

Project Name:	Golden Sun Moth Surveys for ACT Accelerated Land Release Program
Project Number:	3002284
Report for:	Conservation Planning and Research Section, Environment and Sustainable Development Directorate

#### PREPARATION, REVIEW AND AUTHORISATION

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2	26/03/2012	Laura Proos	Wil Allen	Wil Allen

#### ISSUE REGISTER

Distribution List	Date Issued	Number of Copies
Conservation Planning and Research Section, Environment and Sustainable Development Directorate:	20/03/2012	Softcopy – 1 Associated Data Files – 1
SMEC staff:	20/03/2012	1 – Peter Gehrke 1 – Liza Miller
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Canberra Office Library (SMEC office location):	20/03/2012	1
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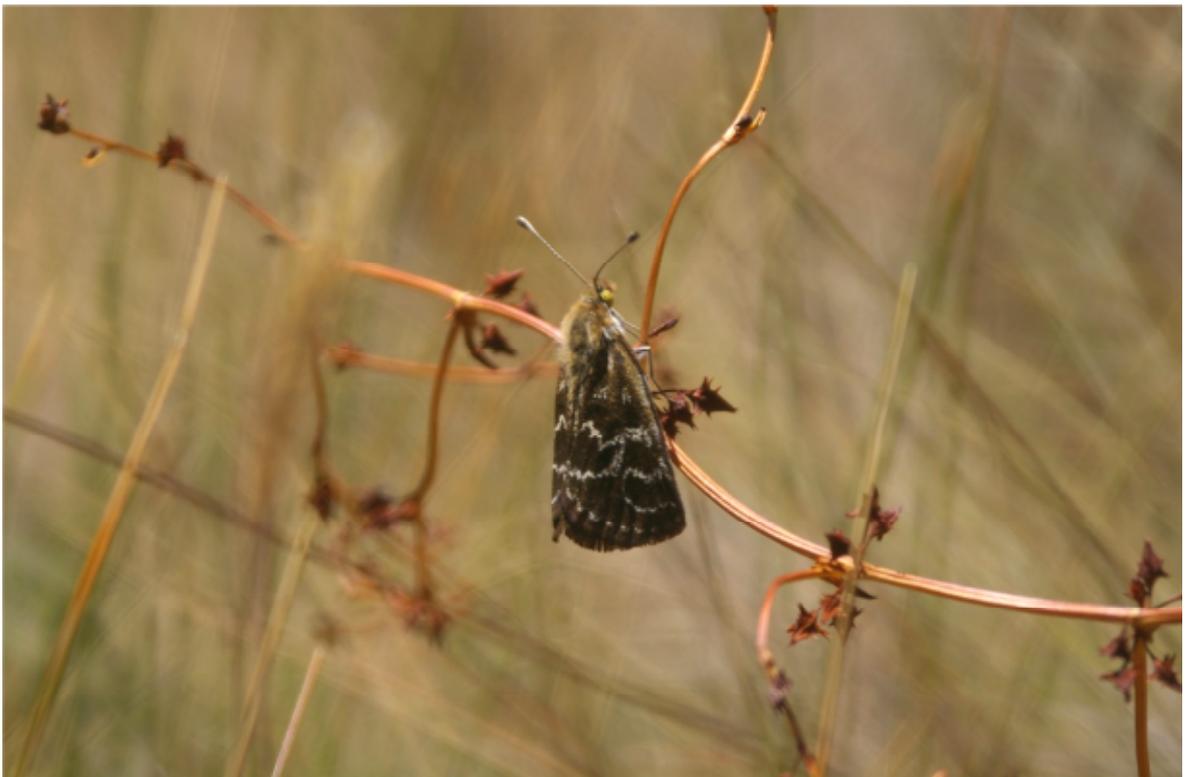
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# **Golden Sun Moth Surveys 2011 for ACT Accelerated Land Release Program**



**For: Conservation Planning and Research Section, Environment and  
Sustainable Development Directorate**

**FEBRUARY 13, 2012**

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## ABBREVIATIONS

ACT.....	Australian Capital Territory
ANIC .....	Australian National Insect Collection
EPBC Act.....	Environment Protection and Biodiversity Conservation Act,
ESDD	Environment, Sustainable Development Directorate
GSM.....	Golden Sun Moth
LTA .....	Long Term Average
PCRS.....	Planning, Conservation and Research Section
SEWPaC.....	Department of Sustainability, Environment, Water, Populations and Communities
SMEC.....	Snowy Mountains Engineering Corporation
DSE .....	Department of Sustainability and Environment
YBRGGW.....	Yellow Box Red Gum Grassy Woodland

# 1 INTRODUCTION

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## 1.1 Project Background

This report describes the results that the Snowy Mountain Engineering Corporation Pty Ltd (SMEC) obtained for the golden sun moth (GSM) *Synemon plana* Walker (Castniidae: Lepidoptera) surveys for East Fyshwick, Gungahlin Blocks, Gungaderra Nature Reserve ('Gungaderra') and RSPCA land at Symonston ('Symonston') (. The aim of these surveys was to confirm the presence or absence of local populations at these sites. The surveys build on previous local survey work on the GSM and aim to identify additional populations.

The purpose of the GSM surveys is twofold. Firstly, data from the GSM surveys will provide an update on the presence and/or absence and density of GSM for various sites over the ACT. Secondly, this information will guide decision-makers on the location of various developments and allow for conservation of the most important sites as a means of offsetting development impacts to the GSM.

This report provides details of the GSM surveys for the 2011/12 flight season and presents details on the local population ecology. Such information on the species distribution could be used by Conservation, Planning and Research for the Accelerated Land Development Program to inform future planning for land release and identify key habitat areas for the GSM that support its viability in the Canberra region.

Additional surveys were commissioned October 2011 to include an additional 14ha to the south of the East Fyshwick block, on the southern side of the railway. This additional work also included surveys for Perunga grasshopper, *Perunga ochracea* Sjöstedt 1921 (Acrididae: Orthoptera), involving greater attention to the ground layer, to record the presence of the grasshopper.

## 1.2 Golden Sun Moth

The GSM is a rare day flying moth that is found in grassy areas on the southern tablelands of New South Wales, ACT and Victoria (Common 1990; Edwards 1993). It inhabits grasslands dominated by wallaby grass (*Austrodanthonia* species) and is associated with native grasslands where it favours grass tussocks (Edwards 1993; Jelinek, Britton and New 1994). The moth can be very localized in its occurrence, but within one or two hectares individuals can be very numerous (Common 1990; Edwards 1993).

The moth is a medium-sized, diurnal moth with green eyes and clubbed antennae (Clarke and Spier-Ashcroft 2003). The upper-side of the female's forewing is dark grey with paler grey patterning, while the hindwing is bright orange with black spots along the edges. The under-side of both wings is white with small black spots along the margins. Adult males have a wingspan of 34 millimetres and have dark brown upper forewings with patterns of pale grey scales. Male hindwings are bronze or brown with dark brown blotches and the underside is pale grey with dark brown spots (DEWHA 2009a).

### 1.2.1 Conservation Status And Threats

The GSM is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The species is also listed as a threatened taxon under the *Victorian Flora and Fauna Guarantee Act 1988*, and as an endangered species under the *Australian Capital Territory Nature Conservation Act 1980* and the *New South Wales Threatened Species Conservation Act 1995* (DEWHA 2009a).

The key threats to the GSM are:

- The loss and degradation of wallaby grass; particularly *Austrodanthonia* species, dominated native temperate grasslands within the species historical range;
- The loss and degradation of open grassy woodlands where the ground layer is dominated by wallaby grass;
- Soil disturbance at extant GSM sites; and,
- Other factors that work in unison with key threats to further threaten the species, include the species' limited dispersal ability and predation pressure (Clarke and O'Dwyer 2000).

Native temperate grasslands are considered to be the most threatened of all vegetation types in Australia, having been cleared for urban development and agriculture; particularly for free range grazing and broad-acre cropping (Kilpatrick 1995 *cited in* Clarke and O'Dwyer 1999). Less than one percent of the approximately 2 million hectares existing prior to European settlement still remains, much of which is heavily degraded by weed invasion and grazing by stock and rabbits (Clarke and O'Dwyer 2000). Natural temperate grassland of the Southern Tablelands (NSW and ACT), which the GSM (among other species) is associated with is listed as an Endangered Ecological Community under the EPBC Act.



## 1.2.2 Biology

### Life History and Breeding Activity

The GSM has two discrete life stages: the larval stage, which appears to last for two to three years and is spent underground; and the adult stage that lasts one to four days. Larvae pupate into adult moths and emerge to breed between mid October and early January (depending on climate and geography) (DEWHA 2009b). Adult moths do not have functional mouthparts and therefore are unable to feed, spending much of their time mate searching and breeding. During the GSM flight season, adult moths emerge continuously in cohorts and males are seen actively flying low (to 1 metre) and fast usually in a zig-zag pattern over the grasses in search of females (Gilmore 2011). The females, which only fly irregularly, position themselves on the ground in a conspicuous location (usually inter-tussock spaces), flashing their yellow hind wings to attract males. Females walk between tussocks and lay 100 - 150 eggs between grass tillers or between tillers and the soil (Gibson 2006 *cited in* Gilmore 2011). Recent research has shown a slight male dominance of sex ratios in GSM populations in the ACT (Richter, Osborne, Robertson and Hnatiuk 2009).

It is likely that male GSM cannot travel more than 100 metres away from suitable habitat patches and therefore populations separated by distances greater than 200 metres can be considered effectively isolated. Moreover, sites from which the species has gone extinct are unlikely to be naturally recolonised (DEWHA 2009b).

According to Clarke and O'Dwyer (2000) GSM only fly on warm (that is, when temperatures are more than 20°C), calm days with little or no cloud and in the hottest part of the day (10:00 – 14:00 hours). However, recent surveys by Gilmore (2011) recorded active male moths in more variable weather conditions. Such conditions include: cooler days (less than 20°C), days with partial or full cloud cover, on days within 24 hours after rainfall, during periods of moderate to strong wind conditions and also at times earlier and later in the day than previously expected. Activity during these conditions typically involved smaller numbers of moths than those observed during 'optimal' conditions, but occasionally large numbers of individuals were recorded (Gilmore 2011).

### Habitat and diet

Potential habitat for the GSM includes all areas which have, or once had, native grasslands or grassy woodlands (including derived grasslands) across the historical range of the species. The GSM is also known to sometimes inhabit degraded grasslands, including those dominated by the exotic Chilean needle grass (*Nassella neesiana*), a weed of national significance (Thorp and Lynch 2000). The GSM occurs in two threatened ecological communities listed under the EPBC Act: the Natural Temperate Grassland of the Victorian Volcanic Plain (EPBC Act Policy Statement 3.8) and the Natural Temperate Grassland of the Southern Tablelands of New South Wales and the Australian Capital Territory (DEWHA 2009a).

Past land management practices at the site are likely to be a key factor in determining whether a potential area for GSM can support its environmental requirements. Although grazing itself does not preclude a patch from having the potential to support the species, the alteration of the vegetative structure, perhaps most importantly, by reductions in inter tussock spaces and soil compaction from heavy grazing, may limit the ability of the moth to recolonise a site (DEWHA 2009b; Gilmore *et al.* 2008).

Golden sun moths prefer slightly sloping sites (3° or less), particularly those with a northerly aspect. Shading is generally very minimal at GSM sites, and increases in shading (e.g. from buildings or tree planting) can negatively affect the temperature, moisture and plant characteristics of a site (DEWHA 2009a). The grassland habitats of the GSM are usually in slightly acidic, sandy clay loam soils that are low in phosphorus (< 14 µg/g), and are characterised by grass tussocks separated by areas of bare ground (that is, inter-tussock space) (O'Dwyer and Attiwill 1999). Inter-tussock space is thought to be important in helping males locate displaying females (Gibson 2006 cited in Gilmore 2011).

The GSM has demonstrated a preference for grasslands containing *Austrodanthonia* species (e.g. short wallaby grass – *A. carphoides*, bristly wallaby grass – *A. setacea*, hill wallaby grass – *A. eriantha*, lobed wallaby grass – *A. auriculata*, and clustered wallaby grass – *A. racemosa*). However, previous definitions of typical habitat being 40 percent *Austrodanthonia* cover (O'Dwyer and Attiwill 1999) are no longer considered accurate, as the species has been found flying and presumably breeding in grasslands dominated by native redleg grass (*Bothriochloa macra*), speargrasses (*Austrostipa* spp.), weeping grass (*Microlaena stipoides*), kangaroo grass (*Themeda triandra*) and in degraded and weed infested patches dominated by the exotic Chilean needlegrass (*Nassella neesiana*) (DEWHA 2009a). Gilmore *et al.* (2008) and Braby and Dunford (2006) have reported observing female GSM ovipositing on *N. neesiana* and cast pupa cases were also found in a dense sward of this species.

The diet of GSM larvae was thought to consist exclusively of the roots of wallaby-grasses (Gibson 2006 cited in Gilmore 2011). Recent surveys suggest that the larvae may also feed on spear-grasses and Chilean Needle-grass (Gilmore 2011). The latest research suggests that GSM feed on a range of C3 plants (*Austrodanthonia*, *Austrostipa*) and (*Nassella* i.e. introduced Needle-grass spp.) (W. Osborne, in prep).

## Distribution

At the time of European settlement, the GSM had a wide and probably continuous distribution in native temperate grasslands and open grassy woodlands, occurring wherever there were high densities of wallaby grasses. In New South Wales, GSM are recorded from Winburndale, near Bathurst, on the Yass Plains, and south through large areas of the Australian Capital Territory. In Victoria, they were recorded across vast areas around Bendigo, Williamstown, Mansfield, Eildon, Salisbury and Nhill, to Bordertown in South Australia (DSE 2004). Presently, less than one percent of the approximately two million hectares of native temperate grasslands remain intact (Kirkpatrick *et al.* 1995 cited in DEWHA 2009a).

In 2009, the GSM was known from 125 sites (post-1990) across its range (DEWHA 2009a). Forty-five sites are known to occur in Victoria, 48 sites occur in New South Wales and 32 sites occur in the Australian Capital Territory (DEWHA 2009a). No extant populations are known to exist in South Australia where the species is thought to be locally extinct (DEWHA 2009a).

Genetic studies suggest that the Victorian populations have been isolated from the New South Wales and the Australian Capital Territory populations since ancient times, and that the populations represent discrete evolutionary units (Clarke and O'Dwyer 2000). Because of their highly fragmented distribution and limited dispersal ability, all populations of this critically endangered moth are considered to be important for the long-term survival and recovery of the species (DEWHA 2009a).

### 1.3 Perunga grasshopper

The perunga grasshopper, *Perunga ochracea* Sjöstedt 1921 (Acrididae: Orthoptera), is listed as 'vulnerable' under the *Nature Conservation Act 1980* (NC Act 1980). It is principally characterised by the presence of a stout femur of the hind leg and an auditory tympanum on the anterior abdomen under the wings. In males, there is a furcula (a forked structure) at the tip of the abdomen. Both sexes of the perunga grasshopper are short-winged and flightless. The wings are shorter than the length of the pronotum and possess many raised longitudinal veins.

In the ACT, the perunga grasshopper is found in Natural Temperate Grassland dominated by *Danthonia* species, species of *Stipa* or *Themeda triandra*, and in native pasture (Stephens 1998). Historic records from the Australian National Insect Collection (ANIC) indicate that the species may also occur in open woodland areas with a grassy understorey, including the endangered Yellow Box Red Gum Grassy Woodland (YBRGGW) community. The species has a yearly lifecycle. ANIC specimens indicate that adult perunga are generally collected from late October to mid February. Nymphs hatch in late summer and autumn and develop over winter and early spring (Rentz 1996).

On the basis of ANIC and other records, the species has a small range stretching 180 kilometres east-west and 150 kilometres north-south. However, the area of occupancy within this range is likely to be low because of the reduction in size or extinction of populations through habitat alteration and fragmentation. The ANIC records and recent collections suggest that the species was once quite widespread across the ACT.

Like the GSM, habitat reduction and its degradation has been a major driver in influencing the viability of this species. Its low dispersal ability and the ongoing degradation and fragmentation of native grasslands have led to a serious decline in the occurrence and viability of this species. Indeed, there has been a serious decline in the quantity and quality of habitat throughout its range including the ACT. About 5 percent or 1000 hectares of the Natural Temperate Grassland still exists in moderate to good condition (ACT Government 1997) and it is possible that as little as 3 to 4 percent of the original area of Yellow Box Red Gum Grassy Woodland community of the ACT may remain in something like its natural state (ACT Government 1999). The perunga grasshopper appears to occur in only a few remnants of these communities, and the ecological parameters of sites containing the species have not yet been identified. Native grasslands are in demand for urban, industrial and infrastructure development as well as being vulnerable to alteration by agricultural practices.



*Figure 2 The Perunga grasshopper*

## 1.4 Objectives

This report provides information on the distribution of the GSM for the Canberra region. The outputs of this work are intended to assist the Land Management and Planning Division in planning for development over the Canberra region. To do this, targeted surveys for the GSM were conducted at selected sites in East Fyshwick, Gungaderra, Gungahlin Blocks and Symonston (RSPCA land)().

The objectives of this project were:

- To undertake targeted surveys for the GSM during the 2011/12 flight season;
- To build on previous studies on this species and identify additional populations within the Canberra region;
- To collect data that can be used to prioritise areas of conservation value across the Canberra region;
- To support the ACT government in its conservation of the GSM; and
- To inform future precinct planning.

## 1.5 Study Area

The survey sites are located at least 11.5 km north and 6.7 km east and south east of Parliament House, Canberra. The study area comprised of East Fyshwick, Gungahlin Blocks, Gungaderra and Symonston. These sites contained native grasslands in varying condition. Some sites, such as Gungahlin Blocks and East Fyshwick, had a history of cattle grazing and others, such as Symonston, are remnants of what once were larger grassy ecosystems.

## 2 METHODS

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### 2.1 Field Surveys

The field surveys comprised of transect and/or meandering surveys for selected sites within the ACT. These surveys were designed to determine whether the GSM occurred at a particular site and where appropriate, its distribution and abundance over that site.

The surveys were done according to the Conservation Planning and Research '*Survey Guidelines for Golden Sun Moth*' (2010), and moth abundance was recorded according to the criteria in '*Semi-Quantitative Assessment of Golden Sun Moth Sites*' by David Hogg (2010). When weather conditions remained suitable for GSM activity, surveys were continued beyond 1400 hours to maximise the chance of detecting the species. The survey sheets are in Appendix A. Prior to field work commencing, Alison Rowell, who has detailed local knowledge on GSM and ecology, trained SMEC staff to identify GSM *in situ* and understand how their behaviour may influence detectability.

The first records for the season of GSM in flight were in the second week of November 2011, and the surveys commenced on 19 November. York Park (Barton) was the nominated reference site, however other reference site information was communicated among survey teams employed by Conservation Planning and Research Section (Environment and Sustainable Development Directorate) and utilised accordingly. Reference site information was recorded where relevant in the survey data (see Appendix 2).

### 2.2 Reference Sites

Six reference sites were used throughout the season based on their proximity to the candidate survey site. These sites were; York Park (Barton), Crace, East Majura Site, McGregor, Yarralumla, and Canberra Airport. York Park which was the main reference site used by SMEC, is bounded by State Circle, Canberra Avenue, National Circuit and the footpath on the East Block side of Kings Avenue. The area that was designated a reference site for the GSM was the native grassland, which is signposted as York Park. The area of York Park is approximately 0.4 hectare. It is a lowland area with a mix of native and exotic grasses. Trees are few and mostly restricted to the perimeter of York Park. The GSM population at York Park is of high to moderate density (Edwards 1994).

Nominated reference sites were visited to determine if a moth community was likely to be in flight. These reference sites were visited on days predicted by climatic conditions to be suitable for flight, as indicated by the Bureau of Meteorology website, and used to indicate whether the GSM would be in flight at a survey site on a particular day. The weather conditions were:

- at least two days since rainfall;
- predicted warm (above 20 degrees Celsius by 10am) days;
- clear or mostly cloudless sky; and
- not excessively windy to disrupt GSM flying and survey accuracy.

## 2.3 Literature and Database Review

To gauge the habitat requirements of the GSM and ensure that field surveys were as accurate and efficient as possible, the following literature and databases were examined.

