Final Report

Year 5 Golden Sun Moth *Synemon plana* Population and Habitat Monitoring (2024/25), 222 Challicum Road, Buangor, Victoria (EPBC Referral 2018/8167)

Prepared for

Frasers Property Australia

April 2025

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DOCUMENT CONTROL

Assessment	Year 5 Golden Sun Moth *Synemon plana* Population and Habitat Monitoring (2024/25)
Address	222 Challicum Road, Buangor, Victoria
Project number	14695
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File name	14695_EHP_GSM_Yr5_Monitoring_Buangor_Final_02042025
Client	Frasers Property Australia
Bioregion	Central Victorian Uplands
CMA	Glenelg Hopkins
Council	Ararat Rural City Council

Report versions	Comments	Comments updated by	Report reviewed by:	Date submitted
Draft	Report sent to client for review	DH	AO	03/03/2025
Final	Updated to final	DH	AO	02/04/2025

Ecology and Heritage Partners Pty Ltd acknowledge the Traditional Owners of the country we live and work on, and we pay our respect to Elders past, present and emerging.

Acknowledgements

We thank the following people for their contribution to the project:

- Neil Marriott of White Gums Australia Environmental Consulting Pty Ltd.
- Landowners who provided access to the offset site and on-site management information within the offset site.

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1 INTRODUCTION

1.1 Background

Ecology and Heritage Partners was engaged by Frasers Property Australia to undertake the Year 4 Golden Sun Moth *Synemon plana* population and habitat monitoring (2023/24) at 222 Challicum Road, Buangor, Victoria as part of the ongoing monitoring requirements set by the Department of Climate Change, Energy, the Environment and Water (DCCEEW), formerly the Department of Agriculture, Water and Environment (DAWE), for the management of the offset site.

The requirement for Golden Sun Moth offsets was associated with the development and subdivision of land located at 410 Cooper Street and 315 O'Herns Road, Epping, Victoria into an industrial estate (Ecology and Heritage Partners 2019). The offset requirements were set under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the removal of 54.36 hectares of confirmed Golden Sun Moth habitat (EPBC Referral 2018/8167).

The following report outlines the results of the Year 5 (2024/25) Golden Sun Moth population and habitat monitoring within the offset site established at 222 Challicum Road, Buangor, Victoria, herein referred to as the Buangor Offset Site. Golden Sun Moth management, population and habitat monitoring was undertaken in accordance with Section 5.5 and Section 5.6 of the endorsed Offset Management Plan (OMP) (Ecology and Heritage Partners 2019) to determine reproductive success and to ensure that management actions and habitats remain suitable to support a viable Golden Sun Moth population into the future. Furthermore, the report provides recommendations for managing Golden Sun Moth habitat within the Buangor Offset Site over subsequent years, as appropriate.

1.2 Study Area

The Buangor Offset Site is 57.51 hectares in size and is located at 222 Challicum Road, Buangor (Figure 1). It is zoned Farming (FZ) and has a Vegetation Protection Overlay (VPO1: Significant and Remnant Vegetation Areas) which covers a small portion of the study area to the north.

The Buangor Offset Site is bound by an existing railway line to the north and beyond that open grazed areas similar to the site. Land to the west is currently used for broad acre cropping, while to the south and east there are open grazed paddocks. The paddocks directly to the north and north-west of the site support similar understorey habitat (i.e. modified Plains Grassy Woodland, and derived native grassland in areas) to the Buangor Offset Site. These areas are partially connected to the offset site and Golden Sun Moth has previously been detected (Ecology and Heritage Partners 2012; Ecology and Heritage Partners 2021) or is considered to have a moderate to high likelihood of occurrence.

At the time of the OMP's inception, the property was lightly grazed and had not experienced pasture improvement (superphosphate application) for several years. There were low numbers of regenerating River Red-gums *Eucalypts camaldulensis* also present. Consistent with the Golden Sun Moth Significant Impact Guidelines (DEWHA 2009), the offset site is open with minimal shading with areas comprising bare or sparsely covered ground between grass tussocks (inter-tussock space).

According to the Victorian Department of Energy, Environment and Climate Action (DEECA) NatureKit Map (DEECA 2025), the Buangor Offset Site occurs within the Central Victorian Uplands bioregion. It is located within the jurisdiction of the Glenelg Hopkins Catchment Management Authority (CMA) and the Ararat Rural City Council municipality.

1.3 Golden Sun Moth (*Synemon plana*)

EPBC Act Conservation Status: Vulnerable*

FFG Act Conservation Status: Vulnerable

Golden Sun Moth (Plate 1) typically occurs in native grassland, grassy woodland, dominated by greater than 40% cover of wallaby-grass, in particular *Rytidosperma* spp. (DSE 2004), but may also inhabit areas dominated by Kangaroo Grass *Themeda triandra* (Endersby and Koehler 2006) and introduced grassland dominated by Chilean Needle-grass *Nassella neesiana* and other introduced species (A. Organ pers. obs.). Male flight is typically low, to about a metre above the ground, fast and can be prolonged, but they are generally not recorded flying more than 100 metres from suitable habitat (Clarke and O'Dwyer 2000).

Plate 1. Golden Sun Moth (*Synemon plana*) Ecology and Heritage Partners Pty Ltd.

Prior to European settlement, the Golden Sun Moth was widespread and relatively continuous throughout its range, inhabiting grassy open woodlands and grassland, although it now mainly inhabits small isolated sites (DSE 2004). The species is threatened by habitat loss, disturbance, and fragmentation due to agricultural expansion and urbanisation. Many populations are isolated and fragmented, impeding the ability of the relatively immobile females to recolonise areas, thereby reducing the likelihood of genetic exchange (DSE 2004). Such populations are therefore vulnerable as there is little likelihood of recolonisation in the event of a local extinction.

***Note: The EPBC Act Conservation Status for Golden Sun Moth was changed from Critically Endangered to Vulnerable, effective on 07 December 2021.**

1.4 Environmental Condition Requirements

The Buangor Offset Site is being managed for the purposes of conservation. Management of the offset site involves the protection of the area, the control of high threat environmental weeds, biomass reduction and general maintenance of the native vegetation. The management actions specified within the OMP form part of a broader strategy for long-term management of Golden Sun Moth and its habitat.

