within the study area during the current surveys, although GSM were found to be flying in relative high numbers at other known sites in the ACT and surrounding area. No GSM were detected during the 2008 season either, although they were recorded at control sites (Letchworth Nature Reserve, Canberra Airport and Belconnen Naval Base (Appendix A).

Searches for pupae cases were also undertaken in better quality habitat, however no pupae cases were found. As a result, following discussion with DEWHA (Tess Ward, DEWHA. pers com. 2009)

5.0 IMPACT ASSESSMENT

5.1 Introduction

Where there is potential habitat (foraging or breeding resources) for threatened species in the study area, further consideration must be given to the potential impact of the proposal on these species. The proposal may impact on threatened species by causing any of the following:

- death or injury of individuals;
- loss or disturbance of limiting foraging resources; and/or,
- loss or disturbance of limiting breeding resources.

Limiting resources are specialised habitat components that species are dependent on for their ongoing survival. Such limiting resources are predominantly associated with specialised breeding habitats (such as tree hollows or suitable nest/maternity roost sites) that occur at low densities, with high levels of competition from a range of species. However, for some species, limiting resources include specialised foraging habitats that have a restricted distribution (such as Golden Sun Moths feeding only on specific grassland species). The study area does contain potential habitat for the GSM, although in poor condition, as such further assessment under the EPBC Act has been prepared for the Golden Sun Moth below.

5.2 Impact of the Proposal

The water reticulation system and associated infrastructure area for the Googong Township would impact 7.33 ha of potential habitat for the GSM. Potential habitat within the study area contains some native species such as the preferred host plant *Austrodanthonia* sp. but is considered to be poor condition as it has been heavily grazed and contains a number of weeds.

Golden Sun Moths have been detected in areas to the west of the study area, approximately 400 m west of Old Cooma Road (Johnstone Centre 2004). No GSMs were recorded during the current surveys or previous survey in 2008. However, the GSM was observed in high numbers at other sites within the ACT and surrounding area. Observations of GSM during the current flight season from other sites in the ACT indicated a shorter GSM flying season in comparison to previous years (David Hogg, *pers com* 2010). Counts during these surveys peaked in late November and declined rapidly during December (David Hogg, *pers com* 2010). Given the surveys were undertaken at the peak time and weather conditions were optimum and no moths were observed in previous surveys, it is unlikely that GSM are present within the study area.

5.3 EPBC Act Assessment of Significance

Is there a real chance or possibility the action will lead to a long-term decrease in the size of a population of a species?

Potential habitat for the GSM occurs within better quality area of the grassland community in the study area. Although these areas are heavily grazed, largely degraded pasture, they contain some native species, including *Austrodanthonia carphoides*, *Austrostipa* spp., *Chrysocephalum apiculatum*, *Convolvulus erubescence* and *Leptorhynchos squamosus*, which are considered to be preferred host plants for the GSM as eggs are laid at the base of the plants and larvae feed on the roots.

The GSM was not recorded in the study area during the current surveys or targeted surveys undertaken in 2008. However, a population had been previously recorded approximately 400 m to the west of Old Cooma Road, in grassland to grassy woodland habitats of higher conservation value (Johnstone Centre 2004).

Given the lack of good quality habitat and records of the species in the study area, it is unlikely that the proposal would lead to the long term decrease in the size of a population of the species. Furthermore mitigation measures will be implemented prior and during construction phase of the project to minimise impacts to potential GSM habitat.

Is there a real chance or possibility the action will reduce the area of occupancy of the species?

The GSM was not recorded area during the 2008/2009 targeted surveys, despite being recorded elsewhere in its range during the same period. As such, it is unlikely to occur within the study area. Given the lack of records and poor quality of habitat it is unlikely that the Proposal would reduce an area of occupancy for this species.

Is there a real chance or possibility the action will fragment an existing population into two or more populations?

The nearest known population of the GSM is approximately 400 m to the west of Old Cooma Road. The only other record within 10 km is approximately 5 km to the north-west of the study area. Golden Sun Moths are poor flyers, and gaps of 200 m can fragment a population. The areas of potential habitat within the study area are considered isolated from these known habitat areas.

Degraded pasture, intensive grazing, sheep trails and electricity transmission lines already fragment the potential habitat for the GSM in the study area. It is unlikely that the Water Cycle Project would result in further fragmentation or

isolate an existing population into two or more.