- Commonwealth: EPBC Act Protected Matters Search Tool EPBC Section of the [www.environment.com.au](http://www.environment.com.au) website;
  - EPBC Act Significant Impact Guidelines 1.1 and species-specific relevant policy statements, the Species Profiles and Threats Database (SPRAT), and Environmental Reporting Tool (ERT); and
  - National species recovery plans and conservation advices.
- Listing of Threatened Species, Ecological Communities and Threatening Processes under the *Nature Conservation Act 1980*;
- Integrated Nature Conservation Plan (INCP, <http://incp.environment.act.gov.au/>): information on nature conservation planning and management, statistics and maps of threatened species and nature conservation activities;
- Relevant published and unpublished work e.g. consultant reports. In particular, scientific literature was reviewed in light of the findings from the field surveys; and
- Aerial photos, topographic maps, and GIS information.

## 2.4 Survey Sites

The key survey areas were those which were designated as having a moderate to high potential for GSM habitat (*Figure* ). The survey sites for this report are: East Fyshwick, Gungahlin Blocks, Gungaderra and Symonston. The locations are shown in Figure 1; details of the survey method and the area surveyed are in the table below.

Table 2 The sites surveyed for GSM and the type of survey used to detect moths.

Site	Survey Type	Area (hectares)
East Fyshwick	Meander	77
Gungahlin Blocks	Transect and Meander	44
Gungaderra	Meander	155
Symonston	Meander	6

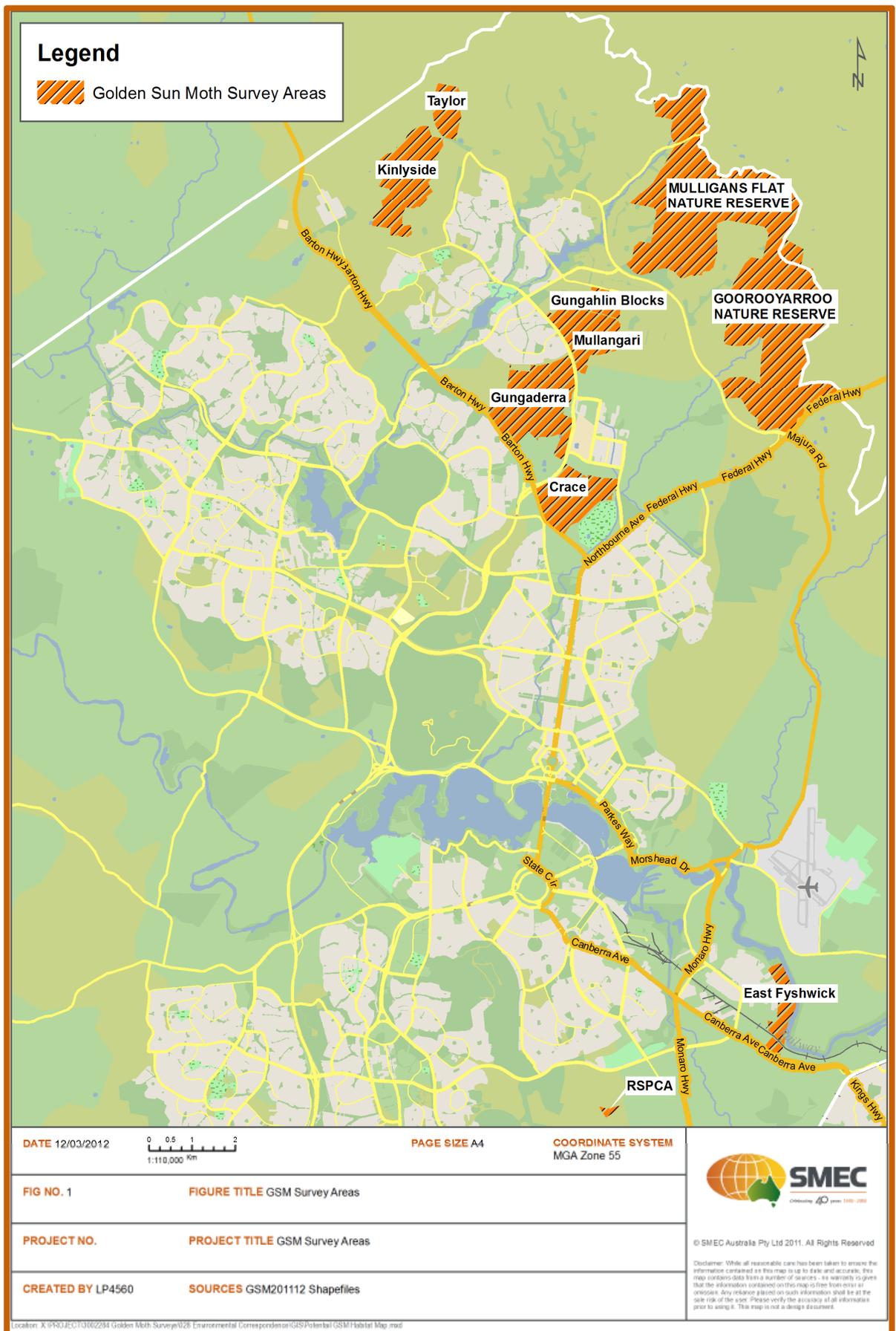


Figure 3 Golden sun moth sites over the Canberra region.

### 2.4.1 East Fyshwick

This site is between Canberra Avenue, Tom Price Street, Tennant Street and Beaconsfield Street at East Fyshwick. The Molongolo River borders the area and a railway bisects it. The area appears to have been used for livestock grazing and parts of the area are still being grazed by cattle.

### 2.4.2 Gungaderra

Gungaderra Nature Reserve is bounded by Gungahlin Drive. It provides important habitat for the vulnerable striped legless lizard, *Delmar impar*, the perunga grasshopper, the endangered button wrinklewort, *Rutidosia leptorrhynchoides*, and the GSM (Schedules 1 and 2 of the Nature Conservation (Species and Ecological Communities) Declaration 2005 (No. 1)). About 60 hectares of the reserve is occupied by Natural Temperate Grassland EEC. The reserve also includes several significant weeds including Chilean Needle grass and serrated tussock. The ACT Department of the Territory and Municipal Services manages the reserve.

### 2.4.3 Gungahlin Blocks

Gungahlin Blocks 292, 352, 499 and 588 is bound by Anthony Rolfe Avenue, Hamer Street, Manning Clarke Crescent and Hinder Street. The area is comprised of old pasture lands which supported livestock activities. Gungahlin Blocks is intended to be developed under Control Plan No. 171/08/0002 to establish planning and urban design provisions including building height, setback, landscape character, access and parking. A small part of the study area is adjacent to a Uniting Church and a childcare centre.

### 2.4.4 Symonston

The Symonston, or RSPCA site, is located on Narrabundah Lane (Symonston). It is a triangular shaped block and is about 6 hectares in size. The area appears to have been used for livestock grazing. According to ACTMAPi, the block contains a small amount of EPBC qualifying Box Gum Woodland and Lowland Woodland (partially modified).

## 2.5 Perunga grasshopper

The perunga grasshopper was surveyed at the East Fyshwick site. The rationale for this survey was to gauge the presence of the grasshopper. The survey was undertaken during GSM surveys with greater attention to the ground layer. Incidental observations were made during all surveys.

## 2.6 GIS Data Gathering

**Meandering Traverse:** The field data was mapped using handheld GPS units in WGS 84 datum, waypoints were taken upon a change in direction, in search for suitable habitat, until all likely habitat was surveyed. The waypoints were used to create polylines indicating the track taken by the surveyor.

**Walked Transect:** The field data was mapped using handheld GPS units in WGS 84 datum, using it to stay on track (N, S, E or W), and 100 metre segments were measured. The readings were transferred to a spreadsheet, and 50 metres subtracted from the end point of the transect so that the GSM results are mapped at the mid-point of the segment.

**Perunga Survey:** During the East Fyshwick meandering survey, perunga grasshoppers were also surveyed using handheld GPS and waypoints taken in WGS84 datum to indicate location.

**Weather Information:** While the weather conditions were checked on the day of survey, finer detailed information was obtained from Bureau of Meteorology ([www.bom.gov.au](http://www.bom.gov.au)) to inform the results post survey. This data was entered into the relevant shape files.

### **2.6.1 Quality Control**

As a quality control measure, data entry was carried out and standardised across sites with reference to weather information and reference sites moth densities. Manually mapped survey paths were cross checked with GIS output

## 3 RESULTS

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### 3.1 Site Condition Assessments

#### 3.1.1 East Fyshwick

The quality of this site varied from paddock to paddock. The original vegetation may have been open Yellow Box Red Gum Grassy Woodland, as there are remnant patches of this vegetation type nearby at Harman, Oaks Estate and Newline Quarry.

South of the railway line:

- the western paddock contains some native grasses but is dominated by exotic forbs, and was probably ploughed. This area is not likely to support GSM;
- the central area (near a belt of eucalypt trees) is native dominated. Most of the area is native pasture with patches of *Austrodanthonia*, and diverse secondary native temperate grassland. This area is of moderate quality for potential GSM habitat.
- the eastern area contains patches of low quality GSM habitat, with native grasses including species of *Austrodanthonia*. However, much of the area is weedy and/or low-lying.

North of the railway line:

- the first paddock north of the railway line is bounded by the Molongolo River and a broad drainage line which runs to the river. It is mostly weedy pasture, with patches of *Austrostipa* and *Austrodanthonia* at the western edge. The western section is of low quality potential GSM habitat.
- north of the drainage line is an area of ungrazed weedy native grassland, disturbed by tracks and dumping of soil and other materials. This area contains patches of native temperate grassland with a high component of low wallaby grasses *Austrodanthonia carphoides* and *A. auriculata*. These patches, with a total area of 0.5 hectares, are of moderate quality potential GSM habitat. There is a known patch of the endangered button wrinklewort in this area, but it was not seen during the survey.
- cattle graze the paddocks between the Molongolo River and Tennant Street. These paddocks contain short weedy native pasture, dominated by *Austrostipa bigeniculata* and small patches of *Austrodanthonia*. The drainage lines were dominated by exotic species. These paddocks are of low quality potential GSM habitat.

#### 3.1.2 Gungaderra

The main drainage line from the southeastern part of the site contains dense Phalaris on wet ground, and is not GSM habitat. Other areas show evidence of past pasture improvement, with subterranean clover, ryegrass and scattered Phalaris; as well as weedy areas on nearby hills that are probably from former stock camps.

During the site surveys much of the site was dominated by weedy native pasture. Tall speargrass (*Austrostipa bigeniculata*) was the dominant native species, with *Austrodanthonia* in patches or co-dominant in parts. *A. caespitosa* was also common and *A. fulva* was seen in wetter areas. *A. carphoides* and *A. auriculata* were occasionally found in shorter grassland on knolls.

A ridge north of the drainage line contained a patch of diverse natural temperate grassland, with many native forbs including daisies, lilies and onion orchids. The native-dominated areas were low to moderate quality potential GSM habitat. During the surveys the grass was long and dense in most areas, and little bare ground was present.

### 3.1.3 Gungahlin Blocks 292, 352, 499 and 588

The original vegetation of this site would have been YBRGGW, and there are remnant trees scattered throughout. The mown area south of The Valley Avenue, Gungahlin, is moderately weedy but dominated by native grasses, mainly Tall Speargrass, with a moderate component of Wallaby Grasses *Austrodanthonia* (mainly *A. caespitosa*). This is low quality potential GSM habitat.

The paddocks north of Hibberson Street also have a high component of native grasses, with weedy patches and some evidence of pasture improvement (Phalaris and Ryegrass). Wallaby Grasses (mainly *A. caespitosa*, occasionally *A. laevis* and *A. carphoides*) are a minor to moderate component throughout. That part of the area not covered by trees or weed patches and is low quality potential GSM habitat.

The broad mown southern verge of Hibberson Street has been planted with an exotic dryland grass mix near the road, but contains some native grasses in the southern section. The degree of disturbance and high cover of exotics makes this very low quality potential GSM habitat.

The grasses south of Hibberson Street and east of Kate Crace Street were very long and dense in December 2011. This area contains a mixture of native grasses, Phalaris and weeds. There are patches of Wallaby Grasses (mainly *A. caespitosa*, occasionally *A. laevis*). The degree of disturbance, pasture improvement and weed invasion makes this area low quality potential GSM habitat.

### 3.1.4 Symonston

The eastern half of the site contains very open YBRGGW / derived native grassland, with four mature yellow boxes and red gums, and a very small amount of eucalypt regeneration. The ground layer is native dominated. The dominant species is Tall Speargrass *Austrostipa bigeniculata*, subdominants are Ringed Wallaby Grass *Austrodanthonia caespitosa* and Redleg Grass *Bothriochloa macra*. There are some patches of Short Wallaby Grass *Austrodanthonia carphoides*. Native grasses cover about 90 percent of this half of the site, and there is a small amount of bare ground.

Native forbs are uncommon in this section. Twelve native forb species were recorded, but their cover is very low and several were species which persist on grazed sites or colonise ground bared by overgrazing. There is also low cover of exotic perennial grasses and broad-leaved weeds, but these include serious agricultural weeds such as serrated tussock, saffron thistle, African lovegrass, Paterson's curse and St John's wort. There is evidence that some of these had been sprayed this season.

This area is potential GSM habitat. This habitat was cleared and maintained as secondary grassland by grazing, and would have been in contact with primary NTG just to the east within the last 40 years.

On the western section there are about 11 mature eucalypts in this part of the site and there is moderate eucalypt regeneration; which borders dense YBRGGW to the west. The ground layer in the higher southwestern corner contains many agricultural weeds; probably a stock camp effect. The ground layer in the northwestern corner is native-dominated, with moderate eucalypt regeneration. This part of the site is less likely to

contain GSM, due to weediness on the rise and woodland regeneration in the lower wetter area near the road.

The eastern half of the site is potential GSM habitat, but the poor GSM season in 2011/12 may mean that low-density populations were not detected by the standard survey method. Nonetheless, the GSM habitat quality is relatively low; as the site is secondary native grassland (that is, cleared from Box-Gum woodland), and has a probable history of past moderate grazing with associated major fluctuations in biomass and bare ground.

Table 3 The sites surveyed for GSM and the potential as GSM habitat.

Site	Potential for GSM habitat	Relevant Habitat Features
East Fyshwick	Low	Native grassland / pastures
Gungaderra	Low	Native grassland / pastures
Gungahlin Blocks	Low	Native grassland
Symonston	Low	Secondary native grassland

## 3.2 Golden Sun Moth Sightings

No GSM were recorded in any of the surveyed sites for the 2011/12 flight season. The table below details the timing, weather conditions and methods for the surveys. For the Gungahlin Blocks the survey method on the last event was changed from 'transect' to 'meander' as per the guidelines as no moths were sighted in three previous field surveys.

Table 4 The timing and weather conditions for moth surveys at each site

Survey Site	Survey Date (dd/mm/yyyy)	Time (hours)	Weather conditions	Transect type	Moths detected (Y/N)	Reference Site Activity
East Fyshwick (Figure 4)	19/11/2011	11:00 – 14:20	Maximum temperature 27°C No cloud cover 28/35 km/h NW wind Last rain 19/11/2011	Meander	N	Low numbers at York Park (Barton)
	14/12/2011	13:10 – 14:57	Maximum temperature 19°C Cloud cover 75% 13 km/h N – ESE wind Last rain 11/12/2011	Meander	N	4 moths at Crace, low temps, all flushed
	23/12/2011	11:30 – 14:10	Maximum temperature 27°C Cloud cover 10% 33 km/h E wind Last rain 22/12/2011	Meander	N	sighted 21 moths at York Park in 2 hrs
	20/01/2012	12:50 – 14:30	Maximum temperature 33°C Cloud cover 15% 52 km/h ENE wind Last rain 20/01/2012	Meander	N	18 at East Majura Site

Survey Site	Survey Date (dd/mm/yyyy)	Time (hours)	Weather conditions	Transect type	Moths detected (Y/N)	Reference Site Activity
<b>Gungaderra</b> (Figure 5)	03/12/2011 (1)	12:00 – 15:32	Maximum temperature 18°C No cloud cover 5-10 km/h NW Last rain 1/12/2011	Meander	N	Low GSM activity at York Park
	03/12/2011 (2)	12:10 – 15:00	Maximum temperature 18°C No cloud cover Moderate NW wind Last rain 1/12/2011	Meander	N	Low GSM activity at York Park at 11:30 - 8 GSM in 10 minutes
	03/01/2012	11:15 – 15:00	Maximum temperature 34°C Cloud cover 10% 31 km/h WNW wind Last rain 22/12/2011	Meander	N	37 GSM in 2 hours at the Airport
	18/01/2012	11:30 – 15:00	Maximum temperature 32°C, Cloud cover 10% 39 km/h E wind Last rain 22/12/2012	Meander	N	Moderate GSM Numbers at Airport
<b>Gungahlin</b> (Figure 6)	23/12/2011	12:00 – 12:25	Maximum temperature 27°C Cloud cover 10% 33 km/h E wind Last rain 22/12/2011	Meander	N	Low numbers at York Park
	24/12/2011	11:50 – 12:25	Maximum temperature 18°C Cloud cover 10% 44 km/h E wind Last rain 23/12/2011	Meander	N	11 marked in 2 hours in York Park
	13/01/2012	13:30 – 14:05	Maximum temperature 27°C Cloud cover 10% 44 km/h NW wind Last rain 01/01/2012	Meander	N	Low numbers at Yarralumla
	20/01/2012	13:20 – 15:00	Maximum temperature 33°C Cloud cover 10% 52 km/h ENE wind Last rain 01/01/2012	Meander	N	High numbers at McGregor

Survey Site	Survey Date (dd/mm/yyyy)	Time (hours)	Weather conditions	Transect type	Moths detected (Y/N)	Reference Site Activity
<b>Gungahlin Blocks</b> (Figure 7)	22/12/2011	12:00 – 15:00	Maximum temperature 25°C Cloud cover 80% 27 km/h SSW wind Last rain 19/12/2011	Transect	N	Moderate numbers at York Park
	24/12/2011	12:30 – 15:00	Maximum temperature 25°C Cloud cover 10% 5 - 15 km/h NE wind Last rain 22/12/2011	Transect	N	Moths flying at York Park
	29/12/2011	12:50 – 15:15	Maximum temperature 26°C Cloud cover, 10% 39 km/h NNE wind Last rain 22/12/2011	Transect	N	Low moth numbers at York Park
	13/01/2012	12:00 – 13:30	Maximum temperature 26°C Cloud cover: 10% 39km/h ENE wind Last rain 22/12/2011	Meander	N	NA
	20/01/2012	12:20 – 14:21	Maximum temperature 33°C Cloud cover 10% 52km/h ENE wind Last rain 1/1/2012	Meander	N	NA
<b>Symonston</b> (Figure 8)	8/12/2011	13:30 – 14:10	Maximum temperature 21°C Cloud cover 75% 20 km/ NE wind Last rain 1/12/2011	Meander	N	9 moths in 5 mins at York Park
	9/12/2011	11:15 – 12:00	Maximum temperature 21°C Cloud cover 65% 13 km/h NNE wind Last rain 1/12/2011	Meander	N	3 moths in 17 mins at York Park
	10/12/2011	13:25 – 14:10	Maximum temperature 25°C Cloud cover 25% 15 km/h NE wind Last rain 4/12/2011	Meander	N	3 moths in 5 mins at York Park
	13/12/2011	12:20 – 13:05	Maximum temperature 18°C Cloud cover 85% 11 km/h SE wind Last rain 10/12/2011	Meander	N	Low numbers in Symonston area