1.4.1 Specific Year 5 Environmental Condition Requirements

The Conditions relevant to this report (Year 5) are as follows:

Condition 6.

The approval holder must ensure that the environmental conditions specified at Attachment B (EPBC approval 2018/8167) are achieved (at each offset site) within five years of the date that the offset is legally secured (9 October 2019). The environmental conditions are:

a. Average percentage cover of native grass and understory species is at least 40%;

b. Percentage cover of high threat weeds is less than 10% of total vegetation cover;

c. Percentage of woody weeds is less than 1% of total vegetation cover;

d. 20-40% cover of bare ground or inter-tussock space; and,

e. Golden Sun Moth abundance of greater than 10 moths per hectare.

Condition 7.

Within three months after the five-year anniversary of each offset site being legally secured the approval holder must submit to the Minister for approval, and then publish on a website, a report prepared by a suitably qualified ecologist in respect of that offset site that:

a. Describes the ecological condition of the offset site, including Golden Sun Moth habitat, and providing evidence demonstrating which of the environmental conditions required under condition 6 at the offset site have been achieved; and,

b. For each environmental condition required under condition 6 for that offset site for which it cannot be demonstrated that is has been achievable, the report must:

    i. Include a review of the effectiveness of relevant management practices;

    ii. Specific commitments as to the additional actions that will be implemented to ensure the environmental conditions are subsequently achieved;

    iii. Set out the timeframe within with those environmental conditions will be achieved; and

    iv. If any environmental conditions cannot be achieved before the completion of the action, include commitments to provide commensurate compensatory offsets

Condition 6 is addressed in Section 4.2 and condition 7 is addressed in Section 4.3 of this report.

2 METHODS

2.1 Golden Sun Moth Habitat Assessment

A vegetation assessment was undertaken by an experienced ecologist on 22 November 2024 to obtain up-to date information on the quality and extent of vegetation cover and Golden Sun Moth habitat within the study area.

The study area was walked with the overall condition of vegetation noted, and the percentage cover of native vegetation, biomass levels and weed levels determined. The presence and percentage cover of weed species and any new and emerging weed species was also noted.

2.2 Golden Sun Moth Population Monitoring

Survey procedures were undertaken in accordance with the recommended survey guidelines detailed in the significant impact guidelines for the species (DEWHA 2009). The following measures were undertaken as part of population and habitat monitoring for Golden Sun Moth at the Buangor Offset Site:

- Four surveys were conducted by suitably qualified observers;
- Surveys took place during the species' flight season. In western Victoria, the flight season is generally late October to early January. Surveys were undertaken when the species was known to be active on the day of assessment by using a reference site;
- Surveys were undertaken during conditions suitable for detecting the species.
    - Male Golden Sun Moth generally fly between 9am and 4pm on warm (over 20˚C by 10am) days with minimal cloud cover and still conditions. However, if males were observed flying after 3pm or during moderately windy conditions surveys continued until males were no longer observed flying; and,
- Surveys were conducted using 50-metre wide, parallel transects with two observers walking or driving in a car at <10 kilometres / hour (flying male Golden Sun Moth can be readily seen from a vehicle).

2.2.1 Targeted Golden Sun Moth Surveys

Targeted surveys for Golden Sun Moth were undertaken on November 22 and 29, and December 2 and 13 2024 in accordance with approved monitoring guidelines for Golden Sun Moth prepared by DCCEEW (DEWHA 2009). Surveys were conducted throughout all areas of the Buangor Offset Site which were offset for the protection of Golden Sun Moth. The entire site was walked by a qualified ecologist a total of four times during a time when the species was known to be flying at other sites in Victoria and the broader region.

2.3 Assessment Qualifications and Limitations

2.3.1 Golden Sun Moth

Targeted Golden Sun Moth surveys were undertaken by experienced personnel during the known flight period of the species and during appropriate conditions by following suitable survey guidelines.

All fieldwork was carried out under the appropriate licences, including a Wildlife Research Permit (#10010981) (expires December 2026) under the *Wildlife Act 1975*, and a Protected Flora Research Permit (#10010917) issued by DEECA on 14 November 2023 under the *Flora and Fauna Guarantee Act*. Ethics Committee Approval to conduct research using live animals has been granted by the Wildlife and Small Institutions Animal Ethics Committee (25.23).

During 2022/23 and 2023/24, the Golden Sun Moth season presented some survey condition challenges, and Ecology and Heritage Partners Pty Ltd closely monitored the emergence, distribution, and abundance of the species at reference sites across Victoria. Due to unseasonably wet and cool conditions through November to January, suitable survey conditions including periods of more than two days between rain, and temperatures of 20 degrees or above by or around 10am were scarce throughout the traditional survey season.

Typically, Golden Sun Moth emergence declines in the lead up to and in early January. In temperate regions, insect larvae often face a decision between development into their adult stage, or ongoing growth for emergence in the subsequent season (Richter *et al*. 2013; DAWE 2021). In the previous two seasons, we experienced a truncated emergence period for the species once conditions became suitable. However, in order to complete all four survey efforts while the species was known to be flying, surveys were undertaken slightly outside of the guideline's environmental constraints, (i.e. on days over 20˚C by 10am following at least two rain-free days) at times when the species was known to be active at other sites.

The 2024/25 season began promisingly for Golden Sun Moth, with south-eastern Victoria experiencing hot and dry conditions suitable for emergence. However, heavy isolated downpours and localised thunderstorms, typical erratic conditions of an ongoing El Niño phase, again made complying with all guideline environmental constraints challenging.

Given the known species presence on site and the experience of surveyors, the results of this assessment are considered suitable for the purposes of monitoring the population of Golden Sun Moth and associated habitat in the context of Year 5 of the monitoring program.

3 RESULTS

3.1 Golden Sun Moth Monitoring

The following section summarises previous Golden Sun Moth monitoring results for the Buangor offset site.