Is there a real chance or possibility the action will adversely affect habitat critical to the survival of a species?

Critical habitats are areas of land that are crucial to the survival of particular threatened species, populations or ecological communities. The Minister, under the EPBC Act, maintains a Register of Critical Habitat. To date, no critical habitat has been listed for the Golden Sun Moth (DEWHA 2008a).

Austrodanthonia tussocks are believed to be important for the survival of the species (however, other species may also be valuable, including weeds such as *Nassella nessianta*), as it lays its eggs at the base of these plants, and the larvae feed on them. Given no GSM was recorded during the current or previous surveys, and only poor quality habitat is present, it is unlikely habitat within the study area would be critical to the survival of a local population. The proposal is therefore not likely to affect habitat critical to the survival of the species.

Is there a real chance or possibility the action will disrupt the breeding cycle of a population?

Grassland vegetation within the study area contains species (including *Austrodanthonia carphoides*) which are important for the breeding cycle of the GSM. After mating, the GSM deposits its eggs at the base of tussocks of *Austrodanthonia* grasses, but may also use tussocks of *Austrostipa* spp. and other grasses. When the eggs hatch and the larvae emerge, they tunnel underground where they remain feeding on the roots of the grass species (DEWHA 2008b).

Clearing and grubbing of vegetation, stripping and stockpiling of topsoil, bulk excavation and trench excavation would disrupt the remaining native grasses, including *Austrodanthonia* habitat. However no GSM or pupae casings were recorded within the study area, as such it is unlikely the proposal would disrupt potential breeding and foraging habitat for the GSM.

Is there a real chance or possibility the action will modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Potential habitat for the GSM occurs within the better quality grassland vegetation community. The draft guidelines for determining a significant impact on the GSM (under the EPBC Act) suggest that habitat loss, degradation or fragmentation of greater than 0.5 ha for a large area of habitat (greater than 10 ha), or any habitat loss, degradation or fragmentation for small or fragmented habitat areas could be considered a significant impact (DEWHA 2009b).

The potential habitat that occurs within the study area is considered to be small and fragmented. No GSM were recorded during the targeted surveys, as such it is unlikely that disturbance to the potential habitat within the study area would affect the habitat sufficiently to lead to the decline of the species. Furthermore, mitigation measures will be implemented prior to and during the construction phase of the project to minimise impacts to potential GSM habitat.

Is there a real chance or possibility the action will result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species habitat?

Grassland habitat in the study area has been previously disturbed and is currently subjected to heavy grazing and pasture improvement. The study area currently contains a variety of exotic species, which dominate the landscape. Providing weed management practices (to be outlined in the Flora and Fauna Management Plan) are implemented prior to and during construction, such as washing down of vehicles and machinery and weed control (using no drift herbicides and/ or fire regimes to avoid spread of weed), it is unlikely that the proposal would result in an increase in the establishment of invasive species that may be harmful to the habitat of the GSM.

Is there a real chance or possibility that the action will introduce disease that may cause the species to decline?

There are no currently known disease records for the GSM. If the species is present within the study area it is unlikely that the proposal would introduce any diseases that may cause the species to decline.

Is there a real chance or possibility the action will interfere substantially with the recovery of the species?

A national recovery plan for the GSM is currently in preparation by DECC (DEWHA 2008b). Until this plan becomes available, a range of priority actions are recommended to help the GSM recovery, including the following:

- Search for the species in suitable habitat in areas that are proposed for development or management actions;
- Do not change management of sites where species exists unless changes are likely to be beneficial;
- Do not destroy habitat and surrounding areas by ploughing and do not allow heavy, prolonged grazing on habitat;
- Retain and protect natural grassland remnants within the known distribution of the species; and

- Ensure remnant populations remain connected or linked to each other; in cases where remnants have lost connective links, re-establish links by revegetating sites to act as stepping-stones for dispersal.

As previously discussed, the current landuse (intensive animal farming and grazing) has resulted in severely degraded grassland habitat, where some patches of native species occur. The level of fragmentation of habitat is already high.

The nearest population of the GSM is approximately 400m to the west of Old Cooma Road. The only other record within 10 km is approximately 5 km to the north-west of the study area. Golden Sun Moths are poor flyers, and gaps of 200 m can fragment a population. The areas of potential habitat within the study area are considered isolated from these known habitat areas.