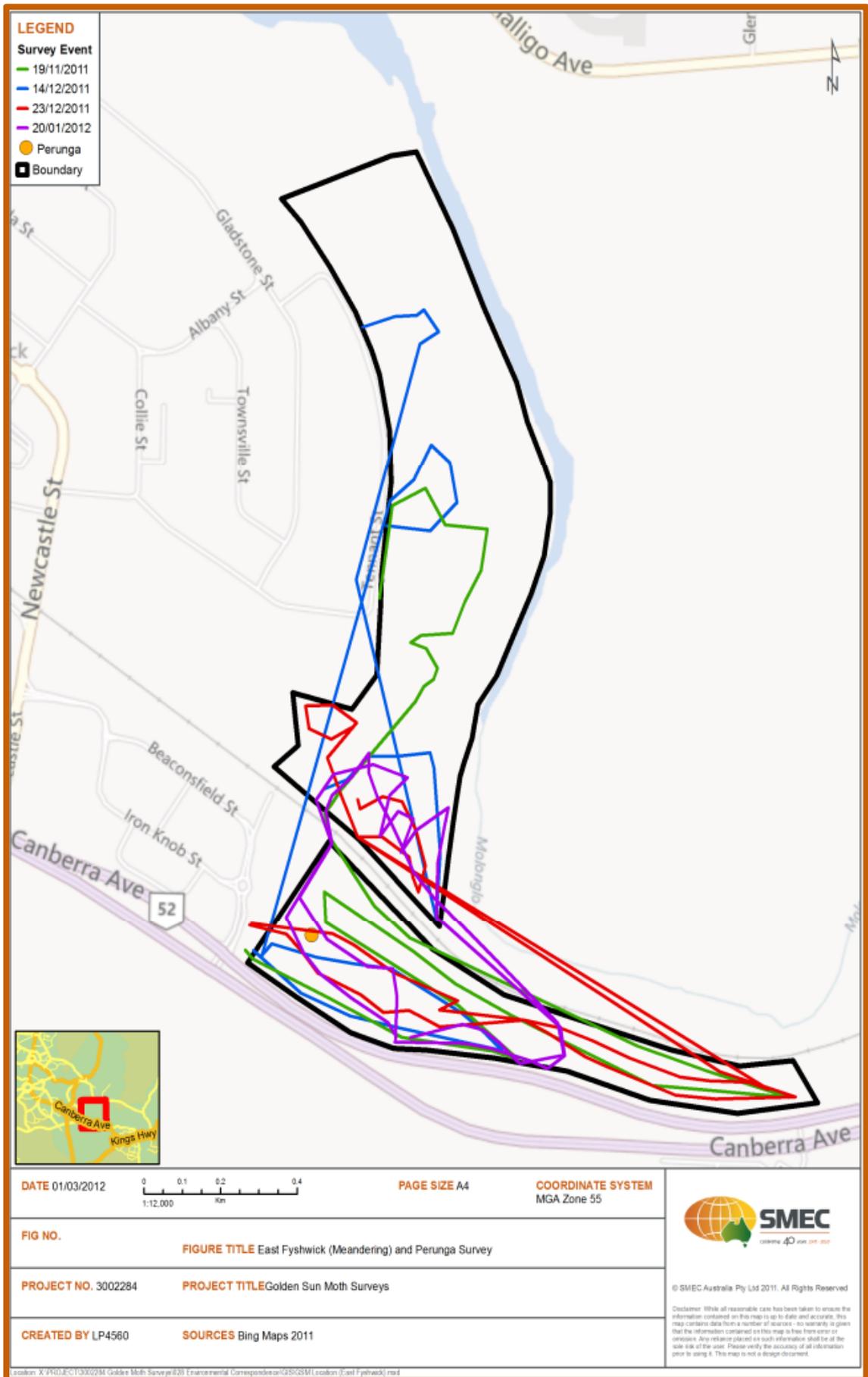


Figure 4 East Fyshwick GSM meander and perunga survey

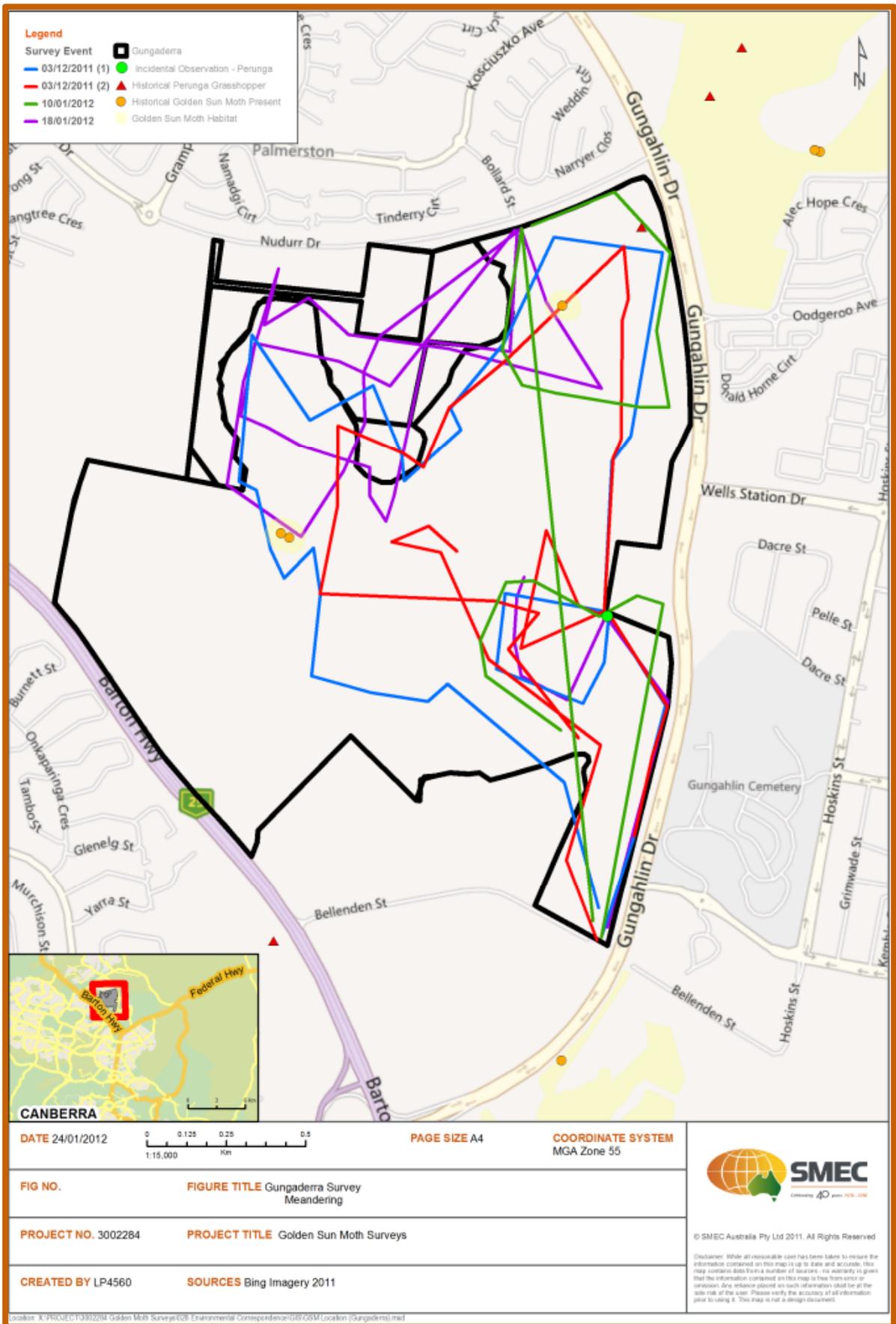


Figure 5 Gungahlin GSM meander survey

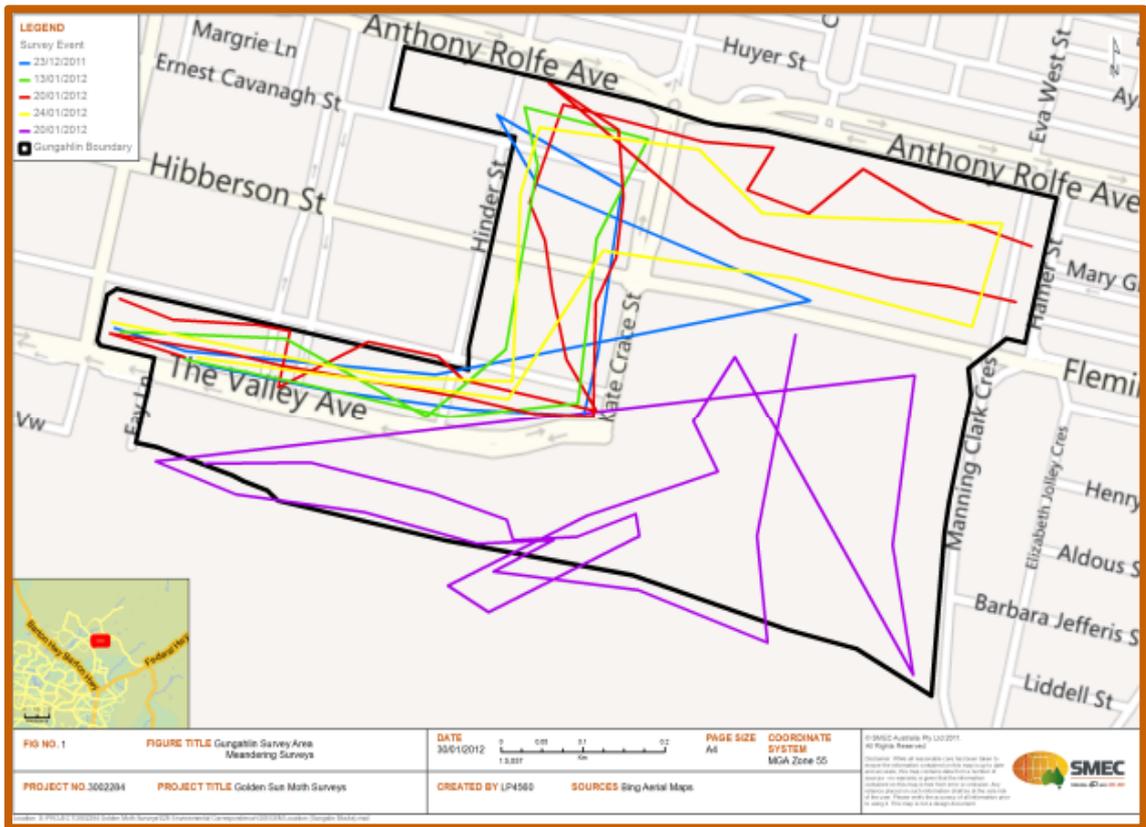


Figure 6 Gungahlin block GSM meander survey

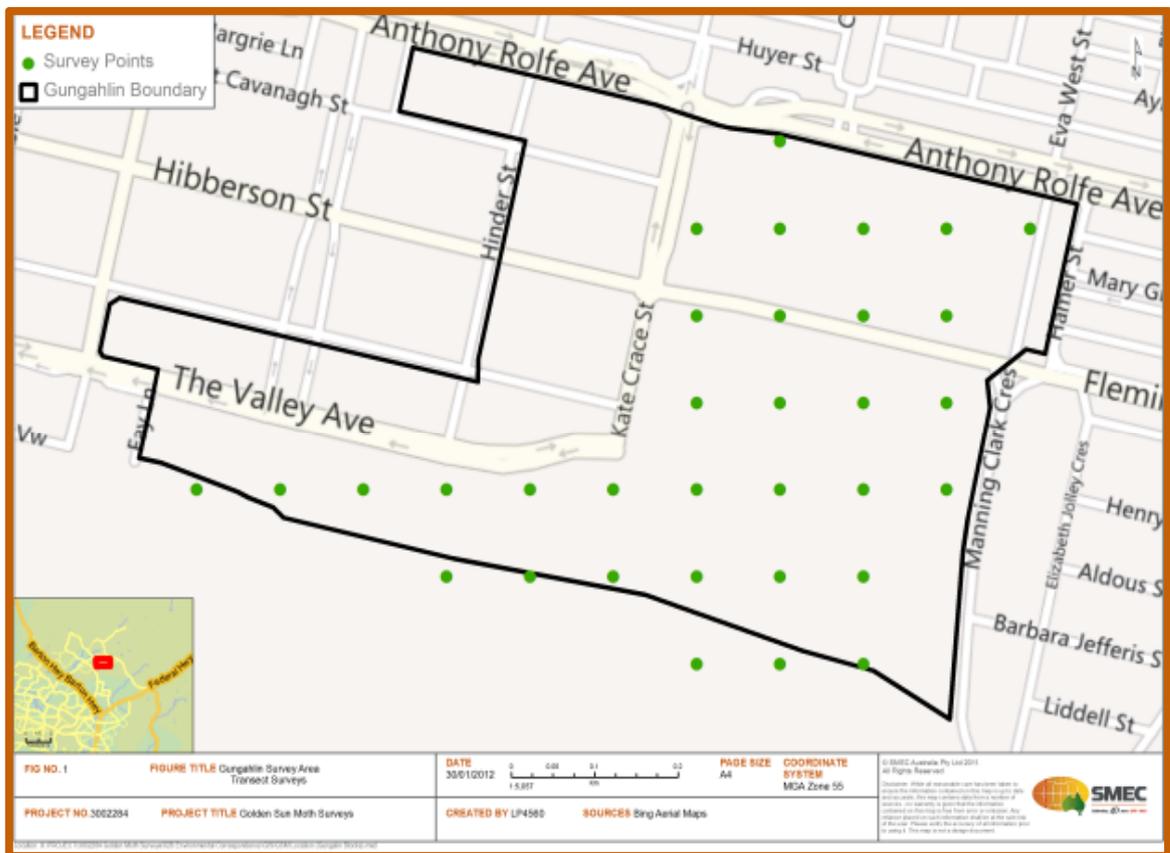


Figure 7 Gungahlin blocks GSM transect survey

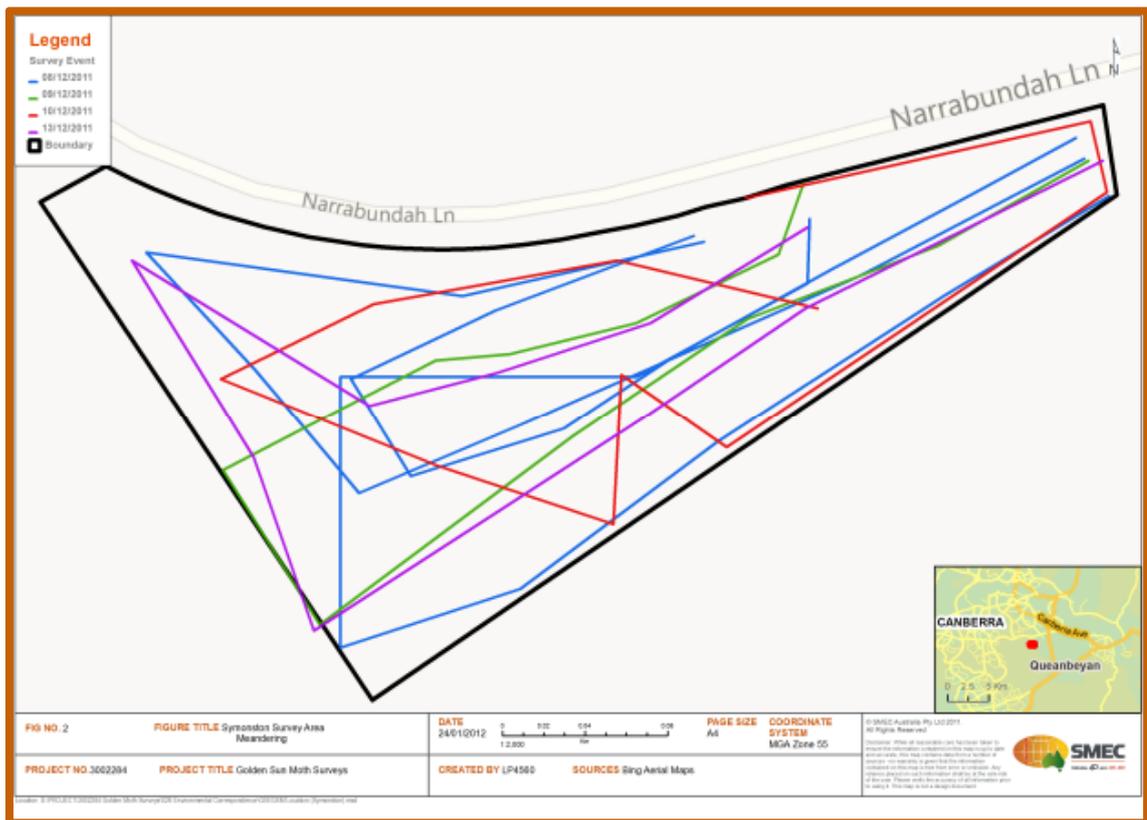


Figure 8 Symonston GSM meander survey

### 3.3 Incidental sightings

Incidental sightings of various flora and fauna are detailed in the table below.

Table 5 Sightings of other flora and fauna for the 2011 – 2012 flight season.

Site	Date	Sighting	Coordinates (WGS 84)
Gungahlin	3/12/2011	Perunga grasshopper	693848 6101531
Gungahlin Blocks	22/12/2011	Grass Parrots (x2)	694769 6104222
Gungahlin Blocks	20/01/2012	Adult dragonfly	694901 6103842
		Two adult dragonflies	694137 6104143
		Tettgoniid grasshopper	694756 6104233
		Adult robber fly (Asilidae)	695165 6104198
East Fyshwick	21/01/2012	Pierid butterfly (cabbage white)	698871 6087264
		Darter butterfly (Hesperiidae)	
		Hare ( <i>Lepus capensis</i> )	698691 6087190
		Calliphorid fly (house fly)	
		No other apparent insect activity	

Site	Date	Sighting	Coordinates (WGS 84)
		Acrididae grasshoppers (short horned grasshoppers) Pierid butterfly (cabbage white)	698800 6087475
East Fyshwick	23/12/2012	Short horned grasshopper	698768 6086917
		Cerambycid (longhorn) beetles	699354 6086768
		Perid butterfly (cabbage white), Nymphalid butterfly (common brown), Acridoidea (short horned grasshoppers), ants (Formicidae)	699412 6086744
		Microlepidoptera (small moths), Acridoidea (short horned grasshoppers)	699694 6086666
		Acridoidea (short horned grasshopper)	699775 6086669
		Lycaenid butterfly, scarab beetles, unidentified moth (Lepidoptera)	699902 6086672
		Lucanid beetle (stag) in flight	699704 6086733

### 3.4 Perunga grasshopper

The perunga grasshopper (Figure 2) was surveyed for on the 25 October 2011 at East Fyshwick, prior to the GSM season. One individual was recorded and is illustrated in *Figure*. The location details are as follows: E 215931 N 597344 (ACT AGD 1966) (Easting 698639, Northings 6087061 (WGS84). Incidental observations were also noted, specifically during the Gungaderra survey E210850 N611716 in ACT Grid (E693848 N6101531 in WGS84)

## 4 DISCUSSION

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No GSM were recorded in any of the surveyed sites for the 2011/12 flight season (Table 3). The sites were assessed as having a 'low potential for GSM habitat' (Table 2). The degree of 'weediness' of the sites, the presence and abundance of *Austrodanthonia* species and inter tussock spaces were key drivers in determining how potential GSM habitat was evaluated. For East Fyshwick, Gungaderra, Gungahlin Blocks and Symonston bare ground was infrequent and exotic grasses were commonplace. It is likely that the presence of exotic grasses and other weeds are largely due to past grazing practices at these sites.

In addition, local weather patterns is likely to have contributed to the lack of GSM sightings. Days of good flying conditions (warm, dry, sunny, low wind) for GSM were relatively few in November and December 2011. The weather was relatively cool and cloudy, and rainfall was above the long term average (LTA) for these months. In November, 113 millimetres of rain fell (LTA 64 millimetres), and there were 10 days with more than 1 millimetre of rain. In December, the highest maximum temperature was 28.8°C and only seven days had a maximum over 25°C. The cool and wet conditions may have hampered pupal emergence and adult flight activity, thus limiting moth sightings.

Largely due to the poor flight season, the surveys were extended to January 2012, as moths continued to be recorded on reference sites. Despite this no moths were sighted on the allocated survey sites in January. Compared to previous flight seasons, many surveys for the 2011 / 2012 season recorded low numbers of GSM. For example, the number of GSM recorded at several sites in the Canberra region was about 10 percent of the total number of GSM recorded for the 2009 surveys (A. Rowell obs.). These low numbers could be due to poor flying conditions in 2011 / 2012 flight season, poor breeding success in preceding season(s) and/or low numbers of larvae surviving to pupation. Heavy rain on some days prior to suitable surveys days kept soil moisture levels elevated and is suspected to have delayed emergence or at least influenced the number of moths emerging from the soil.

The effect of poor weather conditions is fourfold:

- The number of suitable survey days is reduced (which limits coverage);
- The number of possible repeat visits to a particular site may be reduced;
- The reliability of the data collected is probably reduced (because emergence and activity of adults and therefore the ability to detect them is reduced); and
- Locally damp soil conditions might prevent or reduce the emergence of GSM at some sites. This scenario is likely at sites which have previously recorded GSM and the larvae either drowned or remained in torpor.

## 4.1 Limitations

### 4.1.1 Survey Protocols

In poor weather and low habitat quality conditions the survey protocols themselves can be a limitation to such studies as they can be quite labour intensive. In this situation key issues are:

- The need to repeat surveys up to four times at a particular site where the GSM was not initially recorded can mean the number of teams available to undertake surveys at different locations over the GSM flight period. Alternative sites across the region that may support the GSM cannot be surveyed because time is spent re-surveying sites that may not support a population. The survey design is efficient when a population is readily observed on a site on the first survey; however, where GSM were not readily observed then the need for repeat visits becomes a constraint and limits coverage over an area; and
- High grass (more than one metre) for the Gungahlin Blocks and East Fyshwick in particular, restricted the potential for GSM sightings. It is likely that GSM would not occur in such an environment, however, their possibility cannot be discounted owing to the difficult field conditions.