3.1.1 Previous Records

- Forty-three Golden Sun Moth were detected at the offset site during the species' 2020/21 flight season (Ecology and Heritage Partners Pty Ltd 2021);
- Twenty-three Golden Sun Moth recorded at the offset site during the species' 2021/22 flight season (Ecology and Heritage Partners Pty Ltd 2022);
- Thirty-four Golden Sun Moth recorded at the offset site during the species' 2022/23 flight season (Ecology and Heritage Partners Pty Ltd 2023); and,
- Twenty-six Golden Sun Moth recorded at the offset site during the species' 2023/24 flight season (Ecology and Heritage Partners Pty Ltd 2023).

3.1.2 Monitoring Results 2024/25

Targeted Golden Sun Moth surveys were undertaken between 22 November and 13 December 2024 when the species was known to be flying in the local area (Table 1). During the current monitoring period Golden Sun Moths were detected at similar locations across the Western and Eastern Paddocks as the previous targeted surveys (Ecology and Heritage Partners Pty Ltd 2021, 2022, 2023, 2024), with increasing numbers recorded in the Central Paddock following restoration of this area.

Golden Sun Moth was observed during all four survey days (Table 1), unlike Year 4 where the species was recorded on two of the four surveys (Ecology and Heritage Partners Pty Ltd 2024). On 13 December 2024 (Figure 2), seven Golden Sun Moth were detected in Central Paddock, the highest number of moths detected during targeted surveys in this Paddock since it was scalped and seeded in May 2020. This is a significant achievement given this paddock supported low quality habitat dominated by exotic pasture grasses (i.e. predominately Toowoomba Canary-grass *Phalaris aquatica*) prior to the site being registered as an offset site and actively managed over the past 5 years. With one Golden Sun Moth recorded in Central Paddock in Year 4, and seven in Year 5, it is highly likely that the species' distribution and population size will increase across the Central Paddock over the coming years.

Table 1. Golden Sun Moth survey results during the 2024/25 flight season.

Date	Temperature (°C) (starts and end of survey)		Wind (km/hr)	Cloud cover (%)	No. of days since rain	No. GSM recorded within study area
22/11/2024	25.9	33.6	9 NNW	15	4	16
29/11/2024	18.9	28.4	2 N	20	1	9
02/12/2024	20.0	30.1	13 S	60	1	32
13/12/2024	19.1	27.5	1 SW	10	5	23

3.1.3 *Stocking Rate*

Based on the monitoring results of the Year 5 surveys, the stocking rate for the 2024/25 flight period was 01.39 Golden Sun Moth per hectare (Table 2). As such, the stocking rate result is currently below the Environmental Condition requirement of greater than 10 Golden Sun Moths per hectare for the Offset Site that is required to be achieved prior to Year 5 as stated in Attachment B of the OMP (EPBC 2018/8167).

Table 2. Golden Sun Moth Stocking Rate.

Year	No. Moths	Stocking Rate*
1	43	0.75
2	23	0.40
3	34	0.59
4	26	0.45
5	80	1.39

Note: *Golden Sun Moth recorded per hectare.

3.2 Golden Sun Moth Habitat Assessment

The offset site comprises Plains Grassy Woodland in varying condition and has been split into three Management Areas (Figure 2):

- Eastern Paddock
- Central Paddock
- Western Paddock

During the 2020 management period the majority of the Central Paddock (i.e. 14 hectares across the entire area of Habitat Zone 2A) was scalped, then direct seeded by the revegetation and land management contractor Flora Victoria. Direct seeding was consistent with species characteristic of the Plains Grassy Woodland, which included Bristly Wallaby Grass *Rytidosperma setaceum* (30%), Common Wallaby-grass *Rytidosperma caespitosum* (30%), Brown Back Wallaby Grass *Rytidosperma duttonianum* (10%), Clustered Wallaby-grass *Rytidosperma racemosum* (10%), Copper-awned Wallaby-grass *Rytidosperma fulvum* (10%) and Rough Spear Grass *Austrostipa scabra* (10%). The Central Paddock is now dominated by native grasses (99% proportional cover) with juvenile regenerating River Red-gums *Eucalyptus camaldulensis* (Plate 1 and 2).

The remainder of the offset site (Habitat Zones 1A, 3A, 4A and 5A) continues to support Plains Grassy Woodland (EVC 55) with an open structure with a variable understorey of native grasses, primarily wallaby-grasses and spear grasses that are known food and/or host plants for Golden Sun Moth, in addition to some exotic grasses (Plate 3 and 4).

The most common weed species include Rats-tail Fescue *Vulpia bromoides*, Toowoomba Canary-grass, Yorkshire Fog *Holcus lanantus* and Brown-top Bent Grass *Agrostis capillaris*. Weed levels across these habitat zones has remained the same as at the commencement of the management. The ongoing removal and

management of these weeds will continue to expand the extent and increase the quality of Golden Sun Moth habitat.

Plate 1. Establishment of native grasses across the Central Paddock with regenerating River Red-gums (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 2. Plains Grassy Woodland with variable understory cover of native and exotic grasses (Zone 3A) (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 3. Contractor spraying weeds under trees across (Zone 1A) (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 4. Toowoomba Canary-grass sprayed with herbicide in Zone 1A (Ecology and Heritage Partners Pty Ltd, November 2024).

4 MANAGEMENT TARGETS AND RECOMMENDATIONS

The following section discusses the performance measures outlined within the OMP (Ecology and Heritage Partners Pty Ltd 2019), and the recorded cover of biomass, bare ground, and weed cover during the 2024/25 monitoring of the Buangor Offset Site.

4.1 Management Targets and Environmental Conditions

The following interim performance targets have been provided to ensure that the time until ecological benefit is achieved at the proposed offset site after 5 years of the commencement of the OMP (Ecology and Heritage Partners Pty Ltd 2019):

- Offset site secured via a section 69 agreement under the *Conservation Forests and Land Act 1987*;
- An average of 40% native understorey / grass cover;
- Percentage cover of high threat weeds <10%;
- Percentage cover of woody weeds <1%;
- A 20% to 40% cover of bare ground or inter-tussock space;
- Golden Sun Moth abundance greater than 10 moths/hectare;
- External fences maintained;
- Areas supporting weeds will be removed (scalped or sprayed) and replaced (direct seeding) with native grasses, with an overall target of at least 60-80% cover of native vegetation in treated areas; and,
- Pest animals such as rabbits controlled with no detectable impacts (i.e. extensive soil disturbance, over grazing) to habitat.