Surveys have been undertaken for the GSM over the past two seasons (2008/2009) and it has not been found within the study area. Furthermore mitigation measures will be implemented including a weed management plan prior and during construction phase of the project; and revegetation/ landscaping of the area using native grasses, to minimise impacts to potential GSM habitat.

The proposal is therefore not inconsistent with the recovery actions listed above.

Conclusion

The potential habitat that occurs within the study area is considered to be small and fragmented. No GSM were recorded during the targeted surveys, as such it is unlikely that disturbance to the potential habitat within the study area would affect the habitat sufficiently to lead to the decline of the species. A referral under the EPBC Act is not recommended.

6.0 **RECOMMENDATIONS**

The proposal is not considered likely to have a significant impact on any GSM under the EPBC Act. However, recommendations have been made to reduce the impact of the proposal on potential GSM habitat in the study area:

- Landscaping in adjacent areas should contain native species suitable to the area and should not include trees that would encourage predatory birds to nest and breed; and,
- Implementing weed management plan.

7.0 CONCLUSION

Targeted surveys for the GSM were undertaken within the study area during November and December 2009. No GSM were recorded during the current surveys or previous survey in 2008. However, the GSM was observed in high numbers at other sites within the ACT and surrounding area. Given the lack of records and poor quality habitat within the study area it is unlikely the GSM is present.

The study area does contain potential habitat for the GSM, although it is considered to been poor condition. Based on the impact assessment it is unlikely that the proposed Water Cycle project would have a significant impact on the GSM. A referral under the EPBC Act is not recommended.

APPENDICES

Appendix A: Survey Data

Table A1: Golden Sun Moths recorded during the current (2009) targeted surveys.

Golden Sun Moths Observed				
Study Area	**Date**			
Transect				
1	**18/11/2009**	**26/11/2009**	**02/12/2009**	**07/12/2009**
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20	0	0	0	0
Point Counts				
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
Letchworth Nature Reserve	26 GSM males flying	15 GSM Males Flying	20 GSM Males Flying	0

Table A2: Golden Sun Moths recorded during 2008 surveys

Date	Time	'Googong'	Weather		Control Sites		
			Temp °C	Wind km/hr	Letchworth Nature Reserve	Belconnen Naval Base	Airport
29/10/2008					-	GSM flying (obs)	-
04/11/2008	11:00 -14:00	no GSM obs	20.9	13	-	-	-
05/11/2008	11:00 -14:00	no GSM obs	21.2	17	-	-	-
06/11/2008	11:30 -13:00	no GSM obs		-	-	-	few GSM flying (obs)
07/11/2008	11:45 -13:30	no GSM obs	19.6	9	-	-	-
08/11/2008	12:30 -14:30	no GSM obs	17.9	19	-	-	-
10/11/2008	11:30 - 11:45	no GSM obs	26.6	11	~ 15 GSM males (obs)	-	-
12/11/2008	12 noon	no GSM obs	30.4	11	-	-	-
13/11/2008	10:00 -12:30	no GSM obs	30.0	11	-GSM flying	-	-
14/11/2008	10:00 -12:00	no GSM obs	32.3	31	-	-	-
16/11/2008	10:30 -12:00	no GSM obs	24.3	9	-	-	-

Highest recorded monthly

Lowest recorded monthly

Weather Data recorded for Tuggeranong Weather Station 070339 Bureau of Meteorology Website <http://reg.bom.gov.au/climate/data/weather-data.shtml>

Appendix B: Weather Data

Weather data for each day during the month of November and December 2009. Data was obtained from the Bureau of Meteorology's webpage for the Canberra Airport Weather Station (http://www.bom.gov.au/products/IDN60903/IDN60903.94926.shtml).