## 4.2 Recommendations

- Annual GSM surveys provide an opportunity for the Conservation Planning and Research to evaluate potential changes in GSM populations over time. Indeed, the use of reference sites and a defined survey period ensure that moth sightings are rigorous and comparable across sampling seasons and areas. In the interests of maintaining the scientific rigor of the field method, several changes could be made. For example, options to change the defined flying season subject to weather conditions. That is the total length of the field season and the sampling period could be altered to ensure that as many GSM populations as possible are detected for a flight season. Prior to commencing a GSM field season, the long-term weather forecast could be considered and the period for surveying GSM could be adapted to the prevailing weather conditions. This approach would ensure as the maximum detection of GSM populations.
- Retention of areas of low-quality grasslands that support GSM is problematic as it will not necessarily provide continuing habitat or support the viability of the GSM. Nonetheless as the survey sites are proposed for urban development, any retained GSM habitat is likely to become fragmented and isolated. As such, a strategic approach to the conservation of GSM should be considered, and integrated with conservation efforts for the local populations on surrounding developments. This approach would promote the long term viability of the moth.
- Sites having even low potential for GSM should be maintained at low to moderate biomass until they can be properly surveyed for GSM as sites mostly suffered from lack of grazing or mowing.

- Connectivity between survey sites needs consideration with regard to the location of viable GSM populations and the condition of their supporting habitat. This is particularly vital as the GSM cannot travel more than 100 metres from suitable habitat patches; therefore populations separated by distances greater than 200 meters can be considered effectively isolated, and sites from which the species has gone extinct are unlikely to be recolonised (DEWHA 2009b). As part of the ACT Government planning process suitable habitat corridors and patches could be allocated to enhance the viability of the GSM across the Canberra region.
- Conservation actions designed for the GSM could provide an opportunity to protect associated flora and fauna assemblages of the grassland community. If the GSM is a key determinant in preserving extant native grasslands, then it would be useful to understand what proportion of native flora and fauna would also receive some measure of protection. This is because if only sites which support the largest moth populations are preserved, or if portions of habitat patches classified as being of 'marginal' value to the moth are lost, then the proportion of associated plant and animal species in grassland ecosystems receiving protection may decline. Therefore, the full complexity of natural temperate grasslands would be lost.

## 5 REFERENCES

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ACT Government, (1997). Natural temperate grassland: An endangered ecological community. Action Plan No.1. Environment ACT, Canberra.

ACT Government, (1999). Yellow Box Red Gum Grassy Woodland: An endangered ecological community. Action Plan No.10. Environment ACT, Canberra.

ACT Government (2010). Survey guidelines for golden sun moth. Conservation Planning and Research, Land Management and Planning Division. Macarthur House 12 Wattle Street, Lyneham ACT 2602

Braby, M. F. and Dunford, M. (2006). *Field observations on the ecology of the Golden Sun Moth, Synemon plana Walker (Lepidoptera: Castniidae)*. Australian Entomologist **33**, 103-110.

Clarke, G. M. and O'Dwyer, C. (2000). Genetic variability and population structure of the endangered golden sun moth *Synemon plana*. Biological Conservation 92: 371–381.

Clarke, G. and F. Spier-Ashcroft (2003). A Review of the Conservation Status of Selected Australian Non-Marine Invertebrates. Environment Australia, Canberra. Available at: <http://www.environment.gov.au/biodiversity/threatened/publications/action/non-marine-invertebrates/index.html>

Common, I.F.B. (1990). 'Moths of Australia.'(Melbourne University Press: Melbourne).

Conservation Planning and Research (2010) Survey Guidelines for Golden Sun Moth. Land Management and Planning Division, Macarthur House GPO Box 158 Canberra ACT 2601

Department of the Environment, Water, Heritage and the Arts (2009a). Background Paper to EPBC Act Policy Statement 3.12 – Nationally Threatened Species and Ecological Communities: Significant Impact Guidelines for the Critically Endangered golden sun moth (*Synemon plana*). Available at:

<http://www.environment.gov.au/epbc/publications/pubs/background-paper-goldensun-moth.pdf>

Department of the Environment, Water, Heritage and the Arts (2009b) EPBC Act Policy Statement 3.12 – Nationally Threatened Species and Ecological Communities: Significant Impact Guidelines for the Critically Endangered Golden sun moth (*Synemon plana*). Available at: <http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth.pdf>

Department of Sustainability and Environment (DSE) (2004). Golden sun moth *Synemon plana*, Action Statement No. 106. Department of Sustainability and Environment, East Melbourne. Available at:

[http://www.dse.vic.gov.au/\\_\\_data/assets/pdf\\_file/0016/103219/106\\_Golden\\_Sun\\_Moth\\_2000.pdf](http://www.dse.vic.gov.au/__data/assets/pdf_file/0016/103219/106_Golden_Sun_Moth_2000.pdf)

Edwards, E.D. (1993). Golden Sun Moth. Australian Natural History. 24(6), 16-17.

Edwards, E.D., (1994). Survey of lowland grassland in A.C.T. for the Golden Sun Moth (*Synemon plana*). Report to the Wildlife Research Unit, ACT Parks and Conservation Service. CSIRO Division of Entomology, Canberra.

Gibson, L. (2006). Surveys of the Golden sun moth (*Synemon plana* Walker) population and ant assemblage at the Craigieburn Grassland Reserve. Unpublished BSc Hons Thesis, La Trobe University, Bundoora.

Gilmore (2011). Sub-regional Fauna Surveys: Golden sun moth *Synemon plana* 2009/2010. Biosis Research Pty Ltd.

- Gilmore, D., Koehler, S., O'Dwyer, C. and Moore, W. (2008). Golden sun moth *Synemon plana* (Lepidoptera: Castniidae): results of a broad survey of populations around Melbourne. *The Victorian Naturalist* 125 (2): 39 – 46.
- Jelinek, A., Britton, D.R. & New, T.R. (1994). Conservation of a threatened butterfly community. *Memoirs of Queensland Museum*. 36, 115-120.
- Kirkpatrick, J.B., K. McDougall & M. Hyde (1995) Australia's most threatened ecosystem – the southeastern lowland native grasslands. Surrey Beatty and Sons, Chipping North, New South Wales.
- O'Dwyer, C. and Attiwill. P. M. (1999). A comparative study of habitats of the Golden sun moth *Synemon plana* Walker (Lepdoptera: Castnidae): implications for restoration. *Biological Conservation* 89: 131–141.
- Parkes, D., Newell, G., and Cheal, D. (2003). Assessing the quality of native vegetation: The 'habitat hectares' approach. *Ecological Management and Restoration Vol 4 Supplement: S29 – S38*.
- Rentz, D.C.F., (1996). Grasshopper country: the abundant orthopteroid insects of Australia. University of NSW Press, Sydney.
- Richter, A, Osborne, W., Robertson, G., Hnatiuk, S. (2009). Community Monitoring of olden sun moths in the Australian Capital Territory Region, 2008-2009. Report Funded by the Threatened Species Network, a community-based program of the Australian Government and WWF-Australia, Canberra.
- SMEC Australia Pty Ltd (2011) Biodiversity Assessment Report Contract Area 1068 – Mickleham Road, Yuroke. For the Growth Areas Authority Biodiversity Mapping 2010-2011 Project Reference: 3004445. PO Box 6208, 600 St Kilda Road, Melbourne, VIC 8008.
- Stephens, C.J., (1998). Grasshopper (Orthoptera: Acrididae) assemblages in natural temperate grasslands of differing native plant diversities. BSc (hons) thesis, Department of Botany & Zoology, Australian National University.
- Thorp, J R, and Lynch, R (2000) The Determination of Weeds of National Significance. National Weeds Strategy Executive Committee, Launceston. Available at: <http://www.weeds.org.au/docs/WoNS/>

# APPENDIX A FIELD SHEETS

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## APPENDIX B SURVEY DATA 2011-12

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Survey Event	Point No.	Date	Surveyor	Time	Easting (WGS 84)	Northing (WGS 84)	No. moths between point numbers	Temp (°C)	Cloud Cover (%)	Wind (Speed/ direction)	Last Rain / Forecasted	Landmarks	Habitat Details (Predators, vegetation etc.)	Reference Site Comments
EAST FYSHWICK														
19/11/2012	1	19/11/2011	Alison	11:00	698466	6087025	0	27°	0	28-35 km/h NW	19/11/2011		Exotic forbs dominant, native grasses, bare ground, probably ploughed.	Low numbers at York Park
	2	19/11/2011	Alison		698485	6087004	0	27°	0	28-35 km/h NW	19/11/2011		<50% native, some A/danthonia, weedy.	
	3	19/11/2011	Alison		698693	6086905	0	27°	0	28-35 km/h NW	19/11/2011		<50% native, drain, thistles, occ Chilean Ngrass	
	4	19/11/2011	Alison		698875	6086815	0	27°	20	28-35 km/h NW	19/11/2011		Next paddock, >50% nat., Austrostipa/Bothriochloa	
	5	19/11/2011	Alison	11:20	699110	6086782	0	27°	20	28-35 km/h NW	19/11/2011		Nat. pasture/2 <sup>o</sup> grassland, diverse, A/danthonia patches	
	6	19/11/2011	Alison		699179	6086761	0	27°	20	33-37 km/h NW	19/11/2011		As above, plus low shrubs	
	7	19/11/2011	Alison		699023	6086891	0	27°	25	33-37 km/h NW	19/11/2011		Entering weedy paddock, not habitat	
	8	19/11/2011	Alison		698676	6087093	0	27°	25	33-37 km/h NW	19/11/2011		End weedy paddock	
	9	19/11/2011	Alison		698672	6087168	0	27°	25	33-37 km/h NW	19/11/2011		Native dominated strip south of railway, habitat	
	10	19/11/2011	Alison	12:00	698905	6087022	0	27°	25	33-37 km/h NW	19/11/2011		Weedier but native-dominated, habitat	
	11	19/11/2011	Alison		699014	6086944	0	27°	50	33-37 km/h NW	19/11/2011		Entering exotic area	
	12	19/11/2011	Alison		699159	6086869	0	27°	50	33-37 km/h NW	19/11/2011		Entering A/stipa A/danth, African LG, other weeds	
	13	19/11/2011	Alison		699529	6086699	0	27°	50	33-37 km/h NW	19/11/2011		Crossing drain	
	14	19/11/2011	Alison		699586	6086695	0	27°	50	33-37 km/h NW	19/11/2011		Native pasture, very weedy, Redleg Grass	
	15	19/11/2011	Alison		699885	6086671	0	27°	50	33-37 km/h NW	19/11/2011		Weedy native pasture, some A/danthonia	
	16	19/11/2011	Alison		699673	6086734	0	27°	50	33-37 km/h NW	19/11/2011		Sweetbriar and gully	
	17	19/11/2011	Alison		699489	6086794	0	27°	50	33-37 km/h NW	19/11/2011		Patches A/danth, other natives, weedy	
	18	19/11/2011	Alison		698896	6087055	0	27°	50	33-37 km/h NW	19/11/2011		Swale, claypan, native but prob. not habitat	
	19	19/11/2011	Alison		698803	6087134	0	27°	50	33-37 km/h NW	19/11/2011		Claypan with narrow strip A/danthonia on margins	
	20	19/11/2011	Alison	13:00	698696	6087288	0	27°	50	33-37 km/h NW	19/11/2011		Crossing railway	
	21	19/11/2011	Alison		698673	6087357	0	27°	50	33-37 km/h NW	19/11/2011		Into paddock, patches A/stipa, A/danthonia	
	22	19/11/2011	Alison		698692	6087382	0	27°	50	33-37 km/h NW	19/11/2011		Weedy, thistles, ploughed or sprayed	
	23	19/11/2011	Alison		698715	6087413	0	27°	50	33-37 km/h NW	19/11/2011		Weedy+ native grasses, then crossing Phalaris creekline	
	24	19/11/2011	Alison		698910	6087627	0	27°	50	33-37 km/h NW	19/11/2011		N edge swamp, entering weedy paddock, patches nat.	
	25	19/11/2011	Alison	13:40	698932	6087663	0	27°	50	33-37 km/h NW	19/11/2011		Next paddock, weedy native grasses, dumping	
	26	19/11/2011	Alison		698958	6087680	0	27°	50	33-37 km/h NW	19/11/2011		Patch NTG, 5 x 20 m, habitat	
	27	19/11/2011	Alison		698968	6087707	0	27°	50	33-37 km/h NW	19/11/2011		Patch NTG, 20 x 20 m, habitat	
	28	19/11/2011	Alison		698938	6087755	0	27°	50	33-37 km/h NW	19/11/2011		Larger nat. patch, A/danth carphs+auriculata, habitat	
	29	19/11/2011	Alison		698898	6087769	0	27°	50	33-37 km/h NW	19/11/2011		As above	
	30	19/11/2011	Alison	13:50	698925	6087786	0	28°	0	37-40 km/h NW	19/11/2011		Paddock at bottom of Tennant St, weedy native pasture	
	31	19/11/2011	Alison		699007	6087791	0	28°	0	37-40 km/h NW	19/11/2011		with A/stipa, A/danthonia	
	32	19/11/2011	Alison		699039	6087866	0	29°	0	37-40 km/h NW	19/11/2011		As above	
	33	19/11/2011	Alison		699081	6087943	0	29°	0	37-40 km/h NW	19/11/2011		Drainage line	
	34	19/11/2011	Alison		699098	6088042	0	30°	0	37-40 km/h NW	19/11/2011		Weedy native pasture, with A/stipa, A/danthonia	
	35	19/11/2011	Alison		698988	6088052	0	30°	0	37-40 km/h NW	19/11/2011		Austrostipa dominated, weedy	
	36	19/11/2011	Alison		698936	6088141	0	31°	0	37-40 km/h NW	19/11/2011		As above	
	37	19/11/2011	Alison		698850	6088099	0	31°	0	37-40 km/h NW	19/11/2011		A/stipa+patches A/danthonia + occ. patches Phalaris	
	38	19/11/2011	Alison	14:20	698816	6087876	0	32°	0	37-40 km/h NW	19/11/2011		As above	

Survey Event	Point No.	Date	Surveyor	Time	Easting (WGS 84)	Northing (WGS 84)	No. moths between point numbers	Temp (°C)	Cloud Cover (%)	Wind (Speed/ direction)	Last Rain / Forecasted	Landmarks	Habitat Details (Predators, vegetation etc.)	Reference Site Comments
EAST FYSHWICK														
14/12/2011	1	14/12/2011	Cameron	13:10	608487	6087024	0	19°	75	13 km/h N	11/12/2011	Start		4 moths at Crace, low temps, all flushed
	2	14/12/2011	Cameron	13:17	608611	6086922	0	19°	75	13 km/h N	11/12/2011	Near fence	Long grass	
	3	14/12/2011	Cameron	13:22	608739	6086867	0	19°	75	13 km/h N	11/12/2011		Weeds	
	4	14/12/2011	Cameron	13:30	608875	6086836	0	19°	75	13 km/h N	11/12/2011		Dried up creek	
	5	14/12/2011	Cameron	13:40	608921	6086827	0	19°	75	13 km/h N	11/12/2011		Next sector shorter grass	
	6	14/12/2011	Cameron	13:46	609136	6086783	0	20°	75	13 km/h N	11/12/2011	Corner (9)	Good habitat	
	7	14/12/2011	Cameron	13:49	609089	6086828	0	20°	75	13 km/h N	11/12/2011	Walk back on north side	Low grass	
	8	14/12/2011	Cameron	13:52	609031	6086874	0	20°	75	13 km/h N	11/12/2011		Rock	
	9	14/12/2011	Cameron	14:05	608847	6086980	0	20°	75	9 km/h ESE	11/12/2011		Low grass	
	10	14/12/2011	Cameron	14:08	608753	6086992	0	20°	75	10 km/h ESE	11/12/2011		Longer grass	
	11	14/12/2011	Cameron	14:10	608652	6087008	0	20°	75	11 km/h ESE	11/12/2011		Through middle trying to flush out moths	
	12	14/12/2011	Cameron	14:12	608535	6087040	0	21°	75	12 km/h ESE	11/12/2011			
	13	14/12/2011	Cameron	14:14	608509	6087013	0	21°	75	13 km/h ESE	11/12/2011		Thicker longer grass, next sector	
	14	14/12/2011	Cameron	14:55	608844	6088110	0	21°	75	13 km/h N	11/12/2011	Start sector 3		
	15	14/12/2011	Cameron	15:02	608906	6088161	0	21°	75	13 km/h N	11/12/2011			
	16	14/12/2011	Cameron	15:05	608951	6088247	0	21°	75	13 km/h N	11/12/2011		Decent habitat, Danthonia	
	17	14/12/2011	Cameron	15:10	609000	6088205	0	21°	75	13 km/h N	11/12/2011			
	18	14/12/2011	Cameron	15:14	609019	6088106	0	22°	75	13 km/h N	11/12/2011		Poor habitat weedy, with thistle	
	19	14/12/2011	Cameron	15:17	608948	6088038	0	22°	75	13 km/h N	11/12/2011		Signs of cattle	
	20	14/12/2011	Cameron	15:20	608835	6088050	0	22°	75	13 km/h N	11/12/2011		Finish	
1	15/12/2011	Cameron	13:34	608773	6088532	0	21°	50	9 km/h NE	11/12/2011	Storm water drain	Thistle		
2	15/12/2011	Cameron	13:37	608856	6088557	0	21°	50	9 km/h NE	11/12/2011	Cattle	Cattle, thistle, Chilean Needle Grass		
3	15/12/2011	Cameron	13:40	608914	6088560	0	21°	50	9 km/h NE	11/12/2011	Ridge	Oats		
4	15/12/2011	Cameron	13:45	608932	6088574	0	21°	50	9 km/h NE	11/12/2011	River bank	Approaching marseland, poor habitat		
5	15/12/2011	Cameron	13:48	608971	6088521	0	21°	50	9 km/h NE	11/12/2011	Large tree	Poor habitat close to river		
6	15/12/2011	Cameron	13:57	608922	6088491	0	21°	50	9 km/h NE	11/12/2011	Cattle	Poor habitat		
7	15/12/2011	Cameron	14:05	608755	6087920	0	22°	50	13 km/h N	11/12/2011	Road	Poor habitat		
8	15/12/2011	Cameron	14:35	608965	6087103	0	22°	50	15 km/h N	11/12/2011	Corner	Oats and thistle		
9	15/12/2011	Cameron	14:40	608975	6087261	0	22°	50	15 km/h N	11/12/2011	15m from fence	Oats		
10	15/12/2011	Cameron	14:45	608959	6087467	0	22°	50	15 km/h N	11/12/2011		Thistle and less oats		
11	15/12/2011	Cameron	14:48	608948	6087504	0	22°	50	15 km/h N	11/12/2011	River, trees	Thistle, weeds and oats		
12	15/12/2011	Cameron	14:50	608873	6087495	0	22°	50	15 km/h N	11/12/2011		Oats and thistle		
13	15/12/2011	Cameron	14:52	608788	6087495	0	22°	50	15 km/h N	11/12/2011	Swamp, river	Half oats half thistle		
14	15/12/2011	Cameron	14:55	608731	6087439	0	22°	50	15 km/h N	11/12/2011		Danthonia, thistle		
15	15/12/2011	Cameron	14:57	608669	6087415	0	22°	50	15 km/h N	11/12/2011	Swamp/river	Danthonia, very little thistle		