4.1.1 Access Control

The entire perimeter of the proposed Golden Sun Moth offset site is currently fenced and there were no gaps in the fence that needed to be fixed. As such, permanent fences are maintained surrounding the perimeter of the offset site, and this target is met.

4.1.2 Biomass Control / Bare Ground Cover

As previous years, biomass and bare ground targets have been met for Habitat Zone 2A of the offset site (Ecology and Heritage Partners Pty Ltd 2021, 2022, 2023, 2024). Grazing occurred in the Eastern and Western Paddocks. Scalping and direct seeding across the Central Paddock has reduced biomass and high percentage cover of bare ground / inter-tussock space, however management of River Red-gum recruits will be undertaken in the future if it is assessed that these trees are having, or likely to result, in a reduction in the quality of Golden Sun Moth habitat through the Central Paddock.

At the time of the Year 5 vegetation assessment, bare ground cover was approximately 20% within the remaining habitat zones, broadly consistent with previous seasons (Ecology and Heritage Partners Pty Ltd 2021, 2022, 2023, 2024).

Given optimum Golden Sun Moth habitat typically comprises at least 20% bare ground, biomass reduction will continue to be implemented (during Winter and Spring 2025). This will enable the maintenance of suitable vegetation structure throughout the site (i.e. low to moderate biomass levels) to maintain the open structured Plains Grassy Woodland which is suitable for Golden Sun Moth dispersal and breeding.

4.1.3 Weed Control

Spot spraying occurred in the Eastern and Western Paddocks, and weed control continued during 2024 and early 2025 throughout the Central Paddock. This involved spraying exotic grasses and weeds under the mature River Red-gums where the scalp was not undertaken due to the provision of Tree Protection Zones, and across the scalped and directed seeded area (i.e. the paddock). An extensive area in the northern portion of the Western Paddock has also been sprayed over two years with four separate treatments (i.e. 20 July 2022, between 6 and 8 February 2023, 14 July 2023, and 19 to 22 February 2024) in preparation of direct seeding which was completed on 22 and 23 April 2024. Additional spot spraying occurred across the site between 11 and 14 February 2025 and will continue throughout 2025.

As of December 2024, the percentage cover of all herbaceous and grassy weeds (including high threat herbaceous and grassy weeds) across Habitat Zone 2A remains broadly consistent with the Year 4 assessment.

4.1.4 Scalping and Direct Seeding

Scalping and direct seeding was undertaken across the Central Paddock in Year 1 in areas that supported >90% of weeds (i.e. with a low cover of native flora) and this has led to a significant improvement in the quality of Golden Sun Moth habitat in this area. Ongoing monitoring of the direct seeded area occurred during the Year 5 monitoring period and most of the area now supports native grass cover that provides suitable habitat for Golden Sun Moth. A large area in the Western Paddock that has been treated with herbicide on several occasions (see Section 4.1.3 above for the dates) and was direct seeded on the 22 and 23 April 2024.

4.1.5 Pest Animal Control

There were no observable pest threats from foxes and no evidence of fox dens. However, one active rabbit warren was observed adjacent to Zone 1A boundary on 22 November 2024 and has now been treated (Figure 2). Ongoing monitoring of pest animals will continue, and should any threat be observed to Golden Sun Moth habitat then active control will be undertaken.

4.1.6 Photo-Points

Five photo-points have been established across the offset site (Figure 2) and photos were taken during the 5th year of management (Plates 5-9). Photographs taken from these points are representative of the Golden Sun Moth habitat management objectives of the OMP (Ecology and Heritage Partners Pty Ltd 2019). Namely, photographs are typically taken between October and December each year and clearly labelled. Each photo is taken from as near to the same point each year, in the same direction, trajectory and camera settings as is practicable. With the exception of the dramatic improvement of Golden Sun Moth habitat across the Central Paddock and marginal improvement across the Eastern and Western Paddock, the photos taken at the photo points provide a baseline for future comparison of grassland habitat for the species.

Plate 5. Photo Point 1, looking north (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 6. Photo Point 2, looking north-west (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 7. Photo Point 3, looking north-east (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 8. Photo Point 4, looking north-west (Ecology and Heritage Partners Pty Ltd, November 2024).

Plate 9. Photo Point 5, looking north-west (Ecology and Heritage Partners Pty Ltd, November 2024).

4.2 Summary of Environmental Condition Requirements and Performance Targets (Condition 6)

A summary of the management actions and condition of the offset site against the Environment Condition requirements for the Buangor Offset Site detailed in Appendix B of EPBC 2018/8167 are provided below (Table 3).

Table 3. Summary of performance against the Environment Condition requirements.

Objectives	Year 1	Year 2	Year 3	Year 4	Year 5	Target	Status
Average percentage cover of native grass and understory species is at least 40%.	East – 45% Central – 99% West – 50%	East – 35% Central – 99% West – 50%	Not required to be directly assessed as per Year 3 survey requirements	East – 35% Central – 99% West – 50%	East – 35% Central – 99% West – 50%	**40% native understory cover**	**Objective currently met for Central and West.** **Below target for East**
Percentage of high threat weeds is less than 10% of total vegetation cover.	East – 55% Central – 5% West – 35%	East – 55% Central – 5% West – 35%	Not required to be directly assessed as per Year 3 survey requirements	East – 55% Central – 5% West – 20%	East – 50% Central – 5% West – 18%	**<10%**	**Objective currently met for Central.** **Below target for East and West**
Percentage of woody weeds is less than 1% of total vegetation cover.	<1%	<1%	<1%	<1%	<1%	**<1%**	**Objective currently met**
20-40% cover of bare ground or inter-tussock space.	Zone 2A – 40% Remaining Zones – 15%	Zone 2A – 40% Remaining Zones – 15%	Zone 2A – 20% Remaining Zones – 15%	Zone 2A and 4A – 20% Remaining Zones – 15%	Zone 2A and 4A – 20% Remaining Zones – 15%	**20-40%**	**Objective currently met for 2A and 4A.** **Below target for 1A, 3A and 5A**
Golden Sun Moth abundance of greater than 10 moths per hectare.	0.75	0.4	0.59	0.45	1.39	**10**	**Currently below target**

4.3 Review and Recommendations (Condition 7)

For each environmental condition required under Condition 6 of the EPBC Act approval that has been classified as 'objective below target' (i.e. as provided in Table 3), a review into the environmental conditions and management practices are provided below (Table 4).