Table B1: Monthly weather data for November/December 2009

Date	*Day*	*Temps*		*Rain*	*Max wind gust*		
		Min	**Max**		**Dir**	**Spd**	**Time**
		°C	°C	mm	km/h		local
1	Sun	11.3	31.6	0.2	E	35	17:35
2	Mon	15.2	32.3	3.4	ESE	37	17:56
3	Tue	15.8	30.3	0.2	W	61	12:04
4	Wed	10.9	24.2	0	NNW	39	15:45
5	Thu	9.8	19.6	0	NE	41	13:56
6	Fri	12.3	20.4	0	NE	33	14:11
7	Sat	9.3	24.6	0	E	28	16:58
8	Sun	7.6	28.5	0	NW	46	16:06
9	Mon	10	31.2	0	S	43	13:32
10	Tue	9.3	32.7	0	ENE	37	17:50
11	Wed	10.3	33.2	0	E	35	17:43
12	Thu	10.5	34.9	0	SW	48	13:30
13	Fri	14	27.6	0.6	S	41	5:48
14	Sat	8.3	33.1	0	ESE	37	18:04
15	Sun	11.8	33.1	0	WNW	41	12:49
16	Mon	13.4	34.1	0	WNW	52	13:46
17	Tue	11	28.1	0	ENE	39	17:33
18	Wed	13.7	31.4	0	NW	28	14:39
19	Thu	13.5	37	0	W	43	15:42
20	Fri	15.8	37.9	0	W	50	15:25
21	Sat	19.1	29.7	0	W	43	10:46
22	Sun	16.8	28.7	0	WNW	59	15:14
23	Mon	14.9	18.3	0	NE	33	11:26
24	Tue	12.8	20.5	1.6	WSW	48	18:15
25	Wed	11.5	33.9	0	E	39	17:23
26	Thu	14.2	32.8	0	NW	44	17:55
27	Fri	13.7	26.5	6.8	NW	69	1:11
28	Sat	12.7	28.3	0	WNW	50	10:20
29	Sun	13.3	18.7	0	NW	41	11:25
30	Mon	10.8	20.7	0	SE	46	11:38
Statistics for November 2009							
Mean		12.5	28.8				
Lowest		7.6	18.3	0			
Highest		19.1	37.9	6.8	NW	69	
Total				12.8			

Date	*Day*	*Temps*		*Rain*	*Max wind gust*		
		Min	**Max**		**Dir**	**Spd**	**Time**
		°C	°C	mm	km/h		local
1	Tue	8.4	20.8	1.6	SSE	61	8:06
2	Wed	7	25	0	E	35	18:37
3	Thu	8.5	28	0	WNW	41	15:07
4	Fri	9	28.8	0	NW	43	13:00
5	Sat	11.5	26.6	0	NW	44	15:04
6	Sun	8.6	30.1	0	ENE	31	20:05
7	Mon	12.1	31.8	0	WNW	37	14:35
8	Tue	12.4	33.7	0	W	65	16:15
9	Wed	11.5	23.9	9.6	NNE	35	15:17
10	Thu	10.2	27.9	0.2	NW	57	12:27
11	Fri	11.3	23.9	0			
12	Sat	7	27.4		NW	41	13:12
13	Sun	9.1	32.1	0	ENE	46	17:25
14	Mon	15.7	27.4	0	ENE	43	16:48
15	Tue	14.9	32	0	ENE	35	15:43
16	Wed	15.5	36	0	W	39	14:56
17	Thu	14.3	38.2	0	WNW	56	11:55
18	Fri	15	26.9	3.6	NNW	43	13:06
19	Sat	8.1	31	0	ENE	48	16:47
20	Sun	14.4	27.5	0	NE	33	19:30
21	Mon	15.5	31.8	0	NNW	41	13:23
22	Tue	11.7	34.1	0	NW	39	14:16
23	Wed	13.7	35.7	0	ENE	44	19:06
24	Thu	17.1	34.7	0	NNW	46	15:49
25	Fri	17.6	19.1	16.4	S	43	0:08
26	Sat	12.7	18.9	30.6	ESE	20	19:37
27	Sun	13.3	27.2	0.4	NE	31	18:41
28	Mon	17.5	29.1	35.6	ENE	33	18:48
29	Tue	14.2	31.4	0.4	ENE	39	17:40
30	Wed	13	29.3	0	NNE	35	13:12
31	Thu	14.1	28.9	0	N	31	11:47
Statistics for December 2009							
Mean		12.4	29.0				
Lowest		7.0	18.9	0			
Highest		17.6	38.2	35.6			
Total			98.4				

The following weather details give the condition, air temperature, wind speed and direction during surveys. Weather Data recorded for Tuggeranong Weather Station 070339 Bureau of Meteorology Website http://reg.bom.gov.au/climate/data/weather-data.shtml

Table 3: Weather conditions during the 2009 survey period.