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EAST FYSHWICK														
23/12/2011	1	23/12/2011	Liza	11:30	608477	6087086	0	27°	10	33 km/h E	22/12/2011			sighted 21 moths at York Park in 2 hrs
	2	23/12/2011	Liza	11:39	608573	6087064	0	27°	10	33 km/h E	22/12/2011			
	3	23/12/2011	Liza	11:41	608615	6087020	0	27°	10	33 km/h E	22/12/2011			
	4	23/12/2011	Liza	11:44	608656	6086969	0	27°	10	33 km/h E	22/12/2011			
	5	23/12/2011	Liza	11:46	608685	6086956	0	27°	10	33 km/h E	22/12/2011			
	6	23/12/2011	Liza	11:50	608768	6086917	0	27°	10	33 km/h E	22/12/2011			
	7	23/12/2011	Liza	11:53	608822	6086878	0	27°	10	33 km/h E	22/12/2011			
	8	23/12/2011	Liza	11:56	608894	6086880	0	27°	10	33 km/h E	22/12/2011			
	9	23/12/2011	Liza	12:00	608974	6086840	0	27°	10	33 km/h E	22/12/2011			
	10	23/12/2011	Liza	12:15	609193	6086853	0	27°	10	33 km/h E	22/12/2011			
	11	23/12/2011	Liza	12:16	609253	6086827	0	27°	10	33 km/h E	22/12/2011			
	12	23/12/2011	Liza	12:20	609354	6086768	0	27°	10	33 km/h E	22/12/2011			
	13	23/12/2011	Liza	12:23	609412	6086744	0	27°	10	33 km/h E	22/12/2011			
	14	23/12/2011	Liza	12:39	609589	6086676	0	27°	10	33 km/h E	22/12/2011			
	15	23/12/2011	Liza	12:43	609694	6086666	0	27°	10	33 km/h E	22/12/2011			
	16	23/12/2011	Liza	12:46	609775	6086669	0	27°	10	33 km/h E	22/12/2011			
	17	23/12/2011	Liza	12:56	609902	6086672	0	27°	10	33 km/h E	22/12/2011			
	18	23/12/2011	Liza	13:00	609704	6086733	0	27°	10	33 km/h E	22/12/2011			
	19	23/12/2011	Liza	13:40	608759	6087300	0	27°	10	33 km/h E	22/12/2011			
	20	23/12/2011	Liza	13:43	608719	6087395	0	27°	10	33 km/h E	22/12/2011			
	21	23/12/2011	Liza	13:45	608694	6087456	0	27°	10	33 km/h E	22/12/2011			
	22	23/12/2011	Liza	13:48	608680	6087491	0	27°	10	33 km/h E	22/12/2011			
	23	23/12/2011	Liza	13:55	608756	6087576	0	27°	10	33 km/h E	22/12/2011			
	24	23/12/2011	Liza	13:58	608694	6087618	0	27°	10	33 km/h E	22/12/2011			
	25	23/12/2011	Liza	14:00	608623	6087616	0	27°	10	33 km/h E	22/12/2011			
	26	23/12/2011	Liza	14:03	608632	6087562	0	27°	10	33 km/h E	22/12/2011			
	27	23/12/2011	Liza	14:05	608690	6087536	0	27°	10	33 km/h E	22/12/2011			
	28	23/12/2011	Liza	14:09	608742	6087564	0	27°	10	33 km/h E	22/12/2011			
1	23/12/2011	Cameron	11:30	608482	6087090	0	27°	15	33 km/h E	22/12/2011				
2	23/12/2011	Cameron	11:43	608694	6087065	0	27°	15	33 km/h E	22/12/2011		Wooden post	Thistle, oats, weeds	
3	23/12/2011	Cameron	11:46	608748	6087038	0	27°	15	33 km/h E	22/12/2011		Couple of trees	Danthonia, weeds	
4	23/12/2011	Cameron	11:53	608854	6086970	0	27°	15	33 km/h E	22/12/2011		Road	Weeds, some danthonia (poor)	
5	23/12/2011	Cameron	11:59	609021	6086903	0	27°	15	33 km/h E	22/12/2011			Habitat to the south (decent)	
6	23/12/2011	Cameron	12:05	608973	6086881	0	27°	15	33 km/h E	22/12/2011			Danthonia grass, improved grassland quality	
7	23/12/2011	Cameron	12:12	609194	6086856	0	27°	15	33 km/h E	22/12/2011			Oats, cattle	
8	23/12/2011	Cameron	12:18	609290	6086837	0	27°	15	33 km/h E	22/12/2011			Danthonia	
9	23/12/2011	Cameron	12:24	609369	6086809	0	27°	15	33 km/h E	22/12/2011		Approaching creek	Danthonia	
10	23/12/2011	Cameron	12:30	609470	6086765	0	27°	15	33 km/h E	22/12/2011		Other side of creek	Coming into thicker thistle	
11	23/12/2011	Cameron	12:37	609602	6086719	0	27°	15	33 km/h E	22/12/2011			Thistle	
12	23/12/2011	Cameron	12:42	609678	6086710	0	27°	15	33 km/h E	22/12/2011		Power lines	Lots of high thistle	
13	23/12/2011	Cameron	12:49	609780	6086707	0	27°	15	33 km/h E	22/12/2011			Danthonia and thistle poor habitat	
14	23/12/2011	Cameron	12:55	609831	6086690	0	27°	15	33 km/h E	22/12/2011		Start	Poor habitat, pwr lines, creek etc, concrete	
15	23/12/2011	Cameron	13:40	608762	6087301	0	27°	15	33 km/h E	22/12/2011		Fenceline	Middle paddock	
16	23/12/2011	Cameron	13:43	608822	6087301	0	27°	15	33 km/h E	22/12/2011			Poor habitat lots of dead thistle	
17	23/12/2011	Cameron	13:45	608894	6087253	0	27°	15	33 km/h E	22/12/2011			Thistle, grazed, weeds	
18	23/12/2011	Cameron	13:47	608904	6087203	0	27°	15	33 km/h E	22/12/2011			Thistle, grazed, weeds	
19	23/12/2011	Cameron	13:50	608918	6087168	0	27°	15	33 km/h E	22/12/2011			Thistle, danthonia	
20	23/12/2011	Cameron	13:52	608936	6087231	0	27°	15	33 km/h E	22/12/2011			Oats	
21	23/12/2011	Cameron	13:55	608912	6087317	0	27°	15	33 km/h E	22/12/2011			Bare, thistle	
22	23/12/2011	Cameron	13:57	608875	6087386	0	27°	15	33 km/h E	22/12/2011				
23	23/12/2011	Cameron	14:00	608829	6087397	0	27°	15	33 km/h E	22/12/2011			Thistle, oats, small amount of danthonia	
24	23/12/2011	Cameron	14:05	608765	6087369	0	27°	15	33 km/h E	22/12/2011			Thistle, pretty bare	
25	23/12/2011	Cameron	14:10	608759	6087391	0	27°	15	33 km/h E	22/12/2011			Thistle, bare	

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EAST FYSHWICK														
	1	20/1/2012	Cameron	12:50	608898	6086815	0	33°	15	52 kmh ENE	20/1/2012		Block 9 decent habitat	18 at East Majura Site
	2	20/1/2012	Cameron		699033	6086846	0	33°	15	52 kmh ENE	20/1/2012		Long Chilean need grass	
	3	20/1/2012	Cameron	12:53	699086	6086833	0	33°	15	52 kmh ENE	20/1/2012		small area of good habitat	
	4	20/1/2012	Cameron		699130	6086802	0	33°	15	52 kmh ENE	20/1/2012		relatively bare, semi decent habitat	
	5	20/1/2012	Cameron	13:00	699165	6086767	0	33°	15	52 kmh ENE	20/1/2012		not fantastic habitat, cattle	
	6	20/1/2012	Cameron		699183	6086752	0	33°	15	52 kmh ENE	20/1/2012		Chilean needle grass	
	7	20/1/2012	Cameron		699298	6086772	0	33°	15	52 kmh ENE	20/1/2012		quite poor habitat	
	8	20/1/2012	Cameron		699282	6086849	0	33°	15	52 kmh ENE	20/1/2012		weeds	
	9	20/1/2012	Cameron		699955	6087157	0	33°	15	52 kmh ENE	20/1/2012		poor weedy habitat overgrown with weeds	
	10	20/1/2012	Cameron	13:30	699905	6087217	0	33°	15	52 kmh ENE	20/1/2012		poor weedy habitat	
	11	20/1/2012	Cameron		699850	6087329	0	33°	15	52 kmh ENE	20/1/2012		only thing a live is thistle	
	12	20/1/2012	Cameron		699810	6087398	0	33°	15	52 kmh ENE	20/1/2012		Thistle (long), some danthonia	
	13	20/1/2012	Cameron		699789	6087454	0	33°	15	52 kmh ENE	20/1/2012		thistle, some danthonia and natives	
	14	20/1/2012	Cameron		699789	6087503	0	33°	15	52 kmh ENE	20/1/2012		less thistle, more swamp	
	15	20/1/2012	Cameron		699742	6087444	0	33°	15	52 kmh ENE	20/1/2012		patches of long Chilean needle grass	
	16	20/1/2012	Cameron		699692	6087401	0	33°	15	52 kmh ENE	20/1/2012		bare, with thistles	
	17	20/1/2012	Cameron		699676	6087364	0	33°	15	52 kmh ENE	20/1/2012		long weeds	
	18	20/1/2012	Cameron	14:06	699692	6087285	0	33°	15	52 kmh ENE	20/1/2012			
	19	20/1/2012	Cameron		699609	6087159	0	33°	15	52 kmh ENE	20/1/2012			
	20	20/1/2012	Cameron		699679	6087052	0	33°	15	52 kmh ENE	20/1/2012		Pretty bad. Overgrown with weeds	
	21	20/1/2012	Cameron		699785	6086986	0	33°	15	52 kmh ENE	20/1/2012		Overgrown, weeds	
	22	20/1/2012	Cameron		699851	6086980	0	33°	15	52 kmh ENE	20/1/2012		Small patch of slightly grazed area. Poor.	
	23	20/1/2012	Cameron		699862	6086912	0	33°	15	52 kmh ENE	20/1/2012		Poor habitat	
	24	20/1/2012	Cameron	14:30	699858	6086811	0	33°	15	52 kmh ENE	20/1/2012		Finish	
20/01/2012	1	20/1/2012	Liza	12:55	699856	6086804	0	29°	15	52 kmh ENE	20/1/2012		native grass	
	2	20/1/2012	Liza		699036	6086799	0	33°	15	52 kmh ENE	20/1/2012		grasshoppers and kangaroos sighted	
	3	20/1/2012	Liza		699209	6086758	0	33°	15	52 kmh ENE	20/1/2012			
	4	20/1/2012	Liza		699254	6086740	0	33°	15	52 kmh ENE	20/1/2012			
	5	20/1/2012	Liza		699298	6086771	0	33°	15	52 kmh ENE	20/1/2012			
	6	20/1/2012	Liza		699288	6086840	0	33°	15	52 kmh ENE	20/1/2012			
	7	20/1/2012	Liza		699963	6087107	0	33°	15	52 kmh ENE	20/1/2012		high proportion of weeds	
	8	20/1/2012	Liza		699967	6087242	0	33°	15	52 kmh ENE	20/1/2012		Scotch thistle ( <i>Oncopeltus acanthium</i> ) - high numbers	
	9	20/1/2012	Liza		699988	6087331	0	33°	15	52 kmh ENE	20/1/2012			
	10	20/1/2012	Liza		699996	6087372	0	33°	15	52 kmh ENE	20/1/2012			
	11	20/1/2012	Liza		699911	6087316	0	33°	15	52 kmh ENE	20/1/2012			
	12	20/1/2012	Liza		699871	6087264	0	33°	15	52 kmh ENE	20/1/2012		Dandelion plants present. Pierid and darter butterflies in flight and a hare sighted.	
	13	20/1/2012	Liza		699904	6087344	0	33°	15	52 kmh ENE	20/1/2012			
	14	20/1/2012	Liza		699864	6087366	0	33°	15	52 kmh ENE	20/1/2012			
	15	20/1/2012	Liza		699818	6087302	0	33°	15	52 kmh ENE	20/1/2012			
	16	20/1/2012	Liza		699842	6087400	0	33°	15	52 kmh ENE	20/1/2012			
	17	20/1/2012	Liza		699888	6087443	0	33°	15	52 kmh ENE	20/1/2012		Native grass present, danthonia - like plants present, acridid (short-horned) grasshoppers	
	18	20/1/2012	Liza		699800	6087475	0	33°	15	52 kmh ENE	20/1/2012		as a above, lots of short-horned grasshoppers and native grasses (Pomacea sp.).	
	19	20/1/2012	Liza		699697	6087443	0	33°	15	52 kmh ENE	20/1/2012			
	20	20/1/2012	Liza		699696	6087451	0	33°	15	52 kmh ENE	20/1/2012			
	21	20/1/2012	Liza		699649	6087389	0	33°	15	52 kmh ENE	20/1/2012			
	22	20/1/2012	Liza		699691	6087285	0	33°	15	52 kmh ENE	20/1/2012			
	23	20/1/2012	Liza		699691	6087284	0	33°	15	52 kmh ENE	20/1/2012		no apparent insects flight except for odd calliphoid fly	
	24	20/1/2012	Liza		699627	6087190	0	33°	15	52 kmh ENE	20/1/2012			
	25	20/1/2012	Liza		699571	6087108	0	33°	15	52 kmh ENE	20/1/2012			
	26	20/1/2012	Liza		699618	6087018	0	33°	15	52 kmh ENE	20/1/2012			
	27	20/1/2012	Liza		699661	6086968	0	33°	15	52 kmh ENE	20/1/2012			
	28	20/1/2012	Liza		699744	6086909	0	33°	15	52 kmh ENE	20/1/2012			
	29	20/1/2012	Liza		699838	6086850	0	33°	15	52 kmh ENE	20/1/2012			
	30	20/1/2012	Liza	14:30	699860	6086817	0	33°	15	52 kmh ENE	20/1/2012			

Survey Event Gungaharra	Point No.	Date	Surveyor	Time	Easting (WGS 84)	Northing (WGS 84)	No. moths between point numbers	Temp (°C)	Cloud Cover (%)	Wind (speed/direction)	Last rain/forecasted	Landmarks	Habitat Details (Predators, vegetation etc.)	Reference Site Comments
3/12/2011	1	03/12/2011	Wil	12:00:00	693830	6100515	0	18	0	5-10 knots NW	1/12/2011	Start	secondary habitat <i>Stipa/Danthonia</i> /Woods	Low GSM activity at York Park. Ground is okay. The notes refer to the previous section, behind the waypoint
	2	03/12/2011	Wil		693926	6100831	0	18	0	5-10 knots NW	1/12/2011	Gate (N)	Mown Path - NILL	
	3	03/12/2011	Wil		693984	6101084	0	18	0	5-10 knots NW	1/12/2011	Gate (N)	Low quality,	
	4	03/12/2011	Wil		694026	6101245	0	18	0	5-10 knots NW	1/12/2011	N	weedy, marginal, St John's Wart	
	5	03/12/2011	Wil		693848	6101531	0	18	0	5-10 knots NW	1/12/2011	N	Occasional blobs of natives, Snow Gums, Perunga	
	6	03/12/2011	Wil		693832	6101379	0	18	0	5-10 knots NW	1/12/2011	N	three cement poles moderate habitat on a Knoll	
	7	03/12/2011	Wil		693765	6101250	0	18	0	5-10 knots NW	1/12/2011	N	Increasing weeds mostly <i>Stipa</i>	
	8	03/12/2011	Wil		693492	6101358	0	18	0	5-10 knots NW	1/12/2011	N	flat weeds pasture improved	
	9	03/12/2011	Wil		693520	6101596	0	18	0	5-10 knots NW	1/12/2011	N	flat weeds <i>Phalaris</i> , pasture improved	
	10	03/12/2011	Wil		693833	6101540	0	18	0	5-10 knots NW	1/12/2011	N	Return to gate	
	11	03/12/2011	Wil		693856	6102011	0	18	0	5-10 knots NW	1/12/2011	N	commute wet walk Golden Headed <i>Cisticolas</i>	
	12	03/12/2011	Wil	13:30:00	693916	6102090	0	18	0	5-10 knots NW	1/12/2011	N	pasture improved - subclover indicates no GSM	
	13	03/12/2011	Wil	13:40:00	694017	6102668	0	18	0	5-10 knots NW	1/12/2011	N	no habitat - weeds	
	14	03/12/2011	Wil	13:47:00	693674	6102716	0	18	0	5-10 knots NW	1/12/2011	N	no habitat - weeds	
	15	03/12/2011	Wil		693516	6102383	0	18	0	5-10 knots NW	1/12/2011	N	no habitat	
	16	03/12/2011	Wil	14:03:00	693347	6102179	0	18	0	5-10 knots NW	1/12/2011	N	patches of grassland mostly weeds	
	17	03/12/2011	Wil	14:05:00	693380	6102110	0	18	0	5-10 knots NW	1/12/2011	N	Low quality patch, only daisy	
	18	03/12/2011	Wil	14:07:00	693201	6101949	0	18	0	5-10 knots NW	1/12/2011	N	Low quality patch, only daisy	
	19	03/12/2011	Wil	14:13:00	693194	6102031	0	18	0	5-10 knots NW	1/12/2011	N	area where tiles are, OK. Gate	
	20	03/12/2011	Wil	14:19:00	693104	6102250	0	18	0	5-10 knots NW	1/12/2011	N	Up hill, weeds increasing - no habitat	
	21	03/12/2011	Wil		692904	6102140	0	18	0	5-10 knots NW	1/12/2011	N	Habitat, low quality, dam	
	22	03/12/2011	Wil	14:34:00	692721	6102409	0	18	0	5-10 knots NW	1/12/2011	N	low quality - weeds increasing	
	23	03/12/2011	Wil	14:41:00	692680	6101946	0	18	0	5-10 knots NW	1/12/2011	N	trees increasing, butterflies	
	24	03/12/2011	Wil	14:45:00	692735	6101920	0	18	0	5-10 knots NW	1/12/2011	N	butterflies - gate	
	25	03/12/2011	Wil	14:49:00	692779	6101734	0	18	0	5-10 knots NW	1/12/2011	N	fence - weeds - dam	
	26	03/12/2011	Wil	14:51:00	692823	6101642	0	18	0	5-10 knots NW	1/12/2011	N	mostly native - low density	
	27	03/12/2011	Wil	14:53:00	692915	6101738	0	18	0	5-10 knots NW	1/12/2011	N	mostly native - low density	
	28	03/12/2011	Wil	14:55:00	692937	6101595	0	18	0	5-10 knots NW	1/12/2011	N	top of hill, low quality	
	29	03/12/2011	Wil		692909	6101337	0	18	0	5-10 knots NW	1/12/2011	N	fence and gates - easement, small patches of habitat on hill	
	30	03/12/2011	Wil		693096	6101285	0	18	0	5-10 knots NW	1/12/2011	N	fenced off area - wet	
	31	03/12/2011	Wil		693276	6101257	0	18	0	5-10 knots NW	1/12/2011	N	go towards trees	
	32	03/12/2011	Wil	15:20:00	693338	6101311	0	18	0	5-10 knots NW	1/12/2011	N	head to car	
	33	03/12/2011	Wil	15:30:00	693706	6101002	0	18	0	5-10 knots NW	1/12/2011	N	head to car	
	34	03/12/2011	Wil	15:32:00	693814	6100608	0	18	0	5-10 knots NW	1/12/2011	N	head to car	