Table 4. Summary of below target (as shown in Table 3) Environment Condition requirements.

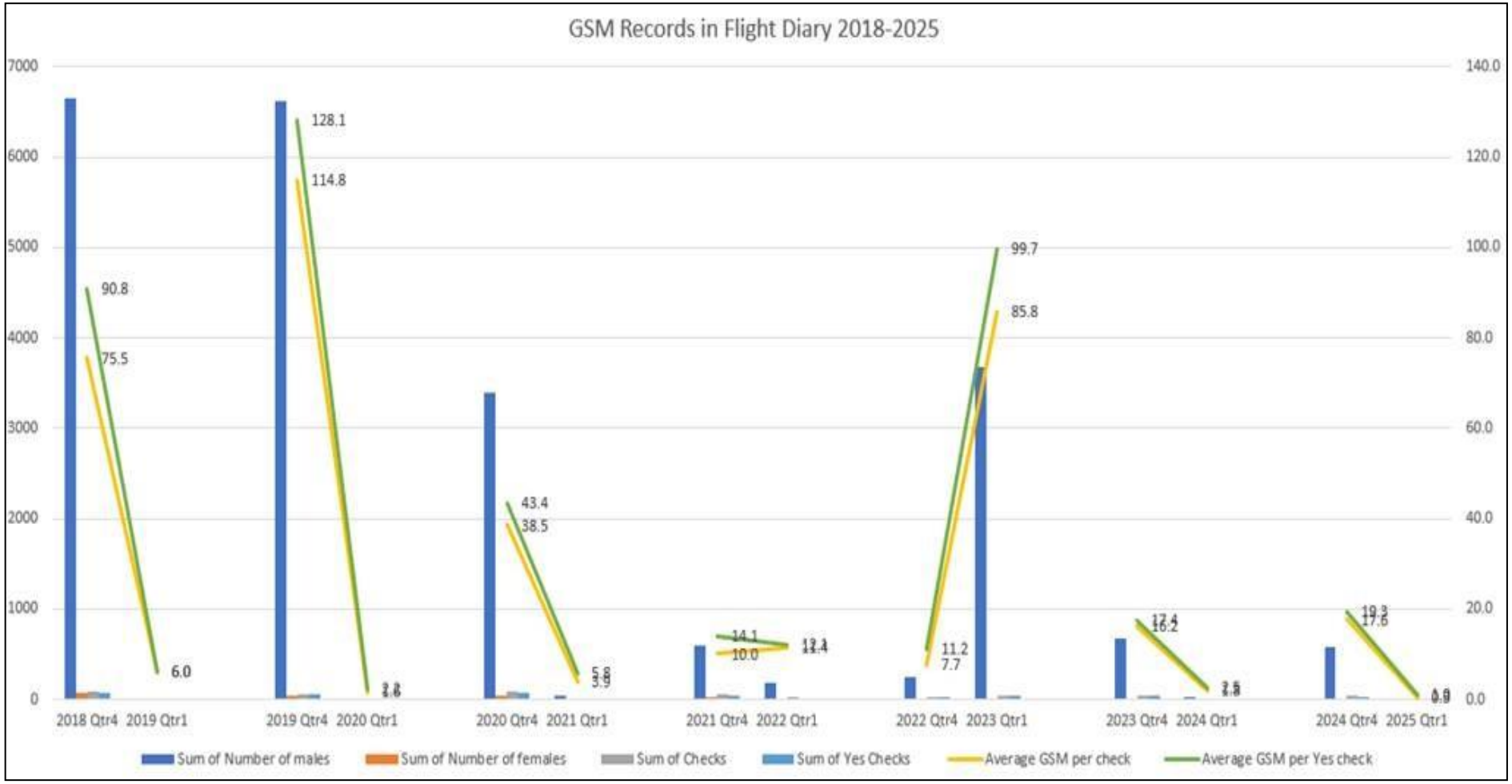
Environmental Objectives	Status	Review of management practices	Recommended additional actions	Timeframe for actions	Commensurate compensatory offset
Average percentage cover of native grass and understorey species is at least 40%.	Objective currently met for Central and West. **Below target for East**	At 35% average percentage of native grass and understorey species, the Eastern Paddock is 5% below target level where the Central and Western Paddock are well above target levels (Table 3). Spot spraying and direct seeding has dramatically improved native vegetation cover in these areas (Section 4.1.3).	To align with the Western and Central Paddocks, additional spot spraying and direct seeding efforts should be undertaken to increase the percentage cover of native grass and understorey species to at least 40%.	Ongoing, over the next 5 years.	Not likely to be required.
Percentage of high threat weeds is less than 10% of total vegetation cover.	Objective currently met for Central. **Below target for East and West**	Spot spraying and direct seeding has drastically improved native vegetation cover in Central and Western Paddocks but needs to be expanded to reduce over of high threat weeds across all areas of the offset site (Section 4.1.3).	At 50% (East) and 18% (West) percentage cover of high threat weeds, additional and immediate action is required to reduce high threat weed cover.	Before Year 10 surveys.	Not likely to be required.
20-40% cover of bare ground or inter-tussock space.	Objective currently met for 2A and 4A. **Below target for 1A, 3A and 5A**	Bare ground levels across Zone 2A and 4A show how effective management can improve habitat values at this offset site (Section 4.1.3). At 15% average bare ground cover across Zone 1A, 3A and 5A, management in these sites need to follow actions of Zone 2A and 4A.	At 15% cover of bare ground (Zone 1A, 3A, 5A) requires ongoing and additional action to increase levels to that of Zone 2A and 4A.	Before Year 10 surveys.	Not likely to be required.
Golden Sun Moth abundance of greater than 10 moths per hectare.	**Currently below target**	Over the first five years of management, the Golden Sun Moth stocking rate has varied between 0.4 and 1.39 moths per hectare, remaining well below the target of 10 moths per hectare. The low stocking rate at Buangor is consistent with trends observed across Victoria, based on publicly available data from the Flight Diary (Graph 1; ECA 2025). The average number of	The OMP was developed with a high level of confidence that the future quality of the offset would achieve a weighted score of 7 (Ecology and Heritage Partners Pty td 2019). By Year 5, this target has been met (i.e. higher percentage cover of native understorey) despite the stocking rate not reaching 10 / hectare. This outcome demonstrates the success of the OMP and the effectiveness of the implemented	End of Year 10	Review at end of Year 10