Date	Weather				Comments
	Temperature °C	Wind km/h	Direction	Rain	
18/11/2009	31.4	28	NW	-	Sunny
26/11/2009	32.8	15	N	-	Sunny
02/12/2009	25	9	SSW	-	Sunny- some cloud cover
07/12/2009	31.8	20	WNW	-	Partly cloudy

FIGURES

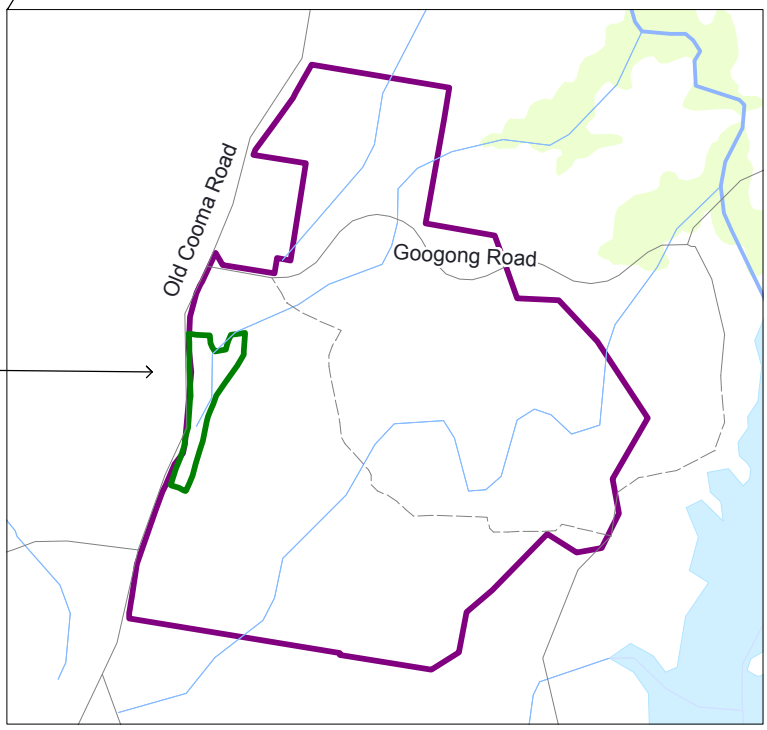

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Figure 1: Location of the Study Area in a regional context