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Gungaharra	1	03/12/2011	Cameron	12:10:00	693928	6100835	0	18	0	Moderate NW	1/12/2011	Gate (N)	Starting gate on Bellenden Street - Secondary habitat with Chilean Needle Grass, possibly ploughed, reducing quality of habitat	Low GSM at York Park
	2	03/12/2011	Cameron		693983	6101080	0	18	0	Moderate NW	1/12/2011	N	Low to very low quality habitat between pt. 1 and pt. 2	
	3	03/12/2011	Cameron		694032	6101240	0	18	0	Moderate NW	1/12/2011	N	Fence, occasional suitable patches away from eastern fence line	
	4	03/12/2011	Cameron		693849	6101529	0	18	0	Moderate NW	1/12/2011	N	Snow Gums	
	5	03/12/2011	Cameron		693832	6101525	0	18	0	Moderate NW	1/12/2011	N	Split up	
	6	03/12/2011	Cameron		693751	6101558	0	18	0	Moderate NW	1/12/2011	N	Turn left 90°	
	7	03/12/2011	Cameron		693650	6101792	0	18	0	Moderate NW	1/12/2011	N	Turn right 90° a lot of sub clover	
	8	03/12/2011	Cameron		693570	6101423	0	18	0	Moderate NW	1/12/2011	N	Loop back to snow gums (pt.4)	
	9	03/12/2011	Cameron		693839	6101536	0	18	0	Moderate NW	1/12/2011	Gate (N)	Gate next to snow gums	
	10	03/12/2011	Cameron		693860	6102020	0	18	0	Moderate NW	1/12/2011	N	Fenced stock route with golden headed cisticolas. Sub-clover suggests no GSM	
	11	03/12/2011	Cameron		693886	6102079	0	18	0	Moderate NW	1/12/2011	N		
	12	03/12/2011	Cameron		693889	6102457	0	18	0	Moderate NW	1/12/2011	N		
	13	03/12/2011	Cameron		693909	6102523	0	18	0	Moderate NW	1/12/2011	N	Fox	
	14	03/12/2011	Cameron		693895	6102686	0	18	0	Moderate NW	1/12/2011	N	Finish at fence	
	15	03/12/2011	Cameron		693520	6102327	0	18	0	Moderate NW	1/12/2011	Gate (N)	Gate	
	16	03/12/2011	Cameron		693344	6102180	0	18	0	Moderate NW	1/12/2011	N	Good patch amongst oats	
	17	03/12/2011	Cameron		693262	6101992	0	18	0	Moderate NW	1/12/2011	N	Around to here following fence line	
	18	03/12/2011	Cameron		693197	6102036	0	18	0	Moderate NW	1/12/2011	Gate (N)	Gate at the top of the hill	
	19	03/12/2011	Cameron		692993	6102123	0	18	0	Moderate NW	1/12/2011	N	Blue moth, similar to GSM same height similar flight pattern	
	20	03/12/2011	Cameron		692990	6101866	0	18	0	Moderate NW	1/12/2011	Gate (N)	Gate	
	21	03/12/2011	Cameron		692936	6101595	0	18	0	Moderate NW	1/12/2011	N	Top of Gungahlin Hill oats, windy	
	22	03/12/2011	Cameron		693488	6101572	0	18	0	Moderate NW	1/12/2011	N	Starting N shaped walk through south-eastern paddock	
	23	03/12/2011	Cameron		693625	6101533	0	18	0	Moderate NW	1/12/2011	N	Change direction heading south	
	24	03/12/2011	Cameron		693530	6101420	0	18	0	Moderate NW	1/12/2011	N	Change direction heading south-east	
	25	03/12/2011	Cameron	15:00:00	693751	6101142	0	18	0	Moderate NW	1/12/2011	N	Finish	
3/12/2011	1	03/12/2011	Alison	14:00:00	693810	6100506	0	18	0	Moderate NW	1/12/2011		Start	Finished at 15:00. Low GSM habitat. Low GSM activity at York Park at 11:30 - 8 GSM in 10 minutes
	2	03/12/2011	Alison		693713	6100759	0	18	0	Moderate NW	1/12/2011		0.5ha of NTG, moderate GSM habitat	
	3	03/12/2011	Alison		693821	6101119	0	18	0	Moderate NW	1/12/2011			
	4	03/12/2011	Alison		693468	6101389	0	18	0	Moderate NW	1/12/2011		Shallow soil and rocky outcrops	
	5	03/12/2011	Alison		693317	6101724	0	18	0	Moderate NW	1/12/2011		Moderately clean native pasture, low to medium quality habitat	
	6	03/12/2011	Alison		693162	6101757	0	18	0	Moderate NW	1/12/2011			
	7	03/12/2011	Alison		693279	6101807	0	18	0	Moderate NW	1/12/2011		weedy, wet and pasture improved (subclover, phalans and rye grass)	
	8	03/12/2011	Alison	15:00:00	693367	6101728	0	18	0	Moderate NW	1/12/2011		weedy, wet and pasture improved (subclover, phalans and rye grass)	

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Gungaharra	1	03/01/2012	Cameron	11:15:00	693824	6100515	0	34	10	31 km/h WNW	22/12/2011	Start		37 in 2 hours at the Airport
	2	03/01/2012	Cameron	11:40:00	694018	6101562	0	34	10	31 km/h WNW	22/12/2011		Oats, danthonia, etc, moderate habitat	
	3	03/01/2012	Cameron	11:50:00	693937	6101588	0	34	10	31 km/h WNW	22/12/2011		High danthonia	
	4	03/01/2012	Cameron	11:55:00	693817	6101523	0	34	10	31 km/h WNW	22/12/2011		Snow Gums	
	5	03/01/2012	Cameron	12:05:00	693603	6101639	0	34	10	31 km/h WNW	22/12/2011		Possible GSM, quite orange, low fast flying, stopping for rests, flushed. Later confirmed by Alison Rowell that it was not a GSM.	
	6	03/01/2012	Cameron	12:17:00	693522	6101630	0	34	10	31 km/h WNW	22/12/2011		Weeds	
	7	03/01/2012	Cameron	12:20:00	693441	6101447	0	34	10	31 km/h WNW	22/12/2011	Pines	Danthonia	
	8	03/01/2012	Cameron	12:25:00	693459	6101337	0	34	10	31 km/h WNW	22/12/2011	Pines, minor drainage line	Danthonia, relatively grazed	
	9	03/01/2012	Cameron	12:30:00	693695	6101166	0	34	10	31 km/h WNW	22/12/2011		Danthonia, oats hundres of Kangaroos	
	1	03/01/2012	Cameron	12:46:00	693797	6100567	0	34	10	31 km/h WNW	22/12/2011	Finish south sector	Poor, weedy habitat	
	2	03/01/2012	Cameron	13:12:00	693570	6102744	0	34	10	31 km/h WNW	22/12/2011	Start North sector		
	3	03/01/2012	Cameron	13:17:00	693511	6102362	0	34	10	31 km/h WNW	22/12/2011		very poor habitat towards centre of paddock	
	4	03/01/2012	Cameron	13:20:00	693573	6102251	0	34	10	31 km/h WNW	22/12/2011		Oats, Danthonia	
	5	03/01/2012	Cameron	13:25:00	693682	6102226	0	34	10	31 km/h WNW	22/12/2011		Danthonia, native daisies	
	6	03/01/2012	Cameron	13:30:00	693951	6102181	0	34	10	31 km/h WNW	22/12/2011		Grazed paddock	
	7	03/01/2012	Cameron	13:32:00	694037	6102181	0	34	10	31 km/h WNW	22/12/2011		Grazed, poor, weedy habitat	
	8	03/01/2012	Cameron	13:37:00	693998	6102423	0	34	10	31 km/h WNW	22/12/2011		Oats, danthonia	
	9	03/01/2012	Cameron	13:40:00	694041	6102666	0	34	10	31 km/h WNW	22/12/2011		Thick, tall oats next to grazed paddock	
	10	03/01/2012	Cameron	13:55:00	693864	6102858	0	34	10	31 km/h WNW	22/12/2011		Tall, long grass, pooris habitat	
	11	03/01/2012	Cameron	14:05:00	693604	6102752	0	34	10	31 km/h WNW	22/12/2011	Finish		
3/01/2012	1	10/01/2012	Cameron	13:30:00	693558	6102736	0	34	10	31 km/h WNW	22/12/2011	Start		3 in 5 mins at York Park
	2	10/01/2012	Cameron	13:40:00	693535	6102357	0	34	10	31 km/h WNW	22/12/2011		Danthonia	
	3	10/01/2012	Cameron	13:48:00	693272	6102389	0	34	10	31 km/h WNW	22/12/2011		Danthonia, long grass	
	4	10/01/2012	Cameron	14:00:00	693169	6101902	0	34	10	31 km/h WNW	22/12/2011	Hill	Long grass, windy due to elevation	
	5	10/01/2012	Cameron	14:04:00	693144	6101822	0	34	10	31 km/h WNW	22/12/2011		Oats, Danthonia	
	6	10/01/2012	Cameron	14:08:00	693093	6101900	0	34	10	31 km/h WNW	22/12/2011		Oats, Danthonia, very windy	
	7	10/01/2012	Cameron	14:12:00	693093	6101991	0	34	10	31 km/h WNW	22/12/2011		Danthonia, very windy	
	8	10/01/2012	Cameron	14:16:00	692873	6102061	0	34	10	31 km/h WNW	22/12/2011		Danthonia, good habitat, very windy	
	9	10/01/2012	Cameron	14:20:00	692771	6102118	0	34	10	31 km/h WNW	22/12/2011		Semi decent habitat	
	10	10/01/2012	Cameron	14:30:00	692685	6102155	0	34	10	31 km/h WNW	22/12/2011		Moderate habitat	
	11	10/01/2012	Cameron	14:37:00	692731	6102383	0	34	10	31 km/h WNW	22/12/2011		Moderate habitat	
	12	10/01/2012	Cameron	14:45:00	692996	6102326	0	34	10	31 km/h WNW	22/12/2011		Moderate habitat	
	13	10/01/2012	Cameron	14:50:00	693068	6102289	0	34	10	31 km/h WNW	22/12/2011		Moderate habitat	
	14	10/01/2012	Cameron	14:55:00	693157	6102248	0	34	10	31 km/h WNW	22/12/2011		Moderate habitat	
	15	10/01/2012	Cameron	15:00:00	693550	6102739	0	34	10	31 km/h WNW	22/12/2011	Finish	Poor habitat on hill	

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Gungaharra	1	18/01/2012	Cameron	11:30:00	693569	6102742	0	32	10	39 km/h E	22/12/2011	Start north end	Start North End	MODERATE GSM NUMBERS AT AIRPORT
	2	18/01/2012	Cameron	11:42:00	693650	6102513	0	32	10	39 km/h E	22/12/2011			
	3	18/01/2012	Cameron	12:00:00	693824	6102241	0	32	10	39 km/h E	22/12/2011			
	4	18/01/2012	Cameron	12:10:00	693343	6102365	0	32	10	39 km/h E	22/12/2011		Decent habitat on fire trail	
	5	18/01/2012	Cameron	12:15:00	693026	6102410	0	32	10	39 km/h E	22/12/2011		common butterfly	
	6	18/01/2012	Cameron	12:22:00	692900	6102525	0	32	10	39 km/h E	22/12/2011		long grass, danthonia mainly	
	7	18/01/2012	Cameron	12:27:00	692761	6102440	0	32	10	39 km/h E	22/12/2011		decent habitat, Danthonia short	
	8	18/01/2012	Cameron	12:31:00	692805	6102617	0	32	10	39 km/h E	22/12/2011		semidecent habitat grazed	
	9	18/01/2012	Cameron	12:41:00	692695	6102262	0	32	10	39 km/h E	22/12/2011		Meander of good habitat	
	10	18/01/2012	Cameron	12:46:00	692642	6101936	0	32	10	39 km/h E	22/12/2011		too many trees	
	11	18/01/2012	Cameron	12:55:00	692876	6101773	0	32	10	39 km/h E	22/12/2011		meander, good habitat, no moths	
	12	18/01/2012	Cameron	13:05:00	693011	6101980	0	32	10	39 km/h E	22/12/2011		Decent low danthonia	
	13	18/01/2012	Cameron	13:10:00	693078	6102133	0	32	10	39 km/h E	22/12/2011		decent habitat danthonia, possibly too windy due to land structure	
	14	18/01/2012	Cameron	13:12:00	693073	6102290	0	32	10	39 km/h E	22/12/2011		Decent Danthonia short	
	15	18/01/2012	Cameron	13:15:00	693124	6102405	0	32	10	39 km/h E	22/12/2011		long grass, bad	
	16	18/01/2012	Cameron	13:30:00	693572	6102744	0	32	10	39 km/h E	22/12/2011	Finish north end	finish north end	
	1	18/01/2012	Cameron	14:00:00	693842	6100547	0	32	10	39 km/h E	22/12/2011	start south end	start south end	
	2	18/01/2012	Cameron	14:15:00	694034	6101256	0	32	10	39 km/h E	22/12/2011		poor habitat	
	3	18/01/2012	Cameron	14:25:00	693838	6101525	0	32	10	39 km/h E	22/12/2011		med length danthonia medium density	
	4	18/01/2012	Cameron	14:30:00	693715	6101262	0	32	10	39 km/h E	22/12/2011		short danthonia medium density	
	5	18/01/2012	Cameron	14:40:00	693571	6101337	0	32	10	39 km/h E	22/12/2011		danthonia	
	6	18/01/2012	Cameron	14:47:00	693548	6101449	0	32	10	39 km/h E	22/12/2011		some weeds mainly danthonia	
	7	18/01/2012	Cameron	14:50:00	693557	6101583	0	32	10	39 km/h E	22/12/2011		danthonia reasonable quality habitat	
	8	18/01/2012	Cameron	15:00:00	693580	6101646	0	32	10	39 km/h E	22/12/2011	0	weeds and danthonia	

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Gungahlin Blocks - Meandering														
23/12/2011	1	23/12/2011	Wil	12:00	694144	6104148	0	27°	10	33km/h E	22/12/2011			Low numbers at York Park
	2	23/12/2011	Wil	12:05	694230	6104122	0	27°	10	33km/h E	22/12/2011	In trees?	No moths, mown, lots of weeds	
	3	23/12/2011	Wil	12:08	694535	6104094	0	27°	10	33km/h E	22/12/2011	Hinder Street	Zig-Zag walk, work site	
	4	23/12/2011	Wil	12:10	694993	6104182	0	27°	10	33km/h E	22/12/2011	Sitesheds	Carpark, work sheds	
	5	23/12/2011	Wil	12:12	694660	6104319	0	27°	10	33km/h E	22/12/2011	Small tree	Mown - low condition	
	6	23/12/2011	Wil	12:15	694610	6104402	0	27°	10	33km/h E	22/12/2011	Wool sheds	scorched earth	
	7	23/12/2011	Wil	12:16	694763	6104317	0	27°	10	33km/h E	22/12/2011	Stump	life a sports oval	
	8	23/12/2011	Wil	12:17	694733	6104117	0	27°	10	33km/h E	22/12/2011		Trashed	
	9	23/12/2011	Wil	12:18	694716	6104045	0	27°	10	33km/h E	22/12/2011		Kate Crace/Valley intersection	
	10	23/12/2011	Wil	12:20	694577	6104052	0	27°	10	33km/h E	22/12/2011		Like a sports oval	
	11	23/12/2011	Wil	12:22	694404	6104075	0	27°	10	33km/h E	22/12/2011		Stock pile	
	12	23/12/2011	Wil	12:25	694250	6104105	0	27°	10	33km/h E	22/12/2011	Small tree	Patterson's Curse - Finish	
24/12/2011	1	24/12/2011	Wil	11:50	694140	6104156	0	18°	10	44 km/h E	23/11/2011		As above	11 marked in 2 hours at York Park
	2	24/12/2011	Wil		694471	6104092	0	18°	10	44 km/h E	23/11/2011			
	3	24/12/2011	Wil		694629	6104086	0	18°	10	44 km/h E	23/11/2011			
	4	24/12/2011	Wil		694639	6104308	0	18°	10	44 km/h E	23/11/2011			
	5	24/12/2011	Wil		694662	6104387	0	18°	10	44 km/h E	23/11/2011			
	6	24/12/2011	Wil		694857	6104361	0	18°	10	44 km/h E	23/11/2011			
	7	24/12/2011	Wil		694934	6104287	0	18°	10	44 km/h E	23/11/2011			
	8	24/12/2011	Wil		695005	6104281	0	18°	10	44 km/h E	23/11/2011			
	9	24/12/2011	Wil		695228	6104273	0	18°	10	44 km/h E	23/11/2011			
	10	24/12/2011	Wil		695191	6104151	0	18°	10	44 km/h E	23/11/2011			
	11	24/12/2011	Wil		694972	6104208	0	18°	10	44 km/h E	23/11/2011			
	12	24/12/2011	Wil		694740	6104241	0	18°	10	44 km/h E	23/11/2011			
	13	24/12/2011	Wil		694624	6104065	0	18°	10	44 km/h E	23/11/2011			
	14	24/12/2011	Wil	12:25	694244	6104114	0	18°	10	44 km/h E	23/11/2011			

Survey Event	Point No.	Date	Surveyor	Time	Easting (WGS 84)	Northing (WGS 84)	No. moths between point numbers	Temp (°C)	Cloud Cover (%)	Wind (speed/direction)	Last rain/forecasted	Landmarks	Habitat Details (Predators, vegetation etc.)	Reference Site Comments	
Gungahlin Blocks - Meandering															
20/01/2012	1	20/01/2012	Cameron	13:20	694149	6104184	0	33°	10	52 km/h ENE	1/01/2012	Road carpark	Mown, weeds, rubbish	High numbers at McGregor. Paddocks were being mown as we arrived	
	2	20/01/2012	Cameron	13:23	694214	6104159	0	33°	10	52 km/h ENE	1/01/2012	Yellow LJ hooker sign	no moths, weeds		
	3	20/01/2012	Cameron	13:25	694317	6104153	0	33°	10	52 km/h ENE	1/01/2012		trees, oats, weeds, mown, bare.		
	4	20/01/2012	Cameron	13:27	694357	6104146	0	33°	10	52 km/h ENE	1/01/2012	small block			
	5	20/01/2012	Cameron	13:29	694343	6104079	0	33°	10	52 km/h ENE	1/01/2012	finish small block	poor, mown habitat		
	-	20/01/2012	Cameron	13:32			0	33°	10	52 km/h ENE	1/01/2012	block 226	construction site		Site Comment - Walk along Gribble Street
	6	20/01/2012	Cameron	13:34	694453	6104133	0	33°	10	52 km/h ENE	1/01/2012	building site	trashed. Block 226		
	7	20/01/2012	Cameron	13:36	694538	6104116	0	33°	10	52 km/h ENE	1/01/2012	block 3	trashed construction site		
	8	20/01/2012	Cameron	13:40	694570	6104087	0	33°	10	52 km/h ENE	1/01/2012	block 227 start			
	9	20/01/2012	Cameron	13:44	694732	6104051	0	33°	10	52 km/h ENE	1/01/2012	block 227 finish	mown, weeds, crap		
	10	20/01/2012	Cameron	13:47	694695	6104112	0	33°	10	52 km/h ENE	1/01/2012	block 1 north of 227	trashed, with carpark to the west		
	11	20/01/2012	Cameron	13:48	694678	6104192	0	33°	10	52 km/h ENE	1/01/2012	same block	construction site to the west joined with carpark		
	12	20/01/2012	Cameron	13:51	694669	6104253	0	33°	10	52 km/h ENE	1/01/2012	block between Hibberson and Ernest Cavanaugh streets			
	13	20/01/2012	Cameron	13:52	694650	6104298	0	33°	10	52 km/h ENE	1/01/2012		Mown, some danth, lots of daisies		
	14	20/01/2012	Cameron	13:54	694691	6104414	0	33°	10	52 km/h ENE	1/01/2012		Mown, some danth, lots of daisies		
	15	20/01/2012	Cameron	14:16	694863	6104370	0	33°	10	52 km/h ENE	1/01/2012	block 1	Heavily mown		
	16	20/01/2012	Cameron	14:18	694948	6104363	0	33°	10	52 km/h ENE	1/01/2012	block 1	heavily mown, with trees		
	17	20/01/2012	Cameron	14:20	694916	6104313	0	33°	10	52 km/h ENE	1/01/2012	block 1	heavily mown, with trees		
	18	20/01/2012	Cameron	14:21	694990	6104287	0	33°	10	52 km/h ENE	1/01/2012	block 1	very heavily mown, poor condition		
	19	20/01/2012	Cameron	14:23	695058	6104338	0	33°	10	52 km/h ENE	1/01/2012	block 1	very heavily mown, poor condition		
	20	20/01/2012	Cameron	14:25	695144	6104288	0	33°	10	52 km/h ENE	1/01/2012	block 1	bare		
	21	20/01/2012	Cameron	14:27	695264	6104246	0	33°	10	52 km/h ENE	1/01/2012	block 1	completely bare some trees at end, crap.		
	16	20/01/2012	Liza	13:30	694228	6104115	0	33°	10	52 km/h ENE	1/01/2012		No apparent insect activity		
	17	20/01/2012	Liza		694137	6104143	0	33°	10	52 km/h ENE	1/01/2012		2 dragonflies copulating		
	18	20/01/2012	Liza		694285	6104119	0	33°	10	52 km/h ENE	1/01/2012		Paterson's curse ( <i>Echium plantagineum</i> )		
	19	20/01/2012	Liza		694345	6104105	0	33°	10	52 km/h ENE	1/01/2012		closely mown grass		
	20	20/01/2012	Liza	14:30	694567	6104067	0	33°	10	52 km/h ENE	1/01/2012				
	21	20/01/2012	Liza		694656	6104047	0	33°	10	52 km/h ENE	1/01/2012				
	22	20/01/2012	Liza		694728	6104044	0	33°	10	52 km/h ENE	1/01/2012				
	23	20/01/2012	Liza		694729	6104092	0	33°	10	52 km/h ENE	1/01/2012				
	24	20/01/2012	Liza		694731	6104180	0	33°	10	52 km/h ENE	1/01/2012				
	25	20/01/2012	Liza		694756	6104233	0	33°	10	52 km/h ENE	1/01/2012		Tettigoniid grasshopper		
	26	20/01/2012	Liza		694765	6104304	0	33°	10	52 km/h ENE	1/01/2012				
	27	20/01/2012	Liza		694759	6104384	0	33°	10	52 km/h ENE	1/01/2012				
28	20/01/2012	Liza		694673	6104440	0	33°	10	52 km/h ENE	1/01/2012					
29	20/01/2012	Liza		694844	6104298	0	33°	10	52 km/h ENE	1/01/2012					
30	20/01/2012	Liza		694908	6104257	0	33°	10	52 km/h ENE	1/01/2012					
31	20/01/2012	Liza		694987	6104234	0	33°	10	52 km/h ENE	1/01/2012					
32	20/01/2012	Liza		695094	6104208	0	33°	10	52 km/h ENE	1/01/2012					
33	20/01/2012	Liza		695165	6104198	0	33°	10	52 km/h ENE	1/01/2012		adult asilid (robber fly)			
34	20/01/2012	Liza	15:00	695244	6104180	0	33°	10	52 km/h ENE	1/01/2012					