Environmental Objectives	Status	Review of management practices	Recommended additional actions	Timeframe for actions	Commensurate compensatory offset
		Golden Sun Moth per positive record in the Flight Diary during the fourth quarter over the past seven years is as follows: 2018 (90.8 moths), 2019 (128.1 moths), 2020 (43.4 moths), 2021 (14.1 moths), 2022 (11.2 moths), 2023 (17.2 moths), and 2024 (19.3 moths). As illustrated in Graph 1, a notable decline in Golden Sun Moth has been recorded in the past two seasons across Victoria, based on records within the Flight Diary (ECA 2025). A broad decline in the Golden Sun Moth population between 2019 and 2025 aligns with a study conducted between 2008 to 2012, in which a period of drought preceded a period of above average rainfall, resulting in a dramatic decline in Golden Sun Moth spatial distribution and abundance (Kutt *et al.* 2014). Kutt *et al.* (2014) argues that during period of above average rainfall, the species spatial distribution may restrict, and traditional monitoring methods may be inadequate to estimate populations.	management practices. Most aspects of the OMP that are within the control of the responsible parties are being successfully executed (as described in this report). Ongoing weed control is required across the entire offset site with a comparatively higher intensity of weed control required across the Eastern and Western Paddocks over the next 5 years compared with the Central Paddock. The low stocking rate is highly likely to be attributable to recent climatic conditions across Victoria, rather than any deficiencies in management. The habitat quality score and stocking rate should be reviewed in Year 10 and should take into account the broader patterns of the species' emergence and populations / stocking rates at occupied sites across Victoria.		

Table 5. Comparison of habitat quality at the Buangor Offset Site.

Habitat Quality	Source	Site Condition	Site Context	Stocking Rate	Subtotal	Weighted Quality Score
Year 5*	This report	3/3	3/3	1/4	7/10	**7**

*Scoring system updated from a maximum possible score of 30 to a maximum possible score of 10. Both weighted to a quality score of 10 and are considered comparable.



Graph 1. Golden Sun Moth records within the Flight Diary (ECA 2025). Total number of records (498), total number of positive records (415). Assumptions: If male was 1+, and female was blank, then female assumed to be 0; If female was 1+, and male was blank, then male assumed to be 0; If both were blank, and category was no, then both assumed to be 0; If both were blank, and category was yes, then male assumed to be 1, and female assumed to be 0; If both were blank, and category was blank, then record was removed.

4.3.1 Method for Calculating GSM Habitat Quality

The habitat quality of Buangor offset site was assessed using the EPBC Act Offsets Assessments Guide. Assessments of species habitat quality are based on separate assessments of three parameters: 1) Site context, 1) Site condition, and 3) Species stocking rate consistent with the key considerations outlined in the Offset Assessment Guide and Offset Policy (DSEWPaC 2012a; 2012b), including an assessment of site condition and site context within the broader property/landscape. The following is an update in the scoring system from a maximum score of 30 to a maximum score of 10. However, these are both weighted to a quality score of 10 and are considered comparable. The scores are determined as follows:

- Site context – assessed as a score out of three where the habitat patch is:
    - 0/3 = < 0.25 hectares
    - 1/3 = > 0.25 hectares < 10 hectares
    - 2/3 = > 10 hectares, shaped to reduce edge effects (i.e. not narrow and/or linear)
    - 3/3 = > 10 hectares, shaped to reduce edge effects, and connects previously unconnected suitable/known habitat
- Site condition – assessed as a score out of three as follows:
    - 0/3 = dominated by non-native vegetation that isn't a preferred food source for Golden Sun Moth
    - 1/3 = a cover of at least 20% of a known food source
    - 2/3 = a cover of 20% - 40% of a known food source of which is predominantly native; OR, up to 40% cover of a known food source, which is predominantly non- native (i.e. Chilean Needle-grass). Limited inter-tussock space, (i.e. below 10%)
    - 3/3 = a cover of at least 40% of a known food source which is predominantly native. Suitable biomass levels and inter-tussock space (i.e. 10% - 40% cover of bare ground) present.
- Stocking rate - assessed out of four as follows:
    - 0/4 = species not confirmed to be present
    - 1/4 = species modelled to occur, or confirmed at 0-5 moths per hectare
    - 2/4 = > 5-20 moths per hectare
    - 3/4 = > 20–50 moths per hectare
    - 4/4 = > 50 moths per hectare

4.4 Management Actions Summary – 2024/25

A summary of the required management actions and completion dates for 2024/25 of the OMP are provided below (Table 6).

Table 6. Summary of performance against the Environment Condition requirements.

Performance Target	Year 1	Year 2	Year 3	Year 4	Year 5	Recommendations
Offset site secured via a Section 69 agreement under the Conservation Forests and Land Act 1987.	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	N/A
An average of 40% native understorey / grass cover	Zone 2A: **Yes** Remaining Zones: same as previous year	Zone 2A: **Yes**	Zone 2A: **Yes**	Zone 2A: **Yes**	Zone 2A: **Yes**	See Sections 4.1.2 and 4.1.3
Percentage cover of high threat weeds <10%.	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A and 4A: **Yes** Remaining Zones: **No**	Zone 2A and 4A: **Yes** Remaining Zones: **No**	See Sections 4.1.2 and 4.1.3
Percentage cover of woody weeds <1%.	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	See Sections 4.1.3
A 20% to 40% cover of bare ground or inter-tussock space.	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A and 4A: **Yes** Remaining Zones: **No**	Zone 2A and 4A: **Yes** Remaining Zones: **No**	See Sections 4.1.2 and 4.1.3
The persistence of a Golden Sun Moth population	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	N/A
Golden Sun Moth stocking rate increased to 10 moths per hectare	**No**	**No**	**No**	**No**	**No**	Continue to follow recommendations provided in Section 4.3