Date: 25 May 2010	Drawn by: ANP
File number: S5530	Checked by: TE

Location: P:\5000\5500s\5530\Mapping\S5530 F1_Locality.WOR

Scale: 0 0.5 1.0 1.5 2.0 kilometres

N W E S

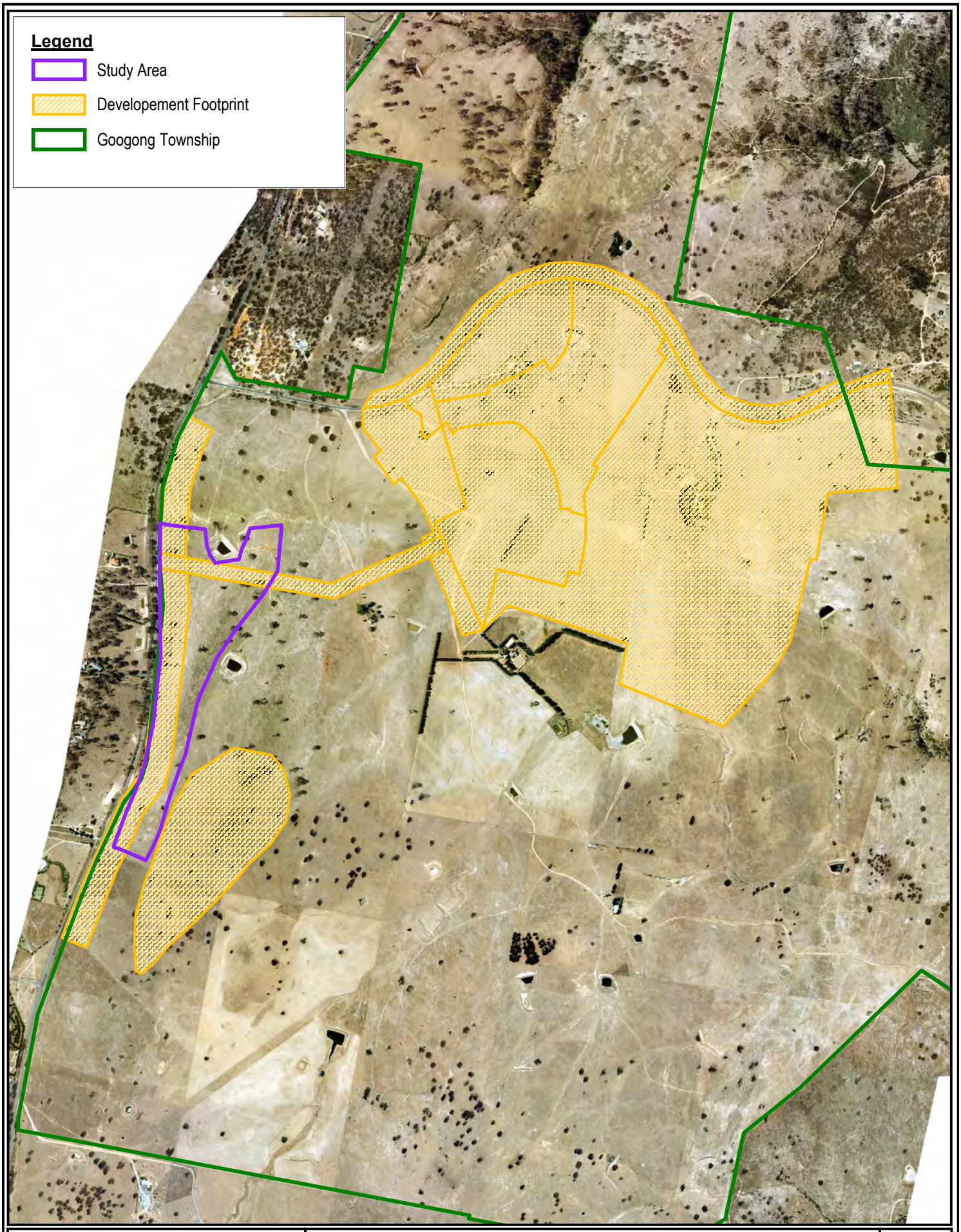

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Figure 2: Study Area

Date: 25 May 2010	Drawn by: ANP
File number: S5530	Checked by: TE

Location: P:\5000\5500s\5530\Mapping\S5530 F2_Study Area.WOR

Scale: 0 150 300 450 600 Metres

N W E S

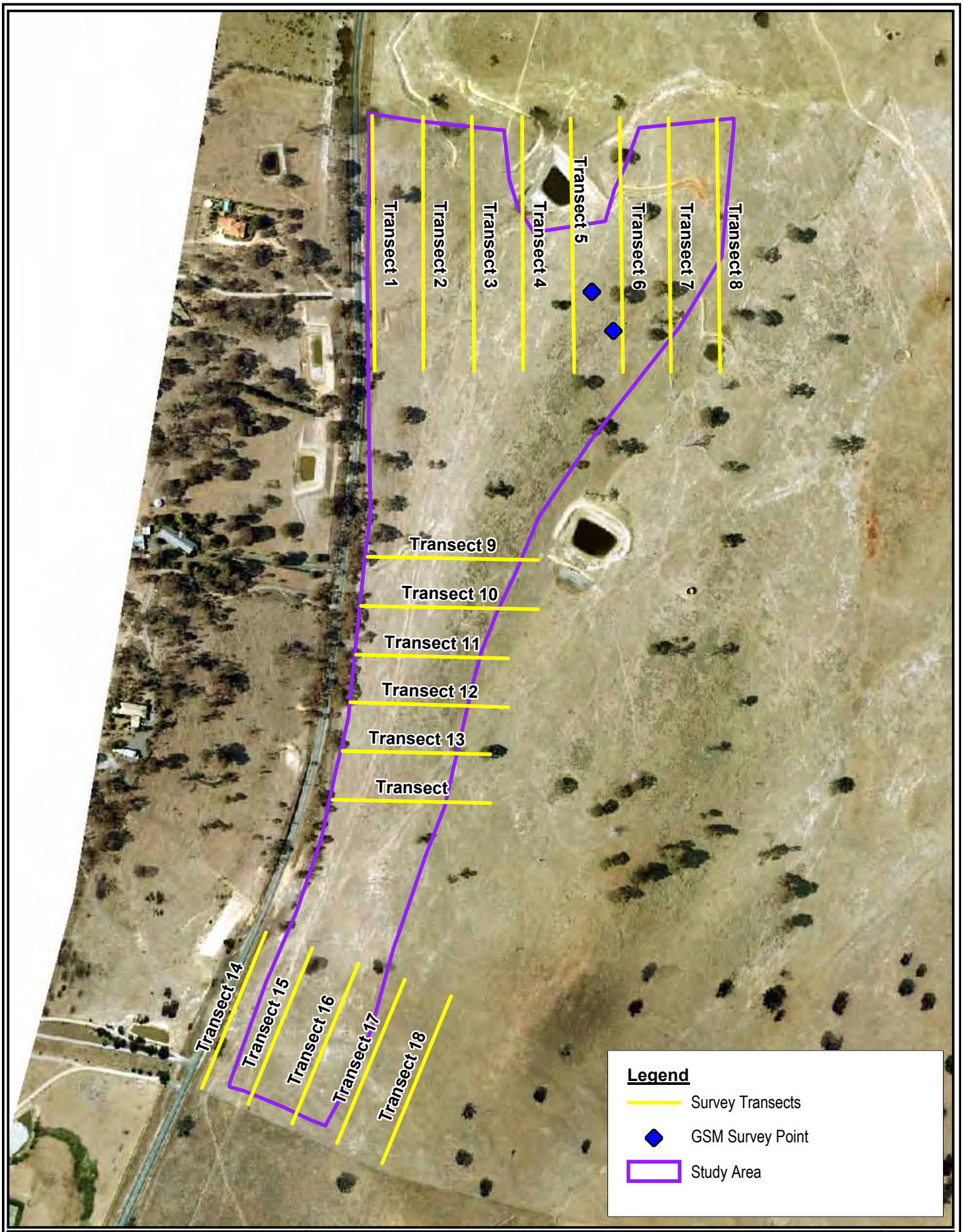

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Figure 3: Survey Transects

Date: 1 April 2010	Drawn by: ANP
File number: S5530	Checked by: TE

Location: P:\5000\5500s\5530\Mapping\S5530 F3_Survey Transects.WOR

Scale: 0 50 100 150 200 Metres

N W E S

REFERENCES

ACT Government (2007) 'Googong Draft Foreshores Plan of Management.'.

Braby MF and Dunford M (2006) Field observations on the ecology of the golden sun moth, Syemon plana Walker (Lepidoptera: Castiidae). *Australian Entomologist* 33**,** 103-110.

Clarke GM (1999) 'Survey and Monitoring for the Endangered Golden Sun Moth, *Synemon plana.* A report prepared for the Threatened Species Unit, NSW National Parks and Wildlife Service, Southern Zone.' CSIRO Entomology, Canberra.

Clarke GM (2001) 'Surveys and genetic analysis of NSW populations of the endangered Golden Sun Moth, *Synemon plana*. A report prepared for the Threatened Species Unit, NSW National Parks and Wildlife Service, Southern Zone.' CSIRO Entomology, Canberra.

Clarke GM and Whyte LS (2003) Phylogeography and population history of the endangered golden sun moth (*Synemon plana*) revealed allozymes and mitochondrial DNA analysis. *Conservation Genetics* 4**,** 719-734.