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Gungahlin Blocks - Meandering															
13/01/2012	1	13/01/2012	Wil	13:30	694150	6104145	0	27°	10	44 km/h NW	1/01/2012		poor habitat	Low numbers at Yaralumla	
	2	13/01/2012	Wil		694351	6104137	0	27°	10	44 km/h NW	1/01/2012		poor habitat		
	3	13/01/2012	Wil		694524	6104044	0	27°	10	44 km/h NW	1/01/2012		poor habitat		
	4	13/01/2012	Wil		694621	6104124	0	27°	10	44 km/h NW	1/01/2012		Carpark		
	5	13/01/2012	Wil		694660	6104342	0	27°	10	44 km/h NW	1/01/2012		trashed		
	6	13/01/2012	Wil		694644	6104411	0	27°	10	44 km/h NW	1/01/2012				
	7	13/01/2012	Wil		694795	6104373	0	27°	10	44 km/h NW	1/01/2012				
	8	13/01/2012	Wil		694732	6104255	0	27°	10	44 km/h NW	1/01/2012				
	9	13/01/2012	Wil		694709	6104060	0	27°	10	44 km/h NW	1/01/2012			exotics	
	10	13/01/2012	Wil		694551	6104043	0	27°	10	44 km/h NW	1/01/2012			exotics	
	11	13/01/2012	Wil		694382	6104081	0	27°	10	44 km/h NW	1/01/2012			no habitat	
	12	13/01/2012	Wil	14:05	694229	6104112	0	27°	10	44 km/h NW	1/01/2012			finish	

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Gungahlin Blocks - Transect															
22/12/2011	1	22/12/2011	Wil	12:00	Transect	604787	6104275	0	25	80	27 km/h SSW	19/12/2011			Moderate numbers at york park
	2	22/12/2011	Wil		Transect	604887	6104275	0	25	80	27 km/h SSW	19/12/2011			
	3	22/12/2011	Wil		Transect	604887	6104375	0	25	80	27 km/h SSW	19/12/2011			
	4	22/12/2011	Wil		Transect	604987	6104375	0	25	80	27 km/h SSW	19/12/2011			
	5	22/12/2011	Wil		Transect	604987	6104275	0	25	80	27 km/h SSW	19/12/2011			
	6	22/12/2011	Wil	12:15	Transect	604987	6104175	0	25	80	27 km/h SSW	19/12/2011			
	7	22/12/2011	Wil		Transect	604087	6104175	0	25	80	27 km/h SSW	19/12/2011			
	8	22/12/2011	Wil		Transect	604087	6104275	0	25	80	27 km/h SSW	19/12/2011			
	9	22/12/2011	Wil		Transect	604187	6104275	0	25	80	27 km/h SSW	19/12/2011			
	10	22/12/2011	Wil		Transect	604287	6104275	0	25	80	27 km/h SSW	19/12/2011			
	11	22/12/2011	Wil	12:45	Transect	604187	6104175	0	25	80	27 km/h SSW	19/12/2011			
	0	22/12/2011	Wil	1:30	Transect	604187	6103975	0	25	80	27 km/h SSW	19/12/2011			Gate corner with fence
	1	22/12/2011	Wil	1:30	Transect	604287	6103975	0	25	80	27 km/h SSW	19/12/2011			Mown mixed pasture
	2	22/12/2011	Wil	1:32	Transect	604387	6103975	0	25	80	27 km/h SSW	19/12/2011			Mown mixed pasture
	3	22/12/2011	Wil	1:35	Transect	604487	6103975	0	25	80	27 km/h SSW	19/12/2011			
	4	22/12/2011	Wil	1:38	Transect	604587	6103975	0	25	80	27 km/h SSW	19/12/2011			
	5	22/12/2011	Wil	1:45	Transect	604687	6103975	0	25	80	27 km/h SSW	19/12/2011			
	6	22/12/2011	Wil		Transect	604787	6103975	0	25	80	27 km/h SSW	19/12/2011			Fence intersect (Liza split)
	7	22/12/2011	Wil		Transect	604887	6103975	0	25	80	27 km/h SSW	19/12/2011			Long grass/weeds
	8	22/12/2011	Wil		Transect	604887	6104075	0	25	80	27 km/h SSW	19/12/2011			Moved to Liza's path
	9	22/12/2011	Wil		Transect	604987	6104075	0	25	80	27 km/h SSW	19/12/2011			Long weeds
	10	22/12/2011	Wil		Transect	605087	6104075	0	25	80	27 km/h SSW	19/12/2011			Long weeds/meet mown area
	11	22/12/2011	Wil		Transect	605187	6104075	0	25	80	27 km/h SSW	19/12/2011			
	12	22/12/2011	Wil		Transect	605187	6103975	0	25	80	27 km/h SSW	19/12/2011			Road
	13	22/12/2011	Wil		Transect	605087	6103975	0	25	80	27 km/h SSW	19/12/2011			Weeds. Via drain
	14	22/12/2011	Wil		Transect	604987	6103975	0	25	80	27 km/h SSW	19/12/2011			Weeds/canbinis (wood beetles)
	15	22/12/2011	Wil		Transect	604887	6103975	0	25	80	27 km/h SSW	19/12/2011			Back to deviation point
16	22/12/2011	Wil		Transect	604887	6103875	0	25	80	27 km/h SSW	19/12/2011			Rosella/tree	
17	22/12/2011	Wil		Transect	604987	6103875	0	25	80	27 km/h SSW	19/12/2011			Weeds	
18	22/12/2011	Wil		Transect	605087	6103875	0	25	80	27 km/h SSW	19/12/2011			Weeds	
19	22/12/2011	Wil		Transect	605087	6103775	0	25	80	27 km/h SSW	19/12/2011			Gate	
20	22/12/2011	Wil		Transect	604987	6103775	0	25	80	27 km/h SSW	19/12/2011				
21	22/12/2011	Wil		Transect	604887	6103775	0	25	80	27 km/h SSW	19/12/2011				
22	22/12/2011	Wil		Transect	604887	6103875	0	25	80	27 km/h SSW	19/12/2011				
23	22/12/2011	Wil		Transect	604787	6103875	0	25	80	27 km/h SSW	19/12/2011				
24	22/12/2011	Wil		Transect	604687	6103875	0	25	80	27 km/h SSW	19/12/2011				
25	22/12/2011	Wil		Transect	604587	6103875	0	25	80	27 km/h SSW	19/12/2011			Back into mown area	
26	22/12/2011	Wil		Transect	604487	6103875	0	25	80	27 km/h SSW	19/12/2011				
27	22/12/2011	Wil	15:00	Transect	604387	6103875	0	25	80	27 km/h SSW	19/12/2011				
	1	22/12/2011	Liza		Transect	604284	6103976	0	25	80	27 km/h SSW	19/12/2011			closely mown pasture with evidence of erosion
	2	22/12/2011	Liza		Transect	604385	6103982	0	25	80	27 km/h SSW	19/12/2011			
	3	22/12/2011	Liza		Transect	604485	6103975	0	25	80	27 km/h SSW	19/12/2011			2 cerambycid beetles in flight (also known as long-horned beetles or longicorns beetles)
	4	22/12/2011	Liza		Transect	604588	6103980	0	25	80	27 km/h SSW	19/12/2011			
	5	22/12/2011	Liza		Transect	604588	6103772	0	25	80	27 km/h SSW	19/12/2011			?
	6	22/12/2011	Liza		Transect	604686	6103976	0	25	80	27 km/h SSW	19/12/2011			?
	7	22/12/2011	Liza		Transect	604785	6103978	0	25	80	27 km/h SSW	19/12/2011			fence
	8	22/12/2011	Liza		Transect	604785	6104078	0	25	80	27 km/h SSW	19/12/2011			
	9	22/12/2011	Liza		Transect	604776	6104078	0	25	80	27 km/h SSW	19/12/2011			?
	10	22/12/2011	Liza		Transect	604769	6104123	0	25	80	27 km/h SSW	19/12/2011			hit the road
	11	22/12/2011	Liza		Transect	604769	6104222	0	25	80	27 km/h SSW	19/12/2011			2 ground parrots sighted
	12	22/12/2011	Liza		Transect	604776	6104082	0	25	80	27 km/h SSW	19/12/2011			
	13	22/12/2011	Liza	15:00	Transect	604876	6104080	0	25	80	27 km/h SSW	19/12/2011			

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Gungahlin Blocks - Transect															
24/12/2011	1	24/12/2011	Wil	12:30	Transect	604188	6103975	0	25	10	5-15 km/h NE	22/12/2011		Start point - corner gate/fence	MOTHS FLYING AT YORK PARK
	2	24/12/2011	Wil		Transect	604288	6103975	0	25	10	5-15 km/h NE	22/12/2011		big tree low condition	
	3	24/12/2011	Wil		Transect	604388	6103975	0	25	10	5-15 km/h NE	22/12/2011		STIPA - mown	
	4	24/12/2011	Wil		Transect	604488	6103975	0	25	10	5-15 km/h NE	22/12/2011		Cerated tussocks sprayed - overkill	
	5	24/12/2011	Wil		Transect	604588	6103975	0	25	10	5-15 km/h NE	22/12/2011		Weeds near road - site shed	
	6	24/12/2011	Wil		Transect	604688	6103975	0	25	10	5-15 km/h NE	22/12/2011		Sheep camp	
	7	24/12/2011	Wil		Transect	604788	6103975	0	25	10	5-15 km/h NE	22/12/2011		Hit fence	
	8	24/12/2011	Wil		Transect	604788	6104075	0	25	10	5-15 km/h NE	22/12/2011		Mulch	
	9	24/12/2011	Wil		Transect	604788	6104175	0	25	10	5-15 km/h NE	22/12/2011		Roundabout	
	10	24/12/2011	Wil		Transect	604788	6104275	0	25	10	5-15 km/h NE	22/12/2011		median	
	11	24/12/2011	Wil		Transect	604888	6104275	0	25	10	5-15 km/h NE	22/12/2011		Red flower grass/ weeds	
	12	24/12/2011	Wil		Transect	604888	6104375	0	25	10	5-15 km/h NE	22/12/2011		Big red gum - Birds	
	13	24/12/2011	Wil		Transect	604988	6104375	0	25	10	5-15 km/h NE	22/12/2011		Building site dump - woodland - mown	
	14	24/12/2011	Wil		Transect	604988	6104275	0	25	10	5-15 km/h NE	22/12/2011		Yellow daisy weed	
	15	24/12/2011	Wil		Transect	604988	6104175	0	25	10	5-15 km/h NE	22/12/2011		hibberson Street	
	16	24/12/2011	Wil		Transect	605088	6104175	0	25	10	5-15 km/h NE	22/12/2011		Beg red gum / fence	
	17	24/12/2011	Wil		Transect	605088	6104275	0	25	10	5-15 km/h NE	22/12/2011		Yellow daisy	
	18	24/12/2011	Wil		Transect	605188	6104275	0	25	10	5-15 km/h NE	22/12/2011		through fence	
	19	24/12/2011	Wil		Transect	605288	6104275	0	25	10	5-15 km/h NE	22/12/2011		Fence corner (left turn only sign)	
	20	24/12/2011	Wil		Transect	605188	6104175	0	25	10	5-15 km/h NE	22/12/2011		Diagonal - weeds	
	21	24/12/2011	Wil		Transect	605188	6104075	0	25	10	5-15 km/h NE	22/12/2011		Cross road/fence/drain	
	22	24/12/2011	Wil		Transect	605088	6104075	0	25	10	5-15 km/h NE	22/12/2011		Mown verge	
	23	24/12/2011	Wil		Transect	604988	6104075	0	25	10	5-15 km/h NE	22/12/2011		tall weeds	
	24	24/12/2011	Wil		Transect	604888	6104075	0	25	10	5-15 km/h NE	22/12/2011		rosellas heaps	
	25	24/12/2011	Wil		Transect	604888	6104175	0	25	10	5-15 km/h NE	22/12/2011		weeds/verge	
	26	24/12/2011	Wil		Transect	604788	6103975	0	25	10	5-15 km/h NE	22/12/2011		tall weeds	
	27	24/12/2011	Wil		Transect	604988	6103975	0	25	10	5-15 km/h NE	22/12/2011		tall weeds	
	28	24/12/2011	Wil		Transect	605088	6103975	0	25	10	5-15 km/h NE	22/12/2011		Cross fence/tall weeds	
	29	24/12/2011	Wil		Transect	605188	6103975	0	25	10	5-15 km/h NE	22/12/2011		Road/fence/drain	
	30	24/12/2011	Wil		Transect	605088	6103875	0	25	10	5-15 km/h NE	22/12/2011		Drain - diagonal	
	31	24/12/2011	Wil		Transect		6103875	0	25	10	5-15 km/h NE	22/12/2011		Cross fence	
	32	24/12/2011	Wil		Transect	604888	6103875	0	25	10	5-15 km/h NE	22/12/2011		Danthonia/oats/weeds	
	33	24/12/2011	Wil		Transect	604788	6103775	0	25	10	5-15 km/h NE	22/12/2011		Snake skin - one foot	
	34	24/12/2011	Wil		Transect	604888	6103775	0	25	10	5-15 km/h NE	22/12/2011		(diagonal) otherside of fence	
	35	24/12/2011	Wil		Transect	604988	6103775	0	25	10	5-15 km/h NE	22/12/2011		travel through fence	
	36	24/12/2011	Wil		Transect	605088	6103775	0	25	10	5-15 km/h NE	22/12/2011		Tile transect	
	38	24/12/2011	Wil		Transect	604788	6103875	0	25	10	5-15 km/h NE	22/12/2011		(Repeat point - back on blocks)	
	39	24/12/2011	Wil		Transect	604688	6103875	0	25	10	5-15 km/h NE	22/12/2011		Kangaroo grass/St. John's Wart	
	40	24/12/2011	Wil		Transect	604588	6103875	0	25	10	5-15 km/h NE	22/12/2011		Crace fence - mown	
	41	24/12/2011	Wil	15:00	Transect	604488	6103875	0	25	10	5-15 km/h NE	22/12/2011		Finish	

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Gungahlin Blocks - Transect															
29/12/2011	1	29/12/2011	Alison	12:50	Transect	604188	6103975	0	26	10	39km/h ENE	22/12/2011		B mae, H radi, Danth, St b, Rb, Planc	LOW MOTHS NUMBERS AT YORK PARK
	2	29/12/2011	Alison		Transect	604288	6103975	0	26	10	39km/h ENE	22/12/2011		Miscip mown but approximately 20cm	
	3	29/12/2011	Alison		Transect	604388	6103975	0	26	10	39km/h ENE	22/12/2011		St b/ Danthonia/H radi/Wa h/Plums/Panic	
	4	29/12/2011	Alison	13:05	Transect	604488	6103975	0	26	10	39km/h ENE	22/12/2011		Danthonia sub/and Sr b/sc H radi Plan, YB/RG	
	5	29/12/2011	Alison		Transect	604588	6103975	0	26	10	39km/h ENE	22/12/2011			
	6	29/12/2011	Alison		Transect	604688	6103975	0	26	10	39km/h ENE	22/12/2011		Site shed, YB, horsehound, Sco, Th, St b Danthonia	
	7	29/12/2011	Alison		Transect	604788	6103985	0	26	10	39km/h ENE	22/12/2011		Hit fence, Tum north	
	8	29/12/2011	Alison		Transect	604788	6104075	0	26	10	39km/h ENE	22/12/2011		Carpark, mulch heaps St sc Tbig D, YB/RG	
	9	29/12/2011	Alison	13:30	Transect	604788	6104175	0	26	10	39km/h ENE	22/12/2011		St sc/b D, H radi, end at roundabout	
	10	29/12/2011	Alison		Transect	604788	6104275	0	26	10	39km/h ENE	22/12/2011		Chl.tr, Goose AFLG, H radi, D1, weeds, YB M ship	
	11	29/12/2011	Alison		Transect	604888	6104275	0	26	10	39km/h ENE	22/12/2011		Turn E mown paddock, St b/D1, weeds YB mShip	
	12	29/12/2011	Alison		Transect	604888	6104375	0	26	10	39km/h ENE	22/12/2011		Turn N, D1>Dom, Stsc b, weeds occuring YB, Large YB	
	13	29/12/2011	Alison		Transect	604988	6104375	0	26	10	39km/h ENE	22/12/2011		Turn E Stsc D1, Wahl, H radi, verge weeds, lump	
	14	29/12/2011	Alison		Transect	604988	6104275	0	26	10	39km/h ENE	22/12/2011		Turn S, RG/AB clump + phal/D1, weeds Lolium to D1 dom/H radi	
	15	29/12/2011	Alison	13:50	Transect	604988	6104175	0	26	10	39km/h ENE	22/12/2011		tSts weedy NP Hibberson street	
	16	29/12/2011	Alison		Transect	605088	6104175	0	26	10	39km/h ENE	22/12/2011		Turn E Stb/sc/D1/H radi YB + RG (1x)	
	17	29/12/2011	Alison		Transect	605088	6104275	0	26	10	39km/h ENE	22/12/2011		Turn N, Stsc/D2/H radi/D carph/D1	
	18	29/12/2011	Alison		Transect	605188	6104275	0	26	10	39km/h ENE	22/12/2011		Turn E, Hradi/D1/2 Tbr Mic St	
	19	29/12/2011	Alison		Transect	605288	6104275	0	26	10	39km/h ENE	22/12/2011		D1/Hradi/coats/phal/couch/weeds/ St sc/b	
	20	29/12/2011	Alison		Transect	605188	6104175	0	26	10	39km/h ENE	22/12/2011		Turn SW, Stsc/H radi/D1/Phal + weeds couch AFLG	
	21	29/12/2011	Alison		Transect	605188	6104075	0	26	10	39km/h ENE	22/12/2011		Turn S, cross Hibberson Street	
	22	29/12/2011	Alison	14:20	Transect	605088	6104075	0	26	10	39km/h ENE	22/12/2011		Turn W, mown verge, dryland mix lolium Felat Trs rep + D1/St/chlors/phal mown, D1 St b/weeds b grd (dist) mown + carph	
	23	29/12/2011	Alison		Transect	604988	6104075	0	26	10	39km/h ENE	22/12/2011		(tiles) enter unmown, NP+Phal. Dlaev/D1/2 Stsc	
	24	29/12/2011	Alison		Transect	604888	6104075	0	26	10	39km/h ENE	22/12/2011		Phaleurs/weeds+(NP) not habitat? Some D tiles	
	25	29/12/2011	Alison		Transect	604888	6104175	0	26	10	39km/h ENE	22/12/2011		Turn N: Phal/NP/RG + Habitat to verge mown St/D	
	26	29/12/2011	Alison		Transect	604888	6103975	0	26	10	39km/h ENE	22/12/2011		i.e. reverse over same ground, start 100m S	
	27	29/12/2011	Alison	14:55	Transect	604888	6103975	0	26	10	39km/h ENE	22/12/2011		Start St b/D1/H radi/ very weedy Y Fog, Plan, Phal	
	28	29/12/2011	Alison		Transect	604788	6103975	0	26	10	39km/h ENE	22/12/2011		Mainly weeds	
	29	29/12/2011	Alison		Transect	604688	6103975	0	26	10	39km/h ENE	22/12/2011		cross fence to mown area St b/sc D1 weeds. Moved 50m S, restart at	
	33	29/12/2011	Alison		Transect	604688	6103950	0	26	10	39km/h ENE	22/12/2011		at fence + brg YB, continue West	
	34	29/12/2011	Alison		Transect	604588	6103950	0	26	10	39km/h ENE	22/12/2011		St+2/D1/H radi mown	
	35	29/12/2011	Alison		Transect	604488	6103950	0	26	10	39km/h ENE	22/12/2011		St+2/D1+ 1 yellow box	
	36	29/12/2011	Alison		Transect	604388	6103950	0	26	10	39km/h ENE	22/12/2011		D1/Stsc/BG/Hradi/D2 Mic Street RG	
	37	29/12/2011	Alison		Transect	604288	6103950	0	26	10	39km/h ENE	22/12/2011		D1/Stsc/BG/Hradi/D2 Mic Street RG	
	38	29/12/2011	Alison	15:15	Transect	604227	6103950	0	26	10	39km/h ENE	22/12/2011		D1/Stsc/BG/Hradi/D2 Mic Street RG weeds, short run, hit fence	