Performance Target	Year 1	Year 2	Year 3	Year 4	Year 5	Recommendations
External fences maintained	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	Continue to check permanent fences surrounding the offset property are secure
Areas supporting weeds will be removed (scalped or sprayed) and replaced (direct seeding) with native grasses, with an overall target of at least 60-80% cover of native vegetation in treated areas	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A: **Yes** Remaining Zones: **No**	Zone 2A and parts of 4A: **Yes** Remaining Zones: **No**	Zone 2A and parts of 4A: **Yes** Remaining Zones: **No**	N/A
Pest animals such as rabbits controlled with no detectable impacts (i.e. extensive soil disturbance, over grazing) to habitat.	**Yes**	**Yes**	**Yes**	**Yes**	**No**	Action required for rabbit warren near Zone 1A. Continue to monitor populations of pest animals and conduct control works if required.

4.5 Management Actions Summary – 2024/25

A summary of the required management actions and completion dates for 2024/25 of the OMP are provided below (Table 7).

Table 7. Management Action Table for the Buangor offset site for the 2024/25 monitoring period.

Year 5 Actions	Management action	Performance Target	Resource/ personnel required	Timing of action	Completed (Yes/No)	Date
5.1	Conduct weed control, direct seeding and revegetation actions	Reduce woody weeds to <1%, priority/high threat weeds to <10% and environmental weeds to <10%. Areas supporting weeds will be removed (scalped or sprayed) and replaced (direct seeding) with native grasses, with an overall target of at least 60-80% cover of native vegetation in treated areas.	Landowner / contractor	Ongoing throughout the year	Yes (ongoing)	Provided by Landholder
5.2	Monitor populations of pest animals and conduct control works if required	Pest animals such as rabbit and fox controlled with no detectable impacts (i.e. extensive soil disturbance, over grazing) to habitat.	Landowner / contractor	Ongoing	Ongoing	Provided by Landholder
5.3	Maintain fences	Maintain fencing in good condition around entire boundary of all sites where fencing exists or is required. Conduct yearly monitoring to ensure all fencing meets the required standard.	Landowner / contractor	Ongoing	Yes	Provided by Landholder
5.4	Monitor biomass density and implement a suitable stock grazing regime.	An average of 40% native understorey / grass cover. Maintain at least 70% vegetation cover and a 20% to 40% cover of bare ground or inter-tussock space	Landowner / contractor	Between late October to the end of January. (Between 1 October 2025 to 31 January 2026 no stock, or very low numbers of stock, is to be present on the property during the Golden Sun Moth flight period).	Yes (ongoing)	Provided by Landholder

Year 5 Actions	Management action	Performance Target	Resource/ personnel required	Timing of action	Completed (Yes/No)	Date
5.5	Monitor and assess works (no report)	Condition 7 (this report)	Qualified ecologist	Five years after commencement of OMP	Yes (this report)	This report

5 CONCLUSION

Targeted surveys identified a total of 80 Golden Sun Moth within the offset site over four days (22 and 29 November, and 2 and 13 December 2024). Golden Sun Moth were detected in higher abundance compared with previous years, and although the species' stocking rate was below the target for Year 5, the results show that the species is using habitat across the site and is expanding into reseeded areas (i.e. the Central Paddock).

Golden Sun Moth was detected at similar locations as the previous targeted surveys (Figure 2). During the final survey, Golden Sun Moth was recorded in the Central Paddock in the highest abundance (seven), since it was scalped and seeded in May 2020. Central Paddock currently supports high quality habitat, and as such, the species is likely to further colonise the area over the next couple of years. Similarly, it is expected that given direct seeding has occurred in the Western Paddock (April 2024) the species will expand across Zone 3A and 4A over the next couple of years into areas supporting suitable food plants for the species.

Spot spraying occurred in the Eastern and Western Paddocks, and weed control continued during 2024 and early 2025 throughout the Central Paddock. This involved spraying exotic grasses and weeds under the mature River Red-gums where the scalp was not undertaken due to the provision of Tree Protection Zones, and across the scalped and directed seeded area. An extensive area in the northern portion of the Western Paddock has also been sprayed over two years with four separate treatments in preparation of direct seeding which was completed on 22 and 23 April 2024. Additional spot spraying occurred across the site between 11 and 14 February 2025 and will continue throughout 2025.

REFERENCES

Clarke, G.M. and C. O'Dwyer 1999. Further survey in southeastern New South Wales for the endangered golden sun moth, *Synemon plana*. Pg 77. CSIRO Entomology, Canberra

DAWE 2021. Conservation Advice for *Synemon plana* (Golden Sun Moth), Canberra.

DEECA 2025. NatureKit Map [www Document]. URL: https://maps2.biodiversity.vic.gov.au/Html5viewer/index.html?viewer=NatureKit. Victorian Department of Energy, Environment and Climate Action, Melbourne, Victoria.

DEWHA 2009. Significant impact guidelines for the critically endangered golden sun moth (Synemon plana). Background paper to EPBC Act policy statement 3.12. Canberra, Australia: Department of the Environment, Water, Heritage and the Arts.

Ecology and Heritage Partners Pty Ltd 2012. Western Highway Project: Section 2, Beaufort to Ararat, Victoria. Impact Assessment Report – Flora, Fauna and Ecological Communities. Prepared for VicRoads.

Ecology and Heritage Partners Pty Ltd 2018. Targeted Golden Sun Moth *Synemon plana* survey for proposed offset site, 222 Challicum Road, Buangor, Victoria. Prepared for Frasers Property Australia Pty Ltd.

Ecology and Heritage Partners Pty Ltd 2019. Golden Sun Moth *Synemon plana* Offset Management Plan: 222 Challicum Road, Buangor, Victoria (EPBC 2018/8167). Prepared for Frasers Property Australia Pty Ltd.

Ecology and Heritage Partners Pty Ltd 2021. Golden Sun Moth *Synemon plana* Population and Habitat Monitoring (2020/21): 222 Challicum Road, Buangor, Victoria (EPBC 2018/8167). Prepared for Frasers Property Australia Pty Ltd.