DECC (2005). Golden Sun Moth - threatened species profile, http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10791, Department of Environment and Climate Change

DEWHA (2008a). Register of Critical Habitat, http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl, Department of Environment, Water, Heritage and the Arts

DEWHA (2008b). *Synemon plana* - Golden Sun Moth - in Species Profile and Threats Database, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25234, Department of the Environment, Water, Heritage and the Arts

DEWHA (2009a). Background paper to EPBC Act Policy statement 3.12 - Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*), http://www.environment.gov.au/epbc/publications/golden-sun-moth.html, Department of the Environment, Water, Heritage and the Arts

DEWHA (2009b). Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*). EPBC Act Policy statement 3.12, http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth.pdf , Department of the Environment, Water, Heritage and the Arts

Ecowise Environmental and Biosis Research (2009) 'Googong Water Cycle Project - ecological assessments - flora and fauna. Report prepared for Canberra Investment Corporation.'.

Hogg D (2010) 'Semi-quantitative assessment of Golden Sun Moth sites.' David Hogg Pty Ltd, Canberra.

Johnstone Centre (2004) 'Environmental Assessment Googong Urban Investigation Area.' Charles Sturt University, Wagga Wagga.

Keith D (2004) 'Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT.' Dept. of Environment & Conservation (NSW),

O'Dwyer C and Attiwill PM (1999) A comparative study of habitats of the Golden Sun Moth *Synemon plana* Walker (Lepidoptera: Castniidae): implications for restoration. *Biological Conservation* 89**,** 131-141.