Survey Event	Point No.	Date	Surveyor	Time	Survey Type	Easting (WGS 84)	Northing (WGS 84)	No. moths between point numbers	Temp (°C)	Cloud Cover (%)	Wind (speed/direction)	Last rain/forecasted	Landmarks	Habitat Details (Predators, vegetation etc.)	Reference Site Comments
Gungahlin Blocks - Transect															
13/01/2012	1	13/01/2012	Wil	12:00	Transect	694887	6103975	0	26	10	39km/h ENE	22/12/2011		weeds dere	
	2	13/01/2012	Wil		Transect	694987	6103975	0	26	10	39km/h ENE	22/12/2011		weeds high	
	3	13/01/2012	Wil		Transect	696087	6103975	0	26	10	39km/h ENE	22/12/2011		on road	
	4	13/01/2012	Wil		Transect	696187	6103975	0	26	10	39km/h ENE	22/12/2011			
	5	13/01/2012	Wil		Transect	696087	6103875	0	26	10	39km/h ENE	22/12/2011			
	6	13/01/2012	Wil		Transect	694987	6103875	0	26	10	39km/h ENE	22/12/2011			
	7	13/01/2012	Wil		Transect	694887	6103875	0	26	10	39km/h ENE	22/12/2011			
	8	13/01/2012	Wil		Transect	694787	6103775	0	26	10	39km/h ENE	22/12/2011			Tracks
	9	13/01/2012	Wil		Transect	694887	6103775	0	26	10	39km/h ENE	22/12/2011			
	10	13/01/2012	Wil		Transect	694987	6103775	0	26	10	39km/h ENE	22/12/2011			
	11	13/01/2012	Wil		Transect	696087	6103775	0	26	10	39km/h ENE	22/12/2011			Corner of block
	12	13/01/2012	Wil		Transect	694787	6103875	0	26	10	39km/h ENE	22/12/2011			commute - same habitat near tracks
	13	13/01/2012	Wil		Transect	694687	6103875	0	26	10	39km/h ENE	22/12/2011			
	14	13/01/2012	Wil		Transect	694587	6103875	0	26	10	39km/h ENE	22/12/2011			small patches
	15	13/01/2012	Wil	13:30	Transect	694487	6103875	0	26	10	39km/h ENE	22/12/2011			finish
20/01/2012	1	20/01/2012	Cameron	12:20	Meander	694975	6104141	0	33	10	52 km/h ENE	1/01/2012		Start. Good native patch	
	2	20/01/2012	Cameron	12:27	Meander	694928	6103901	0	33	10	52 km/h ENE	1/01/2012		poor, heavily mown habitat	
	3	20/01/2012	Cameron	12:30	Meander	694941	6103775	0	33	10	52 km/h ENE	1/01/2012		poor, heavily mown habitat	
	4	20/01/2012	Cameron	12:40	Meander	694783	6103837	0	33	10	52 km/h ENE	1/01/2012		poor, heavily mown habitat	
	5	20/01/2012	Cameron	12:54	Meander	694606	6103859	0	33	10	52 km/h ENE	1/01/2012		poor, heavily mown habitat	
	6	20/01/2012	Cameron	12:59	Meander	694679	6103896	0	33	10	52 km/h ENE	1/01/2012		poor, heavily mown habitat	
	7	20/01/2012	Cameron	13:03	Meander	694586	6103892	0	33	10	52 km/h ENE	1/01/2012		very heavily mown	
	8	20/01/2012	Cameron	13:05	Meander	694448	6103929	0	33	10	52 km/h ENE	1/01/2012		very heavily mown	
	9	20/01/2012	Cameron	13:07	Meander	694291	6103950	0	33	10	52 km/h ENE	1/01/2012		very heavily mown	
	10	20/01/2012	Cameron	13:10	Meander	694193	6103989	0	33	10	52 km/h ENE	1/01/2012		very heavily mown	
	11	20/01/2012	Cameron	14:37	Meander	696121	6104093	0	33	10	52 km/h ENE	1/01/2012	block in between 1 and 3		
	12	20/01/2012	Cameron	14:41	Meander	696094	6103890	0	33	10	52 km/h ENE	1/01/2012	block 3	Heavily mown, crap paddock	
	13	20/01/2012	Cameron	14:45	Meander	696119	6103737	0	33	10	52 km/h ENE	1/01/2012	block 3	decent habitat, poor to the west.	
	1	20/01/2012	Liza	12:30	Meander	694901	6104115	0	33	10	52 km/h ENE	1/01/2012		mown pasture	
	2	20/01/2012	Liza		Meander	694850	6104037	0	33	10	52 km/h ENE	1/01/2012		no insects in flight	
	3	20/01/2012	Liza		Meander	694880	6103977	0	33	10	52 km/h ENE	1/01/2012		no insects in flight	
	4	20/01/2012	Liza		Meander	694720	6103925	0	33	10	52 km/h ENE	1/01/2012			
	5	20/01/2012	Liza		Meander	694550	6103842	0	33	10	52 km/h ENE	1/01/2012		adult dragonfly	
	6	20/01/2012	Liza		Meander	694600	6103811	0	33	10	52 km/h ENE	1/01/2012			
	7	20/01/2012	Liza	12:40	Meander	694784	6103901	0	33	10	52 km/h ENE	1/01/2012			
	8	20/01/2012	Liza	13:00	Meander	694780	6103927	0	33	10	52 km/h ENE	1/01/2012			
	9	20/01/2012	Liza		Meander	694708	6103900	0	33	10	52 km/h ENE	1/01/2012			
	10	20/01/2012	Liza		Meander	694630	6103896	0	33	10	52 km/h ENE	1/01/2012		tettigoniid grasshopper	
	11	20/01/2012	Liza		Meander	694622	6103920	0	33	10	52 km/h ENE	1/01/2012		various microlepidoptera	
	12	20/01/2012	Liza		Meander	694531	6103952	0	33	10	52 km/h ENE	1/01/2012			
	13	20/01/2012	Liza		Meander	694382	6103988	0	33	10	52 km/h ENE	1/01/2012			
	14	20/01/2012	Liza	14:21	Meander	694254	6103985	0	33	10	52 km/h ENE	1/01/2012			

Survey Event Syncoston	Point No.	Date	Surveyor	Time	Easting (WGS 84)	Northing (WGS 84)	No. moths between point numbers	Temp (°C)	Cloud Cover (%)	Wind (speed/ direction)	Last rain forecast	Landmarks	Habitat Details (Predators, vegetation etc.)	Site Reference Comments	
8/12/2011	1	8/12/2011	Cameron	13:30	685194	8095570	0	21	75	20kmhNE	1/12/2011			9 moths in 5 mins York Park. Moderate habitat lots of thistle and created tussock that has been sprayed	
	2	8/12/2011	Cameron	13:35	685114	8095522	0	21	75	20kmhNE	1/12/2011		Lots of thistle		
	3	8/12/2011	Cameron	13:40	685035	8095552	0	21	75	20kmhNE	1/12/2011			Thistle thickening	
	4	8/12/2011	Cameron	13:45	684939	8095481	0	21	75	20kmhNE	1/12/2011			Thistle thinning	
	5	8/12/2011	Cameron	13:50	684822	8095453	0	21	75	20kmhNE	1/12/2011		Field at south corner fence post		
	6	8/12/2011	Cameron	13:55	684822	8095583	0	21	75	20kmhNE	1/12/2011		Start 100m north of last point		
	7	8/12/2011	Cameron	14:00	684965	8095583	0	21	75	20kmhNE	1/12/2011			Thistle	
	8	8/12/2011	Cameron	14:05	685045	8095528	0	21	75	20kmhNE	1/12/2011			Thistle thickening	
	9	8/12/2011	Cameron	14:10	685049	8095589	0	21	75	20kmhNE	1/12/2011		Field at Gate		
	1	8/12/2011	Lba	13:30	685175	8095666	0	21	75	20kmhNE	1/12/2011		Start		
	2	8/12/2011	Lba	13:35	685135	8095571	0	21	75	20kmhNE	1/12/2011				
	3	8/12/2011	Lba	13:40	685090	8095535	0	21	75	20kmhNE	1/12/2011				
	4	8/12/2011	Lba	13:45	684982	8095562	0	21	75	20kmhNE	1/12/2011				
	5	8/12/2011	Lba	13:50	684930	8095558	0	21	75	20kmhNE	1/12/2011				
	6	8/12/2011	Lba	13:55	684896	8095535	0	21	75	20kmhNE	1/12/2011				
	7	8/12/2011	Lba	14:00	684827	8095582	0	21	75	20kmhNE	1/12/2011				
	8	8/12/2011	Lba	14:05	684897	8095515	0	21	75	20kmhNE	1/12/2011				
	9	8/12/2011	Lba	14:10	684893	8095551	0	21	75	20kmhNE	1/12/2011		Field		
	1	8/12/2011	Wl	13:30	685192	8095588	0	21	75	20kmhNE	1/12/2011		Start		
	2	8/12/2011	Wl	13:35	685074	8095532	0	21	75	20kmhNE	1/12/2011				
	3	8/12/2011	Wl	13:40	684912	8095561	0	21	75	20kmhNE	1/12/2011				
	4	8/12/2011	Wl	13:45	684831	8095527	0	21	75	20kmhNE	1/12/2011				
	5	8/12/2011	Wl	13:50	684781	8095585	0	21	75	20kmhNE	1/12/2011				
	6	8/12/2011	Wl	13:55	684735	8095543	0	21	75	20kmhNE	1/12/2011				
7	8/12/2011	Wl	14:05	684881	8095522	0	21	75	20kmhNE	1/12/2011					
8	8/12/2011	Wl	14:10	684935	8095545	0	21	75	20kmhNE	1/12/2011		Field			
9/12/2011	1	9/12/2011	Cameron	11:15	685194	8095587	0	21	65	13kmhNNE	1/12/2011	East fence	Gravel, little grass	3 moths in 17 mins at York Park. Moderate habitat lots of thistle and created tussock that has been sprayed	
	2	9/12/2011	Cameron	11:19	685111	8095545	0	21	65	13kmhNNE	1/12/2011		Danthonia patch		
	3	9/12/2011	Cameron	11:23	685019	8095611	0	21	65	13kmhNNE	1/12/2011		Danthonia, small amount of thistle		
	4	9/12/2011	Cameron	11:25	684934	8095554	0	21	65	13kmhNNE	1/12/2011		Lots of thistle		
	5	9/12/2011	Cameron	11:30	684812	8095454	0	21	65	13kmhNNE	1/12/2011	West fence	Poor habitat		
	6	9/12/2011	Cameron				0	21	65	13kmhNNE	1/12/2011	Commuter			
	7	9/12/2011	Cameron	11:33	684765	8095538	0	21	65	13kmhNNE	1/12/2011	West fence	Lots of trees		
	8	9/12/2011	Cameron	11:37	684665	8095581	0	21	65	13kmhNNE	1/12/2011		Lots of thistle (sprayed)		
	9	9/12/2011	Cameron	11:42	684604	8095594	0	21	65	13kmhNNE	1/12/2011		Small black moth Bc GSM, flying at 10m high		
	10	9/12/2011	Cameron	11:45	684655	8095609	0	21	65	13kmhNNE	1/12/2011		Lots of thistle		
	11	9/12/2011	Cameron	11:48	685034	8095542	0	21	65	13kmhNNE	1/12/2011		Danthonia		
10/12/2011	1	10/12/2011	Wl	12:00	685046	8095576	0	21	65	13kmhNNE	1/12/2011	Commuter to car			
	2	10/12/2011	Wl	13:25	685015	8095589	0	25	25	15kmhNE	4/12/2011	Field			
	3	10/12/2011	Wl	13:30	685195	8095705	0	25	25	15kmhNE	4/12/2011	Fire break along fence line	Fence line running east	3 moths in 5 mins at York Park. Butterflies, grasshoppers, Rosellas, but no moths.	
	4	10/12/2011	Wl	13:35	685193	8095572	0	25	25	15kmhNE	4/12/2011	Fire break along fence line	Fence line running south		
	5	10/12/2011	Wl	13:40	685009	8095549	0	25	25	15kmhNE	4/12/2011	Fire break along fence line	Fence line running west		
	6	10/12/2011	Wl	13:45	684958	8095584	0	25	25	15kmhNE	4/12/2011	Few weeds	Head into grassland patch		
	7	10/12/2011	Wl	13:50	684954	8095512	0	25	25	15kmhNE	4/12/2011	Fence line	In grassland patch		
	8	10/12/2011	Wl	13:55	684899	8095540	0	25	25	15kmhNE	4/12/2011	Fence line	Back to fence line		
	9	10/12/2011	Wl	14:00	684764	8095582	0	25	25	15kmhNE	4/12/2011		Head into woodland		
	10	10/12/2011	Wl	14:05	684835	8095515	0	25	25	15kmhNE	4/12/2011		In woodland		
	11	10/12/2011	Wl	14:07	684956	8095639	0	25	25	15kmhNE	4/12/2011		Out of Woodland		
13/12/2011	1	13/12/2011	Wl	14:10	685053	8095516	0	25	25	15kmhNE	4/12/2011		Fence line		
	2	13/12/2011	Cameron	12:20	685191	8095587	0	15	85	11kmhSE	10/12/2011	Home circle is grass	Some thistle, some good grass, and gravel	low numbers in syncoston area. Butterflies, bees, beetles, no moths.	
	3	13/12/2011	Cameron	12:27	685115	8095551	0	15	85	11kmhSE	10/12/2011	East fence	Decent habitat		
	4	13/12/2011	Cameron	12:32	685047	8095516	0	15	85	11kmhSE	10/12/2011	South fence	Decent habitat		
	5	13/12/2011	Cameron	12:37	684973	8095586	0	15	85	11kmhSE	10/12/2011	South fence	Lots of thistle		
	6	13/12/2011	Cameron	12:41	684895	8095515	0	15	85	11kmhSE	10/12/2011		Poor habitat, low grass, thistle		
	7	13/12/2011	Cameron	12:45	684839	8095451	0	15	85	11kmhSE	10/12/2011	West fence	Trees, low grass, less thistle		
	8	13/12/2011	Cameron	12:50	684790	8095544	0	15	85	11kmhSE	10/12/2011	West fence	Trees, low grass, lots of beetles		
	9	13/12/2011	Cameron	12:52	684721	8095539	0	15	85	11kmhSE	10/12/2011	North west corner	Trees, lots of butterflies and 4 hares		
	10	13/12/2011	Cameron	12:55	684836	8095589	0	15	85	11kmhSE	10/12/2011	North fence	Trees, good patches of habitat		
	11	13/12/2011	Cameron	12:58	684895	8095585	0	15	85	11kmhSE	10/12/2011	North fence	Lots of thistle		
	12	13/12/2011	Cameron	13:01	684872	8095609	0	15	85	11kmhSE	10/12/2011		Thistle with patches of good habitat		
	12	13/12/2011	Cameron	13:05	685045	8095555	0	15	85	11kmhSE	10/12/2011	Field			

## APPENDIX C GIS METADATA

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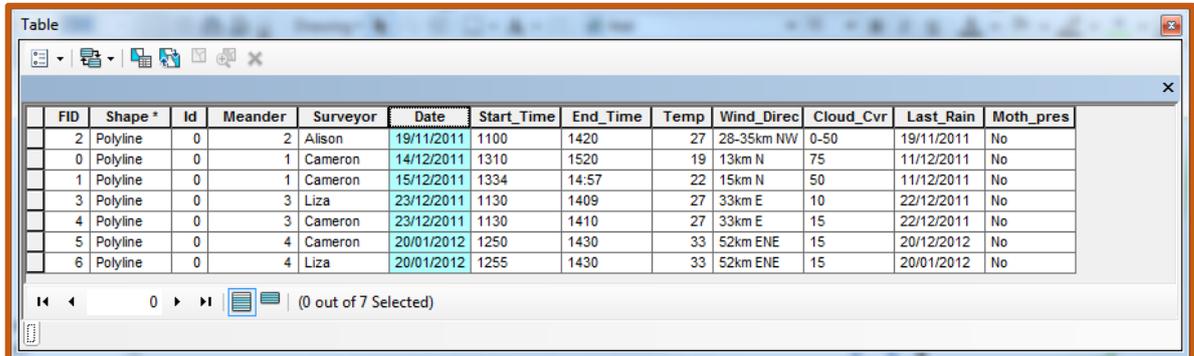
## GIS MetaData

The metadata created to support and map the GSM survey conducted by SMEC varies depending on the type of survey. Each block has two associated shape files according to the survey undertaken. The following shape files will accompany this report:

- GSM\_East\_Fyshwick\_2011 (meander survey of East Fyshwick);
- GSM\_Gungaderra\_2011 (meander survey of Gungaderra);
- GSM\_Gungahlin\_Transpoints\_2011 (walking transect points for Gungahlin Blocks);
- GSM\_GungahlinM\_2011 (meander surveys for Gungahlin Blocks);
- GSM\_GungahlinT\_meander\_2011 (meander survey associated with the initial walking transects of GSM\_Gungahlin\_Transpoints\_2011);
- GSM\_Symonston\_2011 (meander survey of Symonston);
- Perunga\_East\_Fyshwick\_2011 (Perunga observation point at East Fyshwick); and
- Perunga\_Gungaderra\_2011 (Incidental Perunga observation at Gungaderra).

## Meandering Metadata

The metadata for meandering polylines are shown for all blocks by survey event (date). Data associated with each survey event includes surveyor (text field), dates (date field), start time (text field), end time (text field), temperature (°C, text field), wind speed and direction (text field), cloud cover (%) (text field) and time since last rain / forecasted (date field). Each site is represented as an individual shapefile, projected in WGS84, and includes information shown in Figure 9 .



The screenshot shows a table window titled 'Table' with a toolbar at the top. The table contains the following data:

FID	Shape *	Id	Meander	Surveyor	Date	Start_Time	End_Time	Temp	Wind_Direc	Cloud_Cvr	Last_Rain	Moth_pres
2	Polyline	0	2	Alison	19/11/2011	1100	1420	27	28-35km NW	0-50	19/11/2011	No
0	Polyline	0	1	Cameron	14/12/2011	1310	1520	19	13km N	75	11/12/2011	No
1	Polyline	0	1	Cameron	15/12/2011	1334	14:57	22	15km N	50	11/12/2011	No
3	Polyline	0	3	Liza	23/12/2011	1130	1409	27	33km E	10	22/12/2011	No
4	Polyline	0	3	Cameron	23/12/2011	1130	1410	27	33km E	15	22/12/2011	No
5	Polyline	0	4	Cameron	20/01/2012	1250	1430	33	52km ENE	15	20/12/2012	No
6	Polyline	0	4	Liza	20/01/2012	1255	1430	33	52km ENE	15	20/01/2012	No

At the bottom of the table window, there are navigation icons and the text '(0 out of 7 Selected)'.

Figure 9 Example of Meandering Transect attribute table

## Transect Metadata

The data associated with the transect survey includes eating, northing and moth count in WGS84 datum, attributes detailed in this type of metadata include those shown in Figure 10.

FID	Shape *	FID_	E	N	Object_ID	Surveyor	Point_No_
0	Point	1	69418	610397	1	Wii	1
1	Point	2	69428	610397	2	Wii	2
2	Point	3	69438	610397	3	Wii	3
3	Point	4	69448	610397	4	Wii	4
4	Point	5	69458	610397	5	Wii	5
5	Point	6	69468	610397	6	Wii	6
6	Point	7	69478	610397	7	Wii	7
7	Point	8	69478	610407	8	Wii	8
8	Point	9	69478	610417	9	Wii	9
9	Point	10	69478	610427	10	Wii	10
10	Point	11	69488	610427	11	Wii	11
11	Point	12	69488	610437	12	Wii	12
12	Point	13	69498	610437	13	Wii	13
13	Point	14	69498	610427	14	Wii	14
14	Point	15	69498	610417	15	Wii	15

Figure 10 Extract of Transect attribute table

### Perunga Metadata

The Perunga shape files including date (Text field), observer (text field), easting (in ACT AGD66, text field), northing (in ACT ADG66, text field), East g94 (in GDA94, text field), North g94 (in GDA94, text field) and No (number) of Perunga (long integer), as shown in Figure 11 .

FID	Shape *	Id	Date	Observer	Easting	Northing	East_g94	Noth_g94	No_Perunga
0	Point	0	25/10/2011	William Allen	215931.61*	597344.94*	698639.97*	6087061.1*	1

Figure 11 Example of Perunga attribute table