Ecology and Heritage Partners Pty Ltd 2022. Golden Sun Moth *Synemon plana* Population and Habitat Monitoring (2021/22): 222 Challicum Road, Buangor, Victoria (EPBC 2018/8167). Prepared for Frasers Property Australia Pty Ltd.

Ecology and Heritage Partners Pty Ltd 2023. Golden Sun Moth *Synemon plana* Population and Habitat Monitoring (2022/23): 222 Challicum Road, Buangor, Victoria (EPBC 2018/8167). Prepared for Frasers Property Australia Pty Ltd.

Ecology and Heritage Partners Pty Ltd 2024. Golden Sun Moth *Synemon plana* Population and Habitat Monitoring (2023/24). 222 Challicum Road, Buangor, Victoria (EPBC 2018/8167). Prepared for Frasers Property Australia Pty Ltd.

Endersby, I and Koehler, S. 2006. Golden Sun Moth *Synemon plana*: discovery of new populations around Melbourne. The Victorian Naturalist 123, 362-365.

Kutt, A.S., Mckenzie, V.J., Wills, T.J., Retallick, R.W.R., Dalton, K., Kay, N., and Melero-Blanca, E. 2014. Spatial and temporal determinants of golden sun moth *Synemon plana* distribution. Austral Ecology doi:10.1111/aec.12181.

Richter, A., Osborne, W., Hnatiuk, S. and Rowell, A. 2013. Moths in fragments: insights into the biology and ecology of the Australian endangered golden sun moth *Synemon plana* (Lepidoptera: Castniidae) in natural temperate and exotic grassland remnants. Journal of Insect Conservation 17, 1093-1104.

FIGURES

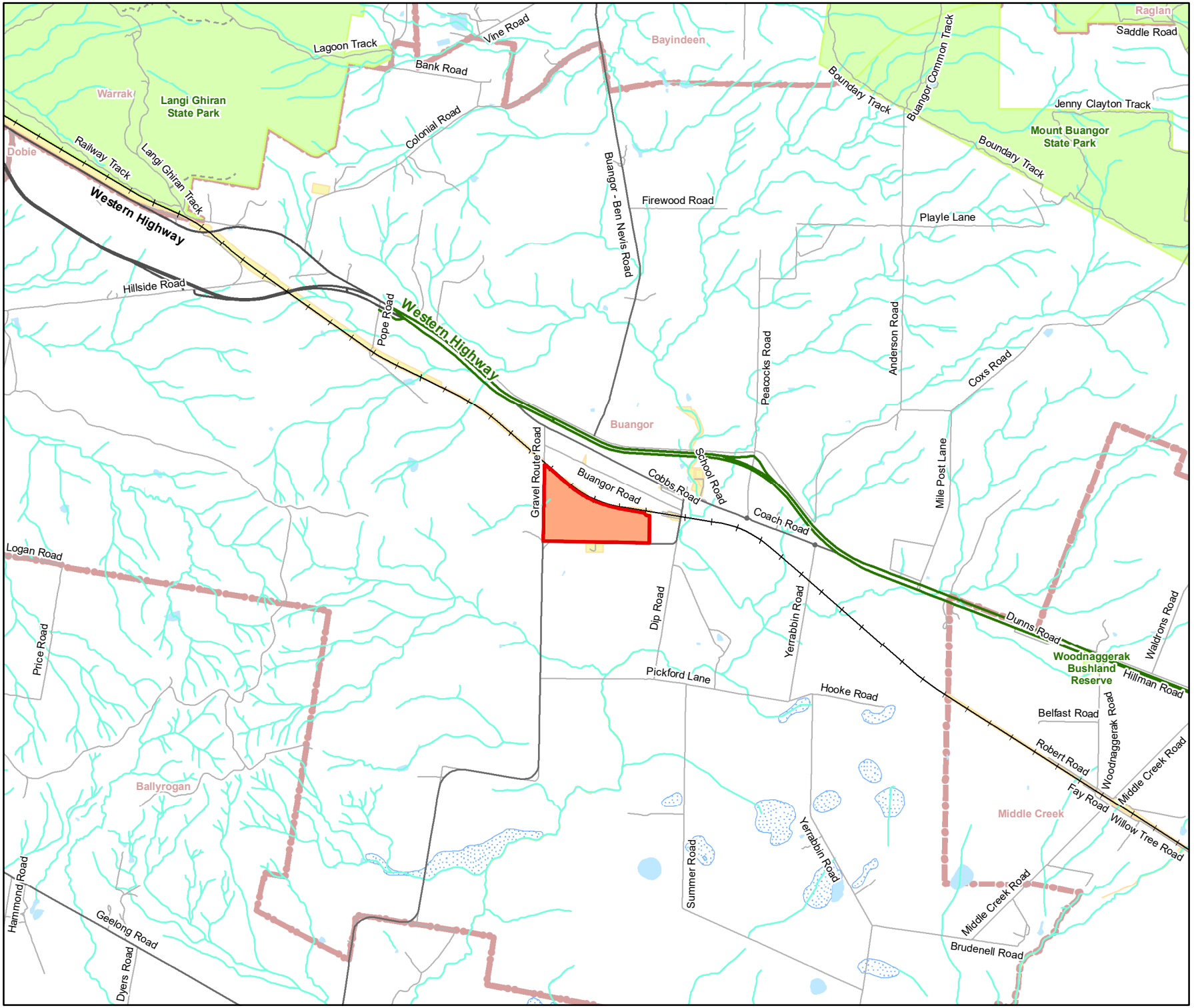


Figure 1

Location of the study area

Golden Sun Moth Monitoring, Buangor

ecology & heritage partners

14695_Fig01_StudyArea 17/04/2024 dvaladares

Legend

- Study Area
- Offset site
- Area scalped and seeded May 2020
- Photo points
- Rabbit holes

Golden Sun Moth records

- Survey 1: 22/11/2024
- Survey 2: 29/11/2024
- Survey 3: 2/12/2024
- Survey 4: 13/12/2024

Figure 2

Survey Results

Golden Sun Moth Monitoring, Buangor

N

0 75 150

Metres

ecology & heritage partners